

RESEARCH

I. ON-GOING RESEARCH PROJECTS

Sr. No.	P.I./Co-P.I.	Title of the Project	Budget outlay (in lakhs)	Funding Agency	Duration of the Project
1.	Dr.G.L.Bansal	Vermitechnology based empowerment of women of economically backward district Chamba of H.P.	20.60	DBT	1.08.10-31.07.13
2.	Dr.R.C.Chauhan	Harmonizing Biodiversity conservation and agricultural intensification through integration of plant, animal and fish genetic resources for livelihood security in fragile ecosystem.	24.00	World Environmental Agency	
3.	Dr.S.S.Kanwar Dr.M.K.Gupta Dr.RS.Jamwal Dr.N.K.Sankhyan Dr.Pardeep Kumar	Development of liquid biofertilizers and bio-fertilizer based integrated nutrient management in District Kangra	57.48	RKVY	2009 3 years
4.	Dr.S.S.Kanwar Dr. M.K. Gupta	Probiotics Potential of indigenous isolates obtained from traditional fermented foods of Himachal Pradesh	27.95	DST	2012 2 years
5.	Dr. Sharda Singh Dr. R.S.Rana Sh. Vaibhav Kalia	GIS based Agriculture Resource Information System	11.20	State Adhoc Project	April 2010
6.	Dr. Sharda Singh Sh. Vaibhav Kalia	Integrated Geo Database model for effective planning of DRDA	15.00	State Adhoc Project	April 2010
7.	Dr. R.S.Rana Dr. Sharda Singh Sh. Vaibhav Kalia Dr. Sanjay Sharma	Impact, adaptations and vulnerability of Indian Agriculture to climate change	43.00	ICAR, New Delhi	2008
8.	Dr. R.S.Rana Dr. Sharda Singh Sh. Vaibhav Kalia Dr. S.K. Upadhyay Dr. Vinod K. Sharma (Kullu) Dr. B.S. Mankotia (Malan)	Application of Extended Range Forecast in Crop Planning and Operations under Sub-humid and Temperate Wet Conditions of H.P	14.99	Dept. of Agriculture and Co-operation, New Delhi	2009
9.	Dr. R.S.Rana Dr. Sharda Singh Sh. Vaibhav Kalia	Impact of climate change on mountain Agriculture	44.00	RKVY	2011

Research Information updated as per the COBS Annual Report 2011-12

	Dr. Pawan Sharma				
10.	Dr. R. S. Rana Dr. J. Shekhar	Integrated Experimental Agro meteorological Advisory Service at Palampur in H.P	22.00 Annual	IMD, Ministry of Earth Sciences, New Delhi	2007
11.	Dr. R. S. Rana Dr. Suresh Kumar Sharma Dr. B.S. Mankotia	Forecasting Agricultural Output Using Space, Agro Meteorology And Land Based Observations (Fasal)	6.31	Dept. of Agriculture and Co-operation, New Delhi	2011

II. RESEARCH PROJECTS COMPLETED

Sr. No.	P.I./Co-P.I.	Title of the Project	Budget outlay (in lakhs)	Funding Agency	Duration of the Project
1.	Dr. Virendra Singh	Morphological and ecological characterization of germplasm collection and propagation of Seabuckthorn in cold deserts of Himachal Pradesh	40.00	DBT,GOI	1.1.2009-31.12.2011
2.	Dr. Virendra Singh	A value chain on Seabuckthorn	3,17.00	NAIP	June 2008-June 2012

III. RESEARCH PROJECTS SUBMITTED

Sr.No.	Title of the project	Budget outlay (In lakhs)	Funding Agency
1.	Evaluation of indigenous <i>Lactobacillus plantarum</i> Species of Himachal Pradesh for functional and protective attributes during DMH induced colon carcinogenesis	58.09	DBT
2.	Mass cultivation and distribution of liquid biofertilizer made from indigenous Plant Growth Promoting Rhizobacteria of Himachal Pradesh	85.00	RKVY
3.	Evaluation of indigenous probiotics of Himachal Pradesh for functional and protective attributes: experimental studies in DMH induced colon carcinogenesis	54.11	ICMR
4.	Establishment of Central Instrumentation Laboratory at CSKHPKV, Palampur	400.00	RKVY
5.	Collection, Evaluation, Conservation and Popularization of Singli-Mingli (<i>Dioscorea deltoidea</i> Wall ex kunth)-A Critically Endangered Palnt Species of Himachal Pradesh.	23.38	National Medicinal Plants Board, Department of AYUSH, Ministry of Health & Family Welfare, Govt of India

	Studies on phytochemical , antioxidant properties and free radical-scavenging activity of Calamus and Foxglove species	20.00	National Medicinal Plants Board, Department of AYUSH, Ministry of Health & Family Welfare, Govt of India
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IV. Research Highlights

Research Highlight -1 Standardization of seabuckthorn as anti-microbial agent:

Methanolic leaf extract of seabuckthorn was able to inhibit the growth of bacterial pathogens and highest activity was observed at 5% concentration, while no effect was seen at 0.5%. Maximum inhibition was observed for *Staphylococcus* spp.(from wound infection). 2% seed oil concentration showed maximum percentage inhibition in *Staphylococcus* spp. followed by *Pseudomonas* spp., *Streptococcus* spp., *Proteus* spp.and *Klebsiella* spp. i.e. 10.10%, 9.21%, 7.54%, 4.90% & 4.21% respectively.

Research Highlight -2

Cluster analysis revealed that populations of *Hippophae salicifolia* studied from the Tinu, Lahaul valley are morphologically different from the accessions studied in the Kullu and Kinnaur district of Himachal Pradesh (Fig.1 and 2). It may be other species or subspecies or hybrid of *Hippophae rhamnoides*. Accession of *Hippophae salicifolia* studied in the Tinu and Kardang village are best for the commercially cultivation because it bears few thorns and have bigger fruit size (28-32g /100 fruit).



Fig. 1 Different genotypes of *H. salicifolia*

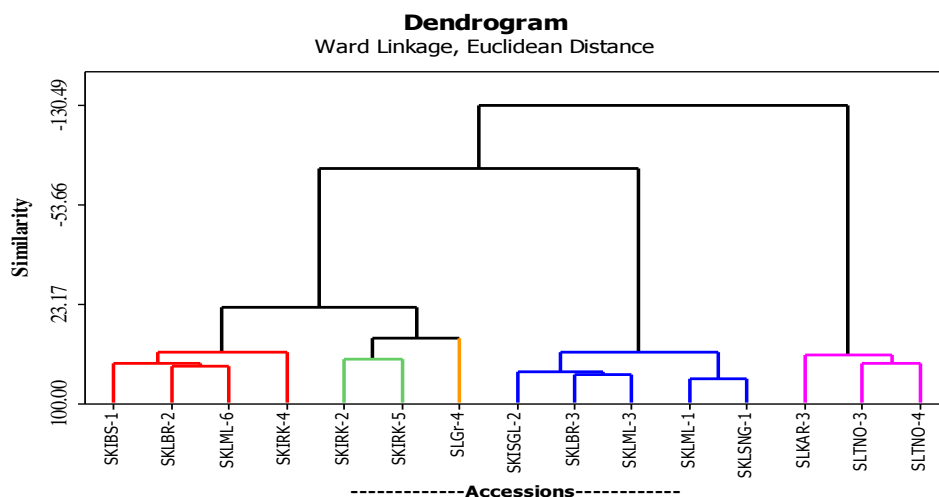


Fig.2 Dendrogram of cluster analysis of *Hippophae salicifolia* female accessions of H.P.

Research Highlight -3 Saliva as diagnostic fluid:

Preliminary studies conducted on the role of saliva as diagnostic fluid in diabetes mellitus and hypertension clearly indicated the usefulness of the fluid which can be collected non invasively .The saliva of diabetics has significantly higher values of glucose as compared to the non-diabetics. Similarly, salivary total cholesterol (TC), triglycerides (TG), low density lipoprotein-cholesterol (LDL-C) and High density lipoprotein-cholesterol (HDL-C) concentrations were significantly higher in patients with hypertension when compared with control groups. Lipid profile can be assessed in saliva and can be used as simple, monitoring tool in hypertension individuals with reasonable accuracy. The accuracy of salivary lipid profile estimation may help physician and other health personnel to pay more attention to use saliva as monitoring tool for patients at risk of cardiovascular diseases. Similarly, salivary glucose levels were significantly higher in diabetics than the normal healthy controls.

