ANNUAL REPORT
2019-20

PUNJAB AGRICULTURAL UNIVERSITY
LUDHIANA

Dr Baldev Singh Dhillon, Vice Chancellor, PAU, giving a floral welcome to Mr Suresh Kumar, Chief Principal Secretary to Chief Minister of Punjab, during the 13th Indo-Japanese Dialogue on "Indian Economic Development"

Participants of PAU-Industry Interface posing for a group photo

Alumni meet of College of Agriculture (L) and College of Agricultural Engineering and Technology (R)

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ANNUAL REPORT OF PUNJAB AGRICULTURAL UNIVERSITY

(July 1, 2019 to June 30, 2020)

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Printed and Published by

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Punjab Agricultural University, Ludhiana in March 2021.
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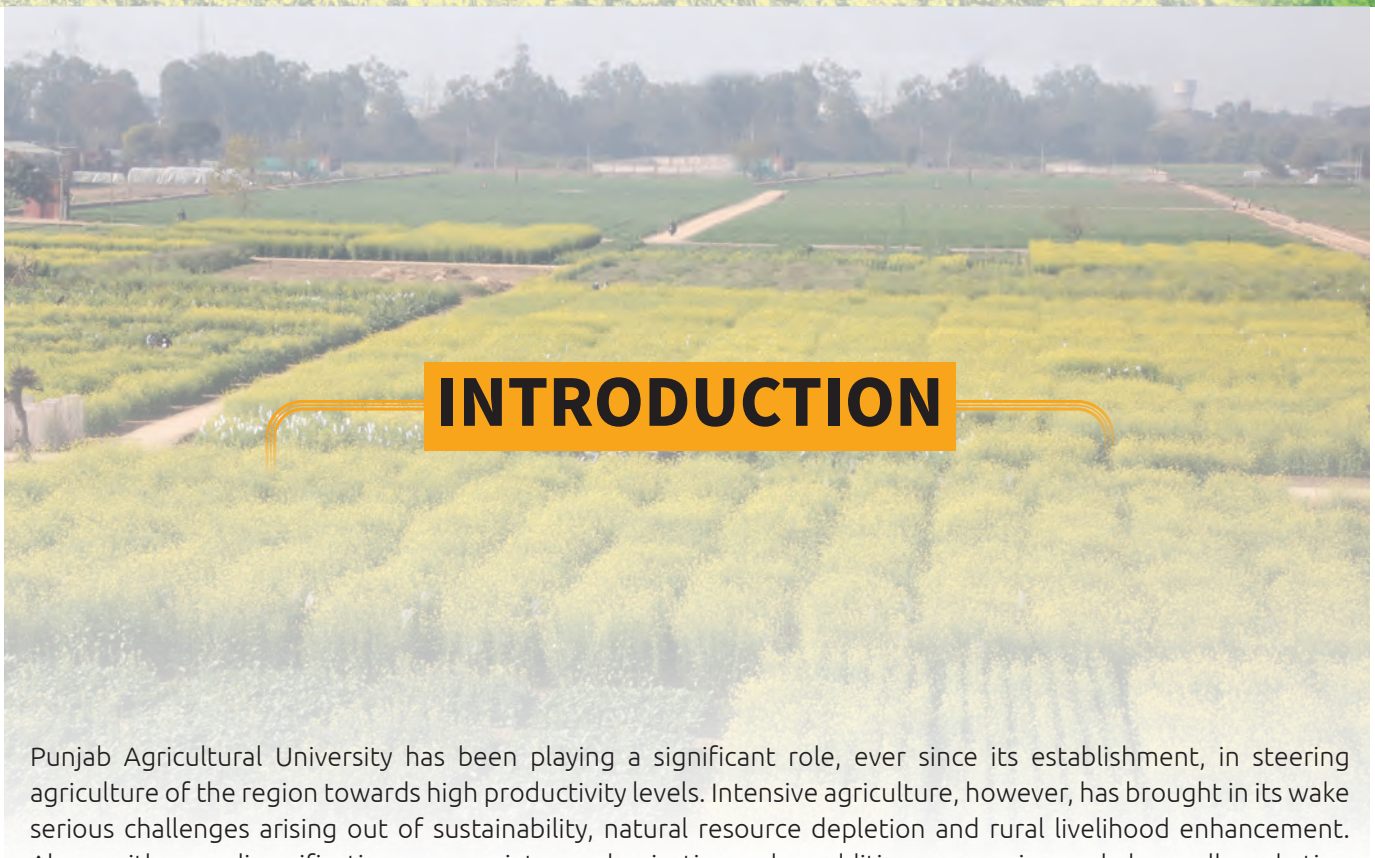


INTRODUCTION

Punjab Agricultural University has been playing a significant role, ever since its establishment, in steering agriculture of the region towards high productivity levels. Intensive agriculture, however, has brought in its wake serious challenges arising out of sustainability, natural resource depletion and rural livelihood enhancement. Along with crop diversification, appropriate mechanization, value addition, processing and above all marketing are required to address these issues. Mandate of the University has been continuously evolving in the face of these challenges.

The research work of the University is carried out at Ludhiana campus, eight Research Stations, three Fruit Research Stations and one Vegetable Research Farm, whereas seed production is taken up at four Seed Farms under the Directorate of Research.

Extension system of the University, providing two-way lab to field link in all the districts of the state through 18 *Krishi Vigyan Kendras* (KVKs) and 15 Farm Advisory Service Centres (FASCs), was successfully backstopped with a variety of virtual tools to keep communication channels open during COVID-19 induced disruptions.

Teaching set-up of the University is upgraded in alignment with the emerging needs of agriculture in the state and the region, for example College of Horticulture and Forestry was started during the last year and two more colleges have been proposed. Punjab Agricultural University continues its efforts towards national and global leadership in quality research, extension and teaching. The report in hand presents achievements of the University during the period of July 1, 2019 to June 30, 2020.

RESEARCH

Research activities of the University are aligned to the existing as well as upcoming challenges of agriculture in the region. Major thrust is on sustainability wherein conservation of natural resources, particularly water is a priority, while enhancing profitability of the farmers. To this end, research interventions include improved varietal base, complementary crop production-protection technologies, high input use efficiency, crop residue management, integrated pest and disease management, and appropriate farm mechanization. The objective was to promote a diversified set of economically and ecologically viable climate resilient crops and technologies. Research agenda also encompasses value addition and income enhancement through post-harvest handling and processing technologies, subsidiary occupations, farm drudgery reduction, nutritional interventions for family and community health, study of value chains, and agricultural market and agribusiness analysis. Besides, certain express adjustments were made in the research focus and activities to tackle challenges related to COVID-19.

CROP IMPROVEMENT

Crop improvement programmes focused not only on productivity and resistance but also addressed traits related to longer storage life, premium market segment, nutraceutics, and milling quality. Diversification crops including maize, barley, pulses, oilseeds, nutri-cereals, and fodder crops had more than 75 per cent share in the varietal output.

The University developed/released 14 varieties of different crops (3 of vegetable crops and 11 of other crops including, 3 of rice, 2 of barley, and one each of maize, mash, groundnut, wheat, *bajra* and fodder maize). Besides these releases, nine varieties (two each of *Bt* cotton and oat, and one each of wheat, barley, Napier bajra, chickpea and ryegrass) were identified at national level, out of which three stand notified. The former will be considered shortly for release at state level on the basis of adaptive research trials. The target areas of eight of the nationally identified varieties include Punjab and one (of chickpea) is identified for North-Eastern plains of India.

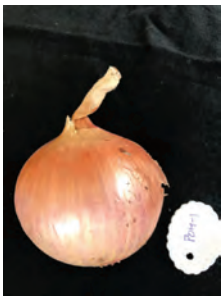
VEGETABLE CROPS

- **POH 1 (Onion):** It is the first hybrid variety of onion developed by PAU. Its bulbs are round, large and light-red. It takes 142 days to harvesting. It is tolerant to bolting and has longer storage life (4 months under ambient conditions in comparison to complete rotting in check hybrid T-821 within this period). It is rich in vitamin C (50 mg/100 g). Its average yield is 221q/acre.
- **Punjab Bharpoor (Brinjal):** Its fruits are small-oblong, shining, deep purple with green calyx and are borne in heavy clusters (6-9 fruits). Its plants are medium-tall (92 cm), compact and thorn-less with green foliage. It is resistant to bacterial wilt. Its average yield is 224 q/acre. The variety will cater to the demand of small fruit segment.
- **Punjab Nikhar (Sponge gourd):** It is an early maturing variety, which takes 143 days from transplanting to first picking. Its fruits are slender, smooth, tender, long and attractively light green with average fruit weight of 110 g. The vines are medium long with intermediate inter-nodal length. Its average yield is 82 q/acre.

FIELD CROPS

- **JC 12 (Maize):** This variety is recommended for *Kharif* season cultivation in traditional composite maize growing sub-mountainous zone of Punjab. It has semi-flint, yellow orange grains. It matures in about 99 days. Its average yield is 18.5 q/acre. It has medium thick stem with medium ear placement and resists lodging.

