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ANNUAL PROGRESS REPORT

(2008-2009)

Department of Plant Pathology

CHAUDHARY SARWAN KUMAR

HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA

PALAMPUR-176062 (H.P.)

ACKNOWLEDGEMENT

The 23rd Annual Progress Report of the department has been brought out with the active co-operation of the scientists of the department as well as from different research and extension centres (HAREC, MAREC, SAREC), research – substations and KVKs of the university located at different regions of the state. To all of them I express my appreciation. I am thankful to Drs. A.S. Kapoor, B.M. Sharma, P.N. Sharma and D.K. Banyal for compiling and editing different sections of the report critically.

We are indebted to the Hon'ble Vice-Chancellor, Dr. Tej Pratap for motivation and encouragement to scientists of the department. The advice and guidance provided by Director of Research, Dean Post Graduate Studies, Dean College of

Agriculture, and Director of Extension Education in the spheres of research, teaching, and extension education is gratefully acknowledged.

I gratefully acknowledge the faculty members of the department for their necessary help and scientific co-operation whenever required. My thanks are also due to Sh. K.S. Katoch, M.S. Nag and other staff of the department for their co-operation especially Sh. Kehar Singh for photostat printing of the report.

Head of the Department

CONTENTS

INTRODUCTION

The Department of Plant Pathology has the mandate for teaching, research and extension education pertaining to plant diseases and mushrooms. The students admitted to M.Sc. and Ph.D. programmes are assigned research problems on different aspects of diseases of field and vegetable crops including mushrooms.

The research work in various projects is being carried out in the main department at Palampur and at Hill Agriculture Research and Extension Centre (Bajaura, Dhaulakuan and Kukumseri), Mountain Agriculture Research and Extension Centre (Sangla), Shivalik Agriculture Research and Extension Centre (Kangra) and Research Stations (Malan, Berthin and Lari). Research on wheat diseases is being carried out at Malan, Dhaulakuan and Bajaura, on rice diseases is exclusively carried out at Malan and that on maize diseases at Bajaura and Dhaulakuan, whereas the research on diseases of pulses is being carried out at Palampur, Sangla, Berthin and Dhaulakuan and on oilseed crops at Kangra. Among the diseases of vegetable crops, bacterial wilt and fruit rots of solanaceous crops, powdery mildew, white rot and root rot/wilt complex disease of peas, fungal, bacterial and viral diseases of French bean and Phomopsis leaf blight and fruit rot of brinjal receive special attention.

The department also carries out research on different aspects of mushroom cultivation. The spawn laboratory at present is meeting the demand of Horticulture department and private mushroom growers. Teachers/scientists/students of the department are actively participating in the various seminars and symposia conducted by different scientific societies from time to time.

Several adhoc research projects are being carried out in the department with financial support from the ICAR, CSIR, DST/DBT and fungicide companies.

The department is engaged in extension education activities such as advisory service to farmers for diagnosis and control of diseases and participation in district/state level workshops/seminars. The scientists of the department are also actively involved in disseminating mushroom cultivation technology to the mushroom growers.

STAFF POSITION

TEACHING	
Professor & Head	Dr. S. K. Sugha (till 3rd Oct. 2008)
Professor/Senior Scientist	Dr. A. K .Sood Dr. Y. S. Paul Dr. B .M. Sharma Dr. P. N. Sharma
RESEARCH	
Palampur Campus	
Professor & Head	Dr. R. P. Kaushal Dr. A. S. Kapoor
Sr. Scientist	Dr. J. Pal (Ret. on 31st March, 2008)
Scientist	Dr. B. R. Thakur Dr. D. K. Banyal
Hill Agricultural Research & Extension Centre, Bajaura	
Scientist	Vacant
Assistant Scientist	Dr. R .K Devlash
Hill Agricultural Research & Extension Centre, Dhaulakuan	
Sr. Plant Pathologist	Dr.A. K. Basandrai Dr. Dhanbir Singh Dr. Akhilesh Singh
Hill Agricultural Research & Extension Centre, Kukumseri	
Sr. Plant Pathologist	Dr. S. Dhancholia
Shivalik Agricultural Research & Extension Centre, Kangra	
Sr. Scientist	Dr. Ashok Kumar
Rice and Wheat Research Station, Malan	
Sr. Rice Pathologist	Vacant
Sr. Scientist (Wheat Pathology)	Dr. S. K. Rana
Mountain Agricultural Research & Extension Centre Sangla (Kinnaur)	
Assistant Scientist	Dr S K Sharma
Research Sub-Station, Berthin	
Sr. Scientist	Dr. C. L. Bhardwaj
Research Sub-Station, Salooni (Chamba)	
Assistant Scientist	Vacant
Research Sub-Station, Lari (Spiti)	
Assistant Scientist	Vacant
EXTENSION EDUCATION	
Sr. Extension Specialist	Dr. K.S. Rana (DEE Palampur)
Sr. Scientist	Dr. A. Singh (KVK Mandi) Dr. V.K. Rathi (KVK Dhaulakuan)
Scientist	Dr. B. K.Sharma (KVK, Una) Dr. A. K. Sud (KVK, Kangra)
Asst Ext. Specialist	Dr. Suman Kumar (DEE Palampur) Dr. Amar Singh (KVK Mandi) Dr. Pardeep Kumar(KVK, Kukumseri)

FINANCIAL OUTLAY AND STAFF POSITION IN DIFFERENT SCHEMES OF THE DEPARTMENT 1.7.08 TO 30.6.2009

Name of the Scheme	**Budget allocation (Lac Rs.)**	**Expenditure (Lac Rs.)**	**Staff**
APL-001-17 "Creation of facilities for PG studies in the Department of Plant Pathology", CSKHPKV, Palampur	38.50	49.50	Dr.A.K.Sood, Sr. Scientist Dr. S.K.Sugha, Professor Dr. Y.S. Paul, Professor Dr. P.N.Sharma, Professor Smt. Shashi Sharma, Sr. Asstt. Sh.M.S.Nag,Jr.Scale Stenographer Gr.I (w.e.f.14.08.07) Sh. Prem Chand, Jr. Technician Sh. Kishori Lal, Lab. Asstt.
APL-010-17 "Facilities for Teaching in the College of Agriculture and creation of facilities for Postgraduate Studies" in the Plant - Pathology, CSK HPKV, Palampur	20.92	24.10	Dr. B.M.Sharma, Professor Sh. Partap Raj Sharma,Supdt.Gr.II(EC) (w.e.f. 10.03.08 to 11.2.09) Sh. K.S.Katoch,Sr.Asstt. w.e.f 25.2.09 Sh. Swami Ram, Tech. Asstt. Gr.II Sh. Guldev Singh, Jr. Technician Sh. Vijay Kumar, Chowkidar
APL-21-17 "Strengthening of facilities for research of Plant Pathology" CSKHPKV, Palampur	16.43	19.70	Dr. J.Pal, Sr. Scientist Sh. Ramesh Kumar, Beldar Sh. Dalip Kumar, Beldar Sh. Hans Raj, Beldar Sh. Desh Raj, Beldar Sh. Madho Ram, Beldar Sh. Rattan Chand, Beldar
APL-59-17 "Facilities for research in the department of Plant Pathology" CSKHPKV, Palampur	15.02	21.40	Dr.R.P.Kaushal, Professor Sh. Ravi Shankar Rana,Jr.Asstt. Sh. Dharam Chand,Beldar/Sunil Kumar Sh. Hem Raj, Beldar Sh. Kehar Singh, Peon
ICAR-017-17 Pt.-II" All India Coordinated Research Project on Seed Technology Research" under NSP	12.91	12.38	Dr.A.S.Kapoor, Professor Sh. Amar Nath Walia,Sr.Tech.Asstt.Gr.I Sh.Himat Ram, Lab. Asstt.
APL-076-17 Department of Plant Pathology	-	3.00	Sh.Ghanshyam Singh, Lab.Asstt. Sh.Ravi Kumar,Beldar Sh.Sugreev Kumar, Beldar

FINANCIAL OUTLAY OF AD HOC PROJECTS FOR THE YEAR 2008-2009

Scheme No.	Name of the scheme	Allocation	Expenditure	Staff
CSIR-614-17 terminated 30.09.08	Collection, identification & culturing of fleshy fungi prevalent in Western Himalayan region of Kangra District and adjoining area of HP (CSIR)	165260/-	245495/-	Dr.B.M.Sharma (PI) Dr.R.K.Singh, RA Sh. Tilak Raj,Field Assistant
Misc.-887-17 890-17	Evaluation of antifungal of Panchgavya against soil borne pathogens	3808/-	3808/-	Dr. S.K. Sugha (PI)
Misc.887-17	Management of foot rot and seedling blight of barley in Spiti valley	32248/-	32248/-	Dr. Suman Kumar(PI)
GOI-417-17	Characterization of variability in Erysiphe pisi on pea	493000/-	633464/-	Dr.D.K. Banyal (PI) Dr.S. Upmanyu JRF Mrs.Nisha Kumari,JRF
GOI-428-17	Assessment of genetic diversity in Colletotrichum capsici using molecular markers and evaluation of resistance in capsicum.	430800/-	408046/-	Dr. P.N.Sharma(PI) Ms. Prachi Sharma JRF
GOI-432-17	Molecular tagging of resistance specificity in KRC 5 cv of kidney bean against Colletotrichum.	682000/-	653065/-	Dr. P.N. Sharma (PI) Sh. Sanjeev Naryal, JRF Dr. Vikas Kapoor JRF Sh. Raj Kumar, F.H.
Misc.-958-17	Production of substrate and spawn and training of entrepreneurs for mushroom cultivation in H.P.	1479706/-	1022972/-	Dr. B.M.Sharma (PI) Dr. Savita Jandaik
ICAR-200-17 terminated on 31.10.08	Assessing diversity in Ascochyta blight complex of peas using molecular markers and its management through resistance.	134985/-	103280/-	Dr. R.P.Kaushal, (PI)
GOI-439-17	Socio Economic Upliftment of hill farm Women through integrated Mushroom Farming in Himachal Pradesh.	400000/-	275177/-	Dr Deepika Sood (PI)
GOI-442-17	Studies on genetic diversity ---of R.Solani Kuhn associated with root/collar and aerial blight in H.P	641000/-	511989/-	Dr.Sachin Upmanyu,(PI)
Misc-CSIR-677-17	Culturing of Fleshy fungi of western Himalayan Region for Bio-active Molecular.	671000/-	460758/-	Dr.B.M.Sharma,(PI) Mr. Sapan Kumar JRF
Ad hoc ICAR-NAIP-1004-17	Biopesticides Mediated value chain for clean vegetables component-2 (production to consumption system) of NAIP	733000/-	104510/-	Dr.Y.S.Paul (PI) Mr. Sachin Masand JRF
Ad.ICAR-211-17	Experimental learning setting up of facilities for hands on training strengthening of Mushroom Research and production facilities for training & skill development (S&D Agril. Education)	4500000/-	4443265/-	Dr.B.M.Sharma (PI)
GOI-381-17 terminated on 10.7.2008	Extraction of biologically active compounds from edible Mushrooms.	105000/-	109341/-	Dr Savita Jandaik (PI)

I. TEACHING

Courses taught: The following courses were taught during the year under report:

FIRST SEMESTER

Course No.	Course title	Credit hours	Name of Instructor
Pl. Path. 111	Plant Pathogens & Principles of Plant Pathology	2+1	Dr. A.K. Sood
Pl. Path.231	Introductory Plant Pathology	1+1	Dr.Y.S. Paul
Pl. Path. 232	Mushroom Cultivation	0+1	Dr.J.Pal
Pl. Path 241	Crop Protection	0+1	Dr. Suman Kumar
Pl. Path. 243	Diseases of field crops & their management	2+2	Dr. Y.S. Paul/ Dr. B.R. Thakur
PC-301	Plant Clinic-I	0+1	Dr.Y.S, Paul
Pl. Path. 501	Systematic Mycology	2+1	Dr.B.M.Sharma
Pl. Path. 502	Physiology of Fungi	2+1	Dr.B.M.Sharma
Pl. Path. 511	Principles of Plant Pathology	3+1	Dr.S.K.Sugha/ Dr.D.K.Banyal
Pl. Path. 512	Plant Pathological Techniques	0+2	Dr. YS Paul
Pl. Path. 515	Plant Disease Epidemiology	2+1	Dr.A.S.Kapoor/ Dr.D.K.Banyal
Pl. Path 517	Biological Control of Plant Diseases	1+1	Dr. Y.S. Paul
Pl.Path.521	Biotechnology in Plant Pathology	2+1	Dr. P.N. sharma/ Dr.R.P.Kaushal
Pl. Path. 612	Advanced Plant Disease Epidemiology	2+1	Dr.A.S.Kapoor/ Dr.D.K.Banyal
Pl. Path. 613	Advances in Plant Disease Management	2+1	Dr. A.K. Sood, Dr. A.S. Kapoor & Dr. P.N. Sharma
Pl.Path.622	Physiology of Pathogenesis	2+1	Dr.Y.S.Paul
Pl. Path. 600	Master's Research		Respective Major Advisor
Pl. Path. 700	Ph.D. Research		
Pl. Path.591/ 691	Seminar		Dr. P.N. Sharma
RAWE	RAWE Programme		Dr. B.M. Sharma
SECOND SEMESTER			
Pl. Path. 111	Plant Pathogens & Principles of Plant Pathology	2+1	Dr. A.K. Sood
Pl. Path.243	Crop Diseases and Management	2+2	Dr.P.N.Sharma/ Dr.Y.S.Paul
PC 302	Plant Clinic	0+1	Dr. Y.S. Paul
Pl. Path 484	Mushroom cultivation	1+2	Dr. B.M. Sharma
Pl. Path 513	Fungal diseases	2+1	Dr.D.K.Banyal
Pl.Path.514	Principles of Plant Disease Management	2+1	Dr. AS Kapoor/ Dr. S.K. Rana
Pl. Path. 516	Seed Pathology	2+1	Dr. A.S. Kapoor/ Dr. Y.S. Paul
Pl. Path.525	Diseases of Field Crops	3+1	Dr.Y.S.Paul/ Dr.P.N.Sharma
Pl. Path. 528	Plant Disease Resistance	2+0	Dr.R.P.Kaushal
Pl. Path. 531	Plant Bacteriology	2+1	Dr.A.K.Sood/ Dr. Pradeep Kumar
Pl. Path. 561	Plant Virology	2+1	Dr.O.P.Sharma
Pl. Path 601	Advanced Mycology	2+1	Dr. B.M. Sharma
Pl. Path.-611	Mechanism of pathogenesis	2+0	Dr. B.R. Thakur
Pl. Path. 625	Fungicides	2+1	Dr. S.K.Sugha
Pl. Path. 628	Advances in Plant Dis. Resistance	2+0	Dr.P.N. Sharma
Pl. Path.591/ 691	Seminar	1+0	Dr.A.S.Kapoor
Pl.Path.600/700	Research		Respective Major Advisor

STUDENTS ADMITTED

The following students were admitted to the P.G. programme during the year under report:

Name of the Student	Admission No.	Major Advisor
MSc		
Ms. Anuradha	(A-2008-30-19)	Dr. A.S. Kapoor
Mr. Arun Kumar	(A-2008-30-20)	Dr Ashok Kumar
Mr Varun Kumar	(A-2008-30-23)	Dr.A.K.Basandrai
Ms. Devanshi Pandit	(A-2008-30-21)	Dr. R.P.Kaushal
Mr. Abhishek Katoch	(A-2008-30-18)	Dr. P.N.Sharma
Mr. Sharvan Kumar	(A-2008-20-22)	Dr.Dhanbir Singh
Ph.D		
Ms. Ashlesha	(A-2008-40-05)	Dr. Y.S. Paul
Mr. Yussauf Khan	(A-2008-40-06)	Dr. B.M.Sharma

The following students completed their M.Sc./ Ph.D. programme during the year under report:

M.Sc.

