Captain Amarinder Singh, Chief Minister of Punjab, having a look at maize varieties along with Dr Baldev Singh Dhillon, Vice Chancellor, at PAU.

The Governor of Punjab and Chancellor of PAU Sh VP Singh Badnore, and Former President of Islamic Republic of Afghanistan Sh Hamid Karzai inaugurating the Kisan Mela at PAU on September 20, 2018. Also seen in the picture is Dr Baldev Singh Dhillon, Vice Chancellor, PAU (centre).

Dr Baldev Singh Dhillon, Vice Chancellor, PAU, being conferred with Padma Shri by the President of India Sh Ram Nath Kovind at Civil Investiture Ceremony, held at Rashtrapati Bhawan, New Delhi, on March 11, 2019.
# CONTENTS

## RESEARCH

- CROP IMPROVEMENT ......................................................................................................................... 1-20
- GERMLASM ACQUISITION AND UTILIZATION ....................................................................................... 1
- BIOTECHNOLOGY ................................................................................................................................. 5
- SEED TECHNOLOGY ............................................................................................................................... 6
- CROP PRODUCTION TECHNOLOGIES ....................................................................................................... 8
- CROP PROTECTION TECHNOLOGIES ..................................................................................................... 11
- FOOD SCIENCE AND TECHNOLOGY ..................................................................................................... 11
- FOOD AND NUTRITION .......................................................................................................................... 15
- POST-HARVEST TECHNOLOGIES ........................................................................................................... 15
- RENEWABLE ENERGY ENGINEERING .................................................................................................. 16
- AGROFORESTRY ......................................................................................................................................... 16
- BEEKEEPING ............................................................................................................................................ 17
- PESTICIDE RESIDUE ANALYSIS .............................................................................................................. 17
- MUSHROOMS ............................................................................................................................................ 17
- FARM MACHINERY ................................................................................................................................. 17
- RODENT AND BAT CONTROL .................................................................................................................. 18
- AGRICULTURAL ECONOMICS ............................................................................................................... 18
- APPARELS AND TEXTILES ................................................................................................................... 19
- TECHNOLOGIES COMMERCIALIZED ..................................................................................................... 20

## EDUCATION

- EXAMINATION CELL ............................................................................................................................... 21-33
- NEW COURSES ......................................................................................................................................... 22
- STUDENTS’ ACADEMIC ACCOMPLISHMENTS ....................................................................................... 23
- SCHOLARSHIPS AND FINANCIAL ASSISTANCE .................................................................................. 24
- STUDENTS’ WELFARE ACTIVITIES .......................................................................................................... 24

## EXTENSION

- KISAN MELAS ........................................................................................................................................... 34-43
- FIELD DAYS ............................................................................................................................................. 34
- ADAPTIVE RESEARCH TRIALS .................................................................................................................. 35
- ON FARM TRIALS .................................................................................................................................... 35
- DEMONSTRATIONS ................................................................................................................................. 36
- SPECIAL CAMPAIGNS ............................................................................................................................. 39
- TRAININGS AND EXHIBITIONS ............................................................................................................... 40
- WORKSHOPS .......................................................................................................................................... 41
- FARMERS’ ORGANIZATIONS .................................................................................................................... 42
- INFORMATION AND COMMUNICATION TOOLS (ICTs) ...................................................................... 42
COMMUNICATION THROUGH MASS MEDIA ...............................................................................................................43
FARM PUBLICATIONS ...................................................................................................................................................43

HUMAN RESOURCE, FINANCE AND INFRASTRUCTURE DEVELOPMENT ...................................................... 44-62
NEW APPOINTMENTS, PROMOTIONS AND RETIREMENTS .....................................................................................44
AWARDS, DISTINCTIONS AND RECOGNITIONS ........................................................................................................44
NATIONAL AND INTERNATIONAL LINKAGES ...........................................................................................................50
TRAININGS AND VISITS ABROAD ..........................................................................................................................52
IMPORTANT EVENTS ORGANIZED ..........................................................................................................................53
ESTATE ORGANIZATION ........................................................................................................................................57
FACULTY PARTICIPATION ........................................................................................................................................57
NEW EQUIPMENT ACQUIRED ......................................................................................................................................60
NEW LABORATORIES AND INFRASTRUCTURE CREATED AND UPDATED.............................................................60
FINANCES ..................................................................................................................................................................61

MS RANDHAWA LIBRARY .......................................................................................................................................63-64

IMPACT ..................................................................................................................................................................... 65-67

ADMINISTRATION ................................................................................................................................................... 68-72
BOARD OF MANAGEMENT ...........................................................................................................................................68
ACADEMIC COUNCIL ...................................................................................................................................................70
IMPORTANT DECISIONS OF THE BOARD OF MANAGEMENT ..................................................................................71
IMPORTANT DECISIONS OF THE ACADEMIC COUNCIL .......................................................................................72

ANNEXURE-1 Important building construction and renovation projects ................................................................. 73
ANNEXURE-2 (Publications)................................................................................................................................ 74-129
SALIENT RESEARCH PAPERS IN HIGH IMPACT JOURNALS .............................................................................128

SUMMARY AND HIGHLIGHTS OF ANNUAL REPORT ........................................................................................... 130-140
Research programmes of the University are drawn in response to the prevalent situations as well as emerging challenges of agriculture in the region. The priority areas include crop improvement, enhanced productivity, sustainable natural resource management, crop diversification, climate resilient crops and technologies, crop residue management, integrated pest and disease management, high input use efficiency, and appropriate farm mechanization. Research programmes have also been oriented towards value addition and income enhancement through post-harvest handling and processing technologies, subsidiary occupations, study of value chains, and market analysis so as to help farmers make informed decisions about crop planning and marketing.

CROP IMPROVEMENT
The crop improvement programmes focused on productivity, tolerance to biotic and abiotic stresses, natural resource management, nutritional and processing quality, and in some cases novel traits of interest to producers/consumers. Varieties of field crops including pulses and forages (important for diversification) were released. Fruits, vegetables and ornamentals, having a diversification as well as income enhancing potential, constituted the larger component of varietal releases.

The University developed/released 19 varieties of different crops (7 of field, 3 of fruit, 8 of vegetable and 1 of ornamental crops) which were recommended for cultivation in Punjab. Out of these, two varieties of wheat, PBW 752 and PBW 757, developed by PAU were released at national level. Besides, one variety of lentil (LL 1373) and three varieties of vegetables (CH 27 of chilli, Matar Ageta 7 of pea and Punjab Raunak of brinjal) have been identified at national level, one in zones which do not include Punjab.

FIELD CROPS
• PBW 752 (Wheat): It has been released for cultivation under late-sown irrigated
conditions of the North Western Plains Zone of India and carries Yr10 gene for resistance against yellow rust. It is resistant to brown rust as well. It matures in about 120 days and yields on an average 19.9 q/acre. It also possesses high hectolitre weight and grain zinc concentration.

- **PBW 757 (Wheat):** It has been released for cultivation under very late-sown irrigated conditions (second half of December and first half of January) for the North Western Plains Zone of India. It is resistant to yellow and brown rust diseases and carries Yr15 gene for resistance against yellow rust. Under very late planting, it matures in about 104 days and yields 14.7 q/acre on average. It has very good chapatti quality.

- **Pusa Basmati 1718 (Basmati rice):** It is an improved version of Pusa Basmati 1121 and has been developed by Indian Agricultural Research Institute (IARI), New Delhi. It has resistance to bacterial blight disease (conferred by two genes Xa13 and Xa21). Its average plant height is 121 cm and it matures in about 114 days after transplanting. It possesses extra-long slender grains. Its average paddy yield is 17.0 q/acre.

- **SML 1827 (Summer mungbean):** It has been developed from an interspecific cross and has yellow mosaic disease (YMD) resistance derived from ricebean. The YMD resistance makes Kharif season seed production possible, which would facilitate its wider adoption. The variety SML 1827 matures in 62 days. It possesses medium sized shiny grains with good culinary properties including absence of hard grains. The average seed yield is 4.7 q/acre.

- **PMH 11 (Maize):** It is a single cross hybrid suitable for cultivation in Kharif season. The plants have sturdy stem and well developed root system. Ears are long with dark orange, flint grains. It matures in 95 days. Its average yield is 22.0 q/acre.

- **P1844 (Maize):** It has been developed by PHI Seeds Pvt. Ltd. and has been approved for cultivation in spring season. It is moderately tolerant to charcoal rot and Fusarium stalk rot diseases, and is moderately susceptible to shoot fly. Its average yield (in spring season) is 32.0 q/acre.

- **PBN 342 (Napier Bajra):** It is a hybrid with long, broad and smooth leaves. It sprouts early in spring and remains in vegetative growth till the onset of winter. It is resistant to leaf blight and possesses non-hairy and succulent leaves that enhance its fodder quality. It yields 877 q/acre of green fodder.
HORTICULTURAL CROPS

Fruit Crops

- **Punjab Apple Guava**: Trees of this variety possess round crown with drooping branches. Fruits are medium in size and round in shape. Fruits attain dark red (apple coloured) peel during winter season and have creamy flesh with medium-sized seeds. Fruits have 11.8% TSS and 0.45% acidity. Average fruit yield per tree is 58.0 kg. It is recommended for bearing in winter season only in order to fetch premium price due to attractive apple coloured peel.

- **Black Fig I**: Trees of this variety are compact and dwarf, and yield on an average 13.0 kg fruits per tree. Fruits mature from mid-June to first week of July. Fruits are medium to large in size, delicious with purplish-pink colour and have a medium sized eye. The flesh is cream to pink coloured and has an excellent flavour. It is suitable for dense planting (440 plants/acre in comparison to 110 plants/acre in earlier variety, Black Turkey).

- **Daisy Tangerine on Rough Lemon Rootstock**: Daisy tangerine plants propagated on Rough Lemon (*Citrus jambhiri*) rootstock are more suitable for cultivation in alkaline soils (pH more than 8.0) prevalent in South-Western zone of Punjab. Daisy Tangerine was previously recommended on Carrizo rootstock. The scion-stock combination of Daisy Tangerine-Rough Lemon imparts tolerance to tree decline along with higher yield (15%) in alkaline soils. Average yield of this combination is 47.4 kg fruits/tree.

Vegetable Crops

- **PTH 2 (Tomato)**: First picking of this hybrid tomato is possible after 114 days of transplanting. Fruits are round, deep red, medium sized (75 g) and firm with 3-4 locules. Fruits have 4.2° Brix TSS and 4.7 mg/100 g lycopene content. It is resistant to late blight and root knot nematodes. It yields on an average 270 q/acre and is suitable for processing purposes.

- **PSM 1 (Capsicum)**: Fruits of this bell pepper variety are uniform, non-pungent, sweet flavored, each weighing about 82 g under poly-net house and 75 g under low tunnel. It gives an average yield of 246 q/acre under poly-net house and 82 q/acre under low tunnel cultivation. It is an early maturing variety and gets ready for first picking in 109 days after transplanting under poly-net house and in 120 days under low tunnel cultivation. It has shelf life of 4 days at ambient temperature and is suitable for fresh market and distant transportation. It is tolerant to high temperature and its seed can be produced in plains.
• **PRO 7** (**Onion**): Its bulbs are red, medium-large and round with thin tight neck. It is an early maturing variety and takes 120 days from transplanting to harvesting. It has good keeping quality and tolerance to bolting. Its average yield is 159 q/acre. It is suitable for fresh consumption and early maturity will help fetch premium prices.

• **PWO 35** (**Onion**): Its bulbs are white, medium-large and round with tight neck. It takes 139 days from transplanting to harvesting. It has good keeping quality and tolerance to bolting. Its average yield is 155 q/acre. White colour and high TSS make it suitable for flakes and powder making. These products have good export potential and are getting established in Indian market also.

• **PYO 102** (**Onion**): Its bulbs are yellow, large and globular with tight neck. It takes 141 days from transplanting to harvesting. It has good keeping quality and tolerance to bolting. Its average yield is 164 q/acre. It is suitable for fresh consumption and export.

• **PC 161** (**Carrot**): It is a tropical variety with deep red colour. The carrots on an average are 30.7 cm long and slender with 2.8 cm diameter. This variety has an average yield of 256 q/acre.

• **Punjab Karela 15** (**Bitter gourd**): Its fruits are dark green and have a matted appearance. It is moderately resistant to yellow mosaic disease. Its average yield is 51 q/acre. It takes 71 days from sowing to first fruit harvest.

• **Punjab Nawab** (**Pumpkin**): Its fruits are medium sized with flat-round shape and

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Varieties identified/released at national level

<table>
<thead>
<tr>
<th>Variety (Crop)</th>
<th>National Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBW 752 (Wheat)*</td>
<td>North Western Plains Zone</td>
</tr>
<tr>
<td>PBW 757 (Wheat)*</td>
<td>North Western Plains Zone</td>
</tr>
<tr>
<td>LL 1373 (Lentil)</td>
<td>North Western Plains Zone</td>
</tr>
<tr>
<td>CH 27 (Chilli)</td>
<td>Zone IV (Punjab, UP, Bihar and Jharkhand)</td>
</tr>
<tr>
<td>Matar Ageta (Pea)</td>
<td>Zone IV (Punjab, UP, Bihar and Jharkhand)</td>
</tr>
<tr>
<td>Punjab Raunak (Brinjal)</td>
<td>Zone VI (Haryana, Delhi, Rajasthan and Gujarat) and Zone VII (Madhya Pradesh, Maharashtra and Goa)</td>
</tr>
</tbody>
</table>

*Released at national level*
mottled-brown colour at maturity. Fruit cavity is medium, and flesh is thick and golden-yellow. It is tolerant to pumpkin yellow vein mosaic virus disease (which is serious during rainy season). It gives 137 q/acre yield. Its suitability for lean period rainy season cultivation is expected to attract premium prices.

**Flowers and Ornamentals**

- **Punjab Glad 3**: Its leaves are green and sword shaped. Its spike length is 103 cm with 17 florets. The florets are bright yellow with 17 days vase life. It takes 105 days to flower; produces 1 corm, 22 cormels per corm on an average; and is suitable for cut flower production.

**GERMLASM ACQUISITION & UTILIZATION**

In order to tap genetic diversity for various valuable traits, the PAU has been continuously acquiring and sharing germplasm resources with other institutes. During the year 2018-19, 4,921 accessions of different field; vegetable and fruit crops; flowers and ornamentals; and forest trees were acquired.

**Cereals**

- In case of wheat, 1,263 lines were obtained from various Consultative Group on International Agricultural Research (CGIAR) organisations: 903 elite germplasm lines from International Maize and Wheat Improvement Center (CIMMYT), 280 from HarvestPlus for biofortification, and 80 lines were obtained from International Center for Agricultural Research in the Dry Areas (ICARDA) for stress traits like drought tolerance.
- In case of rice, 581 lines sourced from International Rice Research Institute, Philippines represented genetic sources for resistance to blast, bacterial blight, brown plant hopper (BPH) and iron biofortification.
- Maize accessions (636) were obtained from International Maize and Wheat Improvement Center, ICAR - National Bureau of Plant Genetic Resources (NBPGR) and ICAR - Indian Institute of Maize Research.
- Germplasm received in case of pearl millet involved 152 accessions from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) which were explored for high biomass and potential for dual purpose variety development.

**Cotton**

- Germplasm utilization in cotton focused on advancing derivatives from interspecific hybrids between *Gossypium hirsutum* and wild cotton species *G. armourianum* and *G. anomalum*.

**Pulses**

- In case of pigeonpea, 20 restorer and CMS lines were sourced from Indian Agricultural Research Institute, New Delhi and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad which are being employed in hybrid breeding. Besides, 20 extra-early determinate and non-determinate ICRISAT lines are being evaluated.
- *Mungbean* germplasm entries (25), sourced from ICAR - Indian Institute of Pulses Research, Kanpur, were evaluated for yellow mosaic virus resistance and other useful traits and utilized in crossing programme.
- Chickpea materials (288) from ICRISAT were evaluated for *Ascochyta* blight, *Botrytis* grey mould and yield components for prospective donor identification.
Oilseeds

- Germplasm activities in soybean involved evaluation of 200 soybean lines sourced from United States Department of Agriculture (USDA). Besides, 50 lines obtained from ICAR - Indian Institute of Soybean Research, Indore were screened against yellow mosaic virus.
- In case of sunflower, germplasm received from ICAR - Indian Institute of Oilseeds Research, Hyderabad involved various oil and confectionery purpose inbred lines that are being evaluated for use in heterosis breeding.

Vegetable Crops

- Okra germplasm procured from The ICAR-NBPGR Regional Station, Thrissur was employed as donor to transfer yellow vein mosaic virus resistance in cultivated okra varieties.
- Potato lines from ICAR - Central Potato Research Institute were evaluated for frost tolerance.
- Chilli accessions obtained from *Krishi Vigyan Kendra*, Dhalai, Tripura; Indian Agricultural Research Institute, New Delhi and Israel were evaluated for traits like pungency, leaf curl virus resistance, and to develop pickle type variety.
- Brinjal germplasm included *Solanum insanum*, collected by PAU from South India; *S. torvum*, introduced from USA; *S. xanthocarpum* from Palampur, Himachal Pradesh; and *S. sisymbrifolium*, collected by PAU from South India. These collections were evaluated for resistance to nematodes, bacterial wilt and borer, and tolerance to frost.
- Muskemelon accessions, obtained from The ICAR-NBPGR, New Delhi were evaluated for various yield and quality traits.
- Snapemelon and wildmelon entries collected from Sangrya, Rajasthan and Bathinda, respectively were evaluated for disease resistance.

Fruits

- Dragon fruit accessions of different colours were collected from Central Island Agricultural Research Institute, Port Blair for exploring its adaptability to Punjab conditions.
- Papaya accessions were collected from local farmers of Port Blair.
- Taiwan Pink guava from Vijaywada, Andhra Pradesh was obtained for exploiting desirable traits related to flesh colour, fruit quality and shelf life.

Flowers and Ornamentals

- Flower plant entries including chrysanthemum (3), gladiolus (1) and rose (2) were acquired for evaluation and breeding under local conditions besides 5 orchid entries for evaluation and standardization of production technology.

Agroforestry

- Germplasm characterization efforts in agroforestry encompassed willow, poplar, neem and Eucalyptus materials, which were sourced from Dr YS Parmar University of Horticulture and Forestry, Solan; Forest Research Institute, Dehradun and Rajasthan.

BIOTECHNOLOGY

Field Crops

- Two wheat varieties i.e. PBW 752 and PBW 757, released during the report period, are based on marker assisted selection for Yr10 and Yr15 genes, respectively.
- Four populations derived from two synthetic hexaploid wheats and two cultivated wheat genotypes were evaluated for nitrogen use efficiency.
(NUE). Genotyping by sequencing was conducted for two populations and genes/quantitative trait locus (QTL) governing NUE will be mapped. Differential gene expression of the genes implicated in NUE is being studied in the parental lines.

- Mapping populations are being developed through speed breeding for mapping Karnal bunt resistance in wheat transferred from three wild species, *Aegilops triuncialis, Ae. tauschii* and *Triticum monococcum*.

- Aphid resistance is being transferred from two *Ae. tauschii* accessions to bread wheat background. The BC2F3s with aphid resistance will be characterized with molecular markers for identifying the introgressions and the markers linked to the resistance.

- Advanced breeding lines carrying brown plant hopper (BPH) resistance conferred by *Bph 34* gene (previously transferred from *Oryza nivara*) were developed.

- To help identify genomic regions responsible for nematode resistance, introgression profiling of interspecific lines derived from the cross of PR 121 x *O. glaberrima* has been generated.

- The genetic mapping for heat stress tolerance in maize has indicated location of quantitative trait locus on chromosome 3 and 5.

- The *Bt-Cry1Ac* gene has been introgressed into elite chickpea lines through backcross breeding. The introgressed lines were evaluated against *Helicoverpa armigera*.

### Horticultural Crops

- Genome editing approach involving CRISPR/Cas9-pectate lyase gene construct is being used in tomato variety Punjab Ratta for enhancing shelf life.

- New molecular markers have been developed in guava by comparative transcriptomics of Allahabad Safeda, Punjab Pink, Purple Local, CISH-G5/Apple Colour and L-49/Sardar Guava.

- High-throughput genome sequencing of

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### Seed production (q) during 2018-19

<table>
<thead>
<tr>
<th>Field crops</th>
<th>Breeder seed</th>
<th>Foundation seed</th>
<th>Certified seed</th>
<th>Truthfully labelled</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Kharif</em> 2018</td>
<td>618</td>
<td>1,184</td>
<td>14,879</td>
<td>5,014</td>
<td>21,695</td>
</tr>
<tr>
<td><em>Rabi</em> 2018-19</td>
<td>3,574</td>
<td>5,652</td>
<td>24,567</td>
<td>1,736</td>
<td>35,529</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,192</strong></td>
<td><strong>6,836</strong></td>
<td><strong>39,446</strong></td>
<td><strong>6,750</strong></td>
<td><strong>57,224</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetable crops</th>
<th>Breeder Seed</th>
<th>Foundation Seed</th>
<th>Certified Seed</th>
<th>Truthfully labelled</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer season</td>
<td>1.47</td>
<td>0.88</td>
<td>6.10</td>
<td>41.45</td>
<td>49.90</td>
</tr>
<tr>
<td>vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter season</td>
<td>21.75</td>
<td>51.50</td>
<td>242.50</td>
<td>246.45</td>
<td>562.20</td>
</tr>
<tr>
<td>vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>23.22</strong></td>
<td><strong>52.38</strong></td>
<td><strong>248.60</strong></td>
<td><strong>287.90</strong></td>
<td><strong>612.10</strong></td>
</tr>
<tr>
<td>Potato</td>
<td>81.50</td>
<td>1,863.00</td>
<td>620.00</td>
<td>217.50</td>
<td>2,782.00</td>
</tr>
<tr>
<td>Turmeric</td>
<td>35.00</td>
<td>-</td>
<td>-</td>
<td>247.00</td>
<td>282.00</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>116.50</strong></td>
<td><strong>1,863.00</strong></td>
<td><strong>620.00</strong></td>
<td><strong>464.50</strong></td>
<td><strong>3,064.00</strong></td>
</tr>
</tbody>
</table>
guava cv. Allahabad Safeda has been carried out for creating chromosomal level genome assembly (500 X Illumina data, 55X PacBio data, 100-400X BioNano optical mapping data).

SEED AND NURSERY PRODUCTION
- In order to provide the farmers with quality seed input, the University has been carrying out a comprehensive seed production programme by following rigorous standards of seed purity. During the year 2018-19, PAU produced 57,224 q seed of field crops, 612 q of vegetable crops, and 3,064 q propagation material of potato and turmeric.

Nursery production
- About 5.70 lakh quality nursery fruit plants and 63,500 agroforestry seedlings were produced and provided to farmers.

CROP PRODUCTION TECHNOLOGIES
Research programmes of the University aim at developing production technologies for tapping full potential of crop varieties, conservation of natural resource base, crop residue management and for enhancing farm profits. Technologies developed during the report period laid emphasis on micro-irrigation/fertigation, new cropping systems, efficient nutrient management with special focus on digital technologies, energy conservation and soil-less vegetable cultivation for urban/peri-urban areas.

Field Crops

Micro-irrigation
- Sub-surface drip irrigation and fertigation technology package in summer moong-maize-wheat cropping system has been recommended. Sub-surface drip lines need to be placed at 20 cm depth with drippers 20 cm apart using row to row spacing of 67.5 cm. Two rows of summer moong, one row of maize and two rows of wheat sown on each line of sub-surface drip during respective seasons gave 18.4 per cent higher system productivity (maize equivalent yield) besides saving 28.5 per cent of irrigation water and 20 per cent of fertilizers.
- Surface and sub-surface drip fertigation recommended in sugarcane at 100 per cent cumulative pan evapotranspiration with 80 per cent recommended dose of N fertilizer in 10 equal splits helps save 40-50 per cent of irrigation water and 20 per cent of N fertilizer.
- Drip irrigation schedule recommended in raya and gobhi sarson results in 12.7 per cent and 23.0 per cent higher seed yield, respectively. Besides, drip irrigation saves 15.8 per cent and 26.2 per cent of irrigation water in raya and gobhi sarson, respectively along with 20 per cent of nutrients in both the crops.

Cropping systems integrating micro-irrigation and conservation agriculture
- A solar energy operated tubewell and drip irrigation system has been recommended in two sub-surface drip irrigation systems: direct seeded zero-till rice-wheat system and maize-wheat permanent bed system. The rice-wheat and maize-wheat systems save about 48 per cent and 53 per cent of water, respectively, over conventional flood irrigation and confer 2 per cent and 9 per cent yield advantages, respectively.

Direct seeded rice and legume based systems
- Direct seeded rice (DSR)-potato-onion, DSR-potato-mentha, and direct seeded basmati rice (DSBR)-potato-mentha cropping systems have been recommended. The cropping systems with mentha and onion gave 124, 119 and 115 per cent increase in rice equivalent yield, respectively as compared to transplanted rice-wheat cropping system. Rice equivalent yield for DSBR-potato-mentha and soybean-pea-
summer *moong* system was 115 and 51 per cent higher, respectively than the conventional transplanted rice-wheat system. An all legume cropping sequence of soybean-pea-summer *moong* has also been recommended. Introduction of direct seeded rice and legumes in sequences confers water saving and soil health advantages.

**Fine-tuning method and time of planting**

- Planting on beds with row to row spacing of 67.5 cm and plant to plant spacing of 20 cm or on 60 cm apart ridges in *Kharif* maize provides a yield advantage of 10 per cent and 14 per cent, respectively over flat sown crop. In addition, planting by these methods witnesses low incidence of bacterial stalk rot and banded leaf and sheath blight.

- For obtaining better yields from transplanted *gobhi sarson* and African *sarson*, seedling age of 30 days is optimum for current set of varieties.

- Sowing time of *toria* has been extended from first half of September to whole of September as germination of crop was noticed to suffer from rainfall and high temperature. Earlier time recommended for *toria* sowing allowed it to be grown as a catch crop before late sown wheat which is not that common. Now, *toria* can be grown as a catch crop before other crops (like sunflower, spring groundnut, etc.) sown in January and February.

**Minor crop and intercrop agronomy**

- Package of standardized production technologies for sugarbeet, a short duration sugar crop, has been recommended. Sugarbeet can potentially extend crushing season by two months besides being suitable for bio-ethanol production.

- Relay planting of pea, on ridges placed 60 cm apart, with celery germinating naturally from shattered seed of previous crop has been recommended. The recommended practice yielded on an average 32.4 q/acre pea and 4.8 q/acre celery in comparison to 35.6 q/acre pea and 5.8 q/acre celery in respective sole crops.

