

ANNUAL REPORT

2019-20



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

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डा. महेंद्र सिंह ठा



औद्योगिक

उद्योग

श्री महेंद्र सिंह ठा

माननीय सिंचाई एवं जन स्व



FOREWORD



Indian agriculture has made a fabulous progress during the last five decades. The food grain importing country in late sixties, attained self-sufficiency after green revolution in 1970, and has emerged as an exporter of food grains which is one of the important landmarks in the history of growth of Indian agriculture. With the consistent efforts of scientists, corporate houses and above all the Indian farmers, the production of agricultural commodities such as food grains, fruits, vegetables, and plantation crops has continuously increased despite all odd vagaries of climatic situations under changing climatic scenario world over. As a result, its overall contribution to GDP is 19.2 % and provides employment to about 60% of Indian population. The growth in GVA (gross value added) during 2020-21 for the entire economy contracted by 7.2 per cent. However, GVA for agriculture maintained a positive growth of 3.4 per cent. The continuous supply of agricultural commodities, especially staples like rice, wheat, pulses and vegetables also enabled food security. In 2019-20, total food grain production (296.65 million tonnes) in the country was higher by 11.44 million tonnes than 2018-19. The substantial increase in production has resulted with the help of the technologies requiring intensive input of fertilizers, pesticides, growth regulators, seeds and infrastructure. In order to continuously increase the production of food grains, it is imperative to redefine the crop production and management practices which at present have become highly input intensive. Hence, the emphasis has to be given on increasing productivity levels of the existing cultivated area through, cropping intensity, precision farming, diversification of farming systems, climate smart agriculture, water harvesting technologies, mushroom cultivation, honeybee rearing, medicinal and aromatic plant cultivation, marketing, storage, and processing and value addition etc. in order to fulfil the dream of doubling farmers income by 2022. India witnessed the shift in area from food grain towards horticulture crops. The production of horticulture crops have outpaced the production of food grain since 2012-13. The horticultural crops can contribute in a bigger way in enhancing the income of farmers. During 2017-18, the production of horticulture crops was 311.71 million tonnes from an area of 25.43 million hectares. The production of vegetables has increased from 101.2 million tonnes to 184.40 million tonnes since 2004-05 to 2017-18 and production of fruits has increased from 50.9 million tonnes to 97.35 million tonnes since 2004-05 to 2017-18. The total horticulture production of the country is estimated to be 320.48 million tonne in 2019-20, which are estimated to be 3.13% higher than last year. The fruits production is estimated to be around 99.07 million tonne, compared to 97.97 million tonne of 2018-19.

Presently 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. 3313.68 crores, involving about 4,64,254 farmers in horticulture business thereby generating 900 lakh mandays employment. Beside fruits, horticulture industry also produced 14206 MT of mushrooms, 1591 MT of honey, 12347 MT and 1769 lakh number of flowers. During 2018-19, the overall productivity of fruits in the State is 2.13 MT though the maximum productivity has been recorded in papaya (5.88 MT) followed by apple (3.25MT), malta (1.77 MT) and orange (1.69MT) whereas it is minimum in case of almond (0.13 MT). The vegetables are an indispensable part of our diet. Vegetable cultivation not only contributes to food and nutritional security but also to poverty alleviation and income generation. To eradicate food and nutritional insecurity on sustainable basis, we need to further enhance our vegetable productivity. The production and productivity of vegetables still can be increased by adopting good quality seed and planting material of improved varieties and hybrids, concept of seed village, protected cultivation, improved cultural practices or technologies, hydroponics, followed by plant protection measures. The flower crops have emerged as a new viable diversification in horticulture- business supported by diverse agro climatic conditions in the State. Increasing trends in area and production of flowers have been observed since 2003-04. A consistence increase of 10-15 % in flower trade has been visualized during the last few years, which is largely due to the adoption of modern technologies. There is an increasing trend of acreage under floriculture since 2009-10 to 2018-19 (709 ha) in the State with annual increase of about 4%. Medicinal and aromatic plants are used in this country since time immemorial. Approximately two thousand plant species are used for their curative properties and one thousand three hundred are known for their aroma and flavour. Lot of efforts are required to improve the productivity of medicinal plants such as potential utilization of hybrid vigour in terms of yield as well as secondary metabolites, conservation and sustainable utilization of medicinal plants and systemic approach envisaging interaction between social, economic and ecological systems.

The development achieved in the horticulture sector is indicative of the fact that there is growing demand for horticulture produce. The horticulture industry, to be competitive requires efficient production techniques, sustainable natural resource management, the development of supply and marketing alliances, high quality products and marketing to meet market trends and consumer preferences. The emphasis is required to be given to enhance the production and productivity along with quality improvement of horticulture produce through the introduction of regular bearing, high-yielding and good quality hybrid varieties and adoption of improved production technologies such as high density planting, integrated orchard management practices, precision farming, hi-tech greenhouse cultivation, mechanization of horticulture, rain water harvesting and integrated pest and disease management as well as modern post-harvest technologies such as creation of cold chain from producing areas to the terminal markets including primary and secondary processing techniques for value addition of the produce.

The University has been, and is continuing to contribute for the overall development of the horticulture and forestry through strategic, cohesive, interdisciplinary, and need based farmer oriented research, education, and extension activities in Himachal Pradesh. The university has made spectacular progress in human resource development, research, and dissemination of technology to the farmers in horticulture, forestry and allied sciences during the last year to achieve higher production and productivity of crops while safeguarding the environment and natural resources of the State. It is a matter of great pride that our University has been ranked 80th amongst 750 universities ranked by the National Institutional Ranking Framework (NIRF) of the Ministry of Human Resource Development, Govt. of India in 2019 and only university in the state in the top 100. The university has further improved its ICAR ranking from 12th position during 2018 to 11th position in the 2019. The university has further been categorized as "Band A" Institution (rank 6-25) in category of Government and Government aided universities in Atal Ranking of Institutions on Innovation Achievement (ARIIA) 2020. Similarly India Today has ranked the University at 25th position under the category general universities (Govt.) during 2020.

The fourth constituent College of the University- College of Horticulture and Centre of Excellence for Horticulture Research and Extension, Thunag was inaugurated by the Hon'ble Chief Minister of Himachal Pradesh Shri Jai Ram Thakur in October 2019. The university has recently bagged a prestigious world bank funded ICAR's National Agricultural Higher Education Project entitled 'Institutional Development Plan' (IDP). The project has an outlay of Rs 25.00 crores which will be utilized to provide a holistic learning/teaching environment to the students and faculty. Our students have excelled in national level competitive examinations such as ICAR-NET, JRF, SRF etc. examination. The University Centre of All India Coordinated Research Project (AICRP) on Post Harvest Engineering and Technology was adjudged 2nd Best Centre in the country for the year 2019-2020 for outstanding contribution in development of technologies. Krishi Vigyan Kendra –Shimla at Rohru bagged best KVK award in HP while the other KVK at Lahaul & Spiti-II got best presentation award at the Annual Zonal Workshop of KVKs (Zone-1) held at GBPUAT, Pantnagar. Similarly KVK Chamba was awarded at the national level for the successful implementation of NICRA project in Lagga village of the district. The university has also signed two MOUs to share research and development facilities, and transfer of technologies. A demonstration unit on Subhash Paleker Natural Farming (SPNF) has been established where vegetable and fruit crops are being grown by utilizing all the components of SPNF.

The Government of Himachal Pradesh, Hon'ble Chief Minister and the Council of Ministers, have extended full support to the University for clearing the outstanding liabilities of DA/DR/pension/gratuity/leave encashment of the employees. I am highly thankful to the Hon'ble Chief Minister of Himachal Pradesh and Chief Secretary, Additional Chief Secretary (Finance) and Principal Secretary (Horticulture) for providing full support to the university. The scientists and staff of the university have put in best effort to substantially enhance domestic income from Rs. 24.90 crores in 2017-2018 to 28.50 crores in 2019-20. Sincere gratitude is also expressed to ICAR, and other funding agencies for their support to the University. The support provided by Board of Management and various executive committees of university including various employees and students organizational bodies is thankfully acknowledged for their cooperation and help in running the university. I would like to congratulate my entire team of scientists, staff and students for carrying out all the teaching, research and extension activities as planned, and contributing to the progress of the University. I appreciate the sincere and concerted efforts of Director Research and Joint Director's Research (Horticulture, Forestry & Planning), and all the staff members of the University for publication of the Annual Report for the year 2019-20.


(Parvinder Kaushal)
Vice Chancellor



PREFACE



Himachal Pradesh is situated in the heart of western Himalayas having an altitude ranging from 350 meters to 6,975 meters above the 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. 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. Amongst the fruit crops, perhaps all kind of fruits grown in the country, except those which are grown in the warm humid coastal regions, are being produced in the State. Apple dominates the fruit industry of the state. Out of total area of 2,32,139 hectares under horticultural crops, apple alone occupies about 1,13,154 hectares which constitutes about 48.74 per cent of the total area under fruits in the state whereas mango, citrus and other subtropical fruits area is 80,377 hectare. Similarly, apple production is 368603 MT which contributes to 74.41 per cent of total fruit production (4, 95,362 hectare) in the state. However, mango, citrus and other subtropical fruits contributes to the extent of 17.35 per cent.

The University has continued to focus on its mandate to achieve the goals of strategic, need based and farmer oriented development of horticulture and forestry in Himachal Pradesh through excellence in education, research and extension for food and ecological security, improved livelihood opportunities and economic prosperity of hill farming communities of the State. The colleges of Horticulture and Forestry situated at main campus of the university, Neri-Hamirpur and Thunag-Mandi are imparting quality education to undergraduate and postgraduate students of different states of India. During this year 567 students have completed their B.Sc. (Hort.), B.Sc. (Fort.), M.Sc., MBA, and Ph.D. degrees from COH and COF Nauni, and COH&F, Neri. For the next academic session, 911 students have been enrolled in undergraduate and post graduate programmes. The students of university are not only excelling in their studies but they also undergo a rigorous training in RAWE at Regional Stations and Krishi Vigyan Kendra's of the university, industries, and State Forest Department under the student READY (RAWE) programme of ICAR. Our students have also excelled in national examinations and qualified various exams such as Senior Research Fellowship, Junior Research Fellowship, National Eligibility Test, Rajeev Gandhi National Fellowship for ST/SC Students, Agricultural Research Services, DST Inspire Fellowship, and NTS Scholarship etc. Two students in the field of Agroforestry and Agricultural Statistics have been selected for ARS-2019-20. It was unique opportunity for our two students -Dr Reena Kumari and Mr. Sachin who were amongst 100 meritorious students of the country to witness the Republic Day Parade, 2020 from the prestigious PM's Box.

The students of the university are also participating in extra-curricular activities in Inter-agricultural Universities Youth Festival/ Sports and Games meet. Ms Sandhya of COH&F Neri, bagged Gold Medal in Super Giant Slalom event and Silver Medal in free style ski, organised by Indian Olympic Association, at Solangnala, Manali. Mr. Lokesh Bhanot bagged silver in International Kickboxing Championship in Argentina and was also selected for International Kick Boxing Tournament in Jordan. Other activities during the period included NSS/ NCC Camp, North Zone Volleyball Championship (Women), Youth Parliament, Swachhta Pakhwada, Run for Unity, Constitution day, Agricultural Education Day, International Day of Yoga, Personality Development Programme, Stress Management Programme, Inter-class Football Championship, Drug De-addiction Seminar, Annual Function and Prize Distribution of College of Horticulture & Forestry, Neri, and the Republic Day celebrations. In athletics, Shubham Ranaut of College of Horticulture was awarded 'best sports person' (boys) whereas Kritika Saklani best sports person (girls) of the University during Inter College Games and Youth Festival.

The Directorate of Research is playing a pivotal role in planning, implementing, monitoring, evaluating and coordinating research through different departments and research stations in diverse agro-climatic zones of the

State. New varieties of cucumber cv. Solan Srijan and Ginger cv. Solan Giriganga have been released for cultivation in mid and foot hills of western and eastern Himalayan Regions and Lower Gangetic plains of India. A new Plum variety "Cacanska" has been recommended for commercial cultivation. The fruits of this variety mature earlier than the commercial cultivar Santa Rosa. Field gene banks of Melia dubia (Malabar Neem-17 cultivars), Mango (10 cultivars including Baramasi mango), Guava (7 cultivars), Pomegranate (14 cultivars) and Avocado (3 cultivars), coffee (3 cultivars), Sapota (Cricket Ball), Custard Apple (2 cultivars), Jackfruit (1 cultivar), Carambola and Macademia nut have been established. Five low chilling apple cultivars (Anna, Michael, Molli's Delicious, Red Fuji and Scarlet Gala) revealed that cv. Anna and Gala surpassed all other cultivars. The initial yield of 10kg/plant was recorded in cultivar Anna which was observed to be maximum in comparison to other cultivars. In order to increase the productivity of fruits, the university is advocating high density plantation on clonal rootstocks in areas suitable for high density plantation of mango, guava, apple etc. in Himachal Pradesh. Traditional system of guava cultivation often poses problem in attaining desired levels of productivity. Meadow orcharding technique was adopted for enhancement of productivity of quality fruits and seven year old trees of guava cv. Lalit planted under ultra-high density (2x2 m) plantation gave fruit yield of 26.5 kg/tree during rainy and winter season. The University has identified four varieties of apple, namely Redlum Gala, Red-Velox, Red-Cap Valtod and Jeromine to be suitable for high density plantations under Nauni conditions with tall spindle system of training as the best system for high density plantations of apple. Plant spacing of 2.5 m x 1.0/1.5 m with a density of 2666/4000 trees/ ha was found better which resulted in production of better size and quality fruits with highest productivity (24-28 t/ha). Shiitake (Lentinula edodes) is one of the priced mushrooms and production technology is standardized for the same. Among different strains of shiitake mushroom evaluated at Nauni, strain OE-388 was found to be the best with biological efficiency of 35 per cent on saw dust substrate. In Jeevak (Malaxis acuminata)- a unique & stable morphotype (named Solan selection) having distinct colour of floral buds, flowers, sheath on base of shoot (rhizome) and pseudo bulbs have been developed & registered with National Bureau of Plant Genetic Resources, New Delhi and allotted registration no. INGR- 18043.

All the research outputs of the university are being disseminated to the farming community through institutional trainings/exposure visits (83), in which about 2260 farmers have been benefitted. Krishi Vigyan Kendras –Shimla at Rohru, Lahaul & Spiti-II got best presentation awards. Similarly KVK Chamba was awarded at the national level for the successful implementation of NICRA project in Lagga village of the district. State Level Workshop on Package of Practices of Vegetables, Fruits and Ornamental crops was held after gap of about 7 years. The university is issuing regular Agro-Advisory Services to media and newspapers so that farmers can plan their farm operations in advance. All the scientists of the university are actively participating in the programme "Mera Gaon Mera Gaurav" and visited various villages adopted by a team of scientists. The university is supplying quality planting material of temperate, subtropical fruit crops, medicinal and aromatic plants, and forest plants as well as seeds of vegetables, flowers, mushroom spawn etc. every year to the farmers of Himachal Pradesh and adjoining states. The university is in process of substantially increasing its capacity in the coming years to satisfy the growing demand of the orchardists.

I take this opportunity to thank all the Statutory Officers, Heads of Departments, Associate Directors (R&E) of Regional Research Stations and Incharges of different Research Stations for providing input for Annual Report. I appreciate the sincere and concerted efforts of Joint Director's Research (Horticulture, Forestry & Planning), staff of the Directorate of Research and other university scientists associated in bringing out the Annual Report for the year 2019-20.


(Parvinder Kaushal)
(Director Research)





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INTRODUCTION

Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan has its origin from Himachal Agriculture College, 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 four constituent colleges viz., College of Horticulture and College of Forestry located at the main campus, Nauni, having nine and seven departments, respectively besides a College of Horticulture and Forestry at Neri, Hamirpur and Thunag, Mandi. In addition, there are five Regional Horticultural Research and Training Stations, one Regional Horticulture & Forestry Research Station, nine Research Sub-Stations and five Krishi Vigyan Kendras (KVKs) situated in different agroclimatic zones of the State.

The University is located at an elevation of about 1270 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 know how 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

Fruit Crops

Apple

- Among eight different varieties of apple evaluated, Jeromine, Red Cap Valtod, Scarlet Spur II and Redlum Gala performed better under lower elevation (Nauni) and these varieties have been recommended in Package of Practices for the commercial cultivation (FS, Nauni).



Jeromine



Redlum Gala

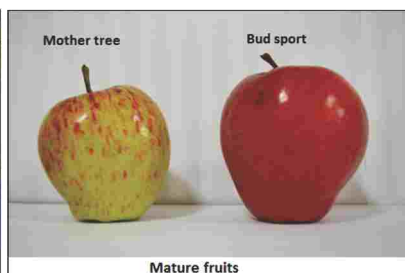


Scarlet Spur – II

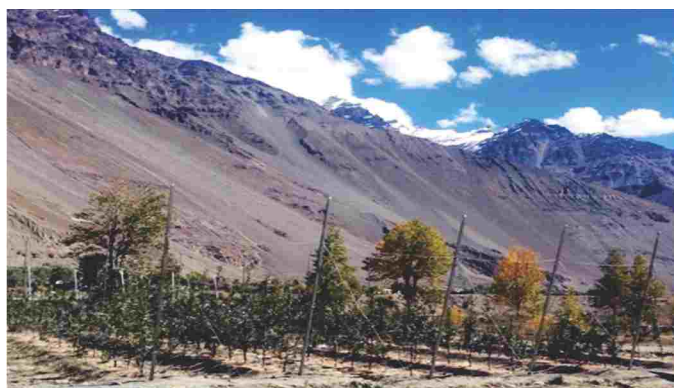


Red Cap Valtod

- A total of 7,154 apple trees from 40 orchards located in the districts of Shimla, Kullu, Kinnaur and Lahaul & Spiti of Himachal Pradesh during 2016-17 were preliminary screened for identification of bud sports. An early colouring bud sport in cv. Red Delicious was identified in Shimla district. Bud wood of this identified bud sport was collected and propagated successfully at RHRTS, Mashobra (FS, Nauni).



- New varieties of apple viz., King Roat, Dark Baron Gala and Chelan Spur on EMLA-111 rootstock while Schnico Gala on EMLA-9 rootstock has been introduced for evaluation (RHR&TS Bajaura).
- High density plantation of latest apple varieties in tribal areas of Himachal Pradesh for improving productivity are under progress: 180 plants of cultivars viz. Jeromine, Super Chief, Red Velox, Gale Gala, Auvil Early Fuji, and Redlum Gala having different scion and clonal rootstock combinations, have been planted at varying distances between plant to plant and row to row with the objectives to screen out the potential of high-density plantation at this specific region of Lahaul and Spiti. The results revealed that, maximum plant height and plant spread was found in Super Chief/MM 106 cultivar rootstock combinations planted at a density of 2.5x1.5 m than the remaining cultivar and rootstock combinations. Maximum fruit yield was found in cultivar, Auvil Early Fuji/M9 planted at a density of 2.5x1.5 m and Super Chief/M9 planted at a density of 2.5x1.5 m, respectively. Among different training systems and rootstock combinations on growth parameters of various apple cultivars found that tall spindle system of training is best, easy to practice as compared to other systems of training. The high density plantation for community demonstration have also been laid out at village Ledang in Spiti valley (KVK Tabo).



High density plantation of apple at Tabo

- In a study on top working techniques of apple viz., cleft grafting, tongue grafting, bark grafting, chip budding and T-budding for bud wood production carried out. It was concluded that top working by tongue grafting at a height of 1.25 m gave the best

results in respect of graft/bud take success, average shoot length, total number of shoots, internodal length and percentage of graftable scion wood (*FS, Nauni*).



Cleft grafting Tongue grafting Bark grafting

- ❖ Among different plant spacings the plant spacing of 2.5×1.5 m and 1.0 m with a density of 2666 to 4000 trees/ ha was found better as these resulted in production of better size and quality fruits with highest productivity (24-28 t/ha) after 3 years of plantation (*FS, Nauni*).



$2.5 \text{ m} \times 1.5 \text{ m}$ (2666 trees/ha) $2.5 \text{ m} \times 1.0 \text{ m}$ (4000 trees/ha)

- ❖ The trees of standard variety raised on M9 rootstock were planted at a spacing of 2.5×1.0 m and the trees were trained with tall spindle, slender spindle and vertical axis systems of training. Among different training systems, the tall spindle training system performed well in respect of better yield and quality fruit production in comparison to other training systems (*FS, Nauni*).



Tall spindle training system

- ❖ High density plantation block of 1000 apple plants consisting of five varieties namely; Jeromine on EMLA111, Redvelox on EMLA111, King Roat on EMLA111, Schelect Spur on EMLA111 and Gala SechnigaSchinco on EMLA111 and EMLA9 rootstocks has been established at spacing 1.5×2.5 m and 1.5×2.0 m apart under Institutional Development Project of NAHEP (*FS, Nauni*).
- ❖ Maximum plant stock and scion girth (13.70 cm and 11.89 cm) was observed when plants were spaced at 2.5×1.0 m. Minimum plant stock and scion girth (10.38 cm and 9.78 cm) was recorded with plants spaced at 2.5×0.75 m. Annual extension growth was maximum (29.62 cm) in plant spaced at 2.5×0.75 m. Minimum annual extension growth (25.12 cm) recorded with plants spaced at 2.5×1.5 m, which was significantly lower than other spacing. Fruit weight and fruit size 148.14 g and fruit size (63.52 x 71.62 mm) was also recorded in plants spaced at 2.5×1.5 m. Minimum fruit weight (140.85 g) and fruit size (60.90 x 69.55 mm), when plants were planted at closer spacing (2.5×0.75 m) (*RHR&TS, Mashobra*).
- ❖ To study the effect of interstock (M9) on vegetative growth, dwarfism, precocity and yield of apple cv. Redlum Gala has been initiated in the year 2019 for high density plantation. Six different rootstocks (Merton 793, EMLA111, M116, MM111, MM106, Seedling) were used and Redlum Gala was grafted with M9 interstock and raised in nursery for one year. During the year 2020, these plants were transplanted at experimental plots at a spacing of 2.5×1.0 m for evaluating and comparing the performance of Redlum Gala grafted on seedling rootstock (*FS, Nauni*).
- ❖ Keeping in view the current queries of the farmers regarding the field performance of tissue cultured plants, the preliminary field experiment on the orchard performance of tissue cultured clonal rootstock of apple has been initiated from the year 2019. Five tissue cultured apple clonal rootstocks (Merton 793, MM106, MM111, M9, M7) were grafted with Jeromine cultivar and raised in nursery for one year. In the next year during January 2020, the plants were planted at a spacing

of 2.5×1.0 m in experimental field for studying their comparative field performance with mound layered clonal rootstocks. The further observations on growth, cropping and fruit quality will be recorded in coming years (*FS, Nauni*).

- ❖ Maximum plant stock girth (12.45 cm) was recorded in Red Velox which was significantly at par with Super Chief and significant higher than all other varieties. Whereas, minimum trunk girth (10.25 cm) was recorded in Auvil Early Fuji, which was at par with Redlum Gala. Scion girth (10.06 cm) was recorded maximum in Red Velox which was significantly higher than all other varieties. Jeromine variety recorded minimum plant scion girth (7.11cm) which was at par with Auvil Early Fuji and Scarlet Spur-II. Maximum plant height (254.87 cm) was also recorded in Red Velox which was significantly higher than all other varieties. Minimum plant height (154.00cm) was recorded in Super Chief which was significantly lower than all other varieties (*RHR&TS, Mashobra*).
- ❖ Fruit weight (159.60 g) was recorded maximum in Super Chief which was at par with Scarlet Spur-II, Red Cap Valtod and Super Chief. Whereas, minimum fruit weight (107.42g) was recorded in Jeromine which was at par with Auvil Early Fuji and Redlum Gala. Fruit size in terms of length and breadth was maximum (64.14 x 72.47 mm) in Super Chief whereas minimum fruit size (51.76 x 63.60 mm) was recorded in Auvil Early Fuji (*RHR&TS, Mashobra*).

- ❖ High density plantation on clonal rootstock at Kandaghat, revealed that among the eight apple cultivars tested viz., Auvil Early Fuji, Jeromine, Gale Gala, Red Cap Valtod, Redlum Gala, Red Velox, Scarlet Spur II and Super Chief, maximum yield of 9.28 t/ha was recorded in Red Cap Valtod grown on MM106 whereas maximum fruit weight, length and diameter of 152.7 g, 61.4 mm and 71.2mm respectively, was observed in Jeromine grown on M9 (*KVK Kandaghat*).
- ❖ To evaluate various apple cultivars at different altitude namely Jeromine, Super Chief, Red Cap Valtod, Scarlet Spur II, Red Velox, Auvil Early Fuji, Gale Gala and Redlum Gala on M9 and MM106 rootstocks were studied. The study revealed that the maximum plant height (313.50 cm), plant spread (183.13 cm EW, 180.75 cm NS) and trunk diameter (43.08 mm) was recorded in Red Velox/M9. However, the minimum plant height (191.63 cm) was recorded in Red Cap Valtod / MM 106, plant spread in East- West direction of 77.17 cm in Gale Gala/M9 and trunk diameter of 23.50 mm and plant spread in North-South direction (92.75 cm) was noted in Jeromine/M9. The annual shoot extension growth was found maximum (17.61 cm) in Red Velox/M9 followed by Super Chief/MM106 (17.33 cm) whereas; it was recorded minimum (12.31 cm) in Gale Gala/M9 (*RHR&TS Sharbo*).



Gale Gala

Redlum Gala

Auvil Early Fuji



Super Chief

Red Velox

Red Cap Valtod



Auvil Early Fuji



Redlum Gala

Gale Gala



Red Cap Valtod



Red Velox



Jeromine



Super Chief

- ❖ A field gene bank of temperate fruits viz. 268 varieties of apple, 78 of pear and 46 of cherry were planted at Mashobra. Morphological characterization of these varieties for vegetative, flowering and fruit characters are being done. Morphological characterization of apple varieties for vegetative parameters (one year old shoot) thickness, internodal length, number of lenticels, colour on sunny side and pubescence on shoot, leaf blade: length, leaf blade: width, leaf blade: ratio length/width) has been recorded (*RHR&TS, Mashobra*).

Colour on sunny side :

Dark brown



Oregon Spur Light brown

Medium brown



Gloster Reddish brown



Granny Smith



Wealthy Double Red

Leaf blade: pubescence on lower side :

Absent or weak



Gold Spur

Medium



Cox's Orange Pippin

Strong



James Grieve

Flowering stage:

Full Bloom
Adam50 per cent flowering
James GrievePink bud stage
Mutsu

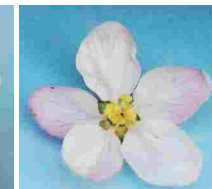
Flower: arrangement of petals

Free



Worcestor Pearmain

Intermediate



Silver Spur

Overlapped



Red Baldwin

Flower: position of stigma relative to anthers

Below



Real Mecoy

Same



Ambstarking

Above



Vance Delicious

- ❖ An experiment was carried out to assess the effect of different N P K doses on growth of grafted apple nursery plants with an objective to find out the optimum dose of nutrients for production of quality planting material of apple. Among the various NPK combinations tried, NPK @ 18:6:4.5 g/m² and 18:6:9 g/m² nursery bed were found most effective in improving the linear growth, radial growth, total root length and total plant biomass of Starking Delicious and Oregon Spur apple nursery plants raised on Merton 793 rootstock (*FS, Nauni*).

- ❖ The application of 1000 g Agrisilica granules followed by three sprays of Agrisilica liquid @ 45 ml (pink bud, one week after petal fall and walnut stage) with recommended dose of fertilizers enhanced the fruit weight, size and yield of apple. Phosphate Rich Organic Manure (PROM) on apple had significant effect on the fruit weight and yield (62.7 kg/plant). The highest fruit weight (218.8 g/fruit), fruit length (8.4 cm) and diameter (8.1 cm) was recorded with the application of PROM (1500 g) + 12:32:16 (300 g) (*RHR&TS Bajaura*).
- ❖ Foliar application of AgroGain had a significant effect on annual shoot growth, fruit set, yield and physical parameters of apple fruit. Maximum annual shoot growth (45.11 cm) was recorded in trees sprayed with AgroGain @ 1.5 ml per litre at pink bud and petal fall stage. Maximum fruit set (32.40%) was recorded when AgroGain was sprayed @ 0.5 per litre at pink bud, petal fall and walnut stage. Maximum fruit weight (167.50 g) size in terms of length and breadth (66.79 x 73.28 mm), fruit firmness (7.43 kg/cm²) and TSS (10.37°B) were recorded in trees treated with AgroGain @ 1.5 ml per litre at pink bud and petal fall stage (*RHR&TS, Mashobra*).
- ❖ An experiment on evaluation of Macarena and Brique on apple was conducted during the year 2019. Fruiting and quality parameters of apple fruit was significantly affected by different treatments. Maximum fruit retention (82.56%) and fruit yield (42.25 kg/tree), fruit weight (152.29 g) and size in terms of length and breadth (62.42 x 71.70 cm) was recorded in trees sprayed with Brique @ 2.0 per litre at pea stage, walnut stage and 25 to 30 days before harvesting. Maximum fruit set (48.67%), TSS (13.27°B) and total sugar (9.4%) was recorded with application of Macarena @ 1.5 per litre at pink bud, pea and walnut stage (*RHR&TS, Mashobra*).
- ❖ Field experiments on SPNF on apple crop were conducted at Mashobra in four blocks (Oregon Spur on seedling, Bright-n-Early on M9 rootstock, Red Chief on M7 rootstock and Espalier (Royal Delicious) on MM 111 rootstock) and apple nursery. The data collected after one year revealed that there was no significant difference in the yield of apple crop (*RHR&TS, Mashobra*).



Field trial SPNF on apple

- ❖ Different mulching materials viz. black poly mulch, grey poly mulch and straw mulch in conserving soil moisture and maintaining soil temperature under apple at five locations were evaluated which revealed that straw mulching resulted in higher moisture content in soil throughout the crop growing season (April to October) by reducing evaporation losses followed by grey poly mulching and black poly mulching as compared to farmers practice where no mulch was applied. On an average the straw mulching in apple basin resulted in 40 per cent higher moisture content in soil followed by 20 per cent in grey poly mulch and 18 per cent in black poly mulch. The soil temperature was studied at two depths (5 cm and 10 cm). During morning hours, higher temperature was recorded at both soil depths where black and grey poly mulching was applied. During afternoon maximum soil temperature at both the soil depths was recorded in treatment where black poly mulch sheet was applied followed by grey poly mulching. Minimum temperature at both soil depths during morning and afternoon was recorded in treatment where straw mulch was applied. Yield of apple was recorded highest (41.65 t/ha) in treatment where straw mulch was applied which was 25 per cent higher compared to the farmers practice where no mulch was applied (*KVK Tabo*).



Evaluation of mulches under apple

- ❖ A front line demonstration on balanced application of fertilizers in apple was carried out at 10 locations. The balanced application of fertilizers resulted in increase of apple yield. Apple yield ranged from 33 to 40 t ha⁻¹ at locations with average yield of 36.7 t ha⁻¹. On an average, the balanced application of fertilizers resulted in 22 per cent higher apple yield as compared to farmer's practice (*KVK Tabo*).
- ❖ A front line demonstration was conducted to show the effect of application of plant growth regulator. Results revealed that application of Promalin @30 ppm spray at king bloom stage increased the size and weight of apple fruits. Fruit length, breadth and weight increased by 6, 7 and 13 per cent, respectively with application of Promalin as compared to the farmers practice highest yield of apple (33 t ha⁻¹) was recorded in treatment where promalin @30 ppm was sprayed (*KVK Tabo*).



Effect of promalin application

- ❖ On farm trial was conducted to evaluate varietal performance of different cultivars of apples viz. Royal Delicious, Super Chief and Scarlet Spur-II at five locations in the Spiti valley. Super Chief recorded maximum fruit yield (37 t ha⁻¹), fruit size length (83 mm) and breadth (88.4 mm) and fruit weight (282 g) as compared to traditional variety Royal Delicious with minimum fruit yield (32 t ha⁻¹), fruit size (length 76.39 mm and breadth 81.38 mm) and fruit weight (252 g). Spur type

cultivars bear more spur per unit area leading to heavy cropping with dark red coloured fruits (*KVK Tabo*).

- ❖ On farm trial conducted at farmers' field, to study the performance of four apple cultivars viz., Gale Gala, Early Red One, Scarlet Spur II and Oregon Spur introduced for crop diversification in the mid hill zone of Himachal Pradesh, maximum production per hectare was obtained in Gale Gala (35.76 q/ha) which is a pollinizer with B:C ratio of 1.68 followed by Early Red One (27.44 q/ha) a semi spur cultivar with B:C ratio of 1.25 the fruits were ready for harvest by the first week of July which can fetch a good price for the farmers thereby making apple cultivation a viable diversification option for growers of the mid hill zone of Himachal Pradesh (*KVK Kandaghat*).
- ❖ *In vitro* propagation technique of apple variety Oregon Spur using axillary buds as explants was standized. Buds collected in June - July resulted in maximum bud break of 40-50 per cent and survival of 25 per cent. Four fold multiplication rate and upto 2 cm long shoots were obtained on MS medium with 0.8 mg/l BA, 0.5 mg/l GA₃ and 0.1 mg/l IBA. Leaf explants regenerated best on MS medium containing 4mg/l BA and 0.2mg/l NAA which resulted in 75 per cent regeneration with 4-5 shoots per explant. The shoots were multiplied, rooted on 0.1 mg/l IBA with 70 per cent frequency and hardened. Effect of antibiotic sensitivity showed 65% shoot induction on 100mg/l cefotaxime and 40-45 per cent on 5mg/l kanamycin while leaves turned yellow on higher conc. These experiments were done prior to transformation studies (*BT, Nauni*).

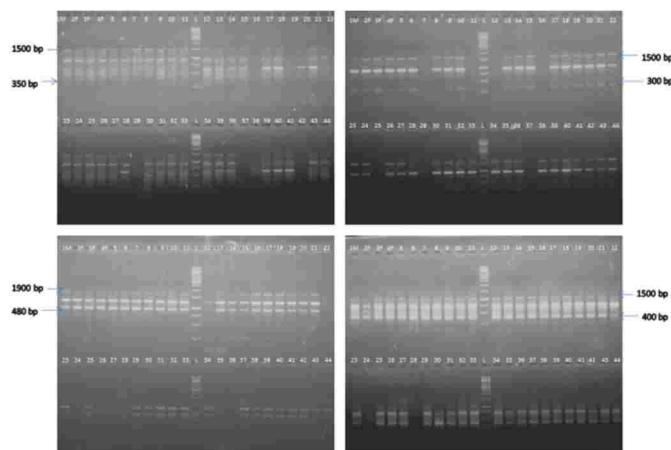


Micropropagation from axillary buds and regeneration from leaves

- ❖ Molecular level genetic stability testing of micropropagated shoots and plants of crab apple (*Malus baccata* Himaliaca biotype Kashmir) growing in the field showed true to typeness with 24 RAPD and 20 SSR primers which resulted in 95.56 per cent monomorphism when compared with the mother plant. Out of ten plants in the field, three were multiplied by mound layering, four grafted with variety Golden Delicious and three maintained in the field gene bank at RHRS, Mashobra. There were 8-12 shoots in mound layers. All the plants showed 100 per cent graft success and survival (BT, Nauni).



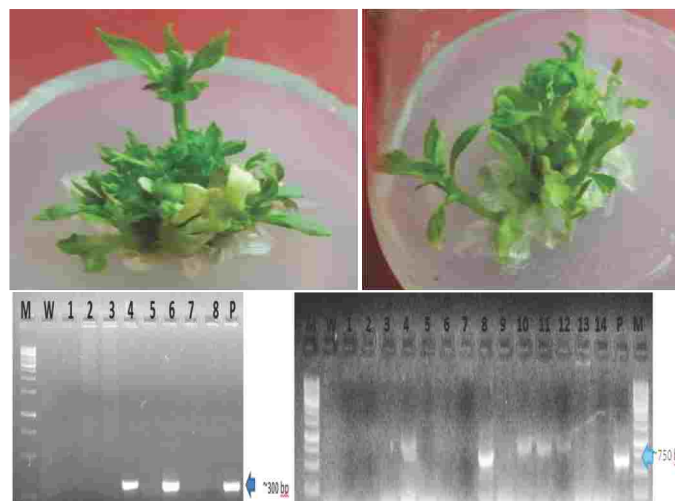
Field transfer of collar rot and white root rot resistant somaclonal variant of apple rootstocks



RAPD profiles with primer OPB-05(e), OPB-13(f), OPB-19(1)(g) and OPC-02(h) for 44 samples of *Malus baccata* Srinagar

- ❖ Host Induced Gene Silencing technique was used to develop resistance in apple cultivar “Red Chief” to Marssonina. *A. Tumefaciens* strain EHA105 harboring the vector pRI101-AN hpRNA:calm and *A. tumefaciens* strain GV3101 with pRI 101-AN-HSP-90RNAi, containing the

desired calmodulin and HSP-90 genes in sense and antisense orientation under CaMV 35S promoter and NptII gene as selection marker were used for transformation experiments. A construct pRI 101-AN-HSP-90 RNAi developed earlier in our laboratory was used for transformation of apple cv. Red Chief. MS medium supplemented with 5 mg/l BA and 0.2 mg/l NAA resulted in the best shoot regeneration frequency (96.35%). Regenerated shoots were multiplied, rooted and hardened successfully. Kanamycin was found highly toxic to leaf explants and affected the regeneration rate even at lower concentrations. Infection time of 7 min was found the best for transformation of Red Chief apple, which resulted in 9.35% shoot regeneration with 1.65 shoots per explants. Medium containing 5 & 6 mg/l kanamycin with 500 mg/l cefotaxime was used for the selection of the transformed shoots. In PCR analysis of putative transformed shoots, only two lines E-8 & E-10 were found to be positive with HSP-90 gene specific primers and five lines positive using nptII gene specific primers (BT, Nauni).