- **Mash 1137 (Urdbean):** It is a spring urdbean variety recommended for sub-mountainous zone of Punjab. It has erect and compact plant type with short stature (30 cm). It matures in about 74 days. Pod bearing is profuse and each pod contains 6-7 seeds. It is resistant to yellow mosaic disease. Its average grain yield is 4.5 q/acre. Its grains are bold, blackish in colour and possess good culinary properties.
- **J 87 (Groundnut):** It is an early maturing bunch type variety suitable for cultivation during spring as well as *Kharif* season in Punjab. Its 100 kernel weight is 79 g. It has 69 per cent shelling outturn. Its average pod yield is 15.3 q/acre in spring season and 12.8 q/acre in *Kharif* season. It has 49 per cent oil content and 5.2 per cent sucrose content. It matures in 112 days. On account of higher oleic acid (65.7%), it has longer shelf life and is more suitable for deep frying. Larger seeds qualify it for confectionary purposes. Early maturity helps it fit as a third crop in potato/pea based cropping systems.
- **PCB 165 (Pearl millet):** It is a quick growing and tall (2.51m) dual purpose composite variety. Being a late flowering variety (comes to 50 per cent flowering after 73 days), it provides wider window of use. It is tolerant to all the major diseases of *bajra*. It possesses good fodder and grain quality. It has high crude protein (7.9%) content. Grains of this variety are suitable for popping. On an average, fodder crop gives 234 q/acre of green fodder and grain crop yields 12.8 q/acre.
- **J 1007 (Fodder maize):** Its plants are tall (2.20 m) with broad leaves that stay green for longer time. It is moderately resistant to Maydis leaf blight and charcoal rot. It possesses high crude protein and digestibility. It gives 168 q/acre of green fodder yield.
- **PBW 752 (Wheat):** It is a bread wheat variety for irrigated late sown conditions. It carries *Yr10* gene which confers resistance to all prevalent pathotypes of yellow rust. It is also fairly resistant to brown rust disease. Its average plant height is 89 cm and matures in about 130 days. Its average grain yield is 19.2 q/acre. It has better hectolitre weight and grain zinc concentration than check varieties.
- **PL 891 (Barley):** It is a two rowed hull-less barley variety suitable for human food consumption. It has 4 per cent β-glucan and 12 per cent protein content. It matures in 144 days. It is a medium tall (102 cm) variety. It is resistant to major pathotypes of yellow rust, brown rust and leaf blight diseases. Its average grain yield is 16.8 q/acre. Hull-less



POH 1

Punjab Bharpoor

Punjab Nikhar

JC 12

Mash 1137

PCB 165

J 1007

PBW 752

PL 891

PR 128

Punjab Ryegrass 2

barley can be consumed as whole grain cereal, barley flakes and barley flour. Its *sattu* (roasted grain ground into fine powder) is suitable for use as a traditional energy drink. The β-glucan content is helpful in preventing heart diseases and Type-II diabetes.

- **DWRB 123 (Barley):** It is a two rowed malt barley variety developed by Indian Institute of Wheat and Barley Research, Karnal. It matures in 141 days. It is a medium tall (101 cm) and bold-seeded variety with 11 per cent protein content. It is resistant to major pathotypes of yellow rust, moderately resistant to brown rust and tolerant to leaf blight disease. Its average grain yield is 19.4 q/acre. This variety is particularly suitable for brewing industry.
- **PR 128 (Rice):** It is an improved version of PAU 201. It possesses long slender clear translucent grains. Its average plant height is 110 cm and matures in about 111 days after transplanting. It is resistant to all the 10 presently prevalent pathotypes of bacterial blight pathogen in the Punjab state. Its average paddy yield is 30.5 q/acre.
- **PR 129 (Rice):** It is also an improved version of PAU 201. It possesses long slender clear translucent grains. Its average plant height is 105 cm and matures in about 108 days after transplanting. It is resistant to all the 10 presently prevalent pathotypes of bacterial blight pathogen in the Punjab state. Its average paddy yield is 30.0 q/acre.
- **HKR 47 (Rice):** This variety has been developed by CCS Haryana Agricultural University, Hisar, Haryana. It is a mid-early maturity variety of rice. It takes 104 days to mature after transplanting and its average plant height is 117 cm. Its average yield is 29.5 q/acre. It is suitable for parboiling.

GERMPLASM COLLECTION AND UTILIZATION

Collection, evaluation, conservation and exchange of germplasm play a vital role in crop improvement. During the report period, 7,418 accessions of a host of vegetable, fruit, flower and field crops were sourced from CGIAR (Consultative Group for International Agricultural Research) institutes, various ICAR institutes, agricultural universities and

Varieties identified at national level

Variety (crop)	National Zone
PBW 771 (Wheat)*	North Western Plains Zone
PL 891 (Barley)*	North Western Plains Zone
PBN 351 (*Bajra*)*	Central Zone
PAU *Bt* 2 (Cotton)	North Zone (Punjab, Haryana and Rajasthan)
PAU *Bt* 3 (Cotton)	North Zone (Punjab, Haryana and Rajasthan)
GL 13001 (Chickpea)	North Eastern Plains Zone (Manipur, Mizoram and Tripura)
OL 1861 (Oat)	All India except Hill Zone
OL 1869-1 (Oat)	North West Zone and Central Zone (Rajasthan, Punjab, Haryana, Terai region of Uttarakhand, Western Uttar Pradesh, Maharashtra, Gujarat, Madhya Pradesh and Chhattisgarh)
PBRG 2 (Ryegrass)	Irrigated areas of Jammu and Kashmir, Himachal Pradesh, Punjab and Uttarakhand

*Notified at national level

farmers. In case of vegetable crops, the procured germplasm comprised pea and sweet potato (20 each); muskmelon (12); brinjal (10); cucumber, chilli and Chinese cabbage (8 each); tomato (7); potato and onion (6 each); amaranth, bittergourd and cauliflower (5 each); fenugreek, turmeric, pumpkin and garlic (4 each); *palak*, coriander and okra (2 each); and cowpea and fennel (1 each).

Germplasm material sourced in case of fruit crops included citrus, *ber* and mulberry (3 each); and guava (2). The Indian Agricultural Research Institute (IARI) and Central Citrus Research Institute, Nagpur contributed towards citrus germplasm (three Pummelo varieties – US Pummelo, White Pummelo and PM-3). Guava strains were sourced from Lucknow. Three mulberry species (*Morus alba, M. rubra, and M. nigra*) were explored and collected from South-Western Punjab. Three local strains of *ber* were sourced from Ludhiana district.

Chrysanthemum (2), gladiolus (2), narcissus (1) and Phalaenopsis (1) constituted the germplasm procurement in floriculture.

Sesame (3,351), sunflower (27) and soybean (40) accessions were procured to leverage crop improvement programme in oilseeds. Sunflower germplasm included four A lines from Latur centre of All India Coordinated Research Project on Sunflower for crossing programme and 23 inbred lines from University of Agricultural Sciences, Bengaluru and University of Agricultural Sciences, Raichur, Karnataka for validation of characters.

Germplasm material procured for breeding in pulses included urdbean (2,267), chickpea (60), fababean (50) and pigeonpea (40). Germplasm procurement in pulse crops was primarily aimed at identification of promising lines for different traits in the hybridization programme. Soybean, urdbean and fababean materials were procured from ICAR-National Bureau of Plant Genetic Resources, New Delhi. International Crop Research Institute on Semi-Arid Tropics (ICRISAT) provided chickpea and pigeonpea germplasm. Soybean germplasm included two photoperiod insensitive lines, which have been further used in crossing programme. Some promising lines from urdbean material are being used for Yellow Mosaic Virus resistance and determinate plant type. Some pigeonpea lines are being exploited for earliness and short-statured traits. Fababean material is being screened for bold seed trait.

In case of forage crops, sorghum (132) and oat (120) accessions were acquired. Besides, 108 entries were received in millets including pearl millet (100), finger millet and little millet (4 each).

Germplasm receipts in cereal crops included maize (786), wheat (260) and rice (5). Most of the maize germplasm material was sourced from CIMMYT (Mexico and India) to harness traits related to abiotic stresses like waterlogging, fall armyworm and Maydis leaf blight. Out of 260 wheat lines, 120 were received from CIMMYT, Mexico for evaluating international yield nurseries for grain yield, agronomic traits and disease resistance. Some promising lines were involved in hybridization and shortlisted for evaluation in replicated trials. The remaining 140 lines were obtained from ICAR-National Bureau of Plant Genetic Resources, New Delhi with the purpose of screening against rusts and Karnal bunt. Promising entries were retained for inclusion in crossing block.

BIOTECHNOLOGY

Research in biotechnology complemented crop improvement programmes in citrus, vegetable crops, pulses, rice and wheat with respect to resistance/ tolerance to biotic and abiotic stresses and for improving rice milling quality.

- Transgenic pigeonpea with *cry1Ab* gene for resistance against *Maruca vitrata* has been developed. A total of 12 T_1 events in varieties AL 201 and AL 15 with high expression of the gene have been identified.
- Biotechnological interventions in wheat included:
  - PBW 771 variety was identified and notified at national level by introgressing *Lr57-Yr40* gene from *Aegilops geniculata* in DBW 17 background by marker assisted selection (MAS).
  - High grain weight gene has been pyramided with two stripe rust and one leaf rust resistance genes (*Lr57-Yr40+Yr15*) in PBW 550 background.