Name	Admission No.	Advisor
MSc		
Mr. Pawan Kumar	A2006-30-28	Dr. D.K. Banyal
Ms. Ashlesha	A2006-30-27	Dr. S.K. Sugha
Ph.D		
Mr Vikas Kapoor	A2004-40-10	Dr. R.P. Kaushal

THESES ABSTRACTS

Ashlesha (A-2006-30-27 Major Advisor: Dr. S.K. Sugha

Title: Investigation on antifungal activity of microbes present in Panchgavya

Panchgavya- combination of five products of cow (milk, curd, ghee, urine and dung) showed the presence of six microbial species; *Bacillus (B*-I, *B*-II, *B*-III), *Serratia*, *Pseudomonas* and *Actinomycetes* on the basis of morphological and biochemical characteristics. Evaluation of these against four soil borne fungal pathogens viz., *Fusarium solani, F. oxysporum, Rhizoctonia solani* and *Sclerotium rolfsii* under *in vitro* conditions showed that only five possessed strong antagonistic activity. *B*-I, *B*-II, *B*-III, *Actinomycetes* and *Serratia* when applied at different concentrations (10^{-1} to 10^{-5},) caused maximum mycelial growth inhibition of *R. solani, S. rolfsii, F.oxysporum* and *F. solani* whereas *B*-II showed fungitoxicity against, *F. oxysporum* and *F. solani* low against, *S. rolfsii* and least in *R. solani*. *S. rolfsii, R. solani* and *F. solani* were found more and *F. oxysporum* less sensitive to *B*-III. *Serratia* and *Actinomycetes* found highly effective in inhibiting the mycelial growth of all the test pathogens. Ageing of Panchgavya caused progressive decrease in number of bacterial colonies of all the isolates without any effect on its antifungal activity up to six months. Seed dip in Panchgavya for 2 h and seed bacterization with *Bacillus*-III and *Serratia* provided good control of damping-off of cauliflower seedlings. Seed dip in Panchgavya for 2 h and seed bacterization with *Bacillus*-III gave 100 and 88.89 per cent control of root rot of pea. Soil drench at germination with *Actinomycetes* and Panchgavya supported very good seedling stand and reduced the incidence of damping-off and root rot significantly. Seedling dip before transplanting for 1 h followed by seedling drench after transplanting with Panchgavya, *Serratia* and *Bacillus*-I were found effective in the management of collar rot of tomato caused by *S. rolfsii*.

Pawan Kumar (2006-30-28) **Major Advisor: Dr. D.K. Banyal**

Title of thesis: Epidemiology and management of cowpea anthracnose

Cowpea anthracnose caused by *Colletotrichum dematium* (Pers.) Grove is an important disease prevalent in Kangra, Hamirpur and Bilaspur districts of Himachal Pradesh. The disease severity ranged between 19.7 to 53.5 per cent, maximum being at Palampur (53.5%). The pathogen perpetuate in infected seed , diseased debris and infested soil, however, infected seed serves as main source of inoculum. The optimum temperature for the germination of *C. dematium* spores is 25°C. Temperature is negatively correlated with disease severity (r=-0.55 to -0.93) whereas, relative humidity had positive effect (r=0.14 to 0.92) on disease. Among the 49 genotypes evaluated, 21 genotypes were moderately resistant. Sowing dates and row to row spacing influenced the disease development. The disease was more in early sown crop (5th June) with row spacing of 30 cm as compared to late sown crop with wider row spacing. However, highest grain yield was recorded in timely sown crop (19th June) at a row spacing of 30 cm. Among the *in vitro* tested antagonists, local strains of *T. harzianum* (JMA-4 and SMA-5) were more effective against *C. dematium.* Under pot culture, seed treatment and soil application with *T. harzianum* (JMA-4) showed maximum seed germination (78.4%) and disease control (60%). Among fungicides evaluated inder *in vitro,* Vitavax power caused complete inhibition of mycelial growth of *C. dematium* @ 250 µg/ml. Under field conditions, seed treatment with Vitavax power and three sprays of Companion starting from last week of July at an interval of 10 days resulted in maximum disease control (63.9 per cent) followed by Vitavax power as seed treatment and three sprays of Bavistin (61.7%).

Ph.D. Thesis

Name of the student: Vikas Kapoor **Major Advisor: Dr. R.P. Kaushal**

Title: Molecular characterization of Ascochyta spp. causing pea blight and evaluation for resistance

Ascochyta blight was found to occur across Himachal Pradesh (2006-2007) with an average incidence of 15.77 per cent. High disease incidence was observed in district Mandi (33.37%) followed by Chamba (32.88%) and Kinnaur (32.83%). No single criterion was sufficient to distinguish various species of *Ascochyta* but when considered in combination, 36 isolates were designated as *A. pinodes*; 2 as *A. pinodella* and 1 as A. *pisi*. RAPD analysis of 40 isolates grouped them into 6 clusters vis-à-vis geographic location. Isolates from Sangla (Kinnaur) formed cluster V, 2 Chamba isolates were placed in cluster I whereas Jinjhiali (Mandi) isolates formed 3 clusters (II, III and VI). This indicated limited exchange of seed within these valleys and maintaining region specific reproductive isolation. Nucleotide sequence analysis of ITS region helped in the confirmation of isolates as *Ascochyta* spp., overcoming ambiguities of conventional methods of identification. Identity of isolate As2 was finally settled as *A. pinodes* instead of *A. pisi*. Similarly, As3 which could not be identified as either *A. pisi* or *A. pinodes* was finally designated as *A. pinodes*. As per phylogenetic analysis of 33 isolates, they were grouped into 5 different clades. Nucleotide sequence analysis could not differentiate *A. pinodes* and *A. pinodella*. Net genetic distance between *A. pinodella* and *A. pinodes* group was zero forming clade I. *A. pisi* formed a separate clade II and showed lower mean/net genetic distance with *A. rabiei* group than *A. pinodes*/*A. pinodella* group indicating its kinship to *A. rabiei.* Similarly isolate As 44 infecting chickpea was clustered in clade III making it distinct species infecting pea. As 43 isolated from *Vigna mungo* formed clade IV. The genetic distance within individuals of a species was 0.007, 0.005, and 0.001 for *A. pisi*, *A. pinodes* and *A. pinodella*, respectively. The lowest genetic distance (0.001) within individuals of *A. pinodes* indicate capability of *A. pinodes* to undergo sexual reproduction. This could explain *A. pinodes* to be predominant *Ascochyta* spp. infecting pea as compared to the dominance of *A. pisi* in 1980's in Himachal Pradesh. The evaluation for resistance of three hundred and sixty seven pea genotypes by detached leaf method revealed all the genotypes susceptible to *A. pinodes*. Different mutants did not show any resistance.

2. RESEARCH

Survey and surveillance

Wheat: A severe out break of yellow rust was occurred during *rabi* 2008-09 in the state. In Kangra, Hamirpur, Una, Bilaspur and Mandi, most of the wheat varieties viz. Sonalika, HS240, HS277, HS295, HS420, VL738, UP2338, Raj 3765, HPW42, HPW184, HPW211, HPW251, PBW343, PBW373, PBW502 etc. recorded high severity of YR, from 40-80S. However varieties viz. HPW89, HPW147, HPW155, VL616, VL829, Raj3777 and PBW550 recorded low severity from 5-40S. The severity of LR in cvs HPW184, HS295, HS420, PBW343, VL829 and Sonalika ranged from TS-60S. The severity of powdery mildew was moderate to severe (5-8 on 0-9 scale) on different cultivated varieties. It was severe on HPW155, HPW184, PBW343, HS295, HS420 and HPW42. The overall incidence of loose smut ranged from 0.5-3.0 % during this year. The incidence of flag smut varied from 2-35 % in foot and mid hills. It was quite high in varieties PBW343 and PBW502 in Una district.

In district Sirmour and Solan incidence of yellow rust was very high on most of the varieties which ranged from traces on varieties Raj 3777, Raj 3765, HPW 89, HPW 42 and VL 616 to 80- 90S on HS295, and WH 711. Brown rust ranged between 5S to 40S. Karnal bunt incidence ranged between 0.01 to 0.05 percent.

Barley: In barley, the severity of yellow rust varied from 20-80S. LR with severity TS-5 S was recorded at few locations. The incidence of loose smut and covered smut ranged 0.5-2.0 percent and 1.0- 4.0 %, respectively.

Rice: High incidence/ severity of leaf blast, neck blast and glume discoloration was recorded on few varieties at some locations in Kangra, and Mandi districts, otherwise it was moderate. Severity/ incidence of bacterial leaf blight and false smut was low to moderate and restricted to some locations in Kanga and Mandi districts. High severity (40-50%) of bacterial leaf blight on Sabarmati variety was recorded at Samloti area in Kangra district. High incidence of false smut, 10-30% was recorded on hybrids. In Sirmour district, incidence of brown spot was 60 percent on PR 116 and incidence of false smut was invariably high on hybrids in Sirmour and Mandi districts.

Maize: In Sirmour district Erwinia stalk rot incidence ranged from 10-15 percent whereas BSDM ranged from traces to 2.5 percent. In Mandi district, Maydis and Turcicum blights were low to medium and brown spot ranged between medium to high.

Rajmash : Anthracnose , floury leaf spot and angular leaf spot were moderate to high intensity in Mandi district.

Mash – Moong: In Mandi district**,** Anthracnose, Cercospora leaf spot and Yellow mosaic were predominate diseases whereas Leaf crinkle was found in traces. In Sirmour district, mung bean yellow mosaic virus, anthracnose and web blight were the major diseases.

Chickpea: Stem rot and black root rot were of major occurrence in Mandi district whereas in Sirmour district Ascochyta blight, wilt, root rot, stem rot were predominant

Rapeseed – mustard: The severity of Alternaria blight on leaves remained low to moderate (10-25%) at the farmer's fields. Gobhi sarson and Karan rai crops escaped from the pod infection of Alternaria blight due to uncongenial weather conditions during Feb. and March. However, low severity (up to 10%) of Alternaria blight on pods was observed on brown sarson and mustard crops.

Similarly, very low severity of white rust (below 10%) was observed in the mustard crop at the farmer's fields. No stag head formation was noticed in the mustard crop at the farmer's fields. Some incidence (10-25%) of powdery mildew was observed in Gobi sarson crop at the pod stage in some localities under rainfed situations.

Linseed: Wilt and rust remained the serious diseases of linseed at Kangra and adjoining areas. Wilt appeared in the month of December in most of the localities surveyed in Kangra and adjoining areas. Dry weather conditions of Nov. coupled with average maximum and minimum

temperatures (26.1 and 9.3^{0}C) were favourable for the outbreak of Fusarium wilt. 20-90 per cent severity of wilt was observed in the susceptible cultivars like Chambal at Kangra farm in the fields where linseed is grown continuously for the last many years. 5-10 per cent wilt incidence was recorded in the variety Kangra local at Malan whereas variety Chambal showed 10-15 per cent disease incidence at Palampur.

Rust appeared in the susceptible varieties like Chambal at Kangra during the second fortnight of January, whereas it appeared during the month of Feb. at farmer's fields around Nagrota Bagwan and Malan weather conditions of Feb and March were also quite congenial for the further progress of rust.

Powdery mildew appeared in the first week of March at Kangra, however rains Powdery mildew appeared in the second fortnight of March at Palampur and 100% severity was noticed in the susceptible varieties like Himalini.

Sesame: In sesame, leaf and pod blight caused by, *Cercospora sesami* and *C. sesamicola* remained the major disease problem at the farmer's fields. Apart from this, some incidence of Phytophthora blight was also recorded in some of the areas at seedling stage.

Soybean : Mainly, three diseases viz., target spot (*Corynespora cassiicola*), pod blight (*Colletotrichum truncatum*) and Rhizoctonia aerial blight (*Rhizoctonia solani*) were found to occur in areas surveyed in Kangra and Mandi districts where soybean is mainly grown. However, Rhizoctonia aerial blight was confined to Kangra district, a comparatively warmer area in the foothills of Himalayas

Pea: The incidence of root rot / wilt disease of pea in farmers' fields was low as compared to the previous years in Lahaul valley. The minimum disease incidence (traces) was found in Miyar valley whereas in Pattan valley the incidence was comparatively high (20-50%) in some pockets. In Sirmour district, white rot, root rot complex and powdery mildew were predominant whereas in Mandi district root rot / wilt complex, rust and powdery mildew were the main diseases.

Potato : Incidence of late blight during 2008 was between traces to 10 percent at the but incidence of early blight raged from 10 to 60 percent in Malan, Pathiar, Lakhamandal, Jadrangal, Jia, Ramerh, Tangroti, Parour, Menhja, Panaper, and of Kangra district. In Mandi and Sirmour districts late blight incidence ranged from moderate to high.

Ginger: Rhizome rot , Phyllosticta leaf spot, Rhizoctonia leaf blight and bacterial wilt were the predominant diseases.

Fodder crops: During period under report wilt/root rot , Anthracnose/stem rot, and blights of cowpea, blight of maize, Helminthosporium blight of bajra and sorghum were the main diseases In the season oat crop was affected by powdery mildew, whereas leaf spot was observed in Berseem and Lucerne.

Tea: Blister blight caused by *Exobasidium vexans* appeared in the end of July, 2008 and remained with low disease pressure due to low initial inoculum build-up. Grey and brown blight appeared with low disease intensities, whereas sooty moulds due to mealy bug infestation are becoming a serious problem in tea plantations.

Poly-house: In Mandi district, under protected cultivation diseases viz; Root rot/collar rot in capsicum and tomato, powdery mildew Bacterial wilt, and viral diseases in capsicum were found predominant.

I. Cereals

Wheat

Germplasm evaluation

During 2008-09 crop season 2392 entries were screened under artificial inoculation condition against major diseases in various plant pathological nurseries and 77, 501, 990 and 11 entries were found resistant to Karnal bunt, yellow rust, brown rust and powdery mildew, respectively . Similarly, in other plant pathological nurseries, out of 518 entries, 13, 38, and 10 were found resistant to head scab, yellow rust and powdery mildew, respectively.

Under All India Coordinated Wheat and Barley Improvement, 126 wheat entries were evaluated against local isolates of *Tilletia indica* under artificial inoculation condition. Eight entries namely; HS 461, TL 2949, HI 8681, K 0607, HI 8682(d), HI 8682(d) UAS 304 and VAS305 were found resistant to Karnal bunt.

Out of 130 wheat genotypes, seven genotypes namely; HI8680 (d), VAS 304, KRL 210, HPW 297, K 0707, WH 1078, MACS 5009 were recorded resistant to powdery mildew. Two hundred fifty wheat entries were screened by artificial inoculation of head scab pathogen, nine entries namely; PDW 314, HI 8680, UAS 305, KRL 210, HPW 297, K 0707, WH 1078 and MACS 5009 were found resistant to head scab. Out of 67 genotypes evaluated against yellow rust, brown rust, karnal bunt and powdery mildew, six genotypes namely ; TL 2955(T) , HPW 285, HW 5044, HW 2308, DDK 1033(Dic.) and MACS 2980(Dic.) showed multiple disease resistance.

Out of 1535 wheat entries screened for resistance to YR under artificial epiphytotic conditions at RWRC, 908 entries remained free from YR. However, out of 42 entries pertaining to this centre, 29 remained free from YR.

A total of 556 entries, comprising of AVT-II, AVT-I and NIVT material, were screened for resistance to YR under artificial epiphytotic conditions. Of these, 40 entries from AVT-II (118), 77 from AVT-I (132) and 111 from NIVT (306) remained free from YR. Among entries pertaining to Northern Hill Zone which remained free from YR were; AVT-II: HS502, VL907, HS490, TL2942, VL804, VL892

AVT-I: HPW289, 296, 297, 308, 309, 315, HS505, 507, 511, 513, 521, TL2963, TL2966, VL916, 920, 925, 933, 934, UP2771

A total of 122 entries were evaluated for resistance against powdery mildew under artificial epiphytotic conditions in the field at Malan. Of these, 5 entries viz. TL2934, TL2942, HW1095, DDK1009 and DDK1029 were found immune scoring 0 on 0-9 scale. One entry MACS2971 was moderately resistant .

52 wheat entries comprising of AVT-I & II (NHZ) material, were screened against *Tilletia caries* and *T. foetida* by inoculating the seed of individual/each entry with teliospores @ 5.0 % (W/W) before sowing. Of these, 13 entries viz. HPW289, HPW308, HPW309, HS521, HS522, TL2963, TL2966, VL916, VL921, VL925, TL2942, VL616 and HS240 remained free from the disease and 17 entries recorded resistant reaction (below 10 %).

Trap Plot Nursery comprising of 20 wheat lines was planted at SAREC Kangra and KVK Sundernagar. YR and LR infection under natural conditions was recorded and rusts samples were sent to DWR Regional Station, Flowerdale for identification of races. The pathotypes identified by DWR Regional Station, Flowerdale were 104-2, 104-3 and 77-5 of LR and 78 S 84 and 46 S 119 of YR. The same pathotypes of YR were also most prevalent on wheat in Sirmour and Solan districts.

Management

Management of loose smut and karnal bunt by seed dressing fungicides: All the fungicides gave significant reduction in loose smut incidence except mancozeb and Thiram (Table 1). Vitavax resulted excellent plant vigour and cent percent control of loose smut and karnal bunt followed by F100 and carbendazim.