**Nutrient management**

- The GreenSeeker optical sensor technology that recommends optimum nitrogen (urea) dose based upon greenness index called Normalized Difference Vegetation Index (NDVI) has been recommended for wheat crop. It allows mid-season correction of nitrogen deficiency. Precise application of N in this way benefits both farmers and environment.

- A smart phone application, PAU Urea Guide App, has been developed. The App uses data collected from PAU Leaf Colour Chart and GreenSeeker for working out optimum urea dose for crops like wheat, rice, *basmati*, maize and cotton. Efficient urea consumption extends both economic and environmental advantages.

- Using 100 kg N/ha through neem-coated urea in wheat gives yield equivalent to that obtained by using 120 kg N/ha through ordinary urea, but using neem-coated urea @ 120 kg N/ha provides additional yield (8.6%) advantages. Hence, use of neem-coated urea @ 120 kg N/ha has been recommended in wheat to derive higher yields.

- The previously recommended schedule (three equal splits: basal, 21 and 42 days after transplanting for nitrogen fertilizer (urea)
application in rice) has been modified to three equal splits – 7, 18 and 36 days after transplanting – in case of short duration varieties PR 126 and PR 124 to get higher yields.

- Foliar application of potassium nitrate and/or salicylic acid has been recommended in wheat for yield enhancement through mitigating the effect of heat stress. Two sprays of potassium nitrate (N:P:K::13:0:45) @ 2% at flag leaf stage and anthesis stage or alternatively, two sprays of salicylic acid (75 mg/ml) may be given. Foliar applications of potassium nitrate and salicylic acid in this way enhanced yield by 12.5 and 8.1 per cent, respectively. Salicylic acid use significantly improved 1,000-grain weight as well.

Biofertilizers

- Dipping of rice seedlings in *Azospirillum* (free-living, nitrogen fixing bacteria) biofertilizer solution (@ 5 g/litre of water) for 45 minutes before transplanting has been recommended for yield and soil health advantages.

- The recommended wheat consortium biofertilizer cultures were analyzed for their tolerance/susceptibility towards recommended plant protection chemicals (chlorpyrifos, fipronil, triazole, carboxin, thiram, sulfosulfuron, and isoproturon) for wheat crop. Soil microbial population (total bacteria, fungi, actinomycetes, nitrogen fixers and phosphate solubilizers), soil enzymatic activities (dehydrogenase, alkaline phosphatase and urease), soil NPK content, plant growth promoting characters and yield of wheat crop were not affected when plant protection chemicals were used at recommended rates.

- During 2018-19, the University produced biofertilizers for 69,500 acres of various crops for distribution among farmers.

Horticultural Crops

Micro-irrigation

- Drip irrigation and fertigation technology package has been recommended for densely planted *Kinnow* (6m X 3m spacing) involving fertigation in 15 equal splits from February to April and 12 splits from July to mid-September. It raises yield by 30 per cent besides saving water and fertilizers (20%) in comparison to conventional irrigation system under high density plantation.

- During scarcity of canal water, life-saving irrigation to *Kinnow* mandarin trees can be occasionally provided through drip irrigation by mixing fresh (canal water) and saline water (tubewell water with electrical conductivity around 2 mmhos/cm).

- Micro-irrigated soil-less rooftop/terrace vegetable nutrition garden model for urban/peri-urban areas and hobbyists has been recommended. A five-row model requires a gross area of 20 m², whereas a three-row model needs gross area of 13 m². The structure can withstand wind speed up to 169 km/hour. Staggered sowing/transplanting/cutting can ensure vegetable supply throughout the year for a family of 3-4 persons.

- Drip irrigation and fertigation package has been recommended in pumpkin (at 100% replenishment of cumulative evapo-transpiration and 80% of recommended fertilizer dose), which provides 55 per cent higher yield besides saving 50 per cent of water in comparison to conventional system.

- Micro-irrigated soil-less (cocopeat slabs) cultivation of seedless (parthenocarpic) cucumber under naturally ventilated polyhouse has been recommended. The technology increased fruit yield by 26.5 and 21.2 per cent over the conventional soil-
based system in September and January sown crop, respectively.

- Drip irrigation in marigold involving 100 per cent replenishment of cumulative evapotranspiration along with fertigation of 100 kg N/ha (220 kg urea per ha) has been recommended. The technology provided 20.6 per cent increase in flower yield over the conventional system.

### Nutrient management

- Two foliar sprays of potassium nitrate @ 1.5% during mid-November and again in mid-January helped to increase the ber fruit weight and yield (by 15.8 and 11.7%, respectively).
- Dipping of *Rabi* onion seedlings in biofertilizer solution, made by mixing one kg of biofertilizer consortium (*Azotobacter* sp.+*Sphingobacterium* sp.+*Burkholderia* sp.) in 100 litres of water, for 30 minutes has been recommended for onion yield improvement (by about 16%).

### CROP PROTECTION TECHNOLOGIES

Plant protection research initiatives laid emphasis on preventive management of wheat rust; eco-friendly pest control interventions in *basmati* rice, cotton and vegetables; and weed control in wheat through integrated approach and through paddy straw mulching in soybean and poplar nursery. In fruits and vegetable crops, the focus was on weed control and maintaining healthy moisture regimes through paddy straw mulching and extension of trap technology for eco-friendly management of fruit fly in some vegetable crops.

#### Field Crops

**Wheat**

- Forewarning system for the effective management of yellow rust of wheat has been recommended. It is a weather-driven (within season hourly weather variables) model and is based on well-established effects of environmental factors on disease cycle of yellow rust.
- Regular surveys for yellow rust disease were conducted during off season of wheat in mid- and lower-Himalayan ranges falling in Himachal Pradesh during October and November 2018. Snowfall in October led to drop in temperature that made yellow rust fungus dormant and as a result, no uredial infection was observed during surveys. Low inoculum in hills eventually led to overall low incidence of yellow rust during *Rabi* 2018-19 in Punjab.

- Loose smut of wheat can be managed by treating seed with *Tebuseed 2DS* (tebuconazole 2%) @ 4 g per kg seed. The treatment reduced loose smut and flag smut by 95 per cent and 90 per cent, respectively.
- The DNA barcoding studies to characterize 11 samples of wheat armyworm collected from different regions like Patiala, Fatehgarh Sahib, Kapurthala, Shambhu border and PAU Ludhiana, led to identification of nine samples as *Mythimna loreyi* and two as *Mythimna separata*.

**Rice**

- Spider populations, which act as natural enemies, were monitored in rice fields in South-Western region (Fazilka and Abohar) of Punjab. *Tetragnatha javana* was predominant spider species (45.6%) followed by *Tetragnatha maxillosa* (30.2%), *Neoscona theisi* (18.2%) and *Oxyopes kusumae* (6.0%).
- To manage seed-borne diseases in rice, slurry of *Sprint 75WS* (@ 3 g in 10 ml water/kg seed) can be used for seed treatment.

**Basmati Rice**

- Application of neem based formulation, *Achook* (azadirachtin 1,500 ppm) @ 1,000
ml/acre has been recommended in *basmati* rice for the management of rice stem borers and leaf folders under organic and normal cultivation conditions, especially, when their population/damage level is low in the season. The recommendation will add to options of mechanical control with coir/jute rope and tricho cards available to organic *basmati* growers.

- The augmentative releases of *Trichogramma chilonis* and *T. japonicum* each @ 1,00,000/ha (5-6 releases at weekly interval) in *basmati* rice at farmers' fields (294 acres) resulted in 51.2 and 57.1 per cent reduction in stem borers and leaf folders, respectively.
- Planting of border rows of flowering plants viz. marigold, Mexican marigold, spotted snapweed/balsam, sesame, soybean, *arhar* and okra raised the abundance of natural enemies in *basmati* rice.
- The bio-intensive pest management (BIPM) practices in organic *basmati* rice involving recommended variety, optimum time of transplanting, proper spacing, green manuring, water management, erection of straw bundles, planting marigold and balsam on bunds and one spray each of neem (azadirachtin 50,000 ppm @ 200 ml/ha) and biopesticide (*Metarhizium anisopliae* @ 2.5 kg/ha) resulted in 31.7 per cent reduction in plant hoppers' population.

**Cotton**

- Home-made neem extract @ 1,200 ml/acre (using 125-150 litres of water) has been recommended for managing cotton whitefly. The extract is prepared by boiling 4 kg biomass of terminal shoot parts including leaves, green stems and fruits in 10 litres of water for 30 minutes. The home based neem extract performs at par with the recommended commercial neem based formulations. This extract is recommended for use during initial build-up of whitefly population in order to conserve natural enemies.
- Study on temporal distribution of whitefly, a polyphagous pest, showed that its population remained low during winter and spring seasons (average 0-3.3 per leaf), whereas the highest population was recorded during second half of April. Brinjal, tomato, potato, radish, mustard, Congress grass, *bathu* and *hiran khuri* serve as main hosts for overwintering whitefly. Spring season *moong*, cucurbits and okra along with weeds like Congress grass, *puthkanda* and *chulai* help in initial build-up of population.
- Whitefly in cotton can be controlled with the application of Applaud 25SC (buprofezin) @ 400 ml and Dantotsu 50WDG (clothianidin) @ 20 ml per acre using 125-150 litres of water. This recommendation will widen the choice of pesticides for the cotton farmers.
- Delegate 11.7 SC (spinetoram) @ 170 ml/acre (125-150 litres of water) has been recommended for managing thrips, *Thrips tabaci*, in cotton.

**Maize**

- Banded leaf and sheath blight, caused by *Rhizoctonia solani*, has been identified as an emerging disease in maize. Amistar Top 352 SC (azoxystrobin 18.2%+difenoconazole 11.4% w/w SC) @ 100 ml/acre has been recommended to manage this disease.

**Sugarcane**

- Bio-suppression of sugarcane borers using egg parasitoids,*Trichogramma* spp. @ 50,000 per ha at 10 days interval reduced the incidence of early shoot borer, top borer and stalk borer by 54.2 to 59.4 per cent.
- Sugarcane leaf hopper, *Pyrilla perpusilla* Walker, can be managed with Dursban 20 EC (chlorpyriphos) @ 600 ml/acre.
Fodder Crops
• In fodder maize, *Trichogramma* based T-cards (50,000 parasitized eggs per acre) can be used to control stem borer. The cards cut into 50 strips need to be placed in plant whorls twice – first release on 10 days old crop and second one week thereafter.

• Sorghum shoot fly, *Atherigona soccata*, in forage sorghum can be managed by seed treatment with Slayer 30FS (thiamethoxam) @ 10 ml/kg seed. Seed treatment helps save labour involved in foliar application of insecticides. Also, this chemical is relatively less adverse to population of natural enemies.

Pulses
• Pod borer complex (*Maruca vitrata* and *Helicoverpa armigera*) in pigeonpea can be managed by using green triangle (slightly toxic) insecticides Coragen 18.5 SC (chlorantraniliprole) @ 60 ml or Fame 480 SC (flubendiamide) @ 40 ml per acre (using 100-125 litres of water) at flower initiation and pod initiation stages.

• Gram pod borer, *Helicoverpa armigera*, in gram can be managed by spraying 50 ml Coragen 18.5 SC (chlorantraniliprole) or 80 g Proclaim 5 SG (emamectin benzoate) or 160 ml Rimon 10 EC (novaluron) in 80-100 litres of water per acre on the appearance of pest at the start of pod formation. The application can be repeated, if necessary, after two weeks. The waiting period for consumption of green leaves and pods gets significantly reduced to three days (in comparison to 20 days in case of earlier recommended pesticides) when green triangle Coragen 18.5 SC (chlorantraniliprole) is used.

• Integration of microbial and insecticide spray schedule for the management of pod borer complex in *mungbean* reported minimum pod damage (6.9%) in treatment with two sprays of Spinosad 45 SC. It was at par with treatments involving first spray with Bt formulation and second with Spinosad 45 SC; and two sprays of Bt formulation. Significantly higher pod damage (15.6%) was recorded in untreated control.

Oilseeds
• Sclerotinia rot disease in rapeseed-mustard can be partly managed (reduction in disease incidence by 46.9%) by avoiding irrigation during the period December 25 to January 15.

• Collar rot or seed rot of groundnut can be managed by seed treatment with Tebuconazole 2 DS @ 1.5 g per kg kernels.

Vegetable Crops
• Eco-friendly management of fruit fly, *Bactrocera cucurbitae*, using cue-lure based bottle trap in cucurbits (bitter gourd and sponge gourd) has been recommended.

The technology employs male annihilation technique (MAT) which keeps male population levels below mating threshold. The traps when used @16 traps/acre (during
second half of March in bitter gourd and of April in early season sponge gourd crop and fourth week of June in main season crop) recorded 21.3 per cent fruit fly infestation in comparison to 23.5, 16.6 and 74.8 per cent in commercially available trap, insecticide application and untreated control, respectively.

- Evaluation of BIPM (involving seed treatment with *Trichoderma harzianum* @ 10 g/kg of seed, marigold as trap crop, pheromone traps @ 1 trap per plot, *Trichogramma pretiosum* @ 50,000 per release (6 releases) and azadirachtin 1,500 ppm @ 2 ml/litre water) in tomato resulted in 31.6 per cent reduction in fruit damage due to tomato fruit borer as compared to 42.5 per cent in chemical control. The fruit damage in untreated control was 18.8 per cent.

- Three releases of *Chrysoperla zastrowi* sillemi @ 4 larvae/plant resulted in 88.2 per cent reduction in aphid population over untreated control on capsicum grown under net house.

- Ratoon crop of brinjal recorded more moth catch as compared to uprooted stalks and within the ratoon crops, the plants left as such recorded more moth catch than the plants which were cut. Thus, the plants left in the field as such serve as a source of inoculation/carry-over of the pest.

- Spiromesifen 22.9SC @ 150 ml/acre can be used for wheat sowing, herbicide application and hand pulling of escaped weed plants provides effective weed control and depletes weed seed bank.

- Post-emergence spray of ACM-9 (metribuzin 20% + clodinafop propargyl 9%) @ 600 g/ha provides effective control of herbicide resistant *P. minor* and other grass and broadleaf weeds; the herbicide, however, should not be used on wheat variety PBW 550.

- New pre-emergence weedicides pyroxasulfone 85 WG (@ 150 g/ha) and flumioxazin (Maxx 50% SC @ 200-250g/ha) have been recommended. However, flumioxazin should be restricted to medium- or heavy-textured soils in order to avoid phytotoxicity to wheat crop.

- With resistance emerging to widely used post-emergence weedicides, emphasis has been shifted to pre-emergence sprays. The dosage of pre-emergence spray of pendimethalin 30 EC has been enhanced to 3.75 litres/ha to provide effective control of *P. minor*.

**Soybean**

- Integrated use of paddy straw mulch @ 6 t/ha and one hand weeding at six weeks after sowing provides effective control of broad spectrum of weeds in organic soybean.

**Ber**

- To control weeds and derive higher yields in ber orchards, application of paddy straw mulch @ 5.0 tonnes/acre in the second fortnight of October after application of second dose of fertilizers has been recommended. Thereafter, it should be incorporated during May-June along with the application of recommended dose of organic manure. This practice has potential to reduce weed biomass by 91 per cent and increase yield by 8.5 per cent.
Poplar
• Using paddy straw as a mulch @ 4 t/acre in poplar nursery provides an eco-friendly and cost-effective weed control.

FOOD SCIENCE AND TECHNOLOGY

Fruit products
• Technology for processing coloured flesh guava varieties into value added products such as guava squash, nectar and leather/bar has been standardized for Punjab Kiran and Punjab Pink varieties. The products are shelf stable for more than one year with nutritional and sensory quality intact.

Vegetable products
• Blanching and freezing technology for potato fingers and pea grains has been developed. Potato fingers and de-podded pea grains are blanched followed by freezing at -30°C using blast freezing technology. The frozen products are shelf stable up to one year with their nutritional quality intact. Microbial growth under storage conditions was almost negligible even after six months of storage. These products can be used in different curried vegetables and specialty products such as aloo tikki, kabab and parantha.
• Technology developed for preparation of potato paratha/samosa mix from dehydrated tubers of table purpose potato variety ‘Kufri Pukhraj’ has been recommended. Conversion of potatoes into potato flour extends their shelf life and lowers storage cost. The mix (containing potato flour, red chilli powder, cumin and black pepper) is suitable for use upto 12 months of storage at room temperature in 200-gauge polythene bags sealed in air-tight container.

Cereal and milk products
• Technology for development of fibre (oat bran) incorporated probiotic Kulfi has been recommended. The ingredients include 1.5% oat bran, milk (standardized to 5.5% fat) and 2% Lactobacillus casei culture. The product can be stored for 35 days when stored at -18±1°C.

Beverages and fermented foods
• Diverse microbial germplasm accessions including Saccharomyces cerevisiae, Pichia membranifaciens, Cyberlindnera fabianii, Clavispora lusitaniae and Micrococcus luteus have been isolated mainly from traditional beverages (Gudanj, Sura, Lugari, Faasur, Chatki, etc.) and fermented foods (Chilra, Bhaturu and Babru) of Himachal Pradesh. These are being explored for various brewing and dough fermentation traits.

FOOD AND NUTRITION
• Incorporation of black carrot concentrated powder was acceptable up to 7.5 per cent level in dairy products and bread, whereas 1 per cent level was acceptable in cookies, cakes, laddoo and seviyan. There was a significant increase in minerals, namely magnesium, iron and zinc, polyphenolic compounds and anti-oxidant activity as a result of incorporation of black carrots.
• Nutrition awareness training was given to 1,516 rural school girls (13-18 years) from eight villages of Moga and Ludhiana districts. A positive change in attitude and practices was observed after the delivery of five nutrition awareness 2-hour sessions.

POST-HARVEST TECHNOLOGIES

Fruits
• Technology for preparation of jamun
(Syzygium cumini) vinegar by batch and packed bed fermentation at 20 L scale has been developed by employing ethanolic fermentation of jamun juice with *Saccharomyces cerevisiae* MTCC 11815 inoculum. Jamun vinegar has potential for its wider acceptance due to its phenolic constituents, anti-oxidants and anti-inflammatory properties.

- Process for dietary fibre extraction from by-products of Kinnow peel and pomace has been standardized. Peel part showed higher phytochemical and anti-oxidant activity.

**Vegetables**
- A batch-type refraction based drying system for potato flakes has been developed for reducing drying time and maintaining quality of dried product in comparison to convective tray dryer.

**Cereals**
- Wheat flour prepared from recommended wheat varieties at low milling speed of 80 rpm and vacuum packed thereafter was the best in retaining the properties of wheat flour in terms of protein, fat, carbohydrate and starch content upto 60 days.
- Technology for ethanol production from damaged wheat grains (at 50 L scale producing ethanol @ 33.6 g/100 g) was standardized and patent filed.

**Flowers**
- Technology of modified atmospheric packaging and storage of gladiolus spike to enhance their post-harvest life has been recommended. Gladiolus harvested at tight bud stage (basal 1-2 florets show colour) and packed @ 10 spikes per polypropylene sleeve (100 gauge or 25 µm thickness having 120 cm length, 18 cm width with 50 perforations) can be stored vertically in cold room (5±0.5°C) for 10 days with acceptable flower quality and vase life up to 13 days.

**Honey**
- Honey heating-cum-filtration unit developed for handling 50 litres of honey has been recommended. The honey can be heated to 50 °C for 40 minutes and then filtered. The system takes 86.5 seconds to reach 50 °C and filters the honey in about 6 minutes in comparison to about 98 minutes in conventional four-layered muslin cloth.

**RENEWABLE ENERGY ENGINEERING**

**Solar energy**
- A re-circulatory 'Agro-industrial Solar Dryer' has been developed. Average drying time (in case of bitter gourd and fenugreek) of this dryer was cut down by 27.6 per cent in comparison to conventional open loop solar dryer and average moisture removal rate went up by 47 per cent. The payback period for solar dryer of loading capacity of 100 kg bitter gourd is about 150 drying days and that for fenugreek is about 340 days.
- Solar dryer with evacuated tube collector for faster drying of 30-40 kg vegetables like fenugreek and turmeric has been developed. It can be used by small farmers for drying high value produce. Drying time was reduced by 72-82 per cent over open sun drying. The quality of dried product is better. In case of fenugreek, the technology helps retain its green colour (total chlorophyll content 2.21 mg/g in solar dryer versus 0.82 mg/g in sun-dried samples).

**AGROFORESTRY**

**Phytoremediation**
- Evaluation of phyto-remediation potential of Eucalyptus clones irrigated with effluents from distillery unit led to identification of C-413 (maximum height) and PE-5 (largest diameter) clones.
Intercropping
- A study on suitability of wheat varieties for intercropping in poplar plantations revealed that amongst the 16 wheat varieties, the highest wheat yield (averaged over two tree spacings of 6-year old poplar plantation) was observed in case of PBW 725 (3.26 t/ha).

BEEKEEPING
Foraging intensity
- *Apis dorsata* had the highest foraging intensity followed by *Apis florea*. Intensity was higher in American cotton as compared to Desi cotton.

Pesticide toxicity and residue
- The median lethal value (LD₅₀) of thiamethoxam to *Apis mellifera* foragers through contact exposure was 7.63 ng bee⁻¹ after 24 h of exposure while LD₅₀ (oral) was 5.490 ng bee⁻¹.
- The bee-foraged nectar samples collected a day after application contained thiamethoxam residues (0.02±0.01 mg kg⁻¹) which on third day became below limit of quantification (LOQ). Residues at the level of 0.01 and 0.02 mg kg⁻¹ in case of recommended and double dose of thiamethoxam were detected in honey samples collected after 30 days of foliar application in mustard.

Selective breeding for hygienic behaviour
- The daughter queen bees were reared from the hygienic colonies. Twenty daughter colonies so developed were found to possess hygienic behaviour. After 24h of pricking, mean brood removal was 92.7 per cent (range 80.0-95.0%) in the hygienic colonies and 67.9 per cent (ranged from 36-75%) in the non-hygienic colonies.

PESTICIDE RESIDUE ANALYSIS
- Pesticide residue analysis of 920 samples of various food products collected from Bathinda, Mansa and Sangrur districts and comprising vegetables (608), *basmati* rice (216), red chilli powder and milk (36 each), and water (24) showed that 51 samples (5.54%) were contaminated with various pesticide residues and seven samples (0.76%) had levels above Maximum Residue Limits (MRL). Red chilli powder samples were more prone to contamination, whereas milk and water samples did not contain any pesticide residues.

MUSHROOM CULTIVATION
- Two wild mushrooms, *Pleurotus sapidus* and *P. floridanus*, identified through 18s rRNA sequencing, have been collected from locations in Punjab and are being evaluated for edible purposes.

FARM MACHINERY
Lucky Seed Drill
- Lucky Seed Drill has been developed and recommended for simultaneous seeding and spraying of pre-emergence herbicide in direct seeded rice. It provides effective and timely weed control, and labour-saving benefits. The drill consists of an inclined plate seed metering mechanism, nine furrow openers, a tank and a boom sprayer.

Sub-surface Drip Laying Machine
- Tractor operated sub-surface drip laying machine developed for placing drip laterals at...
30 cm depth with adjustable row to row spacing (varying from 40 to 75 cm) has been recommended. It has an average field capacity of 0.25 acres/hour and saves more than 95 per cent of labour costs.

Testing for quality control
- During the period under report 32 machines, namely, Happy Seeder (11), Paddy Straw Chopper/Mulcher (7), Chaff Cutter (4), Rotavator (3), Potato Planter (3), Seed-cum-Fertilizer Drill (1), Rotary Weeder (1), Mould Board Plough (1) and Inter-row Rotary Cultivator (1) were tested for their conformation to laid out standards.

RODENT AND BAT CONTROL
- Laboratory studies revealed the efficacy of Dharek and neem seed extracts as anti-feedant and anti-fertility agents against both sexes of *Rattus rattus* and *Bandicota bengalensis*. Application of Dharek and neem seed based sprays in grain stores prevented rodent damage to bags for 21-30 days.
- Survey of wheat crop fields sown under different practices of rice residue management revealed that rodent infestation is more location specific depending upon the surrounding field areas rather than the method of residue management.
- Among different methods evaluated for managing bats in litchi crop, integrated approach involving lightening with LED bulbs (30 watt) installed above the tree canopy and facing upwards, drum beating and firing crackers gave fruitful results.

AGRICULTURAL ECONOMICS
- A study on sustainability of Farmer Producer Organizations (FPOs) under agricultural value networks in India found that one crucial determinant for the sustainability of FPOs is institutional support that should not be limited only to the formation of FPO but should also provide new market linkages, adoption of agricultural best practices, and requisite managerial skills to the farmers.
- The study on impact of supermarkets on neighbourhood fruits and vegetable markets in Punjab revealed that these supermarkets have had an adverse impact on the sales and returns of fruits and vegetable retailers.
APPARELS AND TEXTILES

- The dyeing conditions of cotton and wool fabrics were optimized using two natural dyes obtained from roots of Ratanjot (*Onosma echioides*) and bark of Arjun (*Terminalia arjuna*) by using ultrasonic dyeing technique and four selected mordants including *amla*, *babool*, alum and tannic acid. Ultrasonic dyeing techniques led to a significant increase in colour strength and darkness of both cotton and wool fabric.
- Cotton waste and paddy fibre could be spun successfully when blended in proportion of 70:30. When the yarn was dyed using two natural dyes (bark of *Terminalia arjuna* and rind of *Punica granatum*) and two reactive
dyes, the rubbing fastness grades for both the natural sources ranged between good to excellent.

• Low cost woven and non-woven mats were developed using paddy straw which were effective as mulch in papaya crop.

TECHNOLOGIES COMMERCIALIZED

• During the report period, 47 memoranda of agreement (MoA) were signed to commercialize a host of technologies (see following Table).

