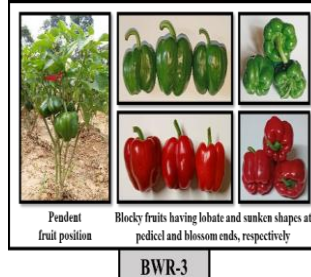
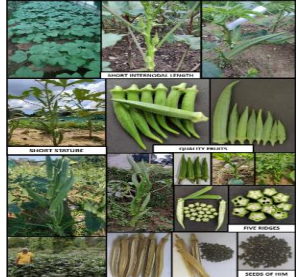


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19th MEETING OF THE RESEARCH COUNCIL (January 21, 2025) AGENDA PAPERS



Directorate of Research
CSK HP Krishi Vishvavidyalaya, Palampur (HP)
2025

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**Directorate of Research
CSK HP Krishi Vishvavidyalaya, Palampur (HP)
2025**

**19th MEETING OF THE RESEARCH COUNCIL
(21st January, 2025)**

AGENDA ITEMS

1. **To confirm the proceedings of 18th meeting of the Research Council held on January 30, 2023.**
2. **To report action taken on the decisions of 18th meeting of the Research Council.**
3. **To present the research achievements of the University from January 31, 2023 to date.**
4. **To place before the Council, the research projects sanctioned from January 31, 2023 to date.**
5. **To place before the Council, the results of theses of Ph.D. students from January 31, 2023 to date.**
6. **New items put forth by the Hon'ble members of the Research Council.**
7. **Any other item (s) with the permission of the Chair.**

DETAILED AGENDA ITEMS

Item No.1: To confirm the proceedings of the 18th meeting of the Research Council held on January 30, 2023.

Item No. 2 To report action taken on the decisions of 18th meeting of the Research Council.

2.1 Researchable issues received from Director-cum-Warden, Fisheries, Bilaspur

1. Identifying suitable fish varieties for stocking in high altitude lakes in HP.
2. Evolving breeding technology of indigenous snow trout for replenishing natural stock in state rivers.
3. Developing formula of low cost trout feed using local ingredients.

In response to the issues received from the Director-cum-Warden, Fisheries, Dr. Mandeep Sharma, Dean, CoVAS and Dr. Ravindra Kumar, Associate Director of Research informed the members of Council that the projects on above issues were submitted and if sufficient funds are provided then such assignments can be taken up.

Action Taken Report:

Issue 1: Stocking of high-altitude lakes.

A suggestion for collaborative project proposal was given to the state Fisheries Department w.r.t. letter No. QSD. DR-CSKHPKV/3-1 (Tech)/ 1464-66 dated 23.05.2023. For which they were asked telephonically to provide a list of high altitude lakes to be stocked. But no response has been received till date.

Issue 2: Captive breeding of Schizothorax (Snow trout)

In this context, it was proposed that a fish farm of State Fisheries Department was provided for the research work. So, Machiyaal fish farm was visited by two scientists of the Department of Fisheries, CSKHPKV Palampur on 03.07.2023 to see the feasibility of research work to be done. Subsequently, a project proposal was submitted to the State Department on **captive breeding and seed production of snow trout in Himachal Pradesh** along with MoU vide letter No. QSD.DR-CSKHPKV/3-1(Tech)/1464-66 dated 23.05.2023. It was concluded in the meeting to resubmit the proposal with desired changes as discussed in the meeting along with MoU. The detailed project proposal with suggested modification and MoU was resubmitted (letter No. QSD. DR-CSKHPKV/3-1 (Tech)/7028-29 dated 12.12.2023). However, the response is still awaited.

Issue 3: Preparation of low-cost feed

A project proposal on the issue has been submitted vide letter No. QSD. DR-CSKHPKV/3-1 (Tech)/ 1464-66 dated 23.05.2023 and is waiting for a favorable response.

2.2 Researchable issues received from the Dean, Dr. GC Negi COVAS, CSKHPKV, Palampur

1. **Impact of climate change on production and reproduction of livestock of Himachal Pradesh:** Himalayan region is more prone to rise in temperature, besides the winter stress makes the livestock of HP more stressful, thus hampering the production and reproduction throughout the year. Demands a comprehensive study in mission mode.
2. **Research on herbal plants:** Focused research needs to be carried out on isolation of active ingredients of herbal plants of importance, which could be effective in treatment of important animal diseases.
3. **Studies on parasitic diseases:** Comprehensive study on parasitic diseases of sheep and goat be taken up along with anthelmintic resistance. During discussion, the Department of Animal Husbandry was requested for providing financial support to address the above issues.

Action Taken Report:

Three project proposals were submitted to the Director, Animal Husbandry, Himachal Pradesh for financial assistance to initiate work on the above issues raised by the Hon'ble Members of the Council vide letter No. QSD. DR-CSKHPKV/3-1 (Tech)/ 1464-66 dated 25.03.2023:

Sr. No.	Project Title	Principal Investigator	Budget Outlay (Rs. in lakh)
1.	Baseline studies for impact of climate change on production and reproduction of livestock in Himachal Pradesh	Dr. Krishnender Dinesh, Asstt. Professor, Department of Animal Genetics and Breeding	27.77
2.	Pharmacological evaluation of medicinal properties of herbal plants used in ethno-veterinary medicine in Himachal Pradesh	Dr. Pallavi Bhardwaj, Asstt. Professor, Department of Veterinary Pharmacology & Toxicology	55.00
3.	Gastrointestinal parasitism and threat of reduced efficacy of benzimidazole drugs in Gaddi sheep-Intervention, strategies and headway options for enhancing health productivity	Dr. Devina Sharma, Asstt. Professor, Department of Veterinary Parasitology	25.00

The matter was again taken up with the Director, Animal Husbandry, Himachal Pradesh vide letter No. QSD. DR-CSKHPKV/3-1 (Tech)/ 6277-78 dated 20.11.2023 and QSD. DR-CSKHPKV/3-1 (Tech)/ 9362 dated 12.02.2024. In response, the Director of Animal Husbandry vide e-mail dated 27.02.2024 has intimated that there is no provision of funds at Government level for the project proposals so submitted and it was advised to seek financial assistance from NLM under Innovation and Extension component. The concerned scientists have been directed to explore possibility for submission of the above mentioned proposals under National Livestock Mission for financial assistance.

2.3 Researchable issues put forth by Hon'ble Members during the meeting

2.3.1 Dr. Ravi Prakash, Joint Director (representative of Director of Animal Husbandry) Department of Animal Husbandry, HP, raised the issue of infertility in cattle and desired that it should be monitored on project basis/Ph.D. thesis research work.

Action Taken Report:

The Department of Veterinary Gynaecology & Obstetrics of the University is regularly undertaking work on infertility management of cattle of the state. Till date seven projects on this aspect have been completed by the Department with financial assistance under RKVY starting from the year 2009. Under these project, more than 700 clinical camps have been organized in all the districts of the state and approximately 8000 bovines were treated for infertility. In addition, the department is regularly planning and executing large animal reproduction based work in the form of M.V.Sc./Ph.D. research and during last five years and 14 post graduate students have worked on this aspect.

- 2.3.2 Dr. Mandeep Sharma, Dean, CoVAS informed that one of the important researchable area is conservation and propagation of indigenous breeds. He further added that *Pahari* Cow is now registered with ICAR-NBAGR, Karnal. He emphasized on the need of a *Pahari* Cow farm in the state and comprehensive study for afterward outcome and impact assessment by the Department of Animal Husbandry. He also necessitated on the registration of 'Gaddi Dog' and afterward impact studies.

Action Taken Report:

As informed by the Director, Animal Husbandry vide letter No. HLDB-17/2008-Hilly Cattle-Vol-8 sent through e-mail dated 4.1.2025, a project on "Conservation and Propagation of Himachali *Pahari* cattle under Rashtriya Gokul Mission has been approved by the Government of India for which Rs. 4,64,00,000/- (Rupees Four Crore Sixty-Four Lakh) has been sanctioned and the **Farm for conservation and propagation of Himachali *Pahari* Cattle of Himachal Pradesh** is being established at Cattle Breeding Farm, Bagthen, Distt. Sirmour.

Registration of Gaddi Dog:

The Gaddi Dog of Himachal Pradesh has been registered with ICAR-National Bureau of Animal Genetic Resources (NBAGR), Karnal with Accession Number: India_DOG_0600_Gaddi_19004.

- 2.3.3 Dean, CoVAS inquired whether the funding on Veterinary component under RKVY has stopped and if so communication in this concern has not been received in the university. He also added that Department of Animal Husbandry should keep some funds (minimum 2 crore rupees) for research priorities in 18 departments of the College.

Action Taken Report:

The funding under Animal Husbandry component has been stopped by the Govt. of India since 2022-23. However, the Department of Animal Husbandry is providing grant-in-aid under non-salary head to the College of Veterinary and Animal Sciences for carrying out research activities on research priority areas since 2021-22. During last years (2023-24) also grant-in-aid amounting to Rs. 38.00 lakh has been provided under non-salary head for ad-hoc project entitled “**Establishment of artificial intelligence-based milking parlor in University Dairy Farm augmented Robotic Milking Machine equipped with Sensors**” which is in operation in the Department of Livestock Farm Complex.

- 2.3.4 Dr. Amar Singh Kapoor, member inquired about the hybrids of cauliflowers released from the university. In response, Dr. Sanjay Chadha, Principal Scientist informed that extensive work on development of Cytoplasmic Male Sterility based cauliflower hybrids is going on in the Department of Vegetable Science and Floriculture of the University and likely to come up with some potential hybrids in the coming years.

Action Taken Report:

Two new hybrids of cauliflower *viz.*, **Him Palam Phool Gobhi Hybrid-1 and Him Palam Phool Gobhi Hybrid-2** have been developed by the Department of Vegetable Science and Floriculture which have been approved in the recently held Agricultural Officers’ Workshop on Vegetable Crops on 4th May, 2024 at CSKHPKV, Palampur. This approval paves the way for their submission to the State Variety Release Committee for potential release and cultivation in the state.

- 2.3.5 Dr. Kapoor also inquired about the possibility of growing blue berry in zone IV of the state. The Director of Research, Dr. SP Dixit informed that the Department of Horticulture, CSKHPKV, Palampur is conducting research on blueberry. Dr. S.K. Upadhyay, representative of Dean, CoA, informed that some work for the standardization of package of practices of blue berry and its multiplication is going on in the Department of Horticulture and Agroforestry.

Action Taken Report:

A new project entitled “**Creation of facilities for modern nursery production unit for supply virus free quality planting materials of important sub-tropical fruits including**

blueberries” worth Rs. 45.20 lakh has been approved under RKVY for implementation in the Department of Horticulture and Agroforestry of the University which will further boost and speed up the ongoing work on standardization of package of practices and multiplication of blue berry.

2.3.6 Dr. Kapoor also inquired about incidence of Lumpy Virus disease in animals in HP. In response to this Dr. Ravi Prakash, Joint Director, informed that the disease is almost under control and very few cases are noticed that too in Chamba district only.

2.3.7 Sh. Lekh Raj Rana, Outstanding Social Worker showed his concern about the use of female sex semen and its after effects of creating imbalance in number of animals. Joint Director Dr. Ravi Prakash clarified that sex semen of male is also available and can be used to maintain the balance. Sh. Lekh Raj Rana further added that due to increasing population of wild animals, even fertile lands are not being used by the villagers. There must be some suggestions of suitable crops which can be grown and research is needed for the same. Dr. Mandeep Sharma told that no doubt alternatives like solar fencing, growing of turmeric and ginger are the potential crops and some other crops can be identified.

Action Taken Report:

- There are some agricultural crops like elephant foot yam (zimikand), okra, ginger, turmeric, chilli, sarson, marigold which are least attacked by wild and stray animals. Due to acidity in zimikand corms, hairs on okra crop/ fruits, underground spicy edible part of ginger and turmeric, allergy from marigold, chilli plants as well as their flowers for monkeys, they are least preferred by stray and wild animals. Apart from this, some medicinal / aromatic plants like *tulsi*, lemon grass, aloe vera, *sarpgandha*, marigold etc. can also be grown in areas invaded by the wild/stray animals. Besides, in monkey prone areas, fodder crops including some perennial fodder grasses like napier bajra hybrid, setaria grass, guinea grass, clovers etc. (as per the suitability of the agroclimatic zone), which are not damaged by the monkeys, can be planted to strengthen the dairy component.
- The other alternative measures for protection of crops from wild animals are electric as well as wire fences. The State Government has implemented Mukhya Mantri Khet Sanrakshan Yojna, under which, a subsidy of 80-85% is being provided for installation of fencing by the farmers.

2.3.8 Dr. Raghubir Singh, Joint Director (representative of Director of Agriculture) Department of Agriculture, GoHP told that identification of crops in wild animals invaded areas is a researchable issue. Dr. Singh further highlighted the need of Package of Practices for

Millets and emphasized that PoP of different crops should be on Zone wise basis. Dr. Raghubir informed that National Mission on Natural Farming is likely to be implemented from next year and package of practices for natural farming are required so University should work on this as there is Department of Organic and Natural Farming.

Regarding developing of PoP Zone wise, Director of Extension Education, Dr. V.K. Sharma informed that in package of practices there is already mention of time of sowing, varieties, etc. zone wise. In response to that Dr. Raghuvir requested to compile the information zone wise for easy access to the farmers.

Action Taken Report:

The Package of Practices (PoPs) of different crops *viz.*, *Kharif*, *Rabi* and Vegetable crops are continuously published by the Directorate of Extension Education for the benefit of farming community. The recommendations mentioned in the PoPs are Zone wise *i.e.* Sub-tropical mountain and lower hills zone, Sub humid mid hills zone, Wet temperate high hill Zone and High hills dry temperate zone. The recommendations for the particular crop for a specific zone is issued when the same is provided by the Research Evaluation Committee and duly approved in the Agriculture Officer Workshop of respective season.

Package of Practices for Millets:

Currently, no comprehensive research is being carried out on the cultivation practices and package of practices for millets in this region. This is a concerning issue as the unique agro-climatic conditions of Himachal Pradesh have the potential to support millet cultivation, which in turn can enhance the livelihood of local farmers and contribute to the overall agricultural diversity of the state. However little work on mainstreaming the cultivation of local millets landraces on farmer's fields is being carried out at one or two sites by following the farmers' practices.

Sufficient budget is required for initiating or supporting research projects focused on the cultivation of millets in Himachal Pradesh. Such research would provide valuable insights into the best practices for growing these crops, optimize yield, and address any region-specific challenges. Moreover, it would empower farmers with the knowledge and resources needed to adopt millet cultivation as a viable and profitable agricultural practice.

Package of Practices on Natural Farming:

Ad-hoc Package of Practices for Crop Cultivation under Natural Farming Conditions have been developed and after recommendation from the Research Evaluation Committee and further approval in the Agricultural Officers' Workshop on *rabi* crops-2024 have been submitted to the State Project Implementation Unit (SPIU)- *Prakritik Kheti Khushhal Kisan Yojna* (PK3Y).