Compatibility of seed dressing fungicides, biocontrol agent and insecticides for use in IPM: All the seed dressing fungicides were found compatible with Endosulfan, Chlorpyriphos and biocontrol agent *T. viride*. There was no adverse effect on seed germination and disease control efficiency of the fungicides. Seed treatment with fungicides + insecticides followed by one spray of Tilt and insecticide gave significant reduction in loose smut, karnal bunt, yellow rust, termite damage, aphid population and significantly increased grain yield . However, seed treatment with Vitavax / Bavistin + Chlorpyriphos + one foliar spray of Tilt and Chlorpyriphos was found best treatment for the control of diseases and insect pests of wheat.

Table 1: Effect of seed dressing fungicides on the incidence of loose smut and Karnal bunt of wheat

Treatment	Germination (%)	Seedling vigour	Infected ears (%)	KB incidence (%)	Yield /plot (g)
F100 @2.5g/kg	90	Good	0.86	0.02	1075
F100 @ 3.0 g / kg	90	Good	0.76	0.01	925
F100 @ 3.5g / kg	95	Good	0.13	0.0	1108
Carbendazim @ 2.0 g/kg	95	V. Good	0.40	0.02	1033
Mancozeb @2.5 g/ kg	90	Fair	3.93	0.04	783
Vitavax @2.5 g/kg	85	Excellent	0.00	0.01	1208
Thiram @2.5 g /kg	88	Good	5.01	0.08	783
Vitavax power @ 3.0 g / kg	88	Excellent	0.92	0.06	850
Check	82	Fair	4.21	1.02	700

Plot size 1x1m^2

Management of Karnal bunt by different formulations of *Trichoderma viride*: All the formulations of *T. viride* gave significant reduction in Karnal bunt and loose smut incidence over check (Table 2). However, foliar spray of Ecoderma and Ecoguard gave minimum Karnal bunt infection (0.01%) followed by Trichoguard (0.15%) and Tricho-X (0.22%). Seed treatment with Ecoguard and Ecoderma resulted in hundred percent control of loose smut.

Biological control of wheat diseases in the production of organic wheat: A field trial on control of loose smut and Karnal bunt was conducted by using biocontrol agents at organic farm indicated that *Trichoderma viride* resulted complete control of loose smut as well as Karnal bunt (Table 3). However, *T. harzianum* gave 0.20 and 0.09 percent infection of loose smut and Karnal bunt, respectively. *Trichoderma hamatum* was least effective in controlling both the diseases.

Table 2: Management of Karnal bunt of wheat with different formulations of *Trichoderma viride*

Treatment	Karnal bunt incidence (%)	Loose smut incidence (%)	Yield / plot (g)
Ecoderma	0.01	0.00	633
Sanjeevani	1.78	0.13	600
Ecoguard	0.01	0.00	683
Trichoguard	0.18	0.43	550
Trico - X	0.24	0.34	495
Check	1.09	0.53	450
CD (P= 0.05)	0.56	0.09	105

Seed treated with BCAs @2.5g/kg before sowing
Plot size 2.0x1.75 m^2
1st spray of biocontrol agent @ 5g/l was given at flag leaf stage followed by another spray at 50% emergence of ears i.e. 10days after 1st spray

Table 3: Biological control of wheat diseases in the production of organic wheat

Treatment	Loose smut incidence (%)	Karnal bunt incidence (%)	Yield / plot (g)
Trichoderma viride	0.00	0.00	300
T. harzianum	0.20	0.09	216
Pseudomonas fluorescens	0.22	0.02	160
Bacillus subtilis	0.17	0.05	130
T. hamatum	1.10	1.00	208
Check	0.45	0.90	133
CD (P= 0.05)	0.09	0.06	48

Figures are square root transformed before analysis
Plot size : 2.0 x 1.25m^2
Biocontrol agents were applied as seed treatment and foliar spray given at 50 percent emergence of ears

Assessment of losses caused by powdery mildew in wheat: A field trial was conducted on assessment of losses caused by powdery mildew using six fungicidal treatments on wheat variety PBW 343. All the test fungicides were effective in controlling powdery mildew, however, maximum disease control was achieved with Tilt followed by Bavistin. Yield losses varied in different treatments and maximum loss of 19.77 percent was recorded in check plots at HAREC Dhaulakuan.

At RWRC, Malan during trial consisted of 7 treatments viz. one spray of Tilt @ 0.1% at initiation of disease, two sprays of Tilt @ 0.1% at 15 days interval, one spray of Bavistin @ 0.1% at initiation of disease, two sprays of Bavistin @ 0.1% at 15 days interval, three sprays of Sulfex @ 0.3% at 10 days interval, two sprays of Karathane @ 0.05% at 15 days interval and a check and three replications of each. w. The treatment, two sprays of Tilt @ 0.1% at 15 days interval from initiation of the disease, was the most effective giving complete control of the disease. Highest yield of 34.7 qt/ ha was observed in case of two sprays of Tilt. The losses due to powdery mildew were 25.6 per cent.

Barley

Germplasm evaluation

Out of 478 entries of barley in EBDSN, NBDSN and IBDSN, 120 entries were found resistant to yellow rust under artificial inoculation condition in field.

Rice

Germplasm evaluation

Rice germplasm consisting of 174 lines from various national nurseries viz. NSN-H, NHSN and DSN were screened under natural epiphytotic conditions against leaf blast. The most promising entries were HPR 2512, HPR 2177, UPRI 2005-15, VL 30917, VL 30919, HPR 2558, VL 31329, VL 31330, VL 31335, VL 31327, RCM 16 and VL 31334 in NSN (H); IHRT-ME-9 in National Hybrid Screening Nursery; and VL 30336 and VOHP 3102 in Donor Screening Nursery.

Ninety eight entries of rice from NSN-H and DSN were screened against neck blast under natural epiphytotic conditions in transplanted conditions. Highly resistant entries against neck blast were:

NSN-H: SKAU 292, HPR 2309, HPR 2558, VL 30560, VL 31329, VL 31330, VL 31327, UPR 2992-17-3-1, HPR 2303, HPR 2598, HPR 2143 and RP 2421.

DSN: VOHP 3102, VL 7318, VL 30921 and VL 30922.

Ten genotypes of paddy were screened under natural infection condition against major diseases at HAREC Dhaulakuan indicated that Jaya was free from brown leaf spot, blast, and leaf

scald. Pusa Sugand showed maximum incidence of brown leaf spot. None of the cultivars / genotypes showed false smut incidence.

Fungicidal management of rice diseases: Nine fungicides evaluated against major diseases of rice indicated that two sprays of Tilt @ 0.1 % after 45 and 60 days of transplanting resulted maximum reduction of brown leaf spot (Table 4) whereas at lower dose (0.05%) it was less effective. Bavistin gave best reduction of leaf and neck blast followed by Controll 5 EC and Result 5 EC. Blitox-50 gave good control of false smut.

Chemical control of major rice diseases

In an other experiment consisting of four new fungicides; Metominostrobin 20 SC (0.5, 1.0 and 2.0 ml / L), RIL 013/F1 35 SC (1.5 and 2.0ml/L), Baan 75 WP (0.6 g /L) and Fuji-One 40 EC (1.5 ml/L) were evaluated in RBD with 8 treatments and 4 replications. A susceptible variety T-23 was planted in 2.00 x 2.70 m^2 plots. Four sprays of fungicides were given at 15 days intervals starting from the date of appearance of the disease. The results revealed Fuji-One 40 EC (1.5 ml/L) to be the most effective against leaf and neck blast followed by RIL 013/F1 35 SC (2.0 ml/L).

Table 4: Chemical control of rice diseases

Treatment	Conc. (%)	Brown leaf spot intensity (%)	Leaf blast intensity (%)	Neck blast intensity (%)	False smut incidence (%)	Grain yield (kg)/plot
Indofil M-45	0.25	10.66	10.00	1.00	1.00	2.200
Blitox-50	0.30	22.33	8.00	2.00	**0.50**	2.000
Bavistin 75WP	0.10	52.00	2.33	0.33	5.00	2.000
Controll 5EC	0.10	9.33	3.23	2.66	2.00	1.900
Tilt 25EC	0.05	**9.66**	6.33	2.33	3.00	**2.010**
Tilt 25EC	0.10	**1.33**	6.33	3.01	3.69	**2.900**
Antracol75 WP	0.25	29.33	6.66	4.00	5.66	2.200
Contaf 5EC	0.10	36.66	4.33	4.33	3.00	2.500
Result 5EC	0.10	20.00	3.33	3.66	3.00	2.200
Check	-	50.33	13.00	8.33	7.33	1.125
CD (P=0.05)	-	5.08	1.58	0.48	0.45	0.200

Figures are angular transformed before analysis Cv. PR 116

Plot size= 2x2 m

Evaluation of fungicides against location specific diseases: Five fungicides namely, Metominostrobin 20 SC (0.5, 1.0 and 2.0 ml/ L), Sanit 70 WDG (4.0 g/ L), Taqat 75 WP (1.5 g/ L), Contaf 5 SC (2.0ml/ L) and Dhanteam 75 WP (0.6 g/L) were evaluated against rice blast under field conditions. A susceptible variety Pusa Sugandh was planted in RBD consisting of 8 treatments and 3 replications with plot size of 2.40 x 3.00m^2. Four sprays of fungicides were given at 15 days interval starting from the date of appearance of the disease. The results revealed Dhanteam 75 WP (0.6g/ L.) to be the most effective followed by Metominostrobin 20 SC (1.0 and 2.0 ml/ L) and Taqat 75 WP (1.5g/ L).

Maize

Germplasm evaluation

Trap nursery comprising of 14 inbred lines was planted in isolation and observed for appearance of various diseases under natural epiphytotic conditions. Erwinia stalk rot (ESR), brown stripe downy mildew (BSDM), banded leaf and sheath blight (BLSB), Maydis leaf blight (MLB), Curvularia leaf spot (CLS) and brown spot were observed in these lines. Genotypes V341,V356,V335,V340,V372,V400,V382,CM501 and CM 202 remained free from ESR, whereas V345 was highly resistant to this disease .Genotypes V355,V340,V383,V382 and CM501 were resistant to BSDM,BLSB,MLB,CLS and brown spot. Similarly at HAREC Bajaura

maize disease trap nursery consisting of 14 lines was planted to determine the prevalence of different diseases of maize. Maximum disease incidence of TLB and MLB were recorded on CM-202 and V-335, respectively. Maximum incidence of BLSB and Curvularia leaf spot were observed on V-335 and CM-501, respectively

Two hundred nineteen entries of advanced breeding materials comprising early, medium and full season maturity group (IET and AVT) were evaluated against ESR and BSDM of maize under artificial epiphytotic conditions. The entries JH-11652,GH-727,EHK-40108,B H-407135,B H-408001, X 7 B401 X 7 B403,LAXMI-9495,M O5 -008,JKMH-8001,KMH-3669,SEEDTECH-2324 were found resistant to BSDM and JH-11858,EHK-40108 ,B H-407135,B H-408001 ,LAXMI-9495,M O5 -008,PHS-520247,KMH-SUPER-244,BISCO-4564 to ESR.

Two hundred nineteen lines/ genotypes of different maturity groups received from Directorate of Maize Research were screened against turcicum leaf blight (TLB) and Maydis leaf blight (MLB) pathogen under artificial inoculated conditions at HAREC Bajaura. Disease severity was recorded as per 1-5 scale. GH-727, EHK-40008, EHK-40108, GK-3059, M-05 008, BH-407144, PRO-376, HTCH-5201, HM-9, EHK-30508, EH-1871, BISCO-2225, FH-3463, FH-3473, AH-7026, AH-7028, JH-11693, BH-40702, JH-11535, VL-113, VIVEK-17 were found resistant to TLB. The genotypes ; JH-11158, JH-11925, JH-12046, KMH-40876, BH-407138, PAC-745, PAC-746, SMH-4502, KDMH-104, BIO-9681, JH-31150, MMH-17006, BH-40707, JH-31192, JH-31197, UMC-11, LAXMI-207, M-06-108, PAC-7401, JH-31153, BH-40704, CP-828, JH-31110, FQH-38, QPMMMH showed resistance against MLB, whereas genotypes BH-408001, BH-408004, LAXMI-9445, BL-2801, HTCH-5102, MEH-07-3, COM-R-2006-1, FH-3464, VIVEKQPM-9, HIM-129, JH-11180, JH-11422, JH-11433, MDMH-101, NECH-134, PRO-373, KMH2288 SUPER, CP-808, NECH-131, MH-3904, BIO-9681, KDMH-1001, V-37,MCH-35, UMC-1,FH-3358, VEHQPM, VEHQPM-3027, HQPM-5 were found resistant to both the diseases.

Fifteen maize hybrids from private sector were evaluated against banded leaf and sheath blight disease under natural as well as artificial conditions at Kangra .All the hybrids showed moderately resistant reaction under natural conditions. None of the hybrid was found resistant to the disease under artificial conditions. Hybrids namely Vivek-21, Vivek-23, EHL-1611, 115-K-08-05 and Bisco-1141were found highly susceptible, 900M Gold, Girija composite, Euro-1201, EHL-1610, Bisco -1121, Bisco-1840 were observed susceptible and 110-08-01, Bisco-1111, DKC-7074 and PMZ-4 were found moderately susceptible.

Management of banded leaf and sheath blight of maize:

A trial was conducted on the management of BLSB using cultural practices, bioagents and fungicides. Minimum disease intensity (1.46 on 1-5 scale) and maximum yield (43.22 q/ha) was found in the case of foliar spray of validamycin (0.25%) followed by Tilt (0.1%) and Bavistin (0.1%) (Table 5).

Management of banded leaf & sheath blight of maize

Four seed dressing fungicides viz. Carbendazim (2.5 gm / kg seed), Vitavax Power (3.0 gm / kg seed) Thiram (3.0 gm / kg seed) and Carboxin (2.5 gm/ kg seed) were evaluated against BLSB. All the fungicides were found superior over control. Carbendazim followed by Vitavax Power were found most effective against BLSB. Similar trend was also observed in yield and germination.

Table 5 : Management of banded leaf and sheath blight of maize with chemicals, biocontrol agents and cultural practices

Treatment	Average disease rating (1-5)	Average yield (q/ha)
Weeding-clean plot and removal of old leaves	3.81	30.92
Removal of lower leaves and no removal of weeds	4.34	28.61
Seed treatment with *Trichoderma viride* (10g/Kg seed)	3.61	33.01
Seed treatment with *Pseudomonas fluorescens* (10g/Kg seed)	3.70	32.9
Contaf (0.1%) spray	2.29	39.9
Tilt (0.1%) spray	1.48	41.40
Validamycin (0.25%) spray	1.46	43.22
Saaf (0.25%) spray	2.51	39.30
Indofil M-45 (0.25%) spray	3.01	35.31
Bavistin (0.1%) spray	1.80	40.60
Check	4.74	27.43
CD at 5%	0.32	3.69

Management of Turcicum leaf blight of maize

Six fungicides viz. Carbendazim @ 0.1%, Mancozeb @ 0.25%, Difenconazol @0.015%, Propineb @ 0.2%, Copper oxychloride @ 0.3% and Chlorothalonil @ 0.2% were evaluated against TLB. A Single spray of all the fungicides were given at tasseling stage when disease started appearing. All the fungicides were found superior over the control. Spray with Mancozeb, Carbendazim and difenconazole were found effective against TLB and MLB (Table 6).

Table 6. Fungicidal management of turcicum leaf blight (TLB) and maydis leaf blight (MLB)

Treatment	Trade names of fungicides	TLB *	MLB *	Yield (q / h)
Carbendazim @ 0.1%	Bavistin	2.0 (1.58)	2.5(1.73)	68.2
Mancozeb @ 0.25%	Dithane M-45	2.0 (1.58)	2.0(1.57)	67.9
Difenconazol @0.015%	Score	2.3(1.68)	2.1(1.62)	71.7
Propineb @ 0.2%	Antracol	2.7(1.78)	2.5(1.73)	70.9
Copper oxychloride @ 0.3%	Blitox	2.6(1.77)	2.7(1.77)	67.8
Chlorothalonil @ 0.2%	Kavach	2.3(1.68)	2.3(1.67)	64.9
Control (No spray)	-	4.0(2.12)	3.8(2.08)	63.7
CD (P 0.05)		(0.23)	(0.21)	Ns

* 1-5 scale. Figures in parentheses are square root transformed values.

II. Pulses

Mash

Germplasm evaluation

Fifty eight lines/ genotypes of urdbean were received from Indian Institute of Pulses Research, Kanpur under All India coordinated research project on MULLaRP. These genotypes

were evaluated against cercospora leaf spot pathogen. None of the entry was found resistant against cercospora. However, entries, P-1034, P-1014, P-1009, P-1021, P-1030, P- 1017, P-1005, P-1036, P-1031, P-1013, P-1038, P-1054 and P-1058 found moderately resistant.