<table>
<thead>
<tr>
<th>Technology/Hybrid/Variety</th>
<th>MoA (count)</th>
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<tr>
<td>Varietal technologies</td>
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<tr>
<td>CH 27 (Chilli hybrid)</td>
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<tr>
<td>PRO 7 (Onion)</td>
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<tr>
<td>PBH 4 (Brinjal)</td>
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<tr>
<td>PMH 5 (Maize)</td>
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<tr>
<td>PSM 1 (Bell Pepper)</td>
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<tr>
<td>Punjab Karela 15 (Bitter Gourd)</td>
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<td>Punjab Kheera 1 (Cucumber)</td>
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<td>PAU Super SMS Technology</td>
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Academic programmes of the University are run through its five constituent colleges at Ludhiana, namely College of Agriculture (CoA), College of Horticulture and Forestry (CoHF), College of Agricultural Engineering and Technology (CoAET), College of Basic Sciences and Humanities (CoBSH), College of Community Science (CoCS), and two Institutes of Agriculture at Gurdaspur and Bathinda. During 2018-19, the University offered 7 Undergraduate, 43 Masters’, 29 Doctorate and 2 Diploma programmes as per the following details:-

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<tr>
<th>Programme</th>
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<th>Number of Seats</th>
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<td>B.Sc. (Hons) Fashion Designing 4-year</td>
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<td>B.Sc. Interior Design 4-year</td>
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<tr>
<td>B.Sc. (Hons) Agri. 6-year (2+4) at Institutes of Agriculture, Bathinda and Gurdaspur, and at Ludhiana</td>
<td>126</td>
<td>-</td>
<td>126</td>
<td>63</td>
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<tr>
<td><strong>POSTGRADUATE</strong></td>
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<tr>
<td>M.Sc. Agriculture</td>
<td>148</td>
<td>34</td>
<td>178</td>
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<td>M.Sc. Home Science</td>
<td>45</td>
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<td>25</td>
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<td>M.Sc. Basic Sciences</td>
<td>115</td>
<td>25</td>
<td>103</td>
<td>91</td>
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<tr>
<td>5-year Integrated M.Sc. (Hons)</td>
<td>80</td>
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<td>76</td>
<td>34</td>
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<tr>
<td>M.Tech. including Remote Sensing and Geographic Information System (GIS), and MJMC</td>
<td>55</td>
<td>7</td>
<td>34</td>
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<tr>
<td>MBA</td>
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<td>32</td>
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<tr>
<td>MBA (Agribusiness)</td>
<td>30</td>
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<td>36</td>
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<tr>
<td>MCA 3-year and MCA (lateral entry) 2-year</td>
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<td>8</td>
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<td>Ph.D.</td>
<td>104</td>
<td>27</td>
<td>128</td>
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<td><strong>DIPLOMA</strong></td>
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<tr>
<td>Diploma course in Hybrid Seed Production Technology (two semesters)</td>
<td>40</td>
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<tr>
<td>Diploma in Agriculture 2-year</td>
<td>120</td>
<td>-</td>
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</table>
EXAMINATION CELL
The Examination Cell conducts entrance tests every year for admitting meritorious students to various academic programmes of PAU. Besides, it conducts competitive exams, recruitment tests and Higher Standard Departmental Examination. During the period under report, the Examination Cell conducted the following examinations:

Entrance Tests (Academics)
- Common Entrance Test (CET) for admission to B.Sc. (Hons) Agri. 4-year, B.Sc. (Hons) Hort. 4-year, B.Tech. (Biotechnology) 4-year, B.Tech. Food Tech. 4-year, B.Sc. (Hons) Community Science 4-year, B.Sc. (Hons) Nutrition and Dietetics 4-year and 5-year Integrated M.Sc. (Hons) programmes in June 2019 (3,018 candidates).
- Entrance test for admission to B.Sc. (Hons) Agri. 6-year programme in June 2019 (625 candidates).
- Fifteen Masters’ Entrance Tests (MET) for admission to M.Sc./MBA/ MBA(AB)/ MJ/ M.Tech. programmes during June-July 2019 (1,169 candidates).
- Entrance tests for admission to 29 Ph.D programmes during November-December 2018.

Recruitment Tests/Competitive Examinations
- Typewriting test (in English as well as Punjabi) for recruitment to the posts of Clerks in July 2018 for 53 candidates.
- Written test for recruitment to the posts of Farm Manager in August 2018 for 281 candidates.
- Written test and typewriting test (in English and Punjabi) for recruitment to the post of Clerk on compassionate grounds in August 2018 and January 2019, and February 2019, respectively.
- Written test for filling up the post of Office Assistant in August 2018 for 29 candidates.
- Shorthand dictation test (in English as well as Punjabi) for recruitment to the posts of Stenotypists in September 2018 for 162 candidates.
- Written test for filling up the post of Agromet Observer in October 2018 for 124 candidates.
- Written test for recruitment to the post of Legal Assistant in February 2019 for 21 candidates.
- Written test for recruitment to the posts of Assistants at Krishi Vigyan Kendras in February 2019 for 74 candidates.
- Written test for recruitment to the post of Cinema Operator in February 2019 for four candidates.

Higher Standard Departmental Examination
- Six papers of Higher Standard Departmental Examination for the PAU employees in February 2019.
# NEW COURSES

## College of Agriculture

<table>
<thead>
<tr>
<th>Course title</th>
<th>Course number</th>
<th>Credit hours</th>
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<tbody>
<tr>
<td>In-house Skill Development in Plant Biotechnology</td>
<td>Biotech. 491</td>
<td>0+20</td>
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<tr>
<td>In-house Skill Development in Bioinformatics</td>
<td>Biotech. 492</td>
<td>0+20</td>
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<tr>
<td>Project, Formulation, Execution and Presentation</td>
<td>Biotech. 493</td>
<td>0+10</td>
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<tr>
<td>Entrepreneurial Development in Biotechnology</td>
<td>Biotech. 494</td>
<td>0+10</td>
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<tr>
<td>General Orientation and On-Campus Training</td>
<td>RAWE 401</td>
<td>0+1</td>
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<tr>
<td>Village Attachment</td>
<td>RAWE 402</td>
<td>0+8</td>
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<tr>
<td><em>Krishi Vigyan Kendra</em> and Research Station Attachment</td>
<td>RAWE 403</td>
<td>0+5</td>
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<tr>
<td>Plant Clinic</td>
<td>RAWE 404</td>
<td>0+2</td>
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<tr>
<td>Landscape Gardening</td>
<td>Flori. 301</td>
<td>2+1</td>
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<tr>
<td>Ornamental Horticulture</td>
<td>Flori. 101</td>
<td>1+1</td>
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<tr>
<td>Introductory Agroforestry</td>
<td>Forst. 102</td>
<td>1+1</td>
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<tr>
<td>Introduction to Forestry</td>
<td>Forst. 101</td>
<td>1+1</td>
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<tr>
<td>Agro-industrial Attachment <em>(Floriculture and Lands)</em></td>
<td>Flori. 491</td>
<td>0+4</td>
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<tr>
<td>Elements of Horticulture</td>
<td>Hort. 101</td>
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<tr>
<td>Agro-industrial Attachment <em>(Fruit Science)</em></td>
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<tr>
<td>Processing Technology of Meat and Poultry Products</td>
<td>FT 205</td>
<td>2+1</td>
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<tr>
<td>Technology of Bakery, Confectionery and Snack Foods</td>
<td>FT 206</td>
<td>2+1</td>
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<tr>
<td>Processing Technology of Legumes and Oilseeds</td>
<td>FT 207</td>
<td>2+1</td>
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<tr>
<td>Processing Technology of Spices and Plantation Crops</td>
<td>FT 208</td>
<td>1+1</td>
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<tr>
<td>Processing Technology of Fruits and Vegetables</td>
<td>FT 301</td>
<td>2+1</td>
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<tr>
<td>Processing Technology of Cereals</td>
<td>FT 302</td>
<td>2+1</td>
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<tr>
<td>Processing Technology of Dairy Products</td>
<td>FT 303</td>
<td>2+1</td>
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<tr>
<td>Sensory Evaluation of Food Products</td>
<td>FT 304</td>
<td>2+1</td>
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<tr>
<td>Instrumental Techniques in Food Analysis</td>
<td>FT 305</td>
<td>1+2</td>
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<td>Food Plant Sanitation</td>
<td>FT 306</td>
<td>1+1</td>
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<tr>
<td>Processing Technology of Fish and Marine Products</td>
<td>FT 307</td>
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<td>Processing Technology of Beverages</td>
<td>FT 308</td>
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<tr>
<td>Food Quality, Safety Standards and Certification</td>
<td>FT 309</td>
<td>2+0</td>
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<td>Food Packaging Technology and Equipment</td>
<td>FT 310</td>
<td>2+1</td>
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<tr>
<td>Principles of Food Science and Nutrition</td>
<td>FT 311/313</td>
<td>2+0</td>
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<tr>
<td>Food Safety and Standards</td>
<td>FT 312/314</td>
<td>2+1</td>
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<td>Agro-industrial Attachment <em>(Food Science and Technology)</em></td>
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<tr>
<td>Crop Improvement I <em>(Kharif crops)</em></td>
<td>PBG 301</td>
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<tr>
<td>Crop Improvement II <em>(Rabi crops)</em></td>
<td>PBG 302</td>
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<tr>
<td>Intellectual Property Rights</td>
<td>PBG 303</td>
<td>1+0</td>
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<tr>
<td>Principles of Seed Technology</td>
<td>PBG 304</td>
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<tr>
<td>Molecular Breeding Technologies</td>
<td>PBG 305</td>
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<tr>
<td>Agro-industrial Attachment Commercial Hybrid Seed Production Unit</td>
<td>PBG 491</td>
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STUDENTS’ ACADEMIC ACCOMPLISHMENTS

College of Agriculture


- Mr Eajaz Ahmed Dar (L-2013-A-02-D) was conferred with Jawaharlal Nehru Best Thesis Award by ICAR, New Delhi.


- Ms Viswajyothi K (L-2014-A-49-M) was awarded Dr Sardar Singh Medal by PAU in 2018.

- Mr Buta Singh Dhillon (L-2012-A-01-D) was awarded the Best Ph.D. Thesis Award from the Indian Society of Agronomy in 2018.
• Ms Ishwinder Kamboj (L-2017-A-48-D) received Plant Pathology Alumni Award from Department of Plant Pathology, PAU in 2018.

• Ms Sujata (L-2017-A12-D) secured first position in Anveshan-Students’ Research Convention (North Zone), organized at National Institute of Food Technology Entrepreneurship and Management, Sonipat, from January 16-17, 2019.

• Ms Shivali Pathania (L-2014-A-11-D) won first prize in National Student Research Convention (agriculture field), organized by Association of Indian Universities, Delhi, at Ganpat University, Mehsana, Gujarat, from March 12-14, 2019.

• Ms Monica Patel (L-2014-A-34-M) got the Best Oral Presentation Award during the International Conference on “Food Security and Sustainable Agriculture” held at Pataya, Bangkok, Thailand, from December 21-24, 2018.

• Ms Sumedha (L-2017-A-11-D) got the Best Poster Presentation Award during the “22nd Punjab Science Congress” held at Punjab Academy of Sciences, Patiala, from February 7-9, 2019.

• Ms Ankita Kataria (L-2017-A-25-D) and Mrs Jagbir Rehal (L-2017-A-24-D) won first and second prize in oral presentation, respectively, during the “SLIETCON-2019” a Multi-Track National Conference, organized by Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, at National Institute of Technical Teachers Training and Research, Chandigarh, from March 1-2, 2019.

College of Agricultural Engineering and Technology
• Mr Gurkaranbir Singh (L-2016-AE-187-M) received the National Award from the Indian Society for Technical Education for the Best M.Tech. Thesis in Agricultural Engineering.


College of Basic Sciences and Humanities
• Ms Jaspreet Kaur (L-2014-BS-98-D) was conferred with Young Scientist Award 2019 by Punjab Science Academy.

• Mr Kailash Chand (L-2014-BS-94-D) and Ms Sharon Nagpal (L-2012-BS-17-IM) were awarded the Best Ph.D. Thesis Award 2018 and the Best PG Thesis Award 2017 by Dr Ram Avtar Shiksha Samiti (DRASS), respectively.

• Ms Inderpal Kaur (L-2016-BS-66-D) attended Summer Training Programme at Tel Aviv University's Food Safety and Security Summer Institute, Tel Aviv University International, Israel, from June 27 to July 29, 2018.

• Ms Reetu Bhanot (L-2015-BS-86-D) attended two-month training programme on “Environmental Toxicology and Access to Laboratory Techniques” at the Institute of Applied Ecology, University of Canberra, Australia, from February 21 to April 22, 2019.

• Mr Yuviana Singh (L-2017-BS-249-M) attended Summer Research Programme, organized by Department of Plant Molecular Biology (DPMB), Delhi University, under Indian Academy of Science from May 28 to July 23, 2018.

• Ms Avninder Kaur (L-2015-BS-20-IM) attended Summer Training in “Science and Engineering-2019” organized by Indian Institute of Science and Indian Academy of Sciences, Bangalore, from June 6 to July 5, 2019.
• Ms Shaina Jain (L-2016-BS-73-D) secured first position in Anveshan—Students’ Research Convention (North Zone), organized at National Institute of Food Technology Entrepreneurship and Management, Sonipat, from January 16-17, 2019.
• Ms Manpreet Kaur (L-2016-BS-238-M), Mr Charandeep Singh (L-2016-BS-234-M), Ms Megha Sakhuja (L-2012-BS-54-IM), Ms Misha (L-2016-BS-240-M), Ms Vritika Jain (L-2017-BS-248-M), Ms Manpreet Kaur (L-2018-BS-74-D) and Ms Geetika Rani (L-2016-BS-263-M) cleared Graduate Aptitude Test in Engineering (GATE), conducted by Indira Gandhi Center for Atomic Research (IGCAR), Kalpakkam, Tamil Nadu.
• Ms Anchal Aggarwal (L-2013-BS-21-IM) bagged the Best Research Paper Presentation Award during the National Conference on “Advances in Agriculture and Natural Sciences for Sustainable Development,” held at Quantum University, Roorkee, from October 12-13, 2018.
• Ms Ekta (L-2015-BS-77-D) won first prize for oral presentation in chemical sciences during Research Scholars’ Meet, organized by Indian Science Congress, Punjabi University, Patiala Chapter, and Department of Zoology, PAU, at Punjab Agricultural University on March 27, 2019.
• Ms Vritika Jain (L-2017-BS-248-M) bagged first prize for oral presentation in life sciences during Research Scholars’ Meet, organized by Indian Science Congress, Punjabi University, Patiala Chapter, and Department of Zoology, PAU, at Punjab Agricultural University on March 27, 2019.
• Ms Radha Rani (L-2016-BS-80-D) got the Best Paper Award during the second International Conference on “Recent Trends in Science, Engineering and Management” held at Kuttumb International, Jaipur, from March 30-31, 2019.
• Mr Sachin Kumar (L-2018-BS-106-D) received the Best Oral Presentation Award, while Ms Navleen Kaur (L-2017-BS-326-M) got the Best Poster Award during the National Seminar on “Climate Change, Biodiversity and Urban Environment: Current Trends and Challenges in the Conservation of Urban and Peri-urban Biodiversity” held at Guru Gobind Singh Indraprastha University Dwarka, New Delhi, on April 26, 2019.
• Ms Jasgeet Sophia (L-2014-BS-108-D) won second prize in poster presentation during the National Seminar on “Environmental Changes and its Impact on Faunal Diversity in Indian Agro-ecosystems,” organized by Department of Zoology and Zoological Survey of India (ZSI) at Punjab Agricultural University from November 19-20, 2018.

SCHOLARSHIPS AND FINANCIAL ASSISTANCE
College of Agriculture
• Eleven students received ICAR/UGC Senior Research Fellowship, 46 ICAR/UGC Junior Research Fellowship, four ICAR-PG Scholarship, 17 ICAR Fellowship (foreign students), 76 ICAR - National Talent Scholarship and two ICAR - Agricultural Scientists Recruitment Board (ASRB) Scholarship.
• Three students each got Indian Council of Social Science Research (ICSSR) Senior Research Fellowship, Rajiv Gandhi National Fellowship (UGC) and Maulana Azad National Fellowship (UGC).
• Twenty five students were awarded Innovation in Science Pursuit for Inspired Research Fellowship (Department of Science and Technology - DST), 13 Bayer Crop
Science Fellowship and two Monsanto Beachell Borlaug International Scholarship.

- Eighty eight students received University Merit Scholarship, 152 Student READY stipend, six COA Alumni Association Scholarship and 155 Punjab State Agricultural Marketing Board Scholarship.

- Two students got Dr Gurdev Singh Khush Scholarship, six Sardar Gurdit Singh Kang Scholarship, five Mrs Jaswant Kaur Bindra Scholarship, 11 Piara Singh Parmar Memorial Fellowship, three Shri Bal Krishan Vaid Merit Scholarship, two Dhanuka Agritech Limited Fellowship, and two Tagra and Batra Families Trust Fund Scheme Scholarship.

- One student each bagged Commonwealth Split Site Scholarship (Commonwealth Scholarship Commission), Science and Engineering Research Board (SERB) Fellowship (DST), Women Scientist Scholarship (DST) and Borlaug Higher Education for Agricultural Research and Development (BHEARD) Fellowship (Michigan State University, USA).

- Forty five students qualified ICAR - National Eligibility Test (NET).

### College of Agricultural Engineering and Technology

- One student was awarded ICAR/UGC Senior Research Fellowship, six ICAR/UGC Junior Research Fellowship, 40 ICAR - National Talent Scholarship and two ICAR - Agricultural Scientists Recruitment Board (ASRB) Scholarship.

- Three students got Dr Gurdev Singh Khush Scholarship, 48 University Merit Scholarship and four Piara Singh Parmar Memorial Fellowship.

- One student each received Innovation in Science Pursuit for Inspired Research Fellowship (DST), RN Kaul Scholarship, India Africa Fellowship Programme-III and Research Scholarship (Borlaug Institute for South Asia, Ladhowal).

- Three students bagged Tractors and Farm Equipment Limited (TAFE) Sivasailam Prize and four CLAAS India Scholarship.

- Fifteen students qualified ICAR - National Eligibility Test (NET).

### College of Basic Sciences and Humanities

- Five students were awarded ICAR/UGC Senior Research Fellowship, six ICAR/UGC Junior Research Fellowship, one ICAR - Agricultural Scientists Recruitment Board (ASRB) Scholarship and four Indian Council of Social Science Research (ICSSR) Senior Research Fellowship.

- Four students got Rajiv Gandhi National Fellowship (UGC), three Maulana Azad National Fellowship (UGC) and four Innovation in Science Pursuit for Inspired Research Fellowship (DST).

- Four students received Dr Gurdev Singh Khush Scholarship, 15 University Merit Fellowship and one SS Guraya Memorial Fellowship (PAU).

- Three students were awarded India - Afghanistan Fellowship (ICAR).

- Thirty three students qualified National Eligibility Test (NET), conducted by ICAR, UGC and Council of Scientific and Industrial Research (CSIR), New Delhi.

### College of Community Science

- Six students were awarded ICAR/UGC Senior Research Fellowship, 17 ICAR/UGC Junior Research Fellowship and 14 ICAR - National Talent Scholarship.

- Two students got Innovation in Science Pursuit for Inspired Research Fellowship (DST).
• Forty-three students received University Merit Scholarship, 37 Student READY stipend and eight Dr Gurdev Singh Khush Scholarship.

• One student each got Smt Vidyawati Saini Scholarship, Sardarni Gurbachan Kaur Memorial Scholarship, Mai Tej Kaur Memorial Scholarship and Maulana Azad National Fellowship (UGC).

• Twelve students qualified UGC - National Eligibility Test (NET).

STUDENTS’ WELFARE ACTIVITIES

Outstanding Sports Achievements of Students/Teams

National level

• Ms Ujjalpreet Kaur Dhatt (CoA) won first position in the 20th Inter Zone (M&W) Handball Championship, held at Sangrur from April 9-12, 2019.

• Ms Nimrat Kaur Sekhon (CoA) participated in the 62nd National Shooting Championship, held at Trivandrum, Kerala, from November 15 to December 5, 2018.

• Mr Tejvir Singh Grewal (CoCS) participated in the 56th National Roller Skating Championship (Senior), held at Visakhapatnam, Andhra Pradesh, from December 18-23, 2018.

• Mr Manveer Singh (CoA) participated in the 9th Hockey India Senior Men National Championship, held at Chennai, Tamil Nadu, from January 7-20, 2019.

• Mr Angrej Singh (CoA) participated in the 23rd National Senior Deaf Sports Championship, held at Chennai, Tamil Nadu, from January 27-31, 2019.

• Mr Arshdeep Singh (CoA) participated in the 47th Senior (M) National Handball Championship, held at Tiruvannamalai, Tamil Nadu, from February 23-28, 2019.

All India Inter University Championships

• Mr Tejvir Singh Grewal (CoCS) won Gold Medal in 10 km Road Point to Point, Silver Medal in 10 km Track Elimination, Bronze Medal in 1,000m Track Race and Runners-up Team Championship Trophy during the All India Inter University Roller Skating Championship, held at Maharshi Dayanand University, Rohtak, Haryana, from January 28-31, 2019.

• The PAU Handball (M) team won the fourth position during the All India Inter University Championship, held at Guru Nanak Dev University, Amritsar, from March 8-12, 2019.

• The PAU Athletic (M&W), Aquatic (M), Cycling (M&W), Shooting (M&W) and Weight Lifting (M) teams participated in the All India Inter University Championships, conducted by the Association of Indian Universities.

All India Inter Agricultural University Sports and Games Meet

The Punjab Agricultural University clinched Overall Championship Trophy, Overall Games Trophy (M) and Overall Runners-up Trophy in Athletics (M) during the All India Inter Agricultural University Sports and Games Meet, held at PAU from January 2-5, 2019. In the Team Games (M&W), PAU won three Gold Medals (Basketball (M), Handball (M) and Volleyball (M)); one Silver Medal (Basketball (W)); and one Bronze Medal (Badminton (W)). The PAU contingent consisting of 45 students and 7 officials participated in Basketball (M&W), Badminton (M&W), Handball (M), Athletic (M&W) and Volleyball (M).

• The Basketball (M) Team won Gold Medal. It comprised students, namely Mr Khushpreet Singh Brar (CoCS), Mr Ishwardeep Singh Brar (CoA), Mr Navneet Singh Sidhu (CoA), Mr Harjot Singh (CoA), Mr Rajdeep Singh
Riar (CoA), Mr Angadjeet Singh Brar (CoCS), Mr Karan Bawa (CoA) and Mr Pukhraj Singh Brar (CoA).

• The Handball (M) Team won Gold Medal. It comprised students, namely Mr Gurminder Pal Singh Kang (CoA), Mr Dharminder Singh (CoA), Mr Arshdeep Singh (CoA), Mr Ankush Kumar (CoA), Mr Ramanjit Singh (CoA), Mr Nobelpreet Singh (CoA), Mr Angadjeet Singh Brar (CoCS) and Mr Jagmanjot Singh (CoA).

• The Volleyball (M) Team won Gold Medal. It comprised students, namely Mr Jagmanjot Singh (CoA), Mr Jatinder Singh (CoAET), Mr Rajwinder Singh (CoA), Mr Bavneet Singh (CoA), Mr Nishanth (CoA), Mr Sandeep Singh (CoA), Mr Sunil Kumar (CoAET) and Mr Arshdeep Singh (CoA).

• The Basketball (W) Team won Silver Medal. It comprised students, namely Ms Ravneet Kaur (CoCS), Ms Manpreet Kaur (CoCS), Ms Harmeet Kaur (CoCS), Ms Prabhsangam Kaur Dhillion (CoBSH), Ms Jasleen Kaur (CoBSH), Ms Arshpreet Kaur (CoBSH), and Mr Dilpreet Kaur (CoA).

• The Badminton (W) Team won Bronze Medal. It comprised students, namely Mr Gagandeep Kaur (CoBSH), Ms Winglengphy Zimik (CoA), Ms Tanya (CoCS) and Ms Navdeep (CoBSH).

• The Athletic (M) Team was declared Runners-up. Mr Sanpreet Singh (CoA) won first position in 5,000m Walk, while Mr Arshdeep Singh (CoA) got second position in 110m Hurdles (M). Ms Mehatpreet Kaur Randhawa (CoA) got second position in 800m and 1,500m races.

Inter Varsity Tournaments
The teams of PAU participated in the North Zone Inter Varsity Tournaments in the games of Lawn Tennis (M), Cricket (M), Football (M), Table Tennis (M&W), Basketball (M&W), Swimming (M&W), Kabaddi (M), Cycling (M&W), Handball (M&W), Badminton (M&W), Volleyball (W), Hockey (M), Athletics (M), Shooting (M&W) and Weight Lifting (M).

North Zone Tournament
Ms Aditi Sewak (CoCS), Mr Aayush Sewak (CoAET), Mr Adeshpal Singh Gill (CoA), Mr Satmeet Singh (CoA), Mr Tanveer Singh (CoA) and Mr Rassanpreet Singh Mann (CoA) participated in the 38th North Zone Shooting Championship, held at Dehradun, Uttarakhand, from October 25 to November 1, 2018.

Inter District Tournament
• Mr Shahbaj Singh Bhullar (CoA) got first position in 4x50m Freestyle Mix Relay, second position in 4x50m Medley Mix Relay and third position in 4x100m Medley Relay during the 41st Abhey Oswal Senior Punjab Swimming and Water Polo Championship-2018, held at PAU from August 31 to September 2, 2018.

• Mr Amritpal Singh (CoA), Mr Navdeep Singh Brar (CoA), Mr Randhir Singh Sandhu (CoA) and Ms Garima Jindal (CoA) participated in the 41st Abhey Oswal Senior Punjab Swimming and Water Polo Championship-2018, held at PAU from August 31 to September 2, 2018.

• Mr Sanpreet Singh (CoA) and Ms Sandeep Kaur (CoA) participated in the Open State Athletic Tournament, held at War Hero Stadium, Sangrur, from August 30 to September 1, 2018.

• Ms Aditi Sewak (CoCS) and Ms Nimrat Kaur Sekhon (CoA) participated in the Punjab State Shooting Championship, held at Mohali from October 8-9, 2018.
Tournaments/Events Organized

XIX All India Inter Agricultural University Sports and Games Meet 2018-19

The XIX All India Inter Agricultural University Sports and Games Meet was successfully conducted by the Directorate of Students’ Welfare, PAU, from January 2-5, 2019. A total of 62 Universities participated in the tournament.

Inter College Tournament

As per sports calendar of PAU duly approved by Sports and Youth Activities Council for the session 2018-19, the Inter College Tournament was organized in the games of Volleyball (M&W), Basketball (M&W), Football (M), Swimming (M&W), Lawn Tennis (M), Handball (M&W), Hockey (M), Badminton (M&W), Weight Lifting (M), Kabaddi (M), Table Tennis (M&W) and Cycling (M&W). Mr Jashanpreet Singh (Institute of Agriculture, Gurdaspur) was adjudged as the Best Cyclist, Mr Ravinderpal Singh Maan (CoA) as the Best Hockey Player, and Mr Shahbaj Singh Bhullar (CoA) and Ms Garima Jindal (CoA) as the Best Swimmers in men and women category, respectively.

Annual Athletic Meet

The 53rd Annual Athletic Meet of PAU for the session 2018-19 was held at University Athletic Track on March 7, 2019. Mr Tejinderpal Singh (CoA) was declared the Best Athlete, whereas, Mr Pardeep Singh (CoA) and Mr Gurdeep Singh (CoA) were declared the second and the third Best Athletes, respectively, in men category. Ms Mehakpreet Kaur Randhawa (CoA) was declared the Best Athlete, while Ms Sukhpreet Kaur (CoCS) and Ms Sushil Grewal (CoA) were declared the second and the
Students of PAU participating in International Yoga Day.

third Best Athletes, respectively, in women category.