- Biotechnological research advances in rice constituted:
  - Development of new varieties PR 128 and PR 129, white grained versions of PAU 201, was facilitated by the MAS for bacterial blight resistance and grain pigmentation.
  - Introgression lines of *Oryza nivara* and *O. rufipogon* with brown plant hopper resistance have been developed in cultivated rice background.

SEED AND NURSERY PRODUCTION

The University has been producing quality seed and planting material, to meet farmers' needs, by following rigorous quality standards. Innovative seed provisioning plan drawn by the University was effective in ensuring almost doorstep delivery to the farmers during the lockdown period.

- During the year, the University produced 424 q seed of vegetable crops and 63,279 q seed of field crops, besides providing 5,403 q propagation material of turmeric and potato (see the following Table).
- Various fruit plant seedlings (including grafted/ cuttings) totalling 6,01,289 (worth Rs 1.37 crore) were made available to the farmers.
- In case of agroforestry seedlings, 93,539 seedlings were provided to the farmers and one lakh poplar cuttings were supplied to the Department of Forests and Wildlife Preservation, Punjab.

CROP PRODUCTION TECHNOLOGIES

Crop production interventions laid thrust on microirrigation, conjunctive use of poor quality irrigation water, income augmentation through intercropping, planting method manipulations and premium market capture, and residue management. Rapid need-based shift to labour- and water-saving technology of direct seeded rice was facilitated through some instant adjustments in the technology package.

Horticultural crops

Microirrigation

- Drip irrigation and fertigation schedule for guava involving application of water equivalent to 80 per cent of crop evapotranspiration and 80 per cent of recommended fertilizer dose has been recommended. Plastic mulch (25µ) confers additional yield advantage. The technology provides higher yield and better quality.
- Drip irrigation and fertigation schedule recommended for bittergourd provides 37 per cent irrigation water saving (over conventional system) and 20 per cent saving in fertilizers besides higher and better quality yields. Plastic mulch, followed by straw mulching, provides additional yield advantages.

Seed production (q) of field and vegetable crops during 2019-20

VEGETABLE CROPS					
Season	**Breeder seed**	**Foundation seed**	**Certified seed**	**Truthfully Labelled**	**Total**
Summer 2019	5.60	0.82	4.05	55.90	66.37
Winter 2019-20*	26.00	27.00	55.00	250.00	358.00
Sub-total	**31.60**	**27.82**	**59.05**	**305.90**	**424.37**
Potato	160.00	1,565.00	2,731.50	671.00	5,127.50
Turmeric	25.00	-	-	250.00	275.00
Sub-total	**185.00**	**1,565.00**	**2,731.50**	**921.00**	**5,402.50**
Total	**216.60**	**1,592.82**	**2,790.55**	**1,226.90**	**5,826.87**
FIELD CROPS					
Kharif 2019	776	1,044	15,429	6,150	23,399
Rabi 2019-20*	3,248	4,212	24,740	7,680	39,880
Total	**4,024**	**5,256**	**40,169**	**13,830**	**63,279**

- In coarse textured soils of canal command areas of South-Western Punjab, mixed water (fresh and saline water) of electrical conductivity up to 2.0 dS/m and residual sodium carbonate (RSC) <2.5 mEq/l can be used through drip irrigation in potato planted in paired rows on raised beds, to tide over good quality canal water shortage.

Paddy residue mulching

- Paddy straw mulching (@ 5.5 tonnes/acre, 10 cm thick layer) after fruit set and application of second dose of inorganic fertilizers in pear during second week of April, and during first week of March in peach and plum has been recommended for attaining better fruit yields.

Intercropping

- Short-duration groundnut variety TG37A can be grown as an intercrop in *ber* orchards after pruning in May to derive additional income of about Rs 20,000/- per acre.

Floriculture

- In order to shorten four-year long natural development process of gladiolus cormels into flowering grade corms to two years, gladiolus cormels (0.5 cm) can be treated with GA_3 (gibberellic acid) @ 200 mg/l (dipping for 24 hours) for two consecutive years in order to obtain flowering grade corms (4.2 cm).

Field Crops

Cultivation methods

- New DSR (direct seeded rice) technique - '*Tar wattar* DSR' has been proposed. The technique involves laser levelling followed by pre-sowing (*rauni*) irrigation and preparation of the field upon reaching *Tar wattar* condition (high soil moisture at workable stage). Rice is then immediately sown with tractor operated Lucky Seed Drill which simultaneously handles sowing of rice and pre-emergence herbicide application. In the absence of Lucky Seed Drill, rice can be sown alternatively with rice seed drill having inclined plate metering mechanism followed immediately by herbicide application. Under '*Tar wattar* DSR', first irrigation is given at about three weeks after sowing, thus conferring advantages of better root growth, low weed population, low incidence of micronutrient deficiencies and significant water saving.

- The AL 882, a short duration and early maturing variety of *arhar*, can be densely planted (30 cm row spacing instead of conventional 50 cm and seed rate 12 kg/acre instead of 6 kg/acre) from June 15 - 25 to obtain about 20 per cent higher yield.

Intercrops, relay crops and new cropping sequences

- Wider inter-row spacing and longer duration of sugarcane can be utilized for intercropping with okra to enhance income. Two rows of okra can be intercropped in spring sugarcane planted at 90 cm X 30 cm or 120 cm X 30 cm.
- A new diversification oriented cropping system, groundnut-pea-sunflower, has been recommended. Groundnut should be sown in the second half of May, pea during second half of October and sunflower during first half of February. The system increases net returns (over conventional rice-wheat system) by 56 per cent.
- Under certain soil situations (such as waterlogged/sodic soils) prohibiting timely harvesting of *parmal*/*basmati* rice and use of farm machinery, wheat can be relay cropped in paddy/*basmati* by

broadcasting wheat seed in standing rice crop just before or immediately after last irrigation to rice during October 10 to 25. The practice entails higher seed rate (55-60 kg/acre) of wheat crop and leads to 18-27 per cent higher yield under the above conditions.

- Celery can be relay cropped in short duration varieties of pea for higher returns. For this purpose, 4 kg of celery seed/acre can be broadcast immediately after first irrigation to pea sown on ridges (two rows of pea on 60 cm ridges). Alternatively, pea can be planted in fields under celery during the previous year and naturally germinated seedlings from the shattered seed of celery crop can be retained.

Nutrient management

- Nitrogen (urea) fertilizer schedule in wheat has been modified to derive higher nitrogen fertilizer use efficiency in wheat. In addition to basal application of N through 55 kg/acre DAP, urea @ 45 kg/acre in timely sown wheat and @ 35 kg/acre in late sown wheat should be applied each with the first and second irrigation. In case of the likelihood of delay in second irrigation due to seasonal rainfall, second split of urea should be applied about 55 days after sowing.
- Use of Leaf Colour Chart (LCC) for need-based nitrogen fertilizer application has been extended to *basmati* rice. Critical greenness shade level, however, depends on variety and varies from 3.5 (CSR 30, Basmati 386 and Basmati 370) to 4 (Punjab Basmati 4, Punjab Basmati 5, Pusa Basmati 1637, Pusa Basmati 1509, Pusa Basmati 1718, Punjab Basmati 2, Punjab Basmati 3 and Pusa Basmati 1121). The LCC should be used weekly, starting from 21 days after transplanting. Urea @ 9 kg/acre needs to be top-dressed in case greenness of 60 per cent leaves slips below the critical threshold.

Biofertilizers

- Liquid microbial inoculant comprising *Burkholderia seminalis* and *Bradyrhizobium* sp. in trehalose (5mM) basal medium has been recommended for enhancing yield and quality of forage cowpea. Using the culture in addition to recommended dose of fertilizers (RDF) improved green and dry fodder yield by 5.3 and 6.1 per cent, respectively. Besides, it improved forage quality by reducing acid detergent fibre (ADF) and neutral detergent fibre (NDF) content, and by increasing crude proteins and *in vitro* digestibility of dry matter (IVDMD). Additionally, liquid formulation enhances shelf life and ease of application.
- The University prepared and provided biofertilizers for 16 crops (including rice, wheat, maize, sugarcane, *arhar*, *moong*, soybean, pea, *berseem*, mash, summer *moong*, gram, lentil, turmeric, potato and onion), which were enough for inoculating more than 63 thousand acres.

Productivity enhancement through growth regulators

- To obviate low germination concerns in sugarcane, seed cane setts can be soaked overnight in Etherel (2-chloroethyle phosphonic acid) solution @ 100 ppm (25 ml Etherel in 100 litres of water). It regulates plant growth and germination timings. The practice improves germination by 23 per cent and yield by 22 per cent.
- Foliar application of urea @ 2% in chickpea at flowering and pod formation stages has been recommended. The practice provides 7.3 per cent increase in yield and 3 per cent increase in protein content, and does not increase the susceptibility of crop to insect-pests and diseases.
- Foliar application of potassium nitrate @ 1.5% recommended for paddy crop at boot stage increased grain yield by 5.4 per cent. The increase in yield was largely driven by improvement in panicle weight, which was further caused by improvement in number of filled grains per panicle and spikelet fertility.

Salinity stress management

- Irrigation induced salinity stress in cotton-wheat system can be managed with the addition of rice residue biochar @ 4 t/ha in cotton. Besides, the practice leads to carbon accretion and subsequent sequestration.

