

RESEARCH ACHIEVEMENTS & FUTURE RESEARCH PRIORITIES

Kharif and Vegetable Crops

Rainfall pattern and crop performance during *Kharif*, 2023 in Himachal Pradesh

The state of Himachal Pradesh receive an average rainfall of 734.4 mm during *kharif* (1st June to 30th September) season. During *kharif*, 2023, the total rainfall received was 876.4 mm which was 19% above normal (Table 1). The onset of monsoon was on 24th June against its normal date of 25th June. Among different districts Kangra district received rainfall of 1810.5 mm, Sirmaur 1680.7 mm, Mandi 1587.5 mm, Solan 1500.3 mm, Hamirpur 1397.6 mm, Bilaspur 1335.5 mm, Shimla 1034.3 mm, Una 1003.7 mm, Chamba 893.0 mm, Kullu 758.3 mm, Kinnaur 287.0 mm while lowest rainfall of 192.5 mm was received in Lahaul & Spiti district.

The total rainfall received in the state during May and June this year was 116.8 mm and 121.7 mm which was 85 % and 20 % above normal for these months, respectively. The excess rainfall received in the month of May 2023 resulted in damage to the standing wheat crop in middle and upper areas of the state. Also in certain pockets the harvested wheat crop was adversely impacted resulting in blackening of wheat panicles. The excess rainfall also resulted in the increased incidence of late blight in onion and potato besides resulting in increased fungal attack on mango inflorescence. The hailstorm observed in large parts of the state also had an adverse impact on different horticultural crops like apple, plum, pear, peach as well as other stone fruits. The heavy pre monsoon showers received in the month of May and June 2023 ensured timely sowing of maize in the lower and middle areas of the state.

During July 2023, 437.5 mm rainfall was received in the state which was above normal by 71%. Ten out of 12 districts received excess (≥ 20 %) rainfall whereas Kangra and Lahaul & Spiti districts received normal (-19 to +19 %) rainfall. This excess rainfall received in July 2023 resulted in significant damage to maize and other *kharif* crops. There were reports of damage to the tomato crop in Mandi and Solan districts as well as in pea crop in Lahaul & Spiti. Significant damage was also reported in apple as well as other fruit crops in different districts of the state (Kullu, Shimla, Kinnaur, Mandi and Lahaul & Spiti districts).

During August 2023 a total of 247.6 mm rainfall was received in the state which was below normal by 4 %. Five of the twelve districts of the state (Bilaspur, Hamirpur, Mandi, Shimla and Solan) received excess (≥ 20 %) rainfall while two districts (Kangra and Una) received normal rainfall (-19 to +19 %) during August 2023. Four districts namely Chamba, Kinnaur, Kullu and Sirmaur received deficit (-20 to -59 %) while

Lecture delivered by Dr. S.K. Upadhyay, Director of Research, CSK H.P. Krishi Vishvavidyalaya, Palampur on May 03, 2024 on the occasion of Agricultural Officers' Workshop on kharif and Vegetable Crops held at CSK HPKV, Palampur on May 3-4, 2024.

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Lahaul & Spiti district received scanty (-60 to -99 %) rainfall in this month. Highest single day rainfall of the season 220.0 mm was received at Palampur on 14th August 2023.

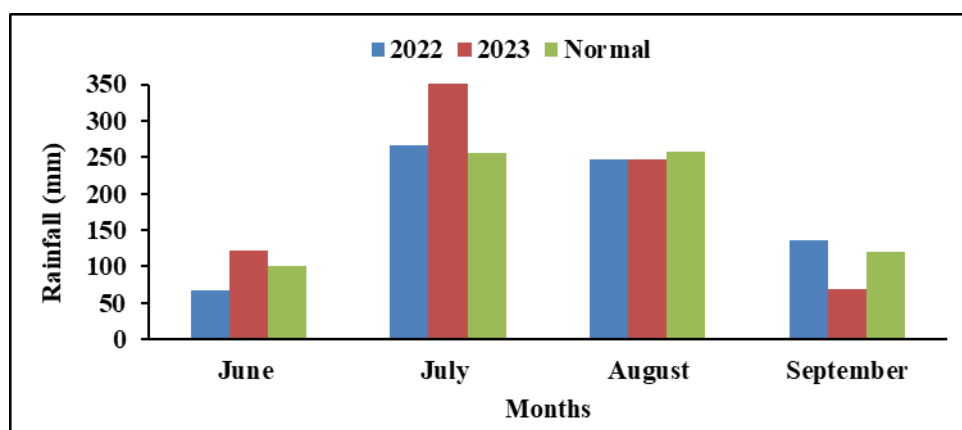
During September 2023, 69.6 mm rainfall was received in the state which was below normal by 42 %. Four out of 12 districts (Bilaspur, Hamirpur, Kangra and Una) received normal (-19 to +19 %) rainfall while four districts (Chamba, Kullu, Mandi and Sirmaur) received deficit (-20 to -59 %) rainfall whereas four districts (Kinnaur, Kullu, Shimla and Solan) received scanty rainfall (-60 to -99 %). This lower rainfall received during September 2023 had an adverse impact on the maize crop in certain districts.

As per the data available from the State Disaster Management Agency (SDMA) there were 52 incidences of cloudburst (highest in Kullu), 83 incidents of flash floods (highest in Kangra) and 5480 incidents of landslides (highest in Kullu) were reported during the entire monsoon / *kharif* season. Large parts of the Kangra district (downstream to Pong Dam) inundated due to release of water resulting in large scale losses to the crops. Also the release of water from Kol dam has also inundated areas in Bilaspur and Mandi districts causing losses to different crops. Heavy to very heavy rainfall has also resulted in damage to crops in almost all the districts of the state.

Monsoon withdrew from the state on 06th October against its normal withdrawal date of 24th September.

