



वार्षिक प्रतिवेदन ANNUAL REPORT 2024



भा.कृ.अनु.प.-केन्द्रीय आलू अनुसंधान संस्थान

शिमला-171001, हिमाचल प्रदेश

ICAR-CENTRAL POTATO RESEARCH INSTITUTE

Shimla-171001, Himachal Pradesh



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प्रस्तावना

संस्थान का वार्षिक प्रतिवेदन 2024 आपके समक्ष प्रस्तुत कर मुझे अपार हर्ष की अनुभूति हो रही है। अपने स्थापना वर्ष 1949 से यह संस्थान आलू के शोध पर विभिन्न कृषि-जलवायु क्षेत्रों के अनुरूप नई किस्मों और तकनीकों के माध्यम से आलू उत्पादन में उल्लेखनीय उन्नति कर अग्रणी रहा है। जिसके परिणामस्वरूप राष्ट्रीय आलू उत्पादन में लगभग 39 गुना वृद्धि हुई है जो 1949-50 में 1.54 मिलियन टन से बढ़कर 2024-25 में रिकॉर्ड 60.17 मिलियन टन तक पहुँच गया है। वर्तमान में भारत विश्व में आलू उत्पादन के क्षेत्र में दूसरे स्थान पर है और विश्व उत्पादन में लगभग 15% योगदान देता है।

वर्ष 2024 में संस्थान के सभी संभागों में उल्लेखनीय प्रगति हुई है। संस्थान ने नीदरलैंड, यूके, रूस, जर्मनी और फ्रांस से 16 नए इन-विट्रो एक्सेशन आयात किए और अपने जर्मप्लाज्म संग्रह को मजबूत किया परिणामस्वरूप अब इसमें 30 देशों से प्राप्त 4700 से अधिक जंगली और खेती वाले आलू प्रजातियों के एक्सेशन शामिल हैं। साथ ही, तीन उत्कृष्ट आनुवंशिक स्टॉक्स को ICAR-NBPGR में पंजीकृत कर राष्ट्रीय आनुवंशिक संसाधनों को समृद्ध किया है। संस्थान में 722 क्रॉस से 1.32 मिलियन से अधिक टू पोटेटो सीड उत्पन्न किए गए और 28,620 आशाजनक क्लोनों का चयन आगे की प्रजनन प्रक्रिया के लिए किया गया। वर्षों की निरंतर उपलब्धियों के आधार पर 14 उन्नत संकर बहु-स्थान परीक्षण हेतु AICRP में शामिल किए गए। चार नई किस्में—कुफरी रतन (लाल छिलका), कुफरी चिपभारत-1 और कुफरी चिपभारत-2 (प्रोसेसिंग के लिए), तथा कुफरी तेजस (ताप सहनशीलता)—को 41वीं AICRP (Potato) बैठक में राष्ट्रीय स्तर पर अनुशंसित किया गया। वहीं कुफरी जमुनिया और कुफरी सुख्याति को CVRC द्वारा अधिसूचित किया गया है।

कुल 27809.49 क्विंटल नाभिकीय और ब्रीडर बीज का उत्पादन मैदानी और पहाड़ी क्षेत्रों के 131.83 हेक्टेयर में हुआ। जिसमें से विभिन्न सरकारी एवं निजी एजेंसियों को 22,086 क्विंटल ब्रीडर सीड की आपूर्ति की गई और ब्रीडर सीड के विक्रय से 11 करोड़ रुपये का कुल राजस्व प्राप्त हुआ। आलू में बैक्टीरियल विल्ट प्रतिरोध से जुड़े प्रमुख जीन और नियामक तत्वों की पहचान के लिए PacBio आधारित SMRT सिक्वेंसिंग की गई।

तेज और सटीक विश्लेषण के लिए एक AI-ML आधारित पद्धति "PCCAnalyzer" विकसित की गई, जो आलू फसलों की RGB छवियों से CC% का स्वचालित रूप से आकलन करती है। साथ ही, ग्राउंड आधारित विजुअल (RGB) इमेजिंग और गैर-आक्रामक माप के लिए प्रोटोकॉल मानकीकरण पर कार्य किया गया। एरोपोनिक तरीके से उत्पादित मिनी-ट्यूबर्स की सटीक रोपाई हेतु एक अर्ध-स्वचालित रोपण मशीन और जीपीए से संचालित चालकरहित रोबोट वाहन विकसित किए गए।

नियर इन्फ्रारेड (NIR) स्पेक्ट्रोस्कोपी ने आलू कंद में लेट ब्लाइट और ड्राई रॉट का क्रमशः 93% और 88% सटीकता से निदान किया। इंडो-ब्लाइटकास्ट मॉडल ने विभिन्न कृषि-परिस्थितियों में लेट ब्लाइट की समयपूर्व भविष्यवाणी कर किसानों को समय पर कृषि परामर्श प्रदान करने में मदद की। राइजोक्टोनिया सोलेनाई (स्टेम कैंकर और ब्लैक स्कर्फ) के खिलाफ केवल NaOCl (1.0 और 2.0%) प्रभावी पाया गया। वहीं, ट्रेक्टर-माउंटेड स्प्रेडिंग ने सफेद मक्खी नियंत्रण और कीटनाशक अवशोषण में बेहतर परिणाम दिए। डिप्लॉइड किस्म 'BS 303' सामान्य स्कैब के प्रति 5.1% रोग तीव्रता के साथ अपेक्षाकृत प्रतिरोधी पाई गई। जैविक एजेंटों, फसल चक्रों और

रोटेशन का उपयोग कर एकीकृत नीमेटोड प्रबंधन ने आलू सिस्ट नीमेटोड की जनसंख्या को प्रभावी रूप से नियंत्रित किया।

पोस्ट-हार्वेस्ट टेक्नोलॉजी में, एक नए प्राकृतिक रूप से पाए जाने वाले तेल का संयोजन पहचाना गया है जो 10-12°C पर संग्रहीत आलू में अंकुरण (स्पाउट) को नियंत्रित करने में प्रभावी है। आलू के पोषण घटकों पर विभिन्न खाने वाले तेलों के प्रभाव पर किए गए उच्च शोध में पाया गया कि विभिन्न तेलों के उपयोग से आलू का ग्लाइसेमिक इंडेक्स (GI) और ग्लाइसेमिक लोड (GL) उल्लेखनीय रूप से कम होता है। आलू के रस से बने कार्यात्मक किण्वित प्रोबायोटिक पेय पदार्थों पर किए गए शोध में तीन आशाजनक सूक्ष्मजीवों लैक्टोबैसिलस एसिडोफिलस, लैक्टोबैसिलस प्लांटेरम, और लैक्टोबैसिलस फर्मेंटम की पहचान की गई। इसके साथ ही आलू-बंगाल ग्राम आधारित बूंदी और आलू आधारित बूंदी स्नैक जैसे नवीन मूल्यवर्धित उत्पाद विकसित किए गए।

सामाजिक विज्ञान विभाग के द्वारा उपभोक्ताओं और किसानों पर विस्तृत सर्वेक्षण किए, जिसमें ताजे आलू और आलू बीज गुणवत्ता के प्रति उनकी प्राथमिकताओं और भुगतान करने की इच्छा को उजागर किया गया। संस्थान ने 833 फ्रंट लाइन डेमोंस्ट्रेशन और 55 प्रशिक्षण कार्यक्रमों के माध्यम से व्यापक जागरूकता अभियान चलाया। साथ ही 24 से अधिक प्रदर्शनी, जागरूकता कार्यक्रम और कार्यशालाओं का आयोजन किया गया, जिनमें राष्ट्रीय आलू महोत्सव-2024 और राष्ट्रीय आलू दिवस-2024 शामिल थे, इनमें 5000 से अधिक हितधारक लाभान्वित हुए। देश में हजारों किसानों को तकनीकी परामर्श सेवाएँ और तकनीकी प्रकाशन सामग्री के द्वारा लाभ पहुंचाया गया। मानव संसाधन विकास (HRD) के अंतर्गत 74 कर्मचारियों ने विभिन्न प्रशिक्षण कार्यक्रमों में भाग लिया और IGOI कर्मयोगी प्लेटफॉर्म के माध्यम से 190 पाठ्यक्रम पूर्ण किए।

इस अवधि में संस्थान द्वारा विकसित की गई तकनीकी (Grow Box) के लिए एक पेटेंट प्रदान किया गया और दो तकनीकों को प्रमाणित किया गया। संस्थान के वैज्ञानिकों ने 59 शोध प्रकाशन और लगभग 100 अन्य प्रकाशन प्रकाशित किए। साथ ही वैज्ञानिकों को 24 प्रतिष्ठित पुरस्कारों और मान्यताओं से सम्मानित किया गया।

यह सभी उपलब्धियाँ संस्थान के वैज्ञानिकों, तकनीकी अधिकारियों और प्रशासनिक कर्मचारियों के समर्पित सहयोग का परिणाम हैं, साथ ही यह परिषद के महानिदेशक एवं सचिव (डेयर) डॉ. मांगी लाल जाट और उपमहानिदेशक (बागवानी विज्ञान) डॉ. संजय कुमार सिंह, के सतत नेतृत्व और मार्गदर्शन का भी योगदान है। समिति के सदस्यों और संपादकीय टीम के प्रति गहरी कृतज्ञता व्यक्त की जाती है, जिन्होंने इस व्यापक रिपोर्ट को समय पर पूरा करने में सहयोग दिया। यह रिपोर्ट केन्द्रीय आलू अनुसंधान संस्थान द्वारा आलू पर शोध को आगे बढ़ाने और भारतीय कृषि को और अधिक समृद्ध और मजबूत करने की प्रतिबद्धता को दर्शाता है।



(ब्रजेश सिंह)

निदेशक

PREFACE

It is a great pleasure to present the Annual Report 2024 of ICAR-Central Potato Research Institute (CPRI), Shimla. Since its establishment in 1949, the institute has pioneered the advancement of potato research and development in India, transforming potato production with improved potato varieties and technologies suited to multiple agro-climatic regions. As a result, national potato production has increased approximately 39 times, from 1.54 million tonnes in 1949–50 to a record 60.17 million tonnes in 2024–25. India currently ranks as the second largest potato producer globally, contributing nearly 15% to the total world production.

In 2024, the germplasm collection was enriched with the import of sixteen new in-vitro accessions from the Netherlands, UK, Russia, Germany and France, resulting in a repository exceeding 4700 accessions of cultivated and wild potato species, obtained from 30 countries. Three elite genetic stocks were registered with ICAR-NBPGR, augmenting national genetic resources. Over 1.32 million true potato seeds were generated from 722 crosses and selected 28620 promising clones for further breeding. Based on consistent performance over the years, 14 advanced hybrids have been introduced into the AICRP for multi-location testing. Four new varieties: Kufri Ratan (red skin), Kufri Chipbharat-1 and Kufri Chipbharat-2 (processing traits), and Kufri Tejas (heat tolerance) were recommended at the national level at the 41st AICRP (Potato) meeting, while Kufri Jamunia and Kufri Sukhyati were notified by CVRC.

A total production of 27809.5 q of nucleus and breeder seed was produced from an area of 131.83 ha in plains and hills. A total of 22086 q of breeder seed was supplied to state government and private agencies and a total revenue of Rs. 11 crores has been generated from the disposal of breeder seed. PacBio-based SMRT sequencing was conducted on potato to identify key genes and regulatory elements controlling bacterial wilt resistance.

An AI-ML methodology (deep learning-based approach), "PCCAnalyzer" was developed for rapid and accurate estimation of crop cover (%) from visual (RGB) images of potato crops in automated mode. Work on protocol standardization for ground based visual (RGB) imaging and image processing for non-invasive measurements of potato crop biophysical parameters was developed. A semi-automatic planting machine was developed for precise planting of aeroponically produced mini-tubers and a GPS-guided unmanned robotic vehicle for field operations.

Near infrared (NIR) spectroscopy diagnosed late blight and dry rot in potato tubers with 93% and 88% accuracy, respectively. The Indo-Blightcast model effectively predicted late blight well in advance across agro-ecologies, enabling timely agro-advisories. Against *Rhizoctonia solani* (stem canker and black scurf), only NaOCl (1.0 and 2.0%) proved effective. Tractor-mounted spraying proved superior for whitefly control and insecticide uptake. Diploid variety 'BS 303' was found comparatively resistant (5.1% disease severity) to common scab. Integrated nematode management employing biological agents, cropping systems, and rotation achieved impressive suppression of potato cyst nematode populations.

In post-harvest technology, a new combination of naturally occurring oil which is effective to control sprout grown in potatoes stored at 10–12°C have been identified. Advanced research into the effect of cooking oils on potato nutritional content revealed addition of different cooking oils exhibited significant glycemic index (GI) and glycemic load (GL) lowering effects on potato. Research on functional fermented probiotic beverages from potato juice identified three promising

microbes: *Lactobacillus acidophilus*, *Lactobacillus plantarum*, and *Lactobacillus fermentum*. Novel value-added potato products (potato-Bengal Gram based *boondi* and potato-based *boondi* snack) were developed.

The Division of Social Sciences conducted comprehensive consumer and farmer surveys to assess preferences and willingness to pay for quality fresh potatoes and potato seeds of improved varieties. Extensive outreach programmes included 833 Frontline Demonstrations, 55 training programmes, 24 exhibitions, awareness programmes and workshops, including National Potato Festival-2024 and National Potato Day-2024, benefiting more than 5000 stakeholders. Advisory services and technical publications of the institute continued to support thousands of farmers across India. Under HRD, 74 staff participated in various training programmes and 190 courses were completed on iGOT Karmayogi platform.

One patent (Grow Box) was granted and two technologies were certified during this period. The scientists of the institute published 59 research publications and about 100 other publications. The scientists were conferred with 24 prestigious awards and recognitions.

These achievements are the result of dedicated teamwork by scientists, technical officers, and administrative staff, as well as sustained leadership and guidance from Dr Mangi Lal Jat, Secretary (DARE) & Director General, ICAR, and Dr. Sanjay Kumar Singh, Deputy Director General (Horticultural Science). Deep gratitude extends to the editorial team for timely completion of this comprehensive report, which embodies ICAR-CPRI's commitment to advancing potato science and strengthening agricultural prosperity in India.


(Brajesh Singh)
Director

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भारतीय
ICAR

ICAR-CPRI: AN INTRODUCTION



The ICAR-Central Potato Research Institute was established during August 1949 at Patna (Bihar) on the recommendation of the then Agricultural Advisor to the Government of India, Sir Herbert Steward under the Ministry of Agriculture, Government of India. The institute was later on, shifted to Shimla in 1956 in order to facilitate hybridization work in potato breeding programme and maintain seed potato health. It was transferred to the Indian Council of Agricultural Research (ICAR) in April 1966.

The Research and Development activities of the institute are carried out under the five divisions namely, Division of Crop Improvement & Seed Technology Crop Production, Plant Protection, Crop Physiology, Biochemistry and Post Harvest Technology and Social Sciences. The institute headquarters is located in the heart of Shimla city, 4 kilometers from Shimla bus stand near Bemloe. It is located at an altitude of 2000 meters above mean sea level and has a wet temperate climate. It has six regional stations located across the country viz. Modipuram (UP), Jalandhar (Punjab), Gwalior (MP), Patna (Bihar), Shillong (Meghalaya) and Ooty (Tamil Nadu) to cater the

need for location specific research and extension activities.

The institute has created the state-of-the-art laboratories for conducting basic and strategic research in different areas of potato. The All India Coordinated Research Project on potato (AICRP-Potato) is also located in this institute and has been functioning since 1971. It has 25 regional centers located in nearly all agro climatic zones of the country to test the performance of new potato varieties and technologies in different locations. An Agricultural Technology Information Centre (ATIC) is also functioning in the institute which looks after the transfer of technology activities of the institute. The institute not only develops new varieties and technologies for potato growers of the country but also takes care of dissemination of these technologies to the ultimate consumers through various trainings, demonstrations, farmers fair, exhibitions etc. Currently the institute has a dedicated team of 54 scientists, 118 technical staffs and 61 administrative staff & 43 Skilled Support Staff working on potato crop.



THE MISSION

Research, education and extension on potato in collaboration with national and international partners for enhancing productivity and profitability, achieving sustainable food and nutritional security and alleviating rural poverty.

THE MANDATE

The ICAR-Central Potato Research Institute is a non-profit scientific institution under the Indian Council of Agricultural Research, working exclusively on potato. The institute has played a key role in popularizing potato cultivation and utilization under sub-tropical agro-ecosystem. We believe that potato can play an important role in food and nutritional security of India, while helping the rural poor to rise out of poverty. The institute focuses all its energy to make that belief becomes a reality. The mandate of the institute is given below

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of potato.
- Repository of genetic resources and scientific information on potato.
- Transfer of technology, capacity building and impact assessment of technologies.
- Disease-free nucleus and breeder seed potato production.
- Coordinate research and validation of technologies through AICRP on potato.

DIVISIONS

Work of the Institute is being carried out by the five Divisions namely: Crop Improvement & Seed Technology, Plant Protection, Crop Production, Crop Physiology, Biochemistry & Post Harvest Technology and Social Sciences under 11 well defined research programmes. In addition to regular research programmes, a total of 11 externally funded research projects sponsored by different agencies viz. ICAR, DBT, PPV & FRA, CIP, IASRI, NASF, NEC and UPCAR are also under operation. Production of Breeders' seed is being done by the Institute under a Revolving Fund Scheme and National Seed Programme.

STAFF & FINANCE

The institute has 437 sanctioned staff strength comprising of 87 scientific, 168 technical, 67

administrative and 103 supporting staff excluding RMP. The staff position as on 31.12.2024 was 276 including 54 scientists, 118 technical staffs and 61 administrative staff & 43 skilled support staff. In 2024-25, total allocation was Rs. 87,97,74,000/- and total expenditure was Rs. 87,97,64,877/-. During the year, 1 scientist got transferred as inter institutional transfer, 1 Sr. Scientist (RGP 9000) got promoted to Principal scientist, 5 senior scientists promoted to Sr. Scientist (RGP 9000), 3 Scientists (SS) were promoted to Sr. Scientist, 5 Scientists promoted from Scientist to Scientist (SS) and 2 Principal Scientists retired. In technical category, 6 joined, 25 were promoted, 3 were transferred (inter) and 3 were transferred (intra), 2 were retired and one resigned. Under administrative category, 6 joined, 2 promoted, 1 transferred and 3 retired. In skilled supporting staff, 6 promoted, 4 got grant of MACP benefit, 3 retired and 2 got transferred to other ICAR institutes on selection basis.

FACILITIES

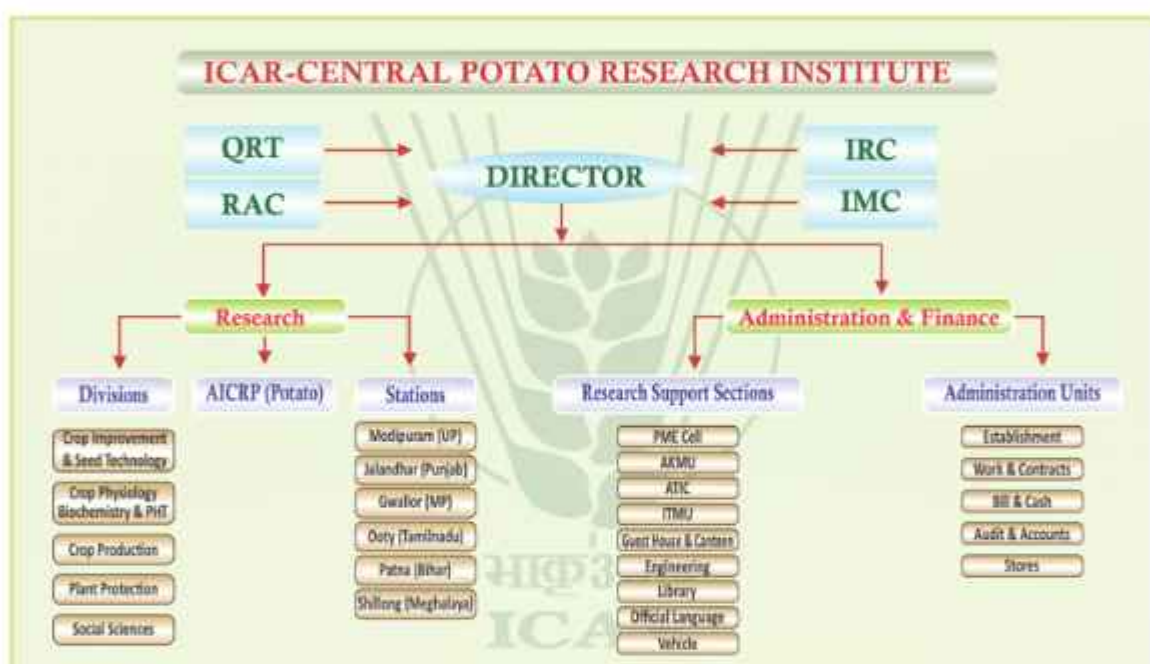
The institute created state-of-the-art laboratories for conducting basic and strategic research in the field of biotechnology, genetics and plant breeding, plant protection, soil science and agronomy, plant physiology, biochemistry, and post-harvest technology. The ICAR-CPRI is the first institute, among plant science research institute of India, to introduce ELISA (1984) and ISEM (1987) for plant virus diagnosis. The virus diagnosis laboratory is now equipped with automated ELISA system, PCR and NASH facilities. Because of its unique record in the field of virus diagnosis, the Government of India has notified this laboratory as 'Accredited Test Laboratory' for testing and certification of tissue culture raised potato micro plants and minitubers.

The biotechnology laboratory of the institute, created in 1992, presently houses all the facilities for transgenic research, DNA fingerprinting, molecular breeding, micro propagation and cryo-conservation. A new laboratory has recently been created for conducting basic research on cell biology and somatic cell genetics. The radio-tracer laboratory of the institute was created in 1996 for carrying out basic research on nutrient dynamics in soil and

plant. This laboratory is also helping in molecular diagnosis of plant pathogens and other molecular biology related works. The institute has a well-equipped fungal pathology laboratory that has world-class facility for basic and applied research on late blight pathogen.

The institute has 514.84 ha farm lands distributed over 15 units for conducting field experiments and undertaking breeders' seed production. Recently, Aeroponic facility was created at ICAR-CPRI, Shimla, ICAR-CPRI, RS, Modipuram, ICAR-CPRI, RS, Patna and

ICARCPRI, RS, Shillong for soil less disease-free seed potato production. A BPD Unit has been established at ICAR-CPRI, RS, Jalandhar for commercialization of potato technologies developed by the institute. The institute library is the second largest library in the world. Besides, the institute has well-equipped AKMU cell, ATIC, museum, auditorium, conference hall, committee room at the hqrs. and similar facilities have been provided at the regional stations. The institute is well equipped to organize training programmes with the facilities like audio-visual aids, projector, Guest house, farmers' hostels etc.



Regional Stations



ICAR-CPRI, RS, Modipuram



ICAR-CPRI, RS, Patna



ICAR-CPRI, RS, Jalandhar



ICAR-CPRI, RS, Gwalior



ICAR-CPRI, RS, Ooty



ICAR-CPRI, RS, Shillong

विशिष्ट सारांश

फसल सुधार एवं बीज प्रौद्योगिकी प्रभाग

फसल सुधार की वर्तमान और भविष्य की आवश्यकताओं को पूरा करने के लिए पौधों के अनुवांशिक संसाधन सबसे महत्वपूर्ण और आवश्यक अवयव हैं। इस वर्ष पाँच देशों से 16 इन-विट्रो एक्सेशन आयात किए गए—नीदरलैंड से 9, यूके से 3, रूस से 2, और जर्मनी तथा फ्रांस से 1-1। वर्ष के दौरान क्वारंटीन कीटों से मुक्त 45 एक्सेशन जर्मप्लाज्म भंडार में शामिल किए गए। वर्तमान में संस्थान में 4700 से अधिक खेती और जंगली आलू प्रजातियों के एक्सेशन 30 देशों से प्राप्त कर संरक्षित हैं। ये संग्रह फील्ड जीन बैंक, इन-विट्रो भंडार और सत्य आलू बीज के रूप में सुरक्षित रखे गए हैं। इन्हें आसानी से शोधकर्ताओं के लिए उपलब्ध कराया गया है। कई एक्सेशनों का जैविक एवं अजैविक तनाव, भंडारण गुणवत्ता, प्रोसेसिंग गुण और विभिन्न थर्मो-फोटोपीरियड के अनुकूलन के आधार पर मूल्यांकन कर उनमें से आशाजनक एक्सेशनों की पहचान की गई। इनसे संबंधित जानकारी इलेक्ट्रॉनिक डेटाबेस में संग्रहीत है। साथ ही तीन श्रेष्ठ अनुवांशिक स्टॉक्स ICAR-NBPGR, नई दिल्ली में पंजीकृत किए गए हैं।

हाईब्रीडाइजेशन कार्यक्रम में 722 क्रॉस से 13,22,998 सत्य आलू बीज का उत्पादन किया गया। जिसमें उच्च उपज, गुणवत्ता, और जैविक व अजैविक तनावों के प्रति प्रतिरोध/सहनशीलता के लिए चुने गए श्रेष्ठ पेरेंटल लाइंस का उपयोग किया गया। कुल 6,08,339 सत्य आलू बीज से 2,65,915 पौधे प्राप्त हुए और फसल कटाई के समय 28,620 आशाजनक क्लोन चयनित किए गए। प्रारंभिक क्लोनल पीढ़ी में 41,826 क्लोन का मूल्यांकन किया गया जिससे 7,298 आशाजनक क्लोन चुने गए। 35 उन्नत संकर परीक्षणों में 543 क्लोन का उच्च कंद उपज, पोषण और प्रोसेसिंग गुणों को ध्यान में रखते हुए चयन कर मूल्यांकन किया गया और 187 आशाजनक क्लोन चयनित किए गए। ताकि मानव स्वास्थ्य के लिए आवश्यक उच्च पोषण और खनिज मूल्य सुनिश्चित किए जा सकें इसके साथ ही लेट ब्लाइट प्रतिरोध और पोषणयुक्त उन्नत क्लोनों की उपचार गुणवत्ता का भी मूल्यांकन किया गया।

वर्षों की निरंतर उपलब्धियों के आधार पर 14 उन्नत संकर, जैसे MS/19-268 (पोषण में श्रेष्ठ), MS/19-571 (बेबी आलू), MSP/19-190 (पोषण में श्रेष्ठ), J/16-78, J/16-84 (अर्ली

बल्कर), MP/18-285, MP/18-705, MP/18-217, MP/18-296 (प्रोसेसिंग उपयोग), HT/17-164 (ताप सहनशील), OS/15-276, OS/16-79 (सिस्ट नीमेटोड सहनशील), PS/17-09, PS/18-60 (लाल छिलका), को बहु-स्थानीय परीक्षण हेतु AICRP में शामिल किया गया।

K Chipsona-5 में अनुकूल नाइट्रोजन स्तर पर किए गए अध्ययन में पाया गया कि 200 किग्रा/हेक्टेयर नाइट्रोजन देने पर प्रोसेसिंग ग्रेड कंद की उपज 9.43 टन/हेक्टेयर और कुल कंद उपज 31.5 टन/हेक्टेयर प्राप्त हुई जो कि सांख्यिकीय तुलना में कम और अधिक नाइट्रोजन डोज के बराबर थी। इस स्तर पर कंद की शुष्क सामग्री (22.8%), विशिष्ट घनत्व (1.080), और चिप रंग स्कोर (3.36) भी अपेक्षाकृत बेहतर पाए गए। इस स्तर पर कंद शुष्क पदार्थ सामग्री (22.8%), विशिष्ट गुरुत्व (1.080), और चिप कलर स्कोर (3.36) भी अपेक्षाकृत बेहतर थे। आलू की अनुवांशिक स्टॉक्स B S 48-6 (INGR24081) और BS 49-1 (INGR24082), जिन्हें श्रेष्ठ स्व-संगत Sii जीन होमोजाइगस डिप्लॉइड लाइनों के रूप में पहचान कर अध्ययन किया गया और ICAR-NBPGR में पंजीकृत किया गया। आलू की चार नई किस्में कुफरी रतन (लाल छिलका), कुफरी चिपभारत-1, कुफरी चिपभारत-2 (प्रोसेसिंग गुण), और कुफरी तेजस (ताप सहनशील) को 41वें AICRP (Potato) समूह बैठक, जो 22-24 सितंबर 2024 को अयोध्या, उत्तर प्रदेश में टिलीज़ के लिए अनुशंसित किया गया। इसके अतिरिक्त उत्तर भारत के मैदानों हेतु उपयुक्त आलू की अगेती बल्किंग किस्म कुफरी सुख्याति और कुफरी जमुनिया, जो बैंगनी गूदे वाली बायो-फोर्टिफाइड किस्में हैं को CVRC द्वारा अधिसूचित किया गया।

कुल 27,809.49 क्विंटल नाभिकीय और ब्रीडर बीज का उत्पादन मैदानी और पहाड़ी इलाकों में 131.83 हेक्टेयर क्षेत्र से प्राप्त किया गया। इसमें से 20,234.52 क्विंटल बीज 99.77 हेक्टेयर क्षेत्र से पारंपरिक विधियों द्वारा और 7574.97 क्विंटल बीज 32.05 हेक्टेयर क्षेत्र से उच्च तकनीक आधारित बीज उत्पादन प्रणालियों द्वारा प्राप्त हुआ। पारंपरिक प्रणाली से नाभिकीय और प्रजनक (ब्रीडर) बीज का योगदान 72.72% तथा उच्च तकनीक प्रणाली से 27.27% रहा। साल 2024 में मैदानी और पहाड़ी क्षेत्रों से कुल 22,086.21 क्विंटल प्रजनक

बीज विभिन्न सरकारी और निजी एजेंसियों को आपूर्ति किया गया। साथ ही 28 किस्मों के 56 पॉट लगाए गए और ELISA/PCR परीक्षणों के माध्यम से विभिन्न आलू वायरसों की जांच की गई। कई परीक्षणों के बाद सभी स्वस्थ किस्मों को इन-विट्रो में स्थानांतरित कर माइक्रोप्लॉट गुणन और आपूर्ति श्रृंखला में शामिल किया गया। देशभर में 35 बीज उत्पादक संस्थाओं को आलू की 28 किस्मों के कुल 281 वायरस-मुक्त इन-विट्रो कल्चर ट्यूब वितरित किए गए जिससे ₹. 28,10,000 का राजस्व प्राप्त हुआ। इसके अतिरिक्त, ब्रीडर बीज के निस्तारण से कुल ₹11 करोड़ की आय अर्जित हुई।

मौसम के दौरान चार सेटों (A,B,C,D) नियंत्रण और प्रजनन बीज कुफरी बहार का गुणन किया गया ताकि नेट हाऊस परिस्थितियों के तहत प्रारम्भिक ट्यूबर (केन्द्र) आकार के दर्ज अवलोकनों को सत्यापित किया जा सके। बीज अनुसंधान में *Bacillus cereus* (B5) के उपचारों का उपयोग एरोपोनिक मिनीट्यूबर्स के उत्पादन व्यवहार पर अध्ययन किया गया। वर्तमान मौसम में परिणामस्वरूप A और B उपचार, जो माइक्रोप्रोपेगेशन के दौरान GA के साथ और बिना मेटिक्लोन से प्राप्त किए गए थे, ने वायरस-मुक्तता और कंद आकार की अनुवांशिक अखंडता बनाए रखी। वहीं, C उपचार में लगातार विकृति ने इन-विट्रो परिस्थितियों के फेनोटाइपिक अभिव्यक्ति पर गंभीर प्रभाव को उजागर किया। फील्ड परिस्थितियों में तीन रोपण सामग्री-एपिकल रुटेड कटिंग (ARC), स्प्राउट कटिंग, और एरोपोनिक मिनीट्यूबर्स-की तुलनात्मक प्रारंभिक अध्ययन से पता चला कि प्रसार विधि और किस्म का चयन लक्ष्य के आधार पर बीज उत्पादन में महत्वपूर्ण भूमिका निभाता है, चाहे उद्देश्य उपज हो या गुणन।

आलू में बैक्टीरियल विल्ट प्रतिरोध से जुड़े प्रमुख जीन और नियामक तत्वों की पहचान के लिए PacBio आधारित SMRT सिक्वेन्सिंग की गई। इसमें दो आलू जीनोटाइप, SM/92-338 और कुफरी लीमा को नियंत्रित परिस्थितियों में ग्रीथ चेंबर में बैक्टीरियल विल्ट रोग के लिए स्क्रीन किया गया और उनके पत्तों के नमूनों का ट्रांसक्रिप्टोम सिक्वेन्सिंग किया गया।

आलू के 12 प्रतिनिधि जीनोटाइप सेट का मूल्यांकन आलू के सभी लिंकेज समूहों को कवर करने वाले कुल 600 जीनोमिक एसएसआर मार्करों का पॉलिमोर्फिक क्षमता के लिए किया गया। आलू के SSR मार्करों का एक मुख्य सेट आलू जर्मप्लाज्म और पॉलीमोर्फिक के लक्षण विकसित

करने के लिए किस्मों, जर्मप्लाज्म, दैहिक संकर और जंगली प्रजातियों को शामिल कर अब तक 285 एसएसआर मार्कर पॉलिमोर्फिक पाए गए हैं साथ ही, शुष्क सड़न प्रतिरोध से जुड़े जीनोमिक क्षेत्रों की पहचान के लिए जीनोम-वाइड एसोसिएशन अध्ययन (GWAS) किया गया। इसमें क्षति के आयतन का विश्लेषण एडिटिव और डॉमिनेंस मॉडल दोनों के आधार पर किया गया। विश्लेषण में 6 मार्कर-ट्रेट एसोसिएशन पाए गए, जो सभी क्रोमोसोम 7 पर स्थित थे।

एडिटिव मॉडल के तहत मार्कर CHR07_8537762, एकमात्र महत्वपूर्ण मार्कर था, जिसमें 0.001 के अत्यधिक महत्वपूर्ण पी-मान के साथ फेनोटाइपिक विचरण का 6.7% था। एक अन्य मार्कर, CHR07_15660835 में 3.3% भिन्नता के बारे में 1-डोम-एलली मॉडल के तहत पहचाना गया।

फसल उत्पादन प्रभाग

आलू उगाने वाली मिट्टी में उच्च तापमान की परिस्थितियों में कार्बन फ्रेक्सन डायनामिक्स (CFD) और बजट का अध्ययन किया गया। विभिन्न जैविक संशोधनों वाले मिट्टी में तापमान बढ़ने (लगभग 3°C) पर कंद की उपज में गिरावट देखी गई। धान के भूसे के मिश्रण में गिरावट सांख्यिकीय रूप से महत्वपूर्ण नहीं थी, जबकि वर्मीकम्पोस्ट लगाने और नियंत्रण उपचार में यह गिरावट महत्वपूर्ण पाई गई। इसके अतिरिक्त, विभिन्न प्रतिरोध स्तर वाली किस्मों में अगेता झुलसा और काली रुसी रोग की गंभीरता पर विभिन्न बुवाई तिथियों का प्रभाव का भी अध्ययन किया गया। अर्ली ब्लाइट के मामले में, 17 अक्टूबर 2023 की बुवाई पर, संवेदनशील समूह में सबसे अधिक AUDPC (Area Under Disease Progress Curve) किस्म K. Lavkar में दर्ज हुई, इसके बाद K. Chandramukhi और K. Deva रहे। वहीं, प्रतिरोधी समूह में सबसे अधिक AUDPC K. Pukhraj में पाया गया, उसके बाद K. Khyati और K. Sindhuri रहे। ब्लैक स्कर्फ रोग के मामले में 17 अक्टूबर, 2023 की बुवाई पर, संवेदनशील समूह में सबसे अधिक रोग संक्रमण किस्म Atlantic में पाया गया, उसके बाद K. Sindhuri रहा। वहीं प्रतिरोधी समूह में सबसे अधिक रोग संक्रमण K. Deva में पाया गया, उसके बाद K. Sherpa किस्म में रहा।

बुवाई तिथियों का एफिड (Aphid) और व्हाइटफ्लाई (Whitefly) की जनसंख्या पर प्रभाव भी अध्ययन किया गया। पंख वाले एफिड की जनसंख्या मानक मौसम सप्ताहों (SMWs) और बुवाई तिथियों के अनुसार उल्लेखनीय रूप से

बदलती रही। बिना पंख वाले एफिड की जनसंख्या में भी यही प्रवृत्ति देखी गई। व्हाइटफ्लाई की जनसंख्या पर SMW, बुवाई तिथि और उनके परस्पर प्रभाव का स्पष्ट असर पाया गया। जल्दी बुवाई वाली फसलों में संक्रमण अधिक देखा गया, जबकि मध्य से देर से बुवाई वाली फसलों में संक्रमण कम पाया गया।

इसके अलावा, Aquacrop मॉडल के इनपुट डेटा जनरेशन हेतु एक नई कार्यप्रणाली विकसित की गई। आलू की फसल की दृश्य (RGB) छवियों से CC% का तीव्र और सटीक आकलन करने के लिए AI-ML आधारित "PCCAnalyzer" विकसित किया गया।

पटना में सर्वोच्च जल उपयोग दक्षता (WVF) (143/7 किग्रा/हेक्टेयर-मिमी) तब दर्ज की गयी जब पानी सिंचाई के दौरान 30 मिमी की दर से दिया गया, जोकि रिज-फरो विधि से पौधारोपण में और 100% अनुसंश्लित मात्रा में NPK के उपयोग के साथ था। जालंधर में आलू की फसल के जैवभौतिक मापों के लिए गैर-आक्रामक दृश्य इमेजिंग (RGB) और इमेज प्रोसेसिंग प्रोटोकॉल का मानकीकरण विकसित किया गया। शिलांग की अम्लीय मिट्टी में 50% SSP + 50% समृद्ध रॉक फॉस्फेट वर्मी कम्पोस्ट (RPVEC) की संयोजित खुराक से 16.57 टन/हेक्टेयर कुल कंद उपज और 8.16 टन/हेक्टेयर बाजार योग्य उपज प्राप्त हुई, जो अकेले SSP और RPVEC से बेहतर रही। उर्वरित और बिना उर्वरक वाले स्थिति में पत्ती में फॉस्फोरस की सांद्रता में भी व्यापक अंतर देखा गया।

पटना में PS/18-21 (23.7 t/ha), PS/17-20 (23.4 t/ha), PS/17-15 (22.3 t/ha), PS/18-44 (21.9 t/ha) ने बिना फॉस्फोरस के भी अच्छा प्रदर्शन किया। जालंधर में J/15-91 को सबसे अधिक P उपयोग दक्ष पाया गया। ऊटी में 3 महीने पुराना कंपोस्टेड SMS, जिसमें 2% P शामिल था, से सर्वोच्च कंद उपज प्राप्त हुई।

मोदीपुरम में इन किस्मों HT/12-751, MS/14-243, MS/13-391, MP/14-505, MS/15-1001, MS/14-1381, HT/12-830, MS/18-393, MS/13-391, MS/16-1156 के

चौथे वर्ष में भी निर्यात गतिविधि आशाजनक रही। प्राकृतिक खेती के लिए तकनीकी विकास मोदीपुरम, पटना और शिलांग में जारी है। मोदीपुरम में जैविक प्रणाली के अंतर्गत आशाजनक उन्नत क्लोन HT/12-751, MS/13-391,

MS/14-243, HT/12-830, MS/19-400, MS/18-465, MS/19-175, MS/15-1001 पाए गए।

शिलांग में कु. हिमालिनी किस्म ने पोल्ट्री मैन्योर + वर्मी कम्पोस्ट (14.80 t/ha) के साथ सर्वोच्च उपज दी, इसके बाद पोल्ट्री मैन्योर (13.91 t/ha), सुअर के गोबर और वर्मी कम्पोस्ट का संयोजन (13.83 t/ha) तथा सुअर का गोबर (12.15 t/ha) रहा, जबकि नियंत्रण में यह केवल 5.29 t/ha रहा।

काले फफूंद (ब्लैक स्कर्फ) का जैविक तरीके से नियंत्रण संभव है। 100% शुद्ध गौ मूत्र से डूबोने पर सबसे कम औसत रोग-दर (24.33%) और गंभीरता (10.12%) दर्ज हुई, इसके बाद क्रमशः जीवामृत @ 200 ml/l (रोग-दर: 56.56%; रोग-गंभीरता: 25.94%), नीम के बीज का 20 g/l शुद्ध पिसा हुआ पाउडर (रोग-दर: 57.71%; रोग-गंभीरता: 27.41%) और गौ मूत्र (1:10 अनुपात) डूबोने का उपचार (रोग-दर: 58.53%; रोग-गंभीरता: 24.22%) रहे, जबकि रोगग्रस्त नियंत्रण में ये आंकड़े क्रमशः 82.17% (रोग-दर) और 38.37% (रोग-गंभीरता) थे। इस अध्ययन के आधार पर, नीमाज़ल और पोंगामिया साबुन का उपयोग कर व्हाइटफ्लाई और एफिड का प्रभावी नियंत्रण प्राकृतिक खेती में संभव पाया गया। पटना, मोदीपुरम और शिलांग में प्रणालीगत तकनीकी विकास चल रहा है। पटना में, ग्रीन ग्राम-आलू प्रणाली (16.5 t/ha) ने अन्य क्रमिक फसलों की तुलना में अधिकतम और महत्वपूर्ण रूप से बेहतर कुल कंद उपज दी और पोषक तत्व प्रबंधन क्रियाओं में, 100% NPK पोषण (18.0 t/ha) अन्य उपचारों की तुलना में सर्वाधिक और सांख्यिकीय रूप से बेहतर कुल कंद उपज प्राप्त किया। मोदीपुरम में प्रथम वर्ष के परिणामों से पता चला कि एकीकृत फसल प्रबंधन (ICM) प्रथा ने ऑर्गेनिक और प्राकृतिक खेती प्रथाओं की तुलना में महत्वपूर्ण रूप से अधिक कुल कंद उपज (25.34 t/ha) प्रदर्शित की है। शिलांग में आलू-पाक चोई प्रणाली ने रबी फसल में 49.03 t/ha और सिस्टम PEY में 65.56 t/ha की सर्वोच्च उपज दी। जालंधर में C.P.R. फॉर्म्युलेशन द्वारा कंद संख्या बढ़ाने की तकनीक का परीक्षण कर किस्मों के लिए अनुकूल खुराक का निर्धारण किया गया। विभिन्न किस्मों में कंद संख्या में 10.8% से 19.4% तक वृद्धि देखी गई। एरोपोनिक तरीके से उत्पादित मिनी ट्यूबर्स की सटीक रोपाई के लिए चार पंक्तियों वाली अर्ध-स्वचालित रोपण प्रणाली का विकास किया गया। जालंधर में मेकाट्रॉनिक्स गतिविधि के तहत GPS-संचालित बिना

चालक रोबोट वाहन (UGV) विकसित किया गया, जो खेतों में लक्षित कृषि रसायनों के अनुप्रयोग हेतु उपयोग किया जाएगा।

पौध संरक्षण प्रभाग

इस वर्ष झुलसा रोग का असर नहीं था जिसके कारण उपज में कमी पर कोई प्रभाव नहीं पड़ा। जैसा कि पिछले वर्षों में देखने में आया था। फाइटोफ्थोरा इन्फेस्टेन्स ने साइमोक्सानिल के प्रति प्रतिरोध विकसित कर लिया है रोगाणु वृद्धि (ED) को 50% तक बाधित करने के लिए 518.607 mg/L आवश्यक प्रभावी खुराक थी, जिसका 95% अंतराल 435.40 से 627.00 mg/L के बीच था। हालांकि, आइसोलेट को डाइमिथोमॉर्फ और फेनामिडोन कवकनाशकों के प्रति संवेदनशील पाया गया।

आलू कंदों में पिछेता झुलसा रोग और शुष्क सड़न संक्रमणों का पता लगाने के लिए और निदान हेतु नियर इन्फ्रारेड (NIR) स्पेक्ट्रोस्कोपी का उपयोग किया गया। पिछेता झुलसा रोग और शुष्क सड़न संक्रमणों के लिए पता लगाने की सटीकता दर क्रमशः 93% और 88% थी। इंडो-ब्लाइटकास्ट मॉडल ने कृषि-पारिस्थितिकी में पिछेता झुलसा रोग के प्रकट होने का पूर्वानुमान पहले ही लगा लिया था और तदनुसार इसके प्रबंधन के लिए कृषि परामर्श जारी किए गए थे।

पिछेता झुलसा महामारी विज्ञान संबंधी अध्ययनों से पता चला है कि स्व-उर्वरक आइसोलेट, A1 और A2 मेटिंग टाइप्स समान प्रतिस्पर्धी हैं, जिससे लेट ब्लाइट प्रबंधन के लिए गंभीर खतरा उत्पन्न होता है। लेट ब्लाइट के नियंत्रण में Valifenalate 6% + Mancozeb 60% WG @ 0.5% का प्रभाव Fenamidon 10 + Mancozeb 50% WG @ 0.3% और Dimethomorph 50% WP @ 0.1% के समान पाया गया। ब्लैक स्कर्फ के खिलाफ उपचार में Fluxapyroxad 333FS @ 0.6% कंद बीज उपचार ने Tebuconazole 15% + Zineb 57% WDG @ 2.5%, Thifluzamide 24% SC @ 0.5% और Imidacloprid 17.8 SL @ 0.04% + Penflufen 22.43% FS के समान प्रभाव दिखाया। तीन एंडोफाइटिक बैक्टीरिया—*Bacillus amyloliquefaciens* (E-21), *Stenotrophomonas maltophilia* (E-33) और *Pseudomonas geniculata* (E-45) —ने *Streptomyces scabiei* की वृद्धि को इन-विट्रो परीक्षणों में अच्छी तरह नियंत्रित किया। इसी तरह, *Streptomyces scabiei*, *Pectobacterium brasiliense*, *Ralstonia*

solanacearum और *Fusarium sambucinum* की वृद्धि तब पूरी तरह रुक गई जब इन्हें ClO₂ (0.2 और 0.3%) तथा NaOCl (1.0 और 2.0%) के साथ 20 मिनट उपचारित किया गया। वहीं Boric Acid (2.0 और 3.0%) केवल *Ralstonia solanacearum* के खिलाफ प्रभावी पाया गया। *Rhizoctonia solani* (स्टेम कैंकर और ब्लैक स्कर्फ) के खिलाफ केवल NaOCl (1.0 और 2.0%) ही प्रभावी रहा। रोपण के समय कॉमन स्कैब का कंद डिप उपचार में सोडियम हाइपोक्लोराइट (NaOCl) @ 2% और क्लोरीन डाइऑक्साइड (ClO₂) @ 0.3% से 30 मिनट उपचार करने पर का न्यूनतम प्रकोप दर्ज हुआ। डिप्लॉइड किस्म 'BS 303' ने कॉमन स्कैब के प्रति तुलनात्मक रूप से प्रतिरोध (5.1% रोग गंभीरता) दिखाई।

एफिड और व्हाइटफ्लाई की मौसमी निगरानी से पता चला कि विशेष रूप से बिना पंख वाले एफिड की संख्या फसल की परिपक्वता अवस्था में तेजी से बढ़ती है, जिससे आर्थिक सीमा पार होने पर वायरस संक्रमण का खतरा बढ़ जाता है। इसके विपरीत, व्हाइटफ्लाई की गतिविधि प्रारंभिक वानस्पतिक अवस्था में अधिक देखी गई और बाद में कम हो गई, जिससे देर के मौसम में जोखिम सीमित रहा लेकिन प्रारंभिक निगरानी आवश्यक मानी गई। फरवरी की शुरुआत में पीले चिपचिपे जाल (Yellow Sticky Trap) के डेटा ने दोहरी मोड़ वाले एफिड उड़ान गतिविधि की महत्वपूर्ण वृद्धि देखी गई। जो पंख वाले वाहकों के लिए मौसम के अंत में निगरानी के महत्व को मजबूत करती है।

किस्मों के स्क्रीनिंग परीक्षणों में कीटों के प्रति अलग-अलग संवेदनशीलता देखी गई। कुफरी सूर्या और कुफरी पुखराज ने एफिड के प्रति सबसे अधिक प्रतिरोध दिखाया, जबकि कुफरी चिपसोना-1 ने व्हाइटफ्लाई के खिलाफ मजबूत प्रतिरोध प्रदर्शित किया। कुफरी किरण सबसे अधिक संवेदनशील किस्म रही, जिससे कीट दबाव और मौसमी गतिशीलता के आधार पर किस्म चयन की आवश्यकता उजागर हुई।

हर्बिवोर इंडयूसड प्लांट वॉलेटाइल्स (Plant Volatiles) पर एक नवीन अध्ययन में पाया गया कि *Bemisia tabaci* संक्रमण ने *Tuta absoluta* को आलू के पौधों की ओर अधिक आकर्षित किया। यह प्रभाव β -caryophyllene और germacrene D जैसे वाष्पशील पदार्थों के माध्यम से हुआ, जो कीट व्यवहार में हेरफेर के लिए रासायनिक पारिस्थितिकी उपकरणों की संभावना प्रस्तुत करता है।

यह पारिस्थितिक इंटरैक्शन कीट व्यवहार संशोधन के लिए रासायनिक पारिस्थितिकी उपकरणों का उपयोग करने की संभावनाएँ प्रस्तुत करता है। कीटनाशक के अनुप्रयोग (application) के तरीकों का तुलनात्मक मूल्यांकन यह दर्शाता है कि ट्रेक्टर पर लगे स्प्रे ने इमिडाक्लोप्रिड का सर्वश्रेष्ठ अवशोषण प्राप्त किया और सफेद मक्खियों पर बेहतर नियंत्रण किया (अनुप्रयोग के 3 दिन बाद 83 % कमी) उसके बाद सिलिका आधारित एडजुवंट के साथ ड्रोन छिड़काव आया। केवल ड्रोन प्रयोग का सीमित प्रभाव दिखा और कीटनाशक की प्रणालीगत गतिशीलता भी कम पाई गई। यह दर्शाता है कि तकनीक के चयन से प्रणालीगत कीटनाशकों के प्रभाव में सुधार संभव है।

आलू सिस्ट नेमाटोड (PCN) के खिलाफ एकीकृत प्रबंधन रणनीतियों का परीक्षण किया गया। *Bacillus cereus* SGL6 को ट्रेप क्रॉपिंग और फॉलो के साथ संयोजित करने पर PCN की सबसे अधिक दमन दर ($R_f = 0.52$) और अंडों की जीवितता में 93.6% की कमी देखी गई।

गेट-होस्ट फसलों और ब्लीचिंग पाउडर से संबंधित अतिरिक्त उपचारों ने भी मजबूत प्रभावशीलता प्रदर्शित की। देशी जैव एजेंटों के क्षेत्रीय मूल्यांकन में पाया गया कि पल्लुओपाइराम का विभाजित अनुप्रयोग सिस्ट की संख्या में 51.2% की कमी लाता है। *Bacillus cereus* और *Chaetomium globosum* की समृद्ध तैयारियों ने भी आशाजनक परिणाम दिए।

दीर्घकालिक फसल चक्र परीक्षणों में पाया गया कि सरसों, फ्रेंच बीन्स, ओट और ट्रेप फसलों को शामिल करने वाली विविध प्रणालियों ने PCN जनसंख्या को 84.6% तक घटाया। ये परिणाम प्रणाली आधारित और जैविक रणनीतियों की महत्ता को दर्शाते हैं।

PCN प्रतिरोधी किस्में जैसे कुफरी स्वर्णा और कुफरी सह्याद्री रुट-नॉट निमेटोड (RKN) के प्रति संवेदनशील पाई गईं, जिससे स्पष्ट होता है कि PCN और RKN प्रतिरोध अलग-अलग तंत्रों पर आधारित हैं।

फसल देहिकी, जैव-रसायन एवं फसल उपरांत प्रौद्योगिकी प्रभाग

आलू के फसल उपरांत प्रबंधन के तहत स्वाभाविक रूप से होने

वाले तेल के एक नए संयोजन की पहचान की गई जो 10-12 डिग्री सेल्सियस पर संग्रहीत आलू में उगाए गए अंकुरण को नियंत्रित करने के लिए प्रभावी पाई गई। इस साल 19 विभिन्न किस्मों पर इस फॉर्मूलेशन की प्रभावकारिता का मूल्यांकन किया गया। जिसके परिणामस्वरूप यह फॉर्मूलेशन आलू को 120 दिनों तक अंकुरित कर सकता है। संवेदी और गुणवत्ता विशेषताओं के प्रभाव के अध्ययन के क्रम में आलू पकाने के दौरान पकाने के विभिन्न तरीकों से पता चला कि आलू को आलू - खाने के तेल के संयोजन से पकाने पर आलू में उपलब्ध कार्बोहाइड्रेट (ACHO) काफी कम ($P < 0.05$) हो जाता है कुफरी ज्योति के मामले में ACHO 13.78 ग्राम/100 ग्राम DW था और सरसों, सूरजमुखी, सोयाबीन, घी, जैतून, चावल की भूसी और नारियल तेल को मिलाने पर ACHO क्रमशः 10.87, 11.26, 10.81, 8.84, 7.90, 9.85 और 9.06 ग्राम/100 ग्राम DW हो गया। ACHO में अधिकतम (42.7%) और न्यूनतम (18.3%) कमी क्रमशः आलू (KJ)-जैतून तेल और आलू (KJ)-सोयाबीन तेल में देखी गई। इसी प्रकार, कुफरी चिपसोना-3 किस्म के कंदों में ऑलिव तेल, घी और नारियल तेल के साथ पकाने पर ACHO में क्रमशः 47.7%, 39.4% और 39.3% की उल्लेखनीय कमी दर्ज की गई। आलू को आलू-घी, आलू-नारियल तेल और आलू-जैतून के तेल के मिश्रण में पकाने से, स्टार्च हाइड्रोलिसिस इंडेक्स (SHI) में नियंत्रण की तुलना में क्रमशः 30.8, 30.1 और 28.1% की वृद्धि हुई। आलू के कंद को विभिन्न तेलों में पकाने और फिर ठंडा करने से भी SHI में उल्लेखनीय कमी आई। इसके अलावा, विभिन्न खाना पकाने के तेलों को मिलाने से आलू के ग्लाइसेमिक इंडेक्स (जीआई) और ग्लाइसेमिक लोड (जीएल) कम करने वाले महत्वपूर्ण प्रभाव देखे गए। खाना पकाने के तेल (सात अलग-अलग प्रकार) को मिलाने से आलू के कंदों में प्रतिरोधी स्टार्च की मात्रा (आरएससी) में उल्लेखनीय वृद्धि हुई। आलू की फसल की परिपक्व अवस्था में या कटाई के समय अत्यधिक वर्षा आलू की गुणवत्ता को गंभीर रूप से प्रभावित करती है। आलू की दो किस्मों कुफरी चिपसोना-3 और कुफरी फ्राइसोना में अत्यधिक जल तनाव के कृत्रिम सिमुलेशन अध्ययनों से आलू कंदों के मुक्त अमीनो अम्लों और कुल फिनोल सामग्री पर जल की कमी के किस्म-विशेष प्रभाव दिखाई दिए। आलू के रस से सक्रिय किण्वित प्रोबायोटिक पेयों का विकास किया गया। तीन संभावित सूक्ष्मजीवों—*Lactobacillus acidophilus*, *Lactobacillus plantarum*, और *Lactobacillus fermentum*—को प्रोबायोटिक गुणों के लिए पहचाना गया।

आलू से नए मूल्य संवर्धित उत्पाद विकसित किए गए। इनमें आलू-चना आधारित बूंदी को मिठाई और रायते में उपयोग हेतु नमकीन बूंदी शामिल हैं। बूंदी एक पारंपरिक तले हुए गोल आकार का उत्पाद है जो चने या बंगाल ग्राम (बेसन) के घोल से बनाया जाता है। इसमें 50% से अधिक चने के आटे को आलू के आटे से बदल कर बूंदी विकसित की। विकसित बूंदी की कुरकुराहट पारंपरिक बूंदी से बेहतर पाई गई। यह बूंदी मिठाई और रायता दोनों बनाने के लिए उपयुक्त है। एक अन्य नमकीन संस्करण में आलू का आटा, उड़द दाल का आटा, मक्का का आटा और चने का आटा मिलाकर स्नैक बूंदी बनाई गई। अन्य तले हुए आलू उत्पादों की तुलना में यह बूंदी किसी भी प्रकार के आलू से बनाई जा सकती है। आलू की शेल्फ लाइफ और उपरांत गुणवत्ता पर शर्करा चयापचय की भूमिका को समझने हेतु सुक्रोज ट्रांसपोर्टर (SUT) जीन का विश्लेषण किया गया। इसमें पाया गया कि आलू जीनोम अनुक्रम डेटाबेस में केवल एक SUT जीन (i d PGSC0003DMG400025610) मौजूद है, जो क्रोमोसोम 5 पर स्थित है। इस जीन का आकार 1515 न्यूक्लियोटाइड पाया गया, जिसमें 825 न्यूक्लियोटाइड का ओपन रीडिंग फ्रेम (ORF) है, इसमें 5 इंद्रॉन हैं और यह 274 अमीनो अम्ल वाले प्रोटीन का निर्माण करता है। इसका आइसोइलेक्ट्रिक पॉइंट 5.25 तथा आणविक भार 28.99 kDa पाया गया। विभिन्न किस्मों में भंडारण के दौरान इस जीन की अभिव्यक्ति अलग-अलग देखी गई।

सामाजिक विज्ञान प्रभाग

इस संभाग द्वारा किए गए अनुसंधान कार्य में उपभोक्ता और किसान की प्राथमिकताओं पर व्यापक अध्ययन संरचित (structured) सर्वेक्षणों के माध्यम से आयोजित किए गए। ऑनलाइन गूगल फॉर्म सर्वेक्षण के माध्यम से उपभोक्ताओं की ताजे आलू की विशेषताओं की प्राथमिकताओं का विश्लेषण किया गया। इसमें (मैदान से 42 और पहाड़ी क्षेत्रों से 52) कुल 93 प्रतिक्रियाएँ प्राप्त हुईं परिणामों से स्पष्ट क्षेत्रीय प्राथमिकताएँ सामने आईं – मैदान के उपभोक्ताओं ने शेल्फ लाइफ (4.88), पकाने का समय (4.71) और स्वाद (4.71) को प्राथमिकता दी, जबकि पहाड़ी क्षेत्रों के उपभोक्ता स्वाद (4.67), उबालने की उपयुक्तता (4.63) और शेल्फ लाइफ (4.49) को महत्व दिया। Mann-Whitney U परीक्षण से यह भी स्पष्ट हुआ कि कंद के आकार, छिलके के रंग, शेल्फ लाइफ और प्रोसेसिंग की उपयुक्तता में थे (सभी $p < 0.001$) क्षेत्रीय अंतर

अत्यंत महत्वपूर्ण। उपभोक्ताओं ने मध्यम आकार के कंद (87.1%), सफेद छिलके वाले कंद (97.1%), और लंबी शेल्फ लाइफ (86.0%) को प्राथमिकता दी। उपभोक्ता (मैदान: 88.10% और पहाड़: 62.75%) लगभग 74.19% गुणवत्ता वाले आलू के लिए अतिरिक्त भुगतान करने को तैयार थे। मेघालय और उत्तराखंड से प्राप्त 107 प्रतिक्रियाओं के आधार पर किस्म विशेषताओं पर किसानों की प्राथमिकताओं का अध्ययन किया गया। इसमें शुष्क सहनशीलता (WMS=5.00), उत्पादकता (4.98), बाजार योग्यता (4.98) और पिछेता झुलसा रोग प्रतिरोध (4.90) को शीर्ष प्राथमिकताएँ दी गयीं। क्षेत्रीय भिन्नताओं में पाया गया कि मेघालय में गोल कंद (59.3%) पसंद किए गए जबकि उत्तराखंड में लंबे आकार वाले कंद (50%) को पसंद किया गया। आकार में अंतर और छिलके की चिकनाई में अंतर महत्वपूर्ण पाया गया। क्षेत्रीय रूप से गुणवत्तापूर्ण बीज के लिए भुगतान की इच्छा भिन्न भिन्न थी – मेघालय में 88.14% और उत्तराखंड में 66.67%।

संस्थान ने बिहार, उत्तर प्रदेश, पंजाब, मध्य प्रदेश, झारखंड, पश्चिम बंगाल और मेघालय में 833 फ्रंट लाइन डेमोंस्ट्रेशन (SCSP=381, NEH=105, TSP=342, अन्य=05) आयोजित किए।

CPRI शिमला और क्षेत्रीय केंद्रों पर 55 प्रशिक्षण कार्यक्रम आयोजित किए गए, जिनसे लगभग 2000 किसान, वैज्ञानिक और विस्तार अधिकारी लाभान्वित हुए। संस्थान ने 24 से अधिक प्रदर्शनियाँ, जागरूकता कार्यक्रम और कार्यशालाएँ आयोजित कीं, जिससे 5000 से अधिक हितधारकों को लाभ हुआ। इसमें राष्ट्रीय आलू महोत्सव-2024 (मार्च 9-10, 2024) और मोदीपुरम में राष्ट्रीय आलू दिवस (15 फरवरी, 2024) शामिल थे। सलाह सेवाएँ 7 राज्यों (उत्तर प्रदेश, बिहार, पंजाब, मध्य प्रदेश, हिमाचल प्रदेश, मेघालय और तमिलनाडु) के 40 MGMC गाँवों तक पहुँचीं। नियमित सलाह 2000 से अधिक किसानों तक व्हाट्सएप समूहों के माध्यम से भेजी गई और लगभग 15 लाइव फोन-इन कार्यक्रम दूरदर्शन पर प्रसारित किए गए।

ATIC के माध्यम से लगभग 250 तकनीकी बुलेटिन बेचे गए और 5000 से अधिक प्रकाशन नि:शुल्क वितरित किए गए। लगभग 8000 आगंतुकों को संस्थान की तकनीकों से अवगत कराया गया। HRD कार्यक्रम के तहत 74 स्टाफ ने विभिन्न प्रशिक्षण कार्यक्रमों में भाग लिया और 190 पाठ्यक्रम iGOT कर्मयोगी प्लेटफॉर्म पर पूर्ण किए गये।

EXECUTIVE SUMMARY

DIVISION OF CROP IMPROVEMENT & SEED TECHNOLOGY

Plant genetic resources are the most valuable and essential basic raw materials for meeting current and future needs of crop improvement. Sixteen in-vitro accessions were imported from three different countries: nine from the Netherlands, three from the UK, two cultures from Russia, and one each from Germany and France. During the year, 45 accessions free from quarantined pests were introduced to the germplasm repository. Currently, more than 4700 accessions of cultivated and wild potato species, obtained from 30 countries, are conserved at the institute. The collection is evaluated, characterized, and documented in an easily accessible form for researchers. These are conserved in field gene banks, in-vitro repositories, and as true seeds. A large number of accessions were evaluated for various biotic and abiotic stresses, keeping quality, processing attributes, and adaptability to different thermo-photoperiods, resulting in the identification of promising accessions. The generated information is stored in electronic databases. Three elite genetic stocks have been registered with ICAR-NBPGR, New Delhi.

The hybridization programme produced 1322998 true potato seeds from 722 crosses involving superior parents selected for yield, quality, and resistance or tolerance to biotic and abiotic stresses. Overall, 265915 seedlings were obtained from 608339 true potato seeds of 499 crosses, and at harvest, 28620 promising clones were selected. In the initial clonal generation, 41826 clones were evaluated, and at harvest, 7,298 promising clones were selected. In advanced hybrid trials, 543 clones were assessed across 35 trials for yield, quality, and resistance or tolerance to stresses, with 187 promising clones retained at harvest. Selections emphasizing high tuber yield, nutritional, and processing qualities were made to ensure high nutritional and mineral values vital for human health. Resistance to late blight and the curing qualities of nutritionally superior advanced clones were also evaluated.

Based on consistent performance over the years, 14 advanced clones, including MS/19-268 (nutritionally superior), MS/19-571 (Baby Potatoes), MSP/19-190 (nutritionally superior), J/16-78, J/16-84 (Early bulker), MP/18-285, MP/18-705, MP/18-217, MP/18-296 (Processing use), HT/17-164 (Heat tolerant), OS/15-276, OS/16-79 (Cyste nematode tolerance), PS/17-09, and PS/18-60 (Red skin), have been introduced into the AICRP for multi-location testing. Optimization of nitrogen levels for K Chipsona-5 revealed that an N level of 200 kg/ha yielded process-grade tubers (9.43 t/ha) and total tuber yields (31.5 t/ha) statistically comparable to those obtained with lower and higher N doses. Tuber dry matter content (22.8%), specific gravity (1.080), and chip color score (3.36) were also relatively better at this rate. Potato genetic stocks, namely BS 48-6 (INGR24081) and BS 49-1 (INGR24082), identified as elite self-compatible Sli gene homozygous diploid lines and registered as genetic stocks with ICAR-NBPGR. Four new potato varieties, including Kufri Ratan (red skin), Kufri Chipbharat-1, Kufri Chipbharat-2 (processing traits), and Kufri Tejas (heat tolerant), were recommended for release at the 41st AICRP (Potato) group meeting held at ANDAU, Ayodhya, Uttar Pradesh, from September 22-24, 2024. Additionally, the new potato varieties Kufri Jamunia and Kufri Sukhyati were notified by CVRC. Kufri Sukhyati, an early bulking variety suitable for north Indian plains, and Kufri Jamunia, a bio-fortified potato with purple flesh, can also be cultivated in the north Indian plains.

A total production of 28541. 21 qtls of nucleus and breeder seed was achieved from an area of 136. 83 hectares in plains and hills, respectively. Of this, 20779. 23 qtls production from 103. 27 hectares was through conventional methods, and 7761. 98 qtls from 33. 56 hectares through hi-tech seed production systems. The percentage of nucleus and breeder seed from the conventional system was 72.80, and 27.20 from the hi-tech system, respectively. During 2024, a total of

22086. 21 qtls of breeder seed was supplied to various government and private agencies from plains and hills. A total of 56 pots containing 28 varieties were planted and tested with ELISA/PCR against different potato viruses. After conducting multiple tests through PCR/ELISA, all healthy varieties were shifted in vitro and included in the microplant multiplication and supply chain. A total of 281 virus-free in vitro culture tubes of 28 potato varieties were distributed to 35 seed-producing organizations across India, generating a revenue of ₹ 28,10,000. Additionally, a total revenue of Rs. 11 crores has been generated from the disposal of breeder seed. In seed research, the use of *Bacillus cereus* (B 5) treatments on the production behavior of aeroponic minitubers has been explored. Field multiplication of four sets (A, B, C, Control, and Breeder Seed K. Bahar) was carried out during the current season to validate initial tuber shape observations recorded under net-house conditions. The results reaffirm that treatments A and B, derived from mericlones (with and without GA₃ during micropropagation), maintained virus freedom and genetic integrity regarding tuber shape. Meanwhile, the persistent deformity in Treatment C highlights the critical impact of in vitro conditions on phenotypic expression. A preliminary study comparing three planting materials—Apical Rooted Cuttings (ARC), Sprout Cuttings, and Aeroponic Minitubers under field conditions—indicates that the choice of propagation method and variety plays a crucial role in optimizing seed potato production depending on target objectives—yield or multiplication.

PacBio-based SMRT sequencing was conducted on potato to identify key genes and regulatory elements controlling bacterial wilt resistance. Two potato genotypes, SM/92-338 and Kufri Lima, were screened for bacterial wilt disease in growth chambers under controlled conditions, and leaf samples were subjected to transcriptome sequencing. A total of 600 genomic SSR markers covering all linkage groups of potato were evaluated for their polymorphic potential in a representative set of 12 potato genotypes, including varieties, germplasm, somatic hybrids, and wild species, to develop a core set of SSR markers for potato germplasm and variety

characterization. So far, 285 SSR markers have been found to be polymorphic. A genome-wide association study was conducted to identify genomic regions linked to dry rot resistance. The GWAS analyzed lesion volume using both additive and dominance models. The analysis revealed six marker-trait associations, all located on Chromosome 7. The marker chr07_8537762, detected under the additive model, was the only significant marker, explaining 6.7% of the phenotypic variance with a highly significant p-value of 0.001. Another marker, chr07_15660835, identified under the 1-dom-alt model, explained 3.3% of the variation.

DIVISION OF CROP PRODUCTION

Carbon fraction dynamics (CFD) and budgeting under elevated temperature conditions in Potato growing soils was studied. Effect of elevated temperature on tuber yield in soils with different organic amendments revealed that tuber yield decreased with temperature elevation of 3°C (approx.). The decrease was statistically non-significant in case of paddy straw incorporation but the same was significant in case of vermicompost application and control. Besides the effects on early blight severity and black scurf disease at different levels of resistance cultivars on different dates of planting was also studied. In case of early blight, results revealed that on October 17, 2023, date of planting, under the susceptible group, the highest AUDPC (Area Under Disease Progress Curve) was recorded on cv. K. Lavkar followed by K. Chandramukhi and K. Deva. Under the resistant group, the highest AUDPC was on cv. K. Pukhraj followed by cv. K. Khyati and K. Sindhuri. Whereas in case of black scurf results revealed that on October 17, 2023, date of planting, under the susceptible group, the highest disease incidence was recorded on cv. Atlantic followed by K. Sindhuri. Similarly, in the resistant group, the highest disease incidence was recorded in cv. K. Deva followed by K. Sherpa. Influence of planting dates on aphid and whitefly populations was also studied. The population dynamics of winged aphids varied significantly across Standard Meteorological Weeks (SMWs) and sowing dates. Non-winged aphid populations followed similar trends, with significant effects of SMW and sowing date. Whitefly populations were also significantly

influenced by SMW, sowing date and their interaction. Early sowings experienced higher infestations. Conversely, mid- to late-sown crops consistently recorded lower whitefly densities. A New Methodology for Aquacrop model input data generation was also developed. An AI-ML methodology (deep learning based approach) and "PCCAnalyzer" was developed for rapid and accurate estimation of CC % from visual (RGB) images of potato crops in automated mode.

At Patna highest WUE (143.7 kg/ha-mm) was recorded when water was applied at the rate of 30 mm per irrigation in ridge-furrow method of planting and 100% recommended dose of NPK. At Jalandhar, work on protocol standardization for ground based visual (RGB) imaging and image processing for non-invasive measurements of potato crop biophysical parameters was developed. In studies on improving Phosphorus use efficiency, a combination of 50% dose of P applied as SSP + 50% as enriched rock phosphate vermicompost (RPVEC) resulted in significantly higher total (16.57 t/ha) and marketable tuber yield (8.16 t/ha) as compared to sole SSP and RPVEC alone in acid soils of Shillong. A large variation in leaf P concentration was observed amongst evaluated genotypes both under fertilized (0.33- 0.73%) and unfertilized (0.27-0.56%) conditions. At Patna, PS/18-21 (23.7 t/ha), PS/17-20 (23.4 t/ha), PS/17-15 (22.3 t/ha) and PS/18-44 (21.9 t/ha) exhibited prominence without P application. At Jalandhar, genotype J/15-91 was found most P-use efficient. At Ooty, 3-month composted SMS enriched with 2% P alone resulted in highest tuber yield.

In export activity, clone HT/12-751, MS/14-243, MS/13-391, MP/14-505, MS/15-1001, MS/14-1381, HT/12-830, MS/18-393, MS/13-391, MS/16-1156 were promising during the fourth year at Modipuram. Technology development for natural farming is continuing at Modipuram, Patna and Shillong. Promising advance clones recorded at Modipuram were HT/12-751, MS/13-391, MS/14-243, HT/12-830, MS/19-400, MS/18-465, MS/19-175 and MS/15-1001 under organic system. At Shillong, cv. K. Himalini had highest yield with poultry manure and vermicompost (14.80 t/ha), followed by poultry manure (13.91 t/ha),

combination of pig manure and vermicompost (13.83 t/ha), pig manure (12.15 t/ha) as compared to control (5.29 t/ha).

Organic management of late blight at Modipuram concluded that lowest terminal disease severity (38.0%) was recorded in treatment neem oil@ 6.0%, followed by fennel extract@ 5.0% and black pepper @ 5.0% against control (65.0%) in cv. K. Mohan, and similar trend was observed in K. Bahar. Management of black scurf by organic means is possible as cow urine@ 100% pure dip recorded the lowest average disease incidence (24.33%) and severity (10.12%) followed by Jeevamrit @ 200 ml/l (DI: 56.56%; DS: 25.94%), neem kernel@ 20 g/l pure crushed powder (DI: 57.71%; DS: 27.41%) and cow urine (1:10 ratio) dip treatment (DI: 58.53%; DS: 24.22%) in comparison to diseased control (DI: 82.17%; DS: 38.37%). Based on results of a study at Modipuram, white flies and aphids can effectively be controlled by use of *Neemazal* and *Pongamia* soap in natural farming.

System based technology development studies were conducted at Patna, Modipuram and Shillong. At Patna, maximum and significantly better total tuber yield was attained by green gram- potato system (16.5 t/ha) over other sequences and along nutrient management practices, highest and statistically better total tuber yield (18.0 t/ha) was found in 100% NPK nutrition over other treatments. At Modipuram, first-year results revealed the integrated crop management (ICM) practice exhibited significantly higher total tuber yield (25.34 t/ha) compared to organic and natural farming practices. Evaluation of five systems (potato-cabbage, potato- kale, potato- pak choi, potato-leafy type lettuce & potato- head type lettuce) at Shillong during 2024-2025 showed that potato-pak choi attained significantly higher potato-equivalent yield (PEY) of *Rabi* crop (49.03 t/ha) and System PEY (65.56 t/ha) in comparison to other systems. At Jalandhar, CPRI-formulation for enhancing tuber number was evaluated to optimize the dose for potato varieties. Total tuber number enhancement was 10.8% in Kufri Khyati, 10.6% in Kufri Gaurav, 13.2% in Kufri Badshah, 16.7% in Kufri Chandramukhi and 19.4% in Kufri Himalini. Development and refinement of a four row semi-automatic

planting system have been done for precise planting of aeroponically produced mini-tubers. A remotely controlled GPS guided unmanned robotic ground vehicle (UGV) has been developed for targeted application of agro-chemicals under field crops at Jalandhar under mechatronics activity.

DIVISION OF PLANT PROTECTION

This was non blight year and had no impact on yield reduction. As indicated last year, *Phytophthora infestans* has acquired resistance towards cymoxanil and the effective dose required to inhibit 50% of pathogen growth (ED_{50}) was 518.607 mg/L, with a 95% confidence interval ranging from 435.40 to 627.00 mg/L. However, the isolates were found sensitive to dimethomorph and fenamidone fungicides. Near infrared (NIR) spectroscopy was utilized to diagnose and detect late blight and dry rot infections in potato tubers. The detection accuracy rate was 93% and 88% for late blight and dry rot infections, respectively. Indo-Blightcast model predicted appearances of late blight well in advance across agro-ecologies and accordingly agro-advisories were issued for its management. Epidemiological studies revealed that self-fertile isolates are equally competitive with A1 and A2 mating types thus imposing a serious threat to late blight management. The application of Valifenalate 6% + Mancozeb 60% WG @ 0.5% was found equally effective against late blight as Fenamidon 10 + mancozeb 50% WG @ 0.3% and Dimethomorph 50% WP @ 0.1%. Tuber seed treatment with Fluxapyroxad 333FS @ 0.6% was at par with Tebuconazole 15% + Zineb 57% WDG @ 2.5%, Thifluzamide 24% SC @ 0.5% and Imidacloprid 17.8 SL @ 0.04% + Penflufen 22.43% FS against black scurf of potato. Three endophytic bacteria namely *Bacillus amyloliquefaciens* (E-21), *Stenotrophomonas maltophilia* (E-33) and *Pseudomonas geniculata* (E-45) gave good control of *Streptomyces scabiei* growth when tested *in-vitro*. The growth of *Streptomyces scabiei*, *Pectobacterium brasiliense*, *Ralstonia solanacearum* and *Fusarium sambucinum* was completely inhibited when cell / spore suspensions of these bacteria / fungus were treated with ClO_2 (0.2 and 0.3%) and NaOCl (1.0 and 2.0%) for 20 minutes whereas boric acid (2.0 and 3.0%) proved ineffective except against

Ralstonia solanacearum. Against *Rhizoctonia solani* (stem canker and black scurf), only NaOCl (1.0 and 2.0%) proved effective. Tuber dip treatment with sodium hypochlorite (NaOCl) @ 2% and chlorine dioxide (ClO_2) @ 0.3% for 30 min at the time of planting recorded minimum incidence of common scab. Diploid variety 'BS 303' was found comparatively resistant (5.1% disease severity) to common scab.

Seasonal monitoring of aphids and whiteflies revealed that aphid populations, particularly non-winged forms, increased sharply during the crop's maturity stage, exceeding economic thresholds and indicating a high-risk period for virus transmission in seed potato fields. In contrast, whiteflies were active primarily during early vegetative growth and declined thereafter, suggesting limited late-season threat but highlighting the need for early monitoring. Yellow sticky trap data further confirmed bimodal aphid flight activity, with a significant peak in early February, reinforcing the importance of late-season surveillance for winged vectors. Varietal screening trials demonstrated significant differences in insect pest susceptibility. Kufri Surya and Kufri Pukhraj showed the highest resistance to aphids, while Kufri Chipsona-I exhibited strong resistance to whiteflies. Kufri Kiran emerged as the most susceptible variety, underlining the need for strategic varietal selection based on pest pressure and seasonal dynamics. A novel study on herbivore-induced plant volatiles revealed that *Bemisia tabaci* infestation increased the attraction of *Tuta absoluta* to potato plants, mediated by volatiles such as β -caryophyllene and germacrene D. This ecological interaction offers potential for pest behavior manipulation using chemical ecology tools. A comparative evaluation of pesticide application methods highlighted that tractor-mounted spraying achieved the highest uptake of imidacloprid and superior control of whiteflies (83% reduction at 3 days after application), followed by drone spraying with silica-based adjuvant. Drone-alone applications showed limited efficacy and lower systemic movement of the insecticide. These findings highlight the role of application technology in optimizing the performance of systemic insecticides in potato crops.

In the domain of nematode management, integrated approaches against potato cyst nematode (PCN) were validated. The combination of *Bacillus cereus* SGL6 with trap cropping and fallow showed the most effective suppression of PCN ($R_f = 0.52$) and a 93.6% reduction in egg viability. Additional treatments involving non-host crops and bleaching powder also demonstrated strong efficacy. Field evaluation of native bio agents revealed that split application of fluopyram led to the highest cyst population reduction (51.2%), with enriched formulations of *Bacillus cereus* and *Chaetomium globosum* also yielding promising results. Long-term crop rotation trials showed that diverse systems integrating mustard, French bean, oat and trap crops significantly reduced PCN populations, achieving up to 84.6% reduction at the Fagu site. These results highlight the importance of system-based and biological strategies in nematode suppression. PCN resistant varieties such as Kufri Swarna and Kufri Sahyadri were susceptible to RKN which indicates that PCN resistance is different than RKN resistance.

DIVISION OF CROP PHYSIOLOGY, BIOCHEMISTRY AND POST-HARVEST TECHNOLOGY

Under the post-harvest management of potatoes, we have identified a new combination of naturally occurring oil which is effective to control sprout grown in potatoes stored at 10-12°C. This year we have evaluated the efficacy of this formulation on 19 different varieties. Results revealed that this formulation can suppress the potato sprouting upto 120 days. In continuation to the work on effects on sensory and quality attributes, of various cooking methods and ingredients during cooking of potato, experimentations on effect of potato-cooking oil combination and retrogradation on available carbohydrate (ACHO) revealed that the addition of cooking oil to the potato tubers significant lowering ($P < 0.05$) of available carbohydrate (ACHO) in the potato-cooking oil combination. In case of Kufri Jyoti ACHO was 13.78 g/100 g DW and on the addition of mustard, sunflower, soybean, ghee, olive, rice bran and coconut oil the ACHO was reduced to 10.87, 11.26, 10.81, 8.84,

7.90, 9.85 and 9.06 g/100 g DW, respectively. The maximum (42.7%) and minimum (18.3%) reduction in ACHO were noted in potato (KJ)-olive oil and potato (KJ)-soybean oil, respectively. Similarly, the addition of olive oil, ghee and coconut oil to tubers of Kufri Chipsona-3 variety resulted in a significant reduction ($P < 0.05$) in ACHO by 47.7, 39.4 and 39.3%, respectively. Cooking of potato in potato-ghee, potato-coconut oil and potato -olive oil combinations, resulted in increase in starch hydrolysis index (SHI) by 30.8, 30.1 and 28.1 %, respectively when compared with control. Cooking of potato tuber with different oils followed by cooling also resulted in a significant lowering of SHI. Also, addition of different cooking oils exhibited significant glycemic index (GI) and glycemic load (GL) lowering effects on potato. The addition of each of the cooking oil (seven different types) increased the resistant starch content (RSC) significantly for potato tubers.

Excess rains on the time of ready to harvest or fully mature potato is very challenging and deteriorate the quality of crop. The artificial simulation on excess water stress studies in two potato varieties Kufri Chipsona-3 and Kufri Frysona showed variety specific effects of water dipping on free amino acids and total phenol content of potato tubers.

Work on development of functional fermented probiotics beverages from potato juices resulted in identification of three potential microbes viz: *Lactobacillus acidophilus*, *Lactobacillus plantarum* and *Lactobacillus fermentum* having probiotics attributes for potato probiotics beverages. Work on exploring novel value-added products from potatoes led to the development of potato-Bengal Gram-based *boondi* for sweet and *raita*, and potato-based *boondi* snack. Boondi is a deep-fat fried spherical traditional product made out of droplets of chickpea/ Bengal gram / *besan* (*Cicer arietinum*) flour batter. We have developed the boondi by replacing more than 50% of Bengal gram flour with the potato flour. The crispiness and crunchiness of the developed boondi was found to be better than traditional *boondi*. Developed boondi was suitable for both sweet and *raita* preparation. Another *boondi* variation

was developed by combining potato flour, black gram flour, corn flour and chickpea flour to be eaten as a salty snack. The developed boondi snack. Unlike other fried processed potato dishes, the *boondi* can be made from any type of potato. In-continuation to work on understanding sucrose metabolism and its role in potato shelf-life and post-harvest sensory attributes, genome-wide landscape of sucrose transporter (SUT) genes in potato was analysed. The analysis revealed presence of only one SUT gene (id PGSC0003DMG400025610) in Potato Genome Sequence Database which was found to be located on chromosome number 5. The size of the Gene was found to be 1515 nucleotides containing Open Reading Frame (ORF) of 825 nucleotides, possessing 5 introns and encoding a protein composed of 274 amino acids, having theoretical isoelectric point of 5.25 and molecular weight of 28.99 kDa. The gene exhibited different expression behaviour in different cultivars on potato during post-harvest storage.

DIVISION OF SOCIAL SCIENCES

Research work conducted by the division included comprehensive consumer and farmer preference studies through structured surveys. An online survey for analyzing consumer preferences for fresh potato attributes yielded 93 complete responses (42 from Plains, 52 from Hills), revealing distinct regional preferences with Plains respondents prioritizing shelf life (4.88), cooking time (4.71), and taste (4.71), while Hills respondents preferred taste (4.67), suitability for boiling (4.63), and shelf life (4.49). Mann-Whitney U tests revealed significant regional differences in consumer preferences for tuber size, skin colour, shelf life, and processing suitability (all $p < 0.001$). Consumers showed strong preferences for medium-sized tubers (87.1%), white skin colour (97.1%), and long shelf life (86.0%), with 74.19% expressing willingness to pay premium for quality potatoes

(Plains: 88.10% vs Hills: 62.75%). The farmer preference study for varietal attributes based on 107 responses from Meghalaya and Uttarakhand identified drought tolerance (WMS=5.00), yield (4.98), marketability (4.98), and late blight resistance (4.90) as top preferred attributes. Regional variations showed round tubers preferred in Meghalaya (59.3%) versus elongated types in Uttarakhand (50.0%), with significant differences in shape ($\chi^2=26.24$, $p<0.001$) and skin smoothness preferences ($\chi^2=29.16$, $p<0.001$). Willingness to pay for quality seed varied regionally at 88.14% in Meghalaya versus 66.67% in Uttarakhand.

The institute conducted extensive outreach activities including 833 Front Line Demonstrations (SCSP=381, NEH=105, TSP=342, Others=05) in Bihar, Uttar Pradesh, Punjab, Madhya Pradesh, Jharkhand, West Bengal, and Meghalaya. A total of 55 training programmes were organized at CPRI, Shimla and regional stations, benefitted nearly 2000 farmers, scientists and extension functionaries. The institute organized over 24 exhibitions, awareness programmes and workshops benefiting more than 5000 stakeholders, including National Potato Festival-2024 (March 9-10, 2024) and National Potato Day (February 15, 2024) at ICAR-CPRI RS, Modipuram. Advisory services reached 40 MGMG villages across seven states (Uttar Pradesh, Bihar, Punjab, Madhya Pradesh, Himachal Pradesh, Meghalaya and Tamil Nadu) with regular advisories sent to over 2000 farmers through WhatsApp groups and around 15 live phone-in programmes through Doordarshan. Through ATIC, about 250 technical bulletins were sold and over 5000 publications freely distributed and about 8000 visitors were apprised of institute technologies. Under HRD, 74 staff participated in various training programmes and 190 courses were completed on iGOT Karmayogi platform.

RESEARCH PROGRAMMES

Sl. No.	Research Programmes & Institute Code No.	Programme Leader and Associates
1	Management of potato genetic resources HORTCPRISIL202000300142	PIs: Vinod Kumar, Co-PIs: SK Luthra, Raj Kumar, Ajay Kumar Thakur, Salej Sood, Dalamu, Vikas Mangal, Sarla Yadav, Ratna Preeti Kaur, Babita Chaudhary, Pooja Mankar, Sanjeev Sharma, Anuj Bhatnagar, Arvind Kumar Jaiswal, Bandana, Ashwani Kr. Sharma, Priyank Hanuman Mhatre, Aarti Bairwa, Kailash Chandra Naga, Rahul Tiwari, Name Singh, Jagdev Sharma, Som Dutt, Vinay Sagar, Brajesh Singh, Clarissa Challam and P Janani.
2	Genetic enhancement of potato through molecular and genomic tools. HORTCPRISIL202000500144	PIs: Ajay Kumar Thakur, Co-PIs: Som Dutt, Salej Sood, Dharmendra Kumar, Sanjeev Sharma, Aarti Bairwa, Jagdev Sharma, Tanuja Buckseth, Vinod Kumar, Satish K. Luthra, Devendra Kumar, Hemant B. Kardile, Ratna P. Kaur, Ashwini K. Sharma, Dalamu, Priyank Mahatre, Clarissa Challam, Vikas Mangal, Chandan Maharana.
3	Breeding trait specific varieties for productivity, quality and resistance to biotic and abiotic stresses HORTCPRISIL202000400143	PI: Dr SK Luthra, Co-PIs: Babita Chaudhary, Dalamu, Vinod Kumar, Brajesh Singh, Jagdev Sharma, Bandana, Arvind Kumar Jaiswal, Dinesh Kumar, Sanjay Rawal, Mehi Lal, Pooja Mankar, Yvonne Angel Lyngdoh, Raj Kumar, Ratna Preeti Kaur, Sarla Yadav, VK Gupta, Salej Sood, Vikas Mangal, Sanjeev Sharma, Priyank Hanuman Mhatre, Clarissa Challam, Aarti Bairwa, Kailash Chandra Naga, Ashwani Sharma, Tanuja Bukseth, Ajay Kumar Thakur, Anuj Bhatnagar, Som Dutt, Sugani Devi, Prince Kumar.
4	Development and production of nucleus and breeder seed of notified potato varieties through conventional and hi-tech systems. HORTCPRISIL202001000149	PIs: Dr. Vinod Kumar, Co-PIs: Drs. Rajesh K Singh, Dhruv Kumar, SK Luthra, Ashwani Kumar Sharma, Subhash S., Anil Sharma, RP Kaur, Sugani Devi, Murlidhar Sadawarti, Subhash Katare, SP Singh, Raj Kumar Singh, C. Clarissa, Priyank H Mahatre, Anil Choudhary, Jagdev Sharma, Sunayan Saha, Tanuja Buckseth.
5	Vulnerability and resilience to climate change for sustainable potato production HORTCPRISIL202100100150	PI: Dr. Anil Sharma, Co-PIs: Drs. Sanjay Rawal, SP Singh, Paresh Chaukhande, Sunayan Saha, Vijay Paul, Prince Kumar, Jagdev Sharma, VK Gupta, Som Dutt, Hemant Kardile, Brajesh Nare, Sanjeev Sharma, Mehi Lal, Anuj Bhatnagar, Anil Kumar Choudhary, Subhash Katare, Subhash Chander, Rabindra Padariya, Pynbianglang Kharumnuid, Subhash, Yogesh Gupta

Sl. No.	Research Programmes & Institute Code No.	Programme Leader and Associates
6	Nutrient and water management for improved productivity and sustainability of potato HORTCPRISIL202000200141	PI: Dr. Sanjay Rawal, CO-PIs: Drs. SP Singh, Prince Kumar, Sunayan Saha, RK Singh, Sunayan Saha, Jagdev Sharma, Manoj Kumar Nanda, Brajesh Nare, Anil K Choudhary, Janani P., Divya K Lekshmanan, Dharmendra Kumar, Priyank Mhatre, Ajay Thakur, Yogesh Gautam
7	Technology development and refinement for potato and potato-based cropping system HORTCPRISIL202000100140	PIs: Dr. Sanjay Rawal, CO-PIs: Drs. Pooja Mankar, Sanjeev Sharma, SK Luthra, VK Gupta, Mehi Lal, Subhash S., SP Singh, Subhash Katare Murlidhar Sadawarti, Anil Sharma, Anil K Choudhary, RK Singh, Janani P, Clarissa Challam, N. Sailo, Anuj Bhatnagar, Vinay Sagar, Paresh Chaukhande, Brajesh Nare, Sukhwinder Singh, Sugani Devi, Som Dutt, Ratna Preeti Kaur, Prince Kumar, Dharmendra Kumar, Kailash C Naga, Yogesh Gautam
8	Re-defining epidemiological parameters and management approaches for potato pathogens HORTCPRISIL202000600145	PI: Dr. Sanjeev Sharma, CO-PIs: Drs. Vinay Sagar, Mehi Lal, Jagdev Sharma, Kailash Naga, Subhash S, Murlidhar Sadawarti, Subhash Katare, Chandan Maharana
9	Biology, ecology and management of insects and nematodes pests of potato. HORTCPRISIL202000700146	PI: Dr. Anuj Bhatnagar, CO-PIs: Drs. Subhash Katare, Kailash Naga, Subhash S., Aarti Bairwa, Priyank Mhatre, Sanjeev Sharma, Kamala Jayanthi, Jagdev Sharma, N Sailo, Ashwani Kumar Sharma, Tanuja Buckseth, Dalamu,
10	Post-harvest management and nutritional enhancement of potatoes HORTCPRISIL202000800147	PI: Dr. Som Dutt, CO-PIs: Drs. Brajesh Singh, Dharmendra Kumar, Bandana, Arvind K Jaiswal, N Sailo, SK Luthra, Ratna Preeti Kaur, Hemant Kardile, Vinay Sagar, Jagdev Sharma, Sanjay Rawal, Pynbianglang Kharumnuid, Sukhwinder Singh, Brajesh Nare, Mehi Lal, Alka Joshi, Vineet Sharma, Yogesh Gupta.
11	Transfer of potato technologies to stakeholders and assessment of their impacts HORTCPRISIL202000900148	PI: Dr. Alok Kumar, CO-PIs: Drs. Pynbianglang Kharumnuid, RK Singh, Yogesh Gautam, Rajesh Kumar Singh, Anil Sharma, Subhash Katare, N Sailo, Priyank Mhatre.

