

GENETIC RESOURCES

Barley Genetic Stocks Registered

Three novel barley lines registered with ICAR-NBPGR:

- BHS 491 (BBM 880) – INGR24061 : Seedling resistance to all known leaf and stripe rust pathotypes and adult plant resistance to stripe and leaf rust.
- BHS 488 (BBM 861) – INGR24062 : Seedling resistance to leaf rust (except H1 race), adult plant resistance to yellow rust and moderate resistance to leaf blight.
- BHS 489 (BBM 863) – INGR24063: Naked barley with seedling resistance to all yellow rust pathotypes and adult plant resistance to yellow and leaf rust.



RESEARCH AND TECHNOLOGICAL INNOVATIONS

Cereals

Promising barley genotypes evaluated under AICRP

Barley genotype BHS497 : BHS497 with average grain yield of 32.5q/ha under rainfed conditions of Northern Hill Zone (NHZ) was promoted from AVT-I to AVT-II under timely sown rainfed production conditions of NHZ, due to its grain yield superiority and rust resistance over the check. Two entries i.e. BHS 499 and BHS 500 were promoted to AVT-1 in IVT/AVT-TS-RF (grain and dual purpose) and one entry i.e. BHS 498 was promoted for AVT-1 FB-Uncut and two entries i.e. BHS 498 and BHS 502 was promoted to AVT-1 dual purpose.

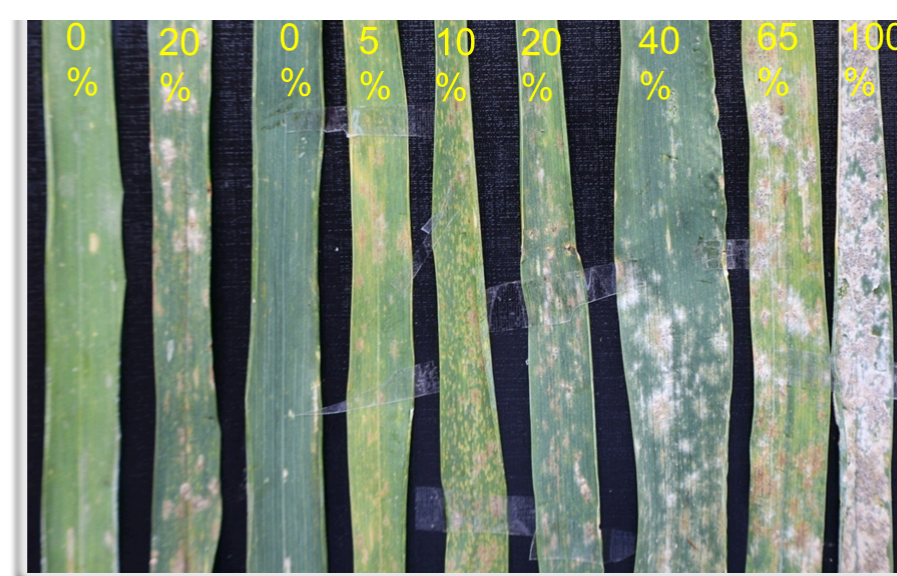
Intergeneric introgression for rust and mildew resistance in wheat using triticale as bridge species

Leaf rust resistance: A triticale x wheat derivative SW288 (T/W17-5) derived from the cross TL2942/HS562 was identified to carry seedling resistance to 38 pathotypes of leaf rust including 77-5, 77-9 considered as most virulent in Northern India. Broad spectrum of resistance to leaf (brown) rust shown by SW288 (T/W17-5), might be due to the accumulation of genes from both of the parents.