Research Highlight -4

Adaptive trials on seasonal crop (Potato) were conducted in the farmers’ fields at Rakh and Bundla villages in the vicinity of Palampur (total 10 trials). Vermicompost significantly enhanced the yield (27.2%) over FYM and even in combination with recommended NPK+VC (8.6%), thereby showing a beneficial effect of Vermicompost.

Treatments	Data on Potato trials in Farmers’ Fields										
	Yield (t/ha)										
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Mean
VC(8t/ha)	31.25	7.50	19.0	-	13.0	5.33	11.11	20.83	18.0	12.5	15.39
FYM(25t/ha)	12.5	11.11	13.33	2.5	15.0	3.33	-	10.0	23.33	18.75	12.21
FYM+VC (25t/ha+8t/ha)	15.0	15.83	7.5	4.44	15.0	8.0	11.16	12.5	20.0	20.83	13.03
Recom.NPK+ VC(8t/ha)	18.0	10.83	11.33	5.55	8.66	5.55	14.44	33.33	13.0	11.87	13.26

Research Highlight -5

Adaptive trials on the Pea crop, conducted in the University farm showed promising results of vermicompost as compared to FYM and other treatments. Pea yield increased 3 times under vermicompost @10 ton/ ha as compared to FYM @ 10ton/ha and also much better results as compared to the use of other recommended fertilizers.

Treatments	Yield (Kg/ha)		
	Straw weight without pods	Pod weight	Seed weight
FYM (10t/ha)	273.43	136.71	295.31
Vermicompost (5t/ha)	218.75	218.75	404.68
FYM (10t/ha)+100% NPK (recommended fertilizer)	164.06	54.68	218.75
Vermicompost (5t/ha) +100% NPK	656.25	240.62	568.75
Vermicompost (5t/ha) +75% NPK	546.87	218.75	437.5
Vermicompost (10t/ha)	656.25	382.81	929

Research Highlight -6 Molecular Characterization of Major Begomovirus Infecting Pulse Crops In Himachal Pradesh

Molecular characterization of major begomovirus infecting pulse crops in Himachal Pradesh focused on the scenario of emerging begomoviral diseases in sub-temperate areas of Himachal Pradesh, India. This is one of the important studies related to begomoviral diseases in Himachal Pradesh. As majority of people in India are vegetarian so pulses play important role in supplying required protein diet. During past few years geminiviruses are causing major losses to pulse crops which also affect economy, as India is one of the largest producers of pulses. It's very important to study how viruses affect the crop. Sometimes yield is too low and sometimes crops do not even reach fruiting stage due to infection by these viruses.

Complete genomes of the infecting begomoviruses were molecularly characterized from pulse crops. Begomoviral genomes were amplified by rolling circle amplification technique, cloned, and sequenced using primer walking. A monopartite begomovirus species Ageratum enation virus (AEV) associated with nanovirus was completely characterized, causing downward curling, yellowing and crumpling of pulse leaves (Fig1 & 2). This is a novel association found in soybean. It's previously reported in weeds which mean it's widely spread in fields and can transfer easily into other crops easily by vector Bemisia tabaci. This knowledge of genome of causal virus can help in checking RNA silencing activity further which could suppress viral infection.

Fig1: Phylogenetic relationship between AEV (IN:11) Glycine max and other begomovirus isolates in the complete AEV.

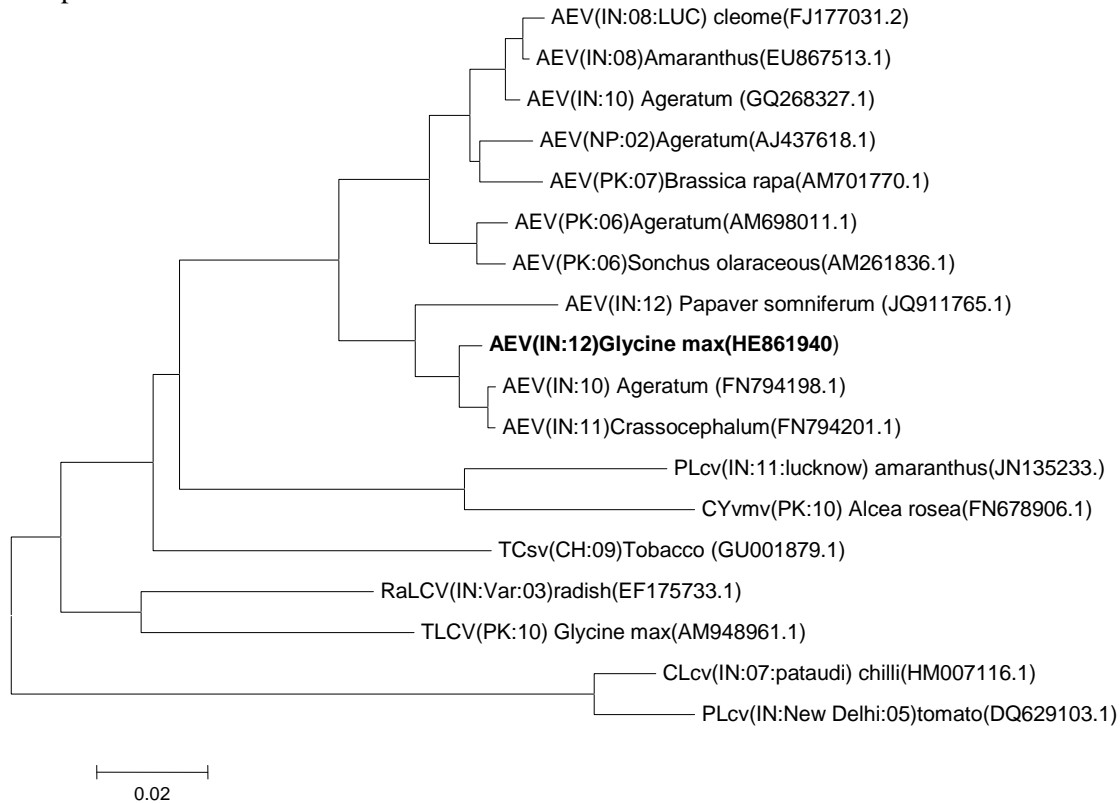
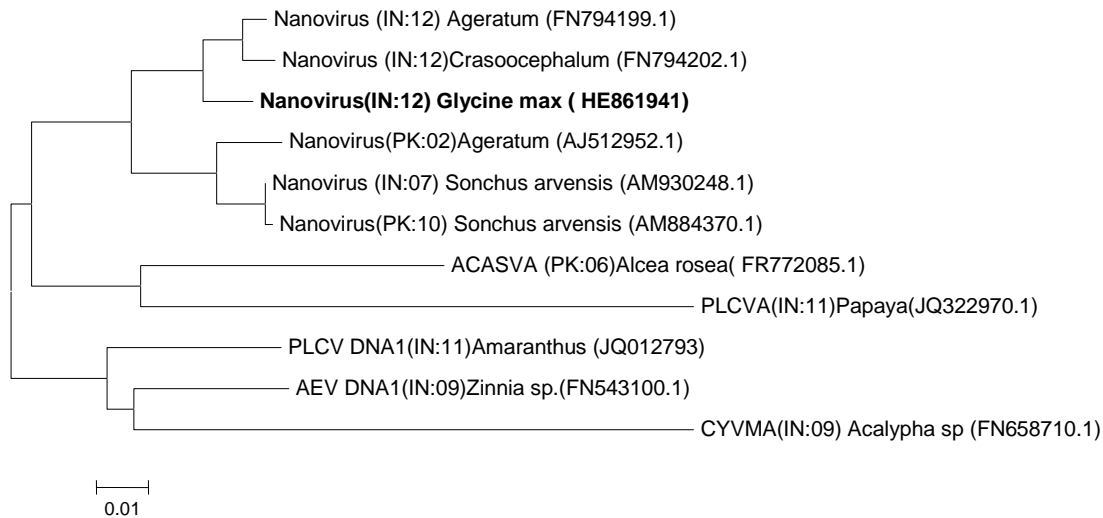