2.3.9 Dr. Inder Dev, Director of Extension Education (Representative of Director of Research) Dr. YSP UHF, Solan necessitated that for the improvement of university ranking, there is need to work on various IPR related issues (trademarks, copyright, GI, patent, etc.). He also highlighted the importance of collaboration of different institutes for such issues.

Action Taken Report:

- GI application in respect of japonica red rice of H.P. has been filed with Registrar, GI Registry, IPR Office, Chennai in June, 2021.
- GI task forces for crops/products *viz.*, Rice, Maize, Wheat, Barley, Ginger, Rajmash, Mash, Kulthi, Seabuckthorn, Millets (Ragi, Kangni, Cheena and Swank), White Honey, Zimikand, Nadauni Mooli, Gandyali, Foxtail Orchids, Gaddi dog, Spiti Poni, Tissa Poni and Pashmina Chegu, Red Jungal Fowl, Textile Products of CoCs, Kinnauri Chulli and Moori etc. have been constituted at the University level.
- Three projects of GI information on Red Rice, Chamba Chukh and Karsog Kulthi completed. Information/Report have been submitted to HIMCOSTE Shimla for further needful.
- A Memorandum of Understanding between CSKHPKV, Palampur and Dr. YSP UHF, Solan for fostering academic and research cooperation for exchange of students for PG Degree Programme, joint research programmes, conferences, seminars, workshops and faculty exchange has been signed on 31st July, 2024.

2.3.10 Dr. (Mrs.) Kavita Sharma, Pr. Extension Specialist, CSKHPKV, KVK Sundernagar necessitated on the development of Package of Practice in the field of Community Science as KVK scientists are getting problems in laying out OFTs and demonstrations on farmers' fields.

Action Taken Report:

The PoPs for Technologies on Community Science are in final stage of preparation and will be published shortly after finalization in the Workshop.

2.3.11 Dr. Satish Guleria, member felt the need of Central Quality Testing Laboratory in the University on the analogy of PAU, Ludhiana and HAU, Hisar at CSKHPKV Palampur for analyzing different quality parameters, required for release of new varieties.

Action Taken Report:

A project proposal “**Establishing quality testing laboratory for nutritional evaluation of crop varieties**” with budget outlay of Rs. 60.00 lakh was submitted under **RKVY CAFETERIA** for financial assistance during the financial year 2024-25 which was approved by the State Level Sanctioning Committee of RKVY in its meeting held on 4th







April, 2024. However, the funds were not released for the same. Now, the same proposal with enhanced budget outlay of Rs. 95.00 lakh has again been submitted under **RKVY CAFETARIA** for financial assistance during the financial year 2025-26 and has been considered favourably.

Item No. 3: To present the Highlights of Research work done from January 31, 2023 to date

3.1 Technologies developed by the University

3.1.1. Varieties Developed and Released:

Six varieties of different crops viz., Maize (Him Palam Composite-2), Rice (Him Palam Dhan 3, Him Palam Dhan 4), Soybean (Him Palam Soya 1), Gobhi Sarson (Him Palam Gobhi Sarson-2) and forage oat (Him Palam Oat-1) have been released by the Central Variety Release Committee (CVRC) for cultivation in different regions of the Country.

Varieties developed and released by CSK HPKV		
		
Him Palam Maize Composite 2	Him Palam Dhan-3	Him Palam Dhan-4
		
Him Palam Soya 1	Him Palam Gobhi Sarson 2	Him Palam Oat 1

In addition to these, 16 new varieties/hybrids of different crops have also been developed by the University and recommended by the Research Evaluation Committee and approved in the Agricultural Officers' Workshops. The same have been submitted to the State Variety Release Committee for consideration and further recommendation to the Central Variety Release Committee for notification. These varieties/hybrids are:

1. **Maize: Him Palam Sankar Makka 3**
 - Suitable for cultivation in low and mid hills of the state. The variety had yield of 65-70 q/ha, moderately resistant to turcicum leaf blight and bacterial stalk rot.
2. **Wheat: Trombay Him Palam Gehun 4**
 - It is suitable for timely sown rainfed and irrigation conditions under low and mid hills of Himachal Pradesh.
 - Maturity: medium.
 - Average yield: 30-35 q/ha.
3. **Garden Pea: Him Palam Matar 3**
 - Medium plant growth habit.
 - Medium maturity and is ready for first harvest in about 75 days during off-season in high hills and 100-130 days as main season crop in low and mid hills.
 - Synchronized flowering and maturity.
 - Pods: long (10-12 cm), lush green, and attractive; 9-13 seeds/pod (10 seeds), shelling 50% and fresh seeds are comparatively bold.
 - High pod yield potential (140-180 q/ha).
 - It escapes powdery mildew infestation under field conditions compared to Him Palam Matar-1 and Pb-89 but showed moderately susceptible reaction to the disease under protected conditions at par with Him Palam Matar-1 and Pb-89
4. **Cauliflower: Him Palam Phool Gobhi Hybrid 1**
 - First hybrid from mid-late group of cauliflower from any public institute using genetic mechanism (CMS).
 - It has semi-erect growth habit and bears around 13-16 leaves.
 - It forms retentive white compact marketable curds weighing around 850–1,100 g (480-650 g net weight).
 - Curds are hemi-spherical with polar curd diameter of 8-10 cm and equatorial diameter of 12-15 cm.
 - Curd initiation starts at 60-65 days after transplanting and marketable curds are ready for first harvest in 85-90 days (2-3 weeks earlier than popular private sector hybrid ‘Maharani’).
 - High marketable curd yield potential (450-550 q/ha) about 10-15% higher over check ‘Maharani’.
 - Suitable for planting during late September to mid-October in low and mid hills of Himachal Pradesh while during summer in high hills as off-season crop.
5. **Cauliflower: Him Palam Phool Gobhi Hybrid 2**
 - First hybrid from mid-late group of cauliflower from any public institute using genetic mechanism (CMS)
 - It has semi-erect growth habit and bears around 15-17 leaves.
 - It forms retentive white compact marketable curds weighing around 750–1,000 g (450-525 g net weight).
 - Curds are hemi-spherical with polar curd diameter of 8-9 cm and equatorial diameter of 12-14.25 cm.
 - Curd initiation starts at 54-60 days after transplanting and marketable curds are ready for first harvest in 80-85 days (3 weeks earlier than popular private sector hybrid ‘Maharani’ & one week earlier than HPPGH-1).

- High marketable curd yield potential (400-500 q/ha) about 10% higher over check 'Maharani'.
 - Suitable for planting during late September to mid-October in low and mid hills of Himachal Pradesh while during summer in high hills as off-season crop.
 - Planting these two hybrids simultaneously provide steady supply in the market by avoiding glut and help to provide premium price to the farmers.
6. **Capsicum: Him Palam Shimla Mirch 1**
- First bacterial wilt resistant bell pepper variety having blocky, dark green and four lobed fruits, ready for picking in 60 days from transplanting.
 - Average fruit weight is 85 g and green fruit yield is 295 q/ha. Recommended for low, mid and high hills of Himachal Pradesh.
7. **Capsicum: Him Palam Shimla Mirch 2**
- An early, high yielding and bacterial wilt resistant variety, ready for picking in 53 days from transplanting. Fruits are blocky, dark green, having four lobes, thick pericarp.
 - Average fruit weight is 60 g and green fruit yield is 330 q/ha. Suitable for areas with high rainfall due to cordate fruit shape at pedicel end and intermediate fruit position, hence, recommended for all agro-climatic zones of the state.
8. **Chilli: Him Palam Chilli Hybrid 1**
- Erected fruit bearing habit that result in low incidence of fruit rot. This trait is known as destalking and is in demand especially in spice/processing industry.
 - Fruits are medium long (9-10 cm) with moderate width (2.75-3.1 cm), bright green, attractive and pungent. It bears single fruit on each inflorescence with erect habit.
 - Plants are erect in growth and medium tall (65-85 cm).
 - Flowers in about 45-50 days after transplanting and ready for first harvest in 60 days.
 - High fruit yield potential (220-265 q/ha) about 10% higher over 'CH-27'.
 - It exhibited a yield advantage of about 10% under station and about 15-25% under on-farm trials over the years.
 - Bacterial wilt incidence with 70% plant survival and low incidence of fruit rot (<10%), significantly better than hybrid 'CH-27'.
 - Suitable for cultivation in low and mid hills of Himachal Pradesh particularly in high rainfall areas during rainy season.
9. **Chilli:Him Palam Chilli Hybrid 2**
- Released keeping in view the farmers interest from low and certain parts of mid hills having drooping fruit habit that remain protected by plant foliage from scorching sun heat to avoid sun scalding.
 - Also, varied preference for fruit colour *i.e.* light green to dark green and for long fruit length based on consumers' acceptability.
 - Fruits are long (10-11 cm) with optimum fruit width (3.0-3.3 cm), light green in colour, attractive and pungent.
 - Plants are semi-spreading in growth and medium tall (60-75 cm).
 - Ready for first harvest in 55 days.
 - High fruit yield potential (275-325 q/ha) about 15-25% higher over 'CH-27'.
 - Comparatively less bacterial wilt incidence with 50% plant survival at fag end stage of plant growth besides showed comparable incidence of fruit rot of 40% particularly in red ripe fruit crop to that of 'CH-27'.

- Suitable for cultivation in low and mid hills of Himachal Pradesh.
10. **Chilli: Him Palam Chilli Hybrid 3**
 - Released keeping in view the farmers interest from low and certain parts of mid hills having drooping fruit habit that remain protected by foliage of the plant from scorching sun heat to avoid sun scalding.
 - Also, varied preference for fruit colour *i.e.* light green to dark green and for long fruit length based on consumers' acceptability.
 - Fruits are very long (10-11 cm) with optimum fruit width (3.5-3.6 cm), dark green, attractive, and pungent.
 - Plants semi-spreading in growth and medium tall in height (65-80 cm).
 - Ready for first harvest in 55 days.
 - High fruit yield potential (275-350 q/ha), about 20-30 % higher over 'CH-27/Farmer's check variety'.
 - Comparatively less bacterial wilt incidence with 50% plant survival at fag end stage of plant growth besides showed comparable incidence of fruit rot of 25% particularly in red ripe fruit crop to that of 'CH-27'.
 - Suitable for cultivation in low and mid hills of Himachal Pradesh.
11. **Okra: Him Palam Bhindi 1**
 - First okra variety with short internodal length and stature. Early and ready for harvest in 48 days. Attractive, slender, green fruits with a long tip, 5 ridges and smooth surface. Fruits remain tender for longer period. High yield potential with an average yield of 245 q/ha and 18-20 fruits per plant. No incidence of yellow vein mosaic disease. Recommended for low and mid hills of Himachal Pradesh.
12. **Tomato: Him Palam Tamatar 1**
 - Him Palam Tamatar-1 (DPT-1) has been recommended in Zone-1 and Zone-II of the Himachal Pradesh during off season (monsoon). It is developed after selection from the segregating material of commercial hybrid. The average marketable fruit yield during rainy season is 250-275 q/ha, about 17 percent higher over Palam Pride and 13 percent over Palam Pink varieties. The proposed variety is indeterminate in growth habit (plant height about 95 cm) and high resistance to bacterial wilt disease (>95%). The fruits are deep red in colour on ripening and round in shape weighing about 65-70 g /fruit. The variety matures in 70-75 days after transplanting and also suitable for transportation as it has thick Pericarp of 6.25 mm and good TSS (5.2°B) content.
13. **Tomato: Him Palam Tamatar 2**
 - The proposed variety "Him Palam Tomato-2" (DPT-2) is recommended for Zone-1 and Zone-II of the Himachal Pradesh during off season (monsoon). It is developed after selection from the segregating material of commercial hybrid. The average marketable fruit yield during rainy season is 240-260 q/ha, about 11.5 percent higher over Palam Pride and 7.33 percent over Palam Pink varieties. The variety is indeterminate (85-90 cm) in growth habit, having high resistance to bacterial wilt disease. The fruits are deep red in colour on ripening and oblong in shape weighing about 70-75g /fruit. The variety gets mature in 70-75 days after transplanting and also suitable for transportation as it has thick Pericarp of 6.75 mm and good TSS (5.3°B) content.
14. **Yellow Capsicum: Him Palam Yellow Capsicum-1**
 - The Him Palam Yellow Capsicum-1 is renowned for its high beta-carotene content and suitability for protected cultivation. It features an indeterminate growth habit and is

resistant to bacterial wilt, making it especially beneficial for regions prone to this disease. The fruits are characterized by their four-lobed, blocky bell shape, a feature highly sought after in the market. Each plant produces an impressive 13 to 18 fruits, contributing to a substantial yield of 800 to 850 quintals per hectare under optimal conditions. This variety has been developed through the pedigree method of selection, ensuring its superior traits. As of now, there is no officially recommended capsicum variety for protected cultivation, positioning Him Palam Yellow Capsicum-1 as a promising choice for farmers across all agro-climatic zones of Himachal Pradesh. For nutrient management, the variety requires an initial basal dose of 50:50:50 kg/ha of N: P: K., followed by fertigation with water-soluble fertilizers @ 150:150:150 kg/ha. Optimal plant spacing is 60 × 30 cm, and the plants should be pruned using a four-stem system to encourage better fruit development and higher yields.




15. **Cherry Tomato: Him Palam Red Cherry Tomato**






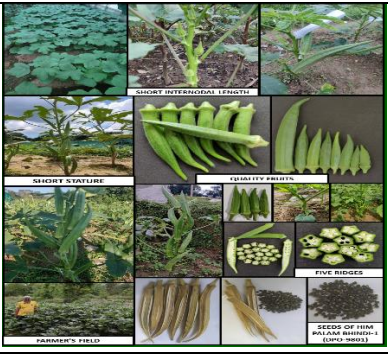
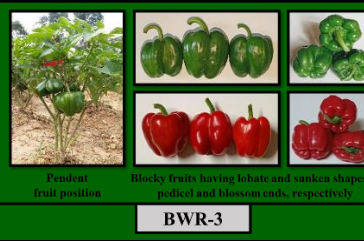
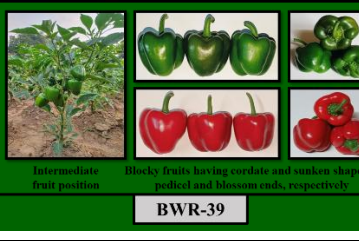

- The variety having vibrant red fruits that are well-suited for protected cultivation across all agro-climatic zones of the state. These oval-shaped tomatoes are not only visually appealing but also exhibit an indeterminate growth habit, producing clusters of 22 to 25 fruits. Developed through pedigree selection, the average yield ranges from 490 to 520 quintals per hectare. Notably, this variety is first red colour cherry tomato in the Package of Practices (POP) for protected cultivation. It require a basal application of 50 kg each of nitrogen, phosphorus, and potassium (N:P:K), followed by fertigation using water-soluble fertilizers @ 150 kg each of N, P, and K per hectare. For optimal growth and yield, a plant spacing of 70 by 30 cm is recommended, along with a two-stem pruning method. This approach not only facilitates better air circulation and sunlight penetration but also enhances fruit quality and overall productivity.