DIVISION OF CROP IMPROVEMENT & SEED TECHNOLOGY

PROGRAMME: MANAGEMENT OF POTATO GENETIC RESOURCES

PI: Vinod Kumar, **Co-PIs:** SK Luthra, Raj Kumar, Ajay Kumar Thakur, Salej Sood, Dalamu, Vikas Mangal, Sarla Yadav, Ratna Preeti Kaur, Babita Chaudhary, Pooja Mankar, Sanjeev Sharma, Anuj Bhatnagar, Arvind Kumar Jaiswal, Bandana, Ashwani Kr. Sharma, Priyank Hanuman Mhatre, Aarti Bairwa, Kailash Chandra Naga, Rahul Tiwari, Name Singh, Jagdev Sharma, Som Dutt, Vinay Sagar, Brajesh Singh, Clarissa Challam and P Janani.

Plant genetic resources are the most valuable and essential raw materials for meeting both current and future crop improvement needs. This program aims to conserve and provide diverse genetic material to potato researchers. The

collection is evaluated, characterized, and documented in an easily accessible form for researchers to use.

Collection:

Sixteen in vitro accessions were imported from three different countries: nine from the Netherlands, three from the UK, two from Russia, and one each from Germany and France. During the year, 45 accessions free from quarantined pests were introduced to the germplasm repository. Currently, more than 4700 accessions of cultivated and wild potato species, obtained from 30 countries, are conserved at the institute.

Table 1. Potato germplasm holding at CPRI, Shimla

Material	No. of accessions				No. of donor countries
	Tuber	<i>In vitro</i>	True seed	Total	
a) Tuberosum (Cultivars / parental lines)					
Indian					
Cultivars bred at CPRI	72	76		76	
Advanced hybrids	86	50	-	125	
Indigenous varieties	117	107	-	117	
Indigenous samples	97	44		97	
Exotic	1945	2850	-	3205	30
b) Andigena	572	77	-	605	5
c) Wild/ semi -cultivated sps.	119 (40 species)	130 (29 species)	294 (70 species)	525 (125 species)	5
Total germplasm				4750	

Conservation:

Field conservation:

One thousand five hundred and thirty-nine (1539) Tuberosum accessions, 572 Andigena accessions and 62 indigenous samples were maintained in fields at Jalandhar. Under field conditions at Kufri, 1,590 cultivated potato germplasm samples were conserved. This includes CPRI-bred varieties (62 Nos.), Indigenous varieties (117 Nos.), and CP No. (*Solanum tuberosum ssp. tuberosum*) (1411 Nos.)

Additionally, 380 Tuberosum were maintained at Modipuram. In wild species, 305 clones of 133 accessions representing 38 *Solanum* species were propagated for maintenance breeding, while 294 accessions of 70 species were preserved in TPS form. Overall, 540 accessions (in tuber, TPS, or in vitro form) of 125 species were conserved at CPRI, Shimla.

In vitro conservation:

Nearly 3000 *Tuberosum* accessions and 130 accessions from 29 wild species were maintained in vitro. Minutubers of 31 accessions from the in vitro repository were produced and added to the germplasm collection maintained under field conditions at Modipuram. During this year, two potato varieties, namely Kufri Jamunia and Kufri Daksh, along with four potato samples collected from Meghalaya state- Lah Taret, Lah Saw, Lah Lalhew, and Lah Shidieng- were made virus-free using meristem tip culture. Thirty-four in-vitro tubes were provided to different agencies, generating a revenue of Rs. 6,65,000 from the sale of germplasm line in-vitro tubes.

Evaluation:

Adaptability

Temperate long days (Kufri):

Thirty-one cultivated germplasm and controls, including Kufri Jyoti, Kufri Girdhari, and Kufri Himalini, were evaluated for adaptability based on tuber yield per plant. SVAM-15, SVAM-21, SVAM-23, and SVAM-26 performed well under Kufri conditions with a higher average yield per plant than the best control, Kufri Girdhari (133 gms).

Sub-tropic short days:

Jalandhar

One hundred (100) *Tuberosum* accessions were evaluated under spring planting conditions. The yield of germplasm accessions ranged from 20 to 370 g per plant, while the best control variety was Kufri Jyoti (270 g per plant). The other control, Kufri Pukhraj, yielded 250 g per plant. Promising accessions were: CP 3469 (370 g per plant) and J/15-36 (310 g per plant).

Modipuram

Under early planting, 54 *Tuberosum* genotypes were evaluated under heat stress conditions in a replicated trial at 75 DAP. The total tuber yield (g/plant) ranged from 20 to 465 g/plant. The highest total tuber yield was recorded for CP 3735, followed by K Lima (463 g), K Bhaskar (403 g), CP4446 (375 g), K Kiran (348 g), CP3545 (296 g), CP3340 (293 g), CP3718 (290 g), K Neelkanth (288 g), K Thar3 (282 g), CP4546 (280 g), CP3005 (271 g), K Pukhraj (264 g), K Surya (262 g), K Chipsona3 (261 g), and CP3722 (258 g).

In another lot, 58 accessions received from private companies were evaluated during early planting at 75 DAP. The total tuber yield (g/plant) ranged from 92 to 460 g/plant, with the highest yield recorded in Alibaba (460 g), followed by Buster (394 g), Atlantic (384 g), Sound (366 g), Navigator (343 g), Buffalo (340 g), Memphis (318 g), MI-2007-0194-039 (300 g), Delia Red (287 g), Alcander (286 g), and Sun Red (286 g).

Under normal planting conditions, 37 *Tuberosum* genotypes were evaluated in a replicated trial at 95 DAP. The total tuber yield (g/plant) ranged from 191 to 490 g/plant, with the highest yield recorded at CP3735 (490 g), followed by CP4446 (484 g), K Gaurav (466 g), CP3579 (460 g), K Pukhraj (457 g), CP4452 (446 g), CP3681 (443 g), CP3545 (439 g), CP4546 (432 g), CP3674 (429 g), CP3673 (406 g), CP3334 (400 g), CP4545 (399 g), K Khyati (396 g), CP3340 (395 g), and CP3894 (381 g).

Reaction to late blight

Thirty-one cultivated germplasm and controls, including Kufri Jyoti, Kufri Girdhari, and Kufri Himalini, were assessed for foliar blight resistance under epiphytotic conditions at Kufri. Based on late blight incidence recorded four times at seven-day intervals between readings, six accessions-SVAM-15, SVAM-17, SVAM-22, SVAM-23, SVAM-26, and SVAM-28—were highly resistant (AUDPC < 250), while one accession, SVAM-15, was moderately resistant (AUDPC 351-650).

Thirty-four germplasms were evaluated for late blight resistance under lab conditions, i.e., for tuber resistance by the tuber slice method and foliar resistance by the detached leaf method. Sixteen genotypes were moderately resistant in the tuber slice method based on reaction. In the Detached leaf assay, four accessions (SVAM-5, SVAM-21, SVAM-26, SVAM-29, and SVAM-37) were highly resistant, whereas three accessions, namely SVAM-31, SVAM-39, and NJ-47, were moderately resistant. The remaining were susceptible.

Viruses

Forty-one germplasm accessions were screened

for resistance using DAS-ELISA against PVX and PVY. Eleven accessions, including AGR/56, Australian White, Desi Alu, Dehati Alu, DRR Blue, Edony, Garlentic, NJ-47, NJ-62, NJ-78, and Panamera, showed combined resistance to PVX and PVY, while 16 and 24 accessions exhibited resistance to PVX and PVY, respectively.

Leaf-hopper and mites

Screening of potato germplasm for hopper burn and mite damage was conducted under field conditions at Modipuram. The hopper burn incidence varied from 0-83.3 % while mite damage ranged from 0-91.7%. Of 117 accessions, 47 had hopper nil hopper burn, whereas no mite damage was observed in as many as 76 accessions.

Cyst nematodes

For resistance against cyst nematodes (PCN), 132 accessions along with three controls were evaluated in a glasshouse at Kufri. Among these, 16 accessions (CP Nos. 1225, 1302, 1384, 1487, 1597, 1735, 1809, 1833, 1860, 2335, 3211, 3395, 3456, 3549, 3678, 3881) showed high resistance (HR) to both PCN species. Additionally, six accessions (CP Nos. 1214, 1868, 2089, 3641, 3766, 3907) demonstrated HR specifically to *Globodera pallida*, while one accession (3593) exhibited HR to *G. rostochiensis*. Furthermore, eight accessions (CP Nos. 1355, 1368, 1689, 1827, 2399, 3558, 3649, 3853) were classified as resistant (R) to both species. Six accessions (CP Nos. 1214, 1868, 2089, 3641, 3766, 3907) were resistant (R) to *G. rostochiensis*, whereas another set of six accessions (CP Nos. 1312, 2093, 3424, 3593, 3761, 3764) were resistant (R) to *G. pallida*. The remaining accessions were categorized as either moderately resistant, susceptible, or highly susceptible.

At Ooty, out of 146 accessions, nine accessions (CP 1137, CP 1674, CP 1932, CP 1988, CP 2285, CP 2418, CP 3183, CP 3201, and CP 3881) were resistant to both species of PCN (*G. rostochiensis* & *G. pallida*). In contrast, twenty-one accessions were resistant to *G. rostochiensis*.

Keeping quality

Seventy-five accessions, along with three control varieties-Kufri Dewa, Kufri Ashoka, and Kufri

Pukhraj-were evaluated for their keeping quality under ambient storage conditions (15-39°C, 44-75% relative humidity). Periodic observations of weight loss, sprouting, and spoilage in tubers were recorded at 60 and 90 days of storage. Firmness was rated on a scale of 1-5, with a score of 5 assigned to the firmest potatoes, similar to freshly harvested or cold-stored ones. Accessions were categorized based on storage performance in terms of weight loss, rotting, total loss, and physical appearance of tubers after 90 days. Out of the 75 accessions, only eight (CP Nos. 1709, 3432, 3620, 3624, 3681, 3686, 3687, and 3851) were found to be good keepers (total storage losses between 10-15%), 18 were average keepers (losses between 15-20%), and the remaining 49 were poor keepers (losses over 20%).

Chipping and Physico-Chemical constituents

At Jalandhar, 76 *Tuberosum* accessions were assessed for processing quality parameters, such as chip color, dry matter, and reducing sugar and sucrose contents. The dry matter content ranged from 12.97% to 23.12%. Twenty-three accessions had a mean dry matter content over 20%, with CP-3622 having the highest at 23.12%, while the lowest was in CP-3686 at 12.97%. Based on chip color (acceptable score up to 3 on a 1-10 scale of increasing dark color), dry matter (>21%), and reducing sugar (<100 mg/100g fresh tuber weight), only one accession (CP 3917) was suitable for chipping.

The Vitamin C content (mg/100 g fresh weight) varied greatly among the 75 evaluated potato genotypes, highlighting considerable genotypic variability. The values ranged from a low of 13.25 mg/100 g (found in genotypes CP 4143 and CP 4243) to a high of 42.88 mg/100 g (CP 3908). Several genotypes showed high Vitamin C levels, including: CP 3908 (42.88 mg/100 g), CP 3889 (41.74 mg/100 g), CP 3890 (40.38 mg/100 g), CP 4224 (40.08 mg/100 g), and CP 3959 (39.82 mg/100 g). Twenty genotypes had Vitamin C contents above 30 mg/100 g, indicating their potential for use in breeding programs focused on improving nutritional quality. Genotypes such as CP 4089, CP 4094, and CP 4228 also consistently recorded values above 33 mg/100 g.

Protein Content

The total soluble protein content in 50 potato

accessions was measured. Five freshly harvested tubers from each accession were thoroughly washed, peeled, and then cut into small pieces, which were mixed together. Samples were taken from these mixed pieces, further cut into smaller portions, weighed, and stored at -80°C for future analysis. Soluble protein levels were determined using the Bradford method, with three replicates of each sample used for measurement.

The estimated soluble protein content of the 50 accessions is shown in Figure 1. The protein content ranged from 0.58% in accession CP 4268 to 1.07% in accession CP 4534, based on fresh weight (FW). Among the accessions, four (CP 4052, CP 4149, CP 4196, and CP 4534) had soluble protein contents exceeding 1% on a FW basis.

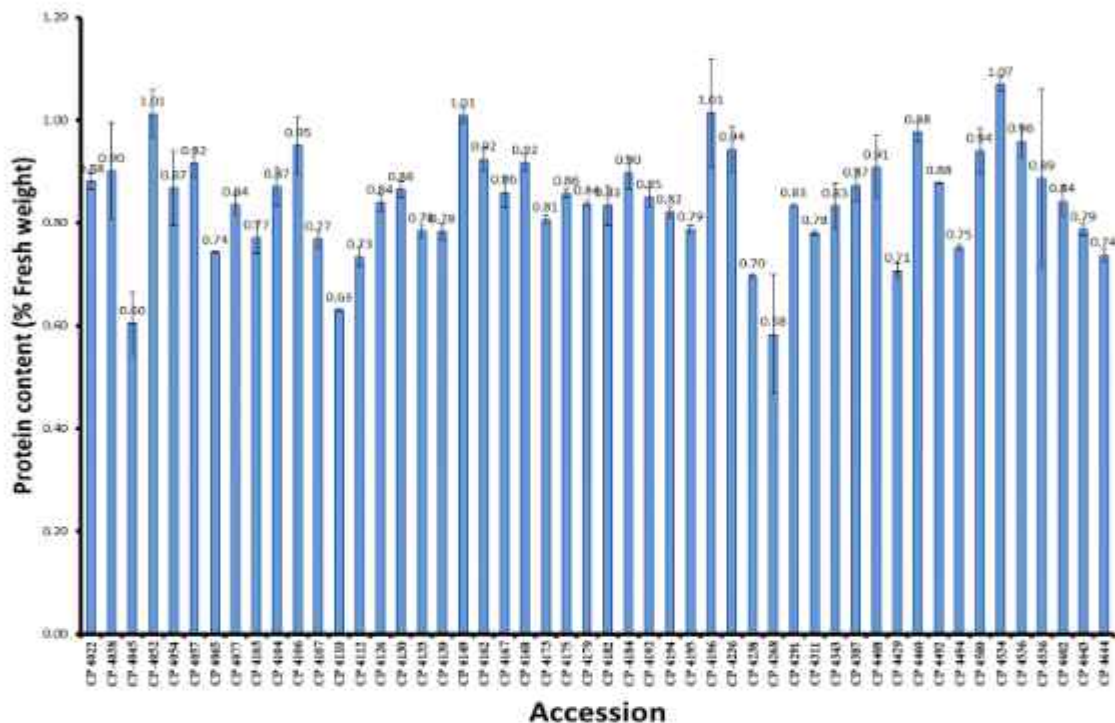


Fig. 1: Total soluble protein content of potato tubers of 50 accessions (Samples received in March 2025 from CPRI Kufri)

Micro-nutrient Content

Twenty-five accessions were evaluated for iron and zinc content. Iron content ranged from 28.49 mg/kg (CP 4161) to 42.14 mg/kg (CP 4139), while zinc content ranged from 19.07 mg/kg (CP 4394) to 25.32 mg/kg (CP 4459) on a dry weight basis. The top five accessions for zinc content (mg/kg) were CP 4459 (25.32), CP 4531 (24.98), CP 4111 (24.52), CP 4499 (24.42), and CP 4256 (24.36). For iron content (mg/kg), the top five were CP 4139 (42.14), CP 4499 (41.76), CP 4177 (40.02), CP 4403 (39.36), and CP 4197 (36.06). Accessions CP 4177, CP 4403, and CP 4499 were identified as promising for both iron and zinc (iron content > 39.69 mg/kg and zinc content > 23.08 mg/kg).

Water use efficiency

Germplasm accessions are evaluated under three moisture regimes, i.e., 0.20-0.25, 0.40-0.45, and

0.60-0.65 bars/atm soil moisture tension at 15 cm soil depth, for higher yield and water use efficiency. Out of 20 accessions, eight—namely CP 3770, CP 3780, CP 3797, CP 3850, CP 3853, CP 4030, CP 4140, and CP 4388—were found promising in the third-year evaluation. In another set, 20 accessions were tested, and four—namely CP Nos. 4393, 4473, 4535, and 4536—produced significantly higher yields, comparable to those of the variety Kufri Pukhraj, and appear promising for higher water use efficiency.

Foliage maturity

Out of 140 Tuberosum accessions screened for foliage maturity at Patna, 39 CP numbers, including 1339, 1358, 1390, 1406, 1416, 1439, 1457, 1461, 1474, 1548, 1567, 1578, 1596, 1604, 1613, 1665, 1670, 1671, 1683, 1686, 1691, 1708, 1718, 1754, 1763, 1765, 1773, 1790, 1798, 1816, 1827, 1829, 1910, 1912, 1919, 1933, 1936, 1958,

and 1970-were found to be early maturing with more than 80% foliage maturity at 80 DAP.

Wild Species:

Wild species screening against late blight resistance

Thirty-eight clones from 24 accessions across 12 species were screened for late blight resistance under natural epiphytotic conditions at Kufri. Three pots of each clone were used to record late blight incidence at weekly intervals. Of the 38 clones, 2 clones were highly resistant [*S. demissum* (3114-02), *S. brevicaulle* (2895-02)], 3 were resistant [*S. acaule* (2837-09 and 2837-08) and *S. boliviense* (2658-02)], and the remaining were susceptible or highly susceptible.

Germplasm registered with the NBPGR, New Delhi.

Three elite potato clones were registered with the ICAR-NBPGR, New Delhi.

S. No.	Elite Germplasm	INGR No.	Details of Special Achievements
1.	Kanpuria Safed	24085	Highly resistant to late blight
2.	BS 48-6	24081	An elite self-compatible <i>Sli</i> gene homozygous diploid line. The plants are vigorous, flowered profusely, showed good fertility and berry setting.
3.	BS 49-1	24082	An elite self-compatible <i>Sli</i> gene homozygous diploid line. The clone flowered profusely, showed good pollen viability, and set berries upon selfing (Indicating Female fertility).

Documentation:

Computer databases of cultivated and wild species were updated by incorporating evaluation data for various accessions.

Screening against white-fly resistance

Twenty-one wild potato germplasms were tested for resistance to the whitefly, *Bemisia tabaci*, using SM/11-120 as the control. A choice assay method was used for screening. About one thousand newly emerged adult whiteflies were released into a cage containing randomly arranged wild potato germplasms. After two days, the number of adults settled on each plant was counted by gently inspecting the leaves in the early morning. The results showed that none of the screened wild germplasms had a lower preference for whiteflies than the control, SM/11-120.

Databases of the availability of various accessions at different conservation sites were also updated.

PROGRAMME: GENETIC ENHANCEMENT OF POTATO THROUGH MOLECULAR AND GENOMIC TOOLS

PI: Ajay Kumar Thakur, **Co-PIs:** Som Dutt, Salej Sood, Dharmendra Kumar, Sanjeev Sharma, Aarti Bairwa, Jagdev Sharma, Tanuja Buckseth, Vinod Kumar, Satish K. Luthra, Devendra Kumar, Hemant B. Kardile, Ratna P. Kaur, Ashwini K. Sharma, Dalamu, Priyank Mahatre, Clarissa Challam, Vikas Mangal, Chandan Maharana

Transcriptome sequencing for bacterial wilt resistance in potato

Efforts have been initiated to identify key genes and regulatory elements governing the bacterial wilt resistance trait in potato using a transcriptome-sequencing approach. Two potato genotypes viz. SM/92-338 (resistance to BW) and Kufri Lima (highly susceptible to BW) were raised and established in pots under glasshouse conditions using *in vitro* developed potato plantlets. At a time point of 30 days after

transplanting, roots of plants of both the genotypes were injured manually and inoculation of *R. solanacearum* (potato race) was done for proper infection. The plants in pots were immediately moved to growth chamber maintained at 28°C temperature under a 16 hrs/8hrs light and dark period regime along with the check untreated plants of both the genotypes. The symptoms of bacterial wilt were observed critically and first symptom appeared on 13th day after infection and Kufri Lima plants started wilting, whereas no wilting symptoms appeared on SM/92-338 (resistance to BW) plants (Fig. 1). Leaf samples were procured from both the genotypes in three technical replicates, prior to infection and at 13th day, at the time of symptoms appearance. The leaf material was immediately frozen in liquid nitrogen and then stored at -80°C for RNA extraction and sequencing work.



Fig. 1: Screening of potato genotypes against bacterial wilt disease

Leaf samples from SM/92-338 (control-prior to bacterial infection, designated as SM1-1) and after infection (designated as SMAI_2-1) were used for RNA extraction and subjected to PacBio SMRT sequencing.

Circular Consensus Sequence (CCS) calling and Demultiplexing

The Iso-Seq data processing began with circular consensus sequence (CCS) generation using the SMRT tool ccs, serving as the initial step in handling PacBio reads. Barcode and primer sequences were identified using Lima, a standard tool for PacBio single-molecule sequencing data. HIFI data statistics for demultiplexed samples is given in Table 1; Fig. 2 & Fig. 3.

Table 1: HIFI data statistics for the sample after CCS conversion

Sample	SM1-1	SMAI_2-1
HiFi Reads	1518395	423394
HiFi Yield (bp)	2381148024	678227646

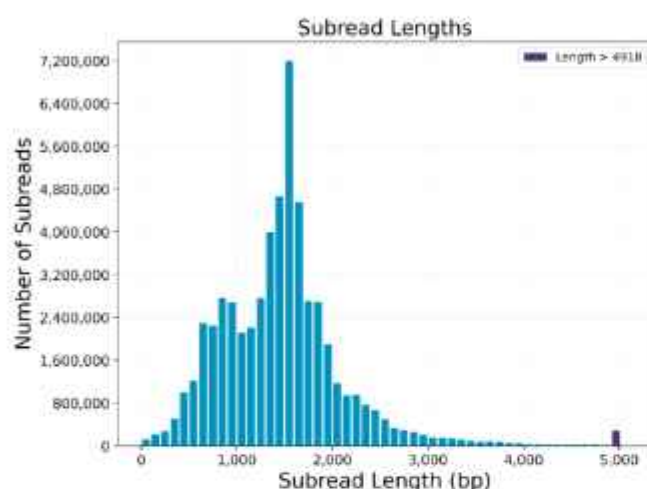


Fig. 2: Read Length distribution of the Pacbio sample SM1-1

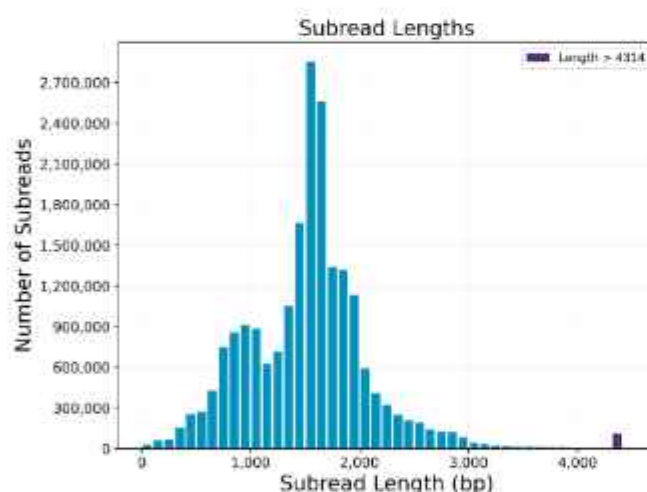


Fig. 3: Read Length distribution of the Pacbio sample SMAI_2-1

Full-length non-chimeric (FLNC) reads were generated for the sample using isoseq3 refine, which removes poly(A) tails and concatemers from the reads. The trimmed full-length reads are clustered at the isoform level. The transcripts with predicted accuracy ≥ 0.99 are considered as the high-quality reads and < 0.99 is considered as low-quality reads (Table 2).

Table 2: Clustered transcript statistics shows FLNC read count of samples

	SM1-1	SMAI_2-1
Clustered High quality (HQ) reads	68536	20438
Clustered Low quality (LQ) reads	7	4

High-quality FLNC reads were mapped to the potato genome (*Solanum tuberosum*, SolTub_3.0) obtained from Ensembl using pbmm2 software. The FLNC reads were aligned in transcriptomic mode to accurately capture splicing patterns and exon-intron boundaries. This step ensured precise mapping of transcripts to the genome, enabling the identification of isoform structures and gene annotations. Redundant transcripts were collapsed into unique isoforms using IsoSeq Collapse. Transcript classification performed using the Pigeon tool to annotate and categorize the collapsed transcripts. The tool assigned each transcript to specific isoform categories, such as novel isoforms, known isoforms, or novel genes, based on their alignment to the reference genome and annotation files (Table 3). This step provided insights into the transcript diversity and novelty within the dataset, facilitating the identification of alternative splicing events, novel exons, and potential new genes.

Table 3: Classifications by isoforms

	SM1-1	SMAI_2-1
Full splice match	247 (15.96%)	297 (29.91%)
Incomplete splice match	249 (16.09%)	113 (11.38%)
Novel in catalog	66 (4.26%)	21 (2.11%)
Novel not in catalog	303 (19.57%)	210 (21.15%)
Antisense	37 (2.39%)	23 (2.32%)
Genic intron	0 (0.00%)	0 (0.00%)
Genic genomic	165 (10.66%)	64 (6.45%)
Intergenic	473 (30.56%)	252 (25.38%)

The quantification of isoforms was carried out using FeatureCounts software. This quantification step provided the data required for the differential expression of the isoform analysis. The differential expression analysis is done using the EdgeR package in R. Volcano plots plot $-\log_{10}$ of the adjusted p value on y-axis and $\log_2$ fold change on the x-axis is shown in Fig. 4. Lower the adjusted p value, higher would be its $-\log_{10}$ transformed values. Transcripts with large absolute value on x-axis and large value on y-axis are highly significant and show large changes in expression.

SM1.1 vs SMA2.2.1

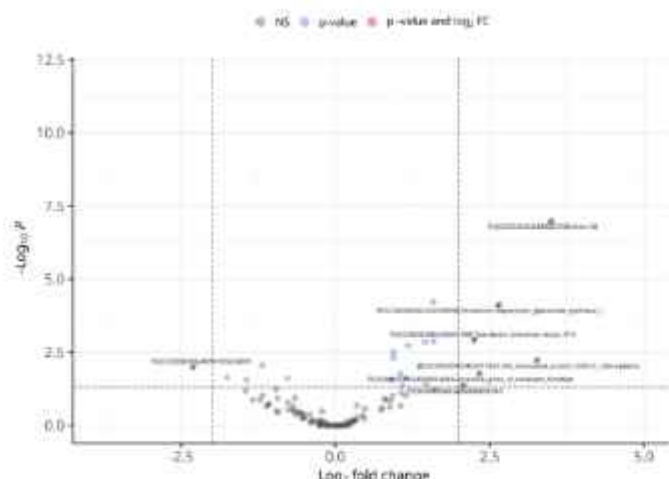


Fig. 4: Volcano plot showing distribution of differentially expressed transcripts between treated vs control

(Black = Not significant, Green = Absolute log₂ fold change above 1, Red = Significant with FDR less than 0.05 and absolute log₂ fold change greater than 2)

Normalized expression values were scaled and centered before plotting the heatmap. Normalization of the read counts was performed and the differentially expressed genes between 2 groups are filtered according to log₂FoldChange values (>0). The representation of top 50 differentially expressed genes for the comparison has been shown in heatmap (Fig. 5). Further gene annotation and transcript analysis work is in progress.

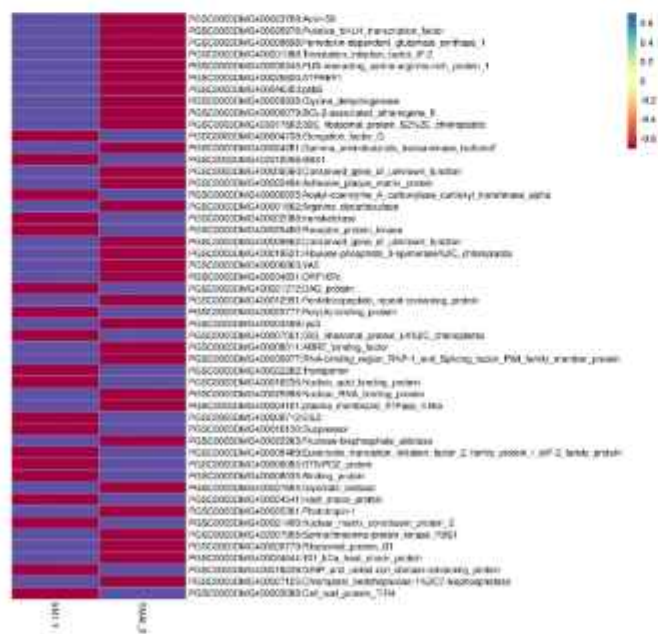


Fig. 5: Heatmap representing the expression of top 50 most significant differentially expressed isoforms between the comparison

Development of a core set of SSR markers for characterization of potato germplasm and varieties

A total of 600 genomic-SSR markers covering all the linkage groups of potato had been evaluated for their polymorphic potential in a representative set of 12 potato genotypes, comprising of varieties, germplasm, somatic hybrids and wild species to develop a core set of SSR markers for potato germplasm and varieties characterization. So far, 285 SSR markers were found to be polymorphic.

Comparative Genomics to Understand the Self-Incompatibility in Diploid Potatoes

There has been interest in developing the potato hybrids at the diploid level. However, most diploids are self-incompatible (SI) that impede the progress in inbred development. Recently, some diploid accessions have found a naturally self-compatible (SC), that creates the interest to study their genomic architecture. With this objective, genomes of two SC clones, *S. chacoense* (M6) and *S. tuberosum* group tuberosum, RHRH89-039-16 (RH) were compared to study to species level genome architecture. In addition, these SC clones were also compared with the other SI clones, *S. tuberosum* group Phureja (DM) to study the molecular mechanism underlying the SI in diploid potatoes.

Publicly available genomic sequences of RH, M6 and DM (<http://spuddb.uga.edu/>) were used for pairwise alignment, utilizing the minimap2 available at galaxy server (<https://galaxy.science.oregonstate.edu/>). Per base divergence plots at 5 % and 10 % do not show many differences in this comparative analysis. For a longer alignment, there was less per base sequence divergence, and for shorter alignment, there was larger per base divergence. Coverage plots (Fig. 1) consisting of five longer alignments, Scaffold_0, 11, 6, and 7 spanning the 6 Mbp of the genome, show the high level of coverage between these two genomes.



Fig. 1: Coverage plot showing five longer alignments, Scaffold_0, 11, 6, and 7 spanning the 6 Mbp of the genome between M6 and RH genome, indicating high level of coverage between these two genomes

S-locus inhibitor is a key player in overcoming the SI barrier. We were interested to find the orthogroups of this gene in SC species. For orthogroup analysis, functional annotation file of RH and M6 was searched for the *Sli* gene. Six

orthogroups were identified for *S-locus inhibitor* gene using gene ID PGSC0003DMT400043434 in RH genome. In order to find the synteny between the selected orthologs, RH genome was compared with genome of SI diploid potato clone, DM. SynMap for RH and DM illustrates the syntenic relationship throughout the genome without significant genome instability. Since the *Sli* gene located on chromosome number 12, so that region of the SynMap was critically analysed for genome instability, however, no significant events were observed when comparing RH with M6 and DM (Fig. 2). In addition, the genome segment housing the genes from one of the selected orthologs (OG0002502) showed the synteny for chromosome 1 and chromosome 4 for RH and DM genome, respectively (Fig. 3).

Syntenic relationship among the SC/SC and SC/SI genomes using the SynMap

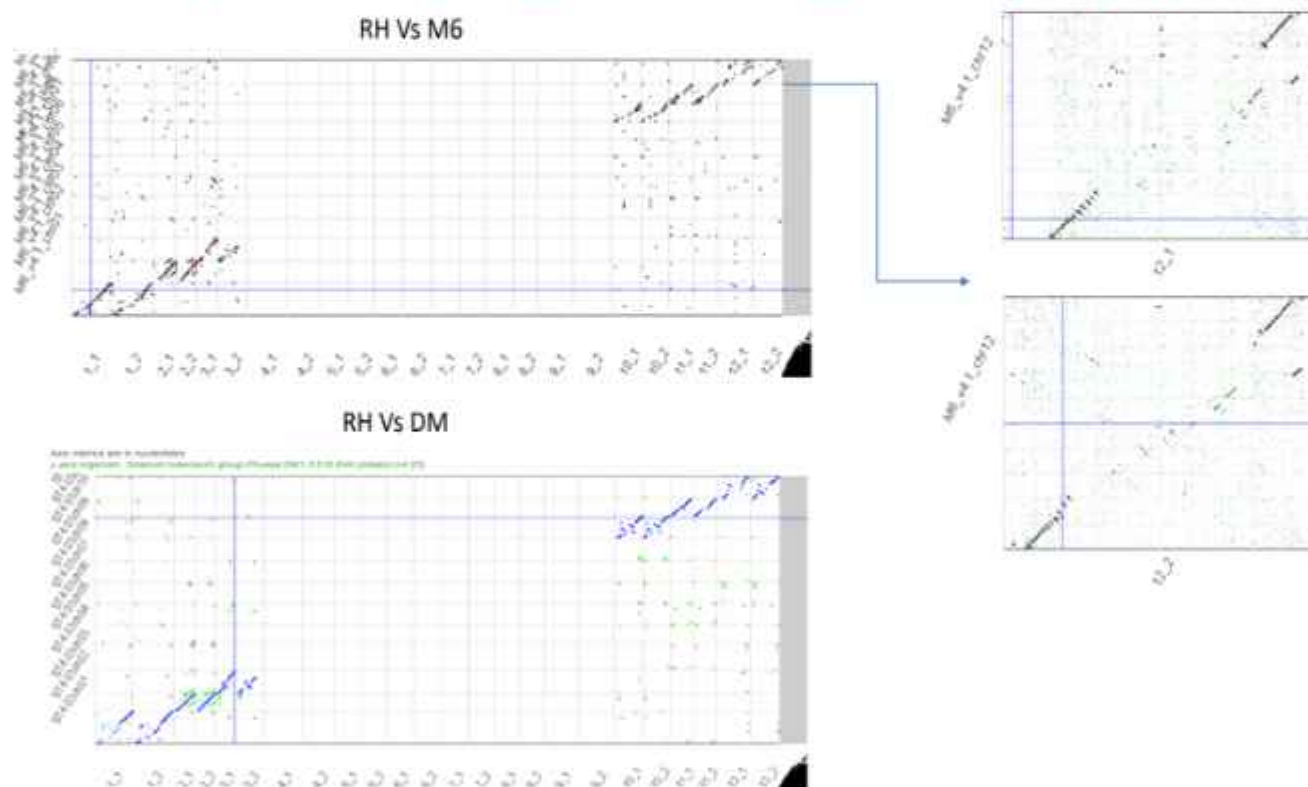


Fig. 2: SynMap showing syntenic regions between SC potato clone, RH Vs M6 (top) and synteny between SC, RH and SI, DM genome (bottom)

In parallel, genome-wide association analysis (GWAS) was carried out to identify genomic regions associated with dry rot resistance. Genotypic data were generated using a double enzyme-based genotyping-by-sequencing (GBS) approach. The GWAS was conducted for the trait lesion volume using both additive and dominance models. The analysis revealed six marker-trait associations, all located on Chromosome 7. The marker chr07_8537762, which was detected under the additive model, was the only significant marker in this study, explained 6.7% of the phenotypic variance

with a significant p-value of 0.001. Another marker, chr07_15660835 which was identified under the 1-dom-alt model, explained 3.3% of the variation. Although additional markers such as chr07_38981121 and chr07_32252485 were found but they were not statistically significant. Overall, the results indicated that chromosome 7 carries few loci which can contribute to dry rot resistance. The Manhattan plot in the Fig. 3 depicted multiple association peaks on Chromosome 7, which highlights significant genomic regions linked to lesion volume and dry rot resistance in the evaluated potato panel.

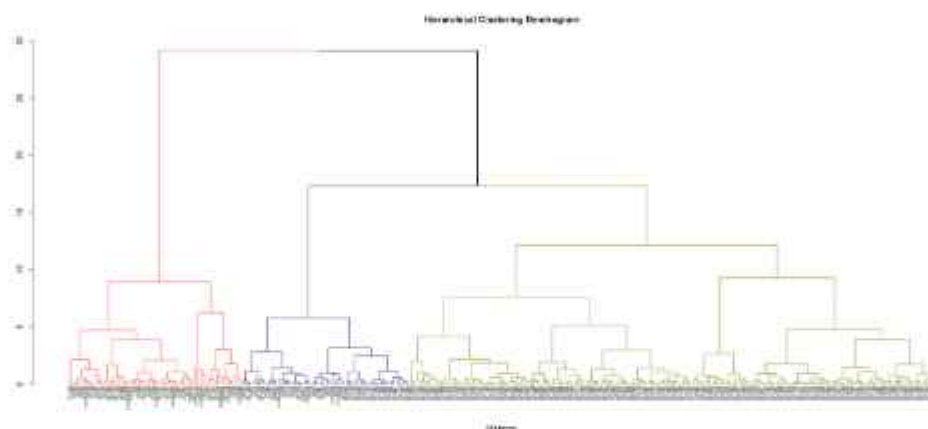


Fig. 1: Hierarchical clustering of potato accessions based on lesion diameter, lesion height, and lesion volume after inoculation with *Fusarium sambucinum*

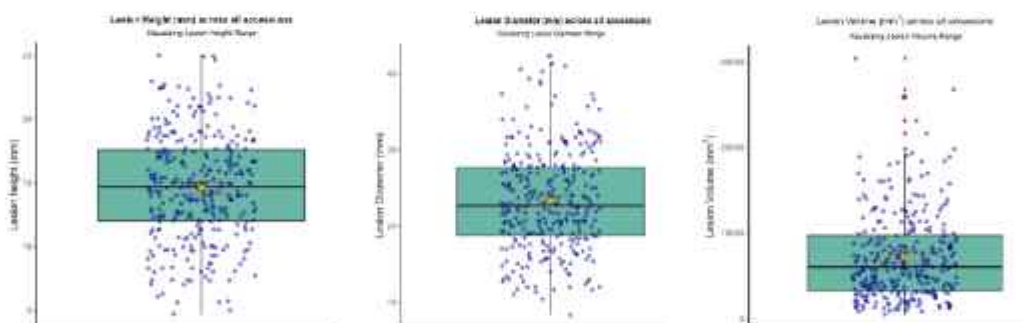


Fig. 2: Box plot showing distribution of lesion diameter, lesion height, and lesion volume variation in dry rot resistance

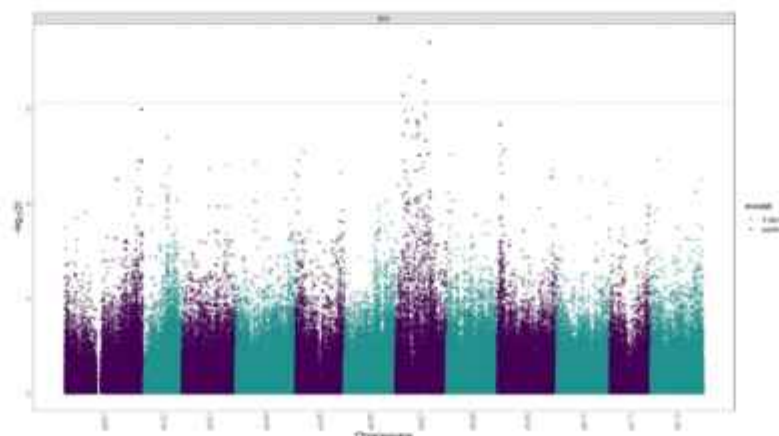


Fig. 3: Manhattan plot of GWAS results for lesion volume (mm^3) in potato accessions

PROGRAMME: BREEDING TRAIT SPECIFIC VARIETIES FOR PRODUCTIVITY, QUALITY AND RESISTANCE TO BIOTIC AND ABIOTIC STRESSES

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Breeding nutritionally superior potato varieties

Hybridization: A total of 3,92,096 TPS were generated at Modipuram from 87 crosses involving diverse parental lines at Modipuram. In addition, a total of 45, 529 TPS were produced in the summer season crop at Kufri from 35 diverse crosses.

Seedling stage: At Modipuram 1036 clones of 83 crosses were selected from 37,790 seedlings obtained from 101953 TPS of 91 crosses. At Shillong, 60 clones of 4 crosses were selected from 6518 seedlings obtained from 25370 TPS of 20 crosses.

Initial clonal stages (F_1C_1 , F_1C_2 and F_1C_3 stage): In F_1C_1 stage, 1218 clones of 51 families were evaluated at 90 days and at harvest 196 promising clones were selected from 45 families. In F_1C_2 stage, 115 clones of 25 families were evaluated at 90 days and at harvest 43 promising clones (19 families) were retained. In F_1C_3 stage, 41 clones belonging to 20 families were evaluated at 90 days and at harvest 23 (14 families) promising clones were selected.

Advanced stage trials: In all, 56 advanced clones were evaluated in five yield trials at 75/90 days at Modipuram and 27 promising advanced clones were selected. In Preliminary yield trial 1 (red skin), nine promising clones namely MP/19-787,

MS/14-1381, MS/17-198, MS/18-101, MSH/19-241, MSP/19-190, MSP/20-1048, MSP/20-554 and MSP/20-666 were selected from the 17 advanced clones evaluated. In preliminary yield trial 2 (white skin) five promising advanced clones namely MSA/16-126, MSH/20-10, MSP/20-129, MSV/20-24 and MSV/20-27 were retained from the 12 advanced clones evaluated. In preliminary yield trial 3 (white skin) three promising advanced clones namely MP/19-77, MP/19-256 and MSP/20-1100 were retained from the 10 advanced clones evaluated. In the confirmatory yield trial (baby potatoes), four promising advanced clones namely MS/18-1272, MS/19-571, MS/19-602 and MSP/15-60 were retained from the four advanced clones evaluated. In the confirmatory/final yield trial, based on tuber yield and tuber characters, six advanced clones namely MP/19-738, MS/14-243, MS/19-253, MS/19-268, MS/19-400 and MS/19-664 were retained from the 13 clones evaluated.

Chip colour score at Modipuram: Processing attributes investigated in 84 advanced clones/varieties revealed chip colour range from 3.0 (K. Chipsona-3) to 9.2 (MSH/20-10) and mean values 5.0 on the visual score. An acceptable chip colour score was found in K. Chipsona-3, Lady Rossetta, MP/19-174, MP/20-1693, MS/17-198, MSP/20-666.

Nutritional profiling at Shimla: In all 79 genotypes were assessed for nutritional components.

Amylose content (%): It ranged from 20% (MS/14-243) to 36% (MSP/21-916) with mean values of 29%. The genotypes with high amylose content were MP/19-256, MSP/21-419, MSP/21-916 (36%) MP/19-738, MS/19-253, MS/19-602, MSP/20-1163, MSP/20-415, MSP/21-291 (35%).

Ascorbic acid content (mg/100 g FW): It ranged from 23.4 (MSP/21-595) to 47.2 (MSP/20-554)

with mean values of 35 mg/100 g FW. The genotypes with high ascorbic acid content were MSP/20-554 (47), MSP/21-288, MSP/20-445, MSP/21-826 (46), MSP/21-883, MSP/19-190 (45), MSP/21-626, MSP/21-291, CP 4659 (44 mg/100 g FW).

Carotenoids (ug/100g FW): Carotenoids in flesh ranged from 0 (MSP/20-1048) to 337 (MSP/21-733) with mean values of 102 ug/100g FW. The genotypes with high carotenoids were MSP/21-733 (337), MSP/21-741 (323), MS/19-268 (302), MSP/20-415 (298), MSH/21-47 (280), K. Ratan (276), K. Neelkanth (275), MS/18-1272 (223 ug/100g FW).

Anthocyanins (mg/100 g FW): Anthocyanins in flesh ranged from 0.06 to (MSP/21-430) to 81 (K. Jamunia) with mean values of 8 mg/100 g FW. The genotypes with high anthocyanins in flesh were K. Jamunia (81), MSP/20-415 (78), MSP/20-1048 (63), MSP/20-1100 (43), MSP/20-554 (20), MSP/20-445 (18), CP 4641 (17), MSP/21-288 (16), MSP/21-291 (15), MSH/21-34, K. Manik (14) and MS/17-198 (12 mg/100 g FW).

Zinc content (ppm): Zinc content (flesh) on a dry weight basis ranged from 20 (MSP/20-1163) to 31 ppm (MSP/21-770) followed by MSV/20-27, MSP/21-430, MP/19-787 (30), MSH/21-44, MSP/21-288, MSP/21-767, MSA/16-126 (29), LR, MSV/20-24, MS/18-1272, K. Chip-1, CP4634, MSP/21-741, CP4628 (28 ppm).

Iron content(ppm): Iron content (flesh) on a dry weight basis ranged from 31 (MSP/20-1048 &

MSP/20-1100) to 44 ppm (MSV/20-24, K. Uday, MSP/21-883) followed by MSP/21-770 (43), MSH/21-44, CP4641, MSP/21-767 (42), K. Neelkanth, MP/20-1844, MS/14-243, K. Chip-1 (41), MS/18-1272, MSP/21-761, MP/19-256, MP/19-787, MSV/20-27 (40 ppm).

Sharing of breeding material: About 2,74,270 TPS of promising crosses were sent to CPRI regional stations Patna and Shillong, AICRP center, Bhubaneswar, Deesa, Dholi, Raipur, Pasighat and Kanpur for seedling raising and further selection as per institute breeding protocol for promotion of region-specific breeding. Eighty (88) promising advanced clones/parental lines were sent to Kufri for hybridization and late blight screening.

Introduction of advanced clones in AICRP: Introduced advanced clones MS/19-268, MS/19-571 and MSP/19-190 (Fig. 1,2,3) in AICRP for multi-location testing.

MS/19-268 (CP4511 x MS/0-3740): The advanced clones produced attractive 9-10 tubers/plant having white-cream ovoid tubers (Fig. 1) with shallow red eyes and cream flesh. MS/19-268 (45 t/ha) produced an 18% high total tuber yield as compared to K. Bahar (38 t/ha) at 90 days. MS/19-268 possesses 18% tuber dry matter (90 days), medium tuber dormancy, very good keeping quality, mealy texture, high carotenoids (101 ug/100g FW), anthocynins (5 mg/100g FW), Vitamin C (35 mg/100g FW), amylose (33%), Fe (35 ppm). It is resistant to late blight (AUDPC:236) than K. Bahar (1467).



Fig. 1: Morphological characters of MS/18- MS/19-268: Leaf, inflorescence, tubers and sprouts

MS/19-571 (K. Himsona x CP4242): The advanced clone MS/19-571 (suitable for baby potatoes) produced a 19 and 11% high total tuber yield of 38 and 37 t/ha as compared to 23 and 34 t/ha of MSP/15-60 (prevailing baby potato advanced clone) at 75 and 90 days. It produces attractive 20-22 tubers/plant having dark red ovoid tubers with shallow eyes and cream flesh containing mottled red colour (Fig. 2). It possesses high tuber dry matter (21%) as

compared to 20% in MSP/15-60 at 90 days. It possesses excellent keeping quality by virtue of low total weight losses and medium tuber dormancy (6-8 weeks) period, mealy texture, higher vitamin C (45 (mg/100g FW), anthocyanins (19 mg/100g FW), zinc (23 ppm), iron (36 ppm) in flesh. It is moderately resistant to late blight (AUDPC:538) as compared to MSP/15-60 (AUDPC:1094).



Fig. 2: Morphological characters of MS/19-571: Leaf, Inflorescence, tubers and sprouts

MSP/19-190 (Sarpomira x Kala Aaloo): The advanced clones produced attractive 12-14 tubers/plant having dark red ovoid tubers with medium eyes and yellow flesh containing mottled red colour (Fig.3). MSP/19-190 (39 and 47 t/ha) produced a 25 & 24% high total tuber yield as compared to K. Manik (31 & 38 t/ha) at 75 & 90 days respectively. MSP/19-190 possesses

20% tuber dry matter (90 days), excellent good keeping quality with long tuber dormancy, floury/mealy texture, high total carotenoids (203 ug/100g FW), anthocyanins (25 mg/100g FW), Vitamin C (42 mg/100g FW), amylose (33%), Fe (31 ppm) in flesh. It is moderately resistant to late blight (AUDPC:358) as compared to K. Manik (AUDPC:981) under field conditions.



Fig. 3: Morphological characters of MSP/19-190: Leaf, inflorescence, tubers and sprouts

Notification of biofortified potato variety: Specialty potato variety Kufri Jamunia (MS/8-1148 x CP4242) has been notified by the CVRC meeting during July/August 2024. The new variety is medium maturing (75-90 days) with a yield potential of 32-35 t/ha and possesses a moderate level of late blight resistance, excellent keeping and culinary quality. It produces attractive purple oblong tubers, with shallow eyes

and purple flesh colour (Fig. 4). It possesses 18-19% tuber dry matter, very good taste and a mealy texture. High anthocyanins (32), ascorbic acid 52 mg/100g FW), carotenoids (163 ug/100g fresh weight) & flavouring compounds 5 (AMP+GMP) ug/g than controls. Kufri Jamunia also possessed at par zinc (23 ppm) and iron (32 ppm) content on a dry weight basis with Kufri Manik. It is easy to cook, texture mealy,

flavour mild, free from after-cooking discoloration. It is suitable for table potatoes and the preparation of speciality products like dalia, suji, ice cream, and biscuits. The new variety is suitable for growing in north Indian plains.



Fig. 4: Purple fleshed biofortified potato variety Kufri Jamunia

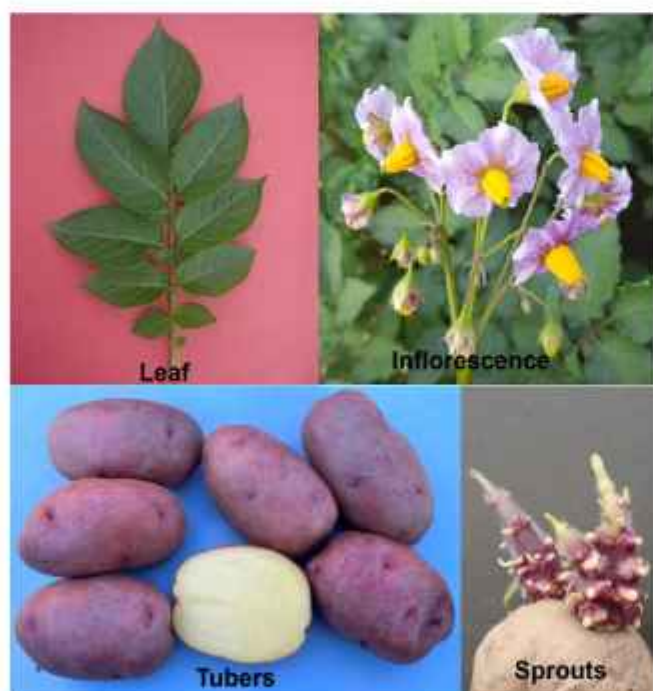


Fig. 5: Red skinned new potato variety

Release of new potato variety: An improved red coloured advanced potato variety MS/14-1381 (CP3391 x K Sutlej) has been recommended for release in the 42nd AICRP (Potato) Group Meeting, 22-24 September 2024, ANDUAT, Kumarganj, Ayodhya. The new variety is

medium maturing (75-90 days) with yield potential of 36-38 t/ha and possesses field resistance to late blight, very good keeping and culinary quality. It possesses 18% tuber dry matter, very good taste and a mealy texture. It has an edge over prevailing red skin varieties like K. Manik, K. Lalit and K. Lalima and Kufi Lohit for tuber yield quality attributes. It produces attractive red, ovoid tubers with shallow-medium eyes and yellow flesh colour (Fig. 5). The new variety is suitable for growing in North Indian plains (Haryana, Punjab, Plains of Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Chhattisgarh, Odisha, Bihar, West Bengal, Assam and Arunachal Pradesh) and Plateau regions (Maharashtra-Rabi & Kharif Crop and Karnataka-Kharif Crop).

Evaluation for late blight resistance at Modipuram: Eighty potato genotypes were evaluated for late blight resistance under field and lab conditions. The Area Under Disease Progress Curve (AUDPC) ranged from 26 in CP4681 to 1515 in MP/19-492. All advanced clones/accessions showed less Area Under Disease Progress Curve (AUDPC) than control highly susceptible variety K. Bahar (1249) except MP/19-174 (1295) and MP/19-492 (1515). Among all genotypes CP 4681 ((26), CP4638 (43), MSH/21-47 (74), MSA/16-126 (84), CP4659 (90) and MSV/20-12 (97) showed high resistance to late blight as compared to K Bahar (1249). These advanced clones also showed less rAUDPC. However, rAUDPC ranged from 0.01 to 0.49. Under laboratory conditions, by detach leaf method three clones (CP4681, CP4638, CP4659,) were highly resistant; 45 were moderately resistant (MSH/21-47, MS/19-602, MS/19-268, MSV/20-15, K.Frysona, MP/19-72, MSH/19-241, MSH/21-37, MSP/20-758, MSP/20-445, MSP/20-307, MSP/19-190, MS/14-1381, MP/19-433, MS/18-1272, MS/18-101, MP/19-646, MSP/20-121), 3 were resistant (K. Uday, MSP/20-149, MS/19-571) and remaining 29 were susceptible.

Under laboratory condition, by tuber slice method, 38 clones (CP4681, CP4638, MSH/2-47, MS/19-602, K.Frysona, MP/19-72, MSH/19-241, MSP/20-445, MSP/20-307, MP/19-433, MS/18-101, MSP/20-149, MS/19-

571, MP/19-256, MP/19-672, MSP/20-125, MSP/20-1163, K. Sangam, MP/19-185, MP/19-128, MP/19-209, MSH/20-10, K. Himalini, MSA/16-126, MSV/20-12, MSP/20-878, CP4641, K. Chipsona-1, MS/19-400, MSH/21-44, MP/19-787, MS/18-465, MP/19-20, MP/19-77, MP/19-923, MSP/20-415, MS/19-664, MP/19-492) showed moderately resistant and remaining 42 genotypes were susceptible.

Screening of advanced clones for the hollow heart: Among the eighty genotypes evaluated four advanced clones namely MSP/15-60, MSP/20-878, MS/17-198, and MS/19-400 (10.0%) showed hollow heart-like symptoms, and 6 clones namely MP/19-20, MSP/20-125, MSP/20-129, MSH/20-10 (10.0%) and MP/19-738 and MP/19-923 (20.0%) showed brown spot type symptoms.

Screening of advanced clones for black scurf and common scab: Among the eighty genotypes evaluated for black scurf, the disease incidence of black scurf ranged from 0.0 to 70.0%. In 19 genotypes namely CP4634, CP4659, CP4681, CP4730, MP/19-72, MP/19-174, MP/19-738, MP/19-433, MP/19-860, MS/14-1381, MS/19-571, MSH/21-37, MSH/21-47, MSP/20-307, MSP/20-415, MSP/20-1048, MSV/20-15, MSV/20-12 and K. Manik showed 0-5% disease incidence of black scurf. The remaining varieties and clones showed more than a 5% disease incidence level. The highest disease incidence was in K. Sangam (70%), followed by MS/14-243 (65%) and MP/19-77, MS/18-393, MSP/15-60, and MSP/20-1100, K. Pukhraj (50%). Similarly, the incidence of common scab was also recorded, and it ranged from 5% to 90%. In genotypes namely MS/19-571 (5%), CP4659 (10%), MSP/20-121, CP4681 & K. Neelkanth (15%), CP4638, CP4641, K. Uday, MP/19-787, MSH/19-241, MSP/19-190, MSP/20-1048 (20%) levels of disease incidence were recorded. The remaining varieties and clones showed more than a 20% disease incidence level.

Keeping quality studies: Forty six genotypes were assessed for storage studies under ambient temperatures from March to May 2024. Observations on weight loss, roting and sprouting were recorded up to 75 days of storage.

Among white skinned 14 advanced clones, the total weight loss ranged from 7% (MSP/20-100) to 18% (MS/19-243). The advanced clones namely MSP/20-1100, MS/19-400, MP/19-77 and MSV/20-27 showed excellent keeping quality (>10% total weight loss) and remained at par with controls K Sangam, K Chipsona-1, K. Ganga, K Frysona and K Bahar with less than 10% total weight loss. Among 19 red/purple skinned advanced clones, the total weight loss ranged from 5% (MSP/20-1048) to 28% (MS/19-602). The advanced clones namely MSP/20-1048, MP/19-787, CP4730, MP/19-174, MS/14-1381, MSP/19-190, MS/18-1272, MSV/20-15, MSP/15-60, MSH/19-241 and MS/17-198 showed excellent keeping quality (>10% total weight loss) and remained at par with controls K Lohit, K Uday, Lady Rosetta and K Neelkanth with less than 10% total weight loss.

Breeding early bulking agile potato varieties suitable for intensive cropping systems

Hybridization: A total of 268770 seeds of 107 crosses were obtained.

Seedling stage: 10643 promising clones were selected from 46939 seedlings raised by sowing 93520 true potato seeds of 60 crosses.

Initial clonal stages: In the initial clonal stages (F_1C_1 , F_1C_2 and F_1C_3), 2048 promising clones were selected from the 14869 clones evaluated.

Advanced stage trials: In all, 61 advanced clones were evaluated in 5 yield trials at 60/75 days at Jalandhar and 24 promising advanced clones were selected. In preliminary yield trials (three) at 60 and 75 days, 17 clones namely J/18-057, J/18-070, J/18-079, J/18-081, J/18-084, J/18-168, J/18-184, J/18-209, J/18-217, J/18-223, J/18-247, J/18-294, J/18-305, J/18-307, J/18-313, J/18-320 and J/18-329 were selected of the 40 advanced clones evaluated. In confirmatory yield trial, 7 advanced clones J/17-141, J/17-210, J/17-212, J/16-4, J/16-78, J/16-84 and J/16-196 were selected from the 21 advanced clones evaluated.

Introduction of hybrids in AICRP: Based on consistently good performance over the years, two advanced clones namely J/15-36 and J/15-

91 (**Fig. 6**) were introduced in the All India Coordinated Research Project on Potato (AICRP Potato).

J/16-78 (J/96-238 x EX/A 680-16): Based on yield average over years, J/16-78 gave 13.3 % and 12.6% higher yield over control K Khyati at 60 and 75 days harvests, respectively. It produces round, yellow tubers with shallow-medium eyes and white-cream flesh colour. It possesses 17% tuber dry matter and good keeping quality.



Fig. 6: Tubers of advanced clone's J J/16-78 and J/16-84

J/16-84 (J/97-243 x CP1462): Based on yield average over years, J/15-91 gave 21.9 % and 24.3% higher yields over control K Khyati at 60 and 75 days harvests, respectively. It produces white oblong tubers with shallow-medium and pale yellow flesh colour. It possesses 16% tuber dry matter and good keeping quality.

Notification of early bulking potato variety: A new early bulking potato variety Kufri Sukhyati (Clone of K Khyati) has been notified by the CVRC meeting during July/August 2024. The new variety is medium maturing (75-90 days) early bulking with a yield potential of 35-37 t/ha and possesses a field resistance to late blight, excellent keeping and culinary quality. It produces attractive white-cream round-ovoid tubers, with shallow medium eyes and cream flesh colour (**Fig. 7**). It possesses 17% tuber dry matter, very good taste and a mealy texture. The new variety is suitable for growing in north Indian plains.



Fig. 7: Early bulking variety Kufri Sukhyati

Breeding improved red skinned varieties for eastern plains

Hybridization: Produced 51,675 TPS from 120 successful crosses at Patna and Kufri

Seedling stage: A total of 47,205 seedlings from 78,675 TPS (144 crosses) were transplanted in the field and 856 clones were selected based on tuber attributes at 90 days.

Initial clonal stages: In the initial clonal stages (F_1C_1 , F_1C_2 and F_1C_3), 490 promising clones were selected from the 1830 clones evaluated at 75 days.

Advanced stage trials: In all, 39 advanced clones were evaluated in 2 yield trials at 75/90 days at Patna and 15 promising advanced clones were selected. In the preliminary yield trial, 10 clones namely PS/19-02, PS/19-04, PS/19-12, PS/19-24, PS/19-26, PS/19-31, PS/19-41, PS/19-43, PS/19-44, PS/19-50 were selected of the 24 advanced clones evaluated at 60 and 75 days. In the confirmatory yield trial, 5 advanced clones namely PS/17-09, PS/17-20, PS/18-04 PS/18-28, PS/18-60) were selected from the 15 advanced clones evaluated.

Introduction in AICRP: Advanced clones namely PS/17-09 (purple fleshed), PS/18-60 (red skin), (**Fig. 8**) have been introduced in AICRP for multi-location testing.

PS/17-09 (K. Arun x PS6/82-2): The advanced clone with 36 t/ha total tuber yield showed a yield increase over K. Lalit (28 t/ha) and K Lohti (33 t/ha) by 28 and 12% respectively at 90 days. It produces red ovoid tubers with shallow eyes, creamy flesh with red ring and a mealy texture. It possesses 18% tuber dry matter, good keeping quality and a moderate level of late blight resistance to late blight.



Fig. 8: Tubers of PS/16-2 and PS/17-12

PS/18-60 (K. Arun x PS6/82-2): The advanced clone with 37 t/ha total tuber yield showed a yield increase over K. Lalit (31 t/ha) and K Lohti (36 t/ha) by 19 and 3% respectively at 90 days. It produces red ovoid tubers with shallow eyes, creamy flesh and a mealy texture. It possesses 21% tuber dry matter, good keeping quality and a moderate level of late blight resistance to late blight.

Breeding for processing varieties

Hybridization A total of 121933 TPS of 30 crosses at Modipuram and 35550 TPS of 24 crosses at Kufri during 2022-23 were produced.

Seedling stage: A total of 1092 clones were selected from 35 crosses from 31620 seedlings. (72061 TPS) of 37 crosses were sown in a nursery bed and transplanted.

Initial clonal generations: In total 1288 clones were evaluated in F_1C_1 , F_1C_2 and F_1C_3 stage and 225 promising clones were selected based on superior tuber characters and chip colour, dry matter.

Preliminary yield trial: In F_1C_4 generation 26 advanced clones having superior performance were selected from the 45 clones evaluated in a replicated trial.

Confirmatory yield trials: Based on the 75, 90 and 110 days trials 14 clones (MP/17-330, and MP/17-824, MP/18-217, MP/18-285, MP/19-296, MP/18-705 etc) having superior or at par yield (total and processing), dry matter, Chip colour and synchrony as compared with control varieties were selected from 19 clones evaluated.

Early planting evaluation at Modipuram: Thirty eight advanced clones and 6 control varieties were evaluated in early season planting at 90 days and based on performance 6 advanced clones namely MP/18-34, MP/19-7, MP/19-104, MP/19-370, MP/19-614, MP/19-709, were found to be superior concerning yield and acceptable quality traits.

CPRI – ITC - Potato Trial – South, East and Northern India (Rabi): Multi-location field trials

were conducted involving processing genotypes across three locations, Viz., Karnataka (24 genotypes at Chikaballapur), West Bengal (26 genotypes at Bankura) and Telangana (15 genotypes at Zaheerabad) in 2023-24 rabi season. Based on yield and quality the following entries were shortlisted. Genotype MP/14-171, MP/15-651, MP/19-333 and MP/18-163 (Karnataka ITC Rabi), MP/14-171, MP/15-651, MP/19-333, MP/19-718 and MP/18-136 (Telangana ITC Rabi), MP/15-651, MP/18-534, MP/19-709, MP/19-702, MP/19-722, MP/19-313 (WB, ITC, Rabi).

In the Northern region (Meerut) a total of 17 genotypes were evaluated and based on yield and quality, the six genotypes namely K Chipsona-5, MP/17-378, MP/16-315, MP/17-60, MP/17-428, and MP/9-28 were found to have superior quality traits and yield.

CPRI – ITC - Potato Trial - South India (Kharif): Multi-location field experiments were conducted involving 26 promising processing genotypes across three locations, Viz., Yeradanklu–Chikamagalur (Karnataka), Hasanur, Erode, (Tamilnadu) and Igglur –Thalavadi, (Tamilnadu) in Kharif 2024.

Based on field performance, yield potential and quality potential clones were short-listed. In, Thalavadi- (TN) shortlisted 3 clones namely MP/14-171, MP/20-2003 and MP/19-313. In Hasanur (TN) shortlisted 9 clones namely MP/17-746, MP/15-651, MP/19-333, MP/18-285, MP/19-702, MP/19-62, MP/19-99, MP/19-405 and MP/19-313. In Chikamagalur (KA) shortlisted 4 clones namely MP/19-313, MP/19-99, MP/19-46 and MP/19-281.

Evaluation trial on new French fry genotypes in Gujarat: Promising advanced clones including control varieties were evaluated by various industries following MoU for conducting an evaluation trial.

JRS India Foods Gujarat: A total of 10 advanced clones including control varieties were evaluated to identify suitable French fry genotype (s). Based on overall yield and quality parameters, MP/11-30, K Sangam, MP15-651

were found superior (Fig. 9). K FryoM resulted in average yield but had lower defects and good tuber size and shape for processing into French fries.

McCain's Food in Gujarat: A total of 5 advanced clones, including control varieties,

were evaluated to identify suitable French fry genotypes and results showed superior performance having good potential with total yield and processable grade and quality of tubers of K FryoM MP/15-651, K Sangam and MP/17-824.

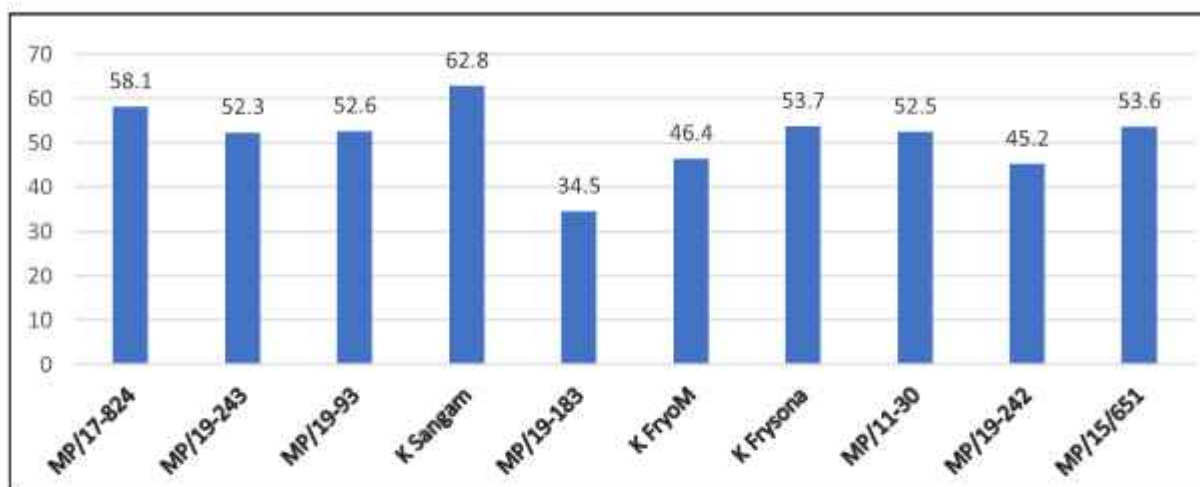


Fig. 9: Processing tuber yield t/ha at JRS Simplot, Banaskantha, Gujarat 2023-24

Hyfun Food, Gujarat: A total of 7 advanced clones including control varieties were evaluated and results indicated higher total and processing tuber yield in, MP/17-824, K FryoM, MP/19-93, K Frysona and MP/15-651.

Falcon Agrifriz, Gujarat: A total of 9 advanced clones including control varieties were evaluated and results indicated higher total and processing tuber yield in, MP/17-824, MP/19-93, MP/19-242 and MP/15-651.

Processing quality (Fry Colour Test Report) of potato genotypes after long-term storage during 2023-24: Ten genotypes were tested for fry colour variation after 3, 6 and 9 months of storage. Results showed that the fry colour index increased after 9 months of storage period (Fig. 10). All genotypes showed good fry colour index in long-term storage, however, MP/17-824 was found suitable for making French fries for up to 6 months only after storage. MP/19-243, K Frysona and MP/15-651 had shown the lowest fry colour index through the storage period as compared to other genotypes.

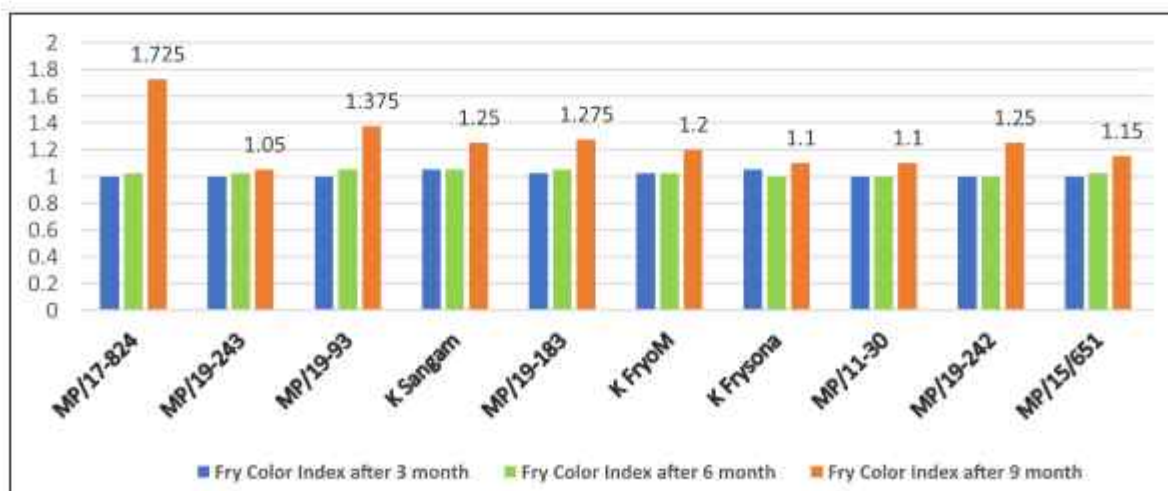


Fig.10. Fry Color Index after 3,6 and 9 months of storage at JR Simplot, Gujarat, India

Evaluation at McCain India: Average colour scores of advanced clones and varieties were

tested during 2021-23 under long-term storage. The results were as under-

Genotypes	May	July	August	September
K FryoM	1.75	1.50	1.30	1.20
K Sangam	1.80	1.25	1.20	1.10
K Frysona	1.15	1.45	1.10	1.25
MP/15-651	1.10	1.10	1.05	1.15

Note: Fry Colour Index Score

Fry Colour Index	Fry Colour	Processing Status
Below 1.5 score	Good	Accept
Above 1.5 score	Poor	Reject

Tuber yield and processing quality of genotypes during autumn at Jalandhar: Thirteen processing genotypes were evaluated for yield and processing quality at 90 DAP. Among them, MP/16-226 had the highest total tuber yield, followed by K Frysona and K Chipsona-3. The processing grade (Fry and Chip) yield was also higher in these hybrids. The highest fry grade yield was observed in K Frysona, followed by MP/16-226 and MP/17-257. For chip grade tubers, K Chipsona-3 produced the highest yield, followed by K Chipsona-5, LR, and MP/16-178. The dry matter content of the advanced clones ranged from 20.6 to 24.8%. Higher dry matter was found in MP/16-178 followed by K Chipsona-3 and MP/17-216.

Changes in processing attributes during storage (180 days) at 12°C with CIPC (2023 storage): At the end of storage highest dry matter was found in MP/16-178 (24.44%) followed by Santana and MP/17-216. Overall, the lowest chip colour score among all hybrids was recorded for MP/16-178. It was found that out of 17 advanced clones, only 6 genotypes (MP/14-129, K Chipsona-1, MP/13-662, ATL, MP/16-178 and MP/16-173) were found suitable for processing into chips and fries.

Screening of Advanced clones for Late blight at Shimla: Among the 12 genotypes evaluated at Kufri for late blight resistance, the advanced clones viz., MP/17-601 and MP/19-740 recorded the lowest AUDPC value of 553 and 999, respectively, while the control varieties Lady Rosetta (1557) and Atlantic (1657) recorded the highest AUDPC.

Screening of Advanced clones for Late blight at Modipuram: Six advanced clones along with control varieties were evaluated for late blight resistance under field and lab conditions during the *Rabi season* and all advanced clones showed less Area Under the Disease Progress Curve (AUDPC) than controls and highly susceptible varieties K. Bahar (1249) & Lady Rosetta (1293). Among clones, less AUDPC was recorded in MP/13-662 (79), MP/15-173 (295), MP/15-651 (550), K Chipsona-5 (594) as compared to standard cv. K. Bahar (1249).

Screening of Advanced clones for Hollow heart, Black scurf and Common Scab: Among the six clones along with control varieties evaluated for black scurf and MP/12-126 (45.0%), Atlantic (45.0%) observed for the higher incidence of black scurf symptoms, however, advanced clones namely MP/13-662 (0%), MP/15-173 (7.5%) and varieties namely K Chipsona-5 (10.0%), K Bahar (10.0%), recorded lesser black scurf incidence.

Optimizing nitrogen requirement of K Chipsona-5: A field experiment was conducted during the crop season of 2023-24 for optimizing nitrogen requirement of the newly released chipping variety K Chipsona-5 consisting of 8 treatments (0, 50, 100, 150, 200, 250, 300 & 350 kg N/ha) in RBD design having three replications. Level of P (120 P₂O₅ kg/ha) and K (150 K₂O kg/ha) was kept static at a sufficient level. Findings suggest that N level of 200 kg /ha has yielded statistically comparable process grade (9.43 t/ha) and total tuber yield (31.5 t/ha)

to lower and higher N doses. Tuber dry matter content (22.8%), specific gravity (1.080) and chip colour score (3.36) were also fairly better at this dose.

Based on performance during 2022-23-2023-24 at Modipuram four advanced clones viz., MP/18-285 (K Chipsona-1 x Navigator) for chips, MP/18-705 (MP/09-45 x FL 2137) for chips, MP/18-217 (MP/09-45 x CP 4512) for specialty and French fries and MP/18-296 (K Chipsona-1 X Navigator) for processing into specialty and French fries are introduced into AICRP for multi-location trials (Fig. 10).

MP/18-285 (K Chipsona-1 x CP4434) for chips: It produced 36 t/ha mean processing tuber yield which was 30, 34, 21 and 5% higher than K Chipsona-1, LR and ATL and K Chipsona-5 respectively. It has white cream, ovoid tubers, shallow eyes and light-yellow flesh.

MP/18-705 (MP/09-45 x CP4458) for chips: it produced 35 t/ha mean processing tuber yield

which was 28, 32, 19 and 3% higher than K Chipsona-1, LR and ATL and K Chipsona-5 respectively. MP/18-705 has white cream, round tubers, shallow eyes and cream flesh. Both clones possess 20-21% dry matter, acceptable chip colour score and very good keeping quality.

MP/18-217 (MP/09-45 x CP 4512) for specialty and French fries: It produced 38 t/ha mean processing tuber yield which was 14, 26 and 16% higher than, K FryoM, K Frysona and Santana respectively. It has white cream, oval oblong tubers, shallow eyes and cream flesh.

MP/18-296 (K Chipsona-1 x cp4434) for specialty and French fries: It produced 39 t/ha mean processing tuber yield which was 18, 29 and 19% higher than K FryoM, K Frysona and Santana respectively. MP/18-296 has white cream, oval oblong tubers, shallow eyes and white cream flesh. Both clones possess 21% dry matter, acceptable fry colour score and very good keeping quality.



Fig. 10: Tubers of processing purpose advanced clones introduced in AICRP

Release of new potato varieties: New processing varieties namely Kufri Chipbharat-1 (MP/12-126) and Kufri Chipbharat-2 (MP/15-651) have been recommended for release in the 42nd AICRP (Potato) Group Meeting, 22-24 September 2024, ANDUAT, Kumarganj, Ayodhya.

Kufri Chipbharat-1 (CP4047 x MP/99-322): Medium maturing (100 days), high yielding (35-38t/ha) processing clone for chips, has a

substantial yield advantage of 11% over the best control, Kufri Chipsona-5 and is recommended for Indian plains (Haryana, Punjab, UP, Uttarakhand, MP, Gujarat, Rajasthan) and Karnataka, Telangana and Tamil Nadu in the main season. The clone produces white cream, round tubers, shallow eyes, white cream flesh (Fig.11), high dry matter (21%) and has very good storability under ambient storage conditions. The clone has an acceptable chip colour and low reducing sugars.



Fig. 11: New processing potato variety Kufri Chipbharat-1

Kufri Chipbharat-2 (MP/9-90 x MP/9-11):

High-yielding (35-37t/ha) processing clone for chips with early foliage maturity (90 days). MP/15-651 has a substantial yield advantage over early-maturing exotic varieties used for processing. It is recommended for Indian plains (Haryana, Punjab, UP, Uttarakhand, MP, Gujarat, Rajasthan) and southern India

(Karnataka, Telangana and Tamil Nadu) in the main season. The clone produces white cream, ovoid tubers, shallow-medium eyes, cream flesh (Fig. 12), high dry matter (21%) and very good storability under ambient storage conditions. The clone has wide adaptability and acceptable chip colour and reducing sugars.



Fig. 12: New processing potato variety Kufri Chipbharat-2

Notification of new potato variety:

The new processing variety Kufri Chipsona-5 (K Himsona x CP1371) has been notified by the CVRC meeting during July/August 2024. The new variety is medium maturing (90-100 days) with a yield potential of 30-35 t/ha and possesses a moderate level of late blight resistance, very good keeping and processing quality. It produces attractive white-cream round ovoid tubers with

shallow-medium eyes, cream flesh and mealy texture (Fig. 13). It possesses 21% tuber dry matter, low reducing sugars (67 mg/100g fresh tuber weight) and acceptable chips colour score (2.5) and thus it is suitable for processing into chips. The new variety is suitable for growing in Haryana, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Gujarat and Rajasthan, Chhattisgarh.



Fig. 13: New processing potato variety Kufri Chipsona-5

Commercialization of processing potato varieties: Kufri FryoM (suitable for French fries, 20 licenses) and Kufri Chipsona-5 (suitable for chips, 6 licenses) have been commercialized through non-exclusive licensing to the producer/processing industry.

Breeding for biotic stresses (late blight, viruses & cyst nematodes)

Hybridization: One hundred twenty three successful crosses at Kufri/ Shimla and Ooty between PCN, late blight and virus tolerant parents having early to medium maturity, better quality traits and good adaptability resulted in 1,84,507 hybrid TPS.

Seedling raising and screening for late blight resistance: A total of 16250 seedlings of 6 crosses obtained from 27000 TPS were screened under controlled conditions against complex races of *Phytophthora infestans* at Shimla. A total of 2111 resistant seedlings were obtained, which were, transplanted in the earthen pots in the glass-house and poly-house. The highest number of resistant seedlings (%) were obtained in the cross K. Karan x K. Himalini (22.5%), followed by CP4311 x K. Himalini (21.7%), Rangpuria x K. Himalini (17.8%), K. Jyoti x CP1971 (16%), SM/11-120 x CP1971 (12.3%) and LBY 24 x CP1971 (9.8%). At harvest, 1051 clones were obtained from 2111 resistant seedlings of 6 crosses. At Ooty 44000 true seeds belonging to 12 cross combinations were sown and 3237 seedlings were transplanted in the poly house for screening against late blight under natural conditions. At maturity, 850 resistant selections were made.

Initial clonal evaluations: In the initial stages (F_1C_2 to F_1C_4), 4630 genotypes were evaluated under natural field conditions at Kufri/Ooty for their disease resistance and adaptability and 1640 clones were selected.

Evaluation of advanced clones at Modipuram: Eighty advanced clones along with five control varieties were evaluated in two trials and at harvest twelve promising advanced clones were selected. In trial 1, four clones viz., SM/13-154, SM/15-486, and SM/15-245 were found superior to K Bahar and K Himalini. In the

second trial, eight clones namely, SM/18-296, SM/17-429, SM/17-251, SM/18-337, SM/18-305, SM/16-333, SM/17-788 and SM/10-220 were found promising and were superior to K Bahar and K Himalini.

Yield trials at Kufri: Among the 36 advanced clones evaluated in 5 trials at Kufri and 13 advanced clones were selected. SM/09-82, SM/09-163, SM/10-101, SM/10-103, SM/10-117, SM/10-121, SM/10-234, SM/10-255, SM/15-245, SM/15-486, SM/16-41, SM/16-73, SM/17-251 were selected due to superior yield performance and late blight resistance.

Yield trials at Ooty: At Ooty, five promising advance clones were evaluated along with four control varieties and a significant difference in yield was recorded in two clones namely OS/15-267 (30.14t/ha), OS/16-79 (28.28t/ha) and both were found highly resistant to late blight and both species of potato cyst nematode.

MAS for Late Blight, Viruses and Nematodes:

A total of 156 *Solanum tuberosum* advanced clones were genotyped for resistance to late blight, viruses (PVY, PVX, and PVS), and potato cyst nematodes using 28 PCR-based molecular markers linked to resistance genes (Fig 14-17). The number of markers detected per genotype ranged from 4 to 24, which reflects wide variation in the extent of resistance gene stacking. The highest marker presence was observed in the breeding clone SM/17-829 and SM/17-539, each with 24 resistance-linked markers, followed by SM/17-106 (presence of 23 markers) and SM/17-557 (22 markers). These lines represent valuable candidates for multi-trait resistance breeding. In contrast, genotypes such as SM/18-279, SM/17-754, and SM/17-125 exhibited the lowest marker presence (4-5 markers), indicating limited resistance coverage across the screened biotic stressors. Out of 156 clones, only two clones (SM/17-800 and SM/17-829) showed the presence of all the late blight resistance genes, seven clones (SM/17-629, SM/17-52, SM/17-582, SM/18-151, SM/18-269, SM/18-339, and SM/17-283) showed the presence of all the markers for screened viruses. MAS enabled the efficient identification of advanced breeding potato clones (SM/17-829, SM/17-539, and SM/17-106) with multiple

biotic stress resistance to late blight, PVY, PVX, PVS, and PCNs. These findings provide a framework for breeding multi-resistant cultivars, enhancing agricultural sustainability.

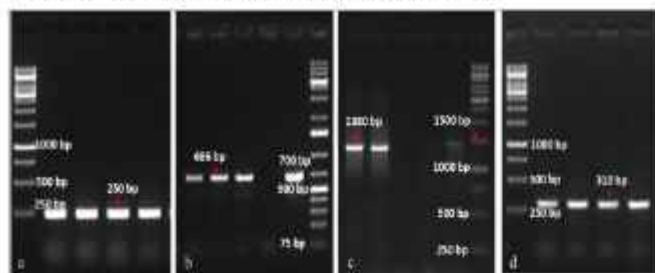


Fig. 14: Agarose gel electrophoresis showing the PCR products of different late blight resistant genes/markers (a) CosA marker- 250 bp, 1 kb marker (b) R2 marker - 686 bp, 1 kb plus marker (c) R3- 1380 bp, 1 kb marker (d) cLET5E4 marker-310 bp, 1 kb marker

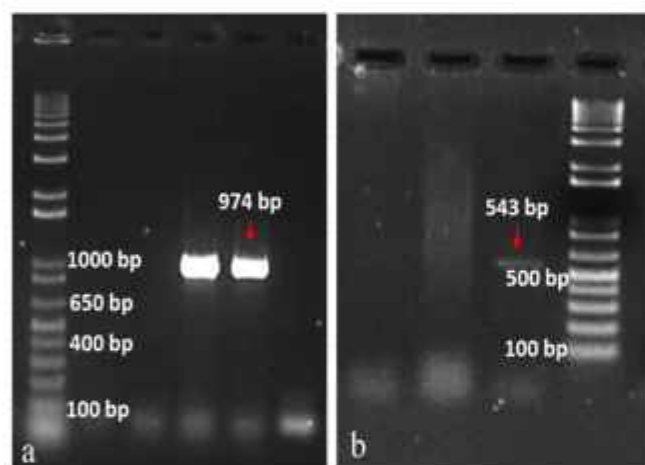


Fig. 15: 1Rx1 marker of PVX resistant gene Rx2 974 bp, 1 kb plus marker (b) 106Rx2 marker of PVX resistant gene Rx2 (Marker - 100 bp plus, desired gene product size-543 bp)

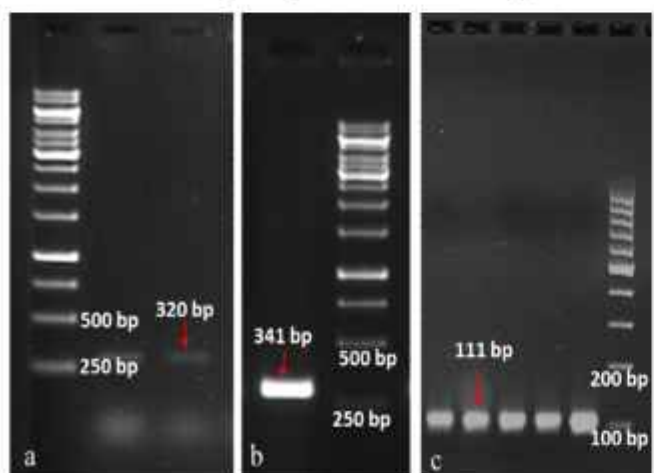


Fig. 16: RYSC3 marker - 320 bp, 1 kb marker (b) YES3-3 A marker- 341 bp, 1 kb marker (c) STM0003 marker- 111 bp, 100 bp marker

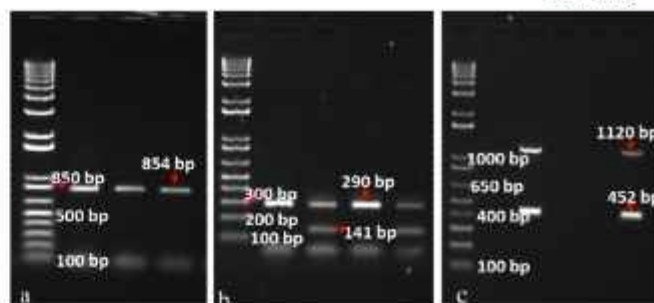


Fig. 17: Gro-VI-XO2 marker-854 bp, 1 kb marker (b) TG689 marker-141 bp, 1 kb plus marker, BCH internal control-290 bp (c) GPA 2-1-1120 bp and GPA 2-2-452 bp, 1 kb plus marker

Screening of advanced clones for *Sclerotinia* rot: Eighty clones were evaluated along with four control varieties for *Sclerotinia* rot resistance and 17 clones showed the incidence of *Sclerotinia* rot of potato. Among these clones, disease incidence ranged from 6.67 to 20%. The minimum disease incidence was in SM/11-120 (6.67%), followed by SM/17-621 (8.89%), SM/15-132 (11.67%), SM/15-45, SM/17-02, and SM/18-342 (13.33%), and in SM/17-120 (20%).

Screening of advanced clones for leaf spot complex: 82 clones were evaluated along with four control varieties for leaf spot complex (Phoma and early blight) resistance and among these 35 clones (SM/10-253, SM/15-132, SM/15-245, SM/15-307, SM/15-486, SM/17-102, SM/17-106, SM/17-65, SM/17-251, SM/17-262, SM/17-560, SM/17-582, SM/17-609, SM/17-621, SM/17-629, SM/17-630, SM/17-706, SM/17-709, SM/17-719, SM/17-740, SM/17-771, SM/17-786, SM/17-788, SM/18-03, SM/18-147, SM/18-150, SM/18-163, SM/18-266, SM/18-276, SM/18-298, SM/18-299, SM/18-337, SM/18-339, SM/19-172, and K. Karan) recorded up to 5.0% disease severity of leaf spot disease complex. The highest disease severity was recorded in SM/17-636, SM/18-280, and SM/18-297 (75%); K. Jyoti (70%); and SM/17-429, and SM/18-114 (65%).

Development of varieties with resilience to abiotic factors

Breeding for heat tolerance

Hybridization: A total of 1,28,931 TPS were

recovered from the 124 crosses attempted at Kufri/Modipuram

Seedling stage: In all 15,550 seedlings were recovered from 54,430 TPS (38 crosses) and 631 clones of 31 crosses were selected. 40 selections were made from 80 single tubers derived from 6 crosses screened under a heated glass house.