Residue management

Field trials for *in situ* paddy straw degradation were carried out at five locations (PAU Ludhiana campus,

Ladhowal, Sangrur, Kapurthala and Gurdaspur) with four different microbial preparations developed by PAU and four commercial products. Total fibre content in terms of cellulose, hemicellulose and lignin as well as C:N ratio showed higher decrease at more locations with *Delftia* based PAU microbial consortia.

CROP PROTECTION

Research in the domain of crop protection laid emphasis on eco-friendly pest and disease management, biocontrol, seed treatment and management of herbicide resistance.

Fruits

- Rainy season guava crop is severely infested by fruit fly. On-tree bagging protects the fruits from fruit fly and eliminates the use of pesticides. Mature green and hard guava fruits of rainy season before colour break stage can be covered with white non-woven bags at the end of June to middle of July. It also improves the fruit size and quality. The technology will be particularly useful for backyard/kitchen garden plantations.
- The common brown snail, *Macrochlamys indica*, is an important pest of citrus nursery in Punjab. Integrated approach recommended for managing this pest involves application of metaldehyde (2.5% dust) based bait (metaldehyde 25 g + jaggery 250 g + wheat bran 750 g), cleaning up debris in/around nursery, placing papaya leaves or gunny bags in the nursery area to attract snails and destroying snails by immersing in salted water.

Vegetable crops

- Use of aqueous neem fruit extract has been recommended for eco-friendly management of mites in capsicum under protected cultivation. The technology involves mixing 5 kg shade dried fresh neem fruits in 100 litres of water, leaving the mixture overnight, and then filtering the extract through a muslin cloth. The filtered extract can then be used as a spray (5%) to control mites in capsicum.
- '*Saag*' – a thick curry of rapeseed-mustard foliage often served with maize flour *chapatti* – has been a winter staple of North-West India. It has been recommended that a minimum waiting period of one week, 20 and 30 days may be observed in case the crop has been sprayed with Thiomethoxam 25 WG, Dimethoate 30EC or Chlorpyriphos 20EC, and Quinalphos 25 EC, respectively.
- Purple blotch of onion, a fungal disease, can be managed by foliar application of Caviet 25WG (tebuconazole 25% w/w) @ 300 g/100 litres of water/acre. The recommended technology reduced onion blotch disease severity to 3.9 per cent as compared to 9.4 per cent in conventionally used Indofil M-45 (Mancozeb 75%) and the yield increased by 7.5 per cent.
- Black scurf of potato can be managed by dipping tubers in Emesto Prime (penflufen 22.43%FS) for 10 minutes. The seed treatment can help reduce inoculum for the next tuber crop.
- Mites infesting capsicum under protected cultivation can be managed by foliar spray of Omite (propargite) 57 EC @ 200 ml/acre or Oberon (Spiromesifen) 22.9 SC @100 ml/acre.
- Mites in okra can be controlled by foliar spray of Oberon (spiromesifen) 22.9 SC @ 150 ml/acre.
- Whitefly was accorded the status of a pest of brinjal. Whitefly nymphs and adults suck sap from brinjal leaves and make leaves sticky by excreting honey dew onto them. Diafenthiuron 50 WP @ 200 g/acre can be used as a foliar application to manage this pest.
- A study on the biology of whitefly on brinjal revealed that average life cycle of *Bemisia tabaci* was shorter during June-July as compared to during April-May. The nymphal period in different instars (4 instars) ranged from 3.11-3.56 days, whereas adult longevity for its male and female was 4.18 and 6.13 days, respectively.

Oilseeds and pulses

- Commercial *Bt* formulation, Mahastra 0.5 % WP @ 800 g/acre was found effective and resulted in 66.8 per cent reduction in pod damage due to *Helicoverpa armigera* in gram.
- Pod sucking bug, *Clavigralla gibbosa* Spinola, has been identified as a pest of pigeonpea in Punjab. Both nymphs and adults of this pest use their mouthparts to pierce the pod wall and suck the sap from the developing seeds. Foliar application

of home-made neem extract (@ 1,250 ml/acre in 100-125 litres of water) has been recommended for managing this pest.

- White rust in rapeseed and mustard can be managed by foliar application of metalaxyl M4% + mancozeb 64% WP (Ridomil Gold) @ 250 g/100 litres of water/acre.

Maize

- Bio-suppression of maize stem borer using *Trichogramma chilonis* @ 1,00,000/ ha (2 releases at 10 and 17 days old crop) carried out at farmers' fields (448 acres) resulted in 53.2 per cent reduction in dead hearts incidence as compared to 82.9 per cent in chemical control. The additional benefit over untreated control in biocontrol package was Rs 5,483/- per ha as compared to Rs 9,764/- per ha in chemical control.
- Foliar application of chlorantraniliprole 18.5 SC @ 0.4 ml/litre, Emamectin benzoate 5 WG @ 0.4 g/litre, and Spinetoram 11.7 SC @ 0.5 ml/litre using 120 litres of water (for crop younger than 20 days) or 200 litres of water (for crop older than 20 days) has been recommended for managing fall armyworm, a new trans-boundary invasive pest, in grain maize. For fodder maize, spray of chlorantraniliprole 18.5 SC @ 0.4 ml/litre has been recommended. These recommendations along with the earlier recommended non-chemical management practices broaden the spectrum of management options.

Sugarcane

- Biocontrol of sugarcane borers using egg parasitoids, *Trichogramma* spp. @ 50,000 per ha at 10 days interval for the management of early shoot borer (8 releases; mid-April to end-June), top borer (8 releases; mid-April to end-June) and stalk borer (10-12 releases; July to October) carried out at farmers' fields (11,406 acres) reduced their incidence by 53.9 to 57.4 per cent.
- Early shoot borer, *Chilo infuscatellus* Snellen, can be managed with Takumi 20WG (flubendiamide) @ 150 g/acre.
- Sugarcane termite, *Odonto termesobesus* Rhamb, can be managed with Coragen 18.5 SC (chlorantraniliprole) @ 200 ml/acre. Residue of the chemical in various parts of sugarcane was found to be below detection limit.

Cotton

- Celcron 50 EC (profenofos) @ 500 ml/acre has been recommended to manage thrips.
- Foliar application of Keefun 15 EC (tolfenpyrad) @ 300 ml/acre has been recommended for the management of jassid.
- Daita 10 EC (pyriproxyfen) @ 500 ml/acre and Sefina 50DC (afidopyropen) @ 1,000 ml/ha, as foliar spray, have been recommended for managing whitefly.
- Amistar 325 SC (azoxyustrobin 18.2% + difenoconazole 11.45 SC) @ 200 ml in 200 litres of water per acre has been found effective against fungal leaf spot. It also provides effective control of sooty mould.

Wheat

- Foliar application of Opera 18.3SE (pyraclostrobin 133 g/l and epoxyconazole 50 g/l) or Caviet 25 WG (tebuconazole 25% WG) has been recommended to control yellow rust in wheat.
- Neonix (a formulation of imidacloprid 18.5% and hexaconazole 1.5% FS) has been recommended to manage termites and smuts (loose smut and flag smut) in wheat.
- Seed treatment with Cruiser (thiomethoxam 70 WS) @ 1 g/kg seed has been recommended to manage termites in wheat.

Rice

- Rice root nematode, *Meloidogyne graminicola*, in nursery beds can be managed in an eco-friendly way by applying mustard cake (@ 40 g/m^2) 10 days before sowing of nursery. This practice reduced nematode infestation by 48 per cent and improved seedling population upto 15 per cent.
- Sheath blight can be controlled by two foliar applications of Pikapika 25EC (propiconazole) @ 200 ml/acre.
- Treating rice seed with Sprint 75 WS (carbendazim 25% + mancozeb 50%) @ 3 g/kg seed has been found effective in controlling seed borne and early soil borne infections of sheath blight, brown spot and blast.

- Effectiveness of the augmentative releases of *Trichogramma chilonis* and *T. japonicum* each @ 1,00,000/ha (5-6 releases at weekly interval) in organic *basmati* rice in controlling stem borer and leaf folder was validated at farmers' fields (248 acres) with 55.2 per cent and 49.9 per cent respective reduction.

Molecular characterization

- The capability receptor (CAPAr) gene from whitefly (Asia II-I genetic group) was characterized and two isoforms were identified. Preliminary qPCR studies revealed that CAPAr gene expression was comparatively higher in late nymphal instars.

Weed control

Phalaris minor

- *Phalaris minor* is showing resistance to most of the widely used weedicides. The situation calls for deploying new chemical and other control measures to counter possible herbicide resistance.
  - New pre-emergence herbicides AWKIRA 85 WG (pyroxasulfone) (@ 60 g/acre) and Platform 385 SE (pendimethalin 35% + metribuzin 3.5%) @ 1 litre/acre have been recommended to broaden pre-emergence management choices. The latter helps manage certain broadleaf weeds as well.
  - Existing recommended dose (one litre/acre) of pre-emergence herbicide Stomp 30 EC (pendimethalin) has been revised upward to 1.5 l/acre to manage likely risk of development of resistance against pendimethalin.
  - New post emergence herbicide ACM-9 (clodinafop 9% + metribuzin 20% WP) @ 600 g/ha has been recommended.
- A selective post-emergence herbicide Hitweed Maxx 10MEC (pyrithiobac sodium 6% + quizalofop ethyl 4%) @ 125 g a.i./ha (in moist soil after first irrigation) has been recommended for broad spectrum weed control in cotton.