16. **Capsicum Paprika: Him Palam Capsicum Paprika 1**

First capsicum paprika variety. Early, high yielding, bacterial wilt resistant having green triangular fruits with two locules. Ready for harvest in 56 days. Average fruit weight is 17 g and green fruit yield is 133 q/ha. Recommended for low, mid and high hills of Himachal Pradesh.

CSKHPKV Developed Varieties submitted to SVRC

	 <p align="center"><i>Trombay Him Palam Gehun 4 (HPW 484)</i></p>	
<p>Him Palam Sankar Makka 3</p>	<p>Trombay Him Palam Gehun 4</p>	<p>Him Palam Matar 3</p>

		
<p>Him Palam Phool Gobhi Hybrid 1</p>	<p>Him Palam Phool Gobhi Hybrid 2</p>	<p>Him Palam Chilli Hybrid 1</p>
		
<p>Him Palam Chilli Hybrid 2</p>	<p>Him Palam Chilli Hybrid 3</p>	<p>Him Palam Bhindi 1</p>
		
<p>Him Palam Shimla Mirch 1</p>	<p>Him Palam Shimla Mirch 2</p>	<p>Him Palam Capsicum Paprika 1</p>

			
<p>Him Palam Tamatar 1</p>	<p>Him Palam Tamatar 2</p>	<p>Him Palam Yellow Capsicum 1</p>	<p>Him Palam Red Cherry</p>

3.1.2. **Technologies developed**

S. No.	Title of the product/variety/process developed	Technology brief
1.	Management of late blight of Tomato caused by <i>Phytophthora infestans</i>	Two sprays with Cymoxanil 8% + Mancozeb 64% WP @ 20 gm per 10 litres water/ Azoxystrobin 18.2% + Difenconazole 11.4% w/w SC @ 10 gm per 10 litres water or two-three sprays with Zineb 75% WP @ 25 gm per 10 litres water at 10-15 days interval.
2.	Management of Early blight of tomato caused by <i>Alternaria solani</i>	Two sprays with Azoxystrobin 23% SC @10 gm per 10 litres of water at fortnight interval or 2-3 sprays with Zineb 75% WP @25 gm per 10 litres water at 10 -15 days interval.
3.	Management of Buckeye rot of tomato caused by <i>Phytophthora nicotianae</i> var. <i>parasitica</i>	Two-three sprays with Propineb 70% WP @ 25 gm per litres water at 10-15 days interval.
4.	Management of Purple blotch of onion caused by <i>Alternaria porri</i>	Two sprays with Difenconazole 25% EC or Tebuconazole 25.9% EC or Azoxystrobin 18.2%+ Difenconazole 11.4% w/w SC or Azoxystrobin 11% + Tebuconazole 18.3% w/w SC@10 gm per 10 litres water at fortnight interval.
5.	Management of Stemphylium blight caused by <i>Stemphylium vasicarium</i> of onion	Two sprays with Azoxystrobin 18.2%+ Difenconazole 11.4% w/w SC or Azoxystrobin 11% + Tebuconazole 18.3% w/w SC @10 gm per 10 litres water at fortnight interval.
6.	Weed management in maize	Post emergence application of either topramezone 25.2 g/ha+ atrazine 750 g/ha or post emergence application of tembotrione 120 g/ha at 2-3 leaf stage of weeds. New recommendation for chemical weed control Tembotrione (a new herbicide).
7.	Weed management in rice	Recommendation for chemical weed control in transplanted and puddled rice with Pretilachlor (dose a substitute for alachlor) with safener @ 800 g/ha at 4 DAT in transplanted paddy.

8.	Spacing and seed rate of fodder oat in dry temperate zone	Sowing of fodder oat in rows at 25 cm spacing with seed rate of 100 kg and basal application of 40 kg N and 40 kg P ₂ O ₅ per hectare in second fortnight of June after harvest of main crops in dry temperate region of H.P.																		
9.	Integrated management of greenhouse whitefly in tomato	Drenching of tomato seedlings after one day of transplanting with 100 ml solution prepared by dissolving 5 ml Imidacloprid 17.8 SL in 10 liters of water. A waiting period of 5 days is to be observed for harvesting of produce.																		
10.	Management of brinjal shoot and fruit borer	<ul style="list-style-type: none"> • Installing sex pheromone baited water pan traps @12/ha. • Soil application of neem cake @ 250 kg/ha (one week before transplanting). • Application of emamectin benzoate 5 SG @ 0.4g/L or spinosad 45 SC @ 0.3 ml/L with the observance of 1st adult catch in the trap. • Repeat the insecticidal application at 14 days interval. 																		
11.	Adhoc recommendation of leaf type varieties of lettuce for hydroponic system	Leaf type varieties of lettuce are more suitable for growing in hydroponic system.																		
12.	Seed Rate of Tomato, Capsicum & Cucumber under protected conditions	<table border="1"> <thead> <tr> <th rowspan="2">Crop</th> <th rowspan="2">Seed Rate (g/100 m²)</th> <th colspan="2">Spacing (cm)</th> </tr> <tr> <th>R x R</th> <th>P x P</th> </tr> </thead> <tbody> <tr> <td>Tomato</td> <td>2.5</td> <td>70</td> <td>30</td> </tr> <tr> <td>Capsicum</td> <td>4.0</td> <td>60</td> <td>30</td> </tr> <tr> <td>Parthenocarpic Cucumber</td> <td>20.0</td> <td>70</td> <td>30</td> </tr> </tbody> </table>	Crop	Seed Rate (g/100 m ²)	Spacing (cm)		R x R	P x P	Tomato	2.5	70	30	Capsicum	4.0	60	30	Parthenocarpic Cucumber	20.0	70	30
Crop	Seed Rate (g/100 m ²)	Spacing (cm)																		
		R x R	P x P																	
Tomato	2.5	70	30																	
Capsicum	4.0	60	30																	
Parthenocarpic Cucumber	20.0	70	30																	
13.	Package of Practices for crop cultivation under natural farming	Adhoc recommendations for package of practices on paddy, finger millet + soybean, wheat + gram and, garlic + methi + palak + radish + coriander.																		

3.1.3. Technologies commercialized and income generated

S. No.	Agency	Commercialization status (MoUs for Seed Production and Marketing)	Income generated (Rs. in lakh)
1.	Garden Pea variety Him Palam Matar 1	M/S. K.D. Farm House, Sundernagar, Distt. Mandi (HP)	1.00
2.		M/S. Suttind Seeds Pvt. Ltd., Delhi	1.00

3.		M/S. ACSEN Agriscience Pvt. Ltd., Bengaluru	1.00
4.		M/S Sharma Enterprises, Theog, Shimla	2.00
5.		M/S Pramaanit Seeds Pvt. Limited, Khodsama	2.00
6.	Garden Pea variety Him Palam Matar 2	M/S. K.D. Farm House, Sundernagar, Distt. Mandi (HP)	1.00
7.		M/S. Durga Seeds Farm, Ner-Chowk, Distt. Mandi (HP)	1.00
8.	Rye grass variety Him Palam Rye Grass 1	M/S. Hanstech Seeds Pvt. Ltd., Chatanyapuri, Hyderabad	1.00
		Total	10.00

3.1.4 Registration of Crop Varieties

✓ **Registration of CSKHPKV Developed crop varieties with PPV & FRA**

SN.	Crop	Denomination of the Candidate Variety	Year of registration
1.	Barley	HBL 713 (Him Palam Jau 1)	2023
2.	Rice	HPR 2865 (Him Palam Dhan 3) HPR 3201 (Him Palam Dhan 4)	2024

✓ **Registration of Farmers varieties (PPV & FRA)**

Rice: Farmer varieties *Kalijhini* of Kangra district, *Matali* and *Jattu* of Kullu district got registration certificate from in PPV&FRA.

Maize: Farmer variety *Talaw Makki* of Mandi district also got registration certificate from in PPV&FRA..

✓ **Awards and Honours:**

Name/ Particulars	Award details
Farmers of Shong Valley of Kinnaur district	Plant Genome Saviour Community Award For conservation of Kala Zeera and the award was received on 12.09.2023 (Rs. 10 Lakhs) by PPV&FRA, New Delhi.
Sh. Garib Das (Burli Kothi, Paprola) of Distt. Kangra	Plant Genome Recognition Award For conservation of Local Kheera and the award was received on 12.09.2023 (Rs. 1.0 Lakh) by PPV&FRA, New Delhi.
AICRP on Seed (Crops)	Best AICRP Centre (2023) for quality Seed Production

Other Research Accomplishments

Crop Improvement:

Rice:

- Rice hybrids Vijetha 100 (54.61 q/ha), AHR- 8213 (50.75 q/ha) and Star-797 (50.02 q/ha) had performed well in both the years in Zone I and hence recommended for cultivation in Zone I of the state. Vijetha-100 (55.47 q/ha) AHR-8213 (53.47 q/ha) and star-797v (49.60 q/ha) have been recommended for cultivation in Zone –II.
- HPR 3106 was found promising for medium northern hill zone for the state of Uttarakhand. In Coordinated trials, this variety gave an average yield of 3883 kg/ha under medium northern hills against the national check Vivekdhan 86 (3671 kg/ha) and zonal check Shalimar Rice 3 (1902 kg/ha) from 2019-2021. It has long bold grain type with other desirable grain quality.
- In IVT (J) trial, the entry Koshikari was promoted to AVT 1 (J).
- Nucleus Seed (Stage II) of 127.320 kg of 11 rice varieties in seed chain was produced.
- Breeder Seed of 67.67 q against DAC indent of 38.00 q of 9 rice varieties in seed chain was produced.

Wheat:

- Two drought tolerant wheat genetic stocks TAW 185 (INGR23080) and TAW 186 (INGR 23081) were registered in the ICAR- NBPGR in collaboration with the BARC, Mumbai under MoU between CSKHPKV, Palampur and BARC, Mumbai.
- One wheat variety, Trombay Him Palam Gehun 4 (HPW 484) has been recommended for release by the State variety Release Committee. It is suitable for timely sown rainfed and irrigation conditions for low and mid hills of Himachal Pradesh. Maturity: medium and average yield: 30-35 q/ha.

Maize:

- Two medium and early maturing maize hybrids viz., KGH-22-01 (84.00 q/ha), KGH-22-03 (82.22 q/ha), KGH-22-35 (74.67q/ha and KGH-22-37 (73.33 q/ha), showed more than 20% heterosis over the respective checks BIO 9544 (67.00 q/ha) & BIO 605 (61.00 q/ha) have been inducted in NIVT 62 and NIVT 63, respectively during *kharif*, 2023.
- Twenty-eight maize hybrids supplied by various private seed companies were evaluated along with three checks viz., Bio-9544, Palam Sankar Makka-2 (P.S.M.-2) and Bio-605. On the basis of two years evaluation (2022 and 2023), hybrids such as 2745 (89.72 q/ha), PRADHAN-333 (89.09 q/ha), 1024 A 384-01 (85.33 q/ha), K25-05 (84.25 q/ha), DKC-8174 (82.04 q/ha), KMH-8322 (81.66 q/ha), KH-2136 Gold (81.22 q/ha), SMS-371(80.51 q/ha), NK-6110 (79.04 q/ha), KH-115-08-05 (78.83 q/ha), PAC-740 (78.22 q/ha), AHC-2337 (77.13 q/ha), DKC-7240 (76.55 q/ha), KMH-8333 (76.06 q/ha), PL-1515 Gold (75.93 q/ha), whereas, hybrids viz., 1024 A 384-01 (80.42 q/ha), KH-2136 Gold (78.93 q/ha), KMH-8333 (76.34 q/ha), AHC-2337 (74.42 q/ha), DKC-7240 (74.38 q/ha), K25-05 (72.60 q/ha), KMH-8322 (72.25 q/ha), HYM 333 (71.85 q/ha), PRADHAN-333 (71.57 q/ha),

2745 (71.40 q/ha) and NK-6110 (108.58 q/ha), AHC-1212 (103.53 q/ha), 2745 (102.14 q/ha) and PL-1515 Gold (100.03 q/ha) have been found suitable for cultivation in Zone-I, Zone –II and Zone –III of HP, respectively.

- LMH 2342, an early maturing maize hybrid was promoted from NIVT to AVT I (early maturity) for testing during *kharif*, 2024.

Soybean:

- In Soybean, five entries *viz.*, P104-5-12-1-1 (PK 472 × Hara Soya), Himso-1689 (NRC 2008 × G 1-12), P3-10-1-2 (Hardee × JS 20-87), P164-4-3-6-2 (PK 472 × Hara Soya) and P10-20-2-5 (Pb-1 × Him Soya) significantly out yielded the best check Him Soya (1328 kg/ha) by producing 1989, 1871, 1866, 1619 and 1614 kg/ha, respectively. None of the entries recorded significantly early maturity than the best check Palam Soya (113 days).
- In Progeny row trial, the entry P4-1-3-2 (Hara Soya × RSC-1046) (3053 kg/ha) followed by nine other entries significantly out yielded the best check Himso-1685 (2088 kg/ha).
- In **AVT**, five strains *viz.*, P104-5-12-1-1 (PK 472 × Hara Soya), Himso-1689, P3-10-1-2 (Hardee × JS 20-87), P164-4-3-6-2 (PK 472 × Hara Soya) and P101-20-2-5 (Pb-1 × Hara Soya) significantly out yielded the best check Him Soya (1328 kg/ha). Three strains *viz.*, P3-10-1-2, Himso-1689 and P101-20-2-5 also exhibited resistance against frogeye leaf spot and pod blight diseases.
- In **BARC** soybean multilocal evaluation trials (Palampur, Kangra, Akrot, Dhaulakuan and Sundernagar), six soybean strains *viz.*; TS-6 (1758 kg/ha) followed by TS 59 (1648 kg/ha), VLS 99 (1634 kg/ha), Himso-1696 (1586 kg/ha), TS 11 (1535 kg/ha) and TS 46 (1533 kg/ha) appeared as top seed yielders compared to the best check Himso-1685 (1512 kg/ha). The entry TS-6 was also evaluated in IVT under AICRP on soybean in the name of THPS 6 during *kharif* 2023. It showed statistical equivalence (1727 kg/ha) to the best check VLS 63 (1766 kg/ha).

Indian mustard:

- Based upon the evaluation under multi-location trials (Palampur, Sundernagar and Bajaura), one BARC mustard entry TM 312-2 appeared as top seed yielder (1699 kg/ha) in comparison to the best check RCC-4 (1696 kg/ha). The entry also appeared to be bold seeded (6.65 g) than the best check RCC-4 (5.36 g per 1000-seed weight).