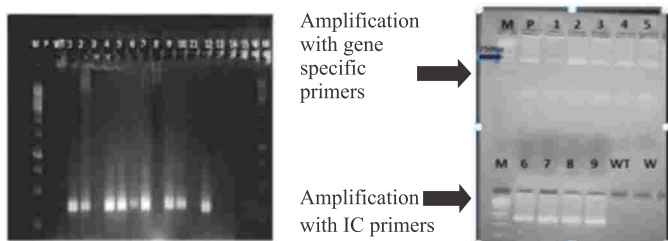
Transformed shoots of apple 'Red Chief' containing HSP-90 gene showing in PCR analysis

- ❖ Putative transformants were selected (6mg/l kanamycin) after 2 days pre-culturing and 72 hours co-cultivation with 11min infection time. A total of 10 putative shoots from 13 events were obtained which were further micropropagated. Gene integration was done by PCR which gives amplified product at 381bp and 250 bp with calm and NPTII gene specific primers respectively. Semi-quantitative RT-PCR was performed to

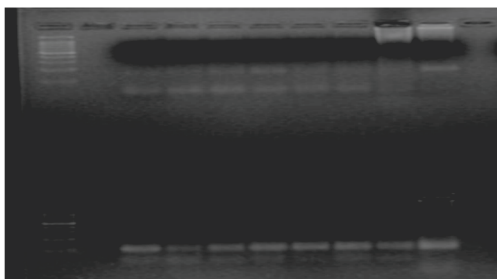
check the expression of the transgene in the developed RNAi apple plants with actin as housekeeping gene. No expression was obtained in untransformed control plants whereas, a variable level of expression was observed in transformed lines. The same level of expression of actin gene was observed in untransformed control and transformed lines (*BT, Nauni*).



Multiplication of putative shoots on SRM containing 6mh/l kn + 100mg/l cefotaxime



Multiplication of putative shoots on SRM containing 6mh/l kn + 100mg/l cefotaxime



Confirmation of putative shoots with calm gene and NPTII gmr specific primer. M- DNA ladder; P-positive control; WT- Wild type; (A) Lane 1-15 (B) Lane 1-9 putative transgenic lines; W- water control)

- ❖ Surveys were conducted during 2019 to observe disease prevalence in apple orchards in different blocks (Mashobra, Theog, Jubbal & Kotkhai, Rohru, Narkanda, Rampur, and Chopal) of district Shimla. During surveys, incidence and severity of apple scab, Marssonina blotch, Alternaria leaf spot, root rot, collar rot, cankers and powdery mildew were recorded. Maximum severity (15.0 %) of apple scab was recorded in apple orchards at Nankhari and Kharapathar during the survey. Disease incidence of root rot, collar rot, cankers, powdery mildew, Marssonina and Alternaria leaf spots was recorded maximum

13.0, 17.0, 22.0, 21.0, 20.0 and 25.0 per cent, respectively in different orchards of district Shimla (*RHR&TS, Mashobra*).

- ❖ Eighty seven apple orchards across five districts of Himachal Pradesh viz. Kinnaur, Shimla, Kullu, Mandi and Lahaul&Spiti were surveyed for the presence of ACLSV. Maximum incidence of 31.90 per cent was recorded from Shimla district and minimum incidence of 10.58 per cent from Lahaul & Spiti district (*PP, Nauni*).
- ❖ LAMP was standardized for early detection of *Marssonina coronaria* causing premature leaf fall in apple. Primers for LAMP were designed using online software Primer Explorer V4 by using DNA sequences obtained from *M. coronaria*. The temperatures of 64°C and 65°C were found to be the best in optimization of LAMP conditions in PCR machine for detection of pathogen. Field detection was done through LAMP, standardized using water bath and results were confirmed after viewing a colour change from colourless to light green on addition of SYBER Green dye. During the study, the leaf samples were collected before symptom development i.e. from 12th April, 2019 to 30th May, 2019. There was no detection of pathogen in the leaf samples collected from 12th April 2019 to 27th April 2019. After 27th April, 2019, presence of *M. coronaria* was detected, this was confirmed by colour change in the samples. The results in the LAMP study showed the presence of *M. coronaria* before its symptom development on leaves. So, it is concluded from the study that the LAMP can be used for early detection of *Marssonina coronaria* i.e. before symptom expression (*RHR&TS, Mashobra*).

- ❖ Compatibility of fungicides (hexaconazole, tebuconazole 50%+ trifloxystrobin 25%, captan, mencozeb, copper oxychloride, dodine, difenoconazole, carbendazim, myclobutanil, metiram 55% + pyraclostrobin 5%) with insecticides (malathion 50% EC, thiacloprid 240 SC, Chlorpyrifos 20% EC) and acaricides (propargite 57% EC, fenazaquin 10% EC, spiromesifen 240 SC, hexythiazox 5.45% EC) were evaluated at their recommended concentrations by preparing different combinations as tank mix for the purpose of

reducing the cost of application and to conserve water by combined application at the simultaneous occurrence of both diseases and pests during growth period. In laboratory studies, it was observed that dodine precipitated in most of insecticides and acaricides (chlorpyrifos 20% EC, thiacloprid 240 SC, fenazaquin 10% EC, spiromesifen 240 SC and hexythiazox 5.45% EC. The efficacy of these fungicides with other insecticides and acaricides was not affected, when used as tank mix and no phytotoxicity symptoms were observed in any of the treatments (RHR&TS, Mashobra).

- ❖ Eight fungicides viz. DA 3176 10% SC, GOD F001, GOD F002, UPF 513, UPF 209b, WCPL 68, VISMA 38% WG and Buprimate 25%EC at different concentrations were evaluated against *Marssonina* blotch (*Marssonina coronaria*), *Alternaria* leaf spot (*Alternaria* sp.) and powdery mildew (*Podosphaera leucomotricha*) in apple. Bio- efficacy studies revealed that DA 3176 10% SC @ 0.045% gave the highest disease control i.e. 66.02 and 80.59 per cent, against *Marssonina* blotch and *Alternaria* leaf spot, respectively. GOD F001@0.08% recorded maximum disease control i.e. 84.39, 85.21 and 71.17 per cent against *Marssonina* blotch, *Alternaria* leaf spot and powdery mildew, respectively of apple in comparison to control. GOD F002@ 0.04% gave the highest disease control i.e. 76.64 and 64.71 per cent against *Marssonina* blotch and powdery mildew of apple, respectively. UPF 513 @ 0.4% gave maximum disease control i.e. 83.85 and 81.48 per cent against *Marssonina* blotch and *Alternaria* leaf spot of apple, respectively. UPF 209b @ 0.4% recorded maximum disease control i.e. 76.49 and 74.54 per cent against *Marssonina* blotch and *Alternaria* leaf spot of apple, respectively. WCPL 68 @ 0.3% gave maximum disease control i.e. 82.74 and 64.34 per cent against *Marssonina* blotch and powdery mildew of apple, respectively. Buprimate 25%EC gave the highest disease control i.e. 86.65 per cent against powdery mildew of apple. VISMA 38% WG recorded the highest disease control i.e. 75.43 per cent against powdery mildew of apple (RHR&TS, Mashobra).
- ❖ Pastes/ paints (Blitox with linseed oil, Chaubatia Paint, Black Paint, White enamel paint and

Modified Chaubatia Paint) were evaluated on cut ends of winter pruned apple trees during 2019. All pastes performed well in three years studies as compared to control (without paste application). The recovery of pruned cut was maximum (13.13mm) on the cut ends pasted with Modified Chaubatia Paint in comparison to the other pastes (RHR&TS, Mashobra).



Pruned cuts on apple and recovery of cut ends

- ❖ Pest surveillance surveys conducted for finding the status and degree of infestation of various insect-pests reported the attack of San Jose Scale at walnut stage in apple orchards located in Mandi and Kinnaur districts. Orchards in Shimla district were found infested with apple root borer, woolly apple aphid and thrips. Attack of fruit moth was reported from Kinnaur district (RHR&TS, Mashobra).
- ❖ Apple is an important cash crop in lower areas of Spiti valley. The incidence of woolly apple aphid is becoming a serious threat to realize the optimum returns. The efficacy of timely application of recommended dose of Chloropyrifos 20% EC at ten different locations of farmer's field in comparison to farmer's practices. The data of the FLDs revealed that the timely application of Chloropyrifos 20% EC resulted in 8.82% higher yield in comparison to the farmer's practices of managing pest population (KVK Tabo).
- ❖ The infestation of *Helicoverpa armigera*, defoliating beetles, shoot borer, green aphid and apple leaf folder was recorded in HP-HDP high density apple plantations raised at Nauni, Solan during the summer of 2019. The infestation of the fruit borer, *H. armigera* was observed at the walnut size stage of the fruit and the extent of infestation was around 10 per cent which later increased upto 40 per cent. The infestation of rest of the pests was quite low. The shoot borer infestation was mainly centered around burr knot

regions as observed in the Experimental Farm of the Department of Soil Science (*Ento, Nauni*).



Shoot borer infestation in burr knot region

- ❖ The infestation of woolly apple aphid was recorded in high density apple plantations (HP-HDP) in the Experimental Farm of Department of Fruit Science during December 2019 and the extent of infestation was around 20 per cent. Out of different test insecticides and biopesticides, chlorpyrifos proved most effective followed by buprofezin. The biopesticides namely neem oil and *Beauveria bassiana* did not provide the satisfactory control of the pest (*Ento, Nauni*).
- ❖ The bioefficacy study conducted for the management of *H. armigera* in high density apple plantations, revealed flubendiamide (0.01%) and spinosad (0.002%) as the most effective treatments (6.67% infestation) in comparison to 40.00 per cent in control, after 21 days of spray application (*Ento, Nauni*).
- ❖ Four new horticulture mineral oils viz., HP Spray Oil E, Power Garnet AG HMO, Sparrow spray oil and Trichol-turbo super HMO were evaluated against phytophagous mites on apple. All the HMO's @ 1.0% provided significant suppression of mite population and was found to be effective for 7-10 days (*RHR&TS Bajaura*).
- ❖ New miticide Ceasemite (Propargite 42% + Hexythiazox 2%EC) was evaluated for its bio-efficacy against phytophagous apple mites which provided good control of mite population showing 2.35 mites/leaf @ 1.0 ml/L after 28 days of spray as against control (42.30 mites/leaf) (*RHR&TS Bajaura*).
- ❖ NC-129 (20% WP) at 0.5 g/L of water was found effective against the mixed population of phytophagous mites on apple showing 3.65 mites/leaf as compared with control (43.60 mites/leaf) after 14 days of spray (*RHR&TS Bajaura*).
- ❖ Bifenthrin 8% SC evaluated against apple phytophagous mites was found to be promising @ 0.75ml/L showing 1.03 mites/leaf as against 61.03 mites/leaf in control after 28 days of spray (*RHR&TS Bajaura*).
- ❖ New insecticide INIG003 (Phosmet 50 WP) provided effective suppression of woolly apple aphid @ 1.0g /L in comparison with the already recommended Dursban (0.04%) (*RHR&TS Bajaura*).
- ❖ A field trial laid out to test the efficacy of Phosmet against aerial forms of woolly apple aphid, *Eriosoma lanigerum* at post harvest stage revealed that Phosmet @ 2.0g/L of water and Dursban @ 2.5 per litre of water provided complete suppression of woolly apple aphid colonies on 21st day of spray while, lower dose of Phosmet i.e. 1.5g/L of water exhibited 95.83% control after 21 days of spray with complete control after 28 days of spray (*RHR&TS, Mashobra*).
- ❖ Goldban 20EC @ 20ml/10litres of water was effective against blossom thrips infesting apple and cherry and was found at par with already recommended chlorpyrifos (Dursban 20 EC). On the other hand, Neemadol and cow urine were comparatively less effective in controlling the thrips population (*RHR&TS, Mashobra*).
- ❖ *Helicoverpa armigera* has been observed to damage young tender fruits of apple in dwarf root stock plantation. The incidence of this pest has been observed during last week of May. Application of Thiodicarb (0.15%) or Flubendamide @ 0.012 per cent at walnut stage provided effective control of this pest (*RHR&TS Bajaura*).
- ❖ Drip irrigation level 100% ETc and fertigation level 100% AD (NPK) performed significantly superior in terms of vegetative growth, cropping, yield and quality parameters over conventional irrigation and surface method of fertilization. The seasonal water requirement of Super Chief apple of 3 and 4 years old plants under drip irrigation came out to be 29.94 and 34.95 cm with an effective rainfall 19.40, 13 cm with an irrigation requirement of 10.54 and 21.94 cm, respectively which can be met effectively by operating drip irrigation system at bi-weekly intervals w.e.f.

mid-March to first week of July. Fertigation in 15 splits of 100% AD (NPK) dose @ 35:17.5:35 g/tree/yr ($N:P_2O_5:K_2O$) resulted in higher apple productivity. This schedule may be preferred over conventional method of irrigation and fertilization. But in the absence of drip irrigation system, however, conventional irrigation at 100% ETc with 125% AD (NPK) may be followed to get higher productivity. Drip irrigation level 100% ETc and fertigation level 100% AD (NPK) resulted maximum effect on yield of apple i.e. 30 t ha⁻¹ (SSWM, Nauni).



High density apple plantation
cv Red Velox

View of high density
apple plantation at flowering
cv. Red Velox



Fruit bearing in 5 years old plants

- ❖ The studies suggested 83.59% (say 85%) of ETc and 76.1% (75%) of AD (NPK) as optimum irrigation and fertigation levels, respectively for drip fertigation. It may thus be concluded a saving of about 15 and 25 per cent in irrigation water and fertilizers can be achieved through fertigation besides significant improvement in yield and quality of apple (SSWM, Nauni).

Low Chill Apple

- ❖ The observations recorded on growth and yield of five low chilling apple cultivars (Anna, Michael, Mollies Delicious, Red Fuji and Gala) planted on clonal (M9) and seedling rootstock revealed that the cultivar Mollies Delicious had maximum trunk girth (38.0 cm), tree height (345.0 cm) whereas Anna had the highest tree spread in EW (285.0 cm) and NS (247.0 cm) directions on clonal rootstock. However, cultivar Michael was found to have maximum trunk girth (25 cm), tree

height (315.0 cm) on seedling rootstock whereas Red Fuji had maximum tree spread in EW (185.0 cm) and Michael in NS (190.0) direction. However maximum fruit yield (18.5 kg/tree) was recorded in Anna cultivar irrespective of the rootstock involved compared to any other cultivar under study (RHR&TS Jachh).



Fruiting in Anna

- ❖ The observations recorded on growth and yield of three low chilling apple cultivars (Anna, HRMN99 and Golden Dorset) planted on clonal (M7) and seedling rootstock revealed that the cultivar Anna surpassed all other cultivars as it had maximum trunk girth (32.0 cm), tree height (344.0 cm) and tree spread in EW (175.0 cm) and NS (180.0 cm) irrespective of the rootstock used. However maximum fruit yield (13.4 kg/tree) was recorded in Golden Dorset cultivar on the clonal rootstock compared to any other cultivar under study (RHR&TS Jachh).



Fruiting in Golden Dorset

Pear

- ❖ Varietal evaluation of two pear cultivars i.e. Carmen and Concord grafted on BA 29 in their 4th year of planting revealed significantly higher shoot extension growth (17.26 cm), trunk girth (61.04 mm), plant height (289.14 cm) and plant spread (82.30 N-S, 83.06 E-W) in cultivar Carmen, whereas, minimum growth parameters were recorded in cultivar Concord. The data

depicted maximum number of fruits per tree (15.32) and yield (2.06 g/tree) in Carmen/BA29 cultivar whereas maximum fruit weight (241.90 g/fruit) was recorded in cultivar Concorde/BA29. Significantly higher fruit firmness (10.0 Kg/cm²), breadth of fruit (76.97 mm) was recorded in cultivar Concord, whereas, TSS (16.54 °B) and fruit length (101.42 mm) were observed in cultivar Carmen. Whereas, minimum fruit breadth (60.82 mm) and firmness (8.82 mm) was recorded in cultivar Carmen (*RHR&TS Sharbo*).



Pear cv. Carmen



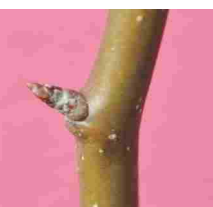
Pear cv. Concorde

- ❖ In pear and cherry, data were recorded for vegetative parameters (tree: vigour, tree: branching, tree: habit, one year old shoot; growth, one year old shoot: length of internodes).

One-year-old-shoot: growth

Straight
(Severenta)Wavy
(William Pear)Zig-zag
(Dr Jules Guyot)

One-year-old-shoot: position of vegetative bud in relation to shoot

Addressed
(Hayward)Slightly held out
(Jargonelle)Markedly held out
(Beurre Hardy)

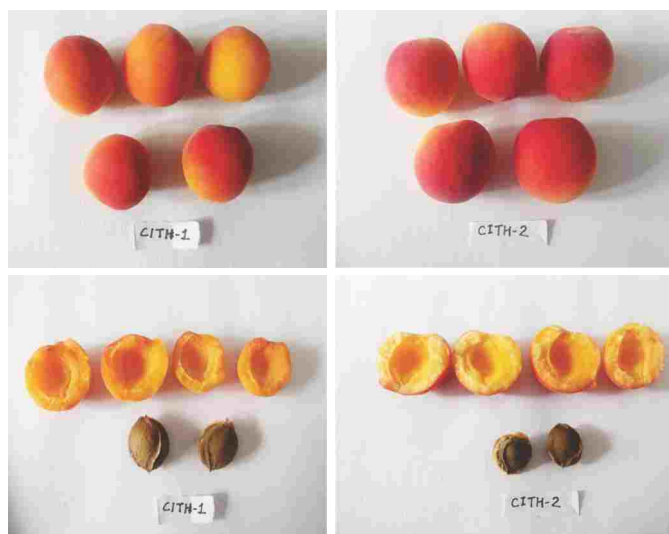
Leaf blade: shape of base



Acute (Flemish Beauty) Right-angled (Doyennedu Comice) Obtuse (King's Pear) Truncate (Gentle Blanca)

Apricot

- ❖ Front line demonstration on canopy management in apricot for higher yield and quality, there was 31.9% increase in yield in demonstration as compared to farmer's practice with B:C ratio of 3.96 and 3.08 in demonstration and farmer's practice respectively (*KVK Kandaghat*).
- ❖ A field experiment was conducted to evaluate various apricot cultivars i.e. CITH-1, CITH-2 and CITH-3 in dry temperate conditions. Results revealed that highest plant height, fruit weight and TSS were recorded in cultivar CITH-1 and minimum in cultivar CITH-2. Trunk girth and tree spread (N-S and E-W) was found maximum in cultivar CITH-3 and minimum in cultivar CITH-2. Flower initiation to petal fall stage came earliest in cultivar CITH-2 followed by CITH-1 and CITH-2 (*KVK Tabo*).



Fruit characteristics of different cultivars

Peach

- ❖ Effect of dormancy breaking substances on bud break and cropping behaviour of low chilling peach (*Prunus persica* L. Batsch) was studied.

The earliest leaf fall in Glohaven was induced by application of urea @ 2% + CuSO₄ @ 5% + ZnSO₄ @ 2% and in Royal Paradelux, in treatment ZnSO₄ @ 3%. Among all treatments, ZnSO₄ @ 3% proved to be the best for advancement of bud break, full bloom and improvement of physical and biochemical parameters while urea @ 4% was best for enhancement of vegetative growth. In another experiment on dormancy breaking chemicals, the bud break, full bloom, yield, fruit set, retention, length, diameter, weight, TSS, acidity, ascorbic acid and sugar content were found best with dormex @ 3% when applied in December end and first week of January (*CH&F, Neri*).



- ❖ A study on the effect of time of summer pruning and summer pruning intensities on the growth, flowering, fruit set, yield and quality of three-year-old low chill peach cultivars viz., Early Grande, Florida Prince and Shan-e-Punjab planted at 2×2 m was conducted. Studies revealed that growth characteristics viz., annual shoot growth, shoot diameter, trunk diameter and leaf area were recorded maximum in “Early Grande” trees pruned on second fortnight of June with 60 per cent pruning intensity. Highest fruit set and fruit yield was recorded in “Early Grande” trees pruned on second fortnight of June with 20 per cent pruning intensity (*COH & COF, Neri*).



- ❖ Among different pruning intensities in peach, 60% summer pruning + winter pruning (WP) significantly influenced the vegetative characters viz., annual shoot growth (50.90 cm), shoot diameter (28.21 %), trunk growth (16.88 %), TCSA (36.62 %), leaf area (35.39 cm²), whereas, in reproductive and qualitative characteristics, 60% summer pruning + WP induced earliness in flowering and reduced flowering duration, obtained maximum fruit weight (94.52 g), maximum fruit size (5.27 and 5.41 cm) and highest TSS (10.50 °B) in the fruits (*CH&F, Neri*).
- ❖ Pillar training system has been standardized for production of quality fruits of low chill peaches cvs. Early Grande, Florida Prince and Shan-e-Punjab under HDP at 2 x 2 m spacing (*CH&F, Neri*).



- ❖ Peach cv. Tropic Sweet has trees spreading type, which flower from last week of January to 1st week of February with moderate bearing. Fruits are attractive, creamy red, medium white fleshed with good sweetness, and early maturity. Susceptible to peach leaf curl and gummosis, average yield: 13 -15 Kg / tree (*FS, Nauni*).



- ❖ A study was conducted to evaluate different mulching material in peach cultivar Redhaven. The results showed that black polyethylene mulch gave the best results in respect of growth, yield and fruit quality followed by nylon mulch mat. The maximum leaf and soil NPK content were recorded in grass mulch which was at par with coir mulch (*FS, Nauni*).



Black polythene mulch

Nylon mulch

Plum

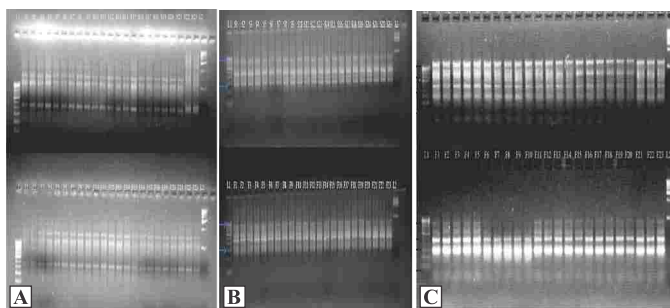
- ❖ Plum cv. Cacanska has trees semi-spreading, flowering in mid-February with moderate fruit bearing, fruit weight 45-50 g, medium, round having red purple skin with orange red flesh, matures by second week of June. Flesh firm with long shelf life of 10-14 days and average yield 15-20 kg per tree (*FS, Nauni*).



- ❖ Front line demonstration on the effect of plastic mulching on yield and quality of plum, mulching resulted in 35.0 per cent increase in yield as compared to control with better qualitative characteristics which helped in improving the income of the farmers (*KVK Kandaghat*).
- ❖ Red Beaut' a promising early cultivar of plum is available in 3rd week of May for marketing. The average fruit weight is 58 g, fruit length 4.8 cm and diameter 4.7 cm with the TSS 12 °B at the time of harvest (*RHR&TS Bajaura*).



- ❖ Clonal fidelity in plum cvs Santa Rosa and Frontier was established by taking six years old axenic *in vitro* cultures and two year old tissue culture raised plants growing in the field as experimental material. RAPD, ISSR and SCoT markers were used to amplify DNA of both the plum cultivars. Out of 28 RAPD primers used, 18 and 15 primers were able to amplify the genomic DNA, with the monomorphism of 96.55% and 100%, respectively and a similarity coefficient of 0.84 between both the cultivars. All the 15 ISSR primers were able to amplify the genomic DNA and produced a monomorphism of 92.72% and 95.45% in Santa Rosa and Frontier respectively. A homology of approximately 65% was found between both the cultivars. Out of 26 SCoT primers, only 10 amplified the genomic DNA of plum cvs. Santa Rosa and Frontier resulting in monomorphism of 96.77 and 90%, respectively. 84-97% similarity was observed between Santa Rosa and Frontier (*BT, Nauni*).

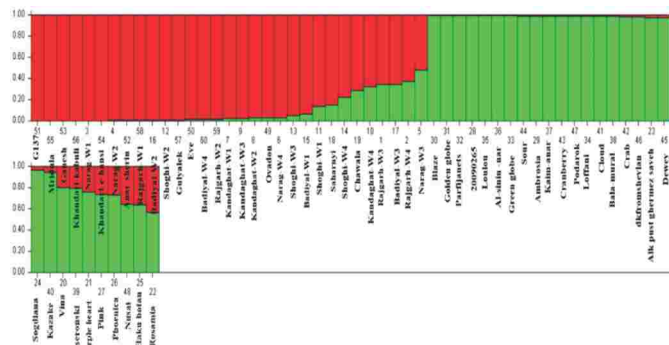


Genetic fidelity testing of *in vitro* propagated plum cvs. Santa Rosa and Frontier using RAPD (A) ISSR (B) & SCoT (C) markers

- ❖ A technique for cost effective *in vitro* propagation of plum cv Santa Rosa has been developed by replacing sucrose and agar with table sugar and isabgol. It was also observed that drenching with 3% Jeevamrit resulted in 60% plantlet survival during hardening (*BT, Nauni*).



In vitro multiplication of plum cv. Santa Rosa on low cost nutrient medium



Genotypic structure inference for *Punica granatum* genotypes based on SSR markers using STRUCTURE software for K = 2

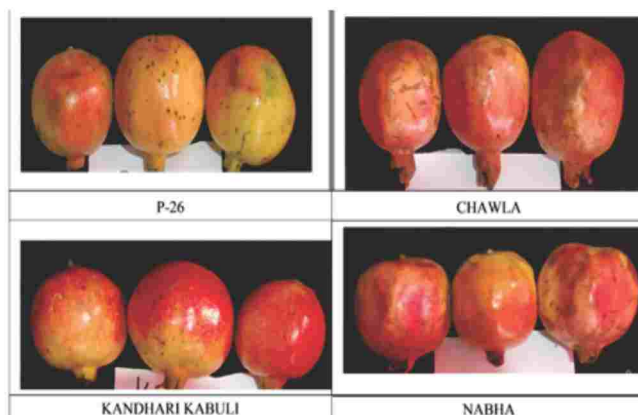
Pomegranate

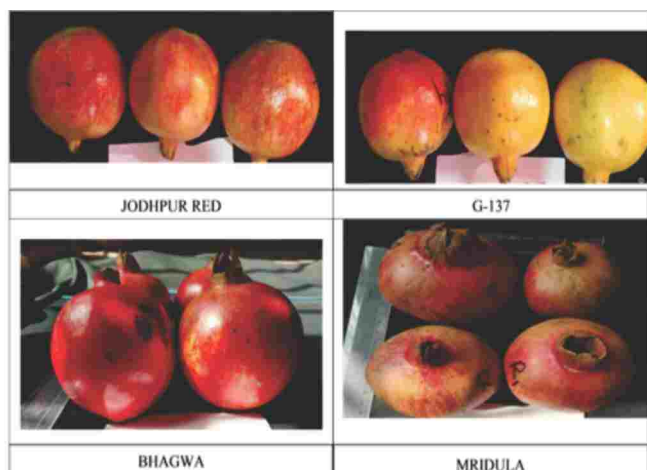
- ❖ Out of 13 progenies of cross between Kandhari Kabuli x Bhagwa, progeny No 181016 was selected for soft seeded arils and high TSS of 13.4°B, with dark red colour arils and having average fruit weight 230g (*RHR&TS Bajaura*).



- ❖ Kandhari Seedless of pomegranate was approved for commercial cultivation in workshop on Package of Practices on Horticulture Crops (*CH&F, Thunag*).
- ❖ Out of a total 102 SSR primers screened among diverse group of 60 cultivated and wild pomegranate genotypes collected from different locations in Himachal Pradesh, 22 primers were found to be polymorphic that amplified a total of 46 alleles with an average of 2.14 alleles per locus. Size of alleles varied from 50 to 300 bp. Genetic diversity analysis revealed high variability among cultivated and wild genotypes of pomegranate present in different clusters. Clustering patterns in PCA was in correspondence with clustering of both UPGMA tree and the structure. The study supported narrow genetic base of pomegranate which might be due to self-pollinated nature of crop and common center of origin (*BT, Nauni*).

- ❖ Morpho-molecular characterization and hybridization among different cultivars of pomegranate (*Punica granatum* L.) was done. Wide range of variation was observed among various genotypes for various quantitative characters under study. High heritability (>60%) was recorded for all the characters. Phenotypic and genotypic correlation coefficients showed that fruit weight had positive and significant association with the characters viz. calyx length, fruit width, crown length, aril length and septum thickness. Genetic diversity studies involved 41 RAPD markers and only 8 primers out of total of fortyone primers yielded scorable bands. A total of 41 bands were amplified in all the eight cultivars and 80.49% polymorphism was obtained. Dendrogram divided all the cultivars in one cluster and Chawla was separated as a singlet. Further, two subclusters were formed and comprised of three cultivars in each of them. In hybridization study of pomegranate genotypes, the highest fruit set per cent in sixteen crosses was observed in cross Mridula × P-26 (77.80%) followed by cross Bhagwa × P-26 (66.70%) and G-137 × Chawla (36.10%) (*CH&F, Neri*).





Variability in fruit shape, colour and size in pomegranate cultivars

- ❖ In Kullu district, *Meloidogyne* sp. was found as most predominant nematode species on pomegranate with 60-1696 J2/200 cc soil in different blocks of the districts, followed by *Helicotylenchus* (38-840 nematodes per 200 cc soil). High infestation of root knot-nematode in nursery plants of pomegranate (50-60 %) at Bajaura (Kullu district) has also been recorded (*Ento, Nauni*).
- ❖ The studies of biology of pomegranate fruit borer (*D. isocrates*), revealed that egg laying by the pomegranate butterfly initiated around the mid-April (2018). Therefore, the pesticides spray should be initiated around second fortnight of April and repeated after 15 days of first spray in the Shivalik and low hills of Himachal Pradesh. As the flowering in pomegranate tree continues for about two months, hence third and fourth spray should be given at an interval of 15 days after second spray (*CH&F, Neri*).
- ❖ From the studies conducted on efficacy of different insecticides/bio pesticides it was concluded that four sprays of different insecticides/bio pesticides required for the effective management of pomegranate fruit borer, as the flowering in pomegranate trees sustains for a longer period and pest found new untreated fruits and flowers even after the spray application during the time interval between the spray schedules. Among the various insecticides/biopesticides/non-chemical methods used for the effective management of *Deudorix isocrates*: spinosad, flubendiamide,

Agniastra, bagging and clipping of calyx were found effective and they were also environmentally safe. Hence they could be incorporated in integrated pest management of pomegranate fruit borer (*CH&F, Neri*).



Freshly laid eggs by *Deudorix isocrates*



Nature of damage



Different larval instars



Pre-pupa and pupa inside fruit and pupal cases



Adults of *Deudorix isocrates* (A) Female (B) Male

- ❖ Early rise in temperature was responsible for early incidence of pomegranate fruit borer in the year 2019 when the incidence of this pest was observed very early than normal years i.e. in the last week of April. It ranged between 12.0 to 38.0 per cent in flowers and 15.0 to 46.0 per cent in fruits. However, its incidence during June and July months was found to be negligible but again in August and September, pest incidence re-emerged and even the matured fruits were damaged by this pest. Therefore, the insecticidal

applications needs to be done based upon proper monitoring of the pest besides keeping in mind the seasonal temperature of the area (*RHR&TS Bajaura*).

- ❖ Low incidence of *Helicoverpa* sp. and *Porthesia scintillans* was found in pomegranate plants during the month of May and June. The caterpillars damaged flowers as well as tender fruits by making bores in the fruits/flowers (*RHR&TS Bajaura*).



Kiwifruit

- ❖ A study was conducted to compare the performance of different exotic kiwifruit cultivars for their rooting behaviour. An equal concentration of 4000 ppm was given to hardwood and semi-hardwood cuttings. Among different cultivars evaluated, Kens Red cv. performed best among both hardwood and semi-hardwood cuttings followed by cv. Chung Bai (*FS, Nauni*).
- ❖ A study was conducted in the kiwifruit to standardize the schedule of fertigation and to elucidate the effect of bio-fertilizers along with fertigation on growth, yield and fruit quality of kiwifruit cv. Allison. The fertigation and bio-fertilizer applications were scheduled by splitting recommended dose into 21, 15 and 10 splits. Conclusively, results revealed that when 80 % recommended dose of NPK given through drip at 10 days interval in 15 splits or when bio-fertilizers were accompanied with fertigation, i.e., 80 % recommended dose of NPK through drip along with Arka microbial consortium @ 5 ml L⁻¹ given once in the month of February and July found to be satisfactory for the yield and quality perspectives of kiwifruit cv. Allison (*FS, Nauni*).



Fully grown kiwifruit vine 80 % RD of NPK given through drip in 15 splits at 10 days interval

- ❖ Studies on rooting of hardwood cuttings in kiwifruit were carried out which revealed that Coco peat + IBA @ 6000 ppm significantly increased the shoot diameter (5.48 mm), number of leaves per cutting (32.91), leaf area (89.06 cm²), number of roots per cutting (40.33), rooting (45.83 %), fresh and dry weight of shoots (32.59 g and 15.66 g) and roots (23.75 g and 11.23 g), total biomass (26.89 g), shoot: root ratio (1.40: 1), survival rate (55.83 %) and saleable plants (44.16 %) in hardwood cuttings of kiwifruit. However, sprouting (84.17 %) and shoot length (179.89 cm) were maximum with Perlite + Coco peat + IBA @ 6000 ppm and Perlite + IBA @ 6000 ppm, respectively, but at par with Coco peat + IBA @ 6000 ppm. The performance of standard practice i.e. Sand + Soil + IBA @ 5000 ppm was not found to be satisfactory in all the growth parameters recorded. The benefit: cost ratio (2.82: 1) was estimated to be the highest with Coco peat + IBA @ 6000 ppm (*SST*).
- ❖ In Kiwi fruit, root- knot nematode, *Meloidogyne* sp. is emerging as serious nematode problems in Solan area with population densities ranging from 330-1650 J²/200 cc soil. The infested nursery plants were found the main source of nematode spread in field (*Ento, Nauni*).



Kiwi roots infected with root-knot nematode

Mango

- ❖ Mango is the prominent crop of lower Himalayas. Hence different varieties of mango were introduced which could mature in August. Mallika is a late maturing cultivar. Fruits are large, oblong, elliptical yellow in colour. Fruit weight ranges from 175-250 g. It is a regular bearer but shy cultivar and produces good quality fruits. Late maturing cultivar ripens in July-August. It is very good responsive to high density planting. Average yield is around 65 kg per tree in on-year and 35 kg in off-year. Mostly used for table purpose. Keeping quality is good (COHF, Neri).
- ❖ Canopy management technique has been standardized for quality production of mango fruits in high density planting at 2.5 x 2.5 m. Out of 10 varieties, 8 varieties viz., Pusa Arunima, Pusa Surya, Pusa Sreshtha, Pusa Pratibha, Mallika, Amrapali, D-51 and Pusa Pitambar have borne fruit samples in the 2nd year and commercial crop in 3rd year (CH&F, Neri).
- ❖ The preliminary studies conducted for standardizing the wedge grafting techniques revealed the highest saleable plants in wedge grafting done in February in nursery sown plants than poly bags, by retaining 3-4 leaves on the rootstock, below the graft. In poly bags, the same treatment was efficient in producing 92 per cent saleable plants when grafting was done in August/September (RHR&TS Dhaulakuan).
- ❖ Studies on the effect of pre-sowing treatments and time of wedge grafting on production of saleable grafts in mango were conducted: the mango stones were collected and given various pre-germination treatments either with intact seed coats or with seed coats removed and the kernels extracted. The pre-germination treatments comprised of KNO₃ @ 0.5, 1.0 and 1.5 %; Benzyl adenine @ 50 and 100 ppm %; GA₃ @ 100 and 200 ppm, Beejamurit @ 2.0 and 3.0 % and Panchgavya @ 2.0 and 3.0%. In another experiment wedge grafting was carried out on mango seedling rootstock on 12th to 15th August, 26th to 30th August, 11th -15th September, 24th - 28 February, 11th -15th March. The data revealed that the maximum bud break was observed in the plants grafted in the month of August and

minimum in the plants grafted in month of February (CH&F, Neri).

- ❖ Many insect pests were observed on mango crop during different periods of the year. There was moderate incidence of mango hopper (*Idioscopus* sp.; *Amritodus* sp.) from March to June with maximum average population of 4-5 hoppers/panicle during May and June month. On an average 20-25 % plants were infested by this pest. A low incidence of this pest was also observed in September-October with average population of 1-2 hoppers/panicle. A low incidence of mango shoot gall psylla (*Apsylla* sp.) was observed on 10 per cent mango plants during December to February month. Mango mealy bug (*Drosicha* sp.) infestation was observed on 5-10 % plants with an incidence of 1-2 bugs per five twigs. Bark eating caterpillars (*Indarbela* sp.) were observed on 5-10 % of mango plants (RHR&TS Jachh).



- ❖ For eco-friendly management of mango fruit fly, *Bactrocera dorsalis*, the male annihilation techniques (MATs) against fruit fly, Methyl Eugenol (4ml) + Malathion (1ml) + Ethanol (6ml) having septum size 8 x 2 x 1.8 cm³ recorded significantly more trapping (127 flies/trap/week) compared to other treatments (CH&F, Neri).
- ❖ Two year studies on monitoring of fruit flies (2018 and 2019) in mango using methyl eugenol based attractant-insecticide traps at Rewalsar, District Mandi, revealed that two fruit fly species namely *Bactrocera dorsalis* and *B. zonata* were trapped in these traps throughout the cropping period. The population started building up near the ripening stage and the highest fruit fly catch (760.00 males/trap/week for *B. dorsalis* and 132.90 males/trap/week for *B. zonata*) was recorded during 4th week of June. The trap catch in the next two months remained high and thereafter there was decline in the population and by first week of October the trap catch/week was

only 45.90 for *B. dorsalis* and 7.70 males for *B. zonata*. Further when the mixture of lures (methyl eugenol+cue-lure) was tried, the trap catch was not encouraging (*Ento, Nauni*).