RESIDUE ANALYSIS

- During the report period, 592 vegetable samples were collected from market (149) and farmgate (443). About 2.22 per cent of market samples and 1.34 per cent of farmgate samples contained pesticides above maximum residue limit (MRL).
- In case of 319 samples of *basmati* rice, six samples had pesticide residues above MRLs. No milk (30 samples) and water samples (18) were found to be contaminated.

FOOD SCIENCE AND TECHNOLOGY

Non-cereal pudding mix

- Potato tubers of table purpose variety Kufri Pukhraj were used for making ready-to-cook non-cereal puddings. Potato starch was isolated and mixed with powdered sugar (45:50), artificial colour (100 mg/100 g) and vanilla flavour (8-10 drops/100 g). The pudding preparation was acceptable in organoleptic evaluation. On account of its non-cereal, gluten free composition, it can cater to special clientele e.g. celiac patients, non-cereal fast keepers, etc. Also, this value addition will contribute towards management of table purpose potato gluts.

Kinnow fruit bar

- *Kinnow* fruit bars, having shelf life of six months, were prepared from *Kinnow* juice. After removing seeds, cut pieces of *Kinnow* were ground with sugar (1:1) in mixer to reduce bitterness. *Kinnow* juice along with pectin (4% of sugar) was concentrated by open pan boiling until a paste like consistency was obtained. The mixture was concentrated till final TSS reached 79^0 B. The bar was microbiologically safe during the entire shelf life period of six months.

Onion products

- Low cost technologies were developed for the production of diverse onion products (onion puree, paste and flakes) which can be available for consumption throughout the year.

Lactic acid starter culture

- Consortium of ten lactic acid bacterial strains was developed as a starter culture for preparing metabiotic lacto-fermented beverages and pickles from powder and rhizomes of turmeric and *amla.* Beverages and pickles prepared from turmeric and *amla,* endowed with antioxidants, polyphenols and flavonoids, exhibited antimicrobial activity

against a range of food borne pathogens and arrested the initial phase of Molt-4 cancer cell line.

New microbes

- Two fungus strains *Aspergillus nomius* and *A. flavus*were were isolated, respectively, from pineapple peel and citrus pulp for their potential use in Kojic acid production.
- Four strains of *Pediococcus acidilactici* were isolated from infant faeces for potential application in lactic acid fermented beverage production.

Incubational facilities

Food Industry Business Incubation Centre, established by Punjab Agricultural University with technical guidance from Ohio State University, USA, has been operational since June 2015. The Centre provides incubation facilities at nominal charges to entrepreneurs in scaling up the technologies developed by Punjab Agricultural University. During the report period, incubation facilities were provided to the following entrepreneurs:

- Mr Sunil Kumar, Upright Foods and Beverages Private Limited, Bihar for bottling of ready-to-serve sugarcane juice.
- Sandhya Self Help Group, Maili, Hoshiarpur, Punjab for processing of guava pulp, squash and nectar.
- Mr Jagjit Singh, B-treat Private Limited, Bathinda, Punjab for processing and bottling of honey lemon drink.
- M/s Maple Foods Private Limited and Ms Alpna Gupta, Ludhiana, Punjab for preparation of whole wheat healthy and nutritious sticks, oats and barn cookies.
- M/s Delicious Bites Private Limited and Ms Harjot Kaur Gambhir, Model Town, Ludhiana, Punjab for preparation of cereal products.
- Pinning Lifestyle, New Delhi for processing of ginger.

FOOD AND NUTRITION

Novel health foods from traditional sources

- Wheatgrass powder prepared from 7-10 days old wheatgrass (shade- or freeze-dried) was found to be suitable for enrichment of often consumed foods. Wheatgrass products, namely, bread, biscuits and spice mix can be commercialized to tap thriving segment of health foods.
- Mulberry fruits are characterized by short seasonality and high perishability. Six products, namely, jam, *chutney*, crush, syrup, leather and dried mulberry, prepared from three types of mulberry fruits, exhibited moderate loss in antioxidant activity after four months.
- Eight products, namely, powder, *chutney, murabba*, two types of pickles, candy, jam and syrup were prepared from ripe and green *karonda* (*Carissa* spp.). After six months storage, powder from green unripe *karonda* exhibited the highest ascorbic acid content (41.6 mg/100 g); pink ripe *karonda* powder had the highest anthocyanins content (388 mg/100 g); and candy had the highest iron content (8.5 mg/100 g). This value addition can help capture premium health food market and help design food-based interventions for anaemic populations.
- Pumpkin seeds are highly nutritive but are generally discarded. Pumpkin seed flour (from raw or roasted seeds) can be used to supplement (upto 30%) various food products like *panjeeri, matthi* and cookies at commercial scale.

Community health

- The nutritional bars developed with the quality protein maize (QPM) and different ratios of other ingredients like cauliflower leaves, carrots, green chickpea and jaggery were highly acceptable in terms of sensory scores and could be safely stored for about four months. Supplementation of QPM bars for 90 days resulted in an increase in total protein, serum albumin and hematological profile of school children.
- Supplementation of carom (*ajwain*) and fennel (*saunf*) seeds significantly improved lipid profile and antioxidant status of adult women.

POST-HARVEST TECHNOLOGY

Solar curing system for *Kharif* onion

- *Kharif* onion needs to be cured by removing excess moisture before storage. Curing slows microbial decay and sprouting. However, cold

weather following *Kharif* onion harvest prolongs curing time and hence necessitates distress sale. The recommended solar curing system allows curing by maintaining room temperature at 30 ^{0}C and relative humidity at 45±10% for nine days to ensure three-month storage life. Average loss with this technology was 15 per cent in comparison to 41 per cent loss due to sprouting after 30 days and complete rotting in 45 days under storage without the curing technology.

Refrigeration system

- A prototype of mobile thermoelectric refrigeration system (100L capacity) has been designed and developed for retail sale and storage of summer fruits and vegetables. It has four thermoelectric modules, liquid cooled evaporators and axial fan which can operate with 12V DC power source, consuming 4.5 kW/day. The system maintains the temperature of 15±2°C and 80-90 per cent relative humidity.

Tuberose tinting

- Tuberose spikes at tight-bud stage can be variably tinted by dipping basal portion (5-7 cm) in solution

comprising 1% food dye of desired colour, 2% sucrose and 300 mg/L citric acid for two hours. The technology will help capture premium market and address requirements of decorators.

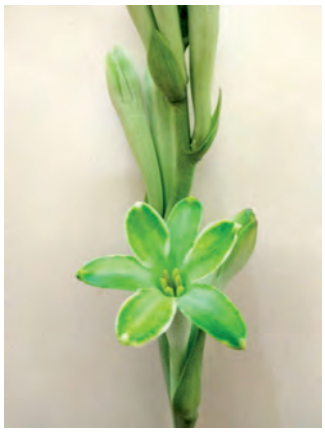
Handholding for agro-processing

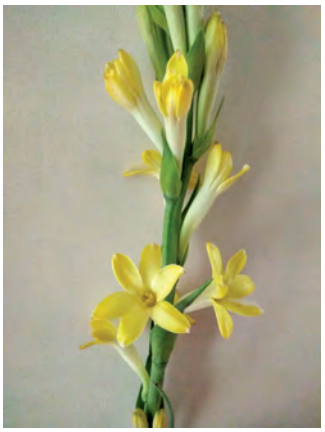
- Seven new agro-processing complexes and 10 jaggery processing plants were established by farmers with technical guidance from PAU.

AGRO-FORESTRY

Eucalyptus clone and planting technology for waterlogged areas

- Clone PE 11 has been found suitable for planting in salt-affected and waterlogged regions of the state. In such areas, *eucalyptus* should be planted





on polythene-covered ridges for better survival (78% against 63% on bare ridges and 6% on flat surface). After four years, average girth and plant height on polythene-covered ridge were higher (22.3 cm and 9 m, respectively) than on uncovered ridge (20.6 cm and 8 m), and average volume index was also higher on polythene covered ridges (26.6 m^3/acre) than on uncovered ridges (18.2 m^3/acre).

Intercropping

- The onion variety, PWO 35, recorded significantly higher bulb yield (19.8 t/ha) as compared to Punjab Naroya, PRO 6 and PRSC 10 under three-year old poplar plantation. The highest bulb diameter, fresh bulb weight and bulb yield were obtained in the end-December planted crop than in mid-January and end-January planted crops.

Nutrient management of nursery

- In a study aimed at examining the effect of inorganic and biological fertilizers on growth performance of *Casuarina junghuhniana* under nursery conditions, dual inoculation (phosphorus solubilizing bacteria (PSB) + *Frankia*) resulted in more plant height, collar diameter and root length as compared to uninoculated control and single inoculation of either PSB or *Frankia*. Nitrogen and phosphorus application, either singly or in combination, had significant effect in increasing the height of the plants, collar diameter and root over control.

BEEKEEPING

- During spring, 10-frame hives performed better than 7- and 8-frame hives in terms of brood rearing and bee population build-up.
- Studies on muskmelon (var. Punjab Sunheri) grown under polynet house revealed that fruit set did not take place in polyhouse without bees. Bee pollination resulted in mean fruit weight of 520 g, having 9.5 per cent TSS in comparison to 525 g and 9.7 per cent, respectively, in hand pollination.