Rapeseed-mustard:

- In **BARC Mustard** multi-local evaluation trials, twelve BARC genotypes were evaluated with four checks *viz.*, PM-25, JD-6, RCC-4 and TM-172 at CSK HPKV, Palampur during *rabi*, 2022-23. Seven genotypes such as TM 307-2 (1770 kg/ha) followed by TM 314-1 (1756 kg/ha), TM 316 (1748 kg/ha), TM 306-1(1726 kg/ha), TM 404 (1652 kg/ha), TM 310-3 (1652 kg/ha) and TM 304-1 (1644 kg/ha) significantly out yielded the best check THPM-1 (1348 kg/ha) for seed yield. Out of these, four genotypes were also evaluated with two checks under multi-local trials at Akrot, Dhaulakuan and Sundernagar. Based on the average data, the entry TM 312-2 produced 1558 kg/ha seed yield in comparison to the best check THPM-1 (1564 kg/ha). The promising genotype(s) will be inducted under AICRP programme.

Fodder Crops:

- Oat entry PLP-29 out yielded the national check RO-19 (fodder yield- 204.60, seed yield-12.3 q/ha) by giving fodder yield of 213.30 q/ha and seed yield of 18 q/ha and was promoted to AVT-2 trial of AICRP on Fodder Crops.
- Three new entries viz., PLP-40, PLP-41 and PLP-42 were nominated to IVT(MC) trials of AICRP on Fodder Crops giving 285, 290 and 275 q/ha fodder yield, respectively in oat station trials.

Seed Production:

- A total of 2170.3725 quintals seed (1012.529 q in *Rabi* 2022-23, 202.501 q in *Kharif* 2023 and 955.3425 q in *Rabi* 2023-24) of cereals, pulses, oil seeds, vegetables and fodder crops was produced by the University. The details are mentioned in the following table:

Seed Class/Crops	Seed Quantity (q)			Total (q)
	<i>Rabi</i> 2022-23	<i>Kharif</i> 2023	<i>Rabi</i> 2023-24	
Nucleus seed	39.26	12.306	24.2575	75.8235
Breeder seed				
Cereals, Pulses & Oilseeds	630.7455	159.835	545.35	1335.9305
Vegetables	7.2835	3.515	8.795	19.5935
Fodder	27.69	3	44.83	75.52
Foundation seed				
Cereals, Pulses & Oilseeds	209.35	20.855	329.86	560.065
Vegetables	96.45	2.62	1.05	100.12
Fodder	1.75	0.37	1.20	3.32
Total	1012.529	202.501	955.3425	2170.3725

- Further, a total of 10,84,501 plantation material by numbers (7,05,514 in *Rabi* 2022-23, 60,874 in *Kharif* 2023 and 3,18,113 in *Rabi* 2023-24) of horticulture, vegetable and fodder grasses were produced by the University.
- Additionally, a total of 174.678 q plantation material by quantity (45.10 q in *Rabi* 2022-23, 70.00 q in *Kharif* 2023 and 59.578 q in *Rabi* 2023-24) of vegetable was produced.

Agricultural Biotechnology:

- **Genome wide identification, characterization and expression of *Early responsive to dehydration 6 (ERD6)-like* gene family in chickpea (*Cicer arietinum* L.):**

Glucose transport is important for plant growth and development, however, genes that transport glucose are one of the least studied in plants. The *ERD6-like* genes in chickpea were

identified and characterized. 8, 12, 6 and 7 ERD6-like genes, respectively were identified in *Cicer arietinum*, *Arachis hypogea*, *Oryza sativa* and *Glycine max*. Nomenclature to the chickpea genes was also proposed and all the genes were characterized. Based on phylogenetic analysis, ERD6-like proteins were divided into five subgroups. To study organ specificity of ERD6-like genes in chickpea, transcription of these genes was studied in four different organs. Majority of the CaERD6-like genes had higher expression in sink organs than source leaves. One CaERD6-like gene overexpressed in leaves, 3 in anthers, 4 each in roots and ovules. Cold stress modulated differentially the expression of CaERD6-like genes in chickpea organs.

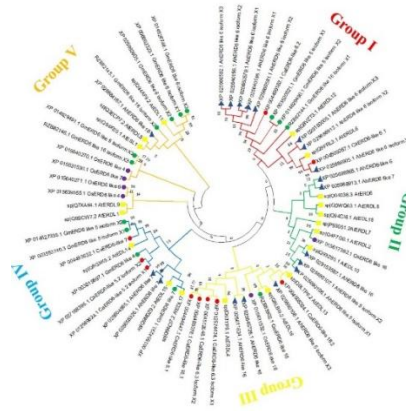


Fig. 1. Phylogenetic analysis of the ERD6-like genes of five plant species, *Cicer arietinum*, *Arabidopsis thaliana*, *Arachis hypogea*, *Glycine max* and *Oryza sativa*.

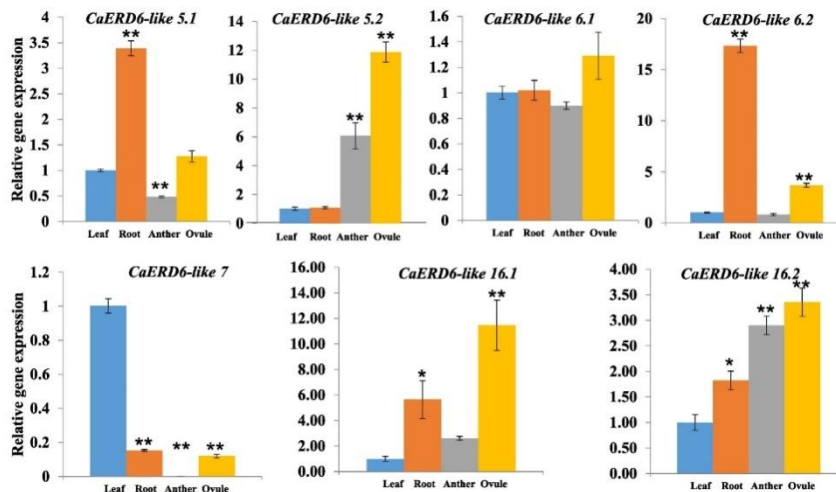


Fig. 2. Relative expression of Early responsive to dehydration 6 (ERD6)-like gene family in various organs (leaf, root, anther, ovule) of chickpea (*Cicer arietinum* L.).

- **Identification of new sources of tolerance to cold stress in chickpea:** Chickpea germplasm comprising of 1000 accessions was evaluated to identify cold-tolerant accessions. The study led to addition of four new sources of cold tolerance to the existing repository of cold-tolerant genotypes in chickpea.
- **Down-regulation of carbohydrate metabolic pathway genes lowers sucrose and starch content in chickpea leaves under high temperature stress leading to high temperature sensitivity:** High temperature (HT) lowers carbohydrate content in leaves but no information is available on HT induced reprogramming of transcription of carbohydrate metabolism genes in chickpea. Impact of HT (35°C) on plant growth, starch content and transcription of sucrose and starch metabolism genes were studied in leaves of chickpea. HT caused leaf chlorosis, flower abortion, reduced seed filling and lowered starch content. The short-term (2 h) as well as long-term (72 h) HT exposure down-regulated all the sucrose and starch metabolism genes except isoamylase 3 and β -amylase 1. The study suggested that HT-induced disruption of sucrose and starch metabolism resulted from down-regulation of carbohydrate metabolic pathway genes. Moreover, β -amylase gene expression suggested increased accumulation of maltose under prolonged heat stress.

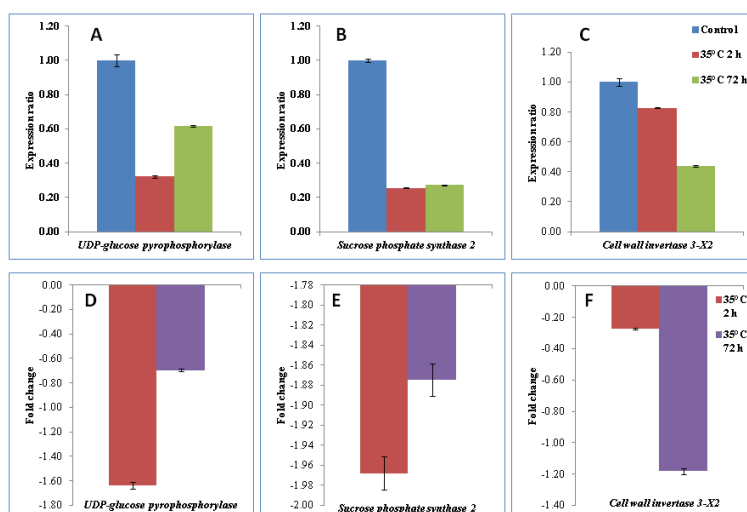


Fig. 3 Influence of short-term (2 h) and long-term (72 h) high temperature (35°C) stress on relative expression of sucrose metabolic pathways genes in leaves of chickpea genotype

- **CRISPR-Cas9 mediated gene editing for functional validation of neck blast resistance gene *Pb2*:**

Two NBS-LRR genes, *Os12g0281300* and *Os12g0281600*, which have been previously shortlisted as candidates for neck blast resistance gene *Pb2*, were targeted for editing by CRISPR/Cas9 system. Guide RNAs targeting each gene were cloned into CRISPR-Cas9 binary vector pRGEB32 (Addgene plasmid # 63142). The gRNA constructs were transformed into *E.coli* competent cells using standard transformation protocol. The correct gRNA constructs confirmed

through colony PCR and Sanger sequencing were mobilized into LBA4404 strain of *Agrobacterium tumefaciens* using modified freeze-thaw method described by Hofgen and Willmizer (1988). The confirmed gRNA constructs were used for the transformation of the resistant genotype RIL-4 to generate CRISPR/Cas9 edited mutants of the candidate neck blast resistance genes *Os12g0281300* and *Os12g0281600*.

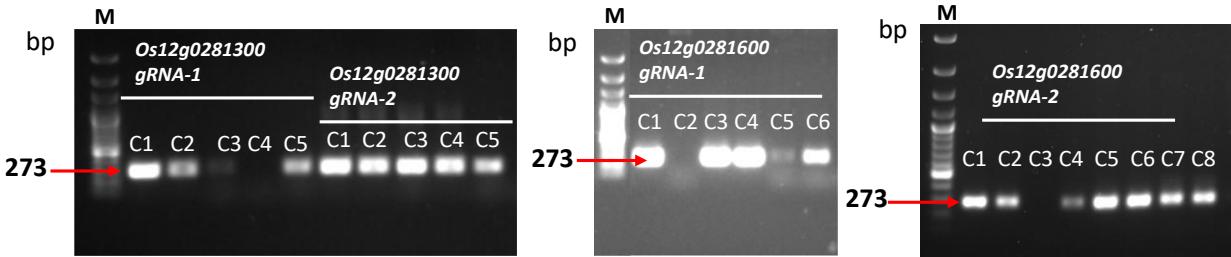


Fig 4. Colony PCR of the *E. coli* colonies to check the presence for gRNA insert in the recombinant vector. The colony PCR was performed using the forward primer specific to vector backbone and reverse primer specific for each gRNA. M= 100 bp DNA ladder.

- **Development NILs of cv. Pb-89 with powdery mildew resistance gene *er2* by marker assisted backcross breeding (MABB):** Nineteen BC₂F₅ near isogenic lines (NILs) of PB89 harbouring powdery mildew resistance gene *er2* were evaluated for their horticultural performance and resistance to powdery mildew under polyhouse conditions. Nine NILs viz., NIL-1, -2, -3, -11, -13, -15, -16, -17 and -19 similar to recurrent parent PB-89 for all the horticultural traits except days to 50% flowering were identified. Two NILs, NIL-9 and NIL-10 exhibited superiority over PB-89 for pod yield and shelling (%) while being essentially similar to recurrent parent for other important horticultural attributes. The identified NILs are the potentials contenders for release as varieties after multi-location yield trials.
- **Mapping of genomic regions for plant height and growth habit in horsegram:** Quantitative trait loci (QTLs) were identified in horsegram (*Macrotyloma uniflorum*) using an intraspecific mapping population comprising of 157 F₈ Recombinant Inbred Lines derived from a cross between HPKM249 and HPK4. Four major QTLs with PVE > 10 per cent (LOD ≥ 2.5) were detected across the ten linkage groups in RIL population. One QTLs each for plant height (qPHT), growth habit trait (qGHT) and seed index (qSI) were found on the LG1, while one QTL for days to flowering (qDTF) found on the LG2. QTL spotted for plant height (qPHT) on LG1 fringed markers OPB116B-MUGR642, explaining 39.74% of the PVE at a LOD value of 22.09 with an additive effect of 9.78 contributed by the allele from HPKM249. Second QTL detected for growth habit trait (qGHT) on LG1 flanked by markers OPB116B-MUGR 642 explaining 40.32% of the PVE at a LOD value of 22.55 with an additive effect of 51.56. Third QTL for days to flowering (qDTF) was found on the LG2 with the position of 135.51 cM and its LOD, additive effect and PVE value was 5.84, -2.88, 13.70, respectively. The flanking markers for this trait are MUD53 and MUGR3543 covering the distance of 10.7 cM. QTL qSI for seed index was found on the LG1 with

the position of 92.01 cM and their LOD, additive effect and PVE value was 3.59, 0.31 and 13.52, respectively.

- **Genome wide association studies for identification of novel QTLs related to four agronomic traits in horsegram (*Macrotyloma uniflorum*):** Efforts were made to comprehend the genetic diversity, population structure analysis, and genome-wide association analyses of a panel of 88 accessions of this plant species. Four important traits namely, plant height, number of branches per plant, days to flowering, days to maturity were selected for association study. This study summarized 79 significant SNPs across 8 chromosomes among four traits and the number of branches per plant was associated with a maximum of 37 SNPs followed by 20 significant associations for days to flowering and 15 SNPs for plant height.
- **Development of e Him Krishi and Him Biowealth portals:** (<http://www.hillagric.ac.in:1005/ekisan1/index.html>) was developed to provide all the information about package and practices approved by the University for various crops zone-wise for farming community in Hindi language, under one umbrella. In addition, the department has also developed Him Biowealth portal containing different databases for the benefit of students/ researchers and farming community. Database at present contains Varietal information (varieties released by the University), Germplasm (Rajmash), Geographic indications of Himachal Pradesh, Medicinal plants etc. (<http://hillagric.ac.in:1005/database.php>).