Triticale x Wheat Derivatives

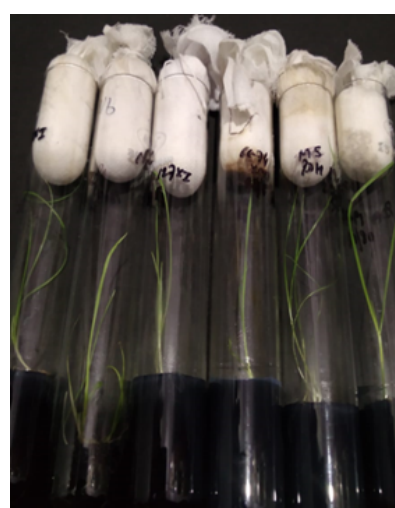
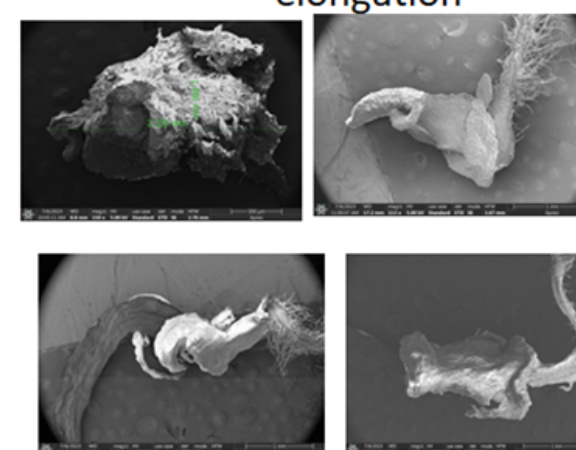
Among 40 Triticale x Wheat derivatives, lines SW244 (T/W7-4) and parent TL2942 showed immune reaction to powdery mildew isolates from Shimla and Wellington. Two genotypes, SW244 (T/W7-4), SW288 (T/W17-5) and the parental genotype TL2942 exhibited low Area under Disease Progress Curve (AUDPC) with score 0.00, 35.00 and 17.50, respectively to powdery mildew under natural conditions at Shimla, considered a hot spot for powdery mildew. The genotype SW288 (T/W17-5) had significant high values for spike length (13.67cm), grains/spike (64.33) and also had numerical superiority for spikelets/spike (23.67) over the best check HS490. Seven genotypes (SW263, SW256, SW253, SW254, SW262, SW259 and SW257) were significantly superior for grain yield/plot over the check HS490. Genotype, SW256 (T/W9-5) has shown superiority for six traits (days to flowering, peduncle length, plant height, grain weight per plant, grain yield per plot and harvest index) under preliminary yield trial.



Doubled Haploidy via *Imperata cylindrica*

Seven novel DH wheat plants were successfully developed using *Imperata cylindrica*-mediated chromosome elimination, validating the protocol's efficiency for haploid induction. Furthermore, scanning electron microscopy (SEM) characterize the structural morphology and progression of haploid embryo formation confirming haploid embryo development stages-marking a breakthrough in DH breeding protocol refinement.

Torpedo shaped, root initiation, shoot elongation



Horticulture

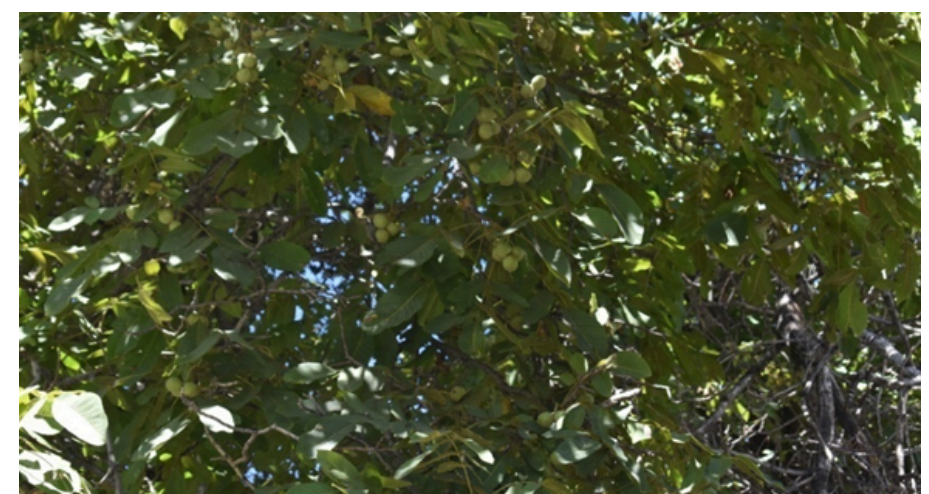
Temperate Fruit Germplasm Exploration: Systematic surveys across Lahaul–Spiti and Leh–Ladakh yielded 25 temperate accessions including walnut (11), Karkichu (local apple) (5), Raktshay Karpo (apricot) (3), plum (1), wild strawberry (2), *Malus spp* (2) and hawthorn (1).