Fig:2 Phylogenetic relationship between [Nanovirus (IN:11) Glycine max] and other nanoviruses associated with begomovirus. The evolutionary history was inferred using the Neighbor-Joining method. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) is shown next to the branches. Evolutionary analyses were conducted in MEGA5 software



Research Highlight -7. Biochemical evaluation of adzuki bean [*Vigna angularis* (Willd.) Ohwi and Ohashi] genotypes

Fourteen genotypes of adzuki bean procured from NBPGR Research station, Shimla were evaluated for various biochemical constituents of quality significance. Effect of heat treatment and sprouting on biochemical constituents was studied. Significant variation in biochemical constituents among various adzuki bean genotypes was observed i.e. moisture (11.72 to 13.54 per cent), crude protein (17.50 to 23.80 per cent), crude fat content (0.30 to 0.60 per cent), ash (2.88 to 3.86 per cent), crude fibre (4.05 to 5.61 per cent), carbohydrate (54.48 to 61.30 per cent), total soluble sugars (3.80 to 5.03 per cent), methionine (0.70 to 1.15 per cent protein), tryptophan (0.66 to 0.86 per cent protein), total phenols (0.17 to 0.28 per cent), in vitro protein digestibility (78.45 to 84.73 per cent), cooking time (39 to 60 minutes), iron (6.6 to 8.3 mg/100g), calcium (160 to 276 mg/100g) and phosphorus (309 to 350 mg/100g). Multipurpose/versatile genotypes were identified based on genotypic rating as HPU-51, IC-341948, IC-341958, EC-340275 and Toturu Local excelling in that order of preference. Processing of legumes i.e. direct cooking, roasting and sprouting revealed the maximum retention of nutrients i.e. significant increase in crude protein, total soluble sugars and total free amino acids (6.39, 12.76 and 5.52 per cent), and substantial decrease in total phenols (upto 20.83 per cent) in sprouted seeds.

Research Highlight -8 Studies on Phytochemical Constituents of *Mentha* species

“Studies on Phytochemical Constituents of *Mentha* species”, procured four species of *Mentha* from HGHR in ISM, Joginder Nagar, District Mandi (H.P.) and transplanted at two locations viz., Kangra and Mandi (H.P.) were evaluated for various biochemical constituents. Besides, polyphenol oxidase activity and essential oil profile of *Mentha* species were also studied. Significant variation in biochemical constituents among various *Mentha* species was observed i.e., total chlorophyll (1.530 to 3.140 mg/g), chlorophyll ‘a’ (1.010 to 1.815 mg/g), chlorophyll ‘b’ (0.495 to 1.325 mg/g), total carotenoids (40.770 to 65.825 µg/g), ascorbic acid (26.745 to 37.340 mg/100g), total phenols (0.650 to 8.360 per cent), moisture (62.510 to 84.620 per cent), ash (9.930 to 15.875 per cent), potassium (938.650 to 2041.705 mg/100g), sodium (178.275 to 536.890 mg/100g), crude fat (0.325 to 0.705 per cent), essential oil by Clevenger (0.430 to 1.060 per cent), essential oil by Simultaneous Distillation Extraction (S.D.E.) (0.450 to 0.815 per cent) showed polyphenol oxidase activity (0.026 to 0.066 ΔOD/min.). *M. piperata* showed the highest value of constituents such as total chlorophyll, chlorophyll ‘a’, chlorophyll ‘b’, total carotenoid, total phenols, essential oil content, moisture and fat content (except ascorbic acid, ash and Na and K content) whereas *M. longifolia* exhibited highest value for ascorbic acid, ash and Na and K content among different species. Maximum of 31 compounds were separated and characterized from *Mentha* species by GC and GC-MS, respectively. Between two locations, Kangra was adjudged better location for the essential oil and the higher levels of major compounds was also observed at Kangra.

Research Highlight -9 Seasonal variations in polyphenols and polyphenol oxidase activity in tea [*Camellia sinensis* (L) O Kuntze].

Three local cultivars viz. Kangra Local (KL), Kangra Asha (KA), and Kangra Jawala (KJ) were evaluated for different quality parameters of tea. Significant variations in biochemical composition and polyphenol oxidase activity due to variations in climatic conditions and varietal differences were observed. Oven dried tea shoots of Kangra Jawala (190.32 g kg⁻¹) had statistically the higher total polyphenol contents followed by Kangra Local (179.12 g kg⁻¹) and Kangra Asha (177.02 g kg⁻¹). Total catechins (122.06 g kg⁻¹) in tea shoots of Kangra Jawala were highest followed by Kangra Local (114.99 g kg⁻¹) and Kangra Asha (101.93 g kg⁻¹). Kangra Local showed the highest total chlorophylls content (0.987 mg g⁻¹) accompanied by Kangra Asha (0.873 mg g⁻¹) and Kangra Jawala (0.721 mg g⁻¹). Kangra Local had significantly the highest value (39.23 µg g⁻¹) of total carotenoids followed by Kangra Asha (36.80 µg g⁻¹) and Kangra Jawala (32.64 µg g⁻¹). Kangra Jawala recorded the highest ascorbic acid value (26.06 mg/100g) followed by Kangra Asha (26.84 mg/100g) and Kangra Local (25.32 mg/100g). Kangra Asha had highest sodium content (361.89 mg/100g) followed by Kangra Local (360.19 mg/100g) and then

Kangra Jawala (350.76 mg/100g). Potassium in dry tea shoots was found maximum in Kangra Asha (1710.92 mg/100g) followed by Kangra Jawala (1686.66 mg/100g) and finally Kangra Local (1628.19 mg/100g). Polyphenol oxidase in fresh tea shoots showed large variations in its activity at different time intervals.

Research Highlight -10 Evaluation of nutritionally important biochemical constituents of adzuki bean, buckwheat and chenopod genotypes.

Biochemical evaluation of 27 genotypes of adzuki bean, 40 genotypes of buckwheat and 21 genotypes of chenopod obtained from NBPGR, Phagli, Shimla was carried out for various quality parameters by following standard procedures.

Research Highlight -11 Indigenous nucleotide sequences and cultures

The department has submitted 5 Nucleotide sequences of following indigenous microorganisms to Gen Bank of National Centre for Biotechnology Information, USA.

S.No.	Organism	NCBI Accession No.
1	<i>Bacillus subtilis</i>	JF772826
2	<i>Lactobacillus plantarum</i>	JN162674
3	<i>Enterococcus durans</i>	JN162675
4	<i>Staphylococcus saprophyticus</i>	JN162676
5	<i>Staphylococcus saprophyticus</i>	JN162677

Research Highlight -12 Studies on developed liquid biofertilizer

i) Effect of pesticides on behavior of Indigenous nitrogen fixers and phosphate solubilizers

Indigenous nitrogen fixers viz. *Azospirillum brasilense* and *Stenotrophomonas maltophilia* along with indigenous phosphate solubilizers viz. *Pseudomonas aeruginosa* and *Burkholderia cepacia* were studied for their tolerance level as well as biofertilizer traits against some common pesticides viz. Bavistin, Uthane M-45 and Ridomil MZ Gold at different doses. Minimum Inhibitory Concentrations (MIC) for different pesticides ranged from 400 to 8000 µg/ml. Out of these isolates, *Azospirillum brasilense* was the most sensitive followed by *Stenotrophomonas maltophilia* and *Burkholderia cepacia*. The most resistant one was *Pseudomonas aeruginosa*. Inhibition in all the cases was bacteriostatic in nature. Phosphate solubilization, nitrogen fixation, IAA production and siderophore production traits decreased progressively with the increase in concentrations of pesticides. However, ammonia production and HCN production traits were not affected by the pesticides. Ridomil MZ was the most toxic pesticide followed by Uthane M-45 and Bavistin.

ii) Testing of prepared liquid formulation on tomato crop under protected cultivation

The developed liquid formulation with indigenous efficient nitrogen fixers and phosphate solubilizers was evaluated under protected field condition. The following treatments were applied:

Treatments	Description
T1	Seed + Basal Dose
T2	Seedling+ Basal Dose
T3	Soil + Basal Dose
T4	Foliar +Basal Dose
T5	Seed + seedling + Basal Dose
T6	Seed + Soil + Basal Dose
T7	Soil + Foliar + Basal Dose
T8	Soil + Seedling + Basal Dose
T9	Seed + Seedling + Soil + Basal Dose
T10	Seed + Seedling + Soil + Foliar + Basal Dose

T11	Control (Basal Dose)
T12	Basal Dose (Biofertilizers only)

Crop: Tomato
Variety: Avtar 7711
Design: RBD
Replication: Three

- The treatments of seed, seedling dipping, soil and foliar spray along with the addition of basal dose (12:32:16 and MOP) were examined with respect to control treatment (basal dose). Seed treatment with liquid formulation was found to be more efficient in germination of seedlings as compared to control treatment.
- Flowering and fruiting on plants were recorded and it was found that fruit quality of biofertilizer treated plants was more superior than plants treated with basal dose only. Total yield of tomato was recorded higher in treated plants as compared to control.