International Yoga Day
About 250 students as well as teachers participated in the International Yoga Day on June 21, 2019. On this day, experts from Unique Yoga Tutors, Ludhiana, were invited to conduct the training session. A practical session on demonstration of various yogic asanas and pranayam was conducted.

Special Sports Coaching Camps/NSO Activities
Before participation of PAU teams in North Zone/All India Inter Varsity/Inter Agricultural University Tournaments, a coaching camp of 15-20 days duration in different games was organized in the University. In addition, Annual National Sports Organization (NSO) coaching camp of 15 days duration was organized at PAU from June 20 to July 4, 2019 in which 173 trainees participated. A total of 202 students were registered in NSO programme in various games, out of which, about 40 NSO trainees participated in Inter College, Inter Varsity and Inter Agri Tournaments.

Sports Scholarships
The Sports Scholarship Committee in its meeting held on March 29, 2019 approved 10 sports scholarships of the value of Rs 500/- each per month (two for major and eight for minor games) for the outstanding sportspersons for their proficiency in sports and games during the academic session 2018-19.

Merit Certificates/University Colour/Roll of Honour
The PAU Sports and Youth Activities Council in its 55th meeting held on October 4, 2018, awarded 26 Merit Certificates, 15 University Colour and 5 Roll of Honour to the outstanding sportspersons/artists of PAU for their proficiency in sports, games, cultural and literary events for the session 2018-19. The students were awarded these honours during the 53rd Annual Athletic Meet of the University.

National Service Scheme (NSS) Activities
- The NSS volunteers, who worked on the motto “Not Me But You,” made exemplary contribution by organizing special donation drives for the collection of old clothes, shoes, stationery, school bags, old books, blankets, toys, etc. and the same were successfully distributed among the needy in the adopted slums/labourers of construction sites.
- Two NSS volunteers attended Pre-Republic Day Camp at Vishwa Bharti Postgraduate College, Sikar, Rajasthan, from October 12-21, 2018.
- Two volunteers also participated in National Integration Camp, held at Odisha University of Agriculture and Technology, Odisha, from November 13-19, 2018.
ANNUAL REPORT OF PUNJAB AGRICULTURAL UNIVERSITY
(July 1, 2018 to June 30, 2019)

• Twenty four NSS volunteers took part in Meditation Camp, organized by Amritapuri University, Kerala, from December 22-25, 2018.

• Twenty one-day regular activity camps were organized by each NSS unit as per the themes given by the Ministry of Youth Affairs and Sports, Government of India. Volunteers also participated in campus beautification, playground cleanliness, village health care camps, yoga camps etc. Awareness was created regarding exercising franchise freely without any fear, road safety and traffic rules, and women empowerment.

• A seven-day workshop on “Personality Development” was organized at PAU in collaboration with University Placement Cell from December 15-21, 2018.

• Sixty NSS volunteers acted as local guide for the participants of XIX All India Inter Agricultural University Sports and Games Meet, held at PAU from January 2-5, 2019.

• Nine NSS volunteers participated in the 7th Conclave of Bhartiya Chhatra Sansad at Pune from January 16-23, 2019.

Cultural Activities
Achievements/Participation

• The students of PAU clinched Silver Medal in Group Song Indian, Patriotic Group Song, Extempore, Skit and Bronze Medal in Collage Making during the 19th All India Inter University Youth Festival 2018-19, organized by Sardarkrushi-nagar Dantiwada Agricultural University, Banaskantha, Gujarat, in association with Indian Council of Agricultural Research (ICAR), New Delhi, from February 3-7, 2019.

• The students of PAU won Bronze Medal in Group Mime and fourth position in Poster Making events during the 34th North Zone Inter University Youth Festival, organized by Panjab University, Chandigarh, in collaboration with Association of Indian Universities, New Delhi, from December 27-31, 2018.

• The PAU team of Group Mime participated in the 34th National Inter University Youth Festival, organized by Chandigarh University, Mohali, in collaboration with Association of Indian Universities, New Delhi, from February 1-5, 2019.
Events Organized

- Independence Day and Republic Day were celebrated with great enthusiasm in the University on August 15, 2018 and January 26, 2019, respectively. Dr Baldev Singh Dhillon, Vice Chancellor, PAU, unfurled the national flag and inspected the parade of NCC cadets.

- A North Zone level Postgraduate Students’ Elocution Contest was organized by the Directorate of Students’ Welfare on the topic “Transforming Agrarian Economy: Innovative Solutions through Science and Technology” at PAU on August 24, 2018 under the aegis of National Academy of Agricultural Sciences (NAAS) and ICAR, New Delhi.

- A five-day “Punjab Kala Utsav” was organized at PAU in association with Punjab Art Council (Government of Punjab), Chandigarh, from September 24-28, 2018. In this event, a state level Inter College Cultural Procession competition was organized and selected events of theatre, music, fine arts and dance were performed by various artists.

- A week-long PAU Inter-College Youth Festival for the session 2018-19 was organized from October 25 to November 3, 2018 in the University. The students from constituent colleges and institutes of PAU participated in dance, music, fine arts, literary, theatre and heritage events. The College of Agriculture lifted the overall trophy.
EXTENSION

The Punjab Agricultural University undertakes the transfer of improved agricultural technologies among farmers and extension functionaries through its 18 Krishi Vigyan Kendras (KVKs) and 15 Farm Advisory Service Centres (FASCs) at district level; various departments; Agricultural Technology Information Centre (ATIC) and Advanced Training Unit at the main campus, Ludhiana. These Centres transfer technologies through various extension modes like *Kisan Melas*, field days, workshops, adaptive research trials, on farm trials, demonstrations, specialized trainings (short, vocational and in-service), exhibitions, campaigns, technical guidance, *Kissan* Club/committee meetings, PAU *Doots*, sale of farm literature, *Kissan* Mobile App, digital newspaper, WhatsApp groups, video capsules, farmer portal and TV/radio talks. The University also plays a key role in capacity building of farmers, farm women and extension functionaries in scientific farm technologies and practices, and subsidiary occupations through various training programmes.

**KISAN MELAS**

*Kisan Melas* play a key role in dissemination of improved agricultural knowledge among masses.

Farmers are acquainted with new technologies through live demonstrations, exhibitions and technical sessions. The question-answer session during these *melas* addresses the queries of the farmers. A total of 14 *Kisan Melas* were organized during the period under report. Seven *Kisan Melas* each were organized during September 2018 and March 2019 at the main campus of PAU, Ludhiana; KVK Rauni (Patiala); KVK Nag Kalan (Amritsar); Regional Research Station (RRS) Faridkot; RRS Ballowal Saunkhri, RRS Bathinda and RRS Gurdaspur. The theme of the *mela* in September 2018 was “*Aau Dharti Ma Bachayiea, Parali Nu Aag Na Layea*” (Let us save Mother Earth by not burning paddy straw). The theme of the *mela* in March 2019 was “*Jinsan Ton Utpad Banayiea, Kheti Munafa Hor Vadhayiea*” (Convert produce into products, enhance farm profitability). A large number of farmers from Punjab and adjoining states participated in these *melas*. Live demonstrations on field crops with improved varieties, production and protection technologies; straw management techniques; beekeeping; mushroom cultivation; nutrition gardening; protected cultivation, etc. were arranged for the visiting farmers.
The seed of improved crops and vegetable varieties, planting material of vegetables/fruit/forest/ornamentals, biofertilizers and farm literature were sold to the farmers during these melas. An agro-industrial exhibition of farm inputs including fertilizers, pesticides, and farm machinery was also put up on these occasions.

Awards to Progressive Farmers

The progressive farmers from various parts of Punjab are honoured during the Kisan Melas for their outstanding contributions to agriculture, horticulture and allied enterprises. During PAU Kisan Mela on September 20, 2018, six progressive farmers including one woman entrepreneur were honoured. Sardar Bir Dalwinder Singh (Patiala) and Sardar Gurpreet Singh (Fazilka) were conferred with Sardar Dalip Singh Dhaliwal Award. Sardar Simerjeet Singh Drall (Patiala) and Sardar Harinder Singh Riar (Gurdaspur) were awarded Parwasi Bharti Award. Sardar Narinder Singh (Moga) was conferred with Sardar Surjit Singh Dhillon Award, while Mrs Rajinder Kaur (Sangur) was awarded Sardarni Jagbir Kaur Grewal Memorial Award.

During PAU Kisan Mela on March 15, 2019, Sardar Gurwinder Singh Sohi (Tarn Taran) and Sardar Sarabjit Singh (Mansa) were conferred with Chief Minister Award for Horticulture. Sardar Pardeep Singh (Patiala) was awarded Sardarni Parkash Kaur Sra Memorial Award, while Mr Rohit Gupta (Jalandhar) was awarded CRI Pumps Award for adopting water management.

FIELD DAYS

The University holds field days in order to popularize specific recommendations among farmers. In all, 388 field days were organized in different villages to promote direct seeded rice technique; mechanical transplanting of paddy; crop residue management techniques; integrated pest management in Rabi and Kharif crops; PAU fruit fly trap; cultivation of pulses (lentil, soybean, gram, etc.), maize, sunflower and gobhi sarson; nutrition garden, etc.

ADAPTIVE RESEARCH TRIALS

Adaptive Research Trials (ARTs) are conducted at farmers' fields under different agro-climatic conditions to test new technologies generated by research system. A total of 1,161 ARTs were conducted at different locations to evaluate new crop varieties, and production and protection technologies. In these trials, 55 technologies
were tested - 15 were of new varieties (8 field crops, 4 vegetables and 3 fruit crops), 8 of production technologies, 24 of plant protection technologies, 3 of post-harvesting handling and 5 of farm machinery technologies.

ON FARM TRIALS

On Farm Trials (OFTs) are conducted to test a new technology/idea under farmer’s field conditions along with PAU recommended practice and farmer’s own practice. In total, 134 OFTs were conducted by KVK scientists. The salient findings of some of the important OFTs are listed below:

• **Assessment of best technique for preparation of garlic pickle:** Three treatments viz. T₁ - Remove skin in luke warm water + sun drying + add spices and oil + vinegar (common practice), T₂ - Remove skin by dry roasting in skillet + add spices and oil + lemon juice (intervention 1) and T₃ - Remove skin by microwave roasting + sun drying + add spices and oil + tamarind (intervention 2) were planned. Best results were obtained with treatment T₂.

• **Assessment of techniques of preparing amla preserve:** Three treatments viz. T₁ - Boiling and cutting of raw amla + grinding of amla shreds + mixing spices + 1 kg sugar/kg amla (common practice), T₂ - Shredding of raw amla + grinding of amla shreds + mixing spices + 900 g sugar/kg amla (intervention 1) and T₃ - Steaming of raw amla + cutting + grinding of amla shreds + mixing spices + 750 g sugar/kg amla (intervention 2) were compared. Best results were obtained with treatment T₂.

• **Comparative evaluation of different methods of paddy transplanting:** Three treatments viz. T₁ - Mechanical transplanting at 30x12 cm spacing - recommended practice, T₂ - Transplanting of paddy with mechanical transplanter at 30 x 15 spacing – intervention and T₃ - Manual Transplanting of paddy-farmers’ practice were compared. The treatment T₁ gave the highest yield (75.2 q/ha) and the highest number of plants/m² (25), T₃ gave the highest number of tillers per plant and cost of transplantation was the lowest in T₁ and T₂ (Rs 7,500/ha).

• **Comparative evaluation of different resource conservation techniques for wheat sowing:** Four treatments viz. T₁ - Conventional sowing (farmers’ practice), T₂ - Sowing with Happy Seeder after harvesting with combine with Straw Management System (recommended practice), T₃ - Chopping of straw with chopper and sowing...
with Happy Seeder (technology assessed) and T₄ - Chopping of straw with chopper followed by rotavator and sowing with SCF/Happy Seeder (technology assessed) were planned. Sowing wheat after harvesting paddy with combine having Straw Management System gave the highest yield in comparison to other sowing methods. Sowing directly with Happy Seeder after harvesting resulted in saving of Rs 3,000/- per ha.

- **Comparative evaluation of wheat sowing with different methods**: Three treatments viz. T₁ - Sowing of wheat with Happy Seeder - recommended practice, T₂ - Sowing of wheat after incorporating paddy straw into soil (Roto-seeder) - intervention and T₃ - Sowing of wheat with conventional seed-cum-fertilizer drill - farmer's practice were planned. Highest yield was obtained in T₃. Total operational cost and weed count were the lowest in T₁.

- **Control of aphid population on wheat**: Three treatments viz. T₁ - Thiomethaxam @ 80-100 g/acre (FP), T₂ - Thiomethaxam @ 20 g/acre (recommended practice) and T₃ - Neem based formulation @ 0.5 l/acre (to be assessed) were planned. As per the results of on farm testing, neem based insecticides provided good control only at initial population, whereas maximum reduction in aphid population and maximum yield/acre were recorded in recommended practice. However, spraying neem based formulation at initial population plus recommended insecticide at later stage provided very effective control.

- **Comparative evaluation of efficacy of different sprayers for control of insect pests in Bt cotton**: Three treatments viz. T₁ - Hand operated knapsack spray pump (farmers' practice), T₂ - Battery operated knapsack pump with boom type nozzle (recommended practice) and T₃ - Knapsack spray pump battery operated with gun type nozzle (technology to be evaluated) were compared. Results showed that spraying with knapsack spray pump having boom type nozzle was more efficient, uniform and effective for the crops of less height i.e. less than 5 feet but if the crop's height was 5 to 5.5 feet, then knapsack battery operated spray pump with gun type nozzle was better option for spraying on the crops. Spraying of crop with knapsack having boom type nozzle gave best effectiveness of spray, ultimately leading to better yield with less investment in comparison to gun type and manual spray pump.

- **Effect of post-harvest application of urea on fruiting of litchi cv. Dehradun**: Three treatments viz. T₁ - Post-harvest application of 500 g urea/plant (farmers' practice), T₂ - Application of 1,600 g urea per plant (800 g in mid-February and 800 g in mid-April) (recommended practice) and T₃ - Application of 600 g urea/plant during mid-April + 1,000 g urea/plant (after harvesting) were compared. Application of 600 g urea/plant during mid-April + 1,000 g urea/plant (after harvesting) resulted in significantly improved yield than recommended and farmers' practice.

- **Weed management in sesame**: Three treatments viz. T₁ - Hoeing of sesame crop three weeks after sowing (recommended practice), T₂ - Pre-emergence application of Lasso @ 1litre/acre (farmers' practice) and T₃ - Pre-emergence application of Stomp @ 1litre/acre (intervention) were compared. Recommended practice (T₁) was found to be better in terms of grain yield and weed density (5.7 q/ha and 2.1 no./m²) than intervention and farmer's practice (T₂ and T₃).

- **Improving egg production in low input
poultry farming: Three treatments viz. farmers' practices with local desi birds: $T_1$ - Rearing birds with balanced feed + proper health management (recommendation), $T_2$ - Rearing birds with 1: 10 male female ratio along with provision of strictly 16 hrs of light (intervention) and $T_3$. Egg production were compared. In $T_3$, egg production was found 8 per cent and 19 per cent higher than $T_2$ and $T_1$, respectively. In $T_3$, mortality was 26 per cent and 14 per cent lower than $T_1$ and $T_2$, respectively.

In case of wheat and rice, on farm trials were also conducted on different establishment methods of paddy, effect of potassium application on productivity of paddy, effect of biocontrol agents on disease control and yield of basmati rice - Pusa 1121, judicious use of machinery for paddy straw incorporation, comparative performance of sowing of wheat (PBW 725) with different methods of paddy straw management, comparative performance of wheat crop sown under various paddy residue conditions, nitrogen fertilizer scheduling in wheat, time of urea application in PAU Happy Seeder sown wheat, induction of systemic acquired resistance against wheat aphid with salicylic acid, management of manganese deficiency in wheat and effect of foliar application of potassium nitrate on wheat productivity.

On farm trials were conducted on transplanting of cotton by different methods to maintain plant population, evaluation of low cost yellow sticky traps for management of whiteflies in cotton, application of phosphatic fertilizer in cotton crop, management of magnesium deficiency in cotton, nutrient management in cotton through foliar application, and effect of potassium application in cotton, chickpea and lentil.

In addition, OFTs were conducted on standardization of seed rate of gobhi sarson, post-emergence weed control in gobhi sarson, performance and preference of different varieties of broccoli, evaluation and assessment of cabbage varieties grown in district Fatehgarh Sahib, methods of sowing turnip, comparative performance of pea crop sown with different methods, varietal evaluation of Rabi onion, different techniques of cultivation of Kharif onion, effect of different dates of planting and size of bulb sets on growth and yield of Kharif onion, different protective structures to raise early capsicum, varietal evaluation of potato, management of phosphorous in potato, effect of different dates of sowing on yield of summer squash under low tunnel, bio intensive management of shoot and fruit borer of brinjal, management of damping-off and fruit rot in chilli, and eco-friendly management of Helicoverpa armigera in tomato.

On farm trials were also conducted on improvement of Kinnow mandarin fruit productivity and quality by urea, boron and zinc foliar spray; quality improvement in Kinnow; management of fruit fly; and effect of different mulching systems on yield and weed growth in bearing orchards.

Other thrust areas were evaluation of fungicide for management of pokka boeng diseases of sugarcane, management of sugarcane pyrilla (Pyrilla perpusilla), effect of insecticide and biopesticides in pest management of Kharif maize, evaluation of insecticides for management of H. armigera in sunflower, post-emergence weed control in Kharif green gram and effectiveness of agricultural messages sent to farmers by using Information and Communication Technology (ICT) methods.

Apart from this, OFTs were conducted on diabetic management through diet, malnutrition among preschool children, prevalence of anemia among rural adolescent girls (in schools/
DEMONSTRATIONS

For the promotion of crop production, protection and other improved agricultural technologies developed by PAU, demonstrations are conducted at farmers' fields and KVK farms. A total of 3,226 cluster front line demonstrations (CFLDs) were conducted on improved varieties of oilseed crops (groundnut, sesame, gobhi sarson, raya and sunflower), pulses (summer moong, main season moong, mash, soybean, gram and lentil), wheat, parmal rice, basmati rice, cotton (American and Desi), maize, maize fodder, celery and winter vegetables. Field demonstrations were also conducted on resource conservation technologies, such as nitrogen management in paddy using Leaf Colour Chart; skipping of P application in rice, cotton and maize after wheat grown with recommended dose of P; seed and nursery treatment for foot rot management in basmati; irrigation of paddy after drainage of ponded water; green manuring before rice cultivation and use of fruit fly trap. Demonstrations were given on paddy straw management by using Baler, PAU Straw Management System (SMS), Chopper; and using Happy Seeder for wheat sowing. Use of biofertilizer; use of fertilizer on soil test basis; management of maize borer using Trichoderma harzianum; weed control in maize and direct seeded rice; management of stem borer/leaf folder in parmal rice and basmati rice; and use of rice transplanter were some of the other focus areas.

Besides, demonstrations were carried out on use of cobalt chloride for control of parawilt in cotton, control of jassid in cotton, mixed cropping of sarson and toria, intercropping of gobhi sarson in sugarcane, nutrition gardening of summer and winter vegetable crops, use of Paddy Straw Chopper, use of Baler-cum-Knotter, seed

The Krishi Vigyan Kendra, Ropar imparts training to the farmers in paddy straw management and sowing of wheat.
treatment of wheat, low tunnel technology for vegetable crops, bulb set technique in Kharif onion production, cultivation of rainy season tomato and broccoli, and fungicidal management of foot rot/gummosis in citrus.

In addition to field demonstrations, method demonstrations were conducted on important practices. A total of 1,790 method demonstrations were conducted on the collection of soil and water samples, seed treatment, *Rhizobium* inoculation in different crops, spray techniques of agrochemicals, calculation of economic threshold levels for plant protection, nursery raising of vegetables, and different aspects of cooking and home management practices.

**SPECIAL CAMPAIGNS**

- **Paddy straw management:** A campaign on paddy straw management was organized in different parts of Punjab by adopting various technologies. A total of 30 villages in different districts of the State were made zero burning villages.

- **Whitefly management in cotton:** A special campaign on the management of whitefly in cotton was initiated from February 2018 onwards by adopting integrated pest management strategies. Whitefly population was monitored and managed on weeds and alternate crop host plants like brinjal, cucurbits (cucumber, long melon, *chappan kaddu*, etc.), tomato, okra and chilli before sowing of cotton crop.

Farmers were advised about clean cultivation, cultivation of recommended Bt cotton hybrids, timely sowing, proper nutrient management, use of non-chemical (yellow sticky traps) and chemical approaches based on economic threshold level through training camps, advertisements in newspapers, WhatsApp, TV/radio talks, etc. Under the chairmanship of PAU Vice Chancellor, meetings of Interstate Consultative Monitoring Committee for Whitefly on Cotton were held at Abohar and Bathinda.

(Clockwise) Students of PAU, farmers and rural women attending training programmes on Beekeeping, Jaggery Making, Poultry Farming, and Preservation of Fruits and Vegetables at *Krishi Vigyan Kendras*, Pathankot, Samrala, Amritsar and Faridkot, respectively.
• **Yellow rust management:** Regular surveillance and monitoring was carried out in a campaign mode for the early detection of initial hot spots of yellow rust in disease prone sub-mountainous regions of Punjab. Timely warnings and advisories were issued to farmers for successful management of disease.

• **Popularization of biofertilizers and bioagents:** Campaigns were conducted for the use of biofertilizers and the area under wheat biofertilizer increased from 56,000 acres (2017-18) to 60,191 acres (2018-19). Besides, an area of 15,070 acres was under trichocards for sugarcane, rice and maize crops. *Trichoderma* for control of foot root in *basmati* rice covered an area of 800 acres.

**TRAININGS AND EXHIBITIONS**

**Trainings**
The *Krishi Vigyan Kendras* and the Centre for Advance Training at PAU organized 1,651 training programmes (1,215 short, 289 vocational, 105 in-service and 42 sponsored) for the farmers, farm women and extension functionaries to enhance their knowledge for increasing agricultural productivity and farm income. Vocational trainings were given on precision farming, hybrid seed production, protected cultivation of vegetables, pruning of fruit plants, mushroom cultivation, apiculture, poultry, dairying, piggery, goatry, value addition of agricultural produce (preparation of pickles/murabbas/ketchup and other recipes), tie and dye, stitching, embroidery, etc. In total, 24,280 farmers, 9,233 farm women and 1,919 extension personnel benefited from these trainings.

**Exhibitions**
Exhibitions are arranged during *Kisan Melas*, training camps, field days, scientific advisory committee meetings, technology week celebrations and special days to create awareness among farmers about new and improved technologies and practices. During the period under report, 827 exhibitions were put up where important production, protection and resource conservation technologies; live and preserved plant specimens; farm machinery; models of various important technologies including drip irrigation; processing equipment and farm literature were exhibited. In these exhibitions, farmers were also enrolled for the monthly magazines of PAU i.e. Progressive Farming and *Changi Kheti.*
WORKSHOPS
Workshops are regularly organized by PAU in which University scientists and extension officers of line departments discuss results of latest technologies, developed by PAU, and finalize Package of Practices for farmers. Extension officers also provide feedback of farmers to the scientists about challenges being faced in the field so as to find solutions to these challenges. During the year, five workshops were organized: Research and Extension Specialists' Workshop for Rabi Crops (August 16-17, 2018); Training-cum-Workshop on Formation of Farmer Producer Organizations (July 9, 2018); Research and Extension Specialists' Workshop for Fruits, Mushroom, Agro-forestry along with Post-harvest Management, Farm Power and Machinery, Food Technology and Agricultural Economics (February 6-7, 2019); State Level Training Planning Workshop (February 20, 2019) and Research and Extension Specialists' Workshop for Kharif Crops (February 26-27, 2019).

FARMERS’ ORGANIZATIONS
The meetings of various farmers' organizations are organized to share the latest technological advancements in various disciplines. Ten monthly training camps were organized for the members of PAU Kisan Club in which 4,397 farmers and farm women participated. Apart from this, 10 monthly training camps were held for the members of Progressive Beekeepers Association in which 1,720 farmers participated. Five training camps each were organized for the members of PAU Seed Producers and Nursery Growers Association and PAU Organic Farming Club, benefitting 472 and 589 farmers, respectively. Four training camps each were organized for the members of PAU Tree Growers Association and PAU Soybean Producers and Processors Club, in which 384 and 269 farmers participated, respectively. One training camp was organized for the members of PAU Flower Growers Club in which 235 growers participated.

INFORMATION AND COMMUNICATION TOOLS (ICTs)

• PAU Doots: The PAU doots are being sent 2-3 messages per week regarding various agricultural practices through e-mail. They further spread that message to fellow farmers through public address system of Gurdwaras/Mandirs for faster spread of technologies. During the period under report, 230 PAU doots were enrolled and 72 messages were sent to them. A total of 6,103 PAU doots have been enrolled so far.

• Digital Newspaper: Kheti Sandesh, a weekly digital newspaper, was started for the dissemination of latest technologies among farmers. At present, more than 5 lakh farmers are receiving this digital newspaper on their WhatsApp.

• Kisan Mobile App: Kisan Mobile App was started and released at Kisan Mela on September 20, 2018.

• Weather Based Agro-advisory SMS: Five lakh farmers were enrolled for weather based agro-advisory.

• WhatsApp Group: A total of 149 WhatsApp groups were formed by the scientists of KVKs/FASCs for the transfer of latest technology to the end users.

• Farmer Portal: The University has developed a ‘Farmer Portal’ which has been put on PAU website (www.pau.edu) for the benefit of stakeholders.

• Video Capsule: Video capsules were developed on improved agricultural technologies including crop varieties, integrated pest management technologies, straw management techniques, etc. for mobile phones for the benefit of farmers.
COMMUNICATION THROUGH MASS MEDIA
The Communication Centre maintains a constant liaison with the print and electronic media including Doordarshan and All India Radio (AIR), Jalandhar, to publicize the activities of PAU. It issues press releases to different newspapers and news channels on regular basis. During the period under report, the Centre issued 884 press releases (426 in English and 458 in Punjabi). The Centre also sent 205 articles in English (40) and Punjabi (165), authored by PAU scientists, for publication in vernacular newspapers and magazines. The Centre provided TV coverage to different events and also produced 14 Kisan Mela reports for telecast from Doordarshan. It coordinated with Doordarshan Kendra, Jalandhar and AIR, Jalandhar for 255 TV/radio talks of PAU scientists. It also prepared 17 documentaries and two advertisements.