Walnut ‘Pusa Khor’: Exhibited prolific cluster-bearing with >20 pistillate flowers and 13 fruits per branch; chip budding showed highest propagation success.

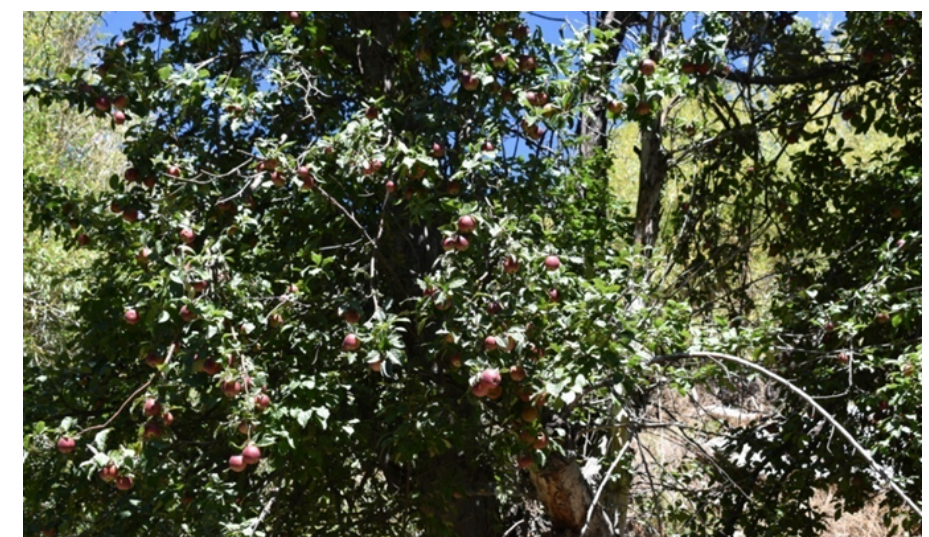
Apple: Scions grafted on multiple rootstocks (M-9, Bud-9, EMLA-9, Pusa Apple Rootstock-101 etc.) revealed inter-stock combinations using, Pusa Apple Rootstock-101 and M-9 in apple and PSR-102 and Chuli in stone fruits, optimized vigour and stress tolerance.

Kiwifruit: Hardwood cuttings showed genotype-dependent variability in root and shoot traits with shoot length varying from 8.5 to 139.6 cm.

Temperate Pomegranate: 20 out of 25 genotypes fruited and showed significant variation in fruit weight (124.5–199.6 g), TSS (14.8–20.7°Brix), and aril pigmentation.



The Walnut fruit samples from Shansha



Malus baccata from Shansha



The Plum fruit (Free Stone) samples from Shansha



Karkichu, the local apple of Leh

First report, pathogenicity, and management of damping-off disease caused by *Fusarium equiseti* in apple (*Malus × domestica* Borkh.)

The damping-off disease in apple (*Malus × domestica* Borkh.) caused by *Fusarium equiseti* was first reported from India in 2022, with disease incidence exceeding 50% in nursery seedlings. The pathogen was confirmed via morphological, microscopic, molecular, and pathogenicity analyses (Fig). *In-vitro* screening of eight fungicides and nine botanicals using the poison food technique identified Propiconazole (1mlL⁻¹), Propiconazole + Difenoconazole (1mlL⁻¹), Fluopyram + Tebuconazole (0.62mlL⁻¹), along with *Curcuma longa* and *Allium sativum* extracts as highly effective (>90% inhibition). Subsequent pot studies confirmed that drenching with Propiconazole and Fluopyram + Tebuconazole achieved 90% seedling survival, establishing these as effective interventions for managing damping-off in apple nurseries.