One thousand genotypes of mash were evaluated against mungbean yellow mosaic virus (MYMV), anthracnose, Cercospora leaf spot (CLS) and powdery mildew (PM). In all 250, 16, 2 and 24 genotypes were free from MYMV, anthracnose, Cercospora leaf spot and powdery mildew, respectively.

In AVT I trial received from All India Coordinated Project, HPBU 35, 67-1 and P93 and KU7-606, HPBU 143, KU7-630, and P93 in AVT II were found resistant to leaf spots caused by *Colletotrichum truncatum* , and *Cercospora* spp. under natural epiphytotic conditions . In the multilocation trials, KU7-606, KU5-527, KU 553, KU6-369 were resistant to moderately resistant to the prevailing diseases while, HIM Mash -1 and HPBU -1 were resistant to moderately resistant.

Mungbean

More than 200 stocks of mungbean were evaluated against MYMV and anthracnose. It was observed that 84 and 7 genotypes were free from MYMV and anthracnose respectively.

Chickpea

Germplasm evaluation

Out of 151, 30, 40 and 217 entries of chickpea of PPSN chickpea, IABN (ICRISAT), ICABN (ICARDA) and National Bureau of Plant Genetics Resources (NBPGR) 38, 16, 21 and 22 entries showed resistance to Ascochyta blight. Genotypes, Himachal Chana 1, P 85, P 93, NNA 20, NNA 25, NNA 26, NNA 28, NNA 32, P 230, P 231 and P 286, EC 517011, ICC 4200, EC 517039, EC 517023, EC 516971, EC 516934, EC 516709, EC 516771, EC 516792, ICCV 98818, ICCV 98815, FLIP 03-36C, FLIP 04-22C, FLIP 03-42C, FLIP 05-99C, FLIP 05-10C, IC 269306, IC 269810, IC 269837, IC 269330, IC 269479, IC 269478 and IC 269522 with disease reaction ≥3 were highly resistant. In addition to it, resistance to Ascochyta blight was confirmed in about 500 genotypes maintained at Dhaulakuan. At KVK, Sundernagar,15 entries were evaluated against root rot/ wilt and viral diseases . The lines; C 123, C127, HPG 17, Himachal Chana 1,and ICCV 95503 were moderately resistant to root rot and Green gram, HPG 117, ICCV 95503 and GPF 2 were resistant to viral diseases

Lentil

Among the national Advanced breeding material (AVT 2008-09) genotypes PL 024, DPL 15, IPL 314, LL 1129, LL 1184, IPL 317, VL 518, IPL 528, VL 514, RLG 73. Out of 93 genotypes of lentil procured from NBPGR, New Delhi, CSAUAT, Kanpur and ICARDA, Syria genotypes L 965, L 971, L 972, L 980, L 986, L 989, L 992, L 995, L 996, L 999, L 1006, L 3413, L 4603, L 4076, LP 117, LP 22127, RL 1, Precoz, (LIRN 07-08) 16102, 16103, 16105, 16107, 16109, 16110, 16113, 16114, 16115, 16117, 1;6118, 16119, 16120, 16123, 16127, 16128, 16138, L 134, IC 248969 IC 241783, IC 201677 and LC 68-17-3-5 were free from rust. Among the entries of Lentil International Rust Nursery from ICARDA, entries ILL 5604, ILL 5883, ILL 5755, ILL 6002, ILL 6811, ILL 7215, ILL 7217, ILL 7219, ILL 7949, ILL 10012, ILL 9899, ILL 9942, ILL 7713, ILL 7717, ILL 8076 and ILL 8077 were free from rust.

Field pea

Out of 106 genotypes of field peas genotype HUVP 1 was free from the rust whereas genotypes P 160, IC 28035, IC 311063 with DR≥2 were highly resistant and genotypes P 127, P 132, P 157, P 158 and P 159 RIL 4 and RIL 5 with disease reaction '3' were resistant.

Disease management

A field trial was conducted to evaluate efficacy of 8 fungicides as two foliar sprays using variety UL 338 for the management of foliar diseases; web blight and powdery mildew of mash. All the fungicides reduced disease incidence of web blight as compared to check (Table 7). Two sprays of tilt 25EC @ 0.1% resulted in minimum disease intensity (3.33 %) followed by Score 25EC (3.66 %) and contaf 5EC (4.17 %). All the treatments significantly improved yield as

compared with the no spray check. The highest yield was recorded in two foliar sprays of Contaf 5EC followed by Bavistin 50 WP (10.81 q/ha) and Score 25EC (10.74q/ha).

Table 7: Efficacy of fungicides for the management of foliar diseases of urdbean

Fungicide (dose %)	Yield (q/ha)	Web blight severity (%)	Powdery mildew (0-5)
Bavistin 50WP (0.1)	10.81	8.66 (17.04)	0.00
Indofil M 45 70WP (0.25)	10.07	14.33 (22.1)	2.67
Copper oxychloride 50WP (0.3)	8.96	25.00 (29.91)	2.83
Bavistin + Indofil M 45 (0.1+0.25)	9.63	9.00 (17.43)	0.00
Tilt 25EC (0.1%)	9.85	3.33 (10.34)	0.00
Score 25EC (0.1%)	10.74	3.66 (10.86)	0.00
Contaf 5EC (0.1%)	11.11	4.17 (11.74)	0.00
Ridomil (0.2%)	7.85	26.67 (30.93)	2.33
Control (no treatment)	7.62	45.00 (42.10)	3.33
CD (p= 0.05)	1.31	5.03	--

III. Oilseeds

Rapeseed and mustard

Germplasm evaluation

Fifty two entries of rapeseed-mustard were screened against Alternaria blight and white rust diseases under artificial inoculation conditions. Most of the entries showed higher disease severity of Alternaria blight on leaves. The minimum disease severity on leaves (45.9%) was recorded in the entry coded as SBG-08-48. The Alternaria pod blight severity ranged from 3.3% in SBG-08-48 to 55.1% in SBG-08-45.

The severity of white rust varied from 0.9% to 35.1%. Entries like SBG-08-20, SBG-08-22, SBG-08-43, SBG-08-44, SBG-08-45, SBG-08-46, SBG-08-47 and SBG-08-50 recorded less than 10% infection on leaves. Staghead infection was only recorded in three entries viz. SBG-08-8, SBG-08-42 and SBG-08

Under uniform disease nursery trial 42 entries of rapeseed-mustard were screened against Alternaria blight and white rust diseases under artificial inoculation conditions. The entries coded UDN-08-37 and UDN-08-38 showed lowest pod infection of 4.2 per cent and 5 per cent respectively. Highest pod infection of 55.1 per cent was observed in UDN-08-44. The entries like UDN-08-5, UDN-08-8, UDN-08-20, UDN-08-25, UDN-08-43, UDN-08-44 and UDN-08-46 remained free from white rust. The entries UDN-08-9, UDN-08-13, UDN-08-31, UDN-08-34, UDN-08-38, UDN-08-41, UDN-08-42 and UDN-08-45 showed less than 10 per cent infection of white rust.

Under National Disease Nursery for white rust resistance 41 entries of rapeseed-mustard were screened. Entries like NDN-08-94 and NDN-08-112 remained free from white rust disease. Disease severity was below 10 per cent in entries like NDN-08-76, NDN-08-78, NDN-08-79, NDN-08-84, NDN-08-92, NDN-08-99, NDN-08-103, NDN-08-105, NDN-08-107, NDN-08-117, NDN-08-118, NDN-08-119, NDN-08-120, NDN-08-121 and NDN-08-122 on 75 and 100 DAS.

Fifteen single and double low oilseed rapeseed-mustard lines were screened. Maximum disease severity of 30.1 per cent on pods was observed on RMQ-08-05, whereas, disease severity remained minimum in case of RMQ-08-14. Entries coded RMQ-08-1, RMQ-08-14 and RMQ-08-15 remained free from white rust at both the stages.

Linseed

Two hundred entries of linseed were screened against rust and wilt diseases under natural conditions at Kangra. The entries like EC-54, EC-547, EC-1497, EC-4752, EC-8363, EC-9204, EC-13222, EC-21749, EC-22635, EC-22684, EC-41496, EC-41616, EC-282827, EC-322652, EC-322688, Omega-1, Omega-2, SJKO-11, SJKO-12, SJKO-13 and SJKO-15 were found resistant to rust as well as wilt.

Out of UDNT 56 entries evaluated against above mentioned diseases; UDN-4, UDN-5, UDN-6, UDN-14, UDN-15, UDN-16, UDN-20, UDN-24, UDN-27, UDN-35, UDN-39, UDN-40, UDN-48, UDN-49 and UDN-52 showed resistance to both rust and wilt diseases. Whereas under artificial conditions entries UDNA-1, UDNA-5, UDNA-6, UDNA-7, UDNA-11, UDNA-19, UDNA-23 were found to be highly resistant to rust.

Forty one promising entries/elite materials of linseed were evaluated against rust under high inoculum pressure at Kangra. Entries observed highly resistant or resistant to rust are given below:

Highly resistant**:** RLC-48, Solapur-9, Sydnog-20, KL-1, LC-2023, PKDL-62, LCK-89512, PKDL-65, LCK-9313, LCK-9320, Surbhi, H-40, OR-8-44, Polf-14

Resistant: RLC-120, R-204×4/9, S-91-38, BAU-08-07, DPL-19, KL-190, LC-2002, BAU-9906, Polf-5, R-1017, BAU-06-07, ES-44, JRF-3.

Similarly, 23 promising entries/elite materials of linseed were screened against wilt under high inoculum pressure at Kangra. Entries like KL-1, LC-2014 and KL-31 were observed resistant to wilt. These entries also possessed resistance to rust.

Disease management

Mustard

Chemical control of Alternaria blight and white rust of mustard

A field experiment was conducted during 2008-09 to evaluate different number of sprays (2, 3) of fungicides like Tilt, Score, Contaf and Ridomil against Alternaria blight and white rust diseases using susceptible variety Varuna and recommended fungicide Indofil M-45(3sprays) and unsprayed plots as controls. Two fungicidal sprays were applied on 60 and 80 days after sowing, whereas third spray was applied on 100 days after sowing. Disease severity of Alternaria blight on leaves and pods was lowest with three sprays of Score (0.05%) followed by two sprays (Table 8). However no significant differences were observed in disease severity on pods among Score (2, 3 sprays), Tilt (2, 3 sprays) and Contaf (3 sprays). Ridomil proved most effective for the control of white rust infection on leaves, however, no significant difference in disease severity was observed between 2 and 3 sprays. Highest yield of 1951 kg/ha was recorded in case of 3 sprays of Score however, it didn't differ significantly from Ridomil MZ (2 or 3 sprays) and Score (2 sprays). Thousand seed weight was also highest (3.47g) in this treatment.

At HAREC Dhaulakuan fungicides Score 25 EC, Tilt 25 EC and Contaf 5EC were evaluated for the management of Alternaria blight. All the fungicides resulted in significantly less Alternaria blight on leaves and more yield as compared to check (47.66%). The least intensity of Alternaria blight was recorded in three sprays of Tilt 25 EC (18.22) followed by 3 sprays of score 25EC (22.44%). The yield was highest (13.11 q/ha) in plots with 3 sprays of Tilt 25 EC followed by three sprays of score 25EC (12.52 q/ha) and Contaf 5EC (11.7 q/ha). White rust was recorded in all the plots sprayed with sterol biosynthesis inhibitors.

Evaluation of bio-agents and botanicals against the foliar diseases of mustard

Seed treatment with *Pseudomonas fluorescens* (Sudocel), *Trichoderma viride* (Biocontrol lab, Palampur) and fresh garlic extract were tested alone or in combination with foliar sprays of aqueous extracts from leaves of *Eucalyptus* and bulbs of garlic against Alternaria blight and white rust diseases of mustard using susceptible cultivar Varuna (Table 9). Seed treatment with Apron along with two sprays of Mancozeb and unsprayed plots were kept as control treatments. Two foliar sprays of extracts were applied after disease initiation on fortnightly intervals. Lowest disease severity of Alternaria blight on leaves as well as pods was observed in case of seed

treatment with Apron combined with two foliar sprays of Mancozeb followed by seed treatment with *Trichoderma* + 2 sprays of leaf extract of *Eucalyptus*. Similarly white rust infection was also lowest in these treatments. Highest yield of 1684 kg/ha was obtained in case of seed treatment with Apron combined with two foliar sprays of Mancozeb closely followed by 1614kg/ha in case of seed treatment with *Trichoderma* + 2 sprays of leaf extract of *Eucalyptus.*

Table 8: Chemical control of major diseases of mustard

Treatment	**Disease severity (%)**			**Yield (kg/ha)**	**1000 seed wt. (g)**
	Alternaria blight (leaves)	Alternaria blight (pods)	White rust		
Tilt (0.1%) 2 sprays	15.2(22.9)	8.0(16.4)	34.6(36.0)	1457	3.04
Tilt (0.1%) 3 sprays	14.9(22.7)	7.1(15.4)	30.8(33.7)	1531	3.26
Score (0.05%) 2sprays	13.3(21.3)	7.8(16.2)	32.1(34.5)	1815	3.21
Score (0.05%) 3 sprays	7.4(15.7)	6.9(15.2)	31.5(34.1)	1951	3.47
Contaf (0.1%) 2 sprays	13.8(21.8)	8.5(16.9)	34.1(35.7)	1543	3.06
Contaf (0.1%) 3 sprays	10.0(18.4)	7.3(15.7)	33.5(35.4)	1568	3.09
Ridomil MZ (0.25%) 2 sprays	27.3(31.5)	8.4(16.9)	0.2(1.6)	1778	2.90
Ridomil MZ (0.25%) 3 sprays	26.2(30.8)	8.2(16.7)	0(0)	1914	3.17
Indofil M-45(0.25%) 3 sprays	31.5(34.1)	8.9(17.3)	13.9(21.9)	1494	3.06
Unsprayed	45.3(42.3)	17.1(24.4	35.8(36.8)	1235	2.87
CD(P=0.05)	1.9	1.1	2.4	197	0.24

Figures in parentheses are arc sine transformed values

Table 9: Role of bioagents and botanicals in the management of major diseases of mustard

Treatment	**Disease severity (%)**			**Yield (kg/ha)**
	AB (leaves)	AB (pods)	White rust	
ST with *Trichoderma* (10g/kg seed)	41.8(40.2)	16.9(24.3)	26.6(31.0)	1357
ST with garlic extract (2%)	43.8(41.4)	17.1(24.4)	27.5(31.6)	1322
ST with *Pseudomonas* (10g/kg seed)	48.6(44.2)	18.1(25.2)	27.2(31.4)	1190
ST with *Trichoderma* + 2 sprays of leaf extract of *Eucalyptus* (2%)	36.9(37.4)	15.9(23.5)	24.6(29.7)	1614
ST with *Trichoderma* + 2 sprays of garlic extract (2%)	42.2(40.5)	17.6(24.8)	28.1(32.0)	1368
ST with garlic+2 sprays of garlic extract (2%)	40.7(39.6)	16.5(23.9)	28.5(32.3)	1298
ST with *Pseudomonas* + 2 sprays of leaf extract of *Eucalyptus* (2%)	39.7(39.1)	16.3(23.8)	26.6(31.0)	1544
ST with *Pseudomonas* + 2 sprays of garlic extract (2%)	43.5(41.3)	16.3(23.8)	28.8(32.5)	1258
ST with *Pseudomonas* + 2 sprays of *Pseudomonas*	38.6(38.4)	17.2(24.5)	28.5(32.3)	1520
ST with Apron (6g/kg seed) + 2 sprays of Mancozeb (0.25%)	35.7(36.7)	14.7(22.5)	22.6(28.3)	1684
Control	49.1(44.5)	20.2(26.7)	31.0(33.8)	1123
CD(P=0.05)	2.0	1.6	2.1	209

AB: Alternaria blight, Figures in parentheses are arc sine transformed values

Assessment of avoidable yield losses due to rust in linseed

A field experiment was conducted for assessment of avoidable yield losses due to linseed rust in seven different varieties of linseed keeping protected and unprotected plots. Repeated sprays of Tilt (0.1%) were applied in the protected plots for control of rust. The yield losses due to rust were highest (87.3%) in case of variety Chambal followed 52.6% in variety R-552, 45.2% in T-397, 43.6% in J-23, 39.5% in Kiran , 26.8% in Kangra local and minimum (8.9%) in variety Nagarkot. Minimum disease severity was also recorded in variety Nagarkot under protected as well as unprotected conditions. Variety Nagarkot gave the highest seed yield of 1403 and 1278kg/ha under protected and unprotected conditions, respectively.