FARM PUBLICATIONS
The Centre publishes two monthly farm magazines Changi Kheti (in Punjabi) and Progressive Farming (in English). Both the farm magazines are printed in four colours on offset machines to maintain top quality. The combined circulation of these magazines was 1,70,400 during 2018-19. The Centre also publishes Package of Practices for Crops of Punjab, twice a year, both in English and Punjabi. Besides, technical farm bulletins are published regularly on various crops and technologies. During the period under report, the Centre brought out 21 farm bulletins in English and 25 in Punjabi. Revised editions of Package of Practices for Rabi and Kharif Crops (in English and Punjabi), Field Problems of Important Crops (in English), etc. were published by the Centre. In addition, new editions, such as Bake and Enjoy, Kinnow Processing, Potato Processing, Food Safety, Kheti Vikas De Sirjak, Chikku Di Kashat, Khumbha Di Kashat, Kitnashkan Di Suchaji Varton, Parali Di Sambh Sambhal, etc. were published.
NEW APPOINTMENTS, PROMOTIONS AND RETIREMENTS

New appointments

During the period under report, following new appointments were made. Besides, 36 Assistant Professors and equivalent were directly recruited.

<table>
<thead>
<tr>
<th>Name</th>
<th>Appointed as</th>
<th>Date of appointment</th>
</tr>
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<tbody>
<tr>
<td>Dr Mahesh Kumar</td>
<td>Head, Department of Processing and Food Engineering</td>
<td>20.08.2018</td>
</tr>
<tr>
<td>Dr Sukhmeet Singh</td>
<td>Head, Department of Mechanical Engineering</td>
<td>28.09.2018</td>
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<tr>
<td>Dr Sanjeev Kumar Chauhan</td>
<td>Head, Department of Forestry and Natural Resources</td>
<td>06.11.2018</td>
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<tr>
<td>Dr Kamal Vatta</td>
<td>Head, Department of Economics and Sociology</td>
<td>05.04.2019</td>
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<tr>
<td>Dr Kiranjeet Kaur Dhatt</td>
<td>Head, Department of Floriculture and Landscaping</td>
<td>23.01.2019</td>
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<tr>
<td>Dr Kiran Bains</td>
<td>Head, Department of Food and Nutrition</td>
<td>30.01.2019</td>
</tr>
<tr>
<td>Dr Kamal Gurmeet Singh</td>
<td>Head, Department of Soil and Water Engineering</td>
<td>07.03.2019</td>
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<tr>
<td>Dr Narinder Singh</td>
<td>Head, Department of Plant Pathology</td>
<td>06.07.2018</td>
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<tr>
<td>Dr Ram Sakal Singh</td>
<td>Director, Regional Research Station, Gurdaspur</td>
<td>26.10.2018 (31.01.2019 Retired)</td>
</tr>
<tr>
<td>Dr Paramjit Singh</td>
<td>Director, Regional Research Station, Bathinda</td>
<td>29.10.2018 (second term)</td>
</tr>
<tr>
<td>Dr Manmohanjit Singh</td>
<td>Director, Regional Research Station, Ballowal Saunkhri</td>
<td>01.04.2019 (second term)</td>
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Promotions and retirements

During the period under report, 49 Assistant Professor level teachers having grade pay of Rs 6,000/- were placed in the grade pay of Rs 7,000/- in the pay scale of Rs 15,600-39,100; 42 Assistant Professor level teachers having grade pay of Rs 7,000/- were placed in the grade pay of Rs 8,000/- in the pay scale of Rs 15,600-39,100; one Assistant Professor having grade pay of Rs 8,000/- in the pay scale of Rs 15,600-39,100 was promoted/designated to the post of Associate Professor and equivalent in the grade pay Rs 9,000/- in the pay scale of Rs 37,400-67,000 and 2 Associate Professors having grade pay of Rs 9,000/- were promoted to the post of Professor and equivalent in the grade pay of Rs 10,000/- in the pay scale of Rs 37,400-67,000. Sixteen teachers retired/resigned from the University service.

AWARDS, DISTINCTIONS AND RECOGNITIONS

- The Punjab Agricultural University was decorated with the prestigious Sardar Patel Outstanding ICAR Institution Award 2017 by the Indian Council of Agricultural Research (ICAR).
Faculty strength

<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>ICAR</td>
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<td>153</td>
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<tr>
<td>KVK</td>
<td>126</td>
<td>119</td>
</tr>
<tr>
<td>Others</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>1,361</td>
<td>803</td>
</tr>
</tbody>
</table>

- Dr Baldev Singh Dhillon, Vice Chancellor, PAU, was awarded Padma Shri, one of the highest civilian honours of India, by the President of India Sh Ram Nath Kovind at Civil Investiture Ceremony, held at Rashtrapati Bhavan, New Delhi, on March 11, 2019. Dr Dhillon was awarded in the field of Science and Engineering (Agriculture).

College of Agriculture

- Drs JS Chawla, Gurjit K Gill, Tosh Garg, Mahesh Kumar, Jawala Jindal and Harleen Kaur (Plant Breeding and Genetics) were conferred with the Best All India Coordinated Research Project (AICRP) Maize Centre Award for the biennium 2017-18 and 2018-19 by the ICAR – Indian Institute of Maize Research (IIMR), Ludhiana.
- Dr SS Dhaliwal (Soil Science) received IZA-FAI Award 2018 from International Zinc Association (IZA)-Fertiliser Association of India (FAI) for excellence in promoting zinc in Indian agriculture.
- Dr Madhu Bala (Floriculture and Landscaping) received Young Scientist Award 2018 from Agricultural Technology Development Society, Ghaziabad, Uttar Pradesh.
- Dr Buta Singh (Plant Breeding and Genetics) got the Best Thesis Award 2018 from the Indian Society of Agronomy.
- Drs MK Sidhu and AS Dhatt (Vegetable Science) were awarded Dr Harbhajan Singh Memorial Award by Indian Society of Vegetable Science in 2019 for the best publication in 'Vegetable Science' in 2017. They also bagged second and third prize for poster presentation during the First Vegetable Science Congress on “Emerging Challenges in Vegetable Research and Education” (VEGCON-2019), held at Jodhpur, Rajasthan, from February 1-3, 2019.
- Dr BS Brar (Soil Science) was elected as Fellow of Indian Society of Soil Science, New Delhi, in 2018.
- Dr Pushp Sharma (Plant Breeding and Genetics) was enrolled as Fellow of Society of Rapeseed Mustard Research, Bharatpur, in 2019.
• Dr Sukhjeet Kaur (Vegetable Science) got the **Best Poster Award** from the Indian Society of Plant Pathologists during the National Symposium on “Role of Plant Pathology in Empowering and Doubling Farmers’ Income” held at ICAR Research Complex for North-Eastern Hill Region, Umiam, Meghalaya, from October 25-27, 2018.

• Drs Sukhjeet Kaur, SS Kang, A Sharma, SK Jindal and MS Dhaliwal (Vegetable Science) received **Dr RK Arora Best Paper Award** from Indian Society of Plant Genetic Resources, New Delhi, in 2018.

• Dr Sarwan Kumar (Plant Breeding and Genetics) got the **Best Oral Presentation Award**, while Dr PS Sandhu (Plant Breeding and Genetics) bagged the **Best Poster Presentation Award** during the 4th National Brassica Conference on “Innovative Approaches in Oilseed Brassica towards Self-sufficiency,” held at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, from February 1-3, 2019.

• Dr Poonam A Sachdev (Food Science and Technology) bagged the **Best Paper Presentation Award** during the International Conference on “Food Security through Agriculture and Allied Sciences” (FAAS-2019), organized by the Tribhuvan University, Kathmandu, Nepal, in collaboration with the Society for Agriculture Innovation and Development, Ranchi, and the Indian Society of Genetics, Biotechnology Research and Development, Agra, India, in Nepal from May 27-29, 2019.

**College of Agricultural Engineering and Technology**

• Drs KG Singh and Angrej Singh (Soil and Water Engineering) received the **Best All India Coordinated Research Project (AICRP) Centre Award 2018** from ICAR-Central Institute of Post-harvest Engineering and Technology (CIPHET), Ludhiana.
• Drs Manjeet Singh, GS Manes, HS Sidhu, Manpreet Singh, Rajesh Goyal, Aseem Verma and SK Singh (Farm Machinery and Power Engineering) were conferred with **GS Khush Team Award 2018-19** by Khush Foundation, PAU, for excellence in transfer of technology.

• Drs Manjeet Singh, GS Manes, HS Sidhu, Manpreet Singh, Rajesh Goyal and Aseem Verma (Farm Machinery and Power Engineering) received cash award of Rs 1,00,000/- from PAU in 2019 for the development of outstanding technology - PAU Super Straw Management System (PAU Super SMS).

• Drs Manjeet Singh, GS Manes, HS Sidhu, Manpreet Singh, Jaskarn Singh Mahal, Rajesh Goyal and Aseem Verma (Farm Machinery and Power Engineering) bagged **ISAE Team Award 2018** from Indian Society of Agricultural Engineers (ISAE), New Delhi.

• Dr Satish Kumar Gupta (Training Unit) was conferred with the **Best Teacher Award 2018** by the Indian Society for Technical Education (ISTE).

• Dr Nilesh Biwalkar (Soil and Water Engineering) got the **Best Teacher Award 2019** from the International Association of Research and Development Organization.

• Dr Rajan Aggarwal (Soil and Water Engineering) was awarded **Gold Medal** by Soil Conservation Society of India, New Delhi, in 2018.

• Dr Monika Sachdeva Taggar (Renewable Energy Engineering) received the **Best Research Article Award** from the Academy of Environment and Life Sciences during the National Conference on “Promoting and Reinvigorating Agri-Horti, Technological Innovations” (PRAGATI-2018), held at Jaipur from December 15-16, 2018.

• Dr Preetinder Kaur (Processing and Food Engineering) received the **Best Poster Presentation Award** during the “53rd Annual Convention of Indian Society of Agricultural Engineers and International Symposium on Engineering Technologies for Precision and Climate Smart Agriculture,” held at Banaras Hindu University, Varanasi, Uttar Pradesh, from January 28-30, 2019.

• Drs Kirandeep Devgan, Preetinder Kaur, Satish Kumar (Processing and Food Engineering) and Manpreet Singh (Renewable Energy Engineering) won first prize in oral presentation during the “SLIETCON-2019,” a Multi-Track National Conference, organized by Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, at National Institute of Technical Teachers Training and Research, Chandigarh, from March 1-2, 2019.

• Drs Preetinder Kaur, TC Mittal and SR Sharma (Processing and Food Engineering) got second prize in oral presentation during the “SLIETCON-2019,” a Multi-Track National Conference, organized by Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, at National Institute of Technical Teachers Training and Research, Chandigarh, from March 1-2, 2019.

• Drs Gagandeep Kaur and Preetinder Kaur (Processing and Food Engineering) were awarded the **Best Poster Presentation Award** during the “SLIETCON-2019,” a Multi-Track National Conference, organized by Sant Longowal Institute of Engineering and Technology (SLIET), Longowal, at National Institute of Technical Teachers Training and Research, Chandigarh, from March 1-2, 2019. Dr Preetinder Kaur also won second prize in poster presentation during this national conference.

**College of Basic Sciences and Humanities**

• Dr Sangeet Ranguwal (Economics and Sociology) was awarded **Orange**
• Drs Bavita Asthir, Manjeet Kaur Sangha and Satvir Kaur Grewal (Biochemistry) were enrolled as Fellow of Indian Society of Agricultural Biochemists by Indian Society for Agricultural Biochemistry in 2018.
• Dr Param Pal Sahota (Microbiology) received Professor Manjit Singh Chhinan Distinguished Professor Chair from PAU in 2018. She was also instrumental in getting Patent Grant (Patent No.- 305767) from Patent Office, Government of India, for “A Process for Production of Non-alcoholic Naturally Carbonated Beverage from Fruit Juice with Yeast.”
• Dr GS Kocher (Microbiology) got Plaque and Merit Certificate along with citation from PAU in 2019 for his excellence in research, extension and teaching work.
• Dr Rimaljeet Kaur (Biochemistry) was conferred with the Department of Science and Technology (DST)- Innovation in Science Pursuit for Inspired Research (INSPIRE) Faculty Award 2018 for the project entitled “Associative transcriptomics and metabolomics of stress signal transduction in Brassica juncea alien introgression lines varying for their resistance responses to Lipaphis erysimi herbivory: In continuity.” She was also awarded Newton-Pulses and Oilseed Research Initiative (PORI) research grant for Indo-UK project entitled “Genomics-led improvement of biotic and abiotic stress tolerance in mustard rape for economic and environmental sustainability” in 2018. She is working as Co-investigator of the project which is funded by the Department of Biotechnology (DBT) - Biotechnology and Biological Sciences Research Council (BBSRC).
• Dr Vikramjit Kaur (Biochemistry) got two Best Research Paper Presentation Award during the Proceedings of National Conference on “Advances in Agriculture and Natural Sciences for Sustainable Development,” held at Indian Institute of Technology, Roorkee, from October 12-13, 2018.
• Dr Manjeet Sangha (Biochemistry) bagged the Best Poster Award during the national level “Food and Nutritional Security Conclave and XIV Convention of Indian Society of Agricultural Biochemistry,” held at Mahatama Phule Krishi Vidyapeeth, Rahuri, from February 25-27, 2019.

College of Community Science
• Dr Deepika Vig (Human Development and Family Studies) received Excellence in Education Award 2019 at Chandigarh College of Education, Mohali, for her research work.
• Ms Shipra Saklani (Food and Nutrition) got the Best Poster Presentation Award from the Society for Agriculture Innovation and Development, Ranchi; Asian Institute of Technology and Khon Kaen University, Bangkok, Thailand, for the paper entitled “Oxidative Stability and Antioxidant Potential of Canola Oil.”
• Ms Rajdeep Kaur (Biochemistry) was conferred with the Department of Science and Technology (DST)- Innovation in Science Pursuit for Inspired Research (INSPIRE) Faculty Award 2018 for the project entitled “Associative transcriptomics and metabolomics of stress signal transduction in Brassica juncea alien introgression lines varying for their resistance responses to Lipaphis erysimi herbivory: In continuity.” She was also awarded Newton-Pulses and Oilseed Research Initiative (PORI) research grant for Indo-UK project entitled “Genomics-led improvement of biotic and abiotic stress tolerance in mustard rape for economic and environmental sustainability” in 2018. She is working as Co-investigator of the project which is funded by the Department of Biotechnology (DBT) - Biotechnology and Biological Sciences Research Council (BBSRC).
• Dr Surabhi Mahajan (Apparel and Textile Science) got third prize in poster presentation during the “58th Joint Technological Conference,” held at North India Textile Research Institute, Ghaziabad, from February 15-16, 2019.
Directorate of Research

• Dr Gulzar Singh Sanghera (Regional Research Station, Kapurthala) received the Best Oral Presentation Award during the National Conference on “Promoting and Reinvigorating Agri-Horti, Technological Innovations,” held at Jaipur from December 15-16, 2018.

Directorate of Extension Education

• The Krishi Vigyan Kendra (KVK), Bathinda was conferred with the Best NICRA - KVK Award 2019 in recognition of its best efforts in implementing the National Innovations on Climate Resilient Agriculture (NICRA) - Technology Demonstration Component of ICAR. This award was bestowed on KVK, Bathinda during the Annual Review Workshop of Krishi Vigyan Kendras, organized by Central Research Institute for Dryland Agriculture, Hyderabad, from June 4-6, 2019.

• The Krishi Vigyan Kendra, Sangrur and the Gram Panchayat, Chatha Nanhera were felicitated with the Rajpal Sarvotam Village Award during the Kisan Mela at PAU on September 20, 2018. The village was awarded as the Best Adopted Village under the CM adopted villages.

• Dr Vinay Singh (Krishi Vigyan Kendra, Bathinda) was conferred with Young Scientist Award by Astha Foundation during the International Conference on “Global Research Initiatives for Sustainable Agriculture and Allied Sciences,” organized by Rajasthan Agricultural Research Institute, Durgapura, Jaipur, from October 28-30, 2018.

• Dr Aparna (Krishi Vigyan Kendra, Ropar) received Excellent Extension Scientist Award during the 2nd International Conference on “Advances in Agricultural Biological and Applied Sciences for Sustainable Future,” organized by Agricultural Technology Development Society, Ghaziabad, Uttar Pradesh, from October 20-22, 2018. She also bagged the Best Thesis Award and the Best Oral Presentation Award during the conference on “Livestock Development for Societal Needs: Extension and Allied Sector Initiatives,” organized by Society for Veterinary and Animal Husbandry Extension (SVAHE), Ludhiana and Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, from April 3-5, 2019.

• Dr Prerna Thakur (Krishi Vigyan Kendra, Moga) bagged Dwarika Nath Memorial Award 2018 from Indian Society of Vegetable Science for the Best Thesis in Vegetable Science.

• Dr Balkaran Singh (Krishi Vigyan Kendra, Muktsar) received the Best Trainee Award during the Winter School on “Advances in Salinity and Sodicity Management under different Agro-climatic Regions for Enhancing Farmers' Income,” organized by Central Soil Salinity Research Institute, Karnal, from September 4-24, 2018.

• Dr BS Romana (Farm Advisory Service Centre, Sangrur) bagged first prize for Punjab Naujawan Kisan Sanstha (PNKS) stall during the Kisan Mela, held at PAU from September 20-22, 2018.

• Dr JK Arora (Farm Advisory Service Centre, Abohar) got second prize for the sale of publications during the Kisan Mela, held at PAU from March 20-21, 2019.

• Dr Karamjit Sharma (Krishi Vigyan Kendra, Muktsar) bagged the Best Paper Presentation Award during the 9th National Extension Education Congress, organized by College of Agricultural Engineering and Post-harvest Technology, Sikkim (Central Agricultural University, Imphal), from November 15-17, 2018.
• Drs JS Brar, GS Dhillon, Vinay Singh and PS Sidhu (Krishi Vigyan Kendra, Bathinda) got the Best Poster Presentation Award during the Annual Review Workshop of Krishi Vigyan Kendras, held under National Innovations on Climate Resilient Agriculture (NICRA) - Technology Demonstration Component of ICAR at Central Research Institute for Dryland Agriculture, Hyderabad, from June 4-6, 2019.

• Dr Shikha Bathla (Krishi Vigyan Kendra, Shaheed Bhagat Singh Nagar) received the Best Oral Presentation Award during the International Conference on “Current Approaches in Nutraceuticals and Food Technology for Diabetes Management,” held at Periyar University, Salem, Tamil Nadu, from June 24-25, 2019.

NATIONAL AND INTERNATIONAL LINKAGES

Memoranda of Understanding (MoUs) signed

During the period under report, PAU signed 10 MoUs with various national and international institutions and organizations:

• M/s CDSL (Central Depository Services Limited) Ventures Limited, Mumbai, on July 17, 2018 for enabling the lodging, authentication and verification of the academic awards.

• Mahindra and Mahindra Limited, Mumbai, on October 17, 2018 for preparing a Computer Aided Design (CAD) model followed by working model of the product in accordance with the concept; preparing detailed drawing for the product; preparing detailed check list of the material required and the manufacturing process involved; integration of the product in M&Ms tractor; and testing of the product and improvement/s or modification of the technology.

• Galilee International Management Institute, Israel; Tel Aviv University, Israel; and Arava Institute, Israel, on October 23, 2018 to collaborate on cooperative research; hold joint academic seminars on agricultural sciences and trainings of 200 scientists and extension workers; pursue faculty and student exchange programmes; and cooperate in exchange of scholarship plans of mutual interest.

• University of Birmingham, United Kingdom, on January 9, 2019 to develop cooperative relationship for the general purpose of promoting teaching, research and other collaborative activity for the mutual benefit.

• University of Canberra, Australia, on March 12, 2019 and Nippon Steel and Sumikin Bussan Corporation, Tokyo, Japan, on March 15, 2019 for the exchange of scientists, technologists and students; exchange of germplasm and breeding material following regulations of each country; exchange of scientific literature, information and methodology; and exchange of scientific equipment as variable and required in the programme of common interest as may be mutually agreed upon. Agreement with University of Canberra, Australia, will also focus on the development and implementation of collaborative teaching, research and extension; projects in the identified areas and methodology to be used as mutually agreed upon.

• Michigan State University, East Lansing, Michigan, USA, on April 19, 2019 for the exchange of material in education and research, publications and academic information; conducting joint research and meetings for education, research and outreach; exchange of faculty, students and research scholars; establishing joint Centres of Excellence; technical assistance; and human resource development through training and capacity building.
Punjab and Sind Bank, Amritsar, on June 24, 2019 to analyze the current scenario of agricultural lending in Punjab; assess the effectiveness of lending methods followed by banks in extending crop and investment credit to support farming activities; analyze credit requirement and credit absorption capacity of a farmer and assess the end use of finance; explore new instruments for lending; study recovery in farm credit and impact of State Government's loan waiver on recovery cycle; study scope of value addition and increasing lending opportunities due to value addition; and discuss and carry out study regarding any other aspects related to agriculture/farmer as mutually decided between the bank and the University.

**Eminent Visitors**

- Dr SK Shukla, Project Coordinator of All India Coordinated Research Project (Sugarcane), Indian Institute of Sugarcane Research, Lucknow, visited Regional Research Station, Kapurthala to monitor the field trials. (August 6, 2018)
- A four-member delegation from Kansas State University (KSU), USA, visited PAU to explore opportunities for collaboration in the areas of food, energy and water with focus on understanding their socio-economic aspects. The delegation, led by Dr Stacy L Hutchinson, Professor, Biological and Agricultural Engineering, College of Engineering, KSU, also comprised Dr Vishali Sharda, Assistant Professor, KSU; Ms Kelsey McDonough, a Ph.D. student of Biological and Agricultural Engineering, KSU and Ms Marleigh Hutchinson. (October 8, 2018)
- Captain Amarinder Singh, Chief Minister of Punjab, visited PAU to review its progress. The Chief Minister impressed upon PAU to work on frontier technologies, viz. biotechnology, nanotechnology, big data analysis and climate change to improve the sustainability of state agriculture in future. (January 15, 2019)
- Dr Cecilia Antony, Chairperson of the Department of French and Francophone Studies, Panjab University, Chandigarh, visited PAU to deliver a talk on the “First Declaration of Rights of Woman drafted during the French Revolution.” (March 28, 2019)
- A five-member delegation of the World Bank visited PAU to discuss the crop residue burning issue, and long-term growth and sustainability of Punjab agriculture. (May 10, 2019)
- Mr Henk Ter Stege, an expert from PUM Netherlands, visited PAU to give a word of advice on the project of Technology Business Incubator, which is going to help the new entrepreneurs in setting up their own industries, especially, in the field of food processing. During his 12-day stay at PAU, he...
Wing Drosophila Trapping and Attract and Kill Technology” from June 1 to September 5, 2018.
- Dr Navneet Kaur (Forestry and Natural Resources) visited Wageningen University and Research, The Netherlands, to acquire training in “Resilient and Sustainable Food Systems for a Food Secure Future” from April 1-11, 2019.

College of Basic Sciences and Humanities
- Dr Shivani Sharma (Microbiology) visited Centre for Development Innovation, Wageningen University and Research, The Netherlands, to attend training programme on “Global One Health Towards Animals, Plants and Human Health” from November 5 -16, 2018.
- Dr Priya Katyal (Microbiology) visited Centre for Development Innovation, Wageningen University and Research, The Netherlands, to attend training programme on “Market Access for Food and Nutrition Security” from November 26 to December 12, 2018.
- Dr Sangeet Ranguwal (Economics and Sociology) visited Aeres Training Centre International, Barneveld, The Netherlands, to attend training programme on “Agricultural Training and Extension” from June 6 to July 4, 2019.
- Dr Rimaljeet Kaur (Biochemistry) visited London to attend training programme on “Genomics Led Improvement of Biotic and Abiotic Stress Tolerance in Mustard Rape for Economic and Environmental Sustainability” under Newton Bhabha Project “Genomics Led Improvement of Biotic and Abiotic Stress Tolerance in Mustard Rape for Economic and Environmental Sustainability - Joint Call of Biotechnology and Biological Sciences Research Council (BBSRC)” from June 17 to July 15, 2019.

Trainings and visits abroad

College of Agriculture
- Dr Ritu Rani (Plant Pathology) visited The Ohio State University’s Ohio Agricultural Research and Development Centre (OARDC), Wooster, USA, to attend the three-month training programme on “Coupling Spore Traps and Quantitative (q) Polymerase Chain Reaction (PCR) Assays for Quantification and Detection of the Botrytis cinerea Spores collected in Tomato Production Greenhouses, Storage and Handling Areas” from May 5 to August 4, 2018.
- Dr Sandeep Singh (Fruit Science) visited Michigan State University, East Lansing, USA, to attend advance training on “Spotted...
# IMPORTANT EVENTS ORGANIZED AT PAU

## Dean, Postgraduate Studies

<table>
<thead>
<tr>
<th>Event and Date</th>
<th>Organizing/Sponsoring Agency</th>
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<tbody>
<tr>
<td>The 43rd Vice Chancellors’ Convention on “Artificial Intelligence for Smart Agriculture” (February 11-12, 2019)</td>
<td>Dean, Postgraduate Studies</td>
</tr>
<tr>
<td>Talk by Dr Harsha Kikkeri, CEO Holosuit, on “Immersive Learning Experiences through Virtual Laboratories, Artificial Intelligence and Robotics using Holosuit” (April 4, 2019)</td>
<td>PAU Science Club</td>
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## College of Agriculture

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<thead>
<tr>
<th>Event and Date</th>
<th>Organizing/Sponsoring Agency</th>
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<tbody>
<tr>
<td>5th Rabi Group Meet of All India Coordinated Research Network (AICRN) on “Potential Crops” (September 9, 2018)</td>
<td>Pulses Section, PAU</td>
</tr>
<tr>
<td>Training programme on “Natural Resource Management for Doubling Farmers' Income” (October 10-30, 2018)</td>
<td>ICAR/Centre of Advanced Faculty Training (CAFT) in Soil Science, PAU</td>
</tr>
<tr>
<td>Winter School on “Technological Advances to Minimize Wastage of Horticultural Produce” (November 1-21, 2018)</td>
<td>Department of Fruit Science, PAU</td>
</tr>
<tr>
<td>Winter School on “Recent Advances in Integrated Pest Management of Insects” (November 13 to December 3, 2018)</td>
<td>Department of Entomology, PAU, under the aegis of ICAR</td>
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<tr>
<td>Guava Show-cum-Seminar (December 5, 2018)</td>
<td>Department of Fruit Science, PAU and Regional Fruit Research Station, Bahadurgarh</td>
</tr>
<tr>
<td>Training course on “Genomics Assisted Crop Breeding Techniques” (January 22 to February 11, 2019)</td>
<td>PAU, Ludhiana</td>
</tr>
<tr>
<td>Winter School on “Application of Molecular Epidemiology and Simulation Modeling for Plant Disease Management” (February 13-22, 2019)</td>
<td>Department of Plant Pathology, PAU and ICAR, New Delhi</td>
</tr>
<tr>
<td>Seminar on “Cultivation and Management of Horticultural Crops” (February 28, 2019)</td>
<td>PAU, Ludhiana at MS Randhawa Fruit Research Station, Gangjian</td>
</tr>
<tr>
<td>Hands-on-training on “Statistical Tools and Database Management in Agriculture” (June 10-15, 2019)</td>
<td>Department of Soil Science under ICAR’s National Agricultural Higher Education Project - Centres for Advanced Agricultural Science and Technology (CAAST) - School of Natural Resources Management for Sustainable Agriculture</td>
</tr>
</tbody>
</table>
Dr Baldev Singh Dhillon, Vice Chancellor, PAU, releasing publications along with agricultural experts during the 5th Rabi Group Meet of All India Coordinated Research Network (AICRN) on “Potential Crops” at PAU.

