ANNUAL REPORT
2015-16

Dr Yashwant Singh Parmar
University of Horticulture & Forestry
Nauni, Solan (Himachal Pradesh) – 173 230

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Compiled and Edited by

Dr Diwakar Tripathi, Joint Director Research (Forestry)
Dr Satish K Sharma, Joint Director Research (Horticulture)
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FOREWORD

India is the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, viz. apple, mango, banana, papaya, cashew nut, areca nut, potato, peas, cole crops etc., producing 86.60 million tonnes of fruits (China, 122.18 MT) and 169.47 million tonnes of vegetables (China, 473 MT) annually accounting for 92% of total horticultural crops. It is estimated that per capita fruits availability in our country is less than 200g per day, which is far below the recommended quantity of 230g per person per day. The overall food production scenario over the last sixty years reveals that there is 4 times increase in cereals, 6 times in milk, 10 times in horticulture and 9 times in fish, which is mainly due to expansion in acreage rather than enhancement in productivity. India witnessed a shift in area from food grains towards horticultural crops over last five years (2010-11 to 2014-15). The area under horticultural crops has increased by about 18% but expansion of area under food grains is only 5% during the last five years. During 2014-15, the production of horticultural crops was 280.98 million tonnes on an area of 23.41 million hectares. The total fruit production is highest in the case of Maharashtra (110.89 lakh tonnes) followed by Andhra Pradesh (91.21 lakh tonnes). Out of the six categories of horticultural crops, i.e. fruits, vegetables, flowers, medicinal & aromatic, spices and plantation crops, the highest annual growth of 9.5% is recorded in fruit production during 2014-15.

Himachal Pradesh is situated in the heart of western Himalayas at an altitude ranging from 350 meters to 6,975 meters above mean sea level. Though the State has a deeply dissected topography but it has emerged as a pioneer of hill development model in the country. Himachal Pradesh has a total geographical area of 55,673 Sq. Km. At per capita cultivated land availability of 0.12 hectares with only irrigation of 0.02 hectares, the per capita income has gone up from Rs. 240 in 1948 to the present Rs. 1, 30, 067. The state Gross Domestic Product has increased from 26 crore to Rs. 82, 585 crore. The food grain production has gone up from 2 lakh MT in 1948 to over 16 lakh MT and fruit production from 1200 MT to 7.52 lakh MT with a record production of 10.27 lakh MT fruits during 2010-11. The state has achieved a transformation in horticulture sector during the last fifty years. At present about 37.58% of gross cropped area of Himachal Pradesh is covered with the horticultural crops. Varied agro-climatic zones; subtropical to high altitude cold deserts of Himachal Pradesh enable the farmers of the state to do successful cultivation of a wide range of horticultural crops viz. fruits, vegetables, flowers, spices, medicinal and aromatic plants. At present about 36 types of fruit species are grown in Himachal Pradesh on a big or small scale. Amongst the fruit crops, perhaps all kind of fruits grown in the country, except those which are grown in the warm humid coastal regions, can be produced in the State. Apple dominates the fruit industry of the state. Out of total area of 224352 hectares under horticultural crops, apple alone occupies about 109553 hectares, which constitutes about 49 per cent of the total area under fruits in the state. Similarly, apple production is 625199 MT, which contributes to 83.14 per cent of total fruit production in the state. The share of subtropical fruits is only 10.73 per cent.

The horticulture industry of Himachal Pradesh has established its credibility in improving income through increased productivity, generating employment, and in enhancing exports with an annual turnover of more than Rs. 3582.91 crores, involving about 4,64,254 farmers in horticulture business. Besides fruits horticulture industry also produced 8035 MT of mushrooms, 1633MT of honey, 27204 MT (by weight) and 1868 lakh number of flowers. During 2014-15, maximum productivity was recorded in strawberry (10.16MT) followed by apple (5.71MT), papaya (5.22MT), pear (2.85MT) and kiwifruit (2.17MT) whereas it was minimum in case of olive (0.16MT). Pomegranate is new upcoming crop especially in mid hills of Himachal Pradesh, whose area has increased by 275.38 per cent with a corresponding increase in production by 1700.70 per cent over the last decade. The other minor fruits such as aonla (147.03%), jackfruit (120.43%), strawberry (100.00%), malta (66.20%) and cherry (50.00%) has also shown increasing trends in area during the last decade. Similarly, persimmon (216.46%), cherry (185.06%), loquat (160.00%) and almond (74.29%) have indicated increase in production during the last decade.

This university is a premier organization conducting basic, strategic and applied research on various aspects of fruits, vegetables, ornamental, medicinal & aromatic plants and forestry. The university is now set to play a significant role in promoting major research in World Bank aided Himachal Pradesh Horticulture Development Project (HPHDP), which has been launched recently by the State Government through hpmc, a nodal agency for implementation of the project. In future, thrust and action plan in research would be on crop wise and variety wise diversification of fruits, vegetables and flower crops and extension of the maturity period of selected varieties so as to make them available round the year. Short duration, mixed cultivation and multi-cropping system be introduced would make them offseason crops for the markets and rejuvenate the economy to achieve 'Doubling of Farmer's Income'. We aim and claim this target in the span of next five years.

The various activities carried out by the university would not have been possible without the support of Government of Himachal Pradesh. Sincere gratitude is also expressed to ICAR, State Government and other funding agencies for their support.

I would like to congratulate entire team of scientists and other staff for carrying out teaching, research and extension activities as per plan and bringing out the result. I appreciate the sincere efforts of Director Research and Joint Directors Research (Horticulture, Forestry & Planning) timely bringing out the Annual Report for the year 2015-16.

(Vijay Singh Thakur)
Vice Chancellor

FRUIT AND VEGETABLE PROCESSING UNIT
(Experiential Learning Programme)
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY
DR YS PARMAR UNIVERSITY OF HORTICULTURE & FORESTRY
NAUNI-SOLAN, HP - 173 230
WELCOME
Dr. Y.S. PARMAR UNIVERSITY OF HORTICULTURE & FORESTRY NAUNI, SOLAN (HP)
EXAMINATION HALL
FOUNDATION STONE LAID BY
Dr. NARENDRA SINGH RATHORE
DEPUTY DIRECTOR GENERAL (Edn.)
ICAR, NEW DELHI
In the presence of
Dr. VIJAY SINGH THAKUR
VICE CHANCELLOR
On 20th June 2016

PREFACE

The Dr YS Parmar University of Horticulture and Forestry continued to focus on its mandate to achieve the goals for the overall development of horticulture and forestry, providing livelihood security, growth and nutritional security to the mountain farming community of Himachal Pradesh. The Directorate of Research is playing a pivotal role in planning, implementation, monitoring, evaluation and coordinating research through different departments and research stations in diverse agro-climatic zones of the State.

During the year 2015-16, with the consistent efforts of faculty of horticulture and forestry, the university has got 33 new research projects with a budget outlay of Rs. 9.74 crore funded by various agencies viz., ICAR, MOA, DST, CSIR, Ministry of Communications and Information Technology, UGC, Directorate of Arecanut and Spices Development, CITH, IIRS, NABARD, NHPC Ltd., HP Govt. etc. In addition, the university has also been associated in the research component of the World Bank aided Himachal Pradesh Horticulture Development Project (HPHDP), for which Rs. 5289.57 lakh have been sanctioned to be utilized for strengthening of laboratory facilities, post entry quarantine, soil and leaf analysis, commercialization of bio-control, development of packages of practices for rootstock based density plantations, and pest risk surveillance during project period of seven years. The research and extension activities have also been carried through the ongoing AICRP and AINP (Rs. 5.85 crore), adhoc- projects (Rs.6.40 crore), short term projects (Rs. 6.33 crore) and KVK's (4.00crore) with a total budget of Rs. 22.58 crores during the year under report.

To pursue human resource development in horticulture, forestry and allied sciences, the university has offered undergraduate and post graduate courses and 369 students have complete their degrees during the current year. The B. Sc. final year students are exposed to Experience Learning Programme and Rural Awareness for Work Experience Programme. The university has also upgraded class rooms, library and information services for the benefit of the students and scientists through Central Development Assistant received from ICAR.

In order to diversify fruit production the existing Gene Bank of temperate fruits has been enriched with the addition of new genotypes. The germplasm of low chill apple, kiwifruit, apricot, peach and macadamia under horticulture crops and lilium and China aster under flower crops from various sources. Forty endangered and high value species of medicinal and aromatic plants have been collected, conserved, domesticated and maintained at FRS, Manali and MPRS, Rahla herbal gardens. Under value addition of products methods for preparation of instant porridge mix and technology for production of bitter gourd - aonla appetizer have been standardized. Another notable intervention is the installation and application of solar fencing technology in the university orchard and seed producing farms to check the monkey menace and damage from wildlife. About 838 samples of various food commodities including fruits, vegetables, milk and water etc. were analysed under GC-MS for the presence of various insecticides/pesticides. Nursery plants of temperate fruits (2, 42,843), subtropical fruits (54,862), forest trees and shrubs (42922), medicinal and aromatic tree species (32235) and vegetable /spices seed (10116 Kg) as well as mushroom spawn (5648Kg) have been provided to farmers. An income of about Rs 1450 lakh has been generated through the sale of farm produce and nursery plants of different fruits, forest trees and vegetables. The Directorate also supplements the development efforts of the State Government by making available nucleus planting materials of various high yielding varieties of vegetables and medicinal and aromatic plants.

The university has organized ICAR sponsored Summer Schools and various specialized departmental trainings for Hi-Tech horticulture to farmers, extension officials, supervisors and entrepreneurs by offering superior learning opportunities, along with a perfect blend of hand on trainings. The comprehensive training imparted at the university also caters to the needs and demands of horticulture industry involved in import, export and distribution or production of horticulture plants. The university is also rendering weather forecasting and agro-advisory services to the farmers and orchardists.

I take this opportunity to thank all the Statutory Officers, Heads of Departments, Associate Directors (R&E) and Incharges of Regional Research Stations for providing input for the Annual Report. I appreciate the sincere and concerted efforts of Joint Directors Research (Horticulture, Forestry & Planning) and all the staff of the Directorate of Research for compilation and editing of Annual Report for the year 2015-16.

(Vijay Singh Thakur)
Director Research

National Symposium
Holistic Approaches for Plant Health Management
September 28-29, 2015
organized by
Indian Phytopathological Society
New Delhi
Indian Society of Mycology and Plant Pathology
Udaipur
In collaboration with
Department of Plant Pathology
Dr. Y S Parmar University of Horticulture & Forestry, Nauni, Solan-173 230 (HP)
Dr L. S. NEGI
AUDITORIUM

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INTRODUCTION

Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan has its origin from Himachal Agriculture, Solan, established in 1962 with its affiliation to Panjab University, Chandigarh. The College was raised to the status of Post Graduate College, Himachal Pradesh Agriculture College and Research Institute in 1965 with the introduction of M.Sc. (Agriculture) programme. It was affiliated to Himachal Pradesh University, Shimla in 1970 and thereafter it became Agriculture Complex in July 1971. It further became Horticulture Complex of Himachal Pradesh University and Himachal Pradesh Krishi Vishvavidyalaya, Palampur in 1976 and 1978, respectively. Later on, this complex was recognized as Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan on December 1, 1985. The university has now grown into its own kind, not only in India but in entire Asia with new dimensions of education, research and extension in horticulture, forestry and allied areas. The university has two constituent colleges viz., College of Horticulture and College of Forestry located at the main campus, Nauni, having nine and seven departments, respectively besides a new College of Horticulture and Forestry at Neri, Hamirpur. In addition, there are six Regional Horticultural Research and Training Stations, nine Research Sub-Stations and four Krishi Vigyan Kendras (KVKs) situated in different agroclimatic zones of the State.

The University is located at an elevation of about 1300 m above mean sea level. The total farm area of the university is spread over 545 ha at the main campus and 202 ha with the Regional Horticultural Research and Training Stations and the Krishi Vigyan Kendras (KVKs). The university is fully determined to impart quality education to its students and also to disseminate technical knowhow to end users for overall development of the rural masses with agro based livelihood security. Motivated and enterprising farming community, committed scientific and extension manpower of the university and appropriate policy planning are providing necessary impetus to achieve the university mission and goals.

Mission

- Strategic, need based and farmer oriented development of horticulture and forestry in Himachal Pradesh through excellence in education and research for food and ecological security, improved livelihood opportunities and economic prosperity of farming communities.

Goals

- Human resource development through excellence in education and skill upgradation with intensive practical trainings.
- Creation of sound scientific base for research and extension education in horticulture, forestry and allied sectors.
- Dissemination of generated technologies to farming community through region specific transfer of technology modules.
- Effective management of financial, structural and administrative resources of the University for competitive result oriented initiatives.

Objectives

- Human resource development in horticulture, forestry and allied sciences.
- Advancement of basic and applied research pertaining to horticulture, forestry and allied sciences.
- Extension and dissemination of scientific information among the rural masses of the state.
- Development of linkages with state, centre, international institutions, NGOs, orchardists, farmers and industrialists for ensuring nutritional, economic and ecological security in the state.

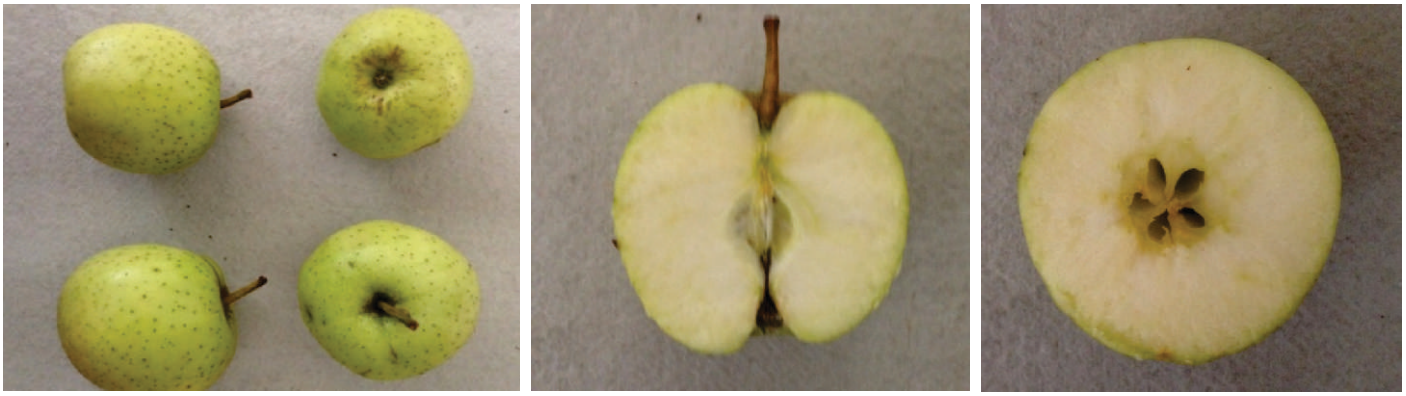
RESEARCH HIGHLIGHTS

Horticulture

- Forty genotypes were sent to Kashmir and Almora for development of apple database. Morphological data on 49 apple genotypes have been uploaded. Twenty nine apple genotypes established in the germplasm repository has initiated fruiting. Eighty eight apple genotypes have been identified and growth characters of apple hybrid seedlings have been recorded. Grafted plants of F_1 mapping population received from Kashmir have been planted in the field (*FS, Nauni*).
- Sixty two varieties of apple and twenty three of cherry were characterized for vegetative, flowering and fruiting characteristics during the year for the development of descriptors (*RHR&TS, Mashobra*).

Bright N Early

Brookfield Gala



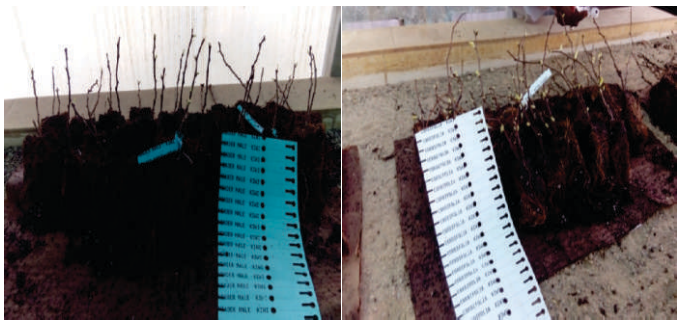
Golden Delicious

Adams

Crimson Beauty

James Grieve

- Variation was recorded in peach germplasm in respect of morpho-physical and quality characters as per UPOV guidelines so as to develop a database for facilitating DUS testing. Hybridity in inter-varietal crosses in peach, apricot and apple has been confirmed using molecular markers (*FS, Nauni*).
- Thirteen varieties of kiwifruit namely: Ana, Cordifolia, Dunbarton Oaks, Issai, Kens Red, MSU, Prolific, Red Beauty, 74-32, 74-49, Meader, Arctic Beauty and Chung Bai. Seven varieties each of blueberries viz., Biloxi, Misty, Sharpblue, Legacy, Bluecrop, Arlene, Revelle and walnut namely: Franquette, Lara, Chandler, Howard, Ferner, Fernette and Maylanaise have been introduced (*FS, Nauni*).



Plants of new kiwifruit introductions

- The plants from the germplasm of open pollinated low chill apple seeds including accessions viz. EC-790620, EC-790621, EC-790622, EC-790623, EC-790624, EC-790625, EC-790626, EC-790627, EC-790628, EC-790629, EC-790630, EC-790631, EC-790632, EC-790633 introduced from National Clonal Germplasm Repository, Geneva were raised and further grafted for evaluation (*FS, Nauni*).
- Forecast model were obtained by applying the multiple regression technique taking yield as dependent variable and weather experienced by the tree at different stages of fruiting as independent variable. Models were developed for forecasting yield of Royal Delicious and Golden Delicious trees separately by taking trees of different age group (*RH&FRS, Bhota*).
- Imported plants planted during the year 2010-11 have stunted growth due to dwarfing effect of rootstocks, low soil depth at the plantation site and formation of immense spur with harvesting heavy crop year after year (*RHRSS, Tabo*).
- Oregon Spur-II cultivar of apple induces better growth with greater sized fruits and have higher yield per tree as compared to the other two spur cultivars of apple. Russet appearance on the fruit of Scarlet Spur has been observed (*RHRSS, Tabo*).

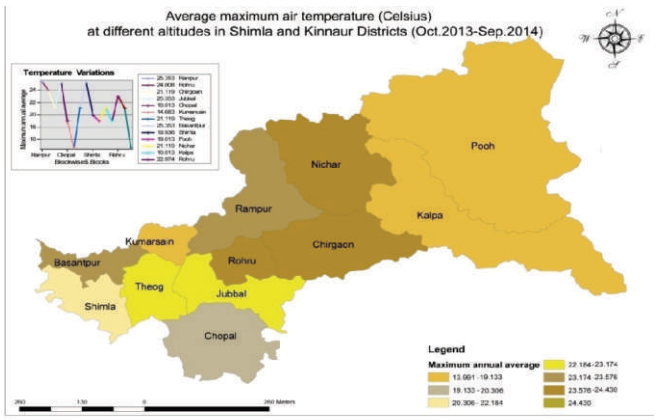
Growth characteristics, fruiting and yield of imported apple under cold desert condition of Spiti valley

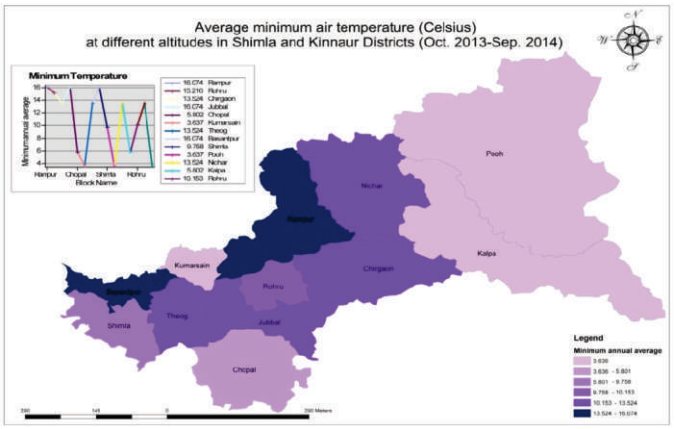
Sr. No.	Variety	Shoot growth (cm)	Fruit colour	No of plants bear fruits	Total yield (kg)	Fruit size		Yield per tree (kg)
						Length (mm)	Breadth (mm)	
1.	Super Chief EMLA-111	12.34	Red	34	120.7	63.61	67.77	3.55
2.	Scarlet Spur EMLA-111	14.12	Dark black red	127	489.5	73.05	74.20	3.86
3	Oregon Spur-II EMLA-111	40.12	Red with stripes	27	162.0	72.72	76.15	6.00

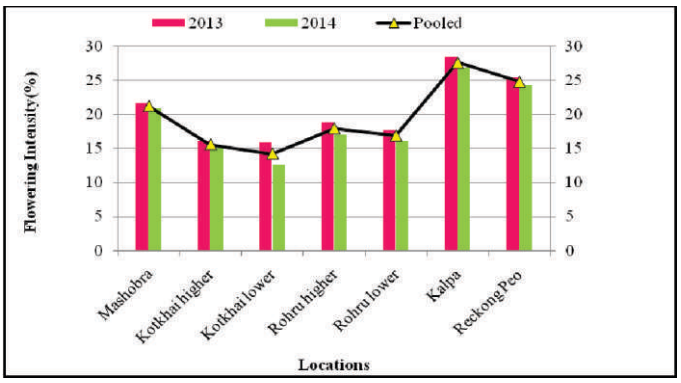
Super Chief

Scarlet Spur

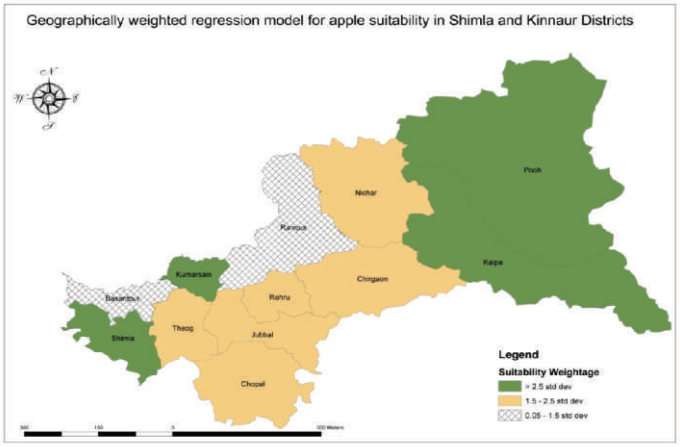
- Studies on fulfilment of chilling requirements of apple were carried out at different locations and altitudes in Shimla and Kinnaur districts of Himachal Pradesh during the years 2012-14. The data on weather, geological, physical, production, quality, soil and socio-economic parameters were recorded. The result revealed that the temperature decreased linearly with the corresponding increase in altitude. Rainfall was recorded significantly lower at both the locations of district Kinnaur in comparison to all the locations of district Shimla. Depending upon the climatic variations at different locations during the course of study, dates of chilling unit initiation, rest completion, end of chilling period, chilling period and full bloom stages of Starking Delicious apple showed discrepancy among the locations and between the years. According to present findings all the locations in Shimla and Kinnaur fulfilled the basic chilling requirement for apple. Different altitudes showed significant positive correlation with flowering intensity, fruit set, yield, productivity, fruit length, diameter, fruit shape index, fruit weight, TSS, TSS/acid ratio and sugars whereas, negative and significant association was found between altitudes and fruit acidity. Soil temperature and moisture increased with the progress in growth period and increase in altitudes. The suitability map of apple for Shimla and Kinnaur districts was obtained after running the geographically weighted regression model. The highly suitable areas included Shimla, Kumarsain, Kalpa and Pooh blocks, where the temperature and altitudes were found to be in the exact optimum range and this area is about 211.79 sq km. In case of fairly suitable zone, there was moderate correspondence between climatic conditions and requirement of apple in these areas compared to best suitable zone. This zone includes Theog, Chopal, Jubbal, Rohru, Chirgaon and Nichar blocks with an area of 157.18 sq km. However, unsuitable zone considered as areas that are not suitable for apple because of non-compatibility between prevailing climatic requirements of apple. This zone included Basantpur and Rampur covering an area of 47.26 sq km (*FS, Nauni*).

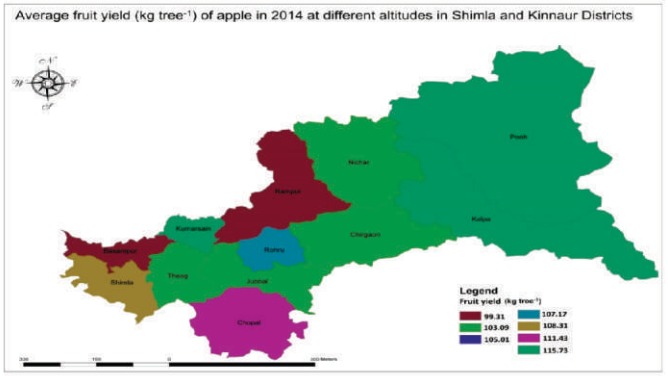




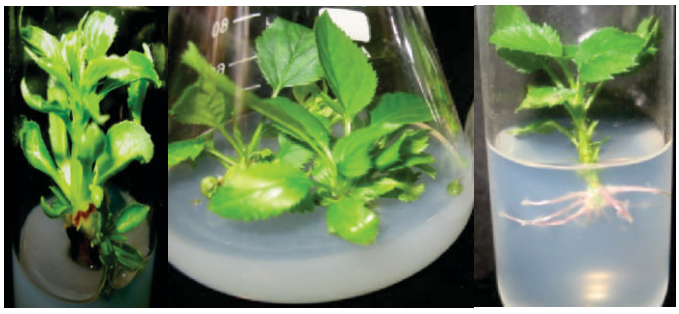


Flowering intensity of apple cv. Starking Delicious at different locations of Shimla and Kinnaur districts



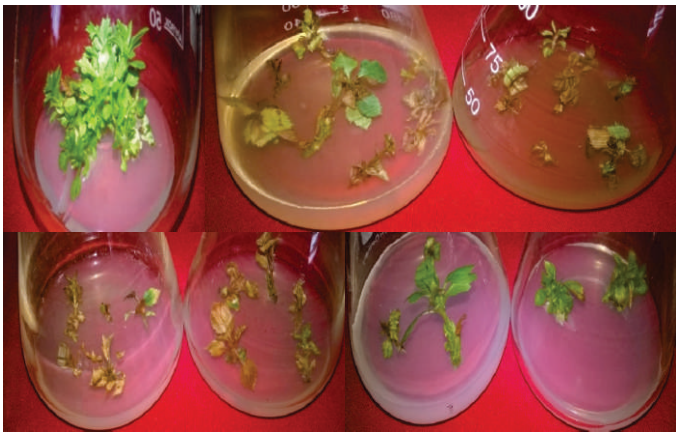


- Two varieties of apple namely, Scarlet Spur and Sansa grafted on MM106. The data revealed that training systems did not show any significant effect on the apple plant height, however, the maximum plant height was recorded in Modified Central Leader System and minimum was in Head and Spread System. The maximum plant height (2.02 m) was observed in Sansa and minimum was in Scarlet Spur. The interaction effect of training system and cultivars was found to be non-significant. The maximum height was recorded in Sansa under Modified Central Leader System. The minimum height was observed in Scarlet Spur trained on vertical Axis System, which was significantly lower than height of trees in Sansa cultivar on training system. The training systems did not show any significant effect on the radial growth of stock, however, the highest plant stock growth was recorded in spindle bush and lowest in trellis system. Cultivars significantly influenced the plant stock girth. The highest plant stock girth was observed in Sansa and minimum was in Scarlet Spur. The interaction effect of training system and cultivars was found to be non-significant. The maximum plant stock girth was observed in Sansa trained on vertical axis system, while minimum plant stock girth was recorded in Scarlet Spur under vertical axis system (*FS, Nauni*).
- In apple *Malus baccata* Kashmir, three fold multiplication rate and good shoot length were found with combination of two cytokinins (Kn and BA) along with IBA and GA_3. However, in *M. baccata* Khrot similar multiplication rate and shoot length were obtained on MS medium having BA and GA3. 0.1 mg/l IBA proved to be more effective for rooting in shoots (*BT, Nauni*).



Shoot induction from bud bursts, elongation, shoot multiplication and rooting in *M. baccata* Kashmir

- Regenerated shoots of apple rootstock MM106 were exposed to selective medium containing 20-80 per cent fungal culture filtrate (FCF) made from pure cultures of *Phytophthora cactorum*. Tolerant regenerants selected on 74 and 72 per cent FCF showed 100 per cent survival and further growth when cultured on FCF free medium, while 33.3 and 50 per cent tolerance/survival on selective medium in continuous 2nd selection cycle (*BT, Nauni*).



Control Tolerant regenerated shoots on 72% and 74% FCF in 2nd selection cycle (continuous and discontinuous cycle)
In vitro selection of apple rootstock shoots tolerant to *Phytophthora cactorum*

- In apple maximum plant height (259 cm) was observed in cv. Lal Ambri followed by cv. Red Delicious (214 cm) and minimum plant height was observed in cv. Royal Delicious (129 cm), whereas maximum trunk girth was reported in Silver Spur (15.6 cm) followed by Red Delicious (12.0 cm) and minimum trunk girth was observed in cv. Red Chief (10.9 cm). Maximum fruit weight, length and breadth were observed in cv. Oregon Spur (187 g, 6.7 cm and 8.0 cm) followed by Red Chief (162 g, 6.3cm and 7.0 cm) and minimum fruit weight, length and breadth was observed in Royal Delicious (145 g, 60.0 cm and 7.0 cm). Maximum total soluble solids was observed in cv. Oregon Spur (14.3^{0}B followed by cv. Silver Spur (13.0^{0}B), whereas maximum total sugars was observed in cv. Oregon Spur (9.0%) and minimum total sugars was observed in cv. Royal Delicious (8.5%) (*RHR&TS, Bajaura*).
- Integrated nutrient management approach in apple cultivar Oregon Spur-II, 100 per cent NPK (recommended dose of fertilizers) + 10 kg vermi-compost along with biofertizers resulted in increase in tree height (175 cm), tree spread (108 cm), shoot growth (37 cm), fruit yield per tree (10 kg), fruit length (63.64 mm), fruit breadth (68.96 mm), TSS (15), pressure (9.3 kg). These initial results depicts that shoot extension growth, tree height and trunk girth was significantly higher in trees treated with 100 per cent NPK + vermi-compost along with bio fertilizers over the rest of the treatments. Whereas, flowering and fruiting characteristics were better in the treatment having 75 per cent NPK along with bio fertilizes + vermi-compost application (*RHRSS, Tabo*).
- To work out the appropriate dose of calcium nitrate in Red Chief and Royal Delicious cultivars of apple, it was found that 60 per cent recommended dose of N through calcium nitrate was as effective as recommended dose of N through calcium ammonium nitrate for improving growth, yield and nutritional status of apple (*FS, Nauni*).

75% NPK + bio-fertilizers+ vermi-compost

100% NPK + bio-fertilizers+ vermi- compost

Fruiting of 100% NPK + Bio- fertilizers+Vermi- compost treatment

- Yaravita Stop IT significantly affected yield and quality of apple. Maximum fruit set (33.60%) and fruit retention (72.00%), fruit yield (158.00 kg/tree), fruit weight (188.22 g), fruit size in terms of fruit length (69.20 mm) and breadth (75.89 mm) was recorded when Stop IT was sprayed at 2.5 ml/l at fruit set, fruit development stage and 15 days before harvesting. However, maximum fruit firmness (8.73 kg/cm^2) was observed in the treatment of Stop IT when sprayed at 7.5 ml/l at fruit set, fruit development stage and 15 days before harvesting (*RHR&TS, Mashobra*).
- Maximum fruit set (35.60%), fruit retention (70.00%), fruit yield (188.40 kg/tree), fruit weight (179.71 g) was observed in plants treated with Zintract @ 1.5 ml/l at petal fall and just after harvest. Whereas, fruit firmness was maximum (6.88 kg/cm^2) in 4.93 g/l zinc EDTA treated fruit at petal fall and just after harvesting (*RHR&TS, Mashobra*).
- Maximum fruit set (40.33%), maximum fruit weight (177.22 g) was recorded when bortrac was sprayed at 1.5 ml/l @ pink bud, petal fall and just after harvest. Maximum fruit retention (72.67%), maximum fruit yield (187.00 kg/tree) and (51.80 t/ha) was observed in plants treated with 1.0 ml/l at pink bud, petal fall and just after harvest (*RHR&TS, Mashobra*).
- Omex agrifluids Bio20 and Calmax Gold @ 2 ml/l sprayed at green tip, pink bud, petal fall, pea nut and walnut stage was effective in improving fruit set and reducing the fruit drop. Whereas, Omex agrifluids Bio20 and Calmax Gold @ 3 ml/l sprayed at green tip, pink bud, petal fall, peanut and walnut stage was effective in improving per cent bloom, yield, quality and shelf life of fruit (*RHR&TS, Mashobra*).
- Dormex was effective in inducing early bud sprouting. Observations was recorded on 6th April, 2015 showed maximum bud sprouting (85.58%) in Dormex treatment when sprayed @ 4.0 per cent, closely followed by Dormex @ 2.0 per cent whereas lowest bud sprouting was recorded in control (67.17%). Dormex was also effective in increasing fruit size in terms of length and breadth, weight, volume and yield of fruits (*RHR&TS, Mashobra*).
- Fertilizer combination i.e. FYM 30 kg/plant + recommended dose of chemical fertilizers + 10 kg Geo Green has positive effect on fruit set, fruit yield and fruit quality of apple cv. Royal Delicious (*RHR&TS, Bajaura*).
- Flower thinning practiced on Super Chief and Scarlet Spur varieties manually at the time of flowering in the year 2015 i.e., 0, 25, 50, 75 and 100 per cent, promoted better growth with larger fruits. Most of the spur varieties on rootstock, which remained stunted due to genetic characteristics of the rootstock and heavy bearing nature of spur plant. (*RHRSS, Tabo*).
- Although the foliar application of 1 per cent calcium (0.1%) boric acid (0.1%) along with recommended dose of fertilizers did not increased the fruit yield in pear plants but reduced 12.6 per cent russeting in fruits over control (recommended dose of fertilizers). While the basal dose of borax (0.1%) along with recommended dose of fertilizers was able to reduce only 5 per cent russeting in fruits over control (*RHR&TS, Sharbo*).
- In apricot, the maximum average fruit length (56.74 mm), breadth (49.58 mm), fruit weight (77 g) and fruit firmness (3.6 kg/cm^2) was recorded in cultivar Yerevani whereas highest TSS content (18°Brix) was recorded in Sateni as compared to Yerevani (16°Brix). The flowering and fruiting was very poor in both the cultivars (*RHR&TS, Sharbo*).
- Five varieties of apricot namely: CITH-1, CITH-2, CITH-3, New Castle and Irani, revealed that maximum plant height was observed in CITH-3, whereas, minimum plant height was recorded in New Castle, which was significantly lower to all other cultivars under study. The highest stock:scion ratio was recorded in CITH-1, while the lowest stock:scion ratio was recorded in CITH-3. The maximum annual extension growth was recorded in CITH-3, which was statistically at par with CITH-1 and CITH-2. Significantly highest canopy volume was observed in CITH-1 which was on par with CITH-2 and CITH-3, while lowest canopy volume was in New Castle that was significantly lower to all other cultivars under study (*FS, Nauni*).