Effect of developed liquid formulation on quality parameters of crop:

- T10 (Seed + Seedling + Soil + Foliar + Basal Dose) showed higher value of total soluble solids (6.78 % bricks) as compared to control basal dose (5.27 % bricks).
- Fruit firmness of tomato was studied by means of penetrometer. It was found that treatments T1 (Seed + Basal Dose) and T12 (Biofertilizers only) showed greater firmness (18.3 lbs) as compared to control (15.6 lbs).
- In case of ascorbic acid content, it has been observed that T3 (Soil treatment + Basal dose) provided higher ascorbic acid content in tomato (48.33 mg/100g) as compared to control (30.10 mg/100g).
- Lycopene content was higher in T8 (Soil + Seedling + Basal Dose) i.e. (39.01 mg/100g) as compared to control treatment i.e. (31.16 mg/100g).
- Shelf life of tomato studies revealed that plants treated with T10 (Seed + Seedling + Soil + Foliar + Basal Dose) showed better shelf life i.e. 28 days at room temperature and 53 days at refrigerator temperature than the plants treated with T11 (basal dose only) where it was 19 days and 32 days, respectively.

Research Highlight -13 Microbiological studies in Model Organic Farm

i) Effect of Agnihotra on aerial microflora

Aerial microflora around the Agnihotra environment was studied in the Model Organic Farm. The total heterotrophic microbial population was significantly affected in the Angihotra environment as compared to non Agnihotra environment. A total of 70 bacterial strains were isolated from the aerial microflora of Agnihotra environment. Many of these were possessing important biofertilizer traits like phosphate solubilization, IAA production, siderophore and ammonia production. As such Agnihotra ash did not show any antimicrobial activity against human and phytopathogens, however, in combination with cow urine activity was noticed against *E. Coli*, *P. Aeruginosa*, *S. aureus*, *S. flexneri* and *L. monocytogenes*.

ii) Probiotic diversity of buttermilk used as an organic input

Microbial diversity of matured buttermilk in terms of probiotics was studied by using standard techniques. Overall 35 bacterial and 27 yeast isolates were obtained from buttermilk samples at weekly intervals upto its maturity i.e. 6 weeks. Out of these, eleven bacterial and eight yeasts were found to be acid and bile salt tolerant. On the basis in *in vitro* tests, 10 bacterial isolates were found to be effective against antibiotic resistant human bacterial pathogens. Whereas, none of the yeast isolates was found to be effective against these pathogens. Six bacterial (LBT3), LBS2-3, LBS2-5, LBS2-7, LBT2 and BS2-4) and one yeast isolates (YS1-2) showed antagonistic activity against selected phytopathogens. However, both yeast and bacterial probiotic isolates were more effective against selected plant pathogens in combination with cow urine. Based on morphological, biochemical and molecular characteristics, three

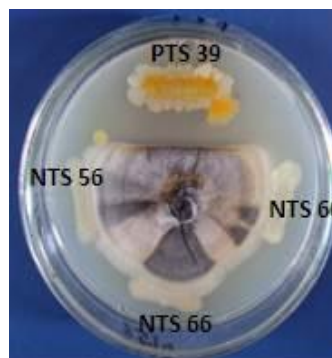
most efficient bacterial isolates were characterized as *Enterococcus durans* (JN162675), *Lactobacillus plantarum* (JN 162674) and *Bacillus subtilis* (JF772826).

iii) Microbial diversity of termite mound soils

In the present study, termite mound soils from different regions of district Kangra were examined with respect to bacterial, fungal and actinomycetes diversity. In total 132 isolates comprising of 70 bacteria, 58 actinomycetes and 4 fungi were isolated from the different samples of termite mound soil. These isolates were screened for various plant growth promoting traits under in-vitro condition. Thirteen isolates were selected as free nitrogen fixers on the basis of qualitative assay. Among these microbial isolates, 21 produced IAA (0.6-47.56 µg/ml), 12 produced siderophores (9.27-65.48% SU) and 13 produced ammonia in peptone broth. Only 10 out of 21 tested bacterial isolates showed antifungal activity against *Fusarium oxysporum*, 8 showed against *Alternaria brassicae* and *Rhizoctonia solani*, only one isolate showed against *Sclerotium rolfsii*. While, all the 21 tested bacterial isolates showed activity against *Colletotrichum truncatum*. Thirteen showed HCN production. Proteolytic activity was observed for 24 bacterial isolates, pectinolytic activity for 9 isolates while only 2 isolates showed cellulolytic activity on plate assay. All the isolates were identified on the basis of morphological, cultural and biochemical characteristics. Four efficient isolates were further screened on the basis of 16S rRNA typing and these were identified as *Staphylococcus saprophyticus*, *Bacillus methylotrophicus* and *Bacillus sp.* The sequences of these isolates were submitted with NCBI GenBank.



Termite mound



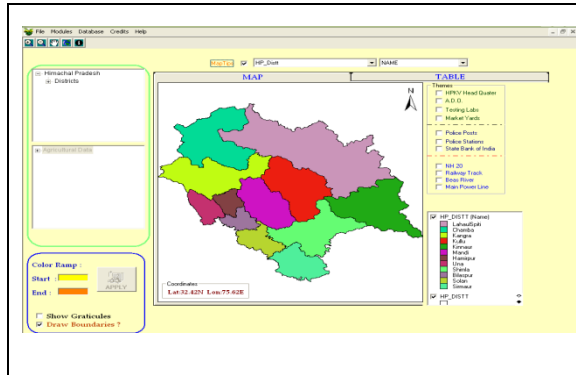
Isolate showing antifungal activity

Research Highlight -14 GIS based Agriculture Resource Information System (State Adhoc Project 2004-34)

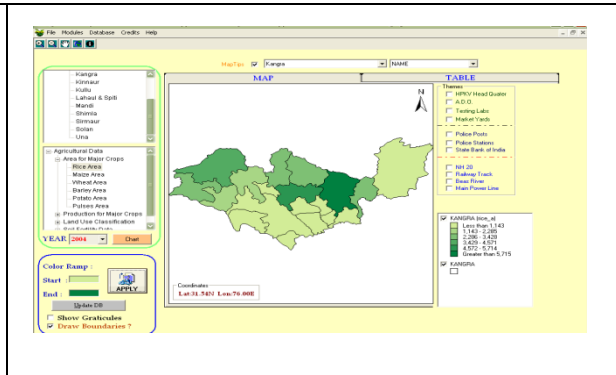
Under this project, GIS based single window information system *AgGIS (Agriculture Geo-spatial Information System)* is being developed. It is being developed as a part of the Department of Agriculture, Govt of Himachal Pradesh, Shimla sponsored project “GIS based Agriculture Resource Information System”. The Software application is being designed and consists of two components: *Stand alone application* and *Web based application* with modules at State level, district level and block level.

Research Information updated as per the COBS Annual Report 2011-12

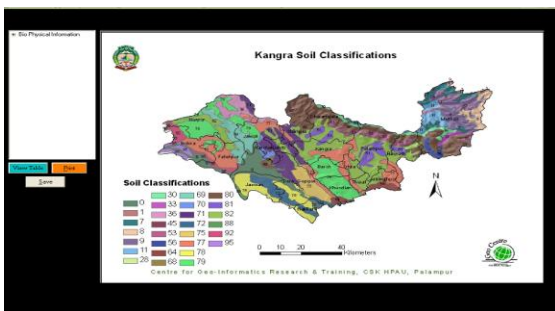
The available Geo-database at district level and block level has been collected and normalized as per the requirement for the customized GIS software. The spatial Agriculture Geo database (Administrative boundaries, Contours, spot heights, Digital elevation Model, Climatic spatial patterns for rainfall & temperature, Landcover, Drainage , Census indicators, Agro-socio-economic data, Spatial Disease/pests insects information (crops & livestock) and other allied information derived through need based spatial analysis as Agro-climatic Zones, niche areas, suitability maps) for the entire state/ districts/blocks level is being attached to both the applications. The information is now being represented in state level maps.