Initial clonal stages: In all 174 promising clones were selected from the 1058 clones evaluated in F_1C_1 , F_1C_2 and F_1C_3 stages.

Preliminary yield trial (F_1C_4): Twenty advanced stage clones were evaluated in the early season at 75 DAP and at five clones namely HT/21-984, HT/21-56 (20 t/ha), HT/21-854 (18 t/ha), HT/21-561 (17 t/ha), HT/21-1149 (16 t/ha) were selected based on high yield, specific gravity, tuber dry matter content and low hopper burn (%).

Confirmatory yield trial (F_1C_5 stage): Fourteen advanced clones were evaluated in the early season at 75 DAP and at harvest four clones namely HT/19-284 (23 t/ha), HTMK/17-12, HT/17-164 (22 t/ha), and HT/19-386 (20 t/ha) were selected based on high yield, specific gravity, tuber dry matter content and low hopper burn (%).

Advance stage trial at Pune and Bhubaneswar: At Pune (Maharashtra) 14 genotypes were evaluated during Kharif 2024 at 80 DAP and high or at par total tuber yield was obtained K Surya, HT/17-162, HT/17-164 and HT/19-284. At Bhubaneswar 14 advanced clones were evaluated in the rabi season of 2023-24 at 75 DAP and high or at par total tuber yield was obtained in advanced clone viz., HTMK/17-2 as compared with control K Kiran.

Storage behaviour of advanced hybrids under ambient conditions: Tubers of five advanced clones/varieties were evaluated for their storage behaviour under ambient temperatures at Modipuram. K Kiran and HT/17-164 were noted for superior storability owing to lesser storage losses (12-14%) after 75 days of storage against other genotypes.

Introduction in AICRP: Based on performance during 2022-23 and 2023-24 at Modipuram advanced heat tolerant clone HT/17-164 (HT/11-3631 X HT/10-1907) for table use introduced into AICRP for multi-location trials (Fig.18). The advanced clone has an 11 % higher total tuber yield than the best control K Surya. It possesses 17% tuber dry matter and has a tolerance to mite burn and a relatively low infestation of hopper burn, which is the main insect pest during early-season crops. The storability is very good (14% total weight loss at 75 days) under ambient conditions.



Fig. 18: tubers of HT/ HT/17-164

Notification of new potato variety: The new heat tolerant variety Kufri Bhaskar (K Khyati x K Surya) has been notified by the CVRC meeting during July 2024. It is early medium maturing, high yielding variety with tolerance to mite and hopper burn, very excellent storability under ambient conditions and 19% tuber dry matter content. Its tubers are medium, attractive white cream, ovoid with shallow eyes and cream flesh (Fig.19). It is suitable for cultivation in Uttar Pradesh, Plains of Uttarakhand, Punjab and Haryana, Chhattisgarh, Rajasthan, Gujarat.





Fig. 19: A new heat tolerant variety Kufri Bhaskar

Release of new potato variety: A new heat tolerant variety Kufri Tejas-HT/12-834 (K

Chipsona-1 x K Khyati) has been recommended for release in the 42nd AICRP (Potato) Group Meeting, 22-24 September 2024, ANDUAT, Kumarganj, Ayodhya. K Tejas is medium maturing (90 days), high yielding (37-40 t/ha) heat tolerant clone for table purpose, HT/12-834 has a substantial yield advantage of 9-16% over the control varieties, K Bhaskar, K Kiran, K Surya, and is recommended for Indian plains (Haryana, Punjab, UP, Uttarakhand-Early season, MP, Gujarat, Maharashtra - Main Season). The clone produces white cream, ovoid tubers, shallow eyes, and white flesh (Fig. 20) and has very good storability under ambient storage conditions.



Fig. 20: A new tolerant variety Kufri Tejas

Breeding for drought tolerance

Seedling stage: In all 5010 seedlings were recovered from 25200 TPS (7 crosses) and 75 clones were selected.

Initial clonal stages: Initial clonal stages: In all 124 promising clones were selected from the 515 clones evaluated in F_1C_1 , F_1C_2 and F_1C_3 stages.

Preliminary yield trial (F_1C_3): Eleven advanced clones were under well-watered control and deficit water conditions along with K. Thar-1 and K. Thar-3 as control at 90 days and five clones namely WS/19-512, WS/19-1706, WS/19-2008, WS/19-1719 and WS/19-701. Irrigations are regulated to be in equal quantity of water, using a digital water meter. WS/19-512 showed minimal yield reduction (1.46%) with yields of 45.64 t/ha (control) and 44.97 t/ha (stress), indicating excellent drought tolerance. Genotype WS/19-2008 yielded 51.03 t/ha under control and 45.83 t/ha under stress, with a 10.18% reduction. Despite some reduction, this line maintained a high absolute yield under both conditions, making it one of the top-performing genotypes.

Confirmatory yield trial (F_1C_3 stage): Four advanced clones were evaluated under well-watered control and deficit water conditions along with K. Thar-1 and K. Thar-3 as control at 90 days and 3 clones namely WS/18-432, WS/18-602 and WS/18-619 were retained (Fig.21). WS/18-432 exhibited the highest yield under both conditions (51.29 t/ha in control and 46.25 t/ha in stress) with a moderate 9.83% yield reduction, which makes it high-yielding and relatively stable line. Genotype WS/18-602 demonstrated minimal yield reduction (2.78%) and stable performance under both control and stress conditions. WS/18-619 also performed well, with a 10.26% yield reduction, making it a moderately tolerant line.

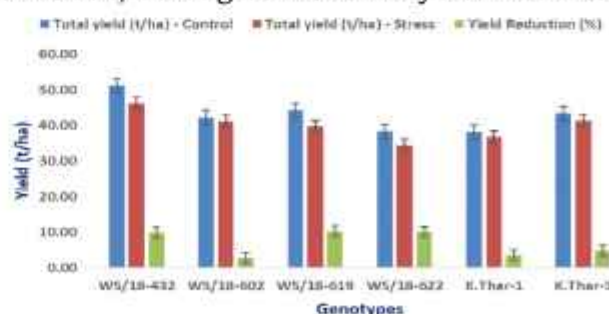


Fig. 21: Comparative performance of WS/18-series potato genotypes and check varieties (K. Thar-1, K. Thar-3) under control and water stress conditions in terms of total yield (t/ha) and yield reduction (%)

Final yield trial: Two advanced clones were evaluated under water stress and well-watered along with K. Thar-1 and K. Thar-3. WS/17-402 recorded the highest yield among all genotypes with 54.04 t/ha (control) and 47.16 t/ha (stress), showing a 12.74% yield reduction, which is significantly lower than both checks. WS/17-814 also performed well, yielding 49.18 t/ha under control and 43.26 t/ha under stress, with a 12.04% reduction, again outperforming the check varieties (Fig.22).

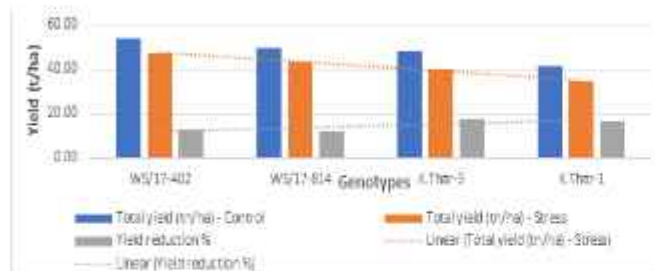


Fig. 22: Yield performance and reduction in advanced stage genotypes and checks under control and stress conditions

Breeding for salt tolerance

Screening of advanced clones for salinity tolerance under natural conditions in collaboration with ICAR-CSSRI, Karnal: Fifty four advanced clones (30 tubers each) along with four control varieties (K Daksh, K Thar-2, K Surya and K Bahar) were evaluated under control (EC<1 dS/m) and saline (EC~6.8-7.05 dS/m) environments at salinity farm of Hisar in the month of Nov, 2023. All the parameters related to yield were recorded at the time of harvesting (Fig 23).

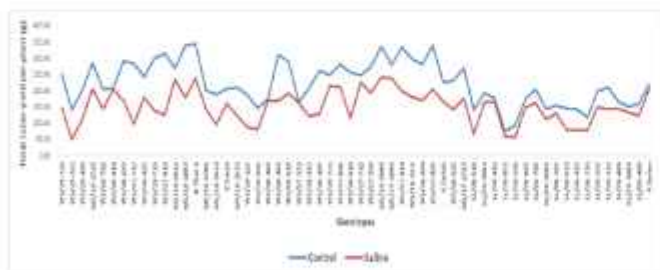


Fig. 23: Total tuber yield (g/plant) of potato genotypes under control and saline treatments

Salinity stress significantly reduced marketable and total tuber yield, with yield reductions ranging from 1.86% to 65.74% and an average reduction of 31.70%. Genotypes such as WS/19-911 (yield reduction-1.86%), WS/17-321 (2.39%) and WS/18-407 (3.16%)

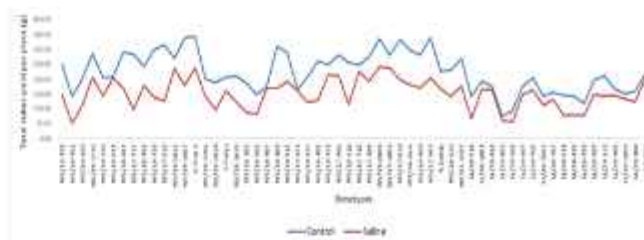


Fig. 24: Stress Susceptibility Index (SSI) of potato genotypes under salinity stress treatments

demonstrated superior tolerance, exhibiting minimal yield reductions, while others, including WS/17-717 (65.74%), WS/19-701 (63.64%) and WS/17-813 (60.43%), showed high susceptibility. Among released varieties, K Bahar exhibited the lowest yield reduction (7.32%) in the current investigation. The Stress susceptibility index (SSI) varied across genotypes, with tolerant lines maintaining stable yields under stress (Fig.24).

Development of nitrogen use efficient varieties

Hybridization: A total of 92434 true potato seeds were obtained from 64 crosses.

Seedling stage: A total of 13136 selections were made from 38763 seedlings transplanted from the sowing of 130131 TPS of 90 crosses.

Evaluation in initial clonal stages: In all 16262 clones were evaluated and at harvest 2335 promising clones were selected.

Advanced clone evaluation: Among the 51 advanced clones evaluated in 5 preliminary/confirmatory yield trials at 90 days under normal planting conditions. In all 10 promising advanced clones namely N/19-210, N/19-245, N/19-117, N/19-237, N/19-243, N/19-297, N/19-335, N/19-333, N/19-341 and N/19-362 in three preliminary yield trials. In two confirmatory yield trails 18 advanced clones namely N/18-8, N/18-12, N/18-19, N/18-38, N/18-44, N/18-101, N/18-162, N/18-393, N/18-405, N/17-46, N/17-56, N/17-63, N/17-136, N/17-161, N/17-240, N/17-258, N/17-320 and N/17-325 were selected.

Evaluation of nitrogen efficient potato genotypes for productivity and NUE: Genotype N/16-32 was found promising as it recorded maximum and significantly better mean

marketable (31.41 t/ha) and total tuber yield (34.89 t/ha), and tuber dry matter content (16.72%) over other genotypes including both the control. Mean N use efficiency (71.84 kg tuber yield on dry matter basis/ kg N uptake) was also comparable to the control K Gaurav (71.84) and K Pukhraj (77.54). In another trial, genotype N/17-240 was found promising as it recorded maximum and significantly better mean marketable (32.8 t/ha) and total tuber yield (35.3 t/ha) over other genotypes including both the control. Mean tuber dry matter content (15.5 %) was also comparable to the control K Gaurav (14.2) and K Pukhraj (15.7). Genotype N/17-136 also exhibited marked performance as it had the second highest and significantly better mean marketable (30.1 t/ha) tuber yield. Its total tuber yield (31.9 t/ha) was also at par with both the control. Although, it recorded comparable mean tuber dry matter content (11.0 %) as compared to control K Gaurav (14.2) and K Pukhraj (15.7), but it was on lower side.

Diploid F_1 hybrid breeding in potato

Dihaploids maintenance breeding: Among the 147 dihaploids (2022 and 2023) planted in pots for tuber multiplication and tubers were formed in only 100 dihaploids (Indian varieties and exotic lines).

Founder lines maintenance and multiplication: Among the 16 founder diploid clones used for selfing to check their self-compatibility and fertility, none of the clones observed berry setting.

Evaluation of diploid clones: Among the 133 diploid clones evaluated for tuber traits at Modipuram. The marketable tuber yield varied from 3.0 - 41.2 t/ha. The histogram of marketable tuber yield followed near normal distribution. Based on tuber yield, promising 80 clones were retained for further evaluation.

Late blight evaluation of diploid lines

Seventy-four clones of 16 families were evaluated for late blight resistance at Kufri and two clones namely ATL×HI (haploid inducer) and GS217×CPD45 were found moderately resistant to late blight.

Inbred development programme: The dihaploids were grown in pots and were subjected to selfing to check the self-compatibility and fertility. Selfed berries and self TPS were harvested from dihaploids of K Swarna (19 clones) and Atlantic (10 clones). Selfing revealed that these dihaploids have self-incompatibility inhibitor (*Sl*) gene present in them. Similarly, selfing resulted in 125 S_4 TPS of the population DM×M18 and 114 S_5 TPS of two families of two populations viz., DM×M18 and DM×M6. The S_5 plants of four families of last year were very weak and did not flower, hence selfing could not be done in this generation.

Hybridization for di-haploid induction: A set of 16 Indian potato varieties were grown under controlled conditions for hybridization with a new haploid inducer line, PL-4 (Fig. 26). Crosses could be attempted in 8 varieties only due to non-synchronous flowering of PL-4 and target varieties. Berry setting was observed in all the varieties. The berries were small and the seed set per berry was very low. The average number of seeds per berry was 11 only. The few number of seeds per berry could be due to ploidy differences and interspecific hybridization. The extracted seed was observed for preliminary screening based on embryo spot morphological markers to separate di-haploids from hybrid seeds. The number of putative di-haploid TPS ranged from 14-299 in 8 different varieties, and total di-haploid TPS number was 1176 out of a total 1613 total seeds.

Ploidy analysis for di-haploids identification:

The sorted non-spotted TPS (1585) from 16 crosses between varieties and haploid inducer line (PL-4) was raised and 30 days individual



Fig. 26: Hybridization for haploid induction.
a) Crossing block at Kufri b) emasculated flower bud for crossing with haploid inducer line c) Successful berry setting and development

seedlings were transplanted in disposable cups for ploidy detection through flow cytometry (Fig. 5b&c). In total 472 seedlings of 16 varieties were raised and examined for ploidy. The ploidy analysis of the seedlings resulted in 262 confirmed dihaploids of 17 varieties. These 262

plants were grown further for flowering and maturity to check their self-compatibility and tuber formation (Fig. 27). At the end, tubers of 33 dihaploids were harvested and 145 dihaploids were in-vitro cultured for maintenance and further multiplication and evaluation.

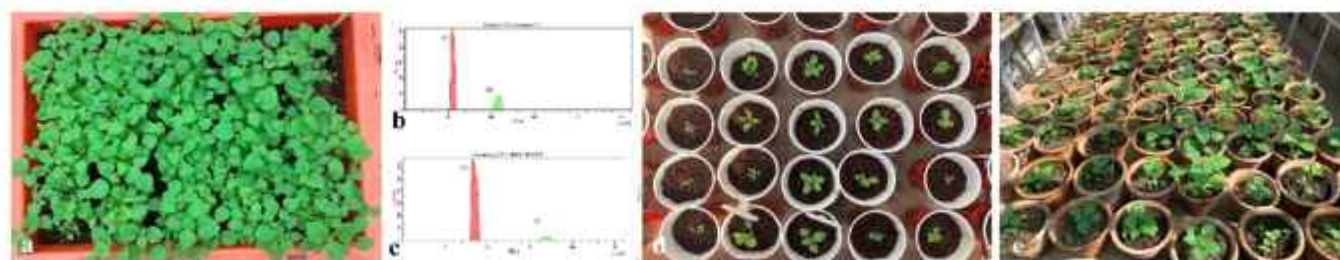


Fig. 27: Di-haploid identification process a) Crossed TPS raising in trays b) ploidy analysis through flow cytometry to segregate dihaploids and c) other ploidy plants d) Identified dihaploids in disposable cups e) Dihaploids transplanted in pots for tuber multiplication.

Germplasm registered with NBPGR

BS 48-6: BS 48-6 was identified as an elite self-compatible *Sli* gene homozygous diploid line and registered as a genetic stock (INGR24081) with ICAR-NBPGR. The plants of BS 48-6 are vigorous, flowered profusely, showed good fertility and berry setting upon selfing and produce 8 -10 medium-size tubers per plant (Fig.28). The improved *Sli* gene donor line, BS 48-6 was homozygous for 79.6% of the total loci.

BS 49-1: BS 49-1 was identified as an elite self-compatible *Sli* gene homozygous diploid line and registered as genetic stock (INGR24082) with ICAR-NBPGR. The plants of BS 49-1 are vigorous, flowered profusely, have good pollen viability, berry setting upon selfing (female fertility) and produce 8 -10 medium-size tubers per plant (Fig.29).



Fig. 28: BS 48-6 a) Canopy b) Flowers c) Stem d) Leaf e) Tubers f) Berries



Fig. 29: BS 49-1 a) Canopy b) Flowers c) Stem d) Leaf e) Tubers f) Berries

PROGRAMME: DEVELOPMENT AND PRODUCTION OF NUCLEUS AND BREEDER SEED OF NOTIFIED POTATO VARIETIES THROUGH CONVENTIONAL AND HI-TECH SYSTEMS

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To maintain high productivity and yield levels, a scientifically sound seed production system is essential to ensure strict adherence to seed crop health standards. Therefore, a program titled "Production of Nucleus and Breeder Seed of Important Notified Varieties of Potato" has been launched under the Revolving Fund Scheme. Scientists from the division oversee the production of nucleus and breeder seeds at various stations across different agro-climatic regions of the country. The breeder seed production and supply details for the 2023–2024 cropping season are provided below.

Production of nucleus and breeder seed of important notified varieties of potato

Seed Production

During 2023–24, a total of 2780.95 tons of nucleus and breeder seed were produced from 131.83 hectares in the plains. In 2024, an additional 73.17 tons were produced from 5 hectares in the hills using conventional and hi-tech seed production systems, respectively.

A. Plains (2023-24)

A total of 27809.49 q of nucleus and breeder seed was produced from an area of 131.83 ha. Of this, 20234.52 q from 99.77 ha were produced using conventional methods, and 7574.97 q from 32.05 ha through hi-tech seed production systems. The percentages of nucleus and breeder seed from the conventional system were 72.77% and 27.23%, respectively, compared to the hi-tech system.

1. Conventional Seed Production System: A total no. of 17023 indexed tubers of different commercial potato varieties were tested at regional stations in the plains (Table 1).

Table 1: Tuber indexing and Field ELISA (Stage-I) Testing

Name of Station	Indexed Tubers		Field ELISA	
	No of tubers tested	Healthy tubers No (%)	No of tubers/hills tested	Healthy tubers/Hills No (%)
Modipuram	4844	4640 (95.78)	4516	4187 (92.71)
Jalandhar	8952	8104 (90.53)	8104	7780 (96.00)
Gwalior	2067	1974 (95.50)	1879	1553 (82.65)
Patna	1160	1043 (89.90)	974	951 (97.63)

2. Station/ stage wise area and production of different potato varieties are given in table 2.

Stage I: A total production of 172.96 quintals was recorded from an area of 3.18 hectares (Table 2), with average yields of 76.90, 23.28, 70.39, and 77.30 quintals per hectare at Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Stage II: A total production of 962.04 quintals

was recorded from an area of 6.11 hectares (Table 2), with average yields of 155.07, 143.24, 165.47, and 216.53 quintals per hectare at Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Stage-III: A total production of 3366.86 quintals was recorded from an area of 17.90 hectares (Table 2), with average yields of 229.47, 269.89, 123.79, and 148.12 quintals per hectare at



Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Stage-IV: A total of 15732.66 quintals was

produced from an area of 72.58 hectares (Table 2), with average yields of 257.85, 202.31, 180.14, and 142.19 quintals per hectare in Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Table 2: Station & variety-wise area and production (qtls) in Conventional system 2024 (Plains)

Variety	Stage-I		Stage-II		Stage-III		Stage-IV		TOTAL	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
I. Modipuram										
K. Anand	0.056	4.10	0.160	25.00	0.32	81.50	2.00	562.00	2.536	672.60
K. Bahar	0.400	34.60	1.170	205.30	3.90	892.00	14.50	3621.30	19.97	4753.20
K. Khyati	0.040	2.95	0.160	29.50	0.60	166.50	2.20	426.50	3.00	625.45
K. Mohan	0.040	3.50	0.130	15.00	0.90	169.50	2.50	705.50	3.57	893.50
K. Pukhraj	0.060	4.75	0.200	35.00	0.73	155.50	1.70	499.25	2.69	694.50
K. Surya	0.065	5.20	0.200	30.00	0.50	129.50	1.90	468.50	2.665	633.20
K. Chipsona-1	0.022	1.20	0.030	4.85	0.15	38.30	3.00	889.00	3.202	933.35
K. Chipsona-3	-	-	0.180	18.00	0.26	59.30	1.04	270.00	1.48	347.30
K. Chipsona-5	0.080	4.50	0.040	2.00	-	-	-	-	0.12	6.50
K. Frysona	0.040	2.80	0.150	27.00	0.25	59.50	1.50	371.00	1.94	460.30
K. Kiran	0.070	5.65	0.150	26.40	0.11	22.00	0.10	23.00	0.43	77.05
K. FryoM	0.052	2.75	0.040	4.40	-	-	-	-	0.092	7.15
K. Bhaskar	0.022	1.10	0.035	1.65	-	-	-	-	0.057	2.75
K. Sangam	0.035	3.30	0.170	18.00	0.14	36.00	0.36	139.25	0.705	196.55
K. Daksh	0.018	0.50	0.025	1.10	-	-	-	-	0.043	1.60
K. Thar-2	-	-	0.050	6.50	0.07	11.15	0.10	24.00	0.22	41.65
K. Neelkanth	-	-	0.060	8.00	0.07	15.00	0.06	15.50	0.19	38.50
K. Lima	-	-	0.050	7.50	-	-	0.28	40.50	0.33	48.00
Total	1.00	76.90	3.00	465.20	8.00	1835.75	31.24	8055.3	43.24	10433.15
II. Jalandhar										
K. Jyoti	0.67	15.48	0.486	57.9	0.95	264.00	9.44	1821.85	11.546	2159.23
K. Pukhraj	0.40	7.72	0.378	67.00	0.81	206.40	6.84	1377.12	8.428	1658.24
K. Himalini	0.096	3.91	0.086	11.25	0.12	34.97	1.46	390.35	1.762	440.48
K. Khyati	0.0096	0.31	0.006	1.26	0.02	6.00	0.42	96.52	0.4556	104.09
K. Surya	0.003	0.05	0.0015	0.20	0.003	0.70	0.18	29.18	0.1875	30.13
K. Badshah	0.056	1.27	0.0486	6.50	0.047	14.21	0.59	114.71	0.7416	136.69
Total	1.2346	28.74	1.0061	144.11	1.95	526.28	18.93	3829.73	23.1207	4528.86
III. Gwalior										
K. Chandramukhi	0.07	5.82	0.21	35.85	0.71	90.00	2.57	574.50	3.56	706.17
K. Jyoti	0.08	6.05	0.17	24.50	0.70	99.40	2.25	209.00	3.20	338.95
K. Sindhuri	0.07	5.13	0.21	33.50	1.14	100.00	4.29	708.50	5.71	847.13
K. Lauvkar	0.07	4.91	0.17	20.89	0.38	40.50	1.28	128.50	1.90	194.8
K. Chipsona-1	0.08	6.02	0.30	34.00	0.80	138.50	-	-	1.18	178.52
K. Chipsona-3	0.07	4.50	0.15	23.50	0.96	103.23	1.80	425.60	2.98	556.83
K. Surya	0.08	8.03	0.21	40.00	0.73	139.35	2.97	664.53	3.99	851.91
K. Pukhraj	0.06	4.08	0.21	42.50	0.55	55.40	1.44	286.65	2.26	388.63
K. Khyati	0.05	3.94	0.13	28.50	0.54	48.00	0.40	89.70	1.12	170.14
K. Bahar	0.06	2.98	0.07	10.86	0.08	7.65	-	-	0.21	21.49
K. Lima	0.02	1.22	0.04	9.42	0.11	11.00	-	-	0.17	21.64
K. Thar-2	0.02	1.25	0.04	8.40	0.13	13.90	0.14	12.50	0.33	36.05
K. Sangam	0.06	2.65	0.08	15.85	0.18	22.50	0.06	11.10	0.38	52.10
K. Kiran	0.04	1.85	0.03	6.49	0.09	9.50	0.22	27.50	0.38	45.34
Total	0.83	58.43	2.02	334.26	7.10	878.93	17.42	3138.08	27.37	4409.70
IV. Patna										
K. Himalini	0.0275	1.82	0.0140	2.50	0.10	12.17	0.30	48.10	0.4415	64.59
K. Jyoti	0.0238	1.77	0.0120	2.70	0.10	24.00	0.45	57.20	0.5858	85.67
K. Kanchan	-	-	0.0084	1.17	0.05	2.73	0.42	34.03	0.4784	37.93
K. Khyati	0.0237	1.80	0.0168	4.50	0.10	17.00	1.00	148.86	1.1405	172.16
K. Lailt	0.0040	0.37	0.0064	1.80	0.10	10.00	1.10	164.75	1.2104	176.92
K. Manik	0.0040	0.36	0.0021	0.30	-	-	0.02	4.01	0.0261	4.67
K. Neelkanth	0.0040	0.41	0.0080	2.00	0.20	22.50	0.25	52.65	0.462	77.56
K. Pukhraj	0.0160	1.70	0.0056	1.50	0.10	29.00	0.75	136.20	0.8716	168.40
K. Sindhuri	0.0120	0.66	0.0120	2.00	0.10	8.50	0.70	63.75	0.824	74.91
Total	0.115	8.89	0.0853	18.47	0.85	125.90	4.99	709.55	6.0403	862.81
Plains' Total	3.1796	172.96	6.1114	962.04	17.90	3366.86	72.58	15732.66	99.771	20234.52

3. Hi-Tech Seed Production System: Station- and generation-wise areas and production of different potato varieties are presented in Table 3.

Generation-1: A total production of 1397.63 quintals was recorded from an area of 6.57 hectares (Table 3), with average yields of 242.44, 214.22, 148.37, and 126.29 quintals per hectare at

Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Generation-2: A total production of 6177.34 quintals was recorded from an area of 25.49 hectares (Table 3), with average yields of 275.35, 219.85, 171.70, and 136.27 quintals per hectare at Modipuram, Jalandhar, Gwalior, and Patna, respectively.

Table 3: Station & variety-wise area and production (qtls.) in Hi-Tech system 2024 (Plains)

Variety	G1		G2		TOTAL	
	Area	Area	Production	Production	Area	Production
I. Modipuram						
K. Ganga	0.38	135.00	4.50	1330.50	4.88	1465.50
K. Khyati	0.25	64.00	2.10	406.00	2.35	470.00
K. Mohan	0.57	125.60	2.50	700.00	3.07	825.60
K. Neelkanth	0.02	6.50	-	-	0.02	6.50
K. Pukhraj	0.08	16.50	0.80	229.50	0.88	246.00
K. Sangam	1.00	162.00	0.58	200.50	1.58	362.50
K. Surya	0.15	26.30	0.60	148.00	0.75	174.30
K. Thar-1	0.01	1.90	0.02	1.50	0.03	3.40
K. Thar-2	0.01	4.00	0.15	36.00	0.16	40.00
K. Chipsona-1	0.63	207.00	3.05	890.50	3.68	1097.50
K. Chipsona-3	0.23	59.00	1.26	350.00	1.49	409.00
K. Frysona	0.11	26.20	0.30	74.50	0.41	100.70
Total	3.44	834.00	15.86	4367.00	19.30	5201.00
II Jalandhar						
K. Jyoti	0.176	36.00	0.54	103.11	0.716	139.11
K. Pukhraj	0.217	50.33	1.64	355.05	1.857	405.38
K. Himalini	0.50	119.70	0.57	154.20	1.07	273.9
K. Khyati	0.149	30.50	0.29	66.77	0.439	97.27
K. Chandramukhi	0.257	40.00	0.41	83.20	0.667	123.2
K. Gaurav	0.216	43.90	0.43	75.40	0.646	119.3
K. Karan	-	-	0.259	78.23	0.259	78.23
K. Pushkar	0.0499	15.82	0.87	187.37	0.9199	203.19
K. Himsona	0	-	0.032	8.25	0.032	8.25
K. Badshah	0.23	47.20	0.19	38.24	0.42	85.44
Total	1.7949	383.45	5.231	1149.82	7.0259	1533.27
III Gwalior						
K. Jyoti	-	-	0.22	21.00	0.22	21.00
K. Chipsona-1	0.09	9.50	0.14	26.00	0.23	35.50
K. Chipsona-3	0.05	3.20	-	-	0.05	3.20
K. Surya	-	-	0.04	10.00	0.04	10.00
K. Pukhraj	0.08	11.22	0.08	16.50	0.16	27.72
K. Khyati	0.05	2.15	0.16	35.50	0.21	37.65
K. Lima	0.07	14.82	-	-	0.07	14.82
K. Thar-2	0.03	3.50	-	-	0.03	3.50
K. Sangam	0.05	9.50	-	-	0.05	9.50
K. Himalini	-	-	0.46	87.60	0.46	87.60
K. Mohan	0.11	24.75	0.28	40.00	0.39	64.75
K. Karan	-	-	0.04	2.42	0.04	2.42
K. Ganga	-	-	0.30	56.30	0.30	56.30
Total	0.53	78.64	1.72	295.32	2.25	373.96
IV Patna						
K. Ashoka	0.0042	0.50	-	-	0.0042	0.50
K. Himalini	0.0546	8.00	0.45	71.60	0.5046	79.60
K. Kanchan	0.0312	0.68	0.05	9.99	0.0812	10.67
K. Khyati	0.0056	0.80	0.25	16.52	0.2556	17.32
K. Manik	0.0050	0.46	0.03	0.19	0.035	0.65
K. Neelkanth	0.33	47.00	0.90	146.80	1.23	193.80
K. Pukhraj	0.0234	0.80	0.30	60.10	0.3234	60.90
K. Sindhuri	0.28	38.50	0.45	31.75	0.73	70.25
K. Surya	0.0700	4.80	0.25	28.25	0.32	33.05
Total	0.804	101.54	2.68	365.2	3.484	466.74
Plains Total	6.5689	1397.63	25.491	6177.34	32.0599	7574.97

4. Total supply of breeder seed

During 2024, a total of 21527.66 qtls of breeder

seed was supplied to various government and private agencies, from plains Table-4 (A & B).

Table 4 (A): Station and variety-wise supply (qtls) during 2024

Sl. No.	Variety	Stations				Total (q)
		Modipuram	Jalandhar	Gwalior	Patna	
1.	Kufri Anand	565.00	-	-	-	565
2.	Kufri Bahar	3621.30	-	-	-	3621.3
3.	Kufri Badshah	-	152.95	-	-	152.95
4.	Kufri Chipsona-1	1758.50	-	26.00	-	1784.5
5.	Kufri Chipsona-3	621.00	-	472.00	-	1093
6.	Kufri Chandramukhi	-	101.73	318.50	-	420.23
7.	Kufri Frysona	427.00	-	-	-	427
8.	Kufri Gaurav	-	92.97	-	-	92.97
9.	Kufri Ganga	1330.50	-	22.50	-	1353
10.	Kufri Himalini	-	568.41	87.60	118.10	774.11
11.	Kufri Himsona	-	10.33	-	-	10.33
12.	Kufri Jyoti	-	1965.41	230.00	56.84	2252.25
13.	Kufri Khyati	832.50	109.07	125.20	165.08	1231.85
14.	Kufri Kiran	23.00	-	27.50	-	50.5
15.	Kufri Kanchan	-	-	-	45.81	45.81
16.	Kufri Karan	-	64.83	2.42	-	67.25
17.	Kufri Mohan	1405.50	-	40.00	-	1445.5
18.	Kufri Manik	-	-	-	4.18	4.18
19.	Kufri Neelkanth	15.50	-	-	198.45	213.95
20.	Kufri Lalit	-	-	-	164.26	164.26
21.	Kufri Lima	40.50	-	-	-	40.5
22.	Kufri Lauvkar	-	-	130.85	-	130.85

Following the easing of quarantine regulations for seed potato production at the Kufri-Fagu farms, as per the Government of India Gazette Notification No. 1413 dated 19 March 2024, nucleus and breeder seed potato production has resumed at the Kufri-Fagu Unit starting from the Kharif season of 2024. A total of 731.72 q

(Tables 5 & 6) of nucleus and breeder seed was produced from an area of 5 ha. Of this, 544.71 q (Table 5) from an area of 3.5 ha was produced through the conventional system, and 187.01 q (Table 6) was produced through the hi-tech system from an area of 1.5 ha.

Table 5: Stage wise area and production of different potato varieties

Variety	Stage-I		Stage-II		Stage-III		Stage-IV		TOTAL	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
K. Jyoti	0.03	4.49	0.03	6.89	0.14	37.74	1.15	155.10	1.35	204.22
K. Himalini	0.02	3.42	0.02	6.01	0.06	30.50	1.20	147.43	1.30	187.36
K. Girdhari	0.02	4.67	0.06	14.70	0.15	28.00	0.35	52.52	0.58	99.89
K. Karan	0.02	2.62	0.03	8.92	0.02	15.00	0.15	23.12	0.22	49.66
K. Kanchan	0.004	0.50	0.01	1.40	0.03	1.22	-	-	0.044	3.12
K. Shailja	0.002	0.20	-	-	-	-	-	-	0.002	0.20
K. Giriraj	0.002	0.14	-	-	-	-	-	-	0.002	0.14
K. Himsona	0.002	0.12	-	-	-	-	-	-	0.002	0.12
Total	0.10	16.16	0.15	37.92	0.40	112.46	2.85	378.17	3.5	544.71

Table 6: Variety-wise area and production (Qts.) under Hi-Tech system 2024-25

Variety	G1		G2		TOTAL	
	Area	Production	Area	Production	Area	Production
K. Jyoti	0.07	3.72	-	-	0.07	3.72
K. Himalini	0.07	2.72	1.00	134.50	1.07	137.22
K. Karan	0.06	5.50	0.15	27.00	0.21	32.5
K. Sahyadri	0.05	2.01	-	-	0.05	2.01
K. Girdhari	-	-	0.07	10.11	0.07	10.11
K. Kanchan	-	-	0.03	1.45	0.03	1.45
Grand Total	0.25	13.95	1.25	173.06	1.5	187.01

During 2024-25, a total of 558.55 qtls of breeder seed was supplied to various government and private agencies, from the hills as given in Table 7

Table 7: Agency and variety-wise breeder seed supplied from Kufri –Fagu-2024-25 (qtls.)

Name of the Agency	K. Jyoti	K. Himalini	K. Girdhari	K. Karan	K. Kanchan	K. Sahyadri	Total
HP	76.00	1.00	26.00	1.00			104.00
UK	30.00	71.00	10.00	14.00			125.00
Meghalaya	10.00	35.00	-	10.00			55.00
Sikkim	-	74.00			1.00		75.00
Manipur	2.00	2.00	2.00	2.00			8.00
J&K				0.50		0.50	1.00
ICAR	10.50	36.00	10.50	14.00			71.00
Farmers/Pvt.	26.57	61.35	16.71	14.04	0.88		119.55
Total	155.07	280.35	65.21	55.54	1.88	0.50	558.55

- Multiplication of basic material and maintenance of mother stock: A total of 56 pots from 28 varieties were planted and tested with ELISA/PCR for different potato viruses. After conducting a series of tests via PCR/ELISA, all healthy varieties were transferred in vitro and included in microplant multiplication and supply. A total of 11560 culture tubes were multiplied through tissue culture. In aeroponics, 35340 minitubers of various varieties, bio-fortified clones, and diploids were harvested.

C. Supply of Microplants to Different Seed Agencies

A total of 281 virus-free in vitro culture tubes of 28 potato varieties were distributed to 35 seed-producing organizations across India (Figure 1). This distribution generated a revenue of ₹ 28,10,000. The number of culture tubes supplied is detailed below.

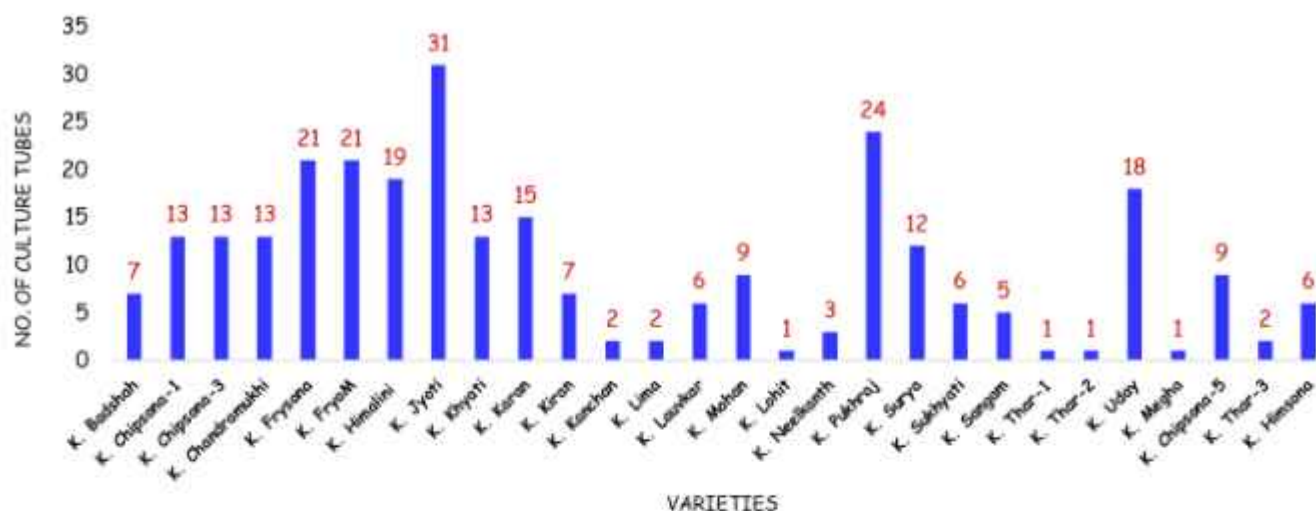


Fig. 1: Variety-wise supply to different seed organizations

Table 8: Microplants supply to different Seed Production Organizations

S. No.	Firms/Agencies	Varieties Supplied
1.	The International Potato Centre (CIP), Shillong, Meghalaya	K. Megha, K. Himalini, K. Jyoti, K. Chipsona-3, K. Karan, K. Uday, K. Surya
2.	The International Potato Centre (CIP), Tripura	K. Chandramukhi, K. Himalini, K. Jyoti, K. Chipsona-3, K. Karan, K. Uday, K. Surya
3.	M/s DF Biotech, Punjab	K. FryoM
4.	M/s Yaduka Agrotech Pvt Ltd. Kolkata, West Bengal	K. FryoM, K. Kiran
5.	M/s Centre of Excellence for Potato, Dhogri, Distt-Jalandhar, Punjab	K. Surya, K. Frysona, K. Himalini, K. Uday, K. Khyati, K. Jyoti, K. Pukhraj, K. Chandramukhi, K. Mohan
6.	M/s UniAgri Bio Sciences Pvt. Ltd., Village- Mundkhera, Patiala, Punjab	K. FryoM, K. Frysona, K. Himsona
7.	The Deputy Director Horticulture, Potato Technology Centre, (PTC) Shamgarh, Karnal, Haryana	K. Pukhraj, K. Jyoti, K. Khyati, K. Uday, K. Chipsona-1
8.	M/s Dhillon Biotech, Village- Chuchak, The- Zira, Ferozepur, Punjab	K. Himalini, K. Chipsona-1, K. Lauvkar, K. Chandramukhi
9.	The Principal Investigator, KSDH Project, RHREC, UHS Campus, Bangalore	K. Karan, K. Jyoti
10.	M/s Survir Agri Tech Pvt. Ltd., Dessa, Gujarat	K. Thar-1, K. Thar-2, K. Thar-3, K. Himalini, K. Khyati, K. Badshah, K. Lauvkar, K. Pukhraj, K. Frysona, K. FryoM
11.	The Farm Superintendent, HREC, Hassan Bangalore	K. Himalini
12.	M/s Bhatti Tissue Tech. Vill.-Alipur, PO -Mithapur, The & Distt.- Jalandhar, PB	K. Himalini, K. Pukhraj, K. Chandramukhi, K. Lauvkar, K. Badshah, K. Jyoti, K. Uday, K. Himsona
13.	The International Potato Centre(CIP), Karnal, Harayana	K. Surya, K. Pukhraj, K. Chipsona-1, K. Chipsona-3, K. Kiran, K. Karan, K. Himsona, K. Frysona, K. Jyoti, K. Uday
14.	M/s Jalandhar Potato Seeds Pvt Ltd, Jalandhar, Punjab	K. Jyoti, K. Pukhraj, K. Sukhyati, K. Badshah, K. Uday, K. Mohan, K. Sangam

S. No.	Firms/Agencies	Varieties Supplied
15.	M/s Madhav Agri Tech, Bhagwati Nagar, Station Road, tunda, Firozabad UP	K. Mohan, K. Chipsona-1, K. Chipsona-3, K. Sukhyati, K. Chipsona-5
16.	The District manager, West Bengal State Seed Corporation Ltd (WBSSCL), Beej Bhawan, Midnapore, Paschim, West Bengal	K. Jyoti, K. Himalini, K. Pukhraj, K. Chandramukhi, K. Khyati, K. Lima, K. Kanchan, K. Mohan, K. Neelkanth, K. Surya, K. Sangam, K. Uday, K. Sukhyati, K. Karan
17.	M/s SF Agritech Pvt. Ltd, Itawah, Uttar Pradesh	K. Surya, K. FryoM, K. Lohit, K. Chipsona-5
18.	M/s Shashanka Agro-tech Pvt Ltd., Ranchi, Jharkhand	K. Surya, K. Uday, K. Jyoti
19.	M/s Utkal Tubers India Pvt. Ltd., Whitefield Road, Garudacharapalya, Bangalore	K. Chandramukhi, K. Chipsona-3, K. Frysona, K. Lauvkar, K. Jyoti, K. Himalini, K. Pukhraj
20.	M/s Jain Irrigation Systems Ltd, Jalgaon, Maharashtra	K. Jyoti, K. Badshah, K. Pukhraj, K. Chipsona-3, K. Khyati, K. Frysona, K. FryoM
21.	M/s GMS Agritech Pvt Ltd, Research & Development Bahiri, Kolkata	K. Jyoti, K. Himalini, K. Pukhraj, K. Chandramukhi, K. Chipsona-1, K. Chipsona-3, K. Uday
22.	M/s Sekhon Biotech Pvt. Ltd, Ropar, Punjab	K. Jyoti, K. Pukhraj, K. Frysona, K. Chipsona-1, K. Chipsona-3, K. Chandramukhi, K. Surya, K. Uday, K. FryoM
23.	M/s Merino Industries Ltd, Village-Achheja, PO- Hapur, UP	K. Himsona, K. Khyati, K. Sangam, K. Jyoti, K. Chipsona-1
24.	The International Potato Centre (CIP), West Bengal	K. himalini, K. Jyoti, K. Uday, K. Chandramukhi, K. Pukhraj, K. Neelknath, K. Mohan, K. Kiran, K. Sukhyati, K. Khyati, K. Surya
25.	M/s Sagar Biotech, Palampur, Kangar, HP	K. Jyoti, K. Uday, K. Pukhraj, K. Chipsona-1, K. Chipsona-3, K. Kiran, K. Frysona, K. Sukhyati, K. Surya
26.	Sh. Chamkaur Singh, VPO Tohra, Patiala	K. Surya
27.	M/s Akshamaala Solution Pvt Ltd, First Floor, Sector-2, Noida, UP	K. Chipsona-3
28.	M/s Kavya Agro Potato Seeds Distt.- Bulandshaehar, UP	K. Chipsona-5
29.	M/s Oddville Foods Pvt Ltd., Anaj Mandi, Indore, MP	K. FryoM
30.	M/s Banas Dairy, Palanpur, Gujarat	K. FryoM, K. Chipsona-1, K. Chandramukhi
31.	M/s Sangha Biotech, Jalandhar, Punjab	K. Thar-3, K. Sangam
32.	M/s Plant Hub Biotech Pvt Ltd., Solan, HP	K. Surya, K. Pukhraj, K. Jyoti, K. Uday, K. Frysona, K. Himalini
33.	Mr. Ram Kumar Jural, Agra, UP	K. Pukhraj, K. Uday, K. Frysona
34.	The Director, Government of Mizoram, Directorate of Agriculture, Mizoram, Aizawl	K. Chipsona-1, K. Khyati, K. Himalini
35.	M/s Technico Agri Sciences Ltd., Mani majara, Chandigarh	K. Chipsona-5

A total of 329 culture tubes of 34 varieties were supplied to different seed production stations/centers i.e. Modipuram, Jalandhar, Patna, Shillong, Ooty and Gwalior (Fig. 2).

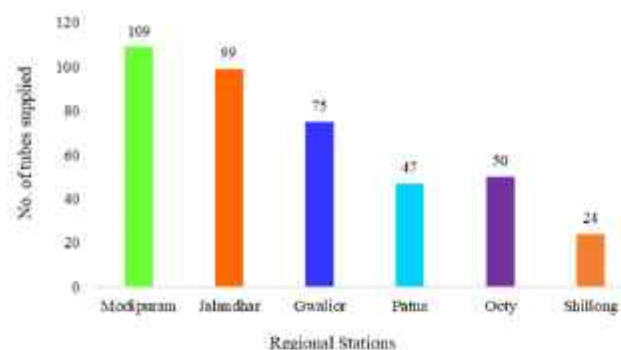


Fig. 2: Station-wise microplant supply to different seed centres

D. Production and supply of quality seed

Production of Quality Seed 2024 (Ooty): In 2024, seed potato crops were cultivated across three seasons- spring, summer, and autumn- using multiple varieties. In spring, five varieties- Kufri Swarna, Kufri Sahyadri, Kufri Girdhari, Kufri Karan, and Kufri Himalini were grown on 0.60 ha, yielding a total of 2.00 tonnes with a low average productivity of 3.33 t/ha. The low yield was mainly due to a lack of irrigation and rainfall; only Kufri Karan received adequate irrigation. In summer, a high-quality seed crop was planted on 1.76 ha using Kufri Swarna, Kufri Girdhari, Kufri Karan, Kufri Sahyadri, and Kufri

Jyoti, resulting in a significantly higher total production of 16.73 tonnes and an average productivity of 41.82 t/ha. Timely intercultural operations, disease management, and rouging of off-types and diseased plants were carried out effectively. However, some cultivars experienced yield losses due to late blight infection. During autumn, Kufri Sahyadri, Kufri Girdhari, Kufri Swarna, and Kufri Karan were planted on 1.8 ha, producing 5.01 tonnes with an average productivity of 19.1 t/ha. Overall, 26.39 tonnes of quality seed potatoes were harvested across all three seasons. Of this, 2443 kg of quality seed was supplied to farmers, 7500 kg to SCSP/TSP farmers, 3903 kg to government organizations, and 457 kg was sold as table potatoes and miscellaneous items to ICAR-CPRS staff and market vendors. The operations generated a revenue of ₹10,70,807, showcasing the institute's contribution to quality seed production and dissemination.

Production of Quality Seed 2024 (Shillong): A total of 130.11 quintals of quality seed was produced across different generations for the mentioned varieties. Additionally, 76.49 quintals of quality seed tubers were sold to various institutions, including state departments, KVKs, universities, research institutions, and farmers.

Table 9: Quality seed production and its distribution to different states/ organization/ agencies.

Variety	Total Production (q)	Quality Seed sales/distributed to different States/Universities/Agencies			Total Distribution (q)
		Nagaland	Meghalaya	CAU/ICAR	
K. Himalini	34.43	15.00	2.03	6.05	23.08
K. Karan	15.37	25.00	2.03	2.10	29.13
K. Megha	11.44	5.00	2.03	1.25	8.28
K. Girdhari	29.84	2.00	2.00	1.10	5.10
K. Chipsona 3	12.78	0.00	2.03	0.10	2.13
K. Giriraj	8.33	0.00	2.01	5.00	7.01
K. Jyoti	5.55	0.00	0.03	0.35	0.38
K. Chipsona 1	1.68	1.00	0.03	0.35	1.38
Total	130.11	48.00	12.19	16.30	76.49

Rooted cuttings from tissue-cultured plantlets were produced at RS, Shillong, beginning in February 2024, in a batch-wise process for seed tuber production. A total of 45,471 cuttings were

generated, planted, or distributed throughout the year. Sales of quality seed tubers earned revenue of Rs. 10,55,140 in 2023 and 2024.

Table 4 (B): Variety/stage & agency wise breeder seed supply from plains (qtls) during 2024

S. N.	Variety	MEG*	CT*	HP*	J&K*	PB*	UK*	UP*	WB*	NHRDF*	NSAI*	SAI*	NSC*	Uni.*	ICAR	Farmers/ Pvt.	Total
1.	K. Anand	-	-	-	-	-	-	200.00	-	-	-	3.00	-	-	-	362.00	565
2.	K. Badshah	-	-	-	23.50	-	-	100.00	-	-	-	-	-	-	-	29.45	152.95
3.	K. Bahar	-	-	-	-	-	-	2911.00	22.00	-	149.30	-	-	-	26.00	513.00	3621.3
4.	K. Chandramukhi	-	17.00	-	71.00	-	-	-	112.00	-	-	-	-	-	5.00	215.23	420.23
5.	K. Chipsona-1	-	-	-	-	-	-	1270.00	-	-	-	-	-	-	-	514.50	1784.5
6.	K. Chipsona-3	20.00	3.00	-	240.00	-	-	350.00	-	-	-	-	-	-	78.50	401.50	1093
7.	K. Frysona	-	-	-	12.00	-	-	200.00	-	-	-	-	-	-	-	215.00	427
8.	K. Gaurav	-	-	-	-	-	-	66.40	-	-	2.50	-	-	-	-	24.07	92.97
9.	K. Ganga	-	17.00	-	-	-	-	100.00	-	-	5.50	-	-	100.00	218.50	912.00	1353
10.	K. Himalini	48.00	-	-	220.00	150.00	-	-	142.50	-	43.49	-	-	-	67.03	103.09	774.11
11.	K. Himsona	-	-	-	-	-	-	-	-	-	-	-	-	-	7.00	3.33	10.33
12.	K. Jyoti	50.00	-	285.00	275.00	376.00	79.00	50.00	308.00	70.00	-	-	170.00	-	31.79	557.46	2252.25
13.	K. Karan	-	2.42	15.00	20.00	-	-	-	-	-	-	-	-	-	16.10	13.73	67.25
14.	K. Kanchan	-	-	-	-	-	-	-	-	-	-	-	-	-	1.84	43.97	45.81
15.	K. Kiran	-	14.00	-	-	-	-	-	-	-	-	3.00	-	-	-	33.50	50.5
16.	K. Khyati	-	11.08	-	15.00	18.00	-	991.00	5.00	-	37.00	-	-	-	29.00	125.77	1231.85
17.	K. Lauvkar	-	28.00	-	-	-	-	-	-	-	-	-	-	-	35.00	67.85	130.85
18.	K. Lalit	-	12.00	-	-	-	-	80.00	-	-	-	-	-	-	35.00	37.26	164.26
19.	K. Lima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40.50	40.5
20.	K. Mohan	-	-	-	-	72.00	-	200.00	20.00	-	130.00	-	-	20.00	86.50	917.00	1445.5
21.	K. Manik	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.18	4.18
22.	K. Neelkanth	-	-	-	-	-	-	40.50	-	-	4.00	-	-	-	137.00	32.45	213.95
23.	K. Pukhraj	-	7.00	-	65.50	520.00	16.00	373.50	60.00	65.00	-	-	100.00	-	657.10	1186.37	3050.47
24.	K. Pushkar	-	-	-	10.00	-	-	33.60	-	-	1.60	-	-	-	16.00	129.68	190.88
25.	K. Sindhuri	10.00	22.00	-	63.00	18.00	-	300.00	-	-	-	-	-	-	26.00	146.28	585.28
26.	K. Surya	-	-	-	-	-	-	678.00	-	-	26.00	-	-	-	16.50	614.39	1334.89
27.	K. Sangam	-	-	-	-	-	-	128.00	-	-	-	-	-	-	11.25	211.60	350.85
28.	K. Thar-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.50	1.5
29.	K. Thar-2	-	-	-	-	-	-	-	-	-	-	-	-	-	11.00	56.00	72.5
Total		128.00	136.00	300.00	1015.00	1154.00	95.00	8072.00	669.50	135.00	399.39	6.00	270.00	120.00	1512.11	7512.66	21527.66

* MEG: Meghalaya; CT: Chhattisgarh; HP: Himachal Pradesh, J&K: Jammu & Kashmir; MP: Madhya Pradesh; PB: Punjab; UK: Uttarakhand; UP: Uttar Pradesh; WB: West Bengal; NHRDF: National Horticulture Research and Development Foundation; NSAI: National Seed Association of India; SAI: Seed Association of India; NSC: National Seeds Corporation

Standardization and refinement of seed production techniques under hi-tech system

Effect of *Bacillus subtilis* (B5) treatments on the production behaviour of aeroponic minitubers

The study conducted under polyhouse conditions revealed that foliar application of *Bacillus subtilis* (B5) bio-formulation significantly impacted the growth and yield of seed potato crops raised from aeroponic minitubers. Among the three doses tested (0.25%, 0.50%, and 0.75%), the 0.50% concentration was the most effective, resulting in the greatest plant height, haulm biomass, and tubers per square meter. Both potato cultivars, Kufri Himalini and Kufri Jyoti, responded positively to B5 treatments, with Kufri Himalini showing greater vigor and tuber yield (Fig 1). While higher B5 doses (0.75%) slightly increased total yield, they led to fewer tubers and more undersized tubers, especially in Kufri Jyoti. Overall, B5 at 0.5% is recommended as the optimal dose to enhance plant vigor, tuber size, and multiplication efficiency, making it a valuable mean for seed potato production in protected environments.

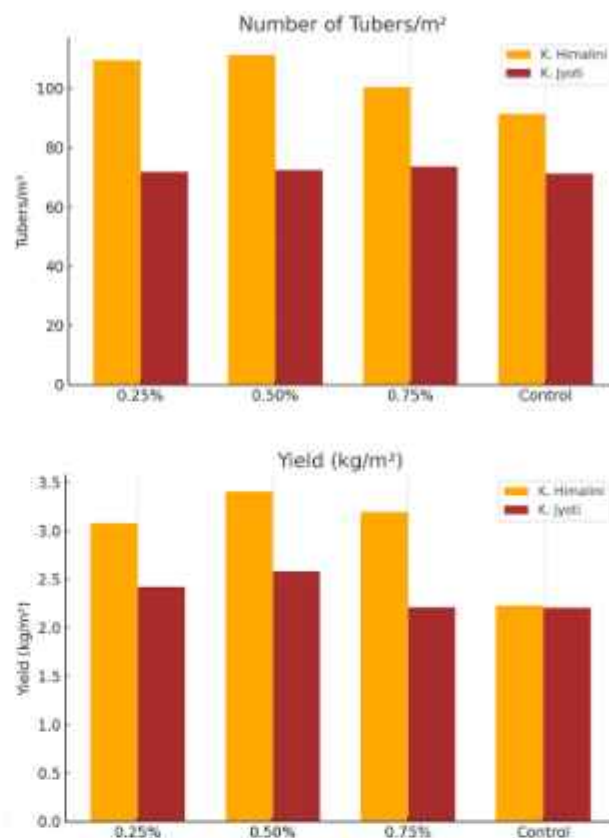
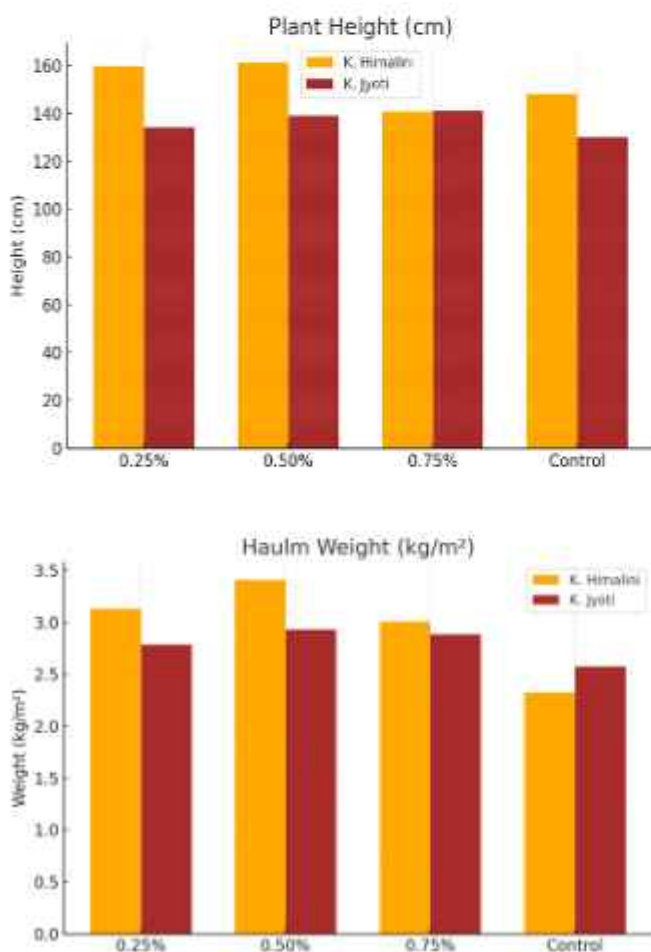


Fig. 1: Effect of B5 doses on the plant vigour in seed crop raised from aeroponic mini-tubers

Tuber shape variation in variety K. Bahar

Field multiplication of the four sets (A, B, C, Control, and Breeder Seed K. Bahar) was conducted during the current season to verify the tuber shape observations initially recorded under net-house conditions. As shown in Figure 2, tuber shape remained mostly consistent in treatments A and B, closely resembling the original Kufri Bahar morphology (round to oval). However, Treatment C continued to display a high proportion of elongated and deformed tubers, confirming earlier concerns about somaclonal variation or hormonal imbalance caused during tissue culture. Although K. Bahar breeder seed produced the highest yield (Table 1), this was mainly due to the use of large-sized conventional tubers as planting material, compared to the smaller net-house derived seed used in other treatments. It is important to emphasize that yield was not the primary parameter for evaluation; instead, tuber shape uniformity was the main criterion to assess clonal fidelity. The results reaffirm that treatments A and B, derived from mericlones (with and without GA₃ during micropropagation), maintained virus freedom and genetic integrity in terms of tuber shape. Meanwhile, the ongoing deformity in Treatment C highlights how in vitro conditions can significantly influence phenotypic expression. To identify the cause, a set of tuber samples from all treatments has been submitted

for hormonal profiling, and results are currently pending. Considering the implications for seed production and cultivar purity, a follow-up field

multiplication trial is planned for the next season to test these initial findings under a broader range of environmental conditions.



Fig. 2: Tuber shape comparison among different treatments of potato cv. Kufri Bahar

Table 1: Field Performance of different treatments of potato cv. Kufri Bahar

Treatments	Plant stand (%)	Plant Vigour (60 days)	Foliage maturity (90 days)	Tubers/plant		Tuber yield (t/ha)	
				Marketable	Total	Marketable	Total
A	94.17	4.65	3.10	5.72	7.62	38.59	41.64
B	96.67	4.80	3.15	6.63	10.77	39.02	42.81
C	97.50	4.70	3.10	6.53	9.99	36.70	40.26
Control	96.67	4.70	3.40	5.34	8.06	40.22	42.71
K. Bahar (B/S)	98.33	4.75	3.35	6.24	9.59	41.32	44.62
C.D.	2.69	0.07	0.07	0.70	2.00	1.78	1.95
SE(m)	0.84	0.02	0.02	0.22	0.63	0.56	0.61
SE(d)	1.19	0.03	0.03	0.31	0.89	0.79	0.87
C.V.	1.51	0.80	1.16	6.18	11.72	2.44	2.48

Varietal Response to Different Propagation Methods

A preliminary study compared three planting materials-apical rooted cuttings (ARC), sprout cuttings, and aeroponic minitubers-in two recently released potato varieties, Kufri Kiran and Kufri Sangam. When evaluating seed propagation systems, sprout cuttings performed better in both tuber count and total yield, producing the highest number of seed-sized tubers and a total yield of up to 242.95 q/ha (see

Fig. 3). Aeroponic minitubers showed the highest emergence rate at 98.22%. ARC provided moderate but consistent results, demonstrating its scalability and suitability for subtropical seed systems. Between the varieties, Kufri Kiran yielded slightly more, while Kufri Sangam produced a larger quantity of tubers. This indicates that selecting the propagation method and variety is essential for optimizing seed potato production, depending on whether the goal is higher yield or greater multiplication.

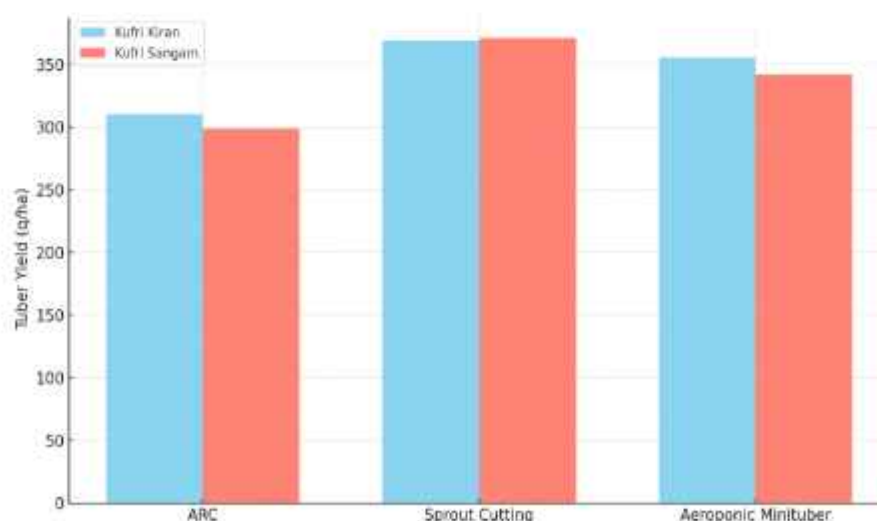


Fig. 3: Tuber yield as influenced by propagation method and variety

Development of agro-techniques for enhancing seed potato quality

Manipulation of seed tuber size in potato with foliar application of N fertilizer in seed potato production.

An experiment was carried out in Gwalior (cv. Mohan) to evaluate the effects of nitrogen fertilizer timing and foliar sprays on seed tuber yield and size distribution in potatoes. Nine nitrogen management treatments were tested, involving various ratios of basal and top-dressed nitrogen, along with one to three foliar sprays of 2% urea. Results from Gwalior indicated that

treatment T4 (50% basal N + 25% top dressing at 25 DAP + one foliar spray at 40 DAP) achieved the highest total tuber yield (38.64 t/ha) and tuber count (659,000/ha). The highest percentage of small-sized tubers (25–50g) was observed in T7 (23.43%), while the greatest proportion of seed-sized tubers was found in T8 (52.97%), which included three foliar sprays (Fig 4). These results indicate that foliar urea application, especially when combined with reduced basal and top-dressed nitrogen, can effectively influence tuber size distribution and enhance seed potato production.

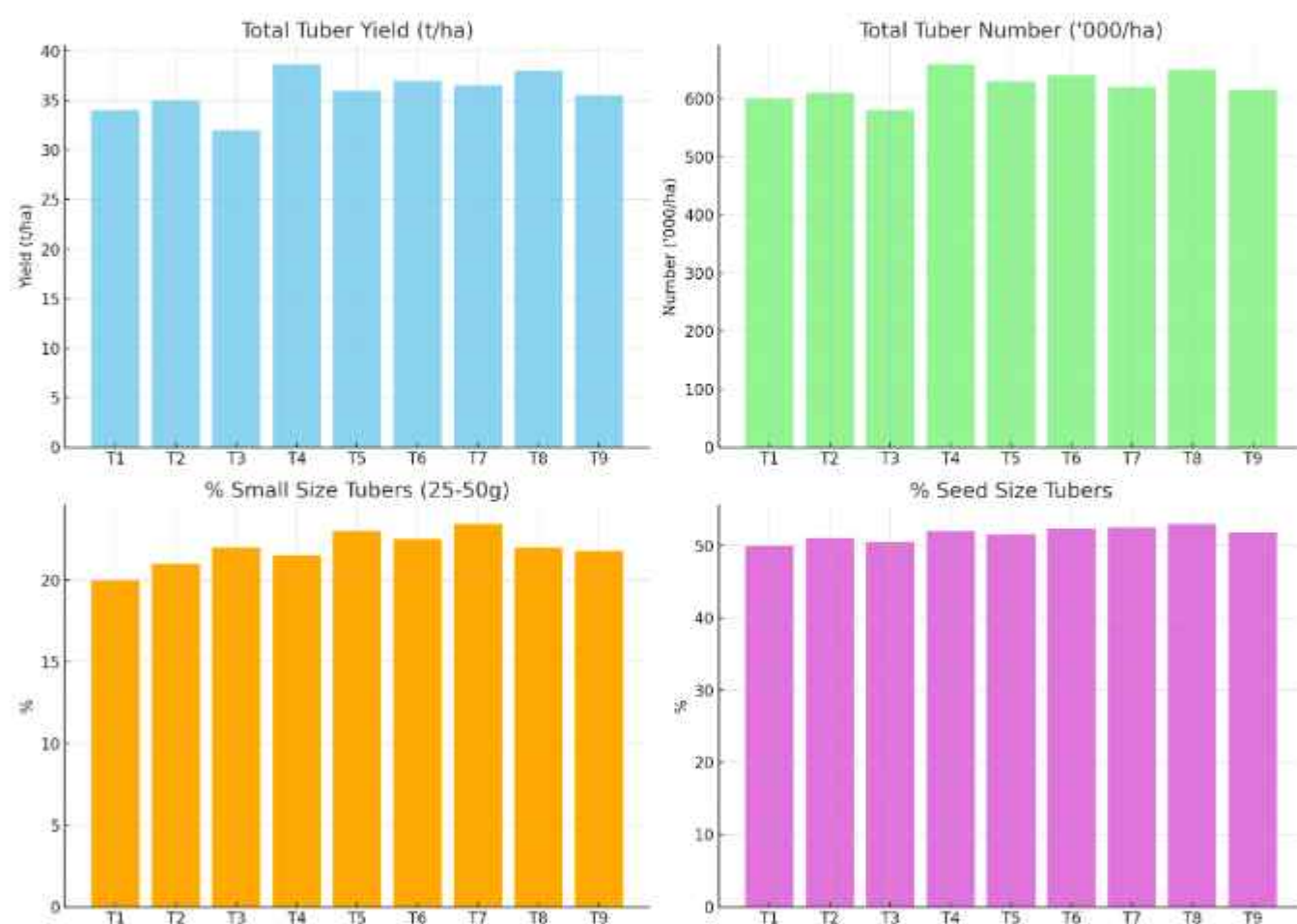


Fig. 4: Effect of nitrogen fertilizer application timings and foliar sprays on the production and size distribution of seed tubers

Effect of Dormancy Breaking Treatments on Potato Seed Production in Kufri Hills

An experiment was conducted during Kharif 2024 in the Kufri hills to assess the effect of dormancy-breaking treatments on the performance of freshly harvested seed potatoes from Jalandhar. Due to the limited availability of

physiologically mature local seed, hill farmers often resort to planting dormant seed tubers sourced from the plains, which are not ideal for immediate planting. The study evaluated two cultivars, Kufri Jyoti and Kufri Himalini, under three treatments: fresh seed with dormancy-breaking dip (1% Thiourea + 1 ppm GA₃), fresh seed without treatment, and local mature seed

from Fagu as the control. Results revealed that germination in fresh seed tubers (treated or untreated) was significantly delayed compared to local seed, with no emergence till 20 days after planting (DAP) and only around 45% germination by 40 DAP. In contrast, local seed showed early and significantly higher germination and ground cover. However, 60 DAP, germination across all treatments exceeded 98%, and full ground cover was achieved by 70 DAP. Plant vigor data indicated that Kufri Himalini had higher plant height (Fig. 5) and haulm weight, while Kufri Jyoti produced more

shoots per plant. Although local seed outperformed others in tuber number and yield (38.0 t/ha), treated fresh seed produced comparable results with only a slight yield reduction (~2 t/ha). Kufri Himalini recorded better performance than Kufri Jyoti in both tuber yield and size distribution. Overall, the study concludes that while local, physiologically mature seed is preferable, fresh seed tubers from the plains can be successfully used for hill cultivation with minimal yield loss, especially if dormancy-breaking treatment is applied.

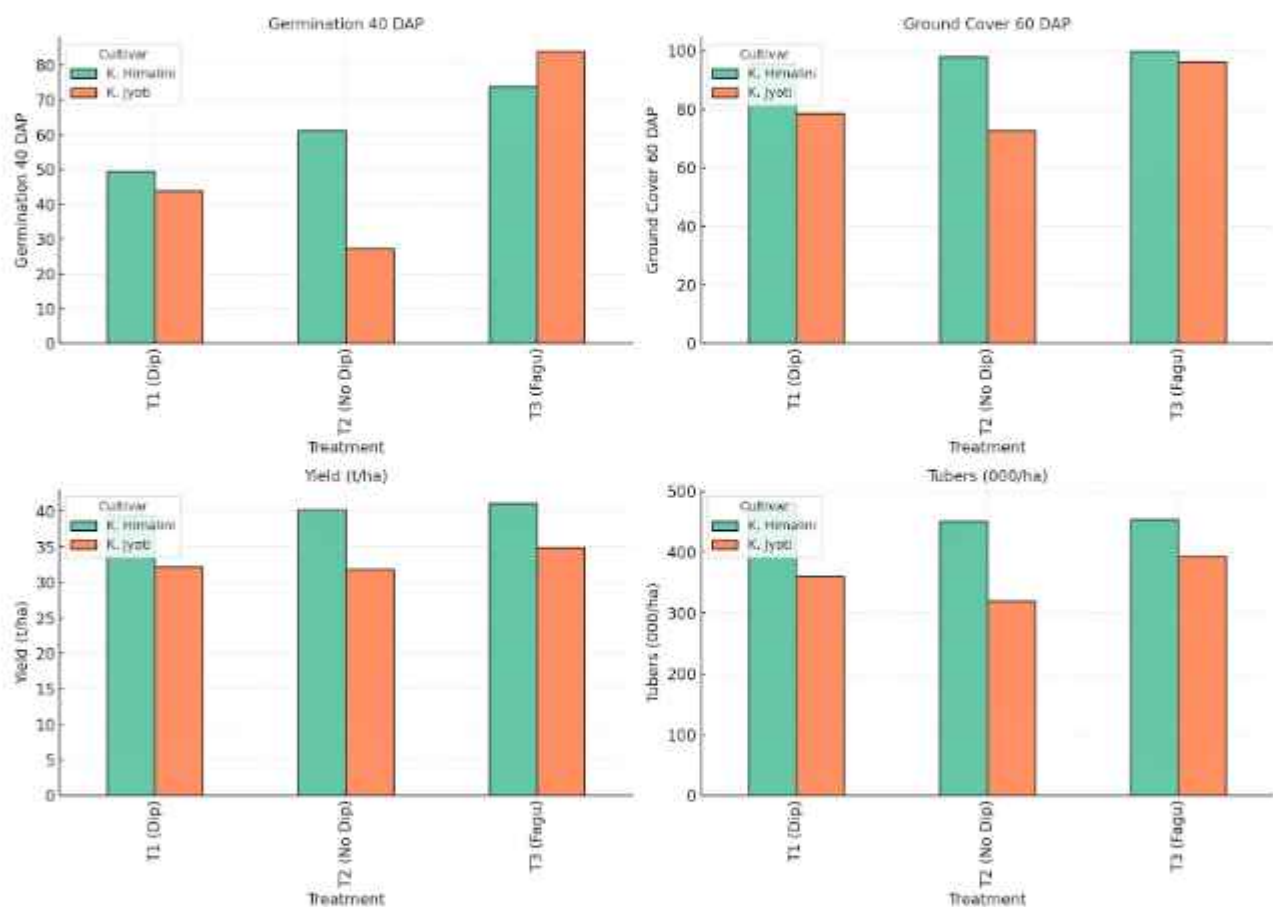


Fig. 5: Dormancy-breaking treatments on germination, ground cover, yield, and tuber number across two potato cultivars

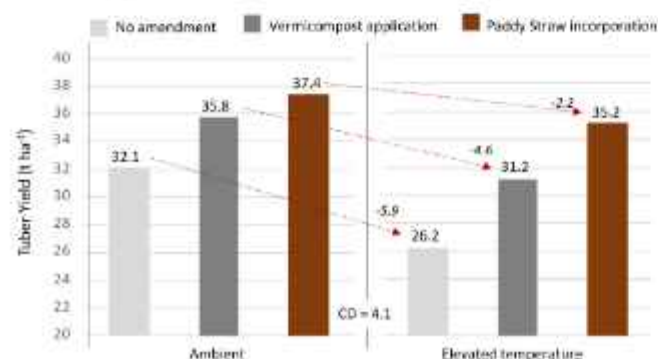
DIVISION OF CROP PRODUCTION

PROGRAMME: VULNERABILITY AND RESILIENCE TO CLIMATE CHANGE FOR SUSTAINABLE POTATO PRODUCTION

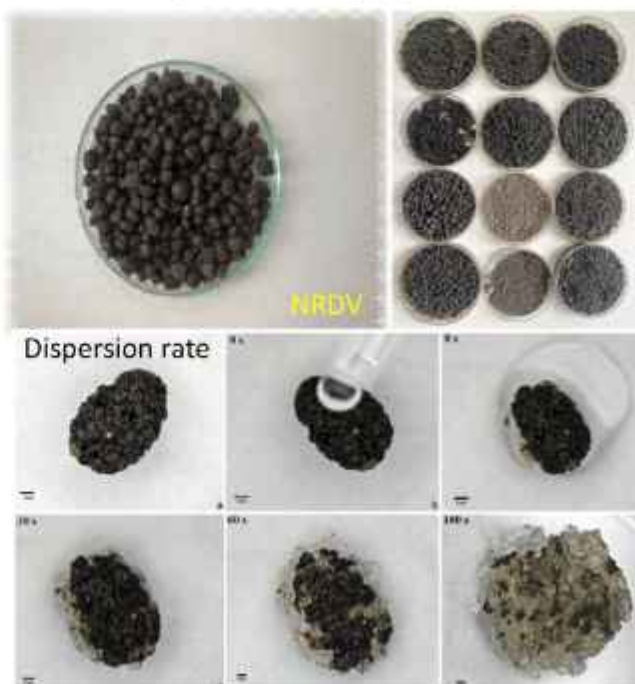
PI: Dr. Anil Sharma, **Co-PIs:** Drs. Sanjay Rawal, SP Singh, Paresh Chaukhande, Sunayan Saha, Vijay Paul, Prince Kumar, Jagdev Sharma, VK Gupta, Som Dutt, Hemant Kardile, Brajesh Nare, Sanjeev Sharma, Mehi Lal, Anuj Bhatnagar, Anil Kumar Choudhary, Subhash Katare, Subhash Chander, Rabindra Padariya, Pynbianglang Kharumnuid, Subhash, Yogesh Gupta

Carbon fraction dynamics (CFD) and budgeting under elevated temperature conditions in Potato growing soils.

Effect of elevated temperature on tuber yield in soils with different organic amendments revealed that tuber yield decreased with temperature elevation of 3°C (approx.). The decrease was statistically non-significant in case of paddy straw incorporation but the same was significant in case of vermicompost application and control. The extent of decrease in tuber yield due to temperature elevation was less in soils where paddy straw was incorporated (-2.2 t/ha) compared to vermicompost application (-4.6 t/ha) and no amendment (-5.9 t/ha). Further to counter the paddy straw burning problem of Punjab, that is responsible not only for environmental degradation and warming but also for reducing organic carbon fractions, two products viz CPRI PSMM (*Paddy Straw Multipurpose Media*) and CPRI NRDV (*Nutrient Rich Dispersible Vermipellets*) were developed using paddy straw. These products from paddy straw are being manufactured commercially.



CPRI PSMM
(Paddy Straw Multipurpose Media)



CPRI NRDV
(Nutrient Rich Dispersible Vermipellets)

Activity: Impact of climate change on black scurf and early blight disease

Effects on early blight severity at different levels of resistance cultivars on different dates of planting

This experiment was conducted using two sets of varieties (resistant/moderately resistant and susceptible). The resistant (Kufri Sindhuri, K. Pukhraj, and K. Khyati) and susceptible group (Kufri Chandramukhi, Kufri Lavkar, and Kufri Deva) were planted during the *Rabi* season 2023–24 to know how these varieties would behave against *Alternaria spp.* under different environmental conditions. In this context, three dates of planting (17 Oct, 2 Nov, and 17 Nov, 2023) were done at a 15-day interval. Results revealed that on October 17, 2023, date of planting, under the susceptible group, the highest AUDPC (Area Under Disease Progress Curve) was recorded on cv. Kufri Lavkar (1515.08), followed by Kufri Chandramukhi (148.58) and Kufri Deva (43.17). Under the resistant group, the highest AUDPC was on cv. Kufri Pukhraj (173.25), followed by cv. Kufri Khyati (110.50) and Kufri Sindhuri (61.17). A similar trend was observed on the planting dates of November 2 and November 17, except in Kufri Sindhuri on November 17 planting. Among the three planting dates, the highest disease severity was recorded on October 17, 2023, followed by November 2 and 17, except in the case of Kufri Pukhraj and Kufri Chandramukhi on the 17 November date of planting.

Effects on black scurf disease incidence at different levels of resistance cultivars on different dates of planting

In another experiment, two sets of varieties (resistant and susceptible) were evaluated to determine their behaviour against *Rhizoctonia solani* on three dates of planting (17 October, 2 November, and 17 November 2023) at a 15-day interval. The resistant group (Kufri Sherpa and Kufri Deva) and susceptible group (Kufri Sindhuri and Atlantic) were selected. Results revealed that on October 17, 2023, date of planting, under the susceptible group, the highest disease incidence was recorded on cv. Atlantic (36.45%), followed by Kufri Sindhuri (18.98%). Similarly, in the resistant group, the highest disease incidence was recorded in cv. Kufri Deva (53.84%), followed by Kufri Sherpa (43.65%).

The highest disease incidence of black scurf was observed on November 2, followed by November 17, date of planting, except on cv. Atlantic & Kufri Sindhuri. The lowest disease incidence was recorded on all varieties on the 17 October date of planting except cv. Atlantic & Kufri Sindhuri. A positive correlation was found between percent disease incidence and temperature, whereas there was a negative correlation between disease incidence, and relative humidity.

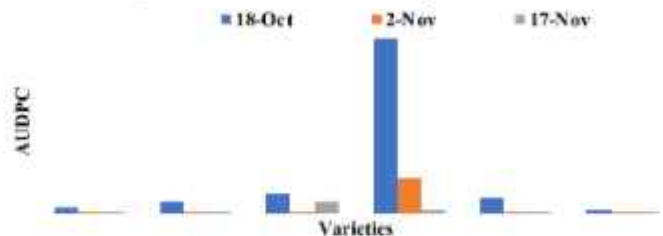


Fig. 1: Impact on early blight disease severity on different sets of varieties at 17 Oct, 2 Nov and 17 Nov date of planting

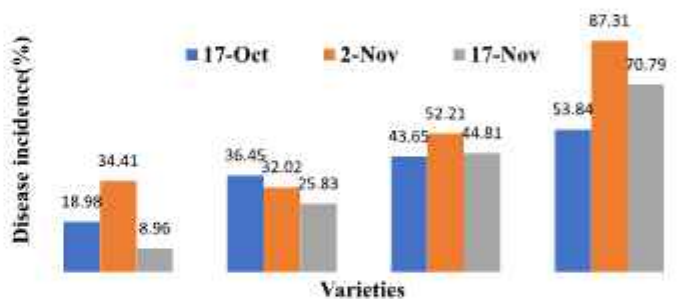


Fig. 2: Impact on black scurf disease incidence on different sets of varieties at 17 Oct, 2 Nov and 17 Nov date of planting [CD (p0.05) DOP= 3.21, Variety= 2.49, variety at same level of planting= 4.75 Planting at same level of variety= 4.88]

Biology and management of potato pests under climate change

Influence of sowing dates on aphid and whitefly populations: Integrating pest dynamics with climatic factors

The present study was conducted to evaluate the effect of different sowing dates on the population dynamics of major insect pests, winged and non-winged aphids and whiteflies in an unsprayed crop of Potato var. K. Mohan. The experiment involved seven planting dates, ranging from September 30 to December 30, 2024 at 15-day intervals (T1: 30 Sep, T2: 15 Oct, T3: 30 Oct, T4: 15 Nov, T5: 30 Nov, T6: 15 Dec, T7: 30 Dec). Weekly observations of pest populations commenced 30 days after planting, allowing for detailed monitoring across the growing season.

In addition to pest assessments, comprehensive meteorological data, including maximum and minimum temperatures, morning and evening relative humidity, rainfall and sunshine hours were recorded. These climatic parameters were analysed through correlation and multiple linear regression analyses to elucidate their influence on pest population dynamics.

The primary objective of this study was to determine how varying planting dates affect the incidence and intensity of key insect pests and to explore the role of climatic factors in modulating these interactions. The findings aim to contribute to the development of sustainable pest management strategies by optimizing sowing schedules, thereby reducing reliance on chemical interventions and enhancing crop resilience under field conditions.

I. Winged Aphids

The population dynamics of winged aphids varied significantly across Standard Meteorological Weeks (SMWs) and sowing dates. A two-way ANOVA revealed that SMW, sowing date and their interaction had highly significant effects on aphid abundance ($p < 0.0001$). Seasonal trends were evident, with SMW contributing substantially to variability ($F_{(6, 844, 84.62)} = 40.64$). Early planting (T1-T3) consistently recorded higher aphid densities compared to later planting (T4-T7) ($F_{(6, 14)} = 12.99$). The significant interaction ($F_{(126, 294)} = 31.58$) indicated that aphid pressure was strongly influenced by the timing of crop phenology relative to seasonal pest peaks.

Post hoc Tukey's tests highlighted that during SMWs 44-47, early planting harboured significantly higher aphid populations, particularly in T1 during SMW 45 ($p < 0.05$). By mid-season (SMW 48-52), aphid numbers declined sharply in late-sown plots (T6-T7), suggesting a "pest escape" phenomenon. Late-season weeks (SMW 1-13) saw aphid populations reduce across all treatments, likely due to cooler temperatures and declining host suitability.

Pearson's correlation indicated moderate positive associations between aphid populations and

temperatures, while morning humidity showed a negative trend. However, the Multiple Linear Regression (MLR) model explained only 27.8% of variance and was not statistically significant, limited by multicollinearity and non-normal residuals.

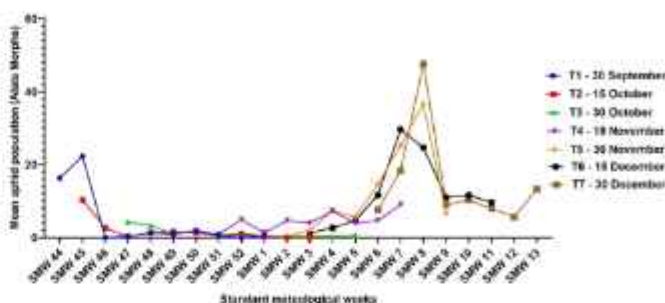


Fig. 1: Mean population dynamics of aphids (alate morphs) across standard meteorological weeks (SMWs) under different sowing dates (T1-T7).

II. Non-Winged Aphids

Non-winged aphid populations followed similar trends, with significant effects of SMW ($F_{(6, 720, 66.08)} = 33.80$), planting date ($F_{(6, 14)} = 32.31$), and their interaction ($F_{(126, 294)} = 20.82$) ($p < 0.0001$ for all). Early planting (T1, T2) consistently supported higher aphid populations during SMWs 44-50. Late planting (T6-T7) maintained lower infestations, particularly evident in mid- and late-season periods. An unexpected resurgence was observed in T5 during SMW 50, indicating potential vulnerability windows depending on planting time alignment with aphid population peaks. By SMW 1-13, aphid counts declined sharply across treatments.

Correlation patterns mirrored those of winged aphids, with temperature positively associated and humidity negatively correlated, though marginally significant. The MLR model again showed limited explanatory power ($R^2 = 0.278$) due to multicollinearity and non-linear relationships.

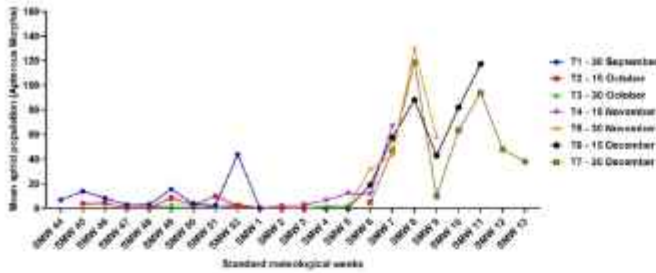


Fig. 2: Mean population dynamics of aphids (non-alate morphs) across standard meteorological weeks (SMWs) under different sowing dates (T1-T7).

III. Whiteflies

Whitefly populations were significantly influenced by SMW ($F_{(6,552, 93.13)} = 33.32, p < 0.0001$), planting date ($F_{(6, 14)} = 54.35, p < 0.0001$), and their interaction ($F_{(126, 294)} = 25.52, p < 0.0001$). Early sowings (T1-T3) experienced higher infestations, particularly during SMWs 45-50. Conversely, mid- to late-planted crops (T4-T7) consistently recorded lower whitefly densities, especially after SMW 50. Random effects analysis indicated minimal spatial variability ($p = 0.565$), confirming that temporal factors were the primary drivers of infestation dynamics.

Sunshine hours emerged as a critical factor, showing a strong negative correlation with whitefly populations ($r = -0.555, p = 0.007$). The MLR model explained 70.1% of the variance ($R^2 = 0.701, p = 0.0026$), identifying sunshine hours

and evening humidity as significant predictors, while temperature and rainfall were non-significant.

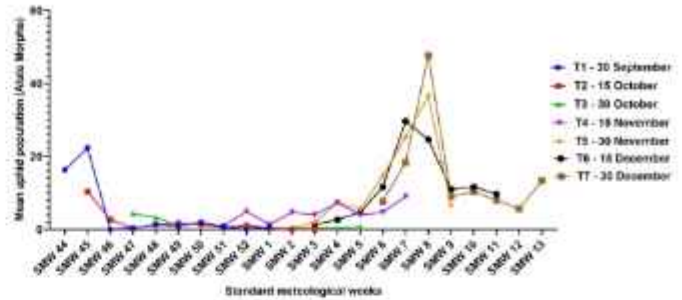


Fig. 3: Mean population dynamics of whiteflies across standard meteorological weeks (SMWs) under different sowing dates (T1-T7).

Evaluating Aquacrop simulation model for forecasting the potato productivity under changing climatic conditions

New Methodology for Aquacrop model input data generation

Green canopy cover percentage (CC %) is an important crop biophysical variable for parameterization/calibration of Aquacrop model. Performance of An AI-ML methodology (deep learning based approach), PCCAnalyzer was also evaluated in comparison to a popular mobile App (Canopeo) (Table 1). Overall accuracy (NRMSE) of the PCC Analyzer method was as good as 2.2 % which was better than Canopeo-android app (5%).

Table 1: Comparative evaluation of model performances for predicting CC% in potato (superscript * statistical significance at $\alpha = 0.01$)

Models/ Method/ Software	Summary univariate measures				OLS Reg. Co-eff.		Difference measures				Correlation measures			
	Mean O	Mean P	SD _O	SD _P	a (intercept)	b (slope)	MBE (O-P)	RMSE (NRMSE)	RMSEs	RMSEu	d- index	r (Pearson)	R ²	adj. R ²
PCCAnalyzer	52.6	52.7	23.0	22.6	1.15	0.98*	-0.2	1.2 (2.2)	0.47	0.84	1.00	0.9988	0.9977	0.9976
Canopeo-H	52.6	54.2	23.0	21.5	5.10	0.93*	-1.6	2.6 (5.0)	2.14	0.33	1.00	0.9979	0.9958	0.9957
Canopeo-M	52.6	51.0	23.0	20.4	4.94	0.88*	1.6	4.5 (8.5)	3.06	0.53	0.99	0.9884	0.9770	0.9765
Canopeo-L	52.6	29.0	23.0	11.4	6.19	0.43*	23.6	27.4 (52.1)	27.08	0.02	0.65	0.8770	0.7691	0.7644

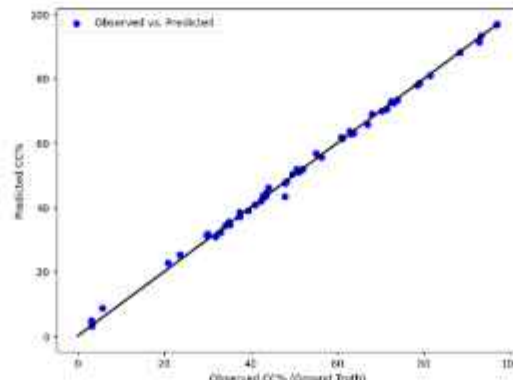


Fig. 1: Observed versus PCCAnalyzer estimated CC% of potato crops. The black straight line represents 1:1 line

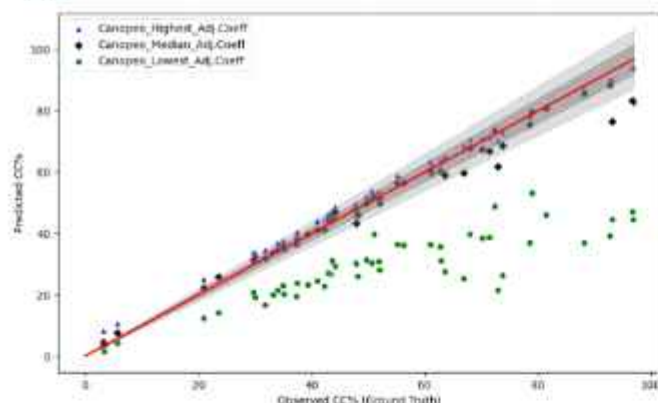


Fig. 2: Estimated CC% in potato crops using the Canopeo- mobile app (android version) as a factor of adjustment coefficients; The dark & light grey zones around the red 1:1 line represents 5% and 10% of observed values, respectively.