- Apricot maximum plant height, and plant girth were observed in cultivar CITH-1 (398 and 34.5 cm) and minimum plant height, and plant girth were observed in cultivar CITH-3 (356 and 32.1 cm). Plant spread was maximum in CITH-1 and minimum in CITH-2. The cv. CITH-3 was first to show full bloom flower and cv. CITH-1 was last to show full bloom. Maximum fruit weight, fruit length and fruit breadth was observed in cv. CITH-3 (43 g, 4.1 and 4.5 cm) and minimum fruit weight, fruit length and fruit breadth was observed in cv. CITH-1 (40 g, 4.0 and 4.3 cm). The maximum TSS was also reported in cv. CITH-3 (16.7°Brix). The cv. CITH-2 have maximum total sugars (10.5%) followed by cv. CITH-1 (10.2%) and cv. CITH-3 (9.9%) (*RHR&TS, Bajaura*).

CITH-1

CITH-3

- Soaking of seeds in 150 ppm GA_3 for 48 hours significantly increased the height and diameter of seedlings and led to production of more number of buddable size seedlings and growth of budded plants in a year under protective conditions (*FS, Nauni*).
- Based upon the evaluation of apricot germplasm available in the departmental germplasm block, variety Gulabi has shown the potential for cultivation in the mid-hills (*FS, Nauni*).

Fruit weight: 25 g; TSS: 17 °B, Date of harvesting: 2nd week of May

Gulabi: A consistent bearer apricot variety suitable for cultivation in mid hills

- In order to infuse early maturity and sweetness in apricots, a hybridization programme was initiated during 2008-09. Out of several crosses attempted by involving different parent varieties viz., Shipley Early, EMA, Kaisha, Nugget, Gulabi and Early Lazy, EC-198240, only one cross combination i.e. Kaisha x EMA has shown its potential as a promising hybrid as a result of top working. The evaluation work is still in progress (*FS, Nauni*).

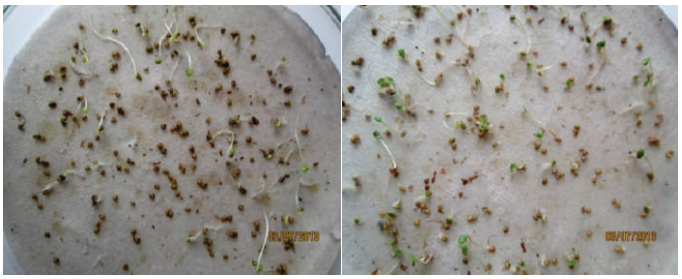
DOH; 1st week of June TSS=16? B Fruit Wt.45g

Promising apricot hybrid

- The maximum kernel weight (14.9 g) was observed with CITH Walnut-1 and minimum kernel weight (6.8 g) was observed with CITH Walnut-8, whereas maximum kernel percentage (61%) was observed with CITH Walnut-3 and minimum kernel percentage (58%) with CITH Walnut-1 (*RHR&TS, Bajaura*).

- Among the different methods and time of budding/grafting in walnut, chip budding done during first and second week of July gave highest (86%) bud take success, followed by patch budding, which also resulted in better growth of budded plants and produced 84 per cent saleable plants in a year (*FS, Nauni*).
- In pomegranate, maximum mean trunk girth and plant height were observed in DK from Shilvan; whereas, these were minimum in Small Leaf. Nochi-shibori and Apseronskikrasnys have been recorded to be early in flowering i.e., 29th March in comparison to Apseronski which was late i.e., 9th April. Among hybrid progeny of pomegranate, maximum mean trunk girth was reported in hybrid from China Seedling x Kandhari Hansi (2/27/9) whereas, it was minimum in hybrid 2B (1/31/2). Maximum mean plant height was observed in hybrid China Seedling x Dholka (1/1/1) whereas, minimum mean plant height was observed in hybrid Bush Large x Mridula (3/1/8) (*FS, Nauni*).
- Crosses were made between Kandhari Kabuli x Bhagwa. One plant was selected out of six thousand hybrid plants. The hybrid has been named as "Kandhari Seedless". This variety ripens in mid October at Bajaura. Six year old plant can yield up to 40 kg per tree. Fruit is very attractive, saffron coloured with smooth and glossy peel. Arils are attractive cherry red colored, soft seeded bold and suitable for table and processing purposes. Sweet in taste with slight acidic blend, having TSS 15.0^{0} B and acidity 0.52 %. Fruit weight 350 to 400g. Better keeping quality, less cracking and suitable for long distance transportations (*RHR&TS, Bajaura*).
- Variability, correlation and path analysis were studied in sixteen strawberry cultivars. Chandler outperformed all other cultivars for vegetative characters. Fruit size, weight and yield were maximum in cultivar Gorella. High co-efficients of variability for total yield, number of fruits per plant, average berry weight and number of runners per plant may be used for improvement through selection. Total yield showed high heritability coupled with high genetic gain. Yield per plant was positively and significantly associated with plant height, plant spread, leaf number per plant, leaf area, number of runners per plant, fruit length, fruit breadth, number of achenes per fruit, number of fruits per plant and average berry weight. Maximum fruit set with better fruit size was from cross-pollination, followed by hand and open pollination and least was in self-pollination. Ethrel (500 ppm) resulted in higher germination, followed by 200 ppm Gibberellic Acid. The line 'Chandler' exhibited good general combining ability for plant height, spread, leaf area, fruit size, number of fruits per plant and TSS and 'Sweet Charlie' was good combiner for plant height, spread, fruit size, fruit weight and TSS (*FS, Nauni*).
- Among the testers 'Torrey' showed good GCA for plant height, leaf number, leaf area, fruit length, fruit weight and 'Selva' for leaf area, number of fruits per plant and TSS. Combining ability depicted prominent role of non-additive gene action for most of the traits except plant height, fruit breadth and TSS. Variability among the crosses was mainly due to higher contribution of lines compared to individual contribution of testers and line x tester interaction (*FS, Nauni*).
- To develop day neutral cultivars, five cultivars viz., Chandler, Sweet Charlie, Gorella, Confectura and Douglas were crossed with three day neutral cultivars viz., Fern, Selva and Torrey. Thirty crosses were made in each cross combination. Maximum fruit set was recorded in 'Chandler' when crossed with 'Torrey' followed by 'Gorella' x 'Torrey' (*FS, Nauni*).

Cross between short day and day neutral cultivars


Strawberry seed germination

Hybrid plant in pots

- Seven varieties of almond namely, Merced, Pranyaj, Primorskij, Non Pareil, IXL, Waris and Makhdoom revealed that the maximum plant height was observed in Non-Pareil, which was significantly superior to all other cultivars under study. The highest plant stock girth was recorded in Non-Pareil, which was significantly superior to all other cultivars under study. The maximum scion girth was found in Non-Pareil, which was significantly superior to all other cultivars, while lowest scion girth was observed in Primorskij that was statistically similar with IXL. Markedly highest annual extension growth was found in Non-Pareil. The stock:scion ratio, and canopy volume was found to be non-significant. However the highest stock:scion ratio was recorded in Waris and minimum in Primorskij. The maximum plant canopy volume was observed in Non-Pareil while the minimum in Primorskij (*FS, Nauni*).
- In kiwifruit, earliest bud break i.e., 11th March was noticed when Dormex (4%) + mineral oil (2%) applied 45 days prior to anticipated date of bud break. The maximum number of shoots emerged in vines treated with Dormex alone and in combination with mineral oil, whereas, minimum number of shoots were found in Dormex and control, recording one shoot each treatment. Maximum number of buds per flowering shoot i.e., 8, were recorded with treatment Dormex + mineral oil followed by treatment Dormex. The treatment resulted in highest number of shoots and number of buds per flowering shoot as compared to all other treatments (*FS, Nauni*).
- In nectarines, treatment with NAA (40 ppm) when applied two weeks after petal fall induced significantly higher thinning thereby, increased shoot growth, tree height and spread, leaf area, photosynthetic rate, chlorophyll content, superior grades and fruit yield. Total soluble solids, total sugar and reducing sugar contents were higher and fruit acidity and firmness lower in the fruits from trees treated with NAA (60 ppm) two weeks after petal fall during both the years, irrespective of locations. Surface colouration was higher in fruit from trees treated with Ethrel (300 ppm) two weeks after petal fall during both the years, irrespective of locations. However, chemical thinners were more effective at Kandaghat, in respect of all these parameters and the induction of fruit abscission, following application of treatments was higher during 2014 in comparison to 2015 over the control. Different NAA and Ethrel treatments resulted in disintegration of cells in pith, vascular and cortex regions was

advanced at Kandaghat in the year 2014 at 20.5-24.5°C/13-14°C maximum and minimum temperature and 47.3-60.3 per cent average relative humidity after application of chemical thinners (*FS, Nauni*).

- In pistachio nut, maximum plant height (370 cm), tree girth (59.50 cm), tree spread East-West (538 cm); North-South (432 cm) was recorded in Kerman. Pistachio nut is not performing well in term of yield and quality (*RHR&TS, Sharbo*).
- Since the apple orchards in Kinnaur contains only 4 to 5 per cent pollinizer varieties (a main reason of low fruit set), the fruit set could be enhanced by incorporating more number of honey bee colonies. Four number of honey bee colonies per hectare enhanced 36.4 per cent fruit set (*RHR&TS, Sharbo*).
- High density orchards of subtropical and low chill temperate fruit crops viz., mango, pomegranate and peach were established on undulated sloppy wasteland after eradication of *Lantana, Parthenium* etc., with a vision to find suitability as alternative crops for frost prone areas (*RH&FRS, Bhota*).

High density orchard of low chill peach established on undulated sloppy wasteland at Neri-I Farm

- Pruning of mango plants at primary, secondary and tertiary branches followed by application of copper oxychloride paste prepared in linseed oil in the month of December resulted in managing the die back of mango during the following season (*RH&FRS, Bhota*).
- The data on sweet orange cultivars evaluation inferred that the cultivar 'EC-660564' is more vigorous and showed maximum average plant height (400.2 cm), tree spread (168.8 cm), tree girth (25.6 cm), annual shoot extension growth (16.3 cm), yield (20.5 kg tree^{-1}), fruit weight (227.7 g) of 58.6 x 56.3 mm size with minimum of 7.87°Brix of TSS followed by 'EC-660559' with corresponding values of 250.8, 161.1, 7.8 and 23.9 cm. In other cultivars namely, 'EC-660559', 'EC-660560' and 'EC-660561', the flowering was observed, however, due to flower drop, no fruit set was recorded (*RHR&TS, Dhaulakuan*).
- Nine guava cultivars (budded) viz., 'Lalit', 'Allahabadi Safeda', 'DK-Red Flesh', 'Punjab Hybrid-I', 'Punjab Hybrid-II', 'L-49', 'Shweta (G-4)', 'Hisar Surkha' and 'Hisar Safeda', planted at 6 x 6 m apart and were evaluated for pomological traits. 'Lalit' was observed to be the predominant cultivar in yield (25.6 kg tree^{-1}), TSS (16.9°Brix) and fruit size (57.7 x 59.3 mm) were at par with 'Allahabadi Safeda' with respective values of 20.8 kg tree^{-1}, 16.4°Brix and 56.9 x 51.6 mm (*RHR&TS, Dhaulakuan*).

Guava cv. Lalit

- The results have shown that in 'Allahabadi Safeda (budded)', the treatment combination of $D_2T_2H_2$ attained tree height (149.5 cm), tree circumference (12.3 cm), tree spread (E-W: 119.8 cm; N-S: 117.8 cm), annual shoot extension growth (44.5 cm), number of primary branches (3) and number of secondary branches (5). Similarly, number of flower buds per shoot (25), fruit set (78.6%), fruit yield (4.5 kg tree^{-1}) and fruit

weight (155.4 g) were recorded in the trees when topped down at 35 cm, followed by $D_3T_1H_1$ at 25 cm of topping. In 'Lalit (inarched)' cultivar, similar growth attributes were recorded in $D_3T_2H_2$ with corresponding values of 177.6, 9.8, 116.6, 88.2, 54.7 cm, 3 and 5 when topped at 35 cm, respectively. Similarly, number of flower buds per shoot (21), fruit set (75.2%),fruit yield (4 kg tree^{-1}) and fruit weight (160.3 g) were recorded in the trees when topped down at 35 cm (*RHR&TS, Dhaulakuan*).

'Lalit' 'Allahabadi Safeda'
Established guava meadow orchard

- In newly rejuvenated guava trees of cultivars Allahabadi Safeda and L-49, three pulse crops viz. moong (SML 668), mash (Himachal Mash-1) and cowpea (C-475) were sown as intercrops and evaluated for their performance during spring-summer season. On the basis of their performance in term of growth, yield and soil ameliorating properties cowpea cv C-475 was observed to be the best followed by moong and mash (*RHR&TS, Jachh*).

Intercropping of pulses viz. moong, cowpea and mash in rejuvenated guava orchard

- Five cultivars of litchi viz., China, Bedana, Shahi, Purbi and Dehrarose were introduced from NRC, Muzzaffarpur (Bihar) and evaluated for growth paramaters, under low hill conditions of the state. Cultivar Shahi excelled for trunk growth, tree height and tree spread over other cultivars evaluated (*RHR&TS, Jachh*).
- Out of 9 varieties of litchi evaluated for growth, flowering, fruit quality and yield, cultivars Dehradun, Large Red, Rose Scented and Seedless Early were observed to be the high yielding early cultivars, whereas Calcuttia was found to be best option for the areas with limited irrigation facilities (*RHR&TS, Jachh*).
- The application of 150 g *A. chroococcum* ha^{-1} + 150 g K-mobilizers ha^{-1} significantly increased cumulative fruit number (62.7), cumulative yield of 654.6 g plant^{-1}, fruit weight (9.79 g), firmness (0.86 g cm^{-2}), leaf area (88.4 cm^2), as compared to non-solarized conditions (*RHR&TS, Dhaulakuan*).

Hardening of air layered litchi

- The treatment 250 g VA-mycorrizae ha^{-1}+ 175 g *A. chroococcum* ha^{-1} recorded maximum survival (86.1%) of air layered litchi plantlets as compared to control (65.4) and better rooting survival and the establishment of the layered *guttee* in soil (*RHR&TS, Dhaulakuan*).

Micronutrient and urea phosphate (N: P: K, 17:44:00) fertilization in litchi

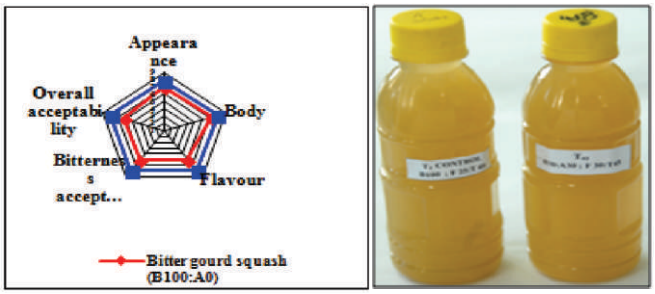
- Sixteen mango cultvars were evaluated for growth, yield and quality attributes. Dashehari gave the highest yield amongst the early varieties. However, Langra, Safeda, Chausa, Fazli, Bombay Green and Sindhuri were observed to be the best as these excelled over other mango cvs. as late season varieties (*RHR&TS, Jachh*).
- In different sections of the research station work on zero budget farming was started during the period under report. In fruit crops viz. mango, litchi, citrus and guava *jeevamrit* formulations were prepared and used as basal and foliar applications. Similarly in vegetable and floriculture crops, the above formulation of *jeevamrit* is being used for improving the soil and plant health (*RHR&TS, Jachh*).

Prunes (dried plum) in bearing

- Potential of prunes, dried plum in cold desert region of Spiti could be explored, as it has been performing excellent at Tabo. Flowering starts in the last week of April and full bloom in the month of May, fruits maturity starts in the 1st week of August, as it starts softening and dropping. It bears fruit in abundance and bears regularly. Softening starts at the time of maturity and after proper drying it is very sweet in taste (*RHRSS, Tabo*).
- Postharvest quality and shelf-life of fruits were studied by pre-harvest sprays of calcium nitrate and calcium chloride (1%) after 60 days from full bloom followed by fungicide spray (0.3%) (ziram-27% SC and Captan-50% WP) individually before 30 days of fruit harvest in Red Delicious apple revealed high firmness in fruits sprayed with calcium chloride. Physiological loss in weight (PLW) and soluble solids concentration increased and firmness decreased continuously during storage. Less PLW and high firmness was observed in calcium chloride than calcium nitrate sprayed fruits during shelf life of 42 days, irrespective of fungicide. Whereas fungicide (0.3%) spray of Captan-50 per cent WP was found to maintained better quality characteristics of fruits than ziram-27 per cent SC (*RHR&TS, Mashobra*).
- A technology has been standardized for the production of high antioxidant beverages like appetizer (40% juice and 40°B TSS and 1.2% acidity) and syrup (25% juice and 70°B TSS and 1.80% acidity) and jelly (50% juice and 45% sugar) from mulberry (*FST, Nauni*).
- The treatment of banana with 300 ppm ethephon for 48 hours was the best for ripening. Use of ripe fruits (apple/banana) in an air tight container was most effective for faster ripening, although the use of *Adhatoda vasica* leaves, ethephon dips @ 250 ppm and 100 ppm C_2H_4 for 24 hours also resulted in ripening of 100 per cent fruits by the 12th day of application of treatments (*FST, Nauni*).
- A combination of 10 per cent water and cooking time of 5 minutes has been standardized for pumpkin pulp extraction on the basis of chemical characteristics and sensory attributes. For standardization of pumpkin RTS beverage recipe, combination of 15 per cent pumpkin pulp, 13°B TSS and 0.3 per cent acidity was selected on the basis of sensory evaluation (*FST, Nauni*).

Ginger-mint flavoured pumpkin RTS beverage

- A combination of 70 per cent bittergourd juice + 30 per cent aonla juice (B_{70}: A_{30}) with 30 per cent fruit part and 45°B TSS has been standardized for the preparation of bittergourd aonla squash (*FST, Nauni*).



Sensory attributes of bittergourd squash (B_{100}:AO) and bittergourd:aonla blended squash (B_{70}:A_{30})

- Paper punnets as well as polypropylene bags (PP 1500 gauge), with 12 g moisture absorber has been recommended for shelf life extension of mushroom for 3 days at ambient conditions (22±2°C) and 7 days at refrigerated conditions (4±2°C) (*FST, Nauni*).
- Pre-treatment of blanching (0.05% with KMS + 0.1% Citric acid +125 ppm EDTA) for 10 minutes and then drying under mechanical dehydrator at 55±2°C to a moisture content of 10.88 per cent has been standardized for development of mushroom powder (*FST, Nauni*).
- Ginger flavoured RTS beverage; 13 per cent pulp + 2 per cent mint extract for mint flavoured RTS beverage and 10 per cent pulp + 2 per cent ginger + 3 per cent mint extract for ginger-mint flavoured RTS beverage were selected on the basis of sensory evaluation for flavoured RTS beverage from pumpkin (*FST, Nauni*).
- Ginger slicing has been optimized for its faster drying and ginger pulp recipe has also been optimized by slicing ginger and cooking for 1 hour under pressure (15 lbs) with 30 per cent water (*FST, Nauni*).
- Dried appetized ginger flakes recipe has been optimized by peeling fresh rhizomes and slicing them into 3-4 x 0.4 x 0.4 cm^3 size followed by blanching (1.0% citric acid or 1.0% lime juice) and dipping in 70 per cent sugar syrup for 4 hours, drying in a mechanical dehydrator (55 ± 2°C) upto moisture content of 11.95 to 12.04 per cent and rolling in 2.0 per cent appetizing mixture (*FST, Nauni*).

Lime juice blanching, 70% sugar syrup, 4 hours dip, 2.0% appetizing mixture

Citric acid blanching, 70% sugar syrup, 4 hours dip, 2.0% appetizing mixture

Osmotically dehydrated appetized ginger flakes

- Pectin extraction from apple pomace has been standardized by following ecofriendly methods either chemical citric acid at pH 2.5 or by enzyme cellulase @ 12µg/g with yield of 26.92 and 20.50 per cent, respectively (*FST, Nauni*).

Pilot plant for pectin extraction

- Amylase producing bacterial colonies isolated from hot water springs of Himachal Pradesh and spent mushroom compost have shown amylase production on apple pomace in various concentrations (*FST, Nauni*).

Isolation of bacterial strains from water samples on nutrient agar

- Six early cauliflower varieties (DC-476, DC-401, DC-23, P Meghna, DC-310-22 and DC-309) and six hybrids (DCH-9325, DCH-1001, DCH-903, DCH-1009, DCH-924 and DCH-1076) were evaluated for three years (2013-2015) in summer season. Among varieties, DC-401 recorded net curd weight of 410.20 g and per hectare yield of 200.07 q followed by DC-310-22 with a net curd weight of 295.28 g and per hectare yield of 196.40 q. Out of hybrids, DCH-903 recorded net curd weight of 617.35 g yield of 320.50 q/ha followed by DCH-924 which exhibited 540.62 g of a curd with an yield potential of 290.45 q/ha (*VS, Nauni*).

Varietal evaluation of different vegetable crops

Tomato

Capsicum

French Bean IET

French Bean AVT-1

- Of the six cabbage hybrids evaluated under IET-1 programme during 2015, hybrid entry 2015/CABHYB-1 observed highest yield (232.05/ha) while lowest yield was exhibited by 2015CABHYB-4 (185.47 q/ha) vis-a-vis standard (KGMR-1) which recorded 206.08 q of marketable cabbage heads per hectare (*VS, Nauni*).
- Capsicum hybrid 'New Cosmos' was tested for yield and other characters. The average fruit yield was 221.9 q/ha with average fruit weight of 61.7 g and 14.8 average number of fruits per plant. Fruits were almost round in shape and plant height was 57.1 cm (*RHR&TS, Bajaura*).
- Amongst the various hybrids of broccoli evaluated during winter season, hybrid 2015/BROHYB-4 performed well for majority of curd characters and gave maximum yield per hectare (302.90 q) over other hybrids (*VS, Nauni*).
- For introgression of useful genes in cucumber for yield and disease resistance, breeding programme has been initiated under the project "Breaking yield barriers in cucumber through introgression of useful genes from un-adapted landraces and wild relatives". Accordingly, the crosses among local landraces, exotic and wild parental lines have been attempted and evaluated under open and polyhouse conditions. The inheritance studies with reference to earliness and disease resistance are being verified by employing molecular markers such as RAPD, ISSR and SSR (*VS, Nauni*).

Flowering and fruit setting in selected crosses of cucumber under protected condition

Performance of selected crosses under protected conditions

Performance of selected crosses under open field conditions

- Evaluated five genotypes of temperate carrots procured from different exotic and indigenous sources. Genotype Sol-Ct-3 produced longest orange coloured roots of 17.97 cm with net root weight of 151.83 g and average marketable root yield of 172.97 q/ha (*VS, Nauni*).
- Initial varietal evaluation of nine genotypes including two checks of early pea showed that the entry 2015/PEVAR-6 was highest yielder (117.91 q/ha) closely followed by 2015/PEVAR-4 which yielded 110.00 q/ha. of pea pods, advance varietal evaluation trial-1 on early pea depicted 2014/PEVAR7 as the highest yielder of 111.25 q/ha closely followed by 2014/PEVAR5 with an yield outlay of 101.25 q/ha (*VS, Nauni*).
- Of the five mustard genotypes evaluated under advanced varietal testing programme, the genotype 2014/MGVAR-3 recorded highest yield (566.62 q/ha) followed by at par yield potential by 2014/MGVAR-4(511.43 q/ha) vis-à-vis a check variety Pusa Sag which yielded 428.24q of mustard leaves per hectare (*VS, Nauni*).
- The mean performance of French bean (bush type) genotypes evaluated under initial evaluation trial showed that entry 2014/FBBVAR-2 recorded highest yield of 145.34 q/ha, which was at par with one of the check i.e. Arka Suvidha (131.60 q) but significantly out yielded the other check variety; Swarna Priya (108.89 q) as well as rest of the entries. Advanced varietal evaluation of another set of six genotypes showed that 2013/FBBVAR-5 recorded highest yield of 168.48 q/ha, which was at par with one of the check i.e. Arka Anup (138.27 q) but significantly out yielded the other check variety; Arka Suvidha (123.02 q) as well as rest of the entries (*VS, Nauni*).
- Of the 36 genotypes of garlic evaluated for three years (2013-15), the genotypes namely SG-30, LC-1 and LC-3 were found to be promising with per hectare yield of 173.50, 169.20 and 155.75 q, respectively (*VS, Nauni*).
- One hundred and eighty three ginger collections were evaluated for rhizome yield and other horticultural traits. The yield range varied from 99.21 q/ha (SG-865) to 134.99 q/ha (SG-1134).

Yield of five lines viz., SG-1134 (134.99), SG-247 (133.43), SG-1083 (132.44), SG BDJR 1088 (132.19 and SG-857 (131.20 q/ha) excelled the check Himgiri which yielded 120.66 q/ha. The rhizome rot disease incidence varied from 10.95-23.65 per cent with 10.95 and 15.79 per cent in SG-857 and Himgiri, respectively (*VS, Nauni*).

- In Ginger, local genotype SG-26-04 (Giriganga) recorded maximum yield (180.20 q/ha) followed by another local check variety Himgiri (120.66 q/ha) whereas, national check variety Varada yielded 83.63 q/ha. The rhizome rot disease incidence varied from 9.47-23.78 per cent with minimum in SG-26-04 (Giriganga) (*VS, Nauni*).
- Fifty five best performing genotypes were analyzed for their quality parameters. The dry matter content (%) and crude fibre (%) ranged between 15.33 (Acc 578) to 24.31 (SG-247) and 3.90 (Ranchi Local) to 5.62 (Himgiri), respectively. Essential oil (%) and oleoresin contents (%) varied from 0.72 (Varada) to 1.67 (SG-857) and 3.18 (SG-1124) to 4.73 (SG-908), respectively. The high yielding genotype SG-26-04 (Giriganga) was found superior/comparable for dry matter content, essential oil, oleoresin and crude fibre contents to the check Himgiri (*VS, Nauni*).
- In turmeric, the dry matter content (%) and curcumin (%) ranged between 15.52 per cent (Zeera) to 24.76 per cent (BDJR-1144) and 1.53 per cent (ST-315) to 6.30 per cent (PCT-14), respectively. The high yielding genotype ST-907 was found superior/comparable for dry matter content and curcumin (%) to the checks Palam Lalima and Palam Pitamber (*VS, Nauni*).
- One hundred and thirty three turmeric collections were evaluated for rhizome yield and other horticultural traits. The yield range varied from 180.07 q/ha (BDJR-1292) to 411.98 q/ha (ST-907). Yield of three lines viz., ST-907 (411.98 q/ha) ST-12M (376.76 q/ha) and PCT-53 (372.07 q/ha) excelled the checks Palam Lalima and Palam Pitamber which yielded 331.75 and 367.04 q/ha, respectively. The curcumin content varied from 1.53-6.30 per cent with 6.30 per cent in PCT-14 whereas, 3.57 and 2.98 per cent in Palam Lalima and Palam Pitamber, respectively (*VS, Nauni*).
- The conjoint use of 75 per cent recommended doses of nitrogen and phosphorus + vermicompost and enriched compost @ 2.5 t/ha + PGPR resulted in significantly maximum gross head weight (1580 g), net head weight (1050 g), harvest index (66.45 %) and head yield (530.34 q/ha). This treatment recorded 34.4 per cent increase in yield over recommended practice of fertilization of cabbage in the State, along with highest net returns (Rs.3,89,992/- per hectare) besides increase in quality parameters (protein and ascorbic acid) and post harvest availability of primary nutrient (NPK) in the soil. The above INM module resulted in saving of 25 per cent chemical fertilizers (NP), better growth, higher yield and net returns besides enhanced soil health (*VS, Nauni*).
- Under integrated nutrient management system (INMS), an application of 75 per cent RDF + biofertilizers (Azotobacter and AM) was found superior among all other treatments for number of bulbs per plot, average weight of bulbs and bulb yield per plot and per hectare. Maximum net returns and B:C ratio was obtained by application of 75 per cent RDF + biofertilizers (*VS, Nauni*).
- To diversify existing vegetable culture, four exotic vegetable crops viz., Gherkin, Lettuce, Swiss Chard and Brussel Sprout have been introduced for standardizations of their cultural practices. In Gherkin (pickling cucumber), summer and rainy season open field crops realized an yield potential of 60-80 and 100-110 q/ha, respectively, while a 500 sq yards poly house planted during beginning of March, 2015 produced 3.43 q of gherkins fruits of 15-20 g each. A head lettuce genotype has registered compact medium sized head @ 150-200 q/ha from mid September planting. Swiss chard has good growth and rejuvenation capacity under poly house vis-a vis open field conditions (*VS, Nauni*).

Gherkin 'Pickling Cucumber"

Head Lettuce

Swiss Chard

- Highest seed yield per hectare of late cauliflower Pusa Snowball K-1 was obtained when the crop was transplanted on 15th October at a spacing of 60 x 30 cm followed by 1st October planted crop spaced at 60 x3 0 cm (*VS, Nauni*).
- Maximum seed yield of carrot cv. Solan Rachana was recorded when stekling were spaced at 30 x 30 cm (6. 85 q/ ha) followed by 45 x 15 cm (5.90 q/ha) (*VS, Nauni*).
- In an integrated weed management study in seed crop of capsicum, the module; mulching with black polythene followed by stale seed bed by glyphosate @ 1.00 kg a.i./ha + one hand weeding at 40 DAT performed best for most of the fruit and seed yield traits. whereas, the former recorded highest seed yield, the later proved outstanding for seed germination and seed vigour traits (*VS, Nauni*).
- An investigation of effect of different oil coating of pea seed on ovi-positioning of pulse beetle concluded that significantly minimum number of eggs (5.89 eggs/5 females) were laid by 5 pairs of *C. chinensis* in neem oil coated seeds followed by Karanj (8.78 eggs/5 female) while Castor (21.22/5 females) and mustard oil (25.67/5 females) were less effective in preventing oviposition. Minimum oviposition recorded in pea seeds treated with neem (2.67 eggs/5 females) at 3 per cent was statistically at par with its 1 per cent concentration but superior to 0.5 per cent content, whereas, karanj was significantly effective at 3 per cent concentration resulting in 3.33 eggs/5 females. As far the effect of these oil on development of *C. chinensis* progeny on treated pea seeds after 60 days of treatment was concerned, the minimum number of adult emergence (1.87 beetles) was recorded in neem oil coated seeds, which was statistically at par with karanj (2.44 beetle) but differed statistically with castor (6.59 beetles). Neem at 0.5 per cent concentrations and castor at 3 per cent were able to restrict progeny production to 3 beetles and karanj at 1 per cent and mustard at 3 per cent produced equal number of beetles (2.67). It is further extrapolated that the minimum seed damage was in neem oil (0.34%) followed by karanj (0.40%) and castor (1.37). Finally, significantly maximum seed germination (82.56%) and seed vigor index (12077.06) was recorded with seed treated with neem oil followed by karanj oil (80.11% and 11171.21, respectively). Seed treated with olive oil resulted in minimum seed germination of 76 per cent and seed vigor index of 7096.88 (*VS, Nauni*).