Stand-alone Application Window



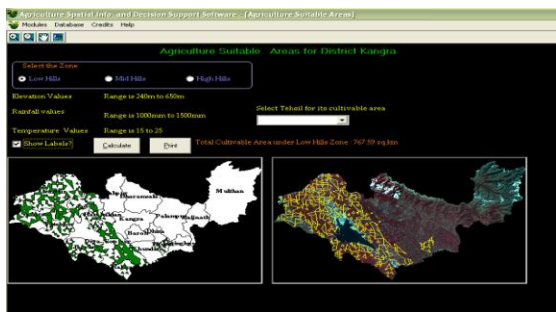
District level Agro Socio-Economic Module



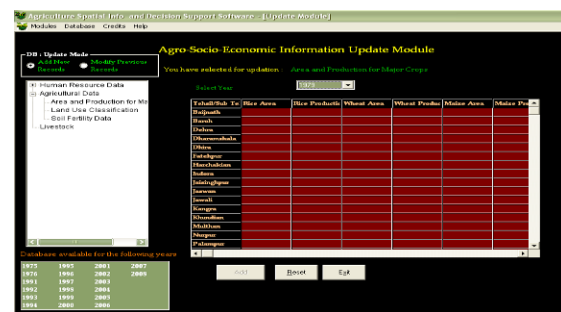
Bio Physical Information Module



Crop Requirement Module



Decision Support System (DSS) Module



Database Update Module

Research Highlight -15 Integrated Geo Database model for effective planning of DRDA

Following data at Block level/Gram Panchayat level has been generated under this project for WATERSHED DEVELOPMENT/ IDENTIFICATION FORMULATION

- No. of schemes

Research Information updated as per the COBS Annual Report 2011-12

- Panchayats covered/ Villages Served
- Land Use and Land cover mapping
- Assets Mapping of Various assets like check dams, irrigation canal, Crate Structures, Land development.
- Area under Watershed
- Beneficiary Population
- Drainage Network
- Irrigation and Fisheries (Site selection for Ponds, Reservoirs, Check Dams)
- Lift irrigations , Tube wells, Kuhl, Canals Spatial Locations
- Roads and transportation Networks
- Thematic Mapping for the policy planners of various schemes and projects

Currently, GPS based mapping of various assets has been completed for thirteen blocks of district Kangra. The data thus collected is now being ported on the internet (WebGIS for DRDA) from where it is being used by the Block officials for planning the rural development schemes.

Research Highlight -16 Impact, adaptations and vulnerability of Indian Agriculture to climate change

- The study on water balance clearly showed decreasing trends in all the agro climatic zones during past three decades. Maximum availability of surplus water balance showed a shift from July during 1974-84 to August during recent five years period (2004-09) and registered a decrease.
- The snowfall trend analysis indicated significant decrease in monthly average snowfall of December and May. The Mann-Kendall trend test showed increasing trends of snowfall during January and February reflecting delay in snowfall during winters.
- The significant decrease of surface water flow of Beas and Sutlej river water flow observed in trend analysis. Thus, the studies clearly indicated that water resources have been impacted due to changes in climatic conditions in mountains of Himachal Pradesh during past two to four decades.
- Farmers are expecting more and more forecast information in order to minimize their losses due to abnormal and abrupt changes in weather conditions.

Research Highlight -17 Application of Extended Range Forecast in Crop Planning and Operations under Sub-humid and Temperate Wet Conditions of H.P

- In the project “Application of Extended Range Forecast in Crop Planning and Operations under Sub-humid and Temperate Wet Conditions of H.P” At state, district and sub-divisional level, the one month advance forecast for SW monsoon, 2011 was more consistent than two months advance forecast while the forecast received for individual months is more accurate than the seasonal forecast received for 2 to 3 months. The verification of SW monsoon revealed a positive trend with varying magnitude in % deviation leading some values to negative. The verification of winter rainfall forecast revealed higher forecast values than the observed rainfall except in January, 2012. The verification of temperature forecast revealed that the forecasted values were near to the observed values however, the magnitude of % deviation varies. The weather based tailor made Agro advisory for wheat and apple as a target crop were issued and value addition in Medium range weather based Agro-advisory were done

Research Highlight -18 Impact of climate change on mountain Agriculture

- In the project “Impact of Climate Change on Mountain Agriculture” The local knowledge (ITKS) with respect to weather information and climate resilient practices followed by farmers of Kangra, Chamba Una and Hamirpur were documented. The climate resilient practices regarding protection from seed borne diseases and insect pest followed by farmers of Kangra, Una, Chamba Hamirpur in agricultural activities, like treating the seeds with mixture of ash & cow urine and dung before sowing or mixed cropping during rainfed conditions or the use of chullah ash, Rambaan and ankhar leaves for

pest disease protection are not only beneficial but they also contribute less towards climate change. Leaves of Drek Plant (*Melia azandrach*) and extract of Tobacco leaves can be used to cure skin diseases of animals. Likewise, dry leaves of Bangru (Wild pudina), Kali Basuti or safeda (*Eucalyptus* sp.) can be used to protect the stored grains, which are again effective low cost remedies to combat negative effects of climate change

Research Highlight -19 Integrated Experimental Agro meteorological Advisory Service at Palampur in H.P

1. Forecast Verifications

i. Palampur (Kangra)

- The validation of forecasts received from IMD for four district viz. Kangra Hamirpur, Una and Chamba was done with the observed data recorded for the respective district. The average rainfall of each district was analyzed for forecast accuracy. The other weather parameters viz. relative humidity, cloud cover, winds etc were compared with data recorded at Palampur for Kangra district only. In Kangra district at Palampur, the rainfall forecast (Correct and Usable %) cases varied between was more than 50% correct in all season except SW monsoon with 15.73%. The Ratio score (%) was more than 63.33% in all the seasons.
- The correct and usable cases varied between 22.22 to 62.97% in all the season for cloud cover. In general higher values of cloud amount were forecasted for all season compared to observed rainfall.
- The error structure for maximum temperature varied from 44.26 to 59.25% and 46.29 to 75.3% in minimum temperature in all the season. The lower accuracy was obtained due to Kharif season in both minimum and maximum as compared to rabi. In general, higher temperature values for maximum temperature and lower for minimum temperature were predicted.
- The accuracy for wind speed forecast varied between 91.23 to 100% in all the season. Whereas, the wind direction reliability varied from 31.41 to 63.15%.

ii. Dharamsala

- For district Kangra at Dharamsala, the observed daily rainfall was higher than the predicted rainfall in all the seasons except winter and hot season. On the contrary, lower weekly-accumulated forecasted rainfall was observed in all the season compared to observe except for SW monsoon winter and kharif season.

iii. Una

- The accuracy for rainfall in district Una varied between 48.72 to 98.65 % in all season. The ratio score was 93.10 % for whole year. The usability was lower in kharif than rabi season. Weekly cumulative rainfall accuracy varied between 22.22 to 78.57 % for all seasons.
- At Akrot, the correct and usable cases of daily rainfall varied from 53.45 to 98.57 for all the seasons. The ratio score was also high and correlation coefficients were also positive. The weekly cumulative in rainfall forecasted was less than observed except SW monsoon and hot season.

iv. Chamba

- For district Chamba the forecasted daily rainfall was higher for all the seasons. While weekly cumulative rainfall was predicted higher for all the seasons except for winter season compared to observed weekly cumulative rainfall.
- At Salooni, for rainfall correct and usable case varied from 46.15 to 97.14%.The highest R score was observed in South West monsoon i.e 86.42. The correlations were positive for all the seasons. Weekly cumulative rainfall observed correct and usable cases from 8.82 to 70 % while the ratio score was highest during SW monsoon The correlation coefficients were significant and positive for all the seasons.