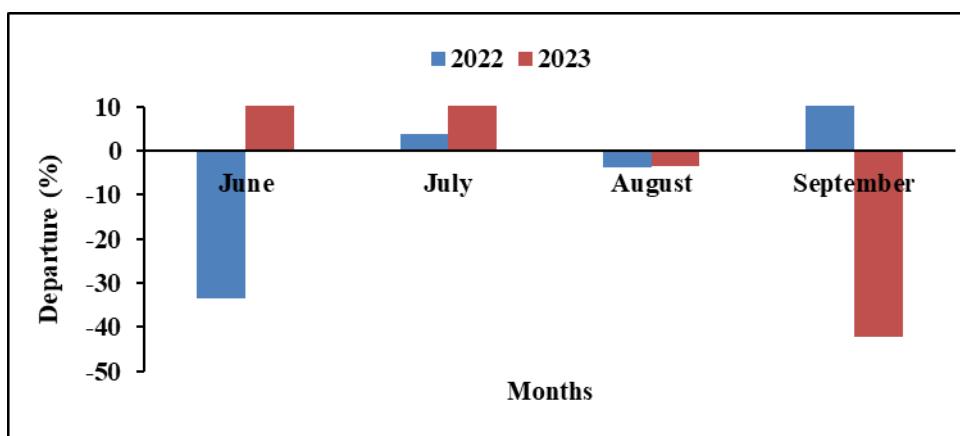
Table 1. Monthly rainfall during *Kharif*, 2023 in Himachal Pradesh as compared to *Kharif*, 2022

Month	June	July	August	September	Seasonal total
Actual (mm)					
2022	67.2	266	247.4	135.8	716.4
2023	121.7	437.5	247.6	69.6	876.4
Normal	101.1	255.9	256.8	120.6	734.4
Departure (%) from normal					
2022	-34	4	-4	13	-2
2023	20	71	-4	-42	19



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RESEARCH HIGHLIGHTS: KHARIF, 2023

Significant research accomplishments for different ongoing programmes of the University during Kharif-2023 are as under:

Rice:

- Rice variety HPR 2865 (Him Palam Dhan 3) has been released for low Elevated Hills of HP and Uttrakhand from CVRC. This variety gave an average yield of 38-40q/ ha. It possesses long bold grains and is moderately resistant to leaf blast.
- HPR 3201 (Him Palam Dhan 4) has been released for entire HP and Uttrakhand from CVRC. This variety gave an average yield of 40-45q/ ha yield. It possesses long slender grain type. It is moderately resistant to leaf blast.
- Nucleus Seed (Stage II) of 127.320 kg of 11 rice varieties in seed chain was produced.
- Breeder Seed of 67.67 qtls. against DAC indent of 38.00 qtls. of 9 rice varieties in seed chain was produced.
- Rice hybrids Vijetha 100 (54.61q/ha), AHR- 8213 (50.75(q/ha) and Star-797 (50.02q/ha) had performed well in both the years in Zone I and hence recommended for cultivation in Zone I of the state. Vijetha-100(55.47q/ha) AHR-8213 (53.47q/ha) and Star-797v (49.60 q/ha) have been recommended for cultivation in Zone –II.

Maize:

- One medium maturing variety '**Him Palam Maize Composite 2 (L 316)**' has been released and notified by CVRC, New Delhi (S.O. 1056(E).55 dated 06.03.2023) for cultivation in Himachal Pradesh, Union Territories of Jammu & Kashmir, Uttarakhand and North East Hills. The variety had yield of 65.65 q/ha, moderately resistant to turcicum leaf blight, bacterial stalk rot and stem borer.

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- Early maturing maize hybrid Him Palam Sankar Makka 3 and medium maturing maize composite Him Palam Maize Composite 1 have been approved by Research Evaluation Committee on 16.07.2022 for inclusion in Package of Practices
- Two medium and early maturing maize hybrids viz., KGH-22-01 (84.00q/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) has been inducted in NIVT, 62 and NIVT, 63 respectively during *kharif*, 2023
- Twenty eight maize hybrids supplied by various private seed 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.

Soybean:

- One soybean variety '**Him Palam Soya-1 (Himso-1689)**' has been released and notified by CVRC, New Delhi (S.O. 1056(E).103 dated 06.03.2023) for the Central Zone of India comprising the states of Madhya Pradesh, Bundelkhand region of UP, Rajasthan, Gujarat and Marathwada and Vidarbha region of Maharashtra. The variety was tested for four years and had the yield of 2078 kg/ha which was 4.2% higher than the best check NRC-86 (1995 kg/ha). It is moderately resistant to charcoal rot, anthracnose, target leaf spot and RAB diseases.
- In Soybean **Station trial**, 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 giving 1989 kg/ha, 1871 kg/ha, 1866 kg/ha, 1619 kg/ha 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).

Vegetable Crops:

Systematic improvement work of potential vegetable crops was initiated in Himachal Pradesh after the establishment of Department of Vegetable Science and Floriculture in 1976

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at Chambaghat, Solan under HPU, Shimla. The Department of Vegetable Science and Floriculture, CSKHPKV, Palampur was established during 1986. The state of Himachal Pradesh has progressed a lot in the field of vegetable cultivation since then. During the last 50 years, there is nearly 300 per cent increase in area (presently more than 88 thousand hectares) and production (presently more than 18 lakh tones), generating a revenue of more than ₹4000.0 crores which account for more than 3.3 per cent contribution to state GDP. Presently, the productivity of vegetables in HP is more than that of the national average productivity.

The Department of Vegetable Science and Floriculture, CSKHPKV, Palampur was established during 1986 whereas; M.Sc. and Ph.D. level degree programmes were started during 1987 and 1991, respectively. The Department of Vegetable Science and Floriculture, CSKHPKV, Palampur is one of the major stakeholders contributing significantly in the field of vegetables improvement, production and seed production in the State. Significant achievements made in vegetable production are:

- A total of 38 varieties of different vegetable and spice crops have been developed and released in the state for commercial cultivation.
- Pioneering work has been done in the development of coloured varieties of broccoli, onion and radish for the first time in the state. Resistance breeding programme on bacterial wilt of solanaceous vegetables and powdery mildew in garden pea has got recognition at the national level. Many lines are in testing phase of AVT-I/IET under AICRP on vegetable crops. Low chill requiring superior cytoplasmic male sterility (CMS), self-incompatible (SI) inbred lines in cabbage, CMS lines in cauliflower and broccoli; GMS lines in chilli; gynoeious lines in cucumber and many heterotic combinations in different vegetable crops have been developed and are being exploited for commercial hybrid development.
- Garden pea variety Him Palam Matar-1 (DPP-SP-22) in 2021 and Radish variety Him Palam Mooli-1 (DPR-1) in 2022 have been identified for Zone-I of the country through AICRP (VC).
- As many as fourteen private companies signed Memorandum of Agreement (MoA) for non-exclusive rights/license to produce seed of garden pea variety 'Him Palam

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Matar-1 while two companies did the same for French bean variety Palam Mridula, tomato hybrid, Palam Tomato Hybrid 1 and onion variety Palam Lohit.