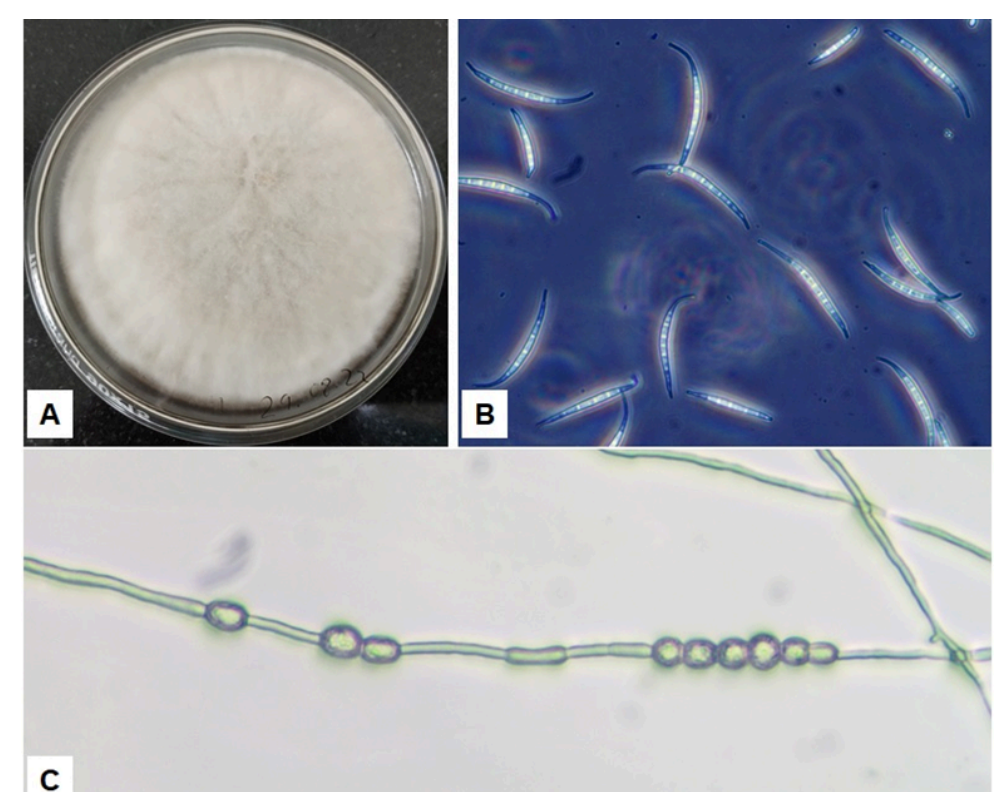


Fig: pure culture of damping-off fungus along with macroconidia and chlamydoconidia. A: pure culture of causative fungus showing whitish mycelium, B: Thick walled, 3-5 septate, moderately curved macroconidia of fungus, C: chlamydoconidia of the fungus

Biocontrol of Woolly Aphid Using Entomopathogenic Fungus

An entomopathogenic fungus, *Clonostachys rogersoniana* isolate “PUSACR01”, was isolated and characterized from a beetle using morphological, microscopic, and molecular techniques—marking the first such report from India. Bioassay results revealed its high virulence against adult females of woolly apple aphid (*Eriosoma lanigerum*), causing 85% mortality on day 11 at a concentration of 1×10⁷ conidia ml⁻¹. Probit analysis indicated decreasing LC₅₀ values over time: 1.12×10⁷ (day 7), 2.52×10⁶ (day 9), and 4.79×10⁵ conidia ml⁻¹ (day 11). Corresponding LT₅₀ values for doses of 1.0×10⁵ to 1.0×10⁸ conidia ml⁻¹ ranged from 18.73 to 5.07 days, highlighting this isolate’s potential as an ecofriendly biocontrol agent for sustainable aphid management in apple orchards.