- The correct and usable cases for maximum and minimum temperature varied from 4.96 to 50.62 and 43.86 to 74.38 respectively. The accuracy to predict temperature was fairly high to simulate in the crop models.
- v. **Hamirpur**
 - The daily rainfall was predicted higher for the wetter season (SW-monsoon and kharif season) and lower for the drier seasons (NE-monsoon, winter and rabi season). The forecasted daily rainfall was lower for the hot season compared to observed. The weekly cumulative rainfall forecasted for district Hamirpur was lower compared to observed rainfall.
- 2. **Bulletins disseminated**
 - 72 AAS bulletins were prepared in English and Hindi and posted in university website. All the English bulletins were published in university website and www.imd.gov.in and www.cropweatheroutlook.com of CRIDA (ICAR).
- 3. **IFFCO SMS to Farmers:**

Five messages sent per day 6219 farmers are registered under the services.

 - Short message services (SMS) for agro-advisories based on Long range forecasting is carried out on the pilot basis for a small group of farmers (15-20) using web GIS portal.
 - Agro-advisory services are uploaded weekly on server which sends SMS to the farmers automatically.
 - In Himachal Pradesh, 17994 SMS were sent during 2010 and 8178 SMS were sent till April 2011.
 - There is an increase of 0.82 million consumers against last year, who receive the SMS.
- 4. **Awareness camps**
 - Three awareness programmes /seminar on climate change and weather were organized to School students and college students at CSKHPKV, Palampur and NGOs Jagori at Dharamshala where 12 Schools 81 school children, 200 college students and 30 faculty and 26 farmers of NGOs participated in the seminar.

Research Highlight -20 Forecasting Agricultural Output Using Space, Agro Meteorology And Land Based Observations (Fasal)

- The study was carried out in six districts of the state viz. Kangra, Chamba, Una, Mandi, Bilaspur and Hamirpur. To accomplish the objectives of the study the area and crop yield data for major cereal crops (rice, wheat, and maize) for Himachal Pradesh as well as for the selected districts was collected from the Statistical Outline published by the Department of Economics and Statistics Himachal Pradesh.
- Field sampling of wheat crop was done for different blocks of the Kangra district for statistical and crop model based forecast. The blocks sampled were Kangra, Nagrota, Nurpur, Baijnath, Lambagaon and Bhawarna. The sampling was done on three different dates each after an interval of one month i.e. 15th November, 15th December and 15th January.
- Crop simulation models Infocrop (Calibrated and validated) and DSSAT (Field database prepared) were used. The observed field data for the year 2000 to 2002 was used to validate the Infocrop model for rice and wheat. Simulated and Observed days to maturity, anthesis and yield for the cereal crops were compared. The simulated results of rice crop yield indicated that 20th June transplanted crop was the best transplanting window for rice followed by 30th June under Palampur conditions. The results also revealed that 30th November was the best planting window followed by 15th December whereas, the sowing done on 30th December resulted in the lowest yield of wheat.
- Weather data (maximum and minimum temperature and rainfall) for the six target districts from IMD Shimla was available since July 2010 to October 2011. The climatic trends for various regions were obtained and studied.

- Three varieties (HPW-155, HPW-42, and HPW-249) and four sowing environments (20th October, 10th November, 30th November and 20th December) were selected in order to validate new crop varieties for wheat crop and pre harvest forecasting model for district Kangra.

Research Highlight -21 Studies on Morphology and Antioxidant properties of Mentha species of Western Himalayan Region

Experiments were carried out to evaluate morphological parameters and antioxidant activity of four Mentha species i.e. M.longifolia, M.piperita, M.arvensis and M.spicata. Maximum plant height and number of shoot branches were recorded in M.spicata whereas number of nodes was maximum in M.arvensis. Maximum no. of leaves was recorded in M.spicata. Maximum leaf area was recorded in M.longifolia at all growth stages. Highest fresh and dry weight of leaves was observed in M.arvensis. Chlorophyll at flowering stage was found maximum in M. piperita. The antioxidant activities of the extracts were investigated with two different methods DPPH[·] and ABTS^{·+}. Mentha piperita exhibited the strongest activity as a DPPH scavenger whereas Mentha spicata exhibited the lowest activity as a DPPH scavenger. On the other hand, all the extracts were active in the ABTS assay and no significant difference was observed in this assay. The results of this study indicate that the genus Mentha is favorable free radical scavengers as well as primary antioxidants that may react with free radicals and limit reactive oxygen species attacks on biological and food systems.

Research Highlight -22 Studies on Morphological and Genetic Variability in Large Cardamom (Amomum Subulatum Roxb.) Germplasm

Experiments were undertaken to estimate the morphological and genetic variation of large cardamom accessions collected from Himachal Pradesh and released cultivars from Sikkim using DNA markers. Cultivar Varlangey showed maximum plant height and number of new buds while cultivar Seremna recorded maximum number of suckers. Biochemical analysis of promising cultivars revealed volatile oil content of 0.22 to 0.60 percent (v/w, dry weight basis) and total chlorophyll from 0.879 to 1.348 mg/g in leaf sample. The highest Values for total chlorophyll and volatile oil were shown by cultivar Dzongu Golsey. RAPD analysis using 15 primers generated 102 scorable fragments, of which 81 fragments (79.41%) were polymorphic. RAPD analysis exhibited 13-33 per cent genetic variation among various accessions. Over all study indicated Varlangey, Dzongu Golsey and Seremna as best accessions which can be further exploited for commercial cultivation and genetic improvement programme.

V. RESEARCH PUBLICATIONS

A. Paper Published

1. Bansal GL, Raj Kumar and Rana SS. 2001. Influence of sources of organic matter on the productivity and nutrient composition of vermicompost using *Eisenia foetida*. CAABI (In Press)
2. Sharma A, Sonah H, Deshmukh RK, Gupta NK, Singh NK and Sharma TR 2011. Cloning of fibrinolytic protease-0 (*Efp-0*) gene from diverse earthworm individuals. *Indian Journal of Biotechnology* 10:, 270-273.
3. K Nishi, Gupta NK and Sharma SC 2012. Study on the incidence of hypertension and Migraine in ABO blood groups. *ISCA Journal of Biological Sciences*
4. Raina SN, Jain S, Sehgal D, Kumar A, Dar TH, Bhat V, Pandey V, Vaishnavi S, Bhargav A, Singh V, V.Rani V, Tandon R, Tewari M and Mahmoudi A 2011. Diversity and relationships of multipurpose seabuckthorn (*Hippophae L.*) germplasm from the Indian Himalayas as assessed by AFLP and SAMPL markers. *Genet Resour Crop Evol*

5. Malik S, Goyal S, Kumar S, Ojha SK, Bharti S, Nepali S, Kumari S, Singh V and Arya DS 2011. Seabuckthorn Attenuates Cardiac Dysfunction and Oxidative Stress in Isoproterenol-Induced Cardiotoxicity in Rats. *Int. J. Toxi.*
6. Rana U and Kumari K 2011. Morphological characterization of Pea (*Pisum sativum*_L.) genotypes for drought tolerance. In: The Proceedings of 1st World Congress for Man and Biodiversity Conservation. PP
7. Kumar P, Singh V and Singh A.2011. Vegetation Associated with Seabuckthorn (*Hippophae* spp.) in Lahaul Valley of Himachal Pradesh. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 1-8.
8. Sharma N, Singh V, Lal M and Devi R.2011. Impact Assessment of Seabuckthorn (*Hippophae rhamnoides*) on Soil Fertility Status. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 9-16.
9. Sharma N, Singh V, Lal M and Devi R.2011. Characteristics of root system of seabuckthorn in Lahaul valley, HP. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 17-24.
10. Kumar A, Rana RK, Pathania P, Kumar P, Singh V and Manuja S. 2011. Rejuvenation of Wild Seabuckthorn Plant Stands for Increasing the Productivity Under Dry Temperate Conditions in Lahaul and Spiti District of Himachal Pradesh, India. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 30-31.
11. Jain S, Singh A, Chaudhary M, Singh V and Raina SN. 2011. Intrataxon Variation in the Internal Transcribed Spacer Sequences of Nuclear Ribosomal DNA in the *Hippophae* L. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 41-47.
12. Lal M, Devi R, Singh V and Rana RK. 2011. Study on the Morphological Variations in *Hippophae tibetana* Populations Growing in Himachal Pradesh. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 68-74.
13. Singh V, Gupta RK, Arumughan C, Sawhney SC, Rana RK , Singh A, Lal M, Devi R and Sharma N.2011.Biochemical Evaluation of *Hippophae salicifolia* and *H. mongolica* as Horticultural Crops in Dry Temperate Himalayas. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 75-92.
14. Dhaliwal YS, Verma R, Anand S, Rana RK and Singh V.2011. Nutritional Characteristics of Seabuckthorn Berries Procured from Spiti Region of Himachal Pradesh. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 114-118.
15. Verma R, Dhaliwal YS, Anand S, and Singh V. 2011.Formulation and Acceptability of Seabuckthorn Powder in Bakery Products. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p. 119-121.
16. Sharma M, Chahota R, Palial A and Singh V. 2011. Comparative Antimicrobial Activities of Leaf Extracts of *Hippophae rhamnoides* and *Hippophae salicifolia* Species of Seabuckthorn Against Bacterial Pathogens Associated with Skin and Wound Infections of Livestock of Himachal Pradesh. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p.136-140.
17. Patial V, Asrani RK, Patil RD, Kumar S, Singh V, Ledoux DR and Rottinghaus GE. 2011. Protective Effect of Seabuckthorn (*Hippophae rhamnoides*) Leaves Against Ochratoxin A-induced Renal Damage in Japanese Quail. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p.141-153.
18. Moudgil A, Mitra S , Agnihotri RK, Asrani RK, Pathak D, Sen D and Singh V.2011. Efficacy of Herbal Immunomodulators Against Larval Toxocariasis in Swiss Albino Mice. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p.162-167.