- The work done on research in hydroponics and protected cultivation has got recognition at national level. Bacterial wilt resistant hybrid of tomato, parthenocarpic cucumber and cherry tomato has been released for cultivation under protected conditions in the state.
- Many production technologies for commercial cultivation of vegetable crops both under open and protected environments; portable low poly-tunnel for raising off-season nursery of vegetables and hi tech nursery raising have been standardized and included in Package of Practices for further adoption by the farming community.
- In an approach for double haploid production in cabbage, the complete protocols (i.e. callus induction, shoot induction, root induction, hardening of plants and induction of double haploidy through colchicine treatment) have been standardized. During *Rabi* 2023-24, a total of 40 in-vitro regenerated cabbage haploid plants have been established in the field conditions. After initiation of flowering, the ploidy level shall be confirmed and plants showing double haploidic status shall be maintained by selfing for development of inbred lines.
- 2019/CABVRAR-5 (115 q/ha) of red cabbage, 2021/CABVAR-2 (197.53 q/ha) of white cabbage gave the maximum head yield
- Under protected cultivation, tomato genotype DDBWR-2 produced significantly higher yield (2.7kg/plant) and capsicum genotype DDCY-1 produced (2.5kg/plant). Both genotypes exhibit high resistance to bacterial wilt. Additionally, the capsicum fruits are yellow in colour with an average weight of 270 grams per fruit.
- The hybrid combinations Gyno-G-1(W) x Him Palam Kheera-2, PLPGY-08-A-G X Him Palam Kheera-1 and PLP-16 x Him Palam Kheera-1 were the top ranking combinations for protected cultivation.
- Two bacterial wilt resistant bell pepper lines (DPBWR-39 and DPBWR-3) out yielded standard check(s) with good horticultural and quality traits over the years.
- Over the years, Paprika line (DPPWR-4) out yielded standard check with resistance to bacterial wilt disease.
- Two yellow vein mosaic virus resistant okra lines (DPO-22 and DPO-98-01) out yielded standard check(s) with good horticultural traits.
- Introduced and evaluated red coloured, round and eight ridged okra.
- First white coloured onion variety for the state named as “Him Palam Shweta” was notified by Govt. of India
- Highly resistant garden pea line DPPPMPR-1/ APL 5-55 has been developed by marker-assisted backcross breeding followed by pedigree selection. The line has also

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shown complete resistance to geographically diverse isolates of powdery mildew under open field/ polyhouse and in vitro conditions.

- New cauliflower hybrids namely, DPCafH-3, DPCafH-5 and DPCafH-1 showed superior performance under evaluation trials at different stations and on-farm trials has been identified with hemispherical, retentive white curds, weighing 750g- 1kg with an average yield of 350-425 q/ha. Two hybrids namely, DPCafH-3 and DPCafH-5 are proposed for Initial Evaluation Trials (IET) under AICRP on Vegetable Crops which is one of the important step for release of variety/hybrids.
- The evaluation of GMS based chilli hybrids in station and on-farm trials (multilocation testing) across the state resulted in isolation of 4 superior hybrid combinations with erect (DPCH-2 and DPCH-4) and drooping (DPCH-5 and DPCH-10) fruit habit with an average yield of 300-425 q/ha
- Garden pea line DPP-SP-6 produced significantly highest pod yield (165.54 q/ha) which was about 7-10% higher than Him Palam Matar-1 and 12-15% over Pb-89.
- Snow pea genotype DPPEPP-15-1 (Him Palam Meethi Phali-1) produced highest pod yield to the extent of 220.46, 111.97 and 127.24 q/ha under conventional polyhouse, natural polyhouse and field conditions, respectively which was 30% higher than Arka Apoorva.
- Garden pea genotype 'DPP-89-10-1' with unique trait of multiple pods (3 pods/peduncle) have been isolated through hybridization that has medium long and lush green pods.
- Garden pea putative mutants namely, L-40-1014-1 and AP-0.3-129 and genotype DPP-SN-2 showed resistance to powdery mildew disease (1 score in scale of 5).
- Also, three garden pea genotypes namely, DPP-SN-22, DPP-SN-5 and DPP-SP-3 with long lush green pods found to have higher pod yield.

Fodder Crops:

- Four private sector Sorghum Sudan Grass (SSG) hybrids *viz.*, BMR Rocket, SUPER-22, Besst-711 and Nutra Red performed better in comparison to respective checks and were recommended for cultivation in Zone-I and Zone-II of Himachal Pradesh.
- Two private sector Bajra hybrids *viz.*, 4747 and MILKFEED GOLD performed better in comparison to respective checks and were recommended for cultivation in Zone-I and Zone-II of Himachal Pradesh.

Registration of varieties under PPV&FRA:

- Rice varieties HPR 2865 (Him Palam Dhan 3) and HPR 3201 (Him Palam Dhan 4) were registered with the PPV&FRA, New Delhi.
- Farmer variety Kalijhini grown in Kangra district got registration certificate from PPV&FRA, New Delhi.

Plant Genome Saviour Community Award:

- Kala Zeera Utpadan Sangh, Shong Distt. Kinnaur awarded with Plant Genome Saviour Community Award by PPV&FRA for the conservation of Kala Zeera.

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Plant Genome Saviour Farmer Recognition Award:

- Sh Garib Dass, Village Burli Kothi (Paprola) Distt. Kangra awarded with 'Plant Genome Saviour Farmer Recognition' award by PPV&FRA for the conservation of Local Kheera Germplasm.

Seed Production and Seed Technology

Nucleus Seed Production

- During *Kharif* 2023, a total of 12.306 q Nucleus seed of different crop varieties was produced by the University as detailed in (Table 2).

Table 2. Nucleus Seed (q) of cereals, pulses, oilseeds and vegetables crops produced by CSKHPKV during *Kharif* 2023

Crop	Variety/Hybrid	Total Nucleus Seed produced (q)
Cereals		
Maize	Him Palam Maize Composite-1, Him Palam Maize Composite-2, Girija, Bajaura Makka	0.40
Paddy	HPR 2612, HPR 2143, HPR 1068, HPR 1156, RP 2421, VL 221, HPR 2720, HPR 2880, HPR 2656, HPR 2795, Kasturi	0.89
Total Cereals		1.29
Pulses		
Arhar	Sarita	0.05
Blackgram	Him Mash 1, Pant U 19, UG 218	0.617
Cowpea	C-475, C-519	0.06
Moong	Suketi, IPM 02-3	0.12
Total Pulses		0.847
Oilseeds		
Til	LTK 4, PB Til-2	0.059
Soybean	Himsoya, Himso-1685, Himso-1689, Palam Soya, Hara Soya, Shivalik, Him Palam Hara Soya-1	10.11
Total Oilseeds		10.169

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Grand total	12.306
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Breeder Seed Production

- The University produced a total of 166.35 q breeder seed of cereals, pulses, oilseeds and vegetable crops during *Kharif 2023* (Table 3).