### College of Agricultural Engineering and Technology

<table>
<thead>
<tr>
<th>Event and Date</th>
<th>Organizing/Sponsoring Agency</th>
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<tbody>
<tr>
<td>- Guest Lecture by Er Umesh Jhamb, Mentor and Advisor, GS Auto International Limited, on “Planning - Mantra of Success” (August 10, 2018)</td>
<td>Training Unit and Placement, and Alumni Association, College of Agricultural Engineering and Technology, PAU</td>
</tr>
<tr>
<td>- Guest Lecture by Er Anil Kaushal, Vice President, Automat Industries, New Delhi, on “Status of Micro-irrigation and its Opportunity in India” (March 26, 2019)</td>
<td></td>
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<tr>
<td>- Guest Lecture by Er Sukhdeep Duggal, Irrigation Engineer, Jain Irrigation, Talwara, on “Scope of Agricultural Engineering in Irrigation Industry” (March 27, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Guest Lecture by Er Amit Kapoor, CEO, Solar Swaraj, Ghaziabad, and Mr Ravinder Nath Kapoor, Managing Director, Solar Division, Patiala, on “Marketing and Dealership Aspects associated with the Industry and Practical Aspects and Government Initiatives for Solar Projects” (March 28, 2019)</td>
<td></td>
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<tr>
<td>- Guest Lecture by Mr Harpal Singh Grewal, Chairman, Heavenly Farm Group and Indian Organic Food, Gurugram, on “Potential and Opportunities Associated with Organic Food, Food Processing Sector and Food Parks” (March 29, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Guest Lecture by Mr Parikshir Sai, Founder, Pranam Kisan, Sirsa, Haryana, on “Opportunities Related to Establishment of Food Parks” (March 29, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Expert Session by Dr TBS Rajput, Emeritus Scientist, Indian Agricultural Research Institute, New Delhi, on “Micro-irrigation for Enhancing Agriculture Income” (March 29, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Guest Lectures by Er Nishima Kathuria, Er Abhishek Chanchal and Er Vanshika Sharma, PAU alumni, who secured admission in prestigious Management Institutes – Indian Institute of Management, Ahmedabad, and Institute of Rural Management, Anand, Gujarat (April 25, 2019)</td>
<td></td>
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<tr>
<td>- Guest Lecture by Er Mehak, Indian Institute Management, Ahmedabad, on “Tips for Admission into Prestigious Management Institutions”(May 1, 2019)</td>
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</table>
Broad Subject Matter Area (BSMA) Committee Workshop for restructuring of Masters’ and Ph.D. curriculum, syllabi and academic regulations for the disciplines of Agricultural Engineering by ICAR (October 22, 2018) and (February 4-5, 2019)  

College of Agricultural Engineering and Technology, PAU

Food Industry and Craft Mela (October 30, 2018)  

Department of Processing and Food Engineering in association with Department of Food Science and Technology, and Department of Food and Nutrition, PAU

10th Annual Workshop of All India Coordinated Research Project on “Ergonomics and Safety in Agriculture” (November 27-28, 2018)  

Department of Farm Machinery and Power Engineering, PAU and ICAR, New Delhi

College of Basic Sciences and Humanities

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<tr>
<th>Event and Date</th>
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<tbody>
<tr>
<td>Winter School on “Proteomics and its Application in Agriculture” (September 5-14, 2018)</td>
<td>Department of Biochemistry, PAU and ICAR, New Delhi</td>
</tr>
<tr>
<td>Farmer-Scientist Interface Meeting (October 30, 2018)</td>
<td>College of Basic Sciences and Humanities, PAU.</td>
</tr>
<tr>
<td>National Seminar on “Environmental Changes and its Impact on Faunal Diversity in Indian Agro-ecosystems” (November 19-20, 2018)</td>
<td>Department of Zoology, PAU and Zoological Survey of India (ZSI)</td>
</tr>
<tr>
<td>Training programme on “Preparation of Natural Vinegar and Low Alcoholic Carbonated Beverages from Fruits” (November 19-20, 2018) and (June 25-26, 2019)</td>
<td>Department of Microbiology in collaboration with Directorate of Extension Education, PAU</td>
</tr>
<tr>
<td>Research Scholars’ Meet (March 27, 2019)</td>
<td>Department of Zoology, PAU and Patiala Chapter of Indian Science Congress Association (ISCA Kolkata)</td>
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Nigerian delegation attending Food and Craft Mela at PAU.
College of Community Science

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<tr>
<th>Event and Date</th>
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<tbody>
<tr>
<td>- Orientation course on “Effective Teaching, Research and Extension” for newly recruited faculty of PAU (August 21-31, 2018)</td>
<td>Department of Extension Education and Communication Management, PAU</td>
</tr>
<tr>
<td>- One-day workshop on “Youth and Mental Health in Changing World” (March 11, 2019)</td>
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<tr>
<td>- Workshops on “3-D Mural Making” and “Clay Modelling” (October 17-18, 2018)</td>
<td>Department of Family Resource Management, PAU</td>
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<tr>
<td>- Staff development programmes on “Sculpture Making” (January 17, 2019) and “Eco-friendly Cleansers” (May 10, 2019) for the staff of Krishi Vigyan Kendras</td>
<td></td>
</tr>
<tr>
<td>- Workshops on “Nutritious Biscuits” (March 18, 2019) and “Innovative Bakery and Decorative Icings” (March 23-24, 2019)</td>
<td>Experiential Learning Unit, Department of Food and Nutrition, PAU</td>
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Directorate of Research

<table>
<thead>
<tr>
<th>Event and Date</th>
<th>Organizing/Sponsoring Agency</th>
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<tbody>
<tr>
<td>Three training programmes:</td>
<td>Dr JC Bakshi Regional Research Station, Abohar</td>
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<tr>
<td>-“Development and Markers Aided Identification of Hybrids in Citrus” (October 29 to November 4, 2018)</td>
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<tr>
<td>-“Use of Biotechnological and Pathogen Diagnostic Techniques in Citrus” (January 5-9, 2019)</td>
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<tr>
<td>-“Hybrid Development in Citrus, their Molecular Identification and Screening against Phytophthora and Soil Salinity” (March 18-22, 2019)</td>
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<tr>
<td>Six workshops/seminars/trainings on:</td>
<td>PAU’s Regional Research Station, Kapurthala</td>
</tr>
<tr>
<td>-“Recent Technologies to Maximize Sugar Recovery in Sugarcane through Agronomic and Plant Protection Manipulations” (January 2-3, 2019)</td>
<td></td>
</tr>
<tr>
<td>-“Varietal Selection, Production and Protection Practices for Quality Jaggery Production” (January 21, 2019)</td>
<td></td>
</tr>
<tr>
<td>-“Recent Technologies to Attain the Potential Yield of Sugarcane” (February 6-7, 2019)</td>
<td></td>
</tr>
<tr>
<td>-“Role of Varietal Identification, Quality Seed Assurance, Recent Agronomical and Protection Technologies Toward Sustainable Sugarcane Production” (February 22-23, 2019)</td>
<td></td>
</tr>
<tr>
<td>-“Recent Technology for Sustainable Sugarcane Production” (March 5, 2019)</td>
<td></td>
</tr>
<tr>
<td>-“Technologies for Production of Healthy Crop of Sugarcane in Reference to Jaggery Production” (March 22, 2019)</td>
<td></td>
</tr>
<tr>
<td>-Training programme on “Seed Processing and Seed Quality Maintenance” (February 22, 2018)</td>
<td>PAU’s University Seed Farm, Naraingarh, Fatehgarh Sahib</td>
</tr>
</tbody>
</table>
### Directorate of Extension Education

<table>
<thead>
<tr>
<th>Event and Date</th>
<th>Organizing/Sponsoring Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Training programme on “In-situ Crop Residue Management” (August 13-14, 2018)</td>
<td>PAU, Ludhiana</td>
</tr>
<tr>
<td>- Orientation of Trainers of KVKs/SAUs/ICAR Institutes for conducting skill development programme during 2018-19 (August 31, 2018) and (September 2-3, 2018)</td>
<td></td>
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<tr>
<td>- Brainstorming Workshop on “Crop Residue Management” (September 6, 2018)</td>
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<tr>
<td>- Workshop on “Impending Insect Threats” (September 14, 2018) and (June 20, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Extension and Research Council Meeting (November 5, 2018) and (June 18, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Training-cum-Workshop for PAU Crop Residue Managers’ Association (December 20, 2018)</td>
<td></td>
</tr>
<tr>
<td>- Farmer - Producer Organizations (FPOs): Awareness Campaign on Promotion in Punjab: State Level Launch Programme (December 27, 2018)</td>
<td></td>
</tr>
<tr>
<td>- Programme on “Jaggery Processing” (March 11, 2019)</td>
<td>ICAR- Agricultural Technology Application Research Institute (ATARI), PAU Campus, Ludhiana</td>
</tr>
<tr>
<td>- Seminar on “Safe Processing of Sugarcane Juice into Jaggery” (March 25-26, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Workshop on Implementation of Demo Farms as a part of “Paani Bachao Paise Kamad” (May 14, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Workshop on “Farmer Producer Organizations” (June 22, 2019)</td>
<td></td>
</tr>
<tr>
<td>- Convergence Meet of Stakeholders on “Crop Residue Management” (October 8, 2018)</td>
<td></td>
</tr>
<tr>
<td>- Seminar on “Judicious Use of Agro-chemicals” (December 5, 2018)</td>
<td>Krishi Vigyan Kendra, Bathinda</td>
</tr>
<tr>
<td>- Seminar on “Safe and Judicious Use of Agro-chemicals and Adoption of IPM Practices” (March 29, 2019)</td>
<td>Krishi Vigyan Kendra, Bathinda, in collaboration with Hindustan Insecticides Limited (Government of India enterprise)</td>
</tr>
<tr>
<td>- Seminar on “PM Kisan Samman Nidhi Scheme” (March 31, 2019)</td>
<td>Ministry of Food Processing Industries, Government of India</td>
</tr>
</tbody>
</table>

### ESTATE ORGANIZATION

Estate Organization looks after the construction and maintenance of University buildings. A total of 14 projects were completed by the Engineering Unit during the period under report. (Annexure I)

### FACULTY PARTICIPATION IN NATIONAL AND INTERNATIONAL EVENTS

The University faculty participated in various national and international seminars, conferences, symposia, workshops, etc. Details are given below:
### International participation

#### College of Agriculture

<table>
<thead>
<tr>
<th>Name</th>
<th>Event and Organizing Agency</th>
<th>Date and Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Varinderpal Singh (Soil Science)</td>
<td>Indo-UK collaborative research project “Cambridge-India Network for Translational Research in Nitrogen (CINTRIN)”</td>
<td>April 22, 2018 to September 24, 2019 University of Cambridge, UK; Rothamsted Research, UK; and National Institute of Agricultural Botany, UK</td>
</tr>
<tr>
<td>Drs Sarvejot Singh and Inderjit Singh (Plant Breeding and Genetics)</td>
<td>International Symposium on &quot;Mutation Breeding and Biotechnology&quot; by International Atomic Energy Agency (IAEA)</td>
<td>August 27-31, 2018 Vienna, Austria</td>
</tr>
<tr>
<td>Drs Vikas Jindal and Vijay Kumar (Entomology)</td>
<td>“3rd International Whitefly Symposium 2018: Putting Farmers First” by University of Western Australia, Perth, Australia</td>
<td>September 16-19, 2018 Perth, Australia</td>
</tr>
<tr>
<td>Dr CS Aulakh (School of Organic Farming)</td>
<td>Workshop on “Strategic and Long Term Impacts of Organic Agriculture” by Research Institute of Organic Agriculture (FiBL), Frick, Switzerland</td>
<td>September 18-21, 2018 Frick, Switzerland</td>
</tr>
<tr>
<td>Dr JS Lore (Plant Breeding and Genetics)</td>
<td>“5th International Rice Congress” by International Rice Research Institute, Philippines</td>
<td>October 14-17, 2018 Singapore</td>
</tr>
<tr>
<td>Dr Hari Ram (Agronomy)</td>
<td>Harvest Zinc Fertilizer Project meeting on “Use of Zinc Containing Fertilizers for Enriching Cereal Grains Zinc and Productivity in Different Countries”</td>
<td>December 24-25, 2018 Sabancı University, Istanbul, Turkey</td>
</tr>
<tr>
<td>Dr AS Dhatt (Vegetable Science)</td>
<td>Memorandum of Understanding for research collaboration</td>
<td>December 30, 2018 to January 11, 2019 Volcani Center, Israel; Tel-Aviv University, Israel and Arava Institute, Israel</td>
</tr>
<tr>
<td>Dr MS Bhullar (Agronomy)</td>
<td>“59th Annual Meet of WSSA” by Weed Science Society of America (WSSA)</td>
<td>February 9-12, 2019 New Orleans, USA</td>
</tr>
<tr>
<td>Dr RIS Gill (Forestry and Natural Resources)</td>
<td>“4th World Congress on Agroforestry” by World Agroforestry</td>
<td>May 19-23, 2019 Montpellier, France</td>
</tr>
<tr>
<td>Dr Poornam A Sachdev (Food Science and Technology)</td>
<td>International Conference on “Food Security through Agriculture and Allied Sciences” (FAAS-2019) by Tribhuvan University, Kathmandu, Nepal, in collaboration with Society for Agriculture Innovation and Development, Ranchi, and Indian Society of Genetics, Biotechnology Research and Development, Agra, India</td>
<td>May 27-29, 2019 Tribhuvan University, Kathmandu, Nepal</td>
</tr>
<tr>
<td>Drs SK Sandhu, PS Sandhu, Pushp Sharma, Gurpreet Kaur and Sarwan Kumar (Plant Breeding and Genetics)</td>
<td>“15th International Rapeseed Congress” by Groupe Consultatif International de Recherche sur le Colza (GCIRC), France</td>
<td>June 16-19, 2019 Berlin</td>
</tr>
<tr>
<td>Dr Sanjula Sharma (Plant Breeding and Genetics)</td>
<td>Department of Biotechnology (DBT)-Biotechnology and Biological Sciences Research Council (BBSRC) Indo-UK Newton Pulses and Oilseed Research Initiative (PORI) Project</td>
<td>June 16 to October 15, 2019 Rothamsted Research, UK</td>
</tr>
</tbody>
</table>
College of Agricultural Engineering and Technology

<table>
<thead>
<tr>
<th>Name</th>
<th>Event and Organizing Agency</th>
<th>Date and Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drs Satish Kumar and Mahesh Kumar (Processing and Food Engineering)</td>
<td>Review meeting and visiting project foreign partner institutes/industry to discuss “Enhanced Rice Milling and Maximized Valorization of Rice Milling Co-Product”</td>
<td>June 26 to July 05, 2018 Sheffield and Nottingham Universities and Kool Mill Systems Limited, UK</td>
</tr>
<tr>
<td>Dr Preetinder Kaur (Processing and Food Engineering)</td>
<td>Quarterly review meeting of the project “Development and Optimization of Fresh Produce Supply Chain and Storage Systems”</td>
<td>September 29 to October 7, 2018 University of Lincoln, Lincolnshire, UK</td>
</tr>
<tr>
<td>Dr Jaspal Singh (Civil Engineering)</td>
<td>Quarterly project review meeting on research activities of the project “Bio-based Packaging for Fresh Food (BioFreshPak)”</td>
<td>June 10 to July 15, 2019 Natural Resources Institute, University of Greenwich, Kent, UK</td>
</tr>
</tbody>
</table>

College of Basic Sciences and Humanities

<table>
<thead>
<tr>
<th>Name</th>
<th>Event and Organizing Agency</th>
<th>Date and Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Manoj Kumar (Zoology)</td>
<td>“Sound Analysis Workshop”</td>
<td>October 15-19, 2018 The Cornell Lab of Ornithology, Cornell University, Ithaca, New York, USA</td>
</tr>
</tbody>
</table>

National participation

<table>
<thead>
<tr>
<th>Name of the College/Directorate</th>
<th>No. of faculty members participated</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Agriculture</td>
<td>94</td>
</tr>
<tr>
<td>College of Agricultural Engineering and Technology</td>
<td>31</td>
</tr>
<tr>
<td>College of Basic Sciences and Humanities</td>
<td>38</td>
</tr>
<tr>
<td>College of Community Science</td>
<td>19</td>
</tr>
<tr>
<td>Directorate of Extension Education</td>
<td>49</td>
</tr>
</tbody>
</table>

Agricultural stalwarts releasing publications during the National Seminar on “Environmental Changes and their Impact on Faunal Diversity in Indian Agro-ecosystems” at PAU.
NEW IMPORTANT EQUIPMENT ACQUIRED

College of Agriculture

<table>
<thead>
<tr>
<th>Equipment/Instrument</th>
<th>Cost (Rs in lakh)</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscometer</td>
<td>5.0</td>
<td>For checking viscosity of different food products</td>
</tr>
<tr>
<td>Satake Dehusker</td>
<td>8.00</td>
<td>For estimation of rice milling quality</td>
</tr>
</tbody>
</table>

College of Agricultural Engineering and Technology

<table>
<thead>
<tr>
<th>Equipment/Instrument</th>
<th>Cost (Rs in lakh)</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing Rig</td>
<td>9.85</td>
<td>For calibration of seed-cum-fertilizer drill and measuring seed to seed spacing</td>
</tr>
<tr>
<td>Headspace Analyzer</td>
<td>7.50</td>
<td>For gas monitoring and analyses</td>
</tr>
<tr>
<td>Gas Mixing and Packaging System for Modified Atmosphere Packaging (MAP)</td>
<td>16.00</td>
<td>For gas flushing and sealing of flexible and rigid packages</td>
</tr>
</tbody>
</table>

Directorate of Extension Education

<table>
<thead>
<tr>
<th>Equipment/Instrument</th>
<th>Cost (Rs in lakh)</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy Seeder</td>
<td>120.54</td>
<td>For sowing of wheat</td>
</tr>
<tr>
<td>Mulcher</td>
<td>69.50</td>
<td>For cutting of paddy straw</td>
</tr>
<tr>
<td>Cutter-cum-Spreader</td>
<td>24.75</td>
<td>For cutting and spreading of paddy straw</td>
</tr>
<tr>
<td>Hydraulic Rev. MB Plough</td>
<td>60.00</td>
<td>For incorporation of paddy straw</td>
</tr>
<tr>
<td>Zero Drill</td>
<td>18.70</td>
<td>For sowing of wheat</td>
</tr>
<tr>
<td>Seed Processing Plant (4) (grader)</td>
<td>19.80</td>
<td>For seed grading</td>
</tr>
<tr>
<td>Solar Power Generating System (3)</td>
<td>4.5</td>
<td>For solar resource used technology</td>
</tr>
<tr>
<td>Cutter-cum-Shredder (3)</td>
<td>12.8</td>
<td>For crop residue management</td>
</tr>
</tbody>
</table>

NEW LABORATORIES AND INFRA-STRUCTURE CREATED AND UPDATED

College of Agriculture

- One rearing unit of Polycarbonate Glasshouse was renovated at Entomological Research Farm.
- One net-house was constructed for conducting trials on the management of mites under net-house conditions.
- Entomology Postgraduate Laboratory No. 213 was updated.

- Renovation of newly allotted laboratory (Laboratory No. 105) was initiated to strengthen Pesticide Residue Analysis Laboratory.
- Three laboratory modules were fitted in Teaching Laboratory No. 107 of Department of Entomology to conduct practicals.

College of Agricultural Engineering and Technology

- An underground piping system was laid down at the research farm of the Department of Farm Machinery and Power Engineering.
• A smart class room was established by the Department of Farm Machinery and Power Engineering under ICAR-1 scheme.
• Solar Pump (5 hp) was installed at the research farm of the Department of Soil and Water Engineering with the support of Black and Dekker.

College of Basic Sciences and Humanities
• A smart class room was established by the Department of Biochemistry.

Directorate of Extension Education
• Solar Power Plant (Grid Tie Solar System) of 2 KW was installed at Krishi Vigyan Kendra, Hoshiarpur.
• A cold storage chamber was constructed at Krishi Vigyan Kendra, Bathinda.
• A farm was developed, an orchard was established, a tubewell was installed, farm machineries were purchased and the building of Krishi Vigyan Kendra, Pathankot was constructed.
• A Goatry Unit, Grader, Poultry Unit, Threshing Floor and Seed Store were set-up at Krishi Vigyan Kendra, Mansa.
• A GreenSeeker, Electrical Conductivity Meter and pH Meter were installed at Krishi Vigyan Kendra, Amritsar.
• A drip irrigation system was installed on one acre of orchard at Krishi Vigyan Kendra, Ferozepur.
• A Technology Hut was established at Krishi Vigyan Kendra, Jalandhar in which all the recommended technologies of PAU have been displayed in the form of charts.
• White leg horn birds were included for egg production at Krishi Vigyan Kendra, Jalandhar to promote integrated farming system.
• A Mushroom Cultivation Unit was established and demonstrations on button and oyster mushrooms were given during the year at Krishi Vigyan Kendra, Jalandhar.
• New specimens of disease samples were preserved at Krishi Vigyan Kendra, Jalandhar for demonstrations.
• A permanent vermicompost pit was constructed at Krishi Vigyan Kendra, Jalandhar for demonstrations.
• A committee room, library and seminar room, three classrooms and two laboratories for Home Science training courses were established at Skill Development Centre.

FINANCES
The Board of Management in its 290th meeting held on March 29, 2019 approved the budget estimates of the Punjab Agricultural University for the year 2019-20 amounting to Rs 67,640.08 lakh. The details of these schemes, budget allocation for research, teaching, extension and for the administrative and miscellaneous activities are as under (see page 62):

As compared to the Budget Estimates amounting to Rs 63,390.20 lakh for the year 2018-19 approved by the Board of Management in its 285th meeting held on March 26, 2018, the actual grants received during the financial year 2018-19 were Rs 51,404.66 lakh. The University raised Rs 8,354.31 lakh through tuition fee and other sources/services.

During the year 2018-19, the actual allocation was 52 per cent on research, 23.2 per cent on teaching, 13.7 per cent on extension and 11.1 per cent on general administration and others.
### Allocation of funds for various activities

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<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Amount</td>
<td>Allocation (%)</td>
<td>Amount</td>
</tr>
<tr>
<td>1</td>
<td>State Schemes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Non Plan Agriculture Schemes</td>
<td>26,507.93</td>
<td>51.61</td>
<td>26,391.37</td>
</tr>
<tr>
<td>ii)</td>
<td>Plan Agriculture Schemes</td>
<td>27,252.63</td>
<td>23.65</td>
<td>23,964.02</td>
</tr>
<tr>
<td>2</td>
<td>Rashtriya Krishi Vikas Yojana (RKVY)</td>
<td>-</td>
<td>-</td>
<td>1,150.00</td>
</tr>
<tr>
<td>3</td>
<td>ICAR Schemes (AICRP/ KVK/Adhoc and Development Grant)</td>
<td>9,887.54</td>
<td>14.66</td>
<td>9,183.13</td>
</tr>
<tr>
<td>4</td>
<td>Central Govt. Funding (University Grants Commission and Centrally Sponsored Schemes, Department of Biotechnology, Department of Science and Technology)</td>
<td>1,625.24</td>
<td>1705.70</td>
<td>1,821.66</td>
</tr>
<tr>
<td>5</td>
<td>Other Schemes (National Horticultural Mission/Misc. Schemes (Private Companies)/ Misc. (Foreign Contribution)) etc.</td>
<td>1,478.66</td>
<td>1,405.85</td>
<td>1,491.84</td>
</tr>
<tr>
<td>6</td>
<td>Self-financing Schemes</td>
<td>6,17.58</td>
<td>5,38.51</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Revolving Fund Schemes</td>
<td>2,70.50</td>
<td>2,01.62</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>67,640.08</strong></td>
<td><strong>63,390.20</strong></td>
<td><strong>51,404.66</strong></td>
</tr>
</tbody>
</table>

*includes Rs 245.60 lakh for strengthening and development of PAU and Rs 39.00 lakh for strengthening of library services.

### Allocation of funds as per Budget Estimates and Actual Grant received

<table>
<thead>
<tr>
<th>Budget Allocation</th>
<th>2019-20 As per Budget Estimates</th>
<th>2018-19 As per Actual Grant received</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount (Rs in lakh)</td>
<td>Allocation (%)</td>
</tr>
<tr>
<td>Research</td>
<td>34,906.57</td>
<td>51.61</td>
</tr>
<tr>
<td>Teaching</td>
<td>15,997.33</td>
<td>23.65</td>
</tr>
<tr>
<td>Extension</td>
<td>9,242.28</td>
<td>13.66</td>
</tr>
<tr>
<td>General administration and others</td>
<td>7,493.90</td>
<td>11.08</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67,640.08</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Discs (CDs). At present, library is subscribing to 22 print journals, out of which, 8 journals were subscribed during the period under report, 5 were received against life membership and 9 were received as gratis. Library also provided access to 5 online databases and 336 e-books. Thus, the total collection of library as on 30-06-2019 stood at 4,09,101.

New infrastructure developed
The implementation of Radio Frequency Identification (RFID) System in the library is underway in a phased manner. The RFID System will help in improving the library operations as well as services which have been feasible with the financial support of ICAR.

New reading hall
Apart from Saxena Night Reading Hall, library has a reading hall named as Dr Kulbir Singh Gill Reading Hall which remains open 24X7 for the users. Ten reading tables and 40 reading chairs were added in this hall, which is being extensively used by the students and researchers.
subscribed by the library provides statistical information pertaining to agriculture and allied areas. In addition, library provides access to 336 e-books of various publishers, whereas ISO standards provide access to various standards on food products.

Library web page
The library web page provides complete information about library resources, rules and regulations, services, e-resources, list of print journals, circulars and new additions to the library collection. Digitized handwritten documents of Dr MS Randhawa are also accessible to the users. All the e-resources like e-journals, e-books, e-theses, e-standards etc. are accessible campus wide from the web page. Only Indiastat.com database is accessible within the library.