Integrated management of vector borne virus diseases of chilli

- The powdery mildew resistance evaluation studies revealed moderate resistance reaction in the pea germplasm entries 2011/PMPM 4 (12.6%), 2011/PMPM 1 (14.6%) and 2011/PMPM-3 (18.8%). The entry 2011/PMPM-3 also recorded the highest yield of 125.0 q/ha beside exhibiting the moderate resistance reaction (*VS, Nauni*).
- Advanced varietal testing of six tomato indeterminate type genotypes including one check was undertaken. Amongst all, genotype 2012/TOINDVAR-4 recorded maximum yield (548.14 q/ha) followed by 2012/TOINDVAR-1 (503.70 q/ha) while the check variety – Arka Vikas exhibited an yield potential of 342.96 q/ha of tomato fruits (*VS, Nauni*).
- Advanced varietal evaluation of six indeterminate tomato hybrids exhibited hybrid entry 2012/TOINDHYB-4 recording maximum yield (533.33 q/ha) followed by 2012/TOINDHYB-2 (527.40 q/ha) vis-a-vis check variety - Arka Vikas observing an yield of 377.03 q/ha (*VS, Nauni*).
- Evaluation of twenty seven different genotypes of bell pepper including California Wonder and Solan Bharpur for three years (2013-2015) was undertaken on the basis of their horticultural attributes. Amongst them, the genotypes UHFBP-14, Kt-1 and UHFBP-10 were found promising for yield and yield contributing characters with an yield outlay of 320.20, 308.00 and 293.00 q/ha, respectively (*VS, Nauni*).
- Under the advanced varietal evaluation programme, five capsicum hybrids including one check were evaluated. Amongst all, hybrid Pusa Deepti recorded maximum yield (176.66 q/ha) followed by 2013/CAPHYB-3 which registered 96.66 q/ha of bell pepper fruits) vis-a-vis Nishat-1 (Check) which yielded only @ 80.00 q/ha (*VS, Nauni*).
- Spray of difenthiuron 50 WP @ 1 g/litre was found effective in controlling major insect- pests of cabbage seed crop and providing higher yield i.e., 245.44 q/ha with a benefit:cost ratio of 1.64:1 in mid hill conditions (*SS&T, Nauni*).
- Mature fruits of tomato showing typical symptoms of bacterial canker were collected, seed were extracted and divided in to two lots. One lot was surface sterilized with mercuric chloride and another lot was not sterilized. The detection of pathogen from the seed lots was done by agar plate method. Observations on bacterial colonies appeared on the medium were recorded after incubation. Number of colonies under untreated seeds was observed 200 times more as compared to sterilized ones. The bacterium was identified as *Clavibacter michiganensiss* sp. *michiganensis*. The present experiment indicated that the pathogen is externally seed borne in nature (*SS&T, Nauni*).
- Seed germination was highest (60.33%) in the treatment where tomato seed were inoculated with *Pseudomonas flourescens* PfS-1 only, followed by *Bacilus subtilis* BsS-1 (57.04%). The lowest seed germination (46.55%) was found in the treatment where seeds were inoculated with the pathogen alone. In the treatment where seeds were inoculated both with biocontrol agent, *Pseudomonas flourescens* PfS-1 + pathogen (*C. michiganensiss* sp. *michiganensis*) the germination was observed to be 57.04 per cent which was significantly higher as compared to the treatment with pathogen alone and other treatments. The disease symptoms could not appear till 30 days of inoculation under this treatment whereas in the pathogen inoculated seedlings symptoms appeared after 21 days of inoculation. The *Pseudomonas flourescens* PfS-1 was found effective biocontrol agent for seed inoculation against bacterial canker of tomato (*SS&T, Nauni*).
- Sterilized sand was inoculated with sclerotia of white rot pathogen, *Sclerotium cepivorum*

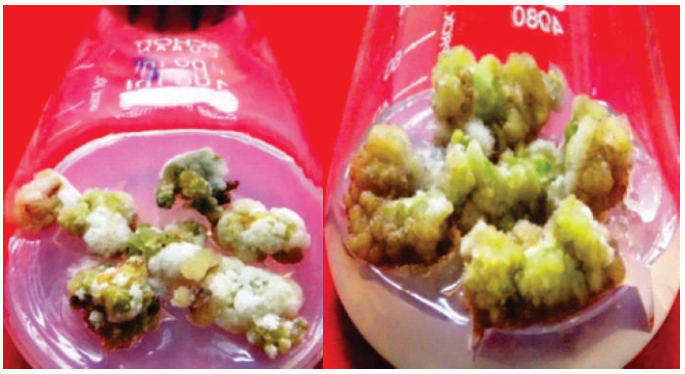
isolated from infected bulbs of garlic. Germinated healthy cloves were sown in the inoculated sand. Typical disease symptoms appeared within three weeks of inoculation. The un-inoculated (control) plants did not show such symptoms. The pathogen was re-isolated from newly infected plants on PDA, the colonies were white, mycelium was hyaline, branched and septate. Small black coloured sclerotia appeared on sides of the Petri plates after few days (*SS&T, Nauni*).

- In okra cv. P-8 while standardizing duration of hydropriming of seed, 54 hours duration was found best based on the observations on per cent increase in weight, germination percentage, seedling length, seedling dry weight and seed vigour index-I and II of hydroprimed seeds as compared to other durations tested (*SS&T, Nauni*).
- In okra cv. P-8, a treatment combination comprising of silver-black mulch, double row (75+45) x 20 cm spacing and triangle method of planting was found statistically superior in terms of plant growth characters, fruit yield parameters, seed yield characters, seed quality characters and benefit:cost ratio in comparison to other treatment combinations (*SS&T, Nauni*).
- In bell pepper cv. California Wonder plasma treatment of seed alone as well as in combination with osmopriming up to 6 minutes plasma exposure was found superior over other treatments in terms of growth characters, fruit yield characters, seed yield characters. Osmoprimed seeds exposed to 6 minutes plasma were found to be the best treatment for most of the traits like days to 50 per cent flowering (45.33 days), fruit yield per plant (1.00 kg), ripe fruit yield per plant (830.35 g) and seed yield per plant (10.74 g) amongst all other treatment combination (*SS&T, Nauni*).

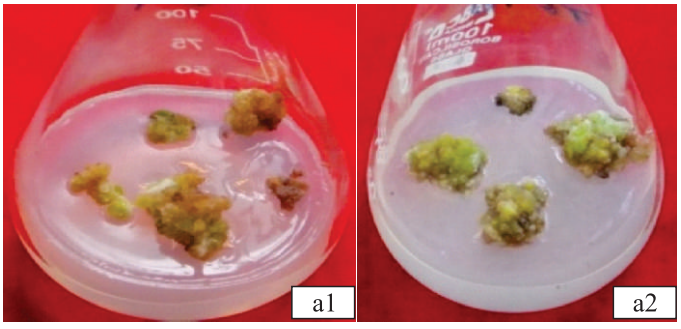
Untreated bell pepper seeds 6 minutes plasma treated seed

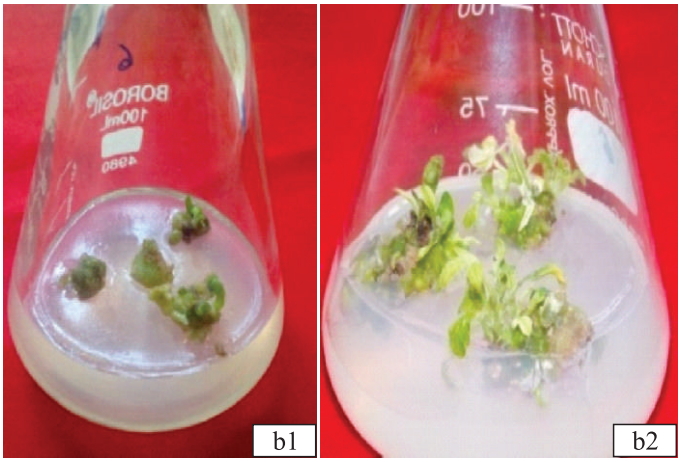
Effect of plasma seed treatment on seedling vigour in bell pepper

- Experiment on retaining fruits on the vines of cucumber for seed revealed that retaining all the fruits on the vine till full maturity produced maximum seed yield (27.67/plant, 147.62 g/ha) of cucumber cv. K-90 (*HR&TS, Kandaghat*).
- In tomato maximum yield (710 q/ha) was obtained with application of Borax (25 kg/ha) + lime (10 kg/ha) + foliar spray of boric acid at fruit set stage (3.5 g/l) + $CaCl_2$ (5 g/l). B:C ratio of 1.78, 1.76 and 1.67 was achieved as compared to 1.62 in farmer's practice (*HR&TS, Kandaghat*).
- *In vitro* cell selection in tomato (*Solanum lycopersicum* L.) against buckeye rot (*Phytophthora nicotianae* var. *parasitica* (Dastur) Waterhouse) was carried out (*BT, Nauni*).



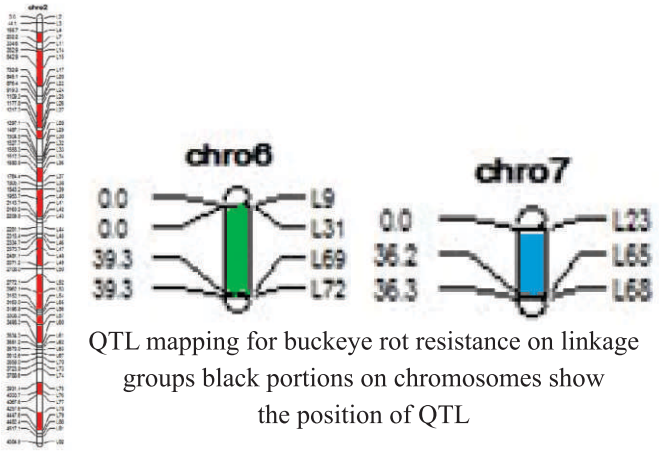
In vitro callus induction on basal medium supplemented with 3.00 mg/l NAA+ 1 mg/l BAP





Shoot regeneration from (a) selected calli and (b) normal calli *In vitro* cell selection in tomato against buckeye rot

- Identification of molecular markers for buckeye rot (*Phytophthora nicotianae* Breda de Hann. var. *parasitica* (Dastur) Waterhouse) resistance in tomato (*Solanum lycopersicum* L.) was carried out. EST-SSRs along with ISSRs and genomic SSRs 25 each were used to conduct genetic diversity studied among 32 tomato genotypes revealing polymorphism of 96.77, 95.36 and 97.36 per cent, respectively. (*BT, Nauni*).



QTL mapping for buckeye rot resistance on linkage groups black portions on chromosomes show the position of QTL

- The evaluation of chemical and non chemicals under field conditions revealed that amongst all the treatments, the treatment combination consisting of soil application of *Trichoderma harzianum* @ 2.5 kg/50 kg FYM/ha in combination with black polythene mulching and four periodical sprays of zineb @ 0.2 per cent at 10 days interval proved most efficacious in limiting the Alternaria leaf spot disease and provided the highest cabbage head yield (370.2 q/ha) (*VS, Nauni*).
- Genic male sterility is being incorporated from chilli line DKC-12 (MS-12) into bell pepper cv. California Wonder (CW) and HC-201. The progenies of BC_5F_2 populations were re-grown in 2015 to isolate male sterile plants (rr). But none of the plants was found to be male sterile in any of the progenies. Hence, the crossing with the respective parents was not done (*RHR&TS, Dhaulakuan*).
- Two cytoplasmic male sterile chilli lines viz., CMS-A and A-7 (originally from IIHR) were introduced from IIVR, Varanasi. These lines were crossed with 10 bell pepper cultivars separately in 2006. The crosses viz., A-7 x No. 12, A-7 x No. 28, A-7 x CW (P-2), A-7 x HC-201, CMS-A x CW (P-3), CMS-A x CW (P-2) and CMS-A x No.12 produced male sterile F_1s in 2007. In such a way, the male sterile progeny (100%) is back crossed with the donor parent in each advanced population. The F_1s were crossed with the respective male parents, identified as maintainer lines (Nmsms). The BC_6 generation would be repeated in 2016, as the seed setting failed in all the crosses. There seems to be the evolution of female sterility under low temperature conditions (*RHR&TS, Dhaulakuan*).
- Two genetically male sterile lines of chilli, carrying *msms* gene, named DKC-12 (MS-12) and DKC-2363 along with four lines of bell pepper, carrying *Nmsms* gene, are being maintained by practicing selfing (*RHR&TS, Dhaulakuan*).

No. 12 CWP -3 CWP-2

No. 28

DKC – 2363

Maintainer lines carrying *Nmsms* gene

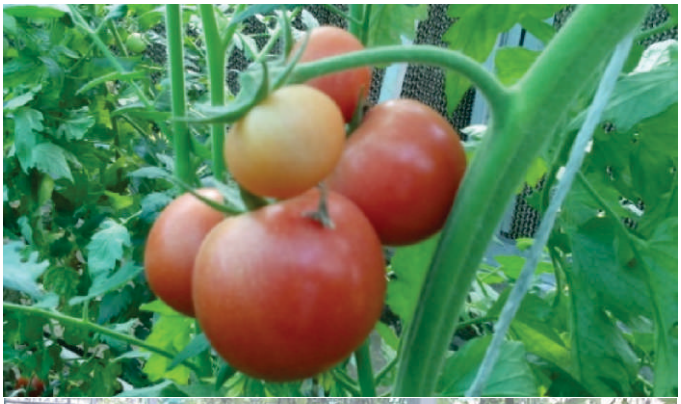
- UHF-CUC-HYD-3 - new cucumber hybrid has been developed and being tested in AICRP on vegetable crops at national level. It is an early fruit bearing cross combination, mature in about 60 days to first fruit harvest after sowing. It bears about 10-12 fruits per plant. Fruits are juicy and green to dark green in colour having 20-22 cm length, 4.8-5.5 cm breadth with average fruit weight of 350 g. Average fruit yield per plot and per hectare is 44.8 kg and 373 q/ha, respectively. (*VS, Nauni*).

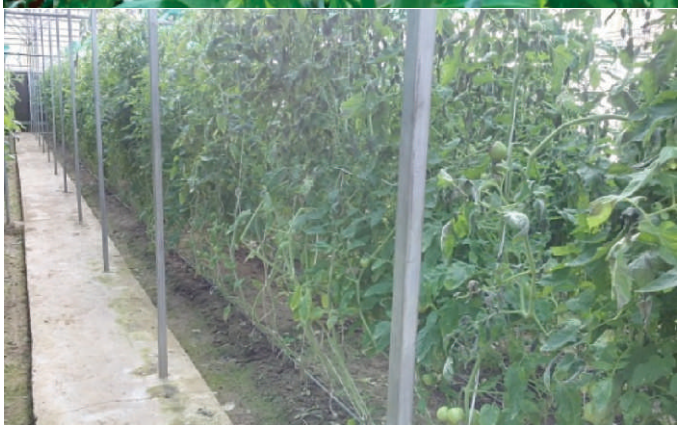
Cucumber hybrid

- The hybrid tomato UHF-13 gave higher yield (457.4 q/ha) as compared to the standard check variety Naveen 2000 Plus (409.2 q/ha) when transplanted during last week of April (*RHR&TS, Jachh*).
- In okra, in an experiment during summer season, the hybrid variety Chetna gave higher pod yield (107.3 q/ha) and performed similar to the standard check variety P-8 which gave yield of 106.1 q/ha. During rainy season, okra hybrid Komal performed well and gave higher pod yield (107.9 q/ha) (*RHR&TS, Jachh*).
- Cauliflower variety "Winter Baby" gave higher yield (290.3 q/ha) as compared to Megha (280.8 q/ha) when planted during the last week of October (*RHR&TS, Jachh*).
- Radish variety "All Round" gave higher yield of quality roots (302.2 q/ha) as compared to the standard check variety "Japanese White" (266.6 q/ha) during winter season (*RHR&TS, Jachh*).
- Four varieties of Gherkin viz., "Ajjex", "Omaxe Gherkin", "Chandini RZ" and "12-705 RZ" and three varieties of cherry tomato viz., "Solan Red Round", "Red Beauty" and "Tuptim Racha" have been procured from various parts of the country to evaluate their performance under polyhouse and shade net house conditions in zone-I of HP (*RHR&TS, Jachh*).

Gherkin crop in shade net house

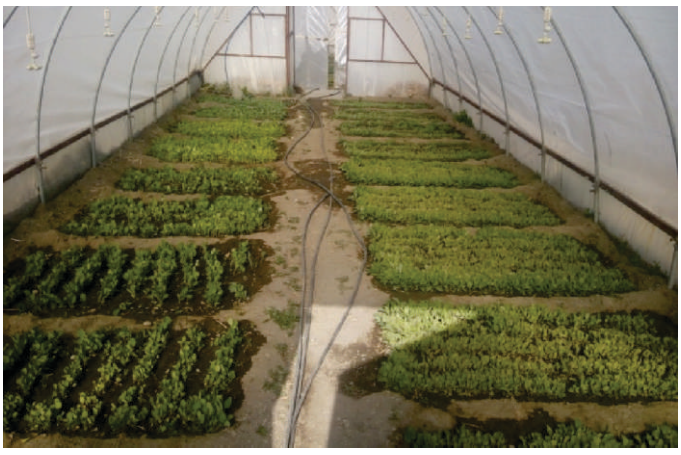
- Tomato (Naveen 2000 Plus and US 2853) and French bean (Falguni) were grown under polyhouse conditions during September-February months by giving soil treatments viz. fumigation with formalin + *Trichoderma harzianum*, soil solarization + *Trichoderma harzianum*, Hydrogen Peroxide + *Trichoderma harzianum* in the already constructed structures with sick soil due to perpetuation of the pathogens by continuous growing of the same crops consecutively over the years. On the one year study basis it was found that formalin + *Trichoderma harzianum* treatment was found best in tomato and French bean crops (*RHR&TS, Jachh*).





Hybrid tomato US-2853 grown inside polyhouse after treating soil with Formaline + *Trichoderma harzianum*

- Vegetable nursery of different vegetables viz., cole crops, solanaceous crops and exotic vegetables was grown in polytunnels at experimental farm of RHRSS Tabo. Total seventeen types of vegetables were grown for field demonstration. Out of these seventeen vegetables, ten vegetables viz. Summer squash, French Bean, Spinach, Tomato, Brinjal, Celery, Capsicum, Parsley, Knol Khol and Brussel Sprouts were grown both under open and protected conditions (*RHRSS, Tabo*).



Field demonstration

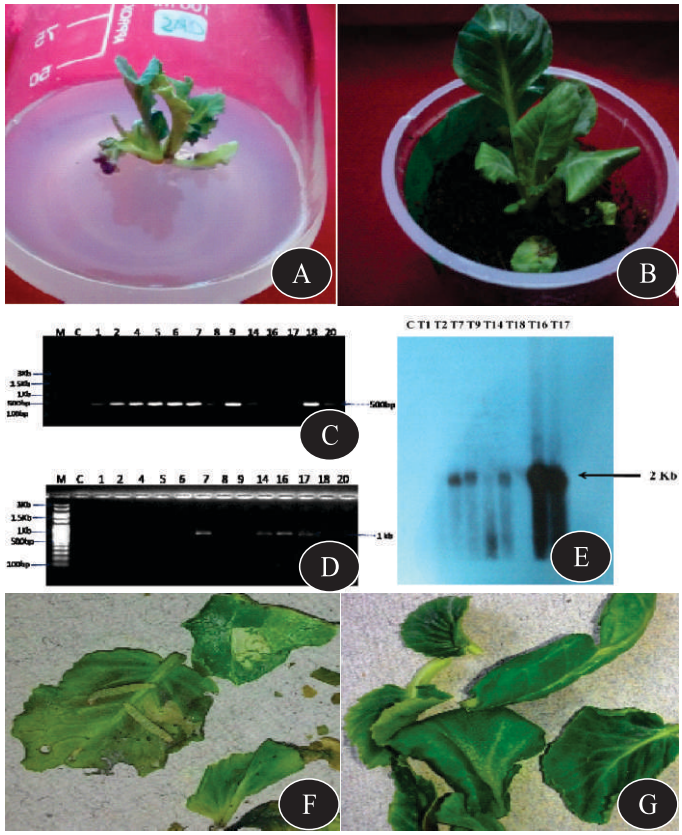
- Effect of different seed rate and row spacing on green pod production of pea in cold desert region revealed that with the increase in seed rate there was increase in green pea pod production. However, green pea pod production increased with increase in line spacing up to certain extent and thereafter decreased. The highest green pea pod production of 117 q/ha was recorded at seed rate of 150 kg/ha with line spacing of 30 cm in Lincon variety (*RHRSS, Tabo*).

- Effect of growing media and fertigation on capsicum production under naturally ventilated polyhouse in cold desert region depicted that there was significant individual effect of growing media and fertigation levels on parameters like harvest duration, plant height, number of fruits per plant, fruit yield per plant, fruit yield per m^2 and fruit yield per hectare. Interaction effect was found significant for harvest duration and number of fruits per plant. Soil less growing media comprising of vermi compost:sand (2:1)

and highest level of fertigation 250 kg/ha recorded the maximum value for harvest duration, plant height, number of fruits per plant, fruit yield per plant, fruit yield per m^2 and fruit yield per ha. Same treatment combination in interaction also recorded the maximum value for harvest duration (52.00 days) and number of fruits per plant (14.94) (*RHRSS, Tabo*).

- The performance of three tomato hybrids in open field condition was studied and significant differences among varieties were found on parameters like days to marketable maturity, harvest duration, fruit length, pericarp thickness, number of fruits per plant, fruit yield per plant, fruit yield per hectare and total soluble solids. Out of three tomato hybrids, Shivalik recorded maximum value for harvest duration (52.11 days), fruit length (50.64 mm), pericarp thickness (7.44 mm), number of fruits per plant (34.20), fruit yield per plant (2.25 kg) and fruit yield per ha (84.06 MT). Solan Lalima recorded the highest value for TSS (5.07^{0}B) and found earliest to reach the marketable maturity (97.75 days) (*RHRSS, Tabo*).

- Protocol for insect resistance gene (*cryIAa*) transfer in cauliflower (*Brassica oleracea* L. var. *botrytis* cv. Pusa Snowball K1) using *Agrobacterium tumefaciens* strain containing *npt-II* and *cryIAa* genes in binary vector pBin-1Aa was standardized. The expression of the transgene (*cryIAa*) in cauliflower at transcriptional level was confirmed by reverse transcriptase-PCR and Real Time-PCR and at translational level by bioassay (*BT, Nauni*).



- A) Regenerated transgenic shoots of cauliflower (*Brassica oleracea* L. var. *botrytis* cv. Pusa Snowball K1). B) Acclimatization of *in vitro* regenerated transgenic plantlets of cauliflower cv. Pusa Snowball K1 after three weeks. C) PCR analysis showing amplification of 1Kb DNA fragment of *cryIAa* gene in regenerated transgenic plantlets of cauliflower. D) RT-PCR analysis showing amplification of 1Kb DNA fragment of *cryIAa* gene in regenerated transgenic plantlets of cauliflower (*Brassica oleracea* L. var. *botrytis* cv. Pusa Snowball K1). E) Southern hybridization of *cryIAa* gene in

regenerated transgenic plantlets of cauliflower. F) *In vitro* bioassay of non-transgenic (control), live larvae of diamondback moth (DBM) on damaged non-transformed (control) leaves after 72 hours. G) *In vitro* bioassay of transgenic cabbage, dead larvae of diamondback moth (DBM) on damaged transformed leaves after 72 hours

- Protocol for insect resistance gene (*cryIAa*) transfer in broccoli (*Brassica oleracea* L. var. *italica* cv. Solan green head) using *Agrobacterium tumefaciens* strain containing *npt-II* and *cryIAa* genes in binary vector pBin-1Aa was standardized. The presence/integration of transgene (*cryIAa*) into the genome of broccoli was confirmed by PCR using gene specific primers and Southern blot analysis using DIG non radiolabelled DNA probe (*BT, Nauni*).
- Total RNA was isolated from cotyledons of developing seeds (40 DAF) of *Phaseolus vulgaris* L. (Baspa) cultivar. Messenger RNA was purified, cDNA was synthesized and amplified using designed primers for Bowman- Birk trypsin inhibitor gene and cloned. After electrophoresis eluted product gave a band of approximately 370 bp (*BT, Nauni*).
- Existing germplasm of ornamental bulbs being maintained and multiplied for further research work and sale purpose, besides this new species/cultivars of Nerine, Iris, Gloriosa, Lycoris etc. have been procured during the year exhibited the performance of different species/cultivars of ornamental bulbs during the year 2015-16 (*FLS, Nauni*).
- Maximum per cent survival (90.00), average number of roots (18.67), average length of roots (15.33 cm) and fresh weight (20.70 g) were recorded when the cuttings of *Aglaonema* x *modestum* were treated with 1000 ppm NAA (*FLS, Nauni*).
- *Fuchsia hybrida* cuttings treated with 2000 ppm IBA produced the plants with maximum survival 76.67 per cent, average number of roots 15.67, average length of roots 13.50 cm and fresh weight 17.14 g (*FLS, Nauni*).
- In *Jacobinia carnea,* the treatment containing 2000 ppm IBA produced significantly higher survival 76.67 per cent, average number of roots 17.00, average length of roots 15.50 cm and fresh weight 21.79g compared to other auxin treatments (*FLS, Nauni*).

Fuchsia

Jacobinia carnea

Schefflera arboricola

Pelargonoium hortorum

Promising pot plants

- *Pelargonium* x *hortorum* cuttings treated with 1000 ppm NAA gave maximum per cent survival (86.67), average number of roots (14.33), average length of roots (27.17 cm) and fresh weight (23.01 g), whereas the treatment consisting of 500 ppm NAA produced 11.67 roots/cutting which is at par with 1000 ppm NAA. Minimum per cent survival (33.33), average number of roots (3.33), average length of roots (5.50 cm) and fresh weight (2.73 g) were recorded in control (*FLS, Nauni*).
- Per cent sprouting of different cultivars of rose was observed to be maximum in cultivar Golden After Noon followed by Dunika and minimum in cultivar Brown Will Will (*RH&FRS, Bhota*).
- *Schefflera arboricola* per cent survival (80.00), average number of roots (17.00), average length of roots (12.17 cm) and fresh weight (11.13 g) were maximum when the cutting were quick dipped in 4000 ppm IBA. While the treatment containing 2000 ppm IBA was at par with 4000 ppm IBA for the parameter of average length of

roots. Minimum per cent survival (30.00), average number of roots (4.00), average length of roots (5.67 cm) and fresh weight (1.85 g) were observed under control (*FLS, Nauni*).

- A 50 per cent combination mixture of perlite and vermiculite was found optimum for getting good rooting percentage in both Fuchsia and Pelargoniums when cuttings were raised in these media in 1st week of June (*RHR&TS, Mashobra*).
- Eight cultivars of Lilium namely, Pavia, Navona, Tresor, Vermeer, Brunello, Ercalano, Courier, Bright Diamond were evaluated for flower production as second year crop under open conditions without shade. The bulbs were not uprooted and allowed to remain under soil for over wintering. The production of flowers started on 15th May. cv. Ercalano was earliest to flower, however, there were no significant differences among the cultivars with respect to date of flowering. Cultivar Ercalano produced longest stems (111.2 cm) followed by Pavia, Tresor, Bright Diamond and Courior. Cultivar Navona produced shortest stems of 59 cm height only. The number of flower buds per stem were highest in Ercalano (7.6) and lowest in Vermeer (3.4). The percentage of high quality saleable cut flowers was also highest in cultivar Ercalano (80) and lowest in cv. Navona (20). The length of the lowest flower bud was highest in cv. Tresor and Ercalano (8.54 cm) and smallest buds were in cv. Navona (5.3 cm). The strongest stems were produced in cv. Ercalano, Pavia and Navona without any bending when held horizontally from distal end, whereas, cv. Vermeer and Bright diamond produced weakest stems with 30 degree bending. The stem diameter at 15 cm height from the surface of soil was highest in cultivar Ercalano (1.72 cm) and lowest in cultivar bright Diamond (0.84 cm) (*RHR&TS, Bajaura*).
- There is a collection of 35 varieties of daffodils and narcissus, out of these cultivars, cv. Carlton, Falconet, Obdam, Ice King, Replete, Yellow Cheerfulness, Pueblo, Tahiti, Fortisimmo, Dick Wilden, Geranium, Blues, Earli cheer, Cassata, White Lion produced flowers during 2015-2016 (*RHR&TS, Bajaura*).

Narcissus cultivars

- Optimum temperature for germination of cyclamen seeds was found to be 20°C under dark conditions. A compost consisting of sieved mixture of loam, leaf mould, cocopeat and farm yard manure in equal proportions was found most suitable for producing healthy seedlings in plastic plug trays. Cyclamen has taken 9 months to come into bloom under Mashobra conditions (*RHR&TS, Mashobra*).

Cymbidium

Red Hydrangea

Calceolaria

Primula

Ranunculus Bloomingdale Yellow

Tuberous Begonia in bloom

Cyclamen in bloom

Regal Pelargonium

Tulips in bloom

Ornamental Crab apple cv. Red Flesh

Alstroemeria cv. Sel. 14

- New cultivars of China aster viz. `Violet cushion', `Arka kamini', `Arka Aadhya', `Arka Archana', `Arka Poornima', `Arka Shashank', `Phule Ganesh Purple', `Phule Ganesh Violet', `Phule Ganesh Pink' and `Phule Ganesh White' etc. have been introduced. Crosses among the cvs. Poornima. Kamini, Shashank and Violet Cushion were attempted during the year. Seeds was harvested and collected and had been sown. Plants shall be observed for change in the coming season (*FLS, Nauni*).
- China aster cv. `Phule Ganesh' violet were found with maximum plant height (101.3 cm), plant spread (51.19 cm), number of flower (32.23), flower diameter (6.85 cm). Different crosses have been attempted viz., Kamini x Poornima, Kamini x Poornima, Violet cushion x Poornima; Poornima x Semi double (pink), Shashank x Violet cushion; Poornima x Violet cushion; Poornima x Kamini; Poornima x Violet cushion; Poornima x Kamini (semi double); Poornima x Kamini (semi double) and seeds have been collected and planted (*FLS, Nauni*).
- Gladiolus 'UHFSGla 11-10' was found to be the most superior for early flowering, number of florets/spike, number of florets open time, size of floret, corm multiplication and size of the corm (*FLS, Nauni*).
- Studies conducted on staggered planting of carnation revealed that flowering could be regulated successfully through staggered planting. Data elucidates that minimum number of days to flower bud formation (127.83) was observed in 15th January planted crop whereas, number of days to flower bud formation was found maximum in 15th March planted crop (165.94). Similarly, number of days to 1st flowering was observed minimum in 15th January planted crop (154.10) which was found at par with all other planting dates except for 15th October and November planted crop. Maximum number of days to 1st flowering (195.79) was noted in 15th October planted crop which was found at par with 15th November planted crop (181.89) (*FLS, Nauni*).
- Maximum number of cut stems in carnation (36,93,600/ha) were obtained with application of GA_3@ 100 ppm after 1st pinch and when axilliary shoots are 8-10 cm length (*HR&TS, Kandaghat*).
- Data for number of carnation flowers per plant and number of flowers/m^2 were found non-significant. However, maximum flowers per plant (4.48) were obtained in 15th October planted crop whereas, minimum flowers per plant (3.77) were recorded in 15th January planted crop. Flowers/m^2 (111.77) were also obtained maximum in 15th October planted crop whereas, minimum number of flowers/m^2 (94.24) was observed in 15th January planted crop. Stem thickness (8.85 mm) was found maximum in 15th March planted crop which was found to be at par with 15th April planted crop (8.28 mm).Whereas, 15th January planted crop resulted into minimum thickness of stem (4.65 mm) and was at par with 15th December planted crop (4.89 cm). Stem length was found maximum in 15th April planted crop (81.18) which was found to be at par with 15th March (80.74) and 15th October (75.38) planted crop whereas, minimum stem length was observed in 15th

December (60.03 cm) planted crop which was at par with 15th November planted crop (62.49 cm). Duration of flowering was found maximum in 15th April planted crop (34.34 days) whereas, minimum duration of flowering was obtained in 15th January planted crop (30.54 days) and was at par with all other planting dates except 15th April planted crop. Vase life of flowers was found maximum in 15th March planted crop (14.38 days) whereas, minimum Vase life of flowers was found in 15th December planted crop (9.89 days) which was at par with 15th October and 15th November planting dates (*FLS, Nauni*).

- Ten cultivars of China aster were evaluated for growth and flowering performance. Among these, 'Phule Ganesh Purple' recorded maximum loose flower yield, whereas 'Arka Archana' resulted in maximum shelf life. For cut flower production, 'Arka Archana' and 'Arka Adhya' resulted in highest yield and vase life also (*FLS, Nauni*).
- Effect of nitrogen and potassium on growth flowering and multiplication of Dahlia (*Dahlia variabilis*) cv. Giani Zail Singh, revealed maximum plant height (137.18 cm), duration of flowering (127.00 days), size of flower (17.587 cm), stem length (110.26 cm), 'A' grade flowers, number of cut stems per plant (10.53), weight of tuberous root per plant (849.73 g), size of tuberous root, total number of tuberous roots per plant (22.66) was recorded best when nitrogen @ of 30 g/m^2 along with potassium @ 24 g/m^2 (*FLS, Nauni*).
- Out of the two carnation cultivars under study, 'Parendillo' showed superiority over 'Yellow Star' for all the characters observed during *in vitro* propagation. Shoot tips were rated better explants than nodal sections for mass multiplication in carnation cultivars. In calcium hypochlorite (5%) explants were surface sterilized for 10 minutes resulted into 100 per cent uncontaminated growing cultures in cv. 'Parendillo' and 15 minutes in cv. 'Yellow Star'. For culture establishment MS medium supplemented with 2.5 mgl^{-1} BA showed maximum per cent response. High quality shoots could be produced from shoot tip raised shoots in multiplication medium containing 2 mgl^{-1} BA, 0.1 mgl^{-1} NAA and 1 mgl^{-1} GA_3. The *in vitro* multiplied shoots were serologically indexed using DAS- ELISA for important carnation viruses viz. Carnation Latent Virus (CLV), Chrysanthemum Virus B (CVB) and Chrysanthemum Aspermy Virus (CAV). All the shoots showing multiplication under *in vitro* conditions were tested free of viruses and put to rooting. MS medium containing 2 mgl^{-1} NAA and 0.1 per cent activated charcoal was found to be the best for *in vitro* rooting of multiplied shoots. The *in vitro* rooted plantlets showed 100 per cent survival and maximum growth of plantlets hardened in a mixture of cocopeat:sand:perlite (2:2:1, v/v) (*FLS, Nauni*).
- Tuberose spacing at 25 x 30 cm with a depth of 2.0 cm had an optimal response on vegetative/growth parameters whereas a spacing of 25 x 30 cm with a depth of 8.0 cm had improved all the flowering and bulb production parameters. The early sprouting (13.96), tallest plant (52.67 cm), more number of leaves/plant (44.93), early opening of first pair of floret (125.86 days), longest spike (62.10 cm) and longest rachis (34.30 cm) were recorded in plant spacing of 25 x 30 cm with a depth of 2.0 cm, whereas, maximum spike diameter (1.33 cm), maximum weight of spike (48,86 g), longest duration of flowering (23.33 days), more bulbs and bulblets/plant (25.80), largest bulb (3.92 cm) and maximum weight of bulbs and bulblets/plant (354.23 g) were recorded in a spacing of 25 x 30 cm with a depth of 8.0 cm. Maximum number of florets per spike (47.46) was observed in spacing of 25 x 30 cm at a depth of 4.0 cm (*FLS, Nauni*).
- Six cultivars of tulip were evaluated for growth, flowering and bulb parameters. Out of these, cultivars 'Red Impression', 'Benja Luka' and 'Golden Oxford' were found to be the most superior for stem length, flower size, duration of flowering and bulb/bulblet parameters (*FLS, Nauni*).
- Standardization of growing medium for growth and flowering performance of alstroemeria cv. 'Capri', revealed that sand + soil + FYM (1:1:1; v/v) + vermi compost + cocopeat (2:1:1; v/v) was found best for number of stems per plant, number of flowering stems per plant, number of days

taken to bud formation, number of days taken to flowering, length of cut stem, duration of flowering and weight of cut stem (*FLS, Nauni*).