- ❖ Amongst the six insecticides namely lambda-cyhalothrin (0.004%), diflubendiamide (0.01%), rynaxypyr (0.006%), spinosad (0.002%), indoxacarb (0.007%) and emamectin benzoate (0.002%) sprayed thrice at an interval of 10 days in mango, lambda cyhalothrin proved both efficacious (12.90 % infestation) as well as economical (BCR 72.2:1). It was followed by spinosad (22.70% infestation). The recommended insecticide, malathion being cheaper than spinosad resulted in better BCR (*Ento, Nauni*).
- ❖ Carbendazim was found to be most effective against mango die-back caused by *Botryodiplodia theobromae* resulting in 98.75 per cent inhibition of mycelial growth followed by chlorothalonil (95.74%) and carbendazim + mancozeb (95.37%)(*PP, Nauni*).

Guava

- ❖ Guava cultivar Lalit has been planted at a spacing of 3 x 3 m on raised bed platform to identify efficient input use technology for improving yield and quality in guava (*CH&F, Neri*).



- ❖ In the study regarding fertigation in guava cv. Lalit it was found that fertilizer treatments had significant effect on cropping parameters in Guava cv. Lalit. The maximum fruit set (80.16 %), fruit retention (64.73%), number of fruit per plant (62.69), fruit weight (121.67g) and fruit yield per plant (7.77 kg/plant) among different treatments was observed in plants treated with

100 per cent recommended dose of fertilizers which was significantly superior to other treatments (*CH&F, Neri*).

- ❖ Studies on the effect of the pruning time on cropping behaviour of winter guava under meadow orcharding was studied. The plants of three guava cultivars viz., Lalit, Shweta and L-49, planted in the ultra-high density meadow orcharding at the plant spacing of 2 X 1m² and varieties were subjected to six different pruning treatments. The findings suggested that single pruning on 15th May performed better for “Lalit” and “L-49” cultivars whereas cultivar Shweta” performed well when pruned during 2nd week of May and 3rd week of July. Although the total yield was higher in the plants producing fruits during rainy season, however, the winter crop was of superior quality (*CH&F, Neri*).



- ❖ Standardization of pre-sowing treatments and wedge grafting in guava (*Psidium guajava* L.) was carried out to find out the effect of grafting time and polycap on the success of wedge grafting in guava and pre-sowing treatments on germination in guava seeds under protected conditions. The studies showed that wedge grafting performed in mid-February with polycap registered maximum graft-take per cent (71.66%) (*CH&F, Neri*).





Wedge grafting in guava

- ❖ Six year old trees of guava cv. Lalit planted under ultra high density (2x2 m) plantation gave fruit yield of 28.5 kg/tree during the rainy and winter seasons (*RHR&TS Jachh*).



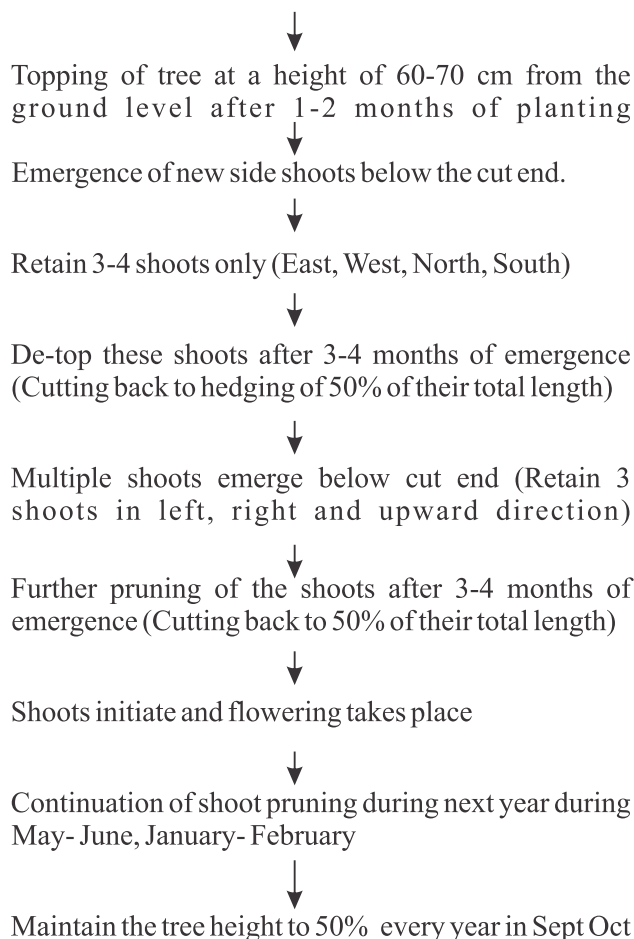
- ❖ Morpho-molecular characterization, evaluation and hybridization among different cultivars of guava (*Psidium guajava* L.) was done significant variation was observed among seven guava genotypes for various quantitative and qualitative traits. Highest fruit length, weight, fruit length/width ratio, pulp weight, leaf width, thickness of outer flesh, high vitamin C content and minimum number of seeds per fruit were recorded in cultivar Shweta. In diversity study using 42 RAPD markers only 12 primers were able to amplify and yielded 48 scorable bands in all seven-guava cultivars out of which 41 bands were polymorphic with 85.42% polymorphism, depicting high level of polymorphism. In RAPD Cluster analysis two major Clusters were formed and Cluster 'I' was found to be bigger Cluster containing five cultivars and Cluster 'II' containing two cultivars. In hybridization study among guava genotypes, the highest fruit set per cent in ten crosses was observed in cross Allahabad Safeda × Lalit (68.33%) followed by cross Shweta × Lalit (66.67%) and Lucknow-49 × Lalit (61.67%) (*CH&F, Neri*).
- ❖ Guava cultivar Lalit bears young shoots deep green in colour with red streaks. Fruits are medium to large and saffron yellow in colour. Fruit weight varies from 175 g to 200 g. its flesh is

firm and pink having TSS of 16.5-18 °Brix with good blend of sugars to acids. Fruit yield is 35-38 kg per tree. The plant is responsive to pruning and high density planting. Fruits are suitable both for table as well as processing purpose (*RHR&TS Dhaulakuan*).

- ❖ Two guava cultivars viz., Allahabadi Safeda (budded) and Lalit (inarched) were planted in the monsoon season of 2013. Two levels each of Hedging (H) and Topping (T) ($T_1=25$ cm; $T_2=35$ cm) were given in each variety (*RHR&TS Dhaulakuan*).
- ❖ Protocol for Meadow Orchard Planting Technology (*RHR&TS Dhaulakua*)

Meadow orcharding in guava is cultivar specific. The cultivar, Allahabadi Safeda (budded) is amenable to a spacing of 2 x 1 m, while, Lalit (inarched) is responsive to 2 x 1.5 m spacing. The technique of meadow planting is as below:

Field planting of Allahabadi Safeda (budded) at 2 x 1 m and Lalit (inarched) at 2 x 1.5 m



After 5 years back pruning i.e. 50% removal of entire portion of the plant



Meadow orcharding of guava

- ❖ Fruit fly damage was observed in the rainy season crop of guava. A moderate to low incidence of fruit fly (*Bactrocera* sp.) was observed in the guava crop from July to September. The maximum incidence was in the month of August when 15-20 per cent fruits were found to be infested by the fruit flies. A study on the effect of methyl eugenol based Pheromone traps for the control of fruit fly in guava was conducted in the field during July-August. On average 14.11 fruit flies were trapped per trap/week (*RHR&TS Jachh*).



Litchi

- ❖ High density planting of litchi cv. Dehradun at various spacings viz. 2 x 2 m, 3 x 3 m, 4 x 4 m, 5 x 5 m and 6 x 6 m spacing has been done to study the impact of high density planting on growth yield and quality of litchi (*CH&F, Neri*).
- ❖ A technology to rejuvenate senile litchi orchard is being developed in which the old litchi plants are head backed at a height of 1.5 m above ground during August – September maintaining 6, 9 and 12 numbers of effective shoots at 2 m radius inside the canopy to rejuvenate the old plants and improve its fruit quality and the yield. From the studies conducted so far it has been observed that on an average 115-120 days were taken for sprouting of new flushes in litches. The flushes mainly emerged during the months of September-October and June-July (*CH&F, Neri*).
- ❖ Five newly introduced litchi cultivars (China, Shahi, Bedana, Purbi and Dehrrase) from NRC on Litchi Muzzafarpur (Bihar) were evaluated for growth, yield and fruit quality parameters during. The findings revealed that cultivar Shahi was the most vigorous for growth parameter as it had the maximum trunk girth (33.6 cm), tree height (3.69m) and tree spread in EW (3.77m) and NS(3.76m) directions. Cultivar Shahi had maximum (4.8 kg/tree) fruit yield (*RHR&TS Jachh*).



- ❖ In litchi Early Large Red is an early maturing cultivar. Fruits ripen in June. Mature in 65 days from full bloom to harvest. It is a regular bearing cultivar. Trees are medium in size having an average height of 5.5 m and spread of 4.4 m. Fruits are large, oval or oblong conical with crimson red tubercles. Fruit weight ranges from 18-22 g. Pulp is creamy-white, soft and juicy with 17-20° Brix of TSS. Seed is small and dirty chocolate in colour. Aril recovery is 65-72 per cent. Average yield varies between 62 kg per tree (*RHR&TS Dhaulakuan*).
- ❖ The other cultivar of litchi i.e. Seedless Late is a late maturing cultivar. Fruits ripen in the first week of July in 75-85 days from full bloom. Trees are vigorous having an average height of 5.7 m and spread of 3.6 m. Fruits are medium to large with shriveled and rudimentary seed, conical in shape, colour at maturity vermilion to carmine with dark-blackish brown tubercles. Fruit weight ranges from 16-18 g. Pulp is creamy-white, soft and juicy with 16-18° Brix TSS. Aril recovery is 90-95 per cent. Average fruit yield is 55 kg/tree (*RHR&TS Dhaulakuan*).

- ❖ Pink and white coloured polypropylene bags were used for bagging litchi fruits at different intervals to assess the quality and yield. The results showed that pink bags produced better quality fruits than white bags (CH&F, Neri).
- ❖ Leaf rollers (*Statherotis* sp.; Tortricidae) were observed on litchi plants during November-December month. Average population was 4-5 caterpillars per plant. Bark eating caterpillars (*Indarbela* sp.) were also observed on 10-15% litchi plants with average population 1-2 caterpillar per plant (RHR&TS Jachh).



Papaya

- ❖ Pre harvest sprays of either carbendazim or mancozeb and post harvest dip treatments of fruits in the same chemicals can effectively manage the anthracnose in papaya and reduce the post harvest losses due to disease (CH&F, Neri).

Citrus

- ❖ Studies were undertaken to determine the time taken for the establishment of uprooted citrus nursery plants in the farmer's field. It was observed that mandarin (Kinnow, Santra), lime, lemon and sweet oranges took (42, 43 days), 38 days, 40 days and 33 days for establishment in the farmers field, respectively (RHR&TS Jachh).

Semi-field experiment on ci^{trus}

Field experiment on citrus

- ❖ Optimum harvesting time has been standardized as mid-February in Kinnow for quality production of fruits under high density planting (HDP) at 2 x 2 m spacing in low hills of HP (CH&F, Neri).
- ❖ Citrus leaf miner (*Phyllocnistis citrella*) was observed on nursery plants in the open field throughout the year. Maximum average incidence was in the month of May-June with 10-15 % plants infested and average population of 2-3 mines/leaf. Citrus scale (*Aonidiella* sp.) was observed on malta and lemon plants. Average infestation was 2-3 scales per leaf (RHR&TS Jachh).
- ❖ In citrus thiamethoxam and imidacloprid sprayed at 10% bloom of citrus showed adverse effect on foraging activity of *A. mellifera* as is evident from significant reduction in quantum of bee activity up to 8th day in thiamethoxam and 4th day in imidacloprid (SFC) and 12th day for both molecules (FC) (Ento, Nauni).
- ❖ However, thiamethoxam spray at pre bloom showed less impact on bee activity. Thiamethoxam and imidacloprid sprayed at 10% bloom also affected colony parameters of introduced *A. mellifera* and resulted significant reduction in brood area, nectar stores, pollen stores and bee strength up to 28th day after thiamethoxam and imidacloprid spray (SFC), however the effect of thiamethoxam and imidacloprid under field conditions was less pronounced with respect to bee mortality and colony parameters (Ento, Nauni).



Strawberry

- ❖ Strawberry i.e. Camarosa is an early season, self pollinating and short day cultivar. Planting time is September-October. Leaves are less concave than Chandler. Fruits are bright, large and firm than Chandler, flat conic and deep red in colour. Fruits also have excellent keeping quality with good flavor. Fruit weight varies from 35-40 g with

10.5-12 °Brix of TSS. The average fruit yield is 400 g per plant. Suited for zone-1 of Sirmour. Fruits start ripening in December. Used for fresh-market and processing (*RHR&TS Dhaulakuan*).

- ❖ Perlite (75%) + cocopeat (25%) along with the foliar application of jeevamrit @ 5 per cent at 30 days' interval resulted in the highest yield of good quality berries. Perlite (75%) + cocopeat (25%) also resulted in the highest runner production and maximum leaf nutrient status (*KVK Kandaghat*).
- ❖ Seeweed extract (SWE) @ 1.25 ml/L at pre-flowering and fruit set recorded highest plant spread, leaf area, number of runners per plant, duration of flowering, percent fruit set, fruit length, fruit weight, total soluble solids (TSS), TSS/acidity ratio, sugars and lowest titratable acidity. Among different treatments, the highest cumulative yield per plant and length/breadth ratio was recorded in SWE @ 1.0 ml/l at pre-flowering and fruit set. However, number of leaves per plant, number of crowns per plant, fruit breadth and ascorbic acid were recorded highest in SWE @ 1.0 ml/L at pre-flowering. The highest anthocyanin content was recorded in SWE @ 1.25 ml/L at pre-flowering (*FS, Nauni*).
- ❖ The comparative efficacy of nano ZnO over traditional ZnSO₄, Zn EDTA and ZnO fertilizers on vegetative growth, flowering, fruit yield, and runner production of strawberry was evaluated. Among different Zn source treatments, maximum plant height, an increment of 50.1 per cent in number of crowns, maximum per cent increase of number of fruits and maximum yield was recorded with nano ZnO at 200 ppm (*FS, Nauni*).
- ❖ A study on the seasonal activity of two-spotted mite, *Tetranychus urticae* on strawberry indicated that population of two-spotted mite fluctuated during April to June and declined drastically in rainy season (July to August). It multiplied with fast rate during dry months (September to November) with peak in mid November (*RHR&TS, Mashobra*).
- ❖ Significant and positive correlation occurred between mite population and mean temperature while the correlation coefficients between relative humidity and rainfall with mite population were highly significant but negative

indicating the adverse effect of rainfall and relative humidity on build-up of mite population (*RHR&TS, Mashobra*).



Longan

- ❖ Average trunk girth of 23.9 cm, tree height (3.57 m) and tree spread of 2.91 m in EW and 2.98 m in NS direction was recorded in studies undertaken for the evaluation of Longan plants for growth parameters. However no fruit set has been observed (*RHR&TS Jachh*).



Walnut

- ❖ Walnut cv. Lara an exotic variety was compared with local selections viz., Kotkhai Selection, Pratap and Gobind which was better with respect to fruit and nut quality characteristics. This variety was recommended for commercial cultivation in Package of Practices on the basis of its fruit and nut quality characteristics (*FS, Nauni*).



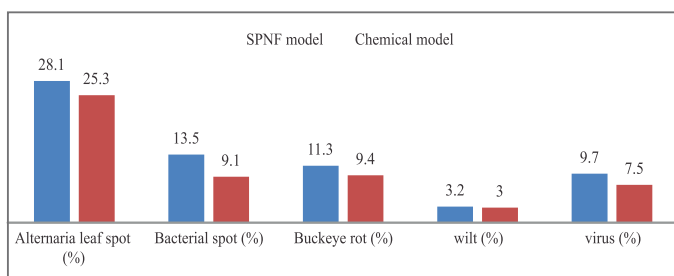
Vegetable Crops

Tomato

- ❖ Twenty four diverse genotypes of tomato were evaluated out of which BT-Best EC-174913, EC-620396, BT-10-12, EC-14078, EC-16465 and EC-620424 performed better over all other genotypes including check variety, Solan Lalima (KVK Kandaghat).
- ❖ Effect of planting dates and training systems on seed yield and quality in tomato grown under protected conditions revealed transplanting on 1st April and four stem training system was found superior to other treatments for most of the fruit and yield traits like number of flower clusters per plant (16.13), number of flowers per cluster (5.84), number of fruits per cluster (4.50), fruit set (76.36 %), total number of fruits per plant (34.73), average fruit weight (75.8 g) thereby resulting in significantly higher fruit yield (2.30 kg/plant, 13.80 kg/m² and 736 q/ha, respectively), however, transplanting on 1st April and two stem training system was also proved at par (SS&T, Nauni).
- ❖ Foliar spray of GA₃ at 100 ppm at vegetative and fruiting stage along with NAA at 40 ppm at flowering stage for commercial cultivation of tomato seed production resulted in higher seed yield with good quality seeds (SST, Nauni).
- ❖ Spray of metiram 55% + pyraclostrobin 5% @ 0.2% with the initiation of frost followed by sprays of copper oxychloride (0.3%)/mancozeb (0.25%) alternatively at 7-10 days intervals, checked late blight of tomato effectively (KVK Kandaghat).
- ❖ Foliar spray of pure formulation of neem silver nano-particles (150 ppm) was found most effective against buckeye rot of tomato which was found at par with the recommended fungicide metalaxyl + mancozeb (2000 ppm). Biochemical analysis of the harvested tomato fruits indicated highest content of ascorbic acid, lycopene content and total phenolics were recorded in those treatments which were sprayed with aqueous extracts of tulsi and neem (PP, Nauni).
- ❖ Plants viz. tulsi (*Ocimum sanctum*), karvya (*Roylea elegans*), darek (*Melia azedarach*), *Eucalyptus* sp., *Aloe barbadensis*, *Vitex negundo* were found effective in inhibiting the growth of important pathogens of tomato, capsicum and cauliflower. Cow urine based botanical formulation with these plants was effective against black rot of cauliflower with 74.8 per cent reduction in the disease index and was at par with Streptocycline + mancozeb with 3.68 times increase in the yield and 4.18 times increase in the curd weight (PP, Nauni).
- ❖ Soil solarization and amendment of soil with *T. harzianum* followed by drenching of seedling with leaf extract of *Lantana camara* (10%) and potassium chloride (300 mM) was found effective for management of damping-off of tomato, resulting in 84 per cent reduction in the incidence of the disease (PP, Nauni).
- ❖ Two foliar sprays of potassium dihydrogen phosphate (1.3%) after 15 days transplanting at 7-days interval followed by six alternate sprays of hexaconazole and zineb (0.2%) and azoxystrobin + difenoconazole (0.15%) (three each) at 10-days interval starting from the initiation of disease were found most effective in reducing early blight of tomato with substantial increase in yield in comparison to control (PP, Nauni).
- ❖ Late blight was observed as a major disease of tomato which appeared in severe to moderate form in different tomato growing localities of four districts (Solan, Sirmour, Shimla and Kullu) reflecting foliage blight severity (17.2 to 60.4 per cent) and fruit rot incidence (9.3 to 39.0 per cent). The soil application of *Trichoderma harzianum* @ 2.5 Kg/50 Kg FYM/ha in combination with six periodic spray of fungicides including fenamidone 10%+ mancozeb 50% (Sectin) @ 0.2% followed by copper oxychloride (Blitox-50) @ 0.3% and mancozeb (Indofil M - 45) @ 0.25% at ten days interval started with the initiation of disease provided significant control of late blight of tomato (PP, Nauni).
- ❖ Application of *Trichoderma* formulation for seed treatment @ 4g/ kg seed and as soil application @ 10g/kg soil during nursery raising in combination with six sprays with copper hydroxide 77% WP (2.0g/l) and fenamidone 10% + mancozeb 50% WDG (0.25%) in rotation at 10 days interval started with the fruit formation was

found most cost effective (ICBR 6.16) for the management of nursery, foliar and fruit rot diseases of tomato with simultaneous increase in tomato fruit yield (390.7q/ha) (VS, Nauni).

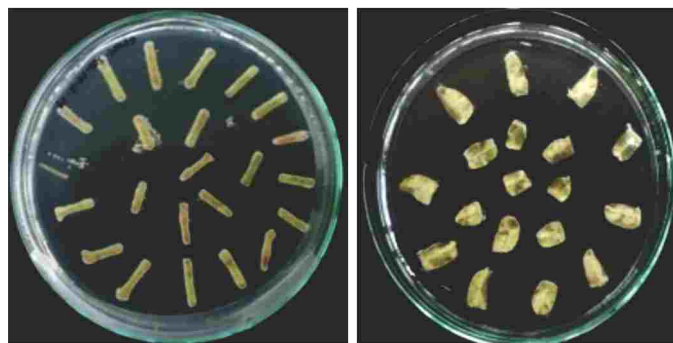
- ❖ A field trial on the validation of Subhash Palekar Natural Farming system in vegetable production was laid out during Kharif season of 2019. Tomato cv. Solan Lalima was the main crop grown with brinjal and French bean as companion crops. Data on the incidence of various diseases revealed that the incidence of major diseases like Alternaria leaf spot (28.4%), bacterial spot (13.50), buckeye rot (11.30%) and viruses (9.70%) was recorded slightly higher in SPNF system than in chemical farming i.e. 25.30, 9.10, 9.40 and 7.50 per cent, respectively. The incidence of wilt under SPNF system (3.20%) was, however, at par with that in chemical farming (3.0%) (SST, Nauni).



Incidence/ severity of various diseases on tomato crop

- ❖ Genetic transformation experiments were conducted in tomato var. Solan Lalima using single constructs of AdSGT1 (*Arachis diogeni*) defense related and TvD1 (*Tephrosia villosa*) defensin genes in binary vector pCambia2300 containing NPT-II selection marker for developing resistance against fungus *Phytophthora nicotianae* var. *parasitica* causing buckeye rot. The antibiotic sensitivity, pre-culturing, infection period and co-cultivation have been standardized. For hypocotyl explants, MS medium augmented with the BAP (2.0 mg/l), IAA (0.1 mg/l) and kanamycin (75 mg/l) along with agro-suppressive antibiotics like timentin @ 500 mg/l + efotaxime @ 250 mg/l was found useful. Likewise, for cotyledons, selective regeneration medium supplemented with zeatin (2.5 mg/l) and IAA (0.1 mg/l) and further fortified with kanamycin (50 mg/l) and timentin @ 500 mg/l resulted in better induction of shoots.

Molecular analysis for the integration of transgene is under progress (BT, Nauni).



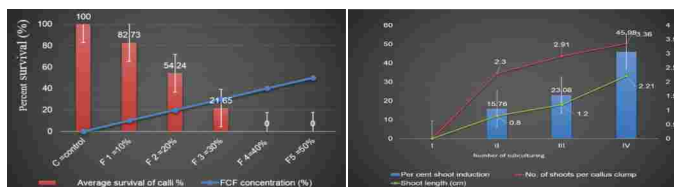
Co-cultivated hypocotyl and cotyledon explants after 48 h



Regenerated putative shoots on selection medium using hypocotyl and cotyledon

Agrobacterium mediated putative transformant in tomato var. Solan lalima

- ❖ *In vitro* cell line selection for developing resistance against *Fusarium oxysporum* f.sp. *lycopersici* in tomato was carried out. The selection of tolerant callus was done at 30 per cent of fungal culture filtrate with 21.65 per cent calli survival. The selected callus was subcultured on the same medium comprising of MS medium supplemented with 0.1 mg/l BA, 0.50 mg/l NAA, 30 % FCF for two subculture passage at the interval of 4 weeks and thereafter on same medium without FCF. An increase in fresh weight of callus upto fourth subculturing was recorded resulting in 1.35 g fresh weight of callus. The calli having 2 subculture passage showed 15.76 per cent shoot induction, and 2.30 shoots per callus clump with shoot length of 0.80 cm. The putative resistant shoots obtained after shoot regeneration were transferred to half strength solid MS medium supplemented with 0.5 mg/l IBA for *in vitro* root induction. Molecular analysis of resistant shoots and bioassay of the resistant plants in protected/field conditions is under progress (BT, Nauni).



Selection of tolerant calli

Effect of sub-culturing on tolerant calli



In vitro shoot regeneration from selected calli

- ❖ Bio-intensive Integrated Pest Management (BIPM) module comprising of pheromone trap (PCI), marigold as trap crop, six releases of *Trichogramma achaeae* @ 50000/ha, two sprays of azadirachtin 1500ppm @ 2ml/L, one spray of *Lecanicillium lecanii* (5g/L of 10^8 conidia/g) were effective in managing *Tuta absoluta* and other pests of tomato. The number of mines by *T. absoluta* as recorded on 28th of August was 0.67, 0.80 and 2.23 mines, respectively. The fruit infestation recorded was 0.81, 1.21 and 3.78 per cent on 12th September in BIPM, chemical and untreated plots, respectively. Both the BIPM and chemical insecticides were equally effective in reducing the fruit infestation by *T. absoluta* in tomato. The yield in BIPM plots (26.1t/ha) was on par (24.9t/ha) with that recorded in chemical treated plots. In untreated plots, the yield was however, significantly lower (18.2t/ha) than that of BIPM and the chemically treated plots. The incidence of *Helicoverpa armigera* and *Macrosiphum euphorbiae* was very low throughout the cropping season (Ento, Nauni).

- ❖ The local strains of entomopathogenic nematodes, *S. feltiae* and *H. bacteriophora* were found effective against larvae of invasive pest, *Tuta absoluta* and tomato fruit fly, *Bactrocera tau* under laboratory conditions (Ento, Nauni).

Larvae of *T. absoluta* infected with entomopathogenic nematode, *Heterorhabditis* sp.

- ❖ IPM modules comprised of integrated module, bio-intensive module and chemical module were tested against the tomato pin worm (*Tuta absoluta*). Maximum number of live mines per plant were observed in case of untreated control (1.20) and the minimum number of mines per plant were observed in the chemical module (0.38) which were significantly different from other treatments. The population of natural enemies per plant was maximum in the bio-intensive module (5.70) which was at par with the integrated module (5.10) and untreated control (4.80). Minimum fruit damage was in chemical module (3.40%) which was at par with integrated module (3.63%) and bio-intensive module (5.57%). The maximum yield was observed in the chemical module (45.3t/ha) which was significantly different from other treatments and the minimum yield per plant was observed in the control (33.4 t/ha) (VS, Nauni).

Capsicum

- ❖ Studies on the effect of training systems and fruit load on seed production in bell pepper concluded that the treatment combination two stem training + retaining ten fruits proved superior in terms of ripe fruit weight (66.65g), ripe fruit length (6.56 cm), ripe fruit width (5.05 cm), number of seeds fruit⁻¹ (187.77), 1000 seed weight (6.21 g), germination (96.50%), speed of germination (15.95), seed vigour index-I (1448.30), seed vigour index-II (284.77) and electrical conductivity of seeds (0.060 dSm⁻¹). Therefore, two stem training system in combination with ten fruits kept for seed production can be recommended for quality seed production of bell pepper after multilocation testing (SST, Nauni).
- ❖ Biointensive management of diseases of capsicum under poly house revealed that incorporation of 5kg FYM fortified with 500g neem cake and 50g *Trichoderma* sp./100m² at the time of bed preparation combined with periodic spray and drenching of Bordeaux mixture @ 0.8% three times at 15 days interval beginning from 30 days after transplanting proved most efficacious in limiting all diseases like collar rot/root rot, powdery mildew, YLCV and in maximizing the fruit yield (647.60 q/ha) (VS, Nauni).

- ❖ Among biocontrol agents, *Chrysoperla zastrowi sillemi* (4 larvae / plant) resulted in 80.6 per cent reduction in the *Myzus persicae* population in capsicum which was on par with that resulted by imidacloprid (0.5ml/L) (90.3%) 10 days of second spray. *Lecanicillium lecanii* (5g/l of 10^8 conidia/ g) (73%) and azadirachtin (2ml/L of 1500ppm) (68%) were also on par with *Chrysoperla zastrowi sillemi* (4 larvae / plant), but could not match imidacloprid (0.5ml/L) in their efficacy against the pest. Other biocontrol agents namely *Metarhizium anisopliae*, *Beauveria bassiana* (5g/L of 10^8 conidia/ g each) and *Blaptostethus pallens* (30 nymphs/ m row length) resulted in 54.3 to 58 per cent reduction in the aphid population over control, 10 days after the second spray/ release (Ento, Nauni).

French Bean

- ❖ The Falguni variety of pencil bean was found most suitable for growing during November-March in the polyhouse and this variety gave nearly double yield in comparison to the standard check variety Contender (RHR&TS Jachh).



- ❖ In dolichos identified two bush type cultivar 2017/ DBBVAR-2 and 2017/ DOLBVAR-6 and one pole type cultivar 2017/DOLPVAR-4 worth for commercial cultivation on account of their high yielding potential along with other quality attributes (VS, Nauni).
- ❖ Seed biopriming with PGPR-1 + *Rhizobium* strain B1 resulted in the highest percentage of field emergence (95.18 %) followed by (93.70 %) emergence in seed biopriming with *Rhizobium* strain B1. The seed biopriming with PGPR-1 + *Rhizobium* strain B1 also resulted in a significant improvement in seed yield as compared to that of hydropriming, carbendazim seed treatment and untreated control (SST, Nauni).
- ❖ Conjoint application of 75% NPK + 25% N through vermicompost produced significantly highest number of pods per plant (30.83), average

pod weight (5.60g) and marketable pod yield (128.89 /ha) in French bean (VS, Nauni).

- ❖ The French bean seed biopriming with bioagents including PGPR, *Rhizobium* and *Trichoderma* alone and their combinations significantly affected the incidence of *Rhizoctonia* root rot in French bean. Amongst different treatments, minimum incidence of *Rhizoctonia* root rot (2.60 %) was observed in the seed biopriming with PGPR-1 + *Rhizobium* strain B1 followed by 3.70 % in *Rhizobium* strain B1, 3.71 % in PGPR-1 + *Rhizobium* strain B1 + *Trichoderma viride*, respectively. The incidence of root rot in French bean plots grown after seed treatment with carbendazim @ 0.2 % was observed to be 9.26 % which was significantly higher than all the biopriming treatments. The disease incidence in untreated plots was observed maximum which was significantly higher than all the other treatments (SST, Nauni).
- ❖ In an experiment laid out in polycarbonate house to study the effect of five horticultural mineral Oils against motile stages of *T. urticae* (Koch) on French bean at 1.0% proved the superiority of Mak all season over rest of the oils and resulted in complete control of mite on 28th day of spray. However, Neem oil controlled the population of TSM up to two weeks only and thereafter, increase in population build up was noticed and for achieving complete control of mite, second application is required after 15 days (RHR&TS, Mashobra).



Mite infested bean leaf

Two-spotted mite on bean leaf

Cucumber

- ❖ In cucumber, variety 2018/CUCUVAR-1 (281.46q/ha), whereas, in hybrids; 2016/CUCUHYB-2 (462.40q/ha) and 2016/CUCUHYB-5 (301.07q/ha) were ranked top with their respective yield potential vis a vis other entries and standard national checks (VS, Nauni).

- ❖ Studies on germplasm evaluation against *Fusarium* wilt of cucumber by artificial inoculation under pot culture conditions revealed that Mamta, Damini and TSCU-1101 were resistant followed by Alisha and Zoya being moderately resistant. KH-1, Nazia, Saira 934 and CAIH 18 were found to be highly susceptible to the disease (*KVK Kandaghat*).
 - ❖ For the control of whitefly and aphids on cucumber, the application of *Lecanicillium lecanii* @ 5g/l was found superior in reducing the population of whitefly and this treatment recorded average survival population of whitefly in the range of 2.89-3.56/plant as against 6.89-7.78 whitefly/plant in untreated control at 3rd, 7th and 14th days after spray. However, the treatment with Neem oil @ 1% was found at par with this treatment and observed mean population of 3.74/plant. As regards yield, the treatments with *Lecanicillium lecanii* @ 5g/l, Neem oil @ 1%, *Beauveria bassiana* @ 5g/l and *Metarhizium anisopliae* @ 5g/l were found equally effective and recorded the yield of cucumber in the range of 19.25-17.44 t/ha as against 12.92 t/ha in untreated control (*VS, Nauni*).
 - ❖ In cue-lure based attractant-insecticide traps installed in the cucumber crop four fruit fly species viz. *Bactrocera tau*, *B. cucurbitae*, *B. nigrofemoralis* and *B. scutellaris* were found trapped. Maximum number of males were trapped during first week of August i.e. 276.60/trap/week for *B. tau* followed by 130.80, 96.80 and 74.00/trap /week for *B. cucurbitae*, *B. nigrofemoralis* and *B. scutellaris*, respectively. During the cropping period, lowest trap catch was recorded during 4th week of September. *B. tau* dominated over the other three species. When a mixture of cue-lure and methyl eugenol was evaluated for attraction of fruit flies associated with this crop, the catch was not significant in comparison to the exclusive cue lure based attractant-insecticide trap (*Ento, Nauni*).
-
- Cue lure trap in cucumber
- ❖ Lambda-cyhalothrin (0.004 %) was found to be most effective and economical treatment among all the test insecticides. Plants treated with Lambda-cyhalothrin resulted in minimum per cent infestation (17.01) and maximum return with a B:C ratio of 29.48:1 (*Ento, Nauni*).
 - ❖ The new chemical molecules viz., fluopyram, fluensulfone and fluazaindoline were found highly effective against root knot nematode in cucumber under protected cultivation. Lower nematode populations, galling indices and higher cucumber yields were recorded in plots treated with new chemicals as compared to standard nematicide and untreated check. The average cucumber fruit yield was found highest in plots treated with fluensulfone (44.74 & 45.86 t/ha) followed by fluazaindoline (43.48 & 41.26 t/ha) and fluopyram (35.76 & 37.34 t/ha). The plants treated with Fluopyram 400 SC showed phytotoxicity on cucumber plants at tested doses (*Ento, Nauni*).
 - ❖ Solomon (Beta cyfluthrin + Imidacloprid) was applied @ 500 ml/ha and 1000 ml/ha on the cucumber crop. The initial residues of beta cyfluthrin on cucumber fruits were 0.698 and 1.409 mg kg⁻¹ at the application rate of 45 and 90 g ai/ha, respectively. The initial residues of imidacloprid on cucumber fruits were 0.840 and 1.560 mg kg⁻¹ at the application rate of 105 g a.i./ha and 210 g a.i./ha, respectively. The residues of beta cyfluthrin and imidacloprid were found below LOQ (<0.05 mg/kg) at 7 and 10 days after last application of the respective doses. Beta-cyfluthrin and Imidacloprid residues in cucumber cropped soil after 21 days of last application were below LOQ (<0.05 mg/kg) (*Ento, Nauni*).
 - ❖ Red pumpkin beetle (*Aulacophora foveicollis*) were observed on cucurbitaceous crops during the month of July and August. In bottle gourd crop, maximum average population of 3-4 beetles/plant were observed in the month of July whereas, in cucumber maximum average population of 5-6 beetles/plant were observed during month of August. A low incidence of hadda beetles (*H. vigintioctopunctata*) was also observed on cucumber crop. Average population on cucumber were 1-2 beetles/plant (*RHR&TS Jachh*).



Brinjal

- ❖ Five lines IVBL-116-131, NBJ-19, CO-11, DRNKV-02-104, DBR-8, and two testers PPL and PPC were involved in hybridization programme and developed different hybrid combinations. Based on mean performance, heterosis per cent and specific combining effects five most promising cross combinations viz. NBJ-19 × PPL, DRNKV-02-104 × PPC, DBR-8 × PPC, IVBL-116-131 × PPC and CO-11 × PPC were found best which performed well for majority of traits. Further, Chi-square analysis revealed that in three crosses which were advanced to work out the inheritance of resistance to shoot and fruit borer, segregated as 15 infested to 1 non-infested in both shoots and fruits revealing the presence of duplicate gene action and the test cross i.e., B_1 segregated in 1:1 ratio whereas, in B_2 reverse pattern of inheritance was observed suggesting that digenic recessive genes were involved in governing the inheritance of resistance to shoot and fruit borer in brinjal (VS, Nauni).
- ❖ Application of vermicompost @ 5 t/ha along with beejamrit (seed treatment) and jeevamrit drenching at 15, 30, 45 days after transplanting + 3 foliar sprays @ 5 per cent at 15 days interval after the completion of soil drenching resulted in better growth, higher yield, least insect pest and diseases incidence and sustainable crop production of brinjal cv. Pusa Purple Cluster (VS, Nauni).



Organic production of brinjal

- ❖ Among the various genotypes of brinjal evaluated for their performance under low hill conditions of

the state genotypes viz. PPR and PPC were found best for cultivation and gave higher fruit yield 314.00, and 308.20 q/ha, respectively when planted during the second fortnight of March, 2019 (RHR&TS Jachh).

- ❖ In brinjal, the treatments with *Pseudomonas putida* and *Bacillus megaterium* also resulted in lower nematode population, root knot index and higher yields as compared to untreated check. Lowest galling index, maximum reductions in *M. incognita* J2 population in soil and roots and highest increase in fruit yield were recorded in treatment where *P. putida* was used in nursery treatment and for overall field application along with neem cake (Ento, Nauni).
- ❖ Four treatments of fluopyram were applied as soil drenching around the brinjal plant root zone that includes single application of fluopyram @ 500 and 1000 g a.i./ha after 3 days of transplanting and two applications of fluopyram @ 250 and 500 g a.i./ha where first application was given after 3 days of transplanting and second application at 21 days after first application. In first case, brinjal fruit samples were collected at 91 days after last application and subsequent samples at 94, 96 and 98 days after last application of Velum Prime. Analysis of fruit samples revealed that the residues of fluopyram and its metabolite fluopyram benzamide were below the limit of quantification (<0.05 mg/kg). In the second case, first brinjal fruit samples were collected at 70 days after last application and subsequent samples were taken at 73, 75 and 77 days of last application. Analysis of fruit samples revealed that the residues of fluopyram and its metabolite fluopyram benzamide were below the LOQ (<0.05 mg/kg) (Ento, Nauni).
- ❖ Hadda beetle (*Henosepilachna vigintioctopunctata*) and fruit and shoot borer (*Leucinodes orbonalis*) were found to be major insect pests affecting brinjal crop. The maximum infestation of *H. vigintioctopunctata* was observed in the month of July with an average population level of 4-5 grubs/leaf and percent leaf infestation of 25-40%. Similarly the infestation of brinjal fruit and shoot borer (*Leucinodes orbonalis*) was maximum in the month of August i.e. 2-3 larvae/plant (RHR&TS Jachh).