Awards
Mohinder Singh Randhawa Library received CeRA Highest User Profile Registration Award and Best Usage of J-gate @ CeRA Award from ICAR.

Library usage: Books: 3,65,750; Theses: 33,175; Bound periodicals: 28,905; Current periodicals: 25,330; Reference books: 16,960; Textbooks: 9,005; Abstracts and Indexes: 8,085; Newspapers: 3,067 and Rare books: 3,461.
Crop residue management

- Paddy straw on about 57 per cent of fields in 2018 was managed without burning (21% through incorporation, 20% through removal and 16% through Happy Seeder) as compared to only 16 per cent in 2017. Some modifications effected recently in Happy Seeder will further help in this direction.

- Punjab Pollution Control Board reported an average 50.1 per cent improvement in Air Quality Index (AQI) during four month period from September to December during 2018 as compared to 2017.

Machines including Super Straw Management System (Super SMS), Happy Seeder, Baler, etc. complemented by varietal interventions involving low biomass, short duration paddy varieties and agronomic interventions like mulching, composting, etc. along with intensive and targeted policy support from the government offer an adequate solution to the crop residue issue.

Impact

Productivity of major field crops

- Short duration rice varieties such as PR 121 and PR 126 recommended by PAU occupied 74 per cent of parmal rice acreage. Being 3-5 weeks shorter in duration, these varieties help in saving groundwater, facilitate use of crop residue management machinery on account of low biomass and require less pesticides. **Krishi Karman Award** was conferred upon Punjab for record paddy productivity of 6,549 kg/ha (parmal and basmati combined) during 2017-18.

- Almost entire (96%) wheat acreage in the State is under recommended wheat varieties. During Rabi 2018-19, the State recorded highest wheat productivity (5,173 kg/ha) and production (182.1 lakh tonnes).

- A record cotton productivity of 776 kg lint/ha was witnessed during 2018-19. Sugarcane productivity during 2018-19 was 81.8 t/ha, surpassed only by productivity achieved during the year 2017-18 (83.6 t/ha).
Eco-friendly pest and disease management

- Integrated pest management approaches in cotton helped save pesticides worth Rs 3,060/- per ha. The highest record productivity of 776 kg lint per ha was obtained during Kharif 2018 amidst this limited chemical use. A variety of extension activities, organized in collaboration with State Department of Agriculture, aimed at timely sowing, balanced nutrition, clean cultivation and use of pesticides on the basis of economic threshold level (ETL) caused this impact.
- Wheat rust continues to be proactively managed by closed surveillance starting from high altitude over-summering sites of Jammu and Kashmir, and Himachal Pradesh up to foothills as well as adjoining plains of Punjab along with weather based predictions. Due to this, large wheat area remained rust free which helped achieve record productivity besides providing economic and environmental advantages through reduced fungicide use. Weather-driven Disease Forewarning Decision Support System recommended recently will further contribute towards this end.
- Consumption of insecticides in Punjab came down from 2,360 tonnes in 2016-17 to 2,268 tonnes in 2017-18. Overall pesticide use also was slightly lower at 5,835 tonnes compared to 5,843 tonnes in the previous year.
- Pesticide residue analysis of total 920 samples of various food products comprising vegetables (608), basmati rice (216), red chilli powder (36), milk (36) and water (24) showed that 51 samples (5.54%) were contaminated with various pesticide residues and seven samples (0.76%) had these levels above Maximum Residue Limits (MRL).

Crop diversification

- Area under major vegetable crops (excluding potato) has grown by 16.48% over 2016-17. Kinnow acreage went up from 50.1 thousand ha during 2016-17 to 53.0 thousand ha during 2018-19. Over the same period, area under second major fruit crop guava increased from 8.1 thousand ha to 9.1 thousand ha.
- Area under less water and nutrient consuming basmati rice was sustained at 5.11 lakh ha, which represents an important diversification option during kharif season.
- Production of fruit and agroforestry nursery by the University for distribution among farmers went up from 5.97 lakh in 2017-18 to 6.33 lakh in 2018-19.

Soil health

- Fertilizer consumption came down from 247 kg/ha in 2015-16, through 246 kg/ha in 2016-17, to 240 kg/ha in 2017-18. The DAP fertilizer use during the Kharif season significantly decreased from 2.21 lakh tonne in 2017, through 1.75 lakh tonne in 2018, to 1.41 lakh tonne in 2019, signifying increased adoption of PAU recommendation not to use P fertilizer during most of the Kharif season crops. Record wheat and cotton productivities were achieved amidst this reduced fertilizer dependence.
- During Kharif 2018, paddy residue either incorporated or retained on 37 per cent of the paddy fields will extend substantial soil health and other ecological benefits.

Entrepreneurship development and subsidiary occupations

- Eighteen improved varieties, 15 farm machinery, 8 processing and 6 other technologies were extended to 47 entrepreneurs for commercialization. The Super SMS and chilli hybrid CH 27 have demonstrated substantial commercialization potential with 121 and 18 MoAs signed so far.
- Six agro-processing complexes were set-up with PAU hand-holding.
• During the period under report, 164 mushroom cultivation, 159 beekeeping, 146 piggery, 141 dairy farming, 114 value addition technologies, 109 goat farming, 96 poultry farming and 52 garment making units were established by the farmers trained in the subsidiary occupations at the KVKs.

• The self help groups (SHGs) dealing with processing of a variety of farm products are being trained and supported by PAU. The hand-holding provided in exploring marketing channels involving Co-operative Societies, Agricultural Technology Management Agency (ATMA), Kisan Hutt and different departmental stores has helped in raising income. Some of the women were recognized at the district, state as well as national level for their contribution to allied agri-enterprises.

Academic accomplishments

• Quality efforts in teaching and research enabled 105 students to qualify National Eligibility Test (NET), conducted by ICAR, UGC and Council of Scientific and Industrial Research (CSIR), whereas seven students cleared Graduate Aptitude Test in Engineering (GATE).

• Two students of PAU bagged Prime Minister Fellowship for their doctoral studies. The Indian Council of Agricultural Research (ICAR) – Jawaharlal Nehru Award for outstanding doctoral research was conferred upon one student.

• Twenty nine students secured admission in prestigious institutes abroad. Handholding by teachers and peers, and orientation provided by Guidance and Placement Cell brought in this impact.

• Thirteen postgraduate students attended summer training programmes and presented research work in international fora abroad.

• Twenty seven postgraduate students received prestigious fellowships and awards, and earned Best Poster/Presentation Awards for their research work.
## BOARD OF MANAGEMENT

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Name and Designation</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Honorary Chairman</strong></td>
<td></td>
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<tr>
<td></td>
<td>Sh VP Singh Badnore</td>
<td>01.07.2018 to 30.06.2019</td>
</tr>
<tr>
<td></td>
<td>Hon'ble Governor, Punjab and Chancellor of the University</td>
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<tr>
<td></td>
<td><strong>Working Chairman</strong></td>
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<tr>
<td></td>
<td>Dr Baldev Singh Dhillon</td>
<td>01.07.2018 to 30.06.2019</td>
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<tr>
<td></td>
<td>Vice Chancellor</td>
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<td></td>
<td><strong>Members</strong></td>
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<tr>
<td>1</td>
<td>Sh Karan Avtar Singh, IAS</td>
<td>01.07.2018 to 30.06.2019</td>
</tr>
<tr>
<td></td>
<td>Chief Secretary</td>
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<td></td>
<td>Government of Punjab, Chandigarh</td>
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<tr>
<td>2</td>
<td>Sh Viswajeet Khanna, IAS</td>
<td>01.07.2018 to 30.06.2019</td>
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<tr>
<td></td>
<td>Additional Chief Secretary (Development)</td>
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<td></td>
<td>Department of Agriculture and Farmers’ Welfare</td>
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<tr>
<td>3</td>
<td>Sh Anirudh Tewari, IAS</td>
<td>01.07.2018 to 30.06.2019</td>
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<tr>
<td></td>
<td>Principal Secretary</td>
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<td></td>
<td>Government of Punjab, Chandigarh</td>
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<tr>
<td>4</td>
<td>Sh Jasbir Singh Bains</td>
<td>01.07.2018 to 31.01.2019</td>
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<tr>
<td></td>
<td>Director of Agriculture, Punjab</td>
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<td></td>
<td>Kheti Bhawan</td>
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<td>Phase-VI, Mohali</td>
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<td>Sh Sutantar Kumar Airi</td>
<td>07.02.2019 to 30.06.2019</td>
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<td>Phase-VI, Mohali</td>
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<td>5</td>
<td>Dr RK Gupta</td>
<td>01.07.2018 to 31.07.2019</td>
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<tr>
<td></td>
<td>Director, Central Institute of Post-Harvest Engineering and Technology (CIPHET)</td>
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<td></td>
<td>PAU Campus</td>
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<td></td>
<td>Ludhiana</td>
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<td></td>
<td>Dr Sujay Rakshit</td>
<td>01.08.2018 to 30.06.2019</td>
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<tr>
<td></td>
<td>Director, Indian Institute of Maize Research (IIMR)</td>
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<td>PAU Campus</td>
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<td></td>
<td>Ludhiana</td>
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<tr>
<td>No.</td>
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</tr>
<tr>
<td>6</td>
<td>Dr SS Gosal</td>
<td>Former Director of Research, PAU</td>
</tr>
<tr>
<td>7</td>
<td>Dr DS Brar</td>
<td>Adjunct Professor, PAU</td>
</tr>
<tr>
<td>8</td>
<td>Sh Kulwant Singh Ahluwalia</td>
<td>Village - Chhauni Kalan, PO Ram Colony, Hoshiarpur</td>
</tr>
<tr>
<td>9</td>
<td>Sh Amardeep Singh Cheema</td>
<td>Gobind Nagar, Kahnuwan Road Batala, District Gurdaspur</td>
</tr>
<tr>
<td>10</td>
<td>Sh Anoop Bector</td>
<td>Managing Director Mrs Bector’s Food Specialties Limited Theing Road, Phillaur</td>
</tr>
<tr>
<td>11</td>
<td>Mrs Manjit Kaur</td>
<td>VPO Sehjomajra, Block Machhiwara Tehsil Samrala, District Ludhiana</td>
</tr>
</tbody>
</table>

**Secretary**

<table>
<thead>
<tr>
<th>Position</th>
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<th>Period</th>
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<tr>
<td>Registrar</td>
<td>Dr RS Sidhu</td>
<td>01.07.2018 to 30.06.2019</td>
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<td>Designation</td>
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<tr>
<td>Vice Chancellor</td>
<td>Dr Baldev Singh Dhillon</td>
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<tr>
<td>Dean, Postgraduate Studies</td>
<td>Dr (Mrs) GK Sangha (Addl. charge)</td>
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<tr>
<td></td>
<td>Dr (Mrs) GK Sangha</td>
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<tr>
<td>Dean, College of Community Science</td>
<td>Dr (Mrs) Jatinder Kaur Gulati</td>
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<td></td>
<td>Dr (Mrs) Sandeep Bains</td>
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<tr>
<td>Director of Research</td>
<td>Dr Navtej Singh Bains</td>
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<tr>
<td>Dean, College of Agriculture</td>
<td>Dr SS Kukal</td>
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<tr>
<td>Dean, College of Agricultural Engineering and Technology</td>
<td>Dr Jaskarn Singh Mahal (Addl. Charge)</td>
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<td></td>
<td>Dr Ashok Kumar</td>
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<tr>
<td>Director of Extension Education</td>
<td>Dr Jaskarn Singh Mahal</td>
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<tr>
<td>Dean, College of Basic Sciences and Humanities</td>
<td>Dr (Mrs) Gurinder Kaur Sangha</td>
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<td></td>
<td>Dr SS Kukal (Addl. Charge)</td>
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<tr>
<td>Head, Department of Zoology</td>
<td>Dr SS Hundal</td>
<td></td>
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<tr>
<td>Head, Department of Forestry and Natural Resources</td>
<td>Dr RIS Gill</td>
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<tr>
<td>Head, Department of Agronomy</td>
<td>Dr Thakar Singh</td>
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<tr>
<td>Head, Department of Vegetable Science</td>
<td>Dr AS Dhatt</td>
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<tr>
<td>Head, Department of Mechanical Engineering</td>
<td>Dr VP Sethi</td>
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<tr>
<td>Head, Department of Renewable Energy Engineering</td>
<td>Dr VS Hans</td>
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<tr>
<td>Head, Department of Soil and Water Engineering</td>
<td>Dr Rajan Aggarwal</td>
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<tr>
<td>Head, Department of Farm Machinery and Power Engineering</td>
<td>Dr Manjeet Singh</td>
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<tr>
<td>Head, Department of Food and Nutrition</td>
<td>Dr (Mrs) Anita Kochhar</td>
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<tr>
<td>Head, Department of Human Development and Family Studies</td>
<td>Dr (Mrs) Tejpreet Kaur Kang</td>
<td></td>
</tr>
<tr>
<td>Registrar, Secretary</td>
<td>Dr RS Sidhu</td>
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</tr>
</tbody>
</table>
During the period under report, the Board of Management held seven meetings (286th to 292nd). The important decisions taken by the Board are as under:

A. Amendment in statutes
   • The Board approved the amendment in Clause 11.1(iii) of the Statutes regarding Provident Fund and Pension Rules by enhancing the limit of salary per year for CPF/GPF advance for higher education of subscribers’ daughter/son. B-3/290

B. Concession to Staff
   • The Board approved the grant of pay scale in respect of the post of Laboratory Attendants working in the pay band of Rs 5,910-20,200 + GP 1,900 to Rs 5,910-20,200 + GP 2,400 w.e.f. 01.12.2011. B-1/287
   • The Board approved the revision of pay scales to the ex-cadre employees transferred from SFCI/PLD&RC to PAU as per the 7th Pay Commission Report on CDA pattern w.e.f. 01.01.2016 and on IDA pattern w.e.f. 01.01.2017. B-4/290

C. Budget
   • The Board approved the audited accounts of the Punjab Agricultural University for the year 2016-17. B-1/286
   • The Board approved the enhancement of funds in the scheme “Training of PAU Faculty Members in the New Technologies, Misc.1” by providing additional funds of Rs 3.20 crore out of the income earned under “Self-Financing Schemes” during the year 2017-18. B-2/286
   • The Board noted the creation and inclusion of new Revolving Fund Scheme “Integrated Farming System in School of Organic Farming, RF-12 (PC-3108)” in the Budget of the University for the year 2018-19 B-3/286
   • The Board approved the creation of four posts of Programmer in the pay scale of Rs 15,600-39,100 + 5,400 Grade Pay. B-3/287
   • The Board noted the creation and inclusion of new Revolving Fund Scheme “Processing and Sale of Agricultural Produce, RF-13 (PC-3109)” in the Budget of the University for the year 2018-19. B-1/288
   • The Board approved the creation of one post of Dean, College of Horticulture and Forestry in the pay scale of Rs 37,400-67,000 + AGP Rs 10,000 + Special Allowance Rs 1,000/-. B-1/289
   • The Board approved the Budget Estimates of the Punjab Agricultural University for the year 2019-20. B-1/290

D. Other decisions
   • The Board approved the re-employment of Dr RS Sidhu as Registrar of PAU after his superannuation on 31.08.2018 for a period of one year. C-8/286
   • The Board approved the establishment of the College of Horticulture and Forestry under Punjab Agricultural University at PAU Campus, Ludhiana. C-2/287
   • The Board approved the transfer of 162.2 acres of land to PAU by Punjab Government in lieu of 176.6 acres of land transferred by PAU to Punjab Government for establishment of AIIMS at Bathinda. C-5/287
   • The Board approved the Annual Report of the Punjab Agricultural University for the year 2017-18. C-6/288
   • Dr Ashok Kumar was appointed as Dean, College of Agricultural Engineering and Technology, PAU. A-3/289
   • Dr Sandeep Bains was appointed as Dean, College of Home Science, PAU. A-4/289
The Board unanimously resolved to appoint Dr Baldev Singh Dhillon as Vice Chancellor of Punjab Agricultural University for a term of two years. Item No. 1/292

Dr Gurinder Kaur Sangha was appointed as Dean, Postgraduate Studies, PAU. A-5/289

The Board approved to change the nomenclature of College of Home Science to that of College of Community Science. C-2/291

IMPORTANT DECISIONS OF THE ACADEMIC COUNCIL

During the period under report, six meetings (396th to 401st) of the Academic Council were held. The important decisions taken by the Academic Council are as under:-

• Approved two-year Diploma in Agriculture at Regional Research Station, Faridkot from the academic session 2019-20.
  Open Discussion (Para No.21(1)/396th
• Approved Personal Accident Cover under Student Group Accident Insurance Policy (YUVA RAKSHA) and Personal Accident Cover for students. Item No.C-4/398th
• Ratified the action taken by the Vice Chancellor in approving the ‘Institution of Rajpal Punjab Sarvotam Pind Puraskar.’ Item No.C-5/399th
• Approved Dr Gurdev Singh Khush Institute of Genetics, Plant Breeding and Biotechnology at PAU. Item No.C-10/400th
• Approved the establishment of PAU College of Agriculture in district Gurdaspur. Item C-11/400th
• Approved the undergraduate degree courses in agriculture and allied subject as ‘Professional Degree Courses.’ Item No.C-1/401st
• Approved the Merit Scholarship, Fellowship/stipend to M.Sc. and Ph.D. students of the School of Agricultural Biotechnology. Item No.C-6/401st
• Approved the general guidelines for the award of Memorial Fellowships to M.Sc. students. Item No.C-7/401st
• Approved the institution of ‘UPL Crop Protection Medal’ to B.Sc. Agri. (Hons) students with ELP in the subject of Entomology along with rules and regulations. Item No.C-8/401st
• Approved the institution of ‘Sardar Harpreet Singh Kalsy Memorial Medal’ along with rules and regulations for MBA (Agribusiness) students. Item No.C-9/401st
• Approved the institution of ‘Dr Madho Singh Medal’ along with rules and regulations for undergraduate students in the field of Plant Pathology. Item No.C-10/401st
• Approved the starting of new degree programme B.Tech. (Mechanical Engineering) from the academic year 2019-20 under Self Supporting Mode. Item No.C-12/401st

PUBLICATIONS

The University scientists published 987 publications which included research papers in peer-reviewed journals, books, book chapters, manuals, research bulletins, etc. Details are given in Annexure II.
## ANNEXURE I

Important projects undertaken by the Estate Organization and the Engineering Unit:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Cost (lakh Rs)</th>
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</thead>
<tbody>
<tr>
<td>Construction of Skill Development Centre at PAU, Ludhiana</td>
<td>470.00</td>
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<tr>
<td>Construction of Girls Hostel at PAU, Ludhiana</td>
<td>400.00</td>
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<tr>
<td>Construction of International Hostel at PAU, Ludhiana</td>
<td>232.00</td>
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<tr>
<td>Chain link fencing around University Seed Farm, Nabha</td>
<td>64.43</td>
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<tr>
<td>Construction of air conditioned Seed Store for the department of Director (Seeds) at PAU, Ludhiana</td>
<td>50.00</td>
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<tr>
<td>Construction of mess and remaining work of Hostel No. 14 at PAU, Ludhiana</td>
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<tr>
<td>Extension of Seed Sale Centre at gate no. 1 at PAU, Ludhiana</td>
<td>27.41</td>
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<tr>
<td>Construction of 1 no. 100 sqm, 2 no. 30 sqm and 3 no. 80 sqm residential houses at new <em>Krishi Vigyan Kendra</em>, Uppal Jagir, Noormahal, Jalandhar (remaining work)</td>
<td>16.50</td>
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<tr>
<td>Construction of open pucca (concrete) water channel at University Seed Farm, Nabha</td>
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<td>Construction of one more house of 80 sqm at <em>Krishi Vigyan Kendra</em>, Muktsar</td>
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<tr>
<td>Construction of 3 no. sheds for farm labour at field areas at PAU, Ludhiana</td>
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<tr>
<td>Construction of additional quarter of 1 no. 80 sqm house at <em>Krishi Vigyan Kendra</em>, Muktsar</td>
<td>13.50</td>
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<tr>
<td>Installation of one deep tubewell at Regional Research Station, Ballowal Saunkhri</td>
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<tr>
<td>Installation of one submersible pump set 12.5 HP at <em>Krishi Vigyan Kendra</em>, Pathankot</td>
<td>11.19</td>
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<td><strong>Total</strong></td>
<td><strong>13,88.48</strong></td>
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</table>
ANNEXURE II

PUBLICATIONS

COLLEGE OF AGRICULTURE

Research Papers in Indian and Foreign Journals


*National Academy of Agricultural Sciences (NAAS) Score

$ Listed more than once depending upon affiliation of the author
inducing a clade III SWEET gene and is nearly identical to a recent Thai isolate. *Front Microbiol* DOI: 10.1101/384289. (10.08)


133. Kaur A, Bedi S and Kumar M (2019). Physiological basis of nitrogen use efficiency at variable rates of...


195. (4.84)


on insect pests and grain yield in basmati rice. *J Bio Contr* 32: 137-141. (5.34)


377. Singh N and Singh G (2018). Plant growth promoting rhizobacteria and *Rhizobium* combinations are the key
to reduce dependence on phosphorus fertilizers in lentil – A review. Agric Rev 39: 76-81. (4.37)


381. Singh P, Sharma SP, Kaur N and Gill RIS (2019). Potato cultivars differ in response to date of planting in intercrop with poplar (Populus deltoides Bartr. ex Marsh.) in irrigated agro-ecosystem of North-West India. Agrofor Syst DOI: org/10.1007/s10457-019-00356-w/Published online. (7.17)


386. Singh R, Mavi MS and Choudhary OP (2019). Saline soils can be ameliorated by adding biochar generated

384. Singh R and Cheema HK (2018). Effect of sunflower as a trap crop on gram pod borer,

383. Singh R and Bala M (2018). Effect of different sources of light as night break on growth and flowering of

382. Singh R and Bala M (2018). Effect of artificial short day conditions on growth and flowering of


377. Ind J Nematol

376. J Insect Sci

375. Comm Soil Sci Plant Anal

374. Korean Chrysanthemum (5.90)


**Books**


**Book Chapters**


Manuals


Research/Technical Bulletins
18. Devi J, Bhatia S and Alam MS (2019). Abiotic elicitors influence anti-oxidative enzyme activities and shelf life...
of carrot during storage under refrigerated conditions. J Plant Growth Regul DOI: 10.1007/s00344-019-09954-5. (8.05)


**Book Chapters**


**Manuals**


**COLLEGE OF BASIC SCIENCES AND HUMANITIES**

**Research Papers in Indian and Foreign Journals**


impeding starch precursors of wheat. *Ind J Exp Biol* **56**: 565-572. *(6.00)*


63. Kler TK, Vashishat N and Kumar M (2018). Chemical composition of excreta of Blue Rock Pigeon (Columbia...


Sharma S, Sharma A and Singh D (2018). Effect of sodium selenate on photosynthetic efficiency, anti-oxidative defence system and micronutrients in maize (*Zea mays*). *Biologia* DOI: org.10.2478/s11756-018-


Department of Agricultural Journalism, Languages and Culture


Books


Book Chapters


**Manuals**


**Bulletins**


**COLLEGE OF COMMUNITY SCIENCE**

**Research Papers in Indian and Foreign Journals**


Book Chapters

Technical Bulletin

Booklets
India Coordinated Research Project – Family Resource Management Component, Punjab Agricultural University, Ludhiana.

DIRECTORATE OF RESEARCH

Research Papers in Indian and Foreign Journals


**Book Chapters**


DIRECTORATE OF EXTENSION EDUCATION

Research Papers in Indian and Foreign Journals


Kaur B and Randhawa V (2018). An analytical study of awareness of MGNREGA functionaries in different
regions of Punjab, India. Asian J Agric Ext Econ Sociol (accepted). (4.35)


Book Chapters


Manuals

Technical Bulletins
SALIENT RESEARCH PAPERS IN HIGH IMPACT JOURNALS


SUMMARY AND HIGHLIGHTS OF ANNUAL REPORT OF PUNJAB AGRICULTURAL UNIVERSITY
(July 1, 2018 to June 30, 2019)

Research, teaching and extension activities in agriculture and related fields constitute the mandate of Punjab Agricultural University. These activities helped the State touch record productivity levels of major crops and address challenges of residue management, pesticide use, soil health and groundwater management.

**RESEARCH**

Main thrusts of research activities of PAU included varieties, production-protection technologies, and farm machinery and processing. Varietal development focused not only on productivity traits but also on other traits, enabling natural resource conservation, limiting chemical use, and capturing premium and processing markets. During the report period, PAU developed/released 19 varieties (7 of field, 3 of fruit, 8 of vegetable and 1 of ornamental crops). Out of these, two varieties of wheat, PBW 752 and PBW 757, were released at the national level. Besides, three varieties of vegetables (CH 27 of chilli, Matar Ageta 7 of pea and Punjab Raunak of brinjal) released earlier at the state level were identified at the national level. Lentil variety, LL 1373, was also identified at the national level.

**Crop/Domain**

**Field crops**
- **Wheat**
  - Marker Assisted Selection (MAS) was used for transferring Yr10 and Yr15 genes in PBW 752 and PBW 757 varieties, respectively.
  - Four populations derived from two synthetic hexaploid wheats and two cultivated wheat genotypes were evaluated for nitrogen use efficiency.
  - Mapping populations are being developed through speed breeding for mapping Karnal bunt resistance transferred from three wild species.
  - Aphid resistance is being transferred from two *Ae. tauschii* accessions to bread wheat background.
- **Rice**
  - Advanced breeding lines carrying brown plant hopper (BPH) resistance conferred by BPH 34 gene (previously transferred from *Oryza nivara*) were developed.
  - To locate genomic regions responsible for nematode resistance, introgression profiling of interspecific lines derived from the cross of PR121 x *O. glaberrima* was generated.
- **Maize**
  - The genetic mapping for heat stress tolerance has suggested location of quantitative trait locus (QTL) on chromosome 3 and 5.
- **Chickpea**
  - The Bt -Cry1Ac gene has been introgressed, through backcross breeding, into elite lines which were subsequently evaluated against *Helicoverpa armigera*.

**Horticultural crops**
- **Tomato**
  - Genome editing approach is being used in tomato variety Punjab Ratta for enhancing shelf life.
- **Guava**
  - New molecular markers were developed in guava by comparative transcriptomics.
  - High-throughput genome sequencing of guava cv. Allahabad Safeda was carried out for creating chromosomal level genome assembly.

**BIOTECHNOLOGY**
Research, teaching and extension activities in agriculture and related fields constitute mandate of Punjab Agricultural University. These activities helped State touch record productivity levels of major crops and address challenges of residue management, pesticide use, soil health and groundwater management.