- For enhancing the vase life of cut flowers, hydrangea plants be fertilized with NPK @ 40:30:50 g/m^2 and cut flowers be held in the holding solution comprising of 3 per cent sucrose + 200 ppm 8-HQC + 10 ppm BA. (*FLS, Nauni*).
- The germplasm of chrysanthemum, gerbera, tuberose, marigold, dahlia, and gladiolus has been evaluated since 2012. The following suitable cultivars screened and were found promising under low Shiwalik foot-hill conditions (*RHR&TS, Dhaulakuan*).
- Chrysanthemum (standard)

  Suitable cultivars: White Star, Yellow Star, Surf, Purnima, Pusa Centennary, Snow Ball, SL Red, Pusa Anmol, Anaestesia White have been found suitable under low hill conditions.

  Ornamental usages: Found promising and suitable to be grown for cut flowers and in pots having rigid and strong flowering stems in addition to attractive colours.

Anaestesia White

Pusa Centennary

Pusa Anmol

Yellow Star

White Star

SL Red

Pink Cloud

Apricot Parasol

Yellow Giant

- Chrysanthemum (spray)

  Suitable cultivars: DKC-Yellow, DKC-Pink, DKC-Button Yellow, Kalpana, White Bouquet have been found suitable under low hill conditions.

  Ornamental usages: Beds for mass effect, best suited for pot plant production and also for making garlands and for loose flower production having more than 50 numbers of flowers, strong stems and longer flowering duration with attractive colours.

Kalpana

DKC-Yellow

DKC-Pink

Autumn

DKC-Button Yellow

Frilly Pink

- Gerbera

  Suitable cultivars: Balance and Dana Ellen

  Ornamental usages: Found promising as cut flowers and tolerant to heat having rigid and strong cut stems and maximum vase life.

Cultivation under Polyhouse

Balance

Dana Ellen

- Tucerose

  Suitable cultivars: Calcuttia Single and Prajwal

  Ornamental usages: Found promising as cut flowers having longest rigid and strong flowering stems, flowers scented and availability during rainy season

Calcuttia Single

Prajwal

Tuberose cultivars 'Calcuttia Single' and 'Prajwal' under open field conditions

- Marigold (African)

  Suitable cultivars: Pusa Basanti, Pusa Narangi, Inca series, Taishon series, Pusa Arpita

  Ornamental usages: For loose flower production and garland making and suitable for peak season flowering

Pusa Narangi

Pusa Basanti

Inca Series

- Marigold (French)

  Suitable cultivars: Red Brocade, Durango series

  Ornamental usages: For loose flower production and garland making, cold tolerant cultivars suitable for December-February except Durango in which flowering can be obtained year round.

Red Brocade Durango Orange

- Dahlia

  Suitable cultivars: Giani Zail Singh, Maa Sharda, Kenya Series

  Ornamental usages: Suitable as cut flowers and potted plants having rigid and strong stems, long vase life

Giani Zail Singh Maa Sharda

- Gladiolus

  Suitable cultivars: Peter Pears, White Friendship, Nova Lux

  Ornamental usages: Suitable as cut flowers having rigid and strong stems, long vase life

Peter Pears White Friendship Nova Lux

- Twenty four cultivars of Chrysanthemum (twenty standard and twelve spray); standard namely White Star, Yellow Star, Pusa Centennery, Pusa Anmol, Apricot Parasol, Anaestasia White, Pink Cloud, SL Red, Snow Ball, Surf, Poornima, Ajina Purple; spray like DKC-Yellow, Frilly Pink, DKC-Pink, DKC-Button Yellow, Kalpana, Peet Singar, Autumn Pink, Birbal Sahni, White Bouquet, Kundan, Shyamal, Ravi Kiran were evaluated on the basis of their growth and flowering characteristics (*RHR&TS, Dhaulakuan*).

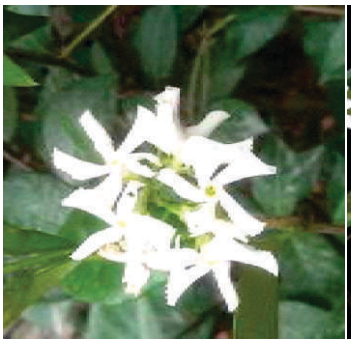
Vegetative propagation in Chrysanthemum in portrays and plugs

Vegetative propagation in Chrysanthemum on raised benches in different media

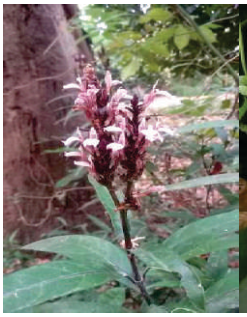
- Propagules of *Barleria cristata, Eranthemum pulchellum, Hypericum obongifolium*, *Jasminum pubescens, Inula cappa*, *Reinwardtia indica, Phlogacanthus pubinervius, Jasminum humile* etc. have been identified and collected from Dhaulakuan and Nahan areas of Himachal Pradesh, Dehradun and Mussourie areas of Uttarakhand (*RHR&TS, Dhaulakuan*).

Phlogacanthus pubinervius *Reinwardtia indica*

Cestrum parquii *Eranthemum pulchellum*



Ichnocarpus frutescens *Jasminum pubescens*



Justicia gendarussa *Thunbergia fragrans*

Barleria cristata *Barleria prionitis*

Curcuma amada *Decandrum nanum*

- For mass multiplication of chrysanthemum plants, different media and growth regulators (vermiculite, cocopeat, cocopeat + sand (1:1), sand were tested on different cultivars. Maximum rooting percentage (78.50%) and root length (8.20 cm) was induced in vermiculite media + NAA 500 ppm in cv. White Star followed by Pusa Centennary in cocopeat:sand (1:1) media + NAA 500 ppm having rooting percentage (73.20) and root length (5.90 cm) (*RHR&TS, Dhaulakuan*).

Propagation in Vermiculite Propagation in Cocopeat:Sand (1:1)

- In pansy (*Viola* x *wittrockiana* Gams.), maximum plant height (39.82 cm), plant spread (42.89 cm), number of flowers per plant (175.67), number of flowers per plot (1581.03), size of flowers (4.63 cm), number of capsules per plant (70.27), seed yield per plant (4.07), seed yield per plot (36.66) was recorded when plants were supplied with 40 g N/m^2 and 30 g K/m^2 in comparison to other treatments under field conditions (*SS&T, Nauni*).

Pansy seed crop in flowering at Khaltoo farm

- In African marigold (*Tagetes erecta* L.), maximum plant height (116.67 cm), number of flowers per plant (58.33 cm), number of seeds per capitulum (212.44), seed yield per flower (0.99 g)

and 100 seed weight (3.14 g) was recorded when the plants were grown in the plots with silver mulch and provided GA_3 @ 100 ppm foliar application (*SS&T, Nauni*).

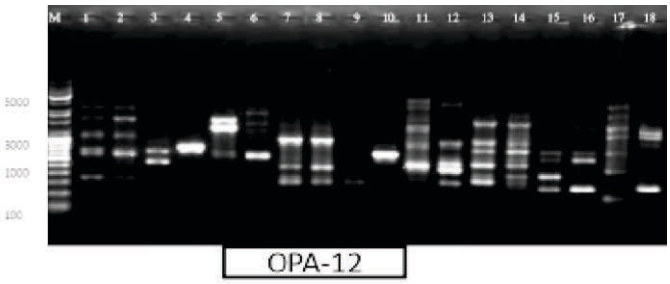
African marigold seed crop in flowering at University Farm, Khaltoo

- Plant regeneration protocol for *Saussurea costus* (Kuth) was standardization using different explants like cotyledonary leaves, hypocotyls and shoot tips (*BT, Nauni*).
- Protocol for *in vitro* propagation of Gisela-5 (*Prunus cerasus* x *Prunus canescens*) cherry rootstock was developed. *In vitro* mother cultures were indexed for CLRV, ACLSV and PNRSV using DAS-ELISA procedure. They showed negative results for the presence of these viruses (*BT, Nauni*)..

Micropropagation of clonal cherry rootstock Gisela 5 (*Prunus cerasus* x *Prunus canescens*)

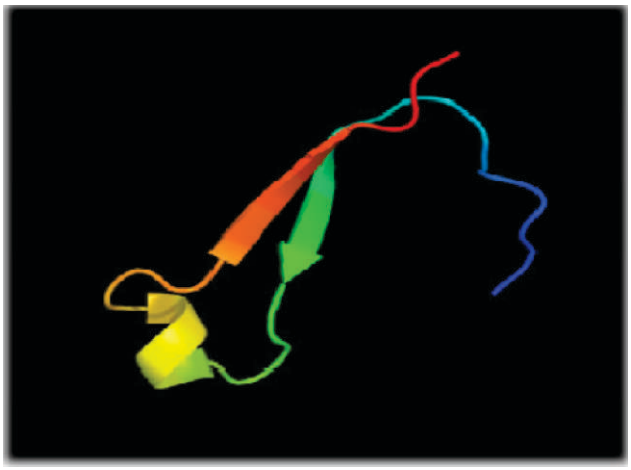
- Chrysanthemum plants of the cultivar "Purnima" were propagated *in vitro* from axillary bud and hardened. The somaclones obtained are being tested under field conditions (*BT, Nauni*).
- Antimicobial activity of partially purified trypsin inhibitor from *Dolichos biflorus* L. cultivar HPK5 was demonstrated against fungus *Alternaria* spp. and bacterium *Ralstonia solanacerum.* Partially purified trypsin inhibitor from seed flour of *Phaseolus vulgaris* L. cultivar Baspa showed inhibitory activity against different fungal strains (viz., *Fusarium oxysporium*, *Alternaria* sp., *Pythium* sp., *Phytophthora nicotiana,* and *Rhizoctonia solani*) (*BT, Nauni*).
- *Rol b* gene sequences were retrieved from NCBI site and after designing, primer pairs were synthesized. Five strains of *Agrobacterium rhizogenes* were checked for the *rol b* gene amplification and one strain showed good amplification of 818bp gene fragment. Fragment was cloned in pGEMT vector and transformed colonies of *E. coli* were selected (*BT, Nauni*).
- Various functional and vital gene sequences *viz.*, calmodulin, β tubulin, Lys M domain, chitin synthase, polyketide synthase, MAPK etc. of *M brunnea* were retrieved from the NCBI GenBank Database and *in silico* analysis was carried out using CLUSTAL W software in order to see the presence of conserved regions of these genes. RNA isolation from the fungal mycelia at different days of maturity was standardized which was further subjected to cDNA synthesis and gene amplification via PCR. In order to standardize the *Agrobacterium* mediated gene transfer of *M. coronaria*, the antibiotic sensitivity tests of various antibiotics was done (*BT, Nauni*).
- Chlorpyrifos degrading bacteria from apple orchard soils of Himachal Pradesh was isolated. They were screened for extracellular and intracellular organo phosphorus hydrolase enzyme production by measuring its activity and characterised at molecular level (*BT, Nauni*).
- Laccase producing thermophilic bacteria from hot water springs of Himachal Pradesh was isolated and characterised. Extracellular laccase was partially purified. It had ability to degrade

textile dyes. Gene encoding for laccase was isolated using designed primers and characterised (*BT, Nauni*).



Lane 1: TS8 | Lane 7: VS8 | Lane 13: KW9.1
Lane 2: KW3.1 | Lane 8: TW5 | Lane 14: KR7.2
Lane 3: VW5 | Lane 9: MS2.2 | Lane 15: TR4.2
Lane 4: TR2 | Lane 10: VS9 | Lane 16: VR2
Lane 5: VW2 | Lane 11: MW17 | Lane 17: VW1
Lane 6: VS10 | Lane 12: KW4 | Lane 18: KW8
Lane M: Molecular marker (100 bp-5 kb DNA ladder)

Thirteen isolates were identified by 16S *rrna* gene technology



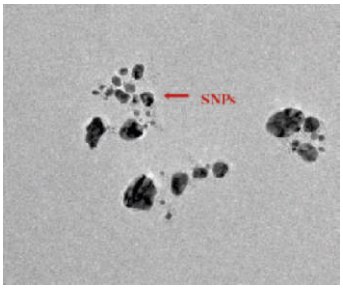
3-D structure of thermolaccase enzyme obtained from *Bacillus licheniformis* strain RSMS

- Kresoxim methyl 50 per cent EC (Ergon) at 0.05 per cent concentration and Saaf (carbendazim 12% + mancozeb 63% WP) at 0.3 per cent concentration has provided the effective control of *Alternaria* (65.19%) and *Marssonina* (91.68%) blotch. Luna (fluopyram 200 + tebuconazole 200) 400 SC at 0.05 per cent and higher concentration has shown complete control of the disease (*RHR&TS, Mashobra*).
- Out of five SAR chemicals, two consecutive sprays of dipotassium hydrogen orthophosphate (0.075%) first in January followed by another spray after 28 days were found effective (99.46 PDC) against powdery mildew of mango. Out six biocontrol agents, three sprays of *Bacillus subtilis* (0.8%) starting with the emergence of panicles followed by another two sprays at an interval of 15 days was found to be the most effective (97.56 PDC) in controlling the powdery mildew of mango. Three sprays with *Ampelomyces quisqualis* at the above-mentioned critical stages were also quite effective (93.63 PDC) (*PP, Nauni*).
- Evaluation of five new novel fungicides viz., Cabrio Top: pyraclostrobin + metiram (0.1%), Nativo : trifloxystrobin + tebuconazole (0.04%), Avtar: zineb + hexaconazole (0.25%), FIL001: dodine + hexaconazole (0.06%) and Amistar top: azoxystroblin + difenoconazole (0.04%) separately against core rot in apple indicated that three consecutive sprays of FIL001 (dodine + hexaconazole (0.06%) at pink bud stage followed by another two sprays at petal fall - pea and marble - walnut stage, respectively was highly effective (99.4%) (*PP, Nauni*).
- The fungicides viz., MACT-01 (Tebuconazole 8% + Captan 32% SC) @ 0.3 per cent, Custodia (Azoxystrobin 11% + Tebuconazole 18.3% SC) @ 0.15 per cent, SAAF (carbendazim 12% + mancozeb 63%) @ 0.3 per cent, Ergon 50 per cent SC @ 0.05 per cent were found highly effective against apple scab (*Venturia inaequalis*) (*RHR&TS, Bajaura*).
- BAS 717 00F (fluxapyroxad 75 g/l + Difenoconazole 50 g/l), Custodia (azoxystrobin 11% + tebuconazole 18.3% SC) @ 0.15 per cent, Proquinazid @ 0.025 per cent and Markvax @ 0.075 per cent were found highly effective against apple powdery mildew (*Podosphaera leucotricha*) (*RHR&TS, Bajaura*).
- Combiproduct of fluopyram 200 + tebuconazole 200-400 SC @ 0.0625 per cent and Ergon 50 per cent SC @ 0.05 per cent were found highly effective against Alternaria blotch (*A. alternata*) in apple (*RHR&TS, Bajaura*).
- Fluopyram 200 + tebuconazole 200-400 SC @ 0.0625 per cent, Custodia (azoxystrobin 11% + tebuconazole 18.3% SC) @ 0.15 per cent and SAAF (carbendazim 12% + mancozeb 63%) @ 0.3 per cent were highly effective against Marssonina blotch (*M. coronaria*) in apple (*RHR&TS, Bajaura*).

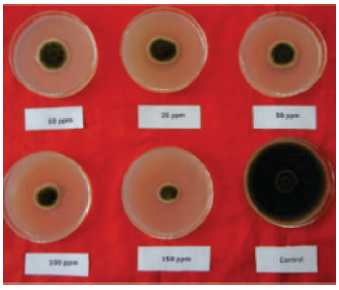
- The combi treatment of copper oxychloride (0.25%) + streptocycline (0.03%) and Conika 50 per cent WP (Kasugamycin 5% + copper oxychloride 45%) @ 0.3 per cent were highly effective against bacterial blight disease (*Xanthomonas axonopodis* pv. *punicae*) in pomegranate under field conditions (*RHR&TS, Bajaura*).
- Morphological and molecular characterization of the isolates of Marssonina blotch of apple (*Marssonina coronaria*) collected from different locations of Himachal Pradesh and Uttarakhand was done and phylogenetic tree depicted that all the isolates were close clustered to Chinese isolates deposited earlier in the NCBI. Salicyclic acid and acibenzolar-S-methyl @ 100 ppm were found to be effective in inducing resistance against Marssonina blotch of apple (*PP, Nauni*).
- Application of salicylic acid (0.01%) resulted in least disease severity of bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae*. Spray of cow-urine (5%) was found effective in comparison to garlic and darek. Amongst nine different chemicals, Bordeaux mixture (1%) was found most effective against the disease. Treatment combinations of copper oxychloride + streptocycline + cowurine + garlic + salicylic acid was found most effective for the management of the disease (*PP, Nauni*).
- Among the different solid media tested for mass multiplication of antagonistic strains (UHFBA-218 and K84) at room temperature, maximum viable counts were observed after eight months of storage in sugarcane bagasse mixed in 1:5 ratio (*PP, Nauni*).
- Botanical formulations made of six botanicals namely Karu (*Roylea elegans*), *Artemisia* (*Artemisia roxburghiana*), Neem (*Azadirachta indica*), Bana (*Vitex negundo*), Tulsi (*Ocimum sanctum*) and Darek (*Melia azedarach*) made in water (BF1) or cow urine (BF2) were found effective in the management of white rot pathogen (*B. dothidea*) in apple. Impregnation of trays with BF2 reduced the incidence of white rot by 72.2 per cent in comparison to control. Though, BF1 was found less effective than BF2 but still treatment of fruits in BF1 and packing of fruits in trays impregnated with BF1 resulted in 83.3 and 61.1 per cent reduction in the incidence of white rot in comparison to control after 30 days of storage (*PP, Nauni*).
- In capsicum, maximum yield (650 q/ha) was obtained with sprays of difenconazole followed by hexaconazole (620 q/ha) sprays as compared to 480 q/ha in farmer's practice. Though all the treatments reduced disease severity however, maximum reduction (79.87%) in disease severity was achieved with difenconazole sprays (*HR&TS, Kandaghat*).
- Serological studies based on DAS-ELISA conducted on apple stem grooving virus (ASGV) have revealed the presence of this virus in a number of apple orchards of Shimla and Kinnaur districts of Himachal Pradesh (*PP, Nauni*).
- Three consecutive sprays of five chemicals viz., Aliette (fosetyl Al), Agsil (Salicylic acid), potassium silicate, potassium metabisulphite and potassium nitrate @ 0.05 per cent, during April, June and August have been found to lower collar rot disease in apple nursery (sick soil) to the extent of 83.2, 89.4, 72.6, 65.3 and 40.5 per cent. Former three were effective under orchard conditions and increased the shoot length up to 35.2, 34.8 and 31.6 cm against 6.2 cm in control and healed the collar region up to 32.6 – 34.1 per cent (*PP, Nauni*).
- Cultivars of mango viz. Bombay Green, Fajri, Baramasi, Lucknow Safeda, Totapari, Parry, Vanraj, Langra, Safeda, Tamoria, Kishan Bhog, Gurjeet and Sindhuri were categorized as highly resistant against malformation (*RHR&TS, Jachh*).
- Combined application of red soil (upto 10 cm 3ft around the stem) + 200 g talc based formation of each antagonist viz., *Trichderma harazianum* isolate 5, *Bacillus* sp. isolate 11 and Curzate (0.3%) was highly effective in increasing the shoot length to 41.7 cm as against 6.1 cm in control untreated plants as well as lesion recovery at the collar portion (36.6%) (*PP, Nauni*).
- Powdery mildew of okra caused by *Erysiphe cichoracearum* required moderate air temperature (25 ± 1°C) coupled with slightly less

relative humidity (<70%) and less cumulative rainfall in disease development. Three cultivars/lines namely Shakti, MH-73, VRO-5 were observed resistant to the disease. Three sprays of difenconazole (0.03%) were found most effective followed by hexaconazole (0.05%) in reducing the severity of powdery mildew and increased fruit yield (*PP, Nauni*).

- Combination of two foliar sprays of salicylic acid (20 mM) with one in between spray of *Pseudomonas fluorescens* was most effective in managing the downy mildew and powdery mildew of cucumber (*PP, Nauni*).
- Acibenzolar-S-methyl (10µM) followed by DL-β-amino-n-butyric acid (BABA) (1 mM) and salicylic acid (10 mM) were effective in managing the *Fusarium* wilt and *Phytophthora* leaf blight and fruit rot of capsicum (*PP, Nauni*).
- Sprays of mancozeb 40 per cent + azoxystrobin 7 per cent (@ 0.3 per cent were found effective in managing Alternaria leaf spots of tomato (*PP, Nauni*).
- Combi-fungicide- AmistarOpti 560 SC comprising of azoxystrobin + chlorothalonil @ 0.04 per cent was found effective against downy mildew of cauliflower (*PP, Nauni*).
- Nanoparticles of CoFeO and NiFeO were effective in inhibiting the mycelia growth of *Colletotrichum gloeosporioides, Fusarium oxysporum* and *Dematophora necatrix* under *in vitro* conditions (*PP, Nauni*).
- Combined application of *T. harzianum* + *A. indica* was found effective against lettuce drop caused by *Sclerotinia sclerotiorum* (*PP, Nauni*).
- Typical ringspot symptoms on leaves of bell pepper (*Capsicum annuum*) and development of red spots on fruits have been observed in crops mainly raised under protected structures. BLASTn analysis of sequence of complete nucleocapsid gene showed 99 per cent nucleotide similarity with *Capsicum Chlorosis Virus* (genus *Tospovirus*, family Bunyaviridae) CaCV isolate from tomato (Accession No. EU216023) (*PP, Nauni*).
- Sowing of methi (*Trigonella* sp.) and green gram (*Vigna radiata*), 50 to 60 days before transplanting of chrysanthemum cuttings in soil solarized with transparent polyethylene mulch was found effective for the management of Rhizoctonia stem rot of chrysanthemum. The treatment resulted in higher growth of the plants with higher number of quality flower yield (*PP, Nauni*).
- Silver nano-particles made from neem (*Azadirachta indica*), tulsi (*Ocimum sanctum*) and euphorbia (*Euphorbia hirta*) were found effective against *Alternaria zinnia* causing a serious leaf spot disease in marigold (*PP, Nauni*).



Transmission Electron Microscope images of Neem silver nano-particles



Efficacy of neem silver nano-particles against *Alternaria zinniae*

- New report of leaf spots caused by *Alternaria alstroemeriae* on *Alstroemeria* sp. was reported in India (*PP, Nauni*).
- New diseases have been reported in *Echinacea purpurea* and *Gloriosa superb*. In *Echinacea purpurea*, seedling blight caused by *Sclerotium rolfsii,* symptoms starts with light brown coloured water soaked lesions usually develop irregularly in the center of the leaves leading to necrosis and then the entire plant gave blighted appearance. In, leaf blight caused by *Curvularia lunata*, the infection starts from the side margins inwards, covering almost entire leaf surface with papery formation of the leaves and light brown colouration. The lesions proceeded upward in direction towards the leaf tip, covering the entire leaf surface (*PP, Nauni*).
- In ginger, the highest germination was found in foliar spray with carbendazim + mancozeb followed by copper oxychloride and tricyclazole, however, they were statistically at par with each other. Minimum leaf spot incidence was recorded by spraying hexaconazole which also resulted in

maximum disease control followed by propiconazole, carbendazim + mancozeb and tricyclazole sprays, giving 71.50, 67.40 and 66.26 per cent disease control, respectively. Hexaconazole sprays also gave maximum yield (97.50 q/ha) followed by sprays of propiconazole and carbendazim + mancozeb which gave 86.25 and 78.75 q/ha ginger rhizome, respectively (*VS, Nauni*).

- The integrated usage of non-chemical and chemical method proved much efficacious in limiting the leaf curl incidence and white fly and thrips infestations besides enhancing the green chilli yield as compared to their independent use. The pre-sowing incorporation of neem cake @ 1 kg/m^2 and use of maize as barrier crop in combination with rotational use of different molecules of pesticides including Acephate @ 1.5 g/l, Fipronil @ 1.0 ml/l, Imidacloprid @ 2 g/15 l combined with neem oil @ 2.0 ml/l proved most efficacious in limiting the leaf curl disease incidence and white fly and thrips populations. The module also provided the highest green chilli yield (121.27 q/ha) (*VS, Nauni*).
- Leaf extracts of *Melia azedarach, Bougainvellia* and *Aloe barbidensis* were found effective against Sclerotium crown rot pathogen *(S. rolfsii)* of *Salvia moorcroftiana***.** Four fungicides namely Kavach (chlorothalonil), Antracol (propineb), Bavistin 50 per cent (carbendazim) and Benomyl (benlate) were found effective in reducing the disease incidence and also improved the seed germination (*PP, Nauni*).
- Fungicides namely Thiram (thiram), Avtar (zineb 68% + hexaconazole 4%) and Bavistin 50 per cent (carbendazim) were found effective in the management of stem rot incidence of carnation caused by *Rhizoctonia solani*. (*PP, Nauni*).
- During spring-summer crop season, there was severe outbreak (64.85-87.30%) of gummy stem blight of cucurbits caused by *Didymella bryoniae* in all vegetable growing areas. The disease incidence ranged from 64.85 to 87.30 per cent (*RHR&TS, Jachh*).
- Among five strains of *Agaricus bisporus* viz. AVT-15-01 to AVT-15-05 evaluated at Nauni centre, strain AVT-15-03 recorded a highest yield of 23.9 kg/100 kg compost (*PP, Nauni*).

- A new economic method of making spawn by avoiding boiling of wheat grains has been developed for making *Pleurotus* spawn (*PP, Nauni*).
- Production technology for the cultivation of oyster mushroom under dry temperate zone of the state was standardized and devised by utilizing local flora (Fungma and Poplar) of the Spiti Valley (*RH&FRS, Bhota*).
- Out of ten different casing combinations tested for the cultivation of button mushroom in natural bamboo hut, a mixture of cocopeat supplemented with ash and gypsum and one year old spent compost (1:1 v/v) proved best as an alternative to standard check (FYM + loam soil, 1:1 v/v) for mushroom production in sub tropical zone of the State. Period from August to November was found to be the most appropriate time for the cultivation of oyster mushroom under natural hut conditions in low hill zone (*RH&FRS, Bhota*).
- *Pleurotus djamor* was successfully cultivated on local substrates along with *P. sajor caju* and *P. florida* during 2015 crop season (*RHRSS, Tabo*).

Dhingri mushroom cultivation under DST project

- Application of copper oxychloride paste in linseed oil on the exposed wood after removing gummosis infected bark in mango plants resulted in complete healing of the wound and healthy growth of the plants (*RH&FRS, Bhota*).

a b c

Fungicidal treatment in a gummosis affected mango tree:
a) Scrapped diseased portion,
b) Diseased portion pasted with fungicide,
c) Healing of diseased portion after one year of treatment

- High incidence (>60 per cent) of fruit flies *Bactrocera dorsalis* and *B. zonata* was recorded in peach and nectarine fruits at model farm of the University. The fruits fell off prematurely and also started rotting (*Ento, Nauni*).
- Psylla infestation was recorded on apple trees at Narkanda, Baghi and Nauni. The nymphs were observed feeding on leaves and unopened flowers. However, the extent of infestation was low (*Ento, Nauni*).
- Management of aphid population in cabbage through eco-friendly treatments concluded that spray of difenthiuron 50 WP @ 1 g/litre was most effective in terms of higher yield (245.44 q/ha) with benefit:cost (B:C) ratio of 1.64:1 in mid hill conditions in Himachal Pradesh (*VS, Nauni*).
- New HMO's SERVO(R) (M/S Indian oil Corporation), BALMEROL BALSPRAY(R) (M/S Balmer - Lawrie & Co. Ltd.) and VEEDOL SPRAY OIL (R) (M/S Tide Water Co.) at 1 per cent concentration was found effective against the phytophagous mites on apple for 14 days in comparison to the standard MAK(R) (1%) which was also effective only for 14 days. All the above tested HMO's recorded low to nil populations of predatory mites for two weeks. However, predatory mites appeared significantly, after two weeks of the spray (*RHR&TS, Bajaura*).
- New HMO SERVO(R) (M/S Indian oil Corporation) and Horticulture Mineral Oil (M/s Petrostar) recorded very high mortality in over wintering eggs of European red mite after one week of the spray at par with the standard MAK(R) (*RHR&TS, Bajaura*).
- New pesticide ULALA(R) (United Phosphorus Ltd.) at 0.02, 0.03 and 0.04 per cent doses was found effective for control of woolly apple aphid in comparison with the already recommended chlorpyriphos (0.04%) (*RHR&TS, Bajaura*).
- While evaluating heterocyclic-based synthetic sulfonamides as potential pesticide against *Galleria mellonella* (wax moth), N-(1-isopropyl-2-oxo-2-morpholino-ethyl) toluene sulphonamide and N-(1-isopropyl-2-oxo-2-piperidino-ethyl) toluene sulfonamide were found to be more effective IGRs in comparison to in use standards IGRs (pyriproxyfen and fenoxycarb) (*RH&FRS, Bhota*).
- Out of six treatments of acaricides, insecticide and HMO given against two spotted mite, maximum kill of mites was obtained with Sedna 0.005% treated plants (0.4 mites per leaf) followed by HMO 1 per cent (0.8 av. mite per leaf) followed by Magister 0.0025 per cent treated plants (2.4 mites per leaf). Untreated plants exhibit increase in mite population right from beginning (25.6 to 39.8 mites per leaf) (*RHR&TS, Mashobra*).
- New insecticide spirotetramat 150 OD (Movento) was evaluated at three concentrations viz., 0.6, 0.8 and 1 ml per litre against aerial population of woolly apple aphid in apple orchard. The higher concentrations of new insecticide Movento (0.8 and 1 ml/l) provided moderate suppression of the aphid (3.80 and 3.73 aphid colonies per twig, respectively) (*RHR&TS, Mashobra*).
- Cherry fly, *Drosophila suzukii*, infestation ranged between 30-40 per cent in Narkanda area. The attractant traps installed during May-June, 2015 based on cider and yeast proved effective. Cider

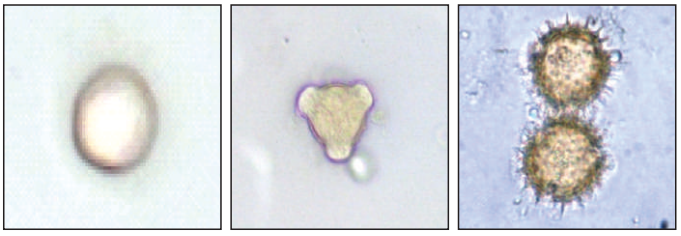
based trap was more effective in comparison to yeast based trap (*Ento, Nauni*).