Crop Production:

- **Identification of need based cropping systems for different agro-climatic conditions**
 - The highest main product yield was recorded under hybrid sorghum+ hybrid bajra- oats + sarson. Maize+soybean-chickpea+linseed recorded lowest main product yield among all the cropping systems.
 - Okra-turnip-tomato resulted in significantly higher maize grain equivalent yield (29.19 t ha⁻¹) followed by babycorn-broccoli-frenchbean (22.25 t ha⁻¹) cropping system. All other treatments remained superior in terms of MGEY compared to maize-wheat sequence (8.04 t ha⁻¹).
 - In terms of net returns, okra-turnip- tomato gave significantly highest net returns (498 Rs. X 10³ ha⁻¹) compared to maize-wheat cropping system (110 Rs. X 10³ ha⁻¹).
 - Babycorn-broccoli-frenchbean resulted in higher cost of cultivation (209 Rs×10³ ha⁻¹) due to labour intensive nature of vegetable crops in the sequence. Soil pH and EC did not vary significantly among the cropping sequences. *Dhaincha* - early cabbage - frenchbean and sunhemp - vegetable pea - frenchbean sequences were the best in terms of soil health as the inclusion of legumes in the cropping sequences helped in maintaining soil fertility.
- **Development and validation of On-Station Integrated Farming System Model**
 - In one hectare On Station IFS model at Bhadhiarkhar farm, gross returns and net returns realized were Rs. 5,56,509/- and Rs. 2,13,846/- respectively. The highest net returns of Rs. 67,185/- were obtained from Horticulture cum vegetable unit followed by Dairy unit with net returns of Rs. 52,302/- followed by cropping system unit with net returns

- of Rs. 49322/- followed by Fodder block with net returns of Rs.25,029/- followed by Poultry unit with net returns of Rs. 15,558/- followed by Mushroom unit with net returns of Rs. 4450/- only. The B:C was 1.62 in terms of economics point of view.
- One ha IFS provide round the year average production of 21.65 t/year with profit of Rs. 2,13,846/- with 438 mandays employment generation. Among different components, highest profit was realized from Horticulture cum vegetable unit (31%) followed by dairy unit (25%).
 - Source and sink relationship of net GHG emission in IFS model in terms of CO₂-e (kg) is concerned. This model was found to have negative value of GHG emission is -3840.4 CO₂-e.
 - Dhaincha - Early cabbage - Frenchbean resulted in significantly higher organic carbon (12.55 g kg⁻¹). Sunhemp - vegetable pea - frenchbean had 219.96 kg ha⁻¹ nitrogen uptake and rice- wheat+gram resulted in higher phosphorus uptake (135.49 kg ha⁻¹) and hybrid sorghum + hybrid bajra - ryegrass + berseem caused the highest potassium uptake (219.11 kg ha⁻¹) among all the cropping sequences.
- **On-Farm evaluation of different management practices in pre-dominant cropping systems**
 - Irrespective of the blocks under study, highest maize grain yield (8805 kg ha⁻¹) was obtained with RDF i.e. recommended fertilizer (NPK) application, which was statistically similar to that obtained under ICM (7223 kg ha⁻¹) but significantly higher than other treatments while, the lowest MGEY was recorded from farmer's practice (5103 kg ha⁻¹).
 - Similarly, highest net profit (Rs.1,54,483/-) and benefit cost ratio (1.84) were accrued with recommended fertilizer compared to other treatments **in both the blocks**.
 - The grain yield under RDF was highest with highest net returns (4047 kg/ha and 3527 kg/ha) in both *Kharif* and *rabi* crops compared to farmers practice (2431 kg/ha and 2351 kg/ha).
 - Application of 75% Organic + Natural farming concoction in **T6** treatment increased the MGEY (**6368**) as well as system net returns (Rs. 98,493/-) compared to farmers practice MGEY (**5103**) as well as system net returns (Rs.82,480/-).
 - **Diversification and improvement of existing farming systems under small and marginal household conditions**
 - Three farming systems were identified at the present operational district (Kullu) of OFR namely field crops + dairy (0.31 ha) with 18 farmers households, Field crops + Dairy + Horticulture (0.4 ha) with 12 farmers household and field crops + Dairy + Goat/ Sheep + Horticulture (0.31 ha) with 6 farmers household.
 - Low cost interventions were given to the farmer households viz., improved seed, recommended dose of fertilizers, fodder crop seeds and animal feed.
 - Diversification studies revealed that out of the three farming systems; Field crops + Dairy system is the dominant being practiced by large number of the farmers compared

to all other farming systems. Also the net returns were highest in this (Rs. 57,556/-) farming system households followed by Field crops + Dairy + Horticulture (Rs. 36,580/-) and Field crops + Dairy + Goat/ Sheep + Horticulture (Rs. 19,714/-).

Technology Generated:

- AICRP-IFS, ICAR-IIFSR, CSKHPKV, Palampur, HP certified for contribution in developing the technology “Bankable Integrated Farming System Model for Himachal Pradesh” (ICAR-NRM-IIFSR-Technology-2024-086 dated 16 July, 2024).
- AICRP-IFS, ICAR-IIFSR, CSKHPKV, Palampur, HP certified for contribution in developing the technology “Integrated Farming System Model for Himachal Pradesh (Technology/Package of technology”. ICAR-NRM-IIFSR-Technology-2023-001 dated 16 July, 2024).

Gramin Krishi Mausam Seva:

- Published 103 AAS Bulletins, during July 1, 2023 to June 30, 2024 for Chamba, Una, Hamirpur and Kangra districts of H.P. on IMD Website, University website ([www.hillagric.ac.in/ kisano ke liye](http://www.hillagric.ac.in/kisano%20ke%20liye) and [www.imdagrimet.gov.in.](http://www.imdagrimet.gov.in)), Kisan Portal ([www.farmers .gov.in](http://www.farmers.gov.in); www.weathershimla.gov.in and mkisan.gov.in) and www.cropweatheoutlook.com of CRIDA (ICAR) websites. Agro-advisory bulletins and weather information were published in local newspapers punjab kesari/ Amar Ujala etc. (39 newspaper clippings). Uploaded and published the advisory content at block scale also for Chamba, Una, Hamirpur and Kangra districts of H.P in “MEGHDOOT APP” published twice in a week
- The futuristic crop water footprints and net irrigation requirements for all districts of Himachal Pradesh with rainfall reduction of 10 and 20% along with 1, 2, and 3⁰C maximum and minimum temperature were determined and validated using district-wise soil profiling drawn from 64 sites and analyzed across the state.

Nutrient Management:

- Long-term fertilizer experiments (since 1972) revealed that integrated use of fertilizers with FYM or lime significantly enhanced wheat productivity, sustainable yield index and soil health compared to sole use of chemical fertilizers.
- Lime proved to be an effective alternative to FYM in acid soils, mitigating soil acidity and improving pH.
- Balanced fertilization is crucial for maintaining wheat productivity, as omission of nutrients, especially S, caused significant yield reductions. Additionally, it also improved soil enzyme activities, with the best results under 100% NPK + FYM, followed by 100% NPK + lime.
- The target yield equations were developed for onion and garlic.
- Natural systems recorded higher available boron and boron pools compared to cultivated systems.
- Approximately 65% of the observed values fall below the critical limit of 0.45 mg kg⁻¹, indicating widespread boron deficiency in acid soils.

- The graded doses of nitrogenous fertilizer significantly impacted the wheat yield. The maximum yield was obtained at 125% of RDN. The spray frequencies of nano-N liquid fertilizer, however, did not show any significant impact on wheat yield.
- NPK levels significantly impacted the wheat yield and maximum yield was obtained under 125% of RDF which showed statistical parity with 100% of RDF. However, organic sources did not show any significant impact on yield.
- Application of 60-80 kg S per ha resulted in significantly higher yields of gobhi sarson, gram and rajmash at Nangal, Palampur, Sundernagar and Kukumseri.
- The conjoint application of B and Mo resulted in higher maize and cauliflower yields and showed incline in all fractions of B and Mo after two years.
- Soil application led to significant improvement in different fractions of the respective nutrient over foliar spray.
- Standardization of suitable soil test methods and determination of critical & optimum levels for diagnosing micronutrient deficiencies in soils and crops:
 - Ammonium oxalate was found the most suitable extractant for Mo estimation in acid soils of Himachal Pradesh.
 - Critical limit for Mo:
 - In soil - 0.147 mg kg⁻¹ (cauliflower) & 0.143 mg kg⁻¹ (french bean)
 - In plant - 4.12 mg kg⁻¹ (cauliflower) and 6.16 mg kg⁻¹ (french bean)

Water Management:

- The assessment of water availability in three major *kuhl* command areas of Kangra district has revealed that although surplus water is available in main *kuhl* but in secondary/tertiary channels the availability is not assured.
- Construction of auxiliary tanks of 100 -200 m³ along the *kuhls* and use of stored water during lean periods can boost the vegetable production in *rabi* season for enhancing the profitability and year around crop production.
- Application of 5 irrigations at 0.8ETc at 20-30 days interval in wheat and 6 irrigations of 0.9ETc at 7-10 days interval (June to mid-July and September) for direct seeded rice.
- Coupling integrated nutrient management practices (75% NPK inorganic + 25% N through FYM+ seed treatment with *Azotobacter* + PSB) led to higher yield, returns, soil health, better carbon sequestration, efficient water uses and sustainability of direct seeded rice - wheat cropping system.
- Significantly higher marketable yield of marigold, net returns, BC ratio and water productivity was obtained with the 0.6 PE sub-surface drip irrigation with 25% NPK basal and 75 % NPK through fertigation @ 7.5% NPK per splits in 10 splits at weekly interval compared to 0.8 PE surface drip irrigation with 25% NPK basal and 25 % NPK through fertigation @ 2.5% NPK per splits in 10 splits + vermiwash @ 750 L ha⁻¹ fertigation at weekly interval.

Crop Protection:

Disease Management:

- For non-chemical management of zonate leaf spot of sorghum, three foliar sprays of extract of eupatorium ark @ 10% was found best with 48.74 % disease control with 12.84 % increase in the yield over check.
- For ecofriendly management of powdery mildew (*Erysiphe trifoliorum*), three foliar spray of dashparni @ 2% was found most effective with 75.45 per cent powdery mildew control and minimum disease severity (7.32%) in white clover.
- Seed treatment with tricyclazole @ 0.6 g/kg seed followed by two sprays of the same fungicide @ 0.3g/l was found most effective against leaf blast in forage pearl millet and showed 77.3 % disease control with 12.89 % increase in the green fodder yield over check.
- In capsicum, disease caused by Phytoplasma was recorded first time from India, which caused vein-thickening, shortening of internodes, downward curling, puckering, greening, phyllody and stunting.
- Talc based formulations of eight endophytic fungi (bio agents) were evaluated against pea root complex under field conditions. All the formulation tested were found effective in controlling the disease over control. However, three formulations viz., *Schizophyllum* sp. isolate JPE19, *Epicoccum* sp. isolate JPE2 and *Talaromyces purpureogenus* isolate JPE38 displayed remarkable plant growth and disease control potential against the disease.
- Germplasms of mushroom were collected from three districts of H.P i.e. Kangra, Mandi and Hamirpur and cultures were deposited at DMR. Four accession numbers viz., DMRX-2127 DMRX-2128 DMRX-2129 and DMRX-2079 were obtained.
- Bio fortification of wheat substrate with organic additives resulted in better morphological characters and biological efficiency of *Pleurotus ostreatus* compared to control where no additives were added.

Insect Pest Management:

- Distribution maps of white grubs and termites in Himachal Pradesh were developed.
- A total of 16 species of termites belonging to 12 genera viz., *Archotermopsis*, *Neotermes*, *Stylotermes*, *Coptotermes*, *Heterotermes*, *Amitermes*, *Angulitermes*, *Odontotermes*, *Microcerotermes*, *Nasutitermes*, *Eremotermes* and *Microtermes* belonging to 5 families Termitidae, Rhinotermitidae, Archotermopsidae, Kalotermitidae and Stylotermitidae were recorded from various locations of Himachal Pradesh.
- For the management of termites in wheat, seed treatment with chlorantraniliprole 18.5 SC @ 2ml/ kg seed resulted in minimum tiller damage (2.2 %) compared to 14.8% in untreated check.
- The economic losses caused by white grubs in potato were estimated to be Rs. 55,308/ha, under un-managed situations. Clothianidin 50 WDG was found most effective for the management of white grubs in potato with least tuber damage on weight basis (6.87%).

Seed treatment with this insecticide @ 1.5g/ kg seed was also found effective for the control of white grubs in Rajmash.

- For the management of fall armyworm, *Spodoptera frugiperda* in maize, emamectin benzoate @0.4g/l followed by spinetoram @ 0.5 ml/l and chlorantraniliprole @ 0.5 ml/l were found highly effective.
- In chickpea, chlorantraniliprole and novaluron+ indoxacarb, when used alone or in integration with biopesticides viz., *Bt* and HaNPV, were found highly effective against the pod borer. The natural products, *Brahmastra* and *Darekastra* showed adverse effects on the developmental biology of the pest.
- For the management of pea leaf miner, spinosad 45 SC @ 0.3 ml/L followed by lambda cyhalothrin 5 EC @ 0.8 ml/L were found most effective treatments.
- Use of neem cake (250 kg/ha) + emamectin benzoate 5 SG (200 g /ha) proved better in checking infestation of brinjal shoot and fruit borer *Leucinodes orbonalis* and getting the highest fruit yield (360.25 q/ha) compared to other treatments.
- A waiting period of 4 days for emamectin benzoate and 2 days for spinosad was worked out for safe consumption of brinjal fruits and that of cyantraniliprole, was 8.3 days at recommended (90 gai/ha) dose on tomato under protected environment.
- Among various modules comprising biorational insecticides and biopesticides evaluated for the management of tomato pin worm, *Phthorimaea absoluta* under field and polyhouse conditions, alternate application of azadirachtin 0.15EC (@ 5ml/l) and indoxacarb 14.5SC (@ 0.15ml/l), OR azadirachtin 0.15EC (@ 5ml/l) and flubendiamide 39.35SC (@ 0.2ml/l) on appearance of the pest at 14 days interval was found highly cost effective.
- Fenazaquin 18.3 SC @ @ 0.5ml/l proved effective against yellow mite, *Polyphagotarsonemus latus* in chilli, red spider mite, *Tetranychus urticae* in okra and two spotted spider mite, *Tetranychus* spp in tomato.
- Under protected environment, tomato russet mite, *Aculops lycopersici* was prevalent throughout the year in mid hills of Himachal Pradesh with the population ranging between 5.8-106.8 mites/three leaves.
- In tea, propargite @ 1ml/l, fenazaquin @ 0.5ml/l, bifenthrin @ 1ml/l and spiromesifen @ 1ml/l were found highly effective against tea mite, *Oligonychus coffeae*.
- Insecticides viz., azadirachtin, cyantraniliprole, diafenthiuron, imidacloprid and spiromesifen were found safe to eggs and larvae of the chrysopid predator, *Chrysoperla zastrowi sillemi* when applied within their maximum field recommended rates and these insecticides may be used in integration with the use of the predator. Whereas thiamethoxam was toxic to *C. zastrowi sillemi*.
- Potato cyst nematode, *Globodera* was recorded from high hill regions (above 2000 masl) with 75-100% frequency of occurrence but not detected from low and mid hills so far.
- Mycorrhiza was evaluated for the management of root knot nematode infecting cucumber in polyhouse revealed *Glomus fasciculatum* + *Pochonia chlamydosporia* @ 1 kg/1000 m² to be effective in reducing the nematode population (68.6%) and increasing the yield (48.7%) over control.