LAC CULTURE

- The life cycle and productivity linked parameters of lac insects (*Rangeeni* strain) were studied on plants of *Flemingia semialata, Flemingia macrophylla* and *Zizyphus mauritiana*species. The *Rangeeni* strain completed all the life stages on these hosts. The duration of Katki crop varied from 105-110 days under Punjab conditions.

MUSHROOM CULTIVATION

- Cultivation technology of king oyster mushroom, *Pleurotus eryngii,* on wheat straw under Punjab conditions has been recommended.

- Among new strains, *Agaricus bisporus* strain AVT19-201 yielded the highest (20.86 kg/q compost) followed by AVT19-202 (18.50 kg/q compost) when grown on wheat straw based compost.

FARM MACHINERY

Boom type sprayer on paddy transplanter

- A boom type sprayer attachment was developed and mounted on the rear of self-propelled four-wheel drive paddy transplanter, after removing its transplanting unit. The field capacity of

the machine for spraying in paddy and wheat was 0.87 and 1.38 ha/h, respectively, with negligible damage/trampling of plants. The fuel consumption was found to be 2.1-3.0 l/h. The technology improves economics of the machine by minimizing its period of disuse.

Sugarcane trench planter

- Existing two paired rows sugarcane trencher has been modified to single paired row trench planter. The machine cuts the setts of desired length, places the sett in furrow and covers the sett with soil along with making trench and furrows. There was 25 per cent reduction in cost of planting and 58 per cent reduction in labour cost as compared to conventional method.

Tractor operated vertical cup type vegetable transplanter

- Tractor operated vertical cup type vegetable transplanter is a two-row semi-automatic tractor mounted vegetable transplanter used for transplanting cell type nursery of different vegetable crops. Field capacity of the machine for transplanting tomato, brinjal and chilli was 0.10 ha/h, 0.13 ha/h, and 0.15 ha/h, respectively at recommended spacing and forward speed with plant missing of less than 4 per cent. Labour saving in tomato, brinjal and chilli was 84.7 per cent, 86.2 per cent, and 85.7 per cent, respectively.

Happy Seeder refinement

- Three flail blade rows, having replaceable sharp edge section of 4 mm thickness mounted on the rotor of Happy Seeder at an angular spacing of 120^0 with tines having serrated bit (4mm replaceable), improved field capacity and fuel consumption of Happy Seeder by 13.7 and 21.5 per cent, respectively, as compared to existing design. The speed improved by 2.87 km per hour. Three flail blades were better than 6, 4 and 2 blades in all aspects.

Sanitizing tunnel

- Two prototypes of sanitizing tunnel (9'x4'x7.5'), capable of running on electrical and solar energy, were designed and developed. The tunnels were quite effective for human disinfection.

Quality control

- The Farm Machinery Testing Centre tested 28 farm machines including Rotavator (3), Post Hole Digger (1), No Till Seed-cum-Fertilizer Drill (1), Pneumatic Planter (1), Potato Planter (1), Super Seeder (7), Happy Seeder (2), Thresher (3), Mulcher (2), Tractor Operated Combine (1), Chaff Cutter (5) and Potato Digger (1).

APPARELS AND TEXTILES

Protective gloves for okra pluckers

- Protective full arm length gloves for plucking okra were prepared from knitted fabric. Double layer of fabric has been provided for palms and fingers. The technology will help reduce farm drudgery and obviate the potential injury-related disability of farm workers in performing other household/ farm chores.

Mosquito repellant fabric

- Control of mosquitoes with synthetic chemicals entails considerable environmental and health issues. Essential oils, on the other hand, are biodegradable and safe for human use. The microencapsulated fabric developed using ***eucalyptus*** oil (10%) was found effective in repelling mosquitoes. The technology will contribute towards management of diseases like malaria, dengue and chikungunya. The finished fabric can be used for developing clothings like shirts, socks, wristbands and handkerchiefs.

Waste management

- The knitted fabrics were constructed from a blend of soybean and waste wool fibre. The weft knitted fabrics were found to be suitable for both apparel and upholstery applications like sweaters, cardigans, socks, T-shirts, cushion covers and table linens. The yarn with 50:50 blend ratio was found to be suitable for making blankets, *khes, durries* and carpets. The cost of the developed weft knitted fabric from blend ratio of 20:80 and 30:70 was Rs 286 and Rs 228 per meter, respectively.
- Paddy straw was used for fibre extraction and blending with cotton to develop yarn for blinds, wall hanging and *durrie*. The developed blended fabric had grams per square meter (GSM) of 957, with 7.5 mm thickness. Tearing strength of the developed fabric was 73 kgf in warp direction and 71 kgf in weft direction. Drapability of the fabric was 46.71 per cent.

Plant-based fabric finishes

- Functional finishes were developed using plant extracts. It was found that pomegranate can be effectively used for treating fabric against bacterial activity, whereas *Mousami* and *Ratanjot* can be effectively used for treating fabric against fungal activity.

Community service

- During lockdown period, stitching of face masks, face shields and gloves was initiated to fulfill the requirement of labour working in fields of the University. A video on the development of protective masks was prepared to create awareness regarding mask preparation.

Rodent, bird and vertebrate pest management

- Survey of rodent damage in wheat crop fields sown with different technologies like conventional tillage, rotavator or drill machine, Happy Seeder with standing stubbles, and Happy Seeder with paddy mulch in different villages of district Fatehgarh Sahib, Tarntaran, Gurdaspur and Hoshiarpur revealed that rodent damage is not technology specific but location specific. Rodent damage in wheat fields ranged from 0 to 8.68 per cent.
- Use of reflective ribbon in tomato and mustard crops was found up to 95-97 per cent effective in bird control. Nylon nets installed in mustard crop

during the germinating stage gave 100 per cent protection from bird damage.

- Damage by fruit bats was minimized by using eco-friendly method of artificial light, using 16 LED (30W) bulbs/acre at 50 feet spacing in downward position (at a height of 6 feet above the top of tree canopy) in *ber* orchard.

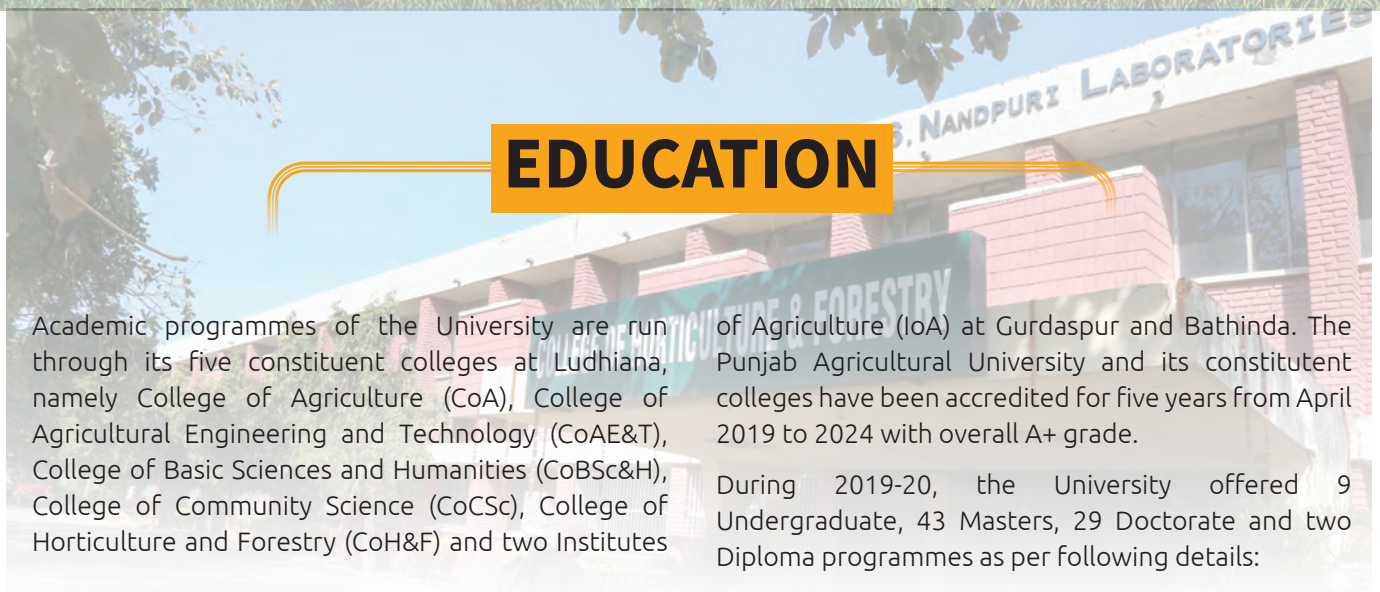
TECHNOLOGIES COMMERCIALIZED

During the report period, 13 Memoranda of Agreement (MoA) were signed to commercialize a variety of technologies (see the following Table).