- Horticultural mineral oils Petrostar and Servo orchard spray oils proved effective against overwintering eggs of European red mite, *Panonychus ulmi*. The egg hatch recorded after week of spray was only 11.48 and 12.24 per cent in comparison to 13.57 per cent in earlier recommended Orchol. The egg hatch in control was 85.03 per cent (*Ento, Nauni*).
- The horticultural mineral oils tested in summer against phytophagous apple mites in apple orchard at Narkanda revealed Veedol spray oil, Bal spray oil and Servo orchard spray oils effective in checking the mite population at both the tested concentrations i.e., 1.0 and 2.0 per cent and were either on par or superior to the earlier recommended oil, Orchol 13 (1%) and superior over control wherein only water was sprayed (*Ento, Nauni*).
- Cyenopyrafen (2.0, 2.5 and 3.0 ml of the product/10l of water) and spirotetramat (8.0 and 10.0 ml/10 l) proved effective in checking the mite population and were on par with the recommended acaricides namely fenazaquin and propargite evaluated at Thanedhar, district Shimla. The mite count remained below 6/leaf in test treatments during all the weekly observations taken for a month after spray in comparison to control where the mite count exceeded 20/leaf (*Ento, Nauni*).
- A number of insecticides were evaluated against woolly apple aphid, *Eriosoma lanigerum* at Matiana during autumn 2015. Spirotetramat, flonicamid and thiamethoxam at the highest dose i.e., 10 ml/10L, 8 ml/10L and 10 g/10L, respectively, were comparable to the chlorpyriphos (Dursban 20EC) treatment and remained effective for three weeks, whereas, flupyradifurone was not effective in checking the aphid infestation. The test chlorpyriphos (Goldban 20EC) at 20 ml/10L was also comparable to the recommended Dursban (*Ento, Nauni*).
- The 3/4 pruning level coupled with single spray of either of the two neonicotinoids (imidacloprid or thiamethoxam @ 0.008%) at pink bud stage was effective both from bioefficacy and economic point of view in comparison to the recommended insecticides (oxy-demeton methyl and dimethoate), in nectarine and peach crops. Dormant oil and biopesticide treatments were found less efficacious. All the test treatments including neonicotinoids did not affect the predator (*C. septempunctata* and syrphid flies) population significantly, meaning thereby, that these treatments are safe to the major predators. Further, no phytotoxicity/fruit injury symptoms were observed indicating their safety to both the crops taken under the study (*Ento, Nauni*).
- During November, 2015, a new invasive leaf miner, *Tuta absoluta* (Gelechidae: Lepidoptera) was recorded on tomato leaves, flowers, terminal shoots and fruits at Nauni. The present report is the first record of the pest from North India. Nearly 60 per cent of plants were infested with the leaf miner and the number of larvae varied from 5 to 17 per infested plant. During the study, mirid bug, *Nesidiocoris tenuis* (Reuter) (Hemiptera: Miridae) was found associated with the pest (*Ento, Nauni*).
- At the end of May and start of June, crawler of scale insect starts moving to new place to feed. So this is the most suitable time to control San Jose Scale using recommended pesticide (Metasystox). Foliar spray of Metasystox @ 200 ml/200 l during May end on economic threshold level of 4-5 scales per sq cm reduced 68.1 per cent San Jose Scale over farmers' practice (*RHR&TS, Sharbo*).
- Comparative fertility parameters of *Bactrocera cucurbitae* and *B. tau* reveal that the net reproductive rate of *B. cucurbitae* and *B. tau* was 32.22 and 35.68 females with the generation time of 40.34 and 31.38 days, respectively. The respective values of the true intrinsic rate of increase was 0.09 and 0.12 female per day. The finite rate of increase was found to be 1.09 and 1.12 female per day for *B. cucurbitae* and *B. tau*, respectively with doubling time of 9.65 and 7.23 days, respectively (*Ento, Nauni*).
- Various vegetable and ornamental plants were surveyed for the aphid species. The aphid species on tomato, brinjal, coriander were identified as

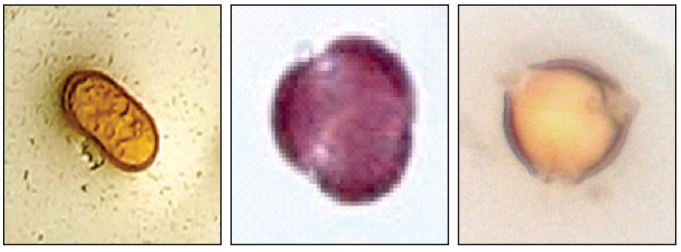
Macrosiphum euphorbiae, Macrosiphum euphorbiae and *Hydaphis coriandri* and seem to be the first record on these hosts (*Ento, Nauni*).

- Variations among the population of tomato fruit borer, *Helicoverpa armigera* collected from different geographical areas (Solan, Kangra, Hissar, Bathinda, Kinnaur and Theog) was recorded in the population collected from these areas. The highest value for the protein content was found in the Bathinda population (33.31 mg/g) and the least for the Kangra population (31.20 mg/g) (*Ento, Nauni*).
- Among different biocontrol agents/bio-pesticide evaluated against the greenhouse whitefly, *Trialeurodes vaporariorum*, Neem Baan (1500 ppm; 3ml/L) was the most effective resulting in 60.2 per cent reduction in the whitefly nymph population over control which was, however, statistically on par with *Lecanicillium lecanii* (5 g/l of 10^8 conidia/g) and *Chrysoperla* (1 larva/plant) where the reduction was 57 and 50 per cent, respectively. However, none of these treatments could match the efficacy of imidacloprid (0.0075%) which reduced the whitefly population to the tune of 94.1 per cent over control (*Ento, Nauni*).
- *Neoseiulus longispinosus* (5 and 10 mites/plant) and Neem Baan (1500 ppm; 3ml/l) were only moderately effective against *T. urticae* on tomato resulting in the population reduction of 47.9 to 54.5 per cent as against 89.9 per cent by fenazaquin (0.0025%). *Neoseiulus longispinosus* at 1:10 predator:prey ratio was the most effective resulting in 74.2 per cent reduction in mite population over control which was on par with fenazaquin (0.0025%) resulting 85.2 per cent reduction (*Ento, Nauni*).
- Among seventeen plant parasitic nematode genera associated with ginger fields in Himachal Pradesh, lesion nematode (*Pratylenchus coffeae*) and root-knot nematode (*Meloidogyne incognita*) have been found most prevalent and of major economic importance (*Ento, Nauni*).
- In eco-friendly management of root knot nematode on okra, the coating/dipping of seeds in botanical formulations viz., Max raze (containing *Ocimum sanctum* 10%, *Andropogon nardus* 35%, Samesol 25%, Nerodicol 20% and dissolving agent 15%) and Max cannon (10,000 ppm azadirachtin) and bacterial bio-agent, *Pseudomonas fluorescens* resulted in improved plant growth, fruit yields and reduced root galling. The application of dried leaf powder of lantana, *Lantana camara* and castor, *Ricinus communis* to the soil also resulted in reduced root galling, juvenile population and higher okra fruit yield. Among different oil cake amendments, neem cake was found most effective in reducing root knot infestation and enhancing okra yield, followed by mustard cake. Among different bio-agents evaluated against root knot nematode *Trichoderma viride* and *Pseudomonas fluorescens* were found effective in reducing nematode infestation and increasing okra yield (*Ento, Nauni*).

Nyctyornis athertoni



Lupinus angustifolius *Rubus ellipticus* *Dendranthema grandiflorum*



Justicia adhatoda *Raphanus sativus* *Papaver rhoeas*

Microphotographs of pollen grains of pollen load

Tomato leaves/fruits damaged by *Tuta absoluta* and its different stages

Migration of aphid (alate) from secondary to primary host

- A Study on comparative analysis of the student satisfaction between a private sector University and a government sector University in Solan town - the key objectives of the study were to measure the level of student satisfaction, most preferred sector, determine the various reasons of preference and level of exposure for career advancement. Apart from the other sectors, it was observed from the study that the quality of education should be upgraded keeping in view all the recent changes and the latest development in the related fields (*BA, Nauni*).
- User's perception and comparative analysis of mobile service provided by BSNL and AIRTEL in Shimla district - the aim of this study was to compare the perception of people for the brand BSNL and AIRTEL regarding the services provided by both the sectors and to what extent people are satisfied with it. It was found through the study that BSNL lacks behind in services like roaming facility, customer care service, online recharge facility, voice mail services and mms, which were perceived not to be satisfactory by the respondents. Therefore, BSNL should strategise to improve upon these services (*BA, Nauni*).
- A study on requirement of finance by farmers and its fulfilment by State Bank of Patiala, Nauni, the study was carried out with the objective to find out the awareness of consumers regarding various schemes and formalities, availability of various agricultural loan schemes in State Bank of Patiala. It was observed that with the changing needs and expectations, the bank must refine the existing schemes and offer some new ones. This would help in fulfilling the requirement of agricultural credit more closely (*BA, Nauni*).
- In the study on job burnout - a case study of health care professionals in Solan town of Himachal Pradesh revealed moderate to high job buran outs in healthcare professionals. The level of job burnout was noted to be relatively lesser in females as compared to males, unmarried as compared to their counterparts. The findings of the study further revealed that effect of gender and income has been significant for mean difference for all three dimensions viz., emotional exhaustion, depersonalization and personal achievement (*BA, Nauni*).
- In the study on job expectations of students - a case study of Solan town, the findings of the study revealed that there is a considerable difference among post graduate and graduate students when it comes to forming expectations related to career. Apart from gradual differences in expected wages, the students tend to have different expectations related to job attributes like expected time to get promoted, etc. The study also depicted that management and engineering sectors were the most preferred stream of educational attainment among students. The study also unveiled that there was very less biasness among students related to government and private sector jobs and students were willing to move from one job to another job until they find a job that suits them (*BA, Nauni*).

Forestry

- In Deodar plantations, the soil available nitrogen (ranged from 253.88 to 511.18 kg ha^{-1}), soil available phosphorus (ranged from 9.27 to 24.75 kg ha^{-1}), soil organic carbon ranged from 1.33 to 2.55 per cent, soil moisture ranged from 20.32 to 39.74 per cent, soil humus depth was higher in northern aspect and ranged between 0.63 to 1.40 cm were higher in northern aspect as compared to southern aspect. However, available potassium ranged from 167.25 to 285.14 kg ha^{-1} and it was higher in southern aspect (*SAF, Nauni*).
- In Rajgarh Forest Division, regeneration was satisfactory in deodar forest (67.50%) and chir forest (55%), moderate in oak forest (37.5%) and poor in kail (27.5) and fir and spruce (15%) forest communities and regeneration was completely absent in khair plantation (*SAF, Nauni*).
- All the families in the seed orchard of *Grewia optiva* established at Nauni behaved differently, no specific trends for different seed traits was noticed during the year under report. However, family number SO-6 registered superiority for seed length, seed width etc. (*SAF, Nauni*).
- Oil content in *Bassia butyracea* seeds was significantly influenced by different seed sources. Among 14 seed sources, seed oil content from Khargiri recorded higher seed oil content (45.79%) followed by Dyari and Dhun seed sources on seed weight basis. However, on seed kernel basis Khargiri seed source recorded higher seed oil content (65.22%) which was closely followed by Dyari seed sources (*SAF, Nauni*).
- The physiological parameters in *Andrographis paniculata* were significantly affected by the application of organic manures and the presence of kinnow. The values for the physiological parameters of medicinal plants were higher under different agroforestry system as compared to open. Use of organic manures improved the physiological parameters in all the medicinal plants, with or without kinnow. However, photosynthetic rate, transpiration rate and water use efficiency were recorded minimum in open condition without kinnow and without application of organic manures. In case of light transmission ratio, higher values were found in plants grown in open i.e. without kinnow and organic manures (*SAF, Nauni*).
- Tree spacing influenced the growth parameters of *Grewia optiva* in terms of tree height, crown spread and number of branches. Three meter tree spacing was found best for crown spread; number of branches and per tree biomass production (leaves biomass, branch wood biomass, bast fibre yield and torchwood yield) (*SAF, Nauni*).
- The returns, gross and net, were highest from agri-silviculture system compared to agri-horticulture, agri-horti-silviculture and agri-silvi-horticulture systems because vegetable crops like tomato, capsicum, garlic and beans, high cash valued crops, were grown in it (*SAF, Nauni*).
- *Setaria sphacelata* (vars. Kajungula, Nandi and Narok), *Panicum maximum* (vars. patris green and green panic), *Chloris gayana,* and Hybrid Napier are potentially good species for improvement of sub-tropical grasslands of Himachal Pradesh (*SAF, Nauni*).
- Side veneer grafting was found better method of vegetative propagation in "Lasura". Sixty per cent success was recorded in Rudraksh when air layering was done in the month of July (*RH&FRS, Bhota*).

A Lasura plant raised through side veneer grafting at Nari-II Farm

- Wheat, barley, pea and dry coriander grown under *Toona ciliata* showed an increase in yield with the increase in the distance from tree trunk with maximum yield of 23.09 q h^{a-1}, 21.69 q h^{a-1}, 116.20 q h^{a-1}, 616 kg h^{a-1} at a distance of outside the tree canopy, respectively. Number of plants, plant height and number of tillers per plant of wheat under *Toona ciliata* tree were recorded significantly higher as 187.67 individuals, 92.62 cm and 4.08 tillers at a distance of outside the tree canopy, respectively (*SAF, Nauni*).
- Akarkara plants when grown at a spacing of 30 x 20 cm produced maximum values for plant height, weight of leaves per plant, root length, root surface area and belowground biomass as 20.09 cm, 6.21 g, 235,74 cm, 39.62 cm^2 and 1.23 g, respectively. However, planting density of 30 x 30 cm produced maximum number of flower heads and collar diameter with values of 33.53 and 4.66 mm, respectively (*SAF, Nauni*).
- Body weight and average daily gain (g/day) was higher in the animals under ban oak fed treatment group as compared to control group. Ban oak leaves feeding @ 1 kg/animal/day did not have any adverse effect on the growth performance and haematological profile of the crossbred heifers and the values of different parameters were well within the normal physiological range of the species. All the blood biochemical parameters were indicative of a positive nutritional status of the animals in ban oak fed treatment group (*SAF, Nauni*).
- Three cultivars of fodder grass viz., Setaria, Ginny and Napier were planted during March, 2012 and 2015 at 45 x 45 cm spacing in 2 x 2 m beds with seven replications. Data on two year trial on survival percentage of three fodder grasses revealed maximum survival (82.72%) in Setaria, followed by Napier (69.86%) and Ginny (61.86%). Maximum proliferation (6.46), plant height (150.54 cm), green grass yield per tuft (6.28) and dry grass yield (3.97) was found in Steria grass which is statistically different with other two species. The two species viz. Napier and Ginny was found at par with each other in all the character under study (*RHR&TS, Dhaulakuan*).

Setaria sphacelata

Panicum maximum

- Different strains of "Harar" were planted in the field. The survival percentage was found 92 per cent. The height of the plants varied from 2.1 feet (63 cm) to 6.7 feet (201 cm). The diameter varied from 1.2 to 4 mm. The maximum growth in harar plant was recorded as 6.7 ft in 5 x 6 genotypes and diameter (4.0 mm) in 7 x 3 genotypes. Minimum height (2.1 ft) was recorded in 3 x1 genotypes and diameter (1.2 mm) in 1 x 6, 3 x 6, 5 x 4 genotypes of harar F_1 generation. The results yielded significant variations in different genotypes (*RHR&TS, Dhaulakuan*).
- In carbon sequestration studies it was found that lower altitude chir pine forests sequestered lower carbon than the pine forests at high altitudes and the CO_2 mitigation potential was higher in forests on the eastern aspect (*RHR&TS, Jachh*).
- A trial consisting of 15 poplar clones sourced from different parts of North India, have been planted in the nursery in order to develop descriptors for characterization of poplar germplasm. A clone bank of poplars was established and about 15 clones namely., L-30/06, L-621/84, G-48, L-6105, S_7C_{15}, S_7C_8, WSL-22, WSL-39, 6503, 5503, 1007, L-200/86, PL-3, PL-6 and PL-7 planted in 3 replications at spacing 60 x 60 cm. The draft DUS guidelines were prepared and submitted to Protection of Plant Varieties and Farmers' Right Authority, Ministry of Agriculture, Government of India, New Delhi. These test guideline applied to all varieties of *Populus deltoides* (*TIGR, Nauni*).

- Line x Tester analysis in *Populus deltoides* was carried out at 2 different stages namely, nursery stage one and nursery stage two with the view to access the nature of gene action, combining ability and heterosis among different hybrids developed from selected clones of *Populus deltoides* in 4 x 4 (Line x Tester) crosses and to analyze their paternity pattern using SSR molecular markers (*TIGR, Nauni*).
- Among 18 SSR markers, fifteen markers showed monomorphic allelic pattern and remaining three markers (PMGC-2060, PMGC-2020 and PMGC-451) showed polymorphic pattern (*TIGR, Nauni*).

Field experimental trial of *Populus deltoides*

- Salix plant material of 4 females (PN 227, J 799, *S. babylonica* and *S. tetrasperma*) and 4 male (NZ 1140, Austree, J 795 and *S. tetrasperma*) clones were crossed using Line x Tester (4 x 4) mating design (*TIGR, Nauni*).
- Line x Tester analysis for combining ability revealed that line PN 227 and tester Austree were found to be good general combiners. On the basis of heterosis over better parent, mean performance and significant desirable SCA effects for morphological, physiological and wood characters the combinations PN 227 x Austree, PN 227 x NZ 1140 and PN 227 x J 795 were found to be the most promising families. The estimates of GCA variance (σ^2 GCA) were more than the SCA variance (σ^2 SCA) for all the characters studied. The gene action study revealed that additive variance was observed more than the dominance variance for all the parameters studied (*TIGR, Nauni*).

Controlled crossing of selected parents

Over view of field trial for hybrid (F_1) performance of willow clones

- A trial was conducted on genetic analysis for growth and oleoresin traits of chirpine (*Pinus roxburghii* Sargent.) to evaluate the different growth traits, needle characteristics and wood traits. Twenty one half sib progenies of chirpine from the progeny trail of 59 families established during 1985. All traits showed significant variation with mean values height, DBH, bark thickness, crown height, crown length , needle length, thickness number of stomata per mm or a row, wood moisture content, specific gravity and tracheid length were recorded 18.08 m, 34.76 cm, 2.73 cm, 7.80 m, 10.38 m, 20.78 cm, 0.61 mm, 9.71, 54.31 %, 0.41 and 1.68 mm, respectively. Molecular characterization through RAPD, ISSR and SSR markers revealed high polymorphic percentage 90.14, 94.84 and 100, respectively, with band size range 105-1490 bp, 198-2015 bp and 103-239 bp. Association mapping with different traits revealed 12,6 and 8 association with RAPD,ISSR and SSR markers, respectively. Maximum oleoresin yield (2417 g) recorded for genotype 30 (Kopra –P5) while minimum yield (200 g) recorded for genotype 2 (Leda -10) (*TIGR, Nauni*).

Half sib progeny trial of *Pinus roxburghii* established during 1985

- A experimental trail was carried out to evaluate various seed and germination parameters, morphometric and fodder quality traits of 20 best families of *Grewia optiva*. The proximate fodder analysis viz., crude protein, crude fiber, ash content, either extract and nitrogen free extract were ranged from 17.35-20-99 per cent, 17.00 - 21-51 per cent, 10-42 -21.50 per cent, 4.21-5.99 per cent and 40.41-50.24 per cent, respectively (*TIGR, Nauni*).
- SO-6 (Amberkothi), KA-3(Varal), HA-1 (Bharari) and KA-2 (Bhalun) families excelled as the best one for seed parameter traits. For morphometric progenies of families KA-3 (Varal), CH-2 (Shahu) and CH-5 (Rajpura) were found to be best among family. SO-6 (Amberkothi), KA-3 (Varal) and KA-1 (Dharmshala) excelled as the best for fodder quality traits. Variability estimates, genetic parameters and correlation studies exhibited high variability among all the families (*TIGR, Nauni*).

Seedling seed orchard and clonal seed orchard of *Grewia optiva* (Beul)

- In bamboo macro vegetative propagation studies indicated that percentage of culm cutting spouted and rooted was significantly higher due to auxins compared to control. NAA registered among the auxins deployed superior compared to other hormones in terms of per cent sprouting and rooting of culm cuttings. Among the various concentration of auxins (IBA, IAA and NAA), NAA,100 ppm at 12 hours soaking duration was found to be superior followed by NAA 200 pm at 12 hours soaking in cold water (*TIGR, Nauni*).
- The growth evaluation studies showed significant variations among 23 clones of *Dendrocalamus strictus*. Among the twenty three clones, four clones, viz., DS 3 (Matan Sidh), DS 10 (Ratera), DS 14 (Kulhwa) and DS 20 (Samella) consistently expressed superiority towards growth characteristics (number of culms, number of full grown culms, average culm height, culm diameter and average leaf length) (*TIGR, Nauni*).

Macro vegetative propagation and growth evaluation studies in bamboos

Morphogenetic variation of Seabuckthorn in Spiti valley

- Variability studies on *Quercus leucotrichophora* population in Himachal Pradesh was undertaken to study the variation in morphometric traits, progeny performance traits, physical and chemical evaluation of fatty oil and nutritional value of deoiled cake in four districts of Himachal Pradesh. For the morphometric traits the site S_8 (Salooni, district Chamba) was found best among the other seven sites and have maximum mean value for clean bole height (2.94 m), crown length

(22.97 m), crown width (5.52 m) and leaf area (46.01 cm^2), however, the site S_6 (Manikaran, district Kullu) is stastically at par and equally best and genotype 9 from the large diameter class showed superiority over small and medium diameter classes. For the germination traits again site S_8 (Salooni, district Chamba) found best and have maximum mean value for germination percentage (65.57) and survival percentage (78.58) and genotype number 1 from the small diameter class showed superiority over medium and larger diameter classes (*TIGR, Nauni*).

Variability in Ban oak population for morphometric traits and progeny performance

- Eighteen genotypes (based on growth performance and leaf nutritional value) were selected from a previously raised progeny trial and grafted on seedling stock of *Bauhinia variegata* to develop best performing clones. The individual ramets were evaluated after three and half years and the observations were recorded on plant height, basal diameter, leaf width, leaf length, number of branches per plant, petiole length and green leaf yield. Analysis of variance revealed significant differences among all the growth traits. Clone C15 recorded maximum height (4.20 m) followed by C1 (3.85 m). Maximum basal diameter (8.84 cm) was exhibited by C15. The highest leaf breadth (13.50 cm) and leaf length (13.28 cm) was shown by clones C9 and C1, respectively. Clone C15 recorded highest number of branches per plant i.e., 35 whereas maximum petiole length (4.53 cm) was exhibited by clone C1. Highest green leaf yield (1210.00 g) was recorded for C15 which was followed by C1 i.e., 1033.00 g. Based on the growth performance particularly with respect to green leaf yield, plant height, basal diameter and leaf size, clones C15, C1, C18 and C9 were found superior as compared to others (*TIGR, Nauni*).

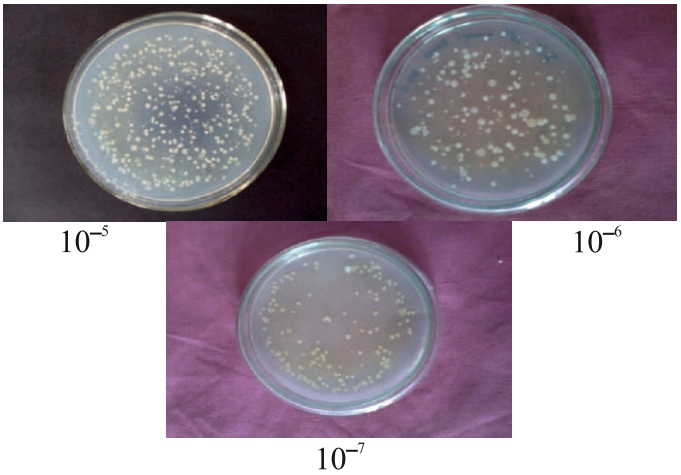
Progeny trial of *Bauhinia variegata*

- Assessment of genetic variability in *Acacia catechu* Willd (Khair) on the basis of growth habit and phenotypic superiority revealed that, the seed source Bhoj Nagar, district Solan followed by Jachh, district Kangra were found the overall best. Bhojnagar also proved better for the seedling growth potential statistically at par with Bilaspur and Subathu seed sources. On the basis of the seed traits Dilman, Maryog and Dhaulakuan of district Sirmour seed sources found to be promising. The half sibs subjected to amplification of genomic DNA, 39 bands were polymorphic, showing 90.6 per cent polymorphism. The unique bands were produced from progeny S_7 B and S_5 A. showing diversity and scope for hybridization (*TIGR, Nauni*).
- Ecological and genetic variation among natural populations of *Terminalia chebula* Retz. was studied in five natural populations of harar distributed in three districts of Himachal Pradesh

laying 5 quadrats of 30 x 30 m (900 sq m) size. Harar was dominant tree species in Jamun Ki Ser, Rakkar and Ghanu population with IVI of 109.01, 78.49 and 78.36 respectively, while Chir pine showed dominance in Praur and Bachhwain, with IVI of 142.38 and 78.36, respectively. Among shrubs *Lantana camara* was dominant species in Praur and Ghanu with IVI value of 96.37 and 63.73, respectively. Overall, seedling phenotypic variation was largely attributed to family and provenance effect except number of leaves, fresh and dry weight and dry root weight. Heritability value was higher to moderate for all the traits. Maximum family heritability observed for leaf area (0.99) whereas minimum family heritability value recorded for fresh shoot weight (0.53) (*TIGR, Nauni*).

Regeneration of *Terminalia chebula* in grassland at Rakkar

- Ecological Studies on Alpine Pastures/ Rangelands of Spiti, Himachal Pradesh was studied for village Demul (4200 m amsl), soil samples from alpine pasture above Demul (4450 m) were analysed for physical properties like pH, bulk density, particulate density, water holding capacity, conductivity, etc. Similarly, the soil samples were also analysed for microbial studies, which depicted that besides harsh conditions, the total microbial count on nutrient agar medium was found to range between 10^{-5} to 10^{-7} (*TIGR, Nauni*).

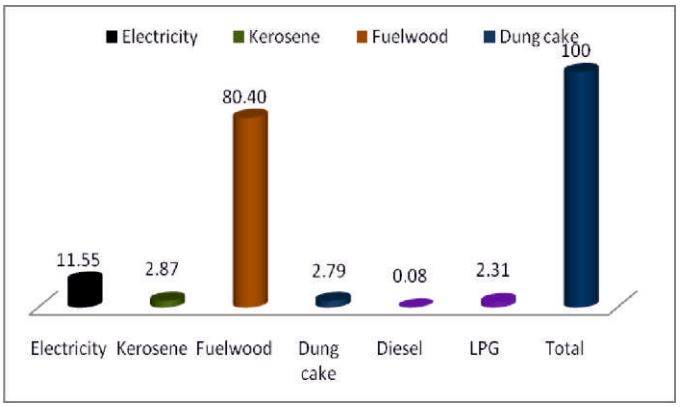


Total microbial count on nutrient agar medium

- Climatic variability analysis indicated that annual average temperature showed an increasing trend at different altitudinal gradients which followed an order as 0.071°C/year at Shimla > 0.027°C/year at Kullu > 0.001°C/year at Kinnaur. The effective apple chill units showed a decreasing trend at different altitudinal gradients followed an order as 11.4 chill units/year at 2000-2500 m amsl > 9.892 chill units/year at 2500-3000 m amsl > 6.385 chill units/year at 1500-2000 m amsl. Sensitivity analysis of apple productivity with maximum temperature revealed that with 1°C rise in annual maximum temperature there might be a decrease in apple productivity to the order of 4.83 tonnes/year at Kullu > 1.34 tones/year at Shimla > 0.68 tones/year at Kinnaur. On the basis of vulnerability index Kullu region falling within the altitudinal gradient of 1500-2000 m amsl has become highly vulnerable followed by Shimla within the range of 2000-2500 m amsl and Kinnaur within the gradient of 2500-3000 m amsl was noticed to be least vulnerable for apple cultivation. In order to adapt to climate variability about 29 per cent of farmers in Kullu region have shifted for the cultivation of alternate crops like pomegranate, kiwifruit, vegetables etc. in place of apple (*ES, Nauni*).
- The study was conducted on a uniform stretch on National Highway 21 from Bilaspur to Mandi in Himachal Pradesh. In order to study the impact of vehicular pollution six plant species namely *Adhatoda vasica, Ficus carica, Melia azederach,*

Morus alba, Murraya koenigii and *Toona ciliata* were selected at three horizontal distances i.e., 0-15, 15-30 and 30-45 m from roadside. The air pollution tolerance of the selected plants species followed an order of *Toona ciliata* > *Melia azederach* > *Adhatoda vasica* > *Ficus carica* > *Morus alba* > *Murraya koenigii*. The carbon storage potential of the selected plants ranged from 0.18 to 169.22 Mg per tree and followed the order of *Toona ciliate* > *Melia azederach* > *Morus alba* > *Ficus carica* > *Murraya koenigii* > *Adhatoda vasica* with respective values of 169.22, 110.90, 84.82, 55.28, 0.19 and 0.18 Mg per tree. Hence, *Toona ciliata* with its higher air pollution tolerance and anticipated performance index has been identified as suitable plant species for plantation along the National Highway. Its higher carbon sequestration potential may be helpful in mitigating the projected climate change in the region (*ES, Nauni*).

- In order to study the fuel consumption pattern and green house gas emission potential in Solan district of Himachal Pradesh a survey was conducted in Dharampur Block. In the region the highest energy is consumed in the form of fuel wood which was 57.25 million tonnes of coal equivalent (MTCE) followed by electricity (10.18 MTCE), LPG (2.23 MTCE), dung cake (1.89 MTCE), kerosene (0.70 MTCE) and diesel (0.09 MTCE). The study further indicated that about 80 per cent of the energy consumed by the household is being contributed by fuel wood. The consumption of fuel wood in the household contributed the annual CO_2 emission about 74,257 tonnes (80.64%) followed by dung cake 6,733 (8.13%), LPG 5,210 tonnes (4.40%), diesel 1,113 tonnes (0.96%) and electricity 7.25 tonnes (0.12%). In the industrial area only electricity and diesel are being used. The annual energy consumption of the electricity was the highest (127.33 MTCE). The diesel consumption was 0.035 MTCE only. The total estimated annual CO_2 emission in the region from households and industries was 93,885 tonnes, out of which households contributed 86,603 tonnes. As a whole the total annual energy consumed in block both by domestic and industrial sector was estimated as 1,127.04 million tonnes of coal equivalent (*ES, Nauni*).



- In order to study the fuel consumption pattern and greenhouse gas emission potential in Kangra district of Himachal Pradesh a survey was conducted in Fatehpur Block. The highest energy consumption in the region was in the form of fuel wood (932.08 TCE) followed by electricity (93.41 TCE), kerosene (10.84 TCE), LPG (10.54TCE) and dung cake (1.63 TCE). In the region the study indicated that about 89 per cent of the energy consumed by the households is being contributed by fuel wood. The use of fuel wood in the household contributed the annual CO_2 emission about 1,208.88 tones followed by LPG (24.65 tonnes), kerosene (4.35 tonnes), electricity (0.005 tonnes) and dung cake (5.79 tonnes) (*ES, Nauni*).
- To assess the impact of industrialization in Paonta Sahib - Dhaulakuan - Kala Amb area, 62 industrial units were selected by using simple random sampling. On the basis of pollution potential categorization industries were sub-divided into red (highly polluting), orange (moderately polluting) and green (non-polluting). These two sub-categories had ten industries in total out of which five produce cement and five was in glass production. Metal industries included three sub-categories viz., iron and steel, ferroalloy and aluminium. A total of nineteen industries were covered under this category. GHGs viz., CO_2 (749.298 Gg), CH_4 (0.024 Gg), N_2O (0.067 Gg), CO (1.344 Gg), NMVOC's (2.810 Gg) emitted from Paonta Sahib-Dhaulakuan-Kala Amb industrial hub region annually. In terms of CO_2 eq. metal industry released (751.734 Gg CO_2 eq.) the

highest amount followed by other industries (528.140 Gg CO_2 eq.) and mineral industry (44.078 Gg CO_2 eq.). Values of different parameters of pulp and paper industrial effluents were high in pre-monsoon as compared to post monsoon season. Principal component analysis (PCA) outcome of three and two factors revealed natural and anthropogenic activities as contributing factors for metal profusion in the rivers. Based on pollution index, Cr, As and Zn were seriously (24.74), moderately (0.616) and slightly (0.380) polluting metals, respectively noticed in Yamuna river. Parameters like Zn, As and NO_3 were slightly polluting, while COD (moderately), BOD (strongly) and Cr (seriously) polluting, respectively in Markanda river. Ground water quality was overall good and heavy metals accumulated in leaf samples of major cereal crops like wheat and maize were below permissible limits (*ES, Nauni*).

- Plants due to C_3 photosynthesis mechanism accumulate more biomass under increased CO_2 concentration of the atmosphere. Preliminary studies under open top chamber conditions indicated improvement in growth parameters of bell pepper and pea crops. Yield increment was 33 and 15 per cent in pea and bell pepper crops with elevated CO_2 of 550 ppm in mid hill region of Himachal Pradesh. The variety Solan Bharpur of bell pepper and PB-89 of pea crop was found to be benefitted by elevated CO_2 level (*ES, Nauni*).
- In *Pinus roxburghii* maximum oleoresin yield in bore hole method was recorded with chemical treatment of HCl 10 per cent + 20 per cent Ethephone (1983.89 g). The highest oleoresin yield (528.00 g/hole/tree) was recorded in diameter class of 45-50 cm with chemical concentration of HCl 10 per cent + 20 per cent Ethephone. The maximum oleoresin yield of 643.25 g/hole/tree was obtained from third borehole with HCl 10 per cent + 10 per cent Ethephone of chemical concentration. Highly significant and positive environmental correlation was observed between oleoresin yield and maximum temperature (*FPU, Nauni*).
- Studies on *Lannea coromandelica* (Houtt.) Merr. wood characteristics using plant extracts of *Lantana camara* and *Ageratum conyzoides* as biopreservatives revealed that maximum value of specific gravity was recorded at 2.00 per cent concentration, whereas maximum swelling and shrinkage of wood samples have been recorded for tangential plane followed by radial and longitudinal planes. The highest volumetric swelling and shrinkage coefficient were observed for *Ageratum conyzoides* at 2.00 per cent and control, respectively. Per cent variation in weight of treated and untreated wood on dry weight basis (swelling) and wet weight basis (shrinkage) were found to be maximum for *Lantana camara*. The extract treated wood samples have shown an increased dimensional stability over untreated samples. With increase in plant extract concentration the chromium retention in wood increased (up to 1%) and was found maximum for *Ageratum conyzoides* treated samples where, petroleum ether was used as a solvent. More variation in swelling and shrinkage after chromium absorption was observed in *Lantana camara* treated wood samples. The maximum fungus colonization was observed in untreated samples. The decay test up to 3 months showed more weight loss as compared to 2 months. The treatment of samples at higher concentrations where, petroleum ether was used as a solvent proved to be effective in protection against the fungal degradation (*FPU, Nauni*).
- Collection, domestication and maintenance of medicinal and aromatic plants have been carried out at RHR&TS, Bajaura (1090 m amsl); FRS, Manali (2050 m amsl) and MPRS, Rahla (2700 m amsl) with the objectives of development of herbal garden and conservation of endangered and high value species of medicinal and aromatic plants. About forty five species have been domesticated and being maintained in these herbal gardens. Some of the important species includes: *Berberis aristata, Glycirhiza glabra, Ocimum sanctum, Rosa damascena, Viola odorata, Taxus baccata, Withania somnifera, Aloe vera, Picrorhiza kurrooa, Aconitum heterophyllum, Lipia alba, Aloe barbadensis, Vitex negundo* and *Xanthoxylum armatum* etc. (*RHR&TS, Bajaura*).