Assessment of avoidable yield losses due to powdery mildew in linseed

A field experiment to assess losses due to powdery mildew in six different varieties of linseed keeping protected and unprotected plots was conducted. Repeated sprays of wettable sulfur (0.3%) were applied in the protected plots for control of powdery mildew. Yield losses were highest (31.5%) in variety T-397 followed by Himalini (17.5%), Chambal (17.1%), Kangra local (12.6%), Him Alsi 1(9.0%) and minimum in variety Nagrakot (7.2%).

Soybean

Germplasm evaluation

Thirty nine lines comprising initial varietal trial (IVT) in coded numbers were received from NRCS, Indore were evaluated under natural hot spot conditions. The disease incidence was recorded when the diseases were at terminal conditions. Code nos.1, 2, 3, 6, 9, 12, 14-16, 18-25, 27, 28, 31 and 35 were free of pod blight while, 1-4, 12, 14, 16, 18, 20, 23, 24, 29, 33 and 34 were resistant to target spot. Many code numbers such as 1-3, 12, 14, 16, 18, 20, 23 and 24 were resistant to both the diseases. Code nos. 1, 6, 8, 17, 18, 23, 28 and 31 were high yielder. In AVT II entries 6 entries were evaluated and entries VLS 67 and Himso 1609 were resistant to both target spot and pod blight diseases whereas RCS 09 was resistant to only pod blight.

At HAREC Dhaulakuan genotypes P 1-2-1-1-, P12-1-1-1, P 1-4, P 2-11-1-1, P 4-12-3-3, P 7-3-1-1, Shivalik, G Sojae x NRC 2, P 12, P 13, P 17, P 18, P 20-1-1-2, P 23, P 24, P 4-6-2-2, NRC 95-03-01 were highly resistant to MYMV.

IV. Vegetables

Pea

Germplasm evaluation

Out of 316 pea cvs / lines screened against powdery mildew, only 78 cvs. / lines viz; FP-180, FP-184, 9160-29-5, FP-211, FP-258, FP-206,FP-256, HPPC-96, FP-218,FP-216,CHP-1,VL-7, JP Ajjila, DPP-9418-06, VRPMR-9, Kukumseri Selection-6, VRPMR, DPP 362, JP-625, Arka Ajeet,DPP-9414,C-96,PMR-4,DPP-107, DPP-102, DPP-11304, CHPM-2, DPP-12,DPP-80, DPP-13, PMR-21,CHP-2,IC-208378, IC-386802, HFP-4, IC-208366,IC-208379, IC-208386, EC-381866-1, KS-221,EC-499762,IC-267733, EC-507771,EC- 538008 ,EC- 328786,NIC-11181 ,IC-296678,IC- 395309,EC- 292156, Rachna, EC- 412883,EC- 292171,EC- 329560,EC- 292166, EC-389376,EC- 329568,EC- 499761, IC- 267732,DPR- 62, IPFP- 2-6, HFP- 8909,P- 212B,Mr. Big,KMNR- 894,JP-15-1,JP-501-A/2, JI-1766, DPP-9411, DPP-25G, DPP-13T, DPP-3, FC-2, DPP-127-R, DPP-120, DPP-168, DPP- LMR-41 and IC-219028 (B)gave resistant reaction against powdery mildew and 34 cvs. / lines gave moderately resistant reaction.

Virulence pattern of *E. pisi*: The virulence pattern of the 31 isolates of *E. pisi* was studied based on differential set (8 lines; viz; JI 2302 (0), EC-334160(136), NIC11181 (212), EC- 292164 (236), EC- 329561(286), JI- 1559(314), JI- 2480(315), and PB29B (464) along with Lincoln as check developed. All the isolates readily produced infection type '4' on susceptible cultivar Lincoln. Infection type 1, 2, 3 and 4 were produced on differential lines by different 5 isolates. On the basis of reaction type the 31 isolates were grouped into 13 different pathotypes ; 9 isolates were placed in pathotypes I, six in pathotypes II, four in pathotypes III, three in pathotypes IV and one each in pathotypes V, VI, VII, VIII, IX, X, XI, XII and XIII.

Disease management

Root rot complex of pea through seed dressing fungicides: The data presented (Table 10) indicated that all the seed dressing fungicides were effective in controlling root rot complex over check, however, Vitavax was the most effective fungicide followed by F- 100 and Bavistin. Thiram was the least effective fungicide

Integrated management of root rot/wilt complex of pea

Pea crop grown in rainy season (July-October) suffers with root rot/wilt complex disease. So, attempt to refine the integrated management of this disease was taken up by carrying out the OFTs. Seed treatment with Vitavax and soil application of bio-agent proved best in managing the disease and gave the maximum green pea pod yield (Table 11).

Table 10: Effect of seed dressing fungicides on germination, plant stand, and root complex incidence and dry grain weight of pea

Treatment	Germination (%)	Plant stand per plot	Root rot complex incidence (%)	Dry grain weight (g) yield / plot
F-100 @2.5g/kg	85	105	2.33	143.33
F-100 @ 7.0 g/kg	90	110	1.66	238.66
Vitavax @2.5 g/kg	90	125	1.33	258.33
Vitavax power @2.5g/kg	79		3.33	183.33
Bavistin @ 2.5g/kg	87	115	2.66	183.33
Thiram @3.0 g/kg	85	100	3.66	86.66
T. viride 2.5g/kg	85	102	4.33	91.66
Indofil M-45 @2.5 g/kg	82	105	3.66	150.33
Check	78	98	5.66	83.66
CD (0.05)	3.04	16.01	1.05	64.60

Table 11: Integrated management of pea root rot/wilt complex disease*

Treatment	% disease severity	Yield (q/ha)
T_1 = Seed treatment with bio-agent (8g/kg seed)	34.3	43.3
T_2 = Soil application of bio-agent (100g/6kg FYM/bigha)	32.3	49.5
T_3 =Seed treatment (Bavistin 2.5g/kg seed)	28.7	54.6
T_4 = T1 + T2	30.6	52.5
T_5 = T2 + T3	24.3	67.5
T_6 = Control	38.6	40.3

*Average of two experiments

Integrated management of root/rot/wilt complex disease of green pea in Lahaul Valley

Eleven on farm trials were conducted at 8 different locations during the period under report but results of 4 representative locations are discussed. The integration of Bavistin + soil application of Himbio, seed treatment with Himbio+ soil application of Himbio or soil application of Himbio gave maximum disease control and higher pod yields in most of the on farm trials (Table 12).

Table 12: Integrated management of pea root rot/ wilt complex

Treatment	Disease incidence (%)				Green pod yield (q/ha)			
	Location				Location			
	I	II	III	IV	I	II	III	IV
Seed treatment with Bavistin	52.34 (45.88)	16.04 (23.22)	15.73 (22.93)	9.68 (17.82)	126.94	131.67	60.55	136.67
Seed treatment with bio-agent	53.88 (46.40)	20.35 (26.56)	10.45 (18.81)	12.65 (20.74)	120.83	124.44	69.44	125.00
Soil application of bio-agent	33.24 (33.59)	24.23 (29.36)	12.60 (20.64)	5.03 (12.66)	136.67	122.78	62.22	170.00
Seed treatment with Bavistin and soil application of bio-agent	60.71 (51.87)	11.59 (19.84)	16.31 (23.61)	6.7 (14.80)	102.78	153.33	59.45	163.33
Seed treatment with bio-agent and soil application of bio-agent	42.39 (40.30)	22.98 (27.24)	6.17 (14.32)	8.93 (17.38)	152.22	123.90	77.33	150.00
Control	80.09 (63.74)	42.65 (40.68)	28.83 (32.30)	16.70 (24.11)	80.00	101.67	38.88	98.33
CD (P=0.05)	23.88	12.09	5.23	5.46	NS	19.63	20.34	35.82

Figures in parentheses are angular transformed values
Location I = Udaipur, II= Phura, III = Goushal , IV= Kyor

Management of white rot of pea

Losses up to the extent of 5-40 per cent have been reported in Una district due to white root rot but it can cause 100 per cent yield losses under favorable environmental conditions. Integration of seed treatment with Carbendazim (2.5 g/kg seed) before sowing and soil drenching of Carbendazim proved superior over fungicide/seed treatment alone. The disease was reduced from 10.6 per cent to 1.6 and yield was increased by 23.5 per cent

Comparative efficacy of selected bioagents against pea root rot/wilt pathogens

Pure cultures of already identified strains of *Trichoderma* viz. *T.harzianum* (JMA-4 and SMA-5*)* and *T. koningii* (DMA-8 and JMA-11) were established through single spore isolation. The cultures were mass multiplied and sent to division of Agrochemicals, IARI after lyophillization for their formulation preparations.

Bioassay studies of these BCAs against pea root rot/ wilt pathogens revealed that all the BCAs effectively inhibited the mycelial growth of pathogens. After inhibition of the pathogens, *Trichoderma* species grew over the colonies of the pathogen 11 to 53.9 per cent except for *Sclerotium rolfsii* where no overlapping occurred.

The experiments on percent colonization by *T. harzianum,* of compost substrates consisting of different ratios of FYM and vermicompost and wheat bran, vermicompost and eucalyptus leaves were conducted. FYM and vermicompost in the ratio of 3:2 or 2:3 resulted in dense mycelia growth and good sporulation. Eucalyptus leaves in different combinations with wheat bran and vermicompost resulted in thin mycelia growth and poor sporulation which shows incompatibility of eucalyptus with the *Trichoderma* spp.

Potato

Evaluation of fungicides against foliar disease of potato: Two years pooled data (Table 13) indicated that foliar sprays of Antracol 75 WP were most effective in controlling early blight and Cercospora leaf spot of potato. Antracol also gave good control of late blight and resulted in significant increase in tuber yield. Ridomil MZ 72 WP gave excellent control of late blight but was less effective against early blight and Cercospora leaf spot.

Tomato

Evaluation of Infinito 68.75% SC (w/v) (Fluopicolide 6.25%+Propamocarb hydrochloride 62.5%) against tomato late blight (fruit rot and leaf blight)

During 2008 a trial was conducted on the farmer's field at Panaper with 8 treatments having 3 replications in RBD. Three fortnightly sprays of Infinito 68.75% SC @ 1500ml/ha was found superior over the recommended fungicide-metalaxyl 8%+mancozeb 64%, 72WP @ 2500g/ha for the control of Phytophthora leaf blight and fruit rot of tomato and gave 67.9 per cent control of disease over check with 180 per cent increase in marketable tomatoes (Table 14).

Organic management of tomato diseases

A field trial consisting of 7 treatments was conducted for the management of fruit rot and foliar blight of tomato with vermiwash, Panchgavya and *Trichoderma* in RBD with 3 replications during kharif, 2008. Three sprays of these organic and bio-control agent was given at 10 days interval. None of the treatments were found effective in managing fruit rot and foliar blight of tomato. However, sprays with vermiwash (1:1) followed by Panchgavya gave less fruit rot incidence and blight as compared to other treatments (Table 15).

Table 13: Relative efficacy of fungicides against foliar diseases of potato *

Treatment	**Conc.**	**Disease severity (%)**			**Yield q/ha**
		Early blight	**Late blight**	**Cercospora leaf blight**	
Indofil M-45	0.25	17.16 (29.46)	15.34 (26.35)	7.49 (43.08)	100.00
Blitox-50	0.30	15.50 (36.29)	15.39 (26.11)	8.47 (35.63)	86.28
Antracol 75 WP	0.25	7.16 **(70.57)**	10.33 **(50.40)**	3.83 **(70.89)**	104.44
Kavach 75 WP	0.25	12.13 (50.54)	19.16 (8.01)	6.96 (47.11)	82.40
Ridomil MZ 72 WP	0.25	19.49 (19.89)	2.33 (88.81)	10.49 (20.29)	106.60
Stuff	0.25	17.16 (29.46)	18.01 (13.53)	9.49 (27.88	62.88
Melody Duo 66 WP	0.25	15.32 (37.03)	3.33 (84..01)	9.83 (25.30)	82.88
Check	-	24.33	26.83	13.16	65.06
CD (0.05%)	-	9.52	12.03	10.38	6.68

Two years pooled data (figures in parentheses are percentage disease control)

Table14 : Evaluation of Infinito 68.75% SC against tomato late blight

Treatment	Dosage Formulation (ml or g/ha)	Fruit rot incidence (%)	Disease control (%)	Yield (q/ha)	Increase over check (%)
Infinito 68.75% SC (Fluopicolide 6.25%) + propamocarb hydrochloride (62.5%)	1000	32.4 (34.7)	51.3	254.0	136.7
Infinito 68.75% SC (Fluopicolide 6.25%) + propamocarb hydrochloride (62.5%)	1250	28.3 (32.1)	71.5	275.0	156.3
Infinito 68.75% SC (Fluopicolide 6.25%) + propamocarb hydrochloride (62.5%)	1500	25.8 (30.5)	79.0	300.7	180.2
Fluopicolide 48%SC	200	30.6 (33.6)	92.5	228.3	112.8
Propamocarb hydrochloride (72.2%) SL	1250	38.2 (38.2)	84.4	200.0	86.4
Metalaxyl 8%+Mancozeb 64%-72 WP	2500	29.0 (32.6)	54.2	285.0	165.6
Cymoxanil 8%+Mancozeb 64%-72WP	1500	35.7 (36.7)	76.0	236.7	120.6
Control	---	80.3 (63.7)	-	107.3	-
CD(P≤0.05)		(3.0)		16.7	

Table 15: Organic management of tomato diseases

Treatment	Fruit rot incidence (%)	Blight severity (%)	Yield (q/ha)
Vermiwash (1:1)	8.96 (17.35)	32.26 (34.47)	138.74
(1:2)	13.20 (21.07)	44.53 (41.75)	135.36
(1:3)	15.06 (22.68)	44.26 (41.57)	111.69
(1:4)	10.21 (17.78)	41.42 (39.82)	124.48
Panchgavya	10.79 (19.14)	35.58 (37.13)	140.50
Trichoderma viride @ 8 gm/litre	11.48 (19.19)	40.02(39.23)	142.71
Control	14.56 (22.42)	52.41 (46.36)	110.08
CD (5%)	NS	NS	NS

Evaluation of plant extracts against *Ralstonia solanacearum* causing bacterial wilt

Fourteen aqueous and organic plant extracts and five essential oils were evaluated *in vitro* and *in vivo* against the tomato isolate of *R. solanacearum.*

In vitro* evaluation of aqueous plant extracts against *R. solanacearum

In paper disc method, Eucalyptus at 100 per cent concentration showed maximum inhibition of 6.20 mm against *R. solanacearum* followed by peppermint, guava and ageratum with inhibition zones of 5.40, 4.60 and 4.10 mm, respectively; however eucalyptus was statistically superior to rest of three extracts. At 50 percent concentration also, the aqueous extract of eucalyptus (3.10 mm) was highly inhibitory followed by peppermint (2.87 mm), guava (1.80

mm) and ageratum (1.50 mm), respectively. In chemicals, Streptocycline gave better inhibition than all the extracts and eucalyptus at 100 percent was more effective than copper oxychloride. The extracts of prickly pear, geranium and Indian oleander had no effect at any concentration. The extracts of jatropha and yellow oleander were least inhibitory.

In vitro evaluation of aqueous plant extracts by spectrophotometeric method also revealed that aqueous extract of eucalyptus at both the concentrations (100 and 50 percent) was most inhibitory against *R. solanacearum* with O.D values of 0.18 and 0.24 followed by peppermint, ageratum and guava, respectively. Similar results were observed with plate count method

In vivo* evaluation of aqueous plant extracts against *R. solanacearum

Eucalyptus and peppermint extracts were at par with each other and resulted maximum survivability days of 17.7 and 16.7 after 60 minutes dip at 100 per cent concentration, followed by ageratum and guava and even after 30 minutes dip, eucalyptus was most inhibitory followed by peppermint and ageratum with survivability days of 15.7, 14.3 and 12.3, respectively. Organic plant extracts of these plants against *R. solanacearum* by all the aforesaid methods also revealed similar results.

In vivo* evaluation of organic plant extracts against *R. solanacearum

The results of *in vivo* evaluation of organic extracts against tomato isolate of *R. solanacearum*, revealed that peppermint extracts showed maximum survivability of 22.7 days after 60 minutes dip and 18.0 days after 30 minutes dip at 100 percent concentration followed by eucalyptus and guava with survivability days of 19.7 and 18.3 days after 60 minutes dip but after 30 minutes dip, eucalyptus and guava were at par with each other with survivability days of 15.3 and 15. Inoculated control plants survived up to 8 days after inoculation however uninoculated control plants survived up to 30 days after inoculation. Wilted plants were confirmed by conducting ooze test.