Crop biophysical and yield data, generated for the variety Kufri Jyoti under drip irrigation scheduling experiments (drip irrigation applications @ 50-125% of Cumulative Pan Evaporation and nitrogen applications @ 0-300 kg N/ha at an interval of 60 kg N/ha) at Jalandhar, were used for model evaluation purpose. Various genetic coefficients, viz., initial canopy cover (CCo), canopy expansion coefficient (CEC), canopy decline coefficient (CDC), maximum canopy cover (CCx), time to reach maximum canopy cover (Tccx) and onset of senescence (Tsen) were computed from the seasonal time dynamics (emergence to haulm cutting) of green canopy cover (%) and thermal time requirement (GDD) for different growth phases were computed from in-season weather data. After partial calibrations (Fig. 3), the model

predicted dry tuber yield of K. Jyoti variety with and accuracy (normalized RMSE) ranging between 20-30% under the central agro-climatic zone of Punjab. Further fine tuning of model parameters and validation using larger data pool as well as promising varieties (Kufri Himalini and Kufri Khyati) are underway.

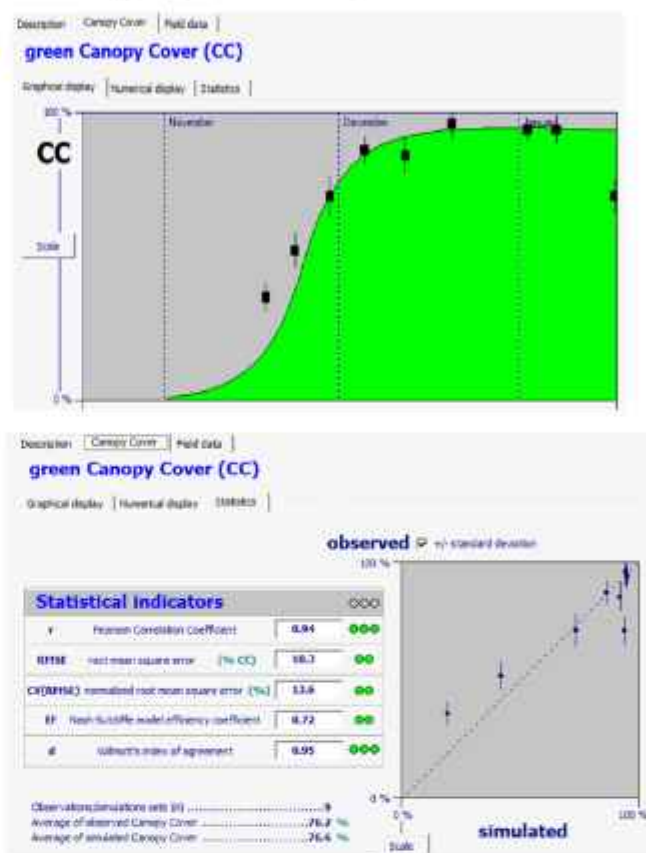


Fig. 3: (L, R): Aquacrop simulated versus measured green canopy cover (%) under potential/non-limiting growing environment (L: graphical display; R: statistical indicators)

PROGRAMME: NUTRIENT AND WATER MANAGEMENT FOR IMPROVED PRODUCTIVITY AND SUSTAINABILITY OF POTATO

PI: Dr. Sanjay Rawal, **Co-PIs:** Drs. SP Singh, Prince Kumar, Sunayan Saha, RK Singh, Sunayan Saha, Jagdev Sharma, Manoj Kumar Nanda, Brajesh Nare, Anil K Choudhary, Janani P., Divya K Lekshmanan, Dharmendra Kumar, Priyank Mhatre, Ajay Thakur, Yogesh Gautam

Developing low-cost technology capsule using organic and inorganic sources of nutrients and micro-irrigation methods in potato

Integrated potassium management in north-Indian plains using potassium solubilizing bacteria (KSB):

A field trial was conducted at Modipuram during 2023-24 to study the effect of K management in potato (cv. Kufri Bahar) by utilizing KSB on productivity, profitability, potassium use-

efficiency and fertilizer K economy under furrow irrigation method. Potassium levels comprised as sole (0, 50, 75, 100 & 125% of recommended doses of K) and in combinations with KSB @ 500 ml/ha (*Bacillus spp.*, 10^8 cfu). Recommended NPK dose of 180 N: 80 P₂O₅: 100 K₂O kg/ha was followed. Only application of K varied, while N and P were applied at 100% of the recommended dose. Results revealed that increase in graded doses of potassium fertilizers from 0 to 100% RDK alone or in combination with KSB led a consistent increase in number and weight of small, medium, large sized and total tubers. Significantly higher total tuber number (494 000/ha) and yield (31.7 t/ha) was observed in K₁₀₀ + KSB treatment which was statistically at par with K₁₀₀ only treatment (30.6 t/ha) (Table 1- 2). Overall KSB application did not affect the total tuber yield at 75,100 % RDF of K dose.

Table 1. Effect of integrated potassium management on potato growth and yield attributes

Treatment		Emergence (%)	Plant height (cm)		Chlorophyll content (SPAD)		Tuber number (000/ha)			
			60 DAT	75 DAT	60 DAT	75 DAT	Small (<50g)	Medium (50-100g)	Large (>100g)	Total
T ₁	K ₀	85.3	37.7	43.3	42.9	35.1	97	261	27	385
T ₂	K ₅₀	85.3	38.3	45.1	46.6	36.3	109	285	39	434
T ₃	K ₇₅	85.3	39.7	47.2	47.7	38.1	117	298	44	459
T ₄	K ₁₀₀	88.3	40.3	48.1	48.3	39.3	122	308	51	481
T ₅	K ₀ + KSB	87.0	39.7	43.6	43.9	35.5	93	277	33	403
T ₆	K ₅₀ + KSB	87.7	40.1	46.4	46.8	37.1	104	297	43	443
T ₇	K ₇₅ + KSB	87.3	41.0	47.8	48.1	38.0	110	314	48	472
T ₈	K ₁₀₀ + KSB	86.7	41.2	48.9	48.9	38.3	113	325	56	494
T ₉	K ₁₂₅ Only	86.0	42.4	48.6	47.9	39.8	111	324	57	493
SE(m)±		0.90	2.34	1.46	1.03	1.14	2.87	4.29	1.98	2.88
CD _{0.05}		NS	NS	4.42	3.12	3.45	8.69	12.97	5.98	8.71

Table 2. Effect of integrated potassium management on tuber yield, tuber dry matter content and haulms dry yield

Treatment		Tuber yield (t/ha)				Tuber dry matter content (%)	Haulms dry yield (t/ha)
		Small (<50g)	Medium (50-100g)	Large (>100g)	Total		
T ₁	K ₀	1.99	17.7	5.06	24.8	19.1	1.56
T ₂	K ₅₀	2.35	18.4	6.73	27.5	20.0	1.74
T ₃	K ₇₅	2.47	19.6	7.53	29.6	20.9	2.09
T ₄	K ₁₀₀	2.72	20.2	7.64	30.6	21.2	2.11
T ₅	K ₀ + KSB	1.88	19.0	6.92	27.8	19.6	1.92
T ₆	K ₅₀ + KSB	2.00	19.7	7.47	29.2	19.2	2.01
T ₇	K ₇₅ + KSB	2.28	20.5	8.09	30.8	20.5	2.27
T ₈	K ₁₀₀ + KSB	2.41	21.1	8.18	31.7	21.2	2.34
T ₉	K ₁₂₅ Only	2.33	20.8	8.06	31.2	21.9	2.18
SE(m)±		0.08	0.22	0.35	0.45	0.62	0.21
CD _{0.05}		0.26	0.68	1.05	1.35	1.88	0.64

Developing low cost potato production technology by adopting various nutrient, water and planting options:

Field experiment comprising two irrigation levels (50 & 30 mm), two nutrition doses (50 & 100% RDF NPK) and two planting methods (ridge-furrow & raised bed planting) were evaluated in heavy soils at Patna. Potato crop (cv. Kufri Lalit) was raised in rice- potato-green gram sequence. Results revealed that highest and significantly marked total tuber number (518 000/ha) were recorded with 50 mm irrigation level as compared to 505 000/ha in 30 mm irrigation (Table 3). Method of planting did not affect this trait. Application of 100% RDF NPK recorded significantly higher tuber number (535 000/ha) over 50% RDF NPK. Interaction of planting method, irrigation and nutrient levels were significant, and highest tuber numbers were recorded with ridge- furrow planting, irrigation at 50mm and 50% RDF NPK (576 000/ha). In case of yield, 30 mm irrigation attained highest total tuber yield (24.2 t/ha), which was significantly

better than 50 mm irrigation level (20.8 t/ha). Planting method did not affect yield statistically. Nutrition influenced yield markedly and 100% RDF NPK had significantly higher total tuber yield (24.4 t/ha) over 50% RDF NPK (20.5 t/ha). Interaction of planting method, irrigation and nutrient levels were non-significant. Highest water use efficiency (WUE) was recorded with 30 mm water (120. 8 kg/ha-mm), which was significantly higher than 50 mm (69.3 kg/ha-mm). Planting method did not affect this parameter. Among nutrition, maximum WUE was observed in 100% RDF NPK (103.8 kg/ha-mm) which was markedly superior to 50% RDF NPK (86.3 kg/ha-mm). Interaction of planting methods, irrigation and nutrient levels were significant and highest WUE (143.7 kg/ha-mm) was recorded with 30 mm irrigation x ridge-furrow planting x 100 % RDF NPK, and it was significantly higher than all other treatment combinations except for 30 mm irrigation x raised bed planting x 100 % RDF NPK (124.4 kg/ha-mm).

Table 3. Influence of nutrient, water and planting method options on total tuber number & yield, and water use efficiency (WUE)

Treatment	Tuber number (000/ha)	Tuber yield (t/ha)	WUE (kg/ha-mm)
Irrigation level (I)			
50mm	518	20.8	69.3
30mm	505	24.2	120.8
SE(m)±	12.54	0.32	2.88
CD _{0.05}	NS	2.00	17.75
Method of planting (P)			
Ridge-furrow	508	22.4	94.2
Raised bed planting	516	22.6	95.9
SE(m)±	19.80	0.81	3.83
CD _{0.05}	NS	NS	NS
Nutrition (F)			
50% RDF NPK	488	20.5	86.3
100% RDF NPK	535	24.4	103.8
SE(m)±	13.59	0.78	3.22
CD _{0.05}	44.27	2.53	10.49

Assessment of consumptive water use pattern and exploring water efficient technologies for potato under changing hydro-climatic regimes

Field experiment was conducted on potato crops (var. *Kufri Jyoti*) under irrigation scheduling (drip irrigation applications @ 50-125% of cumulative

pan evaporation and nitrogen applications @ 0-300 kg N/ha at an interval of 60 kg N/ha) during the 2023-24 autumn/*rabi* season at ICAR-Central Potato Research Institute, RS, Jalandhar).

Protocol standardization for ground based visual (RGB) imaging and image processing for non-invasive measurements of potato crop biophysical parameters:

Images were collected at weekly intervals from potato crop cv. Kufri Jyoti grown in ridge-furrow system at 60 x 20 cm spacing under drip irrigation following different scheduling at Jalandhar during the autumn season of 2023-24. All the images were captured from about 135 cm height of camera lens from the base of ridge with a vertical camera angle. Each image had a footprint of approximately 1.5 m² area on ground (Fig. 1).

The images were captured under natural light conditions and without any particular consideration of sun angle, soil background or environmental visibility. The same camera was used all through (specifications: Canon EOS 80D; DSLR; Tamron lens 18-270 mm; F/3.5-6.3; Resolution 24MP). Images were analyzed using an open source image processing software,

ImageJ ver. 1.53t to measure biophysical parameters, viz., green canopy cover percentage (CC%). Hue-Saturation-Brightness (HSB) thresholding system coupled with outlier pixel removal was followed for image segmentation into green crop and non-green features. Thresholds were worked out for different classes of images (Fig. 2).



Fig. 1: Image acquisition protocol

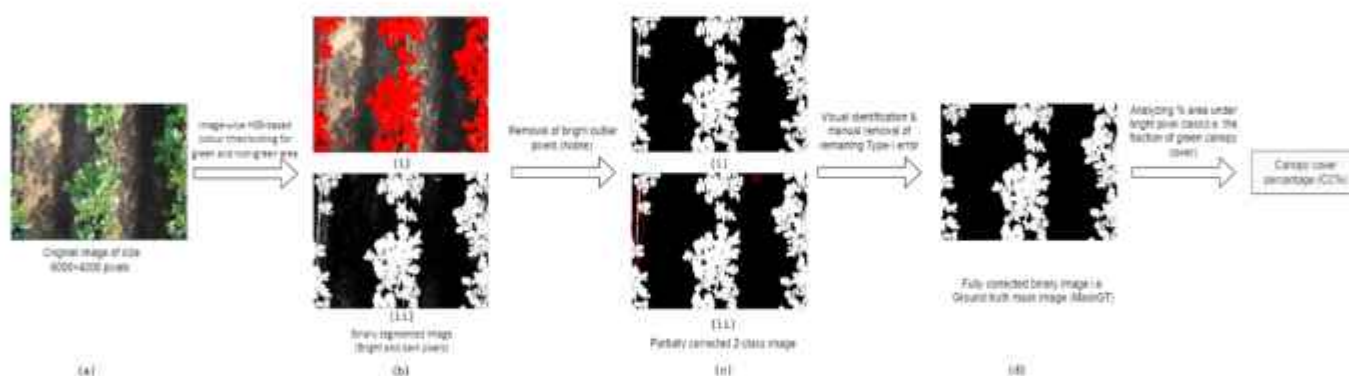


Fig. 2: Schematic diagram for green canopy measurement using ImageJ software

Canopy growth and tuber yields under different water and nitrogen interactions:

Model equations have been developed for estimating green crop cover (CC%), as a function of days after planting (DAP) for various combinations of N and water management (Fig. 3). Second order polynomial equations could describe well these relationships and R^2 varied between 0.89- 0.99. Similarly, functions were generated for tuber productivity (Fig. 4). Relations between N applications and fresh tuber yield under conditions of mild and moderate water stresses, or sub optimal to optimal water regimes could be described well using second

order polynomial functions as R^2 varied between 0.92- 0.98. Based on the results of current and previous years' experiments, it could be concluded that drip irrigation @150 % ET_{ref} (reference evapotranspiration computed from weather data) i.e. equivalent to 125% of Pan-E applied at 2-3 days interval could produce maximum tuber yield for Kufri Jyoti. Whereas, variable rate drip irrigation@100 % ET_{ref} rate with rate adjustments as per growth-stage wise crop coefficients (0.50, 0.75 and 1.15 at early, medium and late growth phases) could produce optimum tuber yield with better physical quality having per cent lower cracking.

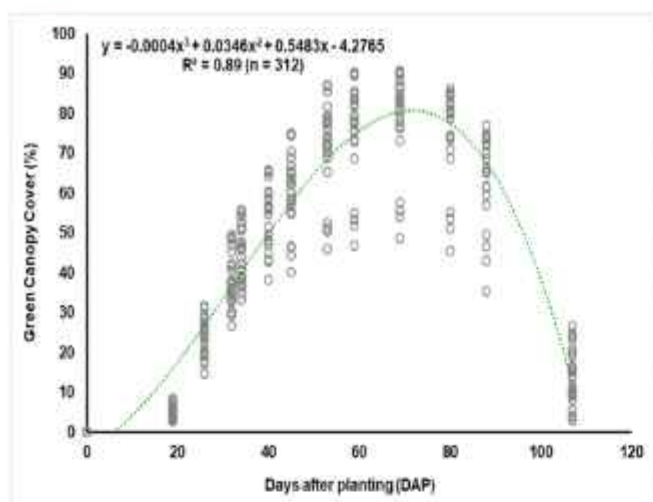


Fig. 3: A generalized relationship from pooled data between days after planting and green canopy cover percentage in potato cv. Kufri Jyoti

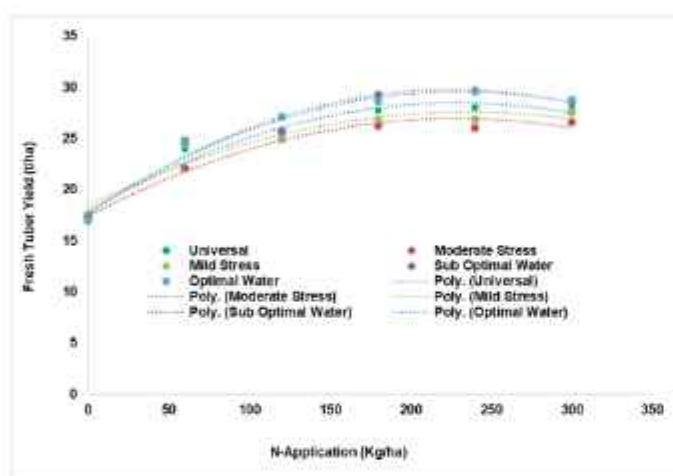


Fig. 4: Empirical models for predicting fresh tuber yield as a function of N-doses under different irrigation regimes in potato cv. Kufri Jyoti

Studies on trace and beneficial elements

Developing site-specific micronutrient mixtures for potato cultivation:

Two field trials were conducted at Jalandhar and Modipuram and four micronutrient mixtures were tested in order to develop site specific micronutrient formulations. These mixtures were prepared based on previous preliminary studies. At Jalandhar, four combinations of micronutrients were evaluated at two application rates (2.0 and 2.5g/liter). Formulation Micromix-I, Micromix-II and Micromix-III enhanced the marketable tuber yield by 10.2-10.4%. Total tuber yield was not influenced statistically though it improved from 1.60- 9. %. Similarly at Modipuram, evaluation of these

formulations improved total tuber yield by 4.93-9.43% and marketable tuber yield also increased from 6.94-10.61%. Selected combinations will further be fine-tuned as per requirement of both the agro-ecology, and evaluated in next cropping season (Fig. 5- 6).

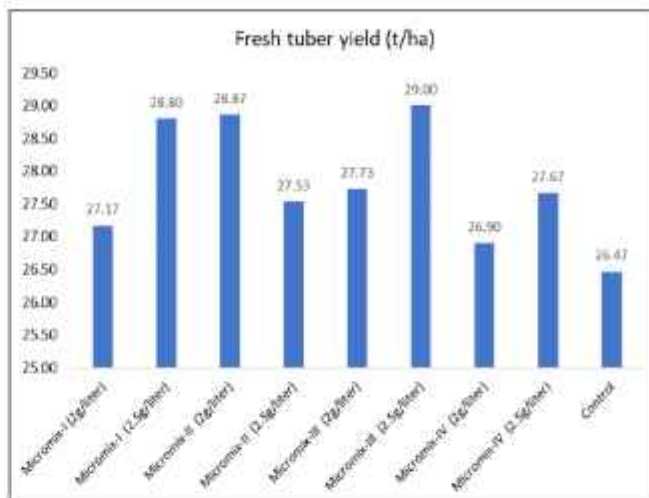


Fig. 5: Effect of different micronutrient formulations on total tuber yield at Jalandhar

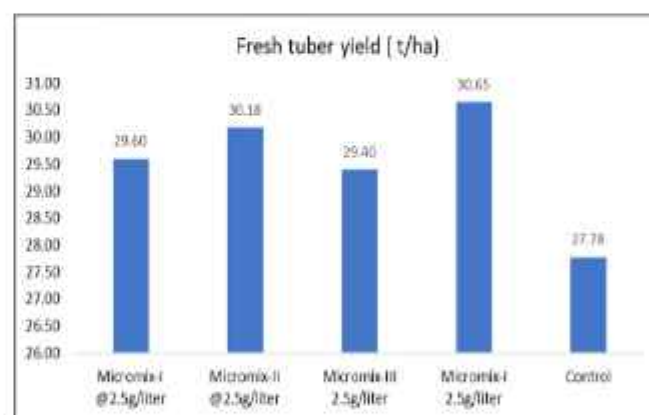


Fig. 6: Effect of different micronutrient formulations on total tuber yield at Modipuram

Developing strategies for improving phosphorus use efficiency in potato

Integrated P management in north- eastern hills:

A field experiment was conducted at Shillong to study the effect of rock phosphate (RP) enriched vermicompost (RPVEC) and two P sources (SSP and RP) at different application rates on potato yield. Results showed that application of P as SSP or RP or enriched compost alone or their mixtures significantly increased the tuber yield over control (Table 4). Integrated P management

i.e. 100 % P supplied through 50% as SSP + 50% as RPVEC, resulted in significantly higher total (607 000/ha) and marketable (241 000/ha) tuber

number as well as total (16.57 t/ha) and marketable tuber yield (8.16 t/ha) as compared to SSP and RPVEC alone.

Table 4: Effect of P sources on tuber number and yield (t/ha)

Treatment	Tuber yield (t/ha)		Tuber number (000/ha)	
	Total	Marketable	Total	Marketable
T1- Vermi compost @ 3.75 t/ha +PSB (control)	11.06 ^{cd}	7.21 ^c	369 ^c	148 ^{bc}
T2- 100% P as RP enriched vermicompost (RPEVC @ 3.75 t/ha)	13.66 ^{abc}	8.58 ^{abc}	476 ^{bc}	180 ^{abc}
T3- 75% P as RPEVC	12.28 ^{bcd}	6.32 ^c	470 ^{bc}	144 ^{bc}
T4- 50 % P as RPEVC	10.63 ^d	6.36 ^c	370 ^c	124 ^c
T5- 75 % P (25% P as SSP + 50% P as RPEVC)	14.32 ^{ab}	9.95 ^{ab}	421 ^{bc}	201 ^{ab}
T6- 100% P (50 % P as SSP+ 50% P as RPEVC)	16.57 ^a	10.85 ^a	607 ^a	241 ^a
T7- 100% RDP (P as SSP)	13.61 ^{abc}	8.16 ^{bc}	520 ^{ab}	164 ^{bc}
T8- 100% RDP (50% P as SSP + 50% P as RP+PSB)	12.58 ^{bcd}	7.33 ^{bc}	444 ^{bc}	173 ^{bc}

Effect of different rates and sources of P on potato growth and yield was studied in another field trial during summer season of 2024 at Shillong under rain fed conditions. Mean tuber yield ranged between 7.70- 14.77 t/ha (Table 5). Different sources and foliar-applied P significantly improved tuber yield attributes and

yield. Maximum total (14.77 t/ha) and marketable (9.03 t/ha) tuber yield as well as total (600 000/ha) and marketable (206 000/ha) tuber number were recorded in T₅ (25% P as SSP + 50% P as RPEVC + Mycorrhiza (*Glomus fasciculatum*) + two sprays of foliar P@1% MAP) conversely.

Table 5: Effect of P sources on tuber number and yield (t/ha)

Treatment	Tuber yield (t/ha)		Tuber number (000/ha)	
	Total	Marketable	Total	Marketable
T1- 0P	7.70 ^c	4.11 ^c	412 ^c	113 ^c
T2- 100% RDP (P as SSP)	12.88 ^{ab}	7.60 ^{ab}	524 ^{ab}	159 ^b
T3- 75% RDP (75% P as RP + PSB)	11.93 ^b	7.19 ^b	508 ^{abc}	164 ^{ab}
T4- 100% RDP (50% P as SSP + 50% P as RP+PSB)	11.97 ^b	7.42 ^{ab}	537 ^{ab}	172 ^{ab}
T5- 75% RDP (25% P as SSP + 50% as P RPEVC) + Mycorrhiza + two sprays of P	14.77 ^a	9.03 ^a	600 ^a	206 ^a
T6- 50% RDP (25% P as SSP + 25% P as RPEVC) +Mycorrhiza+ two sprays of P	12.43 ^b	7.90 ^{ab}	488 ^{bc}	183 ^{ab}

Screening of potato germplasm for P use efficiency:

P- efficient genotypes are needed to be evaluated for improving yield in P deficient soils, reducing reliance on imported & expensive fertilizers, and minimizing environmental pollution. Keeping

this in view red skinned genotypes were evaluated with and without application of P fertilizer at Patna and Jalandhar. Soils of the experimental sites are were medium in available P at both the locations. At Patna fifteen genotypes were evaluated for P use efficiency

(PUE) out of which PS 17-20 (37.0 t/ha), PS 17-15 (29.0 t/ha) and PS/17-11 (28.2 t/ha) were found most promising with P application. Genotype PS/18-21 (23.7 t/ha), PS/17-20 (23.4 t/ha), PS/17-15 (22.3 t/ha) and PS/18-44 (21.9 t/ha) exhibited prominence without P application. These genotypes will be utilized in future breeding programmes. A large variation in leaf P concentration was also observed amongst these genotypes both under fertilized (0.33-0.73%) and unfertilized (0.27-0.56%) conditions. At Jalandhar, three germplasm and four check varieties were tested in a homogenous plot under P deficient and sufficient condition. Amongst these, genotype J/15-91 was found the most P-use efficient and had yield potential equivalent to Kufri Pukhraj. This genotype will be again be evaluated in next cropping season (Fig. 7-8).

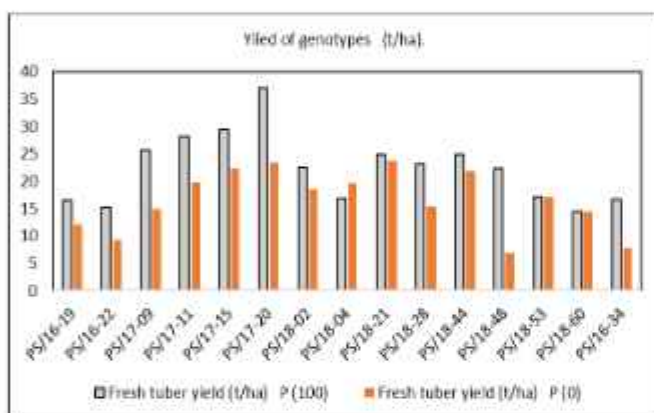


Fig. 7: Performance of genotypes with and without P application at Patna

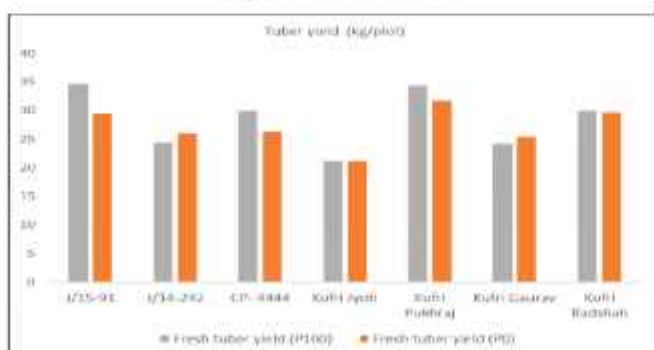


Fig. 8: Performance of genotypes with and without P application at Jalandhar

Soil management for improving nutrient availability in low pH soil

Effect of button spent mushroom substrate (SMS) on yield of potato (Shillong):

A field experiment was conducted in RBD consisting three replications for evaluating the

effectiveness of composted SMS on growth and yield of potato crop. Naturally composted SMS (3 and 6 months) were used as manure for this experiment. Treatments were: T1: No fertilizer (control), T2: Recommended dose of fertilizer (140:120:60 kg N:P₂O₅:K₂O/ha) + FYM (15 t/ha), T3: RDF + SMS3 (20 t/ha), T4: RDF + SMS6 (20 t/ha), T5: FYM alone (15 t/ha), T6: SMS3 alone (20 t/ha) and T7: SMS6 alone (20 t/ha). Results revealed that applying 6-month composted SMS (20 t/ha) combined with recommended dose of fertilizer significantly enhanced vegetative growth, and recorded highest total (23.48 t/ha) and marketable (20.46 t/ha) tuber yield as compared to other treatments including control (Fig. 9).

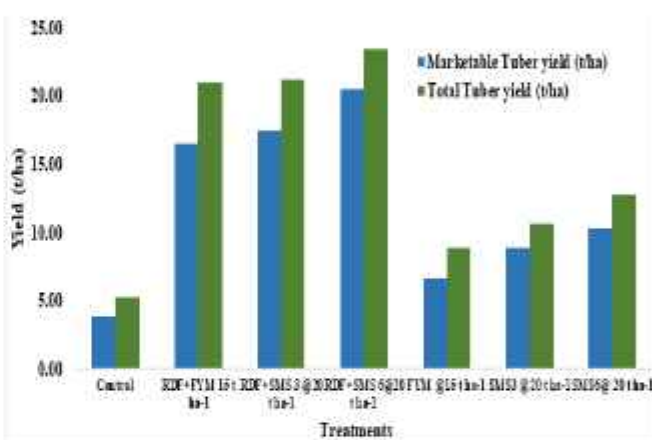


Fig. 9: Effect of spent mushroom substrate on potato productivity at Shillong

Effect of spent mushroom substrate (SMS) on yield of potato (Ooty):

An experiment was conducted during summer season in factorial RBD consisting five treatments and four replications for evaluating the effect of SMS alone and or its combinations with fertilizers and FYM on growth and yield of potato crop. Five treatments were- T₁: Control, T₂: Recommended fertilizer dose + farm yard manure (RDF+ FYM), T₃: RDF+ SMS, T₄: FYM alone, T₅: SMS alone. Recommended dose of fertilizer was 90:135:90 kg N:P₂O₅:K₂O/ha, while FYM and SMS was applied at the rate of 15 t/ha. The SMS was three months withered and enriched with P (2%). Variety Kufri Himalini and Kufri Swarna were utilized for this purpose. Average nutrient content of SMS was: pH- 7.2, N- 1.5%, P- 2.8% and K- 1.6%. Results

showed significant difference for total as well as marketable tuber yield and maximum yields were recorded in T₅: SMS alone treatment. Variety Kufri Himalini and Kufri Swarna attained total

(20.76 & 19.24 t/ha) and marketable tuber yield (18.85 & 17.72 t/ha), respectively in this treatment (Fig. 10).

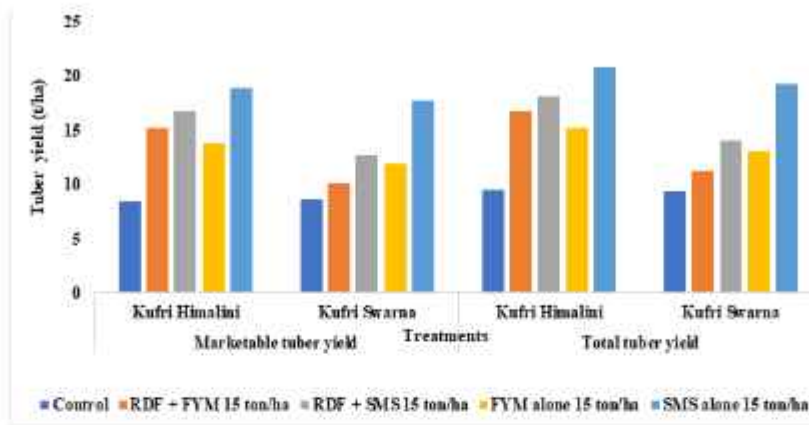


Fig. 10: Effect of enriched spent mushroom substrate on potato yield at Ooty

PROGRAMME: TECHNOLOGY DEVELOPMENT AND REFINEMENT FOR POTATO AND POTATO BASED CROPPING SYSTEMS

PI: Dr. Sanjay Rawal, **Co-PIs:** Drs. Pooja Mankar, Sanjeev Sharma, SK Luthra, VK Gupta, Mehi Lal, Subhash S., SP Singh, Subhash Katore Murlidhar Sadawarti, Anil Sharma, Anil K Choudhary, RK Singh, Janani P, Clarissa Challam, N. Sailo, Anuj Bhatnagar, Vinay Sagar, Paresh Chaukhande, Brajesh Nare, Sukhwinder Singh, Sugani Devi, Som Dutt, Ratna Preeti Kaur, Prince Kumar, Dharmendra Kumar, Kailash C Naga, Yogesh Gautam

Field experiments were carried out in this programme under different research project activities during 2024. Main activities were: Indian GAP for production of potato crop; Refining system based organic potato production technologies; Refining organic potato protection technologies for sustainable yields; development of potato-based cropping systems for different agro-ecologies; development of rapid seed potato production technologies; Engineering technologies for potato production and utilization, and mechatronics in potato

production. Research activity wise salient findings and conclusions are as follows:

Indian good agricultural practices (GAP) for production of potato crop

Field screening of advanced clones at Modipuram for export potential:

Thirty-nine advanced hybrids and check varieties were evaluated during 2023-24 for export parameters i.e. shape (oblong and round), size (>55 mm), tuber dry matter content (>18%), cosmetic value (skin colour, shine, texture *etc.*). Clone HT/12-751, MS/14-243, MS/13-391, MP/14-505, MS/15-1001, MS/14-1381, HT/12-830, MS/18-393, MS/13-391, MS/16-1156 were promising during the fourth year of evaluation (Fig. 1). Twenty-one advanced clones and check were selected during 2023-24 and planted in the field for further evaluation at Modipuram during 2024-25.

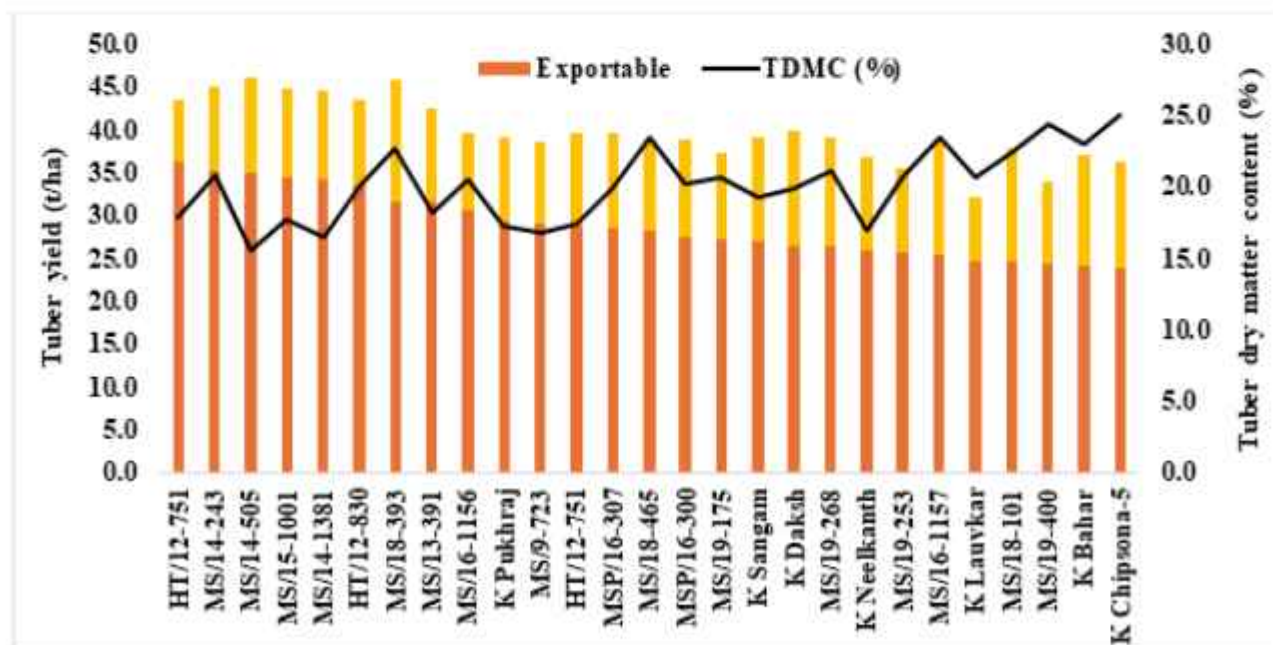


Fig.1: Yield performance of advanced potato clones for export purpose at Modipuram

Refining system based organic potato production technologies

Evaluation of advanced clones at Modipuram for organic/ natural farming:

Thirty-nine advanced clones/hybrids were evaluated during 2023-24 under organic production systems at Modipuram. Selections were made for their earliness, yield performance,

resistance to diseases and pest, appearance of tubers, dry matter content *etc.* Promising advance clones recorded during the crop season were HT/12-751, MS/13-391, MS/14-243, HT/12-830, MS/19-400, MS/18-465, MS/19-175 and MS/15-1001 under organic production system (Fig. 2). Twenty accessions along with checks (control) were selected during 2023-24 and planted in field for screening during 2024-25.

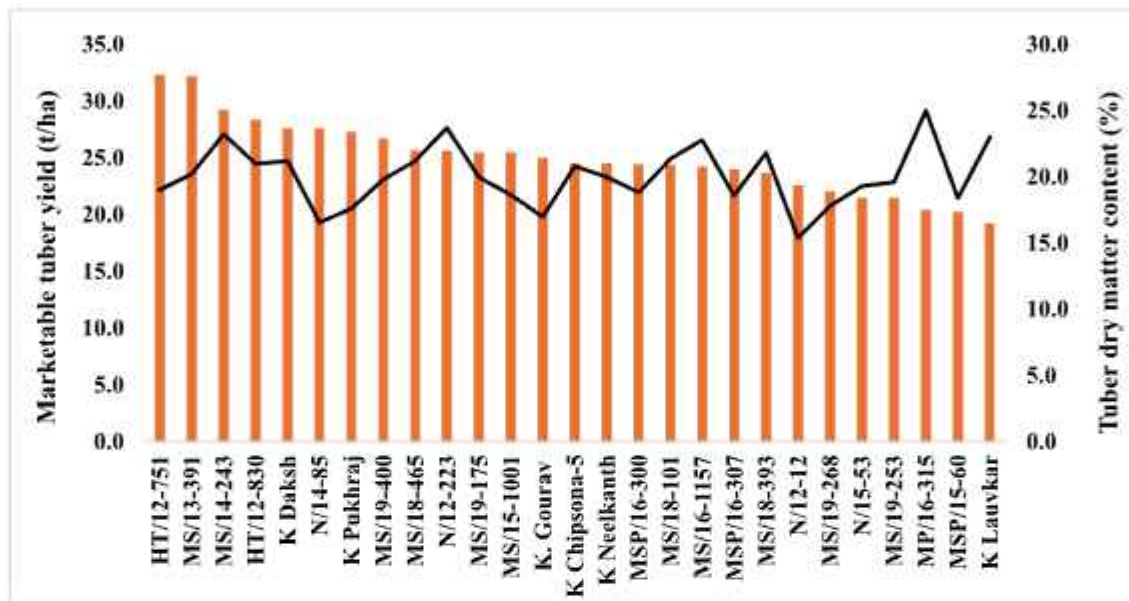


Fig. 2: Yield performance of promising genotypes under organic production system at Modipuram

Developing organic nutrition technology for potato crop in north-eastern Himalayas:

A field experiment was conducted at Shillong to study the effect of different organic manures on potato (cv. Kufri Himalini) growth and yield under rain fed conditions consisting nine treatments- T_1 -control (0), T_2 -100% NPK through inorganic fertilizers, T_3 -100% N through farmyard manure (FYM), T_4 -100% N through Pig manure (PiM), T_5 -100% N through poultry manure (PM), T_6 -50% N through farmyard manure (FYM)+ 50% N through vermicompost (VC), T_7 - 50% N through pig manure (PiM) + 50% N through Vermicompost (VC), T_8 - 50% N through poultry manure (PoM) + 50% N through vermicompost (VC) and T_9 - integrated nutrient management (100% NPK and FYM). The soil at the experimental site had a pH 4.31, organic carbon 1.74% and available N, P, K were 253, 19, 230 kg/ha respectively. The total nitrogen, phosphorus and potassium content of

manures were as follows: FYM - 0.54%, 0.40%, and 0.91%; pig manure - 0.84%, 0.61%, and 0.81%; poultry manure - 1.54%, 0.83%, and 1.28%; and vermicompost - 1.20%, 0.42% and 1%. FYM at 28 t/ha, pig manure at 17 t/ha, poultry manure at 9.0 t/ha and vermicompost at 12.0 t/ha were used on dry weight basis to supply 100% RDN (140 kg N/ha) to the potato crop. Tuber yield ranged from 5.29 t/ha in control to 22.32 t/ha in integrated nutrition from inorganic and organic sources. Results indicated that while yield and other traits significantly increased with combined use of nutrients, organic sources also showed promising results. Among organic manures, highest yield was observed with poultry manure and vermicompost (14.80 t/ha), followed by poultry manure (13.91 t/ha), combination of pig manure and vermicompost (13.83 t/ha), pig manure (12.15 t/ha) and lowest (5.29 t/ha) in control (Fig. 3).

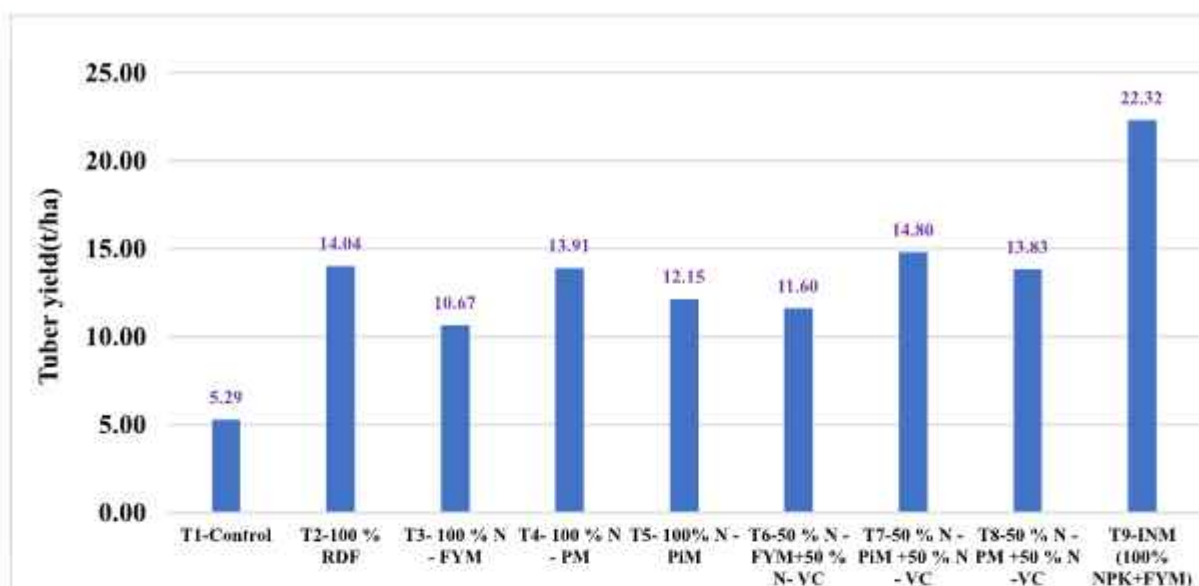


Fig. 3: Effect of organic manures on tuber yield of Kufri Himalini at Shillong

Refining organic potato protection technologies for sustainable yields

Organic management of late blight of potato:

It is a serious disease of potato crop and requires more attention in organic potato production. Eight treatments consisting different plant-based extracts, organic-based products and copper hydroxide (standard check) were evaluated against late blight disease by applying four sprays during the *Rabi* season of 2023-24 on cv. Kufri Bahar (susceptible) and Kufri Mohan (moderately resistant). It was observed that all

treatments recorded less terminal disease severity in comparison to control. Lowest terminal disease severity (38.0 %) was recorded in treatment T4 (neem oil @ 6.0 %), followed by T1 (fennel extract @ 5.0 %) and T3 (black pepper @ 5.0%) against control (65.0 %) in cv. Kufri Mohan (Fig. 4). Treatments T1, T3 and T7 also remained at par with each other. Similar trend was observed in cv. Kufri Bahar, but comparatively with a higher level of terminal disease severity. This study will be repeated during next cropping season in 2024-25 for confirmation of the results.

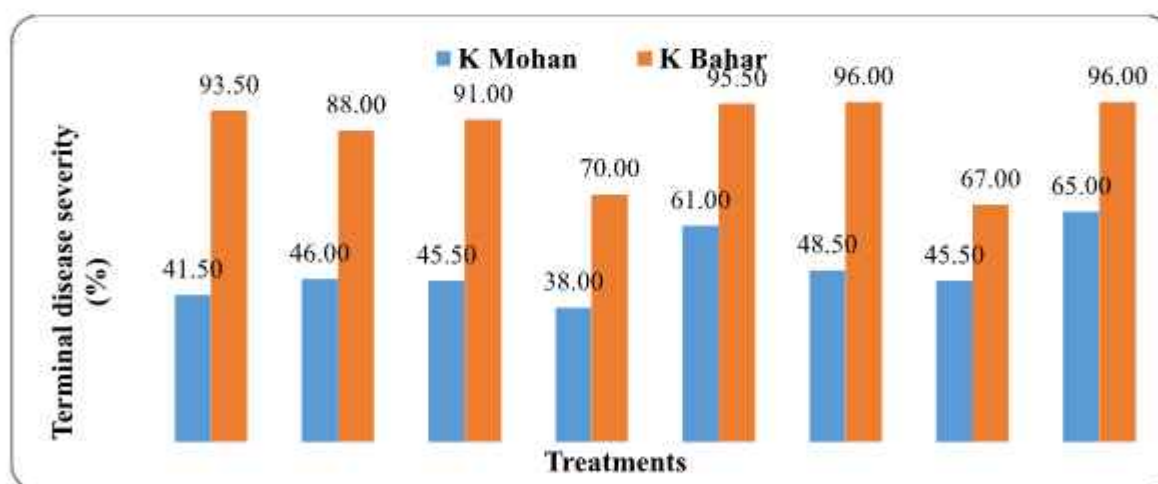


Fig. 4: Effect of different plant based extract against late blight on cv. K Mohan and K Bahar
T1: Fennel extract@ 5.0%; T2: Ginger extract@ 5.0%; T3: Black pepper@ 0.5%; T4: Neem oil@ 6%;
T5: Dashparni@ 5%; T6: Panchgavya@ 5.0%; T7: Copper hydroxide@ 0.2%; T8: Control [Kufri Mohan (CD_{0.05}: 4.58; SE (m): 1.50); Kufri Bahar (CD_{0.05}: 5.79; SE (m): 1.90)]

Organic management of black scurf of potato:

Black scurf of potato is an important soil and tuber-borne fungal disease. In this study, fifteen treatments consisting of neem kernel, cow urine, jeevamrit, rotted whey, waste decomposer, rotted banana, dry turmeric, copper oxychloride, copper sulphate and standard check Pencycuron 22.9% SC were evaluated for management of this disease in potato cv. Kufri Bahar during Rabi season of 2022-23 and 2023-24. It was observed that all treatments showed less disease incidence and severity in comparison to the control. Treatment T1: cow urine @ 100% pure dip recorded the lowest average disease incidence (24.33%) and severity (10.12%) followed by

treatment T8: Jeevamrit @ 200 ml/l (DI: 56.56%; DS: 25.94%), T7: neem kernel @ 20 g/l pure crushed powder (DI: 57.71%; DS: 27.41%) and treatment T12: Cow urine (1:10 ratio) dip treatment (DI: 58.53%; DS: 24.22%) in comparison to the diseased control (DI: 82.17%; DS: 38.37%). Treatment T3: Waste decomposer+ Neem kernel@100 ml/l also exhibited lower disease incidence and severity (Fig. 5). Cow urine, jeevamrit and neem kernel treatments reduced the disease incidence significantly and these above-mentioned treatments combinations may be used for the management of black scurf of potato under organic/ natural farming practices.

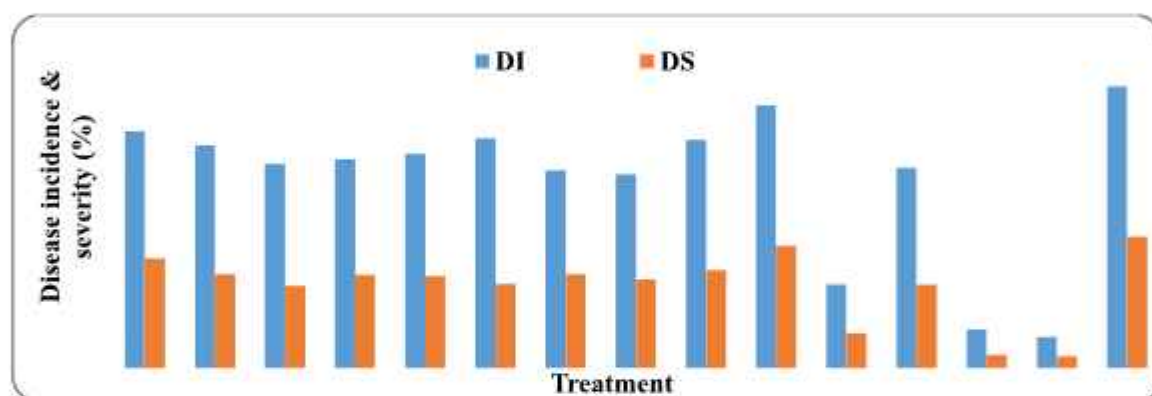


Fig. 4: Effect of different plant based extract against late blight on cv. K Mohan and K Bahar

T1: Fennel extract@ 5.0%; T2: Ginger extract@ 5.0%; T3: Black pepper@ 0.5%; T4: Neem oil@ 6%; T5: Dashparni@ 5%; T6: Panchgavya@ 5.0%; T7: Copper hydroxide@ 0.2%; T8: Control [Kufri Mohan ($CD_{0.05}$: 4.58; SE (m): 1.50); Kufri Bahar ($CD_{0.05}$: 5.79; SE (m): 1.90)]

Evaluation of bio-pesticides against white fly (*Bemisia tabaci*) and aphid (*Myzus persicae*) in potato (*Solanum tuberosum*):

A field trial was conducted to assess the efficacy of various pest management strategies against white fly and aphid in potato cv. Kufri Mohan. The study evaluated six treatments including botanical extracts (neem and pongamia-based formulations), microbial biopesticides (*Beauveria bassiana*), and a conventional chemical insecticide (imidacloprid) in RBD consisting three replications. Two rounds of sprays were administered and pest populations were monitored at multiple intervals post-treatment. Results demonstrated distinct efficacy patterns across treatments and spray intervals. Among biopesticides, *Neemazal* consistently showed high performance in white fly management as it recorded 77.5% reduction at 1 day after second

spray (DAS) and sustained it at 75.7% by 5 DAS. Pongamia soap and neem soap also improved in second spray, while *Beauveria bassiana* and *Neemastra* showed inconsistent outcomes. Imidacloprid (synthetic standard) exhibited strong and sustained late-stage efficacy reaching 48.6% white fly reduction at 7 DAS (Fig. 6).

For aphid control, *Neemazal* and imidacloprid emerged as the most effective treatments, with both achieving 100% reduction at 7 DAS. Imidacloprid showed complete control as early as 3 DAS, reflecting its systemic action and rapid knockdown effect. In contrast, while *Neemastra* and pongamia soap displayed erratic initial efficacy, they too achieved 100% aphid suppression at 7 DAS, suggesting delayed but notable residual activity. *Beauveria bassiana* remained unreliable across both sprays. Negative

reductions observed during early post-treatment intervals likely reflect pest agitation, repellency effects or sampling inconsistencies rather than treatment failure (Fig. 7).

The study highlights the critical role of repeated applications in enhancing bio-pesticide performance and demonstrates that certain bio-

pesticides particularly *Neemazal* can approach the efficacy of conventional insecticides when appropriately applied. These findings support the integration of botanicals into pest management programme for potato crop. However, the variability observed in some treatments highlights the need for further refinement in formulation and application strategies to ensure consistency under field conditions.

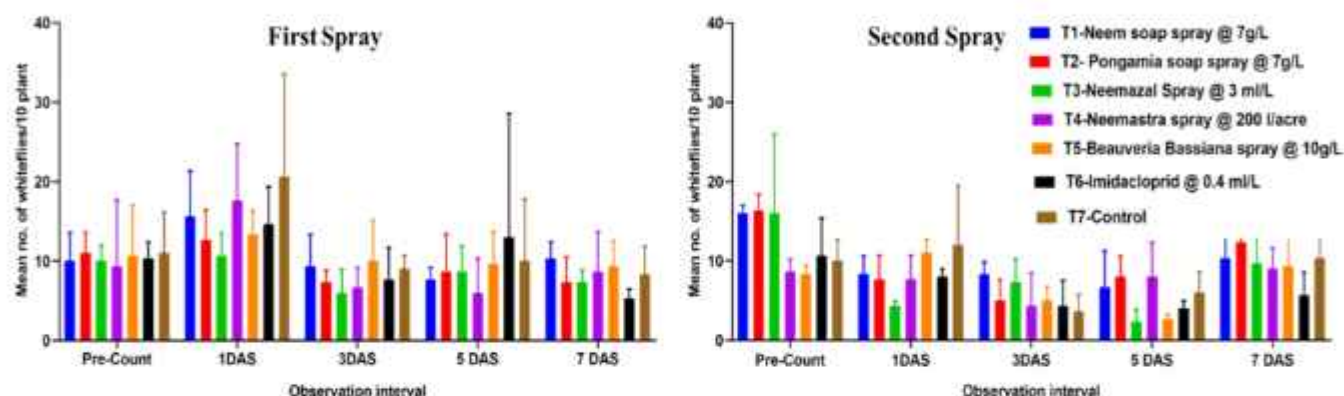


Fig. 6: Pre and post-spray population dynamics after first and second spray as influenced by different treatments against white fly in potato

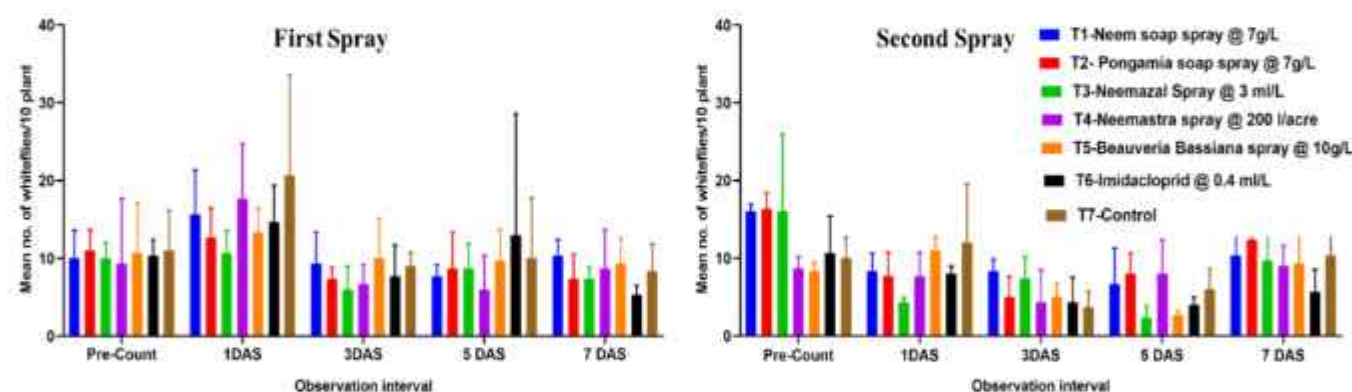


Fig. 7: Pre and post-spray population dynamics after first and second spray as influenced by different treatments against aphid in potato

Development of potato based cropping systems for different agro-ecologies

Potato productivity under different cropping systems and nutrition source:

A field experiment was conducted at Patna having three cropping systems (sorghum fodder-potato, green gram- potato and rice- potato), three nutrient sources (100% recommended dose of NPK fertilizer i.e. RDF (, 100% organic based RDF and control), and consisting three replications. : T₁-control (0), T₂-100% NPK through inorganic fertilizers, T₃-100% N through farmyard manure (FYM), T₄-100% N through pig

manure (PiM), T₅-100% N through poultry manure (PM), T₆-50% N through farmyard manure (FYM)+ 50% N through vermi compost (VC), T₇- 50% N through pig manure (PiM) + 50% N through vermicompost (VC), T₈- 50% N through poultry manure (PoM))+ 50% N through vermicompost (VC) and T₉- Integrated Nutrient Management (100% NPK and FYM). The soil at the experimental site had a pH 4.31, organic carbon 1.74% and available N, P, K were 253, 19, 230 kg/ha respectively. The total nitrogen, phosphorus and potassium content of manures were as follows: FYM - 0.54%, 0.40%, and 0.91%; pig manure - 0.84%, 0.61%, and

0.81%; poultry manure - 1.54%, 0.83%, and 1.28%; and vermicompost - 1.20%, 0.42% and 1%. FYM at 28 t/ha, pig manure at 17 t/ha, poultry manure at 9.0 t/ha and vermicompost at 12.0 t/ha were used on dry weight basis to supply 100% RDN (140 kg N/ha) to the potato crop. Highest and statistically higher total tuber numbers were recorded with green gram- potato sequence (402000/ha) as compared to other rotations. Among nutrient management

practices, highest and markedly superior total tuber numbers were observed with 100% RDF over other two treatments. Highest and significantly higher total tuber yield was attained by green gram- potato system (16.5 t/ha) when compared with rest of two sequences. Among nutrient management practices, higher and statistically significant total tuber yield (18.0 t/ha) was found in 100% RDF over other two treatments (Fig. 8 & 9).

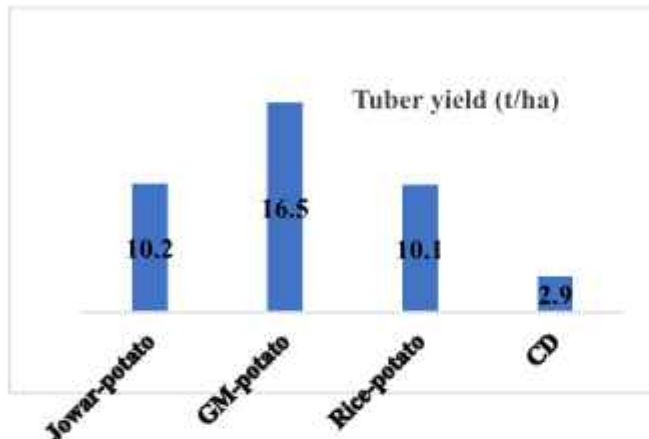


Fig. 8: Tuber productivity under different cropping systems at Patna

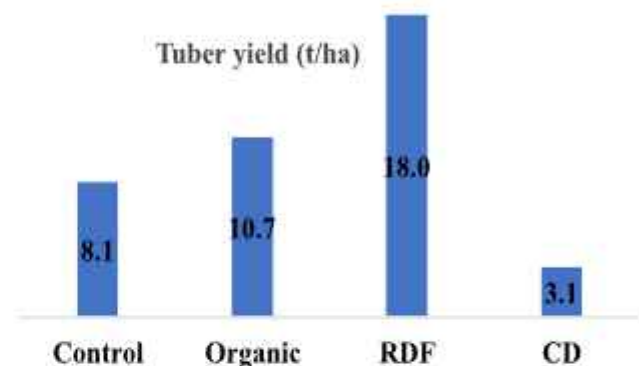


Fig. 9: Tuber productivity under different source of nutrition at Patna

Evaluation of diversified potato-based cropping systems under different crop management practices in Indo-Gangetic plains: Continuous adoption of rice-wheat cropping system (RWCS) in Indo-Gangetic plains (IGPR) has led to decline in soil fertility and groundwater table, emergence of multi-nutrient deficiencies, declining crop yields, low input-use efficiency, and high production costs *etc.* To address these sustainability issues, current study aimed at assessing the comparative performance of three alternative cropping systems (potato-rice, potato-green gram-rice, potato-cowpea-rice) in main-plots under four crop management practices [conventional farming practice (CFP), integrated crop management (ICM), natural farming

(NFP), and organic farming practice (OFP)] taken up in sub-plots at Modipuram in a split-plot design replicated thrice. First year results of *Rabi* 2023-24 revealed that cropping system effect was non-significant on potato (cv. Kufri Bahar) growth and yield. However, among different crop management practices, ICM practice proved more beneficial for plant growth, and graded and total tuber numbers and yield. ICM exhibited significantly higher total tuber yield (25.34 t/ha) followed by CFP (22.4 t/ha), OFP (22.19 t/ha) and NFP (16.27 t/ha), respectively. ICM also recorded comparable tuber dry matter content (19.22%) to OFP (19.39%), whereas, highest of this trait (20.7%) was observed in NFP (Table 1 & 2).

Table 1: Effect of diversified cropping systems and crop management practices on growth and yield attributes of potato at Modipuram

Treatments	Emergence count (%)	Plant ht. (cm)		SPAD values		Tuber numbers (×1000/ha)			
		60 DAT	75 DAT	60 DAT	75 DAT	Small (<50 g)	Medium (50-100 g)	Large (>100 g)	Total
Cropping systems (CS)									
CS ₁ : Potato–Rice	87.1	34.8	37.3	42.2	37.4	114	286	25.2	425
CS ₂ : Potato–Mungbean–Rice	86.9	33.8	36.2	43.3	36.9	120	302	27.6	449
CS ₃ : Potato–Cowpea–Rice	86.2	35.7	38.1	39.7	36.2	98	265	27.4	390
SE(m)±	0.21	1.36	1.50	1.39	1.39	9.31	9.77	4.19	20.92
CD _{0.05}	NS	NS	NS	NS	NS	NS	NS	NS	NS
Crop management practices (CMPs)									
CMP ₁ : Conventional practice	86.6	36.3	38.4	42.2	38.3	93	287	31	422
CMP ₂ : ICM practice	86.3	38.9	42.3	43.5	38.4	117	299	41	459
CMP ₃ : Natural farming practice	85.2	29.5	31.2	39.7	34.8	69	266	13	370
CMP ₄ : Organic farming practice	85.8	34.4	36.8	41.6	35.8	111	286	23	435
SE(m)±	0.54	0.93	1.11	0.61	0.56	5.41	6.43	2.31	8.68
CD _{0.05}	NS	2.78	3.33	1.84	1.67	16.21	19.25	6.91	25.99

Treatment description: CMP₁: Conventional Practice [100% NPK (180:80:100 kg NPK/ha) through Urea, DAP & MOP (50% N at planting & 50% N at 25-30 DAP) alongwith need based chemical weed, pest & disease management; CMP₂: Integrated Crop Management (ICM) practice [100% NPK through chemical fertilizers (50% N at planting & 50% N at 25-30 days after planting (DAP)) + vermicompost, VC @ 5 t/ha + Microbial consortia (MC)-Seed treatment (ST) + Residue mulching @ 3 t/ha + *Need Based NF-IWM, IDM & IPM]; CMP₃: Natural Farming Practice [Beejamrit (Seed treatment-ST) + Residue mulching @ 3 t/ha + Jeevamrit at 30, 45, 60, 75 DAP (Min. 4) + *Lassi* spray at 15 days interval till 90 DAP + Agnisastra for IPM]; CMP₄: Organic Farming Practice (OFP) [VC @ 18 t/ha eq. to 180 kg N/ha (ODWB) + Microbial consortia (MC)-ST + Residue mulching @ 3 t/ha + **Need Based OF-IWM, IDM & IPM + *Trichoderma* spp. The vermicompost had 1% N-0.5% P₂O₅-1.5% K₂O. The Microbial consortia (MC) contained *Azotobacter* + PSB + KSB + AM-fungi.

Table 2: Effect of diversified cropping systems and crop management practices on tuber yield and haulms dry yield at Modipuram

Treatments	Tuber yield (t/ha)				Tuber DMC (%)	Haulm dry yield (t/ha)
	Small (<50 g)	Medium (50-100 g)	Large (>100 g)	Total		
Cropping systems (CS)						
CS ₁ : Potato–Rice	1.42	16.20	4.01	21.62	19.52	1.48
CS ₂ : Potato–Mungbean–Rice	1.30	17.00	4.16	22.46	19.00	1.58
CS ₃ : Potato–Cowpea–Rice	1.15	15.53	3.89	20.56	20.01	1.36
SE(m)±	0.12	1.07	0.48	1.53	0.54	0.18
CD _{0.05}	NS	NS	NS	NS	NS	NS
Crop management practices (CMPs)						
CMP ₁ : Conventional practice	1.21	16.60	4.59	22.40	18.72	1.57
CMP ₂ : ICM practice	1.38	17.73	6.23	25.34	19.22	1.96
CMP ₃ : Natural farming practice	1.10	13.34	1.82	16.27	20.70	1.02
CMP ₄ : Organic farming practice	1.47	17.29	3.43	22.19	19.39	1.35
SE(m)±	0.07	0.67	0.32	0.67	0.40	0.06
CD _{0.05}	0.22	2.03	0.97	2.02	1.20	0.17

Note: CMP₁: Conventional Practice [100% NPK (180:80:100 kg NPK/ha) through Urea, DAP & MOP (50% N at planting & 50% N at 25-30 DAP) along with need based chemical weed, pest & disease management; CMP₂: Integrated Crop Management (ICM) practice [100% NPK through chemical fertilizers (50% N at planting & 50% N at 25-30 days after planting (DAP)) + vermicompost, VC @ 5 t/ha + Microbial consortia (MC)-Seed treatment (ST) + Residue mulching @ 3

t/ha + *Need Based NF-IWM, IDM & IPM]; CMP₃: Natural Farming Practice [Beejamrit (Seed treatment-ST) + Residue mulching (*Achhadan*) @ 3 t/ha + Jeevamrit at 30, 45, 60, 75 DAP (Min. 4) + *Lassi* spray at 15 days interval till 90 DAP (Min. 3) + *Agnisastra* for IPM]; CMP₄: Organic Farming Practice (OFP) [VC @ 18 t/ha eq. to 180 kg N/ha (ODWB) + Microbial consortia (MC)-ST + Residue mulching @ 3 t/ha + **Need Based OF-IWM, IDM & IPM + *Trichoderma spp.* The vermicompost had 1% N-0.5% P₂O₅-1.5% K₂O. The Microbial consortia (MC) contained *Azotobacter* + PSB + KSB + AM-fungi.

Development of potato-millet production system and crop micronutrient bio-fortification in Central India:

This region experiences significant challenges in food security and micronutrient deficiencies (Fe & Zn), particularly among vulnerable population. Millets are known for high nutritional value and resilience to harsh environmental conditions. Hence, developing integrated potato-millet production systems coupled with micronutrient bio-fortification offers a sustainable approach to address malnutrition and food security through agronomic interventions. A field trial has been initiated at Gwalior during 2023 with three cropping systems (potato-pearl millet, potato-sorghum & potato-finger millet) taken up in main-plot, while six integrated micronutrient management practices [IMM₁: 100% NPK; IMM₂: 100% NPK+ ZnSB; IMM₃: 100% NPK + ZnSB + Zn 5 kg/ha (ZnSO₄ @ 25 kg/ha); IMM₄: 100% NPK + FSB; IMM₅: 100% NPK + FSB + Fe 5 kg/ha (FeSO₄ @ 25 kg/ha); and

IMM₆: 100% NPK + ZnSB + FSB + Zn 5 kg/ha (ZnSO₄ @ 25 kg/ha) + Fe 5 kg/ha (FeSO₄ @ 25 kg/ha)] were taken up in sub-plot in a split-plot design having three replications. The initial DTPA-extractable Zn and Fe content in the experimental soil were 0.42 and 4.35 mg/kg soil, respectively. Kufri Khyati was used as the test variety of potato crop. First-year findings of *Rabi* 2023–24 exhibited that treatment IMM₆ resulted in significantly higher number of medium and large sized tubers, while very small & small sized tubers were reduced across all three crop sequences. This resulted into maximum and markedly superior total tuber yield (33.65 t/ha) in IMM₆ (Table 3 & 4). Since, Zn plays a crucial role in stimulating both vegetative growth and tuber formation in potato. Likewise, Fe is vital for chlorophyll synthesis and sugar metabolism leading to improved tuber development. Hence, dual application of Fe and Zn in early bulking var. Kufri Khyati showed higher response in terms of tuber yield in this cultivar (Table 3 & 4).

Table 3: Effect of integrated micronutrient management practices on growth and yield attributes of potato at Gwalior

Treatments	Plant ht. (cm)		Tuber numbers (×1000/ha)				
	60 DAT	75 DAT	Very small (<25 g)	Small (25-50g)	Medium (50-75g)	Large (>75 g)	Total
IMM ₁ : 100% NPK	44.83	55.78	203	162	61	129	555
IMM ₂ : 100% NPK+ ZnSB	51.71	60.73	149	123	69	137	478
IMM ₃ : 100% NPK + ZnSB + Zn 5 kg/ha (ZnSO ₄ @ 25 kg/ha)	56.81	64.03	119	110	79	146	455
IMM ₄ : 100% NPK + FSB	49.27	58.77	164	135	65	133	497
IMM ₅ : 100% NPK + FSB + Fe 5 kg/ha (FeSO ₄ @ 25 kg/ha)	53.38	62.73	148	117	76	144	484
IMM ₆ : 100% NPK + ZnSB + FSB + Zn 5 kg/ha (ZnSO ₄ @ 25 kg/ha) + Fe 5 kg/ha (FeSO ₄ @ 25 kg/ha)	61.80	68.80	110	99	94	153	456
SE(m)±	2.12	3.32	6.35	7.18	3.55	6.48	12.20
CD _{0.05}	6.07	9.49	18.21	20.58	10.20	18.53	34.99

Note: IMM: Integrated micronutrient management; IMM₁: 100% NPK only (150:100:100 kg NPK/ha) through Urea, DAP & MOP (50% N at planting & 50% N at 25-30 DAP); IMM₂: 100% NPK+ ZnSB (Zn-solubilizing bacteria); IMM₃: 100% NPK + ZnSB + Zn 5 kg/ha (ZnSO₄ @ 25 kg/ha); IMM₄: 100% NPK+ FSB (Fe-solubilizing bacteria); IMM₅: 100% NPK + FSB + Fe 5 kg/ha (FeSO₄ @ 25 kg/ha); IMM₆: 100% NPK + ZnSB + FSB + Zn 5 kg/ha (ZnSO₄ @ 25 kg/ha) + Fe 5 kg/ha (FeSO₄ @ 25 kg/ha).

Table 4: Effect of integrated micronutrient management practices on tuber yield & dry matter content and haulm dry yield at Gwalior

Treatments	Potato tuber yield (t/ha)					Tuber DMC (%)	Haulm dry yield (t/ha)
	Very small (<25g)	Small (25-50g)	Medium (50-75g)	Large (>75g)	Total		
IMM ₁ : 100% NPK	1.42	4.19	3.33	19.21	28.16	17.35	1.56
IMM ₂ : 100% NPK+ ZnSB	1.25	3.35	3.98	21.53	30.12	17.50	1.65
IMM ₃ : 100% NPK + ZnSB + Zn 5 kg/ha (ZnSO ₄ @ 25 kg/ha)	1.04	2.97	4.56	23.43	32.01	18.68	1.73
IMM ₄ : 100% NPK + FSB	1.25	3.46	3.93	21.16	29.80	17.46	1.61
IMM ₅ : 100% NPK + FSB + Fe 5 kg/ha (FeSO ₄ @ 25 kg/ha)	0.99	2.77	4.43	22.93	31.12	18.77	1.70
IMM ₆ : 100% NPK + ZnSB + FSB + Zn 5 kg/ha (ZnSO ₄ @ 25 kg/ha) + Fe 5 kg/ha (FeSO ₄ @ 25 kg/ha)	0.95	2.55	5.77	24.69	33.65	19.11	1.86
SE(m)±	0.06	0.14	0.18	0.63	0.71	0.22	0.04
CD _{0.05}	0.17	0.39	0.53	1.79	2.04	0.63	0.13

Note: IMM: Integrated micronutrient management; IMM₁: 100% NPK only (150:100:100 kg NPK/ha) through Urea, DAP & MOP (50% N at planting & 50% N at 25-30 DAP); IMM₂: 100% NPK+ ZnSB (Zn-solubilizing bacteria); IMM₃: 100% NPK + ZnSB + Zn 5 kg/ha (ZnSO₄@ 25 kg/ha); IMM₄: 100% NPK+ FSB (Fe-solubilizing bacteria); IMM₅: 100% NPK + FSB + Fe 5 kg/ha (FeSO₄@ 25 kg/ha); IMM₆: 100% NPK + ZnSB + FSB + Zn 5 kg/ha (ZnSO₄@ 25 kg/ha) + Fe 5 kg/ha (FeSO₄@ 25 kg/ha).

Evaluation of leafy green vegetables in potato-based crop sequences in Meghalaya: A field trial was conducted at Shillong to evaluate five systems (potato- cabbage, potato- kale, potato-pak choi, potato- leafy type lettuce & potato-head type lettuce) during 2024-2025. The results revealed that potato productivity did not differ significantly among the sequences. Highest yield

of *Rabi* crops was recorded in potato- cabbage sequence (30.03 t/ha) followed by potato- pak choi (14.71 t/ ha) and potato- kale (11.24 t/ha) system. Among all cropping systems, adoption of potato- pak choi had significantly higher potato-equivalent yield (PEY) of *Rabi* crop (49.03 t/ha) and system PEY (65.56 t/ha) in comparison to other systems (Table 5).

Table 5: Effect of potato-based cropping sequences on the productivity of potato, individual crops and potato equivalent yield (PEY) of system (t/ha)

Cropping sequence		Yield (t/ha)			
		Potato	<i>Rabi</i> crop	PEY of <i>Rabi</i> crops	System PEY
CS1	Potato- Cabbage	16.94	30.30 ^a	30.30 ^b	47.24 ^b
CS2	Potato-Kale	17.18	11.24 ^{bc}	18.73 ^c	35.91 ^c
CS3	Potato-Pak Choi	16.53	14.71 ^b	49.03 ^a	65.56 ^a
CS4	Potato-Lettuce (leafy type)	16.50	7.10 ^c	23.66 ^{bc}	40.16 ^{bc}
CS5	Potato-Lettuce (Head type)	18.40	9.72 ^c	32.40 ^b	50.80 ^b
CD _{0.05}		NS	4.17	9.85	10.78

Development of rapid seed potato production technologies

Optimization of dose of CPRI formulation for tuber number enhancement in potato crop: A chemical formulation (CPRI-formulation) has been prepared for enhancing number of tubers. Previously dose of this formulation was standardised for varieties Kufri Jyoti and Kufri Pukhraj. New experiment was conducted at

Jalandhar to further optimize the dose of this formulation for other varieties. Five varieties were planted in first fortnight of October 2024 and de-haulming was done after 80 days. Total tuber number enhancement recorded was 10.8% in Kufri Khyati, 10.6% in Kufri Gaurav, 13.2% in Kufri Badshah, 16.7% in K Chandramukhi and 19.4% in K Himalini. Same formulation was provided to more than fifty farmers for their feedback.

Engineering technologies for potato production and utilization

Refinement of potato mini-tuber planting system: Refinements in development of a four row semi-automatic planting system has been done for precise planting of aeroponically produced mini-tubers. The system consists of four seed boxes, seed metering and delivery mechanism, power transmission system, sitting arrangement, ridger and furrow closer. It has been developed in previous year and now has been modified to achieve better performance and efficiency. Single seed box has been replaced with

four small seed boxes for individual rows. This arrangement facilitates the operator to feed mini-tubers at a faster rate. Ridger and seed covering devices have been modified to make uniform ridges, to place mini-tuber at a desired depth and to cover mini-tubers properly (figure 1). In this system, mini-tubers are poured in seed box. These are then placed manually into cavities present in metering unit which is further placed in ridges at a depth of 5-7cm through seed delivery tube. After this, soil covering device covers the placed mini-tubers with 5cm thick soil cover. The capacity of this machine is around 1.6-2.0 ha/day.



Fig. 1: Tractor operated semi-automatic potato minituber planting system

Mechatronics in potato production

Development of unmanned robotic ground vehicle for safe spray application of agrochemicals:

A remotely controlled GPS guided unmanned robotic ground vehicle (UGV) has been developed for targeted application of agrochemicals under field crops. It includes electric powered propelling unit, controlled agrochemical application systems and remotely operated GPS based auto-navigation and control systems mounted on a four wheel drive high clearance robotic vehicle. All wheels steering

system has been employed in UGV to reduce the turning radius which facilitates sharp turning of UGV in field. All wheels are powered with DC electric motors to increase traction of UGV on soil surface. The system is equipped with a GPS, rover controller, a remote controller and a telemetry system. Steering system and wheel rotations are controlled with combination of mechanical and electronic systems as per signal received from GPS. Boom type spraying system has been designed for targeted application of agrochemicals as per canopy cover and crop requirement, and its fabrication is under process.

DIVISION OF PLANT PROTECTION

PROGRAMME: RE-DEFINING EPIDEMIOLOGICAL PARAMETERS AND MANAGEMENT APPROACHES FOR POTATO PATHOGENS

PI: Dr. Sanjeev Sharma, **Co-PIs:** Drs. Vinay Sagar, Mehi Lal, Jagdev Sharma, Kailash Naga, Subhash S, Murlidhar Sadawarti, Subhash Katare, Chandan Maharana

Disease Monitoring and Pathogens Profile

Late blight appeared in the last week of December 2024 in Farrukhabad district of Uttar Pradesh on cv. Kufri Bahar. The disease severity ranged from 1-10%, and further disease could not spread over a large area due to unfavorable weather conditions. Late blight appeared in other parts of the country at a very late stage of the crop. In Shimla hills, though it appeared on 16th July, 2024 but could not develop and spread at faster rate due to prevailing high temperature and low humidity. However, at the end of the season the intensity of the disease reached to 100%.

Comparative Genomics of Potato Pathogens Characterization of *Phytophthora infestans*

A sub-set of population of *P. infestans* collected from different potato agro-ecologies during 2023-24 was monitored for mating types and sensitivity to fungicides. Earlier, we had reported the occurrence of self-fertile isolates in *P. infestans*. This year also the isolates were characterized for mating types and results revealed that 40% isolates from West Bengal, 12.5% from Himachal Pradesh and 16.67% from Punjab were self-fertile (homothallic). This information is important for planning strategies for the effective management of late blight in India.

A sub-set of isolates of *Phytophthora infestans* was also phenotyped for fungicide / oomycide (metalaxyl / mefenoxam, cymoxanil, dimethomorph, fenamidone) sensitivity. All tested isolates were observed to be intermediate resistant/resistant to metalaxyl / mefenoxam. Last year we reported insensitivity in *P. infestans* population towards cymoxanil. This year, further doses of cymoxanil were assessed using a detached leaf disc assay (Fig. 1). Six

concentrations of cymoxanil, ranging from 200 ppm to 700 ppm, were tested. The effective dose required to inhibit 50% of pathogen growth (ED_{50}) was determined using POLO Plus software (version 2.0). The calculated ED_{50} for the *P. infestans* population was 518.607 mg/L, with a 95% confidence interval ranging from 435.40 to 627.00 mg/L. However, the isolates were found sensitive to dimethomorph and fenamidone fungicides.

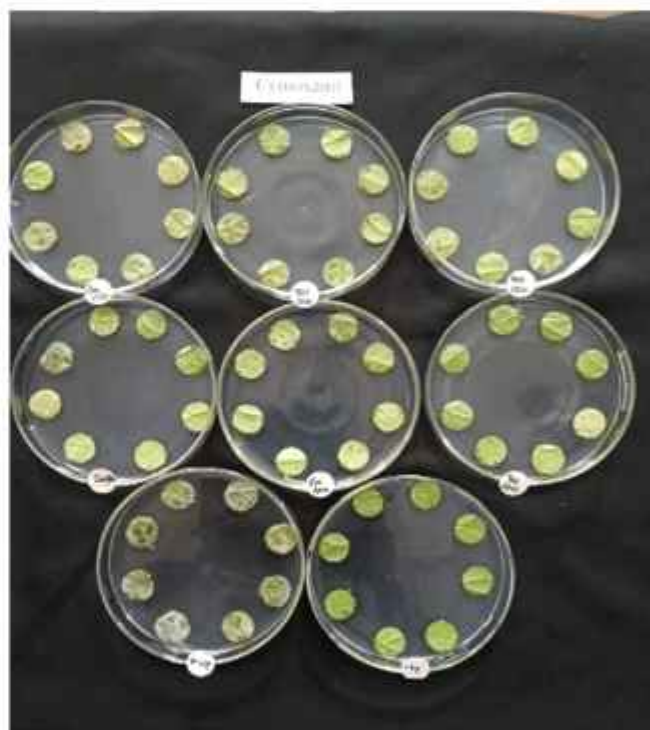


Fig. 1: Evaluation of cymoxanil against *Phytophthora infestans*

Sensitivity of fungicides against *Sclerotinia sclerotiorum*

Stem rot caused by *Sclerotinia sclerotiorum* is an emerging disease, especially in heavy canopy growth conditions and in net houses, due to high moisture and favourable temperature (15-25°C). No registered fungicides is available for its management in potato crop in India. Carbendazim-based chemicals do not show expected efficacy against this pathogen. Therefore, a subset (25 numbers) of collected

isolates of *Sclerotinia sclerotiorum* was evaluated for sensitivity against carbendazim 50% WP (systemic fungicide) at 0.5 and 1.0 ppm by poisoned food technique *in vitro*. Results revealed that 36%, 48% and 16% of isolates were resistant, intermediate sensitive and sensitive at 0.5 ppm, respectively, whereas 4% and 96% of isolates were intermediate sensitive and sensitive at 1.0 ppm, respectively (Fig.2).

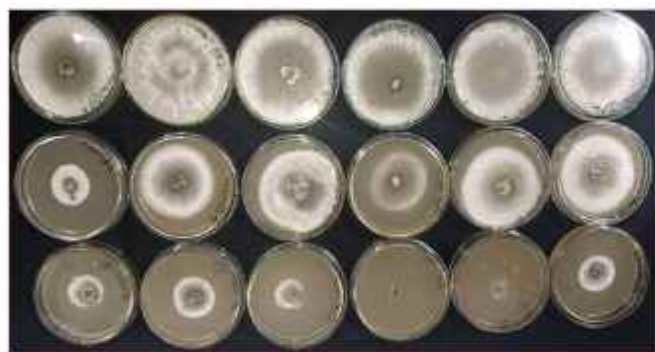


Fig. 2: Sensitivity of *Sclerotinia sclerotiorum* isolates against carbendazim 50% WP

Diagnostics and Detection of Potato Pathogens

Diagnosis and detection of potato pathogens using Near-Infrared spectroscopy

It is essential to have a quick, accurate and non-destructive methods of disease diagnosis and its progression. Sensitive digital solutions are needed that can describe the earliest detectable signatures of pathogen infection to avoid outbreaks and spread. Processing of images captured by different electromagnetic bands has vast applications to detect contamination in agricultural and food products. One of these bands is infrared domain that is acquired by spectroscopy. Near-Infrared (NIR) spectroscopy is based on the interaction between near-infrared light and the molecular bonds within a sample. When NIR light is directed at a sample, specific wavelengths are absorbed by various chemical bonds. The remaining light is either transmitted through or reflected by the sample, and this reflected or transmitted light is captured and analyzed by the device. The manifestation of host tissues can be detected by NIR spectroscopy due to its sensitivity to changes in water content, cellular structure, and other biochemical markers associated with infection and decay. These spectral changes correspond to the absorption features in the NIR region, reflecting alterations in the molecular composition of the infected

tissue resulting in specific spectral signatures that can be distinguished from healthy ones. This technique allows for early detection and progression of infection enabling timely intervention and management. This study was conducted in collaboration with M/s InfyU Labs, #402, Research Park, IIT Gandhinagar, Gujarat and M/s SK Cold Storage, Talod, Sabarkantha, Gujarat under collaborative research on "Development of IoT based Portable Technology for Non-invasive Rapid Potato Crop Management".

To achieve this, we utilized the InfyZer device, which utilizes the near-infrared region of the electromagnetic spectrum, typically ranging from 900 nm to 1700 nm, to probe the molecular structure of biological samples. The InfyZer device is equipped with highly sensitive NIR sensors that emit near-infrared light onto the sample. As the light interacts with the sample, certain wavelengths are absorbed based on the molecular composition of the sample. The reflected light, containing the spectral information of the absorbed wavelengths, is then detected and recorded by the device. The experiment utilized freshly harvested and uniformly sized tubers of potato cv Kufri Jyoti for studying early detection and build-up of late blight and dry rot diseases. Potato tubers were thoroughly washed with tap water to remove any adhering soil and subsequently surface sterilized with sodium hypochlorite (1%) and then rinsed with distilled water and air dried. Two sets of experiments were conducted separately for late blight and dry rot. Each set of experiment was further divided into three sub-sets i.e. healthy (uninjured & uninoculated), injured (without inoculation) and injured with inoculation tubers. Tubers were then incubated at 18°C (late blight) and 25°C (dry rot) for 30 days. Observations were recorded daily with InfyZer device. The captured spectral data was processed using advanced algorithms. These algorithms analyzed the spectral patterns to identify and quantify the presence of specific molecular bonds and compounds within the sample. For the tuber data collection, a meticulous approach was employed wherein each tuber was subjected to scanning at 10 distinct and predefined anatomical points. To enhance the reliability and precision of the data, five individual scans were performed at each of

these points. Statistical techniques were employed to analyze and interpret spectral data, allowing for the extraction of valuable information about potato quality attributes.

The accuracy of the model on Day 0 was observed to be 40%, likely due to the limited data collection period (2-3 hours), which may have constrained the quality and quantity of the initial training data. However, after two days, when

additional data became available, the model was retrained, resulting in a significant improvement in accuracy, reaching 85% (Fig. 3a). This increase suggests that the model benefited from a more diverse and representative dataset over time, enhancing its ability to generalize and make accurate predictions. The device has exhibited a detection accuracy rate of 93% (Fig. 3b) in identifying and diagnosing instances of late blight infections.

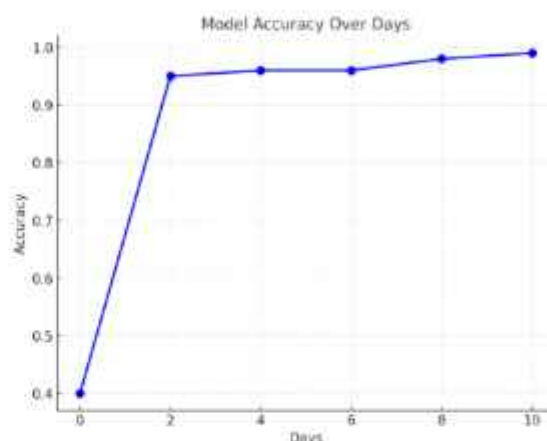
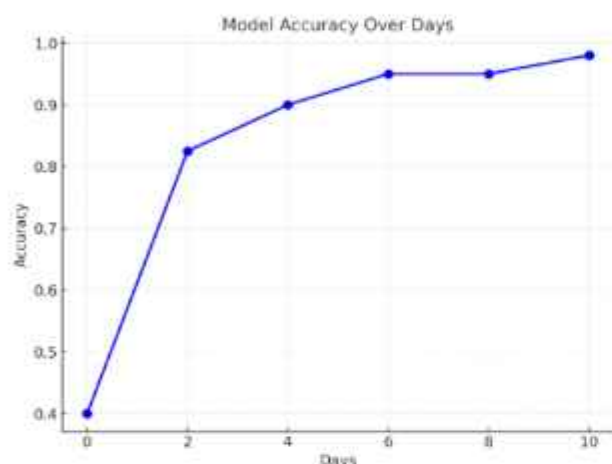


Fig. 3: Detection of late blight infection in tubers using InfyZer spectroscopy device

Similarly, the accuracy of the model on Day 0 for dry rot was observed 40%, which increased to 70% after two days (Fig. 4a) of inoculation. The

device has exhibited a detection accuracy rate of 88% (Fig. 4b) in identifying and diagnosing instances of dry rot infections.

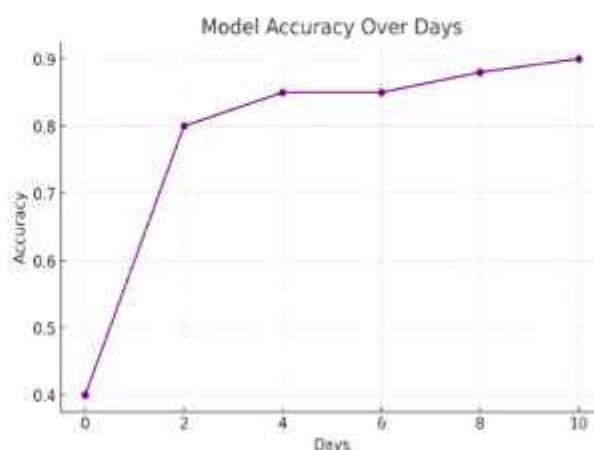
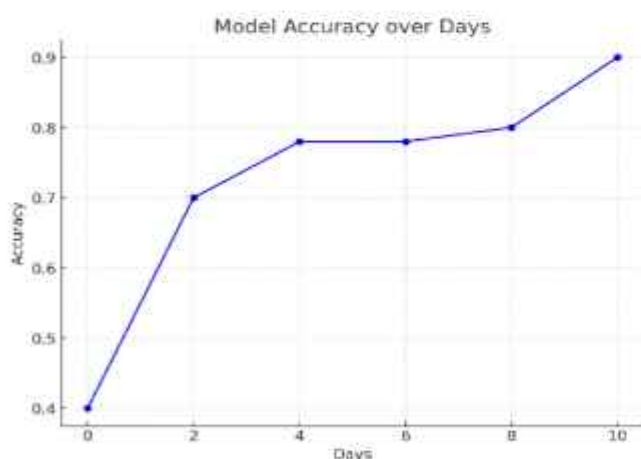


Fig.4: Detection of dry rot infection in tubers using InfyZer spectroscopy device

Epidemiology and Forecasting of Potato Pathogens

Forecasting of late blight

Indo-Blightcast model was used to predict appearance of late blight across the agro-

ecologies during *kharif* 2024 and *rabi* 2024-25 and the model predicted late blight accurately at each location (Table 1). Accordingly, the agro-advisories were issued to respective regions through print and electronic media to protect the crop from the onslaught of late blight.