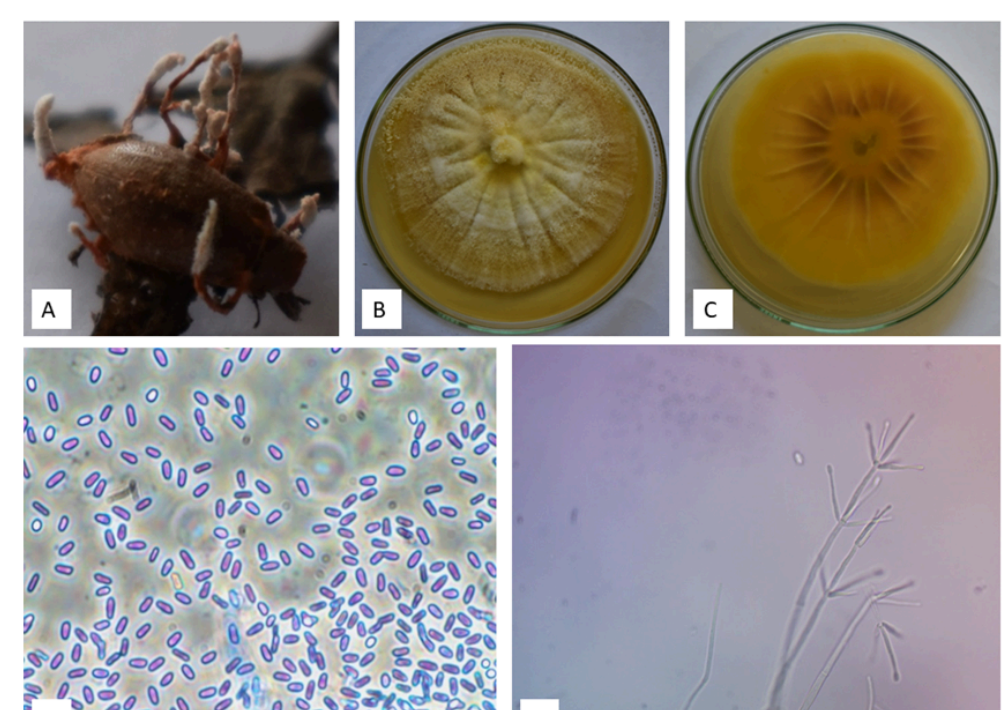


Figure: *Clonostachys rogersoniana* (A) Insect cadaver infected with entomopathogenic fungi (B&C) Pure colony observed on PDA (D) Conidia (E) Verticillium-like primary conidiophore

OUTREACH and DEMONSTRATIONS

- Five Frontline Demonstrations of barley variety BHS400 and BHS380 were conducted at Karot village of district Hamirpur to evaluate and popularize high-yielding, climate-resilient varieties under on-farm conditions.
- As part of the Scheduled Tribe Sub-Plan (STSP) initiative, two training programs were conducted at Boh Dhrini (Kangra) on 18 October 2024 and Halot (Shimla) on 8 November 2024, focusing on location-specific agro-technologies, varietal selection, and disease-pest management in tribal regions.
- Five days on-site trainingcum demonstrartion on Woolly Aphid Management was conducted across the tribal districts of Lahaul–Spiti and Kinnaur (17–21 June 2024).
- Field Day was organized at Mundali Panchayat (Chopal tehsil, District Shimla) showcased woolly aphid trap efficacy under field conditions (17 May, 2024).



NEW PROJECTS SANCTIONED

Title of the project	Funding agency	Total cost
Evaluation of Bio efficacy of Triflumizole 15% EC against powdery mildew and scab disease of Apple	Evaluation of Bio efficacy of Triflumizole 15% EC against powdery mildew and scab disease of Apple	1363599
Evaluation of PIF 320 5% SC against apple diseases	PI Industries Ltd	2135447
Bio-efficacy of Picoxystrobin 7.05% + Propiconazole 11.71 % w/w (Picoxystrobin 7.5% + Propiconazole 12.5% w/v SC) against foliar diseases of apple	Corteva Agrisciences India Pvt Ltd	1646610

AWARDS AND HONOURS

- Dr. Madhu Patial served as an external expert on the Germplasm Registration Committee of ICAR-NBPGR. Additionally, she participated as a committee member in the expert consultation in “Setting the Benchmark Values of Different Traits for Registration of Superior Germplasm”, convened by ICAR-NBPGR on 5th November 2024.
- Dr. Santosh Watpade was conferred with the ‘Best Scientist Award – 2024’ by the Society of Plant Protection Sciences, New Delhi