- ❖ Nine cultivars of were studied for infestation of hadda beetles. DMU-1 was observed with least infestation and 5.0 grubs/plant and 3.80 adults per plant which was at par with Rubeena, PPR, BB-8 and PPC (*RHR&TS Jachh*).



- ❖ Alternaria leaf blight of brinjal was recorded in moderate to severe form (9.4-30.9 %) in different localities of Solan, Bilaspur and Mandi districts of Himachal Pradesh and was effectively managed (80.33%) by the application of four foliar sprays of Contaf (hexaconazole) @0.05 per cent at 10-day interval started with the initiation of disease with enhanced fruit yield (156.90q/ha) (*VS, Nauni*).

Chilli

- ❖ Genetic variability study was conducted on twenty genotypes of chilli along with check variety Surajmukhi. Three genotypes namely LC-C-22, LC-C-17 and LC-C-8 were found to be high yielding as well as better from consumer's point of view (*CH&F, Neri*).
- ❖ 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. All the crosses were found 100% male sterile. The fruit size (LxB) surpassed to the respective donor parent in all the crosses. Among these crosses, maximum fruit yield was recorded in CMS-A x CWP-2 (450.5 g plant⁻¹), which was higher to its donor parent CWP-2 (227.2 g/plant). This shows desirable achievement from chilli to bell pepper, except the persistence of calyx with the fruit. However, the pointed apex re-appeared, than the desirable shape of lobules at the distal end (*RHR&TS Dhaulakuan*).
- ❖ Two genic male sterile lines of chilli, carrying *msms* gene, named DKC-12 (MS-12) and DKC-2363 alongwith four lines of bellpepper, carrying *Nmsms* gene, are being maintained by practising selfing (*RHR&TS Dhaulakuan*).

Cauliflower

- ❖ 25 diverse genotypes of cauliflower collected from different sources were evaluated and maximum curd yield was recorded in Pusa Snowball K-1 (322.14 q/ha) followed by Pusa Snowball K-25 (317.00 q/ha) (*RHR&TS Jachh*).



- ❖ In cauliflower midseason group, the new evolving varieties viz. 2017/CAUMVAR-3 (211.90q/ha), 2018/CAUMVAR-7 (221.5q/ha) followed by 2018/CAUMVAR-1 (217.3q/ha), and hybrid; 2019/CAUMHYB-7 (221.4.9q/ha) followed by 2019/CAUMHYB-5 (217.4 q/ha) 2019/CAUMHYB-7 (216.5 q/ha) excelled in yield. In late season group genotype 2019/CAULVAR-2 gave highest yield i.e. 244.5 q/ha which was at par with 2019/CAULVAR-3 (241.7.3 q/ha) and 2019/CAULVAR-5 (236.2 q/ha) (*VS, Nauni*).
- ❖ In cauliflower hybrid development programme, three new Cytoplasmic Male Sterile (CMS) lines viz., UHF-CAU-CMS-2, UHF-CAU-CMS-3 and UHF-CAU-CMS-4 have also been developed. Twenty-one Cytoplasmic Male Sterility based late maturity group cross combinations, developed during last year, were evaluated along with two checks (Pusa Snow Ball Hybrid-1 and Sweta). In total, 12 new hybrid combinations out yielded both the checks. Maximum curd yield was recorded in UHF-CAUH-27 (51.3 t/ha) which was at par with UHF-CAUH-31 (49.2 t/ha), UHF-CAUH-22 (48.3 t/ha), UHF-CAUH-13 (48.1 t/ha) and UHF-CAUH-14 (47.8 t/ha). These five hybrids also had considerable heterosis over both the checks ranging from 17.7 to 51.3% alongwith other desirable quality traits. The best hybrid combination i.e. UHF-CAUH-27 (Solan Snowball Hybrid-1) after testing shall be released for commercial cultivation (*VS, Nauni*).



UHF-CAUH-27 (Solan Snowball Hybrid-1)

- ❖ Time of transplanting and mulching on seed production in late cauliflower revealed that out of 12 treatment combinations, 16th September transplanting and mulching with black polyethylene sheet was the best for most of the seed yield parameters resulting in minimum days to curd initiation (45.33), early bolters (26.55 %), days to flowering initiation (168.67), days to 50 per cent flowering (185.67), maximum number of branches plant⁻¹ (16.07), maximum number of seeds siliqua⁻¹ (17.53), maximum seed yield plant⁻¹ (22.62 g), maximum seed yield plot⁻¹ (422.00 g) and maximum seed yield ha⁻¹ (625.18 kg). Effect on various seed quality parameters was assessed under laboratory conditions. The maximum values for germination (85.25%), SVI-I (761.70), SVI-II (258.25) and lowest electrical conductivity (0.027 dSm⁻¹) was observed in this treatment were found to be significantly superior compared to rest of the treatment combinations. The benefit: cost ratio was also maximum (4.01:1) in these treatment (*SST, Nauni*).
- ❖ Integrated nutrient management in cauliflower revealed that an application of 50% FYM (125 q/ha) + vermincompost (equivalent to N content of 50% remaining FYM) + recommended dose of NPK through FYM on N equivalent basis) owing to par excellence in yield as well as post-harvest nutrient status (NPK) in the soil vis-à-vis (recommended practice) can be suggested as a cost effective organic combination for getting higher yield on sustainable basis in cauliflower. Similarly, in another experiment on INM with cow manurial amendments in cauliflower, treatment comprising of 90% recommended dose of was found best for all growth and yield related characters besides giving a B:C ratio of 2.08:1 (*VS, Nauni*)

- ❖ Foliar spray with Salicylic acid @ 10mM and cow urine extract of *Azadirachta indica* @ 10 per cent concentration when applied under pot conditions resulted in the management of *Alternaria* blight in cauliflower up to 54 per cent (*CH&F, Neri*).

Cabbage

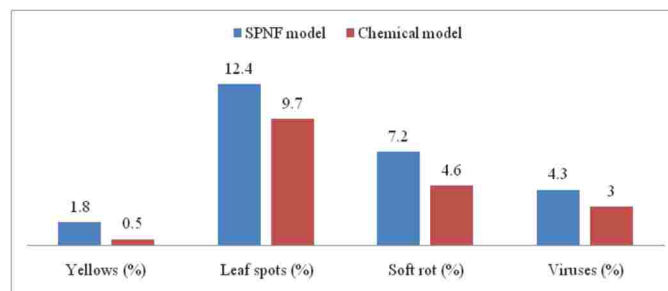
- ❖ The hybrids were evaluated along with check cultivar Pusa Cabbage Hybrid-1 for yield and component traits during 2019-20. In total, 12 new hybrid combinations out yielded the standard check cultivar Pusa Cabbage Hybrid-1. The cross combinations viz., UHF-CAB-CMS-20×UHF-CAB-11(22.19 t/ha) followed by UHF-CAB-CMS-22×UHF-CAB-11(19.97 t/ha), and UHF-CAB-CMS-22×UHF-CAB-10(19.78 t/ha) beside high heterotic effects, also depicted high mean values for marketable head yield and other quality traits under study and registered 55.06, 39.55 and 38.23 per cent increase in yield, respectively over national check Pusa Cabbage Hybrid-1 (14.31t/ha). The best hybrid combination i.e. UHF-CAB-CMS-20×UHF-CAB-11, UHF-CAB-CMS-22×UHF-CAB-11 and UHF-CAB-CMS-22×UHF-CAB-10 shall be released for commercial cultivation after testing in AICRP (VC) and at multi-locations in HP (*VS, Nauni*).

CMS based best cross-combinations (F₁'s) of cabbage

- ❖ In cabbage, variety; 2018/CABVAR-3(364q/ha) out-yielded all other tested varieties and in red cabbage variety 2019/CABVAR-4 found best for various traits and recorded highest yield of 382.94 q/ha amongst the tested varieties (*VS, Nauni*).

- ❖ In a hybrid development programme in cabbage, based on cytoplasmic male sterility (CMS) system, 18 cross combinations have been developed by involving three CMS lines and six testers in Line \times Tester system of mating (*VS, Nauni*).
- ❖ Under SPNF system where cabbage cv. Golden Acre was main crop and coriander cv. Solan Selection and fenugreek cv. IC-74 were companion crops. The infestation of cabbage aphid, *B. brassicae* on cabbage in both the farming systems started during the third week of November, 2019 (46th Standard Week). During this week the aphid population (2.97 ± 0.48 aphids/plant) in SPNF grown cabbage was significantly higher than CF-grown cabbage (1.83 ± 0.36 aphids/plant). Thereafter, the aphid population declined in the CF system and increased in SPNF system. The population of the aphid persisted throughout the cropping season in both the cropping systems. In the SPNF system, the aphids attained two peaks, first peak (5.23 ± 0.75 aphids/plant) in the 49th standard week i.e. second week of December, 2019 and second peak (3.07 ± 1.58 aphids) in the 6th standard week i.e. 2nd week of February, 2020. In conventional farming system, aphid attained its first peak in 49th standard week, i.e. second week of December, 2019, but the population was significantly lower than that of SPNF system. The cabbage aphid attained its second peak in the 4th standard week i.e. last week of January, 2020 under CF system. The aphid population persisted throughout the cropping season under both the systems. In most of the sampling intervals the cabbage aphid (*B. brassicae*) population recorded under SPNF system was significantly higher than CF system (*Ento, Nauni*).
- ❖ In the cabbage crop cultivated under SPNF model where cabbage cv. Golden Acre was main crop and coriander and methi were companion crops, some diseases were noticed viz., yellows, leaf spots, soft rot and viruses. The incidence/ severity of these diseases was recorded at weekly intervals and their mean incidence/ severity was worked out. The data were compared with the crop grown under chemical/ conventional system. It is evident from the data presented in Figure that the incidence of all the diseases in cabbage crop

grown under SPNF model was higher especially in case of leaf spots and soft rot than that of chemical model (*SST, Nauni*).



Incidence/ severity of various diseases on cabbage crop

- ❖ The oviposition preference of the cabbage butterfly (*Pieris brassicae*) was observed in 25 genotypes of cauliflower under open field conditions. Most number of eggs were observed on Jachh CF-2 and Pusa Snoball K-1 (*RHR&TS Jachh*).
- ❖ Various insect pests were infesting the cruciferous crops were observed. Painted bugs (*Begrada cruciferarum*) infestation was observed on cabbage crop from July to September. Maximum average population of 4-5 bugs/plant was observed in the month of August. A very low incidence of tobacco caterpillar (*Spodoptera litura*) was observed from November to February on 10% of cauliflower and cabbage plants. Cabbage aphids (*Brevicoryne brassicae*) were also observed on 10% of cauliflower and broccoli plants from November to February on cauliflower (*RHR&TS Jachh*).

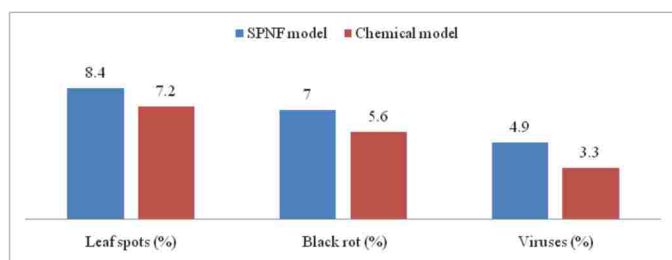


- ❖ The initial residues of spirotetramat on cabbage heads were 0.327 and 0.726 mg kg⁻¹ at the application rate of 90 g a.i./ha and 180 g a.i./ha, respectively after foliar spray of Movento. The residues of spirotetramat were found below LOQ

(<0.05 mg/kg) at 7 and 10 days after last application of both the doses, respectively. Half-life values were calculated to be 2.37 and 2.31 days, at respective doses. Residues of spirotetramat metabolites, viz. BY108330 enol, BY108330 ketohydroxy, BY108330 monohydroxy and BY108330 enol glucoside were found below LOQ (<0.05 mg/kg) in all analyzed samples. Residues of spirotetramat and its metabolites in cabbage cropped soil (21 days after last application) were below the LOQ (*Ento, Nauni*).

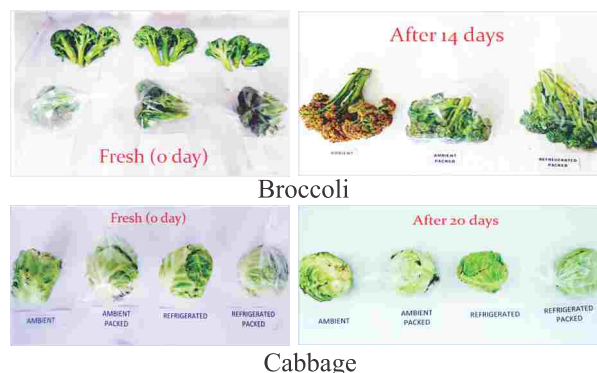
Broccoli

- ❖ In broccoli entry 2019/BROCVAR-1 (198.4) followed by 2019/BROCVAR-4 (198.4) were found best for commercial cultivation on account of their high yielding potential along with other quality attributes. In a leafy crucifer - Mustard green, the genotypes; 2018/MGVAR-6 (292.59q/ha) and 2018/MGVAR-5 (288.89q/ha) were promising ones in term of yield and quality of green leaves (*VS, Nauni*).
- ❖ In the broccoli crop cultivated under SPNF model where broccoli was main crop and coriander and methi were companion crops, some diseases were noticed viz., leaf spots, black rot and viruses. The incidence/ severity of these diseases was recorded at weekly intervals and their mean incidence/ severity was worked out. The data were compared with the crop grown under chemical/ conventional system. It is evident from the data, that the incidence of all the diseases in broccoli crop grown under SPNF model was slightly higher than that of chemical model (*SST, Nauni*).



Incidence/ severity of various diseases on broccoli crop

- ❖ Broccoli and cabbage packed in perforated 100 gauge LDPE pouches (MAP) with refrigerated storage ($5\pm 2^{\circ}\text{C}$) retained their shelf life up to 20th and 30th days, respectively (*FST, Nauni*).



Pea

- ❖ 31 genotypes of pea were evaluated including the check variety PB 89. The genotype BAJ-PEA-8 was found to give highest pod yield (180 q/ha) with 9.1cm long pods, and 24.3 marketable pods per plant and shelling percentage of 63.8 per cent (*RHR&TS Bajaura*).
- ❖ 115 collections of pea collected from NBPGR Delhi were also evaluated and genotype DMR-7 recorded maximum yield per plot followed by EC-8381419 (52.184 Kg per plot) and IC-279125 (50.931 Kg per plot). All these genotypes of pea were found resistant to powdery mildew under natural conditions. These were also evaluated against pea leaf miner (*Chromatomyia horticola*). Lowest mean per cent leaf infestation was 4.8% in genotype EC 838199 and highest was 11.7% in genotype C1, similarly the lowest mean number of maggots per 10 leaves was 0.66 in genotype EC 838199 and highest was 1.30 in genotype C1 (*RHR&TS Jachh*).
- ❖ In early-season garden pea; 2019/PEVAR-6 (105.00q/ha), 2018/PEVAR-6 (98.75/ha) and 2017/PEVAR-6 (100.42q/ha); in edible podded 2018/PEDVAR-4 (102.08q) and in mid-season 2017/PMVAR-6 (121.25q/ha) and 2016/PMVAR-6 (132.92q/ha) excelled in performance over the other tested stocks Nauni.

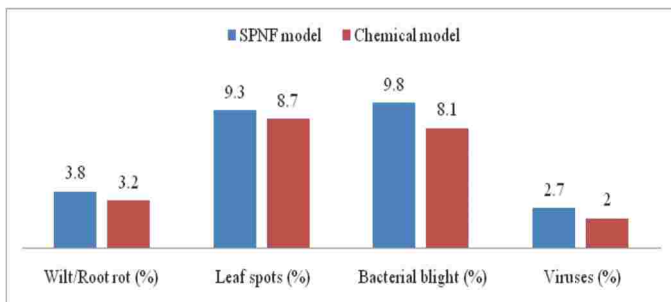


Demonstration on seed treatment with *Rhizobium*

- ❖ Pea is an important cash crop in Spiti valley. Farmers on an average broadcast 30-40 kg bigha⁻¹

pea seed as broadcasting. To avoid the excessive usage of pea seed, demonstration for the use of recommended seed rate with line sowing of pea at ten different locations on farmer's field in comparison to farmer's practices. The data of the FLDs revealed that line sowing of pea reduced the over application of seed, maintained uniform distribution and growth of plants with 36% increase in yield in comparison to farmer's practice (*KVK Tabo*).

- ❖ In the pea crop cultivated under SPNF model where pea cv. PB-89 was main crop and coriander and spinach were companion crops, some diseases were noticed viz., wilt, leaf spots, bacterial blight and viruses. The incidence/severity of these diseases were recorded at weekly intervals and their mean incidence/severity was worked out. The data were compared with the crop grown under chemical/ conventional system. It is evident that the incidence of all the diseases in pea crop grown under SPNF model was slightly higher than that of chemical model (*SST, Nauni*).



Incidence/ severity of various diseases on pea crop

- ❖ The pea crop cv. Pb 89 was grown as main crop and coriander cv. Solan Selection and spinach cv. Palam Harit was grown as companion crop under SPNF system and pea as sole crop under CF system. The pea leafminer was the major insect-pest of the pea crop. The first appearance of the pea leafminer was noticed during the 8th standard week i.e. fourth week of February, 2020 in both the farming systems with densities of 0.83 ± 0.13 and 0.33 ± 0.11 leafminers / leaflet in pea grown under SPNF and CF systems, respectively. Thereafter, the population of the leafminer gradually started rising and reached its peak in the 11th standard week i.e. third week of March, 2020 under SPNF system. Similarly, in the

conventional farming system the population reached to its peak in the 10th standard week i.e. second week of March, 2020. The leafminer population fluctuated between 0.83 ± 0.13 to 19.20 ± 1.03 leafminers/ leaflet in SPNF and 0.33 ± 0.11 to 4.26 ± 0.57 leafmines/ leaflet in CF (*Ento, Nauni*).

Okra

- ❖ Twenty genotypes of okra along with two check varieties P-8 and Palam Komal were evaluated. Genotypes namely LC-16-18, LC-18-18, LC-11-18, LC-9-18 and LC-5-18 were significantly superior to other genotypes and check varieties for yield and yield contributing traits and can be utilized in further breeding programmes (*CH&F, Neri*).
- ❖ In Okra, Indranil Improved gave maximum yield (132.80q/ha) followed by P-8 (125.20q/ha). The varieties Pusa Makhmali and PLG were found highly susceptible to the disease whereas varieties Arka Anamika, Indranil Improved and P-8 cultivars were found field resistant to Yellow Vein Mosaic Virus disease when sown during the first week of June (*RHR&TS Jachh*).



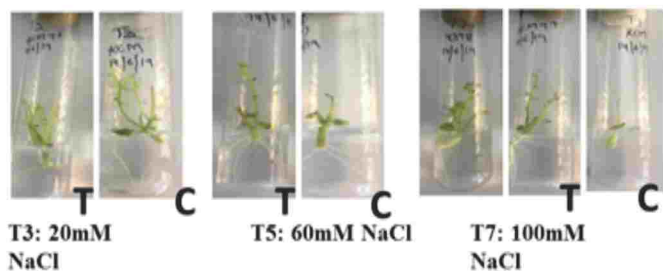
- ❖ Studies on the effect of growth retardant on seed yield and quality in okra [*Abelmoschus esculentus* (L.) Moench] revealed that cycocel @ 500 ppm was significantly superior to other concentrations for fruit, seed yield and seed quality parameters. Among the three stages of cycocel application, foliar spray of cycocel at 30 days after germination was significantly superior in case of number of lateral branches, number of internodes on main stem, internodal length, girth of main stem, fruit length, days to pod maturity, number of fruits per plant, per cent seed germination, seedling length, seedling dry weight, seedling vigour index-I, seedling vigour index-II, cold test and electrical conductivity whereas spray at 40 days after germination was significantly superior for fruit diameter, days to

marketable maturity, plant height at maturity, fruit yield, seed yield, 100 seed weight and accelerated aging test (*SST, Nauni*).

- ❖ The data obtained w.r.t. IPM modules for insect pests complex in okra showed that maximum number of leafhoppers per plant were observed in case of untreated control (10.33) and the minimum number of leafhoppers per plant were observed in the integrated module (2.78). The maximum number of aphids per plant were observed in untreated control module (23.48) and the minimum number of aphids per plant were observed in chemical module (7.80). The maximum number of whiteflies were observed in untreated control (6.15) and the minimum number of whiteflies per plant were observed in integrated module (1.12). Apart from this significantly higher seed yields were observed in the crop using integrated module (16.2 t/ha) and chemical module (15.3 t/ha) (*SST, Nauni*).

Potato

- ❖ Annexin gene *StAnn1* from potato cultivar Kufri Surya (KS) was isolated and cloned into PRI101 binary vector. This construct was used to transform potato cultivar KCM and its presence was confirmed in fifteen out of 52 lines. The effect of salinity stress tolerance in control and putative transgenic shoots of potato cultivar KCM plants was studied under *in vitro* conditions. Seven different concentrations of salt (NaCl) ranging from 0.0, 10mM, 20mM, 40mM, 60mM, 80mM and 100mM were supplemented in basal MS medium. A decline in number of roots, nodes/plant and plant height was observed in control shoots as compared to putative transgenic shoots. The putative transgenic shoots showed emergence of rooting after 6-10 days of exposure to salt stress (*BT, Nauni*).



In vitro testing for salt tolerance in putative transgenic shoots of potato cultivar Kufri Chandramukhi expressing *StAnn1* gene

Ginger

- ❖ Ginger variety Solan Giriganga recommended at national level, developed through clonal selection method from local germplasm of trans-Giri area of Sirmour, plumpy and bold attractive rhizomes having high quality attributes, average yield 18-19 t/ha, variety is quite suitable for cultivation in mid and foot hills of Western and Eastern Himalayan Regions and Lower Gangetic Plain Region of India (*VS, Nauni*).



Ginger cv. Solan Giriganga

- ❖ In ginger, cultivar Solan Giriganga gave the highest fresh rhizome yield of 258.97 q/ha along with improved quality with the use of dry/ green grass mulch, ridges on raised bed planting method and 3×2 m bed size, resulting in the net returns of Rs 9,09,105 and B:C ratio 2.58 (*VS, Nauni*).
- ❖ Combined application of *Trichoderma* and GRB 35 talc formulation were found superior in increasing the plant growth parameters and reducing the incidence of rhizome rot over other treatments in three genotypes of ginger. The talc formulation of *Trichoderma* in combination with talc formulation of GRB-35 resulted in highest germination (84.63%) in Himgiri followed by LC-1 (83.84%) and LC-2 (83.36%). Similarly, combined talc formulations resulted in highest number of tiller per plant, height, yield and other biochemical parameters in all three genotypes and reduced incidence of rhizome rot (*VS, Nauni*).
- ❖ In Ginger cv Himgiri integrated weed management with application of pre-emergence weedicide metribuzin (0.7 kg/ha) followed by mulch (10 t/ha) followed by one hand weeding (75 DAP) gave maximum weed control efficiency (89.72%) and thereby produced better quality fresh rhizome yield of 176.51 q/ha, with net returns of Rs 5,41,157 and B : C ratio of 1.59 (*VS, Nauni*).

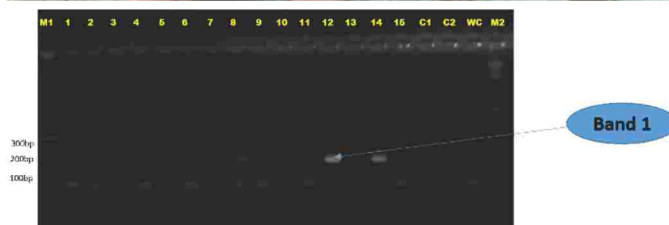
- ❖ Cost effective micropropagation protocol of ginger cv. Himgiri has been developed by replacing sucrose and agar with low cost alternatives. Out of different combination tried, 15 g/l isabgol and 40 g/l table sugar showed maximum multiplication rate of 1:8 with average shoot length of 5.1 cm, following medium gelled with isabgol and sucrose which showed 1:7 multiplication rate. 5 microrhizome per shoot were produced on MS medium with 70 g/l table sugar. Rooted plantlets hardened in potting mixture drenched with 20 ml Jeevamrit (3%) and 5 ml of PGPR showed survival percentage of 95 and 41, respectively. Cost analysis of various components showed that there was a significant cost difference between control medium and low cost medium (BT, Nauni).



In vitro multiplication (A&B) and microrhizome production (C&D) on low cost medium

- ❖ *Fusarium* yellows tolerant plants of ginger (*Zingiber officinale* Rosc.) var. Himgiri were developed using *in vitro* mutagenesis and selection technique. Surviving 10 Gy irradiated shoots were cultured on selective medium containing different concentrations (0-20%) of fungal culture filtrate (FCF) obtained from *Fusarium oxysporum* f.sp. *zingiberi* for *in vitro* selection. FCF concentration of 17.5% in the selective medium was found to be the highest on which 5% shoots survived after 1st selection cycle. Surviving selected shoots from 15 and 17.5% FCF were multiplied on multiplication medium and rooted plantlets were hardened with 100% survival. On *in vivo* evaluation 46.4 and 52% plants selected at 15 and 17.5% FCF were found to be highly resistant. Molecular analysis with disease specific SSR primers differentiated between FCF selected, tissue culture propagated and gamma irradiated plants. Two unique bands were obtained with GIN 6 and GIN 9 primers, sequencing, of which showed 98 and 97% homology with disease resistance protein-like gene CC-NBS-LRR from clones ZwP627 and

ZoP620 of *Z. officinale*. After *in vivo* bioassay, SSR analysis of selected highly resistant plants again confirmed the unique bands with both the primers. The DNA sequences obtained have been published in GenBank with accession numbers MN497252 and MN497253 (BT, Nauni).



Bioassay and molecular analysis of selected plants with GIN6 & GIN9 primers showing unique bands.

Turmeric

- ❖ Turmeric variety Palam Lalima gave the highest fresh rhizome yield of improved quality i.e 346.53 q/ha at 240 DAP by the application of FYM (200 q/ha) + seed treatment with Beejamrit + spray of Jeevamrit having a net return of Rs 7,60,456 with B : C ratio 2.72; whereas, yield of 289.52 q/ha was obtained by the application of seed treatment with Beejamrit + spray of Jeevamrit having a net return of Rs 6,47,169 with maximum B : C ratio 2.92 (VS, Nauni).
- ❖ Combined application of *Trichoderma* and GRB 35 talc formulation were found superior in increasing the plant growth parameters and reducing the incidence of leaf blotch over other treatments in three cultivars of turmeric. The talc formulation of *Trichoderma* in combination with talc formulation of GRB-35 resulted in highest germination (90.59%) in Palam Lalima followed by Palam Pitamber and Local Collection. Similarly, combined talc formulations resulted in highest number of tiller per plant, height, yield and other biochemical parameters in all three

genotypes and reduced incidence of leaf blotch (*VS, Nauni*).

Onion

- ❖ Among, different pre-harvest treatments on enhancement of shelf life of kharif onion, it was observed that the application of 100 ppm salicylic acid performed best over all other treatments in terms of weight loss, reduction in bulb diameter, rotting and sprouting percentage (*CH&F, Neri*).
- ❖ The experiment on the effect of different set sizes and planting dates on storage life of onion was conducted with treatments comprising of four set sizes i.e. small 1- 1.5 cm, medium size 1.5-2.0 cm, large size 2.0-2.5cm and extra-large >2.5cm and four dates of sets planting i.e. 1st date of planting 10th July, 2nd date of planting 25th July, 3rd date of planting 10th August and 4th date of planting 25th August. Treatment combination 1.5-2.0 cm set size and 10th August planting (S2D3) showed significantly lesser post-harvest losses as compared to all other treatments during the storage period. The storage life of kharif onion is generally lesser as compared to rabi season crop due to more moisture content in them. Therefore, reducing moisture content by proper curing can also enhance its shelf life (*CH&F, Neri*).
- ❖ An experiment was conducted to see the effect of seed pelleting with plant products and date of direct seeding on plant growth and bulb yield parameters in onion. The highest emergence (89.00 %) was recorded in seeds pelleted with *Azadirachta indica* leaf powder which was at par with *Melia azedarach* leaf powder pelleted seed (88.58 %) as compared to other treatments. Highest number of leaves per plant (8.17) was recorded in plants raised through seeds pelleted with *Azadirachta indica* leaf powder which was at par with *Melia azedarach* leaf powder pelleted seed (8.08). Maximum polar bulb diameter (45.11 mm) was recorded with *Melia azedarach* leaf powder which was at par with *Azadirachta indica* leaf powder pelleted seed (44.94 mm). Maximum bulb size index (2503.35) was recorded with *Azadirachta indica* leaf powder which was at par with *Melia azedarach* leaf powder pelleted seed (2502.34) (*SST Nauni*).
- ❖ The onion sets of cultivar N-53 planted during the first week of September, 2019 gave increased

production of green onion during off-season. A yield of 286.4 q/ha was recorded during the month of November under sub-tropical condition (*RHR&TS Jachh*).



Garlic

- ❖ Assessment of genetic variability and correlation studies were conducted in Garlic in which 18 genotypes of garlic were evaluated during rabi season 2019-2020. These genotypes were collected from NHRDF, Karnal, Palampur, Kandaghat and some were local collections. Observations were recorded for various horticultural traits viz. Plant height, number of cloves per bulb, number of leaves / plant, colour of bulbs and cloves, leaf length, days to harvest, bulb weight etc. (*CH&F, Neri*).

Spinach

- ❖ Among spinach Pusa Harit and Long standing were found most promising and gave higher yield of quality leaves (290.6 and 245.3 q/ha, respectively) (*RHR&TS Jachh*).



Root Vegetables

- ❖ Turnip cultivar "Purple Top White Globe" performed better for growing in sub-tropical conditions of the state, matured in 52 days after seed sowing and gave higher yield (370.10 q/ha) (*RHR&TS Jachh*).



- ❖ Effect of foliar applications of plant defense activators on Alternaria blight and seed yield in radish seed crop indicated that the foliar application of plant defense activators viz. salicylic acid (SA), jasmonic acid (JA), butyric acid (BABA) and potassium nitrate (KNO₃) at different concentrations on radish seed crop significantly reduced the severity of alternaria blight. The disease severity was observed lowest (11.79%) in the plots sprayed with BABA @ 750ppm which was followed by SA @ 100ppm (13.57%) and BABA @ 500ppm (13.79%). The treatments SA @ 100ppm and BABA @ 500ppm were at par with each other. The maximum disease severity of 24.58 % was, however, observed in the untreated plots) (*SST, Nauni*).
- ❖ In organic seed production of radish highest seed yield of 5.36 q/ha, maximum 1000 seed weight (11.81 g) and seed vigour index (2068.38) was recorded with the application of FYM 10 t/ha + vermicompost 4 t/ha + vermiwash @ 1:1 (v/v – water+ vermin-wash) spray (before flowering, at flowering and 15 days post flowering) (*VS, Nauni*).

Mustard

- ❖ In mustard thiamethoxam sprayed at 10% bloom had adverse impact on foraging activity of *A. mellifera*, which is evident from significant reduction in quantum of bee activity upto 8th day under semi field conditions (SFC) and 13th day under field conditions (FC). However, thiamethoxam spray at pre bloom and imidacloprid seed treatment showed no impact on bee activity and was comparable to control (*Ento, Nauni*).
- ❖ Thiamethoxam sprayed at 10% bloom also affected colony parameters of introduced *A. mellifera* under semi field conditions, which led to decrease in brood area (7th to 28th day), nectar stores (7th to 21st day) pollen stores (7th to 28th day) and bee strength (7th to 28th day) in comparison to thiamethoxam sprayed at prebloom, imidacloprid as seed treatment and control (*Ento, Nauni*).
- ❖ The mortality *A. mellifera* in dead bee trap was maximum in thiamethoxam sprayed at 10%, however it falls under normal category,

suggesting avoidance of foraging on treated crop by honeybees (*Ento, Nauni*).

Fenugreek

- ❖ Fenugreek genotype SF19-16 gave leaf yield of 31.33 g and seed yield of 6.00 g with 6.55 % oleoresin content compared to the check IC-74 producing 25.80 g leaf and 4.97 g seed yield per plant. Coriander genotype SC19-08 gave leaf yield of 7.87g and seed yield of 5.20 g with 3.45 % oleoresin content compared to the check Solan Local producing 7.03 g leaf and 4.07 g seed yield per plant (*VS, Nauni*).
- ❖ The experiment on the effect of cuttings on the leaf yield of methi revealed that second cutting out yielded the first cutting in plant height (59.33 cm), number of leaves per plant (90.33) and fresh weight of leaves per plant (40 g) (*KVK Kandaghat*).

Leafy Lettuce

- ❖ Twenty five genotypes of leafy lettuce collected from Srinagar, Leh/Ladakh and UHF, Nauni were evaluated. The genotypes viz., Lettuce var. 1 recorded the highest yield per plant (420.17 g) followed by LS-2 Selection 1 (375.86 g). Lettuce var-1 was also found earliest in maturity along with highest iron content in leaves (3.17 mg/100g) (*KVK Kandaghat*).

Flower Crops

Gladiolus

- ❖ Solan Uday (UHFGS Glad 4-22) and Solan Swati (UHF GS glad-4-48) of gladiolus were approved for commercial cultivation in POP workshop held on 18.02.2020 & 19.02.2020.
- ❖ Two newly developed hybrids of gladiolus of Solan Centre viz. 'UHFS GlaHb 4-17' and 'UHF GlaHb 15-4' were planted along with newly developed cv. 'Solan Mangla' and commercial varieties 'Nova Lux' and 'Jester' in March, 2019. Maximum plant height was noted in cv. 'Jester' (122.80 cm), whereas minimum was recorded in 'Solan Mangla' (81.20 cm). As regards hybrids under evaluation 'UHFS Gla 4-17' recorded a plant height of 89.58 cm while 'UHFS Gla 15-4' observed a height of 98.60 cm. Data also suggested that earliest flowering was noted in

genotype 'UHFS GlaHb 4-17'(98.53 days).It was however, found to be at par with cv. 'Nova Lux' (99.33 days) and 'Jester' (100.86 days). It is also clear that 'Solan Mangla' took maximum days i.e. 111 days to come to flowering. As regards hybrids under evaluation 'UHFS Gla 4-17' took 98.53 days while 'UHFS Gla 15-4' took 105.43 days to come to flowering (*FLA, Nauni*).



UHFS Gla 4-17

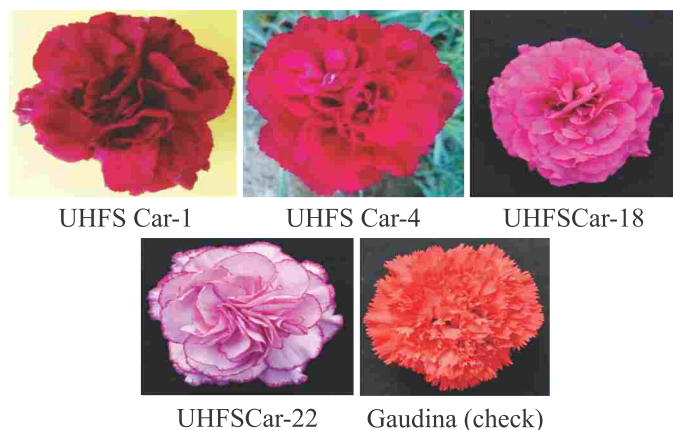
UHFS Gla 15-4

- ❖ On farm trial to study the effect of GA_3 on growth, flowering and corm production in gladiolus, it was observed that spray application of GA_3 @ 300 ppm resulted in highest number of corms /ha i.e. 3,05,000 which also resulted in highest cost: benefit ratio of 1.36 as compared to 1.12 in control (*KVK Kandaghat*).

Carnation

- ❖ The experiment was conducted with four newly developed varieties of carnation viz. UHFS Car-1, UHFS Car-4, UHFS Car-12 and UHFS Car-18 which were planted under polyhouse conditions in Jan, 2019. All the mutants recorded more plant height in comparison to check i.e., 'Gaudina' (60.43 cm). Maximum plant height was, however observed in 'UHFS Car-1' (77.31 cm). Earliest bud formation was noted in 'UHFS Car-22' (104.53 days), whereas 'UHFS Car-4' took maximum days for bud formation (152.87). Earliest flowering was noted in 'UHFS Car-22' (13910 days) while 'UHFS Car-1' took maximum days to flowering. Longest stems were observed in 'UHFS Car-1' (59.63 cm) which was found to be at par with stem length in 'UHFS Car-22' (59.23 cm). Stem length was observed minimum in check i.e., 'Gaudina' (54.00 cm). Maximum flower size was obtained in 'UHFS Car-18' (7.53 cm) which was found to be at par with 'UHFS

Car-22' (7.37 cm). All the mutants recorded larger flower is comparison to check i.e., 'Gaudina' (6.07 cm). Maximum number of flowers per plant were recorded in 'UHFS Car-18' (7.53) which was found to be at par with 'UHFS Car-22' (7.37). Minimum number of flowers per plant were, however recorded in i.e., 'Gaudina' (6.07). Thickest stems were observed in 'UHFS Car-22' (5.10 mm) in diameter. In contrast, minimum stem thickness was noted in 'Gaudina' (4.13 mm), which was found to be at par with 'UHFS Car-1' (4.14 mm). As regards flower yield, it was found maximum in 'UHFS Car-22' (112.00 flowers/m²). All the mutants recorded more flower yield over the check i.e., 'Gaudina' (82.67 flowers/m²). Maximum number of petals per flower (56.80) was found in 'UHFS Car-4' which was found to be at par with 'UHFS Car-18' (56.20). Minimum number of petals per flower was, however noted in 'Gaudina' (41.40). Maximum duration of flowering was noted in 'UHFS Car-1' (69.60 days). All the mutants flowered longer as compared to check cultivar i.e., 'Gaudina' (43.33 days) which recorded minimum duration of flowering (*FLA, Nauni*).