In vitro* evaluation of essential oils against *R. solanacearum

Terpinol oil at all the three concentrations (100, 50, and 25 per cent) showed maximum inhibitory effect with inhibition zones of 13.33, 9.37 and 3.60 mm, respectively followed by citronella oil, lemon grass and palmarosa oil by paper disc method. However, neem oil was inhibitory only at 100 per cent concentration. Almost similar results were observed by plate count and agar well diffusion methods.

Evaluation of crude fractions from effective plant extracts against *R. solanacearum*

Fractions of effective plant extracts were evaluated through contact bioautography following Fisher and Lautner (1961) and Nicolaus *et al*. (1961). Peppermint, eucalyptus and ageratum, produced larger inhibition zones thereby showing that the fractions present in these extracts were inhibitory to *R. solanacearum*.

Colocasia

Management of Phytophthora blight of colocasia

A field trial consisting of 11 treatments was conducted for the management of Phytophthora blight of colocasia with fungicides in RBD with 3 replications during kharif, 2008. Five fungicides and their combinations were evaluated. Amongst the different spray schedule, schedule IX (Ridomil MZ- Ridomil MZ- Ridomil MZ) was found highly effective as indicated by low PDI (6.40 %) and high PDC (86.03%) values (Table 16) followed by schedule I (Ridomil MZ – Blitox – Blitox) and schedule II (Ridomil MZ – Dithane – Dithane) with PDI 12.90 and 14.00, PDC 71.83 and 69.43, respectively. The per cent disease index and percent disease control observed under schedule I and II were statistically at par with each other indicating thereby the importance of application of combination of systemic and protectant fungicides from the date of initiation of the disease.

High corm yields under schedules IX (201.40 q/ha), I (160.04 q/ha) and II (148.16 q/ha) showed their better efficiency, which was further supported by their high cost: benefit ratio (1: 6.05, 1: 6.80 and 1:7.45, respectively).

Table 16: Comparative efficacy of different spray schedules on Phytophthora blight of colocasia

Schedule No.	Treatment	Percent disease index (PDI)*	Percent disease control	Yield (q/ha)	Cost benefit ratio
I	Ridomil – Blitox - Blitox	12.90 (21.05)	71.83	160.04	6.80
II	Ridomil – Dithane - Dithane	14.00 (21.95)	69.43	148.16	7.45
III	Ridomil – Chlorothalonil - Chlorothalonil	16.32 (23.81)	64.36	137.96	3.31
IV	Ridomil – Antracol - Antracol	17.10 (24.35)	62.66	131.92	5.04
V	Blitox - Ridomil – Blitox	18.04 (25.10)	60.61	114.99	3.92
VI	Dithane - Ridomil – Dithane	17.72 (24.88)	61.31	117.92	2.98
VII	Chlorothalonil - Ridomil – Chlorothalonil	16.02 (23.56)	65.02	134.89	3.20
VIII	Antracol – Ridomil - Antracol	20.47 (26.51)	55.30	118.20	2.45
IX	Ridomil – Ridomil - Ridomil	6.40 (14.65)	86.03	201.40	6.05
X	Dithane – Dithane - Dithane	21.50 (27.62)	53.05	114.86	5.71
XI	Control	45.80 (42.59)	-	83.31	-
CD (0.05)		2.21	-	16.79	

Figures in the parentheses are angular transformed values

Integrated management of Colocasia **blight**

Colocasia is a major and popular vegetable crop of Una district. Because of its wide adaptability, high nutritive value, large scale acceptability and high return per unit area, it is grown throughout the district. The veracity of this plant is reflected by the fact that not only the corms but also the petioles and leaves are used for culinary purposes. Besides, it is a subsidiary food after roasting, baking or boiling. Blight disease caused by *Phytophthora colocasiae* is the most destructive amongst the diseases which attack the crop. The disease causes complete destruction of foliage and partial damage to the corms in seasons favorable to the disease resulting in 25-50 % loss in crop yield. KVK Una conducted on-farm trials to refine the control measures. Seed (rhizome) treatment with Mancozeb (0.25%)+ Carbendazim (0.1%) before sowing+ two alternate sprays of each copper oxychloride (0.3%)+ Ridomil MZ (0.25%) at 10-15 days interval starting at appearance of the disease reduced the percentage of disease incidence from 24.5 to 1.2 and yield was increased by 70.59 per cent (Table 17).

Table 17: Effect of rhizome (seed) treatment and foliar sprays for the control of Colocasia blight

Treatment	Blight incidence (%)	Yield (q/ha)	% increase in yield over farmer's practice
Two sprays of mancozeb (0.25%) fortnightly intervals on appearance of the disease (farmers' practice)	24.5	170.0	-
ST with mancozeb (0.25%)+ carbendazim (0.1%0 before sowing)+ Two sprays of Ridomil MZ (0.25%) at 10-15 days interval starting at appearance of the disease (recommended practice)	4.3	275.0	61.76
ST with mancozeb (0.25%)+ carbendazim (0.1%) before sowing+ two alternate sprays of each copper oxychloride (0.3%)+ Ridomil MZ (0.25%) at 10-15 days interval starting at appearance of the disease	1.2	290.0	70.59

Cucumber

Integrated management of sudden wilt of cucumber (Technology assessment)

Sudden wilt disease of cucumber caused by a complex and combined attack of an insect (red pumpkin beetle *Raphidopalpa foevicolis*) and a bacterium (*Erwinia tracheiphila*) is the most destructive amongst the diseases which attack the crop. The disease causes complete and sudden wilting of plants (root injury caused by the insect and subsequent infection by the bacterium).There were reports of development of resistance against pesticides due to excessive and non-judicious spray of plant protection chemicals. In the absence of proper scientific knowledge farmers suffer huge economical losses. KVK Una conducted on-farm trials to refine the control measures. Two alternate sprays each of Dichlorvos (DDVP) (1.5ml/lt), Copper Oxychloride (0.3%) and Bacterimycin/ Bacterinashik (5g/lt) at 15 days interval starting from initiation of disease reduced the percentage of disease incidence from 10.4 to 0.3 and yield was increased by 47.37 per cent (Table 18).

Table 18 : Integrated management of sudden wilt of cucumber (variety-Kheera local)

Treatment	Wilt incidence (%)	Yield (q/ha)	% increase in yield over farmer's practice
Two sprays of Mancozeb (0.25%)/ copper oxychloride (0.3%) at fortnightly intervals on appearance of the disease (farmer's practice)	10.4	190.0	-
Two sprays each of Dichlorvos (DDVP) (1.5 ml/lt), Copper oxychloride (0.3%) at 15 days interval starting from initiation of disease	2.2	240.0	26.32
Two alternate sprays each of Dichlorvos (DDVP) (1.5 ml/lt), Copper oxychloride (0.3%) and Bacterimycin/ Bacterinashik (5 g/lt) at 15 days interval starting from initiation of disease	0.3	280.0	47.37

Capsicum

Evaluation of bio-efficacy of Fluopyram 250+Trifloxytstrobin 250-500 SC against powdery mildew of capsicum

An experiment was conducted during 2008 in the polyhouse of Deptt. of Vegetable Science with 8 treatments. Three fortnightly sprays of Fluopyram 500 SC and Trifloxystrobin 50 WG were found superior to other fungicidal treatments in controlling powder mildew of bell pepper(92.5 and 84.4 %, respectively) and co-ordinated product (Fluopyram +Trifloxystrobin) @ 250ml/h was superior to other lower doses of the same fungicide in controlling the disease and increasing the yield (Table 19).

Bio-efficacy of Ramwan (*Acorus calamus*) against bacterial wilt of bell pepper under protected cultivation

Results of experiments on the efficacy of Ramwan against bacterial wilt of bell pepper conducted in two polyhouses revealed that seedlings planted and drenched with aqueous extract of Ramwan 24 hr after transplanting and there after five times at weekly intervals coupled with soil application of Ramwan @ 2.5% at 30 and 45 days after transplanting gave more than 90.5 per cent control of bacterial wilt (Table 20). Control of wilt in other treatments ranged from 24.4 to 82 .5 per cent.

Table 19: Evaluation of bio-efficacy of Fluopyram 250 + Trifloxytstrobin 250-500 SC against powdery mildew of capsicum

Fungicide	Dosage		Disease severity (%)	Disease control (%)	Yield (q/ha)	Yield increase (%) over check
	g (a.i/ha)	g/ml (forml./ha)				
Fluopyram 250+Trifloxystrobin 250-500 SC	37.5 +37.5	150	23.4 (28.9)	51.3	238.3	16.1
Fluopyram 250+Trifloxystrobin 250-500 SC	50 + 50	200	13.7 (21.7)	71.5	241.7	17.8
Fluopyram 250+Trifloxystrobin 250-500 SC	62.5 + 62.5	250	10.1 (18.4)	79.0	256.7	25.1
Fluopyram 500 SC	62.5	125	3.6 (10.8)	92.5	286.7	39.7
Trifloxystrobin 50 WG	62.5	125	7.5 (15.9)	84.4	270.0	31.6
Hexaconazole 5 EC	37.5	750	22.0 (27.90	54.2	245.0	19.4
Propiconazole 25 EC	125	500	11.5 (19.8)	76.0	270.0	31.6
Untreated control	-	-	48.0 (43.9)		205.2	
CD (p=0.05)	-	-	3.1		18.5	

Table 20: Bio-efficacy of Ramwan against bacterial wilt of bell pepper under protected cultivation

Treatment	Polyhouse I		Polyhouse 2	
	1	2	1	2
T_1, Untreated seedling	88.9 (70.71)	-	60.28 (50.93)	-
T_2, Soil amendment with Ramwan powder 2.5% +T_1	26.67 (30.96)	70.0	28.33 (31.95)	53.0
T_3, Soil drench with aqueous extract of Ramwan +T_1 (0.25%)	37.80 (37.80)	57.5	38.08 (38.04)	36.8
T_4, Soil amendment with 5% Ramwan powder +T_1	26.63 (30.61)	70.0	33.91 (35.45)	43.7
T_5, Soil drenching with aqueous extract of Ramwan (0.5%) +T_1	53.33 (47.06)	40.0	45.56 (42.39)	24.4
T_6, Seedling dip in Bacterinashak (0.06 %) before transplanting	35.57 (36.29)	60.0	29.45 (32.83)	51.1
T_7, T_6 + soil drench with aqueous extract of Ramwan (0.25%)	24.47 (29.58)	72.5	32.53 (34.51)	46.0
T_8,Soil amendment with Ramwan (2.5%) +T_6	42.23 (40.51)	52.5	16.39 (23.32)	72.8
T_9, T_1 + seedling drench with aqueous extract of Ramwan (0.25%) 24hr after transplanting and thereafter at weekly intervals (5 drench)	15.53 (23.10)	82.5	13.07 (18.24)	78.3
T_{10}, T_9 + soil amendment with Ramwan (2.5%) at 30 & 45 DAT	8.48 (16.63)	90.5	5.00 (11.22)	91.7
CD (p=0.5)	8.15		9.97	

[1]Percent wilted plants, [2] Percent disease control, DAT= Days after transplanting

Garlic

Management of Stemphylium blight of garlic

A field trial consisting of 15 treatments was conducted for the management of stemphylium blight of garlic with fungicides in RBD with 3 replications during kharif, 2008. Eight fungicides viz. Carbendazim (0.1%), Mancozeb (0.25%), Companion (0.2%, 0.25%), Zineb + Hexaconazol (0.05%, 0.1%, 0.2%), Difenconazol (0.01%, 0.5%, 0.1%), hexaconazol (0.05%, 0.1%), Zineb (0.25%) and Antracol (0.25%) were evaluated. Three sprays of each fungicide were given at 10 days interval started with the appearance of the disease. Data on diseases were taken using 1-5 scale. All the fungicides were found superior to control (Table 21). Difenconazol (0.1%) was found most effective in controlling stemphylium blight (93.6 PDC).

Table 21: Evaluation of fungicides against stemphylium blight of garlic

Treatment	Dose	Percent disease index (PDI)*	Percent disease control	Yield (q/ha)*
Carbendazim	0.1%	39.3 (38.8)	48.08	92.40
Mancozeb	0.25%	35.7 (36.6)	52.84	100.03
Companion	0.2%	37.5 (37.7)	50.46	95.00
Companion	0.25%	34.4 (36.1)	54.50	90.55
Zineb + Hexaconazol	0.05%	45.1 (42.1)	40.42	91.11
Zineb + Hexaconazol	0.1%	42.1 (40.4)	44.38	93.70
Zineb + Hexaconazol	0.2%	37.7 (37.8)	50.19	99.25
Difenconazol	0.1%	4.8 (12.7)	93.65	121.29
Difenconazol	0.01%	5.5 (13.5)	92.73	117.96
Difenconazol	0.05%	5.6 (13.7)	92.60	118.33
Hexaconazol	0.05%	30.8 (33.7)	59.31	95.00
Hexaconazol	0.1%	25.3 (30.2)	66.57	98.74
Zineb	0.25%	43.2 (41.0)	42.93	93.51
Antracol	0.25%	44.1 (41.5)	41.74	95.18
Control	-	75.7 (60.4)	-	61.85
CD (0.05)		1.4		17.94

Figures in the parentheses are angular transformed values.

Chemical management of garlic leaf blight complex

Continuous mono culture of the crop has resulted in epidemics of leaf blight caused by *Alternaria* and *Stemphylium* spp. So, an experiment was conducted to evaluate the effect of seed treatment of different fungicides in field condition in Mandi district. Seed treatment with Captan proved best in managing the disease by delaying the initial start of the disease in comparison to other fungicides tested (Table 22).

Table 22: Evaluation of different fungicides as seed treatment against garlic leaf blight

Fungicide	Dosage	% leaf blight	Yield (q/ha)
Indofil M-45 (mancozeb)	2.5g/kg	18.33	66.00
Bavistin (carbendazim)	2.5g/kg	16.66	75.33
Captan	2.5g/kg	11.66	96.00
Vitavax	2.5g/kg	18.33	54.00
Ridomil MZ-72	2.5g/kg	15.00	82.00
Kavach (chlorothalonil)	2.5g/kg	21.66	77.33
Fytolan (copper oxychloride)	2.5g/kg	18.33	67.50
Control	-	28.33	50.17
CD (5%)	-	4.43	12.957

Evaluation of fungicides against Stemphylium blight of garlic

Nine fungicides were evaluated for the management of Stemphylium blight of garlic at HAREC Dhaulakuan. All the treatments significantly reduced disease intensity as compared to check. The least disease intensity was observed in the case of foliar spray of Score 25EC (0.02%) followed by Tilt 25EC (0.05%).

Ginger

Management of rhizome rot of ginger: Rhizome rot caused by *Fusarium oxysporum* f sp *zingiberi*, *Pythium* spp. and bacteria *Ralstonia solanacearum* is the major factor for the reduction in area and production of ginger in the state. During the cropping season 2008, a new chemical F 100 along with other fungicides and BCAs were evaluated individually and in combination for the management of rhizome rot. The *Pythium* spp was associated with rhizome rot. All the treatments resulted in significantly less wilt as compared with check (Table 23). Rhizome rot followed the same trend except seed treatment with BCA Niprot (*Trichoderma viride*) used as seed and soil treatment. Seed dip treatment with fungicide F 100 @ 3, 4 and 5 gm/kg for 1 h were highly effective in reducing the plant and rhizome rot. However, seed dip treatment with mancozeb + Bavistin @ 0.25+0.1 % and its drenching with bleaching powder @20kg/ha resulted in least plant and rhizome rot incidence (21.29 and 23.69, respectively). All the treatments except seed treatment with Niprot resulted in significantly more yield as compared with the check .The highest yield was recorded in plots with rhizome seed rhizome dipping in fungicide F 100 (0.5%) followed by seed treatment with Ridomil+ Bavistin @ 04+0.1 % and seed treatment of mancozeb+ Bavistin (0.25+0.1%)+ drenching with bleaching powder @ 20kg/ha.