Bulgarian rose (*Rosa damascena*)

Puja Tulsi (*Ocimum sanctum*)

Kemuk (*Costus speciosus*)

Banfsha (*Viola odorata*)

Ghrit Kunwari (*Aloe vera*)

Jangli Kuth (*Arctium lappa*)

Rattan Jot (*Arnebia euchroma*)

Nihani (*Nardostachys jatamansi*)

Kutki (*Picrorhiza kurrooa*)

Atis/Patish (*Aconitum hetrophyllum*)

Pashanbhed (*Berginia ciliata*)

Fossil tree (*Ginkgo biloba*)

- Studies on the effect of *Acorus calamus* L. rhizome extract treatment on chromium absorption and retention in different wood samples of *Pinus roxburghii* Sargent, *Celtis australis* L. and *Bombax ceiba* L. revealed maximum chromium absorption (%) and chromium retention (%) has been found at 10 per cent chromic acid concentration and minimum at 5 per cent chromic acid concentration. The maximum chromium absorption (27.18%) has been found in *Pinus roxburghii* Sargent and minimum (6.95%) in *Bombax ceiba* L. *Acorus calamus* L. rhizome extract has potential to fix the chromium after bio-preservation and this fixative retention increase with increase in extract concentration. With this bio-preservation there would be less leaching of harmful fixative from wood which reduce health and environment hazards (*FPU, Nauni*).
- Wild and cultivated *Aconitum heterophyllum,* the species has been found amenable for domestication/cultivation which gives higher tuber yield as compared to wild conditions. Vegetative characters as well as tuber yield are positively impacted by domesticated conditions. A unique population (Chansal population), in terms of flower colour (Bluish purple), some flowers with six sepals (as against five normally), dark green coloured anthers (as against yellow) and some flowers with six to seven ovaries/follicles (normal five) have been identified. Based on these floral characters this population appears to be unique amongst all *Aconitum heterophyllum* populations studied, which was also confirmed through RAPD analysis. Conservation measures are needed to conserve this population (*FPU, Nauni*).

- In *Podophyllum hexandrum* floral bud development starts underground before onset of winter and flower sprouts after snow melting only. Pollination studies resulted that the species is mostly self pollinated (58.15%) and produces pollen in groups of four, which is an adaptation towards low pollinator activity. Considerable variation in number of ovules (50-190) per flower (only one flower per plant/season) points to the possibility of plants with different ovule numbers in nature thereby giving different seed yields. No correlation between seed position within berry and seed germination was found indicating no such role in dormancy (*FPU, Nauni*).
- Thirty two collections of *Tagetes minuta* from Himachal Pradesh were evaluated for growth and yield parameters. The maximum oil percentage in leaves was in population TMHP-30 (0.34%) and minimum was in TMHP-3 (0.21%). The maximum oil yield per hectare in leaves was observed in TMHP-32 (17.64 litres) and minimum was observed in TMHP-3 (9.98). The maximum fresh flower biomass (46.62 q) per hectare was observed in TMHP-1, TMHP-8, TMHP-27 and minimum was observed in TMHP-14 (12.95 q). The maximum oil percentage in flowers was in population TMHP-11 (0.64%) and minimum was in TMHP-16 (0.37%). The maximum oil yield per hectare in flowers was observed in TMHP-24 (20.7 litre) and minimum was observed in TMHP-14 (5.67 litre) (*FPU, Nauni*).
- Hydroponic system has been installed in the polyhouse for producing lettuce under nutrient film technique. For making nutrient film, commercial hydroponic fertilizer was used and *jeevamrut* used as a spray (5%) keeping one gully as control without *jeevamrut* spray. *Jeevamrut* treated crop was ready in 27 days with healthy leaves and average root length of 28 cm roots while the treatment without *jeevamrut* matured in 33 days with average root length of 21 cm. The nutrient contents of commercial fertilizer and *jeevamrut* were also determined (*SSWM, Nauni*).

Comparison of nutrient contents of commercial hydroponic fertilizer and *jeevamrut*

Nutrient	EC (dS/m)	pH	N (mg/lt)	P (mg/lt)	K (mg/lt)	Cu (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
Commercial fertilizers	0.70	6.7	160	40	23.5	0.19	8.0	2.30	0.7
Jeevamrut	0.45	5.3	112	34	22	0.24	8.0	1.14	0.6

Healthy plants with healthy roots under nutrient + *jeevamrut*

Control without *jeevamrut*

- Precision Farming Development Centre conducted environmental studies for 3 years on different models of polyhouses in different agro-climatic zones. The data on minimum and maximum temperature and relative humidity inside the polyhouse it can be inferred that NV polyhouse-I is suitable for hot areas where temperature is in the range of 35-40^{0}C while NV polyhouse-II is suitable for hot areas having temperature range of 30-35^{0}C. Fan and pad system polyhouse is also suitable for hot areas but requires extra cost and facilities. Gothic type polyhouse is suitable for cold areas experiencing snowfall (*SSWM, Nauni*).

Suitability of models of polyhouses for different agro-climatic zones

Polyhouse model	Temperature (^{0}C)		Relative Humidity (%)	
	Maximum	Minimum	Maximum	Minimum
Naturally ventilated poly Nethouse - I	44.28	(-) 2.20	78.60	24.12
Naturally ventilated polyhouse - II	46.21	(-) 2.80	84.23	32.00
Fan - pad system polyhouse	45.07	(-) 1.65	87.53	36.00
Gothic type polyhouse	52.89	2.36	94.00	43.52

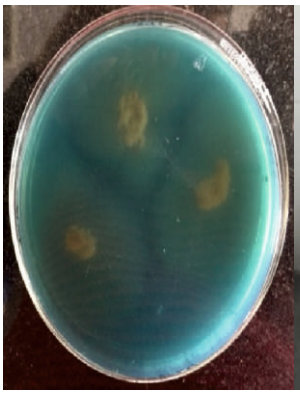
NV Polynethouse-I

NV Polyhouse-II

Fan and pad polyhouse

Gothic type polyhouse

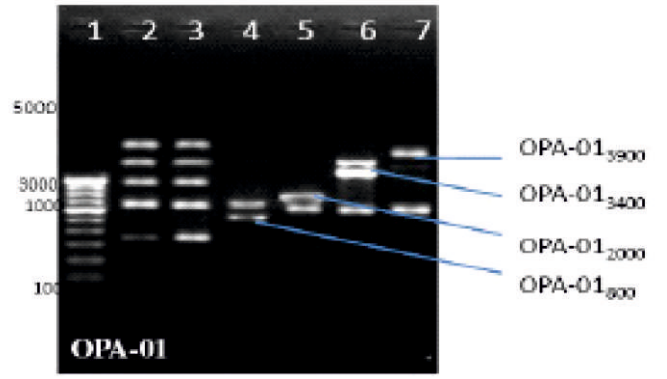
- The authentication of *Frankia* was carried out by growing the culture in liquid medium and no turbidity was noticed even after for 4-5 weeks of inoculation. Further, the colonies remain undisrupted even when shaken on mechanical shaker. These colonies were usually located at the bottom of the vials/flasks and often adhering to the glass wall (*SSWM, Nauni*).
- On the basis of morphology and liquid authentication test, isolates of *Casuarina equisetifolia* and *Alnus nitida* were screened for PGP traits i.e., P-solubilization, growth on N-free medium, Hydrogen cyanide (HCN) production and siderophore production (*SSWM, Nauni*).



Siderophore production activity (yellow zone) by isolates on CAS medium

Authentication of Frankia isolates on *Casuarina equisetifolia*

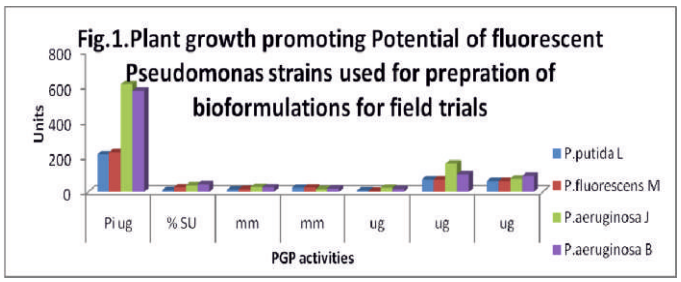
- The farmers are advised to irrigate the pea crop (during winters) with sprinkler irrigation during evening hours (4:30 PM) to get maximum yield and quality of green pod yield. The irrigation should not be applied during morning hours as it may lead to higher disease incidence (*SSWM, Nauni*).
- The soil samples from NICRA village and various other locations of Kinnaur district were collected and analysed. The soils were found near neutral and generally low in nitrogen. The organic carbon is medium to high, very high phosphorus content and medium to high potash was recorded (*RHR&TS, Sharbo*).
- Chlorpyrifos degrading bacteria from apple orchard soils of Himachal Pradesh were isolated. They were screened for extracellular and intracellular organo phosphorus hydrolase enzyme production by measuring its activity and characterised at molecular level (*BT, Nauni*).

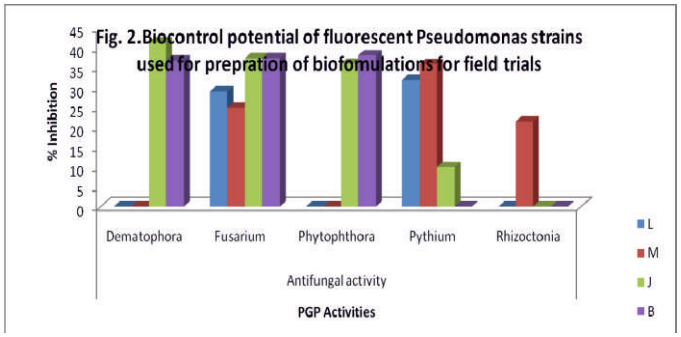


Lane 1: 5 kb ladder Lane 4: $S_3T_{2.1}$ Lane 7: $S_4M_{1.1}$
Lane 2: $S_1K_{3.2}$ Lane 5: $S_3T_{2.2}$
Lane 3: $S_2R_{1.1}$ Lane 6: $S_3T_{3.2}$

Molecular characterisation of chlorpyrifos degrading bacterial isolates by 16S *rrna* gene technology

- Thirty four fluorescent *Pseudomonas* isolates from rhizosphere of apple were screened out for multifarious plant growth promoting activities *viz.*, phosphate solubilization, siderophores, protease, HCN, ammonia and plant growth regulator production and antifungal activity. Significant productions of plant growth promoting activities were recorded from all the strains (*BS, Nauni*).





- For field trials with liquid bioformulation of fluorescent *Pseudomonas* sp. viz., L, M, J and B, three replant sites i.e., Maggota, Sharontha and Siao (Shimla district) were selected and used to treat apple rootstocks (at Maggota) and plants (at Sharontha and Siao). Field trial was started in March, 2013. The inoculums of these fluorescent *Pseudomonas* strains viz., L, M, J and B were applied individually and in different combination of two, three and four strains to treat basins of plants, respectively at an interval of three months from March, 2013 to October, 2015. Per cent survival of apple plants was 60.00 to 100.00 per cent in all the three replant sites as compared to 60.00 to 80.00 per cent in control plants after three years of cyclic treatment. Overall per cent increase in plant height as compared to control at all the three experimental sites with all the treatments with individual and consortial strains was 0.1- 63.26 per cent, 22.8-79.8 per cent and 43.2-121.6 per cent at Maggota, Sharontha and Siao, respectively. At all the three sites treatment with formulation of four strains viz., L+M+J+B were found to be more effective in increasing the plant height followed by treatment with consortia of three strains and that of two strains and individual in the following order: Consortia of four - 121.6 per cent I (Siao) >79.8 per cent I (Sharontha) > 63.26 per cent I (Maggota). Consortia of three- 44.0-102.4 per cent I (Siao) > 46.3-65.1 per cent I (Sharontha) > 18.36-59.1 per cent I (Maggota). On an average there was per cent increase in number of nodes over control in all the treatments with different formulation of individual and consortial strains of fluorescent *Pseudomonas* strains L, M, J and B at all the three experimental sites after three years of plantation. At Maggota, Sharontha and Siao, per cent I in number of nodes was found to be in the range of 0.1 to 54.2 per cent, 0.1 to 31.8 per cent and 24.2 to 100.7 per cent respectively (*BS, Nauni*).
- Overall results on NPK content of rhizospheric soil and total chlorophyll content of leaves revealed that the augmentation of fluorescent *Pseudomonas* strains viz., *Pseudomonas putida* L, *Pseudomonas fluorescens* M and *Pseudomonas aeruginosa* J and B can increase the

available NPK content of soil and chlorophyll content of leaves (*BS, Nauni*).

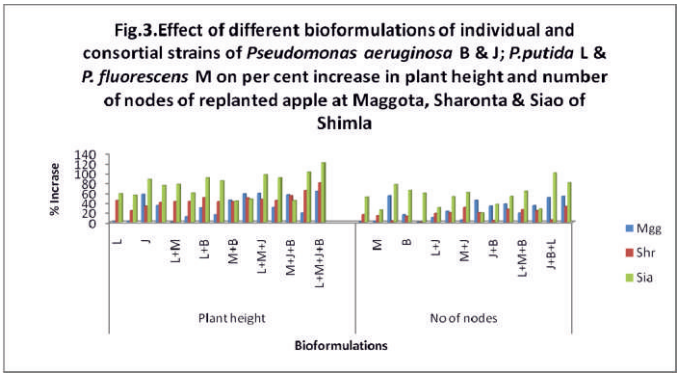


Fig.3.Effect of different bioformulations of individual and consortial strains of *Pseudomonas aeruginosa* B & J; *P.putida* L & *P. fluorescens* M on per cent increase in plant height and number of nodes of replanted apple at Maggota, Sharonta & Siao of Shimla

- The potential fluorescent *Pseudomonas* strains viz., *Pseudomonas putida* L, *Pseudomonas fluorescens* M and *Pseudomonas aeruginosa* J and B were also formulated *in vitro* using different organic (cocopeat, farm yard manure, spent mushroom substrate, vermicompost) and inorganic carriers (bone meal, ground rock phosphate).In case of organic formulation, cocopeat was found to have the longer shelf life of 7 months followed by vermicompost (6 months). The maximum population survival after 7 months of storage was found to be 11-39 x 10^8cfu/g in all the individual and consortial combination in cocopeat whereas the minimum was found in spent mushroom substrate (2-6 x 10^8 cfu/g) after 5 months of storage. In case of inorganic carrier tested the maximum population survival of 1-6 x 10^8 cfu/g was observed in bonemeal followed by ground rock phosphate (4-13 x 10^8 cfu/g) after 3 and 2 months storage, respectively. Further, the application of carrier based viz organic and inorganic bioformulations of consortia of three strains (J+L+M) brought a significant increase in plant height, number of nodes, chlorophyll content and available NPK content of soil after seven months of plantation in replant site of orchard at Maggota (*BS, Nauni*).
- The maximum per cent increase over control in plant height was recorded in cocopeat bioformulation viz., cocopeat + (J+L+M) (32.0%) followed by ground rock phosphate + (J+L+M) (21.3%) whereas the maximum (31.4%) per cent increase over control in case of number of nodes was observed in case of cocopeat + (J+L+M) and spent mushroom substrate + (J+L+M) followed by vermicompost + (J+L+M) i.e. 25.6 per cent (*BS, Nauni*).
- The organic acids present in the root exudates of treated and control apple plants were quantified by HPLC. The different organic acids viz., oxalic acid, malic acid, acetic acid , citric acid and fumaric acid were identified by HPLC and the concentration of organic acids varied in control and bioformulation treated apple plant (*BS, Nauni*).
- The desired apple pomace waste was collected from the dumping sites of HPMC, Parwanoo. Upon chemical compositional analysis of this substrate, it yielded 36 per cent of cellulose, 11 per cent of hemicellulose, 19 per cent of lignin, 8.6 per cent of starch and 16.6 per cent of pectin. Isolation of efficient hydrolytic enzymes producing microorganisms has been done for the production of potential hydrolytic enzymes and on the basis of their qualitative and quantitative assays, screening of different isolates was done and hyper-enzyme producers were identified using 16sRNA as *Brevibacillus parabrevis* C1 and *Streptomyces* sp. C5. Optimization of different process parameters was done under submerged/ solid state fermentation using COFAT and RSM for enhancing titers of enzymes significantly. Purification and characterization of hydrolytic enzymes were done for further increasing the efficiency and purity of pectinase activity. A cocktail of different hydrolytic enzymes was standardized for maximum saccharification of apple pomace. The saccharified syrup produced from hydrolytic action of enzymatic cocktail along with fermenting sugars of pomace had been bioconverted to ethanol by employing suitable ethanologens in different co-culture combinations. The best yield of ethanol with high fermentation efficiency was obtained using co-culture of yeast with optimized inoculum size and incubation time. The process will be scaled up further by exploring various process parameters for its commercial feasibility (*BS, Nauni*).

- Among proteolytic bacterial isolates, ten best isolates selected on the basis of their ability of protease production at pH 7.0 for 72 h of incubation at 37°C in skimmed milk medium. The quantitative protease production of selected 10 isolates has been detected. Maximum protease activity was observed for isolate 52S i.e., 1351.00 µg/ml/min followed by 24S (450 µg/ml/min) and minimum was observed for the isolate 30C i.e., 50.00 µg/ml/min (*BS, Nauni*).

- The selected best treatment of *Bacillus licheniformis* CKA1 (i.e., soil drenching of apple plant basin with one litre of liquid formulation diluted to five liters) was demonstrated in the fields at five different locations of Shimla district. The application of liquid formulation increased the yields of apple by a range of 11.62 to 86.15 per cent at all the five locations over uninoculated control (*BS, Nauni*).

Effect of liquid formulation of *Bacillus licheniformis* CKA1 on growth and yield of apple at different locations

Treatments	Yield (Kg/tree)				
	RHRS Mashobra	Farmers field Matiana (Nanni)	Farmers field Matiana (Sabloab)	Farmers field Thanedhar (Shatla)	Farmers field Kotkhai (Kyari)
Un	15.43	10.53	84.5	60.00	59
CKA1 inoculated	19.94 (29.00)	14.88 (41.31)	112 (32.54)	89.76 (49.60)	84.2 (42.71)

Figures in parenthesis are per cent increase over control

General view of field trial of apple at Nanni, Matiana Shimla

- The selected best treatment (75% NP fertilizers + *Bacillus pumilus*- MK_5 isolate) combination was demonstrated in the fields at three locations at Nauni (Solan), Dharja (Solan) and Jachh (Kangra). The conjoint application of *Bacillus pumilus*- MK_5 + 75 per cent NP (N_{94}, P_{57} & K_{72}) fertilizers increased the yields by about 22.0 per cent at all the three locations over recommended dose of NPK (N_{125}, P_{76} & K_{72}) besides saving of 25.0 per cent NP through chemical fertilizers (*BS, Nauni*).

Effect of MK_5 isolate at 75 per cent levels of NP treatment on growth and yields of cauliflower

Treatments	Curd yield (q/ha)		
	Nauni(Solan)	Dharja (Solan)	Jachh (Kangra)
Recommended package of practices N_{125}, P_{76} & K_{72}	186.9	280.4	270.0
MK_5+N_{94}, P_{57} & K_{72}	236.2 (26.40)	346.8 (23.6)	312.0 (15.5)

Figures in parentheses are per cent increase over package of practices for cauliflower

- The selected best treatment (60% N fertilizers + *Rhizobium leguminosarum* – R2 isolate) combination was demonstrated in the fields at three locations at Nauni (Solan), Rajgarh (Sirmour) and Kandaghat (Solan). The conjoint application of *Rhizobium leguminosarum* R2 isolate + 60 per cent N fertilizers increased the yields by about 26.0 per cent at all the three locations over recommended dose of chemical fertilizers NPK besides saving of 40 per cent N through chemical fertilizers (*BS, Nauni*).

Effect of *Rhizobium leguminosarum* -R2 isolate at 60 % levels of N treatment on growth and yields of pea

Treatments	Curd yield (q/ha)		
	Nauni(Solan)	Rajgarh (Sirmour)	Kandaghat (Solan)
Recommended package of practices	118.0	112.30	103.6
R2+60 per cent chemical N fertilizer	138.40 (17.3)	142.10 (26.5)	139.80 (34.9)

Figures in parentheses are per cent increase over package of practices for pea

- Regression analysis was used to estimate the volume (V) of eucalyptus trees on the basis of diameter (D) and height (H) by using ordinary least square estimation method. For the construction of one way volume table, quadratic model ($V= 0.0044 - 0.2574\ D + 9.3784\ D^2$) was observed best fit on the basis of maximum R^2 value (0.97) and minimum root mean square error (0.0010), whereas linear model ($V = 0.0003 + 0.7842\ D^2H$) was observed best fit for the construction of two way volume table on the basis of highest R^2 value (0.96) and least root mean square error value (0.0282). These models may be used for the construction of volume table (*BS, Nauni*).
- Different statistical models were developed to predict the area and production of mango and potato. Second degree parabola and first order autoregressive model can be used to predict production of mango and potato in Himachal Pradesh (*BS, Nauni*).
- Studies on growth and physio-biochemical responses of *Coriandrum sativum* to water deficit of various magnitudes i.e., 25, 50 and 75 per cent revealed reduction in growth, seed yield and seed quality with maximum reduction of 44.4 per cent in seed yield per plant registered for plants subjected to 75 per cent water deficit, followed by reduction of 30 per cent at 50 per cent water deficit, whereas no substantial reduction was observed at 25 per cent water deficit indicating the better ability of plants to cope with water stress conditions compared to higher water stress levels. Physiological and biochemical indices viz. chlorophyll fluorescence, canopy temperature depression and water potential were also tested in coriander which revealed that 75 per cent water deficit could not maintain better equilibrium between anabolic and catabolic processes and plant water relations, resulting in substantial reduction in growth and seed yield, which was maintained to greater extent at 25 per cent water deficit, resulting in sustaining growth and yield at 25 per cent water deficit. Water stress imposed at flowering phase was found to be very crucial to affect seed yield. Relative accumulation of osmoregulating substances e.g., amino acids, total free proline, total soluble sugars and activities of anti-oxidant enzymes namely catalase, dehydrogenase and peroxidase were in accordance with the growth and yield reduction at different stress levels. Maximum per cent recovery of 50.4 per cent was registered by the coriander plants subjected to 25 per cent water stress followed by 32.9 per cent at 50 per cent water stress, whereas plants subjected to 75 per cent water stress have undergone very low recovery i.e., 9.5 per cent indicating the permanent detrimental effects of water stress on plant growth, seed yield and quality, which is also reflected by substantial reduction in yield at higher water deficit (*BS, Nauni*).
- The pH and temperature of 26 water samples collected from three different hot water springs representing 10 samples from Manikaran, 10 from Tattapani and 6 from Vashisht were

determined. The variability in pH was studied in all the 26 samples and the data revealed that pH ranged from 4.2 to 6.6. The results also revealed that pH in all the samples was below the neutral pH of 7.0. The data showed that the pH of water ranged between 4.3 and 6.1 in the Manikaran hot water springs, between 5.5 and 6.6 in the Vashisht hot springs and 4.2 to 6.0 in Tattapani hot water springs. The maximum pH of 6.6 was recorded in VIII sample of Vashisht site and the minimum pH of 4.2 was observed in TI sample of site Tattapani. Bartlett chi-square test was applied to test the homogeneity of variances among the three sites. Chi-square calculated value was less than the chi-square table value which indicated that the variances were homogenous (*BS, Nauni*).

- The data recorded on the temperature of water collected from different hot springs. The data revealed that temperature ranged from a minimum of 40.0°C to a maximum of 105.0°C in all the three sites. The data also revealed that the temperature varied from 59.0 to 105.0°C in Manikaran site, 95.0 to 104.0°C in the Vashisht site and 30.0 to 80.0°C in the Tattapani site. It was found that M1(I) sample of Manikaran site from Kullu district showed a maximum temperature of 105.0°C and samples T1(I) of Tattapani site of Mandi district showed the minimum temperature of 30°C. Bartlett chi-square test was applied to test the homogeneity of variances among the three sites. Chi-square calculated value was less than the chi-square table value which indicated that the variances were homogenous (*BS, Nauni*).
- A hot spring is produced by the emergence of geo-thermally heated ground water from earth's crust. The hot spring has high sulphur content and hence warrants a therapeutic value to the human beings. The physical properties of the water collected from hot springs are responsible for the kind of microorganisms inhibiting in them (*BS, Nauni*).
- Three prominent pigment producing isolates namely M1 and MS2 from Manikaran, V1 from Vashisht, were selected out of 44 isolates from the 26 water samples on the basis of color sharpness. These isolates produced yellow, orange and pink color shades, respectively. They were identified as *Micrococcus* sp. (M1), *Micrococcus* sp. (*roseus*, V1) and *Sarcina* sp. (MS2) (*BS, Nauni*).
- The selected pigment producing bacterial isolates were marked on the basis of their morphological and biochemical characteristics. Gram's staining reaction for pigment producing bacterial isolates was performed to check the gram's reaction and shape of bacterial isolates. The gram's reaction of the bacterial isolates was determined by light microscopy after gram staining. All the bacterial isolates exhibited blue-purple color by gram staining. The results showed that the selected pigment producing bacterial isolates were gram positive and coccus shaped. Bacterial isolates were found to be non-motile, capsule forming (*BS, Nauni*).
- A series of biochemical tests viz., carbohydrate utilization, catalase, oxidase, citrate and NaCl utilization, and H_2S production were performed for identification on the basis of biochemical tests for the selected pigment producing bacterial isolates. The results on various biochemical tests revealed that all the three pigment producing bacterial isolates were catalase, oxidase and utilize citrate and negative for H_2S production. According to Bergey's manual the M1, V1 and MS2 isolates were identified on the morphological and biochemical tests as yellow color producing *Micrococcus* sp, pink color producing *Miccrococcus* sp. *(roseus)* and orange red color producing *Sarcina* sp. (*BS, Nauni*).
- Isolation of bacterial strains from collected water and compost samples was done by serial plate dilution and spread plate method on nutrient agar (NA) and were incubated at 30°C. Total bacterial count on nutrient agar as $\log_{10}$ cfu/ml was recorded (*BS, Nauni*).
- The pure culture of bacteria were inoculated in the plates and incubated at 30°C for 48 h on starch agar media. Then starch agar plates having growth of bacteria were flooded with Gram's Iodine Solution. The formation of clear zone around the bacterial colonies were observed which indicated starch utilization (*BS, Nauni*).

Formation of clear zone around the bacterial colonies isolated from water samples indicating starch utilization.

- Economic analysis of drip irrigation system has revealed "drip utility" in the light of relative scarcity of water in the state, hence, there has been a need of enhancing irrigation potential through micro and macro level planning of water resources so that water is variable during the water deficit period for drip systems. In the light of importance of drip, growth of drip irrigation has been at the annual compound growth rate of 119 per cent in the country has been found (*SS, Nauni*).
- Annual compound growth rate of productivity of total fruits grown in Himachal Pradesh, has been worked out to be (+) 2.5 per cent for 2002-2014, showing increasing trend of productivity of fruits in the state. However, research and development efforts are needed to bring this development rate still higher at national level (*SS, Nauni*).
- Economics of *harar* in the state revealed that it contributed 39.62 per cent to farm income in on marginal farms, whereas, its contribution was 29.84 per cent on the overall category. The average cost of collection of "*harar*" was found Rs.1042.01 per quintal (*SS, Nauni*).
- Study of the socio-economic indicators of the polyhouse vegetable cultivators revealed that majority of the sampled households had nuclear families, with an average family size of 5 people. A literacy rate of 93.5 per cent was found with a literacy index of 3.52. The cultivation of cereal crops was more common among all the polyhouse farmers followed by vegetables crops. Cropping intensity of 155.86 per cent was found at overall level which is suggestive of the fact that scope to enhance the farm income still exists. Of the initial investment, the proportion of polyhouse cost varied between 91.62 to 95.50 per cent among the different sizes of polyhouse revealing the fact that polyhouse cultivation is capital intensive farming requiring higher investments (*SS, Nauni*).
- Financial analysis of polyhouse cultivation of vegetable and floriculture crops revealed that cultivation of floriculture crops is highly feasible as compared to vegetable crops. As IRR was found to vary between 31 to 37 per cent in carnation 24 to 38 in rose and 16-20 per cent in chrysanthemum (*SS, Nauni*).
- An economic study of high hill temperate wet zone of Himachal Pradesh revealed that the Non-Timber Forest Products (NTFPs) contribution was maximum (28.86%) in the total income on marginal farms whereas, in small farms NTFPs contribution was 20.87 per cent. On an average, 24.99 per cent of the total farm income in the study area was due to the NTFPs contribution. Gini coefficient value without NTFPs income as 0.20, which reduced to 0.18 with the inclusion of NTFPs income, reducing the income inequaity in the study area. Hence, NTFPs are reducing the income inequalities. NTFPs collection generated on an average 72 days of employment to sampled households. Maximum number (20 days) of employment was provided by Dhoop (*Jurinea macrocephala*). Among all NTFPs, maximum income (65.85%) was obtained from Kutki (*Picrorhiza kurroa*) on the overall category, whereas, minimum (1.14%) share was from Sugandhbala (*Valeriana jatamansi*) (*SS, Nauni*).
- The nominal price elasticity for Guchhi (*Morchella esculenta*) (0.92), Patish (*Aconitum heterophyllum)* (0.74) and Sugandhbala (*Valeriana jatamansi*) (0.16) was found less than one which indicated that supply of these medicinal plants is highly inelastic. Real price elasticity analysis showed that *Picrorhiza kurroa* (13.02), Akhnor (*Aeculus indica*) (10.31) and Guchhi (*Morchella esculenta*) (1.30) are highly price sensitive species. Real price elasticity of Patish (*Aconitum heterophyllum*) and Sugandhbala (*Valeriana jatamansi*) and Dhoop (*Jurinea macrocephala*) was found less than one which indicated that supply for these medicinal plants is highly price insensitive (*SS, Nauni*).

- Medicinal plants like Kutki (*Picrorhiza kurroa*), Guchhi (*Morchella esculenta*) and Patish (*Aconitum heterophyllum*) showed positive scarcity ratios, showing their scarcity in the nature. The scarcity ratio was found highest in Guchhi (*Morchella esculenta*) (56.36) followed by Patish (*Aconitum heterophyllum*) (8.20) and Kutki (*Picrorhiza kurroa*) (1.37) whereas, scarcity ratio of Dhoop (*Jurinea macrocephalla*) (-045), Sugandhbala (*Valeriana jatamansi*) (-0.67) and Akhnor (*Aesculus indica*) (0.95) was found negative, indicating their abundant availability in nature (*SS, Nauni*).
- A study on impact of climate change in socio-economic and ecological conditions was done. The regression analysis of secondary data on maximum temperature revealed the increasing trend (0.085°C/year) whereas, regression analysis on minimum temperature and rainfall revealed the decreasing trend. Rainfall showed positive effect on the major cereal crops i.e. with increase in rainfall crops yield were also increasing. The household farming activities was constrained by the wildlife related shocks (76.66%) followed by lack of irrigation facilities (56.67%) and low marker price for crops (56.67%). At block level diversity index was found lower in villages of Solan block with a diversity index of 0.09 followed by Kandaghat (0.10) and Kunihar (0.17) block. Hence, it can be concluded that area with minimum crop diversity index is less susceptible to changing climate and less vulnerable. Vulnerability index study showed that districts Chamba and Mandi were classified as "very highly vulnerable" districts during 2003 whereas in 2013, Kangra, Una and Mandi districts were placed in the category of "very highly vulnerable" districts. Thus, there is shifting of districts from one level of vulnerability to another and the vulnerable population in the state has almost doubled over a period of decade. Amongst blocks in Solan district, Kunihar block was found to be highly vulnerable block and the value for the vulnerability index varied from 0.4084 (Kandaghat) to 0.5992 (Kunihar). The sensitivity played an important role in ranking Kunihar at the first position by contributing to the tune of 38.85 per cent followed by exposure (29.88%) and adaptive capacity (31.27%). Most of the households has opted for cropping strategies like use of organic manure (90.59%), changing crop variety (80.97%) and mixed cropping (87.38%). Out of the 16 adaptive strategies, 7 were highly adopted by the farmers as reflected in their mean score values of $\geq$ 1.93. The remaining 9 strategies were adequately adopted by the households as given mean score values <1.93. Lack of the labour, high cost of adaptation and lack of access to irrigation facilities were the major hindrance to adaptation strategies to climate change. Therefore, to mitigate the hindrances, adaptation strategies like shift to agricultural mechanization, development of water harvest structures and water use efficiency through micro irrigation system should be adopted (*SS, Nauni*).