- *Bacillus amyloliquefaciens* @ 1 kg/1000 m² at the time of planting and 45 days after was the best among different bioagents evaluated against this nematode in cucumber under protected conditions.
- Soil application of *Pseudomonas fluorescence* @ 20 g/m² at the time of rice sowing was found the best treatment followed by *Bacillus subtilis* @ 20 g/m² for the bio-management of rice root-knot nematode, *Meloidogyne graminicola* with maximum increase in yield over control.
- Local bacterial and fungal isolates evaluated against root knot nematode under *in vitro* conditions revealed *Trichoderma afroharzianum* collected from the rhizosphere of rice was found effective with least hatched juveniles and maximum juvenile mortality after 72 hours of incubation.

Weed Management:

- **Weed management in dry direct-seeded rice (DSR)**
Pendimethalin 1000 g/ha fb bispyribac-sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) 4 g/ha has effectively controlled and resulted in 161.6% higher dry direct seeded rice yield over the weedy check. On an average, weeds reduced grain yield of rice by 61.8%. Pendimethalin fb bispyribac-sodium + metsulfuron methyl + chlorimuron ethyl resulted in highest net returns due to weed control (Rs. 49,341/ha).
- **Weed management in soybean**
Sulfentrazone + clomazone, bentazone, and imazethapyr + propaquizafop were the effective herbicidal weed control treatments in soybean. Sulfentrazone + clomazone gave over 322 kg more yield during *kharif 2023*. Diclosulam resulted in highest marginal benefit cost ratio (MBCR) followed by pendimethalin + imazethapyr (RM), fluazifop-p-butyl + fomesafen (RM) and sodium acifluorfen + clodinafop propargyl.
- **Weed management under conservation tillage system on soybean based cropping system**
Conservation tillage was comparable to the conventional tillage treatment in influencing soybean seed and wheat yields during 2022-23. Among weed management treatments, herbicide rotation treatment (HR-HR) and integrated weed management treatment (IWM-IWM) resulted in higher yield, net returns and B:C of soybean and wheat over the partial weedy check.
- **Weed management in organically grown maize-wheat cropping system**
Intensive cropping, crop rotation, intercropping and raised stale seed bed (RSSB) +mulch resulted in significantly lower total weed count and higher maize equivalent yield over the mechanical check. Highest net returns and B:C were accrued in the intensive cropping treatment.

Organic Agriculture and Natural Farming:

1. Crop production under natural farming

- **Paddy:** The multi-locational yield of paddy ranged from 26 - 40 q/ha under natural farming. In addition, 3-4 q/ha yield of mash can also be harvested by growing the crop on bunds.
- **Finger millet + Soybean:** Finger millet grain yield of 5-8 q/ha and intercrop soybean yield of 5-9 q/ha can be obtained with natural farming practices. The total finger millet grain equivalent yield ranged from 14 - 22 q/ha.
- **Wheat + Gram:** The wheat grain yield of 22-25 q/ha can be obtained under natural farming. Additionally, 7.5-9.50 q/ha gram yield can also be harvested when grown as intercrop.
- **Wheat + Pea:** The wheat grain yield of 15-22 q/ha and the grain equivalent yield of 35-48 q/ha can be obtained with natural farming practices. 10-16 q/ha yield of peas can also be harvested through intercropping.
- **Garlic + methi + palak + radish:** In this multiple cropping system, the yields of garlic, methi, palak and radish ranged from 12-21, 4-6, 7-15 and 9-17 q/ha, respectively when grown as intercrop with garlic. The total garlic equivalent yield at different locations ranged from 34-45 q/ha under natural farming.

2. Crop Protection Studies

- The treatment of *Artemisia* + *Lantana* extract 1:1 (81.24- 81.44%) followed by *Lantana extract* treatment (75.05- 77.77%) recorded the highest efficacy against blister beetle in black gram, *Riptortus* population in maize + soybean and *Helicoverpa armigera* in wheat + gram intercropping systems.
- The treatment of neem oil @ 3ml/l showed the highest efficacy to the tune of 74.42% and 80.13% against pea leaf miner maggot in wheat + pea intercropping system and against potato tuber moth in potato, respectively.

3. Soil & microbial studies: Multi locational studies

- The multi locational studies conducted on soil health at HQ, Kangra, Sundernagar, Kullu and Dhaulakuan centres showed that the dehydrogenase activity, available NPK, general bacterial count, actinomycetes count, P-solubilizing bacterial count and nitrogen fixing bacterial count were higher under the natural farming system for most of the crops. Whereas, the percent organic carbon was higher with organic farming treatment during *kharif* season.
- During *rabi* 2023-24, the percent organic carbon, microbial biomass carbon and available NPK were higher under organic farming system in all the crops. Whereas, the general bacterial count, actinomycetes count, P-solubilizing bacterial count and nitrogen fixing bacterial count were equal under natural as well as organic farming system.

VETERINARY AND ANIMAL SCIENCES:

Animal Breeding and Genetics

- During the period, Dahlem Red (DR), Native/Desi, Himsamridhi and DRXN cross poultry stocks were evaluated on farm for different performance traits. The Dahlem Red birds outperformed others for body weight, age at sexual maturity and egg production.
- A total of 1,21,325 chicks of different stocks (Himsamridhi, Dahlem Red (DR) Native (N) and DN) were hatched with a from fertile eggs. The overall fertility and hatchability on TES and FES basis (%) of 89.58, 75.61% and 84.36%, respectively.
- A total 1,15,699 chicks of different stocks were supplied to 1248 farmers from more than 180 villages to establish backyard poultry units..
- A total of 275 units (13,750 chicks) and 160 units (9850 chicks) were established and 5 On Farm Trials and 35 Front Line Demonstrations (FLD) under TSP and SCSP component in collaboration with different KVKs and NGOs were undertaken. Different inputs were provided for the purpose.. were conducted
- The egg production at Poultry Farm was 2,56,950. Out of this, 96,608 eggs were sold as table eggs and 1,60,342 eggs were used for hatching.
- A total sum of Rs 34,87,940 Rs were generated on account of sale of various poultry products (chicks, eggs, culled birds).
- Migratory goat flocks of 31 farmers, 8 of which are in complete transhumance system of production were registered for scientific interventions.
- A total of 34 adult male Gaddi bucks were distributed to selected farmers as breeding input. During the period a total of 652 young kids were added in selected flocks by way of birth and 527 animals of different age groups were sold by the owners.
- 15 Gaddi goat units (1M: 3F) (60 animals) were supplied from AICRP/(ICAR-SCSP) to the Schedule Caste Farmers project, for grading up and genetic improvement non-descript animals. All selected animals were provided health and nutritional coverage.
- Adult female Gaddi dog was monoestrus; the period of male acceptance ranged from 5 to 9 days; and a fecundity rate of 2 to 9 was recorded.
- The first lactation milk yield (305 days, adjusted) of Sahiwal animals averaged 1070.4 L.

Animal Reproduction

- Among causes of infertility, single (true anestrus, endometritis, infantile genitalia and repeat breeding) and multiple (prolonged estrus with endometritis and metestral bleeding with repeat breeding) reproductive disorders were most prevalent in cows aged between 2.5-7 years.
- In cows, urovagina characteristics with respect to severity were influenced by stage of estrous cycle, pelvic girdle angles and parity.
- In cows with clinical and sub-clinical endometritis, supra-basal serum progesterone concentration and higher velocity and volume of blood flow to uterus negatively affected the timely ovulation.

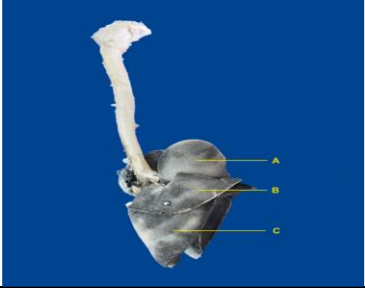
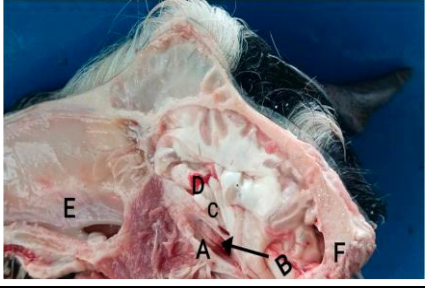
- High prevalence of abortion (20.58%) in cows of Lahaul valley had no direct relationship with progesterone or chromosomal abnormalities.
- In Lahaul valley, low vitamin A, magnesium and body condition scores along with consumption of phytoestrogenic plants posed a significant threat of abortion in cows.
- 34.9% incidence of transition period reproductive disorders was recorded with high preponderance of dystocia (16.7%) followed by metritis (11.7%), genital prolapse (3.7%) and retention of fetal membranes (2.7%) in cows.
- **Sexed semen straws** yielded conception rate at par with conventional semen straws with estrus duration being the key factor affecting conception under field conditions in crossbred cows.
- **Prediction of standing estrus in ewes** can be accurate with conjunction of exfoliative vaginal cytology and vaginal electrical resistance in absence of endocrine investigations.
- **In bitches**, the diagnostic accuracy for estrus detection was highest with serum progesterone concentration (100%), followed by EVC (97.10%) and vaginoscopy (91.30%).
- A new intracervical drug administration route in buffaloes for hastening the cervical dilatation

Animal Nutrition:

- Supplementation of Nishyinda leaf (*Vitex negunda*) powder at 1% level in the diet of broilers improved growth performance antioxidative and immunity status.
- Reducing methionine up till 0.05% with concomitant increase in betaine to the extent of 0.45% in commercial broiler feed positively influenced carcass characteristics and exhibited higher economic returns.
- Supplementing Mn @ 50mg/Kg and turmeric powder (0.5% w/w) positively improved the internal and shell quality of poultry eggs.
- Feeding of ensiled lemon pomace with other feeds enhance the growth performance (81%) in beetal Goats.
- Supplementation of *Vitex negundo* leaf powder in the broiler ration significantly increased ($p < 0.05$) growth performance and hematological parameters in broilers.
- Significant increase in body weight was found in broilers supplemented with Turmeric, Garlic and Ginger extracts as compared to Control group.

Veterinary Anatomy:

- The lungs of Himalayan mongoose, native to the Himalayan region, were characterized. Grossly, the right lung was larger than left and had four lobes, whereas left had only three lobes.
- A study on the gross morphological and biometrical characteristics of the pituitary gland in the Gaddi doe during different seasons revealed that the pituitary gland was most active during breeding season (autumn) from September to November.

	
<p>Right lung of Himalayan mongoose showing, apical lobe (A), cardiac lobe (B) and diaphragmatic lobe (C);</p>	<p>Sagittal section of head showing brain and hypophysis cerebri (A) Sella tursica of sphenoid (B) Hypophysis cerebri (C) Mammillary body (D) Hypothalamus (E) Nasal septum (F) Occipital bone;</p>

Animal Health:

Veterinary Pathology:

- **Livestock, Poultry, Fish and Wild-Life Disease Investigation (A Departmental Project):** During the period a total of 1017 necropsies were performed in different animal species including wild animals and birds, and different diseases, including bacterial, viral, mycotic and parasitic, were characterized.
- **20 autopsies, 111 biopsies and 1035 clinical samples (158 urine and 877 cytology) were diagnosed** by histopathological/ cytological examinations. A spectrum of diseases including mycotic, bacterial and viral affections affecting different body systems were confirmed.
- **Animal Disease outbreaks investigation:** Four (04) outbreaks attended and investigated for spontaneous mortalities in Sambhar deer (*Rusa unicolor*) at Mini Zoo, Rewalsar, District Mandi. Acute haemorrhagic enteropathy due to bacterial & parasitic origin among Bulls in Sperm Station, Palampur District Kangra, Severe Thrush (Candidiasis) associated with immunosuppression in Kalij pheasants in Nehru Pheasantry, Manali District Kullu; and mortalities due to progressive anaemia caused by endoparasitism in the exotic sheep (Merino) at Ram Centre Nagwain, District Mandi, HP, were observed.

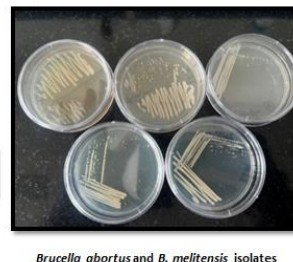
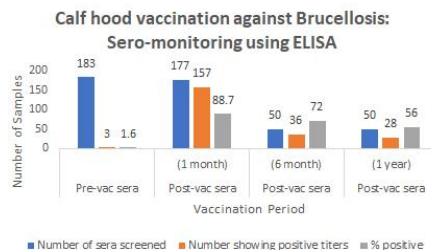
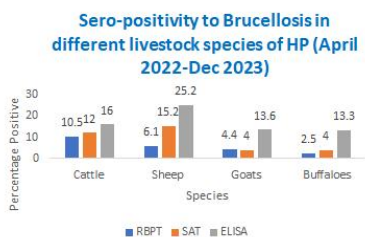
Veterinary Microbiology:

- **Climate Resilience and Adaptability in Livestock Across Himachal Pradesh**

A comprehensive study was conducted on 431 crossbred cows across six districts in Himachal Pradesh, spanning all agro-climatic zones. Key findings included improved reproductive efficiency in plain regions during winters, seasonal variations in milk composition. Endoparasitism prevalence, with significant regional differences, was notably higher in summer (47.54%) compared to winter (39.38%).

- **Sero-Surveillance and Molecular Epidemiology of Livestock Diseases**

Screening of nearly 700 serum samples revealed lingering *Brucella* antibodies in vaccinated cattle. Novel findings included the isolation of a lytic *Brucella* phage.



• **Veterinary Type Culture Network and National Microbial Repositories of Unique Accessions**

Six bacterial isolates were accessioned, including *Brucella melitensis* from a high-abortion sheep farm and *Streptococcus dysgalactiae* from febrile sheep with swollen joints. Twenty-five isolates from animals with infectious diseases were submitted to the National Collection of Veterinary Types Culture, with six accessioned in 2023.

• **Rapid Diagnostics for Tick-Borne Hemoprotozoan Diseases (In collaboration with industry partner SHC Shine Biotech Pvt Ltd Faridabad)**

A cost-effective, field-deployable DNA isolation kit was validated for detecting tick-borne diseases like Theileriosis, Babesiosis, and Anaplasmosis.

• **Point-of-Care Diagnostics for Bovine Leukemia Virus (In collaboration with industry partner SHC Shine Biotech Pvt Ltd Faridabad)**

A LAMP-based diagnostic kit was developed to identify BLV infection rapidly and cost-effectively. Efforts are underway to further validate the kit and enhance its commercial readiness.