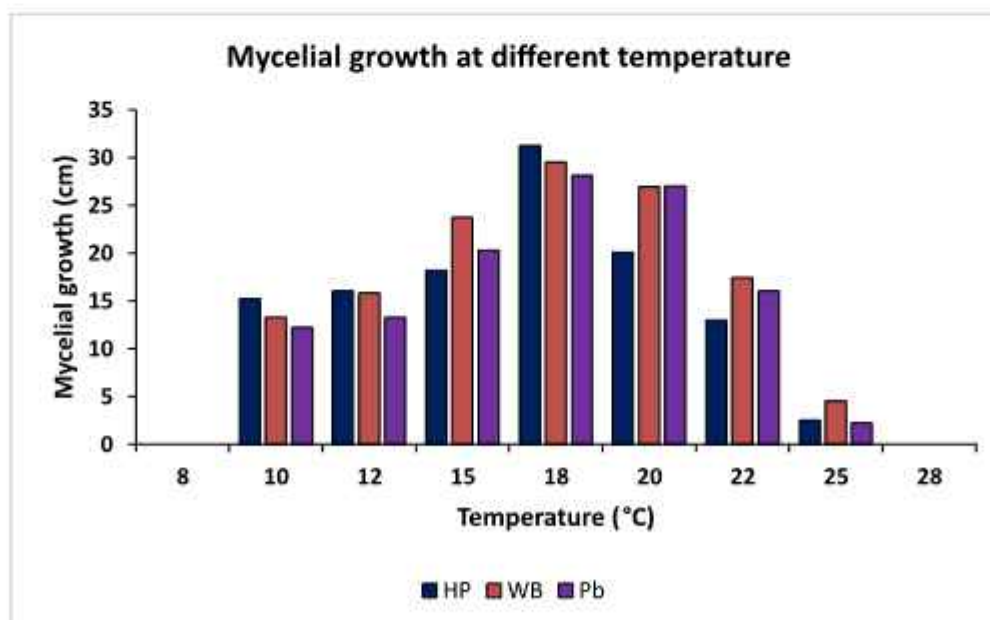
Table 1: Performance of Indo-Blightcast model during *kharif* 2024 and *rabi* 2024-25

Location	Prediction date of late blight	Actual date of late blight appearance
Bhubaneswar (Odisha)	Did not predict	Did not appear
Chhindwara (MP)	Did not predict	Did not appear
Deesa (Gujarat)	Did not predict	Did not appear
Dharwad (Karnataka)	Did not predict	Did not appear
Faizabad (UP)	Did not predict	Did not appear
Hassan (Karnataka)	07.07.2024	10.07.2024
Jorhat (Assam)	13.01.2025	19.01.2025
Kanpur (UP)	Did not predict	Did not appear
Kota (Rajasthan)	Did not predict	Did not appear
Pantnagar (Uttarakhand)	04.01.2025	15.01.2025
Bankura (WB)	08.01.2025	21.01.2025
Burdwan (WB)	12.01.2025	23.01.2025
Hooghly (WB)	09.01.2025	18.01.2025
Jalpaiguri (WB)	16.12.2024	29.12.2024
West Mednapur	16.01.2025	29.01.2025
Shimla (HP)	08.07.2024	16.07.2024

Comparative epidemiological studies of *P. infestans* isolates

A sub-set of isolates of *P. infestans* collected from Himachal Pradesh (HP), West Bengal (WB) and Punjab (Pb) were compared for their mycelial growth at 8, 10, 12, 15, 18, 20, 22, 25 and 28 °C. Diametric growth was observed from 4th day to 14th day and mean values calculated. Results showed that temperature ranging from 8 to 28 °C greatly affected mycelial growth. No mycelial growth was observed at 8 and 28 °C. Mycelial growth was observed in the range of 10–25 °C. There was an increasing trend in mycelial growth

from 10 to 18 °C and thereafter declined with the optimum temperatures being 15–20 °C. At 10 °C, maximum mycelial growth (15.21 cm) was exhibited by HP isolates followed by WB (13.29 cm) and Punjab (12.25 cm). At 12 °C, maximum mycelial growth was exhibited by HP (16.00 cm) and WB (15.83 cm) isolates while lowest was recorded in Pb (13.25 cm) isolates. At 15, 20, 22 and 25 °C, highest mycelial growth was exhibited by West Bengal followed by Punjab and Himachal Pradesh isolates (Fig. 5a) while at 18 °C, maximum mycelial growth was observed in HP followed by WB and Pb isolates.



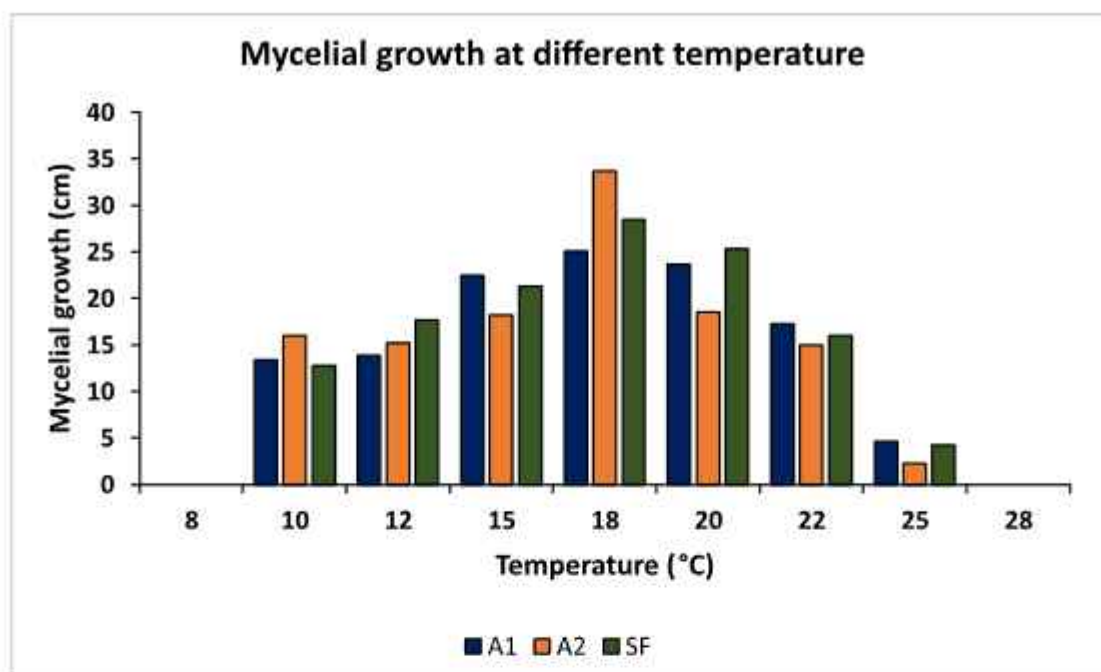


Fig. 5: Effect of temperature on growth of *Phytophthora infestans*:
a) isolates from different locations, b) different mating types

Similarly, different mating types viz., A1, A2 and self-fertile (SF) were also evaluated at different temperatures for their mycelial growth. At 10°C, maximum mycelial growth (16.00 cm) was observed in A2 mating type followed by A1 (13.40 cm) and SF (12.75 cm). At 12°C, maximum mycelial growth was observed in SF (17.65 cm) followed by A2 (15.20 cm) and A1 (13.85 cm) mating types. At 18°C, highest mycelial growth (33.70 cm) was recorded in A2 followed by SF (28.45 cm) and A1 (25.05 cm) mating type. At 15, 20, 22 and 25°C, highest mycelial growth was observed in A1/SF followed by A2 mating type (Fig. 5b). This study clearly indicates that self-fertile isolates are equally competitive with A1 and A2 mating types thus posing a serious threat to late blight management.

Management of Potato Pathogens

Evaluation of new chemicals for late blight management

P. infestans rapidly adapts to fungicides following regular application. Therefore, new fungicides

must be tested frequently to assess their efficacy and determine their suitability for inclusion in spray schedules to effectively manage late blight disease. Seven treatments consisting of existing and new fungicides (Kresoxim-methyl 15% + chlorothalonil 56% WG, Amisulbrom 20% SC & Valifenalate 6% + Mancozeb 60% WG) were evaluated applying three sprays against late blight of potato during the *Rabi* season 2022-23 and 2023-24. Amongst seven treatments, T7: Valifenalate 6% + Mancozeb 60% WG @0.5% (12.75% DS), T6: Valifenalate 6% + Mancozeb 60% WG @0.4% (16.13% DS), T3: Fenamidon 10 + Mancozeb 50% WG @0.3% (17.38% DS), T4: Kresoxim-methyl 15% + chlorothalonil 56% WG @0.2% (17.50% DS), and T1: Dimethomorph @0.1% (22.50% DS) showed less disease severity as against control (87.25%, Fig. 6). The treatments T7 and T6 significantly differed from each other; however, treatments T6, T3 & T4 are on par with each other. This experiment concluded that these chemicals could be used for effective management of late blight of potato.

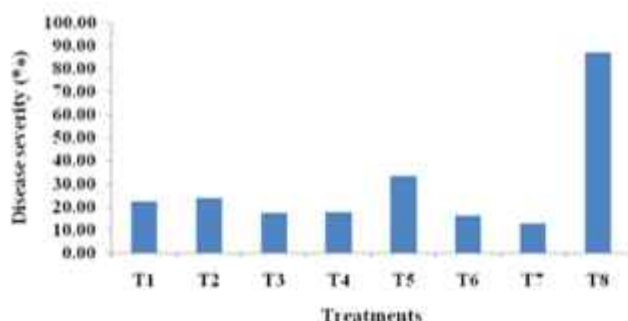


Fig.6: Efficacy of new chemicals against late blight of potato

[T1: Dimethomorph 50%WP @ 0.1%, T2: Cymoxanil 8+mancozeb 64% WP @ 0.3%, T3: Fenamidon 10+mancozeb 50% WG @ 0.3%, T4: Kresoxim-methyle 15%+chlorothalonil 56% WG @ 0.2%, T5: Amisulbrom 20% SC @ 0.1%, T6: Valifenalate 6% + Mancozeb 60% WG @0.4%, T7: Valifenalate 6% + Mancozeb 60% WG @ 0.5%, T8: Control]

Tank mixed spray schedule for management of late blight and insects

Nowadays, the availability of farm labours for timely chemical spraying to manage diseases is challenging. Therefore, an experiment was conducted to evaluate different tank-mixed spray schedules for managing late blight of potato and insect pests, with the objective of minimising the number of sprays while ensuring better efficacy. Six treatments were evaluated during the Rabi season 2022-23 and 2023-24 using three sprays; the first spray was initiated at the appearance of late blight disease and the remaining two sprays at 8–10-day intervals. Results revealed that treatment T3: Propineb 70% WP @ 0.2% + Imidacloprid 17.8 SL @ 0.04% - Dimethomorph 50% WP @0.1% + Flonicamid 20% WG @0.04% - Fenamidon 10 + mancozeb 50% WDG @0.3% + thiamethoxam 25% WG @0.05% showed average minimum disease severity (19.79%), followed by T4: chlorothalonil 75% WP @0.2% + imidacloprid 17.8 SL @0.04% – ametoctradin 27% + dimethomorph 20.27% SC @0.2% + flonicamid 20% WG @0.04% - Azoxystrobin + tebuconazole @ 0.1% + thiamethoxam 25% WG 0.05 (20.63%) and T5: Propineb 70% WP@0.2% + Imidacloprid 17.8 SL@0.04% + Fluopicolide 5.56 + Propamocarb hydrochloride 55.6% SC @0.3% + Thiamethoxam 25% WG @0.05% + Ametoctradin 27% + dimethomorph 20.27%

SC@0.2% + Flonicamid 20% WG@0.04% with 21.38% disease severity against control 92.50% (T7, Fig. 7). These treatments are statistically at par with each other. This experiment concluded that tank-mixed application is effective for managing late blight and insect populations (aphids and whiteflies) of potatoes.

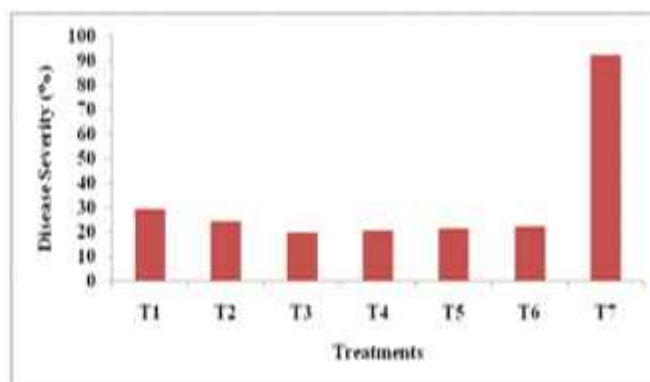


Fig.7: Evaluation of tank mixed formulations for management of late blight of potato

[T1:Chlorothalonil 75% WP @0.2% + Thiamethoxam 25% WG @0.05%-Cymoxnil8+mancozeb 64% WP@0.3% + Flonicamid 20% WG@0.04%-Dimethomorph 50% WP@0.1%+Imidacloprid 17.8 SL@ 0.04%, T2: Mancozeb75% WP@0.2% +Imidacloprid17.8 SL@ 0.04%- Fenamidon10+mancozeb50% WDG@0.3% + Flonicamid 20% WG@0.04%- Cymoxnil8+mancozeb 64% WP@0.3%+ Thiamethoxam 25% WG @0.05%, T3: Propineb 70% WP@0.2% + Imidacloprid 17.8 SL@ 0.04%-Dimethomorph 50% WP @0.1% + Flonicamid 20% WG@0.04%- Fenamidon10+mancozeb50% WDG@0.3% + Thiamethoxam 25% WG @0.05%, T4: Chlorothalonil75% WP @0.2% + Imidacloprid 17.8 SL@ 0.04%, Ametoctradin27% +dimethomorph20.27% SC@0.2% + Flonicamid 20% WG@0.04%, Azoxystrobin + tebuconazol @0.1% + Thiamethoxam 25% WG @0.05%,T5: Propineb 70% WP@0.2% + Imidacloprid 17.8 SL@ 0.04%- Fluopicolide 5.56 + Propamocarb hydrochloride 55.6% SC @0.3% + Thiamethoxam 25% WG @0.05%- Ametoctradin27% + dimethomorph20.27% SC@0.2% + Flonicamid 20% WG@0.04%,T6: Mancozeb 75% WP @0.2% + Imidacloprid 17.8 SL@ 0.04%-Cymoxanil8%+mancozeb64% WP@0.3% + Flonicamid 20% WG@0.04%-Dimethomorph 50% WP@0.1% + Thiamethoxam 25% WG @0.05%, T7: Control]

Evaluation of talc based fungal formulations for management of late blight of potato

A total of seven talc-based fungal formulations of native strains along with market standards and mancozeb 75% WP were evaluated for management of late blight of potato under field conditions during *Rabi* 2023-24 season. Four sprays were applied, one before the appearance of late blight disease and the remaining three after appearance of disease at seven-day intervals. The result revealed that all the formulations showed less terminal disease severity (70.50-87.50%) in comparison to the control treatment (90.0%) after fourth spray. However, after the first, second and third sprays efficacy was more. Treatment T5 (native strain talc-based) and T6 (native strain talc-based) were found effective for the management of late blight of potato and better than the market standard-based formulation.

Evaluation of spray schedules for management of late blight of potato using drone application

Five spray schedules consisted of one

prophylactic spray (contact fungicides) followed by two more sprays of translaminar/systemic fungicides along with a sticker were evaluated during the *Rabi* season 2023-24. A total of 10 fungicides were included whose phytotoxicity, penetration and drift studies had already been studied in earlier experiments. Besides, tank mixed (fungicides + insecticides) formulations were also evaluated during 2020-21 to 2022-23. In spray schedule experiments, it was observed that in all the treatments, less disease severity (29.0-68.33%) was recorded in comparison to the control treatment (98.33). The minimum disease severity (29.0%) was recorded in treatment T4: T3+ sticker@125ml/ha followed by T3 (41.67%) (Fig. 8). The treatments T1, T3 and T5 were statistically at par with each other. Preventive application is better for managing late blight of potato using drone application. Moreover, selection of fungicides and taking precautions at higher incidences of late blight disease is more crucial in the case of drone applications for late blight management.

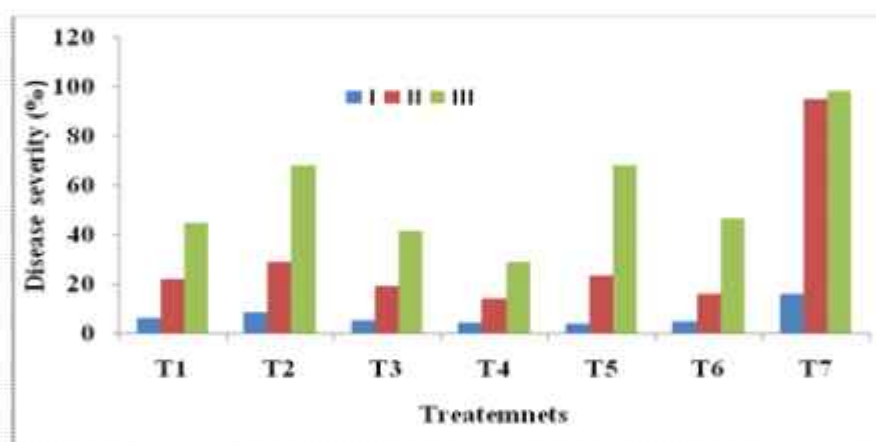


Fig. 8: Evaluation of spray schedules for management of late blight of potato using drone application

[T1: Mancozeb 75% WP (2000g/ha) (disease appearance)-Cymoxanil 8+Mancozeb 64% WP (1500g/ ha) - Fluopicolide 5.56 + Propamocarb hydrochloride 55.6%- SC,T2: Chlorothalonil 75%WP (1250g/ha (disease appearance)-Famoxadone 16.6+ Cymoxanil 22.1 SC (500ml/ ha)- Dimethomorph 50% WP(1000g/ ha), T3: Mancozeb 75% WP (2000g/ ha) (disease appearance)- Ametoctradin 27+Dimethomorph 20.27 SC (1000ml/ ha)- Cymoxanil 8+Mancozeb 64% WP (1500g/ ha),T4: T3+ Sticker @125ml/ha,T5: Chlorothalonil 75%WP (1250g/ ha) disease appearance) - Azoxystrobin 11+Tebuconazol 18.3 SC (750ml/ ha)- Famoxadone 16.6+ Cymoxanil 22.1 SC (500ml/ ha),T6: Propineb70% WP (1500g/ha) (disease appearance)- Fluopicolide 5.56 + Propamocarb hydrochloride 55.6% SC (1500ml/ha)- 5.5% iprovalicarb + propineb 61.25%WP (2000g/ha),T7: Control]

Chemical management of black scurf of potato

Under the category of soil- and tuber-borne fungal pathogens, *Rhizoctonia solani* causing black scurf and stem canker of potato is a major pathogen. Some new fungicides are being registered in CIB & RC in India for the management of black scurf of potato; their bio efficacy at different doses needs to be compared with existing fungicides. In this context, 12 treatments consisting of different fungicides (Penflufen 22.43% FS, Pencycuron 22.9% SC, Boric Acid, Tebuconazole 15% + Zineb 57% WDG, Fluxapyroxad 333FS, Kasugamycin 6 + Thifluzamide 26% SC, Thifluzamide 24%SC, Azoxystrobin 2.5% + Thiophanate Methyl 11.25% + Thiamethoxam 25% FS and Imidacloprid 17.8 SL + Penflufen 22.43% FS) were evaluated for management of black scurf of potato, applying seed treatments by spray methods at the time of planting using different concentrations during the *Rabi* season 2022-23 &

2023-24. It was observed that all treatments showed less incidence and disease severity in comparison to the control treatment. Results revealed that treatment T6: Fluxapyroxad 333FS @ 0.6% recorded the lowest average disease incidence (5.30%) and disease severity (1.49%), followed by Tebuconazole 15% + Zineb 57% WDG @ 2.5% (T4) with disease incidence (5.88%) and disease severity (1.57%), Thifluzamide 24%SC @ 0.5% (T8) and Imidacloprid 17.8 SL @0.04% + Penflufen 22.43%FS (T12) against control (81.08% DI, 33.23 DS) (T13) (Fig. 9). These treatments are statistically at par with each other. The average yield ranged from 28.68 to 34.09 t/ha. The highest average yield (34.09 t/ha) in T5: Fluxapyroxad 333FS @ 0.4% is followed by Pencycuron 22.9% SC @ 0.35% (T1). This experiment concluded that these fungicides could be used for the management of black scurf of potato.

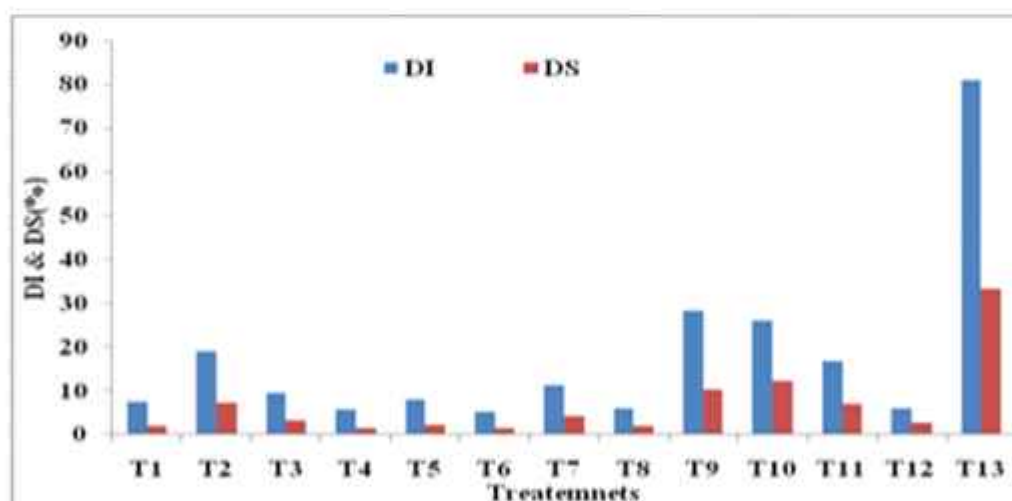


Fig. 9: Evaluation of new chemicals against black scurf of potato application

[T1: Pencycuron @ 0.35%, T2 :Boric Acid (3.0%) spray before cold storage, T3: Tebuconazole 15% + Zineb 57% WDG@ 2%, T4: Tebuconazole 15% + Zineb 57% WDG@ 2.5%, T5: Fluxapyroxad 333FS @ 0.4%, T6: Fluxapyroxad 333FS @ 0.6%, T7: Thifluzamid @ 0.35%, T8: Thifluzamid @0.5%, T9: Kasugamycin6 + Thifluzamide26 -SC @0.5%, T10: Azoxystrobin 2.5% + Thiophanate Methyl 11.25% + Thiamethoxam 25% FS @0.4%, T11: Azoxystrobin 2.5% + Thiophanate Methyl 11.25% + Thiamethoxam 25% FS @0.6%, T12: Imidacloprid 17.8 SL @0.04% + Penflufen @ 0.1%, T13: Control]

Management of common scab

In-vitro evaluation of endophytic bacteria:

Three endophytic bacteria namely *Bacillus amyloliquefaciens* (E-21), *Stenotrophomonas*

maltophilia (E-33) and *Pseudomonas geniculata* (E-45) gave good control of *Streptomyces scabiei* growth when tested in-vitro (Fig. 10).



Fig. 10: In-vitro evaluation of endophytic bacteria *Bacillus amyloliquefaciens* (E-21), *Stenotrophomonas maltophilia* (E-33) and *Pseudomonas geniculata* (E-45) for their efficacy against *Streptomyces scabiei*

In-vitro evaluation of fungicides/ chemicals:

The growth of *Streptomyces scabiei* (common scab), *Pectobacterium brasiliense* (black leg and soft rot), *Ralstonia solanacearum* (bacterial wilt) and *Fusarium sambucinum* (dry rot) was completely inhibited when cell / spore suspensions of these bacteria / fungus were treated with ClO_2 (0.2 and

0.3%) and NaOCl (1.0 and 2.0%) for 20 minutes whereas boric acid (2.0 and 3.0%) proved ineffective except against *Ralstonia solanacearum*. Against *Rhizoctonia solani* (stem canker and black scurf), only NaOCl (1.0 and 2.0%) proved effective (Fig. 11).



Plate 1



Plate 2



Plate 3



Plate 4



Plate 5

Fig. 11: *In-vitro* evaluation of ClO_2 (0.2, 0.3%), NaOCl (1.0, 2.0%) and boric acid (2.0, 3.0%) for their efficacy against *Streptomyces scabiei* (Plate 1), *Pectobacterium brasiliense* (Plate 2), *Ralstonia solanacearum* (Plate 3), *Fusarium sambucinum* (Plate 4) and *Rhizoctonia solani* (Plate 5).

***In-vivo* evaluation of fungicides/endophytes:**

An experiment was conducted in grow bags to see the effect of seed tuber treatment (ST) with ClO_2 (0.3%), mancozeb 72WP (0.3%) alone and in combination of ST followed by drenching of root zone with respective chemical/ fungicide (250ml/ grow bag) 30 days after planting (DAP), tuber treatment alone with NaOCl (2.0%), boric acid (0.3%), endophytic bacteria namely *Bacillus amyloliquefaciens* (E-21), *Pseudomonas* sp. (E-30), *Stenotrophomonas maltophilia* (E-33) and *Pseudomonas geniculata* (E-45) on common scab disease. Grow bags (40x24x24cm) were filled with mixture of autoclaved coco-peat and vermicompost (2:1 ratio) and arranged in CRBD maintaining 03 replications per treatment in glass house. Pathogenic culture of *S. scabiei* grown on oat meal agar in Petri plates for 07-10 days at

$28 \pm 1^\circ\text{C}$ was mixed in pots @ two culture plates per grow bag. The treated tubers of K. Jyoti variety (dipped for 20 minutes in respective chemical/ fungicide) were planted in the grow bags (04 tubers/ grow bag). In control, tubers dipped in water were planted in pathogen inoculated grow bags. The grow bags were irrigated as and when required till harvesting. Results revealed that all treatments reduced common scab severity (7.6 – 21.9%) compared to control (24.9%). Among the endophytic bacteria, ST with *Bacillus amyloliquefaciens* (T-1) resulted in minimum disease severity (7.6%), whereas among chemicals, ST + drenching with mancozeb (0.3%), ST with NaOCl @ 2.0% (T-3) and ST + drenching with ClO_2 (0.3%) resulted in 9.9, 15.0 and 15.4% disease severity, respectively (Fig. 12).

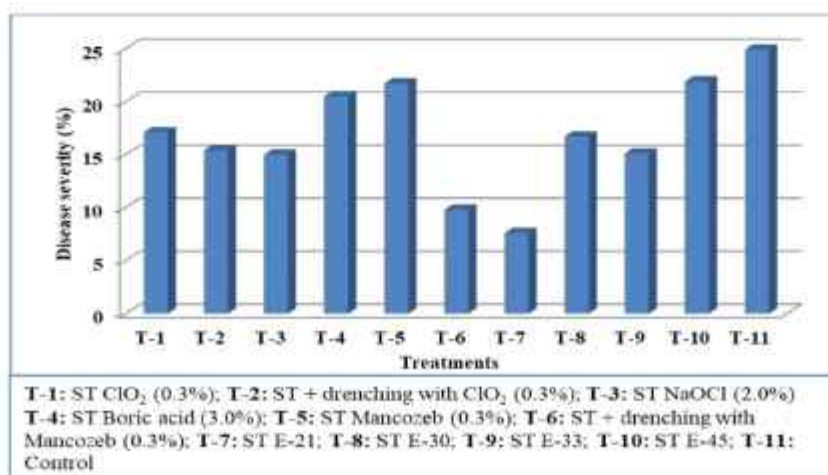
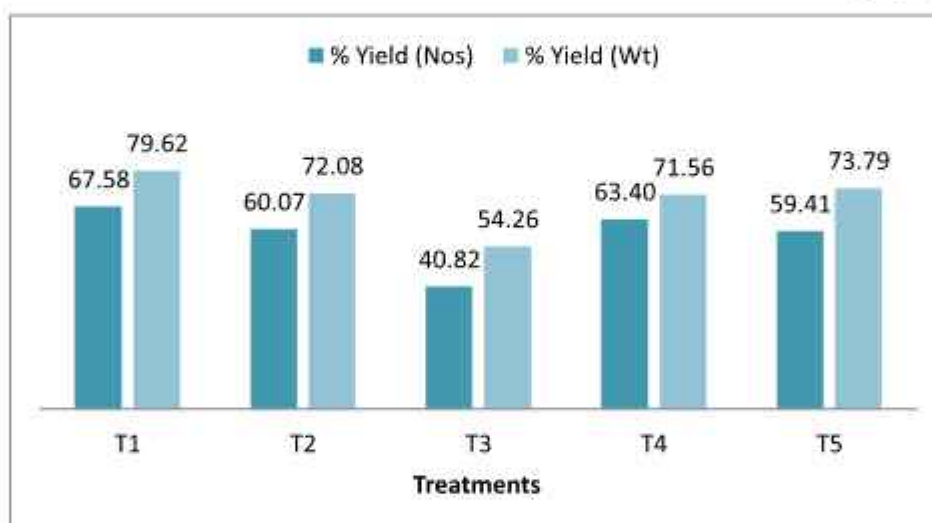
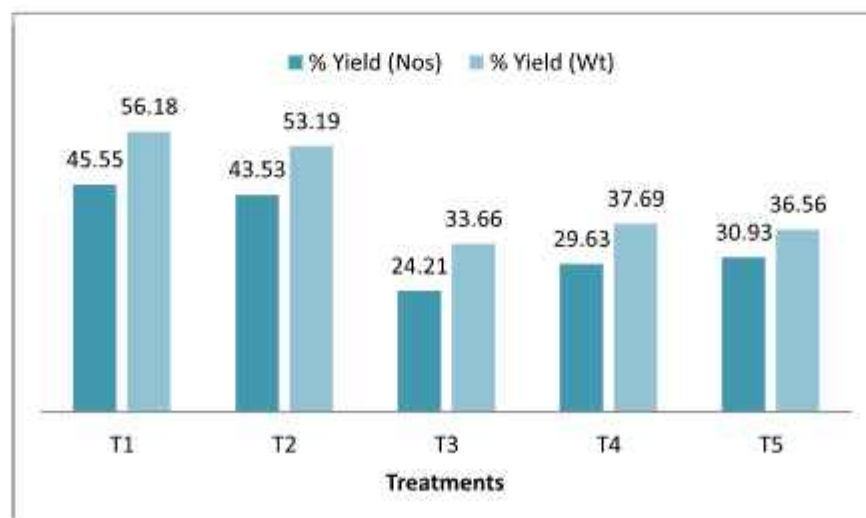


Fig. 12: Effect of tuber treatment (at planting) alone and in combination with drenching (30DAP) with fungicides/ chemicals on common scab disease

Management of common scab of potato under field conditions

An experiment was conducted with common scab infested potato tubers at Modipuram. Total seven treatments consisted of boric acid, sodium hypochlorite, *Trichoderma* formulation, were evaluated during the *Rabi* season 2023-24. The emergence percentage ranged from 93.33 to 97.78%. The highest percentage (97.78%) was in T4 (Tuber dip treatment with chlorine dioxide (ClO_2 @ 0.3%) for 30 min at the time of planting) and minimum was in T1 (Untreated diseased tubers). Among the tested treatment significant difference was not observed due to low incidence and severity level of the disease. The disease severity ranged 9.81-12.22% only. This experiment needs to be repeated with more treatments.

Similarly, another experiment was conducted at Ooty where five treatments were evaluated. The results showed that treatment T3 i.e. tuber dip treatment with sodium hypochlorite (NaOCl) @ 2% for 30 min at the time of planting, recorded the minimum percentage of numbers and weight of the scab infected tubers across varieties such as Kufri Girdhari (40.82% and 54.26%, respectively), Kufri Swarna (24.21% and 33.66%, respectively) and Kufri Himalini (34.10% and 44.63%, respectively), followed by treatment T5-tuber dip treatment with chlorine dioxide (ClO_2) @ 0.3% for 30 min at the time of planting followed by soil drenching at the time of earthing up time and T4-tuber dip treatment with chlorine dioxide (ClO_2) @ 0.3% for 30 min at the time of planting (3 gm/lit). The maximum infection in all the varieties was recorded in untreated control (T1) and T2-tuber dip treatment with 3% boric acid for 20 min before storage (Fig. 13).

A

B


C

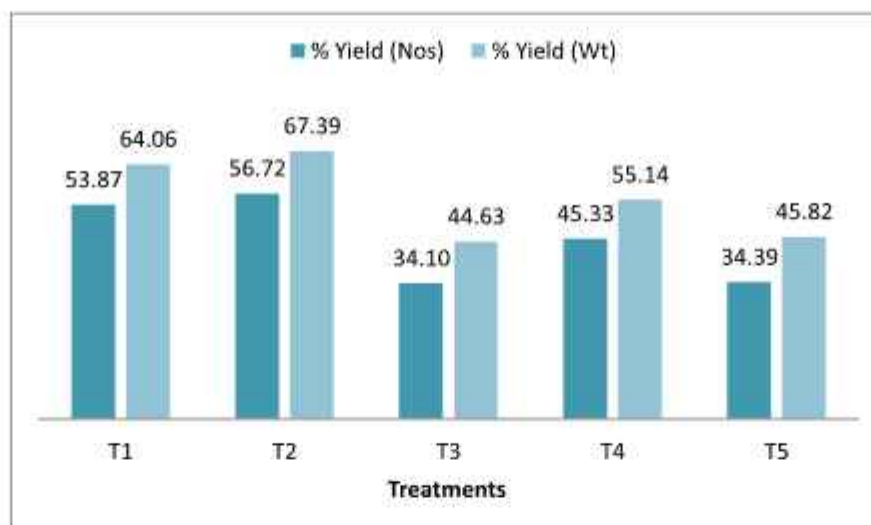


Fig. 13: Effect of different treatments on percentage of scab infected tubers (numbers and weight) in Kufri Girdhari, Kufri Swarna and Kufri Himalini

Glass house screening of potato varieties for resistance to *Ralstonia solanacearum* (bacterial wilt) and *Streptomyces scabiei* (common scab)

Ten potato lines namely CP-3973, CP-3417, CP-3414CP-3413, CP-3412, CP-3411, CP-3410, CP-3409, CP-3408, CP-3210 and 01 collection 'Badami' were tested for resistance to *R. solanacearum* under controlled conditions in a replicated pot experiment. All lines except 'Badami' succumbed to bacterial wilt within 10-12 days of inoculation.

Similarly, 16 diploid varieties/ lines were tested for resistance to *S. scabiei* under controlled conditions in a replicated pot experiment. Among them one variety 'BS 303' was found comparatively resistant (5.1% disease severity), 02 lines low susceptible (8-15% disease severity), 05 lines medium susceptible (15-20% disease severity), 01 line high susceptible (20-24% disease severity) and 07 lines as very high susceptible (>24% disease severity, Fig. 14).

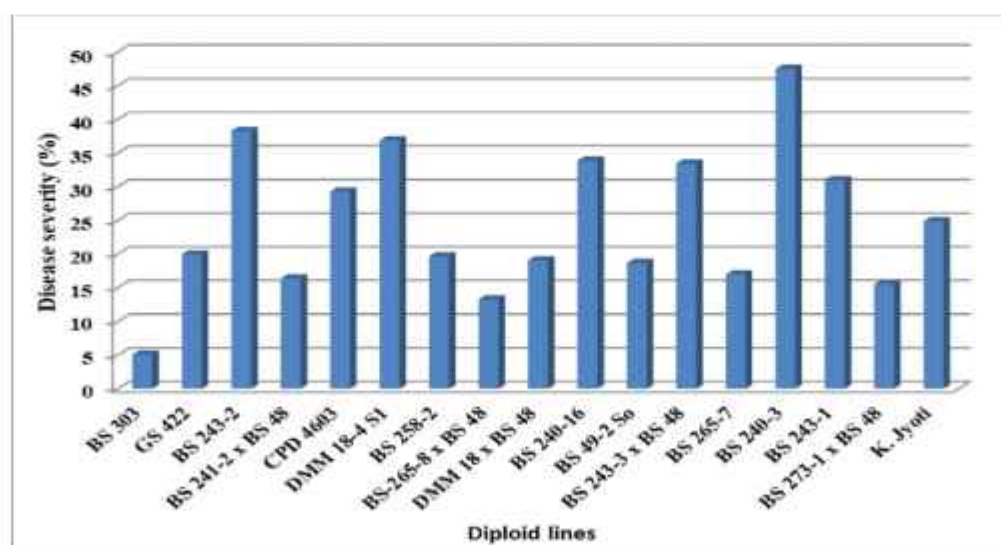


Fig. 14: Screening of potato diploid lines for resistance to *S. scabiei* in pots

***In-vitro* screening of potato varieties for resistance to *S. scabiei*:**

Eight potato varieties namely K. Neelkanth, K. Fryom, K. Garima, K. Uday K. Bahar, K. Lauvkar, K. Sahyadri and K. Frysona were

screened *in-vitro* through novel tissue culture-based method developed at ICAR-CPRI, for resistance to *Streptomyces scabies* and all found susceptible (Fig. 15).



Fig. 15: *In-vitro* screening of potato varieties for resistance to *S. scabies*

Post entry quarantine testing of imported germplasm

A total of 47 *in-vitro* cultures/ TPS lines imported by the institute from USA (30 lines), M/s Mahindra HZPC Pvt Ltd from the Netherlands (05 lines), SGT University, Haryana (02 TPS lines) and M/s Technico Agri-Sciences Private Limited (10 lines) were tested for post entry quarantined pathogens.

Facilitation of potato export

Facilitated export of potato minitubers (seed) by monitoring, inspecting and testing the potato crops raised by the seed producers as per the requirements of the importing countries (Fig. 16). After testing, Phytosanitary Certificates were issued which could lead to the export of 49.54 lakh minitubers to Egypt, Saudi Arabia, Senegal, Tanzania and Turkey by M/s Mahindra HZPC Pvt Ltd, M/s Pepsico India Holdings Ltd. and M/s Technico Agri-Sciences Pvt. Ltd.



Fig. 16: Monitoring of potato crops for export purposes

PROGRAMME: BIOLOGY, ECOLOGY AND MANAGEMENT OF INSECTS AND NEMATODE PESTS OF POTATO

PI: Dr. Anuj Bhatnagar, **Co-PIs:** Drs. Subhash Katare, Kailash Naga, Subhash S., Aarti Bairwa, Priyank Mhatre, Sanjeev Sharma, Kamala Jayanthi, Jagdev Sharma, N Sailo, Ashwani Kumar Sharma, Tanuja Buckseth, Dalamu

Biology, epidemiology and management of insect pests of potato

Seasonal population dynamics of sucking pests (aphids and whiteflies) and their association with growth stages in potato

This study investigated the seasonal population dynamics of sucking pests, primarily aphids (winged and non-winged) and whiteflies, on unsprayed potato crops (variety Kufri Bahar) planted on 20 October 2024.

i) Aphid population dynamics

The population trend of total aphids (sum of winged and non-winged) per 100 compound leaves is presented in Fig. 17. During the early vegetative growth phase (SMW 46-48; 2nd week of November to 4th week of November), aphid populations remained well below the critical threshold of 20 aphids/100 compound leaves, with counts ranging from 3 to 16. A slight increase was observed during tuber initiation (SMW 49-50) and tuber bulking (SMW 51-52), although still below the action threshold. A notable population surge began during the maturity/senescence stage. From SMW 4 (4th week of January) onward, a steep increase in aphid numbers was observed, primarily driven by non-winged forms. The total aphid count exceeded the economic threshold at SMW 4 (120 aphids/100 leaves), further increasing to 678 aphids/100 leaves by SMW 7 (2nd week of February). This sustained rise in aphid pressure during the late season indicates a critical period for pest management intervention.

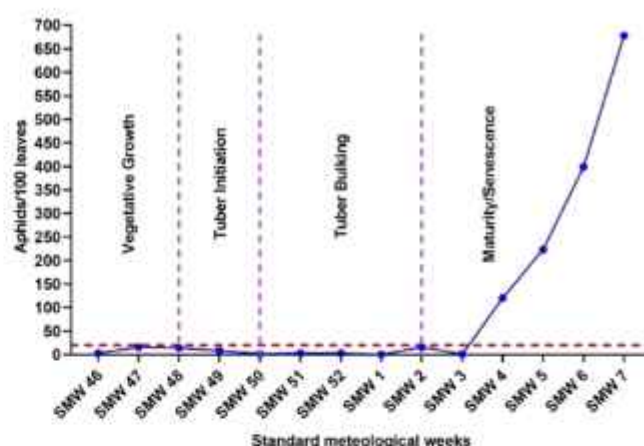


Fig.17: Total aphid population per 100 compound leaves across different (SMW). Dotted horizontal line indicates the critical threshold level (20 aphids/100 compound leaves). Vertical dashed lines separate the key crop growth stages: vegetative growth, tuber initiation, tuber bulking, and maturity/senescence. A clear population rise beyond threshold is observed starting from SMW 4

Growth stage-specific trends

Aphid activity was minimal during vegetative growth and tuber initiation, with population levels remaining below threshold. Tuber bulking coincided with very low pest pressure. However, during the maturity/senescence stage, aphid populations particularly the non-winged form increased dramatically, triggering threshold exceeding in four consecutive weeks (SMW 4 to SMW 7; 4th week of January to 2nd week of February) (Fig. 17). This late-season infestation is critical, especially in seed potato production, due to the potential for virus transmission.

Winged vs. non-winged aphid trends

The line graph illustrates (Fig. 18) separate trends for winged aphids (WA) and non-winged aphids (NWA). Winged aphids were present in small numbers during the vegetative stage (SMW 46-48; 2nd week of November to 4th week of November), likely representing initial colonization. Their presence dropped to negligible levels in mid-season (SMW 49-52; 1st to 4th week of December), before a modest increase toward the end of the crop cycle. In contrast, non-winged aphids exhibited a sharp and continuous increase from SMW 3 (3rd week

of January) onwards, suggesting rapid in-field multiplication. By SMW 7 (2nd week of February), non-winged aphids alone reached 662 per 100 leaves compared to 16 winged individuals. This pattern suggests that the colonizing winged forms established early populations, which then rapidly multiplied in the wingless form under favorable conditions.

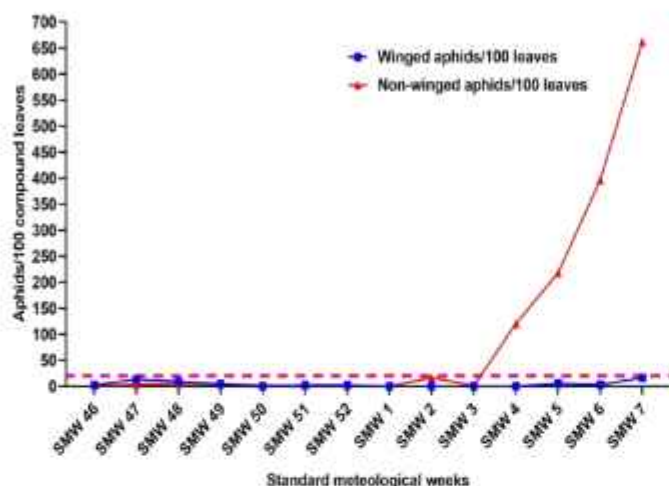


Fig. 18: Weekly trends of winged and non-winged aphid populations, the sharp rise in non-winged aphid numbers post-SMW 3 is evident, while winged aphid counts remain relatively low. Dotted line represents the threshold level of total aphids, helping to visualize when pest pressure becomes critical.

ii) Whitefly population dynamics

The temporal dynamics of whiteflies are depicted in Fig. 19, which showing the weekly mean whitefly population per plant across standard meteorological weeks (SMWs). Whitefly activity was detected early in the season, particularly during the vegetative growth stage (SMW 46–48; 2nd week to 4th week of November), with population levels at or above the threshold in the first three weeks. The highest mean was recorded in SMW 46 (2 whiteflies/plant), coinciding with 25 DAP a period shortly after crop emergence. From SMW 49 (1st week of December; Tuber initiation stage) onward, the population began to decline, reaching zero or near-zero levels during most of the remaining crop cycle. A few intermittent detections of whiteflies at or just below the threshold occurred during SMW 49, SMW 51 and SMW 1. However, following SMW 2 (2nd week of January), no whiteflies were observed through to crop maturity.

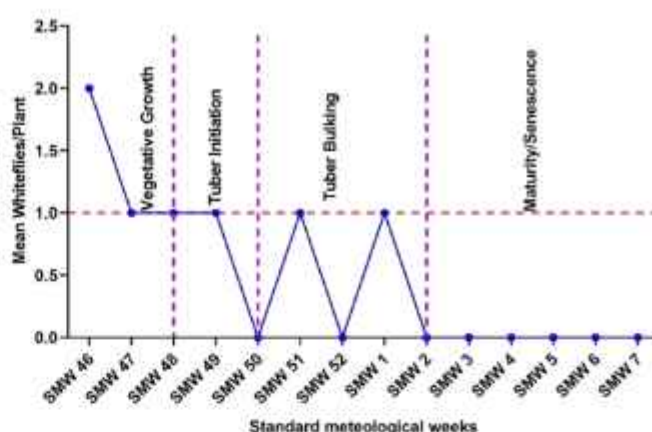


Fig. 19: Weekly trend of mean whitefly population per plant across different (SMW), the dotted horizontal line represents the critical threshold (1 whitefly/plant). Growth stages of the crop are indicated by vertical dashed lines. Whitefly activity peaked during the vegetative stage and dropped to undetectable levels by the maturity phase.

Aphid populations remained below the economic threshold during all yield-sensitive stages (vegetative, tuber initiation and bulking), with a significant surge in non-winged aphids occurring only during crop senescence, suggesting minimal impact on yield but potential risk for virus transmission in seed crops. Whitefly activity was limited to the early vegetative phase, with populations exceeding the threshold only during the first three weeks, followed by a consistent decline. While overall threat remained low during critical growth stages, the early-season presence of whiteflies highlights the importance of timely monitoring, particularly for seed potato production.

Seasonal dynamics of winged aphid flight activity in potato fields monitored with yellow sticky traps

To monitor the seasonal flight activity of winged aphids in potato fields, yellow sticky traps were installed weekly throughout the 2024–25 crop season. The mean number of winged aphids captured per yellow sticky trap is presented in Fig. 20, showing clear temporal fluctuations over the season. During the early crop phase (SMW 44–46; 1st to 3rd week of November), moderate aphid flight activity was recorded, with trap counts ranging from 24 to 59 winged aphids per trap. A notable decline followed from SMW 47 to SMW 52 (late November to late December), during which counts fell below 15 aphids per

trap, reaching a seasonal low of just 1 aphid in SMW 50 (2nd week of December). Starting from SMW 3 (3rd week of January), trap catches began to increase again, with a significant flight peak observed in SMW 5 (1st week of February), where the mean trap count reached 177 aphids. This peak was followed by a gradual decline through SMW 6 to SMW 8 (mid to late February), although trap counts remained well above early-season levels, suggesting continued but declining dispersal.

The flight activity of winged aphids, as captured by yellow sticky traps, showed a bimodal pattern, with an initial moderate phase during early November and a sharp peak in early February (SMW 5). The majority of the crop season (December through mid-January) experienced low aphid flight activity, with trap counts remaining consistently below the action threshold. However, the late-season surge coinciding with crop maturity indicates a potential risk for secondary aphid colonization and virus transmission, particularly in seed potato production systems.

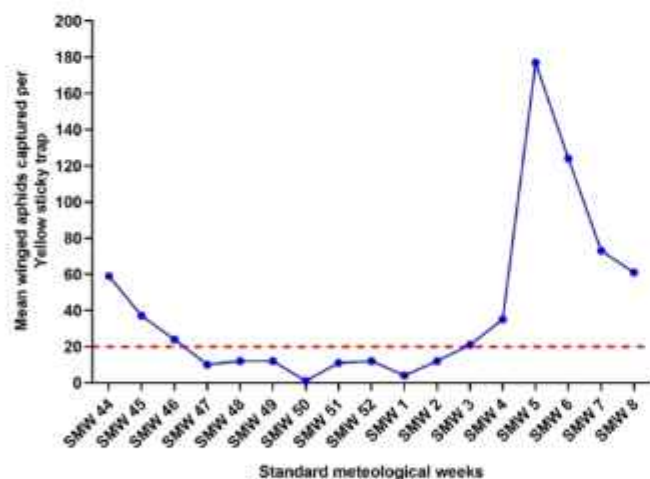


Fig. 20: Mean number of winged aphids captured per yellow sticky trap across (SMW 44 to SMW 8; 1 November 2024 to 28 February 2025). The red dashed line indicates the threshold level of 20 aphids /trap. Peak flight activity is observed during SMW 5, followed by a gradual decline.

Dynamics of colonising aphid species on potato at Jalandhar

The population dynamics of winged aphids were observed from November 7, 2023, to March 7, 2024, on staggered-planted potatoes. The aphid

population exhibited an interesting trend, characterized by two distinct spikes in the number of winged adults. The first spike was recorded on December 19, while the second occurred near the end of February (Fig. 21 a & b). Species-level identification of these winged aphids was conducted by sequencing the mitochondrial cytochrome oxidase subunit-1 (*mtCOI*) gene. Four aphid species were found colonizing potatoes in the Jalandhar area. Among them, *Rhopalosiphum rufiabdominale* and *Aphis gossypii* were present throughout the potato season. *R. rufiabdominale* was observed in high population densities, whereas *A. gossypii* remained at low densities (Figure). Another species, *R. nymphaeae*, was recorded during the early crop season but was no longer observed after the second week of January 2024. The green peach aphid (*Myzus persicae*), a key vector of potato viruses, was first detected in samples collected on December 31. Its population increased thereafter, aligning with the seed plot technique recommendations (Figure 21 a & b).

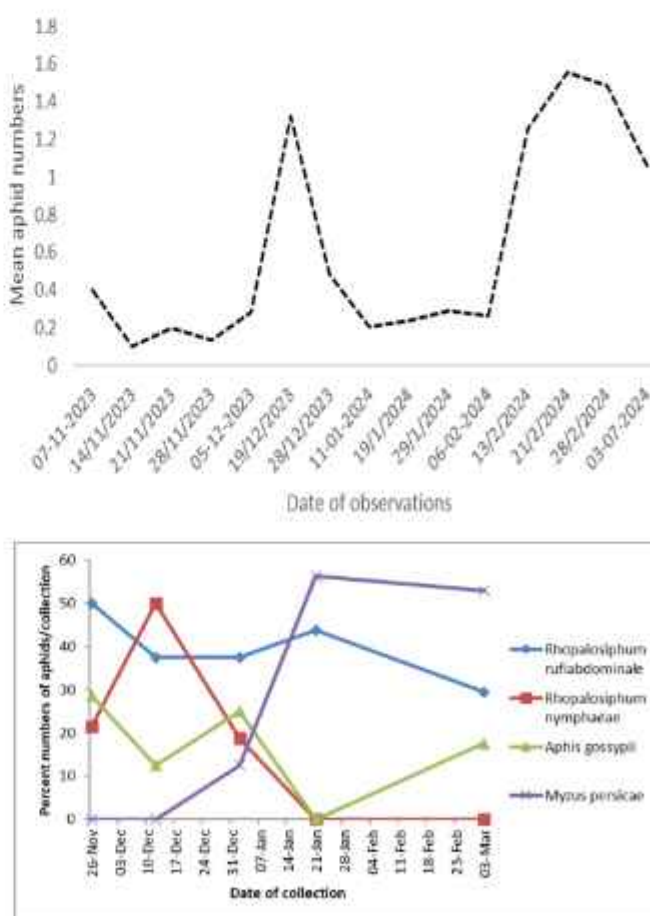


Fig. 21: A) Pooled numbers of winged adult aphids of four species. B) Aphid species dynamics during potato crop season 2023-24

Survey of potato growing areas for *Spodoptera littoralis* infestation in potato tubers

A survey of potato growing areas of Thalavadi (Tamil Nadu), Gundlupete (Karnataka) and Chamarajanagar (Karnataka) was conducted during 2023 and 2024 to understand the problems faced by the potato growers. Based on morphological characters the associated pest was identified as African cotton leaf worm, *Spodoptera littoralis* belongs to order-Lepidoptera; Family-Noctuidae. Further to confirm the species at molecular level, mitochondrial cytochrome

oxidase subunit I gene (*mtCOI*) using LCO (5'GGTCAACAAATCATAAAGATATTGG3') and HCO (5'TAAACTTCAGGGTGACCAAAAATCA3') primers was amplified through PCR that yielded an amplicon of ~ 667 bp. The sequence showed 100% similarity with the *Spodoptera littoralis* isolates from United Kingdom (LR797831), Republic of Korea (MN803323) and South Africa (NC053623, Fig. 22). This is the first record of African cotton leaf worm causing tuber burrows in potato.

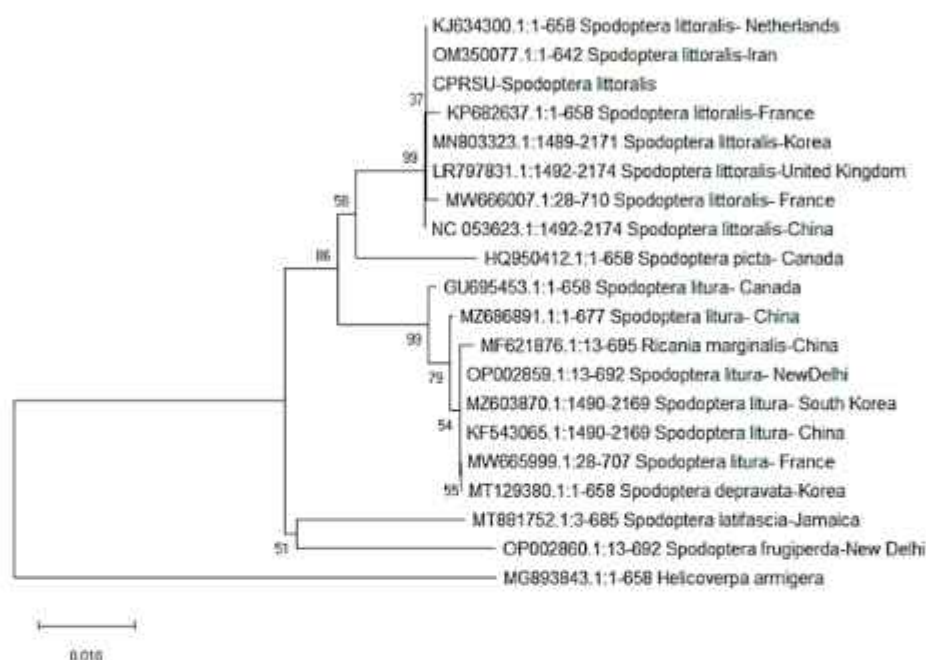


Fig. 22: Phylogenetic relationship of *Spodoptera littoralis* (CPRSU) with other related species

Identification of cutworm species attacking potato at Shimla hills

The cutworm larvae near the damaged plants (Fig. 23) were collected and used for species-level identification by sequencing mitochondrial cytochrome oxidase subunit I gene (*mtCOI*).

DNA from individual larva was isolated using DNeasy Blood & Tissue Kits (Qiagen, Germany) by following the manufacturer's guidelines. The study signifies the possibility of the prevalence of multiple species of cutworms at Shimla hills.



Fig.23: Cutworm-damaged plant and its larva

II. Studies on phyto-semio chemicals involved in insect-plant interactions of major potato pests

A) Temporal dynamics and varietal resistance of potato (*Solanum tuberosum* L.) to aphids and whiteflies: A field study

The study evaluated the population dynamics of aphids and whiteflies on nine potato varieties-K. Kiran, K. Sangam, K. Chipsona-I, K. Frysona, K. Khyati, K. Surya, K. Pukhraj, K. Lohit and K. Daksh.

i) Aphid Infestation Dynamics

The ANOVA revealed significant varietal differences in aphid infestation (4.52% of total variation; $F_{(8, 18)} = 4.379$; $P = 0.0044$), with K. Surya and K. Pukhraj emerging as the most resistant varieties. These exhibited the lowest cumulative aphid loads ($AUC = 88.8 \pm 13.4$ and 94.2 ± 19.1 , respectively) (Fig. 24). Time (week) had a more pronounced effect, explaining 42.01% of the variation ($F_{(2.07, 37.21)} = 34.00$; $P < 0.0001$), with peak infestations occurring around third week of January (Fig. 25). A highly significant variety $\times$ week interaction (28.91% of variation; $F_{(104, 234)} = 2.924$; $P < 0.0001$) indicated that resistance levels varied temporally (Fig. 26). For instance, K. Frysona maintained low early-season counts but showed increased susceptibility later. K. Kiran was the most susceptible variety, recording the highest aphid pressure ($AUC = 403.5 \pm 149.2$) with peak infestation in first week of February.

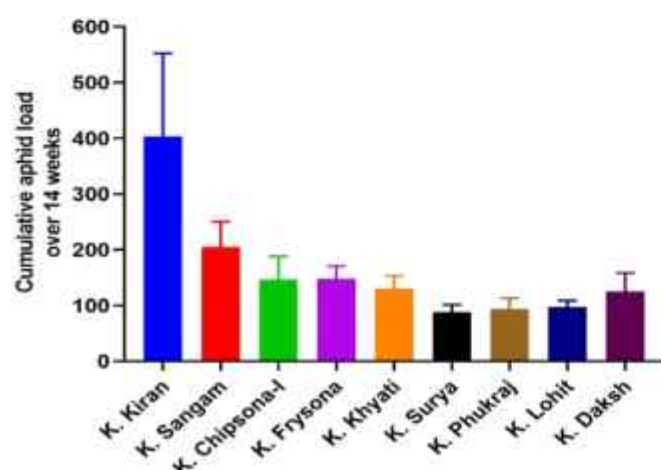


Fig. 24: Total aphid infestation pressure ($AUC \pm SEM$) across potato varieties

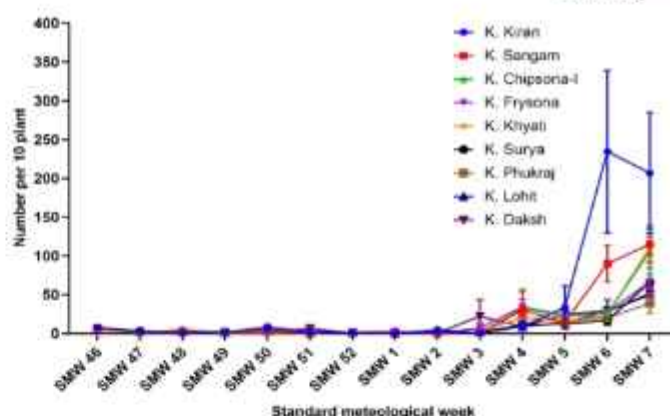


Fig. 25: Weekly aphid population trends across nine potato varieties (Mean $\pm$ SEM)

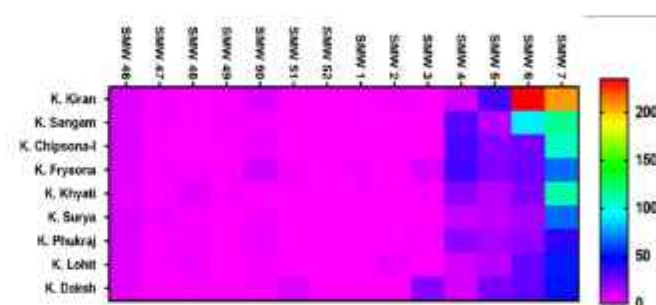


Fig. 26: Heat map of weekly aphid infestation intensity across potato varieties

ii) Whitefly Infestation Dynamics

In the case of whiteflies, the ANOVA revealed a highly significant effect of time (meteorological week), accounting for 60.04% of the total variation ($F_{(4.80, 86.44)} = 57.84$, $P < 0.0001$), indicating substantial temporal fluctuations in whitefly populations across the growing season. The interaction between variety and week was also significant (18.16% variation, $F_{(104, 234)} = 2.187$, $P < 0.0001$), suggesting that different varieties exhibited distinct infestation trends over time (Fig. 27 & 28). Although the main effect of variety was not statistically significant (1.55% variation, $F_{(8, 18)} = 2.224$, $P = 0.0758$), AUC analysis identified K. Chipsona-I as the most resistant variety, with the lowest cumulative whitefly pressure ($AUC = 46.83 \pm 5.87$), while K. Kiran exhibited the highest cumulative infestation ($AUC = 75.50 \pm 11.98$) (Fig. 29). Descriptive statistics further supported these findings, with K. Chipsona-I exhibiting the lowest mean whitefly count (3.81 ± 0.93) and K. Kiran displaying the highest variability ($SD = 7.03$).

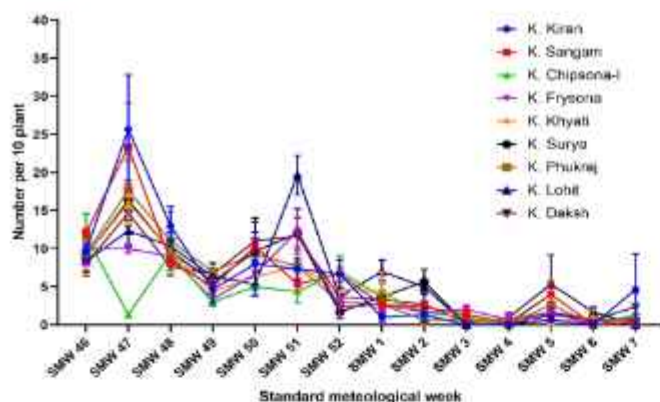


Fig. 27: Weekly whitefly population trends across nine potato varieties (Mean $\pm$ SEM)

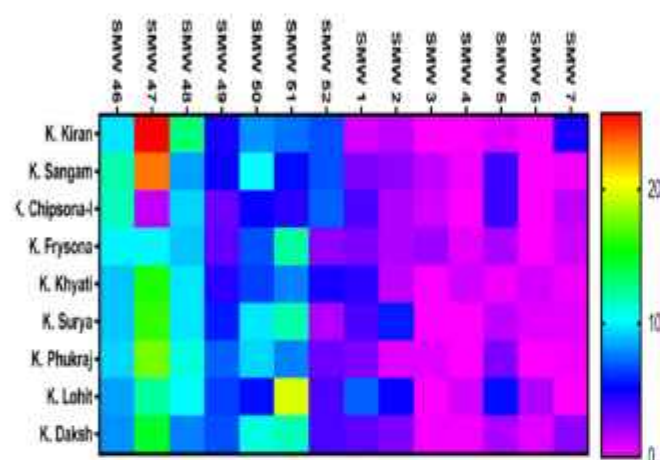


Fig. 28: Heat map of weekly whitefly infestation intensity across potato varieties

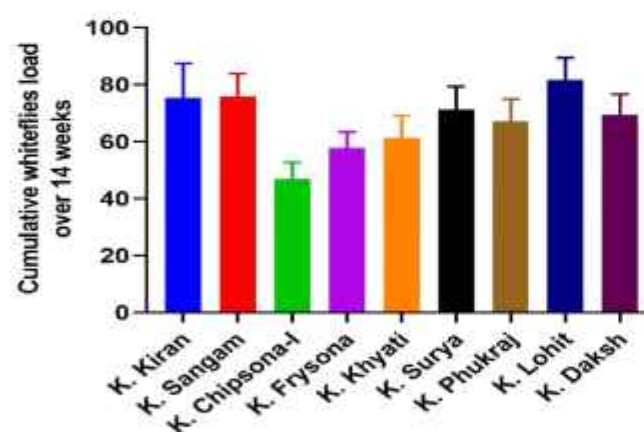


Fig. 29: Total whitefly infestation pressure (AUC $\pm$ SEM) across potato varieties

The findings highlight the critical role of varietal selection and pest monitoring timing in Integrated Pest Management (IPM) for potato cultivation. K. Chipsona-I consistently showed resistance to whiteflies and is recommended for regions with high whitefly pressure. For aphid

management, K. Surya and K. Pukhraj are recommended due to their low and stable aphid populations. Additionally, pest monitoring should be intensified during critical infestation periods-November second week for whiteflies and January third week to February first week for aphids-to enable timely interventions. The high variability in susceptible varieties like K. Kiran suggests a need for frequent scouting and potentially targeted chemical control measures. Future studies should integrate yield assessments to correlate pest load with economic loss, thereby refining resistance screening and supporting decision-making for pest-resilient varietal deployment.

B) Influence of *Bemisia tabaci*-induced plant volatiles on the host-choice behavior of *Tuta absoluta*

This study explores the interaction between two economically significant herbivorous insects, *Bemisia tabaci* (a phloem-feeding whitefly) and *Tuta absoluta* (a leaf-mining moth), on potato plants (*Solanum tuberosum*), focusing on the role of Herbivore-Induced Plant Volatiles (HIPVs) in insect behavior. Field surveys revealed a strong positive correlation between the populations of *B. tabaci* and *T. absoluta*, suggesting a possible ecological link (Fig. 30). Controlled laboratory experiments confirmed that *T. absoluta* exhibited a strong preference for potato plants previously infested by *B. tabaci*, while *B. tabaci* showed no such preference (Fig. 31). Gas chromatography-mass spectrometry (GC-MS) analysis identified specific volatiles, including undecane, β -caryophyllene, and germacrene D, that were significantly upregulated in *B. tabaci*-infested plants. Electroantennogram (EAG) studies further demonstrated that *T. absoluta* antennae responded strongly to these volatiles, confirming their role in attracting the moths (Fig. 32). These findings highlight how HIPVs mediate interspecies interactions and suggest that manipulating plant volatiles could be a novel strategy for integrated pest management. The study provides critical insights into chemical ecology and offers a foundation for developing environmentally friendly pest control solutions.

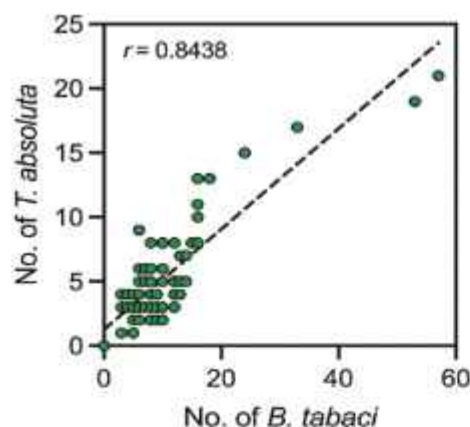


Fig. 30: Co-infestation of *Bemisia tabaci* and *Tuta absoluta* on potato plants

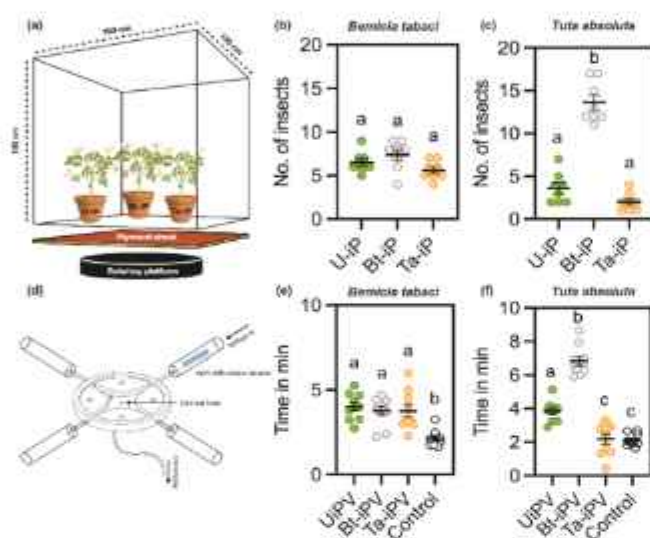


Fig. 31: *Bemisia tabaci*-induced potato plant volatiles influenced the host-choice behavior of *Tuta absoluta*. (a) Schematic representation of the multiple-choice cage assays. (b) The number of *B. tabaci* settling on uninfested potato plants (U-iP), *B. tabaci*-infested potato plants (Bt-iP), and *T. absoluta*-infested potato plants (Ta-iP) after 24 hours did not exhibit significant differences. (c) However, the number of *T. absoluta* settling on Bt-iP significantly differed from those settling on U-iP and Ta-iP. (d) Schematic representation of a 4-arm olfactometer. (e) *B. tabaci* spent a similar amount of time in the olfactometer arms containing uninfested potato plant volatiles (UiPV), *B. tabaci*-induced potato plant volatiles (Bt-iPV), and *T. absoluta*-induced potato plant volatiles (Ta-iPV) compared to the control. (f) However, *T. absoluta* spent more time in the olfactometer arm containing Bt-iPV than in UiPV, Ta-iPV, or the control. Significant differences are indicated by different letters (ANOVA followed by Tukey's test; $p < 0.05$), while no significant differences are indicated by the same letters (ANOVA followed by Tukey's test; $p > 0.05$). Error bars represent the standard error of the mean (s.e.m.).

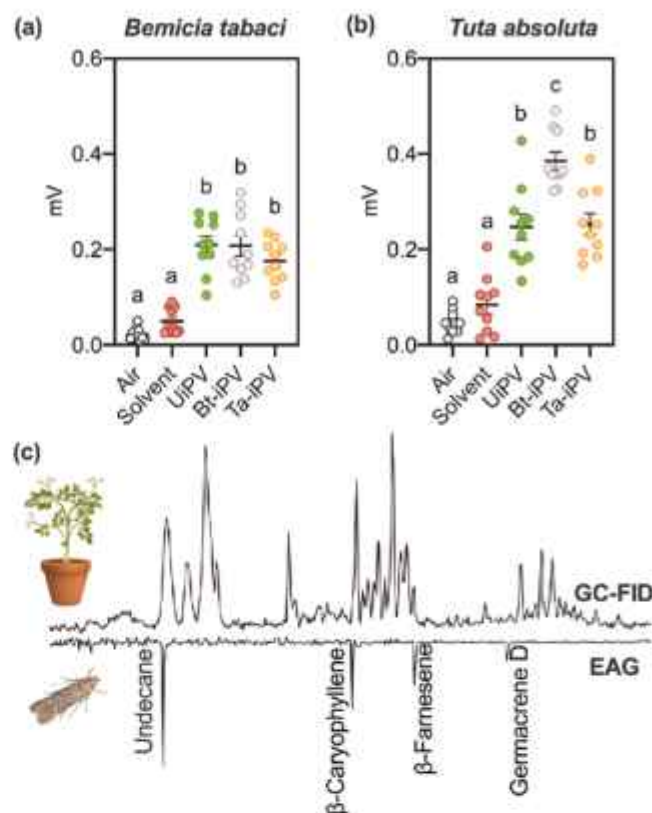


Fig. 32: Electroantennogram (EAG) and Gas Chromatography-Electrogram (GC-EAD) analyses were conducted on herbivore-induced potato plant volatiles. (a) *B. tabaci*'s antennal response to uninfested potato plant volatiles (UiPV), *B. tabaci*-induced potato plant volatiles (Bt-iPV), *T. absoluta*-induced potato plant volatiles (Ta-iPV) was similar. (b) However, *T. absoluta*'s antennal response to Bt-iPV was significantly higher than its response to UiPV, Ta-iPV, or the controls (solvent and air). Significant differences are indicated by different letters (ANOVA followed by Tukey's test; $p < 0.05$), while no significant differences are indicated by the same letters (ANOVA followed by Tukey's test; $p > 0.05$). Error bars represent the standard error of the mean (s.e.m.). (c) A representative GC-EAD run of volatiles from Bt-iPV using the antennae of gravid female *T. absoluta* revealed responses to four compounds. GC-FID: Gas Chromatography-Flame Ionization Detector, EAG: Electroantennogram.

Comparative evaluation of systemic insecticide uptake and bio efficacy in potato crop using drone, knapsack and tractor-mounted application methods against vector pests

The growing adoption of drone technology for pesticide application demands rigorous evaluation of its efficacy compared to conventional methods, particularly for systemic insecticides targeting phloem-feeding pests like

aphids and whiteflies in potato crops. While drone spraying offers advantages in precision and operational efficiency, concerns persist about its ability to achieve adequate canopy penetration and systemic uptake of active ingredients, critical factors for controlling pests on protected foliage. This study presents a comparative evaluation of imidacloprid (17.8 SL) uptake and bioefficacy in potato (*Kufri Chipsona 3*) using three application methods: drone sprays (with and without silica-based adjuvant), tractor-mounted power sprays, and battery-operated knapsack sprayers. Imidacloprid was applied at 150 mL/ha, with half the leaves on tagged plants covered pre-spray to assess systemic movement. Leaf samples (100–500 g) from upper, middle and lower canopy positions were collected at 24 hours and 72 hours post-application, flash-frozen at -80°C and analyzed via HPLC. Bioefficacy was concurrently monitored through pest mortality counts and phytotoxicity assessments.

i) Comparison of the bio-efficacy of imidacloprid against whiteflies across different spray application methods

The effectiveness of imidacloprid in controlling whiteflies (*Bemisia tabaci*) varied notably across application methods and time intervals. At 1 day after spraying (DAS), all treatments recorded negative percent reductions in whitefly populations. The drone spray with silica-based adjuvant (T2) recorded a -18.86% reduction, the tractor-mounted spray (T3) -8.15% , and the knapsack spray (T4) -7.43% . These initial negative values likely reflect disturbance or displacement effects rather than actual mortality, as whiteflies may have temporarily vacated treated areas while remaining viable (Fig. 33).

By 3 DAS, treatment efficacy diverged significantly. The tractor-mounted application exhibited the highest control efficacy with an 82.95% reduction ($p < 0.05$), likely due to superior canopy penetration and optimized droplet deposition facilitating enhanced systemic uptake. The drone application with adjuvant (T2) showed intermediate efficacy (37.77%), markedly outperforming the non-adjuvant drone spray (13.97%), indicating the beneficial role of formulation additives. The knapsack sprayer showed moderate efficacy (39.42%), potentially limited by inconsistent coverage or variable droplet distribution common in manual applications (Fig. 33).

At 7 DAS, the same treatment hierarchy persisted: tractor-mounted spray remained most effective (38.02%), followed by the adjuvant-enhanced drone spray (26.02%), and finally the knapsack application (10.84%) (Fig. 33). This pattern is consistent with imidacloprid's systemic nature, where peak pest control typically emerges between 3 and 7 DAS due to translocation of the active ingredient within plant tissues. The continued superiority of the tractor-mounted method supports its use in scenarios requiring immediate and reliable pest control. However, the improved performance of drone applications with adjuvant indicates a promising future for precision agriculture when combined with suitable formulation enhancements.

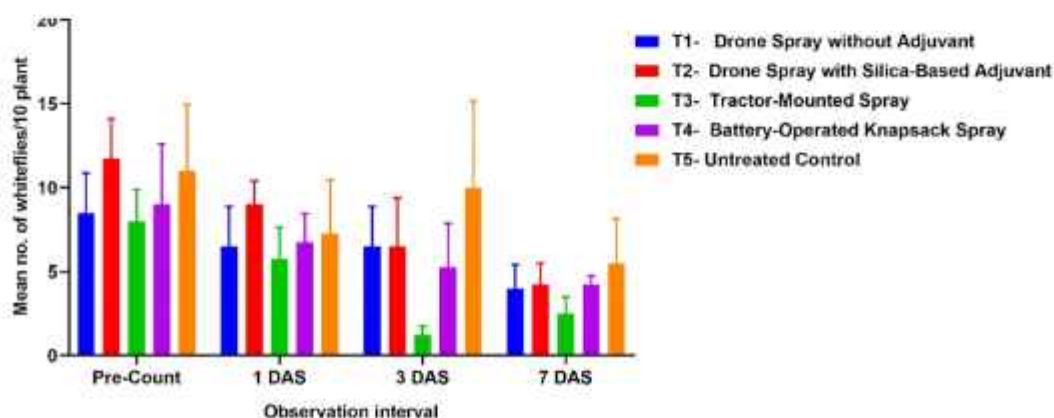


Fig. 33: Bio-efficacy of Imidacloprid against whiteflies across spray application methods at 1, 3 and 7 days after spray (DAS).

ii) Uptake and Systemic Translocation of Imidacloprid in Potato Plants

A two-way ANOVA revealed significant interaction effects between spray method, time point and leaf exposure ($p < 0.0001$), accounting for 8.88% of total variance. Main effects were also highly significant, with time/leaf exposure explaining 61.52% of variation and spray method accounting for 28.00%. Post-hoc analysis showed

that tractor-mounted applications achieved the highest imidacloprid residue levels in uncovered leaves at 24 hours post-spray ($0.2150 \mu\text{g/g}$), which was 54.6% higher than adjuvant-enhanced drone treatments ($0.1577 \mu\text{g/g}$, $p < 0.0001$). This trend continued at 72 hours, where residues from tractor-mounted applications ($0.0862 \mu\text{g/g}$) were more than threefold those from non-adjuvant drone sprays ($0.0274 \mu\text{g/g}$) (Fig. 34 & 35).

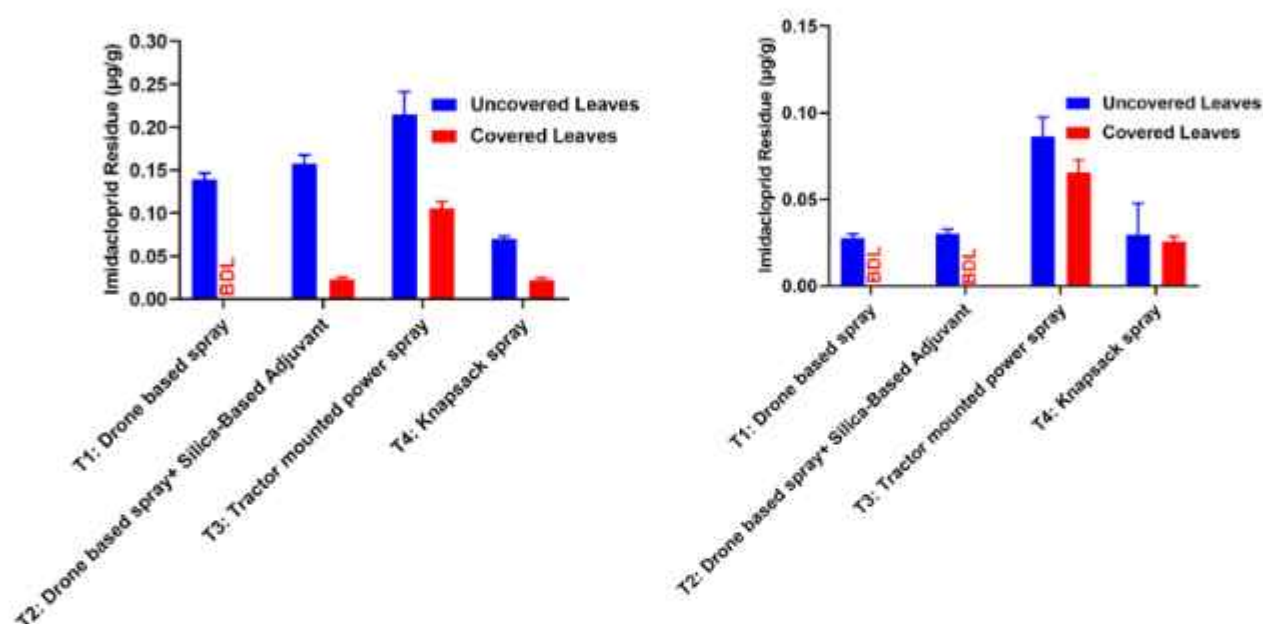


Fig. 34: Comparison of imidacloprid residues in uncovered and covered leaves across application methods at 24 and 72 hours post-spray. Error bars represent standard deviation ($n=3$). BDL = Below Detection Limit ($0.001 \mu\text{g/g}$).

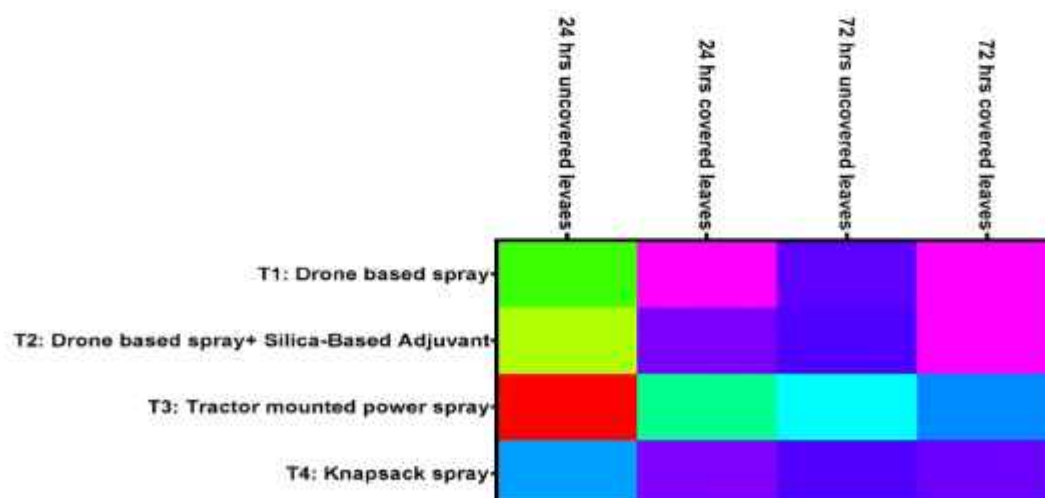


Fig. 35: Heat map representing imidacloprid residue distribution across application methods and timepoints (24h and 72h).

Systemic translocation patterns also varied significantly by method. The tractor-mounted spray achieved substantial residue levels in covered leaves ($0.1054 \mu\text{g/g}$ at 24h, equivalent to 49% of uncovered leaf levels), while the drone application without adjuvant failed to achieve detectable levels (BDL). The systemic translocation index for the tractor method improved from 49% at 24h to 76% at 72h, suggesting progressive internal redistribution. In contrast, knapsack applications showed persistent residue levels with minimal decline from 24h to 72h ($p > 0.9999$), possibly reflecting delayed mobilization or deposition from untreated surfaces (Fig. 36).

While the use of a silica-based adjuvant increased initial drone-based deposition by

12.4%, it did not significantly enhance systemic movement or prolong residue persistence. All treatments exhibited time-dependent residue degradation; however, the tractor method-maintained concentrations above the theoretical efficacy threshold ($>0.05 \mu\text{g/g}$) throughout the 72-hour observation period (Fig. 36).

These findings confirm that application technology plays a crucial role in both the magnitude and temporal-spatial dynamics of systemic insecticide distribution. Among all methods tested, tractor-mounted spraying consistently provided the most effective combination of initial deposition, systemic movement and sustained bioavailability of imidacloprid.

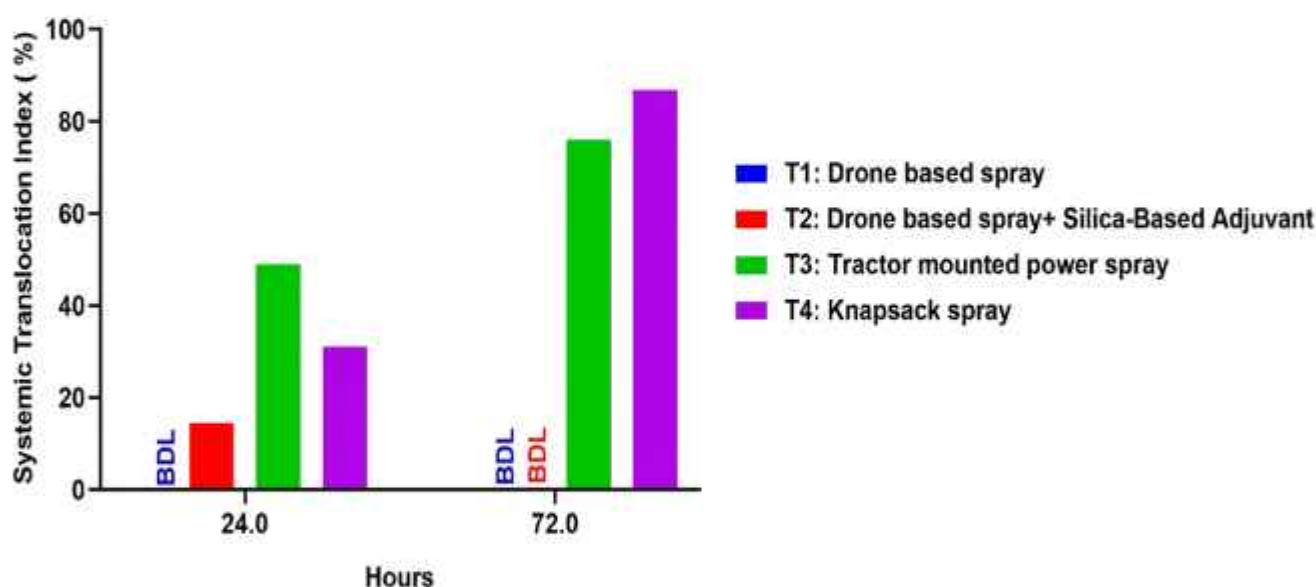


Fig. 36: Systemic translocation index (%) of imidacloprid in potato plants across spray methods at 24 and 72 hours post-application.

Residue analysis for Clothianidin in potato tubers and soil

The clothianidin 50WDG has been found the most effective insecticide against white grubs in Shimla hills. The residues of clothianidin in potato tubers as well as in soil samples were below Limit of Quantification (0.01 mg/kg) in all the tested samples. The study signifies the use of clothianidin 50DWG can be a safer option for the management of white grubs in potato crop.

Effect of date of planting on virus severity in potato at Jalandhar, Punjab

The results revealed a significant difference in virus severity across the different planting dates (Fig. 37). The first and second planting dates had similar levels of virus severity, with aphids being the primary vector. Among the tested viruses, PVM was found to be the most prevalent. Additionally, the severity of aphid-transmitted viruses increased as the planting date was delayed, as shown in the figure 37.

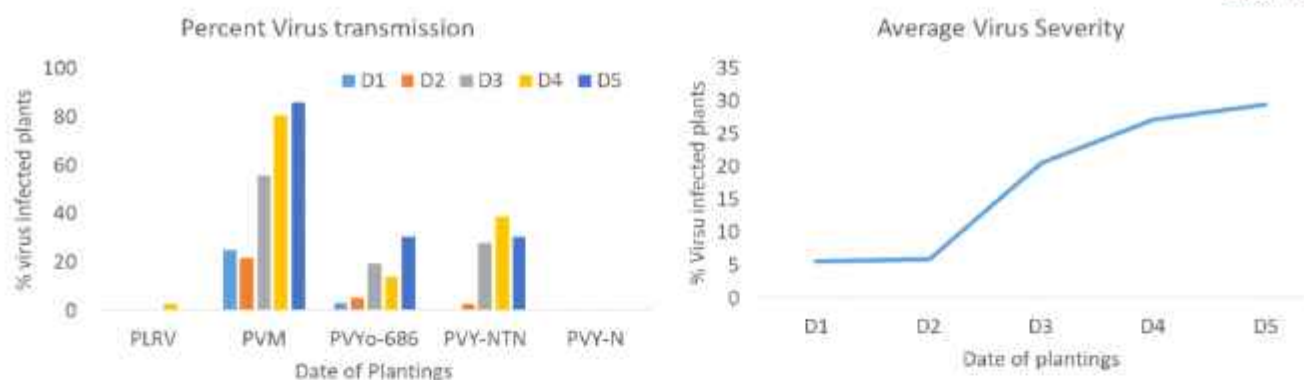


Fig. 37: Effect of dates of planting on aphids transmitted potato viruses. D1-Planting date 15th October, D2- Planting date 30th October, D3- Planting date 15th November, D4- Planting date 30th November and D5- Planting date 15th December

Biology, ecology and management of nematodes pests of potato

Validation of different management options against potato cyst nematode

A field validation trial was conducted at Kufri farm to assess the efficacy of various integrated management strategies against potato cyst nematode (PCN) populations. The study evaluated combinations involving native

bioagent, trap crop, non-host crop, chemical nematicide, and fallow periods (Table 2). Among the treatments, the lowest nematode reproduction factor (R_f : F_p/I_p) was observed in T_1 (R_f : 0.52), followed by T_4 (R_f : 0.72) and T_3 (R_f : 0.73). In contrast, the highest reproduction factor was recorded in T_6 (R_f : 1.42), where the susceptible variety Kufri Girdhari was planted alone (Fig. 38).