Technology/Hybrid/Variety	MoA (count)
Varietal technologies	
Punjab Nawab (Pumpkin)	2
CH 27 (Chilli hybrid)	1
Farm machinery	
Lucky Seed Drill	1
Processing technologies	
Brewed Fruit Vinegar	1
Sugarcane Juice Bottling Technology	3
Fermentation of Fruits and Vegetables with Lactic Acid Starter Culture Technology	2
Other Technologies	
Advanced Domestic Solar Dryer	1
Rooftop Vegetable Nutrition Garden Model using Soil-less Media Technology	2
Total	**13**

Sugarcane Juice Bottling Technology

Lucky Seed Drill



EDUCATION

Academic programmes of the University are run through its five constituent colleges at Ludhiana, namely College of Agriculture (CoA), College of Agricultural Engineering and Technology (CoAE&T), College of Basic Sciences and Humanities (CoBSc&H), College of Community Science (CoCSc), College of Horticulture and Forestry (CoH&F) and two Institutes of Agriculture (IoA) at Gurdaspur and Bathinda. The Punjab Agricultural University and its constitutent colleges have been accredited for five years from April 2019 to 2024 with overall A+ grade.

During 2019-20, the University offered 9 Undergraduate, 43 Masters, 29 Doctorate and two Diploma programmes as per following details:

Programme	Number of seats		Number of students admitted	Number of students passed out
Class/Programme	General Reserved/ Additional	ICAR		
UNDERGRADUATE				
B.Sc. (Hons) Agri. 4-year	102	14	116	83
B.Tech. Biotechnology 4-year	60	-	56	43
B.Tech. Food Tech. 4-year	60	-	60	42
B.Tech. Agric Engg. 4-year	71	12	80	44
B.Sc. (Hons) Community Science 4-year	50	9	51	35
B.Sc. Nutrition and Dietetics 4-year	60	-	60	25
B.Sc. (Hons) Fashion Designing 4- year	-	-	-	24
B.Sc. Interior Design 4-year	-	-	-	21
B.Sc. (Hons) Horticulture 4-year	51	9	56	-
B.Sc. (Hons) Agri. 2+4 year at Bathinda and Gurdaspur, and at Ludhiana	124	-	124	70
B.Sc. Medical (Admission made through 5-year Integrated M.Sc. (Hons)	-	-	-	33
POSTGRADUATE				
M.Sc. Agriculture	133	39	172	119
M.Sc. Horticulture	45	12	57	45
M.Sc. Home Science	49	12	39	15
M.Sc. Basic Sciences	113	26	99	100
5-year Integrated M.Sc. (Hons)	80	-	74	28
M.Tech. including Remote Sensing and Geographic Information System (GIS)	50	8	21	21
MBA	50	-	32	33
MBA (Agribusiness)	30	10	21	16
MCA 3-year and MCA (lateral entry) 2-year	60	-	13	22
Ph.D.	182	43	166	87
DIPLOMA				
Two year Diploma in Agriculture at Ludhiana	60	-	60	25
Two year Diploma in Agriculture at Dr DR Bhumbla, RRS, Ballowal Saunkhri	30	-	21	-

EXAMINATION CELL

The Examination Cell conducted entrance tests for admitting meritorious students to Ph.D. programmes of PAU. Besides, it conducted recruitment tests and Higher Standard Departmental Examination. It also organized Induction Training Course for newly recruited ministerial staff. Details are given below:

Entrance Tests (Academics)

- Entrance tests for admission to 29 Ph.D programmes were conducted during November-December 2019.

Recruitment Tests/Competitive Examinations

The Examination Cell conducted:

- Written test and typewriting test in English and Punjabi for recruitment to the posts of Clerks (reserved for SC/BC/VH) in August and September 2019 for 1,633 and 27 candidates, respectively.
- Written test for filling up the post of Office Assistant (Kheri) and General Assistant (Ballowal Saunkhri) in August 2019.
- Written test for recruitment to the post of Junior Engineer (Civil) (office of Chief Engineer) in October 2019 for 188 candidates.
- Written test for recruitment to the post of Junior Draftsman (office of Civil Engineer) in October 2019 for 22 candidates.
- Written test for recruitment to the post of Farm Manager at KVKs in October 2019 for 121 candidates.
- Written test for filling up the post of Office Assistant and General Assistant (office of Directorate of Extension Education) in October 2019.
- Written test for recruitment to the post of Agricultural Sub-Inspector (Economic Data Collection) in November 2019 for 298 candidates.
- Written test for recruitment to the posts of Tractor Drivers (office of Directorate of Research) and at *Krishi Vigyan Kendras* (office of Directorate of Extension Education) in December 2019 for 590 candidates.
- Shorthand dictation and typing test for recruitment to the posts of Steno-typists at PAU in January 2020 for 380 candidates.
- Written test for recruitment to the post of Media Assistant (CoBSc&H) in January 2020 for 17 candidates.
- Written test for recruitment to the post of Agromet Observer (office of Directorate of Extension Education) in January 2020 for 117 candidates.
- Written test for appointment to the post of Clerk on Compassionate Grounds in June 2020.

Higher Standard Departmental Examination for PAU Employees

- Six papers of Higher Standard Departmental Examination were conducted for the PAU employees in February 2020.

Induction Training Course for Newly Recruited Ministerial Staff

- A two-week Induction Training Course was conducted for the newly recruited ministerial staff from November 4-19, 2019.

NEW COURSES

College of Agriculture

Course title	Course number	Credit hours
Introduction to Livestock Production and Management	LPM 61	2+1
Introduction to Major Field Crops	Agron 104	2+1
Integrated Pest Management	Ent 61	1+2
Integrated Nutrient Management	Soils 61	2+1
Soil Health and Irrigation Water Quality Management	Soils 71	1+2
Recent Techniques in Crop Residue Management *vis-a-vis* Soil Quality	NRM 501	2+1
Integrated Management of Water Resources	NRM 502	2+1
Natural Resources Management under Climatic Variability	NRM 503	2+0
Environmental Pollution and Management	NRM 504	2+0

College of Agricultural Engineering and Technology

Course title	Course number	Credit hours
Farm Machinery and Power	FMP 61	2+1
Farm Machinery and Power for Horticulture	FMP 203	2+1

College of Basic Sciences and Humanities

Course title	Course number	Credit hours
Research and Publication Ethics	RPE 501	1+1
Communication Skills in English Language	Eng 61	0+3
Organic Farming and Biofertilizer Production	Agron 71	0+3
Mushroom Cultivation	Micro 71	0+3
Statistical Methods	Stat 561	2+1
Design of Experiments	Stat 564	2+1

College of Horticulture and Forestry

Course title	Course number	Credit hours
Principles of Landscape Architecture	Flori 102	1+1
Elements of Fruit Science	Hort 101	2+1
Tropical Fruits	Hort 102	2+1
Subtropical Fruits and Plantation Crops	Hort 104	2+1
Plant Propagation and Nursery Management	Hort 205	2+1
Elementary Agroforestry	Forst 51	1+1
Introductory Agroforestry	Forst 201	1+1

STUDENTS' ACADEMIC ACCOMPLISHMENTS

College of Agriculture

- Mr Rajveer Singh (L-2017-A-14-D) got Prime Minister Fellowship for the work on the "Enhancement of rice bran oil quality through CRISPR/Cas9 based editing of Lipoxygenase 3 (LOX 3)." The Science and Engineering Research Board (SERB) of the Department of Science and Technology, Government of India, in collaboration with the Confederation of Indian Industry (CII) and private partner AP Organics limited (Dhuri Punjab), awarded this fellowship.
- Ms Santosh Gudi (L-2016-A-117-M) and Mr Asish Kumar Padhy (L-2017-A-108-M) received **Sardar Iqbal Singh Dhillon Award** from PAU.
- Ms Swas Kaushal (L-2018-A-122-M) was awarded **Dr Sukhdev Singh Award** by PAU.
- Eighteen undergraduate and 19 postgrdaute students got admission in foreign universities/ institutes.

College of Basic Sciences and Humanities

- Ms Komalpreet Kaur (L-2016-BS-92-D) was conferred with **Young Women Scientist Award 2019** during the 2nd International Conference on "Recent Advances in Agricultural, Environmental and Applied Sciences for Global Development," held at YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh from September 27-29, 2019. She was also awarded **Dr MS Randhawa Medal** by PAU for writing the best essay on "Evolution of Life-2018." In addition, she bagged the first prize in poster presentation during the National Conference on "Science and Technology for a Sustainable Future," held at DAV College, Jalandhar, Punjab on March 7, 2020.
- Ms Manpreet Kaur (L-2016-BS-74-D) was awarded **Dr GS Sidhu Gold Medal** by PAU.
- Ms Nisha Jain (L-2013-BS-55-IM) received **Dr Bhupinder Singh Sekhon Medal** from PAU.
- Ms Yamini Tak (L-2014-BS-257-M) received alumni cash award from PAU for excellence in research in biochemistry for 2014-16.
- Ms Jaspreet Kaur Grewal (L-2015-BS-241-M) and Ms Nisha Jain (L-2013-BS-55-IM) received alumni cash award from PAU for excellence in research in chemistry/biochemistry for the years 2017-18 and 2018-19, respectively.
- Ms Manpreet Kaur (L-2017-BS-324-M) and Ms Kiran Rani (L-2017-BS-322-M) received the second and the third prize in poster presentation, respectively, during the National Seminar on "Biodiversity: Issues, Challenges and Opportunities," held at

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana from July 16-17, 2019.