Table 3. Breeder Seed (q) of cereals, pulses, oilseeds and vegetables crops produced by CSKHPKV during *Kharif 2023*

Crop	Variety/Hybrid	Total Breeder Seed Produced (q)
Cereals		
Maize	Bajaura Makka, Girija, Him Palam Maize 2, Palam Sankar Makka 2, Baj popcorn	9.54
Paddy	HPR 2143, HPR 1068, HPR 1156, HPR 2720, HPR 2612, HPR 2795, HPR 2656, HPR 2880, Kasturi	67.67
Buckwheat	Sangla B1	0.85
Total Cereals		78.06
Pulses		
Cowpea	C-475, C-519	0.385
Mash	Plp 93, Kullu 4, Him Mash 1, UG 218, Pant U 19	25.48
Green gram	Suketi	0.27
Rajmash	Him 1, Triloki, Kanchan, Baspa, Jwala	4.62
Arhar	Sarita	0.85
Horsegram	HPK 4, VLG 1	1.44
Total Pulses		33.045
Oilseeds		
Soybean	Shivalik, Himso-1685, Himso-1689, Palam Soya, Hara Soya, Himsoya	47.15
Til	LTK 4, PB-Till No. 2	1.58
Total Oilseeds		48.73
Fodder		
Setaria	-	0.05
Fodder Maize	African Tall	2.95
Total Fodder		3.00
Vegetable		
Chilly	Surajmukhi	0.015
Okra	Palam Komal	3.50
Total Vegetable		3.515
Grand total		166.35

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Foundation Seed Production

- A total of 23.845 q foundation seed of cereals, pulses, oilseeds and vegetable crops was also produced during *Kharif 2023* (Table 4).

Table 4. Foundation Seed (q) of cereals, pulses, oilseeds and vegetable crops produced by CSKHPKV during *Kharif 2023*

Crop	Variety/hybrid	Total foundation seed produced (q)
Cereals		
Paddy	HPR 2612, HPR 1612, HPR 2795	2.50
Finger millet	VL 352, VL 379	0.78
Buckwheat	USDA 1, Uday	0.45
Total Cereals		3.73
Pulses		
Black gram	Him Mash 1, Mash 883, UG 218	13.64
Green gram	Suketi	0.26
Cowpea	C 475, C 519	0.245
Arhar	Sarita	0.60
Total Pulses		14.745
Oilseeds		
Til	LTK 4, Pb. Til-2	1.74
Toria	Bhawani	0.64
Total Oilseeds		2.38
Fodder		
Red Clover	PRC 3	0.02
Tall Fescue	Hima 1	0.35
Total		0.37
Vegetable		
Okra	Palam Komal, P-8	1.09
Chilli	Surajmukhi	0.02
Total		1.11
Potato	Kufri Himalini	1.51
Total Vegetable		2.62
Grand Total		23.845

Planting Material Production

- A total of 60,874 plantation material by numbers of fodder grasses, horticulture and vegetable was produced by CSK HPKV, Palampur during *Kharif 2023* (Table 5).

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Table 5. Total plantation material by numbers produced by CSK HPKV, Palampur during Kharif 2023

	Crop	Variety	Total plantation material (in lakhs)
Fodder Grasses	<i>Napier</i>	CO-5	25000
Horticulture			
	Pomegranate	Kandhari	647
	Kiwi	Allison	2000
	Total		2647
Vegetable			
	Tomato	Heem Sohna	6894
		Lal Sona	3000
	Cucumber	Malav/NS 404	1011
	Brinjal	Hybrid	3000
		Black diamond	2003
	Capsicum	Manhattan	368
		Sweet Pepper Excel	100
	Bitter Gourd	Aman	1116
	Bottel gourd	Sharda/ Victor	1577
		Surajmukhi	6894
	Cauliflower	Megha	2000
		White Bloom 1008	1000
		Charmant	1200
	Broccoli	Green Magic	4230
		Palam Samridhi	2000
	Pumpkin	-	691
	Sponge gourd	-	498
	Round gourd	-	1875
	Total		33,227
	G. Total		60,874

- A total of 70.00 q plantation material by quantity of different vegetable crops was produced by CSK HPKV, Palampur during Kharif 2023 (Table 6).

Table 6. Total plantation material by quantity (q) was produced by CSK HPKV, Palampur during Kharif 2023

Crop	Variety	Total plantation material (in q)
Turmeric	Palam Lalima	5.00
Ginger	Local	2.00
Elephant Foot Yam	Palam Zimikand-1	25.00
	Gajendra	25.00
Colocasia	Local	5.00
Greater Yam	Local	5.00
Rabi Onion	Palam Lohit	3.00
Total		70.00

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Seed Technology Research

- An experiment conducted on evaluation of seed quality attributes and storage potential of bio-fortified maize hybrids revealed that two bio-fortified hybrids viz., Pusa HQPM 1 Improved and VLQPM Hybrid-59 could maintain the germination percentage of 94.12 % and 95.38 %, respectively, above the IMSCS after six months of storage.
- Genetic purity of eight private sector maize hybrids and one bajra hybrid was ascertained using SSR markers and the DNA fingerprints library maintained.

Crop Production

❖ Identification of need based cropping systems for different agro-climatic conditions

Among different cropping systems during *Kharif 2023*, **okra**-turnip-tomato resulted in highest yield followed by **babycorn**-broccoli-frenchbean which is followed by **hybrid sorghum + hybrid bajra** – oats + berseem; however these two cropping systems were at par to each other. The fourth best treatment was **sunhemp**-vegetable pea –frenchbean. Likewise in case of net returns, **okra**-turnip-tomato resulted in significantly highest net returns. The 2nd best treatment in case of net returns was **babycorn**-broccoli-frenchbean.

❖ Development and validation of On-Station Integrated Farming System Model

In different cropping system **rice**-wheat cropping system resulted highest yield followed by **maize**- wheat and **soybean** – gobhisarson (Cropping system). In horticulture cum vegetable block **okra**-radish-garlic resulted in highest yield followed by **okra+soybean**-pea+coriander and **okra**-potato-frenchbean.