Table 2: Effect of different management combination on PCN population

T_1 :	Application of <i>Bacillus cereus</i> SGL6 @ 30 kg/ha with Trap crop (35 DAP) followed by non-host crop (French Bean) followed by fallow
T_2 :	Application of <i>Bacillus cereus</i> SGL6 @ 30 kg/ha with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T_3 :	Planting of non-host crop (French Bean) alone followed by fallow
T_4 :	Planting of non-host crop (French Bean) followed by application of bleaching powder @ 40 kg/ha followed by fallow
T_5 :	Application of Nimitiz @ 50 kg/ha (100% dose) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T_6 :	Planting of susceptible variety (Kufri Girdhari) alone followed by fallow

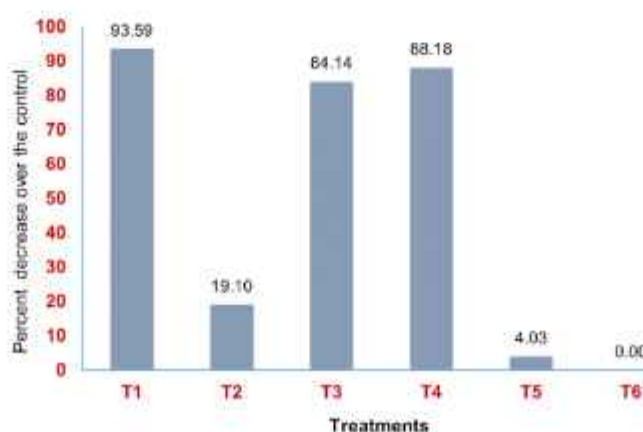


Fig. 38: Effect of different management combination on cyst multiplication

To assess the impact of various treatments on egg viability within cysts, Meldola's blue dye was used. The highest reduction in viable eggs was

observed in T₁ (93.59%), followed by T₄ (88.18%) and T₃ (84.14%) compared to the untreated control (T₀) (Fig. 39).

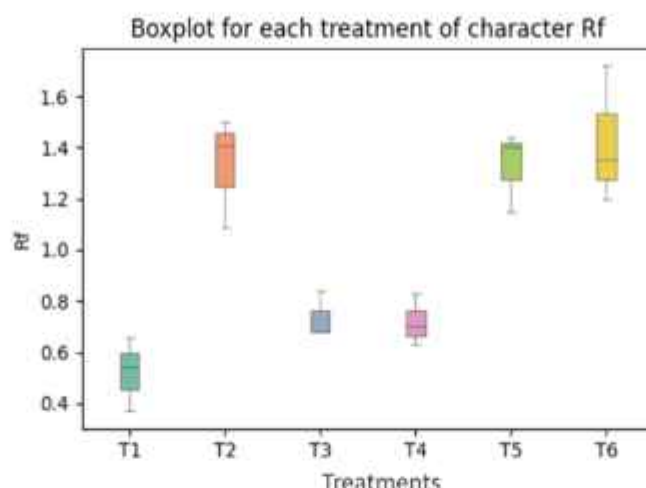


Fig. 39: Effect of different management combination on viable eggs in cyst population

Evaluation of native bio-agents against PCN population under field condition

A field study was conducted at Fagu farm to

evaluate native bioagents, isolated from the soil of Kufri (HP), and chemical treatments for their efficacy against PCN populations (Table 3).

Table 3: Effect of native bio-agents on PCN population.

T ₁ :	Application of <i>Cheatomium globosum</i> KPC3 @ 10 kg/ha (20 ton of Farm Yard Manure has to be enriched by mixing with 10 kg of <i>C. globosum</i> KPC3 for ha) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₂ :	Application of <i>C. globosum</i> KPC3 @ 15 kg/ha (20 ton of FYM has to be enriched by mixing with 15 kg of <i>C. globosum</i> KPC3 for ha) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₃ :	Application of <i>C. globosum</i> KPC3 @ 20 kg/ha (20 ton of Farm Yard Manure has to be enriched by mixing with 20 kg of <i>C. globosum</i> KPC3 for ha) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₄ :	Application of <i>Bacillus cereus</i> SGL6 @ 20 kg/ha (20 ton of Farm Yard Manure has to be enriched by mixing with 20 kg of <i>Bacillus cereus</i> SGL6 for ha) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₅ :	Application of <i>Bacillus cereus</i> SGL6 @ 30 kg/ha (20 ton of Farm Yard Manure has to be enriched by mixing with 30 kg of <i>B. cereus</i> SGL6 for ha) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₆ :	Application of new molecule fluopyram @ 625ml/ha (100% dose) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₇ :	Application of new molecule fluopyram @ 625ml/ha (50% dose) with susceptible variety (Kufri Girdhari) at the time planting and 50% dose at the time of earthing up followed by fallow
T ₈ :	Application of Carbofuran 3CG @ 65 kg/ha (100% dose) with susceptible variety (Kufri Girdhari) at the time planting followed by fallow
T ₉ :	Planting of susceptible variety (Kufri Girdhari) alone followed by fallow

Among the tested treatments, the highest reduction in cyst population (51.19%) was observed in T₇ (application of new molecule fluopyram @ 625ml/ha (50% dose) with susceptible variety (Kufri Girdhari) at the time of planting and 50% dose at the time of earthing up followed by fallow compared to the untreated control (T₀). The next most effective treatment was T₅, where the application of *Bacillus cereus* SGL6 @ 30 kg/ha (application of *Bacillus cereus* SGL6 @ 30 kg/ha (20 ton of Farm Yard Manure has to be enriched by mixing with 30 kg of *B. cereus* SGL6 for ha) with susceptible variety (Kufri Girdhari) at the time of planting followed by fallow, resulted in a 48.32% reduction in cyst population (Fig. 40).

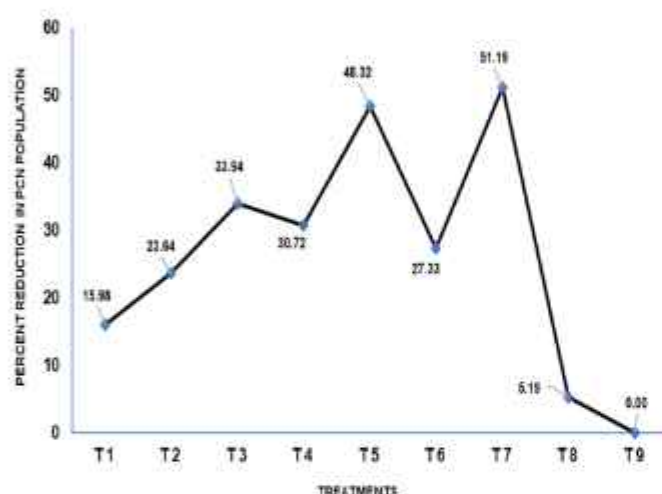


Fig. 40: Effect of native bio-agents on potato cyst nematode (PCN) population density

Effect of different cropping systems on PCN population dynamics

Over six years (2019-2024) of implementing various cropping systems at Kufri Farm, the Mustard-French bean-Trap-French bean-Potato-French bean system achieved the highest reduction in PCN population (72.0%), followed by Trap-Potato-Oat-Trap-Mustard- Oat (71.6%) and Oat-Mustard-Mustard- Trap-French bean-Potato (68.6%). At Fagu Farm, the Trap-Potato-Oat-Trap-Mustard-Trap system resulted in the highest reduction (84.6%), followed by Mustard-French bean-Trap-French bean-Potato-Oat (81.6%) and French bean-Trap-French bean-Potato-Oat-Trap (75.3%).

Effect of partial anaerobic burning for the management of PCN

A total of four treatments with graded nutrients were applied in randomized block design with 5 replications. All the treatments were able to suppress the soil populations of PCN drastically compared to control (Table 4). Among the treatments maximum yield was recorded with the treatment T3: partial anaerobic burning coupled with 100% recommended doses of fertilizers, which was followed by T2 and T1. However, the minimum yield was observed with control (Fig. 41). Additionally, in the current study partial anaerobic burning treatments were found improving the plant growth parameters such as plant height, number of shoots, leaves, chlorophyll content and Leaf Area Index and resulted in reduced incidence of soil borne pests such as cutworms and white grubs compared to control.

Table 4: Effect of partial anaerobic burning on germination of potato tubers and PCN populations

Treatments	Germination (%)	PCN Reproduction		
		IIP	FP	RF
• T1: Partial anaerobic burning without RDF	94.0	63.8	35.4	0.6
• T2: Partial anaerobic burning with 50% RDF	93.5	62.2	29.6	0.5
• T3: Partial anaerobic burning with 100% RDF	94.0	69.2	41.4	0.6
• T4: Control with 100% RDF	95.0	80.2	93.6	1.2

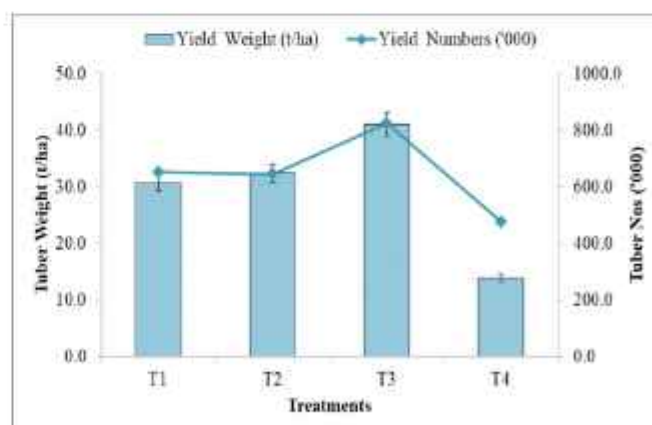


Fig. 41: Effect of partial anaerobic burning on yield parameters of Kufri Girdhari

Screening of potato varieties against root-knot nematodes at Ooty

The observations on root galling and egg masses per gm of root were recorded 55 days after planting. The varieties were scored based on the RKN gall index on 0-5 scale (Scale 0 = No galls; 1 = 1-2 galls; 2 = 3-10 galls; 3 = 11-30; 4 = 31-100 galls; 5 = >100 galls per plant). The maximum numbers of galls were observed in Kufri Karan and comparatively lower were observed in Kufri

Girdhari. The maximum number of egg mass per gm of root was noted in Kufri Himalini and the lowest in Kufri Girdhari. In each variety more than 1000 galls per plant were observed thus indicated that all the evaluated varieties were highly susceptible to RKN (Fig. 42). Moreover, the PCN resistant varieties such as Kufri Swarna and Kufri Sahyadri were also susceptible to RKN which indicates that PCN resistance is different than RKN resistance.

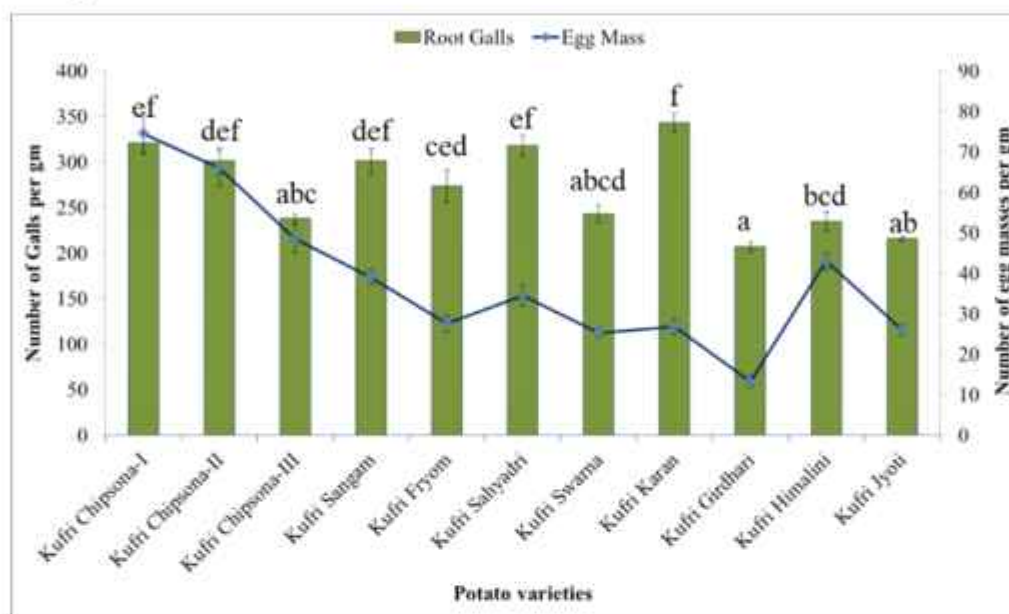


Fig. 42: Screening of potato varieties against RKN

DIVISION OF CROP PHYSIOLOGY, BIOCHEMISTRY & POST-HARVEST TECHNOLOGY

PROGRAMME: POST-HARVEST MANAGEMENT AND NUTRITIONAL ENHANCEMENT OF POTATOES

PI: Som Dutt, **Co-PIs:** Drs. Brajesh Singh, Dharmendra Kumar, Bandana, Arvind K Jaiswal, N Sailo, SK Luthra, Ratna Preeti Kaur, Hemant Kardile, Vinay Sagar, Jagdev Sharma, Sanjay Rawal, Pynbianglang Kharumunid, Sukhwinder Singh, Brajesh Nare, Mehi Lal, Alka Joshi, Vineet Sharma, Yogesh Gupta

Developing management systems for handling and storage of potatoes for minimization of losses

Use of sprout suppressant for enhancing storage life of potatoes (volatiles, new molecules, water-based formulations and organic compounds)

In 2024, a novel and highly effective formulation (An) of seven naturally occurring compounds was evaluated for its sprout suppression efficacy on fourteen different potato varieties (25 kg each) stored at 10-12°C. The selection of this formulation was based on the results of a PET Jar storage study conducted in 2023. Each variety was evaluated in triplicate along with one control sample. After adequate dilution in alcoholic solvent, the 'An' formulation was applied to the tubers as a fine mist. Similarly, blank and CIPC control of each variety were kept in separate chambers running at 10-12°C and RH of 95%. Monthly periodic observations on sprouting (%), sprouting index, percent rotting tubers, change in skin colour, and stiffness were recorded throughout 120 days of storage starting from mid-April to July 2024.

After 30 days of storage, 100% sprouting was recorded in untreated tubers. Whereas, in the 'An' formulation treated tuber there was almost nil sprouting up to 30 days of storage. The skin colour and firmness of the 'An' formulation treated tubers also remained unaltered. However, after 60 days of storage, 25-50 % sprouting was recorded in Kufri Surya, Kufri Chipsona-1, Kufri Frysona, Kufri Chandramukhi, Kufri Himsona, Kufri Lalit, Kufri Himalini, Kufri Chipsona-3,

Kufri Chipsona-4 and Diamont. Whereas in Lady Rosetta, Kufri Mohan, Kufri Jyoti and Atlantic sprouting was less than 20%. After 120 days of storage sprouting percentage reached 70-90% in Kufri Surya, Kufri Chipsona-1, Kufri Frysona, Kufri Chandramukhi, Kufri Himsona, Kufri Lalit, Kufri Himalini, Kufri Chipsona-3, Kufri Chipsona-4 and Diamont. Whereas in Lady Rosetta, Kufri Mohan, Kufri Jyoti and Atlantic sprouting percentage reached upto 50-65%. However, CIPC-treated tubers remained unsprouted throughout storage. These results show that the developed formulation was effective for 2 months of storage at 10-12°C and RH of 95%.

Also, another experiment was conducted using eight natural oils and compounds in a variety of fourteen combinations. The efficacy of each combination was tested on 2 kg of Kufri Chandramukhi potatoes stored in PET jars at a temperature of 10-12°C and 95% relative humidity from April to November 2023. Each combination was diluted in an alcoholic solvent and applied to the tubers as a fine mist, with tests conducted in duplicate. For comparison, one blank control was placed in a PET jar, and another in a Leno bag, while CIPC-treated samples were kept in separate chambers. At regular intervals of 15 days, the lids of the jars were opened for gas exchange. Monthly observations were made on sprouting percentage, sprouting index, percentage of rotting tubers, changes in skin color, and stiffness throughout the storage period. Six treatment combinations-T3, T4, T5, T12, T13, and T14- were found to be highly effective for up to four months of storage without causing any discoloration or skin defects (Figure 1A). However, after seven months (210 days) of storage, only the treatment combinations T4 and T14 effectively prevented sprouting without any skin defects (Figure 1B). In contrast, the control samples (both in PET jars and Leno bags) began to sprout after 30 days of storage, reaching 100% sprouting after 90 days. The

CIPC-treated tubers remained unsprouted throughout the entire seven-month storage period.

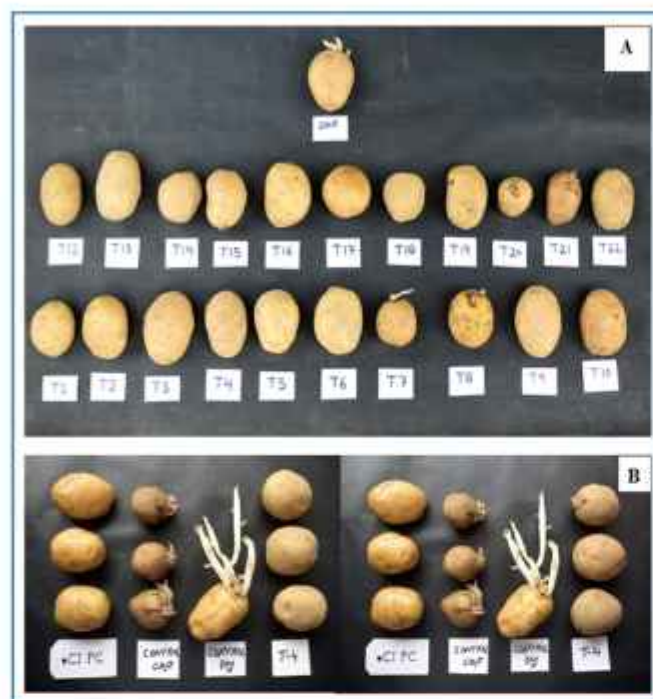


Fig. 1: Sprout suppression efficacy of new suppressant formulations on tubers of K. Chandramukhi after (A) 120 days and (B) 210 days of storage at 10-12°C (in PET jars)

Effect of plant extract on potato seed tubers treatment

Ten treatments consisting of plant extract (neem oil), and boric acid were evaluated during the *Rabi season 2023*. The harvested tubers were treated with different treatments by spray treatments and stored at 2-4°C in cold storage. The observations were recorded after taking out storage-treated tubers from cold storage. It was observed after 2 days and 7 days that no incidence of soft rot was recorded in treatments T1, T2, and T7 & T9. The highest incidence of soft rot was recorded in T5 (8.47%) with neem oil (1500 ppm) + plant leaf extract in water-2%, followed by T3 at 2 days after taking out tubers from cold storage. In the case of dry rot disease, after cold storage of 2 days and 7 days, the incidence was not recorded in treatments T1, T2, and T7 & T9. The highest incidence was recorded in T5 (Neem Oil (1500 ppm) + plant leaf extract in water-2%), followed by T3 and T6 at 2 days after taking out tubers from cold storage (Fig. 2).

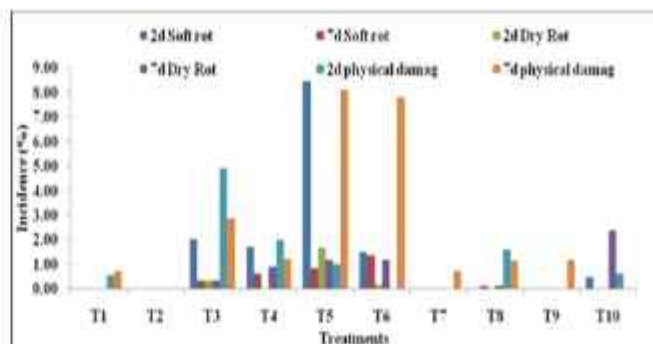


Fig. 2: Effect of plant extracts on potato (seed) treatment on incidence of soft rot, dry rot and physical damage after cold storage

Effect of plant extracts on potato (seed) treatment on chitting percentage after cold storage

In the above experiment, the chitting percentage was recorded after 7 days of taking out storage potatoes. It was noticed that the chitting percentage ranged from 16.67 to 100%. The highest chitting percentage was recorded in T2 & T7 (100%), followed by T3 and T9. The minimum and slow rate of chitting was in T6 (16.67%) and T5 (20%) (Fig. 3).

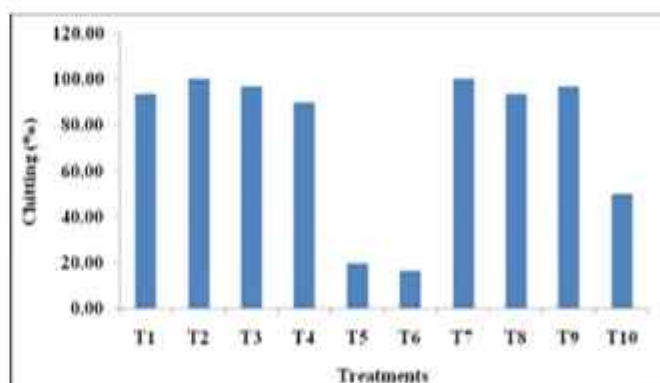


Figure 3: Effect of plant extracts on potato (seed) treatment on chitting percentage after cold storage

Effect of plant extracts on potato (seed) treatment on storage disease management in seed potatoes

Keeping in view recommendations of IRC the experiment was conducted to evaluate potato leaf extract alone and in combination with neem oil for storage disease management in seed potatoes, as a natural option for improving potato shelf life (soft rot/dry rot), especially against sprouting, fungal infections, and pest damage. The extract prepared are presented in Fig. 4. Details of the materials and the treatments are given in Table 1 and Table 2. Observations and

Results are presented in Tables 3 and 4. From results of the present study it was concluded that T6 (Neem Oil + Plant Leaf Extract in Methanol 2%) was the least effective, with the highest rottage and significant tuber decay. T2 (Plant Leaf

Extract in Water 5%) was the best performer with no rottage effectively preserving the tubers in excellent condition. Control treatments such as T9 (Boric Acid 2%) also performed well, showing low rottage levels.



a

b

Fig. 1: a Shade drying of leaves of K. Bahar variety.
b. Preparation of leaf extract/other combination before spray and storage

Table 1: Details of materials and the conditions used

Tubers of potato variety used	Kufri Bahar
Leaves of potato variety used	Kufri Bahar
Storage Temperature	2-4 °C
Total potato used	6.0 quintal
Potato for storage	30kg each per treatment

Table 2: Treatment details

Sr. No.	Treat-ments	Details
1.	T1	Plant Leaf extract in water (2%)
2.	T2	Plant Leaf extract in water (5%)
3.	T3	Plant Leaf extract in methanol (2%)
4.	T4	Plant Leaf extract in methanol (5%)
5.	T5	Neem Oil (1500ppm) +Plant leaf extract in water (2%)
6.	T6	Neem Oil (1500ppm) + Plant leaf extract in methanol (2%)
7.	T7	Potato tubers without any dip (control)
8.	T8	Plain water (control)
9.	T9	Boric acid (2%) (control)
10.	T10	Neem oil (1500ppm) (control)

Table 3: Effect of treatments on seed potatoes during storage

S. No.	Treatments	Total		Healthy		Rotted		General Appearance	Rottage (%)
		Tuber Wt.	Tuber No.	Tuber Wt.	Tuber No.	Tuber Wt.	Tuber No.		
T1	Plant Leaf* extract in water (2%)	29.53	691	29.07	680	0.46	11	Excellent	1.59
T2	Plant Leaf extract in water (5%)	30.13	680	30.13	680	0	0	Excellent	0.00
T3	Plant Leaf extract in Methanol (2%)	30.05	590	28.81	560	1.24	30	Excellent	5.08
T4	Plant Leaf extract in Methanol (5%)	29.93	645	29.12	610	0.81	35	Soft Rot	5.43
T5	Neem Oil (1500ppm) +Plant Leaf extract in Water (2%)	29.59	590	27.72	530	1.87	60	Soft Rot	10.17
T6	Neem Oil (1500ppm) + Plant Leaf extract in Methanol (2%)	29.11	590	18.75	350	10.36	240	Soft Rot	40.68
T7	Potato tubers without any dip (control)	30.54	535	30	525	0.54	10	Bruised/ minor Shrinkage	1.87
T8	Plain water (control)	30.5	680	29.21	650	1.29	30	Excellent	4.41
T9	Boric acid (2%) (control)	30.25	415	30.25	415	0	0	Excellent	0.00
T10	Neem Oil (1500ppm) (control)	30.18	630	30.18	630	0	0	Excellent	0.00

Table 4: Storage studies at room temperature (after taking out potato : from 2-4 °C)

Treatments	Total wt	Total No.	Healthy t. Wt.	Healthy t. No.	Rotted t.Wt.	Rotted t.No.	Appearance	sprouting	Rottage %	
									Number basis	Wt basis
T1, Plant Leaf* extract in water (2%)	29.07	680	28.87	675	0.2	5	Excellent	3.33	0.74	0.69
T2, Plant Leaf extract in water (5%)	30.13	680	30.13	680	0	0	Excellent	100.00	0.00	0.00
T3, Plant Leaf extract in Methanol (2%)	28.81	560	27.82	539	0.99	21	2 soft rot, 1 dry rot	100.00	3.75	3.44
T4, Plant Leaf extract in Methanol (5%)	29.12	610	28.25	592	0.87	18	6 dry rot, 4 physical damage	80.00	2.95	2.99
T5, Neem Oil (1500ppm) +Plant Leaf extract in Water (2%)	27.72	530	25.21	475	2.51	55	Excellent	10.00	10.38	9.05
T6, Neem Oil (1500ppm) + Plant Leaf extract in Methanol (2%)	18.75	350	15.37	284	3.38	66	4 Dry rot, 10 soft rot	3.33	18.86	18.03
T7, Potato tubers without any dip (control)	30	525	30	525	0	0	Excellent	96.67	0.00	0.00
T8, Plain water (control)	29.21	650	28.2	627	1.01	23	Excellent	96.67	3.54	3.46
T9, Boric acid (2%) (control)	30.25	415	30.05	410	0.2	5	Excellent	96.67	1.20	0.66
T10, Neem Oil (1500ppm) (control)	30.18	630	29.54	615	0.64	15	Excellent	50.00	2.38	2.12

Establishing Nutritional Significance of Potatoes

LC-MS Method for extraction, detection and quantification of Vitamin D.

Liquid Chromatography-Mass Spectrometry (LC-MS)-based method for extraction, detection and quantification of vitamin D2 and D3 was developed. The chromatographic conditions included a C18 column (1.7 μ m, 2.1 mm $\times$ 100

mm) with a 95:5 v/v acetonitrile and methanol mobile phase, a flow rate of 0.3 mL/min, and a column temperature of 35°C. Detailed chromatographic conditions are presented as Flow chart (Fig.5). Detection was performed using a photodiode array (PDA) at 265 nm. Mass spectrometry parameters, such as capillary and cone voltages, temperature, and ionization mode, were optimized. The method showed good linearity ($r^2 > 0.9959$ for D2, $r^2 > 0.9978$ for D3)

over the 0-250 ng/mL range (Figs. 6 and 7). The limit of detection was 25 ng/mL. The method was successfully applied to analyse vitamin D₂ and D₃ in mushrooms, potato tissues (spiked),

and vitamin D tablets/capsules. Overall, the method is suitable for effective analysis of vitamin D₂ and D₃ in potato tubers, other plant tissue and vitamin D commercial formulations.

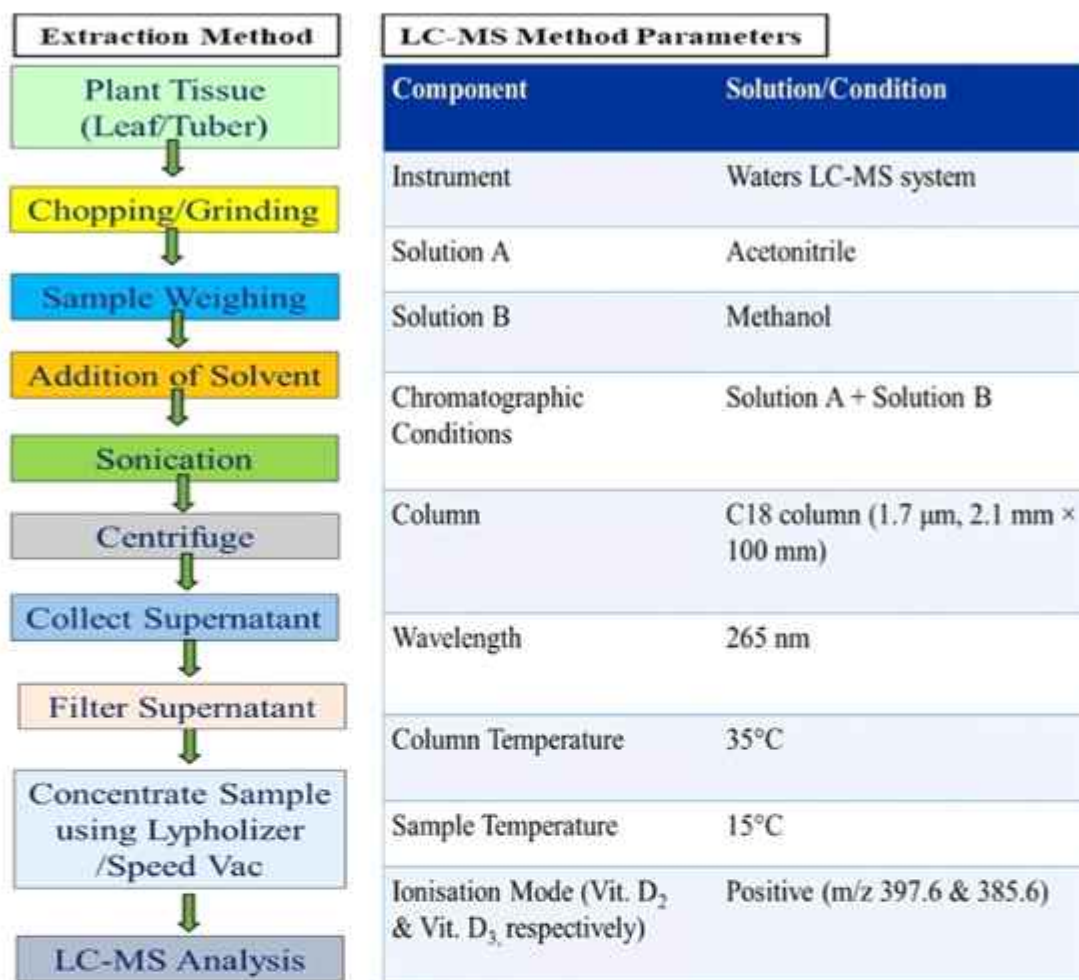


Fig. 5: Flow chart showing sample preparation for LC-MS analysis for Vitamin D

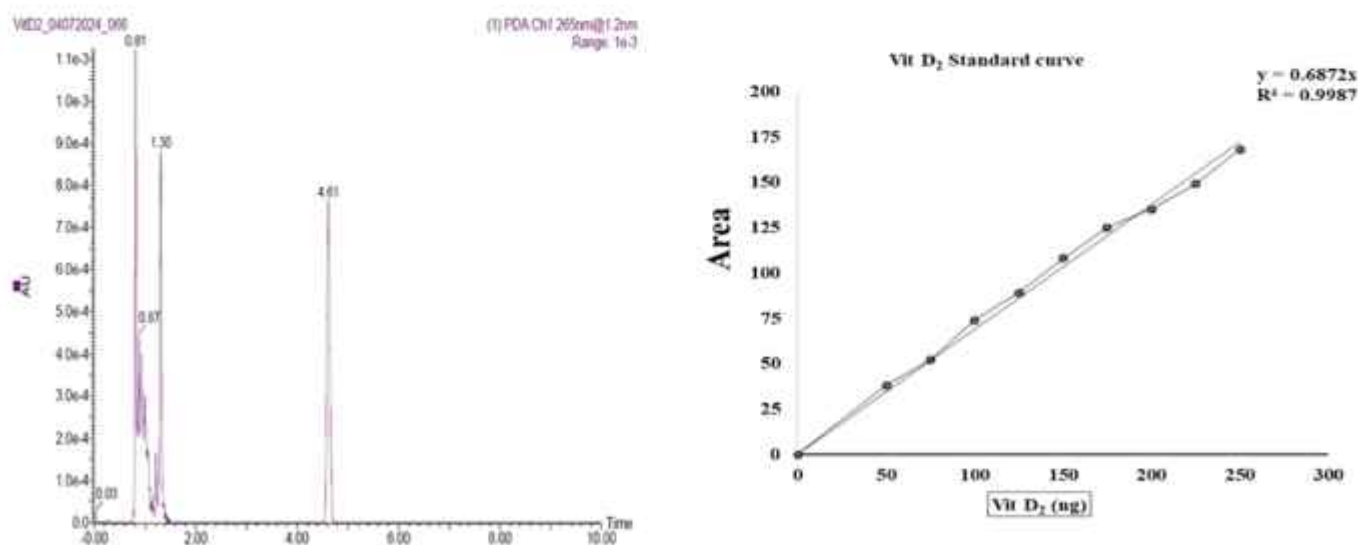


Fig. 6: Calibration curve and chromatographic analysis of Vitamin D₂

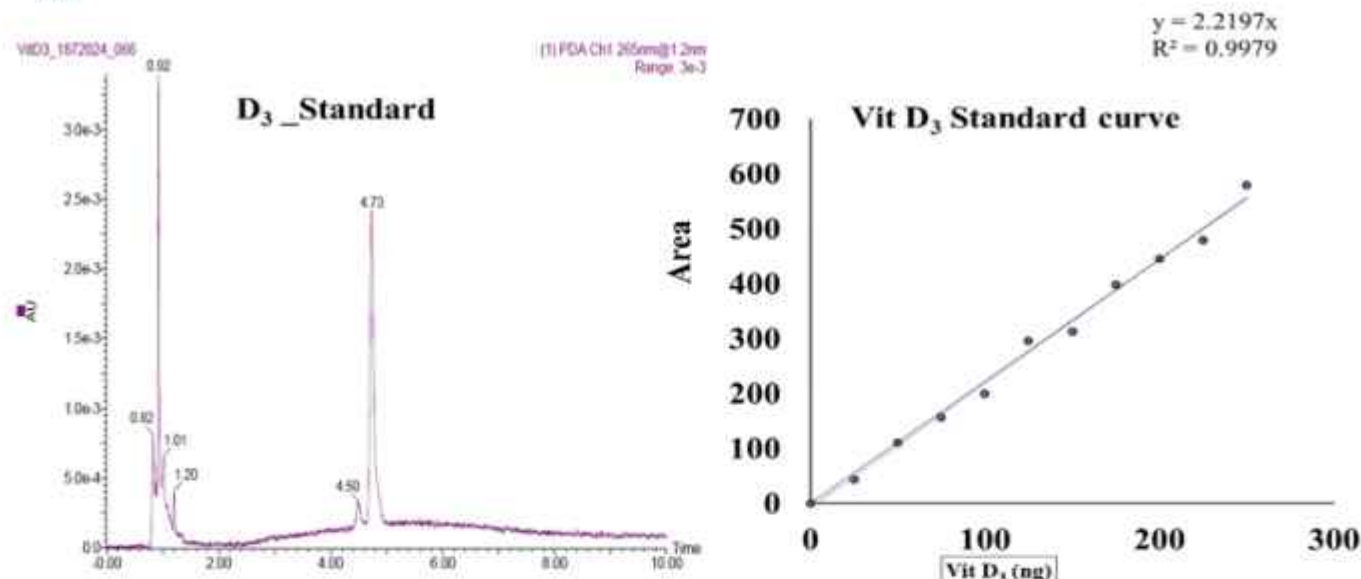


Fig. 7: Calibration curve and chromatographic analysis of Vitamin D3

Biochemical and molecular analysis of enzymatic browning in potato

Browning in potato results in diminishing of tuber's sensory, flavor, and processing attributes. Primary cause of enzymatic browning in potato tubers is the activity of two enzymes: and polyphenol oxidase (PPO) and peroxidase (POD). In the present study, potato tubers collected from potato growing sub-tropical regions of Una and Kangra of Himachal Pradesh (Fig. 8) were used for assays of Polyphenol oxidase (PPO) and Peroxidase (POD) enzymes

associated with browning in potato. The tubers stored at ambient temperature (25 °C) were withdrawn at 0, 15 and 30 days of storage and used for PPO and POD enzymes activity estimation. Changes of PPO activity in Kufri Pukhraj and Kufri Jyoti cultivars at different location and at different days of storage were determined. In both the varieties maximum PPO activity was observed at 15 days of storage (Fig. 9). In case of POD activity maximum activity was observed on day 15 of the storage (except for Kufri Pukhraj from Una) (Fig. 10)



Fig. 8: Kufri Pukhraj and Kufri Jyoti cultivar tubers collected from different locations in H.P.

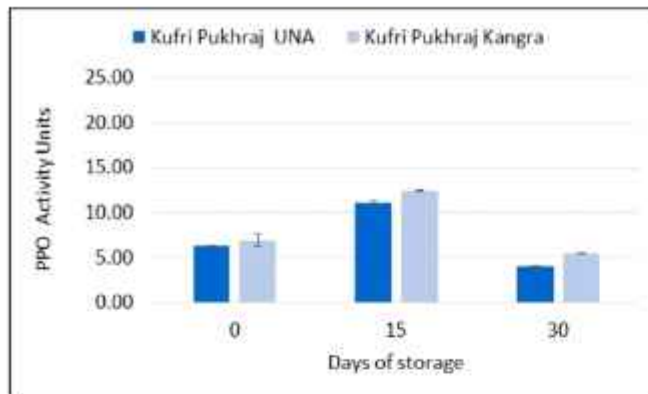


Fig. 9: PPO activity in tubers of Kufri Pukhraj and Kufri Jyoti cultivars collected from different locations.

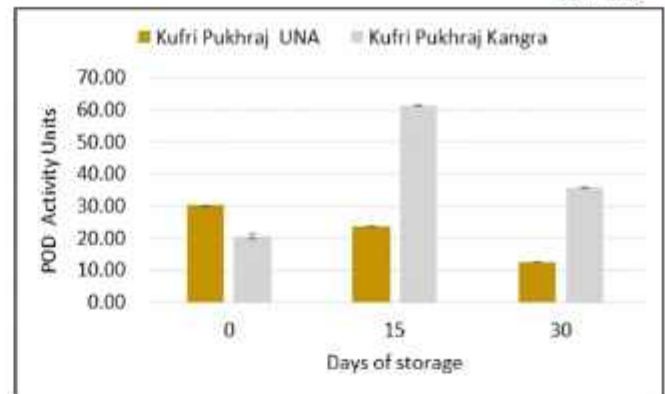


Fig. 10: POD activity in tubers of Kufri Pukhraj and Kufri Jyoti cultivars collected from different locations.

Further, the browning progression and browning index were estimated and compared in the tubers of Kufri Pukhraj and Kufri Jyoti cultivars collected from the two different locations. Both

Browning progression as well as Browning index was found to lower for Kufri Pukhraj and in tubers collected from Una (Figs. 11 & 12).

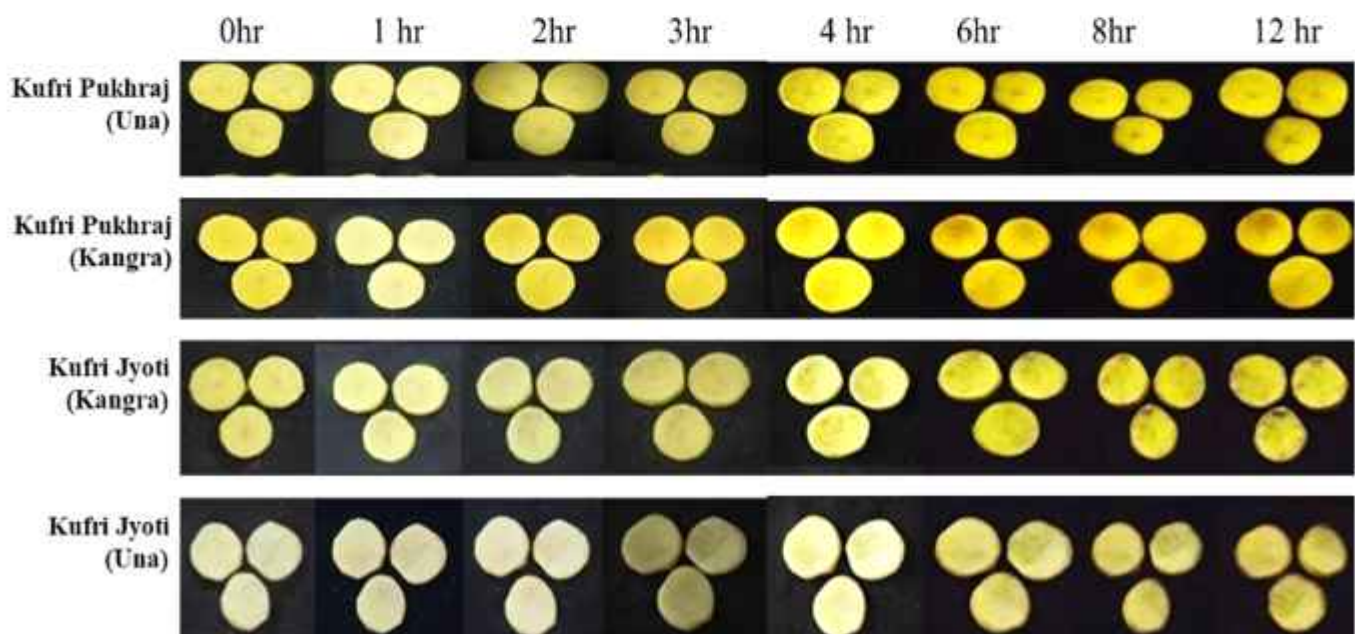


Fig. 11: Browning progression in tubers of Kufri Pukhraj and Kufri Jyoti cultivars collected from different locations.

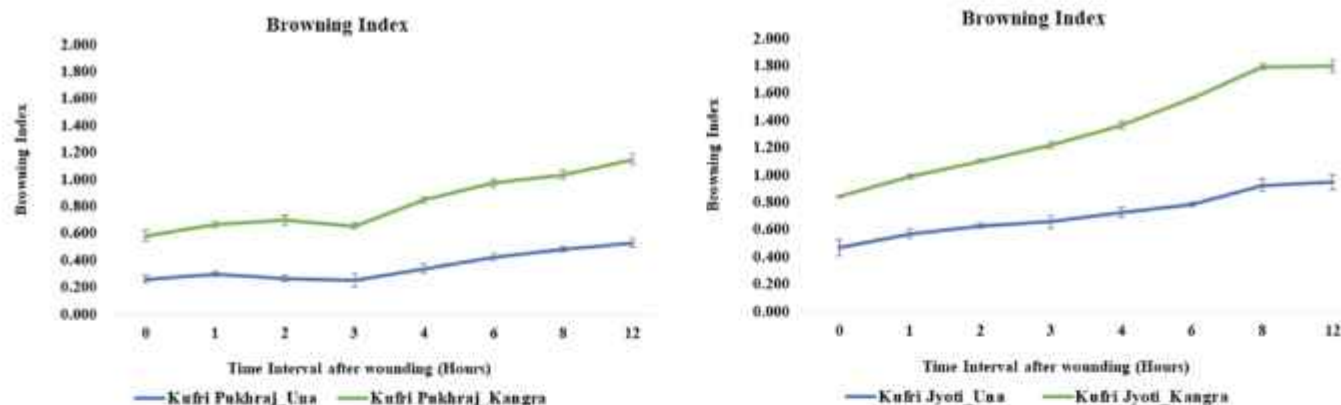


Fig. 12: Browning Index in tubers of Kufri Pukhraj and Kufri Jyoti cultivars collected from different locations.

Genome-wide analysis revealed nine PPO and ninety-nine POD genes in potato genome. Interestingly, 8 Of the 9 PPO genes, were found to be present on chromosome 8. (Fig. 13). On the

other hand, POD genes were found to be distributed through-out the genome on every chromosome. (Fig. 14).

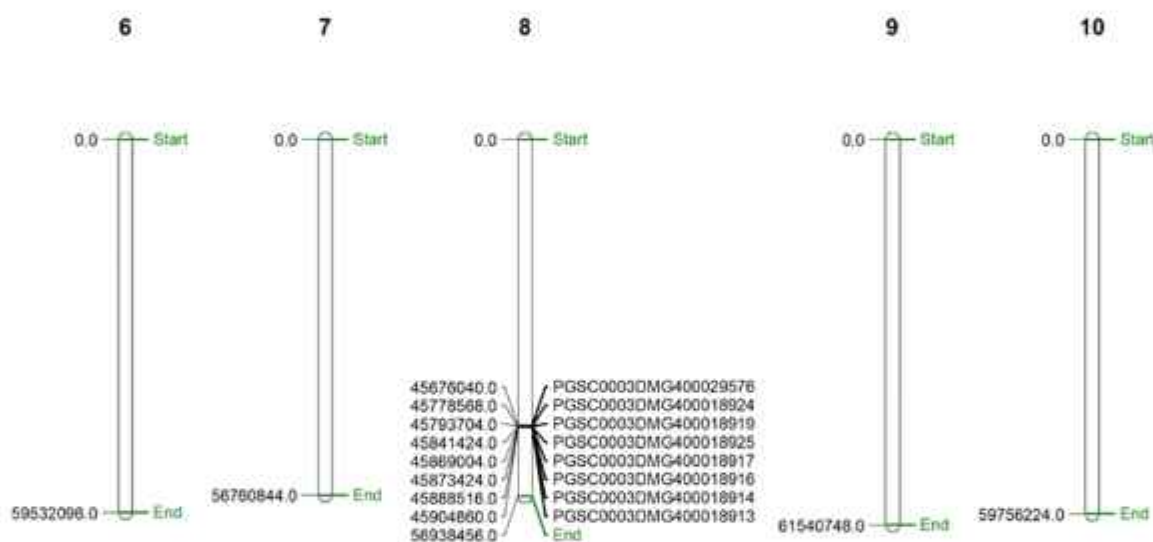
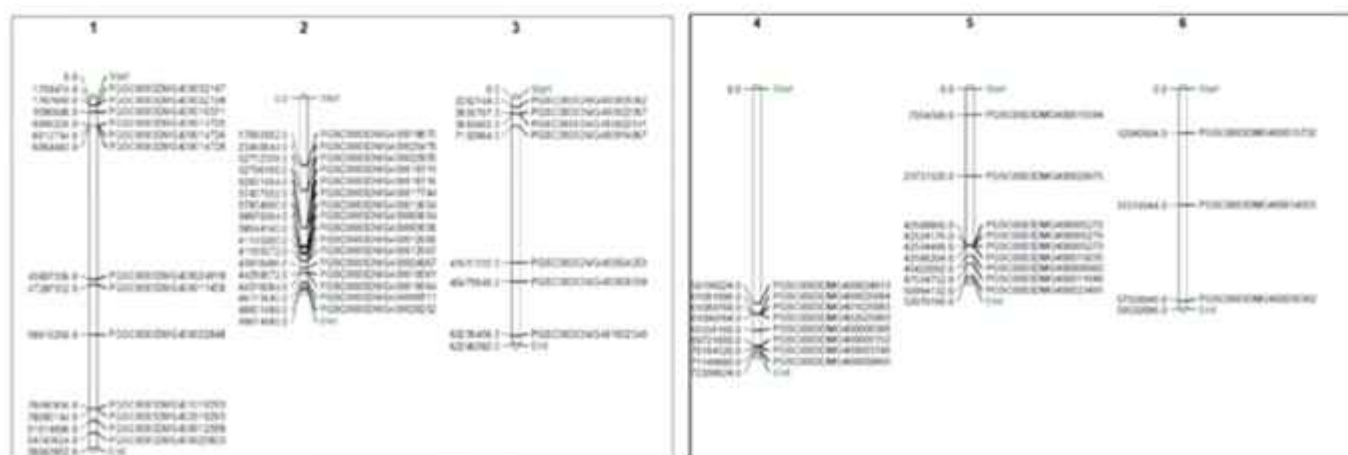


Fig. 13: Polyphenol oxidase gene landscape in potato genome. 8 PPO were found to be present on chromosome 8.



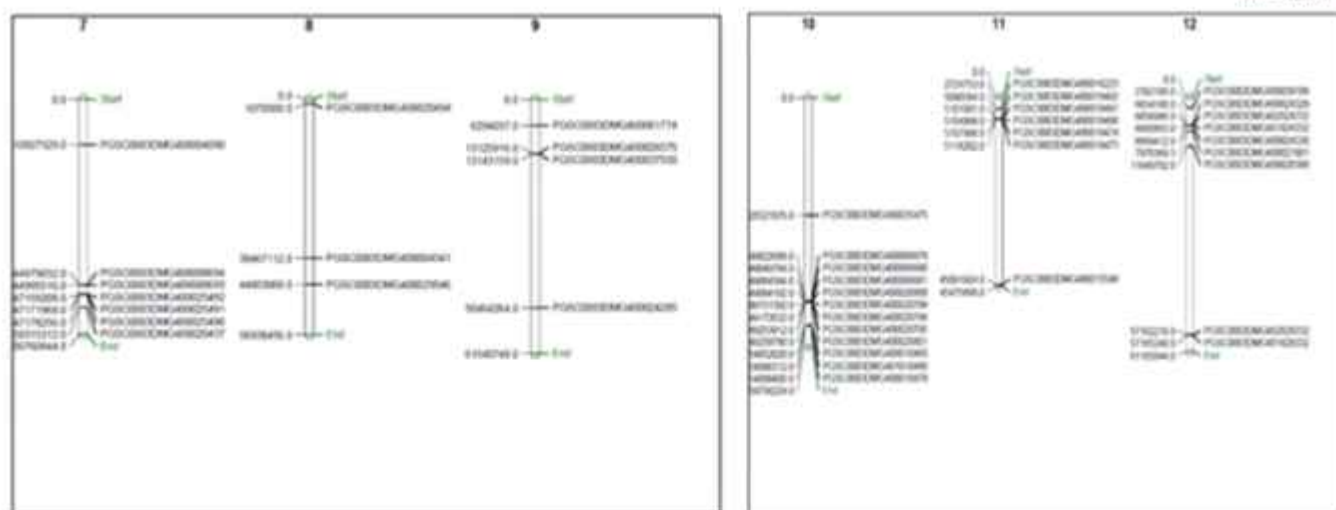


Fig. 14: Peroxidase (POD) gene landscape in potato genome. POD genes were found to be distributed through-out the genome on every chromosome.

Developing custom made potato products

Standardization of ingredients for potato flour-based namkeen boondi

Boondi are tiny crunchy fried snack balls typically made with gram flour. The process of making boondi for sweets and raita was previously standardized, and the ingredients for making potato flour-based boondi for namkeen were standardized this year. A combination of whole potato flour (36%), arrowroot starch (26%), chickpea flour, and moth bean flour, was found to be the best for Namkeen Boondi (Fig. 15). It has been found that a combination of

potato flour, arrowroot starch, and moth bean flour can replace up to 65% of Bengal gram flour. The unique ingredient combination gives these boondi a crunchier texture. Texture analysis revealed that the potato-based boondi was approximately three times less tough than the market sample and besan-based boondi. Similarly, potato-based boondi had the highest crispiness (Table 5). Furthermore, these boondi can be made from any type of potato. These boondi can be stored in inert gaseous conditions with no light or moisture for up to three months.

Table 5: Texture analysis of boondi sample using Ottawa cell

Test ID	Toughness (N.mm)	Crispiness
Besan Lab-made Boondi	1703.820	64.000
Market Sample Boondi	1670.764	79.000
Potato Namkeen Boondi	625.772	93.000



Fig. 15: Potato-based boondi for namkeen

Rehydration/water holding study of raita boondi (curd holding/water holding)

The water and curd holding capacity of the potato-based raita boondi were assessed (Fig. 16). To determine curd holding capacity, curd was diluted with water (1:1). Each sample was soaked for 2 hours. The water holding capacity of potato-based raita boondi was found to be 4.55 g/g, whereas market boondi had a water holding capacity of 2.55 g/g. Similarly, for curd:water (1:1), potato-based boondi had a curd holding

capacity of 4.9 g/g of boondi, while market boondi had a curd holding capacity of 3.0 g/g. The results show that the potato-based raita

boondi has a 2.5 to 3 times higher water and curd holding capacity than market boondi.



Fig. 16: Water and curd holding capacity of the potato-based raita boondi

Potato cushions

Potato cushions is cheesling like product. Commercially available cheeslings are made with refined wheat flour and cheese. At ICAR-CPRI, we have standardized the process of making cheesings from potato flour. Whole potato flour combined with black gram flour, moth bean flour, green gram flour, chickpea flour, and arrowroot starch was tested for better puffing, less hardness, and improved crispiness of potato cushions. The combination of whole

potato flour, green gram flour, chickpea, arrowroot starch, and xanthan gum produced the best results, with more than 98% puffing, less oil absorption, less hardness, and better crispiness. Four of the combinations tested (PC-1, PC-2, PC-16, and PC-17) were found to be the best (Figure 17). These potato cushions can be made with any type of potato. Such products may help to reduce the various types of post-harvest losses that occur in the potato chain.



Fig. 17: Potato cushions made from different combinations of whole potato flour, moth bean, chickpea and green gram flour.

Standardization of the ratio of ingredients for hardness reduction and better crispiness of the potato-based murukku

Potato swirls are similar to the south Indian snack Murukku/chakli. Murukku is a deep-fried snack traditionally made from rice flour and black gram flour, with added spices and salt. Based on previous year's experiments, a combination containing 80% potato flour was deemed satisfactory. This year, the ingredient ratio was standardized with the goal of reducing hardness and increasing crispiness. Whole potato flour

(70%) combined with arrowroot starch, green gram flour, and moth bean flour was found to be the most effective in terms of oil absorption, crispiness, color, and reduced hardness. Textural properties of the selected combination were assessed and compared to rice-based Murukku. Texture analysis was carried out using bulk compression in the Ottawa cell (Table 6, Fig. 18). It was found that the combination M6 (moth bean) and M7 (green gram) performed best in terms of hardness and toughness, which were lower than rice-based Murukku.

Table 6: Texture analysis of potato swirls and rice based murukku

Sample	Hardness (N)	Toughness (N.sec)	Maximum hardness (N)
M1	5.6 ± 2.0	17.8 ± 3.0	32.8 ± 3.3
M2	5.2 ± 2.6	11.5 ± 4.2	22.7 ± 2.5
M3	4.5 ± 2.6	11.8 ± 1.8	22.9 ± 2.9
M4	8.8 ± 3.7	14 ± 5.8	23.6 ± 2.5
M5	3.4 ± 1.2	4.4 ± 1.8	7.5 ± 2.3
M6 Moth	5.5 ± 2.7	7.3 ± 1.5	16.5 ± 1.9
M7 Green gram	3.9 ± 2.6	7.8 ± 2.3	23.5 ± 2.2
M8	15.9 ± 6.8	11.1 ± 5.6	10.2 ± 4.8
M9	44.6 ± 2.6	48.9 ± 2.3	51 ± 4.9
M10	5.5 ± 3.3	13.8 ± 3.7	28.9 ± 6.7
M11	46.6 ± 5.6	43 ± 5.5	39.7 ± 8.5
M13	4.2 ± 2.0	12.2 ± 2.9	26.5 ± 3.3
M14	4.9 ± 2.1	6.3 ± 1.2	14.2 ± 4.5
M16	4.3 ± 2.1	12.8 ± 2.1	21.7 ± 8.3
M17	4.6 ± 2.4	12.2 ± 2.7	26.4 ± 4.9
M18	6.0 ± 1.3	15.5 ± 1.6	28.4 ± 4.2
M19	4.6 ± 1.9	6.8 ± 1.9	14 ± 2.5
M20	6.4 ± 3.1	10.6 ± 1.8	23.2 ± 2.2
Rice	6.2 ± 3.6	18.5 ± 1.6	39.6 ± 1.7



Fig. 18: Potato-green gram-based swirls

Potato-millet based idli premix

Idli is a traditional South Indian dish made by steaming a fermented mixture. It is typically prepared from rice and lentils and is commonly enjoyed at breakfast or as a snack, often accompanied by chutney, sambar, or other side dishes. The inclusion of potatoes in such food products could open up new opportunities in potato processing. Initial trials have been conducted using whole potato flour combined with finger millet flour. These trials revealed that a dry premix consisting of 64% potato flour, 33% finger millet flour, and leavening agents produced soft and spongy idlis (Fig. 19). The ratios of these ingredients will be further refined to enhance the textural properties.



Fig. 19: Potato-Ragi Idli (finger millet 33%)

Potato Waste Management

Bioprospection for saccharification-efficient microbes/ enzymes for management of waste Potato

This year microbes were isolated from insects for improving the saccharification process, specifically for production of glucose syrup from potato polysaccharides. The study involved

isolation, screening, and characterization of α -amylase-producing microbes. The process began with sample collection from insect guts and soil (Fig. 20), followed by the preparation of serial dilutions. Different media were tested for cultivating microbes, viz: potato dextrose agar (PDA) for fungi and nutrient broth agar for bacteria. The microbes were cultured using spread and pour plating techniques. Subsequently, the microbes were screened for α -amylase production. The qualitative estimation of α -amylase enzymes was performed by measuring the optical density (OD) at 600 nm across three replicates ($n=3$) for various isolates. The OD values for different isolates were as follows: CPRI IGB1 (0.439), CPRI IGB2 (0.751), CPRI IGB3 (0.410), CPRI IGB4 (0.450), CPRI IGS1 (0.410), CPRI IGS2 (0.547), CPRI IGS3 (0.681), CPRI IGS4 (0.525), CPRI IGS5 (0.619), and CPRI IGS6 (0.416). These measurements provided insight into the enzymatic activity of each isolate, crucial for selecting the most effective microbes for glucose syrup production.

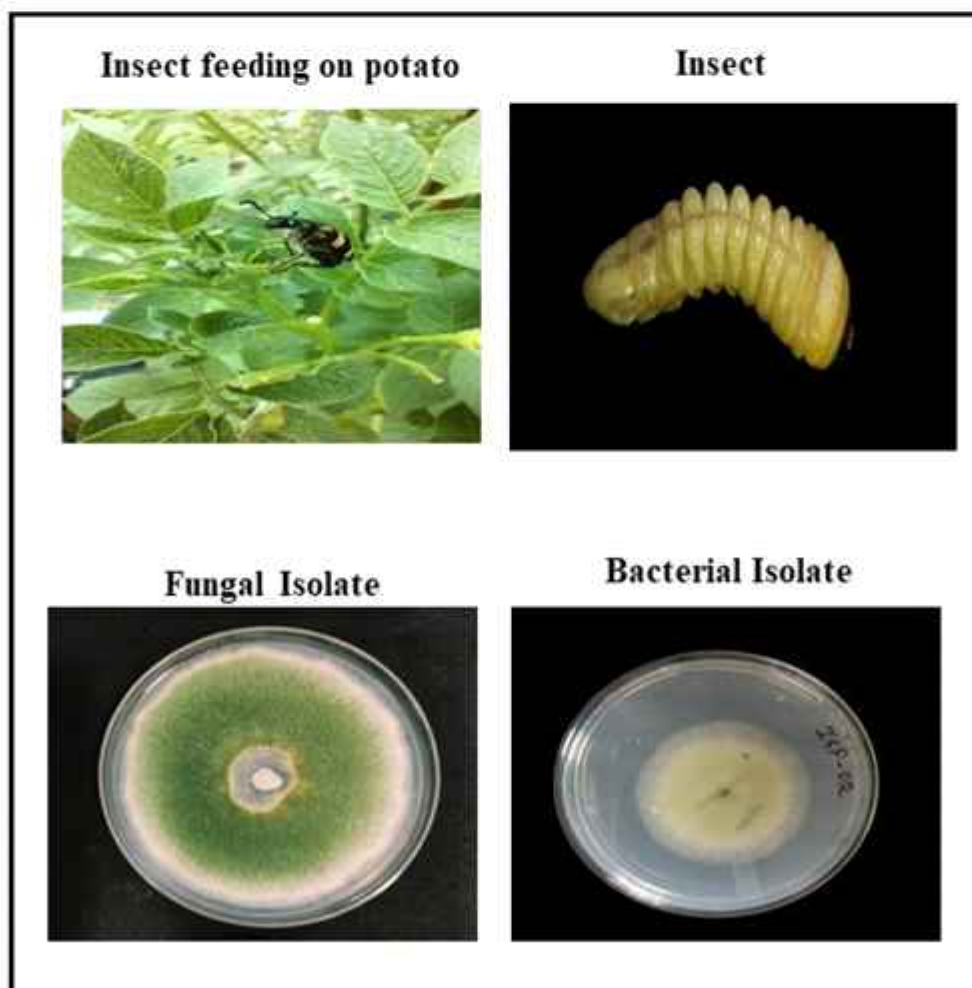


Fig. 20: Beneficial microbes isolated from insects for saccharification process

Bioprospecting yeast for efficient fermentation process

The study involved collection of samples from *Sakthi Sugars Ltd* mill, Coimbatore, Tamil Nadu. The collected effluent from the sugar factory served as the source for microbial isolation (Fig. 21). To initiate the process, serial dilutions of the effluent sample were prepared to ensure a range of microbial concentrations. The Yeast Extract

Peptone Dextrose (YPD) media was used to support yeast growth. Both, spread plating and pour plating techniques were employed for culturing the yeast. The screening process involved selecting colonies with desirable traits for fermentation, such as rapid growth and high alcohol tolerance (Fig. 22). These selected colonies were characterized for their suitability for industrial fermentation.



Fig. 21: Isolation yeast for bioethanol production

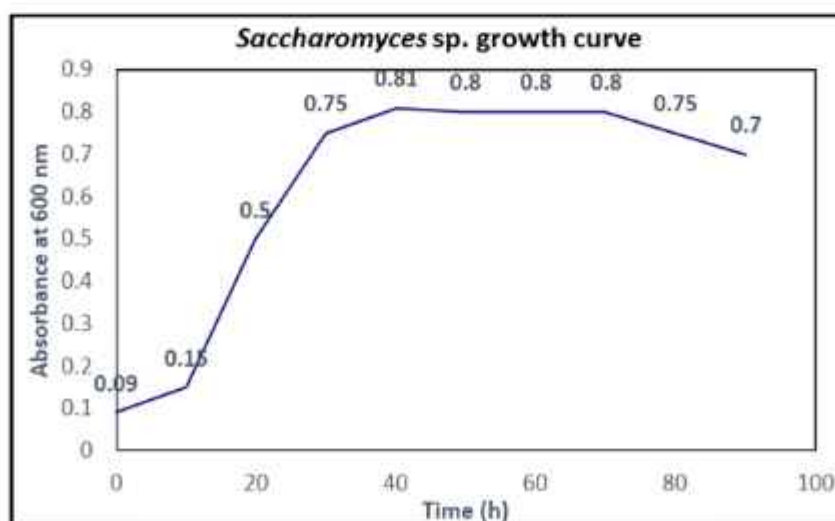
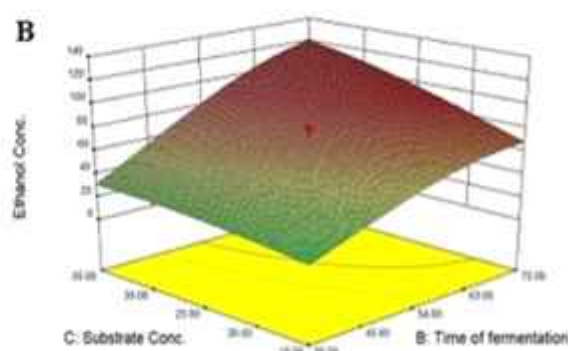
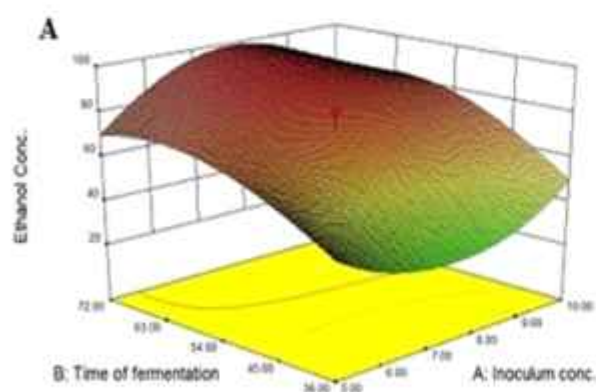


Fig. 22: *Saccharomyces* sp. Growth Curve:

Process optimization for bioethanol production from potato by using Response Surface Methodology (RSM):

Preparation of *Saccharomyces cerevisiae* inoculum involved sourcing the strain (MTCC 178) from the Microbial Type Culture Collection and Gene Bank at CSIR-Institute of Microbial Technology, Chandigarh, India. The MTCC 178 strain was cultivated in a YPD medium and preserved at 4°C, with weekly sub-culturing. Stock cultures were maintained in 20% glycerol at -80°C. The fermentation medium comprised 40.4 g/L of waste potato mash hydrolysate, 50 g/L of malt extract, and 4.84 g/L of MgSO₄·7H₂O. Liquefaction and pretreatment of the potato slurry began with mixing it to a 25% (w/v) solids concentration. The pH was adjusted to 6.5 using 0.1 N HCl. Controlled heating was performed in a shaking water bath, gradually increasing the temperature from 25°C to 80 ± 1°C over 120 minutes. Heating-cooling cycle was repeated twice to enhance pretreatment efficiency. Saccharification was conducted by adding α-amylase, amyloglucosidase, and pullulanase enzymes, sequentially. The hydrolysate was filtered using muslin cloth and reducing sugars were measured using YSI analyzer. Fermentation was conducted in a 1.5-litre BIOAGE fermentor with autoclaved potato slurry at 25% (w/w) glucose of soluble solids, inoculated with 7.5% (v/v) inoculum, and incubated at 30°C for 96

hours. Samples were taken at regular intervals for kinetic analysis of pH, viable cell counts, reducing sugars, and alcohol content, centrifuged at 10,000 rpm, and stored at -4°C. The alcohol content was estimated using YSI. Design of experiments and statistical evaluation were performed using Design Expert 8.0.7.1 software (Stat-Ease, Inc.). The goodness of fit for the regression model was assessed using coefficients of determination (R²) and ANOVA. Response Surface Methodology (RSM) was employed to optimize the saccharification process, evaluating six parameters: α-amylase, amyloglucosidase, pullulanase, temperature, pH, and time. The Central Composite Design (CCD) results were used to develop a second-order polynomial equation to predict glucose production. Potato variety Kufri Chipsona 1, with 22% dry matter and 79% starch content on a dry weight basis, was used. The biochemical composition indicated high carbohydrate content, supporting fermentative ethanol production. The saccharification and fermentation processes demonstrated significant glucose and ethanol yields, with statistical models indicating strong predictive capabilities (R² values) (Fig. 23). The results from ANOVA and regression analysis confirmed the effectiveness of the optimized protocol for bioethanol production from potatoes using RSM.



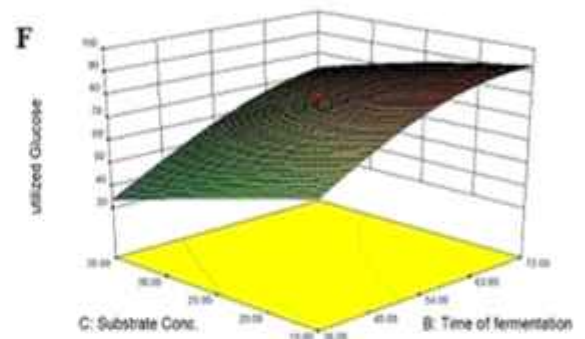
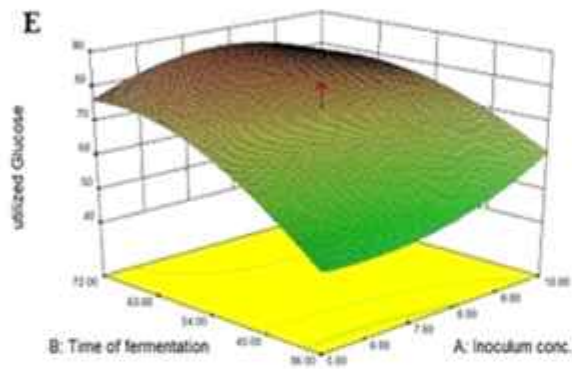
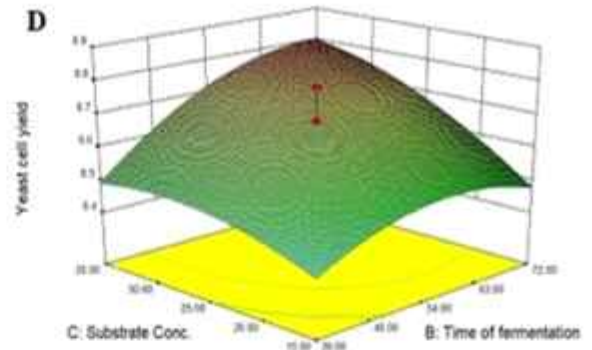
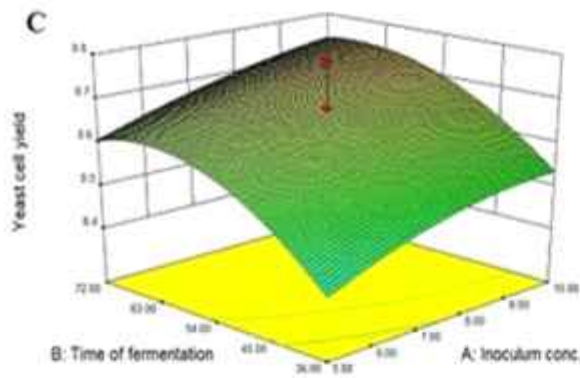


Fig. 23: Contour plots depicting the impact of parameters viz: time, temperature, inoculum, and substrate concentration on the production of bioethanol in the fermentation process.

DIVISION OF SOCIAL SCIENCES

PROGRAMME: TRANSFER OF POTATO TECHNOLOGIES TO STAKEHOLDERS AND ASSESSMENT OF THEIR IMPACTS

PI: Dr. Alok Kumar, **Co-PIs:** Drs. Pynbianglang Kharumnuid, RK Singh, Yogesh Gautam, Rajesh Kumar Singh, Anil Sharma, Subhash Katare, N Sailo, Priyank Mhatre

Assessment of Consumers' Preferences for Attributes of Fresh Potato

Consumers' preferences for attributes of fresh potatoes

A structured online survey was administered through Google Forms, yielding a total of 93 complete responses. The respondents were categorized into two groups: Plains (n = 42), comprising consumers from Madhya Pradesh, Maharashtra, Uttar Pradesh and Rajasthan, and Hills (n = 51) consisting of consumers from Meghalaya and Uttarakhand. The weighted

mean scores for the importance of potato attributes showed notable differences between consumers from the Plains and the Hills. In the plains, the mean scores were highest for shelf life (4.88), followed by cooking time (4.71), taste (4.71), and suitability for frying (4.52) (Fig. 1). In comparison, consumers from the hills ranked taste (4.67), suitability for boiling (4.63), shelf life (4.49), and cooking time (4.47) as the leading attributes. Other attributes showed similar trends with consistently higher scores in the Plains than in the Hills; for instance, tuber size was rated 4.76 in the plains and 3.71 in the hills, skin colour 4.50 versus 3.59, and skin smoothness 4.10 versus 3.71, respectively. Conversely, attributes such as suitability for boiling were rated higher in the hills (4.63) compared to the Plains (4.19).

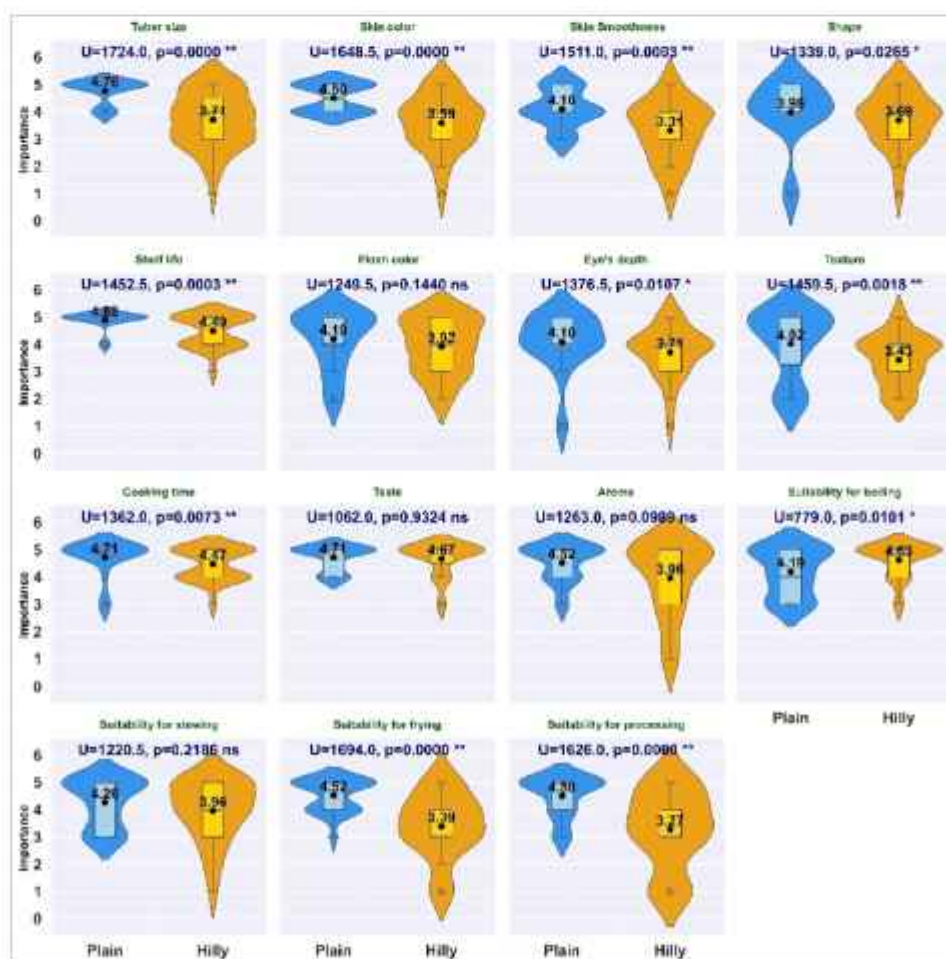


Fig. 1: Violin plots displaying consumer preferences for selected potato attributes in Hilly and Plain Regions. The bold grey line within each boxplot represents the median value, while the black circle denotes the mean value for the respective attribute.

Regional differences for preferences of potato attributes using Mann-Whitney U Tests

Mann-Whitney U tests were conducted to assess the statistical differences in the importance ranking of the potato attributes between the two regions (Fig. 1). Significant differences were observed for several attributes. Tuber size ($u=1724.0$, $p < 0.001$), skin colour ($u=1648.5$, $p < 0.001$), and skin smoothness ($u=1511.0$, $p < 0.001$), shelf life ($u=1452.5$, $p < 0.001$), suitability for frying ($u=1694.0$, $p < 0.001$) and suitability for processing ($u=1626.0$, $p < 0.001$) showed highly significant regional differences. Additionally, shape ($u=1339.0$, $p=0.0265$), eyes depth ($u=1376.5$, $p=0.0107$), texture ($u=1459.5$, $p=0.0018$), and cooking time ($u=1362.0$, $p=0.0073$) also revealed statistically significant differences. In contrast, no significant differences were found for flesh colour

($u=1249.5$, $p=0.1440$), taste ($u=1062.0$, $p=0.9324$), aroma ($u=1263.0$, $p=0.0989$), and suitability for stewing ($u=1220.5$, $p=0.2186$). These findings suggest that while certain attributes such as flesh colour and aroma are similarly preferred across regions, key differences exist in preferences of tuber size, skin properties, and cooking-related attributes. Such insights are pivotal for region-specific varietal development and targeted marketing strategies

Analysis of Consumer Preferences for Potato Attribute Levels

The analysis of consumer responses for various attribute levels revealed notable patterns between Hilly and Plain regions (Fig. 2). For tuber size, a strong preference for medium-sized tubers was evident, with 95.2% of respondents in the Plain region and 80.4% in the Hilly region, with an overall preference of 87.1%. Regarding skin colour, all

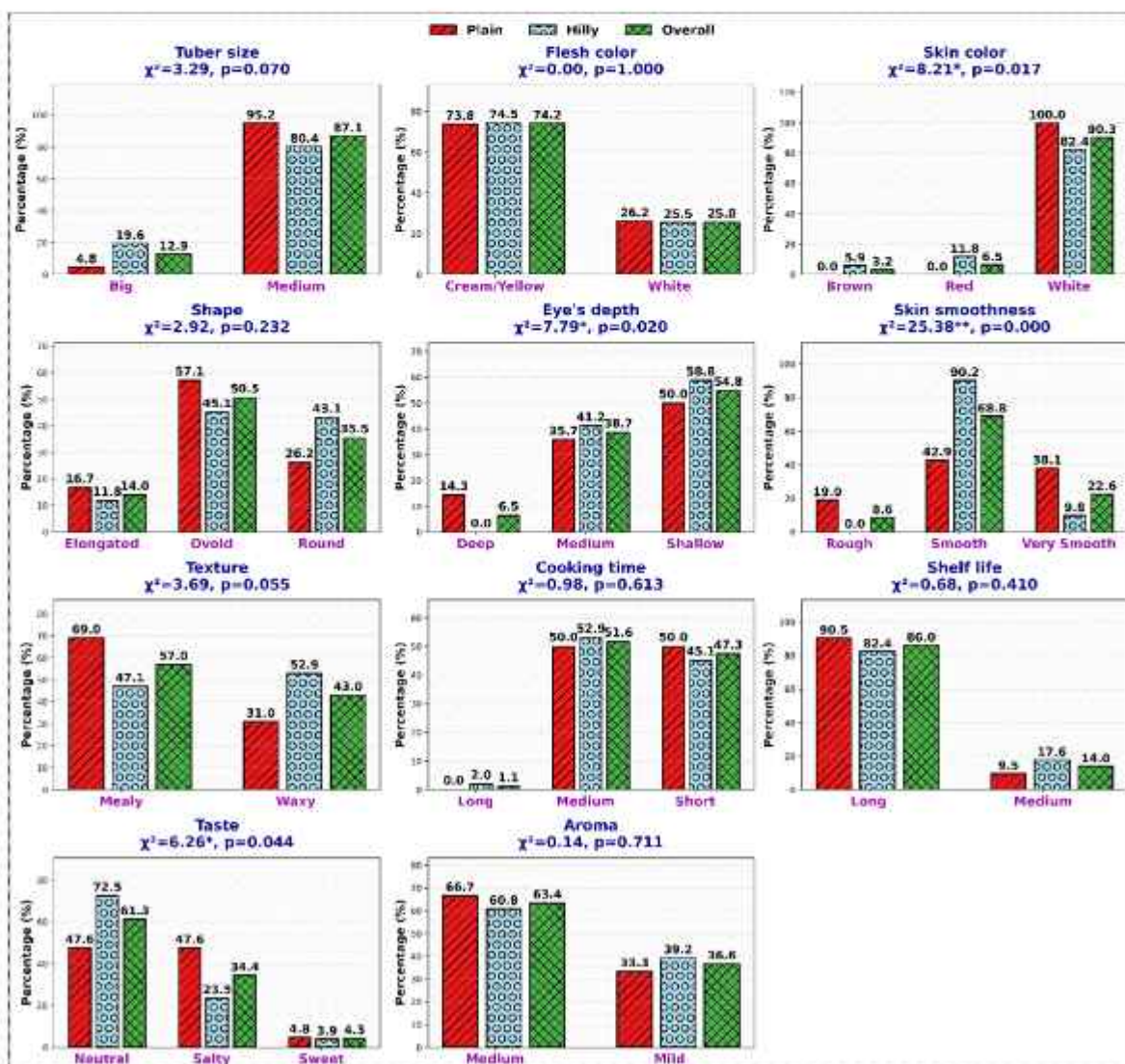


Fig. 2: Bar chart displaying the percentage distribution of consumer preferences for selected potato attribute levels

consumers from the Plain region preferred white (100.0%), whereas 94.1% of Hilly-region respondents preferred white over other colours (5.9%), resulting in an overall white skin preference of 97.1%. In terms of shape, the ovoid shape was most popular (57.1% in Plains and 50.5% in Hills, with overall 53.8%). Taste preferences also differ regionally, with 47.6% of Plain-region respondents versus 72.5% in the Hills, and a salty taste is more predominant among Plain consumers (47.6% against 23.5% in Hills). Cooking time preferences were relatively balanced, with nearly half of the consumers in both regions favouring short cooking times (48.0% in Plains and 47.3% in Hills), and around 50% indicating a preference for medium cooking time. Plain-region consumers were evenly split between smooth (42.9%) and very smooth skin (42.1%), Hilly-region consumers predominantly preferred smooth skin (61.8%) over very smooth (29.6%). Additionally, a long shelf life was highly valued in both regions (90.5% in Plains and 82.4% in Hills), and flesh colour preferences were similar, with approximately 74% favouring cream/yellow varieties. For texture, 69.0% of Plain-region respondents favoured a mealy texture compared to 47.1% in the Hills-where a waxy texture was more common (52.9%). Lastly, regarding eye's depth, Plain consumers expressed similar preferences for shallow (44.4%) and medium (41.2%) eyes, while 54.8% of Hilly respondents preferred shallow eyes, with deep eyes being least preferred in both regions.

Regional differences of preferences of potato attribute levels using Chi-Square Analysis

Chi-square tests were conducted to evaluate whether the observed differences in attribute level preferences between the regions were statistically significant (Fig. 2). The results indicate that skin colour preferences differed significantly between regions ($\chi^2=8.21$,

$p=0.017$). Similarly, taste preferences showed a statistically significant difference ($\chi^2=6.26$, $p=0.044$). Skin smoothness also showed a highly significant regional difference ($\chi^2=25.38$, $p < 0.001$) and eyes depth ($\chi^2 = 7.79$, $p < 0.02$). Other attributes, including tuber size ($\chi^2=3.29$, $p=0.070$), shape ($\chi^2 = 2.92$, $p = 0.232$), cooking time ($\chi^2 = 0.98$, $p=0.613$), shelf life ($\chi^2=0.68$, $p=0.410$), and texture/consistency did not show statistically significant differences between the Hilly and Plain regions. These findings suggest that while certain attributes are similarly preferred across regions, specific sensory and aesthetic attributes like skin colour, taste, and smoothness-exhibit significant regional differences. Such insights are pivotal for informing targeted breeding programmes and region-specific marketing strategies.

Consumers' willingness to pay (WTP) for fresh potatoes of desired quality

The study assessed consumer willingness to pay (WTP) for fresh quality potatoes across two regions, viz., Plains ($n=42$) and Hills ($n=51$). A considerably higher proportion of consumers from the Plains (88.10%, $n=37$) expressed willingness to pay compared to those in the Hills (62.75%, $n=32$), with an overall WTP rate of 74.19% ($n=69$) (Table 1). Among respondents willing to pay, the majority from both regions favoured a premium of less than 10%, i.e., 70.27% ($n=26$) in the Plains and 68.75% ($n=22$) in the Hills. In contrast, a larger percentage of respondents from the Hills (28.12%, $n=9$) indicated willingness to pay a premium of 10–20% compared to 16.22% ($n=6$) in the Plains, while only 13.51% ($n=5$) in the Plains and 3.12% ($n=1$) in the Hills favoured a premium of 20–30%. These results indicated that consumers are prepared to incur a premium if they receive potatoes that align with their specific preferences of attributes.

Table 1: Consumers' Willingness to Pay for fresh Quality Potatoes

Willingness to Pay (WTP)	Percentages of the respondents		
	Plains (n=42)	Hills (n = 51)	Overall (N = 93)
WTP (Yes)	88.10 (37)	62.75 (32)	74.19 (69)
WTP (No)	11.90 (5)	37.25 (19)	25.81 (24)
Premium Category (among those willing)			
<10% premium	70.27 (26)	68.75 (22)	69.57 (48)
10-20%	16.22 (6)	28.12 (9)	21.74 (15)
20-30%	13.51 (5)	3.12 (1)	8.70 (6)
Average rate of fresh potato (₹/kg)	30.71	33.82	32.42

Note: Values in parentheses indicate the number of respondents

Assessment of the Farmers' Preferences for Attributes of Potato Varieties

Farmers' preferences for attributes of potato varieties

Data for this study were collected using an online survey administered via Google Forms. In total, 107 valid responses were received, 59 from Meghalaya and 48 from Uttarakhand states. The importance of various potato attributes was evaluated using a five-point Likert scale, with the results ranked based on the Weighted Mean Score (WMS) and is represented in Table 2 and Fig. 3. The analysed data reveal that drought tolerance is perceived as the most important attribute (WMS=5.00), reflecting an acute priority for

water-use efficiency and stress resilience. Yield and marketable potato/marketability closely follow with WMS values of 4.98, underscoring a strong emphasis on productivity and commercial appeal. Late blight resistance (WMS=4.90), shelf life (WMS=4.83), and adaptation in low soil fertility (WMS=4.79) were also highly rated, indicating that disease management, post-harvest quality, and soil adaptability are key concerns among farmers. Traits such as tuber size (WMS=4.21), cooking time (WMS=3.96), tuber taste (WMS = 3.94), and tuber number (WMS=3.85) were seen as moderately important, whereas bacterial wilt resistance (WMS=2.04) and heat resistance (WMS=1.63) were considered the least important.

Table 2: Weighted Mean Scores (WMS) in farmers' preferences for attributes of potato varieties

Potato Attributes	Very Important	Important	Moderately Important	Slightly Important	Not Important	WMS
Drought tolerance	48	0	0	0	0	5.00
Yield	47	1	0	0	0	4.98
Marketable potato/marketability	47	1	0	0	0	4.98
Late blight resistance	45	1	2	0	0	4.90
Shelf Life	40	8	0	0	0	4.83
Adaptation in low soil fertility	38	10	0	0	0	4.79
Tuber size	20	20	6	2	0	4.21
Cooking time	11	26	9	2	0	3.96
Tuber taste	9	29	8	2	0	3.94
Tuber number	13	18	14	3	0	3.85
Flesh color	10	24	10	4	0	3.83
Skin color	9	20	16	3	0	3.73
Suitability for processing	12	16	16	2	2	3.71
Shape	8	19	20	0	1	3.69
Suitability for boiling	7	21	17	3	0	3.67
Aroma/flavor	9	16	21	1	1	3.65
Suitability for stewing	3	26	18	1	0	3.65
Suitability for frying	7	20	17	4	0	3.63
Early maturity	2	28	10	6	2	3.46
Bacterial wilt resistance	2	2	11	14	19	2.04
Heat resistant	0	2	2	20	24	1.63

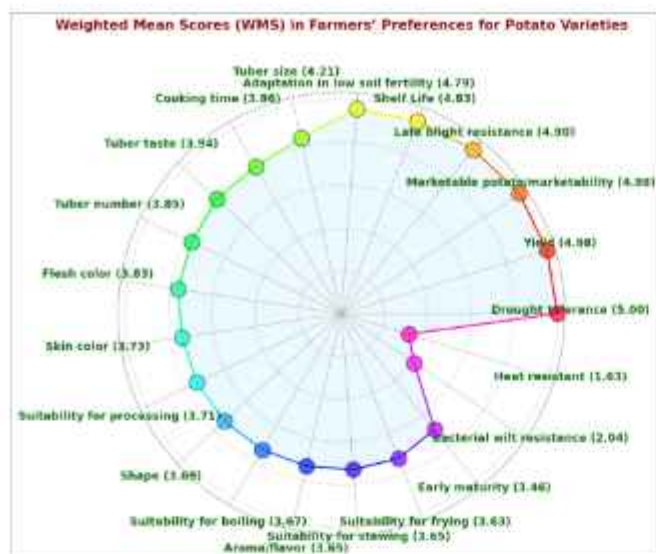


Fig. 3: Spider chart showing weighted mean scores in farmers' preferences for attributes of potato varieties.

Farmers' preferences for potato attribute levels

The analysis of farmer preferences for potato attributes revealed distinct regional differences between Meghalaya (n=59) and Uttarakhand (n=58) respondents (Table 2, Fig. 4). For yield, a

high yield was preferred by 87.5% of Uttarakhand farmers compared to only 54.2% in Meghalaya, whereas medium yield was preferred by 45.8% of respondents in Meghalaya versus 12.5% in Uttarakhand. In terms of maturity, a medium maturity period was the most preferred overall (62.6%), with a higher incidence in Uttarakhand (68.8%) than in Meghalaya (57.6%). Medium tuber size emerged as the major preference (87.9% overall), with 91.5% of Meghalaya and 83.3% of Uttarakhand respondents preferred the medium size. Regarding flesh colour, cream/yellow was strongly preferred (86.0% overall), though the preference in Meghalaya (91.5%) exceeded that in Uttarakhand (79.2%). Similarly, white skin color was chosen by 90.7% overall, with minor regional variations. Notably, shape preferences diverged markedly; round tubers were most popular in Meghalaya (59.3%), whereas elongated tubers in Uttarakhand (50.0%).