Table 23: Management of rhizome rot of ginger through chemicals and biocontrol agents

Treatment	**Plant stand**	**Plant wilt incidence (%)**	**Rhizome rot (%)**	**Rhizome yield (q/ha)**	
				Fresh	Old
F 100 (3g/kg)	69.6 (56.61)	20.0 (26.44)	23.12 (28.49)	83.89	10
F 100 (4g/kg)	65.93 (54.30)	23.33 (28.75)	24.38 (29.88)	82.22	13.89
F 100 (5g/kg)	71.83 (58.00)	16.67 (24.06)	15.27 (22.79)	101.11	10
Recommended	70.36 (57.04)	30.67 (33.56)	31.86 (34.05)	75.00	16.67
Control	43.73 (41.35)	73.33 (59.97)	61.80 (51.90)	40.55	7.22
Trichoderma viride (5g/kg) + SA 5kg/ha	54.1 (47.34)	40.00 (39.13)	67.76 (56.62)	37.77	17.22
Ridomil + Bavistin (4g+1g/kg)	79.27 (63.10)	15.00 (22.71)	21.87 (27.81)	90.77	9.44
Recomm.+ BP	69.33 (56.56)	13.33 (21.29)	16.55 (23.89)	93.89	11.11
Recomm.+BP	68.9 (56.11)	28.33 (32.03)	29.88 (32.82)	83.33	11.11
Companion (4g/kg)	67.40 (55.23)	15.00 (22.63)	24.36 (29.45)	79.44	17.78
CD (p= 0.05)	4.62	9.59	11.27	17.16	5.29

V. Forage crops

Evaluation of breeding material

During *Kharif*, the breeding material of maize, cowpea and cluster bean were evaluated against different diseases and 10 entries of maize were observed resistant to leaf blights, one entry of cluster bean and no entry of cowpea was observed resistant to root rot. In *Rabi* the breeding material of oats and berseem were evaluated and 22 entries of oats were found resistant to powdery mildew. All entries of berseem were resistant to root rot.

Management of diseases

Integrated disease management of fodder maize

Integrated management of brown spot, leaf blights and BLSB fodder maize with ten treatments and three replications was conducted. Seed treatment with Vitavax power @ 2 g/kg seed + three sprays of Indofil M-45 @ 0.25 per cent gave minimum disease incidence i.e. 1.9, 4.4 and 1.3 per cent brown spot, leaf blights and BLSB respectively with maximum yield (328/ha) as compared to 9.5, 26.2 and 6.5 per cent incidence in control with an yield of 293.4q/ha (Table 24). As biocontrol, soaking of seeds in PGPR (*Pseudomonas fluorescens*) suspension followed by three sprays of *P. fluorescens* also found effective for the management of maize diseases as compared to control but not as effective as chemical control.

Table 24: Integrated disease management of fodder maize

Treatment	Disease severity / incidence (%)*			Green fodder (q/ha)
	Brown spot	Leaf blights	BLSB	
Seed treatment with Vitavax power @ 2 g/kg seed	4.4	8.3	2.5	310.6
Seed treatment with *T. viride* @ 5 g/kg seed	6.6	14.8	3.1	302.6
Soaking of seeds in PGPR (*Pseudomonas fluorescens*) suspension @ 10^9 cfu/ml for 1 hr	6.3	17.4	3.1	299.4
T1+ 3 sprays of Indofil M-45 @ 0.25%	1.9	4.4	1.3	328.0
T2+3 sprays of Indofil M-45 @ 0.25%	4.1	8.4	1.6	312.2
T3+3 sprays of Indofil M-45 @ 0.25%	4.2	9.4	1.8	314.7
T1+3 sprays of *P. fluorescens* @ 10^7 cfu/ml	3.9	7.7	2.2	325.7
T2+3 sprays of *P. fluorescens* @ 10^7 cfu/ml	5.6	13.3	3.0	304.9
T3+3 sprays of *P. fluorescens* @ 10^7 cfu/ml	5.5	12.8	2.6	310.5
Control	9.5	26.2	6.5	293.4
CD (P=0.05)	0.61	1.76	0.64	12.67

Bio- intensive pest and disease management in Cowpea: The experiment was conducted with nine treatments and three replications for the management of collar/root rot *(Fusarium, Rhizoctonia, Sclerotium*) of cowpea. For the management of cowpea diseases only bio agents/ bio products i.e. *Pseudomonas fluorescens, Trichoderma viride,* Panchgavya and neem seed kernel extract were used along with carbendazim as chemical check. Seed treatment with *Trichoderma viride* @ 5g/kg seed + foliar spray of neem seed kernels extract @3% with resulted 7.7 pre cent disease incidence and 59.7 q/ha yield as compared to 10.9 per cent incidence in control with an yield of 51.1 q/ha .This was followed by seed soaking in Panchgavya (10%) for 1hr + foliar spray of neem seed kernel extract (3%) gave minimum disease incidence (6.6%) after with maximum yield (58.5q/ha). However, none was superior to chemical check

Validation of non– chemical management of pests of cowpea and maize

For the validation of the given technology an experiment for the pest management of maize and cowpea, 2 treatments having 3 replications each was conducted on large plots. Maize blight and cowpea diseases i.e. wilt/root rot, Phytophthora blight and anthracnose were significantly reduced by the given technology i.e. seed treatment with *Trichoderma* viride @ 5g/kg + FYM @ 4t/ha. +

Need seed extract foliar spray @3% in 30 and 45 days crop have 12.7% maize blight, 18.2% cowpea wilt/root rot, 22.6 % cowpea Phytophthora blight and 18.5% cowpea anthracnose as compared to control i.e. 27.4%, 46.4%, 51.9% and 37%, respectively. The treatment gave 329.7 q/ha and 59.4 q/ha yield of maize and cowpea, respectively as compared to control.

Refinement of disease management technology for seed production in oat

During the season an experiment with 8 treatments and 3 replications was conducted to control the powdery mildew (*Erysiphe graminis* f.sp. *avenae*), leaf blight (*Helminthosporium* sp.) and loose smut (*Ustilago avenae*) of oat. Seed treatment with Vitavax @ 2.5g/kg seed + *Trichoderma viride* @ 5g/kg seed followed by two sprays at 15 days interval of the propiconazole @ 0.01% showed minimum severity/incidence of the powdery mildew (12.0%), leaf blight (5.3%) and loose smut (0%) as compared to 71%, 26.7%, 1.7% respectively in control. The treatment also gave maximum grain yield (63.4 q/ha) as compared to control (Table 25).

Table 25: Refinement of diseases management technology for seed production in oat

Treatment	Disease severity (%)			Yield (q/ha)	
	Powdery mildew	Leaf blight	Loose smut	Grain	Straw
T_1 - Seed treatment with Vitavax @ 2.5 g /kg seed,	60.7 (51.2)	26.0	0.0 (1.0)	16.1	58.9
T_2 - Seed treatment with *T. viride* @ 5g/kg seed,	70.0 (56.8)	24.0	1.3 (1.5)	15.9	55.9
T_3 -Foliar spray of propiconazole (0.01%)	15.3 (23.0)	7.3	1.3 (1.5)	17.8	62.0
T_4 - T_1+T_2	55.7 (48.2)	21.0	0.0 (1.0)	15.9	57.7
T_5 - T_1+T_3	15.7 23.3)	7.3	0.0 (1.0)	17.7	62.3
T_6 - T_2+T_3	15.7 (23.3)	6.0	1.3 (1.5)	17.6	61.8
T_7 - T_1+T_2+T_3	12.0 (20.1)	5.3	0.0 (1.0)	18.9	63.4
T_8 - Untreated control	71.0 (57.4)	26.7	1.7 (1.6)	15.4	54.7
CD (5%)	3.53	4.15	0.19	0.77	2.87

Integrated disease management in white clover

The experiment was conducted to manage powdery mildew (*Erysiphe trifolii)* and clover rot (*Sclerotinia trifoliorum*) for seed production. The trial was conducted at Palampur and it was observed that integrated management including seed treatment with carbendazim @ 2 g/kg and *Trichoderma viride* @ 5g/kg seed followed by alternate sprays of carbendazim and contaf provided best management of powdery mildew (12.3%) and collar rot incidence (0.7%) with maximum seed yield as compared to control.

VI. Tea

Testing of KOCIDE-3000 (Copper hydroxide 46.1 %) against blister blight

Bio-efficacy of KOCIDE-3000 - A Du Pont product showed effectiveness at 750 g/ha against blister blight (Table-26) but was statistically at par with recommended dose of Blitox 50.

Table 26: Bio-efficacy of KOCIDE-3000(Copper hydroxide 46.1% DF) against blister blight

Treatment	Dose(g/ha)	Blister blight incidence (%)
KOCIDE-3000	333	21.59
KOCIDE-3000	500	20.73
KOCIDE-3000	625	21.72
KOCIDE-3000	750	16.98
Blitox 50 WP	1500	15.26
Control	--	22.41
CD (p=0.05) 2.43	1.38	

Evaluation of recommended tea cultivars and tea hybrids against blister blight

Out of 54 tea hybrids, 37 were rated with low blister blight incidence as compared to highly susceptible hybrid genotype 24.10. Hybrid 4.21was found excellent in its phonotypical performance and disease free immune reaction. Hybrid genotypes 6.14 and 9.8 were also found disease free but are phenotypically poor in field performance. Out of nine recommended tea cultivars P-312 was moderately resistant to blister blight.

Effect of shade intensity

Low shade intensities of *Albizzia* species following lopping technique of undesired branches or dense shade tree species has proved to be appropriate shade intensity to minimize the attack of blister blight drought and sum scorch injuries.

VII. Seed pathology

Monitoring and detection of rice bunt, false smut and bacterial leaf blight disease in farmers' seed samples of Himachal Pradesh

Out of 276 rice seed samples collected from 7 districts of Himachal Pradesh only 7 samples showed bunt incidence (1.44 % samples infected) which were within certification limit. A total of 328 farmers' rice fields were surveyed for false smut incidence in 7 districts of H.P. False smut was found in all the location, maximum incidence (scale 3) was found in Sirmour and Mandi districts on hybrids and on basmati at Nalagarh. Similarly 237 farmers' rice fields were surveyed for bacterial leaf blast (BLB) incidence. Out of 7 districts BLB was observed only in Kangra district (range 1-7 scale). It was maximum in Sabarmati and local varieties.

Status of Karnal bunt and loose smut in farmers' own saved wheat samples collected from different locations

413 samples of wheat seed were collected from farmers' own saved seed from 9 districts, for detection of Karnal bunt and loose smut. 4.48 per cent samples were found to be infected with Karnal bunt out of which 1.21 per cent samples infected were above minimum seed certification scale. Highest incidence was observed in Sirmour district. Loose smut was detected from 16 samples only and incidence ranged from 0.05 to 1.19 per cent. Except one samples all were within certification level. Maximum samples (112) were analysed from Chamba, followed by Kangra (101) only 4 and samples were found infected with loose smut which ranged from 0.18 to 0.91 and 0.37 to 0.56. In Sirmour district, out of 45 samples only one samples was found infected with loose smut with a maximum incidence of 1.91.

Efficacy of commercial formulations of bioagents and chemicals against seed and seedling diseases of soybean

Maximum germination and minimum seed rot and seedling blight of soybean were observed for Thiram + carbendazim (2g/kg) followed by *Trichoderma viride* (6g/kg). Bacterial bioagent (*Pseudomonas fluorescens*) was least effective in managing seed rot (Table 27).

Table 27: Efficacy of commercial formulations of bioagents and chemicals against seed and seedling diseases of soybean

Treatment	Dose(g/ kg seed)	Germination (%)	Seed rot(%)	Seedling blight (%)	Remarks
Trichoderma viride	6	95	0.75	0.5	Main fungi associated with seed rot were, *Alternaria, Curvularia,* & *Fusarium* whereas *Fusarium* was associated with seedling disease Variety = PK-472
T. harzianum	6	94	2.5	0.5	
Pseudomonas fluorescens	6	93.5	3.5	0.75	
Thiram + carbendazim	2	95.5	0	0	
Control	-	95	3.5	1.5	

VIII. Molecular plant pathology

Molecular tagging of resistance specificity in KRC 5 cv. of kidney bean against *Colletotrichum lindemuthianum*

Development of RILs and F_2 population and their evaluation against *C. lindemuthianum*

A population of 210 RILs of Jawala x KRC-5 cross was advanced at MAREC, Sangla and Palampur from the F_6 generation and 194 RILs of F_7 generation were produced.

144 F_{2-} F_7 plants of Jawala x KRC-5 cross were screened against the race 3 of *C. lindemuthianum*. The inoculation was done using the germinating seedling dip method using 14 day old sporulating cultures of the test race. The disease reaction was recorded on 0-5 scale. Out of 144 plants, 64 were found susceptible while 80 RILs exhibited resistance.

Assessment of genetic diversity in *Colletotrichum capsici* using molecular markers and evaluation of resistance in capsicum

Screening of Chilli germplasm

Germplasm procured from different institutes was multiplied and evaluated for sources of resistance. For screening both detached green and ripe fruits of chilli were taken. Thirty seven chilli accessions were screened with two isolates of *C. capsici*. Majority of the lines were susceptible to chilli anthracnose. EC-218688, IC-545655, Sel-9**,** PI-201234 and Indira were resistant to Cc-43 isolate of *C. capsici* while only Local sel was resistant to *C. capsici*.

DNA fingerprinting

Genomic DNA of 45 isolates of the test fungus extracted by CTAB method was quantified through agarose gel electrophoresis and used for fingerprinting studies. Out of 50 ISSRs, 27 SSR were screened using two random isolates of *C. capsici* to see polymorphism. Out of these, 20 ISSRs and 23 SSRs exhibiting polymorphism were selected for final analysis of the test isolates.

Studies on molecular characterization and management of BCMV

Molecular characterization of BCMV

3'terminal region comprising NIb, Coat protein and UTR of 5 isolates of BCMV was amplified with self -designed BCMV specific primers. The amplicons generated (~1250 bp) were cloned in pGEMT-Easy vector, transformed in *E. coli* bacteria strain DH5α and subsequently after colony PCR check, lyophilized plasmids carrying desirable inserts purified by Alkali lysis method were custom sequenced. Sequences obtained were submitted to NCBI genbank vide accession no. EU713858, FJ157245, FJ157246, FJ387162 and FJ491262. Sequence analysis revealed that the 3' terminal region comprised of partial NIb (220, 210, 233, 198, and 183), complete coat protein (860 in each isolate) and 3' UTR (208, 224, 208, 239, and 214). Multi-alignment of these isolates at nucleotide level showed homology ranging between 95-99 per cent. Similarly, multi-alignment of translated amino acid of these isolates also showed homology ranging between 94-99per cent.

Identification of resistance genes against bean common mosaic

Twenty five common bean accessions showing resistance to BCMV strains were used to detect the presence of *I* and $bc1^2$ genes. DNA of these lines was extracted by CTAB method. A SCAR marker $SW13_{690}$ linked to I gene amplified a DNA fragment of ~690 bp in 14 lines (Surya, HAFB-1, HAFB-2, VLF-2003, DPDFb-1(M), B-sel, Aparna, DWDFB-57, Hans, Cornell 49-242, To, Montcalm, Kentucky Wonder, HPR-215 thereby confirming the presence of *I* gene. Similarly, SBD5 marker linked to $bc1^2$, amplified a product of ~1250 bp showing the presence of $bc\text{-}1^2$ gene in 15 lines (IVFB-2, Surya, MFB-3, Falguni, HAFB-1, HAFB-2, MFB-2, VLF-2003, DPDFb-1(M), Arka Anoop, B-sel, Aparna, DWDFB-57, Contender and KRC-22. These markers did not amplify any fragment in susceptible line Jawala.

IX. Mushrooms

Culturing of fleshy fungi of western Himalayan region for bioactive molecules

Forest surveys for the collection of fleshy fungi (Agaricales and Gasteromycetes) were regularly conducted to various localities of Kangra and Mandi. As many as 195 collections of the fleshy fungi belonging to nearly 72 species of more than 45 genera were made during the period under report. The species of genera *viz; Coprinus, Lepiota, Lactarius, Lycoperdon,Conocybe,Marasmius,Mycena,Oudmansiella,Schizophyllum,Tyromyces,Oxyporus,Ganoderma,Polyporus,Tremella,Hydnum,Stereum,Vascellum,Xylaria,Daldinia,Innocybe,Ramaria, Thelephora,Coriolus,Hypholoma,Flammulina,Phellinus,Lenzites,Pleurotus,Peniophora,Peziza,Micropor us,Collybia,Helvella,Fomes,Lentinus,Pleurotus* and *Cordiceps* etc. were collected, identified and cultured.

Nearly 130 isolates were obtained in pure culture from fresh specimens. Majority of the cultures grew optimally between pH 6.5 to 7.5 at 24±1ºC on medium 'B'. The cultures were processed for lyophilization following standard protocols. At the close of exponential growth phase, the cultures were chilled, sonicated and centrifuged. The supernatants obtained was lyophilized and sealed under the original vacuum.

Culture extracts of 108 isolates in water have already been deposited with the specified laboratories for further evaluation of bioactivity. Mother cultures of 49 isolates have been deposited at the Institute of Microbial Technology, Chandigarh.