Photos

Nutrient and Water Management

- Ammonium oxalate proved most effective among different extractants used for Mo extraction.
- Critical molybdenum (Mo) concentrations were identified for french bean crop, guiding soil management.
- Critical limit of Mo in soil for French bean – 0.144 mg kg⁻¹
- Critical limit of Mo in French bean for optimum production – 6.17 mg kg⁻¹
- For okra fruit yield, seed priming with 0.05% B concentration coupled with 24 and 36 hours was optimal.
- Treatment combinations consisting of recommended or 125% of recommended N coupled with either two or three foliar feeding of Nano-N+ two foliar sprays of B @ 0.034% produced statistically similar yields in maize.
- Rice yield remained statistically similar with 125% and 150% of recommended dose of nitrogen (RDN), regardless of Nano-N foliar feeding frequency.

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- Conjoint application of FYM @ 10 t ha⁻¹ with 125% RDF yielded the highest rice production, comparable to Bio-FYM at 5 t ha⁻¹ with the same RDF.
- Significantly higher yields were observed in soybean (15.9 q ha⁻¹) with S application via bentonite at 60 kg ha⁻¹, respectively.
- Maize yield showed no significant difference with 125% and 150% of RDN, irrespective of Nano-N foliar feeding frequency. Similarly, combined application of Arka Microbial Consortium (AMC) at 11.25 l/ha with 125% RDF resulted in the highest maize yield, statistically similar to lower doses of AMC at the same RDF.
- The Long-term Fertilizer Experiment since 1972-73 on maize-wheat system showed that combining 100% NPK with FYM @ 10 t ha⁻¹ yielded the highest maize productivity.
- Periodic lime application with 100% NPK enhanced maize yield comparable to 100% NPK + FYM @ 10 t ha⁻¹.
- Using 50% NPK with FYM @ 10 t ha⁻¹ produced maize yields akin to 100% NPK alone.
- Sulphur application is crucial; omitting it led to significant maize productivity decline, necessitating sulphur-containing P fertilizer like single super phosphate.
- Overreliance on nitrogen from urea alone degraded soil health, resulting in zero maize productivity.
- Tomato under protected conditions benefits from NPK drip fertigation, with 25% applied as basal conventional fertilizer and 75% through water soluble fertilizers in 14 weekly splits.
- Similarly, strawberry under protection receives 25% NPK as basal and 75% through fertigation in 7 splits every 10 days, while for open cultivation, double shade plastic mulch and specific irrigation schedule are recommended along with the same fertigation ratio.
- Vegetable crops like cucumber and tomato under protected conditions can benefit from IPNS-based NPK drip fertigation, with 25% RDF applied as basal and 50% RDF through water soluble fertilizers in 10-14 splits at 5-7 days intervals along with liquid manure.
- In direct-seeded rice-wheat systems, irrigating to 1.0 ETc requirement and utilizing integrated nutrient management with 75% NPK inorganic, 25% through FYM, Azotobacter, and PSB seed treatment improve crop, water productivity, and soil health.
- For rainfed maize-wheat systems, combining conventional tillage with mulching, hydro seed priming, and integrated nutrient practices (50% organic + 50% inorganic) enhances crop and water productivity, profitability, and soil quality, including improved soil organic carbon and water storage.

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

Crop Protection

Disease Management

1. New fungicide i.e. CIX-3026 20% SC (w/w) (Pyraclostrobin 7.8 % + Cyproconazole 13.0 % w/v) was tested for its bioefficacy and found effective for the management of yellow rust in wheat.
2. New fungicide i.e. Fluopyram 250 g/l + trifloxystrobin 250 g/l SC (Luna sensation) was found most effective for the management of cucumber powdery mildew.
3. Seed treatment with tricyclazole @ 0.6 g/kg seed followed by two sprays of same fungicide @ 0.3g/l was found most effective against leaf blast in forage pearl millet which gave 77.3 % disease control with 12.89 % increase in the green fodder yield over check.
4. Two foliar sprays of propiconazole @ 1ml/l at 20 and 35 DAE was found most effective against foliar diseases (anthracnose, gray leaf spot and zonate leaf spot) in fodder sorghum which gave 45.73 % disease control with 23.38 % increase in the green fodder yield over check.
5. 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.
6. Trichoderma isolate OTS 5 was found most effective against Palampur isolate of *Drechslera avenae* causing leaf blight of oats with 56.96 per cent mycelial growth inhibition of the pathogen over control in dual culture assay.
7. For non-chemical management of white clover powdery mildew (*Erysiphe trifoliorum*), three foliar spray of dashparni @ 2% was found most effective with 40.0 per cent disease control.
8. 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.
9. Out of 26 soybean lines, seven lines (EC 308312, EC 393153, PK 25, UGM 77, Harder, EC 241778 and CAT 411A) have shown highly resistance against frogeye leaf spot (*Cercospora sojina*) and pod blight (*Colletotrichum truncatum*) diseases.

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10. Germplasm of mushrooms were collected from three districts of H.P. 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.

Insect-Pest Management

- Studies conducted to determine the direct and indirect effects of different insecticides on a biological control agent, the chrysopid predator, *Chrysoperla zastrowi sillemi* revealed that azadirachtin, cyantraniliprole, diafenthiuron, imidacloprid and spiromesifen were safe to eggs and larvae of *C. zastrowi sillemi* when applied at maximum field recommended rates. Whereas, thiamethoxam was found to be toxic to *C. zastrowi sillemi*. Adults of chrysopid predator were more sensitive to all the insecticides particularly to spiromesifen.
- Species profiling of scarab beetles undertaken in ten selected locations of Himachal Pradesh resulted in thirty-five species. the maximum diversity of beetles was evident at Palampur (19 species). *Holotrichia longipennis*, *H. sikkimensis*, *Brahmina coriacea*, *Brahmina flavosericea*, *Maladera thomsoni*, *Schizonycha* sp., *Anomala varicolor*, *A. lineatopennis*, *A. dimidiata*, *Melolontha furcicauda*, *M. indica* and *Polyphylla sikkimensis* were the predominant species of beetles in the state.
- Studies on termite fauna of Himachal Pradesh resulted in ten genera viz., *Archotermopsis*, *Neotermes*, *Stylotermes*, *Coptotermes*, *Heterotermes*, *Speculitermes*, *Amitermes*, *Angulitermes*, *Odontotermes* and *Microtermes* belonging to 5 families.
- For the management of shoot and fruit borer in brinjal, spray emamectin benzoate 5 SG @ 0.002% or spinosad 45 SC @ 0.02% with the appearance of first moth catch in sex pheromone baited traps. Repeat the spray at an interval of 14 days. Follow a waiting period of 4 days for emamectin benzoate and 2 days for spinosad for safe consumption of fruits.
- In okra, shoot and fruit borer, *Earias insulana* was the predominant fruit borer species in district Hamirpur and resulted in fruit infestation to the extent of 48.8%. Field efficacy of eight insecticides, biopesticide and natural products evaluated revealed that emamectin benzoate 5SG @ 8.5 g a.i./ha followed by chlorantraniliprole 18.5 SC @ 25 g a.i./ha were most effective resulting in significant reduction in fruit infestation.
- For the management of white grubs in rajmash, seed treatment with clothianidin 50WDG @ 1.5g/ kg seed was found most effective with 6.0% plant damage followed by chlorantraniliprole 18.5 SC (6.8%) @ 2ml/ kg seed. Whereas, in control 18.3 % plant damage was recorded.
- For the management of root knot nematode, *Meloidogyne incognita* in cucumber under protected environment. Bioagent *Bacillus amyloliquefaciens* @ 1kg/1000