RESEARCH

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BIOTECHNOLOGY

<table>
<thead>
<tr>
<th>Crop/Domain</th>
<th>Research activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field crops</td>
<td></td>
</tr>
</tbody>
</table>
| Wheat            | • Marker Assisted Selection (MAS) was used for transferring Yr10 and Yr15 genes in PBW 752 and PBW 757 varieties, respectively.  
                    • Four populations derived from two synthetic hexaploid wheats and two cultivated wheat genotypes were evaluated for nitrogen use efficiency.  
                    • Mapping populations are being developed through speed breeding for mapping Karnal bunt resistance transferred from three wild species.  
                    • Aphid resistance is being transferred from two Ae. tauschii accessions to bread wheat background.  |
| Rice             | • Advanced breeding lines carrying brown plant hopper (BPH) resistance conferred by BPH 34 gene (previously transferred from Oryza nivara) were developed.  
                    • To locate genomic regions responsible for nematode resistance, introgression profiling of interspecific lines derived from the cross of PR121 x O. glaberrima was generated. |
| Maize            | • The genetic mapping for heat stress tolerance has suggested location of quantitative trait locus (QTL) on chromosome 3 and 5.  |
| Chickpea         | • The Bt-Cry1Ac gene has been introgressed, through backcross breeding, into elite lines which were subsequently evaluated against Helicoverpa armigera.  |
| Horticultural crops | • Genome editing approach is being used in tomato variety Punjab Ratta for enhancing shelf life.  
                         • New molecular markers were developed in guava by comparative transcriptomics.  
                         • High-throughput genome sequencing of guava cv. Allahabad Safeda was carried out for creating chromosomal level genome assembly.  |
SEED AND NURSERY PRODUCTION

- During the year 2018-19, PAU produced 57,224 q seed of various field crops and 612 q of various vegetable crops in addition to 3,064 q propagation material of potato and turmeric.
- About 5.70 lakh nursery fruit plants and 63,500 agroforestry seedlings were produced and provided to farmers.

CROP PRODUCTION TECHNOLOGIES

<table>
<thead>
<tr>
<th>Focus area</th>
<th>Technologies recommended</th>
</tr>
</thead>
</table>
| Micro-irrigation                               | • Drip irrigation was recommended in summer *moong*-maize-wheat; direct seeded rice-wheat; sugarcane; *raya*; *gobhi sarson*; densely planted *Kinnow*; pumpkin and marigold.  
• Micro-irrigated soil-less rooftop/terrace vegetable nutrition garden model, and micro-irrigated soil-less (cocopeat slabs) cultivation of seedless (parthenocarpic) cucumber under naturally ventilated polyhouse were recommended. |
| Cropping systems integrating micro-irrigation and conservation agriculture | • A solar energy operated tubewell and drip irrigation system was recommended in two sub-surface drip irrigation systems: direct seeded zero-till rice-wheat system and maize-wheat permanent bed system. |
| Direct seeded rice and legume based systems    | • Direct seeded rice (DSR)-potato-onion, DSR-potato-mentha, and direct seeded *basmati* rice (DSBR)-potato-mentha cropping systems were recommended.                                                                                                                                                                                                                     |
| Fine tuning method and time of planting        | • Bed planting and ridge planting methods were recommended in maize.  
• For obtaining better yields from transplanted *gobhi sarson* and *African sarson*, seedling age of 30 days is optimum for current set of varieties.  
• Sowing time of *tori* was extended from first half of September to whole of September. |
| Minor crop and intercrop agronomy              | • Package of standardized production technologies for sugarbeet was recommended.  
• Relay planting of pea, on ridges placed 60 cm apart, with celery germinating naturally from shattered seed of previous crop was recommended. |
| Nutrient management                            | • The GreenSeeker optical sensor technology was recommended for nitrogen fertilizer management in wheat crop.  
• A smart phone application, PAU Urea Guide App, was developed for crops like wheat, rice, *basmati*, maize and cotton.  
• Use of neem-coated urea @ 120 kg N/ha was recommended in wheat to derive higher yields.  
• In case of short duration varieties PR 126 and PR 124, the previously recommended schedule for nitrogen fertilizer (urea) application in rice was modified to three equal splits – 7, 18 and 36 days after transplanting.  
• Foliar application of potassium nitrate and/or salicylic acid was recomm-ended in wheat for yield enhancement.  
• Two foliar sprays of potassium nitrate @ 1.5% helped increase the *ber* fruit weight and yield. |
| Biofertilizers                                  | • Dipping of rice seedlings in *Azospirillum* biofertilizer solution was recommended.  
• Dipping of *Rabi* onion seedlings in biofertilizer solution, made by mixing *Azotobacter* sp. + *Sphingobacterium* sp. + *Burkholderia* sp., was recommended for yield improvement.  
• During 2018-19, the University produced biofertilizers for 69,500 acres of various crops for distribution among farmers. |
### CROP PROTECTION TECHNOLOGIES

<table>
<thead>
<tr>
<th>Crop/Focus</th>
<th>Technologies recommended/Salient findings</th>
</tr>
</thead>
</table>
| Wheat      | • Forewarning system for the effective management of yellow rust of wheat was recommended.  
• Loose smut can be controlled by treating the seed with Tebused 2DS (tebuconazole 2%).  
• The DNA barcoding studies were conducted to characterize wheat armyworm collected from different parts of the State.  
• An integrated weed management approach combining Happy Seeder use for wheat sowing, herbicide application and hand pulling of escaped weed plants was developed to tackle multiple herbicide-resistance of *Phalaris minor* to post-emergence herbicides.  
• Post-emergence spray of ACM-9 (metribuzin 20% + clodinafop propargyl 9%) provided effective control of herbicide resistant *Phalaris minor* and other grass and broadleaf weeds.  
• New pre-emergence weedicides pyroxasulfone 85 WG and flumioxazin (Maxx 50% SC) were recommended.  
• The dosage of pre-emergence pendimethalin 30 EC was enhanced to 3.75 litres/ha to provide effective control of *P. minor*. |
| Rice       | • *Tetragnatha javana* (45.6%) was predominant species of spiders (which act as natural enemies), followed by *Tetragnatha maxillosa* (30.2%), *Neoscona theisi* (18.2%) and *Oxyopes kusumae* (6.0%) in South-Western districts.  
• To manage seed-borne diseases, seed treatment with Sprint 75WS was recommended. |
| Basmati rice| • Application of neem based formulation, Achook (azadirachtin 1,500 ppm) was recommended for managing rice stem borers and leaf folders under organic and normal cultivation conditions.  
• The augmentative releases of *Trichogramma chilonis* and *T. japonicum* each resulted in 51.2 and 57.1 per cent reduction in stem borers and leaf folders, respectively.  
• Planting of border rows of certain flowering plants raised the abundance of natural enemies.  
• The bio-intensive pest management (BIPM) practices in organic *basmati* rice resulted in 31.7 per cent reduction in plant hoppers’ population. |
| Cotton     | • Home-made neem extract was recommended for managing cotton whitefly.  
• Study on temporal distribution of whitefly, a polyphagous pest, showed that its population remained low during winter and spring seasons, whereas the highest population was recorded during second half of April.  
• Applaud 25SC (buprofezin) and Dantotsu 50WDG (clothianidin) can be used to control whitefly.  
• Delegate 11.7 SC (spinetoram) was recommended for managing thrips. |
| Maize      | • Banded leaf and sheath blight was identified as an emerging disease and Amistar Top 352 SC was recommended for its management. |
| Sugarcane  | • Egg parasitoids of *Trichogramma* spp. reduced incidence of early shoot borer, top borer and stalk borer by 54.2 to 59.4 per cent.  
• Sugarcane leaf hopper can be managed with Dursban 20 EC (chlorpyriphos). |
| Fodder crops| • Stem borer in fodder maize can be managed by using *Trichogramma* based T-cards.  
• Sorghum shoot fly, *Atherigona soccata*, in forage sorghum can be managed by seed treatment with Slayer 30FS (thiamethoxam). |
| Pulses     | • Pod borer complex in pigeonpea can be managed by using green triangle (slightly toxic) insecticides Coragen 18.5 SC (chlorantraniliprole) or Fame 480 SC (flubendiamide).  
• Gram pod borer, *Helicoverpa armigera*, in gram can be managed by spraying green triangle Coragen 18.5 SC (chlorantraniliprole) or Proclaim 5 SG (emamectin benzoate) or Rimon 10 EC (novaluron).  
• Integration of microbial (Bt formulation Mahastra) and insecticide (Coragen 18.5 SC) spray schedule for the management of gram caterpillar was statistically as good as control involving two sprays of Coragen 18.5 SC. |
Integration of microbial and insecticide spray schedule for the management of pod borer complex in *mungbean* had effect at par with two sprays of Spinosad 45SC.

**Oilseeds**
- Sclerotinia rot disease in rapeseed-mustard can be partly managed by avoiding irrigation during the period December 25 to January 15.
- Collar rot or seed rot of groundnut can be managed by seed treatment with Tebuconazole 2 DS.
- Integrated use of paddy straw mulch and one hand weeding at six weeks after sowing provided effective weed control in organic soybean.

**Vegetables**
- Eco-friendly management of fruit fly, *Bactrocera cucurbitae*, using cue-lure based bottle trap in cucurbits (bitter gourd and sponge gourd) was recommended.
- The BIPM (involving seed treatment with *Trichoderma harzianum*, marigold as trap crop, pheromone traps, *Trichogramma pretiosum* and azadirachtin) in tomato resulted in 31.6 per cent reduction in fruit damage due to tomato fruit borer.
- Three releases of *Chrysoperla zasanoi* sillemi resulted in 88.2 per cent reduction in aphid population over untreated control on capsicum grown under net house.
- Spiromesifen 22.9SC, which is safe to natural enemies and does not cause any phytotoxicity to crop, can be used for managing mites in okra.

**Fruits**
- To control weeds and derive higher yields in *ber* orchards, application of paddy straw mulch was recommended.

### FOOD SCIENCE AND TECHNOLOGY

<table>
<thead>
<tr>
<th>Produce/Food</th>
<th>Technologies recommended/Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fruits</strong></td>
<td>Technology for processing coloured flesh guava varieties (Punjab Kiran and Punjab Pink) into value added products such as guava squash, nectar and leather/bar was recommended.</td>
</tr>
</tbody>
</table>
| **Vegetables** | Blanching and freezing technology for potato fingers and pea grains was developed and recommended.  
  Technology for preparation of potato *parantha/samosa* mix from dehydrated tubers of table purpose potato variety ‘Kufri Pukhraj’ was developed and recommended. |
| **Cereal and milk products** | Technology for development of fibre (oat bran) incorporated probiotic *Kulfi* was recommended. |
| **Beverages and fermented foods** | Diverse microbial germplasm accessions including *Saccharomyces cerevisiae*, *Pichia membranifaciens*, *Cyberlindnera fabiani*, *Clavispora lusitaniae* and *Micrococcus luteus* isolated mainly from traditional beverages and fermented foods of Himachal Pradesh are being explored for various brewing and dough fermentation traits. |

### FOOD AND NUTRITION

<table>
<thead>
<tr>
<th>Focus</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nutraceutical characterization of vegetable products</strong></td>
<td>There was a significant increase in minerals, namely magnesium, iron and zinc, polyphenolic compounds and anti-oxidant activity as a result of incorporation of black carrots in a range of dairy and traditional delicacies.</td>
</tr>
<tr>
<td><strong>Nutrition awareness</strong></td>
<td>A positive change in attitude and practices was observed after the delivery of five nutrition awareness 2-hour sessions to 1,516 rural school girls (13-18 years old).</td>
</tr>
</tbody>
</table>

### POST-HARVESTING TECHNOLOGIES

<table>
<thead>
<tr>
<th>Produce</th>
<th>Technologies recommended/Major findings</th>
</tr>
</thead>
</table>
| **Fruits** | Technology for preparation of *jamun* (*Syzygium cumini*) vinegar was developed.  
  Process for dietary fibre extraction from by-products of *Kinnow* peel and pomace was standardized. |
### Vegetables
- A batch-type refraction based drying system for potato flakes was developed.

### Cereals
- Wheat flour prepared from recommended wheat varieties was the best in retaining the properties of wheat flour in terms of protein, fat, carbohydrate and starch content up to 60 days.
- Technology for ethanol production from damaged wheat grains was standardized and patent has been filed.

### Flowers
- Technology of modified atmospheric packaging and storage of gladiolus spikes to enhance their post-harvest life was recommended.

### Honey
- Honey heating-cum-filtration unit (50 litres capacity) was developed and recommended.

### RENEWABLE ENERGY ENGINEERING

<table>
<thead>
<tr>
<th>Domain</th>
<th>Technologies recommended/salient research output</th>
</tr>
</thead>
</table>
| Solar energy      | • A re-circulatory ‘Agro-industrial Solar Dryer’ was developed and recommended.  
                  | • Solar dryer with evacuated tube collector for faster drying of 30-40 kg vegetables like fenugreek and turmeric was developed and recommended. |

### AGROFORESTRY

<table>
<thead>
<tr>
<th>Focus</th>
<th>Major findings/recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phytoremediation</td>
<td>• Clone C-413 of <em>eucalyptus</em> recorded maximum height and Clone PE-5 attained the largest diameter when grown in stressed environment of irrigation with effluents of a distillery unit.</td>
</tr>
<tr>
<td>Intercropping</td>
<td>• Amongst the 16 wheat varieties evaluated for intercropping in six-year old poplar plantation, highest wheat yield was observed in case of PBW 725.</td>
</tr>
<tr>
<td>Weed control</td>
<td>• Use of paddy straw mulch for managing weeds in poplar nursery was recommended.</td>
</tr>
</tbody>
</table>

### BEEKEEPING

<table>
<thead>
<tr>
<th>Focus</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foraging intensity</td>
<td>• <em>Apis dorsata</em> had the highest foraging intensity followed by <em>Apis florea</em>. Intensity was higher in American cotton as compared to Desi cotton.</td>
</tr>
</tbody>
</table>
| Pesticide toxicity and residue | • The median lethal value (LD₅₀) of thiamethoxam to *Apis mellifera* foragers through contact exposure was 7.63 ng bee⁻¹ after 24 h of exposure while LD₅₀ (oral) was 5.490 ng bee⁻¹.  
                        | • The bee-foraged nectar samples collected a day after application contained thiamethoxam residues (0.02±0.01 mg kg⁻¹) which on third day became below limit of quantification (LOQ). |
| Selective breeding for hygienic behaviour | • Selective breeding for hygienic behaviour: The daughter queen bees were reared from the hygienic colonies. About 84 per cent of colonies so developed were found to possess hygienic behaviour. |

### PESTICIDE RESIDUE ANALYSIS
- Pesticide residue analysis of 920 samples of various food products, namely, vegetables (608), *basmati* rice (216), red chilli powder and milk (36 each) and water (24) showed that 5.54 per cent samples were contaminated with various pesticide residues and 0.76 per cent had levels above Maximum Residue Limits (MRL).
## MUSHROOM CULTIVATION

<table>
<thead>
<tr>
<th>Domain</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characterization and adaptation of germplasm technology</td>
<td>Two wild mushrooms, <em>Pleurotus sapidus</em> and <em>P. floridanus</em>, identified through 18s rRNA sequencing have been collected from various sites in Punjab and are being evaluated for edible purposes.</td>
</tr>
</tbody>
</table>

## FARM MACHINERY

<table>
<thead>
<tr>
<th>Machinery/Focus</th>
<th>Technologies recommended/Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucky Seed Drill</td>
<td>Lucky Seed Drill developed for simultaneous seeding and spraying of pre-emergence herbicide in direct seeded rice was recommended.</td>
</tr>
<tr>
<td>Sub-surface Drip Laying Machine</td>
<td>Tractor operated sub-surface drip laying machine was developed and recommended.</td>
</tr>
<tr>
<td>Testing for quality control</td>
<td>Thirty two machines were tested for their conformation to laid-out standards.</td>
</tr>
</tbody>
</table>

## RODENT AND BAT CONTROL

<table>
<thead>
<tr>
<th>Pest</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodents</td>
<td>Application of Dharek and neem seed based sprays in grain stores prevented rodent damage to bags for 21 30 days.</td>
</tr>
<tr>
<td></td>
<td>Rodent infestation in wheat crop sown in fields with retained paddy residue is more location specific rather than being dependent on the method of residue management.</td>
</tr>
<tr>
<td>Bats</td>
<td>For controlling bats in litchi, integrated approach involving lightening with LED bulbs, drum beating and fire crackers gave better results.</td>
</tr>
</tbody>
</table>

## AGRICULTURAL ECONOMICS

<table>
<thead>
<tr>
<th>Field</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer Producer Organizations (FPOs)</td>
<td>Crucial determinant for the sustainability of FPOs is institutional support.</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>Supermarkets in Punjab have had an adverse impact on the sales and returns of fruit and vegetable retailers in nearby areas.</td>
</tr>
</tbody>
</table>

## APPARELS AND TEXTILES

<table>
<thead>
<tr>
<th>Focus</th>
<th>Salient findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyeing technology</td>
<td>Cotton and wool may be dyed by using ultrasonic dyeing techniques with <em>Ratanjot</em> and <em>Arjun</em> dye using mordants like <em>amla</em>, <em>babool</em>, alum and tannic acid.</td>
</tr>
<tr>
<td>Yarn development from paddy straw</td>
<td>Cotton waste and paddy fibre could be spun successfully when blended in proportion of 70:30 and the yarn can be satisfactorily dyed using two natural dyes (<em>bark of Terminalia arjuna</em> and <em>rind of Punica granatum</em>).</td>
</tr>
<tr>
<td></td>
<td>Low cost woven and non-woven paddy straw mats were developed for use as mulch in papaya crop.</td>
</tr>
</tbody>
</table>

## TECHNOLOGIES COMMERCIALIZED

- Technology Marketing and IPR Cell of the University facilitated commercialization of 18 varietal, 15 farm machinery, 8 processing and 6 other technologies by signing 47 Memoranda
of Agreement (MoA) with various stakeholders. The PAU Super SMS technology and chilli hybrid CH 27 invited 14 and 9 commercial interests, respectively.

EDUCATION

• During 2018-19, the University offered 7 Undergraduate, 43 Masters', 29 Doctorate and 2 Diploma programmes. In total, 65 students from Afghanistan, Africa, Bangladesh, Bhutan, Ethiopia, Iran, Kenya, Myanmar, Nepal, Nigeria and Tanzania are studying in different academic programmes of the University. Admissions to various undergraduate and postgraduate programmes were made through entrance tests. About 970 students in various programmes were awarded scholarships and financial assistance.

• During the year, two students bagged Prime Minister Fellowship, one Jawaharlal Nehru Best Thesis Award, one Young Scientist Award from Punjab Science Academy and several other prestigious fellowships/scholarships.

• In sports, the Punjab Agricultural University clinched Overall Championship Trophy, Overall Games Trophy (M) and Overall Runners-up Trophy in Athletic (M) during the All India Inter Agricultural University Sports and Games Meet, held at PAU from January 2-5, 2019. In the Team Games (M&W), PAU won three Gold Medals (Basketball (M), Handball (M) and Volleyball (M)); one Silver Medal (Basketball (W)); and one Bronze Medal (Badminton (W)).

• Mr. Tejvir Singh Grewal (College of Community Science) won Gold Medal in 10 km Road Point to Point, Silver Medal in 10 km Track Elimination, Bronze Medal in 1,000m Track Race and Runners-up Team Championship Trophy during the All India Inter University Roller Skating Championship, held at Maharshi Dayanand University, Rohtak, Haryana, from January 28-31, 2019.

• Ms Ujjalpreet Kaur Dhatt (College of Agriculture) won first position in the 20th Inter Zone (M&W) Handball Championship, held at Sangrur from April 9-12, 2019.

• Mr. Shahbaj Singh Bhullar (College of Agriculture) got first position in 4x50m Freestyle Mix Relay, second position in 4x50m Medley Mix Relay and third position in 4x100m Medley Relay during the 41st Abhey Oswal Senior Punjab Swimming and Water Polo Championship-2018, held at PAU from August 31 to September 2, 2018.

• In cultural activities, PAU students clinched Silver Medal in Group Song Indian, Patriotic Group Song, Extempore, Skit and Bronze Medal in Collage Making during the 19th All India Inter University Youth Festival 2018-19, organized by Sardarkrushinagar Dantiwada Agricultural University, Banaskantha, Gujarat, in association with Indian Council of Agricultural Research (ICAR), New Delhi, from February 3-7, 2019.

EXTENSION

The University transfers new technologies to the farmers through various extension modes. During the period under report:

• The Punjab Agricultural University organized 14 Kisan Melas during September 2018 and March 2019. Laks of farmers from Punjab and adjoining states of Haryana, Himachal
Pradesh, Jammu and Kashmir, and Rajasthan participated in these melas, shared their problems with scientists, purchased quality seed and farm literature, and participated in produce competition. Ten progressive farmers were honoured during PAU Kisan Melas at Ludhiana for their outstanding contributions to agriculture, horticulture and allied occupations.

- The University organized 388 field days; 1,161 adaptive research trials; 134 on farm trials; 3,226 cluster front line demonstrations; 1,790 method demonstrations; 1,651 training programmes (1,215 short, 289 vocational, 105 in-service and 42 sponsored); 827 exhibitions and three Research and Extension Specialists' Workshops for the benefit of farmers.

- Special campaigns on paddy straw management, whitefly management in cotton, yellow rust management in wheat, and popularization of biofertilizers and bioagents were organized. The campaign on crop residue management resulted in making 30 villages in different districts of Punjab as zero burning villages. In addition, whitefly in cotton and yellow rust in wheat were managed successfully. The area under wheat biofertilizer increased from 56,000 acres (2017-18) to 60,191 acres (2018-19). The area under PAU wheat varieties increased to 95.71 per cent and rice varieties to 73.94 per cent in the State during the year 2018-19.

- The University enrolled 230 PAU doots in various villages of Punjab for the quick dissemination of farm technologies through e-mail. Till date, 6,103 farmers have been enrolled as PAU doots.

- Kisan Mobile App was started and released at PAU Kisan Mela on September 20, 2018.

- More than 5 lakh farmers are receiving the digital newspaper Kheti Sandesh on WhatsApp. Apart from this, 149 WhatsApp groups were formed by the scientists of Krishi Vigyan Kendras and Farm Advisory Service Centres to apprise the end users of latest technology.

- Five lakh farmers were enrolled for weather based agro-advisory.

- The Communication Centre maintains a constant liaison with the print and electronic media for the quick dissemination of agricultural technologies among the farmers. During the period, the Centre published 12 issues each of monthly magazines Progressive Farming and Changi Kheti with a combined circulation of 1,70,400; revised editions of Package of Practices (twice a year of Rabi Crops and Kharif Crops); and 46 new bulletins. In addition, it released 205 articles and 884 press notes in English and Punjabi for publication in various newspapers and magazines. It also organized 255 TV/radio talks of PAU scientists.

**MEMORANDA OF UNDERSTANDING (MoUs)**

To strengthen linkages with national and international institutions/organizations, PAU signed 10 memoranda of understanding during 2018-19:

- Nippon Steel and Sumikin Bussan Corporation, Tokyo, Japan
- University of Birmingham, United Kingdom
- University of Canberra, Australia
- Michigan State University, East Lansing, Michigan, USA
• Galilee International Management Institute, Israel
• Tel Aviv University, Israel
• Arava Institute, Israel
• M/s CDSL (Central Depository Services Limited) Ventures Limited, Mumbai
• Mahindra and Mahindra Limited, Mumbai
• Punjab and Sind Bank, Amritsar

AWARDS, DISTINCTIONS AND RECOGNITIONS

• The Punjab Agricultural University was decorated with the prestigious Sardar Patel Outstanding ICAR Institution Award 2017 by the Indian Council of Agricultural Research (ICAR). Dr Baldev Singh Dhillon, Vice Chancellor, PAU, received the award from Dr T Mohapatra, Secretary, Department of Agricultural Research and Education (DARE) and Director General, ICAR, in New Delhi on March 5, 2019.
• Dr Baldev Singh Dhillon, Vice Chancellor, PAU, was awarded Padma Shri, one of the top civilian honours of India, by the President of India Sh Ram Nath Kovind at Civil Investiture Ceremony, held at Rashtrapati Bhavan, New Delhi, on March 11, 2019. Dr Dhillon was awarded in the field of Science and Engineering (Agriculture).
• Drs JS Chawla, Gurjit K Gill, Tosh Garg, Mahesh Kumar, Jawala Jindal and Harleen Kaur (Plant Breeding and Genetics) were conferred with the Best All India Coordinated Research Project (AICRP) Maize Centre Award for the biennium 2017-18 and 2018-19 by the ICAR – Indian Institute of Maize Research (IIMR), Ludhiana.
• Drs KG Singh and Angrej Singh (Soil and Water Engineering) received the Best All India Coordinated Research Project (AICRP) Centre Award 2018 from ICAR-Central Institute of Post-harvest Engineering and Technology (CIPHET), Ludhiana.
• Dr SS Dhalwal (Soil Science) received IZA-FAI Award 2018 from International Zinc Association (IZA) - Fertiliser Association of India (FAI) for excellence in promoting zinc in Indian agriculture.
• Dr Sangeet Ranguwal (Economics and Sociology) was awarded Orange Knowledge Programme (OKP) Fellowship by Nuffic, Dutch Organisation for Internationalisation, The Netherlands, in 2019.
• The Krishi Vigyan Kendra (KVK), Bathinda was conferred with the Best NICRA - KVK Award 2019 in recognition of its best efforts in implementing the National Innovations on Climate Resilient Agriculture (NICRA) - Technology Demonstration Component of ICAR.
• The Krishi Vigyan Kendra, Sangrur and the Gram Panchayat, Chatha Nanhera were felicitated with the Rajpal Sarvotam Village Award during the Kisan Mela at PAU on September 20, 2018.
• Dr Sarwan Kumar (Plant Breeding and Genetics) got the Best Oral Presentation Award, and
Dr PS Sandhu (Plant Breeding and Genetics) bagged the **Best Poster Presentation Award** during the 4th National Brassica Conference on “Innovative Approaches in Oilseed Brassica towards Self-sufficiency,” held at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, from February 1-3, 2019.

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**ANNUAL REPORT**

**2018-19**

The Annual Report of **Punjab Agricultural University, Ludhiana** for the year **2018-19**

Authenticated

Chandigarh, Dated

Signature

Chief Minister, Punjab

Minister Incharge

Department of Agriculture and Farmers' Welfare
Captain Amarinder Singh, Chief Minister of Punjab, conducting a review meeting at PAU on January 15, 2019.

Trainees of ICAR Sponsored Winter School on “Farmers’ Empowerment through Entrepreneurial Ventures” along with senior officials and experts of PAU.
Vice Chancellors of various Universities attending the 43rd Vice Chancellors’ Convention at PAU.