VISIT OF DIGNITARIES

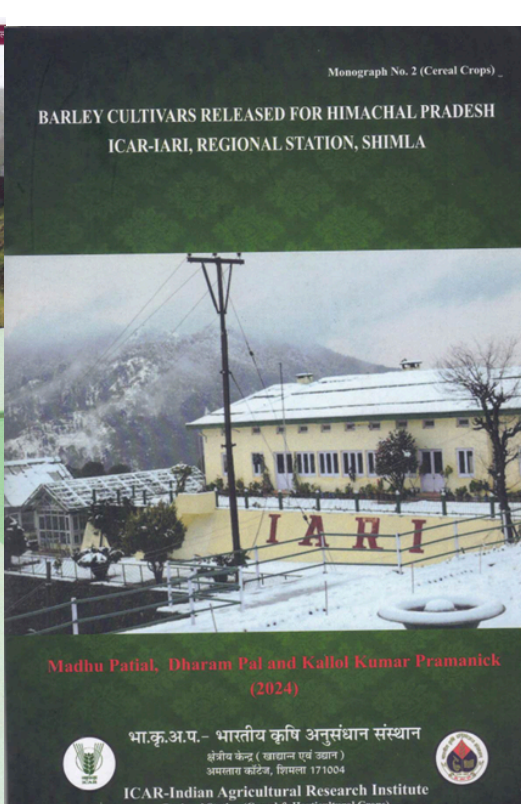
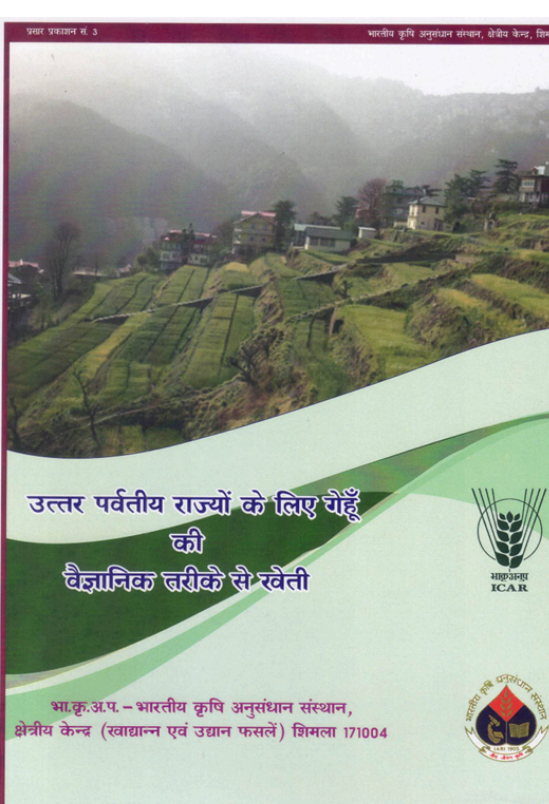
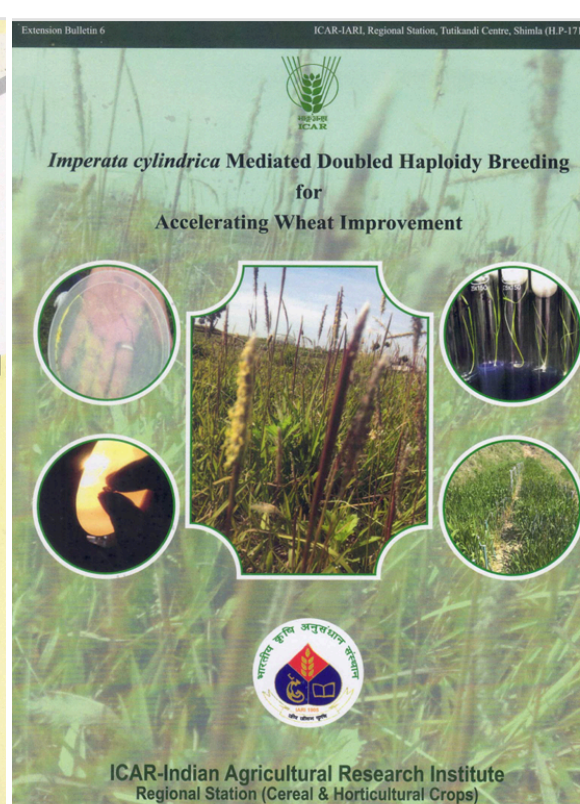
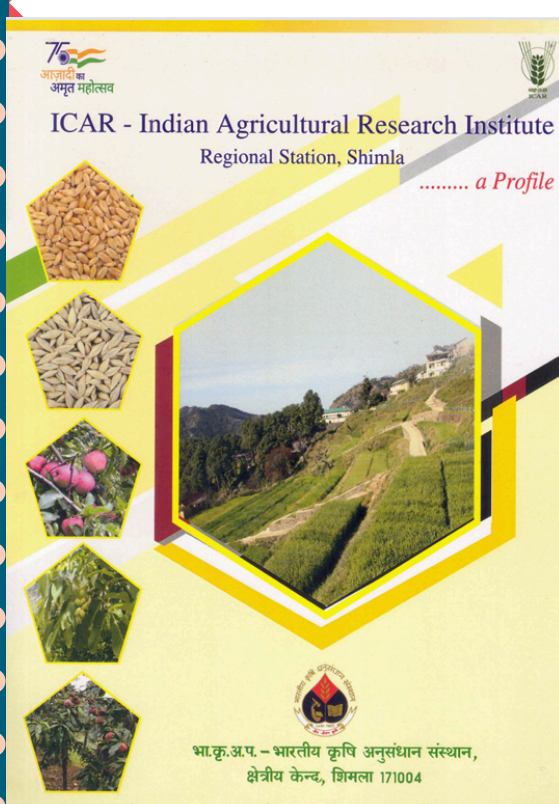