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

m² applied at transplanting and 45 days after planting was found to be the best treatment in reducing the gall index (40.0%), number of egg masses (49.2%), final nematode population (71.2%) along with increasing the yield by 24.8% as compared to untreated control.

- Also, mycorrhizae, *Glomus fasciculatum* in combination with *Pochina chlamydosporia*@ 1 kg/1000 m² was promising in reducing the nematode population by 68.6% and increasing the yield by 48.8%) over untreated control in cucumber under protected cultivation.
- Automatic Comb Foundation Mill facility is now available for beekeepers on charge basis and demonstration to students
- Honey Processing facility made available for beekeepers
- Floral calendar developed and pollen slides prepared for 64 honey bee flora of mid hill zone of Himachal Pradesh
- 10 Honey samples tested for quality characteristics
- Studies on production potential of hive products estimated. Pollen production in different seasons revealed maximum pollen extraction from *Pyrus pashia* and mustard during mid Feb- mid March under Nagrota and Rajasthan conditions, respectively.
- Fermented honey bait kept in bottle is the most suited device to trap *V. tropica* when its population resurges, but trapping was found static in respect of other species of predatory wasps.
- At 10 farmers' apiaries in Kangra district; survey studies were conducted on different management practices being adapted by bee keepers, materials used for hives, disease & enemy management, annual returns, knowledge and extraction of other hive products, machinery used, etc. All the farmers are aware of the good management practices and none was using antibiotics in his apiary.
- Two 5-day training programme under NABARD for 20 farmers in each batch.
- Procured 30 *Apis mellifera* honeybee colonies with hives for distribution to tribal farmers of Kangra district.
- Developed two folders in Hindi on bee enemies.

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 (INR 49341/ha).

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

❖ Weed management in soybean

Sulfentrazone + clomazone, bentazone, and imazethapyr + propaquizafop were the effective herbicidal weed control treatments in soybean. Sulfentrazone + clomazone gave over **322kg** 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 for influencing soybean seed yield and wheat yield during 2022-23. Among weed management treatments, herbicide rotation treatment (HR-HR) and Integrated weed management treatment (IWM-IWM) resulted in higher yield, net return and B:C ratio of soybean and wheat over the partially 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.

Biotechnology

- Major QTLs for plant height, growth habit trait, seed index and days to flowering have been identified in horse gram (*Macrotyloma uniflorum*) through Genome wide association studies (GWAS).
- Existing framework linkage map of horse gram has been enriched with additional 105 SSR markers and genomic regions responsible for plant height and seed size have been identified.
- More than 200 Japonica rice landraces from north-eastern states of India harboring neutral allele of wide compatibility locus (Sn5) were identified through marker-assisted selection for exploitation in indica –japonica hybridization programmes.
- e Him Krishi, a hindi web based portal (<http://www.hillagric.ac.in:1005/ekisan1/index.html>) was developed to provide complete information about package and practices for various crops for the benefit of farming community.
- Him Biowealth portal (<http://hillagric.ac.in:1005/database.php>) was launched. The portal provides information about different crop varieties released by the CSKHPKV and Geographic indications of Himachal Pradesh etc.

Organic Agriculture

1. Crop production: On farm trials (OFT)

- **Paddy:** The yield of paddy at farmers field in Dhaulakuan (40 q/ha) and Mandi (39 q/ha) was higher under natural farming system, whereas at Palampur (29.50 q/ha) it was higher under organic farming practices.

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

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- **Maize+soybean:** The maize grain equivalent yield at Palampur (20.58 q/ha), Dhaulakuan centre (22.32 q/ha), farmer's field at Dhaulakuan (34.1 q/ha) and Mandi (38.9 q/ha) was higher under natural farming system, except at Kullu (30.2 q/ha) where it was higher under organic package.
- **Finger millet +soybean:** The fingermillet grain equivalent yield at Palampur (11.5 q/ha), Dhaulakuan centre (11.1 q/ha), farmer's fields at Dhaulakuan (20.2 q/ha) and Mandi (22.7 q/ha) was higher under natural farming system except at Kullu (14.8 q/ha) where it was slightly higher under organic package.
- **Green chilly +okra+beans+finger millet:** The yield of green chilly and okra at farmer's fields at Dhaulakuan (1.3 & 2.2 q/ha), Mandi (7.3 & 4.3 q/ha) and Kullu (1.0 & 3.0 q/ha) was higher under natural farming system. Whereas, the organic package produced the higher grain yields of beans at Dhaulakuan (2.3 q/ha), Mandi (1.5 q/ha) and of fingermillet at Mandi (1.3 q/ha) and Kullu (0.9 q/ha).

2. Soil & microbial studies

- The soil pH was in the range of 5.2-7.13 and EC was in the range of 0.05-0.92. Percent organic carbon was higher in natural farming than farmer practices. Dehydrogenase activity was higher in natural farming treatment than organic treatment. Available nitrogen was higher in natural farming followed by organic treatment and farmer practice for maize+soybean and fingermillet+soybean. Available potassium was higher in natural farming treatment and organic farming treatment than farmer practices for most of the cropping sequences.
- General bacterial count was higher in organic farming treatment than natural treatment for all crops. P-solubilizing bacterial count was higher in natural farming treatment for green chilli + okra + beans + millet and garlic intercrop and finger millet + soybean crops. Actinomycetes count was higher in organic farming treatment for maize+soybean and finger millet + soybean crops. Nitrogen fixing bacterial count was higher in natural farming treatment than organic treatment for most of the crops.