UHFS Car-1

UHFS Car-4

UHFS Car-18

UHFS Car-22

Gaudina (check)

Chrysanthemum

- ❖ Among different genotypes of chrysanthemum for pot flower production, 'Pusa Sona' (118.00 days) took minimum number of days for bud formation. Earliest flowering noted in case of 'Pusa Sona' (143.20 days). Maximum plant height noted in case of 'Pusa Guldusta' (53.93 cm) was found to be at par with 'DFR-C-2' (53.33 cm). Maximum plant spread noted in case of 'DFR-C-2' (49.72 cm). As far as flower diameter is

concerned, it was recorded maximum 'DFR-C-2' (8.37). Number of flowers per plant as well as durations of flowering was maximum in case of 'Pusa Sona' (287.70 cm and 44.80, respectively) (*FLA, Nauni*).

- ❖ Among different genotypes for cut flower production, 'UHFSChr 125' (97.32 days) took minimum number of days for bud formation which was found to be at par with 'UHFSChr 117' (98.34 days). Earliest flowering noted in case of 'UHFSChr 117' (133.50 days) was found to be at par with 'UHFSChr 125' (134.24 days). Plant height was recorded maximum of 'Pusa Shwet' (99.07 cm) which was closely followed by 'UHFSChr 117' 97.12 cm). Maximum plant spread noted in case of 'UHFSChr 117' (35.79 cm) was closely followed by 'UHFSChr 125' (34.49 cm) and 'TQP' (28.60 cm). As far as number of cut stems per plant is concerned, it was recorded maximum of 'UHFSChr 125' (6.34). Flower diameter as well as number of flowers per plant was maximum in case of 'Pusa Shwet' (9.47 cm and 176.40, respectively) (*FLA, Nauni*).

- ❖ The investigation on the effect of nutrient sources on cutting production and rooting in chrysanthemum revealed that minimum time for cutting production (25.67 and 25.33 days in 2nd and 4th harvest), maximum number of cuttings/plant/harvest (26.83, 32.83, 36.50 and 52.50 in all four harvests, respectively), total number of cuttings/plant (142.67), yield of cuttings/m² (670.83, 820.83, 912.50 and 1312.50 in all four harvests, respectively), minimum days for rooting (20.00 and 18.17 days in 3rd and 4th harvest, respectively), maximum number of roots (36.89 and 34.78 in 3rd and 4th harvests, respectively), maximum weight of rooted cuttings (2.04 g in 3rd harvest), maximum percentage of healthy rooted cuttings (98.55 % in 4th harvest) and intense green colour of leaves (YGG 147 A) were recorded with the application 22.5 g/m² each of NPK + biofertilizers + vermicompost (1 kg/m²) + FYM @ 5 kg/m² (as basal) along with N & K 100 ppm as fertigation twice a week. The cow urine (5%) resulted in maximum fresh weight of cuttings (3.21 and 2.12 g in 2nd and 3rd harvest, respectively) and maximum root length (3.91 cm in 3rd harvest) (*FLA, Nauni*).



Newly evolved genotypes for pot flower production

- ❖ Standard cultivars suitable for zone-1: Anaesthesia White (White), Apricot Parasol (Light Orange), Purnima (Creamish White), White Star (Creamish White), Yellow Star (Yellow), Pink Cloud (Light Pink) (*RHR&TS Dhaulakuan*).

Standard Chrysanthemum cultivars



- ❖ Spray cultivars suitable for zone-1: Ajay (Bright Yellow), Autumn Pink (Creamish and Pink), Baggi (White), Chandramallika (Golden yellow), Kalpana (White), Peet Singaar (Orange), Pusa Anmol (Light Pink), Shyamal (Dark Pink), Surf (White), Yellow Button (Bright Yellow) (*RHR&TS Dhaulakuan*).

Spray Chrysanthemum cultivars





SL Red

Shyamal

Pusa Anmol

Ajay

Gerbera

- ❖ The plants of two newly evolved cultivars of gerbera namely; 'Arka Nesara' and 'Arka Ashwa' were planted under polyhouse conditions. Both the varieties performed well. Flower diameter was recorded more in 'Arka Ashwa' in comparison to 'Arka Nesara'. With regards to vase life, 'Arka Nesara' exhibited more vase life as compared to 'Arka Ashwa'. The experiment on evaluation of five newly evolved cultivars of gerbera for open conditions showed that maximum flower size was noted in genotype RCGH-22 (*FLA, Nauni*).
- ❖ Suitable gerbera cultivars for low hills of HP-Zone-I: Balance (Creamish White), Dana Ellen (Yellow), Rosalin (Pink), Salvadore (Red) (*RHR&TSDhaulakuan*)



Dana Ellen

Balance

Salvadore

Rosalin

Marigold

- ❖ Evaluation of jeevamrit on growth, flowering and shelf life of marigold revealed that maximum plant height (72.02 cm), plant spread (49.60 cm), number of side shoots (6.55), number of flowers per plant (23.55), number of flowers per square meter (211.95), individual flower weight (16.40 g), flower weight per plant (368.52 g), flower weight per square meter (3.32 kg), flower diameter (5.80 cm) and duration of flowering (21.30 days) was recorded with application of recommended dose of fertilizer NPK @30:20:20 g/m². Maximum shelf life (7.71 days) and freshness index (4.16) was recorded with flowers harvested from RDF and stored under cold storage followed by flowers harvested from jeevamrit @ 2 litre/m² and stored under cold storage (*FLA, Nauni*).

- ❖ An experiment was conducted to study the influence of short day treatment on blooming period in African marigold. Artificial short day conditions were provided to the seedlings of marigold by covering seedling trays with black polythene sheets for different durations (i.e. 12 hours, 11 hours, 10 hours, 9 hours, 8 hours and 7 hours every day for 2 weeks starting from the sowing of seeds). The results showed that artificial short day conditions for 9 hours resulted in early flowering, more number of flowers per plant and yield per plant as compared to check (*KVK Kandaghat*).

Rose

- ❖ Performance of twelve cultivars of rose with respect to variation among them and association among yield and yield contributing traits was carried out for cut flower as well as for dry flower production. Hollywood, Tineke, Avalanche and Sweet. Avalanches were identified as promising rose cultivars for cut flower production. Taj Mahal was identified as a suitable cultivar for drying in microwave oven during Flush I (November, 2017) and Flush II (April, 2018) and Corvette during Flush III (June, 2018) and Flush IV (August, 2018). First Red was found to be suitable cultivar for drying in hot air oven during Flush I (November, 2017), Flush III (June, 2018) and Flush IV (August, 2018) and Taj Mahal during Flush II (April, 2018) (*FLA, Nauni*).
- ❖ Studies on post- harvest handling of cut roses were carried out to determine the best postharvest handling method, to increase the vase life of cut rose cvs 'Blush' and 'High and Mora'. The solutions of 3 % sucrose + 100 ppm 8- HQC 4 % sucrose + 200 ppm 8- HQC + 15 ppm BA and 1.5 % sucrose + 100 ppm 8- HQC + 5 ppm BA were standardized as the best bud opening, pulsing and holding solutions, respectively, to enhance the vase life and related post- harvest parameters. Ambient storage method was observed to be better than the dry storage methods, however the best wet storage method comprising of initially pulsing the cut roses in a solution of 4 % sucrose + 200 ppm 8- HQC + 15 ppm BA and later storing them in the solution of 1.5 % sucrose + 100 ppm 8- HQC + 5 ppm BA for 4 days was seen to greatly influence the vase life and related post- harvest

parameters during the flowering seasons of March- April June- July and September- October (*FLA, Nauni*).

- ❖ The initial deposits of fluopyram were 7.254 and 14.228 mg kg⁻¹ due to application of Luna Experience on rose flowers at the application rate of 100 and 200 g a.i./ha, respectively. Fluopyram metabolite, fluopyram benzamide residues were below the limit of quantification. The residues were found below Limit of Quantification (<0.05 mg/kg) at 35th day after last spray of both the doses. Half life values (RL₅₀) were calculated to be 4.94 and 4.59 days, at respective doses. The initial deposits of tebuconazole on rose were 7.671 and 14.949 mg kg⁻¹ due to application of Luna Experience on rose flowers at the application rate of 100 and 200 g a.i./ha, respectively. The residues were found below limit of quantification at 21st day after last spraying. Half life values were calculated to be 3.62 and 3.39 days, at respective doses. Fluopyram, its metabolite fluopyram benzamide and tebuconazole residues were below limit of quantification in rose field soil in all the treatments (*Ento, Nauni*).

Lilium

- ❖ Eighteen diverse genotypes of lilium were evaluated for various growth and flowering parameters to assess the extent of variability, heritability, genetic divergence, stability for various traits and the morphological characterization of these genotypes. Katrain location outperformed Nauni location in performance of almost all the vegetative, flowering and bulb parameters except days taken for bulb sprout emergence. With regards to the performance of genotypes, 'Best Seller' performed well in case of earliness to flowering, 'Yelloween' with respect to plant height and stem length, 'Eyeliner' and 'Prato' produced maximum number of flower per plant. For good flower quality in terms of stem sturdiness and stem length grades, 'Eyeliner' 'Prato', 'Yelloween', 'Best Seller' and 'Brunello' performed well (*FLA, Nauni*).
- ❖ In fertigation studies in lilium, application of nitrogen @20g/m² in the form of Ca(NO₃)₂ +P and K at @ 20 g/m² in five equal split doses in the

form of fertigation at fortnightly intervals, along with NPK (19:19:19) @ 1 g/l applied as foliar spray (till droplet formation on the foliage) along with fertigation resulted in longest cut stems, maximum number of flowers per stem, maximum vase life and bulb weight (*FLA, Nauni*).

Ornamentals

- ❖ The potential of 15 selected native ornamental plants were assessed for various commercial uses as a novelty in floriculture industry. The different plants which can be utilized for various purposes are as (*FLA, Nauni*):
 - ♦ Topiary and Bonsai: *Pyracantha* and *Buxus* have been used for making topiaries.
 - ♦ Flower arrangements: Gloriosa flowers, Berries: *Pyracantha crenulata*; Cut green: *Polystichum squarrosus* were utilized for making flower arrangements.
 - ♦ Biofencing: *Buxus* and *Pyracantha* were planted at a close spacing as hedge plants and can be exploited commercially as biofencing material.
 - ♦ Potted Plants: *Pyracantha*, *Rhincostylis*, *Berginia*, *osbeckia*, *Roscoeia* and *polystichum* have been grown in pots for assessing their potential as commercial pot plants.

Dahlia

- ❖ The investigation was carried out to evaluate the dahlia cultivars on the basis of growth, flowering parameters and genetic variability revealed that 'S P Kamla' was found superior to the other cultivars, cv. 'Bada Kachari' was found suitable for earliness in flowering, whereas cv. 'Red Army' was found suitable for longer flower duration. Cv. 'Kenya Orange' had the maximum flower size, 'Lokeshwar' and 'S P Kamla' cultivars had maximum number of side shoots and cv. 'Anadinath' had maximum stem girth (*FLA, Nauni*). Suitable cultivars of dahlia for zone-1: Arthur Humbley, Bhikhu's Mother, Bhikhu's Red, Cooch Behar, Eternity, Giani Zail Singh, Kelvin, Kenya Dark Pink, Kenya Light Pink, Kenya Orange, Kenya Pink, Kenya White, Kenya Yellow, Maa Sharda, Piyushuna, Red Army, Romeo, SP Srimati (*RHR&TS Dhaulakuan*).



Arthur Humbley



Bhikhu's Mother



Kenya Pink



Giani Zail Singh



Kenya Yellow Orange



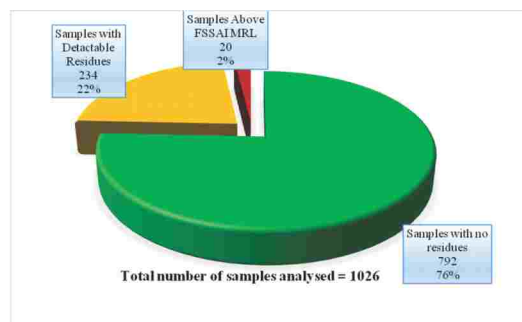
Maa Sharda

Mushroom

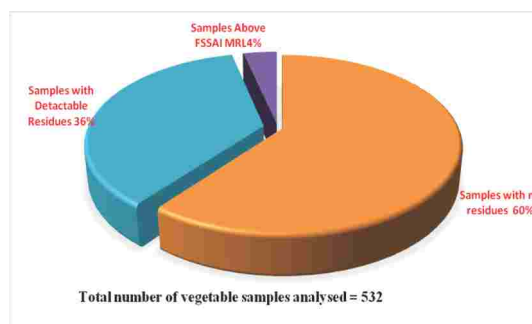
- ❖ Green mould disease of *Agaricus bisporus* caused by *Trichoderma* sp. was found to be prevalent with more than 20 per cent incidence in commercial mushroom units surveyed in districts Hamirpur, Kangra and Una of sub tropical zone of the state (CH&F, Neri).
- ❖ Combinations of leached sawdust with coconut coirpith (1:1v/v), 2 years old spent compost (1:v/v) and 2 years old farm yard manure (1:1 v/v) used as casing substrates for the cultivation of *Agaricus bisporus* led to significant increase in the mushroom yield in comparison to standard check i.e. a mixture of farmyard manure + loam soil (1:1 v/v) (CH&F, Neri).

Pesticide Reduces in fruits and vegetables

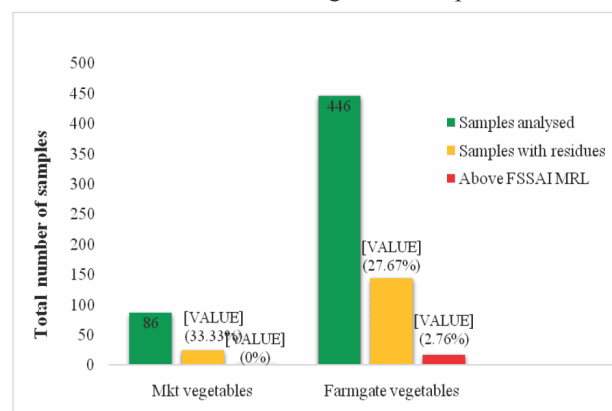
- ❖ In the year 2019-20, 1026 samples of different food commodities were analyzed. These samples, consisted of vegetables (532), mushrooms (60), fruits (278), tea (60), milk(36), red chilli powder (36) and water (24). 532 vegetable samples, 446 were collected from the farm gate, 204 (21.12%) samples were found to contain residues. Amongst the contaminated samples, 198 samples of vegetables were having residues, out of which 20 (3.76%) vegetable samples were having residues above FSSAI MRL (maximum residue limits), whereas, none of the fruit samples exceeded the limit. Nine samples of fruits, 23 of red chilli powder and 4 samples of tea were found contaminated (Ento, Nauni).



Monitoring of pesticide residues in food commodities



Monitoring of pesticide residues in vegetable samples



Monitoring of pesticide residues in market and farm gate vegetable samples

Value Addition

- ❖ Optimization of hybrid drying of apple through response surface methodology (RSM): The minimum range for ultrasonication treatment for hybrid drying of apple fruits with skin and thickness range of 3-5 mm were 10 minutes based on solid gain, water loss, microbial count and enzyme activity w.r.t sucrose concentration (30-70°B on pre-trials). The studies showed that after 50 minutes there was no solid gain and water loss observed. Hybrid drying in apple reduces the

total drying time by 38.0 per cent as compared to osmo-drying technology while the hybrid dried apple had more porous nature with lower shrinkage of 5.0 per cent as compared to osmo-dried samples that had 15.0 per cent shrinkage. Chemical evaluation of developed products showed that hybrid dried apple rings had moisture content of 21.80 per cent (db) as well as lower water activity (0.573) total soluble solids (35.13 OB), total sugars (40.25 %) and non-enzymatic browning (0.075) as compared to osmo-dried samples. Further, crude fibre, ascorbic acid, phenols and antioxidant content were found higher in the hybrid dried fruits (*FST, Nauni*).



Ultrasonicated osmo dried apple rings



Ultrasonicated osmo dried apple rings at 0, 6 and 12 months of storage

- ❖ Technology package for the development of various beverages from jamun: Hot pulping without crushing was optimized for the bulk extraction of jamun juice for development of value added products. Further, enzymatic method by using pectinase enzyme (0.08% for 90 min.) can also be used for the extraction of juice from wild jamun. Wild jamun drink can be developed by using 16.0 per cent juice, 12°B TSS and 0.30 per cent acidity; squash by using 35.0 per cent juice, 40° B TSS and 1.20 per cent acidity; appetizer by using 35.0 per cent juice, 45°B TSS and 1.20 per cent acidity along with spice extract and syrup by using 30.0 per cent juice, 65°B TSS and 1.50 per cent acidity (*FST, Nauni*).



Wild Jamun fruits



Jamun drink



Jamun squash



Jamun syrup

- ❖ Technology for production of bamboo shoot powder and dietary fibre and its application in food products: The protocols for production of

powder and dietary fibre from bamboos grown have been developed. The bamboo shoots were cut into thin slices. The fresh shoots contain hydrogen cyanide (HCN), a toxic substance which needs to be removed prior to use for edible purposes. The bamboo shoot slices were soaked in water for 24 hours. The slices are then boiled for 90 minutes, drained and allowed to cool down at room temperature. The bamboo shoot powder is prepared by grinding the slices in grinder after drying in a mechanical dehydrator at $60 \pm 2^\circ\text{C}$. The powder is sieved through a 36-mesh size sieve. The powder can be stored further use in polyethylene pouches with proper sealing. The dietary fibre was extracted by using enzymatic-gravimetric method and among different time and temperature combinations, the incubation at 100°C for 30 minutes in α -amylase, 45°C for 60 minutes in protease and 40°C for 4 hours in cellulase gave the maximum total dietary fibre yield (70.25 %), insoluble dietary fibre (63.41 %) and soluble dietary fibre (6.84 %) (*FST, Nauni*).



Bamboo shoot powder bamboo shoot dietary fibre

- ❖ The nutritional quality of different food products can be enhanced by the addition of dietary fibres in the food products. Among the different concentrations, dietary fibre extracted from bamboo shoots can be supplemented @ 8.0 per cent in cookies. Recipe I containing refined wheat flour 100 g, vegetable ghee 40 g, sugar powder 35 g, skim milk powder 10 g, salt 0.75 g, sodium bicarbonate 1 g and water 25 mL was selected as standard recipe for preparation of cookies. The cookies contained the maximum value for moisture (4.98 ± 0.06 %), water activity (0.451 ± 0.007), ash (1.62 ± 0.04 %), crude fat (22.91 ± 0.05 %) and total dietary fibre (4.75 ± 0.04 %). The cookies packed in PET jars can be stored for 90 days under ambient condition with maximum quality retention. The cost of production of cookies supplemented with bamboo shoot powder and bamboo shoot dietary fibre is Rs. 40.26 and 103.88/100g flour, respectively (*FST, Nauni*).

- ❖ Pasta was standardized by adding semolina 200 g and 95 ml water. The pasta was then supplemented with bamboo shoot powder and bamboo dietary fibre at the concentration of 92:8 and 92:8, respectively which possessed the maximum value for ash (1.75 ± 0.04 %), total dietary fibre (7.34 ± 0.03 %) and water holding capacity (1.602 ± 0.003 ml/g). The cost of production of pasta supplemented with bamboo shoot powder and bamboo shoot dietary fibre is Rs. 30 and 93/100g semolina, respectively (*FST, Nauni*).
- ❖ Extraction of apricot press cake protein isolate and its application for the development of protein enriched gluten free pasta: Apricot kernel press cake protein isolate had a water activity of 0.88, crude protein 90.15 per cent and soluble protein 14.65 per cent with minerals like potassium (615.00 mg/100g), magnesium (195.00 mg/100g) and calcium (180.00 mg/100g), iron (3.50 mg/100g), zinc (3.50 mg/100g), copper (0.95 mg/100g) and manganese (0.90 mg/100g) which can be utilized for supplementation in extruded and baked products (*FST, Nauni*).
- ❖ Gluten free pasta was prepared from rice with addition of apricot press cake protein isolate at different concentrations (2.5%, 5.0%, 7.5% and 10.0%). Maximum cooking loss was observed in rice pasta while, minimum cooking loss was observed in 5.0 % and 7.5 % protein enriched pasta. Gluten free protein enriched (7.5%) pasta had higher crude protein (12.10%), higher water solubility index (8.55%) and lesser cooking loss (4.30%) with higher mineral content (potassium 130.20 mg/100g, magnesium 30.65 mg/100g and calcium 23.75 mg/100g). The protein percentage in the standardized pasta increased from 2.5 to 10.0 per cent as compared to rice and semolina pasta (*FST, Nauni*).



Rice flour pasta

5% protein
enriched pasta7.5% protein
enriched pasta

- ❖ The standardized cow's milk of 1000 mL and 1.0 % citric acid solution was standardized for paneer preparation on the basis of highest sensory scores. The paneer was enriched with bamboo shoot powder and bamboo dietary fibre at a level of 100:2.5 and 100:2.5,

respectively. The paneer enriched with 2.5 per cent bamboo dietary fibre packed in LDPE pouches can be stored safely upto 10 days under refrigerated condition ($5^{\circ}\text{C} \pm 2$) with minimal changes. The cost of production of paneer supplemented with bamboo shoot powder and bamboo shoot dietary fibre is Rs. 330 and 600 Kg, respectively (*FST, Nauni*).

- ❖ Cow's milk of 1000 ml and 1.0 % yoghurt culture was awarded the highest sensory scores and was selected as standard formulation. The yoghurt was enriched with bamboo shoot powder and bamboo dietary fibre at a level of 100:1.0 and 100:1.0, respectively. The yoghurt enriched with 1.5 per cent bamboo dietary fibre recorded higher values for protein (3.40 %), titratable acidity (1.08 % lactic acid), pH (14.50) and lactose (1.91 %). The yoghurt enriched with 1.5 per cent bamboo dietary fibre packed in polystyrene cups can be stored safely up to 10 days under refrigerated condition ($5^{\circ}\text{C} \pm 2$) with minimal changes in quality. The cost of production of yoghurt supplemented with bamboo shoot powder and bamboo shoot dietary fibre is Rs. 20 and 32/100 ml milk, respectively (*FST, Nauni*).



Bamboo dietary fibre enriched cookies and pasta



Bamboo dietary fibre enriched paneer and yoghurt

- ❖ Technology for preparation and preservation of ripe persimmon pulp: The technology standardized for extraction of ripe persimmon pulp involves cold (10 % water) and hot (10 % water for 10 min cooking time) pulping methods. Pulp extracted by cold pulping method is preserved using KMS (2000 ppm) while pulp

obtained from hot pulping method is preserved using pasteurization + KMS (1000 ppm) for a period of 6 months. Pulp extracted by hot pulping method was used for the preparation of RTS beverage (12° Brix TSS, 15 % pulp and 0.3 % acidity). Further flavoured RTS beverage has been optimized by incorporating 2 per cent ginger extract and 3 per cent mint extract (*FST, Nauni*).



Ripe persimmon pulp extracted by cold and hot pulping method

- ❖ Out of 6 treatments of pulp preservation methods treatment involving pulp with pasteurization and addition of KMS in glass bottle was found to be the best with higher retention of β -carotene (78.94 %) and total phenols (79.13 %) during 6 months of storage under ambient condition (*FST, Nauni*).
- ❖ Flavoured RTS beverages from persimmon pulp: The RTS beverage prepared using hot pulp (12° TSS, Pulp 15 % and 0.3 % acidity) was selected for further preparation of flavoured RTS beverage. Among different ratios of flavouring extracts used, recipe G₂ (12 % pulp+3 % ginger extract) for ginger flavoured RTS beverage and recipe GM₃ (12 % pulp+2 % ginger+3 % mint extract) for ginger-mint flavoured RTS beverage were selected. Ascorbic acid and β -carotene of flavoured persimmon RTS beverage was 2.446 and 2.715 mg/100 g, 22 and 23 μ g/100 g, respectively in these recipes (*FST, Nauni*).



Flavoured persimmon RTS beverage

- ❖ Oat based apple pomace enriched bakery products: The enrichment of oat flour with apple pomace powder improves sensory, nutritional and functional food characteristics of bread, cake and biscuit. An acceptable and palatable oat based biscuit (30% apple pomace powder) combination of 70 per cent oat flour and 30 per cent apple pomace powder for biscuit and cake and 75 per cent oat flour and 25 per cent apple pomace powder for bread are optimum proportions. The prepared products retained higher amounts of functional constituents like fibre, ascorbic acid and total phenols resulting in high antioxidant activity. The apple pomace powder enriched biscuit and cake could be stored safely up to 90 and 30 days at ambient and refrigerated condition, respectively. However, the bread packed in polyethylene pouches remains palatable and microbiologically fit for 6 days at ambient and 15 days at refrigerated temperature condition. Therefore, oat flour along with apple pomace powder can successfully be utilized in bakery products like biscuit, cake and bread resulting in enhanced nutritional, functional and sensory characteristics (*FST, Nauni*).



Biscuit (100% oat flour) Oat based biscuit (30% apple pomace powder)



Bread (100% oat flour)

Bread (25% apple pomace Powder)



Cake (100% oat flour)

Cake (30% apple pomace powder)

- ❖ Utilization of apple pomace for the preparation of functional rolls: Functional fruit rolls prepared from the apple pomace slurry containing 10-15 per cent water/ juice, 25°B total soluble solids and 0.65 per cent titratable acidity are the best as per sensory and nutritional analysis. Overall acceptability sensory score and chemical analysis of the rolls developed in the study reveals that the product has better taste, palatability and nutritive value up to 6 months of storage (*FST, Nauni*).



With sugar With jaggery
Apple pomace functional functional rolls

- ❖ Optimization of process parameters for the development of *aloe vera*-mango soy flour fortified fruit bar: Among different combinations, 65.0 per cent aloe vera pulp and 35.0 per cent mango pulp with initial TSS of 30°B and 0.8 per cent acidity was optimized. 10 per cent full fat soy flour and 10 per cent defatted soy flour with 1.0 per acidity and 0.8 per cent pectin level were optimized as best formulations on the basis of overall sensory quality attributes (*FST, Nauni*).



Aloe vera mango bars with and without fortification
with soy flour

- ❖ Studies on development of *Aloe vera* fortified low calorie functional apple spread using Fructo-oligosaccharide: Formulation consisting of *Aloe vera* pulp (40%) and apple pulp (60%) with 60°B TSS, 0.5% acidity and 0.5% pectin was optimized. *Aloe vera* enhanced the spreadability, besides improving the nutritional (TP, AA and minerals) and sensory qualities. Further replacement of 100% sucrose with sweetos was achieved with 65% reduction in energy value (*FST, Nauni*).



Apple spread

- ❖ The method for preparation of instant guava powder from different varieties of guava viz; Lalit and Shweta by using foam mat drying technique was standardized. Guava pulp was converted into foam by whipping the pulp after addition of car boxy-methyl-cellulose (CMC) and glycerol-mono-stearate (GMS) @ 0-2% each and drying the resultant foam in dehydrator (60±5°C) to a constant moisture content. Drying of guava foam by using 2% GMS was found the most appropriate with respect to desired foaming properties (foam density, foam expansion and foam stability), physico-chemical and sensory characteristics. Fruit powder packed in aluminium and polyethylene pouches exhibited slight increase in moisture content and pH. The value after 90 days of storage of powder packed in polyethylene and aluminium pouches no microbial growth in any of the sample. However, product packed in aluminium pouches exhibited better retention of nutrients as compared to polyethylene pouches. Further, ready-to-serve beverage prepared by guava powder of different cultivars were found most acceptable on 9-point hedonic scale. Thus guava cultivars Lalit and Shweta guava can be utilized for preparation of self-stable powder using foam mat drying technique (*CH&F, Neri*).

- ❖ To standardize parameters for osmotic drying of guava fruit slices, two varieties were selected viz. Lalit and Shweta. Guava fruit slices with and without peel of different thickness (4mm, 6mm, 8mm) were pre-treated with potassium metabisulphite and calcium chloride with different concentration. After pre-treatment best combination of each variety was selected for osmotic dehydration. The slices of both varieties were immersed in sugar syrup till loss in moisture reaches at least 50% at room temperature. After osmosis the slices were spread on stainless steel trays in the drier for dehydration at temperature about 50-55°C till fruit reached constant moisture content. The dried guava slices were packed in aluminium pouches and stored at ambient temperature (*CH&F, Neri*).



- ❖ Standardized technology for extraction of papaya leaf juice using hot extract method with 20% water and further utilized juice for preparation of nectar in proportion of 70% mango pulp and 30% papaya juice. The complete process/methodology was developed for preparation of self-stable powder from papaya cultivar Madhu by using foam-mat drying technique (*CH&F, Neri*).
- ❖ Fruit arils of wild pomegranate fruits were pre-treated and subjected to different drying modes for the preparation of granular powder. Among different modes, granular powder (710 μm particle size) prepared from mechanical cabinet dried arils (60 \pm 2°C) was found the best which was packed in PEP (polyethylene pouches), ALP (aluminium laminated pouches), ALP with oxygen scavenger, ALP with oxygen and moisture scavenger, ALP with moisture scavenger and stored for 6 months under ambient as well as refrigerated temperature conditions with minimum changes (*FST, Nauni*).



- ❖ The different parts of wild pomegranate fruits such as arils, albedo, flavedo and pomace were dried by different drying modes. The selected portion of fruit (flavedo) containing highest phenolic antioxidants was dried by mechanical cabinet drier and dried flavedo was converted into powder form with the help of pulverizer and passed through 36 mesh sieve having particle size of 425 microns. Technology package has been developed for the extraction of phenolic antioxidants from wild pomegranate showed higher retention of phenolics and flavonoids in lyophilized flavedo extract than the oven dried extract and was selected for the extraction of phenolic antioxidants on a pilot scale. The maximum amount of phenolics and flavonoids as well as maximum antibacterial activity against *Staphylococcus aureus* and *E. coli* recorded in combination of ethanol and distilled water (60:40) lyophilized extract after 6 hours of extraction at 30°C by maceration method was selected as best method for the extraction of phenolic antioxidants on large scale (*FST, Nauni*).
- ❖ Among varying slice thickness (5-25mm), the ginger slice of 7.5 mm thickness was optimized on the basis of sensory scores and drying time for conducting the osmotic dehydration studies. The blanched ginger rhizome of 7.50 mm slice thickness was dipped in different solutions using plum pulp as a source of anthocyanin with two different sweetening agents i.e. sugar and honey (70°B) maintained at 50°C temperature in the ratio of 1:3, where an immersion time of 5.0 hours was standardized for anthocyanin enrich candy on the basis of equilibrium state of TSS between the slices and the osmotic solution while a dipping time of 7.0 hours has been optimized for ginger slices in dipped honey solution and 8.0 hours for slices in sugar syrup solution. Nutritionally, the ginger slices immersed in hypertonic solution containing plum pulp contained appreciable amount of anthocyanin content (16.33 \pm 0.53 to 18.64 \pm 0.63 mg/100g), antioxidant activity (50.45 \pm 0.53 to 52.35 \pm 0.60%), total phenols (9.84 \pm 0.25 to 13.08 \pm 0.28 mg/100g) and ascorbic acid (6.11 \pm 0.45 to 6.98 \pm 0.49 mg/100g) as against

sugar or honey solutions with antioxidant activity, total phenols and ascorbic acid in the range of 42.75 ± 0.51 to 44.25 ± 0.55 per cent, 7.56 ± 0.13 to 11.54 ± 0.12 mg/100g and 3.92 ± 0.35 to 5.32 ± 0.39 mg/100g respectively with no anthocyanin content (*FST, Nauni*).



Ginger candy



Anthocyanin enriched ginger candy

- ❖ Studies carried out to refine the technology for colouring and packing of dry flowers. The colour from plant parts of flowers like Rose, Achania, Balsam, Cosmos, Marigold, leaves of Jacaranda, rhizomes of curcuma, seeds of Bixa were extracted with acetone and water. Biocolours extracted with the help of acetone from rose petals, turmeric rhizome, marigold petals and roots of beet root were the best and were good for use even after 90 days of dyeing and used for making different value added products. The best results were obtained with the help of alum as mordant and sodium chloride, acetic acid and hydrochloric acid as dye assistants. Packing boxes (display purpose) of low cost and high cost for dry flower products were standardized (*FLA, Nauni*).



Flower arrangement

Dry flower doll
flower arrangement

Dry flower sticks



Floral rakhis



Key rings



Flower arrangement



Flower arrangement



Packaging boxes (High Cost)

Honey Bees/Bumble Bees

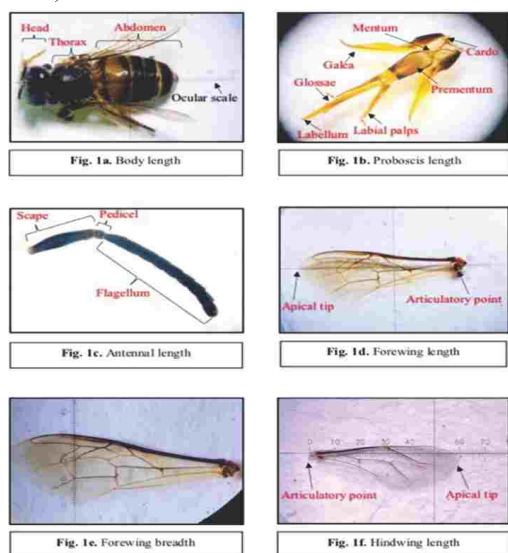
- ❖ Fifty *Apis mellifera* colonies were selected out of 600 colonies for further evaluation and multiplication. These colonies were further evaluated by working out selection indices on their performance such as colony development, economic traits and resistance traits. The remarkable difference was found in case of annual honey production, up to 53 kg in top performing colonies against the average of 20 kg in the apiary. Based on the various parameters, the five top performing colonies (colony number 29, 66, 68, 22 and 95B) have been selected for further evaluation and multiplication. So far, twenty-eight queens have been raised from best performing colonies for further evaluation and multiplication (*Ento, Nauni*).

Queen rearing:
grafted larva in the queen cup;Accepted queen
cells after grafting

- ❖ Eight varieties namely Gale Gala, Jeromine, Red Velox, Red Cap Valtod, Super Chief, Red Lum Gala, Scarlet Spur and Auvil Early Fuzi were studied for their flowering phenology and honey bee behaviour. Significant variations were observed in case of floral characters of different cultivars. Average activity of individual group of visitors did not vary significantly. However, with

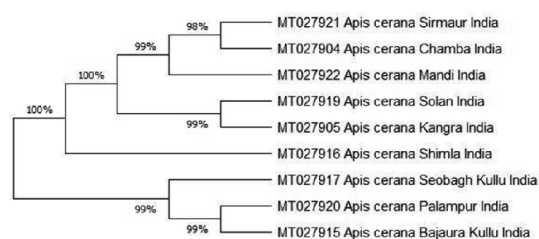
respect to varieties, maximum activity was recorded on Super Chief ($3.47 \text{ /m}^2\text{/min}$) and minimum on Scarlet Spur-II ($2.35\text{/m}^2\text{/min}$). Maximum fruit set was recorded in Auvil Early Fuzi (70.75%) and the lowest in case of Red Cap Veltod (49.99%) (*Ento, Nauni*).

- ❖ In newly introduced high density apple plantation at different distances showed that per cent the fruit set decreased with increase in distance from introduced *A. mellifera* colonies (67.29 % at 10 m, 58.20 % at 25 m, 51.23 % at 50 m, 48.56 % at 75 m and 100 m at 39.78 %). It is thus signified that two strong colonies are sufficient for pollinating 1 ha area of high density apple orchards (*Ento, Nauni*).
- ❖ Morphometric and molecular variability in *A. cerana* F. from different agro-climatic zones of Himachal Pradesh was studied. *A. cerana* workers collected from different agro-climatic zones of Himachal Pradesh were evaluated for their morphometric variability. Significant variations were observed in total body length (10.5-13.0 mm), proboscis length (5.26-5.73 mm), antennal length (4.17-4.39 mm), fore wing length x breadth ($8.62\text{-}8.95 \times 2.76\text{-}3.14 \text{ mm}$), hind wing length x breadth ($6.07\text{-}6.43 \times 1.66\text{-}1.85$) and number of hamuli (17.5-19.6) (*Ento, Nauni*).



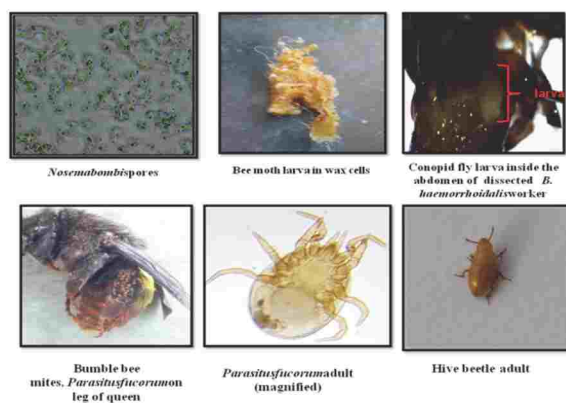
Morphological characters of *Apis cerana* species

These collected workers were further processed for DNA sequencing. The mitochondrial DNA (COI) confirmed the taxonomic identity, which was found close to that of *cerana* species.