New Externally Funded Research Projects sanctioned (01.04.2015-31.03.2016)

Horticulture

1. Establishment of progeny orchards of indigenous and exotic genotypes of walnut under protected conditions of Himachal Pradesh [Dr DP Sharma] – MOA, RKVY
2. Creation and demonstration of rain water harvesting structures for zero run off and production of quality nursery plants of apple, kiwifruit, pomegranate, hazelnut and avocado [Dr Satish K Sharma] – MOA, RKVY
3. Demonstration of plant architecture engineering under high density apple plantation along with mechanization for high productivity on the sloppy land by replacing old orchards [Dr Jayant Kumar] – MOA, RKVY
4. Promotion of kiwifruit cultivation through improved production technologies for diversification under mid-hill conditions of Himachal Pradesh [Dr Vishal Rana] – MOA, RKVY
5. Microbes and SAR inducing chemicals in managing stem rot and wilt diseases of carnation [Dr Sunita Chandel] – UGC
6. Popularization of off season flower production technology of chrysanthemum under low hill conditions of Himachal Pradesh [Dr Priyanka Thakur] - NHB
7. Biotechnological interventions for the development of Fusarium resistance in ginger (*Zingiber officinale* Rosc.) [Dr Manisha Thakur] – UGC
8. ICAR- Consoritum research plateform on hybrid crop- sweet pepper [Dr Manish Kumar] – ICAR
9. ICAR- Consoritum research plateform on hybrid crop- cauliflower (*Brassica oleracea* var. *botrytis* L. [Dr HS Kanwar] - ICAR
10. Evaluation of nitrogen fertilizer sources in apple and their effects on soil properties [Dr Uday Sharma] Directorate of Horticulture, HP
11. Evaluation of regulated deficit drip irrigation strategies in apricot [Dr Pradeep Kumar] - Directorate of Horticulture, HP
12. Plant architectural engineering and drip fertigation schedule for higher productivity and quality of mango, guava, pomegranate and low chill peaches [Dr Som Dev Sharma] - Directorate of Horticulture, HP
13. Establishment of plant health clinic and dissemination of integrated disease and insect pest management practices in tomato [Dr Arti Shukla] - Directorate of Horticulture (HP)
14. Integration, refinement and validation of prophylactic and curative management technologies for white root rot of apple in Himachal Pradesh [Dr Satish K Sharma] – Directorate of Horticulture, HP
15. Diversification of fruit farming through introduction and development of blueberries as new commercial fruit in Himachal Pradesh [Dr Dinesh Thakur] – Directorate of Horticulture, HP
16. Standardization of agro-techniques for replantation of declining orchards of apple in Himachal Pradesh [Dr DP Sharma]– Directorate of Horticulture, HP
17. Strengthening of bud-wood bank and nursery production of temperate fruits [Dr JS Chandel] – Directorate of Horticulture, HP
18. Skill development of unemployed youth through dissemination of dry flower technology [Dr Bharti Kashyap] – Directorate of Horticulture
19. Development and standardization of growing schedule for the year round cultivation of high value exotic vegetables in low hills of HP under protected structure [Dr Dharminder Kumar] – Directorate of Horticulture, HP
20. One year training programme for horticulture supervisors and six month gardener course under HRD component [Dr JS Wazir] – Directorate of Horticulture, HP
21. Evaluation of and *ex situ* conservation of native flowers of western Himalayas for

ornamental usages [Dr Priyanka Thakur] - ICAR

22. Strengthening of floriculture centre in Shatiyan Panchayat of Theog, Distt. Shimla [Dr JS Wazir] - NABARD, Shimla

Forestry

1. Rehabilitation of NHPC dumping site (DS-7) on Parbati river in Kullu district of Himachal Pradesh [Dr DP Sharma] – Chief (Geology Parvati Project St-2, NHPC Ltd., Mandi
2. Design and development of a continuous flow hydroponics system [Dr RS Spehia] – C-DAC, Chandigarh
3. Reclamation of dumping site (DS-5) through vegetable model" along Behali Larji bye pass road opposite CCVT right bank of river Sainj [Dr Manoj Thakur] – NHPC Parbati Hydroelectric Project State-III, Behali, PO Largi, Distt. Kullu
4. Tree fodder [Dr KS Pant] – ICAFRI, Jhansi
5. Strategic research component of NICRA [Dr SK Bhardwaj] – NICRA, Hyderabad
6. Green campus [Dr Rajiv Aggarwal] – Ministry of Newable and Renewable Energy, GOI, Delhi
7. Organic farming promotion through sensitization, awareness generation and capacity building of farmers for sustainable agroecological systems, improved livehood for healthier Himalayan region [Dr Yasmin Janjhua] - GBPIHED
8. Sustainable management of land through imprived *Albizia procera* plants in mid Himalayan region NMH-001-19 [Dr Neerja Rana] – GBPIHED
9. Microbial keratinases-an economic ecofriendly and innovative approach for waste management NMH-002-19 [Dr Sunita Devi] - GBPIHED
10. Selection and genetic improvement of wild pomegranate (*Punica granatum*) – a commercially an ecological important species of mid –hill regions of Himachal Pradesh [Dr Tara Gupta] – GBPIHED
11. Establishment of gene bank, characterization and validation of DUS characteristics of Seabuckthorn (*Hippophae rhamnoides* Linn.) in cold desert of Himachal Pradesh [Dr HP Sankhyan] – PPV&FRA

EXTENSION ACTIVITIES

a) Directorate of Extension Education

S.No.	Activity	No. of participants			
		Farmers		Extension Workers	Total
		Male	Female		
1.	Institutional Trainings (49)	1009	307	12	1328
2.	Guided /Exposure Visits (92)	2066	760	120	2946
3.	Visit of Diagnostic Laboratory of DEE	1276	405	47	1728
4.	Farmer Advisory Services				
	A. Farmers' calls through Kisan Call Centre (12)	-	-	-	197
	B. Courier service (12)	-	-	-	149
	C. Agro - Advisory Sevices (13)				74
	F. TV/Radio Talk (10)	-	-	-	10
5.	Installation of University Exhibition (3)	-	-	-	03
6.	Other Extension education activities	-	-	-	51
7.	Farmer friendly literature sold				15099

Farmer's friendly literature sold

S.N.	Name of the literature	Quantity	Rate(Rs)	Amount(Rs.)
1	Phal Utpadan	2360	100	236000
2	Sabje Utpadan	2284	100	228400
3	Madhu Makhi Palan	32	90	2880
4	Anar Ke Kheti	186	80	14880
5	Harar Avam Reetha	22	80	1760
6	Aonla	1	45	45
7	Vavsayek Foolon Ke Nursery Utpadan	734	70	51380
8	Baghwani Avam Vaniki	72	60	4320
9	Baghwani Avam Vaniki	100	110	11000
10	A Profile	27	75	2025
11	POP Forestry	24	75	1800
12	POP Floriculture	6	30	186
13	POP Floroculture	128	70	8960
14	Root and Seed Carrot	7	40	280
15	Advice in Research	-	200	-
16	Khumb Ke Kheti	480	30	14400
17	Aushdhiya Mushroom	47	60	2820
18	Shitoshan Podhon Ke Kaant - Chhant	372	25	9300
19	Aushdhiya Avam Sugandhit Podhon Ke Kheti	143	130	18590
20	Harar Bahumulya Ped	25	20	500
21	Bans Utpadan	17	30	510
22	Beuns Kisano Ke Lea Upyogi	25	30	750
23	Aam Ke Mukhya Rog	38	20	760

24	Micro Propagation	5	20	100
25	Poplar Ke Kheti	22	20	440
26	Calender 2016	2200	25	55000
27	Phal Avam Sabjeon Ke Mitra Keet	391	10	3910
28	Pecan Nut Ke Kheti	59	10	590
29	Akhrot Ke Kheti	49	10	490
30	Phoolon Ke Vavsayeek Kheti	1403	10	14030
31	Phal Parivakta	186	10	1860
32	Bhagwani Ke Lea Kechuan Khad	910	5	4550
33	Phalon Se Pay Padarath	555	5	2775
34	Phal Va Sabjeon Se Chatani	1049	5	5245
35	Phal Va Sabjeon Se Jam, Murraba Va Kandy	500	5	2500
36	Phal Va Sabjeon Se Aachar	500	5	2500
37	Jangli Aachar	140	5	700
	Total literature sold	15099	-	706230

b) College of Horticulture

	Extension activities of different departments in College of Horticulture						
	Food Science & Technology	Vegetable Science	Floriculture & Landscaping Architecture	Biotechnology	Seed Science & Technology	Fruit Science	Plant Pathology
Books/Manual/ Compendium	2	1	-	-	-	-	-
Lectures delivered	49		31	7	23	-	-
Awareness camps	-	6	-	-	-	5	-
Radio/TV talks	12	9	11		1		5
Meetings organized	-	-	-	-	-	7	-
Trainings Organized	21	1	7	1	3	-	-
No. of farmers visited	-	-	-	-	-	-	-
Book chapter	15	-	-	-	-	2	2
Popular articles	4	-	-	-	-	-	-
Brochures/ Booklet/CDs	6	-	-	-	-	-	-
Technology folders	7	-	-	-	-	-	-
Total	**116**	**17**	**49**	**8**	**27**	**14**	**7**

c) College of Forestry

Extension activities of different departments in College of Forestry				
Particulars	Environmental Science	Soil Science and Water Management	Tree Improvement and Genetic Resources	Social Sciences
Books/Manual	2	1	-	-
Lectures delivered	6	-	1	21
Radio/TV talks	3	1	-	-
Meetings organized	1	-	-	-
Trainings organized	-	23	-	-
No. of farmers visited	-	-	67	-
Book chapters	-	1	-	2
Total	**12**	**26**	**68**	**23**

Horticultural Research and Training Stations

Extension activities at outstations of the University								
Particulars	Jachh (Nurpur)	Dhaulakuan (Sirmour)	Bhota-Neri	Rohru	Tabo	Kandaghat	Mashobra	Bajaura
Books/Manual	-	-	1	-	-	-	-	-
Vocational Training Course (1 yr)	1	-	-	-	-	-	1	1
Lectures delivered	-	37	23	-	-	-	5	24
Radio/TV talks	5	3	14	-	-	-	-	-
Meetings organized								-
Trainings Organized (on and off campus)	10	1	5	71	4	31	11	-
No. of farmers visited	-	-	100	-	-	-	-	-
Popular articles/ booklets/ extension booklets	-	5	27	-	-	-	-	-
Awareness camp	-	2	1	-	-	-	1	4
Exposure & guided visits of farmers	-	8	51	-	-	-	-	-
Farmers/ students - scientists interactions	-	7	-	-	-	-	-	2
Diagnostic field visit (on and off campus)	-	82	2	-	13	123	-	-
Sponsored institutional training	-	-	87	-	-	-	-	-
OFT	-	-	-	6	-	-	-	-
FLD	-	-	-	8	-	-	-	-
Lectures delivered in trainings	-	-	-	-	25	-	-	-
On Farm trials/ Front line demonstrations	-	-	-	-	-	18	-	-
Field Day	-	-	-	-	-	-	-	1
Total	**16**	**145**	**283**	**85**	**42**	**153**	**18**	**31**

Sh. Subash Palekar delivering lecture on Javik Kheti Avam Soonya Lagat Prakirtik Krishi at DEE

His Excellency the Governor of HP, Acharya Dev Varat Visit to University exhibition on 13-10-2015

Principal Scientist explaining the role of forest to the newly recruited forest guard on 5-1-2016

Quarterly review meeting of prestigious GMG Scheme at DEE on 05-03-2016

Women empowerment through trainers and trainees in agriculture farming

Demonstrating Technology to the Farmers

ACADEMIC ACTIVITIES

To pursue human resource development in horticulture, forestry and allied sciences, the University offers following undergraduate and postgraduate programmes through its constituent colleges / institute viz. College of Horticulture, College of Forestry at Nauni (Solan) and College of Horticulture and Forestry, Neri (Hamirpur).

❖ **College of Horticulture:**

- **Undergraduate Programme**

❄ B. Sc. (Honours) Horticulture : Four Year Programme

- **Postgraduate Programmes**

❄ M.Sc. in Entomology, Floriculture & Landscape Architecture, Food Technology, Fruit Science, Molecular Biology & Biotechnology, Nematology, Plant Pathology, Spices Plantation & Medicinal & Aromatic Plants, Seed Science & Technology and Vegetable Science.

❄ Master of Business Administration (Agribusiness) and Master of Business Administration.

❄ Ph.D. in Entomology, Floriculture & Landscape Architecture, Food Technology, Fruit Science, Molecular Biology & Biotechnology, Nematology, Plant Pathology, Seed Science & Technology and Vegetable Science.

- Diploma in Fruit and vegetable processing and bakery products : One Year Programme

❖ **College of Forestry:**

- **Undergraduate Programme**

❄ B.Sc. (Honours) Forestry : Four Year Programme

- **Postgraduate Programmes**

❄ M.Sc. in Agricultural Economics, Agroforestry, Environmental Management, Environmental Science, Forest Genetic Resources, Medicinal & Aromatic Plants, Microbiology, Plant Physiology, Silviculture, Soil Science, Statistics, Watershed Management, Wood Science & Technology.

❄ Ph.D. in Agricultural Economics, Agroforestry, Environmental Science, Forest Genetic Resources, Medicinal & Aromatic Plants, Microbiology, Silviculture, Soil Science, Wood Science & Technology.

❖ **College of Horticulture & Forestry, Neri (Hamirpur):**

- **Undergraduate Programmes :**

❄ B.Sc. (Honours) Horticulture: Four Year Programme.

❄ B.Sc. (Honours) Forestry: Four Year Programme.

❄ B.Sc. (Honours) Biotechnology: Four Year Programme.

❖ **The admissions for the Academic Session: 2015-16 to the following programmes**

Sr. No.	Programme - wise Admissions	No. of Students
1.	B.Sc. (Hons.) Horticulture, COH	102
2.	B.Sc. (Hons.) Forestry, COF	104
3.	B.Sc. (Hons.) Horticulture, COH&F - Neri	64
4.	B.Sc. (Hons.) Forestry, COH&F - Neri	42
5.	B.Sc. (Hons.) BTC, COH&F - Neri	31
6.	M.Sc., COH	111
7.	M.Sc., COF	50
8.	MBA	34
9.	MBA (Agribusiness)	11
10.	Ph.D. COH	29
11.	Ph.D. COF	22
	No. of students enrolled	**600**

❖ **No. of Students Passed out & PDCs/Transcript of academic records issued w.e.f. 01.04.2015 to 31.03.2016:**

College	B.Sc.	M.Sc.	MBA	Ph.D.	Total
College of Horticulture	138	61	37	22	258
College of Forestry	51	44	-	16	111
Total	**189**	**105**	**37**	**38**	**369**

❖ **Academic Council Meetings**

(1) 91st meeting of the Academic Council was held on 14th August, 2015.

(2) 92nd meeting of the Academic Council was held on 3rd March, 2016.

FINANCE

To make the University financially sustainable, the following measures have been taken and being initiated:

- The University has made concerted efforts to bring down the expenditure and utmost economy is being exercised on all spending. The University has been making austerity measures and structural reforms to compress avoidable expenditure and efforts are also being made to reduce the administration expenses to the bare minimum.
- The university resources have been raised to the optimum extent as per commitment with the State Government.
- The university has taken a lead in providing imported nursery plants free from insect- pest and diseases to the farmers/orchardists during this planting season year in the state which also helped in generating income around Rs. 30 lakh.
- To reduce the burden on State budget utilization of funds maximum funds out of externally aided projects is being encouraged. The University scientists have been advised and emphasized that there is great potential for enhancing the generation of domestic income by getting new projects in areas specific to the Regional Research Stations.
- No new engagement of labourers under any State Scheme is encouraged and the work/job is carried out by internalizing the existing manpower or at best through outsourcing through externally funded projects.

The following are the main sources of funding

State Government

- Department of Horticulture, Himachal Pradesh, Shimla
- Department of Forest Farming and Conservation, H.P., Shimla
- Department of Youth Services and Sports, H.P. Shimla

Government of India

- Ministry of Agriculture, Government of India
- Ministry of Energy and Environment, Government of India
- Indian Council of Agriculture Research, New Delhi.
- Indian Council of Forest Research & Education, Dehradun.

The detail of receipts and expenditure during financial year 2015-16 *(Rs. in lac)*

Sr. No.	Main source of funding	Grant-in-aid received	Domestic Income	Total Receipt	Total Expenditure (tentative)
1.	Department of Horticulture	10202.00	1450	10216.50	10200.50
2.	Department of Forest	35.00	0.00	35.00	35.00
	Total	**10237.00**	**1450**	**10251.50**	**10235.50**
1.	Indian Council of Agricultural Research [ICAR]	1123.57	0.00	1123.57	950.87
2.	Govt. of India	356.93	0.00	356.93	190.81
3.	Miscellaneous	511.35	0.00	511.35	339.92
	Total	**1991.85**	**1450**	**1991.85**	**1481.60**
	Grand Total	**12228.85**	**1450**	**12243.35**	**11717.10**

Major achievements

- 92nd, 93rd (23.9.2015) and 94th meeting of the Finance Committee have been conducted during this year.
- The rates of wages of daily wage workers and the part time workers have been revised from time to time on the analogy of the State Govt.
- An additional grant-in-aid amounting to Rs. 45.00 crore was released by State Govt. during the year 2015-16 besides the budgeted Grant-in-aid amounting to Rs.57.35 crore to defray the payment of pension and retirement gratuity.
- A total outlay of Rs.1560.49 lacs through 33 new projects have been received through Govt. of India/UGC/ICAR during the year 2015-2016.
- Domestic income amounting to Rs. 14.50 crores have been realized during the financial year, 2015-2016.

LIBRARY FACILITIES

Satyanand Stokes Library of the University specializes in Horticulture and Forestry information. It serves its users through computerized in-house databases and international databases available on CD-ROM. The library is well connected to Internet and E-mail facilities since January 1998. It is the first Agricultural University Library in the country which has been converted into a Wi-Fi Library in 2003-04. The technology savvy library of the university has established Multimedia Centre in May 2007. This centre is equipped with 40 computers out of which 28 computers have internet facilities. The library has been providing electronic access to 2000+ Journals since July 2008 through CERA: Consortium for e-Resources in Agriculture. The whole collection of the library is computerized and its OPAC is electronically accessible. The library is having 60 E-Learning Tools. The important ones are: HORT CD 1973-2013 , FOREST SCIENCE DATABASE 1939-2013 , CAB CD 1987-95, AGRIS 1975-2001, AGRICOLA 1984-90, Forestry Compendium, Crop Protection Compendium, National Agricultural Research Database etc. The facilities of Book Bank, Inter Library Loan, Lamination, Photocopy, Computerized Information Services etc. are available for readers. The library has a collection of about 69,000 documents excluding the books collection at Regional Horticultural Research Stations situated at different parts of the state. The library is also offering two courses, "Library and Information Services" and "Technical Writing and Communication Skills", to M.Sc. and Ph.D. students. For linking the Regional Research Stations and Krishi Vigyan Kendras of the University with the library, connectivity facilities have been established in all the Regional Stations and KVKs of the University in 2008-09 & 2009-10, respectively.

CD-ROM Services

CD-ROM services are being used by the students and faculty members in the university. The detail of searches conducted during the current year was as under:

Total number of records generated from CD-ROM services	25338
Total number of CD-ROM users	203

E-Services

With the establishment of Multimedia Centre in the library, the Internet and E-mail facilities are available in the library and are being used by the students and faculty members. CERA (Consortium for e-Resources in Agriculture) offers access to 3000+ electronic journals through http://www.cera.jccc.in.

The detail of users are given as under:

Total number of Internet Users	3421
Total copies Xeroxed free of cost	12301

Current Periodical Section

The current periodicals section has subscribed 54 hard copies of 50 Indian, 4 foreign research periodicals.

Technical Jobs

About 2083 documents were classified and catalogued and 2707 documents digitalized to update the existing database.

Circulation

The books are being issued to the students and the faculty members of the University electronically and all the students are entered with photograph in the Library database to maintain the record.

Readers visited	50711
Books issued	15993
Books returned	14415
Books consulted	112480
No. of reference inquires	4262
Journals consulted	60210

Acquisition Section

Following number of documents acquired during the year:

Books purchased	190
Books received as gratis	347
Periodicals	38
Theses added	336

Total holdings as on 31.03.2016

Books	48299
Periodicals	17450
Theses	4926
Others	515
Grand total:	**71190**

Bindery

2608 documents were completely bound in addition to other miscellaneous jobs of other departments/ offices of the university.

Book Bank

The library has approximately 1000 books in the book bank. During this year 21 books have been issued to the needy students.

COMPUTER AND INSTRUMENTATION CENTRE

- Computer Centre of Dr. Y. S. Parmar University of Horticulture and Forestry provides central facility in computer and information technology to all the students, scientists and other staff of the university with more than two hundred regular users on roll. The Instrumentation centre provides facility for the repair and maintenance of the analytical equipments/instruments etc. of all the departments/offices/ research stations of the university.
- Scientists/researchers are supported for transfer of technology by providing them related services such as Internet/E-mail facilities and repair and maintenance facilities.

Software updation and maintenance

Following software were updated and maintained:

- Pay Roll System
- University Accounts Reconciliation System.
- DA Arrear System.
- GPF/CPF accounting System.
- Students Semester Report System.
- Entrance Exam Evaluation system.
- Income Reconciliation System.

E-mail/Internet and Local Area Network (LAN)

- At present all the departments and offices of the University have been provided E-mail/internet facility through campus wide Local Area Network (LAN) and 1 Gbps Internet Leased Line (under NKN project). The e-mail/internet facilities have also been provided to the University Library, Cyber Cafe, Sub-DIC Centre (Biotechnology), Communication Centre and ARIS Cells of College of Horticulture and Forestry. Presently about 495 internet/e-mail nodes at users location have been provided.

University Website

- The University Website is being regularly updated by incorporating the latest information pertaining to departments/offices of the university.

University Entrance Examination

- Result of entrance examination for admission to B.Sc. Horticulture and B.Sc. Forestry four year program and M.Sc./MBA programme for the year 2015-2016 was evaluated and compiled in the Computer Centre. The result was also put on website of the university being maintained at the Centre.
- Result of written exam for the recruitment of forest guards in HP Forest department for all the twelve circles of the State was evaluated and compiled in the Computer Centre and merit list prepared.

Instrumentation Centre

- Instrumentation workshop provided preventive and corrective maintenance support to various departments/offices of the university in main campus as well as to its research stations. During the period 192 requisitions were received out of which 54 jobs have been completed. No objection certificates have been issued to 65 equipments in which either the facility was not existing in the centre or the spares were not available in the open market. Remaining jobs are pending for want of spare or otherwise.
- Technical guidance/inspection facility was provided to university departments/ research stations for purchase of equipment/machines as well as for disposal of unserviceable stock.

STUDENT'S ACTIVITIES

The Students' Welfare Officer is the overall Incharge of students' welfare activities viz. sports and games, hostel management including lodging and boarding, health and hygiene, cultural, literary, NCC, NSS and other extra co-curricular activities. Whole hearted efforts are made by this organization to inculcate the feeling of brotherhood, friendship, amity, goodwill, comradeship, love and respect for each other beside promoting discipline among the students.

NSS Special Camp

A seven day NSS special camp for the B.Sc. third year students was organized in the university campus and adjoining villages w.e.f. 23rd to 29th June 2015. Eighty four NSS volunteers from College of Horticulture and College of Forestry attended the camp and developed Basket Ball playground.

Inauguration of Nandani Hostel

Nandani Hostel was inaugurated by Sh Virbhadra Singh, Hon'ble Chief Minister, Govt. of Himachal Pradesh on 4th August 2015 to accommodate approximately 110 girl students.

Celebration of Ganesh Festival

The students of Maharashtra studying in this university including other students celebrated the Ganesha Festival w.e.f. 18th to 23rd September 2015 under the supervision of Students' Welfare Organization. Dr Vijay Singh Thakur Hon'ble Vice Chancellor was the Chief Guest on this occasion.

Nominations of the Central Students' Association

The Nomination to the Central Students' Association, Dr YS Parmar University of Horticulture and Forestry, Solan for the Academic Session, 2015-16 were held at the campus of the university on 29th October, 2015. Following were nominated as the Executive Members of Central Students' Association:

Name of the student	Class	Office Bearer
Mr Prashant Sharma	B Sc Forestry	President
Mr Kaushal Attri	M Sc Horticulture	Vice President
Mr Vinit Kumar	B Sc Horticulture	General Sec.
Mr Himanshu Rana	B Sc Forestry	Jt. Secy-cum Treasurer

International Non-Violence day

International Non-Violence day was celebrated in Dr Y S Parmar university of Horticulture and Forestry, Nauni-Solan on the call given by United Nations Organization (UNO) on October 2, 2015 in which the students participated with a great enthusiasm. The university students carried a 'Piece March' and exhibited the message of Mahatma Gandhi ji through banners, placards and posters. On this occasion, Dr JN Sharma, Students' Welfare Officer of the university administered the oath of Non-Violence and Peace to the students who were present in a great numbers.

Vigilance Awareness Week

Vigilance Awareness Week with a theme "Preventive Vigilance as a Tool of Good Governance" was celebrated from 26th to 31st October, 2015 in which students of College of Horticulture (1st and 2nd year) participated. Various lectures on the mentioned subject were delivered. Students were asked to prepare posters with slogan. Two girl students were selected winner and 1st runner up for their slogan.

Inauguration of Common Room cum Dining Hall in the International Hostel

Common Room cum Dining Hall in the International Hostel was inaugurated by Dr Vijay Singh Thakur, Hon'ble Vice Chancellor on 23rd December 2015 and started the mess facility for the students residing in the hostel.

National Anthem at the Campus

The equipment for playing the National Anthem from January 2016 was procured by the organization and steps were taken to play the National Anthem daily.

University Participation in National Conference and National Level Inter-University Debate Competition

Four students of this university namely Ms Manisha Guleria, Ms Pooja Sharma, Ms Hitanshi Angrik and Ms Shifali Sharma participated in the National Conference and National Level Inter-university debate competition held on the occasion of Swami Vivekanand Jayanti at GB Pant University of Agricultural Technology, Pantnagar, Uttarakhand on 12th to 15th January 2016.

Trials for Sports and Games Meet

The trials were conducted on 21st to 22nd January, 2016 for the students of the main campus and College of Horticulture and Forestry, Neri, Hamirpur for their selection for the All India Sports and Games Meet to be held at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Republic Day Celebration

The cultural programme and NCC parade were organized on 26 Jan 2016 at the campus. The prizes were also given to the participants.

XVI All India Agricultural Universities Youth Festival "Agri-Unifest" 2015-16

XVI All India Agricultural Universities Youth Festival "Agri-Unifest" 2015-16 was held at Orissa University of Agricultural and Technology, Bhubaneswar, Odisha w.e.f. 1st to 4th February, 2016 in which 22 students participated in different events. The University got second position in Folk Dance, third position in Debate and fourth position in Solo song.

Mimmy Memorial Football Tournament

Mimmy Memorial Football tournament was held at university play ground w.e.f. 11th to 25th February, 2016 in which eight teams of the university and adjoining areas participated. B.Sc. 3rd year football team of the university won the tournament.

XVI All India Agricultural Universities Sports Meet 2015-2016

XVI All India Agricultural Universities Sports Meet 2015-16 was held at Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu w.e.f. 22nd to 26th February, 2016 in which 38 students participated in different events and achieved second position in Long Jump and Triple Jump.

Dhreeraj Memorial Cricket Tournament

Dhreeraj Memorial Cricket Tournament was organized by the Central Students' Association w.e.f. 25th March 2016 to 8th April 2016 in which 10 Cricket teams participated.

Ranjan Memorial Football Tournament

Ranjan Memorial Football Tournament was held on 26th March 2016 to 2nd April 2016 in which 15 teams from North Zone participated.

Legal Services Clinic/Cell

Legal services clinic/cell for the welfare of north-eastern region students studying in the university has been started in the Students' Centre in which the meetings of the north-eastern region students are held every Wednesday. A teacher and three students coordinate the meeting.

NCC Activities

- During the Academic Session 2015-16, 92 students (38 boys & 54 girls) were enrolled under NCC for fulfilling the requirement of BSc Degree programmes under both the colleges.
- A Combined Annual Training Camp of NCC was held on 10th to 19th May, 2015 at Bania Devi (Kunihar) in which 64 cadets (42 SW & 22 SD) of the university participated.
- Attended Service Selection Board (SSB) training at NCC OTA, Kamptee, Nagpur from 11th to 20th May, 2015.
- Organized and participated in International Yoga Day on 21st June, 2015. 100 NCC cadets of UHF Nauni participated in International Yoga Day along with the cadets of Govt. Senior Secondary School, Oachghat and Govt. Senior Secondary School, Narag. Total cadet participated were 273.
- Five cadets (3SD and 2 SW) participated in National Integration Camp, Amritsar from 02-11 July, 2015.
- Three cadets (SW) participated in Trekking Camp, Arki from 12-21 July, 2015.
- Two cadets (SW) participated in Advance Leadership Camp (ALC), Malout, Punjab from 08th to 17th September, 2015.
- 12 cadets (8SD and 4 SW) participated in NIC, Rajasthan from 25th October – 05th November, 2015.
- Eight cadets (4 SD and 4 SW) attended Advanced Leadership Camp at Amritsar from 19th to 29th January, 2016.
- Organized march past on Independence Day and Republic Day.

NSS Activities

- Cleanliness drives / campaigns were undertaken at the university campus on (March 20 & 21 and May 15 & 16, 2015 in which 150 and 120 NSS volunteers participated respectfully. The volunteers cleaned the area surrounding the University Health Centre, University Library, College of Forestry and University Canteen.
- Two lectures were organized on the importance of Yoga and Prayanam with practical demonstration on May 22 & 23, 2015 in which 180 NSS students participated.
- On the occasion of Van Mahotsava celebrated on August 4, 2015 plantation drive was undertaken in which 200 NSS volunteers planted 200 plants at the University campus.
- On August 14 & 21, 2015 cleanliness drives were undertaken around College of Forestry Phase-II building in which 120 NSS students participated.
- Gandhi Jyanti was celebrated as International Non-Violence Day on October 1, 2015. On this occasion, a peace march with banners and display cards was conducted in the University campus. Poster-cum-Slogan writing Contest was also organized. The Students Welfare Officer administered the oath of preserving national unity, integrity and communal solidarity on this occasion.
- A Swachhta Abhiyan was taken on October 9, 2015 around College of Horticulture & Department of Social Sciences in which 120 NSS students participated.
- On August 17, 2015, a cartoon films on HIV positive AIDS and its prevention was shown to the B Sc (Forestry) 2nd year NSS students.
- Organized a lecture on the contributions of Sardar Vallabh Bhai Patel in National Integration to the NSS & NCC students on October 31, 2015. A documentary on his life story was also shown to them.
- A video lecture on "Ambassador of Peace" by Youth Peace Foundation was organized on 18.2.2016 in the University Auditorium in which about 250 NSS students participated.
- International Women's Day was celebrated on March 8, 2016. On this occasion, declamation contest was held in which 18 students participated.
- A video on "Youth Parliament" was shown to the NSS students on March 17 and 31, 2016 in which about 300 students participated.

Annual Sports & Culture Meet

INTRASTRUCTURE DEVELOPMENT

During the financial year 2015-16 (1.4.2015 to 31.3.2016) a sum of Rs. 893.52 lakhs was spent on various works transferred by the Comptroller/ deposited by other departments with the Estate Officer as development assistance from various funding agencies viz. ICAR; ICFRE Govt. of India, State Horticulture/Forestry grants etc. for buildings, roads, water supply, irrigation and electrification etc. at the main Campus Nauni-Solan and various Research Stations and KVK's.

Detail of some of the major/minor works undertaken/completed during the financial year 2015-16 are as under:

Sr. No.	Name of work	Status	Location
1.	Construction of Girls Hostel - V	Completed	Nauni
2.	Construction of Girls Hostel - VI only two floor	Completed	Nauni
3.	Construction of Boys Hostel only two floor	Completed	Nauni
4.	Additional accommodation in ST Girls students of Girls hostel V	Completed	Nauni
5.	Construction of o four nos. LDPE Tanks Department of SST	Completed	Nauni
6.	Construction of 2 Nos. Isolation Cage, Department of SST at main Campus	Completed	Nauni
7.	Additional Toilet Block in Girls Hostel - I	Completed	Nauni
8.	Renovation of Toilets in Girls Hostel - I	Completed	Nauni
9.	Renovation of Toilets in Administration Block at main Campus	Completed	Nauni
10.	Renovation of Toilets in old PG Hostel	Completed	Nauni
11.	Construction of Mist Chamber, Department of FLS	Completed	Nauni
12.	Providing drip irrigation system in Hi-tech polyhouse, Department of FLS	Completed	Nauni
13.	Providing pumping machinery in Hi-tech floriculture project	Completed	Nauni
14.	Renovation of Administrative Block-rain shelter	Completed	Nauni
15.	Construction of road to pump house, Khaltoo under Hi-tech floriculture project	Completed	Nauni
16.	Providing DG set in Hi-tech floriculture project	Completed	Nauni
17.	Providing MS stands in Hi-tech floriculture project	Completed	Nauni
18.	Construction of parking in auditorium building-structure only	Completed	Nauni
19.	Construction of 2 Nos. quarter in Hi-tech floriculture project	Completed	Nauni
20.	Providing ceiling tiles for sound proofing in Gymnasium	Completed	Nauni
21.	Up-gradation of kitchen and dinning hall of Girl Hostel (IH)	Completed	Nauni
22.	Providing chain link fencing of Girls Hostel-VI	Completed	Nauni
23.	Providing chain link fencing of International Hostel	Completed	Nauni
24.	Construction of aluminium cabin for the Department of SST	Completed	Nauni
25.	Renovation of advanced facility training lecture hall, Department of VGS	Completed	Nauni
26.	Renovation of various hostels	Completed	Nauni
27.	Construction of field laboratory-cum-store, Department of Fruit Science	Completed	Nauni
28.	Renovation of Toilet block in Library building	Completed	Nauni
29.	Augmentation of irrigation facility i/c storage, Department of VGS	Completed	Nauni
30.	Repair of road from T&V hostel to Hi-tech floriculture project	Completed	Nauni

31.	Renovation of Laboratory block (office of Dean, COH)	Completed	Nauni
32.	Renovation of Laboratory for the Department of Fruit Science	Completed	Nauni
33.	Renovation of Virbhardra Kisan Bhawan	Completed	Nauni
34.	Up-gradation of 2 Nos. PG Laboratories of COF	Completed	Nauni
35.	Improvement of Katcha farm road in Nando block, Department of Fruit Science	Completed	Nauni
36.	Renovation of Room No. 308 and 205, Department of Fruit Science	Completed	Nauni
37.	Construction of RCC water storage tank	Completed	Kandaghat
38.	Construction of 4 Nos. low cost propagation structure	Completed	Kandaghat
39.	Providing barbed wire fencing	Completed	Kandaghat
40.	Renovation of Farmers Hostel	Completed	Mashobra
41.	Renovation of toilets in Laboratory-cum-office building	Completed	Sharbo
42.	Renovation of Scientist Hostel	Completed	Reckong Peo
43.	Providing barbed wire fencing	Completed	Sharbo
44.	Providing boundary wall/chain link fencing	Completed	Tabo
45.	Mist Propagation Chamber	Completed	Bajaura
46.	Store/pump house	Completed	Seobagh/ Bajaura
47.	Sewerage connection in guest house	Completed	Dhalpur, Kullu
48.	Construction of boundary wall	Completed	Neri
49.	Construction of Mist Chamber	Completed	Neri
50.	Construction of of LDPE Tanks	Completed	Neri
51.	Construction of shed-cum-plateform for cold storage	Completed	Bhota
52.	Construction of RCC water storage tank	Completed	Jachh

In addition to above the following works are in progress and near completion.