Table 3. Distribution of Farmer Preferences for Potato Attributes in Meghalaya and Uttarakhand

Attribute levels	Category	Meghalaya (n=59)		Uttarakhand (n=58)		Overall (N=107)	
		Count	%	Count	%	Count	%
Yield	High	32	54.2	42	87.5	74	69.2
	Medium	27	45.8	6	12.5	33	30.8
Maturity period	Medium	34	57.6	33	68.8	67	62.6
	Early	25	42.4	15	31.3	40	37.4
Tuber size	Medium	54	91.5	40	83.3	94	87.9
	Big	5	8.5	8	16.7	13	12.1
Flesh color	Cream/Yellow	54	91.5	38	79.2	92	86.0
	White	5	8.5	10	20.8	15	14.0
Skin Color	White	55	93.2	42	87.5	97	90.7
	Red	4	6.8	6	12.5	10	9.3
Shape	Round	35	59.3	10	20.8	45	42.1
	Ovoid	19	32.2	14	29.2	33	30.8
	Elongated	5	8.5	24	50.0	29	27.1
Eyes Depth	Medium	48	81.4	37	77.1	85	79.4
	Shallow	11	18.6	9	18.8	20	18.7
	Deep	0	0.0	2	4.2	2	1.9
Skin Smoothness	Smooth	49	83.1	20	41.7	69	64.5
	Very smooth	5	8.5	1	2.1	6	5.6
	Rough	5	8.5	27	56.3	32	29.9
Texture	Mealy	49	83.1	48	100.0	97	90.7
	Waxy	10	16.9	0	0.0	10	9.3
Cooking Time	Short	39	66.1	26	54.2	65	60.7
	Medium	20	33.9	22	45.8	42	39.3
Aroma	Medium	53	89.8	39	81.3	92	86.0
	Mild	4	6.8	4	8.3	8	7.5
	Strong	2	3.4	5	10.4	7	6.5

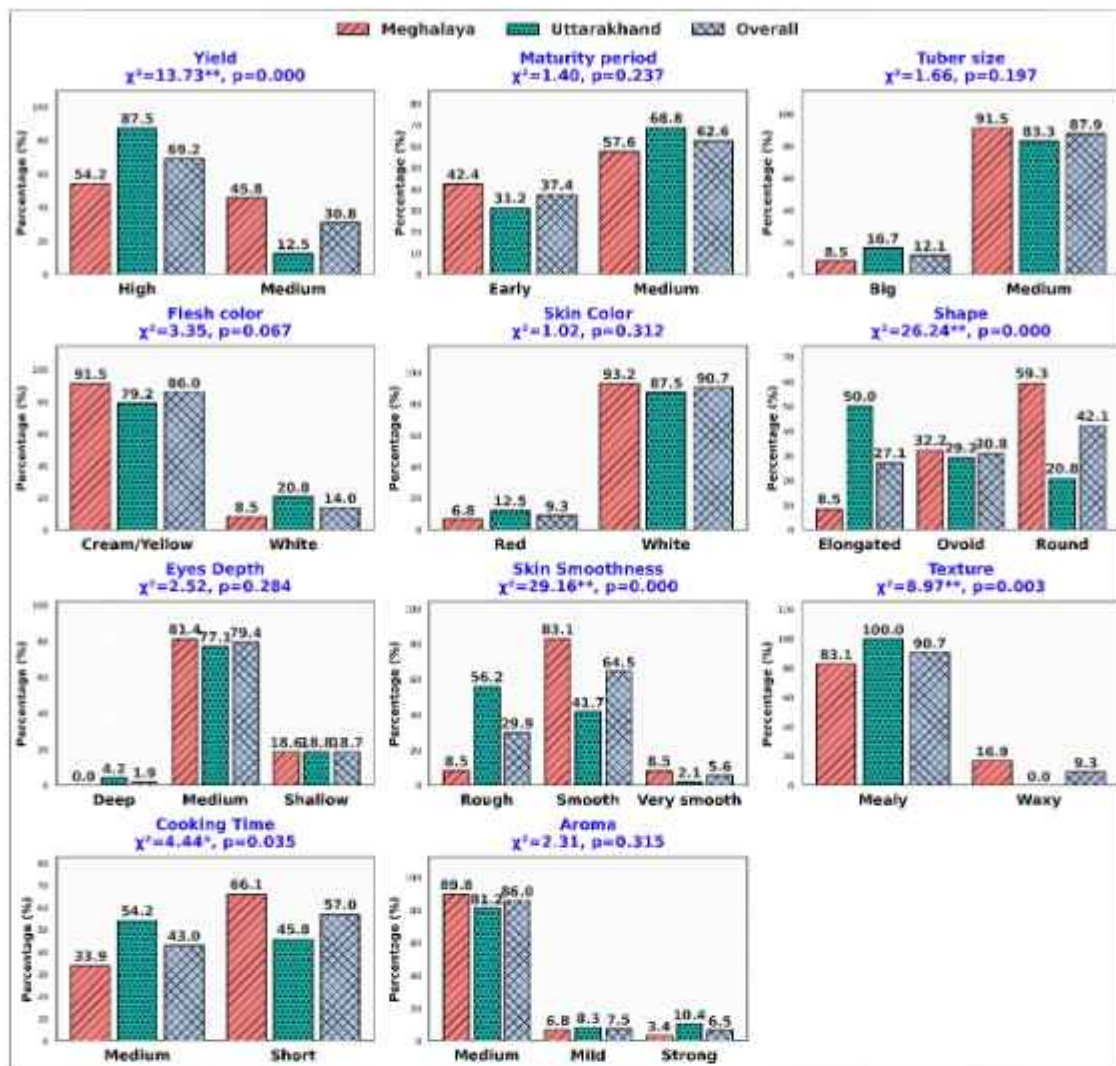


Fig. 4: Bar chart displaying the percentage distribution of farmer preferences for selected potato attribute levels

For eye's depth, a medium depth was preferred by nearly 80% of respondents overall, while shallow eyes were selected by approximately 18.7%, and deep eyes were rarely preferred. The attribute of skin smoothness showed considerable differences; smooth skin was preferred by 83.1% in Meghalaya compared to only 41.7% in Uttarakhand, where rough skin was preferred by 56.3% of farmers. A mealy texture was the predominant choice in both regions, reaching 100% preference in Uttarakhand and 83.1% in Meghalaya. Short cooking time was preferred by 57% of the respondents and a medium aroma was highly preferred (86.0% overall)

Analysis of differences in preferences between farmers of Uttarakhand and Meghalaya using Chi-Square Test

Chi-square tests were employed to examine the differences in farmers' preferences for various

potato attributes between Meghalaya (n=59) and Uttarakhand (n=58) (Table 5). Statistically significant differences were observed for Yield ($\chi^2=13.73$, $p < 0.001$), Shape ($\chi^2=26.24$, $p < 0.001$), Skin Smoothness ($\chi^2=29.16$, $p < 0.001$), Texture ($\chi^2=8.97$, $p=0.003$) and Cooking Time ($\chi^2 = 4.44$, $p = 0.035$). In contrast, preferences for Maturity Period ($\chi^2 = 1.40$, $p=0.237$), Tuber Size ($\chi^2 = 1.66$, $p=0.197$), Flesh Colour ($\chi^2 = 3.35$, $p=0.067$), Skin Colour ($\chi^2 = 1.02$, $p=0.312$), Eyes Depth ($\chi^2=2.519$, $p = 0.284$), and Aroma ($\chi^2 = 2.310$, $p=0.315$) did not significantly differ between the two states. These results suggest that while farmers in both states share similar preferences on several attribute levels, regional differences in the preferences of yield, tuber shape, skin smoothness, texture and cooking time are pronounced, potentially guiding region-specific breeding and marketing strategies.

Table 4: Chi-Square Test Results for Different Attributes

Attributes	Chi-Square Value	p-value
Yield	13.729**	0.000
Maturity period	1.399	0.237
Tuber size	1.664	0.197
Flesh color	3.354	0.067
Skin Color	1.022	0.312
Shape	26.241**	0.000
Eyes Depth	2.519	0.284
Skin Smoothness	29.157**	0.000
Texture	8.974**	0.003
Cooking Time	4.436*	0.035
Aroma	2.310	0.315

Notes: Grouping Variables for Chi-square test: Meghalaya vs. Uttarakhand

Farmers' willingness to pay (WTP) for quality seeds of desired varieties

The study reveals notable regional differences in farmers' willingness to pay (WTP) for quality potatoes (Table 5). Among the respondents, a substantially higher percentage from Meghalaya (88.14%, n=52) expressed WTP compared to those from Uttarakhand (66.67%, n=32), with an overall WTP of 78.50% (n=84). Within the premium categories, the majority

of farmers in Meghalaya predominantly preferred a modest premium of less than 10% (88.46%, n=46), whereas Uttarakhand farmers demonstrated a broader distribution of premium preferences, with only 28.12% (n=9) favoring the <10% bracket and a higher inclination towards the higher premium categories (10–20%, 20–30%).

Table 5: Farmers' willingness to pay (WTP) for quality seeds of desired varieties

Willingness to Pay (WTP)	Percentages of the respondents		
	Meghalaya (n=59)	Uttarakhand (n = 48)	Overall (N = 107)
WTP (Yes)	88.14% (52)	66.67% (32)	78.50 (84)
WTP (No)	11.86% (7)	16 (33.33)	21.50 (23)
Premium Category (among those willing)			
<10% premium	88.46% (46)	28.12% (9)	72.63% (61)
10-20%	(4)	31.25% (10)	11.90% (10)
20-30%	(2)	31.25% (10)	11.90% (10)
30-40%	0 (0)	9.38% (3)	3.57% (3)

Note: Values in parentheses indicate the number of respondents

OUTREACH PROGRAMMES

A. TV/Radio Talks delivered

Sl. No.	Name of the person who delivered	Topic of the talk	Date	Name of the Channel and the Programme
1.	Dr. Mehi Lal	Disease management in potato crop	02/01/2024	Akashvani New Delhi
2.	Dr. Dalamu	आलू की खेती व उसका प्रबंधन	15/01/2024	कृषि दर्शन, शिमला, दूरदर्शन, शिमला
3.	Dr. Vikas Mangal	कृषि शैक्षणिक क्षेत्र में छात्रों के लिए अपाद संभावनाएँ	13/03/2024	DD Himachal, Shimla
4.	Dr. Salej Sood	<i>Bhojy Evan Vidhayan Aalu Ki Kismen Vamuly Vardhit Utpad</i>	03/04/2024	DD Himachal, Shimla
5.	डॉ. सरला यादव	आलू की फसल की बुआई से पहले खेत की तैयारी तथा किस्मों का चुनाव	12/04/2024	कृषि दर्शन, दूरदर्शन बिहार
6.	डॉ. सरला यादव	हटी खाद की बुआई, उपयुक्त फसलों का चुनाव तथा मृदा में जुताई का तरीका तथा प्रबंधन	05/07/2024	कृषि दर्शन, दूरदर्शन बिहार
7.	Dr. Anil K Choudhary	<i>Kharif aaloo mein kharapatavar evan jal aururvarak prabandhan</i>	09/07/2024	DD-Shimla Channel
8.	Dr. Salej Sood	<i>Millets Ka Poshan, Khady Suraksha Evam Jalavayu Parivartan Mein Mahatv</i>	04/11/2024	DD Himachal, Shimla
9.	Dr. Anil K Choudhary	<i>Rabi mein aaloo fasal parbandhan</i>	08/11/2024	DD-Kisan, New Delhi
10.	Dr. Mehi Lal	<i>Alu ki fasal me sichai evm rogprabandhan</i>	11/11/2024	Akashvani New Delhi
11.	Dr. Bandana	विधायन के लिए आलू की खेती	13/11/2024	Prasar Bharati, Doordarshan, New Delhi
12.	Dr. Anil K Choudhary	<i>Aaloo mein fasal parbandhan</i>	13/12/2024	DD-Kisan Channel, New Delhi
13.	Dr. Mehi Lal	<i>Alu fasal me picheeta jhulsa ka roktham</i>	23/12/2024	Akashvani, New Delhi
14.	Dr. Vikas Mangal	कुफरी किस्म: हिमाचल के किसानों के लिए वरदान	25/12/2024	DD Himachal, Shimla

B. CPRI in news/TV/YouTube

Sl. No.	Topic of the talk	Date	Name of Newspaper/media
1.	<i>Aalu anusasandhaan sansthaan me kaarya path kaa ayojan</i>	09/01/2024	Dainik Bhaskar
2.	<i>Aalu ki 90% kismen CPRI se viksit</i>	11/01/2024	Amar Ujjala
3.	<i>Dron kee madad se aalu ki smart kheti karenge kisan</i>	12/01/2024	Amar Ujjala
4.	<i>Dhakava ke ravi kumaar ne ded kanal jamin me paida kiye 11 q aalu</i>	12/01/2024	Dainik Bhaskar
5.	<i>Aeroponik taknik se seed production se bhaar me badi aalu kee paidavar</i>	16/01/2024	Dainik Bhaskar
6.	<i>Sukhe ki maar: Shimla mirch 40 se 120</i>	31/01/2024	Amar Ujjala
7.	<i>Maharashtra ke kisanon ko sahayog degaa CPRI</i>	23/02/2024	Amar Ujjala
8.	<i>Krishi vaigyanikon ne jaanee CPRI kee kaarypranali</i>	10/02/2024	Amar Ujjala
9.	<i>Ab alu bij ka cold store me hoga bhandaran</i>	11/03/2024	Amar Ujjala
10.	<i>Tualchhung Chanchin Thar-Field Day at Tawtawzau zawl, Khawhai, Mizoram</i>	13/03/2024	Zonet
11.	Field Day at Tawtawzau zawl, Khawhai, Mizoram	13/03/2024	DD NEWS Mizoram
12.	<i>Kisanon ko nishulk die gaye seb ke paidhe</i>	15/03/2024	Amar Ujjala
13.	<i>Ka rukom rep phan- potato cultivation</i>	18/03/2024	Krishi Darshan of Doordarshan Shillong, Meghalaya.
14.	Big relief to famers, CPRI to resume potato seed production in Kufri, Fagu	22/03/2024	The Tribune
15.	Surge in potato prices brings cheer to farmers	22/03/2024	The Tribune
16.	<i>CPRI 6 saal baad ab fir taiyar karega aalu bij</i>	22/03/2024	Amar Ujjala
17.	<i>Kisanon ko milegaa CPRI Kufri farm kaa bij</i>	22/03/2024	AmarUjjala
18.	कृषि विशेष 'आलू की खेती'	04/05/2024	https://youtu.be/McHhX0QvoO?si=4nJMsdmJr6Xf3bvp
19.	<i>Pyaj Tamatar Aur Aloo Ki Kimaton Me Uchhal Se Shakahari Thali 7 Fisdhi Mahangi, Masahari Sasti</i>	05/04/2024	Amar Ujjala
20.	'Nagaland potato festival' held in Jakhama	11/05/2024	Eastern Mirror

Sl. No.	Topic of the talk	Date	Name of Newspaper/media
21.	<i>Sabji Mandi Me Pahadi Aalu Ki Dastak 26 Rupye Kil Biko Bika</i>	20/05/2024	Amar Ujjala
22.	<i>Dhalli Mandi Me Pahadi Aalu Ki Dastak 20-25 Ripay Kilo Tak Bika</i>	24/05/2024	Amar Ujjala
23.	<i>CPRI ne Aalu se taiyaar kiye Biscuits, Bundi va Daliya</i>	10/06/2024	Amar Ujjala
24.	<i>E-HRMS 2.0 lagu karne wala sube ka pahla sansthan banaCPRI</i>	25/06/2024	Amar Ujjala
25.	<i>CPRI chhah sau quintal Aalu bij karega taiyar</i>	01/07/2024	Amar Ujjala
26.	<i>Pyaaaj Aalu ke baad ab Tamatar lai</i>	04/07/2024	Amar Ujjala
27.	<i>Himachal, Uttarakhand aur J&K me 50,600 hactor me hogi Aalu bij ki kheti</i>	10/07/2024	Amar Ujjala
28.	<i>Aalu ki fasal me jhulsa rog se savdhan rahen kisan</i>	11/07/2024	Amar Ujjala
29.	<i>Aalu ke dhulai karne wale trakon ko bhi pathkar ke chhut</i>	30/07/2024	Amar Ujjala
30.	<i>Das fiske badh rahi aalu ki processing, dubai katar maleshiya me bhari mang</i>	07/8/2024	Amar Ujjala
31.	<i>BP Sugar ko niyantrit kar sakte hai rang birange anaj sabjiyan</i>	09/08/2024	Amar Ujjala
32.	<i>CPRI ki aalu ki 3 kismen ke PM Modi ne kiya lokarpan</i>	12/08/2024	Amar Ujjala
33.	<i>CPRI ne ab tak tayar ki aalu ki 75 kisme</i>	13/08/2024	Dainik Jagran
34.	<i>CPRI ne pahado se maidan tak pahunchaya aalu</i>	20/08/2024	Amar Ujjala
35.	<i>Aaloo par udyog sathapit karne kee aavshyaktaa</i>	21/08/2024	Anant Gyaan
36.	<i>Aalu se banega ethanol, CPRI taiyar karega nayi kismen</i>	21/08/2024	Amar Ujjala
37.	<i>Aalu utpaadan me Pradesh banye pahchan: shukl</i>	21/08/2024	Amar Ujjala
38.	<i>Madhumeh se ladne me kargar ho sakti hai jimikand, kachalu</i>	21/08/2024	Amar Ujjala
39.	Potato based Industry needed to benefit farmers: Governor	22/08/2024	The Tribune
40.	<i>Badalte jalvaayu parivartan ke drishtigat kisanon ke liye aay ke vaikalpik satrot uplabdh karvaaye jaane chahiye</i>	21/08/2024	Aapka faisala
41.	<i>Rajyapal ne CPRI, Shimla ke 76ven sathapana diwas kaarykram ki adhyakshta ki</i>	21/08/2024	Action India
42.	<i>76 saal ka hua kendriya aalu anusandhan sansthan</i>	21/08/2024	Divya Himachal
43.	<i>CPRI ke shodh karyon se hi bharat pramukh aalu utpadan deshon me</i>	21/08/2024	Dainik jagran
44.	<i>Kisano ko agale maah milega aalu ka bij</i>	19/09/2024	Amar Ujjala
45.	<i>Vidyarthiyon ko sawachhta ke prati kiya jagruk</i>	19/09/2024	Amar Ujjala
46.	<i>Kufri Jyoti aalu bij ki 100 rupye kam bik rahi 50 kg ki bori</i>	21/09/2024	Amar Ujjala
47.	<i>Aalu, pyaaaj aur tamatar ki mahangai se milegi nijat</i>	22/09/2024	Amar Ujjala
48.	<i>Aalu ki nayi kismen svikrit, kam समय me badega utpadan</i>	27/09/2024	Dainik jagran
49.	<i>Musical Chair me kanta Chauhan aur scooter race me sanjay pratham</i>	30/10/2024	Amar Ujjala
50.	<i>Jile me 31 disamber tak kurva sakenge aalu ki fasal ka bima</i>	08/11/2024	Amar Ujjala
51.	<i>Aeroponic taknik se aalu bij ka sankat hoga dur</i>	18/11/2024	Amar Ujjala
52.	<i>Lavi male me pahli bar pahuncha pahadi payaj va kala aalu</i>	19/11/2024	Dainik jagran
53.	Improved potato production technology at Rongjeng, East Garo Hills, Meghalaya.	22/11/2024	Salantini Janera, Garo local newspaper

Sl. No.	Topic of the talk	Date	Name of Newspaper/media
54.	SARS Yisemyong, Nagaland and ICAR-CPRI, Shillong Conduct Training	29/11/2024	HornBill TV
55.	<i>1 kg aalu bij ke chukaane hon 36.75 rupye</i>	28/11/2024	Amar Ujjala
56.	Training and input distribution on organic potato production technology for tribal farmers of Ri-Bhoi district	06/12/2024	ICAR, New Delhi
57.	Training and input distribution on organic potato production technology for tribal farmers of Ri-Bhoi district	07/12/2024	Highland post, Shillong, Meghalaya
58.	<i>Aalu bij gaon ke rup me viksit hoga junga, CPRI dega sahyog</i>	12/12/2024	Amar Ujjala
59.	Training and input distribution on organic potato production technology for tribal farmers of Ri-Bhoi district	12/12/2024	Indian potato
60.	Training on "Improved potato production technology" at ICAR-Research Complex for NEH Region, Tadong, Gangtok, and Krishi Vigyan Kendra, outh Sikkim, Namchi District, Sikkim.	16/12/2024-19/12/2024	Indian potato
61.	<i>Aalu ka utpadan badhane ki di ja jankari</i>	19/12/2024	Amar Ujjala
62.	<i>Unaame 20 crore se lagega potato Flex Plant, niryat honge utpad</i>	29/12/2024	Amar Ujjala
63.	<i>Una me 20 crore se banega aalu pranskaran sanyantra</i>	30/12/2024	Dainik jagran



Photos: Some outreach programmes of ICAR-CPRI, Shimla (Himachal Pradesh)

C. Kisan melas/exhibition organised

Sl. No	Title of the exhibition	Date	Place	No. of participants
1.	Exhibition during the 76 th Foundation Day of ICAR-CPRI, Shimla	20/08/2024	ICAR-CPRI, Shimla	~500
2.	Exhibition during National Potato Festival -2024	09/03/2024-10/03/2024	ICAR-CPRI, RS, Modipuram, Meerut, UP	~1000

D. Kisan gosthis/Farmers' workshops organized

Sl. No	Title of the gosthi	Date	Place	No. of participants
1.	National Potato Festival -2024	09/03/2024-10/03/2024	ICAR-CPRI, RS, Modipuram, Meerut, UP	~1000
2.	Kisan Gosthi during the 76 th Foundation Day of ICAR-CPRI, Shimla	20/08/2024	ICAR-CPRI, Shimla	~200
3.	Review workshop on seed production through CPRI-Aeroponics Technology at Jalandhar Station	18/09/2024	ICAR-CPRI, RS, Jalandhar, Punjab	24
4.	Launching workshop under SC SP components	27/09/2024	ICAR-CPRI RS, Modipuram	~200



Photos: Some outreach programmes of ICAR-CPRI RS, Modipuram (Uttar Pradesh)

E. Kisan Melas/exhibitions participated

Sl. No	Title of the exhibition	Date	Organizers /Place	No. of participants
1.	Farmers scientist interaction program cum kisan mela	29/01/2024	Krishi Vigyan Kendra (KVK), East Khasi Hills District, Meghalaya	>200
2.	Regional Agriculture Fair-2024 for Eastern Region	03/02/2024-04/02/2024	ICAR-NISA Namkum Ranchi Jharkhand	>1000
3.	Kisan Kalyan Mela-2024 (Aatmnirbhar Krishi Cum Bagwani Vistar Evam Pashudhan)	10/02/2024-12/02/2024	Dr Rajendra Prasad Central Agricultural University, Pusa Bihar	>1000
4.	Foundation day celebrations of ICAR-ICAR RCER	21/02/2024	ICAR-ICAR RCER Patna Bihar	>200
5.	National Horticulture Fair 2024	05/03/2024-07/03/2024	ICAR-IIHR, Bengaluru	>1,00,000
6.	126 th Flower show	10/03/2024-26/05/2024	Department of Horticulture and Plantation Crops, Tamil Nadu, India	>2,00,000
7.	Nagaland potato festival 2024	10/05/2024	Jakhama, Kohima, Nagaland	3,000
8.	Participation of CPRI (Shimla) at the agricultural fair	03/02/2024-06/02/2024	RVSKVV, Gwalior	>1000
9.	ICAR-Foundation Day/Technology Day	15/07/2024-16/07/2024	ICAR, at Bharat Ratna Dr C Subramanian Symposium Hall, NASC complex, Pusa, New Delhi	~10000

Sl. No	Title of the exhibition	Date	Organizers /Place	No. of participants
10.	Exhibition	18/09/2024-19/09/2024	DM compound, Kannauj	~500
11.	Exhibition during AICRP meeting	22/09/2024-24/09/2024	ND University, Kumarganj Aydhya	~1000
12.	Participation and stall exhibition at the farmer fair	08/02/2024-10/02/2024	RLBCAU, Jhansi	~500
13.	राष्ट्रीय आलू महोत्सव - 2024	09/03/2024-10/03/2024	ICAR-CPRI, RS, Modipuram, Meerut, UP	500
14.	Akhil bhartiya Kisan mela	16/10/2024-18/10/2024	SVB Patel university	~1000
15.	Foundation Day of ICAR-CIRG, Meerut Cantt	10/12/2024	ICAR-CIRG, Meerut	~500
16.	Kisan Mela	23/08/2024	Directorate of Horticulture Govt of Bihar	>200
17.	TNAU state level Farmers Day and Exhibition 2024	26/09/2024-29/09/2024	TNAU, Coimbatore	>50,000
18.	Kisan Mela	18/10/2024	ICAR-IISS Mau UP	>1000
19.	Exhibited a stall during National Conference on "Managing Agro-Biodiversity in North Eastern India (NCMAN-2024)"	23/10/2024-25/10/2024	Indian Society of Plant Genetic Resources, New Delhi in collaboration with ICAR Research Complex for North eastern Hill Region, Umiam, Meghalaya and ICAR – National Bureau of Plant genetic Resources, New Delhi	500
20.	Kisan Mela cum Exhibition	20/02/2024-21/02/2024	ICAR-NISA, Namkum Ranchi Jharkhand	>1000
21.	District level exhibition cum awareness program on farmers saved seed	13/06/2024	Integrated Agriculture Training Center, St mile, Upper Shillong, East Khasi Hills District, Meghalaya.	200
22.	Krishi Samridhhi Week (KSSW)" as a part of ICAR KVKs Golden jubilee celebration	02/12/2024-06/12/2024	Krishi Vigyan Kendra (KVK), East Khasi Hills District, Meghalaya.	200
23.	Awareness program on "Caring for Soils: Measure, Monitor, Manage" for Celebration of "World Soil Day"	05/12/2024	ICAR CPRI RS Shillong.	20



Photos: Some outreach programmes of ICAR-CPRI RS, Patna (Bihar)

F. Kisan gosthis/ Farmers' workshops participated

Sl. No	Title of the <i>gosthi</i>	Date	Place	No. of participants
1.	Farmer-Scientist Interaction program under SCSP Component	24/10/2024	Village Uthila, District Gwalior	61
2.	किसानों के लिए आलू की प्री-हार्वैस्ट एवं पोस्ट हार्वैस्ट मैनेजमेंट विषयक एक दिवसीय प्रशिक्षण कार्यक्रम	12/11/2024	Up state Horticultural cooperative marketing Federation HOEFD at Aligarh	100

G. Awareness programmes/camps

Sl. No.	Title of the programme	Date	Organizers /Place	No. of participants
1.	International Potato Day	30/05/2024	ICAR-CPRI RS, Modipuram	200
2.	International Yoga Day	21/06/2024	ICAR-CPRI and its regional stations	~700
3.	One day awareness program entitled "Business opportunities in high tech seed potato" at ICAR-Central Potato Research Institute, Regional station Modipuram, Uttar Pradesh	25/06/2024	ICAR-CPRI RS, Jalandhar	51
4.	17th Parthenium Awareness Week: Parthenium weed removal programs	16/08/2024-22/08/2024	ICAR-CPRI RS, Gwalior	300
5.	"A Tree in Mother's Name" plantation program	21/08/2024	ICAR-CPRI RS, Gwalior	~300
6.	Launching Workshop of SCSP	27/09/2024	ICAR-CPRI RS, Modipuram	100
7.	World Soil Day	05/12/2024	ICAR-CPRI and its regional stations	~800
8.	One day Awareness program entitled "Hi-tech seed potato production" under Agri-Business Incubation program for farmers from different districts of Punjab	06/12/2024	ICAR-CPRI RS, Jalandhar	120
9.	One day Awareness program entitled "Hi-tech seed potato production" under Agri-Business Incubation for farmers from different districts of Uttar Pradesh, Haryana, Punjab and Rajasthan	09/12/2024	ICAR-CPRI RS, Jalandhar	180
10.	Farmer awareness program organized by EriZ Foundation	12/12/2024	ICAR-CPRI RS, Gwalior	100
11.	One day Awareness program entitled "Hi-tech seed potato production" under Agri-Business Incubation at Jodha, Ludhiana, Punjab	12/12/2024	ICAR-CPRI RS, Jalandhar	700
12.	Awareness program on "Business opportunities in seed potato" at ICAR-CPRI, RS, Jalandhar, Punjab	27/12/2024	ICAR-CPRI RS, Jalandhar	210
13.	World Soil Day 5 th 2024	05/12/2024	ICAR-CPRI RS, Jalandhar	125
14.	Awareness program on "Caring for Soils: Measure, Monitor, Manage" for Celebration of "World Soil Day"	05/12/2024	ICAR-CPRI RS, Shillong.	20



Photos: Some outreach programmes of ICAR-CPRI RS, Gwalior (Madhya Pradesh)

H. Frontline Demonstrations (FLDs)

Sl. No	Title of demonstration	Place	No. of beneficiaries	Under which schemes (SCSP/ TSP/NEH/ ABI/Others)	Inputs distributed (Quantity)	Percentage yield increase over existing practice
1.	FLDs on varietal production technology and seed production technology (Kufri Daksh, Kufri Uday, Kufri Bahar, Kufri Chipsona-1, Kufri Sangam, Kufri Surya, Kufri Thar-3, Kufri Lohit, Kufri Frysona)	Firojabad, chandauli, Sambhal, Meerut, Baghpat, Aligarh, Bijnor, Kannauj in UP, Malda in WB and Muraina in MP	50	Institute	50q breeder seed	20-30
2.	FLD on improved potato varieties and seed production technology (Kufri Ganga and Kufri Mohan)	Districts-Muzafarnagar Kannauj Jhanshi Barabanki Sitapur Unnao Lakhimpurkhiri Raibareilly Ayodhya Gaziabad Hapur Kosambi Sambhal	216	SCSP	216.5 q breeder seed	20-30
3.	FLDs on varietal and seed production technology (Kufri Ganga and Kufri Mohan)	Meerut (U.P.) Haridwar (Uttarakhand) Dehradun (Uttarakhand)	50	TSP	50 q breeder seed	20-30
4.	45 FLD on Scientific potato cultivation in collaboration with KVK Ujjain	Ujjain District, MP	45	SCSP	50 q breeder seed	20
5.	57 FLD on Scientific potato cultivation in collaboration with KVK Ratlam, MP	Ratlam District, MP	57	TSP	57 q breeder seed	20
6.	FLD on improved potato varieties and seed production technology	Ranchi, Jharkhand	150	TSP	150 q breeder seed, Insecticide and pesticide	25-30

Sl. No	Title of demonstration	Place	No. of beneficiaries	Under which schemes (SCSP/ TSP/NEH/ ABI/ Others)	Inputs distributed (Quantity)	Percentage yield increase over existing practice
7.	FLD on scientific potato cultivation with potato varieties: K Neelkanth, K Lalit and K Himalini	KVK Manpur Gaya (Kandi, Manpur), Bihar	50	SCSP	Potato Breeder Seed (K Neelkanth 35q, K Lalit 13q and K Himalini 02q), Insecticide and pesticide, Fruit	25
8.	FLD on scientific potato cultivation with potato varieties: K Pukhraj, K Khyati and K Sindhuri	KVK Kauwakol Nawada Mahuliya and Kauwakol, Bihar	50	SCSP	Potato Breeder Seed (K Pukhraj-13q, K Khyati 25q and K Sindhuri 12q), Insecticide and pesticide	
9.	FLDs on improved potato varieties, viz., Kufri Himalini, Kufri Chandramukhi, Kufri Karan, Kufri Jyoti	Leh district, Ladakh	85	TSP	85 q breeder seed	Kufri Himalini: 34-36 t/ha Kufri Chandramukhi & Kufri Karan: 28-30 t/ha Kufri Jyoti: 23-25 t/ha Local variety: ~18 t/ha
10.	FLDs on improved potato varieties, viz., Kufri Himalini, Kufri Chandramukhi, Kufri Karan, Kufri Jyoti	Myllem EKHD Meghalaya	1	NEH	1500 cuttings	55 Kg quality seeds (18750 nos. approx.)
11.	Low-cost seed production through ARC	Umphyrnai, EKHD, Meghalaya	1	NEH	5000 cuttings	320 Kg quality seed
12.	Low-cost seed production through ARC	Mawkhan, EKHD, Meghalaya	1	NEH	1q seeds	K. Giriraj : 14.5 t/ha K. Himalini: 18 t/ha
13.	Evaluation of improved potato variety: K. Himalini	Thadnongia and Kyrdem, Ri-Bhoi, Meghalaya	2	NEH	1q seeds	16 t/ha
14.	Evaluation of high yielding potato variety Kufri Pukhraj	Damthang, South Sikkim	2	NEH	1q seeds	Kufri Sindhuri 19 t/ha Local beetey alu (8 t/ha)
15.	Evaluation of improved potato variety Kufri Sindhuri	Khawhai, Khawzawl District Mizoram	10	NEH	15q	The Potato were grown organically and Kufri Jyoti has highest yield (10t/Ha)
16.	Evaluation of Improved Potato variety (Kufri Pukhraj, K. Chandramukhi, K. Ganga and K. Chipsona-3, Kufri Karan, Kufri Sindhuri)	Kolasib District, Mizoram	29	NEH	12q	Kufri Pukhraj, K. Chipsona-3, K. Ganga and K. Karan yielded 19-21t/ha and Kufri Chandramukhi and K. Sindhuri yielded 8-10t/ha.

Sl. No	Title of demonstration	Place	No. of beneficiaries	Under which schemes (SCSP/ TSP/NEH/ ABI/Others)	Inputs distributed (Quantity)	Percentage yield increase over existing practice
17.	Evaluation of Improved Potato variety (Kufri Pukhraj, K. Chandramukhi, and Kufri Sindhuri)	Chotowashiling-1, Langphermukh and Langri, Dima-Hasao District, Assam	6	NEH	12q	
18.	Evaluation of Improved Potato variety (Kufri Pukhraj, K. Chandramukhi, K. Ganga and K. Chipsona-3, Kufri Sindhuri)	Jorhat and Golaghat, Assam	10	NEH	10q	
19.	FLD on Improved Potato variety (Kufri Chandramukhi, K. Sindhuri, K. Pukhraj, K. Ganga, K. Chipsona-3, K. Megha, K. Chipsona-1, K. Girdhari, K. Himalini, K. Jyoti and K. Giriraj)	Tuensang, Mokukchung and Longleng District, Nagaland	17	NEH	25q	
20.	FLD on Improved Potato variety (Kufri Pukhraj, K. Chandramukhi, K. Ganga and K. Chipsona-3)	Medziphema, Peren and Wokha District, Nagaland	6	NEH	12q	
21.	FLD on scientific potato cultivation	Jalandhar, Punjab	20	SCSP	200 q breeder seed	

Potato Cafeteria: During 2024-25 crop season, potato cafeteria of 10-15 newly developed potato varieties was established at KVK's demonstration farms in collaboration with seven KVKs, namely, Sambhal, Bulandshar, JP Nagar, Ayodhiya, Jhansi, and

Lakhimpurkhiri of Uttar Pradesh and KVK Ujiwa (Delhi) to showcase the varietal diversity of potato and evaluation by the farmers and other potato stakeholders. About 5000 beneficiaries visited potato cafeteria.



Photos: Some outreach programmes of ICAR-CPRI RS, Jalandhar (Punjab)

**I. Field days**

No	Title of field day	Place	Date	No. of beneficiaries
1.	Field Day & Discussion of Scientists and Farmers	MGMG villages in Meerut UP	18/01/2024	45
2.	Field day cum Farmer scientist interaction	Village-Baholpur, District Meerut	18/01/2024	50
3.	Field Day program under SCSP component	Village Uilla, District Gwalior	24/11/2024	55
4.	Field Day on Potato Production Technology	Tawitaw Zau, Khawhai, Khawzawl District, Mizoram	13/03/2024	40

J. Visit Coordination

Sl. No.	Date / Period	Visitor Category	Organization / University / College / Category of Visitors	No. of Visitors
1	04/01/2024	Farmers	KUKUS, Karnal, Haryana	20
2	05/01/2024	Farmers	KUKUS, Karnal, Haryana	20
3	08/01/2024	Students	BJR Agricultural College, Sircilla	61
4	08/01/2024	Students	Professor Jayashankar Telangana State Agricultural University, Telangana	95
5	08/01/2024	Students	Agricultural College, Palem	61
6	08/01/2024	Students	Agricultural College, Warangal	59
7	09/01/2024	Farmers	Sub mission on Agriculture Extension, Dist Mirzapur, Govt of UP	40
8	09/01/2024	Students	Kumaraguru Institute of Agriculture, Erode	31
9	10/01/2024	Students	Professor Jayashankar Telegana State Agriculture University	18
10	10/01/2024	Students	Integral University, Lucknow	122
11	12/01/2024	Students	Tamil Nadu Agriculture University, Coimbatore	46
12	24/01/2024	Students	College of Agriculture University, Kerala	92
13	25/01/2024	Students	Sampoorana Institute of Agriculture, Bangalore	18
14	29/01/2024	Students	SBSS Govt. Girls College, GuruKaKhuh, Ropar, Punjab	45
15	29/01/2024	Officers	Hort. Department, Sonepur, Odhisha	10
16	30/01/2024	Farmers	ATMA Nawada, Bihar	48
17	01/02/2024	Students	Punjab Agricultural College, Punjab	30
18	02/02/2024	Students	Kerala Agricultural University, Kerala	105
19	06/02/2024	Students	Government Arts College, Coimbatore	17
20	09/02/2024	Students	Ram Suresh Singh PG College, Dixitpur, Chunar, Mirzapur, U.P.	15
21	14/02/2024	Farmers	District Horticulture Mission Thrissur, Kerala	11
22	15/02/2024	Farmers	Agriculture Department, Dist Mahrajanj, UP	48
23	16/02/2024	Students	College of Agriculture, Centaral Agricultural College, Pasighnt, Andra Pradesh	26
24	16/02/2024	Students	Dr. N.G.P Arts and Science College, Coimbatore	59
25	19/02/2024	Students	GSSS Bagshar, Mandi (HP)	38
26	20/02/2024	Students	University of Agricultural Sciences, College of Community Science, Dharwad, Karnataka	44
27	22/02/2024	Farmers	KVK, Zunheboto, Nagaland university	20
28	22/02/2024	Farmers	Kurukshetra Ambala	20
29	23/02/2024	Students	Department of Botany, School of Life Sciences Mizoram University	28
30	23/02/2024	Farmers	IHT Greater Noida	26
31	26/02/2024	Students	Bharat Institute of Higher Education & Research, Tamil Nadu	58
32	26/02/2024	Students	UAS, GKV, Bangalore	58
33	26/02/2024	Students	Institute of Horticulture G Noida	33
34	26/02/2024	Farmers	IHT, G. Noida	28

Sl. No.	Date / Period	Visitor Category	Organization / University / College / Category of Visitors	No. of Visitors
35	27/02/2024	Students	College of Agriculture, GKVK Campus, University Agricultural Sciences, GKVK, Bangalore	36
36	27/02/2024	Students	University of Agricultural Sciences, Bangalore, College of Sericulture, Chintamani	36
37	27/02/2024	Farmers	IHT, G. Noida	28
38	29/02/2024	Students	PG Deptt. of Biotechnology, Lyallpur Khalsa College, Jalandhar, Punjab	16
39	29/02/2024	Farmers	IHT, G. Noida	24
40	02/03/2024	Farmers	ATMA Dhanbad, Jharkhand	22
41	04/03/2024	Students	Adiprarassakthi Agricultural College, Vellore	83
42	05/03/2024	Officials	NABARD	
43	06/03/2024	Farmers	Sub mission on Agriculture Extension, Dist Sonbhadra, Govt of UP	48
44	06/03/2024	Farmers and Extension Officials	ATMA Nagaland	12
45	06/03/2024	Students	DHT, Greater Noida, Delhi	43
46	08/03/2024	Students	St. Philomena's College (Autonomous), Mysore	21
47	11/03/2024	Students	JSA College of Agriculture and Technology, Tamil Nadu	33
48	12/03/2024	Students	A.V.C College (Autonomous) Mayiladuthurai	20
49	12/03/2024	Farmers	IHT, G. Noida	26
50	13/03/2024	Students	Vanavarayar Institute of Agriculture Manakkadavu, Pollachi, Tamil Nadu	118
51	13/03/2024	Students	Kumaraguru Institute of Agriculture, Nachimuthupuram, Tamil Nadu	122
52	13/03/2024	Students	University of Horticultural Sciences, Bagalkot, Karnataka	58
53	14/03/2024	Students	SRS Institute of Agriculture & Technology, Vendasandur, Dindigul, Tamil Nadu	87
54	14/03/2024	Students	Krishna College of Agriculture & Technology, Tamil Nadu	95
55	14/03/2024	Students	Tamil Nadu Agricultural University (Deptt. Of Agricultural extension & rural sociology, Coimbatore	167
56	14/03/2024	Students	MIT College of Agriculture and Technology, Musiri, Tamil Nadu	116
57	15/03/2024	Students	Sethu Bhaskara Agricultural College & Research Foundation, Tamil Nadu	84
58	15/03/2024	Students	Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University	35
59	18/03/2024	Students	University of Agricultural Sciences, Dharwad, Karnataka	59
60	18/03/2024	Students	Invertis University, Bareilly, Uttar Pradesh	24
61	18/03/2024	Students	Mother Taresa college of Agriculture MTCA, Pudukkottai - IV B.Sc. (Hons.) Agriculture Students	112
62	18/03/2024	Students	Adhiyamaan College of Agriculture and Research, Athimugam, Shoolagiri, Krishnagiri, Tamil Nadu	107
63	18/03/2024	Students	UAS Dharwad	59
64	18/03/2024	Students	Nalanda College of Agriculture, M.R. Palayam, Sanamangalam (Po), Trichy, Tamil Nadu	72
65	19/03/2024	Students	Chaudhary Charan Singh University, Meerut, Dept. of Plant Protection	42
66	19/03/2024	Students	CCSHAU, College of Agriculture, Bawal, Haryana	19

Sl. No.	Date / Period	Visitor Category	Organization / University / College / Category of Visitors	No. of Visitors
67	21/03/2024	Students	Jaya Agriculture College, Arakkonam, Tamil Nadu	47
68	21/03/2024	Students	Adhiparasakthi Horticultural College G.B.Nagar, Kalavai, Ranipet, Tamil Nadu	110
69	22/03/2024	Students	I.K.K. Muniraiah College of Agricultural Science, Tamil Nadu Agricultural University	119
70	26/03/2024	Students	Pushkaram College of Agricultural Sciences, Pudukkottai, Tamil Nadu	112
71	26/03/2024	Students	Adhiparasakthi Agricultural College, G.B. Nagar, Kalavai, Ranipet, Tamil Nadu	120
72	27/03/2024	Students	Alva's college, Sundari Ananda Alva Campus, Vidyagiri, Moodubidre	13
73	28/03/2024	Students	Dhanalakshmi Srinivasan Engineering College, Perabalur	42
74	28/03/2024	Students	College of Agricultural Sciences, SRM Institute of Science & Technology, Chengalpattu, Tamil Nadu	56
75	01/04/2024	Students	College of agriculture, Odisha University of Agriculture and Technology(OUAT),Bhubaneswar	35
76	02/04/2024	Students	College of Agriculture, Bhawanipatna, Odisha	56
77	03/04/2024	Students	College of agriculture, Odisha University of Agriculture and Technology(OUAT), Bhubaneswar	50
78	04/04/2024	Students	Shobhit University, Saharanpur, U.P.	57
79	04/04/2024	Students	Paler Agricultural College, Kothamarikuppam, Tamil Nadu	99
80	05/04/2024	Students	College of Agriculture, Agricultural University Jodhpur, Nagaur, Rajasthan	100
81	09/04/2024	Students	Nammazhvar College of Agriculture & Technology, Tamil Nadu	80
82	12/04/2024	Students	College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Krishaknagar, Raipur, Chattisgarh	64
83	12/04/2024	Students	Lovely Professional University, Jalandhar GT Road (NH1) Phagwara, Punjab	52
84	19/04/2024	Students	PGP College of Agricultural Sciences, Palani Nagar, Namakkal, Tamil Nadu	113
85	19/04/2024	Students	Lovely Professional University, Punjab	52
86	24/04/2024	Students	The Indian Agriculture College, Radhapuram, Tamil Nadu	29
87	25/04/2024	Jeevika members	Jeevika, Kaimur	15
88	29/04/2024	Farmers	BAMETI Patna Bihar	40
89	29/04/2024	Students	Indian Academy, Degree College, Autonomous, Hennur Cross, Bangalore 560 043	22
90	30/04/2024	Students	Division of Fruits and Horticultural Technology ICAR-IARI, Pusa Campus, New Delhi	16
91	02/05/2024	Students	TNAU, Horticultural College & Research Institute, Periyakulam, Tamil Nadu	87
92	03/05/2024	Students	RVS Agricultural College, Thanjavur, Tamil Nadu	119
93	03/05/2024	Students	Thanthai Roever Institute of Agriculture & Rural Development, Perambalur, Tamil Nadu	123
94	09/05/2024	Students	College of Fisheries Engineering Tamil Nadu Dr. J. Jayalalithaa Fisheries University Vettar Riverview Campus, Nagapattinam	27
95	15/05/2024	Students	गन्ना उत्पादक PG College, Baheri, Bareilly, Uttar Pradesh	37
96	15/05/2024	Students	SVB College of Agriculture & Research Station, IGKV, Marra (Patan), Chattisgarh	20

Sl. No.	Date / Period	Visitor Category	Organization / University / College / Category of Visitors	No. of Visitors
97	17/05/2024	Farmers and Extension Officials	ATMA, Nongpoh, Rihoi district	30
98	20/05/2024	Students	Kerala Agricultural University, College of Agriculture, Bellayani, Thiruvananthapuram, 695 522	26
99	23/05/2024	Students	Alva's College Alva Campus, Vidyagiri, Moodubidre-574 227	24
100	30/05/2024	Students	College of Agriculture & Research Station (IGKV), Fingeshwar, Gariyaband, Chattisgarh	14
101	03/06/2024	Farmers	Development foundation,	27
102	05/06/2024	Students	Jawahar Navodaya Vidyalala, Theog, Shimla, HP	50
103	10/06/2024	Students	IGKV, College of Agriculture & Research Station, Mahasamund, Chattisgarh	13
104	12/06/2024	Farmers	Department Of Agriculture, Kohima, Nagaland	36
105	13/06/2024	Students	IGKV, College of Agriculture & Research Station, Jashpur, Chattisgarh	16
106	14/06/2024	Students	BEST Innovation University, Gownivaripalli, Gorantala Mandal, Anantapur, Andra Pradesh.	120
107	14/06/2024	Teachers	DAV Ambuja Vidya Niketan Darlaghat, HP	29
108	01/07/2024	Students	Rani Avanti Bai Lodhi College of Agriculture & Research Station, IGKV, Chhuikhadan, KCG, Chattisgarh	17
109	01/07/2024	Students	YS Parmar University of Horticulture and Forestry, Nauni, Solan	28
110	02/07/2024	Students	Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib, Via Rajgarh, District Sirmour (H.P.)	14
111	05/07/2024	Students	Dean Amrita School of Agricultural Sciences, Coimbatore	107
112	05/07/2024	Students	Chhattisgarh Agriculture College Dhanora Road, Rishali, Bhilai, Durg	07
113	11/07/2024	Students	Sambhota Tibetan School, Chotta Shimla, Shimla	53
114	06/08/2024	Official and students	College of agriculture, Tripura	20
115	23/08/2024	Students	Kerala Agricultural University, Mannuthy	40
116	03/09/2024	Students	TNAU, Agricultural Engineering College & Research Institute, Coimbatore, Tamil Nadu	40
117	04/09/2024	Farmers	Village Randaga, Jharkhand	46
118	11/09/2024	Farmers	ATMA Gaya Bihar	20
119	20/09/2024	Students	S K Y College of Agricultural Sciences, S.S.R Puram, Etcherla (Mandal), Srikakulam (Distt.), Andhra Pradesh	39
120	24/09/2024	Students	Annamalai University, Annamalai Nagar	88
121	24/09/2024	Farmers	Block Sidhwan Bet Ludhiana, Punjab	4
122	24/09/2024	Students	Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences, Bishnupur District, Utlou, Manipur,	23
123	24/09/2024	Students	K.K. Wagh College of Agricultural Biotechnology, Maharashtra	50
124	25/09/2024	Students	Ganpat University, Mehsana Gujarat	58
125	25/09/2024	Students	St. Bede's College, Navbhar Shimla	45
126	26/09/2024	Students	Annamalai University, Annamalai Nagar	90
127	27/09/2024	Farmers	ATMA, Mansa, Punjab	11
128	01/10/2024	Students	SRM University, Chennai	63
129	01/10/2024	Students	K.V.V.S College of Science and Technology, Kerala	18

Sl. No.	Date / Period	Visitor Category	Organization / University / College / Category of Visitors	No. of Visitors
130	08/10/2024	Students	Himachal Pradesh University, Shimla, Himachal Pradesh	23
131	18/10/2024	Students	Dr. Y.S.R. Horticultural University, Anantharajupeta, Annamaiah (Dist.), Andhra Pradesh	28
132	18/10/2024	Students	Sharda School of Agricultural Sciences Sharda University, Knowledge Park III, Greater Noida, Uttar Pradesh	46
133	25/10/2024	Students	Adhiyamaan College of Agriculture & Research, Krishnagiri	87
134	25/10/2024	Students	Baddi University of Emerging Sciences & Technology Baddi, Solan (HP)	28
135	01/11/2024	Farmers and Extension Officials	ATMA, Mawshynrut, West Khasi Hills	25
136	13/11/2024	Students	University of Kerala, Kariavattum, Thiruvananthapuram	18
137	14/11/2024	Farmers and Extension Officials	ATMA, Laitkroh block, East Khasi Hills	25
138	15/11/2024	Farmers	BAMETI Patna	25
139	18/11/2024	123 officials	Institute of Secretariat Training & Management, Department of Personnel & Training, Ministry of Public Grievances & Pensions Old JNU Campus, of Palame Marg, New Delhi	123
140	27/11/2024	Official and students	ICAR- RC for NEH, Umiam, Meghalaya	23
141	02/12/2024	Students	College of agriculture, Kheda Anand	60
142	02/12/2024	Students	ICAR-IIWBR, karnal	37
143	05/12/2024	Students	Mahatma Phule Krishi Vidyapeeth, Rahuri Krishi Vidnyan Sankul, Kashti (Malegaon)	41
144	10/12/2024	Students	Kendriya Vidyalaya No. 3, Gwalior	43
145	11/12/2024	Students	Kendriya Vidyalaya No. 3, Gwalior	82
146	17/12/2024	Students	Tamil Nadu Agricultural University, Coimbatore	46
147	17/12/2024	Students	St. Mary's College, Sulthan Bathery, Wayanad, Kerala-673592	18
148	17/12/2024	Students	Professor Jayashankar Telangana Agricultural University, Telangana -503188	19
149	17/12/2024	Students	College of AIT, Anand Agri. University, Anand (GJ)	27
150	17/12/2024	Students	Kendriya Vidyalaya No. 3, Gwalior	66
151	20/12/2024	Students	SRS Institute of Agriculture & Technology, Vedaandur, Dindugul	89
152	20/12/2024	farmers	ATMA, BHARATPUR (RAJ.)	50
153	24/12/2024	Students	Tamil Nadu Agricultural University, Coimbatore	114
154	26/12/2024	Students	Amrita Vishwa Vidyapeetham School of Agricultural Sciences, Coimbatore	109
155	30/12/2024	Students	Tamil Nadu Agricultural University, Coimbatore	117

Phones attended at Kisan call centre: About 500 queries of potato growers on various aspects from various districts of U.P., M.P., Rajasthan, Gujarat, Punjab, Uttarakhand, Delhi and Haryana states answered through phone.

K. Demonstration of drone technology

Crop Name	Date	No. of demos on insecticide spray	Area covered under insecticide demos (area in ha)	No. of demos on weedicide spray	Area covered under weedicide demos (area in ha)	No. of demos on nutrient spray	Area covered under nutrient demos (area in ha)	Place	collaboration	Participants
Paddy	09/07/2024	0	0	-	0	1	2	Kartarpur	JPGA	2000
paddy	20/09/2024	1	3.5	0	0	-	0	Jalandhar	CPRI	143
paddy	25/09/2024	1	2.7	-	0	-	0	Jalandhar	CPRI	110
potato	10/01/2024	-	0	1	2.25	-	0	Jalandhar	CPRI	126
Paddy	11/05/2024	-	0	-	0	1	2.3	Jallowal	FASC PAU	29
Potato	12/05/2024	-	0	-	0	1	1.3	Jalandhar	World soil day	105
potato	12/09/2024	-	0	-	0	1	3	Jalandhar	CPRI	180
Potato	12/12/2024	-	0	-	0	1	1.6	Jodha	Punjab Potato Growers	800
Potato	18/12/2024	-	0	-	0	1	1.5	Jamsher	IFFCO	60
Potato	18/12/2024	1	3.1	-	0	-	0	Jalandhar	CPRI	100
Potato	02/10/2025	-	0	-	0	1	2.2	Uggi	Toor Biotech	150
Potato	28/02/2025	0	0	1	3	-	0	Garhi Baksha, Jallowal	FASC PAU	29
TOTAL		3	9.3	2	5.25	7	13.9			3832



Photos: Some outreach programmes of ICAR-CPRI RS, Shillong (Meghalaya)

TRAINING AND CAPACITY BUILDING CAPACITY BUILDING PROGRAMMES ORGANIZED BY ICAR-CPRI, SHIMLA

A. ICAR-CPRI, Shimla HQ

Awareness-Cum-Input Distribution Camp at Nako Village, Kinnaur

The ICAR-CPRI Shimla in collaboration with KVK Rekong Peo, organized an awareness-cum-input distribution camp at Nako village, Kinnaur, to uplift the livelihood of hilly tribal farmers on 13th March 2024 under the TSP scheme. One hundred participants, including 30 women from Nako and Maling villages attended the programme, which include in-depth lectures, farmer-scientist interactions and live demonstrations on apple cultivation practices, integrated farming systems, organic methods, value addition, etc. The event culminated in distribution of 1,000 apple saplings (Royal Delicious and Early Red One) to the participants. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]



Regional Workshop on eHRMS 2.0

A one-day Regional Workshop on eHRMS 2.0 was organized for employees of Northern Region institutes of ICAR. A total of 32 officials from ICAR Institutes of Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir and Uttarakhand participated in the workshop held on 24th June, 2024.

[Program Directors: Dr. Alok Kumar, Sh. Joginder Singh]



Workshop on Know Your Inner Strength

A workshop titled "Know Your Inner Strength" under HRD was conducted for the entire staff of the institute headquarters on 3rd July 2024. The workshop focused on identifying individual weaknesses and strategies to address them, while emphasizing the optimal use of personal strengths to contribute towards the growth of the institute and the well-being of the staff. [Program Coordinators: Dr. Pynbianglang Kharumnuid & Sh DK Gupta]



Workshop on Protocol for Decontamination of Potato Cyst Nematode Seed Tubers

A workshop titled "Protocol for Decontamination of Potato Cyst Nematode Seed Tubers" was organized on 9th July 2024 for 10 officers from the Departments of Horticulture and Agriculture of Himachal Pradesh,

Uttarakhand and Jammu & Kashmir. The aim of the workshop is to create awareness among the officials of Agriculture/Horticulture departments of Himachal Pradesh, Uttarakhand, and Jammu & Kashmir and to educate them about the protocol for potato tuber seed treatment for decontamination of PCN infested tubers. [Programme Directors: Drs. Sanjeev Kumar, Vinay Sagar, Aarti Bairwa, Kailash C. Naga]



Training on Recent Advances in Potato Technology

A four days training programme on “Recent Advances in Potato Technology” for 17 participants (9 officials and 8 contract farmers). The training was sponsored by McCain Foods India Pvt. Ltd. and was organized during 6th to 9th August, 2024. Training methodologies like lecture cum discussion, practical sessions, skill demonstration, field visit and video film show etc. were the modes for imparting the training to the participants. [Programme Director: Dr. Alok Kumar, Program Coordinators: Dr. Pynbianglang Kharumnuid & Dr. Salej Sood]



Training on Seed Potato Cultivation and Its Storage

A one-day training programme on “Seed Potato Cultivation and Its Storage” for 55 officials of PepsiCo India Holdings Pvt. Ltd. was organized on 28th August, 2024. Training methodologies like lecture cum discussion and video film show etc. were the modes for imparting the training to the participants. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]



Two-day farmers' training programme at Likir village Leh, Ladakh

A two-day training was held on 30th September–1st October 2024 at Likir village, Leh, Ladakh organised by ICAR-CPRI Shimla and KVK Leh for 50 tribal farmers under TSP fund. Participants received extension folders on high-altitude potato cultivation, learned the importance of quality seed, soil preparation, nutrient management, pest and disease control, and post-harvest storage. Interactive lectures were complemented by field visits to demonstration plots where farmers raised



questions and received on-spot guidance, enhancing their practical skills and confidence in adopting improved potato cultivation practices. [Programme Director: Dr. Alok Kumar, Program Coordinators: Dr. Pynbianglang Kharumnuid, Dr. Salej Sood & Dr. Kunzang Lhamo]

Training Cum Input Distribution Programme

A one-day training cum input distribution programme under SCSP was organized at Glide Inn Adventure Resort, Junga on 11th December, 2024. The programme was attended by 50 farmers from different villages of Junga panchayat. The villagers were made aware about the technologies developed by the institute and at the end battery operated spray pumps were distributed to the farmers. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]



Training Cum Input Distribution Programme

A one-day training cum input distribution programme under SCSP was organized at Pujarli panchayat, Mashobra Block on 18th December,



2024. The programme was attended by 100 farmers from different villages of that panchayat. The villagers were made aware about the technologies developed by the institute and at the end, 100 number sickle, rake, khurpi and spade each, were distributed among the SC farmers. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]

Three-Day Farmer's Training on "Aloo ki Unnat Kheti"

A three-day training on "Aloo ki Unnat Kheti" was conducted at CPRI Shimla from 26–28 February 2024 for 15 farmers and one official. Through a blend of lectures, hands-on demonstrations, field visits and group exercises, participants learned advanced seed selection and treatment, precision nutrient and irrigation management, integrated pest and disease control, post-harvest handling and value-addition techniques and other aspects of scientific potato cultivation. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]

Three-Day Official Training "On High-Tech Seed Potato Production"

A three-day training on high-tech seed potato production covering tissue culture, aeroponics and apical-rooted cuttings was held at CPRI Shimla from 20–22 September 2024, engaging four officials in a blend of lectures, hands-on lab demonstrations and field visits. [Programme Directors: Dr. Alok Kumar & Dr. Vinod Kumar, Program Coordinator: Dr. Tanuja Buckseth]

Three-Day Training on "Recent Advances in Potato Technology"



A three-day training on "Recent Advances in Potato Technology" was held at CPRI Shimla from 20–22 February 2024, engaging 20 progressive farmers in a mix of interactive lectures and hands-on activities on recent advances in potato technology and field visits to Kufri-Fagu farm. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]

One-Day Training-Cum-Input Distribution Programme at Village Kachat, PO Fagu, Shimla

On August 20, 2024, ICAR-CPRI Shimla conducted a one-day training-cum-input distribution programme under SCSP in village Kachat (PO Fagu, Shimla) for 15 Scheduled Caste farmers, focusing on scientific potato cultivation, power sprayer operation and maintenance, calibration techniques, safe agrochemical handling and integrated pest-

management principles. Each participant received a power sprayer. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]

Training-Cum-Input Distribution Programme for 100 Tribal Farmers

On 25 October 2024, ICAR-CPRI Shimla, in collaboration with KVK Reckong Peo, organized a training-cum-input distribution programme under TSP for 100 tribal farmers from Pangi village, Block Kalpa, Kinnaur, focusing on power-sprayer operation and maintenance, calibration techniques, safe handling of agrochemicals and integrated pest-management practices. Each participant received a 16 L power sprayer and took part in hands-on demonstrations, spray scheduling and record-keeping. [Programme Director: Dr. Alok Kumar, Program Coordinator: Dr. Pynbianglang Kharumnuid]

B. ICAR-CPRI RS, Modipuram

Sl. No.	Title of Training	Duration	Nos. Beneficiaries
1.	<i>Beej utpadan ki unnat taknik</i>	11/09/2024-12/09/2024 Two days	15 Farmers
2.	<i>Beej alu utpadan ki unnat taknik</i>	19/11/2024 One days	50 Farmers
3.	Improved potato production Technologies	23/12/2024 one days	70 Farmers, stakeholders and students.



Photos: Capacity Building Programmes Organized by ICAR-CPRI RS, Modipuram

C. ICAR-CPRI RS, Gwalior

Sl. No.	Title	Date	Duration	Venue	Participants
1.	Training on Scientific Potato Cultivation under SCSP component	20/01/2024	1 day	KVK, Ujjain	50 farmers
2.	Advanced techniques for seed, table, and processing potato production SCSP component under	27/09/2024	1 day	CPRI (Regional Station), Gwalior	68 farmers



Photos: Capacity Building Programmes Organized by ICAR-CPRI RS, Gwalior

D. ICAR-CPRI RS, Jalandhar

Sl. No	Title	Date	No. of beneficiaries
1.	Training program on Operation of aeroponic unit at CIP, Bhubaneswar (Odisha)	06/06/2024	5
2.	One day training program on fabrication of CPRI Aeroponic system" at M/s Toor Biotech, Uggi aerponics facility	11/06/2024	7
3.	Training program on Aeroponic system and mechanization in potato at DAE&R, Aizawl, Mizoram	17/06/2024	9
4.	Awareness cum training program on "Hi-tech potato seed production" at Jalandhar Station	20/09/2024	130
5.	One day training program on "VEGFAST technology"	23/09/2024	2
6.	Awareness cum training program on Hi-tech potato seed production and business opportunities at Jalandhar Station	25/09/2024	110
7.	Awareness cum training program on "Hi-tech potato seed production" was organized at ICAR-CPRI (RS) Jalandhar	01/10/2024	120
8.	Awareness cum training program on "New avenues in potato seed production thorough Hi-tech systems" was organized at CPRI (RS) Modipuram, Uttar Pradesh	04/10/2024	70
9.	Awareness cum training program on "Business opportunities in hi-tech potato seed production" was organized at CPRI (RS) Modipuram, Uttar Pradesh	05/10/2024	100
10.	Four days training program entitled "CPRI Aeroponic technology for potato seed production" at ICAR-CPRI, RS, Jalandhar, Punjab	11/11/2024	10

on Improved Potato Cultivation

E. ICAR-CPRI RS, Patna

Sl. No	Title	Date	Place/Venue	No. of participants	Remarks
1.	Three days training programme on Potato Cultivation to farmers	23/02/2024-25/02/2024	ICAR-CPRI RS Patna	25	Female farmers
2.	One day Farmers training of Improved Potato Cultivation	29/02/2024	KVK Amas, Gaya	50	Under SCSP component
3.	Three days training programme on improved Potato Cultivation to Farmers	10/03/2024-12/03/2024	ICAR-CPRI RS Patna	25	--
4.	One days training programme on improved Potato Cultivation to Farmers	05/12/2024	Mahuliyatand, Kauwakol Nawada	50	Under SCSP component
5.	One days training programme on improved Potato Cultivation to Farmers	06/12/2024	Pandeybigaha, Meskaur, Nawada	50	Under SCSP component
6.	One days training programme on improved Potato Cultivation to Farmers	18/12/2024	Kandi, Gaya	50	Under SCSP component
7.	One days training programme on improved Potato Cultivation to Farmers	19/12/2024	Bitho, Kandi Gaya	50	Under SCSP component

F. ICAR-CPRI RS, Shillong

Title of the Programme	Improved potato production technology for West Khasi Hills district, Meghalaya
Programme period, Duration & Venue	16/02/2024, 1 day, Krishi Vigyan Kendra, West Khasi Hills district, Meghalaya.
Team/Co-ordinators	Co-ordinator Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Saikat Sinha, Head, KVK, West Khasi Hills Co Co-ordinator Dr. Janani P, ICAR - CPRI, RS, Shillong Dr Ereneus K Marbaniang, SMS, KVK, West Khasi Hills
Total number of participants (No. of female participants in bracket)	50 (41)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on Scientific cultivation of Potato
Title of the Programme	Improved potato production technology for Jaintia Hills district, Meghalaya
Programme period, Duration & Venue	19/02/2024 to 23/02/2024, 5 days, Krishi Vigyan Kendra, Wahiajer, Jaintia Hills District, Meghalaya
Team/Co-ordinators	Co-ordinator Dr. Yvonne Angel Lyngdoh, Scientist (SS) , ICAR- CPRI, RS Shillong Dr Larika Challam, SS & Head, KVK, Jaintia Hills Co Co-ordinator Dr. Clarissa Challam, ICAR- CPRI, RS, Shillong Dr. Janani P, ICAR - CPRI, RS, Shillong Smt R Lyngdoh, SMS (Agronomy), KVK, Jaintia Hills
Total number of participants (No. of female participants in bracket)	43 (26)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on Scientific cultivation of Potato

Title of the Programme	Improved Potato Production Technologies for tribal women farmers of East Khasi Hills district
Programme period, Duration & Venue	26/02/2024 to 01/03/2024, 5 days, ICAR CPRI RS Shillong
Team/Co-ordinators	Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong
Total number of participants (No. of female participants in bracket)	100 (100)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on women farmers for scientific cultivation of Potato
Title of the Programme	Organic Potato Production Technology
Programme period, Duration & Venue	07/03/2024, one day, South Sikkim
Team/Co-ordinators	Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr. T Shering Lhamu Bhutia, Scientist, ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok, Sikkim
Total number of participants (No. of female participants in bracket)	40 (24)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation
Title of the Programme	Potato Seed production through Apical rooted cuttings
Programme period, Duration & Venue	13/03/2024 (One day), Khawhai, Khawzawl District, Mizoram
Team/Co-ordinators	Dr. N. Sailo, Senior Scientist, ICAR- CPRI, RS Shillong Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Malsawmkimi, Senior Scientist & Head, KVK, Khawzawl, Mizoram Dr Lalrambuatsaiha SMS (Agron), KVK, Khawzawl, Mizoram Dr. Vanlalduati, SMS (Soil science), KVK, Khawzawl, Mizoram
Total number of participants (No. of female participants in bracket)	40 (5)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on Seed Production of Potato
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on ARC
Title of the Programme	Potato Quality Seed Production
Programme period, Duration & Venue	06/06/2024 to 08/06/2024 (Three Day), ICAR-CPRI (RS) Shillong
Team/Co-ordinators	Dr. N. Sailo, Senior Scientist, ICAR- CPRI, RS Shillong Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong
Total number of participants (No. of female participants in bracket)	20(10)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on ARC
Title of the Programme	Training cum interaction of Farmers with Scientist and Officials
Programme period, Duration & Venue	02/08/2024 (One Day), ICAR - CPRI RS Shillong
Team/Co-ordinators	Dr. N. Sailo, Senior Scientist, ICAR- CPRI, RS Shillong Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong
Total number of participants (No. of female participants in bracket)	31 (21)
Objectives of the Programme and Innovation brought, if any.	To assess Farmers Knowledge on Potato Cultivation and impart Scientific technology of Potato Cultivation

Title of the Programme	Hands-on-training for potato seed production through Apical Rooted Cuttings
Programme period, Duration & Venue	28/10/2024 to 04/11/2024, 6 days, Seminar Hall, ICAR-Central Potato Research Institute, Regional Station Shillong
Team/Co-ordinators	Co-ordinator Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Co Co-ordinator Dr. N Sailo, ICAR- CPRI, RS, Shillong Dr. Clarissa Challam, ICAR- CPRI, RS, Shillong Dr. Janani P, ICAR - CPRI, RS, Shillong
Total number of participants (No. of female participants in bracket)	41 (28)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on ARC
Title of the Programme	Improved potato production technology
Programme period, Duration & Venue	22/11/2024, 1 day, Rongjeng, East Garo Hills, Meghalaya
Team/Co-ordinators	Co-ordinator Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr. S Hussain, Principal Scientist & Head, KVK, East Garo Hills Co Co-ordinator Dr. Trudy Tengse A. Sangma, SMS (Horticulture), KVK East Garo Hills
Total number of participants (No. of female participants in bracket)	50 (46 female)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on Potato Production
Title of the Programme	Training on advance in Potato production technology
Programme period, Duration & Venue	25/11/2024, One Day, ICAR-KVK, Namsai, Arunachal Pradesh
Team/Co-ordinators	Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Utpal Barua, Senior Scientist & Head, ICAR KVK, Namsai Mrs. Madhumita Sonowal Bora, SMS (Plant Protection) ICAR-KVK, Namsai
Total number of participants (No. of female participants in bracket)	65 (20)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on Scientific cultivation of Potato
Title of the Programme	Advance Method of Potato Cultivation
Programme period, Duration & Venue	26/11/2024, one day, ICAR Research Complex for NEH Region, Nagaland Centre, Medjiphema, Dimapur, Nagaland.
Team/Co-ordinators	Dr. N. Sailo, Senior Scientist, ICAR- CPRI, RS Shillong Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Aabon Yanthan, Scientist, ICAR Research Complex for NEH Region, Nagaland Centre.
Total number of participants (No. of female participants in bracket)	25 (15)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation
Title of the Programme	Advance Method of Potato Cultivation- Organic Potato Cultivation
Programme period, Duration & Venue	28/11/2024, SARS, Yisemyong, Mokukchung, Nagaland
Team/Co-ordinators	Dr. N. Sailo, Senior Scientist, ICAR- CPRI, RS Shillong Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Yvonne Angel Lyngdoh, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Clarissa Challam, Scientist (SS), ICAR- CPRI, RS Shillong Lipoken Jamir, Joint Director, SARS, Yisemyong, Nagaland

Total number of participants (No. of female participants in bracket)	32 (10)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation
Title of the Programme	Improved potato production technology for farmers in Sikkim
Programme period, Duration & Venue	17/12/2024 to 20/12/2024, 4 days, ICAR- Research Complex for NEH Region, Tadong, Gangtok, and Krishi Vigyan Kendra, South Sikkim, Namchi District, Sikkim
Team/Co-ordinators	Co-ordinator Dr. Yvonne Angel Lyngdoh, Scientist (SS) , ICAR- CPRI, RS Shillong Dr Ramgopal Devadas, HoRC & Principal Scientist, ICAR- Research Complex for NEH Region, Tadong, Gangtok Shri Indra Prasad Shivakoti, Head, KVK, Namthang, South Sikkim Co Co-ordinator Dr. Tshering Lhamu Bhutia, Senior Scientist, ICAR- Research Complex for NEH Region, Tadong, Gangtok Dr. Pravesh Shivakoty, SMS, KVK, Namthang, South Sikkim
Total number of participants (No. of female participants in bracket)	100
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation
Title of the Programme	Organic Potato Production Technology
Programme period, Duration & Venue	06/12/2024, one day, ICAR KVK Ribhoi, Meghalaya
Team/Co-ordinators	Dr. Janani, P, Scientist (SS), ICAR- CPRI, RS Shillong Dr. Meghna Sarma, SMS (Agronomy) KVK Ribhoi Dr. Yvonne Angel Lyngdoh, ICAR- CPRI RS Shillong
Total number of participants (No. of female participants in bracket)	56(35)
Objectives of the Programme and Innovation brought, if any.	To sensitize farmers on organic potato cultivation



Photos: Capacity Building Programmes Organized by ICAR-CPRI RS, Shillong

II. TRAINING PROGRAMMES/SUMMER SCHOOLS/WINTER SCHOOLS ATTENDED BY ICAR-CPRI EMPLOYEES IN INDIA

Name of the staff	Name of the Programme	Duration (From – To)	Place and Organizers
A. Scientific staff			
Dr. Dharmendra Kumar	Recent Advances in Biocatalysts for Biomass Derived Renewable Chemicals	15/12/23 - 04/01/24	TNAU, Coimbatore, Tamil Nadu
Dr. Arvind Kumar Jaiswal	'AgrilP2024' Short course on Patents	15/01/2024 - 15/02/2024	Online mode Jointly organized by IP&TM Unit, ICAR, New Delhi and ZTM-ABI, ICAR-CIFT, Kochi, Kerala
Dr. Janani. P	Patents in Agriculture today	15/01/2024 - 15/02/2024	ICAR-Central Institute of Fisheries Technology.
Dr. Mehi Lal	Nature Positive Farming in view of Climate Change and Food security	19/02/2024 - 23/02/2024	ICAR- Indian Institute of Farming Systems Research Modipuram, U.P.
Dr. Ajay Kumar Thakur	Genomic Data Analysis in Agricultur	18/03/2024 - 28/03/2024	ICAR-IASRI, New Delhi
Dr. Brajesh Singh Dr. Vinod Kumar Dr. Salej Sood Dr. Tanuja Bukseth Dr. Ajay Kumar Thakur Dr. Vikas Mangal Dr. Jagdev Sharma Dr. Anil Kumar Chaudhary Dr. Yogesh Gautam Sh. Paresh Chaukhande Dr. Alok Kumar Dr. Pynbianglang Kharumnuid Dr. Sanjeev Sharma Dr. Vinay Sagar Dr. Kailash Chandra Naga Dr. Dharmendra Kumar	Know Your Inner Strength	03/07/2024	ICAR-CPRI, Shimla
Dr. Salej Sood	CRISPR Genome Editing	22/07/2024 - 26/07/2024	Online
Dr. Bandana	IP awareness week: Copyrights in Agriculture	21/08/2024	University of Delhi
Dr. Bandana	IP awareness week: Copyrights in Agriculture	21/08/2024	University of Delhi
Dr. Bandana	IP awareness week Meeting: Trademarks & designs in agriculture	22/08/2024	Faculty of Law, University of Delhi
Dr. Dr Mehi Lal	National Intellectual Property awareness mission (online)	29/08/2024	IPO India
Dr. Yvonne Angel Lyngdoh	IPA awareness programme through virtual mode	16/08/2024 - 23/08/2024	ICAR-Indian Institute of Spices Research with IP&TM Cell, ICAR
Dr. Salej Sood	CRISPR construct design	22/08/24 - 28/08/24	IISER, Tiruvanthapuram
Dr. Ajay Kumar Thakur	CRISPR-Genome Editing',	21/10/2024 - 24/10/2024	National Agri-Food Biotechnology Institute (NABI), Mohali, Punja
Dr. Vikas Mangal	Translational Genomics and Molecular Breeding in Plants	11/11/24 - 02/12/24	ICRISAT, Hyderabad

Name of the staff	Name of the Programme	Duration (From – To)	Place and Organizers
B. Technical staff			
Sh. Chander Mohan Singh Bist	Digital Competency, New Tools, and Software for Efficient Computer Applications	03/01/2024 - 09/01/2024	ICAR-IASRI, NewDelhi
Smt. Tarvinder Kochhar Sh. Dharminder Verma Sh. Kameshwar Sen Sh. Rajdeep Bux Sh. Kana Singh Chauhan Sh. Chander Mohan Singh Bist Sh. Santosh Kumar Sh. Sumita Sharma Sh. Vinod Kumar Smt. Shruti Gupta Sh. Tilak Raj Smt. Asha Thakur Sh. Dharminder Kumar Gupta Sh. Dharam Prakash Gautam Sh. Sheesh Ram Thakur Sh. Naresh Kumar Sharma Sh. Naresh Chand Sh. Rajinder Kumar Smt. Madhu Bala Smt. Manjeet Syal Sh. Roop Lal Sh. Ravinder Kumar Sh. Deep Ram Sh. Rakesh Kumar Sh. Jagdish Chand (Welder) Sh. Dev Raj Sh. Neem Chand Sh. Laiq Ram Sh. Arjun Dass Sh. Sanjay Kumar Sh. Rakesh Kumar Smt. Sonam Smt. Vandana Parmar Ms. Vineeta Sharma Sh. Kulwant Singh	Know Your Inner Strength	03/07/2024	ICAR-CPRI, Shimla
C. Administrative staff			
Ms. Parwartika Dass	e-HRMS 2.0	24/06/2024	ICAR and ICAR-CPRI, Shimla
Sh. Joginder Singh Thakur	e-HRMS 2.0	24/06/2024	ICAR and ICAR-CPRI, Shimla
Ms Anita Kumari	e-HRMS 2.0	24/06/2024	ICAR and ICAR-CPRI, Shimla
Smt. Poonam Sood	e-HRMS 2.0	24/06/2024	ICAR and ICAR-CPRI, Shimla
Rajat Sethi	Training programme of the newly recruited AOs and FAOs	20/03/2024 - 19/04/2024	NAARM, Hyderabad
Rajat Sethi	Training programme of the newly recruited AOs and FAOs	03/06/2024 - 28/06/2024	ISTM Delhi
Sh. Alok Kumar Smt. Poonam Sood Smt. Meena Verma Smt. Babli Bhawani Sh. Surjit Singh Sh. Gurjeet Singh Smt Shashi Bala Thakur Sh. Suresh Kumar Smt Urmila Verma Sh. Girish Thakur	Know Your Inner Strength	03/07/2024	ICAR-CPRI, Shimla

Name of the staff	Name of the Programme	Duration (From – To)	Place and Organizers
Sh. Ashwani Gupta Sh Tej Singh Smt Sonia chauhan Smt Punam Jyoti Sh. Narender Paul Sh. Raghubir Singh Smt Kiran			
D. Skilled Supporting Staff			
Smt Kajal Smt Manjeet Sh. Amar Nath Sh. Padam Chand Sh. Ashok Kumar	Know Your Inner Strength	03/07/2024	ICAR-CPRI, Shimla

Training, workshops and courses attended by staff in iGOT Karmayogi platform: 190 courses were completed by different categories of ICAR-CPRI staff on iGOT Karmayogi platform.

III. PARTICIPATION IN SEMINAR/SYMPOSIUM/ CONFERENCES/ WORKSHOPS/ MEETINGS/OTHERS

Name of staff	Name of the Programme	Venue / Organized by	Date
Dr. Ajay Kumar Thakur	Workshop on "Genome editing mediated by CRISPR/Cas9: Tools, experimental design and its applications"	NABI, Mohali, Punjab	21/10/2024 - 24/10/2024
Dr. Ajay Kumar Thakur	International Workshop-cum-Webinar on "CRISPR-Genome Editing"	Glostem Pvt. Ltd., Chandigarh	24/07/ 2024 - 26/07/ 2024
Dr. SK Luthra	31 st Meeting of Central SubCommittee on Crop Standards, Notification and Release of Varieties for Horticultural Crops	DDG (Horticulture), ICAR, New Delhi (Online mode)	19/07/2024
Dr. SK Luthra	42 nd group meeting of AICRP (Potato)	ANDU, Ayodhya, UP, Haryana, organized by ICAR-CPRI, Shimla	22/09/2024 - 24/09/2024
Dr. SK Luthra	National Potato Fest-2024	CPRI, RS, Modipuram, Meerut, organized by ICAR-CRPI, Shimla	09/03/2024 - 10/03/2024
Dr. Sarla Yadav	National conference on "Enhancing Farmers' Income by Livestock, Poultry and Aqua Farming Through Sustainable and Eco-Friendly Smart Technologies and Practices"	Bihar Veterinary University, Patna, Bihar	28/02/2024 - 29/02/2024
Dr. Sarla Yadav	आलू एवं सब्जी महामिशन 2024	बिहार बागवानी विकास सोसायटी पटना बिहार राज्य बागवानी मिशन	28/10/2024
Dr. Sarla Yadav	हरिद्वर क्षेत्र सोनपुर मेला 2024 कृषि प्रदर्शनी के आयोजन हेतु विभागीय बैठक	Krishi Bhawan, Patna, Bihar	03/10/2024
Dr. Sarla Yadav	Kisan Mela cum Foundation Day of ICAR Research Complex for Eastern Region	ICAR-Research Complex for Eastern Region, Bihar Veterinary University Campus, Patna	22/02/2024
Dr. Sarla Yadav	Progressive agriculture in the Eastern Region and promotion of tribal culture	ICAR-Research Complex for Eastern Region, Bihar Veterinary University Campus, Patna	21/02/2024
Drs. Sanjeev Sharma, Vinay Sagar and Mehi Lal	National Conference on "Plant health for Food security: Threats and Promises"	ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh	01/02/2024 - 01/02/2024
Dr. Sanjeev Sharma	Brainstorming on "Rust Research in India: Retrospect & Prospects"	ICAR-IIWBR, RS, Flowerdale, Shimla	26/04/2024
Dr. Sanjeev Sharma	Meeting on the Institute Animal Ethics Committee (IAEC)	CRI, Kasauli, HP	15/04/2024
Dr. Sanjeev Sharma	Meeting on the Institute Animal Ethics Committee (IAEC)	Abhilashi University, Mandi	25/05/2024
Dr. Sanjeev Sharma	Review meeting of RFS under the chairmanship of AS&FA, ICAR.	ICAR, New Delhi	04/06/2024
Dr. Sanjeev Sharma	21 st IBSC meeting of ICAR-CPRI, Shimla as a special invitee.	ICAR-CPRI, Shimla	11/07/2024
Dr. Sanjeev Sharma	14 th IMC meeting of ICAR-CPRI, Shimla as a special Invitee.	ICAR-CPRI, Shimla	19/07/2024
Dr. Sanjeev Sharma	Annual Review meeting of ICAR-CPRI/CIP.	ICAR-CPRI, Shimla	14/09/2024
Dr. Sanjeev Sharma	Review meeting of the Global Campaign "Ek Ped Maa ke Naam".	MOA&FW, GoI	17/09/2024
Dr. Sanjeev Sharma	Meeting on the Institute Animal Ethics Committee (IAEC)	CRI, Kasauli, HP	19/09/2024
Drs. Sanjeev Sharma, Vinay Sagar	42 nd Group Meeting of AICRP Potato	NDUAT, Ayodhya	22/09/2024 - 24/09/2024
Dr. Sanjeev Sharma	Meeting on the Institute Animal Ethics Committee (IAEC)	IGMC, Shimla	05/10/2024

Name of staff	Name of the Programme	Venue / Organized by	Date
Dr. Sanjeev Sharma	ICAR-CPRI - Technico Agri Sciences Ltd interface meeting	CPRI, Shimla	15/10/2024
Dr. Sanjeev Sharma	Institute Animal Ethics Committee (IAEC)	Shiva Institute of Pharmacy, Bilaspur	16/10/2024
Dr. Som Dutt	International Workshop-cum-Webinar on "CRISPR-Genome Editing"	Glostem Pvt. Ltd., Chandigarh (Online Mode)	24/07/ 2024 - 26/07/ 2024
Dr. Som Dutt	International Workshop-cum-Webinar on "CRISPR-Genome Editing"	Glostem Pvt. Ltd., Chandigarh (Online Mode)	24/07/ 2024 - 26/07/ 2024
Dr. Bandana	किसानों के लिए- आलू की प्री-हार्वैस्ट एवं पोस्ट हार्वैस्ट मैनेजमेंट "विषयक एक दिवसीय प्रशिक्षण कार्यक्रम"	UP state Horticultural Co-Operative Marketing Federation HOEFD at Aligarh	12/11/2024
Dr. Bandana	किसानों के लिए मोदीपुरम एवं पाबली आलू बीज की नीलामी for entry of bids	ICAR-CPRI, Modipuram, Meerut	14/04/2024
Dr. Bandana	Delivered lecture for farmers on "आलू प्रसंस्करण के उत्पाद एवं बनाने की वैज्ञानिक विधियाँ-राष्ट्रीय आलू महोत्सव"	ICAR-CPRI, Modipuram, Meerut	15/02/2024
Dr. Alok Kumar	Delivered lecture on Developing training modules, training requirements, Capacity Building and Training methods in e-Training Course on ICAR JRF/SRF, NET/ ARS Exam Preparation for agristudents	Mahatma Phule Krishi Vidyapeeth (MPKV) Rahuri.	15/03/2024
Dr. Bandana and Vineet Sharma	International Conference on "Recent Advances and Future Prospects Meeting a Healthier Food System" 7 th AMIFOST 2024	Amity Institute of Food Technology, Amity University.	19/03/2024 - 20/03/2024
Dr. Bandana and Vineet Sharma	Souvenir & Conference Book International Conference in Hybrid Mode on Innovative and Current Advances in Agriculture & Allied Sciences (ICAAAS-2024)	Hanoi, Vietnam, organized by Society for Scientific Development in Agriculture & Technology, Meerut, U.P., India, Published by Astha Foundation, Meerut (U.P.) India	15/07/2024 - 20/07/2024
Dr. Dharmendra Kumar	Short Online Course on Patents (AgrIP 2024)	Jointly organized by Intellectual Property & Technology Management (IP & TM) Unit, ICAR, New Delhi and Zonal Technology Management, ICAR-CIFT, Kochi, Kerala (Online Mode)	15/01/2024 - 15/02/2024
Dr. Yvonne Angel Lyngdoh	National conference on Managing Agro biodiversity in North Eastern India	ICAR research complex for NEH region, Umiam, Meghalaya	23/10/2024 - 25/10/2024
Dr. Janani P	5 th International Conference on Advancement of Science and Technology for Environment, Society and People	Society for Technology, Environment, Science & People, Kozhikode, India	15/11/2024 - 16/11/2024
Drs. RK Singh, Babita Choudhary, Sugani Devi, Aarti Bairwa, Tanuja Buckseth and Murlidhar Sadawarti	03 rd Indian Horticulture Summit-cum - International Conference - 2024	Jaipur, Rajasthan	01/02/2024 - 03/02/2024

Name of staff	Name of the Programme	Venue / Organized by	Date
Dr. Sanjeev Sharma	07th International Conference on "Plant Genetics and Genomics"	NASC Complex, New Delhi	16/02/2024 - 17/02/2024
Drs. RK Singh, Anuj Bhatnagar, Sanjay Rawal and Mehi Lal	National Symposium on "Sustainable Agriculture Practices for Food Security and Environmental Conservation"	SVPU&T, Meerut	15/03/2024 - 16/03/2024
Drs. Som Dutt, Ajay Kumar Thakur, Salej Sood, Priyank Mhatre, Nehanjali Parmar, Vanita Patial, Bhawana Dipta, Neha Sharma, Rasna Devi, Jyoti Verma, Kanika Thakur and Barkha	International workshop-cum-webinar on "CRISPR genome Editing"	Online mode, after office hours only	22/07/2024 - 26/07/2024
Dr. Anuj Bhatnagar	"नेशनल हिन्दी विज्ञान सम्मेलन 2024"	CSIR, Bhopal	30/07/2024 - 31/07/2024
Dr. Priyank Mhatre	National Symposium on "Multidisciplinary Perspectives for Pest and Disease Management in Sustainable Production of Crops"	SKUAST – K, J&K	28/08/2024 - 30/08/2024
Dr. Prince Kumar	International Conference on "Current Innovations and Technological Advances in Agriculture & Allied Sciences"	GKU, Bathinda, Punjab	28/08/2024 - 31/08/2024
Dr. Aarti Bairwa	06 th Symposium on "Potato Cyst Nematode Management"	Harper Adams University, Newport, Shropshire, UK (Online mode)	10/09/2024 - 11/09/2024
Dr. SP Singh	International Conference on "Enabling Sustainable Food Systems through Natural Farming"	YSPUHF, Nauni, Solan	13/09/2024 - 14/09/2024
Drs. Brajesh Singh Jagdev Sharma Vinod Kumar Sanjeev Sharma Dinesh Kumar Alok Kumar Vinay Sagar Anil K Choudhary Salej Sood Dalamu Vikas Mangal Kailash C Naga RK Singh Anuj Bhatnagar Sk Luthra Sanjay Rawal VK Gupta Anil Sharma Raj Kumar Prince Kumar SP Singh Sarla Yadav Subhash Katore Murlidhar Sadawarti Priyank Mhatre Praveen S Patted Clarissa Chalam P Janani	42 nd group Meeting of AICRP (Potato)	ANDUA&T, Kumarganj, Ayodhya	22/09/2024 - 24/09/2024

Name of staff	Name of the Programme	Venue / Organized by	Date
Dr. Ratna Preeti Kaur	Horticulture National Symposium (PHNS - 2024) on "Horticulture in the Himalayas"	HNB Garhwal University, Srinagar	17/10/2024 - 19/10/2024
Dr. Ajay Kumar Thakur	05 th Genome Editing Workshop	NABI, Mohali	21/10/2024 - 22/10/2024
Dr. Janani P.	05 th International Conference on "Advancement of Science and Technology for Environment, Society and People (ICASTESP-V)"	TANU, (Online Mode)	15/11/2024 - 16/11/2024
Dr. Dalamu	IX th International Conference in Hybrid mode on "Global Research Initiatives for Sustainable Agriculture & Allied Sciences"	SKNAU-RARI, Durgapura, Jaipur, Rajasthan	10/12/2024 - 12/12/2024
Dr. Brajesh Singh	National Conference on "Plant Physiology-2024"	ICAR-CPCRI, Kasaragod, Kerala	17/12/2024 - 19/12/2024

IV. INVITED LECTURES DELIVERED IN OTHER UNIVERSITIES/INSTITUTES, ETC. BY THE SCIENTISTS

Name of Staff	Lecture	Programme	Organized by	Place	Date
Dr Mehi Lal	Value addition in Mushroom	Seven-days training programme on "Edible mushroom and spawn production"	Division of Plant Pathology	SVB Patel Uni of Agriculture & Technology, Meerut	06/01/2024 - 12/01/2024
Dr Sanjeev Sharma	Delivered an invited lecture on "Changing scenario of <i>Phytophthora infestans</i> population structure and its impact on disease epidemiology and management"	National Conference on "Plant health for Food security: Threats and Promises"	Indian Phytopathological Society, New Delhi	ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh	01/02/2024 - 03/02/2024
Dr Sanjeev Sharma	Delivered an invited talk on "Managing Potato Late Blight using Host resistance"	7 th International Conference on Plant Genetics and Genomics: GM and Genome edited crops	GLOSTUM	NASC, New Delhi	16/02/2024 - 17/02/2024
Dr. Som Dutt	Invited speaker to deliver a talk in the Eighth Student Seminar Series on 5 th Sept. 2024, honouring Teacher's Day	"Agriculture, Food, and Animal Sciences".	CSIR-IHBT Palampur	CSIR-IHBT Palampur	05/09/2024
Dr. Clarissa Challam	Scope and importance of seed potato production in Meghalaya.	Skill training of Rural youths (STRY)	Meghalaya Agricultural Management and Extension Training Institute, Upper Shillong, Meghalaya	ICAR CPRI RS Shillong	05/03/2024
Dr. Janani P	Advances in Potato cultivation production technology	Skill training of Rural youths (STRY)	Meghalaya Agricultural Management and Extension Training Institute, Upper Shillong, Meghalaya	ICAR CPRI RS Shillong	05/03/2024
Dr Yvonne Angel Lyngdoh	Improved potato varieties for the North Eastern Hill region of India	Skill training of Rural youths (STRY)	Meghalaya Agricultural Management and Extension Training Institute, Upper Shillong, Meghalaya	ICAR CPRI RS Shillong	05/03/2024
Dr Ngursangzuala Sailo	Potato storage, Post-harvest management and Physiology of seed	Skill training of Rural youths (STRY)	Meghalaya Agricultural Management and Extension Training Institute, Upper Shillong, Meghalaya	ICAR CPRI RS Shillong	05/03/2024

Name of Staff	Lecture	Programme	Organized by	Place	Date
Dr. Janani P	Sowing the future: Seed saving for climate resilience	District level exhibition cum awareness program on farmers saved seed	Department of Horticulture, East Khasi Hills District, Meghalaya.	Integrated agriculture training centre, 5t mile, Upper Shillong, East Khasi Hills District, Meghalaya.	13/06/2024
Dr. Clarissa Challam	Scope and importance of potato seed production in Meghalaya	Five days Master Trainers Training of Potato	Meghalaya Basin Development Authority, Shillong, Meghalaya	MIIT, Dhanketi, Shillong	05/08/2024 - 09/08/2024
Dr. Janani P	Advances in potato production technology	Five days Master Trainers Training of Potato	Meghalaya Basin Development Authority, Shillong, Meghalaya	MIIT, Dhanketi, Shillong	05/08/2024 - 09/08/2024
Dr Yvonne Angel Lyngdoh	New improved potato varieties suitable cultivation in North eastern region	Five days Master Trainers Training of Potato	Meghalaya Basin Development Authority, Shillong, Meghalaya	MIIT, Dhanketi, Shillong	05/08/2024 - 09/08/2024
Dr Yvonne Angel Lyngdoh	Diseases and pest management in potato cultivation	Five days Master Trainers Training of Potato	Meghalaya Basin Development Authority, Shillong, Meghalaya	MIIT, Dhanketi, Shillong	05/08/2024 - 09/08/2024
Dr Ngursangzuala Sailo	Potato storage and post-harvest management of potato	Five days Master Trainers Training of Potato	Meghalaya Basin Development Authority, Shillong, Meghalaya	MIIT, Dhanketi, Shillong	05/08/2024 - 09/08/2024
Drs. Yvonne Angel Lyngdoh Janani P	Organic potato cultivation	Farmer-Scientist Interaction program cum exposure visit for 25 farmers from Umsning and Umting C&RD Block, Ri-Bhoi District	ATMA, Ri-Bhoi District, Nongpoh, Meghalaya.	ICAR CPRI RS Shillong	17/05/2024
Drs Yvonne Angel Lyngdoh Janani P	Demonstration on potato cultivation for farmers	One-day training	Joint Seng Nongrep Agrofed FPC Limited.	Syniasya Village, Mawkynrew Block, East Khasi Hills, Meghalaya	11/09/2024
Drs. Yvonne Angel Lyngdoh Janani P	Demonstration on potato cultivation	One-day training	Myllem Agrofed Farmers Producer Company Limited	Mawkhan Village, Myllem Block, EKH, Meghalaya	12/09/2024
Drs. Yvonne Angel Lyngdoh Janani P	Demonstration on potato ICAR -CPRI Package	One-day training	District Project Management Unit, West Jaintia Hill district	Meghalaya Basin Development Authority, Jowai, Meghalaya	03/09/2024

Name of Staff	Lecture	Programme	Organized by	Place	Date
Dr. SK Luthra	Delivered a lecture on Recent Techniques of Drying and Dehydration of Horticultural Crops	Training programme on "Advance Techniques of Post-Harvest Management in Horticultural Crops	College of Horticulture, SVP University of Agriculture & Technology, Meerut (UP).	Meerut (UP)	08/08/2024 - 22/08/2024
Dr. Sarla Yadav	Delivered lecture on आलू बीज उत्पादन उन्नत तकनीक, आलू एवं सब्जी महाअभियान 2024 in बिहार	Training programme	बागवानी विकास सोसायटी पटना, बिहार राज्य बागवानी मिशन	कृषि भवन सभागार, गीठापुर, पटना	28/10/2024
Dr. Vikas Mangal	Delivered a lecture on ggplot2 package in R for graphical representation of data	30 Days International Agriculture Training-cum-Workshop	Hindustan Agricultural Research Welfare Society	Online	08/04/2024
Dr. Vikas Mangal	Delivered a lecture on Career counselling for Agriculture	Career counselling	IARI Jharkhand.	Online	18/10/2024

V. VISITS ABROAD (INCLUDES TRAINING AND MEETINGS, ETC. ATTENDED)

Name of Staff	Programme	Date (From-To)	Organized / Sponsored by	Place
Dr. Ratna Preeti Kaur	12 th World Potato Congress	23-26 June, 2024	Host Organisation	Adelaide, Australia

VI. EDUCATIONAL PROGRAMME-STUDENTS (M.SC. & PH. D) GUIDED BY SCIENTISTS AS MAJOR GUIDE/ SUPERVISOR

Sl. No.	Name of the Scientist	Student Name	Title of the thesis	Programme Name (M.Sc./Ph. D./ Other-Pl. specify)	University /Institute Name
Nil	Dr. Som Dutt	Ms. Ankita Sharma	Biochemical and molecular studies on enzymatic browning in tubers of potato cultivars being grown in subtropical regions of Himachal Pradesh	M.Sc.	Dr. Yashwant Singh Parmar University of Horticulture and Forestry Solan (Nauni) HP -173230 India

OTHER CELLS AND UNITS

LIBRARY AND DOCUMENTATION SERVICES

Introduction: In accordance of one of the CPRI mandate *"To act as national repository of scientific information relevant to potato"* CPRI Library and Documentation Services unit was established in 1956 with a modest collection of 256 documents. Presently this library stacked more than 67 thousand documents and has attained the position of most sought-after library on potato R & D in India. Since its inception this library has acted as repository and clearinghouse of potato literature and information. It continually provided scientific and technical information supports and services towards attainment of research mission of the institute. Efforts were made for strengthening and developing the

information resources and services through undertaking various activities given here below:

Resource Development

At the headquarter (Shimla), a total of 42 documents were purchased, procured and added to library resources. The total collection at Shimla stands at 40308 documents comprised of 16754 books, 15780 back volumes of journals, 2754 serials, 2271 annual reports, 586 theses, 251 standards, 51 maps/atlas, 1663 reprints and 198 CDs. The libraries at six regional stations and one campus at Modipuram are having their own library collection of 28267 books; journals back volumes and other documents i.e. AR/Reprints and Bulletins etc as per the details below (Table-1).