19. Saini JP, Kumar R, Pathania P and Singh V. 2011 Introduction and Effect of Improved Forages Along with Seabuckthorn in Cold Desert Areas of Himachal Pradesh. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3*, p.224-227.
20. Sharma VK , Shama S, Rani D, Parmar A and Singh V. To Increase the Poultry Broiler Production by Probiotics Addition in the Seabuckthorn Cake Based Ration. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3, 2011*, p.228-234.
21. Singh V, Sharma VK, Sharma M, Dhaliwal YS, Tyagi SP and Sharma N. Learning Experiences from the NAIP Projects on “A Value Chain on Seabuckthorn (*Hippophae* L.)”. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3, 2011*, p.242-251.
22. Thakur DR, Guleria J, Kumar A, Jaryal A and Singh V. Role of Seabuckthorn On Socio-Economic and Environmental Conservation in Cold Desert Himalayas. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3, 2011*, p.252-259.
23. Vatsa DK, Singh S and Singh V. An Investigation on Harvesting Tools for Seabuckthorn Fruit. *Proceedings of National Conference on Seabuckthorn, Dec. 1-3, 2011*, p.279-283.
24. Awasthi, C.P.; Kumar Ajay, Singh Nageswer and Thakur Rishi (2011) Biochemical constituents of grain Amaranth genotypes of Himachal Pradesh, *Indian J Agric Biochem* 24(2), 141-144.
25. Awasthi, C.P.; Thakur, Meenakshi; Dua, R. P. and Dhaliwal, Y.S. (2011). Biochemical evaluation of some promising genotypes/varieties of rice bean [*Vigna umbellata* (Thunb; Ohwi and Okashi)]. *Indian J. Agric. Biochem.* 24(1), 39-42.
26. Thakur, Nitasha and Singh, Nageswer (2011) Biochemical evaluation and molecular characterization of garden pea (*Pisum sativum* L.) genotypes. *Indian J Agric Biochem* 24(1), 49-54.
27. Kanika , Sharma and Singh, Nageswer (2011) Effect of different picking stages on biochemical parameters of French bean (*Phaseolus vulgaris*. L.) *Indian J Agric Biochem* 24(1), 73-76.
28. Dogra, Diksha and Awasthi, C.P. (2012) Effect of different storage containers and duration on Biochemical Constituents of Buckwheat. (*Fagopyrum esculentum* Moench) grains. *Indian J Agric Biochem* 25(1), 57-62.
29. Singh B., Bhat T.K., Sharma O.P., Kanwar S.S., Rahi P. and Gulati A. (2012). Isolation of tannase-producing *Enterobacter ludwigii* GRT-1 from the rumen of migratory goats. *Small Ruminant Research* 102:172-176
30. Sourabh A, Kanwar S.S. and Sharma, O.P. (2011). Antagonistic potential of indigenous bacterial probiotics of Western Himalayas against antibiotic-resistant bacterial pathogens. *Current Science* 101 (10): 1-6.
31. Sourabh, A., Kanwar, S.S. and Sharma, O.P. (2011). Screening of indigenous yeast isolates obtained from traditional fermented foods of Western Himalayas for probiotic attributes. *Journal of Yeast and Fungal Research.* 2(8): 117 – 126.
32. Sourabh, A., Walia, S. and Kanwar, S.S. (2011). Role of probiotics in colorectal cancer. *International Journal of Biomedical and Pharmaceutical Sciences* 5(1):1-6
33. Vyas Gitanjali and Kanwar S.S. (2011). Co-immobilization of indigenous amyolytic and alcoholic yeasts of Western Himalayas for fermentation of starch substrates. *International Journal of Food and Fermentation Technology* 1 (1):99-110
34. Ranbir Singh Rana, R. M. Bhagat, Man Mohan Singh , Vaibhav Kalia, Sharda Singh And Rajender Prasad. Trends in Climate over Himachal Pradesh. *Journal of Agrometeorology* 14 (1): 104-109 (June 2012) [Impact Factor =6.6 (2012)]

35. R. S. Rana, R. M. Bhagat and Vaibhav Kalia (2011) Impact of climate change on apple crop in Himachal Pradesh. *Journal of Agrometeorology* 13 (2): 97-103 (Dec 2011) (Impact Factor =6.6_2012).
36. R.S. Rana, A.B. Bhosale, Ruchi Sood, Rohit Sharma and Navell Chander. (2011). Simulating impact of climate change on mustard (*Brassica juncea*) production in Himachal Pradesh. *Journal of Agrometeorology* 13 (2): 104-109 (Dec 2011) (Impact Factor =6.6_2012).
37. Sunita Devi, C.R. Sharma and Kamlesh Singh (2012). Microbiological Biodiversity in Poultry and Paddy Straw Wastes in Composting Systems. *Brazilian Journal of Microbiology*: 288-96

B. Papers Presented in Conferences and Workshops

1. S.S. Kanwar, Satish Paul, Mohinder Pal and Keshani (2011). Retting of flax for extraction of fibre: Microbiological approach. Paper in an International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 156 A.
2. M.K. Gupta, Sapna Thakur, Ritika Kappor, Natasha, Aditi Sourabh and S.S. Kanwar (2011). Diversity of salt tolerant plant growth promoting rhizobacteria in the saline environment of Himachal Pradesh Paper in an International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 130.
3. Natasha, S.S. Kanwar and M.K. Gupta (2011). Evaluation of indigenous immobilized yeast isolated from Lahaul and Spiti region of Himachal Pradesh. Paper in an International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 477.
4. Sohini Walia, S.S. Kanwar & Aditi Sourabh (2011). Effect of prebiotics on survival and activity of indigenous probiotics of Western Himalayas. Paper in an International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 479.
5. Aditi Sourabh & S.S. Kanwar (2011). *Bacillus coagulans*, an indigenous potential probiotic isolate of Western Himalayas: In vitro evaluation. Paper in an International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 475
6. Sohini Walia, M.K. Gupta, S.S. Kanwar and Aditi Sourabh (2011). Survival and Fermentation Ability of Indigenous Yeast Isolates in Seabuckthorn (*Hippophae rhamnoides* L.) Juice. Paper in National Conference on "Seabuckthorn (*Hippophae* L.):Emerging trends in R&D on Health Protection and Environmental Conservation held w.e.f. 1-3 December, 2011 in the CSK HPKV, Palampur. pp. 128-135.
7. Sapna Thakur, M.K. Gupta, Madhu, Payal and YS, Paul (2011). Antifungal traits of bacteria isolated from vermiwash, a bio organic liquid manure. National symposium on strategic issues in plant pathological research held w.e.f. 24-24 November, 2011 in the CSK HPKV, Palampur. pp. 67.