1.	Construction of Hi-tech poly house, Department of VGS at Nauni
2.	Construction of Hi-tech poly house, Department of FLS at Nauni
3.	Augmentaion of irrigation facilities and storage, Department of FLS at Nauni
4.	Construction of 2 Nos. threshing and drying shed, Department of SST at Nauni
5.	Construction of food preservation block, Department of FST at Nauni
6.	Construction of Parking place in Auditorium building at Nauni – finishing thereof
7.	Construction of Parking place in Auditorium building at Nauni – Development
8.	Renovation T&V Hostel at Nauni- repair of toilets.
9.	Renovation of Vice Chancellors residence at Nauni
10.	Construction of stage for celebrating Republic/Independence Day at Nauni
11.	Renovation of 4 Nos. warden residence at Nauni
12.	Extension of Girls Hostel – VI at Nauni completion of 2nd floor and partly 3rd floor
13.	Extension of Boys Hostel in 2nd and 3rd floor at Nauni

14.	Renovation of Administrative Block at Nauni - painting and repair
15.	Renovation of Administrative Block at Nauni, paneling of DR office
16.	Renovation of Seminar Hall (COH) at Nauni
17.	Modernization of Gymnasium at Nauni – Flooring and painting
18.	Renovation of path/fencing, Department of Forest Product at Shilly farm
19.	Construction of Mist Chamber at Kandaghat
20.	Construction of path and farm development at Kandaghat
21.	Construction of irrigation channel at Kandaghat
22.	Construction of Zero energy cold storage Unit at Rohroo
23.	Renovation of Hostel/Laboratory building at Mashobra
24.	Providing boundary wall at Kalpa
25.	Developing Community Beekeeping Demonstration and Training facility at Sharbo
26.	Construction of Trainees Hostel at Kalpa – porch and road
27.	Renovation of KVK building at Reckong Peo
28.	Renovation of Hostel for ELP students at Seobagh
29.	Construction of Girls Hostel for SC students at Neri
30.	Construction of Remain portion of ground floor and first floor in Plant Health Clinic Laboratory at Neri
31.	Construction of 2nd and 3rd floor in Plant Health Clinic Laboratory at Neri
32.	Construction of Badminton Court at Neri
33.	Construction of Toilet and Septic Tank for Security Staff at Neri
34.	Renovation of Farmers Hostel at Jachh.
35.	Providing chain link fencing on the NH road side at Jachh.

Besides above various other major/small works at Nauni as well as various research stations/KVK's etc. were carried out along with annual maintenance of buildings, water supply sanitary installations, electrical installations, maintenance of roads, transportation services, R/M of Guest House etc. during the year.

HEALTH CARE ACTIVITIES

Health Centre is providing health facilities to the students, teachers, employees and surrounding village inhabitants. The progress made during the period under report is as follows.

Number of patients treated as OPD

- New 8899
- Old 5140
- Total 14039

Activities Undertaken

- Two pulse polio camps organized in collaboration with CMO, Solan
- Twelve immunization and vaccination camps organized
- RNTCP Programme collaborated with CMO, Solan for the treatment of tuberculosis
- Round the clock medical cover provided to the residents of the camps including gazetted holidays along with refer all ambulation of serious cases to District Hospital, Solan; IGMC, Shimla and PGI, Chandigarh
- Miscellaneous administrative work for the running of the institute including purchase of essential medicines and laboratory regents

Various health care tests were conducted for different patients as detailed below:

Sr No	Name of test	Total patients
	Heamatology	
1	Haemoglobin	474
2	Total leucocyte count	92
3	Differential leucocyte count	91
4	Erythrocyte sedimentation rate	164
5	Bleeding time/clotting time	15
6	Blood grouping plus Rh grouping	211
7	Blood film for malarial parasite	43
8	Blood haematological profile	271
	Microbiology (Serology)	
1	Typhoid (widal test)	125
2	Syphilis VDRI	37
3	RA test	33
4	HB AIC	9
	Urine	
1	Urine for pregnancy test	48
2	Urine profile	433
3	Urine RE/ME	312
	Fecess	
1	Ova/Cyst	8

Sr No	Name of test	Total patients
	Biochemistry	
	Lipid Profile	
1	Total cholesterol	183
2	HDL cholesterol	183
3	LDL cholesterol	183
4	VLDL cholesterol	183
5	Tryglycrides	183
6	Total lipid	183
	Renal profile	
1	Total protein	115
2	Albumin	115
3	Creatinine	122
4	Blood urea	121
5	Uric acid	398
	Lever profile	
1	Alkaline phosphatase	330
2	Bilirubin	491
3	ALT (SGPT)	332
4	AST (SGOT)	332
	Metabolic profile	
1	Glucose (Blood sugar)	836
	Electrolite profile	
1	Calcium	257
2	Sodium potassium	354
	Others	
1	Thyroid test	22
	Total	7289

UNIVERSITY AUTHORITIES
(01.04.2015-31.03.2016)

The University Authorities comprising of University Senate, Board of Management, Academic Council, Research Council, Extension Council, Finance Committee and Board of Studies for College of Horticulture and College of Forestry

SENATE

1.	Sh Kalyan Singh	Chancellor – Chairman upto 11.08.2015
2.	Acharya Dev Brat	Chancellor – Chairman w.e.f. 12.08.2015
3.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan)
4.	Sh Tarun Shridhar	Additional Chief Secretary (Horticulture) to the Government of Himachal Pradesh
5.	Sh Tarun Shridhar	Additional Chief Secretary (Forests) to the Government of Himachal Pradesh upto 04.10.2015
6.	Sh Deepak Sanan	Additional Chief Secretary (Forests) to the Government of Himachal Pradesh w.e.f. 05.10.2015
7.	Sh JC Rana	Director of Agriculture, Himachal Pradesh upto 30.11.2015
8.	Sh Som Raj Kalia	Director of Agriculture, Himachal Pradeshw.e.f. 01.12.2015
9.	Sh Gurdev Singh	Director of Horticulture, Himachal Pradesh upto 30.06.2015
10.	Sh DP Bhanglaia	Director of Horticulture, Himachal Pradeshw.e.f.29.06.2015
11.	Sh SC Srivastva	Principal Chief Conservator of Forests, Himachal Pradesh upto 31.08.2015
12.	Sh SP Vasudeva	Principal Chief Conservator of Forests, Himachal Pradesh w.e.f.18.09.2015
13.	Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
14.	Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f.01.09.2015 to 30.11.2015
15.	Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
16.	Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
17.	Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
18.	Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
19.	Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
20.	Dr RC Sharma	Director of Research upto 30.11.2015 (Charge rest with the Vice-Chancellor w.e.f. 01.12.2015).
21.	Dr NB Singh	Director of Extension Education w.e.f. 01.04.2015. to 31.07.2015
22.	Dr DK Srivastava	Director of Extension Education w.e.f. 01.08.2015 to 29.02.2016
23.	Dr KS Verma	Director of Extension Education w.e.f. 01.03.2016
24.	Dr NB Singh	Comptroller w.e.f. 01.04.2015 to 04.05.2015 (Additional Charge)
25.	Sh DR Negi	Comptroller w.e.f. 05.05.2015 to 31.07.2015
26.	Sh JM Awasthi	Comptroller w.e.f. 01.08.2015 to 02.09.2015 (FN)
27.	Sh KT Both	Comptroller w.e.f. 02.09.2015 (AN)
28.	Er DN Sharma	Estate Officer Er DN Sharma upto 20.04.2015
29.	Er Sonam Paljore Negi	Estate Officer w.e.f.21.04.2015
30.	Dr Kamlesh Kanwar	Librarian upto 01.04.2015 to 31.08.2015
31.	Dr Vijay Singh Thakur, Vice-Chancellor.	Additional Charge of Librarian w.e.f. 01.09.2015 to 30.11.2015
32.	Dr BS Thakur	Librarian w.e.f. 01.12.2015 to 26.02.2016
33.	Sh Sudesh Kumar Sood	Librarian w.e.f. 27.02.2016
34.	Dr YS Negi	Additional Charge of Students' Welfare Officer w.e.f. 01.04.2015 to 30.04.2015
35.	Dr JN Sharma	Students' Welfare Officer w.e.f.01.05.2015to 30.11.2015
36.	Dr Rakesh Gupta	Students' Welfare Officer w.e.f. 01.12.2015
37.	Sh Ajay Mahajan	MLA, HP Vidhan Sabha, Shimla

38.	Sh Mohan LalBrakta	MLA, HP Vidhan Sabha, Shimla
39.	Dr (Mrs) Tara Gupta	Principal Scientist (Forestry), Department of Tree Improvement & Genetic Resources, UHF, Nauni (Solan)
40.	Mrs Dharminder Kumar	Assistant Professor (Vegetable Science), Regional Horticultural Research and Training Station, Jachh (Kangra)
41.	Sh OP Thakur	Superintendent (EC), College of Horticulture and Forestry, Neri (Hamirpur)
42.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretary upto 16.05.2015
43.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretaryw.e.f. 19.05.2015

BOARD OF MANAGEMENT

1.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan) - Chairman
2.	Dr Krishan Kumar Katoch	Vice Chancellor, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur
3.	Sh Tarun Shridhar	Additional Chief Secretary (Horticulture) to the Government of Himachal Pradesh
4.	Dr Shrikant Baldi	Principal Secretary (Finance) to the Government of Himachal Pradesh
5.	Sh Tarun Shridhar	Additional Chief Secretary (Forests) to the Government of Himachal Pradesh upto 04.10.2015
6.	Sh Deepak Sanan	Additional Chief Secretary (Forests) to the Government of Himachal Pradesh w.e.f. 05.10.2015
7.	Sh Gurdev Singh	Director of Horticulture, Himachal Pradesh upto 30.06.2015
8.	Sh DP Bhanglia	Director of Horticulture, Himachal Pradesh w.e.f. 01.07.2015
9.	Sh SC Srivastva	Principal Chief Conservator of Forests, Himachal Pradesh upto 31.08.2015
10.	Sh SP Vasudeva	Principal Chief Conservator of Forests, Himachal Pradesh w.e.f. 18.09.2015
11.	Sh JC Rana	Director of Agriculture, Himachal Pradesh upto 30.11.2015
12.	Sh Som Raj Kalia	Director of Agriculture, Himachal Pradeshw.e.f. 01.12.2015
13.	Dr NB Singh	Director of Extension Education, UHF, Nauni (Solan) upto 31.07.2015
14.	Dr KL Chadha	House No. 7281, Block-B, Pocket 10, Vasant Kunj, New Delhi – 110070
15.	Dr RA Singh	Pr. Chief Conservator of Forests (Retd.), Village Mansar, Tehsil and District Solan
16.	Sh Prakash Tajta	Village Pandli, PO Kotkhai, District Shimla
17.	Sh Jitender Sirkek	Village Shathla, PO Virgarh, Tehsil Kumarsain, District Shimla
18.	Sh Umesh Negi	VPO Sangla, District Kinnaur
19.	Mrs Kunjana Singh	Ranzor Palace, Nahan, District Sirmaur
20.	Dr RL Chauhan	Ex-Chairman, NIT, Hamirpur, KahanNiwas, Kelston, Shimla
21.	Dr BP Singh	Director, CPRI, Shimla (nominee of ICAR)
22.	Dr VP Tewari	Director, HFRI, Shimla (Nominee of ICFRE)
23.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretary upto 16.05.2015
24.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretary w.e.f. 19.05.2015

ACADEMIC COUNCIL

1.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan) - Chairman
2.	Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
3.	Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f.01.09.2015 to 30.11.2015
4.	Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
5.	Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
6.	Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
7.	Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
8.	Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
9.	Dr RC Sharma	Director of Research upto 30.11.2015 (Charge rest with the Vice-Chancellor w.e.f. 01.12.2015).
10.	Dr NB Singh	Director of Extension Education w.e.f. 01.04.2015. to 31.07.2015
11.	Dr DK Srivastava	Director of Extension Education w.e.f. 01.08.2015 to 29.02.2016
12.	Dr KS Verma	Director of Extension Education w.e.f. 01.03.2016
13.	Director, Forestry Education	Forest Research Institute, Dehradun
14.	Dr Kamlesh Kanwar	Librarian upto 01.04.2015 to 31.08.2015
15.	Dr Vijay Singh Thakur, Vice-Chancellor.	Additional Charge of Librarian w.e.f. 01.09.2015 to 30.11.2015
16.	Dr BS Thakur	Librarian w.e.f. 01.12.2015 to 26.02.2016
17.	Sh Sudesh Kumar Sood	Librarian w.e.f. 27.02.2016
18.	Dr YS Negi	Additional Charge of Students' Welfare Officer w.e.f. 01.04.2015 to 30.04.2015
19.	Dr JN Sharma	Students' Welfare Officer w.e.f.01.05.2015to 30.11.2015
20.	Dr Rakesh Gupta	Students' Welfare Officer w.e.f. 01.12.2015
21.	Dr DK Srivastava	Professor & Head, Department of Biotechnology, UHF, Nauni (Solan)
22.	Dr(Mrs)Kamlesh Kanwar	Professor, Department of Biotechnology, UHF, Nauni (Solan) upto 30.11.2015
23.	Dr PK Mahajan	Professor and Head, Department of Basic Sciences, UHF, Nauni (Solan)
24.	Dr DK Sharma	Principal Scientist (Vegetable), Department of Horticulture, COH&F, Neri).
25.	Dr Kamal Sharma	Principal Scientist, Department of Forestry and Environment, COH&F, Neri
26.	Dr TR Sharma	Principal Scientist, National Biotechnology Centre, LB 5 Building, IARI, New Delhi – 110012
27.	Dr Pawan Mehta	Professor (Entomology), CSK HPKVV, Palampur, District Kangra – 176062
28.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretary upto 16.05.2015
29.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) – Member Secretary w.e.f. 19.05.2016

EXTENSION COUNCIL

1.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan) - Chairman
2.	Sh Gurdev Singh	Director of Horticulture, Himachal Pradesh upto 30.06.2015
3.	Sh DP Bhangalia	Director of Horticulture, Himachal Pradesh w.e.f. 29.06.2015
4.	Sh JC Rana	Director of Agriculture, Himachal Pradesh upto 30.11.2015
5.	Sh Som Raj Kalia	Director of Agriculture, Himachal Pradesh w.e.f. 01.12.2015
6.	Sh SC Srivastva	Principal Chief Conservator of Forests, Himachal Pradesh upto 31.08.2015
7.	Sh SP Vasudeva	Principal Chief Conservator of Forests, Himachal Pradeshw.e.f. 18.09.2016
8.	Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
9.	Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f. 01.09.2015 to 30.11.2015
10.	Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
11.	Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
12.	Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
13.	Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
14.	Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
15.	Dr RC Sharma	Director of Research upto 30.11.2015 (charge rest with the Vice-Chancellor w.e.f. 01.12.2015).
16.	All the Heads of Departments	UHF, Nauni (Solan)
17.	All the Associate Directors (R&E)	UHF
18.	Director of Extension Education	CSK HPKV, Palampur, District Kangra
19.	Dr SK Gupta Joint Director (Comunication)	Directorate of Extension Education, UHF, Nauni (Solan)
20.	Dr ID Sharma Joint Director (Training)	Directorate of Extension Education, UHF, Nauni (Solan)
21.	Extension Coordinator	Directorate of Extension Education, UHF, Nauni (Solan)
22.	Deputy Commissioner	Solan
23.	Sh Mushtaw Mohammad	VPO Dalyana, Tehsil Ghumarwin, District Bilaspur
24.	Sh Shyam Singh Mehta	BaghiPanot (Shilliser), Tehsil Rajgarh, District Sirmaur
25.	Smt Kanta Daishta	Village Samala, Tehsil Rohru, District Shimla
26.	Sh Atam Swaroop	Village Mahlog, PO Chail, Tehsil Kandaghat, District Solan
27.	Sh Rashpal Pathania	VPO Basavazira, Tehsil Nurpur, District Kangra
28.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) upto 16.05.2015
29.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) w.e.f. 19.05.2015
30.	Dr NB Singh	Comptroller w.e.f. 01.04.2015 to 04.05.2015 (Additional Charge)
31.	Sh DR Negi	Comptroller w.e.f. 05.05.2015 to 31.07.2015
32.	Sh JM Awasthi	Comptroller w.e.f. 01.08.2015 to 02.09.2015 (FN)
33.	Sh KT Bodh	Comptroller w.e.f. 02.09.2015 (AN)
34.	Dr NB Singh	Director of Extension Education– Member Secretary w.e.f. 01.04.2015. to 31.07.2015
35.	Dr DK Srivastava	Director of Extension Education– Member Secretary w.e.f. 01.08.2015 to 29.02.2016
36.	Dr KS Verma	Director of Extension Education– Member Secretary w.e.f. 01.03.2016

RESEARCH COUNCIL

1.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan) - Chairman
2.	Sh Gurdev Singh	Director of Horticulture, Himachal Pradesh upto 30.06.2015
3.	Sh DP Bhangalia	Director of Horticulture, Himachal Pradeshw.e.f. 29.06.2015
4.	Sh JC Rana	Director of Agriculture, Himachal Pradesh upto 30.11.2015
5.	Sh Som Raj Kalia	Director of Agriculture, Himachal Pradesh w.e.f. 01.12.2015
6.	Sh SC Srivastva	Principal Chief Conservator of Forests, Himachal Pradesh upto 31.08.2015
7.	Sh SP Vasudeva	Principal Chief Conservator of Forests, Himachal Pradeshw.e.f. 18.09.2016
8.	Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
9.	Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f.01.09.2015 to 30.11.2015
10.	Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
11.	Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
12.	Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
13.	Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
14.	Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
15.	Dr NB Singh	Director of Extension Education w.e.f. 01.04.2015. to 31.07.2015
16.	Dr DK Srivastava	Director of Extension Education w.e.f. 01.08.2015 to 29.02.2016
17.	Dr KS Verma	Director of Extension Education w.e.f. 01.03.2016
18.	All the Heads of Departments	UHF, Nauni (Solan)
19.	All the Associate Directors (R&E)	UHF
20.	Director of Research	CSK HPVK, Palampur, District Kangra w.e.f.28.07.2014
21.	Dr Kumar Singh Sisodia	VPO Tikkri, Upper Neuwal, Tehsil Chopal, District Shimla
22.	Sh Ram Lal Chauhan	Village Dhangvi, PO Gumma, Tehsil Kotkhai, District Shimla
23.	Sh Sahib Singh Mehta	Village Gahana, PO Khunni, Sub-Tehsil Nankhari, District Shimla
24.	Sh Sanjeev Sharma	Vilalge Jathai, PO Cheog, Tehsil Theog, District Shimla
25.	Sh SS Chauhan	Village Bachhrin, PO Morsingi, Tehsil Ghumarwin, District Bilaspur
26.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) upto 16.05.2015
27.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) w.e.f. 19.05.2015
28.	Dr NB Singh	Comptroller w.e.f. 01.04.2015 to 04.05.2015 (Additional Charge)
29.	Sh DR Negi	Comptroller w.e.f. 05.05.2015 to 31.07.2015
30.	Sh JM Awasthi	Comptroller w.e.f. 01.08.2015 to 02.09.2015 (FN)
31.	Sh KT Bodh	Comptroller w.e.f. 02.09.2015 (AN)
32.	Dr RC Sharma	Director of Research – Member Secretary upto 30.11.2015 (Charge rest with the Vice-Chancellor w.e.f. 01.12.2015).

BOARD OF STUDIES
(College of Horticulture)

1.	Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
2.	Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f. 01.09.2015 to 30.11.2015
3.	Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
4.	All the Heads of Departments,	College of Horticulture, UHF, Nauni (Solan)
5.	Dr PK Mahajan	Professor and Head, Department of Basic Science, UHF, Nauni (Solan)
6.	Dr GP Upadhyay	Professor and Head, Department of EEWM, UHF, Nauni (Solan)
7.	Dr AK Randev	Professor and Head, Department of Social Sciences, UHF, Nauni (Solan)
8.	Dr DK Mehta	Sr. Extension Specialist, Department of Seed Science & Technology, UHF, Nauni (Solan)
9.	Dr Dinesh Singh Thakur	Sr. Extension Specialist, Department of Fruit Science, UHF, Nauni (Solan)
10.	Dr Dharmesh Gupta	Sr. Scientist, Department of Plant Pathology, UHF, Nauni (Solan)
11.	Dr (Mrs) Kiran Rana	Associate Professor, Department of Entomology, UHF, Nauni (Solan)
12.	Dr (Ms) Bharti Kashyap	Assistant Professor, Department of Floriculture and Landscape Architecture, UHF, Nauni (Solan)
13.	Dr (Ms) Manisha Thakur	Assistant Professor, Department of Biotechnology, UHF, Nauni (Solan)
14.	Dr (Ms) Santosh Kumari	Scientist, Department of Vegetable Science, UHF, Nauni (Solan)
15.	Dr (Ms) Yasmin Janjhua	Assistant Professor, Department of Business Management, UHF, Nauni (Solan)
16.	Dr Krishan Kumar	Professor, Department of Fruit Science, UHF, Nauni (Solan) - Secretary

BOARD OF STUDIES
(College of Forestry)

1.	Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
2.	Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
3.	All the Heads of Departments, College of Forestry	UHF, Nauni (Solan)
4.	Dr DK Srivastava	Professor and Head, Department of Biotechnology, UHF, Nauni (Solan)
5.	Dr JN Sharma	Professor and Head, Department of Plant Pathology, UHF, Nauni (Solan)
6.	Dr Rakesh Gupta	Professor and Head, Department of Entomology, UHF, Nauni (Solan)
7.	Dr (Mrs) Tara Gupta	Principal Extension Specialist, Department of Tree Improvement and Genetic Resources, UHF, Nauni (Solan)
8.	Dr Rajesh Kaushal	Senior Scientist, Department of Basic Sciences, UHF, Nauni (Solan) upto 21.02.2015
9.	Dr (Mrs) Parminder Kaur Baweja	Senior Scientist, Department of Environmental Science, UHF, Nauni (Solan)
10.	Sh Mukesh Prabhakar	Scientist, Department of Silviculture and Agroforestry, UHF, Nauni (Solan)
11.	Dr Yashpal Sharma	Phytochemist, Department of Forest Products, UHF, Nauni (Solan)
12.	Dr Subhash Sharma	Assistant Professor, Department of Social Sciences, UHF, Nauni (Solan)
13.	Er Ghanshyam Aggarwal	Assistant Professor, Department of Soil Science and Water Management, UHF, Nauni (Solan)
14.	Dr Bhupinder Dutt	Associate Professor, Department of Forest Products, UHF, Nauni (Solan) - Secretary

BOARD OF STUDIES

(College of Horticulture and Forestry, Hamirpur at Neri)

1.	Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
2.	Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
3.	Dr DK Srivastava	Professor and Head, Department of Biotechnology, UHF, Nauni (Solan)
4.	Dr PD Thakur	Principal Scientist, Department of Plant Protection, COH&F, Hamirpur upto 07.04.2015
5.	Dr YC Gupta	Professor and Head, Department of Floriculture and Landscape Architecture, UHF, Nauni (Solan)
6.	Dr RS Prashar	Principal Scientist, Department of Social Sciences, UHF, Nauni (Solan)
7.	Dr DK Sharma	Principal Scientist (Veg.), Department of Horticulture, COH&F, Hamirpur
8.	Dr VK Chaudhary	Principal Scientist (Stat.), Department of Social Sciences and Basic Sciences, COH&F, Hamirpur
9.	Dr KD Sharma	Principal Horticultural Technologist (FST), Department of Food Science and Technology, COH&F, Hamirpur
10.	Dr Sanjeev Thakur	Professor and Head, Department of Tree Improvement and Genetic Resources, UHF, Nauni (Solan)
11.	Dr Kamal Sharma	Principal Scientist, Department of Forestry and Environment, COH&F, Hamirpur
12.	Dr VK Sharma	Scientist (FBGR), Department of Horticulture, COH&F, Hamirpur
13.	Dr Som Dev Sharma	Principal Extension Specialist (Hort.), COH&F, Hamirpur - Secretary

FINANCE COMMITTEE

1.	Dr Vijay Singh Thakur	Vice Chancellor, UHF, Nauni (Solan) - Chairman
2.	Dr Shrikant Baldi	Additional Chief Secretary(Finance) to the Government of Himachal Pradesh
3.	Ms Upma Chawdhry	Additional Chief Secretary (Agriculture) to the Government of Himachal Pradesh
4.	Sh Tarun Shridhar	Additional Chief Secretary(Horticulture) to the Government of Himachal Pradesh
5.	Mrs Rupali Thakur, HPAS	Registrar, UHF, Nauni (Solan) upto 16.05.2015
6.	Sh Suresh Kumar Bhardwaj, HPAS	Registrar, UHF, Nauni (Solan) w.e.f. 19.05.2016
7.	Sh Rajesh Sharma, HAS	Examiner, Local Audit Department
8.	Sh Gurdev Singh	Director of Horticulture, Himachal Pradesh upto 30.06.2015
9.	Sh DP Bhangalia	Director of Horticulture, Himachal Pradesh w.e.f. 29.06.2015
10.	Sh SC Srivastva	Principal Chief Conservator of Forests, Himachal Pradesh upto 31.08.2015
11.	Sh SP Vasudeva	Principal Chief Conservator of Forests, Himachal Pradesh w.e.f. 18.09.2015
12.	Dr RL Chauhan	Ex-Chairman NIT, Kahan Niwas, Kelston, Shimla – 171001
13.	Dr NB Singh	Comptroller, UHF, Nauni (Solan) – Member Secretary w.e.f. 01.04.2015 to 04.05.2015 (Additional Charge)
14.	Sh DR Negi	Comptroller, UHF, Nauni (Solan) – Member Secretary w.e.f. 05.05.2015 to 31.07.2015
15.	Sh JM Awasthi	Comptroller, UHF, Nauni (Solan) – Member Secretary w.e.f. 01.08.2015 to 02.09.2015 (FN)
16.	Sh KT Bodh	Comptroller, UHF, Nauni (Solan) – Member Secretary w.e.f. 02.09.2015 (AN)

OFFICERS OF THE UNIVERSITY

Officers	Designation/Status
Sh Kalyan Singh	Chancellor (Chairperson) upto 11.08.2015
Acharya Dev Brat	Chancellor (Chairperson) w.e.f. 12.08.2015
Dr Vijay Singh Thakur	Vice Chancellor
Dr PS Chauhan	Dean, College of Horticulture upto 31.08.2015
Dr Kamlesh Kanwar	Dean, College of Horticulture w.e.f.01.09.2015 to 30.11.2015
Dr JN Sharma	Dean, College of Horticulture w.e.f. 01.12.2015
Dr KS Verma	Dean, College of Forestry w.e.f. 08.04.2015 to 29.02.2016
Dr PK Mahajan	Dean, College of Forestry w.e.f. 01.03.2016
Dr KS Verma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 07.04.2015
Dr PD Thakur	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 08.04.2015
Dr RC Sharma	Director of Research upto 30.11.2015 (Charge rest with the Vice-Chancellor w.e.f. 01.12.2015).
Dr NB Singh	Director of Extension Education w.e.f. 01.04.2015. to 31.07.2015
Dr DK Srivastava	Director of Extension Education w.e.f. 01.08.2015 to 29.02.2016
Dr KS Verma	Director of Extension Education w.e.f. 01.03.2016
Dr NB Singh	Comptroller w.e.f. 01.04.2015 to 04.05.2015 (Additional Charge)
Sh DR Negi	Comptroller w.e.f. 05.05.2015 to 31.07.2015
Sh JM Awasthi	Comptroller w.e.f. 01.08.2015 to 02.09.2015 (FN)
Sh KT Bodh	Comptroller w.e.f. 02.09.2015 (AN)
Er DN Sharma	Estate Officer Er DN Sharma upto 20.04.2015
Er Sonam Paljore Negi	Estate Officer w.e.f.21.04.2015
Dr Kamlesh Kanwar	Librarian upto 01.04.2015 to 31.08.2015
Dr Vijay Singh Thakur, Vice-Chancellor.	Additional Charge of Librarian w.e.f.01.09.2015 to 30.11.2015
Dr BS Thakur	Librarian w.e.f. 01.12.2015 to 26.02.2016
Sh Sudesh Kumar Sood	Librarian w.e.f. 27.02.2016
Dr YS Negi	Additional Charge of Students' Welfare Officer w.e.f. 01.04.2015 to 30.04.2015
Dr JN Sharma	Students' Welfare Officer w.e.f. 01.05.2015to 30.11.2015
Dr Rakesh Gupta	Students' Welfare Officer w.e.f. 01.12.2015
Mrs Rupali Thakur, HPAS	Registrar upto 16.05.2015
Sh Suresh Kumar Bhardwaj, HPAS	Registrar w.e.f. 19.05.2015
Joint Directors	
Dr D Tripathi	Joint Director Research (Forestry)
Dr SK Gupta	Joint Director (Communication)
Dr ID Sharma	Joint Director (Training)
Dr Satish K Sharma	Joint Director Research (Horticulture)
Dr Manoj Vaidya	Joint Director Research (Planning)
Heads of the Departments	
Dr Narender Sharma	Professor and Head, Department of Fruit Science w.e.f. 01.10.2014
Dr VK Joshi	Professor and Head, Department of Food Science and Technology upto 30.05.2015
Dr (Ms) Anju K Dhiman	Professor and Head, Department of Food Science and Technology w.e.f. 01.06.2015
Dr JN Sharma	Professor and Head, Department of Plant Pathology upto 30.04.2015

Dr NP Dohru	Professor and Head, Department of Plant Pathology w.e.f. 01.05.2015 to 31.10.2015
Dr IM Sharma	Professor and Head, Department of Plant Pathology w.e.f. 02.11.2015
Dr Rakesh Gupta	Professor and Head, Department of Entomology upto 30.11.2015
Dr (Mrs) Anju S Khanna	Professor and Head, Department of Entomology w.e.f. 01.12.2015
Dr HS Kanwar	Professor and Head, Department of Vegetable Science
Dr YC Gupta	Professor and Head, Department of Floriculture and Landscape Architecture
Dr DK Srivastava	Professor and Head, Department of Biotechnology upto 31.07.2015
Dr (Mrs) A K Nath	Professor and Head, Department of Biotechnology w.e.f. 01.08.2015
Dr YS Negi	Professor and Head, Department of Business Management upto 30.04.2015
Dr K K Raina	Professor and Head, Department of Business Management w.e.f. 01.05.2015
Dr NK Gupta	Professor and Head, Department of SAFupto 31.01.2016
Dr Bhupender Gupta	Professor and Head, Department of Silviculture and Agroforestry w.e.f. 01.02.2016
Dr Sanjeev Thakur	Professor and Head, Department of Tree Improvement and Genetic Resources
Dr Kulwant Rai	Professor and Head, Department of Forest Products
Dr AK Randev	Professor and Head, Department of Social Sciences
Dr GP Upadhyay	Professor and Head, Department of Soil Science and Water Management
Dr PK Mahajan	Professor and Head, Department of Basic Sciences upto 29.2.2016
Dr (Mrs) Veena Sharma	Professor and Head, Department of Basic Sciences w.e.f. 03.03.2016
Dr Kuldeep Mehta	Professor and Head, Department of Seed Science and Technology w.e.f. 05.01.2015 to 31.03.2016
Dr Satish Kumar Bhardwaj	Professor and Head, Department of Environmental Sciences
Associate Directors	
Dr BS Thakur	Associate Director (R&E), Regional Horticultural Research and Training Station, Mashobra (Shimla) upto 31.11.2015
Dr MS Mankotia	Associate Director (R&E), Regional Horticultural Research and Training Station, Mashobra (Shimla) w.e.f. 01.12.2015
Dr Jayant Kumar	Associate Director (R&E), Regional Horticultural Research and Training Station, Bajaura (Kullu)
Dr ML Bhardwaj	Associate Director (R&E), Regional Horticultural Research and Training Station, Jachh
Dr AK Joshi	Associate Director (R&E), Regional Horticultural Research and Training Station, Dhaulakuan (Sirmaur)
Dr Rajeshwar S Chandel	Associate Director (R&E) and Programme Coordinator, Regional Horticultural Research and Training Station and Krishi Vigyan Kendra, Sharbo (Kinnaur) upto 26.04.2015
Dr Pankaj Gupta	Associate Director (R&E) and Programme Coordinator, Regional Horticultural Research and Training Station and Krishi Vigyan Kendra, Sharbo (Kinnaur) w.e.f. 27.04.2015
Dr DD Sharma	Associate Director (R&E) and Programme Coordinator, Horticultural Research and Training Station and Krishi Vigyan Kendra, Kandaghat (Solan)
Dr Rajeev Raina	Programme Coordinator, Krishi Vigyan Kendra, Chamba
Dr Manish Kumar	Programme Coordinator, Krishi Vigyan Kendra, Rohru (Shimla) upto 23.11.2015
Dr NS Kaith	Programme Coordinator, Krishi Vigyan Kendra, Rohru (Shimla) w.e.f. 24.11.2015
Dr Arun Kumar	Scientist-cum-Incharge, Regional Horticultural Research Sub-Station, Tabo (Lahaul & Spiti)
Dr Atul Gupta	Senior Scientist-cum-Incharge, LMRS, Nagrota Bagwan (Kangra)

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