Table-1: Library Collection of ICAR-CPRI Regional Stations

Regional Stations		Books	Back vols. of Journals	Other Documents (AR/Rpr/Bull)	Total	Current Journals subscribed (Indian)
1	CPRS, Modipuram	4733	6014	2563	13310	02
2	CPRS, Jalandhar	3366	1591	473	5430	02
3	CPRS, Patna	2118	1280	--	3398	02
4	CPRS, Gwalior	1234	4	82	1420	02
5	CPRS, Ooty	1688	580	565	2833	02
6	CPRS, Shillong	1561	-	171	1732	02
7	CPRS, Kufri	144	-	-	144	--
TOTAL		14844	9469	3854	28267	12

Periodicals and Serials Management

A total of 10 current journals comprising of 1 foreign and 9 Indian have been subscribed at Shimla. Out of which 1 foreign and 9 Indian journals were subscribed on payment basis and rest 5 on exchange or gratis. In all 192 issues of such journals were received, marked and kept in library for use. Besides, 55 books were classified, catalogued, labeled, pasted and transcribed and entered in Library Automation Software for use. The library has the complete series of CABCD (till Dec. 2017 and ISA databases for retrospective and current scientific literature search and use of scientists.

Computerized & Net Based Services

The institute scientists were facilitated with full text access to 5 online databases, 10 institutes subscribed foreign journals and more than 3900+ journals from 913 national and international publishers through ICAR's e-resources consortia (Consortia for E-Resources in Agriculture). The library resources e.g. library catalogue (OPAC), foreign journals, CD Net searching, and Current Journals Received Last Week were regularly updated and maintained on library web page. Now scientists are making use of mostly library resources online from their desktop. Many relevant web sites were visited and information and data were downloaded therefrom for scientists' use. 31 Extension/Technical/Annual

Reports/Station Annual Reports/Content Pages of Potato books available at CPRI library/ Training Manuals/ Newspaper clipping were scanned and uploaded in institute's website under the link "Institutional Repository of CPRI".

Readers and Reference Service

A total of 354 documents were circulated (borrowed and returned) for home studies and 886 readers consulted 7031 documents within the library. Besides, 8 outside scientists and research scholars of various research organizations consulted the library resources. 6 new members were enrolled and 6 old members withdrew their library membership due to their transfer or retirement. At present 85 readers are active members of library including RAs/SRAs. Library received thousands of reference queries from the users of the library and responded to them satisfactorily. Besides, 332 job requests were received for 65030 copies of photocopying and printing work of different scientific and administrative documents.

Documentation and Information Services

192 issues of journals were scanned for potato literature and 224 potato articles were found and recorded. Approximately, 19 records of library resources have been successfully added to 'Koha' an open-source library management software and integrated with World CAT of OCLC through AgriCat OPAC of NARS libraries. This has provided international visibility of CPRI library resources. Besides, the in-house documentation services in the form of Current Periodicals Received Last Week (Weekly) and List of New Additions (Monthly) were brought out regularly and updated for library users. In addition, thousands of pages were scanned for integrating into institute OPAC.

Resource Generation and utilization

The library has generated the revenue of Rs.947.00 through photocopying charges. A total of Rs. 4,34,561.00 was spent on purchase of library resources like books (Rs.22,858.00), and subscription of journals (Rs.3,46,2028.00) at HQ library Shimla.

HINDI CELL

Celebrating Hindi Diwas and Hindi Pakhwada-2024

'Hindi Chetna Maas' was celebrated with great enthusiasm at from September 14, 2024 to October 11, 2024 at Shimla. It was inaugurated By Dr. Brajesh Singh, Director, ICAR-Central Potato Research Institute, Shimla the chief guest of the programme. He welcomed the participants and staff of the institute, in his address informed that our institute is a scientific institute, yet more than 90% of the work done here is in Hindi, he also assured to reach the target of 100% as our institute falls under the 'A' category. Hindi Chetna Maas was concluded on 1st October, 2024. Dr. Pan Singh of Hindi Department of HPU University, Shimla was the Chief Guest and he congratulated and distributed prizes to all the participants and winners of different Hindi competitions organized during the pakhwada. The program was then presided over by Mr. Shail Bhadavari, Mr. Kuldeep Brajwasi, Mr. Puneet Panchaal and Mr. Shiv Kumar poets arrived from New Delhi, the staff and people present on the hall enjoyed the humorous part of the poetry.



Celebration of Hindi Pakhwada/Diwas -2024 at CPRI Centers

Amongst the six centers of the institutes, Hindi Pakhwada was celebrated in Modipuram, Jalandhar, Gwalior, Ooty, Shillong and Patna. The different competitions were organized for the staff and prizes were distributed to the winners. At Modipuram, Dr. Naveen Chandra Lohani of Hindi and Adhunik Bhasha Vibhag of Chaudhary Charan Singh University, Meerut inaugurated the Hindi Pakhwada in the presence of Dr. R. K. Singh. Pakhwada was concluded on

30.9.2024 the Chief Guest of the Samapan Samaroh was Dr. Ram Singh, Vice-Chancellor of Sardar Vallabh Bhai Patel Agricultural and Technology University, Meerut he distributed the

prizes to the winners of the competitions. Likewise, Pakhwada was also celebrated in all the centers of the institute.



Inspection of ICAR-CPRI, RS Ooty by the Regional Implementation Office (South West), Kochi

On 29.11.2024 the Regional Implementation Office (South- West), Kochi conducted an inspection for ICAR-CPRI, RS Ooty to evaluate the Hindi language usage in official works and documentation practices. The inspection was carried out under the chairmanship of Sh. Anirban Biswas, Dy. Director (Implementation), Regional Implementation Office (South West), Kochi, Kerala. During the inspection, all the registers, files, and Hindi quarterly and half-yearly reports were checked. The inspection committee carefully examined these documents and expressed satisfaction with the performance

of the. On the same day office was honoured with the 'Best Performing Office' award by the Ooty-Coonoor TOLIC, for Hindi implementation.



WORKS SECTION

S. No.	Name of the infrastructure	Details	If Inaugurated When and by whom
1	C/o Seed Treatment Channel & Soak Pit at CPRI, Kufri-Fagu Unit, Shimla.	The treatment channel and soak pits have been constructed for treatment of seed potatoes.	-



PUBLICATIONS

Research Papers:

1. Bairwa, A., Dipta, B., Siddappa, S., Singh, B., Sharma, N., Naga, K.C., Mhatre, P.H., Sharma, S., Venkatasalam, E.P. & Singh, B. (2024). Kaolinite nanoclay-shielded dsRNA drenching for management of *Globodera pallida*: An environmentally friendly pest management approach. *Protoplasma*, 261(5), 965-974.
2. Bandana, Sharma, V., Rawal, S. & Singh, R.K. (2024) Calcium effect on potato storage: quality and longevity at 10-12°C (CIPC). *Progressive Research: An International Journal, Society for Scientific Development in Agriculture and Technology*, 19(2), 84-89.
3. Bhatia, N., Tiwari, J.K., Kumari, C., Zinta, R., Sharma, S., Buckseth, T., Thakur, A.K., Singh, R.K. & Kumar, V. (2024). Transcriptome analysis reveals genes associated with late blight resistance in potato. *Scientific Reports*, 14(1), 15501.
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10. Devi, S., Kaur, R. P., Nare, B., Bharti, K., & Sharma, A. (2024). Seed potato productivity as influenced by electrical conductivity of the nutrient solution in soilless media during spring season in subtropical regions of N-W India. *Potato Journal*, 51(1).
11. Dipta, B., Sood, S., Mangal, V., Bhardwaj, V., Thakur, A. K., Kumar, V., & Singh, B. (2024). KASP: a high-throughput genotyping system and its applications in major crop plants for biotic and abiotic stress tolerance. *Molecular Biology Reports*, 51(1), 508.
12. Gouda, M. R., Naga, K. C., Nebapure, S. M., & Subramanian, S. (2024). Unravelling the genomic landscape reveals the presence of six novel odorant-binding proteins in whitefly *Bemisia tabaci* Asia II-1. *International Journal of Biological Macromolecules*, 279, 135140.
13. Gupta, V. K., Sood, S., Bhardwaj, V., Mangal, V., & Luthra, S. K. (2024). Selection of potential chipping advanced potato clones for the processing industry in southern and eastern India. *Potato Journal*, 51(1).
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- Sharma, J. & Katare, S. (2024). Effect of irrigation methods and nutrient management practices on production and economics of potato under different preceding crop sequences in central India. *Potato Journal*, 51(1).
15. Joshi, A., Pradeepika, C., Kaundal, B., Raigond, P., Singh, B., & Kaundal, B. (2024). A non-destructive technique for estimation of amylose, resistant starch and starch in potato using NIR spectroscopy. *Journal of Root Crops*, 50(1), 45-52.
 16. Kaur, R., Bana, R.S., Singh, T., Meena, S.L., Raj, R., Dass, A., Govindasamy, P., Gill, J.S., Kumar, S., Sen, S. & Kumar, S. (2024). Sequential herbicide application coupled with mulch enhances the productivity and quality of winter onion (*Allium cepa* L.) while effectively controlling the mixed weed flora. *Frontiers in Sustainable Food Systems*, 7, 1271340.
 17. Kaur, T., Sharma, P. K., Brar, A. S., Vashisht, B. B., & Choudhary, A. K. (2024). Optimizing crop water productivity and delineating root architecture and water balance in cotton-wheat cropping system through sub-surface drip irrigation and foliar fertilization strategy in an alluvial soil. *Field Crops Research*, 309, 109337.
 18. Kumar, D., Dutt, S., Jaiswal, A. K., Kaundal, B., Kumar, D., & Singh, B. (2024). Bioethanol production from potatoes in India: A SWOT analysis. *Heliyon*, 10(23).
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 23. Kumar, S.P., Tewari, V.K., Chandel, A.K., Mehta, C.R., Nare, B., CR, C., Pareek, C.M. & Mundhada, K. (2024). Automated prototype intra-row weeding system: automated prototype intra-row weeding system. *Journal of Scientific & Industrial Research (JSIR)*, 83(4), 362-374.
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 25. Luthra, S. K., & Kumar, V. (2024). Potato genetic resources and their utilization in India. *Indian Journal of Plant Genetic Resources*, 37(01), 1-19.
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1. Sharma, S.K., Charry, G.R., Dass, A. and Choudhary, A.K. (2024) Recommendations and highlights of 'XXIIth National Symposium on Climate Smart Agronomy for Resilient Production Systems and Livelihood Security', 22-24 November 2023, ICAR-CCARI, Goa, Indian Society of Agronomy, New Delhi, 66p.

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1. Chaudhary, B., Dalamu, V.K., Gupta, S.K., Luthra, A.K., Sakshi, N., Vinod, K., Salej, S., Kaur, R.P., Gautam, Y., Singh, R.K., and Singh, B. (2024). Catalogue of Recently Collected Indigenous Potato Varieties Based on Morphological Descriptors. E-Technical Bulletin No. 112. ICAR-Central Potato Research Institute, Shimla-171001, Himachal Pradesh, India. Pages: 112p. (PME Ref. No.FPME/03-01/2024 dated 20.05.2024).
2. Kharumnuid, P. and Alok, K. (2024). Achieving Sustainable Agriculture through Organic Farming. Kriti Kalp (e-magazine), 11: 3 (January to March 2024), pp 1-6.

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northern western Himalayas of India. Paper presented in Indian Horticulture Summit-cum-International Conference-2024 on Technological Interventions for Boosting Horticultural Production, organized by Rajasthan Agricultural Research Institute (SKN Agriculture University, Jobner, Durgapura) Jaipur, Rajasthan, India from 1st - 3rd February, 2024.

2. Bairwa, A., Sharma, S., Sharma, A.K., Dalamu, Mhatre, P.H., and Singh, B. (2024). *Potato cyst nematodes in India: Distribution and management*. Paper presented in 6th Symposium on potato cyst nematode management organized by the Harper Adams University, Newport, Shropshire, UK from 10-11th September, 2024 (Hybrid mode).
3. Bandana, Sharma, V., Rawal, S., and Singh, R.K. (2024). *Calcium Effect on Potato Storage: Quality and Longevity at 10-12°C (CIPC)*. Paper presented in International Conference on Innovative and Current Advances in Agriculture & Allied Sciences (ICAAAS-2024) during 15-20 July 2024 at Vietnam (Chief Editor : Dr. S.P. Singh), organized by Society for Scientific Development in Agriculture & Technology, Meerut, U.P.
4. Bhatnagar, A (2024). *Hindi is the language of progress*. Presented in Hindi workshop on 06 September, 2024 at ICAR CPRI, RS, Modipuram.
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7. Janani, P., Mankar, P., Sailo, N., Challam, C., and Lyngdoh, Y.A. (2024). *Influence of whole tubers versus cut potato tubers and planting density on the yield and profitability of Potato (Solanum tuberosum L.)*. Paper presented in

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9. Lal, M., Rawal, S., Sharma, S., Singh, R.K. (2024). *Evaluation of organic spray schedules for effective late blight management in potato: A study on moderately resistant and susceptible cultivars*. Paper presented in Souvenir of National Symposium on Sustainable Agriculture Practices for Food Security and Environmental Conservation, 15-16 March 2024, SVPUAT Meerut, p128.
10. Lal, M., Sharma, S., Subhash, S., Kumar, M., and Singh, R.K. (2024) *Standardization of novel fungicides dosages and their impact on Potato agronomics: a comparative study using two treatment methods against black scurf disease*. Paper presented in National Conference on "Plant health for Food security: Threats and Promises" held at ICAR-Indian Institute of Sugarcane Research, Lucknow Uttar Pradesh during 1-3 Feb, 2024
11. Lyngdoh, Y.A., Janani, P., Sailo, N., Challam, C., Sharma, M., and Barua, U. (2024). *An introduction and adaption of improved processing potato variety Kufri Frysona to Ribhoi district of Meghalaya*. Paper presented in Souvenir of National conference on Managing Agro biodiversity in North Eastern India, 23-25 October 2024, IACR Research Complex for NEH Region, Umiam, Meghalaya, p177
12. Maharana, C., Sagar, V., Sharma, S., Bairwa, A. Buckseth, T., Naga, K., and Singh, B. (2024). *Diversity of Streptomyces species associated with common scab of potato in India*. Paper presented in IPS National Conference on "Plant Health for Food Security: Threats and Promises" held at ICAR-Indian Institute of Sugarcane Research, Lucknow (U.P.),
13. Saini, R., Lal, M., Kumar, A., and Singh, R.K. (2024). *Investigation of cultural, morphological and pathogenic variability in Sclerotium rolfii isolates causing Sclerotium wilt of Potato in Western Uttar Pradesh*. Paper presented in National Symposium on Sustainable Agriculture Practices for Food Security and Environmental Conservation held at SVB Patel University of Agri and Technology, Meerut during 15-16 March, 2024.
14. Shrivastava, V.L., Choudhary, A.K., Hariprasad, P., and Sharma, S. (2024) *Surveillance of antibiotic resistance in organic and conventionally managed fields across three-years of field experiments*. Paper presented in International Symposium of Microbiomes for Climate Resilient Agriculture, New Delhi (4 Oct 2024).

Patents and ICAR Certified Technology

Title	Developers	Number and date
Patents		
Grow Box	Er. Sukhwinder Singh	519447, 05-03-2024
ICAR Certified Technology		
Gluten free potato-millet cookies (Potato-Sorghum, Potato-Finger millet and Potato-Pearl millet)	Dr Arvind Kumar Jaiswal, Scientist (Lead); Dr Pinky Raigond; Milan Kumar Lal; Dr Sushil S Changan; Dr Dharmendra Kumar; Dr Som Dutt; Sh Yogesh Kumar Gupta; Dr Brajesh Singh	ICAR-HS-CPRI-Product-2024-014
Dipstick for estimation of glucose in potato tubers	Bandana, Som Dutt, A. Jeevalatha, Brajesh Singh, BP Singh	ICAR-HS-CPRI Technology 2024-25

HAPPENINGS AT ICAR-CPRI, SHIMLA

Visit of Dr. Himanshu Pathak, Secretary DARE & DG ICAR

Dr. Himanshu Pathak, Secretary DARE & DG ICAR Honourable Secretary, DARE & Director General, ICAR Dr. Himanshu Pathak visited and interacted with officials of ICAR- CPRI Shimla on 27th April, 2024.



Celebration of International Yoga Day

On the occasion of International Yoga Day on 21 June, 2024 a yoga session for the staff of the institute was organised in the auditorium. Dr. Som Dutt performed some easy yoga *asanas* which the entire staff replicated as per his instructions. Director CPRI also deliberated a talk on the importance of Yoga in our lives to keep ourselves fit.



Visit of newly appointed AOs and FAOs

63 Newly appointed AOs and FAOs in the ICAR visited the institute on 21st June. They were acquainted with the working, structure, history and the technologies developed by CPRI.



QRT Meeting

The 8th QRT Meeting was held at ICAR-CPRI, Shimla, from 7-8 August 2024, where the ATR on previous QRT recommendations was presented by the Member Secretary. The session included updates from the Director and program leaders highlighting key achievements and future directions. Attendees, including Chairman Prof. Chittaranjan Kole and other QRT members, participated in discussions and visited laboratory, administrative, and seed production units at Kufri and Fagu to interact with staff and review activities.



Creating Momentum for the Global Campaign #एक पेड़ माँ के नाम # Plant 4 Mother

The institute organized the event "Creating Momentum for the Global Campaign" #एक पेड़ माँ के

नाम# Plant4Mother at its headquarters on 21.08.2024 at Lower Lab Farm, Kanlog where lime plantation was done. Besides, the event was also organized at its regional stations where different plant species were planted for beautification of farm areas.

Celebration of 76th Foundation Day

The institute celebrated its 76th Foundation Day on 20th August, 2024. Sh. Shiv Pratap Shukla, Honourable Governor of Himachal Pradesh was the chief guest on this occasion. The programme was presided over by Dr. Sanjay Kumar, Chairman, ASRB, Govt. of India and Sh. Surinder Chauhan, Mayor, Municipal Corporation of Shimla was the guest of Honour.



RAC Meeting

The 30th RAC Meeting of ICAR-CPRI, Shimla was held during 10-11 September, 2024 under the chairmanship of Dr. KR Dhiman, Former Vice Chancellor, Dr. YS Parmar University, Nauni, Solan. Director, ICAR-Central Potato Research Institute, Shimla, Programme Leaders, Heads of Divisions and all the scientists from



Headquarters also participated in the meeting. The progress of ongoing 11 programmes was reviewed and work plan for the next year was also discussed.

Institute RC Meeting

The IRC Meeting was convened on 12-13 September 2024 under the chairmanship of Dr. Brajesh Singh, Director. The meeting was attended by all scientists from the Headquarters and regional stations, ensuring broad representation and active participation. The agenda focused on a comprehensive review of the previous year's recommendations, evaluation of work accomplished during the year, and strategic discussions regarding programme proposals for the next five years.



Swachhata Abhiyan

The Institute celebrated Swachh Bharat Abhiyan under "Swachhata Hi Sewa (with the theme of 'Swabhav Swachhata-Sanskar Swachhata' (स्वभाव स्वच्छता- संस्कार स्वच्छता) as per the direction of the council, New Delhi from 15th Sep, 2024 to 31st Oct, 2024 & "Swachhta Pakhwada" from 16th to 31st Dec, 2024. A number of activities were



undertaken during this period. An awareness programme for school children was organized in the Government Secondary School, Shivpuri, Kanlog, Shimla where children were educated about the importance of cleanliness. An awareness campaign regarding cleanliness in leadership of Dr. Ashwani Kumar Sharma was organized at Gram Panchayat Makhrol, District Shimla where people from different villages participated in huge number.

Vigilance Awareness Week

ICAR-CPRI, Shimla observed Vigilance Awareness Week (VAW) from 28th October 2024 to 3rd November 2024. The VAW commenced with taking of Integrity Pledge by all the staff members of the Institute Headquarters-Shimla as well as Regional Stations on 28.10.2024 at 11.00 AM. During the week, several activities like essay writing, debate competition etc. on the assigned theme were organized to promote integrity in official work at the Institute as well as its regional stations in which staff of CPRI participated in high spirits. A workshop on Vigilance Awareness on the theme "Culture of Integrity for Nation's Prosperity" was organized on 4th November, 2024 (03rd November being Sunday) which was attended by all the staff members of the Institute. Shri Ashish Sharma, Additional SP, State Vigilance and Anti-Corruption Bureau, Khalini, Shimla (H.P.) was the keynote speaker in the workshop.



Diwali Mela

Diwali Mela was organised on 29th October just before Diwali for the staff and their families at the institute. A number of stalls comprising eatables

by staff members and other local vendors, gift items etc., games for children and others were put up in this mela. Lucky seven, tombola and tug of war among different divisions were the main attraction of this mela along with slow scooter race, musical chair for ladies and different kind of races for children were also a part of this mela. The winners of different events were given prizes by the chief guest along with lucky coupon draw at the end of the day long mela.



World Soil Day

World Soil Day was celebrated on 5th December, 2024. A group of 45 students from Govt. College of Agriculture Engineering and Technology, Nasik (Maharashtra) visited the institute on that day. They were addressed by the Director of the Institute followed by a lecture delivered by Dr. Anil Chaudhry on the topic Caring for Soils: Measure, Monitor, Manage. They were made aware about the importance of soil and water in our life through the lecture.



AWARDS & RECOGNITIONS

A. ICAR CPRI BEST WORKER AWARD FOR THE YEAR 2024

S.N.	Name of the Awardee	Category	Award
1.	Dr. Aarti Bairwa	Scientific	ICAR CPRI Best Worker Award
2.	Smt. Seema Verma	Technical	ICAR CPRI Best Worker Award
3.	Sh. R Lakshmanan	Administrative	ICAR CPRI Best Worker Award

B. OTHER AWARDS

S. N.	Name of Award	Name of Awardee	Awarded Institution
1	NAAS-Fellowship	Dr. Anil K Choudhary	NAAS, New Delhi
2	Lifetime Achievement Award (2024-25) for contribution to Agriculture Science	Dr. SK Luthra	Samaj Vikas Sansthan, Meerut
3	Young Scientist Award (2024-25) for contribution to Agriculture Science	Dr. Pooja Mankar	Samaj Vikas Sansthan, Meerut
4	IPA Gold Medal for the best paper published in Potato Journal during the year 2021	Dr. Vikas Mangal	Indian Potato Association (IPA)
5	IPA Gold Medal for the best paper published in Potato Journal during the year 2022	Dr. Pynbianglang Kharumnuid	Indian Potato Association (IPA)
6	IPA Gold Medal for the best paper published in Potato Journal during the years 2021 and 2022	Dr. Dharmendra Kumar	Indian Potato Association (IPA)
7	ISA Fellow-2022 Award	Dr. Anil K Choudhary	Indian Society of Agronomy
8	Best oral presentation award	Dr. P Janani	National conference on Managing Agro biodiversity in North Eastern India at IACR Research Complex for NEH region, Umiam, Meghalaya
9	Best oral presentation award	Dr. P Janani	5th International Conference on Advancement of Science and Technology for Environment, Society and People (ICASTESP-V), 15-16 November 2024, Kozhikode, India.
10	Women Scientist award	Dr. Bandana	Society for scientific development in agriculture and technology, Astha Foundation, Meerut (U.P.) INDIA
11	Fellow of the Indian Potato Association, 2023	Dr. Som Dutt	Indian Potato Association
12	Fellow of the Indian Society of Agricultural Biochemists	Dr. Som Dutt	Indian Society of Agricultural Biochemists

C. RECOGNITIONS

S.N.	Name of Recognition	Name of Scientist	Awarded institution
1.	DBT Nominee as Outside Expert of Institute Biosafety Committee (IBSC) of Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan (HP).	Dr. Sanjeev Sharma	Deptt of Biotechnology, GoI.
2.	Outside Expert of Institute Technology Management Committee (ITMC) of ICAR-Directorate of Mushroom Research, Solan.	Dr. Sanjeev Sharma	ICAR
3.	Member of Institute Management Committee (IMC) of ICAR-Directorate of Mushroom Research, Solan.	Dr. Sanjeev Sharma	ICAR
4.	Nominated as Socially Aware Nominee of Institute Animal Ethic Committee (IAEC) of Central Research Institute (CRI), Kasuali; School of Pharmacy, Abhilashi University, Mandi; Indira Gandhi Medical College, Shimla; LR Institute of Pharmacy, Solan; School of Pharmacy & Emerging Sciences, Baddi University of Emerging Sciences & Technology, Baddi, Solan by CCSEA	Dr. Sanjeev Sharma	Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, GoI.
5.	Nominated as Scientist from Outside institute for the Institute Animal Ethic Committee (IAEC) of Shiva Institute of Pharmacy, Bilaspur (HP) by CCSEA	Dr. Sanjeev Sharma	Deptt of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, GoI.
6.	Member of the Editorial Board of Plant Disease Research	Dr. Sanjeev Sharma	Indian Society of Plant Pathologists (INSOPP), Ludhiana.
7.	Secretary of the Indian Potato Association, Shimla.	Dr. Sanjeev Sharma	Indian Potato Association, Shimla.
8.	Joint Secretary of the Hill Society of Agriculture, Uttarakhand	Dr. Sanjeev Sharma	Indian Society of Plant Pathologists (INSOPP), Ludhiana.
9.	Member, DPC of the Assessment promotion of ARS scientist under new Career Advancement Scheme (ICAR-CCRI, Nagpur)	Dr Alok Kumar	Deputy Director General (Horticulture) Nominee
10.	IPA Joint Secretary	Dr Salej Sood	Indian Potato Association (IPA)

S.N.	Name of Recognition	Name of Scientist	Awarded institution
11.	Associate Editor-Heliyon; Scientific Reports; Genetic Resources & Crop Evolution, Member editorial board of Crop Design and Potato Journal	Dr Salej Sood	Cell Press; Springer; Indian Potato Association
12.	Review Editor -Frontier of Microbiology, Editor of Ecofarming	Dr Dharmendra Kumar	Frontier; Society for Research and Development in Agriculture
13.	Chief Editor	Dr Alok Kumar	Research Journal of Agriculture and Veterinary Sciences, EMBAR Publishers
14.	Member, Editorial Board	Dr Alok Kumar	Indian Journal of Pure and Applied Biosciences

STAFF POSITION

List of Scientific staff (31.12.2024)

1. **Dr. Brajesh Singh, Director**

Division of Crop Improvement & Seed Technology

2. **Dr. Vinod Kumar, Principal Scientist & Acting Head**
3. Dr. Ajay Kumar Thakur, Senior Scientist
4. Dr. Salej Sood, Senior Scientist
5. Dr. (Ms.) Tanuja Buckseth, Senior Scientist
6. Sh. Hemant Balasaheb Kardile, Scientist
7. Dr. Vikas Mangal, Scientist

Division of Crop Production

8. **Dr. Jagdev Sharma, Principal Scientist & Head**
9. Dr. Anil Kumar Choudhary, Principal Scientist

Division of Social Sciences

10. **Dr. Alok Kumar, Principal Scientist & Head**
11. Dr. Yogesh Gautam, Principal Scientist
12. Dr. Pynbianglang Kharumunid, Scientist

Division of Plant Protection

13. **Dr. Sanjeev Sharma, Principal Scientist & Head**
14. Dr. Vinay Sagar, Principal Scientist
15. Dr. (Ms.) Aarti Bairwa, Senior Scientist
16. Dr. Kailash Chandra Naga, Scientist
17. Sh. Chandan Maharana, Scientist

Division of CPB & PHT

18. **Dr. Dinesh Kumar, Principal Scientist & Head**
19. Dr. Som Dutt, Principal Scientist
20. Dr. Dharmendra Kumar, Scientist

CPRI Kufri-Fagu Unit

21. **Dr. Ashwani Kumar Sharma, Principal Scientist & SIC**
22. Dr. (Ms.) Dalamu, Senior Scientist

CPRI Regional Station, Modipuram

23. **Dr. Rajesh Kumar Singh, Principal Scientist & Head**
24. Dr. Satish Kumar Luthra, Principal Scientist
25. Dr. Anuj Bhatnagar, Principal Scientist
26. Dr. Sanjay Rawal, Principal Scientist

27. Dr. Dhruv Kumar, Principal Scientist
28. Dr. Vijai Kishore Gupta, Principal Scientist
29. Dr. (Mrs.) Babita Chaudhary, Principal Scientist
30. Dr. Mehi Lal, Senior Scientist
31. Dr. (Ms.) Bandana, Senior Scientist
32. Dr. (Ms.) Pooja Praful Mankar, Scientist
33. Dr. Subhash. S, Scientist

CPRI Regional Station, Jalandhar

34. **Dr. Anil Sharma, Principal Scientist & Head**
35. Dr. Raj Kumar, Principal Scientist
36. Dr. (Ms) Ratna Preeti Kaur, Senior Scientist
37. Dr. Sunayan Saha, Senior Scientist
38. Dr. Prince Kumar, Senior Scientist
39. Dr. Arvind Kumar Jaiswal, Senior Scientist
40. Dr. (Mrs.) Sugani Devi, Scientist
41. Er. Sukhwinder Singh, Scientist (SG)
42. Er. Brajesh Nare, Scientist (SG)

CPRI Regional Station, Gwalior

43. **Dr. Subhash Katore, Principal Scientist & SIC**
44. Dr. Murlidhar .J. Sadawarti, Senior Scientist

CPRI Regional Station, Shillong

45. **Dr. (Mrs.) Clarissa Challam, Scientist & SIC**
46. Dr. Ngursangzuala Sailo, Senior Scientist
47. Dr. (Mrs.) P. Janani, Scientist
48. Dr. (Mrs.) Yvonne Angel Lyngdoh, Scientist

CPRI Regional Station, Muthurai (Ooty)

49. **Dr. Mhatre Priyank Hanuman, Scientist & SIC**
50. Dr. (Mrs.) Divya K. Lekshmanan, Scientist
51. Dr. Praveen S. Patted, Scientist

CPRI Regional Station, Patna

52. **Dr. Shiv Pratap Singh, Principal Scientist & SIC**
53. Dr. Raj Kumar Singh, Principal Scientist
54. Dr. (Mrs.) Sarala Yadav, Senior Scientist

List of Technical Staff from 01.01.2024 to 31.12.2024

ICAR-CPRI, Shimla (Head Qtrs)			
1.	Mrs.	Tarvinder Kochhar	Chief Tech. Officer
2.	Mr.	Dharminder Verma	Chief Tech Officer
3.	Mr.	Kameshwar Sen	Chief Technical Officer
4.	Mr.	Rajdeep Bux	Assistant Chief Tech Officer
5.	Mr.	Kana Singh Chauhan	Assistant Chief Tech. Officer
6.	Mr.	Parvesh Jassal	Assistant Chief Technical Officer
7.	Mr.	Avinish Kumar Atrey	Assistant Chief Technical Officer
8.	Mr.	Chander Mohan Singh Bist	Assistant Chief Technical Officer
9.	Mr.	Santosh Kumar	Assistant Chief Tech Officer
10.	Dr.(Mrs)	Sumita Sharma	Assistant Chief Tech Officer
11.	Mr.	Vinod Kumar	Assistant Chief Tech Officer
12.	Mrs.	Shruti Gupta	Assistant Chief Tech Officer
13.	Mr.	Tilak Raj	Assistant Chief Tech Officer
14.	Mr	Rakesh Kumar Patyal	Senior Technical Officer
15.	Mrs.	Asha Thakur	Senior Technical Officer
16.	Mr	Dharminder Kumar Gupta	Senior Technical Officer
17.	Mr.	Dharam Prakash Gautam	Technical Officer
18.	Mr.	Sheesh Ram Thakur	Technical Officer
19.	Mr.	Sushil Singh	Technical Officer (Tractor Driver)
20.	Mr.	Naresh Kumar Sharma	Technical Officer
21.	Mr.	Naresh Chand	Technical Officer
22.	Mr	Rajinder Kumar	Technical Officer
23.	Mrs.	Madhu Bala	Technical Officer
24.	Mr.	Ram Singh	Technical Officer
25.	Mrs.	Manjeet Syal	Technical Officer
26.	Mr.	Naresh Kumar	Technical Officer
27.	Mr.	Ranjesh Bhardwaj	Technical Officer
28.	Mr.	Roop Lal	Technical Officer (Driver)
29.	Mr.	Ravinder Kumar	Technical Officer
30.	Mr.	Deep Ram	Technical Officer
31.	Mr.	Rakesh Kumar	Technical Officer
32.	Mr.	Jagdish Chand (Welder)	Sr. Technical Assistant
33.	Mr.	Jagdish Chand (Carpenter)	Senior Technician (T-I-3)
34.	Mr.	Dev Raj	Technical Assistant
35.	Mr.	Parmesh Dutt	Senior Technician
36.	Mr.	Neem Chand	Technical Assistant
37.	Mr.	Laiq Ram	Senior Technician
38.	Mr.	Surinder Pal	Senior Technician
39.	Mr	Mansha Ram	Senior Technician
40.	Mr.	Arjun Dass	Senior Technician
41.	Mr.	Vivek Kumar	Senior Technician
42.	Mr.	Sanjay Kumar	Senior Technician
43.	Mr.	Rakesh Kumar	Senior Technician
44.	Mrs.	Sonam	Senior Technician
45.	Miss.	Vandana Parmar	Senior Technician
46.	Miss	Vineeta Sharma	Senior Technician
47.	Mr.	Kulwant Singh	Technician

ICAR-CPRI, Kufri-Fagu Unit

1.	Mr.	Kedar Singh	Technical Officer
2.	Mr.	Ajit Singh	Technical Officer
3.	Mr.	Ram Jivan	Technical Officer
4.	Mr.	Sayed Danish Abbas Rizvi	Senior Technical Assistant
5.	Mr.	Mohan Lal	Technical Assistant

ICAR-CPRI, Regional Station, Modipuram

1.	Mr.	Mahipal Singh Bharti	Chief Technical Officer
2.	Mr.	Harvir Singh	Chief Technical Officer
3.	Dr.	Ashok Kumar	Chief Technical Officer
4.	Mrs.	Kusum Singh	Assistant Chief Technical Officer
5.	Mr.	Yogesh Kumar Gupta	Assistant Chief Technical Officer
6.	Mr.	Harvir Singh	Assistant Chief Technical Officer
7.	Mr.	Murari Lal	Assistant Chief Technical Officer
8.	Mr.	Subhash Chand	Assistant Chief Technical Officer
9.	Dr. (Mrs)	Vineet Sharma	Assistant Chief Technical Officer
10.	Mr.	Avinash Chaudhary	Assistant Chief Technical Officer
11.	Mr.	Dinesh Singh	Assistant Chief Technical Officer
12.	Dr.	Sanat Kumar	Assistant Chief Technical Officer
13.	Mr.	Harvinder Singh	Assistant Chief Technical Officer
14.	Mr.	Udai Vir Singh	Assistant Chief Technical Officer
15.	Mr.	Ved Singh	Assistant Chief Technical Officer
16.	Mr.	Pushpendra Kumar	Senior Technical Officer
17.	Mr.	Vishvanath Bindermali	Senior Technical Officer
18.	Mr.	Manish Maan	Senior Technical Officer
19.	Mr.	Mahesh Pal Singh	Technical Officer (Driver)
20.	Mr.	Madan Pal	Senior Technician
21.	Mr.	Satpal Singh	Senior Technician
22.	Mr.	Siddharth Saroha	Senior Technician
23.	Mr.	Rohit Verma	Senior Technician
24.	Mr.	Ajay Kumar	Senior Technician
25.	Mr.	Pankaj Kumar	Technical Trainee
26.	Mr.	Sonu Kumar	Technical Trainee

ICAR-CPRI, Regional Station , Jalandhar

1.	Mr.	Munna Lal	Chief Technical Officer
2.	Dr.	Kapil Kumar Sharma	Chief Technical Officer
3.	Mr.	Akhilesh Kumar Singh	Assistant Chief Technical Officer
4.	Mr.	Parveen Kumar	Technical Officer
5.	Mr.	Narinder Mayer	Technical Officer
6.	Mr.	Kulwinder Singh	Technical Officer
7.	Mr.	Pardeep Kumar Upadhaya	Technical Officer
8.	Mr.	Anil Kumar Chandel	Senior Technical Assistant
9.	Mr.	Som Dutt Randev	Senior Technical Assistant
10.	Mr.	Vijay Kumar	Technical Officer
11.	Mr.	Pawan Kumar	Senior Technician
12.	Mr.	Virender Kumar	Senior Technician
13.	Mr.	Anil Kumar	Technical Trainee

ICAR-CPRI, Regional Station, Gwalior			
1.	Dr.	Yogendra Pal Singh	Assistant Chief Technical Officer
2.	Dr.	Sanjay Kumar Sharma	Assistant Chief Technical Officer
3.	Mr.	Shyam Kumar Gupta	Assistant Chief Technical Officer
4.	Mr.	Rajender Kumar Samadhiya	Assistant Chief Technical Officer
5.	Mr.	Surendar Singh	Technical Officer
6.	Mr.	Nihal Singh	Senior Technical Assistant (Driver)
7.	Mrs.	Nisha Verma	Hindi Translator (Sr. Technical Assistant)
8.	Mr.	Tara Chand	Senior Technician
9.	Mr.	Sanjeev Kumar Meena	Technician
10.	Mr.	Vinod Kumar Meena	Senior Technician
ICAR-CPRI, Regional Station, Patna			
1.	Mr.	Arjun Kumar Sharma	Assistant Chief Technical Officer
2.	Mr.	Rakesh Srivastava	Technical Officer
3.	Mr.	Anil Kumar	Technical Officer
4.	Mr.	Alekh Narain	Technical Officer
5.	Mr.	Narendra Kumar	Technical Officer
6.	Mr.	Lal Babu Das	Senior Technical Assistant (Driver)
7.	Mr.	Sunil Kumar Singh	Senior Technician
8.	Mr.	Rishav Kumar	Senior Technician
9.	Mr.	Pratish Kumar Patel	Senior Technician
10.	Mr.	Sumit Kumar	Senior Technician
11.	Mr.	Akhilesh Singh	Technician
ICAR-CPRI, Regional Station, Shillong			
1.	Mr.	Sabarius Nongrum	Senior Technician
2.	Mr.	Anubhav Kumar	Technical Trainee
3.	Mr.	Hureiyan Kahmei	Technical Trainee
4.	Mr.	Shyam Meena	Technical Trainee
ICAR-CPRI, Regional Station, Ooty			
1.	Mr.	R Lakshmanan	Technical Officer
2.	Mr.	B. Suresh	Technical Assistant

Administrative staff position as on 01.01.2025

CPRI, Shimla

S. No.	Name	Designation
1.	Shri Kumar	Chief Admn. Officer
2.	Sh. Amit Kumar	Chief Finance & Accounts Officer
3.	Sh. Joginder Singh Thakur	Administrative Officer
4.	Sh Rajat Sethi	Administrative Officer
5.	Smt Poonam Sood	Asstt. Admn. Officer
6.	Smt.Meena Verma	Asstt. Admn. Officer
7.	Smt Babli Bhawani	Asstt. Admn Officer
8.	Ms Sunita	Deputy Director (Rajbhasha)
9.	Sh Aman Deep Punia,	Asstt. Finance & Accounts Officer
10.	Mohd. Muzafer Lone	Asstt. Finance & Accounts Officer
11.	Sh. Gurjeet Singh,	Private Secretary
12.	Smt. Shashi Bala Thakur	Private Secretary
13.	Sh Suresh Kumar	Private Secretary
14.	Ms. Rita Walia	Assistant
15.	Mrs. Urmila Verma	Assistant
16.	Mrs. Sunita Thakur	Assistant
17.	Sh. Krishan Lal	Assistant
18.	Sh. Om Parkash	Assistant
19.	Mrs. Shyam Lata Beakta	Assistant
20.	Smt Chandni Baghta	Assistant
21.	Sh. Deep Ram	Assistant
22.	Sh. Pawan Kumar	Assistant
23.	Sh. Sachin Kanwar	Assistant
24.	Sh. Hans Raj	Assistant
25.	Sh Sumit Bhauguna	Assistant
26.	Sh. Girish Thakur	Personal Assistant
27.	Mrs. Nirmala Chauhan	Upper Division Clerk
28.	Sh. Ashwani Gupta	Upper Division Clerk
29.	Sh. Tej Singh	Upper Division Clerk
30.	Mrs.Geeta Devi	Upper Division Clerk
31.	Mrs. Sonia Chauhan	Upper Division Clerk
32.	Mrs. Punam Jyoti	Upper Division Clerk
33.	Sh. Mohinder Singh	Upper Division Clerk
34.	Sh. Narender Paul	Upper Division Clerk
35.	Sh. Raghubir Singh	Upper Division Clerk
36.	Sh. Gokal Ram	Upper Division Clerk
37.	Sh. Rakesh Negi	Upper Division Clerk
38.	Sh Ashish Kalyan	Upper Division Clerk
39.	Sh. KundanLal	Lower Division Clerk
40.	Smt Kiran	Lower Division Clerk

CPRS, Jalandhar

41.	Ms Parvartika	AAO
42.	Sh. Suresh Kumar Verma	Private Secretary
43.	Rahul Kumar Sharma	Assistant
44.	Mrs. DaisheyTuli	Upper Division Clerk
45.	Sh. Daljit Singh	Upper Division Clerk
46.	Sh. Naresh Kumar	Upper Division Clerk

**CPRS, Modipuram**

47.	Sh. Sandeep	Asstt. Admn. Officer
48.	Sh Sukhbeer	Assistant
49.	Smt. Sneh Lata	Upper Division Clerk
50.	Smt. Seema Verma	Upper Division Clerk
51.	Sh. Ashok Kumar	Upper Division Clerk
52.	Sh. Rajesh Kumar	Private Secretary
53.	Sh. Suraj Singh	Lower Division Clerk
54.	Sh. Pradyuman K. Saraswat	Upper Division Clerk

CPRS, Patna

55.	Sh. Jagbir Singh	Assistant Admn. Officer
56.	Smt Sandhya Srivastva	Assistant
57.	Sh. RK Gupta	Upper Division Clerk
58.	Sh. Pawan Kumar	Steno Gr-III
59.	Sh. Rajesh Chauhan	Lower Division Clerk

CPRS, Gwalior

60.	Sh Kamal Chand Verma	Assistant
61.	Sh. Sunil Kumar	Lower Division Clerk

CPRS, Ooty

62.	Smt. Dahrma Paul	AAO
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CPRS, Shillong: NIL**List of Skilled Support Staff (SSS), ICAR-CPRI, Shimla & its Regional Stations as on 31.12.2024**

CPRI, Shimla	
1.	Sh. Subhash Chand, SSS
2.	Sh. Rajinder Kumar, SSS
3.	Sh. Sanjeevan Kumar, SSS
4.	Sh. Narender Kumar, SSS
5.	Smt. Kajal , SSS
6.	Sh. Padam Dev , SSS
7.	Sh. Roshan Lal, SSS
8.	Sh. Amar Nath , SSS
9.	Sh. Padam Chand, SSS
10.	Sh. Ashok Kumar, SSS
Kufri-Fagu-Unit	
11.	Sh. Roop Singh, SSS
12.	Sh. Jia Lal, SSS
13.	Sh. Hira Singh, SSS
14.	Sh. Rajinder Singh, SSS
CPRS, Modipuram	
15.	Sh. Jagtey, SSS
16.	Sh. Som Pal, SSS
17.	Sh. Mani Ram, SSS
18.	Sh. Rajbir Singh, SSS
19.	Sh. Raj Kumar, SSS
20.	Sh. Sudesh Pal, SSS
21.	Sh. Gyanendra Kumar, SSS
22.	Sh. Mukesh, SSS
23.	Sh. Murari, SSS
24.	Sh. Rajpal Singh, SSS

CPRS, Patna	
25.	Sh. Teka Rai, SSS
26.	Sh. Jagat Kumar, SSS
CPRS, Jalandhar	
27.	Smt. Rashpal Devi, SSS
28.	Sh. Ram Lubhaya, SSS
29.	Sh. Ram Sarup, SSS
CPRS, Gwalior	
30.	Sh. Ranbir Singh, SSS
31.	Sh. Kallu, SSS
32.	Sh. Ashok Kumar, SSS
33.	Sh. Jaswant Singh, SSS
34.	Sh. Kedar, SSS
35.	Sh. Ram Parkash, SSS
36.	Sh. Mannu Singh, SSS
37.	Sh. Lala Ram, SSS
38.	Sh. Tilak Singh, SSS
39.	Sh. Net Ram, SSS
40.	Sh. Mangal, SSS
41.	Sh. Jandel Singh, SSS
42.	Sh. Bhagirath, SSS
43.	Sh. Sikander Singh, SSS
CPRS, SHILLONG	
	Nil
CPRS, MUTHORAI	
	Nil

Sanctioned, Filled & Vacant Position of Scientific Staff of CPRI & its Regional Stations as on 31.12.2024 (excluding 01 RMP position)

Sl. No.	Discipline	HoD/HoRS			Principal Scientist (DR)			Senior Scientist (DR)			Scientist (including Sr. Sci. & PS promoted Through CAS)			Total		
		S	F	V	S	F	V	S	F	V	S	F	V	S	F	V
1.	AGRICULTURAL BIOTECHNOLOGY	-	-	-	-	-	-	1	-	1	3	3	-	4	3	1
2.	AGRONOMY	-	-	-	-	-	-	1	1	-	4	3	1	5	4	1
3.	AG. ENTOMOLOGY	-	-	-	-	-	-	2	2	-	5	2	3	7	4	3
4.	AG. ECONOMICS	-	-	-	-	-	-	1	-	1	1	-	1	2	-	2
5.	AG METEOROLOGY	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-
6.	AGRICULTURAL MICROBIOLOGY	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-
7.	COM. APPLN.& IT	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-
8.	AG. EXTENSION	-	-	-	-	-	-	1	-	1	1	1	-	2	1	1
9.	AG. ENGG.(FM&P)	-	-	-	-	-	-	-	-	-	3	2	1	3	2	1
10.	PL.BIOCHEMISTRY	-	-	-	-	-	-	1	1	-	2	1	1	3	2	1
11.	FOOD TECHNOLOGY	-	-	-	-	-	-	1	-	1	1	1	-	2	1	1
12.	VEG. SCIENCE	-	-	-	-	-	-	1	-	1	14	10	4	15	10	5
13.	NEMATOLOGY	-	-	-	-	-	-	-	-	-	2	2	-	2	2	-
14.	GENETICS AND PLANT BREEDING	-	-	-	-	-	-	2	1	1	8	7	1	10	8	2
15.	PL. PATHOLOGY	-	-	-	-	-	-	2	1	1	7	2	5	9	3	6
16.	PL. PHYSIOLOGY	-	-	-	-	-	-	1	-	1	5	1	4	6	1	5
17.	SOIL SCIENCE SOIL CHEM./ FERT. MICRO	-	-	-	-	-	-	1	-	1	2	-	2	3	-	3
18.	SEED SCIENCE AND TECHNOLOGY	-	-	-	-	-	-	1	-	1	3	3	-	4	3	1
19.	Head, Crop Improvement & Seed Technology	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1
20.	Head, Social Science	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
21.	Head, Crop Production	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
22.	Head, CPB&PHT	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
23.	Head, Plant Protection	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
24.	Head, CPRI RS, Modipuram	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
25.	Head, CPRI RS, Jalandhar	1	1	-	-	-	-	-	-	-	-	-	-	1	1	-
	TOTAL	7	6	1	-	-	-	16	6	10	64	41	23	87	53	34

S-Cadre Strength F-In Position V-Vacancy

Sanctioned, Filled & Vacant Position of Scientific Staff of CPRI & its Regional Stations as on 31.12.2024

S. N.	Name of the Station	HoD/HoRS			Sr. Scientist			Scientist			Total		
		S	F	V	S	F	V	S	F	V	S	F	V
1.	CPRI, Shimla including AICRP& CPRI Kufri Fagu Unit	05	04	01	07	03	04	30	14	16	42	21	21
2.	CPRS, Jalandhar	01	01	00	01	00	01	10	08	02	12	09	03
3.	CPRI RS, Modipuram	01	01	00	04	02	02	10	08	02	15	11	04
4.	CPRI RS, Gwalior	00	00	00	03	01	02	03	01	02	06	02	04
5.	CPRI RS, Patna	00	00	00	01	00	01	04	03	01	05	03	02
6.	CPRI RS, Ooty	00	00	00	00	00	00	03	03	00	03	03	00
7.	CPRI RS, Shillong	00	00	00	00	00	00	04	04	00	04	04	00
	TOTAL	07	06	01	16	06	10	64	41	23	87	53	34

*Excluding RMP



SCIENTIFIC CATEGORY

New Joining :- NIL

Transfers (Inter-institute) :-

1. Sh. Paresh Baldeorao Chaukhande,
Scientist (Vegetable Science), ICAR-

Central Potato Research Institute, Shimla
relieved on 29.11.2024 (AN) to join at
ICAR-IARI, New Delhi.

Promotions

Sl. No.	Name of Scientist & Discipline	Level on promotion	Date of promotion
Promoted vide ICAR, New Delhi Office Order dated 05.04.2024			
1.	Dr. Ajay Kumar Thakur (Ag. Biotechnology)	Level-14 of 7 th CPC (Pre-revised Pay Band Rs. 37,400-67,000 + RGP Rs.10,000)	07.01.2023
Promoted vide this office order dated 21.02.2024			
2.	Dr. Murlidhar J. Sadawarti (Seed Science & Technology)	Level-13A of 7 th CPC (Pre-revised Pay Band Rs. 37,400 – 67,000 + RGP Rs.9,000)	26.06.2022
3.	Dr. Ngursangzuala Sailo (Plant Physiology)	Level-13A of 7 th CPC (Pre-revised Pay Rs. 37,400 – 67,000 + RGP Rs.9,000)	27.04.2023
4.	Dr. (Ms.) Dalamu (Vegetable Science)	Level-13A of 7 th CPC (Pre-revised Pay Rs. 37,400 – 67,000 + RGP Rs.9,000)	27.04.2023
5.	Dr. Ravinder Kumar (Plant Pathology) (now transferred to ICAR-IARI, New Delhi)	Level-13A of 7 th CPC (Pre-revised Pay Rs. 37,400 – 67,000 + RGP Rs.9,000)	02.05.2023
6.	Dr. Prince Kumar (Vegetable Science)	Level-12 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.8,000)	01.01.2023
7.	Dr. (Ms.) Tanuja Buckseth (Vegetable Science)	Level-12 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.8,000)	01.01.2023
8.	Dr. Arvind Kumar Jaiswal (Food Technology)	Level-12 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.8,000)	01.07.2023
9.	Dr. Subhash S. (Ag. Entomology)	Level-11 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.7,000)	02.07.2022
10.	Dr. Dharmendra Kumar (Ag. Microbiology)	Level-11 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.7,000)	02.07.2022
11.	Dr. Milan Kumar Lal (Plant Physiology) (now transferred to ICAR-NRRI, Cuttack, Odisha)	Level-11 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.7,000)	02.07.2022
12.	Dr. Rahul Kumar Tiwari (Plant Pathology) (now transferred to ICAR-IISR, Lucknow)	Level-11 of 7 th CPC (Pre-revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.7,000)	02.07.2022
Promoted vide this office order dated 15.04.2024:-			
13.	Dr. Vikas Mangal (Genetics & Plant Breeding)	Level -11 of 7 th CPC (Pre -revised Pay Band Rs. 15,600 - 39,100 + RGP Rs.7,000)	04.01.2023
14.	Late Dr. Sundaresha S. (Plant Pathology) (Expired on 19.09.2022)	Level-13A of 7 th CPC (Pre -revised Pay Band Rs. 37,400 - 67,000 + RGP Rs.9,000)	01.09.2022

Retirement

1. Dr. Vinay Singh, Principal Scientist, ICAR-Central Potato Research Institute, Regional Station, Modipuram retired from Council's service w.e.f. 31.01.2024 (AN.)

2. Dr. Devendra Kumar, Principal Scientist, ICAR-Central Potato Research Institute, Regional Station, Modipuram retired from Council's service w.e.f. 30.09.2024 (AN.)

SANCTIONED FILLED AND VACANT POSITION OF TECHNICAL CATEGORY AS ON 31.12.2024

Functional Group	Hqrs.		Shillong		Jalandhar		Modipuram		Gwalior		Patna		Ooty		Kufri		Total		
	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	V
Field Farm Technician (FFT)																			
Cat. I																			
Jr. Tech. Asstt. /Sr. Field Asstt. /Field Asstt.	31	29	5	2+2	9	7	13	7+2	4	4	9	9	4	2	8	5	83	69	14
Cat. II																			
Sr. Tech. Asstt. (T-4) Tech. Asstt. (T-3)	9	3	-	-	4	3	13	09	2	1	2	1	-	-	1	-	31	17	14
Cat. III																			
Farm Supdt. T-6	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	2	2	0
Lab. Technician																			
Cat. I																			
Computer (T-2)	2	2	-	-	-	-	1	1	-	-	-	-	-	-	-	-	3	3	0
Projector Operator, T-2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0
Cat. II																			
Lab. Tech. (T-4)/ Lab. Tech. (T-3)	3	2	-	-	1	-	1	1	1	2	-	-	-	-	-	-	6	5	1
Cat. III																			
Computer programmer T-6	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	0
Lib. Information / Documentation																			
Cat. II																			
Lib. Asstt. (T-3)	1	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3	1	2
Asstt. Librarian (T-5)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1
Documentalist, T-3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1
Tech. Asstt. (Stat.) (T-3)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1
Photography																			
Cat. I																			
Photographer /	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Press & Editorial Staff Cat. II																			
Hindi Translator, T-3	1	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	2	2	0
Workshop & Engg. Staff																			
Cat. I																			
Blacksmith-cum- Carpenter	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0
Sr. Mechanic (T-2)	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	2	2	0
Fitter (T-1) (*new Technical Trainee)	-	-	-	-	1	1*	-	-	-	-	-	-	-	-	-	-	1	1	0
Welder	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0
Mechanic cum Electrician	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3	1	2
Operator Electrical	1	1	-	-	-	1	1	-	-	-	1	-	-	-	-	-	3	2	1
Driver	3	1	-	-	1	-	2	1	-	-	2	1	-	-	-	-	8	3	5
Tractor Driver	1	1	1	-	1	-	2	-	2	1	1	-	1	-	-	-	9	2	7
Cat. II																			
Foreman (T-4)	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	1	1
Asstt. Foreman (T-3)	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	0
Overseer (Civil) T-3	1	-	-	-	-	-	-	01	-	-	-	-	-	-	-	-	1	1	0
Cat. III																			
Instrument Engineer, T-7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1
Total	62	45	06	04	22	13	39	27	10	10	15	11	05	02	09	05	168	117	51

Category wise sanctioned, Filled and Vacant Position as on 31.12.2024

Category	Sanctioned	Filled	Vacant
Category-I	115	81+06*= 87	28
Category -II	49	29	20
Category-III	04	03	01
Total	168	119	49

Promotions:

- Kumari Vineeta Sharma, Technician, CPRI, Shimla promoted to Senior Technician from 22.02.2024
- Smt. Sonam, Technician, CPRI, Shimla promoted to Senior Technician from 08.01.2024
- Smt. Vandana Parmar, Technician, CPRI, Shimla promoted to Senior Technician from 29.01.2024
- Sh. Sanjay Kumar, Technician, CPRI, Shimla promoted to Senior Technician from 21.12.2023
- Sh. Rakesh Kumar, Technician, CPRI, Shimla promoted to Senior Technician from 29.12.2023
- Sh. Vivek Kumar, Technician, CPRI, Shimla promoted to Senior Technician from 24.12.2023
- Sh. Virender Kumar, Technician, CPRS, Jalandhar promoted to Senior Technician from 28.12.2023
- Sh. Ajay Kumar, Technician, CPRS, Modipuram promoted to Senior Technician from 06.02.2024
- Sh. Siddharth Saroha, Technician, CPRS, Modipuram promoted to Senior Technician from 29.12.2023
- Sh. Rohit Verma, Technician, CPRS, Modipuram promoted to Senior Technician from 19.12.2023
- Sh. Rishav Kumar, Technician, CPRS, Patna promoted to Senior Technician from 26.12.2023
- Sh. Pratish Kumar Patel, Technician, CPRS, Patna promoted to Senior Technician from 01.02.2024
- Sh. Vinod Kumar Meena, Technician, CPRS, Gwalior promoted to Senior Technician from 30.09.2024
- Sh. Sumit Kumar, Technician, CPRS, Patna promoted to Senior Technician from 29.12.2023
- Sh. B. Suresh, Senior Technician, CPRS, Ooty promoted to Technical Assistant from 21.06.2023
- Sh. Neem Chand, Senior Technician, CPRI, Shimla promoted to Technical Assistant from 15.04.2024
- Sh. Rakesh Kumar, Senior Technical Assistant, CPRI, Shimla promoted to Technical Officer from 10.06.2024
- Sh. Ajit Singh, Senior Technical Assistant, CPRI, Shimla promoted to Technical Officer from 26.07.2024
- Sh. Ram Jivan, Senior Technical Assistant, CPRI, Shimla promoted to Technical Officer from 08.09.2024
- Sh. Deep Ram, Senior Technical Assistant, CPRI, Shimla promoted to Technical Officer from 23.07.2024
- Sh. R. Lakshmanan, Senior Technical Assistant, CPRS, Ooty promoted to Technical Officer from 13.04.2023
- Sh. Roop Lal, Senior Technical Assistant (Driver), CPRI, Shimla promoted to Technical Officer (Driver) from 17.11.2023
- Sh. Ravinder Kumar, Senior Technical Assistant, CPRI, Shimla promoted to Technical Officer from 30.06.2024
- Smt. Nisha Verma, Technical Assistant, CPRS, Gwalior promoted to Senior Technical Assistant from 25.12.2023
- Sh. Yogesh Kumar Gupta, Assistant Chief Technical Officer, CPRS, Modipuram promoted to Chief Technical Officer from 10.04.2023

Retirements

1. Sh. Parvesh Jassal, Assistant Chief Technical Officer, CPRI, Shimla voluntary retired on 31.01.2024
2. Sh. Om Pal, Chief Technical Officer, CPRS, Modipuram retired on 31.01.2024
3. Sh. Krishan Pal Singh, Chief Technical Officer, CPRS, Modipuram retired on 31.12.2024

Transfer/ Inter-Institutional Transfer

1. Sh. Chander Mohan Singh Bist, Assistant Chief Technical Officer, CPRI, Shimla transferred to IISWC, Dehradun on 07.10.2024

Appointments

1. Sh. Pankaj Kumar, Technical Trainee joined CPRS, Modipuram on 03.05.2024
2. Sh. Soni Kumar, Technical Trainee joined CPRS, Modipuram on 08.05.2024
3. Sh. Vipin Kumar Das, Technical Trainee joined CPRS, Patna on 08.05.2024
4. Sh. Amit Kumar, Technical Trainee joined CPRS, Jalandhar on 10.05.2024
5. Sh. Hureiyan G. Kahmei, Technical Trainee joined CPRS, Shillong on 02.05.2024
6. Sh. Shyam Meena, Technical Trainee joined CPRS, Shillong on 03.05.2024

Resignation

1. Sh. Vipin Kumar Das, Technical Trainee CPRS, Patna resigned on 27.08.2024

Administrative staff sanctioned /Filled/Vacant Position as on 31.12.2024 at CPRI, Shimla

Group	Shimla			Shillong			Jalandhar			Modipuram			Gwalior			Patna			Ooty			Total		
	S	F	V	S	F	V	S	F	V	S	F	V	S	F	V	S	F	V	S	F	V	S	F	V
CAO	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
CF&AO	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
SF&AO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AO	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
F&AO	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
AAO	4	3	1	1	0	1	1	1	0	1	1	0	1	0	1	0	1	-1	0	0	0	8	6	2
AF&AO	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
DD (OL)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
PPS	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
PS	3	3	0	0	0	0	0	1	-1	1	1	0	0	0	0	0	0	0	0	0	0	4	5	-1
PA	2	1	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	4	1	3
Asstt.	16	12	4	1	0	1	2	1	1	2	1	1	1	1	0	1	1	0	1	0	1	24	16	8
UDC	6	12	-6	0	0	0	1	3	-2	1	4	-3	0	0	0	1	1	0	0	0	0	9	20	-11
LDC	3	2	1	1	0	1	1	0	1	1	1	0	1	1	0	1	1	0	1	0	1	9	5	4
Steno.G-III	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-1	0	0	0	0	0	1	-1
Total	43	40	3	3	0	3	6	6	0	6	8	-2	3	2	1	4	5	-1	2	0	0	67	61	6

Appointment/New joining

1. Sh. Shri Rajat Sethi , Administrative Officer, CPRI, Shimla joined on 22.04.2024
2. Sh. Aman Deep punia, AF&AO, CPRI, Shimla joined on 22.8.2024
3. Sh Mohd. Muzafer Lone, AF&AO,CPRI , Shimla joined on 22.08.2024
4. Sh Sumit Bhuguna, Assistant, CPRI, Shimla joined on 03.09.2024
5. Sh Rahul Kumar Sharma, Assistant, CPRI(RS), Jalandhar joined on 05.09.2024
6. Sh. Sukhbeer, Assistant, CPRI(RS), Modipuram joined on 30.08.2024

Appointment/Promotion/Retirement/Transfers/Deaths

1. Sh Nand Lal, LDC,CPRI, Shimla retired on 29.02.2024.
2. Sh Surjit Singh , PPS, CPRI,Shimla Retired on 30.11.2024
3. Smt IC Dharmapaul, AAO, CPRI(RS), Ooty Retired on 30.11.2024

Granted financial up-gradation under MACP Scheme

1. Sh Krishan Lal, Assistant, CPR, Shimla granted 3rd MACP w.e.f. 01.09.2024 in Pay Matrix Level 7.
2. Smt Dashiy Tuli,UDC, CPRI,RS,Jalandhar granted 2nd MACP w.e.f.05.09.2023 in Pay Matrix Level 5.
3. Smt.Chandni Baghta , Assistant, CPRI, Shimla, granted 3rd MACP w.e.f. 06.10.2024 in Pay Matrix Level 7.
4. Sh Suresh Kumar Verma , PS, CPRI,RS, Jalandhar granted 3rd MACP w.e.f. 12.08.2023 in Pay Matrix Level-9.

Transfers on selection basis

1. Sh Chander Prakash, FAO, CPRI Shimla relieved w.e.f. 31.12.2024(A/N) to join as SFAO at ICAR-DMR, Solan.
2. Sh Amit Kumar ,CF&AO,CPRI,Shimla joined on 01.01.2025.

Sanctioned Filled & Vacant position of Skilled Support Staff as on 31.12.2024.

S. No.	Name of the Station	Skilled Support Staff		
		Sanctioned	Filled	Vacant
1	Shimla /Kufri	38	14	24
2	Modipuram	23	10	13
3	Jalandhar	18	03	15
4	Gwalior	10	14	-4
5	Patna	07	02	05
6	Ooty	03	-	03
7	Shillong	04	-	04
8	Total	103	43	60

Retirements:

1. Sh. Prakash Tomar , SSS, CPRS, Gwalior retired on 31.01.2024
2. Sh. Rajpal, SSS, CPRS, Modipuram retired on 31.01.2024.
3. Sh. Jagan Nath, SSS, CPRS, Jalandhar retired on 31.01.2024 .
4. Sh. Hira Singh, SSS, CPRS, Kufri retired on 30.04.2024.
5. Sh. Saran, SSS, Kufri retired on 31.05.2024.
6. Sh. Bharat Singh, SSS, CPRS, Gwalior retired on 31.05.2024.
7. Sh. Punjab Singh, SSS, CPRS, Gwalior retired on 31.05.2024.
8. Smt. Vimla Devi, SSS, CPRS, Gwalior retired on 30.06.2024.
9. Sh. Virendra Singh, SSS, CPRS, Gwalior retired on 30.06.2024.
10. Sh. Jagdish, SSS, CPRS, Gwalior retired on 31.08.2024.
11. Smt. Manjit, SSS, CPRI, Shimla retired on 31.08.2024.
12. Sh. Ramdin, SSS, CPRS, Gwalior expired on 08.05.2024.

INSTITUTE BUDGET (2024-25)

ANNUAL ACCOUNTS 2024-25

S.No.	Head of Account	Amount
(A)	Income items distrutable between Central Corpus & Institute Corpus (30:70)	
1	Sale of Farm Produce	1,73,73,139.00
2	Sale of Fish & Poultry	0.00
3	Sale of Live stock	0.00
4	Sale of Publication and advertisement	0.00
5	Licence Fee	11,52,649.00
6	Analytical and testing fee	0.00
7	Pre -shipment fee	0.00
8	Application fee from candidates	49,500.00
9	Diploma Charges	0.00
10	Receipts from services rendered	0.00
11	Income generated from Internal Resource Generation schemes	0.00
	a) Training	6,67,479.00
	b) Consultancy	0.00
	c) Contract Research	1,40,82,285.00
	d) Sale of Technology	0.00
	e) other(Specify the source)	1,07,420.00
	Net Profit in Revolving funds	3,72,94,699.00
12	Interest earned on Corpus Fund Accumulation	0.00
13	Miscellaneous Receipts	53,41,261.00
	TOTAL	7,60,68,432.00
	Transferred to Institute Corpus Fund 70%.	5,32,47,902.00
	Transferred to Central Council Corpus Fund 30% (Bank account no : 42285360283)	1,59,74,371.00
(B)	Income items transferrable to Central Corpus (100%) (Bank a/c No : 42285360283)	
1	Recoveries of Loans & Advances	13,04,000.00
2	Interest earned on loans & advances	1,11,055.00
	TOTAL	14,15,055.00
(C)	Items to be booked under U-Remittance-II (To be transferred to Bank a/c no: 11084229362)	
1	Sale of Assets	
	(i) Land	0.00
	(ii) Building	0.00
	(iii) Vehicle, Equipment, and other Machine tools	6,37,621.00
2	Leave salary and pension contribution	2,68,974.00
3	Unspent balance of Govt Grant of Previous year (Prior to 2024-25)	
	(i) on account of refund of grant against advances shown in Sch-7B (CPWD etc)	0.00
	(ii) on account of refund of previous years released grant	1,51,691.00
4	Interest earned on Govt. Grant	48,49,556.00
	TOTAL	59,07,842.00
	GRAND TOTAL (A+B+C)	8,33,91,329.00

ANNUAL ACCOUNTS 2024-25

Details of Institute Govt. Grant expenditure for the year 2024-25

Annexure-B

S. No.	Head	Allocation Govt. Grant 2024-25	Allocation out of ICAR Non-scheme (salary+pension+nonscheme)	TOTAL ALLOCATION 2024-25	Expenditure (Govt. Grant) 2024-25					Expenditure - Non Scheme	TOTAL EXPENDITURE 2024-25
					Other than NEH & TSP	NEH	TSP	SCSP	Total Scheme		
1	2	3		5 (3 + 4)	6						8 (6 + 7)
1	Works										
	A. Land										
	B. Building										
	i. Office building	1326000.00	0.00	1326000.00	1326000.00	0.00	0.00	0.00	1326000.00	0.00	1326000.00
	ii. Residential building	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Minor Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Equipments	4554000.00	0.00	4554000.00	4553547.00	0.00	0.00	0.00	4553547.00	0.00	4553547.00
3	Information Technology	1841000.00	0.00	1841000.00	1840022.00	0.00	0.00	0.00	1840022.00	0.00	1840022.00
4	Library Books and Journals	410000.00	0.00	410000.00	409488.00	0.00	0.00	0.00	409488.00	0.00	409488.00
5	Vehicles & Vessels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Livestock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Furniture & fixtures	788000.00	0.00	788000.00	787432.00	0.00	0.00	0.00	787432.00	0.00	787432.00
8	Others	1081000.00	0.00	1081000.00	1080721.00	0.00	0.00	0.00	1080721.00	0.00	1080721.00
	Total - CAPITAL (Grants for creation of Capital Assets)	10000000.00	0.00	10000000.00	9997210.00	0.00	0.00	0.00	9997210.00	0.00	9997210.00
1	Establishment Expenses(Salaries)										
	i. Establishment Charges	0.00	422507000.00	422507000.00	0.00	0.00	0.00	0.00	0.00	422506802.00	422506802.00
	ii. Wages	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Overtime Allowance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total - Establishment Expenses	0.00	422507000.00	422507000.00	0.00	0.00	0.00	0.00	0.00	422506802.00	422506802.00
1	Pension & Other Retirement Benefits	0.00	360267000.00	360267000.00	0.00	0.00	0.00	0.00	0.00	360267000.00	360267000.00
2	T.A.										
	A. Domestic TA / Transfer TA	4317000.00	0.00	4317000.00	4316994.00	0.00	0.00	0.00	4316994.00	0.00	4316994.00
	B. Foreign TA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total - Traveling Allowance	4317000.00	360267000.00	364584000.00	4316994.00	0.00	0.00	0.00	4316994.00	360267000.00	364583994.00
3	Research & Operational Expenses										
	A. Research Expenses	10216000.00	0.00	10216000.00	4207098.00	2197880.00	1738850.00	2071384.00	10215212.00	0.00	10215212.00
	B. Operational Expenses	35136000.00	0.00	35136000.00	24864079.00	9455490.00	181831.00	634493.00	35135893.00	0.00	35135893.00
	Total - Research & Operational Expenses	45352000.00	0.00	45352000.00	29071177.00	11653370.00	1920681.00	2705877.00	45351105.00	0.00	45351105.00

S. No.	Head	Allocation Govt. Grant 2024-25	Allocation out of ICAR Non-scheme (salary+pension+monschmncz 0	TOTAL ALLOCATION 2024-25	Expenditure (Govt. Grant) 2024-25						Expenditure - Non Scheme	TOTAL EXPENDITURE 2024-25
4	Administrative Expenses											
	A. Infrastructure	18054800.00	0.00	18054800.00	17955026.00	95393.00	0.00	0.00	18050419.00	0.00	0.00	18050419.00
	B. Communication	289000.00	0.00	289000.00	239321.00	49564.00	0.00	0.00	288885.00	0.00	0.00	288885.00
	C.Repair & Maintenance		0.00						0.00			
	I. Equipments, Vehicles & Others	2464500.00	0.00	2464500.00	2359342.00	105056.00	0.00	0.00	2464398.00	0.00	0.00	2464398.00
	ii. Office building	3122500.00	0.00	3122500.00	2855225.00	266973.00	0.00	0.00	3122198.00	0.00	0.00	3122198.00
	iii.Residential building	97000.00	0.00	97000.00	96849.00	0.00	0.00	0.00	96849.00	0.00	0.00	96849.00
	iv. Minor Works	941200.00	0.00	941200.00	941108.00	0.00	0.00	0.00	941108.00	0.00	0.00	941108.00
	D. Others (excluding TA)	12351000.00	0.00	12351000.00	8658158.00	1323179.00	578085.00	1792137.00	12351559.00	0.00	0.00	12351559.00
	Total - Administrative Expenses	37320000.00	0.00	37320000.00	33105029.00	1840165.00	578085.00	1792137.00	37315416.00	0.00	0.00	37315416.00
5	Miscellaneous Expenses											
	A. HRD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B. Other Items (Fellowships, Scholarships etc.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C. Publicity & Exhibitions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	D. Guest House - Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	E. Other Miscellaneous	11000.00	0.00	11000.00	5700.00	4650.00	0.00	0.00	10350.00	0.00	0.00	10350.00
	Total - Miscellaneous Expenses	11000.00	0.00	11000.00	5700.00	4650.00	0.00	0.00	10350.00	0.00	0.00	10350.00
	Total --Grants in Aid - General	87000000.00	360267000.00	447267000.00	66498900.00	13498185.00	2498766.00	4498014.00	86993865.00	360267000.00	0.00	447260865.00
	Grand Total (Capital + Establishment+General)	97000000.00	782774000.00	879774000.00	76496110.00	13498185.00	2498766.00	4498014.00	96991075.00	782773802.00	0.00	879764877.00

LIST OF COMMITTEES

Newsletter Committee

1. Dr. Som Dutt
2. Dr. Aarti Bairwa
3. Dr. Tanuja Buckseth
4. Dr. Dharmendra Kumar

Human Resource Development Committee

1. Dr. Alok Kumar-**Chairman**
2. Dr. Pynbianglang Kharumnuid-Nodal Officer

Publication Committee

1. Dr. Jagdev Sharma-**Chairman**
2. Dr. Salej Sood-**Member**
3. Dr. Kailash Chandra Naga-**Member**
4. Dr. Tanuja Buckseth-**Member**
5. Dr. Dharmendra Kumar-**Member**

Institute Gender Cell

1. Dr. Vinay Sagar
2. Dr. Dalamu
3. Dr. Tanuja Buckseth
4. Smt. Babli Bhawani

Institute Deputation Committee

1. Dr. Sanjeev Sharma
2. Dr. Som Dutt
3. Dr. Salej Sood
4. Dr. Aarti Bairwa

PG Committee

1. Director-**Chairman**
2. All Head of Division-**Member**
3. Head of the Administration-**Member**
4. FAO-**Member**
5. Incharge PME Cell-**Member Secretary**

Consultancy Processing Cell

1. Dr. Sanjeev Sharma-**Chairman**
2. Dr. Vinay Sagar-**Member**
3. Dr. Vikas Mangal-**Member**
4. Dr. Tanuja Buckseth-**Member**
5. Dr. Dharmendra Kumar-**Member**
6. Head of the Administration-**Member**
7. Finance & Accounts Officer-**Member**

Committee for Ranking of ICAR Institutes

1. Dr. Sanjeev Sharma-**Chairman**
2. Dr. Tanuja Buckseth-**Member**
3. Dr. Vikas Mangal-**Member**
4. Dr. Pynbianglang Kharumnuid-**Member**
5. Dr. Aarti Bairwa-**Member**
6. Dr. Som Dutt-**Member Secretary**

Institute Transfer Committee

1. Director - **Chairman**
2. CAO/Head of Office - **Member**
3. Head, Crop Production Div. - **Member**
4. Head, CPB & PHT Div. - **Member**
5. Head, Plant Protection Div. - **Member**
6. Finance & Account Officer/Head of Finance - **Member**
7. Dr. (Smt.) Tanuja Buckseth, CI & ST Div. - **Member**
8. Sh. Joginder Singh Thakur, AO/Mrs. Poonam Sood, AAO (Estt.) - **Member Secretary**

Grievance Redressal Committee

1. Director - **Chairman**
2. CAO/Head of Office - **Member**
3. Dr. Ashwani Kumar Sharma, Principal Scientist, Kufri-Fagu Unit - **Member**
4. Dr. Yogesh Gautam, Principal Scientist, Crop Production Div. - **Member**
5. Finance & Accounts Officer/ Head of Finance - **Member**
6. Dr. Aarti Bairwa, Sr. Scientist, Plant Protection Division - **Member**
7. Sh. Naresh Chand, Tech. Officer Secretary SWA - **Member**
8. Sh. Sheesh Ram, Technical Officer, CPRI, Canteen - **Member**
9. Sh. Sachin Kanwar, Asstt, PME Cell - **Member**
10. Smt. Poonam Sood, AAO (Estt.) - **Member Secretary**

Institute Canteen Committee+GH Maintenance Committee

1. Sh. Joginder Singh Thakur, AO - **Chairman**
2. Dr. Kailash Chander Naga, Scientist, Plant Protection Div. - **Member**
3. Smt. Tarvinder Kochhar, CTO, Plant Protection Div. - **Member**
4. Smt. Shashi Bala Thakur, PS to CAO - **Member**
5. Sh. Sheesh Ram Thakur, Technical Officer, CPRI, Canteen - **Member**
6. Sh. Amar Nath, SSS, A&A Section - **Member**
7. Sh. Sachin Kanwar, Asstt, PME Cell - **Member**
8. Sh. Naresh Kumar Sharma, Tech. Officer, Plant Protection Div. - **Member Secretary**

Honorarium Committee

1. Dr. Alok Kumar, PS & Head, Social Sciences Div. - **Chairman**
2. CAO/Head of Office - **Member**
3. Finance & Accounts Officer/Head of Finance -

Member

4. Sh. Rajdeep Bux, Asstt. Chief Tech. Officer, Library Sec. - **Member**
5. Dr. Vikas Mangal, Scientist, CI & ST Div. - **Member**
6. Dr. (Smt.) Sumita Sharma, Asstt. Chief Tech. Officer, CI & ST Div. - **Member**
7. Smt. Babli Bhawani, AAO (B&C) Officiating AAO - **Member Secretary**

Managing Committee of ICAR Staff Welfare Fund Scheme

1. Dr. Jagdev Sharma, PS & Head, Crop Production Div. - **Chairman**
2. CAO/Head of Office - **Member**
3. Finance & Accounts Officer/Head of Finance - **Member**
4. Dr. Dinesh Kumar, PS & Head, CPB&PHT Div. - **Member**
5. Secretary, IJSC (SS) - **Member**
6. Smt. Shruti Gupta, ACTO, CI & ST Div. - **Member**
7. Sh. Padam Dev, SSS, Director Cell - **Member**
8. Sh. Joginder Singh Thakur, AO/Smt. Poonam Sood, AAO(Estt.) - **Member Secretary**

Sports Committee

1. Dr. Som Dutt, Principal Scientist, CPB & PHT Div. - **Chairman**
2. Sh. Chander Prakash, Finance & Accounts Officer - **Member**
3. Sh. Joginder Singh Thakur, Admn. Officer - **Member**
4. Sh. Ajit Singh, Sr. Tech. Asstt, Kufri-Fagu Unit - **Member**
5. Sh. Surinder Paul, Sr. Technician, Plant Protection Div. - **Member**
6. Sh. Sheesh Ram, Tech. Officer, CPRI, Canteen - **Member**
7. Smt. Shyam Lata Beakta, Asstt. (Estt.) - **Member**
8. Sh. Sachin Kanwar, Asstt., PME Cell - **Member Secretary**

Institute Varieties Release Committee

1. Director - **Chairman**
2. I/C AICRP (Potato, CPRI, Shimla) - **Member**
3. Head, Crop Production Div., - **Member**
4. Head, CPB & PHT Div. - **Member**
5. Head, Plant Protection Div., - **Member**
6. PI, DUS Project, CPRI, Shimla - **Member**
7. Head, CI & ST Division, CPRI, Shimla - **Member Secretary**

Prevention of Sexual Harassment at work place Committee

1. Dr. Dalamu, Sr. Scientist, Kufri-Fagu unit -

Chairman

2. Dr. Vinay Sagar, Principal Scientist, Plant Protection Div. - **Member**
3. Dr. Salej Sood, Sr.Scientist, CI & ST, Div. - **Member**
4. Dr. Tanuja Buckseth, Scientist, CI & ST, Div. - **Member**
5. Smt. Asha Thakur, Sr. Tech. Officer, CPB & PHT Div. - **Member**
6. Smt. Shashi Bala Thakur, PS, CAO Cell - **Member**
7. Smt. Bimla Thakur, Member Outside from NGO - **Member**
8. Smt. Poonam Sood, AAO (Estt.) - **Member Secretary**

For help of the above committee the following representatives are nominated for CPRI Regional Stations:

1. Dr. Babita Chaudhary, Principal Scientist (Modipuram)
2. Dr. Ratna Preeti Kaur, Sr. Scientist (Jalandhar)
3. Dr. Sarala Yadav, Sr. Scientist (Patna)
4. Dr. (Smt.) Yvonne Angel Lyngdoh, Scientist (Shillong)
5. Smt. Divya K Lakshmanan, Scientist (Ooty)
6. Dr. Murlidhar J Sadawarti, Sr. Scientist (Gwalior)

Works Committee

1. Dr. Vinod Kumar, PS & Actg. Head, CI & ST Div. - **Chairman**
2. Dr. Som Dutt, Principal Scientist, CPB & PHT Div. - **Member**
3. Dr. Vikas Mangal, Scientist, CI & ST Div. - **Member**
4. Sh. Santosh Kumar, Asstt. Chief Tech. Officer, Eng. Sec. - **Member**
5. Sh. Kana Singh Chauhan, ACTO, Eng. Sec. - **Member**
6. Sh. Chander Prakash, Finance & Accounts Officer - **Member**
7. Smt. Meena Verma, AAO(W&C) Officiating AAO - **Member Secretary**

Cultural Committee

1. Dr. Anil Kumar Choudhary, PS, Crop Prod. Div. - **Chairman**
2. Dr. Ajay Thakur, Sr. Scientist CI & ST, Div. - **Member**
3. Smt. Meena Verma, AAO(W&C) Sec. - **Member**
4. Ms. Vandana Parmar, Technician, CPB & PHT Div. - **Member**
5. Sh. Sachin Kanwar, Asstt. PME cell. - **Member**
6. Sh. Naresh Chand, Tech. Officer, CI & ST Div. - **Member**



7. Smt. Asha Thakur, Sr. Tech. Officer, CPB & PHT Div. - **Member**
8. Sh Raghubir Singh, UDC, BC Section - **Member**
9. Sh. Naresh Kumar Sharma, TO, Div. of PP (Farm Management Unit) - **Member Secretary**

Institute Committee on welfare of SC/ST Staff

1. Dr. Vinod Kumar, PS & Actg. Head, CI & ST Div. - **Chairman** (Nodal Officer)
2. Dr. Ms. Aarti Bairwa, Sr. Scientist, Plant Protection Div. - **Member**
3. Sh. Santosh Kumar, Asstt. Chief Tech. Officer, Eng. Sec. - **Member**
4. Sh. Rakesh Kumar Patyal, Sr. Tech. Officer, Plant Protection Div. - **Member**
5. Smt. Manjeet, Skilled Support Staff, CPB & PHT Div. - **Member**
6. Smt. Babli Bhawani, AAO(B&C) - **Member Secretary**

Purchase Advisory Committee

1. Dr. Sanjeev Sharma, PS & Head, Plant Protection Div. - **Chairman**
2. Dr. Jagdev Sharma, PS & Head, Crop Production Div. - **Member**
3. Dr. Salej Sood, Sr.Scientist, CI & ST. Div. - **Member**
4. Dr. Dharmendra Kumar, Scientist, CPB&PHT Div. - **Member**
5. Dr. Pynbianglang Kharumnuid, Scientist, Social Sci., Div. - **Member**
6. Incharge, Engineering Section - **Member**
7. Sh. Chander Prakash, Finance & Accounts Officer - **Member**
8. Smt. Meena Verma, AAO(S&P) Officiating AAO - **Member Secretary**

Library Committee

1. Director, ICAR-CPRI, Shimla - **Chairman**
2. Dr. Som Dutt, Principal Scientist, CPB & PHT Div. - **Member**
3. Dr. Sanjeev Sharma, PS & Head, Plant Protection Div. - **Member**
4. Dr. Jagdev Sharma, PS & Head, Crop Production Div. - **Member**
5. Dr. Alok Kumar, PS & Head, Social Sciences Div. - **Member**
6. Dr. Ajay Kumar Thakur, Sr. Scientist, CI & ST. Div. - **Member**
7. Head of Administration - **Member**
8. Sh. Chander Prakash, FAO/Head of Finance - **Member**
9. Sh. Rajdeep Bux, Asstt. Chief Tech. Officer, Library Sec. - **Member Secretary**

Weeding Out Committee

1. Dr. Vinay Sagar, Principal Scientist, Plant Protection Div. - **Chairman**
2. Dr. Vinod Kumar, PS & Actg. Head, CI & ST Div. - **Member**
3. Sh. Chander Mohan Bist, ACTO, Officer, CI & ST Div. - **Member**
4. Sh. Chander Prakash, FAO/Head of Finance - **Member**
5. Smt. Poonam Sood, AAO (Estt.) Officiating AAO - **Member Secretary**

Purchase of proprietary items

1. Dr. Jagdev Sharma, PS & Head, Crop Production, Div., - **Chairman**
2. Dr. Sanjeev Sharma, PS & Head, Plant Protection, Div., - **Member**
3. Dr. Dinesh Kumar, PS & Head, CPB & PHT, Div., - **Member**
4. Smt. Meena Verma, AAO(S&P) Officiating AAO - **Member Secretary**



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