• **Medicinal Properties of Indigenous Badri Cattle Urine**

Urine from Pahari cattle exhibited antiviral efficacy against canine parvovirus (CPV), with distillates proving more effective than commercial antivirals. Comparative studies revealed enhanced antiviral properties in urine from pregnant Pahari cattle over Jersey counterparts, supporting its potential as a natural therapeutic.

• **Footrot in Migratory Sheep and Goats: Challenges and Findings**

Under the All-India Network Project on Challenging and Emerging Diseases, surveys on footrot were conducted on 35 flocks, comprising of 9,250 sheep and 7,690 goats. Laboratory analysis of 75 samples confirmed the presence of *Dichelobacter nodosus*, *Fusobacterium necrophorum*, and *Trueperella pyogenes* in affected animals. PCR analysis revealed that 12.5% of the foot lesions were caused by *Dichelobacter nodosus*. Notably, the study reported the first detection of the E serogroup of *D. nodosus* in Himachal Pradesh.

Veterinary Medicine:

• **Diagnosis and management of thoraco-abdominal disorders in cattle and buffaloes**

A total of 62 out of 618 cattle and 24 out of 111 buffaloes were diagnosed with various thoraco-abdominal disorders, which included life threatening traumatic reticulo-peritonitis (TRP) and diaphragmatic hernia (DH). Ultrasonographic findings revealed complex effusion and presence of

fibrinous material in peritoneal cavity of the affected animals. Peritoneal fluid concentration of D-dimer was observed significantly higher 0.70 ± 0.08 in cattle with TRP.

- **Diagnosis and management of Haemoprotozoan and Rickettsial induced renal disorders in dogs**

A total of 89 dogs were found positive for the presence of Haemoprotozoan and Rickettsial induced renal disorders, thus representing prevalence of 3.02% (89/2945); 34 of these with serious renal disorders could be saved by timely intervention and aggressive therapeutic measures.

- **Electrolyte and Acid-Base Imbalances in Canine Gastroenteritis**

Significant decrease in sodium, potassium, and chloride levels in dogs suffering from gastritis, enteritis and gastroenteritis was recorded in dogs (619 out of 3059) with various GIT disturbances. Parvoviral infection was one of the major cause of gastroenteritis.

- **Analysis of Arrhythmia of the Heart in Dogs**

The study showed arrhythmias incidences and revealed 114 dogs (26.21%) exhibited various types, such as atrial fibrillation (30.70%), ST- coving and sinus arrest (9.65%, each), and ST-segment elevation (8.77%, each).

- **In vitro Antibacterial Activities of herbal plants against Bacterial Pathogens causing Subclinical Mastitis in Cows**

The study revealed that aqueous extract of *C. citratus* had the maximum zone of inhibition against *S. aureus* followed by *P. emblica* & *V. negundo*.

- **Clinico-diagnostic of canine otitis externa**

Cytological examination complemented with microbiological investigations were found to be important diagnostic tools for early diagnosis and management of otitis externa.

- **Diagnosis and management of neurological disorders in Canines**

169 (7.53%) dogs, diagnosed with neurological disorders, was linked to Canine distemper, tick paralysis and idiopathic epilepsy. Rapid diagnostic kits for detecting Canine distemper virus, haemoprotozoan and rickettsial infections proved valuable for prompt diagnosis and treatment initiation. Overall, early recognition and a combination of specific and supportive therapies contributed to a 56.80% recovery rate in dogs with neurological disorders.

- **Clinico-therapeutic studies on snake envenomation in dogs**

A total of 20 dogs (0.75%) dogs had snake bite that was most prevalent in the month of June. 16 dogs had venomous snake bite (Russel's Viper) whereas 4 dogs suffered from bite of non-venomous snakes. The dogs presented within first three hours of bite had better chances of survival. Combination of values of LDH, APTT, Blood clotting time, CRP and creatinine on the day of presentation were good prognostic indicators.

- **Clinico-diagnostic studies and therapeutic management of congestive heart failure in geriatric dogs**

With a prevalence of 0.93 percent; dilated cardiomyopathy (DCM) followed by mitral valve diseases (MVD) as the common etiology, and treatment with carvedilol combined with Pimobendan, ACE inhibitors, antihypertensives, and diuretics was most effective.

Veterinary Physiology

• Investigations on minerals profile of migratory sheep and goats in Himachal Pradesh

The haematological analysis in migratory sheep and goats revealed significant altitude-related variations. At lower altitudes, they exhibited reduced levels of haemoglobin (Hb), total erythrocyte count (TEC), and packed cell volume (PCV).

At low-hill altitudes, sheep showed high deficiencies in iron (96%), phosphorus (44%), magnesium (40%), and zinc (24%), while goats exhibited significant magnesium (86.6%) and iron (63.3%) deficiencies. At high-hill altitudes, sheep had deficiencies in calcium (25%), magnesium (41.6%), sodium (37.5%), and chloride (45.8%) while goats experienced deficiencies in phosphorus (4%), magnesium (24%), sodium (44%), and chloride (48%). At mid-hill altitudes, sheep had notable calcium (62.9%), iron (92.59%) and magnesium (44.4%) deficiencies, and goats showed magnesium (54.5%), and iron (68.1%) deficiencies. Treatment with iron dextran, ferrous sulphate, magnesium sulphate (10% solution), magnesium oxide, DCP, calcium borogluconate was well tolerated with no untoward reactions in sheep and goats and resulted in increase in values of these deficient minerals.

Veterinary Surgery:

- Study pertaining to tibial fractures in dogs indicated 42A1 (Diaphyseal simple oblique fracture of tibia) to be the most common. Minimally invasive plate osteosynthesis (MIPO) technique took just 25-30 minutes and allowed an early return of limb function with zero postoperative complications compared to open reduction and internal fixation (ORIF) which took 90-120 minutes.
- In a study on the Coxo-femoral (CF) joint conditions in dogs, hip dysplasia (1.65%) was more common than luxation (0.70%) and CF fracture (0.60%). Open reduction of CF luxation in dogs could be accomplished even after passage of many weeks and its surgical fixation using toggle pin was an effective method. The BVA/KC scoring of hips proved to be a precise and an effective method for diagnosing Canine Hip Dysplasia.
- Nasal leech infestation was found to be the most common clinical condition during rhinoscopy in dogs with a history of chronic intermittent epistaxis. Different dimensions of flexible endoscope for dogs of different body weights were standardized.
- In a study done on anaesthetic management of cats, it was found that Dexmedetomidine @22 µg/kg bwt., Ketamine @4.4 mg/kg bwt. in combination with Butorphanol @ 0.2 mg/kg bwt. or Buprenorphine @20 µg/kg bwt. or Buprenorphine@30 µg/kg bwt. provided safe general anaesthesia.
- Sub-Xiphoid space in dorsal recumbency, right intercostal space in left lateral recumbency during ultrasonography were determined to be the ideal acoustic windows for establishing

value of hepatic vein damping index in normal healthy dogs. Hepatic vein waveform pattern is the reliable non-invasive modality for the assessment of liver dysfunction; the pattern was monophasic in dogs > 4 month and tri-phasic in older healthy ones. It was also determined that the Portal Vein to Aorta ratio (PV/A) were age and weight dependent more than the gender or breeds of dogs and ranged from 0.83-0.91.

- In an echocardiography study on dogs, all linear and cross-sectional measurements obtained from two-dimensional echocardiographic evaluation using different tomographic planes viz. right parasternal long axis, right parasternal short axis, left parasternal long axis and left parasternal apical long axis views were correlated positively and significantly ($P < 0.001$) with each other.
- The “Modified Morgan’s conjunctival pocket technique” used for the repositioning of the prolapsed third eyelid gland in mild to moderate cases of “Cherry eye” condition in dogs proved to be a simple and reliable surgical technique with a success rate of 92.3%. The medial canthoplasties in Pugs and Rhytidectomies in St Bernard breeds of dog were the effective alternatives. In addition, ultrasonographic biometry of lens helped in decision making for selection or rejection of clinical cases of cataract in dogs.
- In a study on dental conditions in dogs, 90% of cases of advanced stages of periodontal disease responded positively to dental extraction (exodontics). The most common radiological pattern of bone loss upon intraoral radiography was horizontal bone loss (around the incisors and mandibular premolar region) followed by vertical bone loss.

Veterinary Parasitology:

- *Rhipicephalus microplus* (Acari: Ixodidae) is a tick species of economic significance that afflicts cattle populations throughout the tropical and subtropical regions. The acaricide resistance status against *Rhipicephalus microplus* (Acari: Ixodidae) for regularly used acaricide classes viz. synthetic pyrethroids namely deltamethrin, macrocyclic lactones (ivermectin) and formamidines (amitraz) was evaluated in twelve districts of HP. The resistance ratios (RR_{50} and RR_{95}) values against deltamethrin, amitraz and ivermectin were evaluated and were indicative of development of multi-acaricidal resistance status of ticks in the northwest Himalayan region.
- The blood samples (n=119) from cattle and buffaloes suspected for haemoprotozoan parasites animals were screened through PCR and revealed prevalence of *Babesia bigemina* (10.08%), *Anaplasma* (7.56%), *Theileria* sp. (5.04%), *Trypanosoma evansi* (0.84%) and mixed infections with *Anaplasma*, *Babesia* and *Theileria* (24.36%). In dogs, Babesiosis was major blood protozoan disease followed by Ehrlichiosis and hepatozoonosis.
- Around 1325 faecal and blood samples of various species of animals including cattle, buffalo, sheep, goat, dog, cat, horse and wild animals were screened for diagnosis of various parasites. The overall prevalence of parasitic diseases was recorded to be 37.35%.

In bovines the prevalence of parasitic diseases was found to be 38.53%. In sheep and goat, strongyle infection was recorded in majority of clinical samples.

- A protostrongylid lung worm, *Varestrongylus* was found in the bronchi and bronchioles in slaughtered hill goat was the first record of its detection in the north western Himalayas.
- *Cymbopogon citratus* syn lemon grass had a very high larvicidal activity against *Boophilus microplus* tick of cattle.
- The anthelmintic properties of Seabuckthorn (*Hippophaerhamnoides L.*) assessed *in vitro* against *Haemonchus contortus* eggs through the Egg Hatch Assay appeared to be promising which, however, and treating *H. contortus* infections in small ruminants. These results merit further *in vivo* evaluations of the plant's potential use as an anthelmintic agent.

Livestock Product Technology:

- On Sensory evaluation meat quality of broilers supplemented with turmeric, garlic and ginger extracts showed excellent colour, very desirable flavour, tenderness, juiciness and overall very much acceptable by the consumers..

Veterinary Public Health:

- Validation of QuEChERS-HPLC-UV protocol for determination of antibiotic Residues in Yak, Dzomo and hill cattle milk.
- Mathematical modeling for consumer's health risk assessments based on antibiotics detected in milk was done.

Fisheries:

- Chemical profiling of *Camellia sinensis* leaf extract and *Rhododendron* leaf extract was done by Preliminary biochemical composition & Gas chromatography-mass spectrometry (GC-MS) for the comparative evaluation of their phytoconstituents and major components. The qualitative test revealed the presence of Alkaloids, Saponins, Flavonoids, Terpenoids, Glycosides and Tannin represented about 82.05% and 88.13% of the total extract, respectively. Notably, carbohydrates and saponins were absent in the former and latter group of plants.
- Feed with 5 gram of tea extract /kg of feed (Feed 1) and 10 gram tea extract / kg feed (Feed 2) and control feed was prepared did not reveal any change in proximate analysis constituents. However, more mean weight as compared to control and highest gain in weight was observed in group fed with feed 1 followed by feed 2 and than control show that it has positive effect on the growth of the fish.
- Hematology and biochemical parameters were studied to see the immune-stimulant effect of tea extract on fish. In hematological parameters Hb, PLT, MPV, PDW and PCT was found to increase significantly. Under biochemical parameters Total protein was found to increase significantly in feed two. Value of SGOT was found to increase in both group feed with feed 1 and feed 2. No significant increase in the creatinine level was found, on the other hand BUN and ALP level was found to increase in treated group as compared to the control group but the change was not significant.

Community Science:

Food science and Nutrition:

Value added products from millets

- Micronutrient and fiber rich biscuits can be prepared by supplementing 30 percent roasted finger millet and foxtail millet flour. Roasted pearl millet and sorghum can be supplemented @ 25 and 30 percent in cookies. In multi millet cookies roasted finger millet, little millet, foxtail millet, pearl millet and sorghum flours can be supplemented up to 35 per cent. Low calorie baked bajra crackers can be prepared by using 50 per cent pearl millet flour.
- Roasted finger millet, pearl millet and little millet flours can be used @ 20 per cent in different dry cakes. Multi millet bread can be prepared by supplementing 25-30 per cent mixed millet flours (finger millet, little millet, foxtail millet, pearl millet and sorghum flour).
- Nutritious millet *pinni* and *ladoos* can be prepared by using finger millet and foxtail millet.
- The kodo millet grains roasted for 10 minutes at 110⁰C, soaked for 36 hours and germinated at 25⁰C for 48 hrs were found best in terms of nutritional profile. The processed grains were dried at 45⁰C for 8 hrs to bring the final moisture content to 7–8 per cent and were ground to produce flour of uniform particle size (60 mesh). A roti-mix was standardized supplementing 30 per cent of processed kodo millet.

Formulation and evaluation of processed foxtail (*Setaria italica*) millet food products

- The foxtail millets were given two treatments *viz.*, roasting and germination. The composite flour was prepared involving 40% wheat, 30% rice and 30% soyabean flours and was used to prepare cookies along with the flour of processed foxtail millet. Cookies were prepared with 100% wheat flour, 100% composite flour as control and six treatments which included composite flour and differently treated foxtail millet flour in 20, 40 and 60% when composite flour decreased from 80 to 40%. The cookies which were incorporated with processed foxtail millet @ 60% increased the nutritional parameters and decreased the antinutritional parameters such as phytates and tannins.

Quality evaluation and utilization of adzuki bean (*Vigna angularis*) for specialty health foods

- Various health-based food products *viz.*, pinni, mathri, cookies, cake, biscuits, nutri-bar, protein shake powder, breakfast cereals, pasta and vermicelli were prepared from adzuki bean flour as well as protein isolates and concentrates extracted from adzuki bean flour. Adzuki bean milk was also standardized.
- Starch extracted from HPU-51 showed high amylose content making it an appropriate ingredient for diabetic people as it inhibits increase in blood glucose levels, also it had good pasting properties making it a potential ingredient for a variety of food formulations. The soup premix was standardized by utilizing the starch extracted from the adzuki bean flour.