Phylogenetic tree of isolates of *A. cerana* collected from different agro-climatic zones of Himachal Pradesh

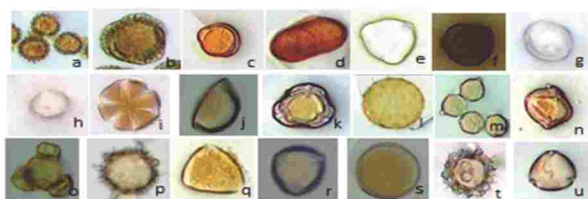
- ❖ Rearing of bumble bee, *Bombus haemorrhoidalis* under laboratory conditions was studied: The *Bombus haemorrhoidalis* queens were harvested from the field nests in the autumn season (September 2019 to February 2020) and were reared under laboratory conditions in artificial wooden and carton domiciles. Ten out of 55 queens developed brood showing possibility of rearing colonies from winter harvested queens. Disease is one of the major hindrances in *Bombus haemorrhoidalis* rearing. The spring collected queens were found infested with *Nosema* sp. Fantham & Porter (50 %), *Physocephala tibialis* Schiner (conopid fly) (18.75%), and *Aphomia sociella* Linnaeus (wax moth larvae) (12.50%) (*Ento, Nauni*).
- ❖ Thirty winter hibernated queens captured during spring (February and March, 2020) from the different flora i.e. *Brassica juncea* L. and *Adhatoda vesica*, are currently being reared in apiculture laboratory (*Ento, Nauni*).



Pests and diseases of *Bombus haemorrhoidalis*

- ❖ Early wax secretion and brood formation was recorded in the invertase fed *Bombus haemorrhoidalis* queens (*Ento, Nauni*).
- ❖ Standard reference pollen slides of 135 flowering plants of Nauni belonging to 49 families were prepared for identification, classification and

confirmation of bee flora. Size and shapes of pollen grains of plant species showed great variations. The shapes of pollen grains of these flowering plants were round, oval, triangular, long, rounded triangular, tri-lobed, boat shaped and pentagonal. Size of pollen grains of flowering plants of Nauni was recorded between $14.29 \pm 0.16 \mu\text{m}$ length, $12.34 \pm 0.25 \mu\text{m}$ breadth (Pepino, *Solanum muricatum*) and $144.86 \pm 1.05 \mu\text{m}$ (4 O'clock, *Mirabilis jalapa*) (Ento, Nauni).



Photomicrographs of pollen grains of some plant species of Nauni

a. *Zinnia elegans* b. *Peltophorum ferrugineum* c. *Moluccella aegis* d. *Justicia adhatoda* e. *Lupinus hartwegii* f. *Actinidia deliciosa* g. *Digitalis lanata* h. *Digitalis purpurea* i. *Salvia moorcroftiana* j. *Agapanthus umbellatus* k. *Capsicum annuum* l. *variegatum* m. *Solanum lycopersicum* n. *Solanum melongena* o. *Oenothera biennis* p. *Dahlia pinnata* q. *Clitoria ternatea* r. *Cassia sophera* s. *Martynia annua* t. *Dahlia imperialis* u. *Cassia fistula*

- ❖ The physico-chemical properties of honey of *A. mellifera* and *A. cerana* collected from different locations of Himachal Pradesh were in the standard range as per FSSAI standards for honey. All the honey samples from hive bees were found contaminated with different bacterial species viz., *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Salmonella typhi*, *Klebsiella pneumoniae* at different levels. The average bacterial load (log (cfu/g)) associated with the honey of different species was 3.74 for *A. cerana* and 3.63 for *A. Mellifera*. In case of *A. cerana* honey, the minimum inhibitory concentration for the honey extracts ranged from 156.5-750.0 $\mu\text{g/mL}$ for *Bacillus subtilis*, 162.5-703.12 $\mu\text{g/mL}$ for *Pseudomonas aeruginosa*, 156.5-703.12 $\mu\text{g/mL}$ for *Klebsiella pneumoniae*, 162.5-750.0 $\mu\text{g/mL}$ for *Salmonella typhi* and 78.0-750.0 $\mu\text{g/mL}$ for *Escherichia coli*, whereas, in the case of *A. mellifera* honey, minimum inhibitory concentration for the honey extracts varied from 162.5-750.0 $\mu\text{g/mL}$ for *B. subtilis*, 78.0-750.0 $\mu\text{g/mL}$ for *P. aeruginosa*, 156.5-1500 $\mu\text{g/mL}$ for *K. pneumoniae*, 162.5-703.12 $\mu\text{g/mL}$ for *S. typhi* and 41.0-375.0 $\mu\text{g/mL}$ for *E. coli* (Ento, Nauni).

- ❖ Analysis of physico-chemical properties of honey of wild bees (*A. dorsata* and *Apis florea*)

collected from different locations of North India revealed that all the honey samples had the physico-chemical properties in accordance with the FSSAI standards for honey. The honey samples were acidic in nature having pH below 5, moisture content less than 20 per cent. Fructose – Glucose ratio was below 1.5 and sucrose content was also less than 10.0 per cent. Microbiological studies revealed that the samples had average bacterial load of 3.63 log CFU/ml for *A. dorsata* and 3.74 log cfu/g for *A. florea* and no yeasts and moulds were found in honey samples. All the honey samples inhibited the growth of pathogens under study i.e. *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella typhi* and *Pseudomonas aeruginosa* and minimum zone of inhibition recorded was 4.00 mm and 6.50 mm for *A. dorsata* and *A. florea*, respectively. Whereas, maximum zone of inhibition was 45.00 mm and 31.00 mm for *A. dorsata* and *A. florea*, respectively (Ento, Nauni).

- ❖ Foraging behavior of honey bees and syrphid flies was studied on citrus and litchi. *Apis mellifera* had maximum foraging activity on citrus with mean activity of 6.3 foragers/2 minutes/ m^2 followed by *Apis cerana* and *Apis dorsata* with mean activity of 3.2 and 1.3 foragers/2 minutes/ m^2 . Whereas, in litchi maximum foraging activity was of *A. mellifera* with mean activity of 9.2 foragers / panicle / 5 minutes which was followed by *Episyrphus balteatus* and *A. cerana* with mean activity of 6.4 and 6.2 foragers/panicle/5 minutes (RHR&TS Jachh).



Syrphid flies on litchi and citrus



Apis mellifera on litchi and citrus



Apis cerana on litchi and citrus

FORESTRY

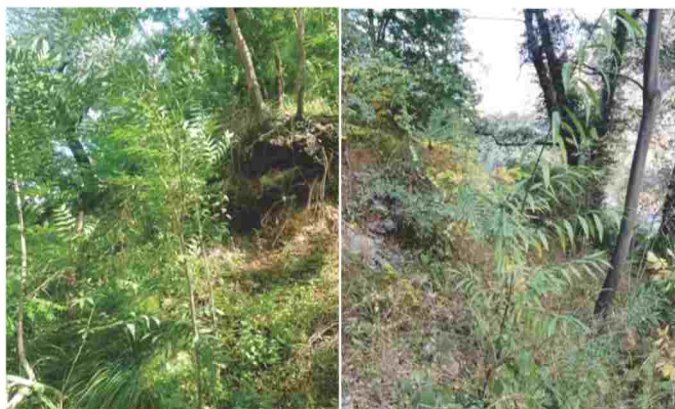
Willows (*Salix* spp.)

- ❖ Indian willow (*Salix tetrasperma*) genotypes from 20 sites from North India included Uttarakhand, Himachal Pradesh, Punjab and Jammu and Kashmir states and one site from Rajasthan, were collected and evaluated for growth leaf and biomass traits in common garden test at Nauni and recorded significant differences for morphological, leaf and biomass traits. Regression analysis depicts that most of the characters were influenced by altitude of the collection site (*TIGR, Nauni*).
- ❖ Molecular studies with ISSR showed 4 groups and genepools, while SSR studies showed three groups and gene pool. Observed heterozygosity was recorded more than expected confirming the out crossing nature of the species (*TIGR, Nauni*).



DUS testing trial and screening of willow clones and genotypes

- ❖ Morphological data was recorded for developing plant descriptors of Willow clones, planted for further genetic stability in field Testing Trials raised to identify stable clones for different land situations in Bharmour area. Maximum height observed with N2-1140 (825 cm) at the age of 4 years followed by J-799 (640cm) and SI-63-007 (628 cm) (*TIGR, Nauni*).



Growth performance of different clones

Beul (*Grewia optiva*)

- ❖ Variation in morphological characteristics among 15 populations of superior and selected trees of *Grewia optiva* were studied in three districts of Himachal Pradesh. Statistical significant variations were observed in plant growth, leaf, fruits/ seeds characteristics. Kothi Kunal, Jajjar and Lamlehri proved the best sources on the basis of natural phenotypical observations. Maximum leaf length (15.87 cm), maximum leaf width (9.88 cm), maximum leaf area (123.49 cm²), maximum fresh weight of 100 leaves (163.78 g), maximum plant height (9.54 m), maximum plant primary branches angle (94.17°) and maximum dry weight of 100 fruits (15.44 g), found in the study conducted (*TIGR, Nauni*).



Identified best and superior trees of *Grewia optiva*

- ❖ On the basis of the scoring index of the morphological and fodder quality parameters under biological screening of *Grewia optiva* HA-3, HA-2, SO-10 showed good growth performances in the field experimental trial laid out at spacing of 1x1 meter (27 genotypes), 2x2 meter (31 genotypes) and 3x3 meter (7 genotypes) in three replications from the best families identified from the Seedling Seed Orchard raised in the demonstration model trial of *Grewia optiva* (*TIGR, Nauni*).



Demonstration model of *Grewia optiva*

- ❖ During Rabi season application of FYM @ 200 Qtl ha⁻¹ in *Grewia optiva* based agroforestry system gave garlic yield of 10.00 t ha⁻¹, which is 5.37 per cent higher over the control. Garlic gave

significantly higher yield (11.46 t ha^{-1}) under sole cropping which is 12 per cent higher over the yield under *Grewia optiva* based AFS ($8\text{m} \times 1 \text{ m}$ spacing; $1250 \text{ plant ha}^{-1}$). French bean grown during rainy season gave a maximum yield of 64.36 t ha^{-1} when supplied with 100 Qtl/ha^{-1} poultry manure, which is 33.86 per cent higher over the control (no application). French bean gave a significantly higher yield of 66.73 t ha^{-1} under the sole cropping, which is 32.71 per cent higher over the yield of French bean under *Grewia optiva* based AFS ($8 \text{ m} \times 3 \text{ m}$ spacing; $416 \text{ plants ha}^{-1}$). Cropping system of Garlic-French bean in *Grewia optiva* based AFS ($8 \text{ m} \times 1 \text{ m}$ spacing; $1250 \text{ plants ha}^{-1}$) gave maximum returns of $1.85 \text{ lakh ha}^{-1}$ (SAF, Nauni).

- ❖ In *Grewia optiva* based Agroforestry System (AFS), maximum yield ($15.17 \text{ tones ha}^{-1}$) of Broccoli recorded in the plant supplied with recommended Doses of Fertiliser (RDF), which remained statistically identical to Jeevamrut ($14.15 \text{ tones ha}^{-1}$), only. Plants raised with *Morus alba* canopy produced maximum yield ($14.03 \text{ tones ha}^{-1}$), which found to be significantly higher than plants raised under *Grewia* ($9.42 \text{ tones ha}^{-1}$) and open conditions ($10.46 \text{ tones ha}^{-1}$). Maximum returns (Rs $2,09,916 \text{ ha}^{-1}$) from Broccoli were received when planted under the *Morus alba* based AF system. In the fertilizer application, maximum returns (Rs. $2,40,930 \text{ ha}^{-1}$) received when Broccoli plants supplied with RDF (SAF, Nauni).



Grewia optiva intercropped with Broccoli (at the time of transplanting)

- ❖ Maximum total yield (leaf + stem) ($1.722 \text{ tonnes ha}^{-1}$) and net returns (Rs. $71,395 \text{ ha}^{-1}$) of *Eclipta prostrata* (Bhringraj) were obtained when raised in *Grewia optiva* based system at $9\text{m} \times 3\text{m}$ spacing and supplied with the fertilizers in the form of 50 per cent NPK of the recommended doses + 25 per cent FYM (SAF, Nauni).



Intercropping under *Grewia* based Silvi-medicinal System (*Grewia optiva*) with *Eclipta prostrata* L.

Kachnar (*Bauhinia variegata*)

- ❖ Plant material of 10 genotypes involving 6 female ($P_3, P_8, P_{16}, P_{24}, P_{27}$ and P_{32}) and 4 male (P_{12}, P_{13}, P_{14} and P_{17}) were taken from the already raised progeny trial of the species and control crossed using Line x Tester (6×4 factorial) mating design. Seedlings of control crosses were raised in the nursery in RBD and were evaluated for morphological and growth characters. Per cent successful cross was highest in $P_{32} \times P_{17}$ (62.50 %) and minimum in $P_8 \times P_{13}$ (13.33 %) (TIGR, Nauni).

Seabuckthorn (*Hippophae rhamnoides*)

- ❖ Identification of six useful grouping characters, namely., Plant : sex, Plant : growth type, Plant: attitude of mature branches, Shoot: number of thorns (from middle part to top), Fruit: shape and Fruit: colour of skin done which includes 04 vegetative stage, 02 at reproductive stage (TIGR, Nauni).



Natural population of Seabuckthorn in Spiti Valley from where vegetative propagules obtained for DUS field testing at farm -Tabo

Bamboos (*Dendrocalamus strictus*)

- ❖ Rhizome cuttings with four buds planted just below soil surface gave more than 58.33 per cent success. Rainy season was found to be the best season for vegetative propagation of Chinese bamboo (TIGR, Nauni).



Bamboo cultivation and plantation in the experimental sites

Pinus (*Pinus* spp.)

- ❖ Maximum mean value bole biomass (151.31 t ha) was observed in family code 10, branch biomass (23.34 t ha⁻¹) in family code 17, twig biomass (7.50 t ha⁻¹) in family code 5 and foliage biomass (7.33 t ha⁻¹) in family code 7. Overall family code 17 (Rakni P2) was found best performing family on the basis of biomass and productivity traits in *Pinus roxburghii* (TIGR, Nauni).



- ❖ A case study Chilgoza (*Pinus gerardiana*) in District Kinnaur of Himachal Pradesh concluded that total cost of production of Chilgoza for the year 2018 was Rs.5,779.48 and net revenue was Rs.27,883.69 per household. The main factors identified for degradation of chilgoza forest were excessive lopping of branches, introduction of developmental projects, less snowfall and deforestation (SS, Nauni).
- ❖ A mixture of bacterial enzymes (cellulase: xylanase) produced from selected bacteria were used for enzymatic hydrolysis of pine needles biomass. Process parameters were optimized by using one factor at a time approach for enhanced hydrolysis of biomass and to get maximum of reducing sugars. Different process parameters were optimized by using one factor at a time approach (OFAT) viz. (i) irradiation dose, incubation period, enzyme dose, enzyme ratio followed by Response Surface Methodology. After the optimization of process parameters a

appreciable increase was observed in reducing sugars (BS, Nauni).



Selected potential hyper hydrolytic enzymes producing bacterial strains

Sheesham (*Dalbergia sissoo*)

- ❖ The conjoint application of chemical fertilizers with selected rhizobial isolates significantly increased the growth parameters of *Dalbergia sissoo* over uninoculated control. The maximum shoot length (49.3 cm), number of leaves (88), leaf area (21.3cm²), collar diameter (4.2 mm) and shoot dry weight (5.27g) were recorded with treatment PGPR1 + PGPR which was significantly superior than all other treatments. However this treatment was statistically at par with PGPR1 + 40% N. The minimum shoot length (25.2cm), number of leaves (72), leaf area (10.2cm²), collar diameter (2.6 mm) and shoot dry weight (3.04 g) were recorded with treatment uninoculated control (BS, Nauni).



T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉	T ₁₀
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Effect of rhizobial inoculation along with N fertilizer on *Dalbergia sissoo* seedlings

Albizia (*Albizia procera*)

- ❖ Effect of rhizobial inoculation alone and in combination with different dose of nitrogen for improvement of *albizia procera* seedlings under net house condition was studied. Selected rhizobial isolates BA2 and FA6 exhibited maximum PGP traits viz., P-solubilization, siderophore, IAA production, HCN production and antagonistic activities in tendom therefore selected for studying their effect on growth parameters of *Albizia procera* seedlings under net house conditions. The combined application

of chemical fertilizers with rhizobial isolates significantly increased the growth of *Albizia procera* over uninoculated control (BS, Nauni).



T1=Control, T2=PGPR1, T3=PGPR2, T4= 20kg/ha Nitrogen, T5= 40kg/ha Nitrogen, T6= 60kg/ha Nitrogen, T7= PGPR1+20kg/ha Nitrogen, T8= PGPR1+40kg/ha Nitrogen, T9= PGPR1+60kg/ha Nitrogen, T10= PGPR2+20kg/ha Nitrogen, T11= PGPR2+40kg/ha Nitrogen, T12= PGPR2+60kg/ha Nitrogen

Effect of rhizobia inoculation T7 with BA2 (Accession No. MK643828.1) along with N fertilizer on *A. procera*

Poplar (*Populus* spp.)

- ❖ Maximum yield of (20.11 t ha⁻¹) of turmeric was obtained when supplied with 75 per cent of recommended doses of natural fertilizer + 25 per cent of recommended doses of nitrogen, which is 194 per cent higher over control (no application). The curcumin content under this treatment were 3.95 per cent in comparison to 2.23 per cent under control (no fertilizer application). Planting of turmeric under poplar based AFS (6 × 4 sq. m.) depressed the turmeric yield by 9 per cent. However, this decrease in the yield were duly compensated by an increase in the curcumin content. Planting under poplar (4 × 4 sq. m.) gave markedly higher curcumin content (3.50%) than sole cropping (2.92 %). Maximum net returns (Rs. 2.46 lakh ha⁻¹) of turmeric in poplar based AFS obtained in 6 × 4 sq. m spacing. Among the nutrient sources, turmeric plants supplied with 75 per cent of RDNF + 25 per cent RDN through FYM exhibited maximum net returns (Rs. 3.90 lakh ha⁻¹) (SAF, Nauni).



Intercropping of turmeric with poplar

Soapnut (*Sapindus mukorossi*)

- ❖ Maximum height (282 cm) was observed in Banjar seed source followed by 139 cm in Grasa seed source in field condition at the age of four years in Soapnut field trial established at Shilly (TIGR, Nauni).



Performances of Soapnut

Wild pomegranate (*Punica granatum*)

- ❖ Basantpur seed source of wild pomegranate attained maximum fruit weight (53.29 g) as compared to Aut (16.22 g) and Mohal (16.02 g), respectively (TIGR, Nauni).

Kaphal (*Myrica esculanta*)

- ❖ Kaphal collection from Shogi yield fruits having maximum fruit breadth (10.87 cm) and fruit breadth (9.06 cm) as compared to collection from Shimla, Sirmour and Solan, respectively (TIGR, Nauni).

Ginkgo (*Ginkgo biloba*)

- ❖ Only 13.30 per cent survival was observed after one year of its planting from cuttings from two years old shoot of *Ginkgo biloba* (Ginkgo) during the month of January (TIGR, Nauni).

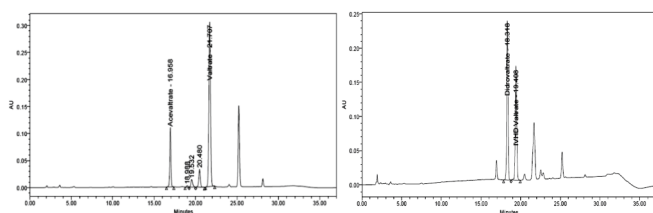


Performance of *Ginkgo biloba*

Medicinal and Aromatic Plants

- ❖ In Indian Valerian (*Valeriana jatamansi*), phytochemical evaluation of different

morphotypes during 3rd consecutive growing season through HPLC revealed wide variability in valtrate, acevaltrate, didrovaltrate & IVHD valtrate content in rhizomes and roots. The total valepotriates ranged from 1.666% to 4.852 % in roots, 2.028% to 5.134% in rhizomes, 1.907% to 4.164% in rootstock of different morphotypes. In rhizomes, the valtrate ranged from 0.791% to 2.384%, ace-valtrate from 0.037% to 0.434%, didro-valtrate from 0.039% to 2.088% and IVHD-valtrate from 0.221% to 1.541%. In roots, the valtrate varied from 1.023% to 3.712%, ace-valtrate from 0.044% to 0.531%, didro-valtrate from 0.033% to 0.259% and IVHD-valtrate from 0.143% to 0.567%. The morphotype D/B/15 consistently performed better (during 2017, 2018 & 2019 growing seasons) in terms of didrovaltrate content (2.08%) and total monoene type valepotriates content (2.57%) in rhizomes (FP, Nauni).



HPLC chromatograms showing different components of valepotriates

- ❖ The different morphotypes of Indian Valerian were morphologically and phenologically evaluated for 3rd consecutive growing season. The distinct morphological features (plant habit, lamina shape, leaf tip and base, leaf margin, leaf profile etc.) of identified morphotypes were found stable except leaf base. Majority of morphotypes flowered during January to February. The morphotype U/F/47 consistently performed stable (during 2017, 2018 & 2019 growing season) in terms of flowering initiation



Early flowering in U/F/47 morphotype (right) in comparison to other morphotypes

(very early flowering in December) and longest flowering duration (147 days). The morphotype U/F/47 is suitable for registration with NBPGR as a unique germplasm in terms of very early flowering type and longer flowering germplasm duration (FP, Nauni).

- ❖ In Glory Lily (*Gloriosa superba*), studies conducted on enhancing seed yield by pollination management for 2nd year revealed that assisted pollination performed much better in terms of fruit set (80%), number of seeds per pod (43), pod length (6.09cm), pod diameter (1.81cm) and 100 dry seed weight (2.527g) as compared to other methods (FP, Nauni).



- ❖ The evaluation of promising germplasms of Jeevak (*Malaxis acuminata*) consecutively for 2nd growing season revealed that Solan Selection germplasm (INGR 18043) performed much better as compared to others with regard to economic yield of 17.96 g/plant (fresh yield of rhizome + pseudobulbs) (FP, Nauni).
- ❖ *Malaxis acuminata* can be successfully propagated by splitting of rhizomes into nodal segments in addition to propagation by whole rhizome and pseudobulbs. However, the basal part of rhizome and whole rhizomes produced plants having maximum growth and yield. Further the size of propagule had pronounced effect on growth and yield parameters and large sized propagules produced plants with highest growth and yield. The pseudobulbs planted at 5 x 10 cm and 10 x 10 cm spacing recorded maximum growth and yield parameters (FP, Nauni).
- ❖ Studies conducted on effect of plant spacings and harvesting schedules on growth and yield of *Stevia rebaudiana* revealed that all the growth and yield parameters were found maximum by planting at 45 x 30 cm spacings (FP, Nauni).
- ❖ Maximum growth and yield of *Stevia repudiana* was recorded by planting at 45 x 30 cm spacing (FP, Nauni).

Wood Science and Technology

- ❖ All the physico-chemical properties viz. specific gravity, extractive yield, lignin content and holocellulose content improved with thermal modification of wood of *Pinus roxburghii* 200°C for 6 hours (FP, Nauni).
- ❖ Bio-preservation of *Pinus roxburghii* wood specific gravity of *Pinus roxburghii* treated wood improved by the application of 0.25% of *Acorus calamus* L. extract. The maximum inhibition (56.37%) of growth of white rot fungi (*Trametes versicolor*) was observed in *Parthenium hysterophorus* L. treated samples (FP, Nauni).



White rot inhibition in plant extract treated sample

Resin Tapping

- ❖ Borehole drilling at height of 150 cm in *Pinus roxburghii* showed the maximum oleoresin yield (3900.89 g/season) (FP, Nauni).



Standardization of Borehole height in chir pine

Herbal Garden

- ❖ RET species viz. *Atropa belladonna* L. *Curculigo Orchioides* Gaertn., *Trillidium govanianum* Wall. ex Royle (Kunth), *Saussurea costus* (Falc.) Lipsch. *Colchicum luteum* Baker, *Ginkgo biloba* L., *Zanthoxylum alatum* DC. and *Berberis aristata* DC. were collected from different locations of Himachal Pradesh, multiplied and are being conserved in the Botanical Garden (FP, Nauni).
- ❖ New species of ferns viz. *Cyrtomium caryotideum* (Wall. ex Hook. & Grev.) Presl,

Dryopteris marginata (L.) A. Gray, *Polystichum squarosum* (D. Don), *Diplazium esculentum* (Retz.) Sw., *Pteris vittata* L. and some of the other economically important species i.e. *Myrica nagi* Thunb, *Mesua ferrea* L., *Spondia spinnata* (L.f.) Kurz, and *Oroxylum indicum* (L.) Benth, ex Kurz were introduced in Botanical Garden (FP, Nauni).



Atropa belladonna



Curculigo orchioides



Trillidium govanianum



Myrica nagi



Dactylorhiza hatagirea



Diplazium esculentum



Cyrtomium caryotideum



Mesua ferrea

Herbarium

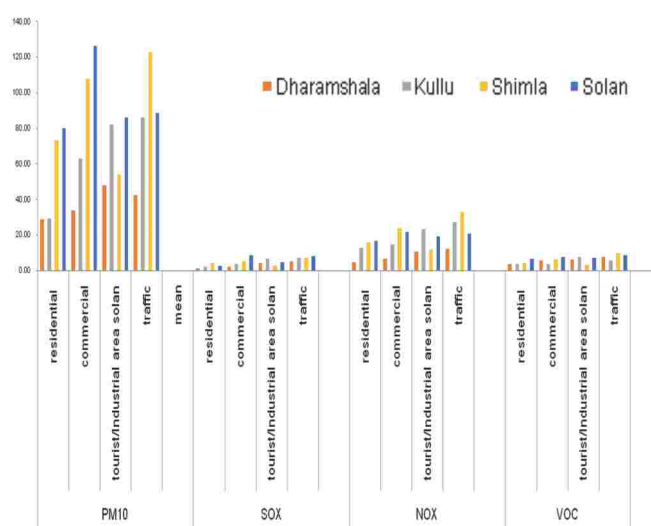
- ❖ A total of 104 plant samples submitted by different researchers from various Colleges/Institutes/Universities were identified. New herbarium sheets (52 no.) of different plant species collected from different regions of Himachal Pradesh were prepared and preserved in herbarium (FP, Nauni).

Miscellaneous

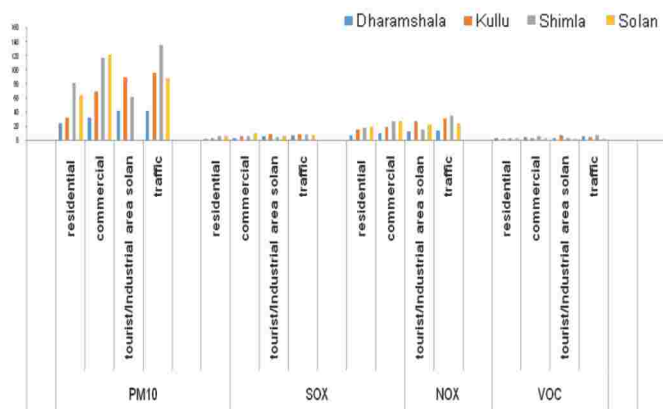
- ❖ Out of 23 isolates on the basis of zone of hydrolysis two (2) isolates were selected as elite plastic degrader's viz., PDBH1 and PDBM 2. Both the isolates were tested for Low Density Polyethylene strips degradation and found that after incubation period of 45 days at 37°C PDBH1 degraded the strip by 50 per cent whereas PDBM2 degraded the strip by 41.7 per cent (*BS, Nauni*).
- ❖ Agri-silviculture in the sub-montane and subtropical Zone-I (365-914 m asl) displayed the maximum value of Shanon-weinner diversity index (2.91). Whereas, in the mid-hill sub-humid Zone-II (915-1523 m asl) (3.15) and High hills Temperate Dry Zone-III (1524-3656 m asl) (2.26), Agri-Silviculture displayed maximum biodiversity conservation. Total carbon storage of different land uses across Himachal Pradesh indicates that different agroforestry systems viz., Agri-Silviculture, Agri-Horticulture, and Agri-Silvi-Horticulture stored markedly higher carbon storage in them than sole cropping system of Agriculture. In climatic Zone-I & II, maximum carbon storage potential displayed by the agri-silvi-horticulture. In the climatic zone, III agri-horticulture systems displayed maximum carbon storage potential (102.87 t ha⁻¹). In the High hill, Temperate Dry zone-IV (115 t ha⁻¹) Agri-Silviculture and Agri-Silvi-horticulture displayed almost equal carbon storage potential (*SAF, Nauni*).
- ❖ On the basis of recorded weather data short term/weather forecasting was done twice a week and accordingly agro-met advisory service bulletins were prepared and disseminated through SMS service, newspapers, Kisan Portal, AIR and TV for the benefit of ultimate users (*EVS, Nauni*).
- ❖ Parthenium Eradication Campaign was organized as a component of Swachh Bharat Abhiyan in the University on 23rd August, 2019 and World Environment Day on 4th June, 2019 (*EVS, Nauni*).
- ❖ The Solar energy potential of the southern aspect of the study area was calculated using ArcGIS software. The potential was found in the range of 8000.01-35764 MW, 100000.01-353055.94

MW, 50000.01-412809.12 MW and 177681.90-428709.3 MW in Hamirpur, Kullu, Shimla and Kinnaur district respectively (*EVS, Nauni*).

- ❖ The power generation of solid waste generated from different households was found to be 149.13, 207.86 and 695.5 KW for Solan, Dharamshala and Shimla town of Himachal Pradesh (*EVS, Nauni*).
- ❖ In major urban areas of Himachal Pradesh, the concentration of gaseous pollutants like NO_x, SO₂, VOC was found within the permissible limits except particulate matter which was found in undesirable concentration in Shimla (135.33 µg/m³) and Solan (126.28 µg/m³) towns. The season of the year was also found to influence the ambient air quality. The PM₁₀ concentration was higher in traffic and commercial areas in Shimla (135.33 µg/m³) and Solan (126.28 µg/m³) towns during post monsoon season in comparison to pre monsoon season that had values of 122.72 µg/m³ and 119.70 µg/m³ at traffic and commercial areas, respectively. However, the concentration of particulates matter was found within the permissible limits at all the locations in Dharamshala (40.99 µg/m³) and Kullu (94.46 µg/m³) towns during both the seasons. The study revealed that in major urban areas particulate matter (PM₁₀) had become a major pollutant especially in areas of high activity (*EVS, Nauni*).



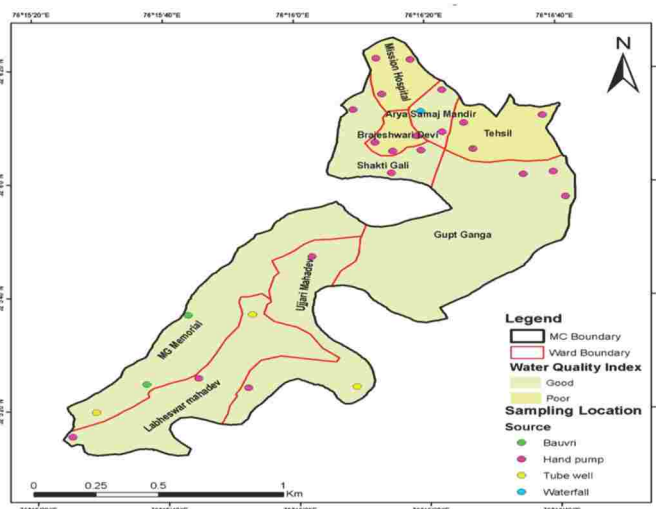
Concentration of particulate matter and gaseous pollutants (µg/m³) in pre monsoon



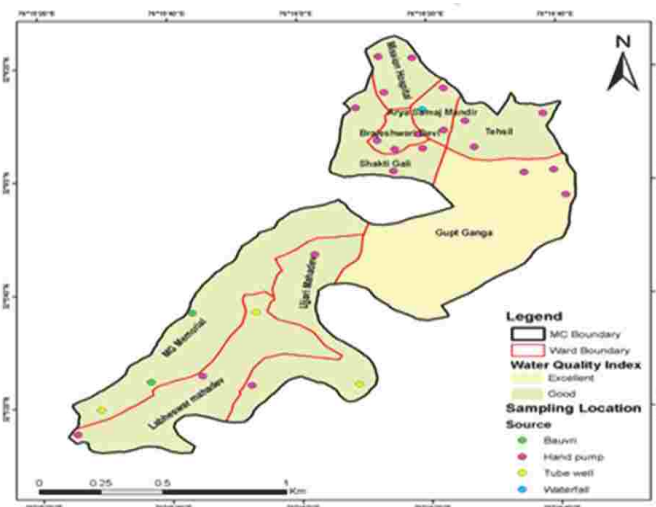
Concentration of particulate matter and gaseous pollutants ($\mu\text{g}/\text{m}^3$) in post monsoon

- ❖ The Solan town of Himachal Pradesh generated 18 tonnes of urban solid waste per day with a rate of 0.46 kg/capita/day during the USW year 2018-2019. Out of total waste generated in the town 79.8 % was biodegradable whereas, 20.2 % was non-biodegradable in nature. The USW of town contained a high percentage of organic fractions (57.7%) with permissible elemental composition. However, the organic fraction constituted the major source of greenhouse gas emissions at dumping sites. The waste of Solan town was alkaline in nature with total NPK content of 0.71, 0.04 and 0.29 %, respectively. The organic carbon of the waste was 37.38 % with C: N ratio of 53.07. The concentration of toxic elements was within the permissible limits and hence considered suitable for bio-recycling through composting. Bio recycling of biodegradable waste with cow dung and earthworms produced compost with high NPK content as compared to other treatments. The conjoint use of 75% recommended dose of NPK and USW compost produced the highest yield and indicated a saving of inorganic fertilizers to the tune of 25% in one of the commercial tomato and pea crop of the region. The USW was also considered suitable for energy generation as its calorific value was greater than 2,000 kcal/kg required for energy generation (EVS, Nauni).
- ❖ The water quality index WQI of ground water of Kangra town calculated by considering various physical, chemical and biological parameters was found to vary with seasons. During pre and post monsoon WQI varied poor to good and good to

excellent, respectively. During pre-monsoon the areas like Tehsil Brijeshwari temple and Arya Samaj Mandir and Mission hospital in the town has exhibited poor WQI (EVS, Nauni).



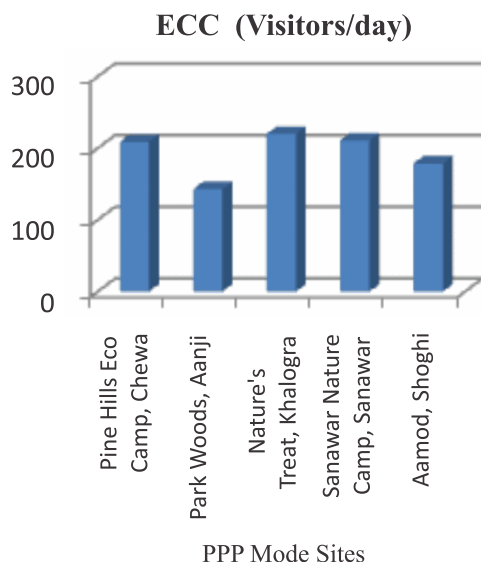
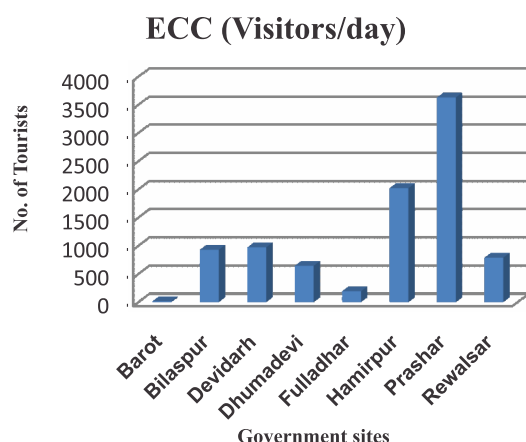
Geo-spatial mapping of WQI of Kangra town ground water during pre-monsoon



Geo-spatial mapping of WQI of Kangra town ground water during post-monsoon

- ❖ The energy potential of USW of major towns of HP ranged from 2347 to 3870 Kcal kg⁻¹ and was in the order of Dharamshala > Shimla > Hamirpur > Palampur > Solan. The total methane emission potential of urban solid waste generated in major cities of HP was highest of 1.40 Gg which of CO₂ equivalent 29.30 per annum in Shimla followed by Dharamshala town (0.37 Gg per annum which was equivalent to 7.85 Gg CO₂ at source level). Whereas it was minimum at Solan (0.33Gg which of CO₂ equivalent 6.85 per annum) (EVS, Nauni).

❖ The assessment of carrying capacity and sustainability of ecotourism activities in HP indicated that, with the current rate of tourists, the carrying capacity of the sites may exhaust in the times to come because of limitations of water availability, increasing visitor frequency, increased energy consumption and incompatible infrastructure with the ecosystem. The sites were assessed for sustainability on the basis of key sustainable tourism indicators. Sustainability score ranged between 24-38 for different departmental run sites. In the State the Prashar and Barot ecotourism site was found to be most and least sustainable, respectively. Higher sustainability and carrying capacity of certain sites can be attributed to the greener alternatives, availability and better utilization of available resources, harmony with nature and community participation (*EVS, Nauni*).



Carrying capacity comparison of different ecotourism sites

❖ The water quality index and Heavy metal pollution index of surface water of Sirsa river was found to range from poor to very poor, whereas, the metal index was seriously affected and was in class III-VI category, indicating thereby that it requires proper treatment before use for irrigation and industrial purpose, however it was unfit for drinking purpose (*EVS, Nauni*).

❖ The study showed that all of the total respondents (100.00%) consume the mushroom pickle, 59.00% respondents use the readymade pickle from market. Pachranga brand (40.00%), 48.00% respondents buy the 250 gms packaging, 50.00 (%) respondents use 1 bottle per month, 54.00 (%) respondents use chapatti as a complimentary food with mushroom pickle, Check quality parameter (55.00%) and (64.00%) check the manufacturing and expiry date (*BM, Nauni*).

❖ It was found from the study that most of the respondents were young and well educated. The study further revealed that respondents were highly aware of the options like Bank savings, Insurance policies and Post office schemes but barely aware of options like Debentures/Bonds and Equity shares. Respondents finds Agents and advisors most useful source of information regarding various investment options. It was also found in the study that most people only saved 10%-25% from their monthly income. The study concluded that majority of the respondents preferred to save and invest their money in bank savings and post office schemes (*BM, Nauni*).