3. Plant Protection Studies

- Highest efficacy was recorded in the treatment of *Artemisia* + *Lantana* extract 1:1 (81.44%) followed by treatment of *Lantana extract* (77.77%) against Riptortus population in maize + soybean intercropping system.
- Highest efficacy was recorded in the treatment of *Artemisia* + *Lantana* extract 1:1 (81.24%) followed by treatment of *Lantana extract* (75.05%) against blister beetle in black gram.

4. Seed production Demonstrations

- During the season eight off farm seed production demonstrations of paddy (HPR 2880) under natural farming conditions were conducted at farmer's field at Palampur and the yield ranged from 7.75 -11.5 q/ha.
- Seven demonstrations of finger millet were raised on farmers fields at different locations in district Mandi, which showed that the variety VL 149 produced maximum yield at all the locations and ranged from 3-5 q/ha. Whereas, the yield of finger millet (variety VL 352) ranged from 7.5- 9.0 q/ha at different locations in Tehsil Banjar of district Kullu.

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

Farm Mechanization

1. **Screening of cellulolytic bacteria from migratory small ruminant for degradation of agricultural wastes in biogas production**

Rumen contents samples (12) of Gaddi sheep and goats (06 each) were collected from slaughtering site at Sungal near Sri Sai University, Palampur in sterile vials and processed on Carboxymethylcellulose (CMC) medium for isolation of cellulose degrading bacteria. 30 bacterial isolates were selected for cellulose degradation activity as clear zone around the colony by congo red dye and Gram's iodine method on CMC medium. Three isolates as cellulose degrading bacteria were screened. Screening of cellulose degrading bacteria was revealed that only 10 per cent recovery was noticed from rumen content.

2. **Farm Demonstration of Solar powered insect-traps under hilly conditions of H.P.**

The maximum catch of beetles was recorded in the month of July-August at Palampur (38.2%), Kullu (46.5 %) and Department of Agricultural Engineering (24.7%). There was a gradual decline in the density of beetle population in August-September, 2023. At Palampur, maximum percentage of the total catch was for that of *Anomala lineatopennis* (25.83 %) followed by *Holotrichia longipennis* (23.15 %) and *Maladera thomsoni* (10.78 %), whereas at Kullu, *Maladera thomsoni* (25.16 %) and *Maladera insanabilis* (19.71 %) were found in maximum numbers.

Energy Auditing in Paddy-Wheat cropping system.

40 farmers were selected from 11 villages from various blocks of Kangra district (Zone I and II) that were following paddy-wheat cropping system. Data pertaining different operations followed by farmer for raising paddy and wheat crop were collected and information from other districts is to be collected in this year and analysed for better energy input through various methods involved in this cropping system in Himachal Pradesh

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

Future Research Priorities

Crop Improvement

- Development of high yielding, early maturing, biotic & abiotic stress tolerant varieties coupled with improved quality in rice, maize, mash, soybean, fodder and potential crops
- Broadening the genetic base of various kharif crops by utilizing the wild genetic resources
- Development of CGMS based hybrids in rice
- Development of quality protein maize varieties
- Development of vegetable type soybean varieties
- Development of nutritive and persistent varieties of grasses and fodder legumes with quick regeneration capacity
- Speed breeding for acceleration of ongoing crop research endeavors with enhanced precision and efficiency by utilizing novel breeding tools
- Breeder seed production of released varieties of vegetable crops.
- Production of quality seed of released varieties of *Kharif* season of various cereals, pulses, and oilseed crops as per the indent of the State Department of Agriculture, NSC, Department of Agriculture and Cooperation (GOI) and other agencies.
- Production of quality seed of okra and chilli.
- Maintenance of genetic purity of the released varieties of *Kharif* season through the Maintenance Breeding.
- Seed quality assessment of breeder seed samples of mash and soybean.
- Testing of genetic purity of maize hybrids (Public/Private Sectors) through DNA fingerprinting.

Vegetable Crops

- Gene Pyramiding of important diseases of vegetable crops
- Development of double haploids in cole crops
- Development of male sterility based hybrids in cauliflower, cabbage, broccoli and chilli
- Development of high yielding bacterial wilt, powdery mildew and Yellow Vein Mosaic Virus (YVMV) resistant varieties of vegetable crops.
- Development of parthenocarpic cucumber varieties for protected cultivation.
- Standardization of cultivation techniques for protected and hydroponic cultivation of potential vegetable crops

Crop Production

- Adverse impact of changing climate on productivity of kharif crops and their mitigation strategies.
- Carbon Footprints in different crop production scenarios.
- Biostimulants for enhancing productivity of different kharif crops.

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

- Crop- weather interaction and its impact on incidence of important diseases and pests in rabi crops (wheat and gobhi sarson).
- Compilation of Agrometeorological data of different locations in the state and use of this data for working out different agromet products
- Development, evaluation and validation of different cropping systems and Integrated Farming System modules for different sized land holders under varied agro-ecological conditions of Himachal Pradesh.

Nutrient and Water Management

- Nutrient dynamics of soil with continuous cropping and recycling of organic resources in the form of plant or animal wastes with different systems over time
- Standardization of application schedules of newly released nano fertilizer
- Long-term effect of fertilizers and amendments on boron and molybdenum dynamics in maize-wheat system
- APSIM maize and wheat models for simulation and prediction of nutrient dynamics, soil acidity and crop productivity under long-term application of fertilizers and amendments
- Creation of fertility gradients for maize
- Development of fertilizers' equations for onion and garlic
- Optimization of boron dose in maize and establishment of critical limit in acid soils of Himachal Pradesh
- Effect of boron and molybdenum application on their dynamics and maize productivity in an acid Alfisol
- Molybdenum & Boron fractions under different land uses in acid soils of H.P.
- Standardization of ETC based drip irrigation schedule in tomato and cucumber under protected conditions
- Standardization of IPNS based drip fertigation schedule in tomato under protected conditions
- Studies on sub surface manuring and NPK fertigation in onion under open condition .