Evaluation of organic substrates for the production of Dhingri at Kukumseri

Four organic substrates; Tudi (wheat straw), Neurcha (Artemisia*)*, Sudi (deodar needle) and Willow leaves were evaluated individually and in different combinations for Dhingri production. But for Neurcha + Sudi, none of the substrates out yielded Tudi, a commonly used substrate though, individually these two substrates yielded very low. Per bag mushroom yield ranged between 100 to 510 g which is very low.

However, since the number of bags per treatment was not kept constant so the results are not comparable. Hence for evaluating locally available substrates, systematically planned experiment will be laid out and cost: benefit ratio of mushroom cultivation calculated. The information thus generated will enable us to know whether mushroom cultivation should be popularized in the valley or not.

3. EXTENSION EDUCATION

The extension activities conducted by the teachers/scientists and extension specialists of the department at the main campus, research stations and KVKs during 2009-2009 are described under the following subheads.

On farm trials

About sixty on farm trials on the management of different diseases of wheat, powder mildew of capsicum, anthracnose of chillies, colocasia blight, rhizome rot of ginger, powdery mildew of cucurbits and pea, fruit rot and early blight of tomato, early blight and late blight of potato, bacterial wilt of tomato, Ascochyta blight of chickpea, Alternaria blight of mustard, collar rot and wilt of gram, Cercospora leaf spot of sesame, Phytophthora blight of arhar etc. were conducted during the year.

Field demonstrations

Field demonstrations on important diseases, their management practices and on other activities were conducted and monitored by the teachers/scientists/extension specialists. During 2008-09 about 350 demonstrations on different cereals, oilseeds and vegetable crops were conducted at different locations.

Training programmes

Scientists/extension specialists organized/ participated in about 42 off-campus, 95 on-campus, 18 in-service and 22 vocational trainings in which amore than 6000 participants received

training. These trainings were organized for the benefit of farmers, farmwomen, rural youth, unemployed graduates and officers of different departments of H.P. and extension personnel. Scientists imparted specialized training on diagnosis and management of diseases of various crops. They also imparted training to different beneficiaries by participating and delivering specialized lectures organized by other agencies.

Scientists of the department also imparted 10 training programmes on mushroom cultivation and benefited about 443 farmers by demonstrating practical mushroom cultivation. Besides this, 70 kg quality spawns of mushroom was produced in the Spawn Laboratory during the year.

Adaptive research

During the period under report the scientists have conducted 48 adaptive research trials at farmers' fields on the management of different diseases.

Kisan Melas/Kisan Divas/Field Days: The teachers/scientists/extension specialists of the discipline participated in the Kisan melas/ divas, field days etc from time to time whenever they were held during the year. They organized 26 field days/divas in which about 4000 farmers attended and were familiarized with various disease problems and their management. Scientists also participated in different crop seminars in which a large a number of farmers participated.

Workshops

The scientists participated in the deliberations of Agricultural Officers workshops (*Kharif* and *Rabi*) in the Directorate of Extension Education, CSK HPKV, Palampur. The queries posed by various Govt. officers and farmers during the deliberations were attended to by the experts in the respective fields. The scientists also attended different workshops and delivered expert lectures.

Farmer's advisory service

A large number of disease samples and seed samples of various crops received from farmers, extension personnel from Department of Agriculture and University were diagnosed and suitable remedial measures suggested. During the field visits and survey tours, this service was also extended to the farmers. Mushroom growers were also advised in making there own compost, setting up and running mushroom houses smoothly.

Twenty three wheat seed samples, 10 turmeric and 6 of ginger received from farmers / Department of Agriculture during the report were analysed for seed health analysis. Necessary guidance was given for the management of seedborne diseases.

Lectures

The teachers/scientists/extension specialists delivered about 600 lectures to the different beneficiaries in different trainings and workshops etc.

TV/ Radio talk

Radio talk : 2

Television talk: 6

Popular Articles

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Research Papers

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Book articles

Singh, D.2009. Keet avum rog parbandan p59-64 in book entitled Krishi Jal Parbandan, KVK, Dhaulakuan (Agarwal Printers, Paonta)

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Dhancholia, S and S. Manuja. 2008. Ecofriendly management of root rot/ wilt complex of green pea in cold temperate region of Lahaul valley in Himachal Pradesh. 3rd Indian Horticulture Congress on "New R & D initiatives in horticulture for accelerated growth and prosperity" held at OUAT, Bhubaneshwar (Orissa), November 6-9, 2008.

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Sharma, P., Sharma O.P**.** and Sharma, P.N. 2009. Biophysical and molecular characterization of BCMV infecting common bean in Himachal Pradesh presented in National Symposium on 'Plant Pathology in Changing Global Scenario" organized by Indian Society of plant Pathologists from 27-28th Feb, 2009 at NBPGR, New Delhi.)

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Tripathi, A.N. and Sood, A.K. 2008. Diversity in *Ralstonia solanacearum* populations existing in Himachal Pradesh. Paper presented for the P.R. Verma award in the annual meeting of Indian Phytopathological Society.

Miscellaneous activities

D.G. ICAR nominee

Dr. Akhilesh Singh has been nominated by the Director General, ICAR, New Delhi as member, Research Advisory Committee of National Research Centre for Seed Spices Ajmer (Raj.) for a period of 3 years from 22.10.08.

Editorial board

- Dr. B.M. Sharma was nominated as the member, Editorial Board of 'Mushroom Research' and member, Editorial Board of 'Himachal Journal of Agricultural Research'.
- Dr. A.K. Sood was nominated as Associate Editor (Bacteriology) in the Editorial Board (2008) of Indian Phytopathology.
- Dr. A.K. Sood was nominated member of the committee constituted for editing/compiling annual report of the University for the year 2007-2008.

Expert member, selection/ assessment committees

- Dr. A. K. Sood was nominated expert member to evaluate the research publications for the assessment of Associate Professors/equivalent for promotion as Professor/equivalent under Career Advancement Scheme in the discipline of Plant Pathology PAU, Ludhiana.
- Dr. A.S. Kapoor was nominated expert member on the Selection Committee which interviewed the candidates for the post of Associate Professor/ Sr. Scientist under CAS/ and Assistant Professor/ Jr. Scientist, Plant Pathology, SKUAST Srinagar through selection.

Awards

- Dr. P.N. Sharma, P. Sharma and Dr. O.P. Sharma were awarded 2nd Best Poster award for their research paper, "Biophysical and molecular characterization of BCMV infecting common bean in Himachal Pradesh presented in the "National Symposium on 'Plant Pathology in Changing Global Scenario" organized by Indian Society of Plant Pathologists from 27-28th Feb, 2009 at NBPGR, New Delhi.
- Dr. Ashwani Kumar was awarded best poster award for his research paper "Variation in *Botrytis cinerea* populations from western Australia causing Botrytis grey mould of chickpea presented in the "International Conference on Grain Legumes, from Feb. 14-16, 2009 held at IIPR, Kanpur.
- Dr. Arun Sud bagged 1st prize in Annual Report presentation in the Zonal Workshop of KVKs' held at UHF, Solan from. Sep. 29 to Oct. 1st, 2008.
- Dr. R.P. Kaushal was selected 'Fellow' of the Indian Society of Pulses Research and Development, Kanpur.

Seminars/ symposia/workshop attended

- Dr. A.S. Kapoor attended 24th Annual group meeting AICRP- National Seed Project (Crops) at TNAU Coimbatore w.e.f.02 -04 April, 2009 and attended 4th Departmental Review Meeting on 23rd May 2009 and peer reviewed the research projects being run by the scientists.
- Drs. A.S Kapoor and Y.S Paul attended two days training on Organic Farming with respect to Internal Control System and Organic Certification on 26th and 27th May 2009 at CSKHPKV, Palampur.
- Dr. B.K.Sharma attended the first meeting of Polyhouse Technology Task Force, 10th Scientific Advisory Committee Meeting at CSKHPKV, Palampur and meeting of Kisan Club (Organized by Lead Bank PNB, Una).
- Dr. B.M. Sharma participated in Project Monitoring Session at PUSA, New Delhi on 30.03.09.
- Dr. D.K.Banyal participated in Annual group meeting – *Rabi 2007* of AICRP- Forage Crops at ANGRU, Hyderabad), from 12-14 Sept., 2008, and Global Potato Conference,

"Opportunities and Challenges in the New Millennium" held at New Delhi on 9-12 December, 2008.

- Drs. Dhanbir Singh and S.K.Rana attended 47th All India Coordinated Wheat and Barley Workers' Meet held at CCS HAU, Hissar w.e.f.. 17- 20th August, 2008,
- Dr. S.K. Rana participated in 44th AICRP – Rice group meeting/ workshop at DRR, Hyderabad, during 10-12th May, 2009,
- Dr. Akhilesh Singh attended 52nd AICRP – Maize workshop at UAS, Dharwad from10-12 April, 2009.

Facilities added in department

- Nikon trinocular stereoscopic zoom microscope was added in seed pathology lab.

Foreign visits

- Dr. Y.S. Paul participated in International Conference of Plant Pathology, held at Torino, Italy and organized a session on 'Plant Disease Diagnosis- Farmers' need in Developing Countries'. w.e.f. 24-30th August, 2008
- Dr. P.N. Sharma acquired advanced training on application of molecular techniques in population diversity study, development of micro satellites markers and their use in marker assisted selection under the auspices of Department of Biotechnology, Govt. of India at CIAT, Cali, Colombia, South America w.e.f. Dec. 3, 2008 to June 20, 2009.

Invited lectures

The scientist of the department delivered invited lectures on specialized topics during symposia / workshop organized by different institutes/departments.

SUMMARY

The Department of Plant Pathology is engaged in teaching, research and extension activities pertaining to plant diseases and mushrooms. The significant findings for the year 2008-09 are summarized below.

Teaching

Department offered 10 undergraduate and 23 postgraduate courses including minor courses. Six students in M.Sc. and two in Ph.D were admitted during the period. Two M.Sc. and one Ph. D students successfully completed their degrees.

Research

Cereals

- A severe out break of yellow rust occurred during *rabi* 2008-09 in the state. Most of the wheat varieties recorded high severity (40-80S.) However, HPW89, HPW147, HPW155, VL616, VL829, Raj3777 and PBW550 recorded low severity (5-40S). The severity of LR ranged from TS-60S. The overall incidence of flag smut varied from 2-35 per cent in foot and mid hills.
- Moderate incidence/ severity of leaf blast, neck blast and glume discoloration was recorded in Kangra, and Mandi districts with few exceptions. Severity of bacterial leaf blight was low to moderate and restricted to some locations in Kangra and Mandi districts. In Sirmour district, incidence of brown spot was 60 per cent on PR 116 and incidence of false smut was invariably high on hybrids in Sirmour and Mandi districts
- In Sirmour district, Erwinia stalk rot incidence ranged from 10-15 percent whereas BSDM ranged from traces to 2.5 percent. In Mandi district, maydis and turcicum blights were low to medium and brown spot ranged between medium to high.
- Two pathotypes; 78 S 84 and 46 S 119 of YR were identified by DWR Regional Station, Flowerdale Shimla.
- A large number of rice, wheat and maize were found resistant to their major diseases. Seventy seven, 501, 990 and 11 entries were found resistant to Karnal bunt, yellow rust, brown rust and powdery mildew, respectively. Out of 1535 wheat entries screened for resistance to YR under artificial epiphytotic conditions, 908 entries remained free from YR.
- Rice germplasm consisting of 174 lines from various national nurseries were screened under natural epiphytotic conditions against leaf blast. Twelve entries of germplasm and one hybrid were found resistant to leaf blast. Out of 14 inbred lines of maize , 9 lines remained free from ESR
- Foliar spray of different formulations of biocontrol agent *Trichoderma viride* managed Karnal bunt significantly. Seed treatment with Ecoguard and Ecoderma @ 2.5g/kg resulted hundred per cent control of loose smut.
- Four sprays of Fuji-One 40 EC (1.5 ml/L) at 15 days interval starting from the date of appearance of the disease found most effective in managing leaf and neck blast followed by RIL 013/F1 35 SC (2.0 ml/L.
- A spray schedule of validamycin (0.25%) followed by Tilt (0.1%) and Bavistin (0.1%) was found most effective in managing BLSB of maize.

Pulses

- In rajmash, anthracnose, floury leaf spot and angular leaf spot were moderate to high intensity in mash – mung anthracnose, Cercospora leaf spot and Yellow mosaic were predominate diseases in Mandi district. In Sirmour district, mung bean yellow mosaic virus, anthracnose and web blight were the major diseases.
- Stem rot and black root rot were of major occurrence in Mandi district whereas in Sirmour district Ascochyta blight, wilt, root rot and stem rot were predominant.
- A large number of germplasm of mash-mung bean and chickpea were identified as resistant to their major diseases.
- Two sprays of tilt 25EC , Score 25EC and contaf 5EC @ 0.1%, significantly managed web blight and powdery mildew of mash.

Oilseeds

- The severity of Alternaria blight on leaves remained low to moderate (10-25%) at the farmer's fields. Similarly, very low severity of white rust (below 10%) was observed in the mustard crop. Wilt and rust remained serious diseases of linseed at Kangra and adjoining areas.
- In sesame, leaf and pod blight remained the major disease problems whereas in soybean mainly, three diseases viz., target spot, pod blight and Rhizoctonia aerial blight were found in Kangra and Mandi districts.
- Seed treatment with *Trichoderma* + 2 sprays of leaf extract of *Eucalyptus* was most effective in managing Alternaria blight and white rust of mustard but was not superior to seed treatment with Apron + two foliar sprays of Mancozeb.
- The yield losses due to linseed rust were highest (87.3%) in susceptible variety Chambal and minimum (8.9%) in resistant variety Nagarkot.

Vegetables

- A differential set of 8 lines of pea was developed for virulence analysis of powdery mildew pathogen (*Erysiphe pisi*) and on the basis of reaction type, 31 isolates collected from H.P. were grouped into 13 pathotypes.
- Seed dressing with Vitavax ((2.5g/kg) was found most effective followed by F- 100 and Bavistin in managing pea root rot complex.
- Integration of seed treatment with Vitavax (2.5g/ kg) and soil application of bio-agent (100g/6kg FYM/ bigha) was found most effective in managing pea root rot / wilt complex disease and improved green pea pod yield.
- Seedlings drenched with aqueous extract of Ramwan 24 hr after transplanting and there after five times at weekly intervals coupled with soil application of Ramwan @ 2.5% at 30 and 45 days after transplanting gave more than 90.5 per cent control of bacterial wilt of bell pepper

Miscellaneous crops

- Three sprays of Difenconazol (0.1%) at 10 days interval were found most effective in controlling stemphylium blight of garlic.
- Seed treatment with Vitavax @ 2.5g/kg seed + *Trichoderma viride* @ 5g/kg seed followed by two sprays at 15 days interval of the propiconazole @ 0.01% significantly managed powdery mildew, leaf blight and loose smut of oats.

Seed pathology

- Out of 413 samples of wheat seed collected from farmers' own saved seed from 9 districts for detection of Karnal bunt and loose smut, 4.48 per cent samples were found to

be infected with Karnal bunt and 1.21 per cent samples infected were above minimum seed certification scale.

- Loose smut was detected from 16 samples only and incidence ranged from 0.05 to 1.19 per cent. Except one sample, all were within certification level.
- Maximum germination and minimum seed rot and seedling blight of soybean were observed for Thiram + carbendazim (2g/kg) followed by *Trichoderma viride* (6g/kg).

Molecular plant pathology

- Twenty five common bean accessions showing resistance to BCMV strains were used to detect the presence of *I* and *bc1*^{2} genes. DNA of these lines was extracted by CTAB method.

Mushrooms

- As many as 195 collections of the fleshy fungi belonging to nearly 72 species of more than 45 genera were made. Thirty seven genera were identified and cultured.

Extension

- Sixty on farm trials on the management of diseases of cereals, vegetables and pulses were conducted.
- Three hundred and fifty demonstrations on different cereals, oilseeds and vegetable crops were conducted at different locations.
- Organized / participated in about 42 off-campus, 95 on-campus, 18 in-service and 22 vocational trainings in which more than 6000 participants received training. Imparted 10 training programmes on mushroom cultivation. Besides this, 70 kg quality spawn of mushroom was produced
- Conducted 48 adaptive research trials at farmers' fields on the management of different diseases.
- Two radio and 6 television talks were delivered and 8 popular articles were published by the scientists.

Publications

- Thirty four scientific papers were published, 4 were accepted for publication, one book chapter contributed and 10 papers were presented in different symposia and workshops.