❖ Women make essential contributions to agriculture and rural economic activities in all developing countries. Even though women contribute 60 to 80% of the labour in agriculture and animal husbandry, their involvement in selection of suitable crops and adoption of innovative and good management practices is very low. The study reported that sampled women respondents have shown participation in all the selected agriculture and livestock activities excluding marketing and financial management. The study put forth that very less households witness female participation in agriculture and livestock activities related decision making. Some of the important reasons for their subdued role in decision making in agricultural production

could be lack of awareness about new opportunities and modern technologies, inadequate facilities for training and capacity building and poor access to extension workers for consultation whenever needed (*BM, Nauni*).

- ❖ Agri-export is the most unexplored sector for increasing income of farmer leading to decline in suicidal rate of farmer and removing poverty from India. Secondary data has been extracted from APEDA's official site. 28 years of data has

been divided into 3 sup-periods and its mean has been used for analysis. Commodities like basmati rice, buffalo meat and fresh onions have shown increment while commodities like nonbasmati rice, walnut, pulses, and wheat have shown decrement. Government need to address certain important measures so that farmers can get good price for their produce by increasing export of their commodities (*BM, Nauni*).



Externally Funded Research Projects Sanctioned w.e.f.01.04.2019 to 31.03.2020

Sr. No.	Title of the project	Principal Investigator	Funding Agency
Horticulture			
1.	Assessment of climate change and its relationship with incidence of dengue vector borne diseases in non-endemic state of Himachal Pradesh	Dr VK Rana	Department of Science & Technology, New Delhi
2.	Resistance management in Bt transgenic crops: Role of gut microflora in <i>Helicoverpa armigera</i> n potentiation and /or detoxification of endotoxin proteins of <i>Bacillus turlingensis</i>	Dr Rakesh Kumar	Department of Science & Technology, New Delhi
3.	Strengthening of diagnostic facilities and infrastructure for establishment of clean plant stock and production of apple for distribution to farmers	Dr Usha Sharma	RKVY-RAFATAR, Directorate of Agriculture, Shimla
4.	Establishment of Hi-Tech nursery to boost production of fruits in subtropical areas of Himachal Pradesh	Dr Sanjeev Kumar Banyal	RKVY-RAFATAR, Directorate of Agriculture, Shimla
5.	Rejuvenation and management of senile apple orchards for sustainable fruit production in Himachal Pradesh HI-206-04	Dr Ranjana Sharma	Department of Science & Technology, New Delhi
6.	Enhancing nutrient use Efficiency , qualitative and quantitative traits of apple with POLY4 Customized Fertilization	Dr Parmod Sharma	Sirius Minerals, New Delhi
Forestry			
1	Designing and fabrication of indigenous anti- hail guns and evaluation of their effectiveness to combat hailstorms for sustainable apple production in Himachal Pradesh Collaborative	Dr S K Bhardwaj	Department of Science & Technology, New Delhi
2	Restructured Bamboo Mission	Dr DR Bhardwaj	Directorate of Agriculture, Shimla





EXTENSION ACTIVITIES

(a) Directorate of Extension Education

Sr. No.	Extension Activity	No. of Participants		
		Farmers		Total
		Male	Female	
1	Institutional Trainings conducted (38 nos.)	840	93	923
2	Guided /Exposure Visits (45 nos.)	1107	230	1337
3	Van Mahotsav and Birth Anniversary of Late Dr. YS Parmar (4 th August, 2019)	-	-	Enmasse
4	Coordinated RAWE Training of Eternal University Barusahib (Sirmour)	-	57	57
5	State Level workshop on Package of Practices of Vegetable crops			180 Approx.
6	State Level workshop on Package of Practices of Fruits and Ornamental crops			250 Approx.
7	Farmers Advisory Services a) Farmer's calls through Kisan Call Centre b) Courier services c) Farmers samples diagnosed d) Agro-Advisory Services d) TV/Radio Talks	- - - - -	- - - - -	275 21 41 Enmasse 4
8	Installation of University Exhibitions (2 Nos.)	-	-	Enmasse
	Other Extension Education Activities	-	-	14
Agriculture Education Week				
Organized Agriculture Education week on the eve of Birthday of First Union Agriculture Minister and First President of India, Bharat Rattan Dr RajendraParasad. Under this programme lectures on "Importance of Agriculture" were delivered to the students of Govt. Sr. Sec. Schools namely Kuniyar, Shamrod, Gaura, Kothon and GSSS for Girls (Solan) from 4 - 6 December, 2019.				540
Mera Gaon Mera Gaurav (MGMG) Scheme.				
Under prestigious MeraGaonMera Gaurav Scheme, 32 villages have been adopted covering Sirmour and Solan districts. A team of four multi-disciplinary Scientists of visited 32 villages under 10 th schedule and 638 farmers were benefitted by this scheme. The scientists resolved the queries raised by the farmers in their fields. Six trainings on kiwi, vegetable, fruit, mushroom cultivation and plant protection were also conducted in which 2001 farmers participated. 27 advisories were also given to the farmers through mobile phone under this scheme.				

Publications of the Directorate

S. No.	Title	No. of Copies
1	सब्जी उत्पादन	3000
2	कृषि वाणी अंक 10 वर्ष 25 जनवरी-जून	500

3	फल उत्पादन	1000
4	Package of Practices of Floriculture and Landscaping	250
5	किनौर कृषि-जुलाई-दिसम्बर	400
6	A Manual of Fundamental Entomology	424



Officer's workshop on POP of fruit crops



Jal Shakti Kisan Mela at Ramshahar



Apple day at KVK Tabo (L&S)



Visit of Hon'ble Governor to University Museum



Officer's workshop on POP of vegetable crops



Exposure visit of farmers to vegetable farm



Forest Minister visiting exhibition on foundation day



Plantation by Hon'ble Forest Minister



Training under Mera Gaon Mera Gaurav



Visit to farmers field

(a) College of Horticulture

Activity	Floriculture and Landscaping Architecture	Plant Pathology	Entomology	Biotechnology	Food Science and Technology	Seed Science and Technology	Fruit Science	Business Management	Vegetable Science
Lectures delivered (on campus)	24	60	-	1	94	12	-	40	21
Lectures delivered (off campus)	7	-	-	-	9	8	-	-	8
Radio/TV talks	3	-	2	1	-	-	2		1



Workshops/Seminars/ Symposia/ Meetings Trainings/Camps organized	2	5	24	-	11	5	22	5	2
Participation in Conferences/ Workshops/Seminars/ Symposia/Trainings etc.	1	5	27	2	10	11	9	-	9
KisanMela (organized)	-	-	-	-	-	-	-	-	4
VIP visits	4	-	-	-	-	-	2	-	-
Guided visits	-	-	-	-	-	-	-	-	44
Diagnostic visits	-	-	-	-	-	1	-	-	39
Farmer advisory service	-	-	-	-	-	-	-	-	52
Farmer-Scientist Interaction	-	-	-	-	-	6	-	-	39
Front Line Demonstration	-	-	-	-	-	3	-	-	12
Book/Manuals/Compe dia	1	-	10	-	5	-	-	-	1
Book Chapters	-	1	1	-	4	1	10	6	2
Review papers	1	-	-	-	-	-	-	-	2
Popular articles	-	4	3	-	7	1	-	-	8
Brochures/Booklets/C Ds/ Extension Leaflet	-	-	-	-	2	3	-	2	-

(b) College of Forestry

Activity	Environ mental Science	Silviculture and Agroforestry	Social Science	Tree Improvement and Genetic Resources	Soil Science and Water Management	Basic Science	Forest Products
Lectures delivered (on campus)	5	6	10	-	-	-	-
Lectures delivered (off campus)	-	-	3	-	-	-	-
Radio/TV talks	-	1	-	4	-	-	-



Workshops/Seminars/Symposia/ Trainings organized	4	12	2	-	-	-	-
Participation in Conferences/Workshops/Seminars/Symposia/Trainings etc.	12	1	3	3	4	-	16
Exposure Visits	-	10	-	-	-	-	-
Book/Manuals/Compendia	1	-	-	-	-	-	-
Book Chapters	-	1	-	-	-	7	2
Bulletins	-	2	-	-	-	3	6
Popular articles	-	-	-	-	-	5	-

(c) College of Horticulture and Forestry, Neri, Hamirpur

Activity	Number of Activities
Lectures delivered (on campus)	112
Lectures delivered (off campus)	23
Radio/TV talks	14
Workshops/Seminars/Symposia/ Trainings organized	20
KisanMela (organized)	2
Participation in Conferences/Workshops/Seminars/ Symposia/Trainings etc.	8
Days celebrated	1
Exposure visit to College	15
Exhibition	2
Book/Manuals/Compendia	
Book Chapters	15
Popular articles	10

(d) College of Horticulture and CEHRE, Thunag, Mandi

Activity	Number of Activities
Lectures delivered (off campus)	62
Radio/TV talks	6
Workshops/Seminars/Symposia/ Trainings organized	2
Participation in Conferences/Workshops/Seminars/ Symposia/Trainings etc.	15
VIP visits	5

Filed Demonstration	32
Field Visits	118
Book Chapters	6
Popular articles	1

(e) Regional Horticultural Research and Training Stations

Activity	Jachh (Kangra)	Bajaura (Kullu)	Dhaulakuan (Sirmour)	Mashob- ra (Shimla)	Tabo (Lahaul & Spiti)	Kandag- hat (Solan)	Rohru (Shimla)	Chamba	Sharbo (Kinnaur)
Lectures delivered (on campus)	-	12	18	18	-	282	12	-	-
Lectures delivered (off campus)	-	12	28	9	-	-	-	-	-
Radio/TV talks	-	-	2	-	-	1	-	1	-
Workshops/Seminars/Symposia/ Trainings organized	-	27	12	9	63	37	236	84	23
KisanMela (organized)	-	-	-	-	1	-	-	-	-
Participation in Conferences/Workshops/Seminars/Symposia/Trainings etc.	-	7	17	16	13	-	-	-	18
VIP visits	-	-	8	8	-	-	-	-	-
Exposure visits to station	8	-	4	12	1	160	12	-	-
Exposure and Guided Visits	-	-	6	-	-	111	-	4	-
Farmers Scientist Interaction	-	1	2	1	-	-	-	4	-
Diagnostic visit (On Campus)	-	-	54	10	-	35	-	-	-
Diagnostic visit (Off Campus)	-	-	12	-	8	-	-	16	-
Telephonic Consultancy	-	-	72	-	166	-	-	-	-
Whatsapp Diagnostics	-	-	72	-	-	44	-	-	-
Inspections	-	-	-	3	-	-	-	-	-
Day Celebration	-	-	1	2	9	15	-	38	1
Soil Samples Tested	-	-	-	-	-	-	-	82	-
Soil Health Cards Issued	-	-	-	-	-	-	-	80	-
KisanMela under Jal Shakti Abhiyan	-	-	-	-	-	3	-	-	-



Kisan Ghosthi	-	-	-	-	-	2	25	1	2
Swachhata Pakhwara	-	-	-	-	-	1	-	-	-
Parthenium Awareness Week	-	-	-	-	-	1	-	-	-
Exhibition	-	1	1	1	1	7	-	2	-
Method Demonstration	-	-	-	-	103	70	-	-	4
FLD	-	-	-	-	-	-	17	8	13
OFT	-	-	-	-	-	-	28	11	11
Advisory Services	-	-	-	-	-	382	-	-	-
Book/Manuals/Compendia	-	-	1	-	-	-	-	-	3
Book Chapters	-	-	1	-	-	-	-	-	3
Popular articles	-	2	1	2	-	16	-	8	-
Brochures/Booklets/CDs/Extension Literature	-	-	-	-	-	3	9	-	3

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 viz. i) College of Horticulture, Nauni (Solan) ii) College of Forestry, Nauni (Solan) and iii) College of Horticulture & Forestry, Neri (Hamirpur) iv) College of Horticulture and Forestry, Thunag (Mandi).

(A) Programmes of study in different colleges

College of Horticulture:

Undergraduate Programme

- ❖ B Sc (Hons) Horticulture- Four year programme

Post Graduate Programmes

- ❖ Masters Programmes

M Sc (Ag.) Entomology, M Sc (Horticulture) Floriculture & Landscape Architecture, M Sc Food Technology, M Sc (Horticulture) Fruit Science, M Sc Molecular Biology & Biotechnology, M Sc (Ag.) Plant Pathology, M Sc (Ag.) Seed Science & Technology, M Sc Spices, Plantation and Medicinal & Aromatic Plants, M Sc (Horticulture) Vegetable Science, Master of Business Administration (Agribusiness), and Master of Business Administration.

- ❖ Doctoral Programme

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

College of Forestry:

Undergraduate Programme

- ❖ B Sc (Hons) Forestry- Four year programme

Post Graduate Programmes

- ❖ Masters Programmes

M Sc (Forestry) Agroforestry, M Sc (Forestry) Environmental Management, M Sc (Forestry) Forest Genetic Resources, M Sc (Forestry) Medicinal & Aromatic Plants, M Sc (Forestry) Silviculture, M Sc (Forestry) Wood Science & Technology, M Sc (Ag.) Agricultural Economics, M Sc (Ag.) Soil Science, M Sc Environmental Science, M Sc Microbiology, and M Sc Statistics

- ❖ Doctoral Programme

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



College of Horticulture & Forestry, Neri (Hamirpur)

Undergraduate Programme

- ❖ B Sc (Hons) Horticulture- Four year programme
- ❖ B Sc (Hons) Forestry- Four year programme
- ❖ B Tech Biotechnology – Four year programme

Post Graduate Programmes

Masters Programmes

- ❖ MSc (Horticulture) Fruit Science, M Sc (Horticulture) Vegetable Science, M Sc

(Forestry) Agroforestry, M Sc (Ag.) Entomology, M Sc (Ag.) Plant Pathology, M Sc (Ag.) Soil Science, M Sc Food Technology, and M Sc Molecular Biology & Biotechnology.

College of Horticulture and Forestry, Thunag (Mandi).

Undergraduate Programme

- ❖ B Sc (Hons) Horticulture- Four year programme

(B) Programme-wise Enrolment in each college during 2019-20

Sr. No.	Programme-wise Admissions	No. of Students
College of Horticulture (Nauni, Solan)		
1.	B Sc (Hons.) Horticulture Programme	404
2.	M Sc Programmes	249
3.	MBA/MBA (Agribusiness)	119
4.	Ph D Programmes	130
	Total	902
College of Forestry (Nauni, Solan)		
1.	B Sc (Hons.) Forestry Programme	450
2.	M Sc Programmes	183
3.	Ph D Programmes	90
	Total	723
College of Horticulture & Forestry, Neri (Hamirpur)		
1.	B Sc (Hons) Horticulture, Forestry, B Tech Biotechnology	566
2.	M Sc Programmes	148
	Total	714
College of Horticulture and Forestry, Thunag (Mandi)		
1.	B Sc (Hons) Horticulture Programme	69
	Grand Total	2408

(C) Programme-wise students admitted (New admissions) during 2019-2020

College of Horticulture, Nauni (Solan)		
1.	B Sc (Hons) Horticulture Programme	123
2.	M Sc Programmes	104
3.	MBA/MBA (Agribusiness)	60
4.	Ph D Programmes	68
College of Forestry, Nauni (Solan)		
1.	B Sc (Hons) Forestry Programme	123
2.	M Sc Programmes	84
3.	Ph D Programmes	29



College of Horticulture & Forestry, Neri (Hamirpur)		
1.	B Sc (Hons) Horticulture Programme	76
2.	B Sc (Hons) Forestry Programme	72
3.	B Tech Biotechnology	36
4.	M Sc Programmes	67
College of Horticulture and Forestry, Thunag (Mandi)		
1.	B Sc (Hons) Horticulture Programme	69

(D) Students passed out w.e.f. 01.04.2019 to 31.03.2020:

College	B Sc	M Sc	MBA	Ph D	Total
UHF, Nauni (Solan)					
Horticulture	102	88	40	29	259
Forestry	141	45	-	22	208
College of Horticulture & Forestry, Neri (Hamirpur)					
Forestry	80	02	-	-	82
Biotechnology	18	-	-	-	18

(E) Meetings of Academic Council/Research Council/Extension Council

1.	100 th Meeting of the Academic Council was held on 18.04.2019
2.	101 st Meeting of the Academic Council was held on 17.08.2019
3.	102 nd Meeting of the Academic Council was held on 26.11.2019
4.	103 rd Meeting of the Academic Council was held on 20.01.2020
5.	104 th Meeting of the Academic Council was held on 18.02.2020
6.	23 rd Meeting of Research Council was held on 05.02.2020
7.	21 st Meeting of Extension Council was held on 06.02.2020

LIBRARY

- ❖ Satyanand Stokes Library of the university is named after Mr. Satyanand Stokes (initially Samuel Nickoles Stokes) a resident of Philadelphia, the USA who was a pioneer in introducing delicious varieties of apple and heralding the economic revolution in Himachal Pradesh. This beautiful building was inaugurated by Sh. R. Venkataraman, former Hon'ble President of India on December 7, 1988. The library specializes in Horticulture and Forestry information services. It serves its users through computerized in house, National and International databases e.g. books, e-books, theses, e-thesis (Krishikosh), Journals, e-journals, and CD-ROM.
- ❖ It has a rich collection of latest books and journals on horticulture, forestry, allied subjects, and business management. The Satyanand Stokes Library has been trying to cope up with new

emerging technologies and adopt the same in the Library to upgrade its functioning. The feedback reports received from its patrons and visitors have also been quite useful and it enabled us to achieve our target. The library not only proactively works on its collection, building, and infrastructural augmentation, but also puts a lot of emphasis on creating facilities for its users.

- ❖ With the implementation of RFID, the issue/return process became more convenient to the users. It saves the time of the member and the staff of the library, now staff can devote more time to satisfy the need of the users.
- ❖ The library has adopted KOHA, Library Management Software (Open Source) with Cloud Server and OPAC (Online Public Access Catalogue) operational for the easy and fast delivery of bibliographic information of documents available in the library with its

transactional history through e-mail to the user. OPAC can be accessed on the web from any corner of the world. Its web address is <http://www.164.52.80.80>.

- ❖ The library has digitized all the Theses available in the library since the inception of the university and uploaded it on krishikosh database of ICAR for providing free access to the users remotely in full text. These theses are available on <https://www.krishikosh.egranth.ac.in> will help the students, as well as faculty to update their knowledge on research being carried out to avoid duplication in research. This initiative helped the users during the lockdown period due to COVID 19.
- ❖ The library has successfully implemented by taking initiative in the use of URKUND software in collaboration with the CIC centre of the university by all the faculty members and students for plagiarism check in the research papers/Theses with the help of INFLIBNET, Ahmedabad. The university is following UGC guidelines for plagiarism level i.e. less than 10 per cent.
- ❖ The university has an Institutional Academic Integrity Panel for prevention of plagiarism. All the departments of the university have a Departmental Academic Integrity Panel (DAIP). As Nodal Officer of CeRA ICAR the Static IP Address of Dr YS Parmar University of Horticulture and Forestry Main Campus and affiliated Colleges updated. Efforts were also made to connect the Research Stations / KVKs by providing the available Static IP Address to ICAR.
- ❖ E-Services: Multimedia Centre has been established in 2007 with the financial support of the ICAR for providing the services to its users viz. free internet, e-mail, access to other-resources i.e. CeRA (Consortium of e-Resources

in Agriculture) online journals, e-books, e-thesis, CD-ROM Databases, OPAC (Online Public Access Catalogue), etc.) to the students and faculty members

- ❖ Online e-Journals Collection: CeRA (Consortium for e-Resources in Agriculture) by the ICAR offers access to 2928+ e-journals through <http://www.Jgateplus.com> on agriculture, horticulture, forestry, and business management subjects to unlimited users through IP as well as remote access by providing common user Id and password during the lockdown period due to COVID 19.
- ❖ Online e-Books Collection: The library has enriched its collection of e-books to ensure the user's academic needs. There are 248 e-books available in its collection for full access and download on perpetual access basis through university IP as well as remotely by providing a common user ID and Password to all the users for maximum use of resources during COVID 19 pandemic.
- ❖ Institutional Repository: The Library has an Institutional Repository for important and rare books collection of the university with the DSPACE (Open Source Software) for internal distribution of information to its users. Uploading of the digitized Annual Reports, Conference Proceedings, and important rare books is in process.
- ❖ CD-ROM Services: CD ROM Services are being used by the students and faculty members for their research.
- ❖ Krishikosh Database: During the year, two hundred and ninety six 296 (M Sc, Ph D Theses) were digitized and 210 newly added Theses have been uploaded on the krishikosh database for open access at <https://www.krishikosh.egranth.ac.in> in the full text during the year.



Statistics of the multimedia section during the year

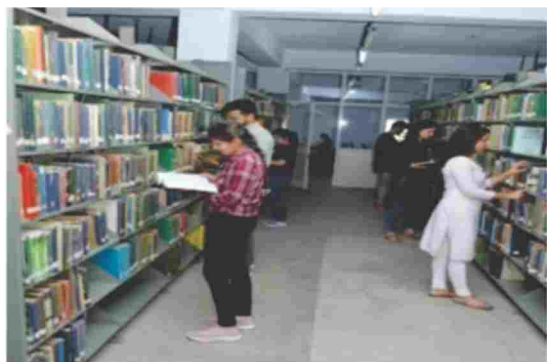
Total No of records generated from CD-ROM	10205
Total No of users in the Multimedia Section Internet/CD-Rom/e-books	2910
Total Income generated from multimedia Section	3144/-

Databases available on CD-ROM

Sr.No	Name of the Database	Year
1	HORT- CD	1973-2013
2	TREE- CD	1939-2013
3	CAB Abstract	1987-1992
4	AGRIS	1975-2000

Collection as on 31/03/2020

Books	50942
Back volumes of Journals	17933
Theses	5817
Others	515
Total	75207
E-Books	248



- ❖ **Technical Processing Section:** The classification, cataloguing, and data entry of more than 1956 new books, theses, and journals received during the period have been completed. Total 2290 bibliographical data of books, theses, and journals have been uploaded on Library Management Software Koha for creating online Public Access Catalogue (OPAC) for users' access and CDS/ISIS software respectively.
- ❖ **Circulation Services:** The Satyanand Stokes Library has a strong base of users and the Circulation Statistics as on 31/03/2020 are as under:-

Circulation Statistics

Readers Visited (Footfalls)	58024
Books issued	12548
Books returned	12872
Journal consulted	86028
Books consulted	71914
Reference queries	3416
Late fee collection (Rs.)	35208/-

Membership: During the year, the library has prepared and distributed 2208 RFID smart cards to the members to enable them to self-check-in/out of books for the fast delivery of documents without human intervention.

Book Bank: The Library has approx. One thousand books in the Book Bank and these books are being used/issued to the underprivileged students on nominal rental charges

Orientation Programmes: To familiarize the students and faculty with the available resources is the priority area of the Library. The orientation program in respect of new students is conducted at the beginning of the session.

COMPUTER AND INSTRUMENTATION FACILITIES

Computer Centre of the university provides central facility in computer and information technology to all the students, scientists and other staff of the university with more than two hundred and fifty regular users on roll. Various activities carried out in the CIC during 2019-20 are as under:

- ❖ CIC is helping scientists/researchers in transfer of technology by providing them related services such as Internet/E-mail facilities and computer hardware and software and maintenance services.
- ❖ 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, Sub-DIC Centre (Biotechnology), Communication Centre and ARIS Cells of College of Horticulture and College of Forestry. Presently about 250 internet/e-mail nodes at users location have been provided.
- ❖ Domain based Email account were created for the Officers and Officials of the university. Domain based (@yspuniversity.ac.in) email from NIC was managed.
- ❖ The University Website is being regularly updated by incorporating the latest information pertaining to departments/offices of the university. All tender notices, jobs notice, training notices, university news and university important

office orders/notifications were uploaded on the website.

- ❖ Result of Undergraduate Entrance Examination (UGEE-2019) for admission to undergraduate programmes for the year 2019-20 was evaluated and compiled in the Computer Centre. Result of common entrance test for admission to Postgraduate Programme (s) (PGET-2019) for the year 2019-20 of the university was also evaluated and compiled in the Computer Centre. Evaluated and compiled the results of objective type examination for the recruitments to the posts of computer programmer. Evaluate and compiled the result for recruitments of Forest Guards for 9 different circles of HP Forest department in which about 10,000 candidates appeared.
- ❖ Antiplagiarism software URKUND was implemented in the university, accounts of all the faculty members were created and support was provided for its use.

STUDENTS' ACTIVITIES

- ❖ The Students' Welfare Organization is looking after the 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 were made by this Student Welfare Organization to inculcate the feeling of brotherhood, friendship, amity, goodwill, comradeship, love and respect for each other besides promoting discipline among the students by organizing two days Personality Development Training Programme on 8th and 9th April, 2019. 150 students took part in the said training programme which was mainly focused on their physical, mental and emotional development.
- ❖ Inter-College Sports & Games and Youth Festival 2018-19 of all the three Colleges of the University w.e.f. 01.05.2019 to 04.05.2019 was organized.



- ❖ One week NSS Special Camp was organized w.e.f. 17.06.2019 to 23.06.2019 for 3rd year students of B Sc (Horticulture) and B Sc (Forestry) of College of Horticulture and College of Forestry, Nauni (Solan) in the surrounding rural areas of Nauni/Shamrod Panchayat(s). 84 students participated in this camp who carried out different activities like cleaning of community park, paths, assisting the local Panchayat in the construction of check dam, filling up of broken road with boulders, plantation, etc.



- ❖ An NSS volunteers interaction programme was organized in the university campus on 21.06.2019 in which about 150 NSS volunteers from YSPUHF, Nauni and PU, Chandigarh participated. During this event cultural programme was also organized.
- ❖ International Day of Yoga was celebrated in the university campus on 21st June, 2019. Sh. Brahammurti Yogtheerath Ji Maharaj and Swami Yog Vrat from Dhyan Yog Ashram Evam Ayurved Shodh Sansthan, Kathni (Subathu), District Solan (HP) were special invitees to the function for practicing and enlightening the participants about the importance of Yoga. About 200 persons including statutory officers, staff and students were present in the celebration. A special NSS troop from Panjab University, Chandigarh also participated in this function.



- ❖ A group of 31 NCC Girl Cadets of B Sc 1st and 2nd years students of College of Horticulture and College of Forestry, Nauni attended 10 days NCC Combined Annual Training Camp (CATC) at Baru Sahib w.e.f. 14.06.2019 to 23.06.2019 in



which cadets from 12 colleges and universities participated. This university won the best college award by defeating the other 11 colleges besides winning gold medals in badminton, volleyball, basketball, Kabaddi, drill, cross country, solo song and group song. In the category of tent pitching, group dance, quiz, firing competition, poster making, group dance and public speaking, university won silver medals.

- ❖ A batch of 56 NCC Boy cadets attended NCC camp at Chitkara University, Baddi w.e.f. 14.06.2019 to 23.06.2019. They won gold medals in the sports events like badminton, volleyball, tent pitching; and silver medals in basketball and Kabaddi events. They were adjudged overall winner amongst all the participating colleges.
- ❖ Swachhta Pakhwara was observed by the NSS volunteers of this university w.e.f. 1st August to 15th August 2019. During the Pakhwara, various activities like lecture on cleanliness, swachhta oath, cleaning class rooms, playground, lawns, roads and making the rural people aware of the uses of cleanliness and disadvantages of open defecation in which on an average 150 NSS volunteers participated.
- ❖ NSS volunteers participated in Van Mahotsav on 4th August 2019 on the birth anniversary of Dr Y.S. Parmar, first Chief Minister of Himachal Pradesh and launched campaign for the eradication of parthenium in the campus. NSS and NCC students participated in the march past on Independence Day celebration on 15th August 2019 in which Hon'ble Vice Chancellor was the Chief Guest. About 200 NSS Volunteers witnessed the live telecast on Doordarshan on 29th August 2019 in the Seminar Hall of College of Forestry wherein Hon'ble Prime Minister launched the FIT India Movement and took Fitness Pledge.
- ❖ Himachal Dastak organized ceremony to award the brilliant students at Dr L.S. Negi Auditorium on 8th August 2019. Five brilliant students in each discipline i.e. B.Sc., M.Sc., Ph.D. and MBA of College of Forestry and College of Horticulture of this university alongwith students of other Institutions/Colleges were honoured in the function.
- ❖ Three days Yog Shivir was organized for B.Sc. first year students in the Gymnasium Hall of this university w.e.f. 17-19 September, 2019 in which about 200 students participated.
- ❖ Mr Saurabh K Pandey, CEO-ISAB & SKIL Advisory, Almunus – GBPUA&T, Pantnagar, conducted Career Orientation Workshop for sensitizing the undergraduate students of this university about future career prospects related to Management in Agriculture, Agri- Engineering, Dairy Tech, Veterinary, Fishery, Food Tech, Horticulture and other allied streams on 20th September, 2019.
- ❖ The students of six Government Schools viz. GSSS Solan, Oachghat, Shamrod, Gaura and GHS Dharja besides constituent Colleges of University participated in 150th birth anniversary celebration of Mahatma Gandhi. Painting Competition was organized on “Gandhiji Vision of Clean India” in which two students each from 9th to 12th Classes and the students of this university participated. Poster Making Competition on three main themes namely, “Cleanliness”, “Fit India” and “Natural Farming” was also organized. 38 students participated. Declamation/Elocution contest both in Hindi & English was organized on contribution of Gandhiji in promoting Small Scale Cottage Industries in the country in which total 15 students participated. Essay Contest on three topics viz. Gandhian Vision of India (Gandhi Ji Ke Sapno Ka Bharat), Mahatma Gandhi – An Apostle of truth, peace and non violence (Satya, Shanti aur Ahinsa Ke Pujari Mahatma Gandhi), “Gandhian Principles and Indian Agriculture in 21st Century (Ek inshvi Satabdi mei Gandhiji Ke Sidhant aur Bhartiya Kheti)” was also organized in which 25 students submitted their essays in Hindi/ English. On the spot Slogan Writing contest on “Hygienic food for good health” was also conducted. On October 1, 2019 cultural programme including skit on the life of Mahatma Gadhi, poems, patriotic songs, folk dance etc. was organized. The prizes were given away to the winners and certificates were distributed to all the participants. The function was chaired by the Hon'ble Vice Chancellor, Dr Parvinder Kaushal. On October 2, 2019, a candle light peace march was launched at 6 PM in which

about 150 students of our university participated. The students chanted prayers and slogans pertaining to Gandhiji.



- ❖ Keshav Hostel Function (Keshvotsava-2019) was organized by the residents of Keshav Hostel on 21st October 2019. Dr Parvinder Kaushal, Hon'ble Vice Chancellor was the Chief Guest of the function. On this occasion, the students of this Hostel participated in colourful cultural programme comprising of songs, group songs, dance, bhangra, poems and Natti etc. in which the Students Welfare Officer, Wardens of different Hostels and students were present. The Hon'ble Vice Chancellor gave away the prizes to the students who participated in cultural evening, winners of different sports events of the hostel and former hostel committee members.



- ❖ Nominations for Central Students Association including 20 Class Representative, 6 Academic Representatives, 2 Sports Representatives and 3 Cultural Representatives of both the colleges of main campus were finalized on 20th September 2019 and subsequently oath was administered by the Hon'ble Vice Chancellor, Dr Parvinder Kaushal to the newly nominated body on 22nd October 2019 in the function organized by this organization. The nominated CSA includes the following:
- | | | |
|----------------|---|-----------------|
| President | : | Mr Ankush Verma |
| Vice President | : | Mr Sunny Sharma |

General Secretary : Mr Milap Singh Rana
Jt. Secretary-cum : Mr Maneshwar
-Treasurer

- ❖ The students and teachers participated in Prabhat Pheri on 15.11.2019 for creating awareness about the bad effects of drug abuse and alcoholism. The Prabhat Pheri began from Sports ground at 7.30 AM taking route of University Housing Colony and ended at 8.30 AM. The oath was administered to the students and the teachers not to indulge in drug abuse and alcoholism and stop others from falling into this vicious trap. An Athletic Meet was also organized on 15.11.19 wherein about 112 students of College of Horticulture participated in various events.
- ❖ Support Group of 126 students (34 males and 92 females) from NSS/NCC students was created on 16.11.2019 for creating awareness and providing support to the peer group whenever needed. The support group will function in close coordination with the Nodal Officers and other teachers and will also be helpful in identifying the students in need of help and providing support in the Hostels/ classes.
- ❖ Career counselling programme for students of class 6-12 from Government Senior Secondary School, Shamror, Solan was organized on 21.11.2019 in which 126 students participated. Dr Parvinder Kaushal, Hon'ble Vice Chancellor, Chief Guest, of the function addressed the students and faculty. During the programme, the faculty members interacted with the students regarding adverse effects of drug abuse and alcoholism and received strong view points of the students. Dr Lokesh Mamgain, addressed the students and faculty and gave a detailed explanation of symptoms and cure of drug abuse. One day trekking of NCC/ NSS students to Dharon Ki Dhar was organized on 24.11.19 in which 110 boys and girl students participated. The students were counselled about the drug prevention and bad effects of alcoholism. In between the students also interacted with villagers and guided them about prevention of drug abuse. Mr Vivek Acharya, IFS and alumni of this university was chosen brand ambassador who interacted with the students of this university on 30.11.2019. He talked in detail about the effect of drugs and alcohol on the student's life and how it can distract students from achieving their goals.



He also guided them towards the path for achieving success in life. About 132 boys and girls students participated.

- ❖ Troops of NCC and NSS participated in the parade on Republic Day Function on 26th January 2020 which was inaugurated by Hon'ble Vice Chancellor of the University.
- ❖ Madhav Hostel Function was organized by the residents of Madhav Hostel on 4th February, 2020. Dr Parvinder Kaushal, Hon'ble Vice Chancellor was the Chief Guest of the function. On this occasion, the students of this Hostel participated in colourful cultural programme comprising of songs, group songs, dance, bhangra and poems etc. in which the Students Welfare Officer, Wardens of different Hostels and students were present. The Hon'ble Vice Chancellor gave away the prizes to the students who participated in cultural evening, mess staff and former hostel committee.



- ❖ A contingent of 29 students, accompanists and team managers participated in ICAR 20th All India Inter Agricultural Universities Youth Festival (AGRI UNIFEST) 2019-20 at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh w.e.f. 8.2.2020 to 12.2.2020 2019 in various events like Music & Dance, Theatre, Literary and Fine Arts.
- ❖ Two NSS Volunteers namely Ms Ankita Singh (F-18-18-BIV) and Ms Teli Nadum (F-18-115-BIV) participated in National Integration Camp at MCM DAV Degree College, Kangra from 24th February to 1st March, 2020.
- ❖ Dr Surinder Ghankrokta, IAS (Retd.), New Delhi delivered exposure lecture on career counselling to the students of this university on 24th February, 2020.
- ❖ The sports team of the university participated in the XX All India Inter Agri-Universities Sports and Games Meet held at Sri Venkateshwara Veterinary University, Tirupati w.e.f. 1.3.2020 to

5.3.2020. The contingent consisted of 39 students/ participants from all three constituent campuses viz. 25 from Nauni, 12 from COH&F, Neri and 2 from COH, Thunag. The team participated in Table Tennis (Girls), Badminton (Boys), Volleyball (Boys), Basketball (Boys), Kabaddi (Boys) and Athletics (Boys and Girls). Students gave their best during the championship and reached quarterfinals in Kabbadi and Badminton, where they lost to previous year champions, namely, Vasantrao Naik Marathwada Agricultural University, Parbhani and HAU, Hisar, respectively.

HEALTH CARE FACILITIES

- ❖ The University Health Centre has provided health care services to 13809 patients (10631 new and 3178 old) including students, staff and local residents for treatment of their illness. National and other Govt. programmes like Pulse Polio Camps, RNTCP and Immunization/vaccination camps (10th of every month) were also conducted in collaboration with the Department of Health & Family Welfare, Solan. Round the clock medical cover provided to the all the residents of the campus.
- ❖ Blood donation camp was organized during the campaign on "Prevention of Drug Abuse and Alcoholism" on 3.12.19 in which 39 male and 69 female students participated. Dr Parvinder Kaushal, Hon'ble Vice Chancellor actively participated in the event and motivated students for blood donation for helping the needy as it is the most sacred donation that anyone can make. A team of Doctors from the District Hospital, Solan helped in successful organization of the same. During the event statutory officers, faculty and staff besides students participated in the event.