Utilization of beetroot (*Beta vulgaris L.*) juice and pomace in functional beverages and convenience food products

- Beetroot pomace can be recovered @ 41.56 per cent after juice extraction from whole beetroots. Protocols for dehydration of beet root pomace using solar dryer, oven dryer and vacuum dryer were standardized. Beetroot pomace powder with maximum retention of betalain content can be prepared in vacuum drier (50⁰C for 3-4 hours). Fresh beetroot pomace jam and toffee can be prepared by blending with papaya pulp @ 50 and 25 per cent.
- Extruded products, such as pasta and breakfast cereals can be formulated using dehydrated beetroot pomace at 30 and 10 per cent levels.

- **Beetroot appetizer:** The beetroot appetizer was prepared by blending beetroot juice with aloe vera juice and chia seeds along with spice extract. The spice extract was prepared by standardizing the concentrations of water, ginger juice, mint juice, black salt, cumin seed powder, and black pepper powder. A syrup was prepared by dissolving 30 g of sugar and 1 g of citric acid in 25 ml of water, which was subsequently cooled. To this syrup, 20 ml of the spice extract was added, followed by 25 ml of beetroot juice and 10 ml of aloe vera juice. Additionally, 10 g of soaked chia seeds were incorporated. To ensure preservation, sodium benzoate was added at a concentration of 600 ppm per liter.
- **Beetroot energy drink:** The energy drink was formulated by blending beetroot juice, litchi juice, pear juice, and *ashwagandha* extract. The *ashwagandha* extract was prepared by boiling 20 g of *ashwagandha* leaves in 100 ml of water until the volume was reduced by half, yielding 50 ml of extract. A syrup was prepared by dissolving 7 g of sugar and 0.2 g of citric acid in 60 ml of water, which was then cooled. Into this syrup, 10 ml of beetroot juice, 10 ml of litchi juice, and 10 ml of pear juice were added, along with 5 ml of *ashwagandha* extract. For preservation, sodium benzoate was included at a concentration of 600 ppm per litre.

Nutritional and functional characterization of flaxseed (*Linum usitatissimum*) based functional baked products

The cake was prepared by incorporating flaxseed gum as an egg substitute in different proportions of 20, 30 and 40 per cent. The amount of crude protein, crude fat, total ash and energy in developed cakes increased with the increased amount of flaxseed gum being incorporated, whereas carbohydrate and antinutritional properties content decreased whereas the antioxidant properties increased. The organoleptic scores were in acceptable limits in terms of color, sponginess, flavour, texture, taste and overall acceptability at different levels of incorporation (20, 30 and 40 per cent) of flaxseed gum. The highest score for the overall acceptability for flaxseed gum based cake was 8.15 by adding 40 per cent of flaxseed gum extracted from whole flaxseed and from the variety *Nagarkot* over *Surbhi*. The study clearly demonstrated that flaxseed gum can be successfully incorporated having good acceptability up to 40 per cent.

Protocol on post-harvest treatments of 1-MCP (1-Methylcyclopropene) on apple to analyze the shelf life enhancement

The post-harvest quality of apples treated with MCP (1-Methylcyclopropene 0.18% Tablet) under refrigeration conditions after 180 days of storage intervals was analysed. The quality parameters and sensory attributes of apples treated with MCP (1-Methylcyclopropene 0.18% Tablet) Double Dose (2.4 g. Tablet/ m³) improved and enhanced the shelf life up to 180 days under refrigerated storage, however showed statistical similarity with apples treated with 1-MCP (1-Methylcyclopropene 0.18% Tablet) Standard Dose-ALSC (1.2 g. Tablet/ m³). Whereas scores for quality attributes and sensory parameters declined in the control samples when compared with the MCP treated samples.

Increasing awareness of nutrition and health amongst school children

A total number of 1370 students (769 boys and 601 girls) from 6th standard to +2 standard were imparted nutrition education in a six module schedule and five numbers of Government High/ Senior Secondary Schools were covered in Una and Kangra districts. The performance was good where knowledge increment was 41.20% from 39.01%, increment in attitude was 43.15% from 41.50% and increment in practices was 45.64% from 42.67%.

Human Development and Family Studies

- **Dynamics of drug abuse and addiction in Kangra and Kullu districts of Himachal Pradesh: Extent, pattern and prevalence**

About 41.4% of the sample were substance users in which 64.5% abused alcohol as a single drug as well as multiple drug. In Kullu district, 34.0% respondents were substance users and about 74.1% of them were using alcohol. In Kangra district, nearly half of the sample i.e. 48.8% of the respondents were substance users and about 59.8% of them were tobacco users. About 37.4% of the sample had moderate level of drug awareness. There was an extremely significant association found between age, peer pressure, substance used by parents, respondent's attitude towards drug abuse/use and bad company with prevalence of drugs at 1% level of significance. The drug prevalence and drug awareness differences with regard to gender, type of study institute and type of educational institute were found significant at 1% and 5%.

- **Assessment of livelihood status of farm women and appropriate interventions for enhancement of livelihood**

- A sample of 800 farm women was selected out of which 400 were from Mahila Kisan Sashaktikaran Pariyojna (MKSP) adopted and 400 were from MKSP non adopted districts i.e. Kangra and Mandi districts of Himachal Pradesh. Regarding Food and Nutrition Security the mean values of MKSP was 0.73 ± 1.09 and were higher when compared with NMKSP (0.69 ± 1.05) and fell under high category.
- Similar was the trend in case of dietary diversity score. The mean scores in MKSP (0.52 ± 0.97) were higher than NMKSP (0.47 ± 0.89) on financial security. The overall Livelihood Security Index was high for both MKSP and NMKSP but the mean values were less in NMKSP.

Textiles and Apparel Designing:

- Refinement in the Developed Technologies on: Plant fibre processing and product development, Eco-holi Gulal, designed eco-friendly bags and trainings were imparted to interested farm women / artisans for adoption / skill upgradation.

Family Resource Management:

- Data collection regarding vulnerability frame work for climate change and drudgery reduction for women in agriculture in eight villages of two districts (Kangra and Mandi) of Himachal Pradesh.
- The tools identified for vegetable cultivation and nutria smart garden under *Poshan Abhiyan* were transferred in the field and were appreciated and adopted by the farm women. Conducted ergonomic interventions of V weeder and improved weeder in maize field under AIRCP on "Women in Agriculture". Impact analysis was done and the results were analyzed statistically which showed significant results.
- Master trainers (2) identified for imparting knowledge to the farmers of their respective and surrounding villages regarding drudgery mitigation tools.

Extension Education and Communication Management:

- Development of Repository of database to Analyze the Dynamics and Role of Women in Agriculture and Allied sectors in selected Agro- Ecological Regions aimed to study women's participatory, supervisory and decision making roles in crop, livestock, fishery and forestry sectors, Mandi, Kullu, Bilaspur and Kinnaur districts of Himachal Pradesh were selected. From each district two blocks were selected viz., Chauntra and Gohar from Mandi district, Nagar and Banjar from Kullu district, Jhanduta and Sri Naina Devi from Bilaspur district and Kalpa and Nichar from Kinnaur district. A sample of 150 farm women from each block was selected thus comprising of 300 from each district and 1200 from the state.
- Out of 1200 women farmers, 930 were engaged in cultivation of cereal crops. Women were found largely involved in retention of farm produce for consumption (57.00%), weeding (55.33%) and nursery raising (51.42%). Women's decision making role alone was found more in activities like retention of farm produce for consumption, weeding and retention of farm produce for seed as reported by 59.00, 46.34 and 34.00 % of the women, respectively. Regarding post-harvest management, women's highest participation was observed in cleaning and storage of the produce. Women took most of the decisions related to drying (59.14%), storing of the produce (57.96%) and cleaning (50.54%). Horticulture/ vegetable cultivation were carried by all the farmers studied in the state. Drying was the activity where majority of the women (81.75%) reported their alone participation followed by hoeing and weeding (53.00%) and seed bed preparation (52.00%). Flower cultivation was reported by 50 women farmers of Gohar block of Mandi District. They grow *Carnations, Gladiolus, Marigolds, Chrysanthemum, Lilioms, Eustoma, Tulips, Gerbera, Gypsy* etc. Sericulture was done by 254 women of selected districts. Women's participation alone was found highest in almost all sericulture activities. Out of the 1200 women, 749 reported that they used to go to forests for collection of different products. More dependency and participation was observed from Kinnaur district in forestry activities. Fishery activity was found to be performed by 300 women farmers of Bilaspur district.

Basic Sciences:

- Isolated rhizobacteria (20) with multifarious plant growth promoting activities from Lahaul, Spiti and Kinnaur regions of Himachal Pradesh were characterized based on 16S rRNA gene analysis and the sequences were deposited in NCBI GenBank.
- The physico-chemical characterization of honey samples collected from different locations of Himachal Pradesh and adjoining areas of J&K and Punjab states varied in values of quality characteristics that ranged between 3.85 ± 0.16 to 5.63 ± 0.01 for pH, **for sucrose**, 34.65 ± 0.09 to 42.06 ± 0.24 for acidity, 66.95 ± 0.62 to 70.79 ± 0.55 for total reducing sugars and 1.19 ± 0.03 to 1.47 ± 0.02 for F:G.
- Metagenomic analysis of cow dung and *Jeevamrit* bioformulations of different cow breeds revealed that taxonomic distribution at 5 top phylum level were dominated by Bacillota, Bacteroidota, Actinomycetota, Pseudomonadota, Verrumicrobiota in cow dung and *Jeevamrit* bioformulation irrespective of indigenous and exotic breeds. Higher Shanon and Simpson index in case of Sahiwal dung followed by Pahari and Jersey, whereas, in case of

Jeevamrit bioformulations, Jersey cow showed higher Shanon and Simpson index followed by Pahari and Sahiwal. InvSimpson index was higher in Sahiwal dung followed by Jeevamrit prepared from Jersey and Jersey cow dung.

- In a study for isolation and screening of halophilic plant growth promoting rhizobacteria 984 culturable microbes were explored around the salt mines of Himachal Pradesh including alkaline soil from Spiti valley at different salt concentrations. Out of these, 35 halophilic bacterial isolates exhibited both EPS production and biofilm formation whereas 27 halophilic bacterial isolates showed maximum PGP traits i.e., nitrogen fixation, P- solubilization, siderophore and IAA production and enzyme activity. Selected halophilic bacterial isolates indicated growth inhibition against *Fusarium oxysporum*, *Pythium aphanidermatum*, *Rhizoctonia solani* and *Sclerotinia sclerotiorum*, respectively. These antifungal properties of halophilic bacterial isolates will be helpful in protecting the plants from soil borne fungal pathogens, maintaining plant health and productivity in saline stressed soils.

Item No.4: To place before the Council the list of research projects sanctioned since January 31, 2023 to date

The summary of research projects sanctioned from January 31, 2023 to date is given below for kind perusal of the Hon'ble members of the Research Council:

Summary of research projects sanctioned from 31.01.2023 to date

Name of the College/ Department/ College/ Station	No. of Project sanctioned	Total Budget (Rs. In lakh)	Funding Agency(ies)
College of Agriculture			
Genetics and Plant Breeding	1	29.53	BRNS, BARC, Trombay, Mumbai
Agronomy	9	91.932	M/S Rainbow Agrosiences, Mumbai; IFFCO India Ltd.; M/s Jivagro Limited, Mumbai; Corteva Crop India Private Limited, Hyderabad; ICAR, Modipuram (Meerut) M/S RRD Oil & Fats Private Limited, Haroli (Una); M/S/ Pushpa J Shah, Gujarat; M/s JU Agri Sciences Pvt. Ltd., Noida (UP); M/S Rainbow Agrosiences Private Limited, Mumbai
Soil Science	2	39.15	DBT, New Delhi; IFFCO, Shimla
Entomology	1	25.00	RKVY
Plant Pathology	1	9.00	RKVY
Vegetable Science and Floriculture	1	9.50	RKVY

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Agricultural Engineering	1	9.84	ICAR-CIAE, Bhopal
Horticulture and Agroforestry	1	45.20	RKVY
Seed Science and Technology	1	23.50	ICAR, New Delhi
Organic Agriculture and Natural Farming	1	22.72	RKVY
Agricultural Biotechnology	2	46.92	Biodiversity International, New Delhi; ICAR, New Delhi
Total	21	352.292	
College of Veterinary and Animal Sciences			
Animal Nutrition	1	5.00	RRD Oil and Fats Limited, Haroli (Una)
Animal Genetics and Breeding	1	48.91	DST (SERB), New Delhi
Veterinary Microbiology	1	3.30	M/S Shine Biotech Pvt. Ltd., Faridabad
Veterinary Pathology	2	7.55	HIMCOSTE, Shimla; Zenex Animal Health India Pvt. Ltd., Baddi
Veterinary Gynaecology and Obstetrics	1	6.00	HIMCOSTE, Shimla
Veterinary Parasitology	1	35.89	DST, New Delhi
Livestock Farm Complex	1	38.00	Deptt. of Animal Husbandry, H.P. Govt.
Livestock Production Management	1	46.00	Deptt. of AH & Dairying (NLM), New Delhi
Veterinary Clinical Complex	3	5.81	M/S Ayurved Limited, Baddi & Zenex Animal Health India Pvt. Ltd., Baddi
Veterinary and Animal Husbandry Extension Education	5	27.04	ICAR-IASR, New Delhi, NIF, Gandhinagar
Fisheries	2	10.00	Deptt. of Fisheries, Govt. of H.P.
Total	19	233.50	
College of Basic Sciences			
Microbiology	1	46.50	DST (SERB), New Delhi
Total	1	46.50	
Research Centres /Stations/KVKs			
RWRC, Malan	2	10.52	PPV & FRA, New Delhi & RKVY
Total	2	10.52	
Grant Total	43	642.812	

The detail of research projects sanctioned from 31.01.2023 to date is annexed as ANNEXURE-I.

Item No. 5: To place before the Council the results of thesis of Ph.D. students from 31.01.2023 to date

College/ Department	Thesis approved
College of Agriculture	
Department of Genetics and Plant Breeding	17
Agronomy	15
Soil Science	14
Entomology	04
Plant Pathology	03
Vegetable Science	05
Agricultural Economics	04
Total	62
College of Veterinary and Animal Sciences	
Animal Nutrition	01
Veterinary Surgery and Radiology	01
Total	02
College of Community Science	
Food Science Nutrition and Technology	03
Total	03
Grand Total	67

The detail of Ph.D. thesis abstracts w.e.f. 31.01.2023 is annexed as ANNEXURE-II

Item No. 6: New items put forth by the Hon'ble members of the Research Council

The Director-cum-Warden of Fisheries, Bilaspur:

1. To Evolve formulation of cheap pelletized feed with locally available ingredients without compromising with the quality, since it will directly affect the FCR (Feed Conservation Ratio).
2. Identifying suitable fish varieties for stocking in High altitude lakes in H.P.

Dr. S.K. Guleria, Ex-Member, Research Council:

- We have number of wheat varieties available in seed production Chain. But most of the varieties are not having good chapati making quality. We should give more attention to identify wheat germplasm for this trait along with resistance for different rusts.

Item No. 7: Any other item (s) with the permission of the Chair