Crop Protection

- Survey and surveillance of important diseases in HP to find out the impact of Global Warming/Climate Change
- Pathogenic and genetic diversity analysis of important plant pathogens and monitoring of races/ strains.
- Identification of resistant sources, study genetics of resistance, molecular mapping of R-genes and Pyramiding of R-genes in commercial varieties
- Development of IDM modules
- Testing & recommendation of CIB registered fungicides and their judicious use
- Survey and surveillance of insect-pests and development of forecasting models
- Studies on population dynamics and management of invasive pests in Himachal Pradesh
- Standardization of mass production technology for important biological control agents and their utilization in biological control of insect-pests
- Management of roof knot and potato cyst nematodes

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

Organic and Natural Farming

- Multi-location testing of university recommended SPNF technology on targeted crops through FLDs on farmers' fields at three KVKs
- Seed production of identified crops (paddy, maize and finger millet) under SPNF conditions at ZBNF farm and through farmer participatory mode
- Surveillance of key insect pests of targeted crops
- Soil analysis and microbial studies on monitoring of soil health at farmers fields
- Development of Model SPNF Nodal Unit at CSKHPKV, Palampur for capacity building
- Production of vermicompost and other organic/natural farming inputs
- Development of guidelines for targeted crops under natural farming system

On Going Research Projects:

<i>Particulars</i>	<i>No. of Projects</i>	<i>Budget Outlay (in Rs. lakhs)</i>
<i>AICRPs</i>	<i>36</i>	<i>1900.00</i>
<i>ICAR Funded Projects</i>	<i>9</i>	<i>112.03</i>
<i>DBT Funded Project</i>	<i>6</i>	<i>334.65</i>
<i>DST Funded Projects</i>	<i>6</i>	<i>240.20</i>
<i>HPCDP-JICA ODA, Hamirpur</i>	<i>7</i>	<i>675.11</i>
<i>Govt. of H.P.</i>	<i>11</i>	<i>1119.13</i>
<i>RKVY Projects</i>	<i>7</i>	<i>389.39</i>
<i>Miscellaneous Adhoc Projects</i>	<i>28</i>	<i>246.89</i>
<i>NABARD</i>	<i>2</i>	<i>20.42</i>
<i>CSIR, NBPGR, PPV &FRA, BARC</i>	<i>5</i>	<i>74.21</i>
<i>HIMCOSTE</i>	<i>2</i>	<i>11.10</i>
<i>GOI</i>	<i>2</i>	<i>358.08</i>
<i>Biodiversity International</i>	<i>3</i>	<i>91.95</i>
<i>Total</i>	<i>124</i>	<i>5573.16</i>

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

New Recommendations:

Programme Area	Variety/Recommendation
REC-2022	
Crop Improvement	Him Palam Sankar Makka 3 (KMH-17-89)
	Him Palam Maize Composite 1 (L-315)
Weed Control	New Recommendation for weed management in maize: Post emergence application of either topramezone 25.2 g/ha+atrazine 750 g/ha at 2-3 leaf stage of weeds or post emergence application of tembotrione 120g/ha+atrazine 750g/ha at 2-3 leaf stage of weeds
REC-2023	
Crop Production	New Recommendation for spacing in fodder oat: Sowing of fodder oat in rows at 25 cm spacing in second fortnight of June after harvest of main crops in dry temperate region of H.P.
Weed Control	Maize: New recommendation for chemical weed control with Tembotrione (a new herbicide).
	Rice: Recommendation for chemical weed control in transplanted and puddle rice with Pretilachlor (a substitute for alachlor).
REC-2024	
Crop Improvement	Him Palam Dhan 3 for inclusion in the package of practices for <i>kharif</i> crops
	Him Palam Dhan 4 for inclusion in the package of practices for <i>kharif</i> crops
	Release proposal of Him Palam Bhindi-1 (DPO-9801)
	Release proposal of Him Palam Capsicum Paprika (BWR-CP)
	Release proposal of Him Palam Shimla Mirch-1 (BWR-3)
	Release proposal of Him Palam Shimla Mirch-2 (BWR-39)
	Release proposal of Him Palam Matar-3 (DPP-SP-6)
	Release proposal of hybrid Him Palam Phoolgobhi Hybrid-1 (DPCafH 3)
	Release proposal of hybrid Him Palam Phoolgobhi Hybrid-2 (DPCafH 5)
	Release proposal of hybrid Him Palam Chilli Hybrid-1 (DPCHYB-4)
Release proposal of hybrid Him Palam Chilli Hybrid-2 (DPCHYB-5)	

RESEARCH ACHIEVEMENTS & RESEARCH PRIORITIES

Kharif and Vegetable Crops

	Release proposal of hybrid Him Palam Chilli Hybrid-3 (DPCHYB-10)
	Release proposal of Him Palam Tomato-1
	Release proposal of Him Palam Tomato-2
	Release proposal of Him Palam Yellow Capsicum (DDCY1)
	Release proposal of Him Palam Red Cherry (DPCTR-1)
Crop Production	Adhoc recommendation of Leaf type varieties of lettuce suitable for hydroponic system
	Seed Rate of Tomato, Capsicum & Cucumber under protected conditions
Crop Protection	
Disease Management	<p>Late Blight of Tomato: Two spray with Cymoxanil 8% + Mancozeb 64% WP @ 0.2% / Azoxystrobin 18.2% + Difenconazole 11.4% w/w SC @ 0.1% or two –three sprays with Zineb 75% WP @ 0.25% at fortnight intervals</p>
	<p>Early Blight of Tomato: Two spray with Azoxystrobin 23% SC @ 0.1% at fortnight interval. Two-three sprays with Zineb 75% WP @ 0.25% at 10-15 days intervals</p>
	<p>Buckeye Rot of Tomato: Two-three sprays with Propineb 70 % WP @ 0.25% at an interval of 10-15 days</p>
	<p>Purple blotch of Onion: Two sprays of fungicides i.e. Difenconazole 25% EC or Tebuconazole 25% WG or Azoxystrobin 18.2% + Difenconazole 11.4% w/w SC or Azoxystrobin 11% + Tebuconazole 18.3% w/w SC @ 0.1%</p>
	<p>Stemphylium blight of Onion: Two spray of crop with Azoxystrobin 18.2% + Difenconazole 11.4% w/w SC @ 0.1% or Azoxystrobin 11% + Tebuconazole 18.3% w/w SC @ 0.1% at fortnight intervals</p>
Insect Management	Pest Integrated management of greenhouse whitefly in tomato (<i>supplementary proposal</i>)
	<p>Management of brinjal shoot and fruit borer</p> <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.