INFRASTRUCTURE DEVELOPMENT

A sum of Rs. 847.69 lakhs only was spent on various works out of the funds transferred by the Comptroller / deposited by other departments with the Estate Organization 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 are as under:

a). Completed Works

Sr. No.	Name of work(s)	Status	Location
1.	C/o Boys Hostel –VI	Completed	Nauni
2.	C/o Field lab. FLS	Completed	Nauni
3.	Construction of incubation centre on top floor of vegetable bakery	Completed	Nauni
4.	Renovation of Existing path for the Deptt. of Forest product	Completed	Nauni
5.	Renovation of existing gate for the Deptt. of Forest Product	Completed	Nauni
6.	Addition / alteration of playground and pavilion block	Completed	Nauni
7.	Renovation of old UG Hostel	Completed	Nauni
8.	Renovation of International Student Hostel	Completed	Nauni
9.	Renovation of New girl hostel (OFH)	Completed	Nauni
10.	Renovation of all boys hostel	Completed	Nauni
11.	Renovation of all girls hostel	Completed	Nauni
12.	Renovation of new UG hostel	Completed	Nauni
13.	Renovation of Electrical supply in boys hostel	Completed	Nauni
14.	Renovation of Library reading room	Completed	Nauni
15.	Conversion of lecture hall into UG / PG lab in COF	Completed	Nauni
16.	Renovation of UG lab for the Deptt. of Entomology	Completed	Nauni
17.	Renovation of UG/ PG Lab in COH	Completed	Nauni
18.	Renovation of bio-chemistry lab Deptt. of basic science	Completed	Nauni
19.	Renovation of smart class rooms in EVS Deptt. under COF	Completed	Nauni
20.	Renovation of lab Deptt. of Forest product	Completed	Nauni
21.	Renovation of UG Lab Deptt. of TIGR	Completed	Nauni
22.	Providing fencing in Samroar Area	Completed	Nauni
23.	Providing fencing in Naganji / Nandho area	Completed	Nauni
24.	Up gradation of Guest House	Completed	Nauni
25.	Completion of STP staff Hut	Completed	Nauni
26.	Providing LED Display boards	Completed	Nauni
27.	Renovation / extension of common room / kitchen in Hostel	Completed	Nauni
28.	Providing 12 Nos. insect net structure for the Deptt. Of Entomology.	Completed	Nauni
29.	Special repair of RCC chajja in various residences	Completed	Nauni
30.	Repair of depressed floor of Comptroller Chamber	Completed	Nauni
31.	Construction of Field Lab in Manjhgaon Farm	Completed	Nauni
32.	Augmentation of water supply scheme	Completed	Nauni
33.	Construction of shade net house Deptt. of FLA	Completed	Nauni
34.	Construction of path Deptt. of FLA	Completed	Nauni
35.	Repair of Mist chamber	Completed	Nauni
36.	Renovation of Glass house Deptt. of Vegetable science	Completed	Nauni
37.	Renovation of cow shed Deptt. of SAF	Completed	Nauni
38.	Construction of Two Nos. waste water tank Deptt. of SAF	Completed	Nauni
39.	Providing Ladder in Nandani Hostel.	Completed	Nauni



40.	Special repair of space rented to BSI.	Completed	Nauni
41.	Special repair of office cum store in shilly farm, Deptt. of TIGR	Completed	Nauni
42.	Providing separate wiring for Gen set in COF	Completed	Nauni
43.	Special repair of set No. 13 type – IV houses.	Completed	Nauni
44.	Replacement of tubelight in VC chamber.	Completed	Nauni
45.	Special repair of VC residence	Completed	Nauni
46.	Replacement of wooden paneling in VC chamber.	Completed	Nauni
47.	Construction of approach path of type-III houses.	Completed	Nauni
48.	Providing pre-painted sheet roofing in type-IV houses.	Completed	Nauni
49.	Providing aluminum partition in VC Chamber.	Completed	Nauni
50.	Repair of 3 Nos. poly houses of vegetable science.	Completed	Nauni
51.	Providing LED TV in PA room of Vice Chancellor Office.	Completed	Nauni
52.	Providing separate earthing to the GCMS instrument of EAP.	Completed	Nauni
53.	Special repair of seminar hall in DEE building.	Completed	Nauni
54.	Providing prefabricated guard cabins.	Completed	Nauni
55.	Providing Solar fencing of SPNF Farm Deptt. of SSWM	Completed	Nauni
56.	Renovation of Polyhouses.	Completed	Kandaghat
57.	C/o Multipurpose building at COH&F Neri, Distt. Hamirpur (SH:- Site Development, Building portion, W/S and S/I).	Completed	Neri
58.	C/o control room for drip fertigation in farm area at COH&F Neri, Distt. Hamirpur (SH:- BP, WS and SI).	Completed	Neri
59.	C/o irrigation water storage tank at COH&F Neri, Hamirpur.	Completed	Neri
60.	Construction of boundary wall around the SC student hostel for girls	Completed	Neri
61.	Providing external electrical connections to Control room	Completed	Neri
62.	Providing three phase LT line in compost / mushroom Unit	Completed	Neri
63.	Development of existing play ground	Completed	Neri
64.	Construction of retaining wall and drain channel	Completed	Neri
65.	Providing chain link fencing Bajaura	Completed	Bajaura
66.	Repairing of retaining wall	Completed	Mashobra

b). Work awarded / in progress / in process

Sr. No.	Name of work(s)	Status	Location
1.	Special repair of shopping centre	In progress	Nauni
2.	C/o multipurpose hall in LS Negi auditorium	In progress	Nauni
3.	Providing inverter in VC office and Auditorium	In progress	Nauni
4.	Providing furniture and fixture of incubation centre on top floor of bakery block.	In progress	Nauni
5.	C/o chamber for disposal of bio medical waste in health centre	In Process	Nauni
6.	Installation of solar steam cooking system for 1500 student	In Process	Nauni



7.	Renovation of new PG hostel	In Process	Nauni
8.	Renovation of old PG hostel	In Process	Nauni
9.	Renovation of mess in boys hostel –V	In Process	Nauni
10.	Renovation of old UG hostel	In Process	Nauni
11.	Providinggyser in boys / Girls hostel	In Process	Nauni
12.	Providing wall fan in Madhav hostel	In Process	Nauni
13.	Providing street light in Boys and Girls hostel	In Process	Nauni
14.	Providing CCTV camera and LED TV in SWO.	In Process	Nauni
15.	Providing irrigation facility in SPNF farm of EAP	In Process	Nauni
16.	Renovation of cow shed of EAP	In Process	Nauni
17.	Providing machinery/ Lab of FST.	In Process	Nauni
18.	C/o new skill development centre building	In Process	Nauni
19.	Providing solar fencing for modal farm under SPNF of EAP.	In Process	Nauni
20.	C/o nursery shed in shilly farm of Forest product	In Process	Nauni
21.	C/o shed of EAP	In Process	Nauni
22.	Installation of angle iron post in Kiwi fruits of EAP	In Process	Nauni
23.	C/o field laboratory-cum-Farmer practical training hall	In progress	Kandaghat
24.	C/o two nos. supporting staff residence below farmer hostel	In progress	Kandaghat
25.	C/o button mushroom production unit	In progress	Kandaghat
26.	Providing floor and wall tiles in farmer hostel	In progress	Kandaghat
27.	Additional alteration of farmer hostel.	In progress	Kandaghat
28.	C/o green house	In process	Dhaulakuan
29.	C/o main gate	In progress	Sharbo
30.	Providing treatment of sewerage waste for irrigation purpose	In process	Sharbo
31.	C/o lab cum store	In progress	Neri
32.	Renovation of faculty centre building	In progress	Neri
33.	Restoration of rain damages – R/wall	In progress	Neri
34.	Restoration of rain damages – repair of fencing.	Completed	Neri
35.	Providing water treatment plant and clear water storage tank	In progress	Neri
36.	C/o first floor of existing scientist residence building	In progress	Neri
37.	Providing interlocking paver in college building	In progress	Neri
38.	Improvement of existing electric system	completed	Neri
39.	C/o PG block building only ground floor	In Process	Neri
40.	Renovation of main office toilet	In progress	Mashobra
41.	Upgradation of poly carbonate house	In progress	Mashobra
42.	Replacement of damages carbonate sheets	In progress	Mashobra
43.	Installation of CCTV camera's	In Process	Mashobra
44.	C/o cow shed	In Process	Mashobra
45.	Upgradation of plant pathology lab	In Process	Mashobra
46.	C/o 3 nos. polycarbonate green houses	In Process	Mashobra
47.	Renovation of toilet in Administrative building	In process	Rohru
48.	Providing stone wall with chain link fencing	In progress	Seobagh



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

FINANCE

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 University has received Grant-in-Aid from the aforesaid agencies during the financial year 2019-2020 (01.4.2019 to 31.3.2020 for carrying out the teaching, research and extension education programmes. The detail of receipts and expenditure is given as under:

Sr. No.	Main source of funding	Grant-in-aid received (Rs. Lakhs)	Domestic Income (Tentative) (Rs. Lakhs)	Total Receipt (Rs. Lakhs)	Total Expdt. (Tentative) (Rs. Lakhs)
1.	Department of Horticulture	12500.00	2850.00	15050.00	13000.00
2.	Department of Forest	50.00	0.00	50.00	45.00
	Total	12550.00	2850.00	15400.00	13045.00
1.	ICAR Development Assistance & other schemes	259.79	0.00	259.79	259.39
2.	Krishi Vigyan Kendra & other schemes	806.83	0.00	806.83	822.81
3.	All India Coordinated Research Projects	684.55	0.00	684.55	626.64
4.	ICAR Adhoc & other Projects	177.96	0.00	177.96	161.15
5.	Schedule Caste Sub-Plan	114.00	0.00	114.00	113.99
6.	Government of India	203.27	0.00	203.27	175.82
7.	Short Term Misc. Projects	326.59	0.00	326.59	276.49
8.	IDP-NAHEP	80.00	0.00	80.00	15.00
	Total	2652.99	2850.00	2652.99	2451.29
	Grand Total	15202.99	2850.00	18052.99	15496.29



- ❖ The University has been making all out efforts to curtail the avoidable expenditure and generate more domestic income by sale of plants and farm produce. All the functionaries in the university have been advised to motivate the manpower and make optimum use of technology, available land increase in nursery production, testing of fungicides/pesticides increase farmer clinical services and evolve new fields of income generation.
- ❖ An additional grant-in-aid amounting to ₹ 30.00 crore was received from the State Govt. to defray the outstanding liabilities/salary/pension of the employees. ₹ 5.00 Crore for the Establishment of College of Horticulture and Center of Excellence for Horticulture Research and Extension UHF Campus at Thunag, District Mandi(HP).
- 07 New Projects with a total outlay of ₹2865.47 lacs were sanctioned by the Govt. of India/UGC/ICAR during the year, 2019-2020.
- Domestic Income amounting to ₹2850.00 lac (appox.) has been realized during the financial year, 2019-2020.

AUTHORITIES OF THE UNIVERSITY

SENATE

1.	Chancellor	The Hon'ble Governor, H.P- Chairman
2.	Vice-Chancellor	UHF, Nauni (Solan)
3.	Secretary (Horticulture)	Government of Himachal Pradesh
4.	Secretary (Forests)	Government of Himachal Pradesh
5.	Director of Agriculture	Government of Himachal Pradesh
6.	Director of Horticulture	Government of Himachal Pradesh
7.	Principal Chief Conservator of Forests	Government of Himachal Pradesh
8.	Dean	College of Horticulture, UHF, Nauni (Solan)
9.	Dean	College of Forestry, UHF, Nauni (Solan)
10.	Dean	College of Horticulture and Forestry, Hamirpur at Neri
11.	Dean	College of Horticulture and Centre of Excellence for Horticulture Research and Extension, Thunag, Distt. Mandi w.e.f. 19.06.2019
12.	Director of Research	UHF, Nauni (Solan)
13.	Director of Extension Education	UHF, Nauni (Solan)
14.	Comptroller	UHF, Nauni (Solan)
15.	Estate Officer	UHF, Nauni (Solan)
16.	Librarian	UHF, Nauni (Solan)
17.	Students' Welfare Officer	UHF, Nauni (Solan)
18.	Shri Balbir Singh Verma	MLA, H.P. Vidhan Sabha w.e.f. 19.06.2019
19.	Dr. K.D. Sharma	Pr. Hort. Technologist, Deptt. of Food Science & Technology, College of Horticulture, UHF, Nauni (Solan) w.e.f. 19.06.2019
20.	Dr. M.K Brahmi	Assistant Professor, Department of Environmental Science, College of Forestry, UHF, Nauni (Solan) w.e.f. 19.06.2019
21.	Sh. Arun Kumar Sharma	Superintendent (EC), O/o the Registrar, UHF, Nauni (Solan) w.e.f. 19.06.2019
22.	Registrar	UHF, Nauni (Solan) – Member Secretary



BOARD OF MANAGEMENT

1.	Vice Chancellor	UHF, Nauni (Solan) – Chairman
2.	Vice Chancellor	CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur
3.	Secretary (Horticulture)	Government of Himachal Pradesh
4.	Secretary (Finance)	Government of Himachal Pradesh
5.	Secretary (Forests)	Government of Himachal Pradesh
6.	Director of Horticulture	Government of Himachal Pradesh
7.	Principal Chief Conservator of Forests	Government of Himachal Pradesh
8.	Director of Agriculture	Government of Himachal Pradesh
9.	Dr. Rakesh Gupta	Dean, College of Horticulture, UHF, Nauni (Solan)
10.	Dr. Mohar Singh Thakur	Principal Scientist & Head, Regional Research Station of National Bureau of Plant Genetic Resources, ICAR, Phagli, Shimla
11.	Prof. Narinder Singh Raina	Division of Agroforestry, SKUAST of Jammu Main Campus, Chatha-180 009
12.	Sh. Arun Verma	S/o Sh. Laxmi Chand, Village Bhannat, Tehsil Rajgarh, District Sirmaur
13.	Sh. Gopal Mehta	Village Halyana, PO Shamathala, Distt. Shimla (HP)-172030
14.	Sh. Jawahar Lal Sharma	S/o Sh. Moti Lal Sharma, VPO Tindi, Tehsil Udaipur, Distt. Lahaul & Spiti, H.P- 175 142
15.	Smt. Manchali Thakur	Village Dhiun, P.O BirTungal, Tehsil Sadar, Distt. Mandi, H.P- 175 001
16.	Er. Ashok Chauhan	Retd. Engineer-in Chief (Projects), H.P PWD, House No.19, Type-V, GAD, Kasumpti, Shimal-171 009
17.	Dr. V.P. Sharma	Director, Directorate of Mushroom Research Chambaghat, Solan-173213 (representative of ICAR, New Delhi)
18.	Dr. S.S. Samant	Director, HFRI, Shimla, H.P (representative of ICFRE)
19.	Registrar	UHF, Nauni (Solan) – Member Secretary

ACADEMIC COUNCIL

1.	Vice-Chancellor	UHF, Nauni (Solan)- Chairman
2.	Dean	College of Horticulture, UHF, Nauni (Solan)
3.	Dean	College of Forestry, UHF, Nauni (Solan)
4.	Dean	College of Horticulture and Forestry, Neri, Hamirpur
5.	Director of Research	UHF, Nauni (Solan)
6.	Director of Extension Education	UHF, Nauni (Solan)
7.	Director, Forestry Education	Forest Research Institute, Dehradun
8.	Librarian	UHF, Nauni (Solan)
9.	Students' Welfare Officer	UHF, Nauni (Solan)
10.	Dr. Y.C. Gupta	Professor and Head, Department of Floriculture and Landscape Architecture, College of Horticulture, UHF, Nauni (Solan) upto 13.08.2019
11.	Dr. Rajesh Bhalla	Prof. & Head, Deptt. of Floriculture and Landscape Architecture, College of Horticulture, UHF, Nauni (Solan) w.e.f. 14.08.2019
12.	Dr. (Mrs.) A.K Nath	Professor, Department of Biotechnology, College of Horticulture, UHF, Nauni (Solan) w.e.f. 15.01.2019



13.	Dr. Anju S Thakur	Professor and Head, Department of Basic Sciences, College of Forestry, UHF, Nauni (Solan) upto 31.7.2019.
14.	Dr. Kulwant Rai Sharma	Prof., Deptt. of Forest Products, College of Forestry, UHF, Nauni (Solan) w.e.f. 14.08.2019.
15.	Dr. Ravinder Sharma	Principal Scientist, Department of Social Sciences, College of Forestry, UHF, Nauni (Solan)
16.	Dr. R.S Prashar	Principal Scientist, Deptt. of Social Sciences, College of Horticulture and Forestry, Hamirpur at Neri upto 28.02.2020
17.	Dr. Som Dev Sharma	Principal Extension Specialist, Department of Fruit Science, College of Horticulture and Forestry, Hamirpur at Neri
18.	Dr. R.C Sharma	Director of Research (Retd.), Flat No. 6, Mehta Estate, Near BSNL Exchange, P.O. Shamti, Distt. Solan
19.	Dr. D.S Ginwal	Dean (Academic), Forest Research Institute, Dehradun, Kaulagarh Road, P.O.E. 248195, Uttarakhand
20.	Registrar	UHF, Nauni (Solan) – Member Secretary

EXTENSION COUNCIL

1.	Vice-Chancellor	UHF, Nauni (Solan) – Chairman
2.	Director of Horticulture	Government of Himachal Pradesh
3.	Director of Agriculture	Government of Himachal Pradesh
4.	Principal Chief Conservator of Forests	Government of Himachal Pradesh
5.	Dean	College of Horticulture, UHF, Nauni (Solan)
6.	Dean	College of Forestry, UHF, Nauni (Solan)
7.	Dean	College of Horticulture and Forestry, Hamirpur at Neri
8.	Dean	College of Horticulture and Centre of Excellence for Horticulture Research and Extension, Thunag, Distt. Mandi
9.	Director of Research	UHF, Nauni (Solan)
10.	All the Heads of Departments	UHF, Nauni (Solan)
11.	All the Associate Directors (R&E)	UHF
12.	Director of Extension Education	CSK HPKV, Palampur, District Kangra
13.	Joint Director (Training)	Directorate of Extension Education, UHF, Nauni (Solan)
14.	Joint Director (Communication)	Directorate of Extension Education, UHF, Nauni (Solan)
15.	Extension Coordinator	Directorate of Extension Education, UHF, Nauni (Solan)
16.	Deputy Commissioner	Solan
17.	Smt. Indu Thakur	W/o Sh. Ashutosh Vidya R/o Friends Colony, Village Chuchuwel, Nalagarh, Distt. Solan, H.P.
18.	Sh. Balwant Singh	R/o Village Janot, P.O Sangalwara, Tehsil Thunag, Distt. Mandi, H.P. - 175047
19.	Sh. Ganesh Sharma	R/o Village Band Kardian, PO Khel, Tehsil Nurpur, Distt. Kangra, H.P.
20.	Sh. Rajesh Gautam	R/o Village Jablu, PO Bakhlag, Kunihar, Distt. Solan, H.P.
21.	Sh. Satish Kumar Sharma	R/o VPO Badsala, Tehsil & Distt. Una, H.P.
22.	Registrar	UHF, Nauni (Solan)
23.	Comptroller	UHF, Nauni (Solan)
24.	Director of Extension Education	UHF, Nauni (Solan) – Member Secretary



RESEARCH COUNCIL

1.	Vice-Chancellor	UHF, Nauni (Solan) – Chairman
2.	Director of Horticulture	Government of Himachal Pradesh
3.	Director of Agriculture	Government of Himachal Pradesh
4.	Principal Chief Conservator of Forests	Government of Himachal Pradesh
5.	Dean	College of Horticulture, UHF, Nauni (Solan)
6.	Dean	College of Forestry, UHF, Nauni (Solan)
7.	Dean	College of Horticulture and Forestry, Hamirpur at Neri
8.	Dean	College of Horticulture and Centre of Excellence for Horticulture Research and Extension, Thunag, Distt. Mandi, H.P.
9.	Director of Extension Education	UHF, Nauni (Solan)
10.	All the Heads of Departments	UHF, Nauni (Solan)
11.	All the Associate Directors (R&E)	UHF
12.	Director of Research	CSK HPKV, Palampur, District Kangra
13.	Sh. Nanak Chand	Pradhan, Kamdhenu Hitkari Manch, VPO Namhol, Distt. Bilaspur, H.P.
14.	Sh. Mohan Singh Thakur	Village Barman, PO Jamta, Tehsil Nahan, Distt. Sirmour, H.P.
15.	Sh. Hariman Sharma	Village Paniyala, P.O Kothi, Tehsil Ghumarwin, Distt. Bilaspur, H.P.-174021
16.	Sh. Amit Mehta	Village Deonghat, PO Saproon Distt. Solan, H.P.
17.	Sh. Sudharshan Parmar	VPO Bhaleta, Tehsil Nurpur, Distt. Kangra, H.P.
18.	Registrar	UHF, Nauni (Solan)
19.	Comptroller	UHF, Nauni (Solan)
20.	Director of Research	UHF, Nauni (Solan)- Member Secretary

BOARD OF STUDIES (College of Horticulture)

1.	Dean	College of Horticulture, UHF, Nauni (Solan) - Chairman
2.	All the Heads of Departments	College of Horticulture, UHF, Nauni (Solan)
3.	Head of the Department of Basic Sciences	College of Forestry, UHF, Nauni (Solan)
4.	Head of the Department of Social Sciences	College of Forestry, UHF, Nauni (Solan)
5.	Head of the Department of Soil Science and Water Management	College of Forestry, UHF, Nauni (Solan)
6.	Dr. DP Sharma	Principal Horticulturist, Department of Fruit Science, COH, UHF, Nauni (Solan) (upto 30.06.2019)
7.	Dr. (Mrs.) ManjuModgil	Professor, Department of Biotechnology, COH, UHF, Nauni (Solan) (upto 30.06.2019).
8.	Dr. Mohinder Singh	Principal Extension Specialist, Department of Entomology, COH, UHF, Nauni (Solan) (upto 30.06.2019).
9.	Dr. Sita Ram Dhiman	Principal Extension Specialist, Department of Floriculture and Landscape Architecture, COH, UHF, Nauni (Solan) (upto 30.06.2019).
10.	Dr. Rakesh Sharma	Assistant Professor, Department of Food Science, COH, UHF, Nauni (Solan) (upto 30.06.2019).
11.	Dr. (Ms.) Meenu Gupta	Assistant Professor, Department of Vegetable Science, COH, UHF, Nauni (Solan) (upto 30.06.2019).



12.	Dr. (Ms.) Shalini Verma	Scientist, Department of Plant Pathology, COH, UHF, Nauni (Solan) (upto 30.06.2019)
13.	Dr. (Ms.) Rashmi Chaudhary	Assistant Professor, Department of Business Management, COH, UHF, Nauni (Solan) (upto 30.06.2019).
14.	Dr. J.K Dubey	Principal Entomologist, Deptt. of Entomology, COH w.e.f. 30.07.2019
15.	Dr. Yog Raj Shukla	Principal Extension Specialist, Deptt. of Vegetable Science, COH w.e.f. 30.07.2019
16.	Dr. (Ms.) Sunita Chandel	Principal Scientist, Deptt. of Plant Pathology, COH w.e.f. 30.07.2019
17.	Dr. Kapil Kathuria	Associate Professor, Deptt. of Business Management, COH w.e.f. 30.07.2019
18.	Dr. Rajesh Kumar Dogra	Scientist, Deptt. of Fruit Science, COH w.e.f. 30.07.2019
19.	Dr. (Ms.) Surekha Attri	Assistant Horticultural Technologist, Deptt. of Food Science & Technology, COH w.e.f. 30.07.2019
20.	Dr. (Ms.) Sapna Katna	Assistant Professor, Deptt. of Entomology, COH w.e.f. 30.07.2019
21.	Dr. (Ms.) Vipin Sharma	Assistant Professor, Deptt. of Vegetable Science, COH w.e.f. 30.07.2019
22.	Dr. Munish Kumar Sharma	Professor and Head, Department of Seed Science & Technology, COH, UHF, Nauni (Solan) - Secretary

BOARD OF STUDIES (College of Forestry)

1.	Dean	Dean, College of Forestry, UHF, Nauni (Solan)- Chairman
2.	All the Heads of Departments, College of Forestry	UHF, Nauni (Solan)
3.	Head of the Department of Entomology	College of Horticulture, UHF, Nauni (Solan)
4.	Head of the Department of Plant Pathology	College of Horticulture, UHF, Nauni (Solan)
5.	Head of the Department of Biotechnology	College of Horticulture, UHF, Nauni (Solan)
6.	Dr. HP Shankhyan	Principal Extension Specialist, Department of Tree Improvement and Genetic Resources, COF, UHF, Nauni (Solan) (upto 30.06.2019)
7.	Dr. KS Pant	Principal Scientist, Department of Silviculture and Agroforestry, COF, UHF, Nauni (Solan) (upto 30.06.2019)
8.	Dr. (Ms.) Ashu Chandel	Associate Professor, Department of Basic Sciences, COF, UHF, Nauni (Solan) (upto 30.06.2019).
9.	Dr. Sudhir Verma	Assistant Professor, Department of Soil Science and Water Management, COF, UHF, Nauni (Solan) (upto 30.06.2019).
10.	Sh. Jai Pal Sharma	Assistant Professor, Department of Tree Improvement and Genetic Resources, COF, UHF, Nauni (Solan) (upto 30.06.2019).
11.	Dr. MK Brahmi	Assistant Professor, Department of Environmental Science, COF, UHF, Nauni (Solan) (upto 30.06.2019).
12.	Dr. Bhupinder Gupta	Principal Agrostologist, Deptt. of Silviculture and Agroforestry, COF w.e.f. 30.07.2019
13.	Dr. Ravinder Sharma	Principal Scientist-cum-Joint Director (Forestry), Directorate of Research, UHF, Nauni (Solan) w.e.f. 30.07.2019
14.	Dr. I.K Thakur	Principal Scientist, Deptt. of Tree Improvement and Genetic Resources, COF w.e.f. 30.07.2019
15.	Dr. Mohan Singh Jangra	Senior Scientist, Deptt. of Environmental Science, COF w.e.f. 30.07.2019



16.	Dr. MukeshPrabhakar	Scientist, Deptt. of Silviculture and Agroforestry, COF w.e.f 30.07.2019 to 31.12.2019
17.	Dr. (Ms.) Anita Kumari	Assistant Professor, Deptt. of Tree Improvement and Genetic Resources, COF w.e.f. 30.07.2019
18.	Dr. Pradeep Kumar	Scientist, Deptt. of Soil Science & Water Management, COF w.e.f. 30.07.2019
19.	Dr. (Ms.) Neerja Singh Rana	Assistant Professor, Deptt. of Basic Sciences, COF w.e.f. 30.07.2019
20.	Dr. Bhupender Dutt	Professor, Department of Forest Products, COF, UHF, Nauni (Solan) – Secretary

BOARD OF STUDIES
(College of Horticulture and Forestry, Neri - Hamirpur)

1.	Dean	College of Horticulture and Forestry, Hamirpur at Neri - Chairman
2.	Dr. Som Dev Sharma	Principal Extension Specialist, Department of Horticulture, COH&F, Neri, Hamirpur (upto 22.05.2019)
3.	Dr. Deepa Sharma	Scientist (Veg.), Department of Horticulture, COH&F, Neri, Hamirpur (upto 22.05.2019).
4.	Dr. Kamal Sharma	Principal Scientist, Department of Forestry and Environment, COH&F, Neri, Hamirpur (upto 22.05.2019).
5.	Dr. Ravi Bhardwaj	Assistant Professor, Department of Forestry and Environment, COH&F, Neri, Hamirpur (upto 22.05.2019).
6.	Dr. Sita Ram Dhiman	Principal Extension Specialist, Department of Floriculture and Landscape Architecture, COH, UHF, Nauni (Solan) (upto 22.05.2019).
7.	Dr. (Ms.) Snehlata Sharma	Assistant Professor, Department of Biotechnology, COH&F, Neri, Hamirpur (upto 22.05.2019).
8.	Dr. KD Sharma	Principal Horticultural Technologist (FST), Department of Food Science and Technology, COH&F, Neri, Hamirpur (upto 22.05.2019)
9.	Dr. Virender Kumar Rana	Principal Extension Specialist, Department of Plant Protection, COH&F, Neri, Hamirpur (upto 22.05.2019).
10.	Dr. Ajay Sharma	Assistant Professor, Department of Plant Protection, COH&F, Neri, Hamirpur (upto 22.05.2019).
11.	Dr. VK Chaudhary	Principal Scientist, Department of Social and Basic Science, COH&F, Neri, Hamirpur (upto 22.05.2019).
12.	Dr. Amit Sharma	Assistant Professor, Department of Social and Basic Science, COH&F, Neri, Hamirpur (upto 22.05.2019).
13.	Dr. VipinGuleria	Senior Extension Specialist, Department of Forestry and Environment, COH&F, Neri, Hamirpur – Secretary (upto 22.05.2019))
14.	All the Heads of the Deptts	College of Horticulture and Forestry, Hamirpur at Neri (w.e.f. 30.07.2019)
15.	Dr. H.S Baweja	Principal Scientist, Deptt. of Floriculture and Landscape Architecture, COH, UHF, Nauni (Solan) (w.e.f. 30.07.2019)
16.	Dr. (Mrs.) Devina Vaidya	Principal Scientist, Deptt. of Food Science and Technology, COH, UHF, Nauni (Solan) (w.e.f. 30.07.2019)
17.	Dr. Rajinder Singh Rana	Principal Scientist, Deptt. of Seed Science & Technology, COH, UHF, Nauni (Solan) (w.e.f. 30.07.2019)
18.	Dr. Rajeev Aggarwal	Associate Professor, Deptt. of Environmental Science, COF, UHF, Nauni (Solan) (w.e.f. 30.07.2019)



19.	Dr. Shiv Pratap Singh	Assistant Professor, COH&F, Hamirpur at Neri (w.e.f. 30.07.2019)
20.	Dr. Som Dutt	Assistant Professor, COH&F, Hamirpur at Neri (w.e.f. 30.07.2019)
21.	Dr. Rajinder Singh Jarial	Scientist, COH&F, Hamirpur at Neri (w.e.f. 30.07.2019)
22.	Dr. Rakesh Kumar	Assistant Professor, COH&F, Hamirpur at Neri (w.e.f. 30.07.2019)
23.	Dr. B.S Dogra	Principal Scientist (Vegetable crops), COH&F, Hamirpur at Neri- Secretary (w.e.f. 06.09.2019)

FINANCE COMMITTEE

1.	Vice Chancellor	UHF, Nauni (Solan) – Chairman
2.	Secretary (Finance)	Government of Himachal Pradesh
3.	Secretary (Agriculture)	Government of Himachal Pradesh
4.	Secretary (Horticulture)	Government of Himachal Pradesh
5.	Registrar	UHF, Nauni (Solan)
6.	Examiner	Local Audit Department
7.	Director of Horticulture	Government of Himachal Pradesh
8.	Principal Chief Conservator of Forests	Government of Himachal Pradesh
9.	Comptroller	UHF, Nauni (Solan) - Member Secretary

OFFICERS OF THE UNIVERSITY

	Officers	Designation/Status
1.	Acharya Devvrat	Chancellor upto 21.07.2019
2.	Sh. Kalraj Mishra	Chancellor w.e.f. 22.07.2019 to 10.09.2019
3.	Sh. Bandaru Dattatraya	Chancellor w.e.f. 11.09.2019
4.	Dr. Hari C. Sharma	Vice Chancellor upto 14.06.2019
5.	Shri R D Dhiman, ACS (Hort) (Additional Charge)	Vice Chancellor w.e.f. 15.06.2019 to 08.07.2019
6.	Dr. Parvinder Kaushal	Vice Chancellor w.e.f. 09.07.2019
7.	Dr. Vijay Singh Thakur	Director of Extension Education upto 30.06.2019
8.	Dr. J N Sharma	Director of Extension Education (additional charge) w.e.f. 09.07.2019 to 29.07.2019
9.	Dr. Rakesh Gupta	Director of Extension Education w.e.f. 29.07.2019
10.	Dr. J N Sharma	Director of Research
11.	Dr. Rakesh Gupta	Dean, College of Horticulture upto 29.07.2019
12.	Dr. Rakesh Gupta	Dean, College of Horticulture (additional Charge) w.e.f. 29.07.2019 to 02.10.2019
13.	Dr. M. L. Bhardwaj	Dean, College of Horticulture w.e.f. 03.10.2019
14.	Dr. PK Mahajan	Dean, College of Forestry upto 31.07.2019
15.	Dr. PK Mahajan	Dean, College of Forestry (additional Charge) w.e.f. 31.07.2019 to 16.09.2019
16.	Dr. Kulwant Rai Sharma	Dean, College of Forestry w.e.f. 17.09.2019



17.	Dr. PC Sharma	Dean, College of Horticulture and Forestry, Neri, Hamirpur upto 30.11.2019
18.	Dr. R. S. Prashar (additional charge)	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 03.12.2019 to 29.02.2020
19.	Dr. Kamal Sharma	Dean, College of Horticulture and Forestry, Neri, Hamirpur w.e.f. 02.03.2020
20.	Dr. Y C Gupta	Dean, College of Horticulture and Centre of Excellence for Horticulture and Extension, Thunag.
21.	Shri Hira Mani Verma	Comptroller upto 10.02.2020
22.	Shri C. R. Sharma	Comptroller w.e.f. 20.02.2020
23.	Er (Ms) Aparna Rohela	Estate Officer upto 30.11.2019
24.	Er. Vijay Kumar Sharma (additional charge)	Estate Officer w.e.f. 01.12.2019 to 02.01.2020
25.	Er. (Ms) Anita Vaidya Kathuria	Estate Officer w.e.f. 03.01.2020
26.	Dr. J N Sharma (Additional charge)	Librarian w.e.f. 08.04.2019 to 11.06.2019
27.	Dr. (Mrs) A K Nath	Librarian w.e.f. 12.06.2019
28.	Dr. Kulwant Rai Sharma	Students' Welfare Officer w.e.f. 01.01.2019 to 31.07.2019
29.	Dr. P K Mahajan	Students' Welfare Officer w.e.f. 31.07.2019
30.	Shri Manoj Kumar Chauhan, HPAS (Additional Charge)	Registrar w.e.f. 01.04.2019 to 05.07.2019
31.	Shri Rajiv Kumar, HPAS	Registrar w.e.f. 05.07.2019 to 11.03.2020
32.	Shri Jai Paul Singh Negi, Deputy Registrar (additional charge)	Registrar w.e.f. 12.03.2020
Joint Directors		
33.	Dr. Ravinder Sharma	Joint Director Research (Forestry)
34.	Dr. RK Thakur	Joint Director (Communication)
35.	Dr. Mai Chand	Joint Director (Training)
36.	Dr. Satish K Sharma	Joint Director Research (Horticulture)
37.	Dr. MK Vaidya	Joint Director Research (Planning)
Heads of the Departments		
38.	Dr. JS Chandel	Professor & Head, Department of Fruit Science
39.	Dr. (Ms) Anju Kumari Dhiman	Professor and Head, Department of Food Science & Technology
40.	Dr. H R Gautam	Professor & Head, Department of Plant Pathology
41.	Dr. Divender Gupta	Professor & Head, Department of Entomology
42.	Dr. A K Sharma	Professor and Head, Department of Vegetable Science upto 31.12.2019.
43.	Dr. Hem Raj Sharma	Professor and Head, Department of Vegetable Science w.e.f. 14.01.2020



44.	Dr. H S Baweja	Additional charge of the post of Professor & Head, Department of Floriculture and Landscape Architecture upto 30.05.2019
45.	Dr. Rajesh Bhalla	Professor & Head, Department of Floriculture and Landscape Architecture w.e.f. 31.05.2019
46.	Dr. Rakesh Gupta, Dean, COH	Additional Charge of the post of Professor and Head, Department of Biotechnology upto 16.07.2019
47.	Dr. (Ms) ManjuModgil	Professor & Head, Department of Biotechnology w.e.f. 16.07.2019 (AN)
48.	Dr. K K Raina	Professor and Head, Department of Business Management
49.	Dr. P K Mahajan (Dean, COF)	Professor and Head, Department of SAF (additional charge upto 16.06.2019
50.	Dr. Kulwant Rai Sharma, (Dean, COF)	Professor and Head, Department of SAF (additional charge) w.e.f. 16.06.2019
51.	Dr. Sanjeev Thakur	Professor and Head, Department of Tree Improvement and Genetic Resources
52.	Dr. (Ms) Meenu Sood	Professor & Head, Department of Forest Product
53.	Dr. D D Sharma	Professor and Head, Department of Social Science
54.	Dr. J C Sharma	Professor and Head, Department of Soil Science and Water Management upto 16.09.2019.
55.	Dr. Kulwant Rai Sharma, (Dean, COF)	Professor and Head, Department of Soil Science and Water Management (additional charge) w.e.f. 16.09.2019 to 16.01.2020.
56.	Dr. J C Sharma	Professor and Head, Department of Soil Science and Water Management w.e.f. 16.01.2020.
57.	Dr. (Ms) Anju S. Thakur	Professor and Head, Department of Basic Sciences upto 31.07.2019
58.	Dr. (Ms) Nivedita Sharma	Professor & Head, Department of Basic Sciences w.e.f. 01.08.2019.
59.	Dr. Manish Kumar Sharma	Professor and Head, Department of Seed Science and Technology
60.	Dr. Satish Kumar Bhardwaj	Professor and Head, Department of Environmental Science

Associate Directors

61.	Dr. Pankaj Gupta	Associate Director (R&E), Regional Horticultural Research and Training Station, Mashobra (Shimla)
62.	Dr. H S Bhatia	Associate Director (R&E), Regional Horticultural Research and Training Station, Bajaura upto 30.11.2019.
63.	Dr. Bhupinder Singh Thakur	Associate Director (R&E), Regional Horticultural Research and Training Station, Bajaura w.e.f. 02.12.2019.
64.	Dr. ML Bhardwaj	Associate Director (R&E), Regional Horticultural Research and Training Station, Jachh upto 01.10.2019
65.	Dr. VipinGuleria	Associate Director (R&E), Regional Horticultural Research and Training Station, Jachh w.e.f. 15.10.2019 to 25.12.2019.
66.	Dr. Atul Gupta	Associate Director (R&E), Regional Horticultural Research and Training Station, Jachh w.e.f. 26.12.2019.
67.	Dr. AK Joshi	Associate Director (R&E), Regional Horticultural Research and Training Station, Dhaulakuan (Sirmaur)

68.	Dr. Shashi Kumar Sharma	Associate Director (R&E) and Prog. Coordinator, Regional Horticultural Research and Training Station and Krishi Vigyan Kendra, Sharbo (Kinnaur) upto 12.06.2019
69.	Dr. Durga Prasad	Routine work of the post of Associate Director (R&E) and Prog. Coordinator, Regional Horticultural Research and Training Station and Krishi Vigyan Kendra, Sharbo (Kinnaur) w.e.f. 16.08.2019 to 09.01.2020.
70.	Dr. Ashok Kumar	Associate Director (R&E) and Prog. Coordinator, Regional Horticultural Research and Training Station and Krishi Vigyan Kendra, Sharbo (Kinnaur) w.e.f. 10.01.2020
71.	Dr. Hem Raj Sharma	Associate Director (R&E) and Programme Coordinator, Horticultural Research and Training Station and Krishi Vigyan Kendra, Kandaghat (Solan) upto 29.08.2019
72.	Dr. D P Sharma	Associate Director (R&E) and Programme Coordinator, Horticultural Research and Training Station and Krishi Vigyan Kendra, Kandaghat (Solan) w.e.f. 30.08.2019.
73.	Dr. Rajeev Raina	Programme Coordinator, Krishi Vigyan Kendra, Chamba
74.	Dr. N S Kaith	Programme Coordinator, Krishi Vigyan Kendra, Rohru (Shimla)
75.	Dr. Sudhir Verma	Programme Coordinator, Regional Programme Coordinator, Horticultural Research Sub-Station and KVK, Tabo (Lahaul & Spiti)





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