8. Ritika Kapoor , M.Kaur , M.K. Gupta and Ruchi Soni (2011). Indole Acetic Acid Production by Fluorescent Pseudomonas Isolated from Rhizosphere of Apple and Pear. International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh. pp 437.
9. Ranbir Singh Rana, Vijayshri Sen , Sharda Singh, and Ruchi Sood , Navell Chander and Kunal Sood,2011 Published in Compendium of Pre- Congress workshop of 1st Indian Forests Congress, on Climate Change Signals, Future Climate Scenarios and Adaptation Strategies in Mountain Agriculture of Himachal Pradesh at Himalayan Forest Research Institute (Indian Forestry Research & Education) Conifer Campus, Panthaghati Shimla -171009(H.P) No QSD.NAIP/Training/1-8/11-692 dated 26.7.2011
10. Ranbir Singh Rana, Ruchi Sood 2012. Impact of climate change on mountain Horticultural Crops. Key lecture presented in National seminar on “New Frontiers and Future challenges in horticultural crops” NFFCHC-2012 from March 6-8 , 2012 PAU Ludhiana

C. Technical Reports Submitted

1. Bansal, G.L. 2011. Annual Report of DBT adhoc Project on Vermitechnology based empowerment of Women of economically backward district Chamba of H.P.
2. Sharda Singh, Vaibhav Kalia, Kunal Sood & Arun Kumar 2012. Annual Technical Reports for all 15 Blocks of District Kangra “Integrated GeoDatabase Model for effective planning of DRDA ” submitted to DRDA, Dharmshala
3. Final Report of the ICAR funded project entitled, “Application of microbial bio-inoculants for extraction of flex fibre” submitted to Project Coordinator Linseed / Flex C.S.Azad Univ. of Agriculture & Technology, Kanpur.
4. Ranbir Singh Rana, Vinod Sharma, S.K. Upadhaya, Bhupinder Mankotia, and Sharda Singh 2012. Annual Project report for 2011-12 Application of Extended Range Forecast in crop Planning and Operations under Sub-humid and Temperate Wet Conditions of Himachal Pradesh. Submitted to CAS, IIT New Delhi.
5. Ranbir Singh Rana, Sharda Singh, Sanjay Sharma and Vaibhav Kalia. 2012. Annual Technical Project Report for 2011-12 “Impact, Vulnerability and Adaptation of Mountain Agriculture to Climate Changes’ submitted to ICAR New Delhi
6. Ranbir Singh Rana and Ruchi Sood 2012. Consolidated report for 2009-12 Application of Extended Range Forecast in crop Planning and Operations under Sub-humid and Temperate Wet Conditions of Himachal Pradesh. Submitted to CAS, IIT New Delhi.
7. Ranbir Singh Rana and Navell Chander 2012. Consolidated (2008-12), 2004-07) and annual report (2012) and report for 2009 of project “Impact, Vulnerability and Adaptation of Mountain Agriculture to Climate Changes’ submitted to ICAR New Delhi.
8. Ranbir Singh Rana,2011 Annual progress report of project entitled “Fifth Annual Review Meeting of Integrated Agromet Advisory Services project to be held at ICAR ,NEH region. Lembuchera, Agartala,Tripura w.e.f. 18-20 October, 2011.
9. Ranbir Singh Rana, Suresh Kumar Sharma and Bhupinder Singh Mankotia. Annual Project report for 2011-12 Forecasting Agricultural Output using Space, Agro meteorology and Land based observations (FASAL).

10. Anita Singh (June 2012) Final Report of the project Establishment of Herbal Garden for teaching & Research was submitted to National Medicinal Plant Board, Ministry of Health & Family welfare, Govt. of India, New Delhi.

VI. WORKSHOPS/ SEMINARS/ TRAINING PROGRAMMES ATTENDED

1. Dr. Virendra Singh attended International Seabuckthorn Association's Conference at Xining, China on September 4-9, 2011.
2. Dr. Usha Rana attended Ist World Congress for Man and Nature, Global climate change and Biodiversity Conservation 11-13th November, 2011 at Haridwar.
3. Dr. Usha Rana attended National conference on Sea buckthorn, Emerging Trends in R&D on Health protection and Environment Conservation, 1-3rd December, 2011, CSKHPKV, Palampur.
4. Dr. Anita Singh attended National conference on Sea buckthorn, Emerging Trends in R&D on Health protection and Environment Conservation, 1-3rd December, 2011, CSKHPKV, Palampur.
5. Dr. Virendra Singh as Organizing Secretary, organized and attended National conference on Sea buckthorn, Emerging Trends in R&D on Health protection and Environment Conservation, 1-3rd December, 2011, CSKHPKV, Palampur.
6. Dr. Virendra Singh attended NAIP Sponsored Training on "*Scientific Report Writing and Presentation*", NAARM, Hyderabad from March 6-9, 2012.
7. Dr.K.P. Singh, Professor-cum-Programme Officer, COBS attended the training Orientation Course for NSS Programme Officers held from 7.4.2012 to 13.4.2012 at CSKHPKV, Palampur organized by Institute for Development and Communication, Ministry of Youth Affair and Sports, Govt. of India, Chandigarh.
8. Dr. Virendra Singh delivered lecture on "R&D on Seabuckthorn in India" at the University of Turku, Turku, Finland on June 4-6, 2012.
9. Dr. S.S. Kanwar Chaired a technical session on Microbiology in 42nd Annual Group Meeting of AICRP (Soybean) held at CSKHPKV, Palampur in collaboration with the Directorate of Soybean Research (ICAR), Indore(MP) from March 22-24, 2012
10. Dr. S.S. Kanwar and Dr M.K.Gupta Attended International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh (India)
11. Dr. S.S. Kanwar participated in International Conference on Microbial Bio-technology for Sustainable Development and 52nd Annual Conference of Association of Microbiologists of India held in November 3-6, 2011 at Panjab University, Chandigarh (India) as one of the judges in poster evaluation
12. Dr M.K.Gupta Attended National Conference on "Seabuckthorn (Hippophae L.):Emerging trends in R&D on Health Protection and Environmental Conservation" held w.e.f. 1-3 December, 2011 in the CSK HPKV, Palampur
13. Dr. Manoj Bhargava attended the Workshop-cum-Installation Training Programme of SAS under NAIP project 'Strengthening Statistical Computing for NARS' from November 08-09, 2011 at NDRI, Karnal.
14. Dr. Manoj Bhargava attended the Third Workshop-cum-Installation Programme of SAS under NAIP project 'Strengthening Statistical Computing for NARS' on June 14, 2011 at NDRI, Karnal.

VII. BOOKS/ BOOK CHAPTERS

1. Ranbir Singh Rana, R. M. Bhagat Vaibhav Kalia and Harbans Lal, Impact of Climate Change on Shift of Apple Belt in Himachal Pradesh, India .In: Climate Change, Development and Governance: A Handbook on Climate Change and India.Edited By Navroz K. Dubash. 2011 Published by Oxford University Press U.K.
2. Ranbir Singh Rana, R. M. Bhagat, Sharda Singh, Rohit Sharma, Vaibhav Kalia and Vijayshri Sen.2011Climate change indicators, impact and mitigations measures in Himachal Pradesh, In Hindi Book “Climate change” Published by Ministry of Earth Sciences (MOES) New Delhi, 2011
3. Ranbir Singh Rana, Sharda Singh, Vaibhav Kalia, Kunal Sood and Rohit Sharma.2011. Role of GIS and RS for effective Agro advisory services based on medium range weather forecast In Hindi Book “Climate change” Published by Ministry of Earth Sciences (MOES) New Delhi, 2011
4. Ranbir Singh Rana, Vaibhav, Kalia, Sanjay Sharma Scientist (Soils) and Sharda Singh 2011. In ICAR Network Project on Annual report (10-11) of project “Impact, Adaptation and Vulnerability to Indian Agriculture to Climate Change. Edited by B. Venkateswarlu et al. Central Research Institute for Dryland Agriculture; Santoshnagar, Hyderabad, A.P. pp 216-221
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VIII. GIS BASED MAPS

Map of District Kangra was released by Sh R.S.Gupta, IAS, Deputy Commissioner of District Kangra on 28th April 2012.