Papers with >6 naas rating=6

RESEARCH PUBLICATIONS

- Pal D., Kumar S., Bhardwaj S.C., Gangwar O.P., Pal A., Patial M., Watpade S., Harikrishna, Mallick N., Fandade V., Roy J.K. 2024. Identification of rust resistance genes in wheat (*Triticum aestivum* L.) using molecular markers and host-pathogen interaction tests. *Journal of Phytopathology*, 172: e13417 doi:10.1111/jph.13417(NAAS rating: 7.5)
- Patial M., Navathe S., He X., Kamble U., Kumar M., Joshi A.K., Singh P.K. 2024. Novel resistance loci for quantitative resistance to *Septoria tritici* blotch in Asian wheat (*Triticum aestivum*) via genome-wide association study. *BMC Plant Biology* 24:846. <https://doi.org/10.1186/s12870-024-05547-x> (NAAS rating: 10.3)
- Godara S., Begam S., Bana R.S., Bedi J., Jain R., Haque M.A., Parsad R., Marwaha S., Patial M., Shirzad S., Nirmal R. 2024. TPTC: topic-wise problems' trend clusters for smart agricultural insights extraction and forecasting of farmer's information demand. *Sci Rep* 14, 29272. <https://doi.org/10.1038/s41598-024-80488-x> (NAAS rating: 9.8)
- Watpade S., Lal M.K., Tiwari R.K., Kumar R., Naga K.C., Kumar R., Pramanick K.K., Kumari H., Devi E., Pal D. (2024). Fusarium core rot disease affects physicochemical and pathophysiological attributes of apple (*Malus × domestica* Borkh.) fruit. 2023. *Postharvest Biology and Technology*, 208, 112648. <https://doi.org/10.1016/j.postharvbio.2023.112648> (NAAS rating: 13.00)
- Watpade S., Kumari H., Mhatre P.H., Kamil D., Kumar R., Devi E., Naga K.C., Pramanick K.K., Pal D. 2024. Pathogenicity and management of damping-off disease caused by *Fusarium equiseti* in apple (*Malus × domestica* Borkh.). *Crop Protection*. 184:1-7. <https://doi.org/10.1016/j.cropro.2024.106850> (NAAS rating: 8.8)
- Kumar D., Kumari N., Mhatre P.H. Pal D., Naga KC., Watpade, S.* 2024. Characterization and pathogenicity of newly recorded *Clonostachys rogersoniana* against woolly apple aphid (*Eriosoma lanigerum* Hausmann) from India. *Egypt J Biol Pest Control* 34, 57 (2024). <https://doi.org/10.1186/s41938-024-00821-4>. (NAAS rating: 8.1)

- Papers with <6 naas rating=6
- Book Chapters=1
- Popular articles = 9
- Extension folders= 5
- Extension Bulletin=2
- Training Manual=2



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