- Ms Lovepreet Kaur (L-2017-BS-314-M) got the first prize in poster presentation during "Big Geospatial Data: Analytics, Modelling and Applications (BIGMAP-2019)," organized by Indian Society of Remote Sensing at Ludhiana from September 25-26, 2019.
- Ms Vishu Chaudhary (L-2017-BS-80-D) bagged **Dr RS Rana Memorial AMI Best Poster Award,** carrying a cash prize of 7,000/-, during the National Conference of Association of Microbiologists of India (AMI-2019), held at Central University of Haryana, Mahendergarh, Haryana from November 15 - 18, 2019.
- Ms Komal Pandey (L-2018-BS-258-M) got the **Best Poster Award** during the "23rd Punjab Science Congress," organized by Punjab Academy of Sciences from February 7-9, 2020.
- Ms Puneet Kaur (L-2015-BS-60-IM) bagged the **Best Poster Award** during the "Professor Ram Chand Paul National Symposium," held at Panjab University, Chandigarh from February 27-28, 2020.

College of Community Science

- Ms Avantika Pathak (L-2014-HSc-126-D) was conferred with **Young Scientist Award 2019** during the National Seminar on "River Development, Water Resource, Conservation and Management," organized by Kailash Research and Welfare Society, Prayag Raj, Uttar Pradesh at Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Satna, Madhya Pradesh from December 6-7, 2019.
- Ms Minakshii Gautam (L-2014-HSc-128-D) secured the first position in poster presentation during the Indian Council of Social Science Research (ICSSR) sponsored National Seminar on "Role of Community Science Education in Rural Development," held at GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand from August 21-22, 2019. She also got the **Best Oral Presentation Award** during the Indian Society of Extension Education (ISEE) National Seminar on "Socio Digital Approaches for Transforming Indian Agriculture," held at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana from November 20-22, 2019.
- Mr Himlesh (L-2017-HSc-96-D) bagged the **Best Presentation Award** during the 6thNational Seminar (webinar), organized jointly by the Department of Economics, Punjabi University, Patiala and the Society of Economics and Development, Ludhiana on June 22, 2020.
- Ms Jaspreet Dhiman (L-2016-HSc-09-BFD) and Ms Mokshi Malhotra (L-2016-HSc-18-BFD) received third prize in the category of Best Start-Up Idea during the "National Incubators Colloquium," held at Agriculture Business Incubation Centre (ABIC), Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana from January 15-16, 2020.

College of Horticulture and Forestry

- Mr Rishav Sodhi (L-2018-A-87-M) received **Dr Sukhdev Singh Prize** from PAU.
- Mr Gurminderpal Singh Kang (L-2017-A-83-M) was awarded **University Colour** certificate by PAU.

SCHOLARSHIPS AND FINANCIAL ASSISTANCE

College of Agriculture

- Twenty students received ICAR/UGC Senior Research Fellowship, 40 ICAR/UGC Junior Research Fellowship, 15 ICAR Fellowship (foreign students) and 50 ICAR - National Talent Scholarship.
- Three students got Indian Council of Social Science Research (ICSSR) Senior Research Fellowship.
- Sixteen students were awarded Innovation in Science Pursuit for Inspired Research Fellowship (Department of Science and Technology - DST).
- Twenty students got Dr Gurdev Singh Khush Scholarship, 10 Piara Singh Parmar Memorial Fellowship and two Dhanuka Agritech Limited Fellowship.
- A total of 175 students received Student READY stipend and 111 Punjab State Agricultural Marketing Board Scholarship.
- A total of 45 students qualified ICAR-National Eligibility Test (NET).

College of Agricultural Engineering and Technology

- Eight students were awarded ICAR/UGC Senior Research Fellowship, nine ICAR/UGC Junior Research Fellowship and 34 ICAR - National Talent Scholarship.
- Three students got Dr Gurdev Singh Khush Scholarship, six Piara Singh Parmar Memorial Fellowship and 72 Student READY stipend.
- One student each received Innovation in Science Pursuit for Inspired Research Fellowship (DST), RN Kaul Scholarship and India Africa Fellowship Programme-III (ICAR).
- Three students bagged Tractors and Farm Equipment Limited (TAFE) Sivasailam Prize and four CLAAS India Scholarship.
- Fifteen students qualified ICAR-National Eligibility Test.

College of Basic Sciences and Humanities

- Five students were awarded ICAR/UGC Senior Research Fellowship, 24 ICAR/UGC Junior Research Fellowship, four ICAR - Fellowship for Ph.D, six ICAR Fellowship (foreign students) and 35 ICAR - National Talent Scholarship.
- Five students received ICSSR Doctoral Fellowship.
- Two students each got Rajiv Gandhi National Fellowship (UGC), Maulana Azad National Fellowship (UGC), National Fellowship for OBC students (UGC), Post Matric Scholarship scheme for SC students (Dr Ambedkar Foundation) and Dr SS Goraya Fellowship.
- Three students each were awarded Innovation in Science Pursuit for Inspired Research Fellowship (DST) and Dr GS Grewal Memorial Fellowship.
- Eight students received Dr Gurdev Singh Khush Scholarship and five Piara Singh Parmar Memorial Fellowship.
- A total of 33 students qualified ICAR/CSIR/UGC - National Eligibility Test.

College of Community Science

- Twelve students were awarded ICAR/UGC Senior Research Fellowship, 27 ICAR/UGC Junior Research Fellowship and 22 ICAR - National Talent Scholarship.
- Two students each received ICCSR Senior Research Fellowship and CK Hira Memorial Merit Fellowship.
- One student each got Smt Vidyawati Saini Scholarship, Sardarni Gurbachan Kaur Memorial Scholarship and Mai Tej Kaur Memorial Scholarship.
- Ten students received Dr Gurdev Singh Khush Scholarship and 23 Student READY stipend.
- Twelve students qualified UGC - NET/JRF.

College of Horticulture and Forestry

- Eight students each were awarded ICAR/UGC Senior Research Fellowship and ICAR/UGC Junior Research Fellowship, two ICAR Fellowship (foreign students) and three ICAR - National Talent Scholarship.
- One student each got Rajiv Gandhi National Fellowship (UGC) and National Fellowship for

A student receiving degree from Sh VP Singh Badnore, Governor of Punjab and Chancellor of PAU, during Annual Convocation of the University

Students in jubilant mood after receiving degrees during Graduate Convocation and Prize Distribution Function

Higher Education for ST Students (Ministry of Tribal Affairs, Government of India).

CONVOCATION

- The Annual Convocation of PAU was held on July 24, 2019, wherein a total of 344 students, who passed out Ph.D, M.Sc, M.Tech, MCA, MBA and MJMC during 2017-18, received degrees. In addition, 70 students were awarded Merit Certificates, Gold Medals/Medals (16) and one student was presented an award. Fourteen scientists were conferred with awards as well as citations. Sh VP Singh Badnore, Governor of Punjab and Chancellor of PAU, was the chief guest.
- The Graduate Convocation and Prize Distribution Function was held at PAU on November 5, 2019, wherein 398 students of B.Sc Agriculture (Hons), B.Sc Biotechnology (Hons), B.Tech (Food Technology), B.Tech (Agricultural Engineering), B.Sc (Hons) Home Science, B.Sc (Hons) Nutrition and Dietetics, B.Sc (Hons) Fashion Designing and B.Sc (Hons) Interior Design were awarded degrees. In addition, 15 students were awarded Gold Medals, two Academic Roll of Honour and 60 students were awarded with Merit Certificates.

STUDENTS' WELFARE ACTIVITIES

Outstanding Sports Achievements of Students/Teams

National level

- Mr Chattarpal Singh (CoAE&T) and Mr Akamjot Singh (CoA) participated in National Powerlifting Championship, organized by Ministry of Youth Affairs and Sports, Government of India and Indian Olympic Association at Palampur from August 6-9, 2019.
- Mr Amandeep Singh (CoA) participated in National Men Classic Powerlifting Championship, held in Kerala from September 26-30, 2019.
- Mr Sanpreet Singh (CoA) participated in the 3rd International Race Walking and the 7th National Open Championship, held at Ranchi from February 15-16, 2020. He also participated in *Khelo* India University Games, held at Bhubaneswar from February 28-29, 2020.
- Ms Ujjalpreet Kaur Dhatt (CoA) represented the State of Punjab in Junior National Handball Championship, held at Ghaziabad from February 4-8, 2020.

All India Inter University Championships

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

All India Inter Agricultural University Sports and Games Meet

The Punjab Agricultural University clinched Silver Medal in Basketball (W) in Team Games (M&W) during the 20th All India Inter-Agricultural Universities Sports and Games Meet, held at Sri Venkateswara Veterinary University, Tirupati from March 1-5, 2020. The PAU contingent consisting of 40 students and four officials participated in Basketball (M&W), Badminton (M&W), Table Tennis (M), Athletic (M&W) and Volleyball (M). The PAU sportspersons who got distinction in different games/events are as under:

- The Basketball (W) team won Silver Medal. The team comprised students, namely, Ms Ravneet Kaur (CoCS), Ms Rajveer Kaur (CoA), Ms Prabhsangam Kaur Dhillon (CoBS&H), Ms Jasleen Kaur (CoBS&H), Ms Gunwant Kaur (CoCS), Ms Harnoor Dhillon (CoCS) and Ms Prabhnoor Kaur (CoCS).
- In Athletics (M), Mr Jobanjit Singh (CoA) secured the first position in 400 m and second position in 800 m, and Mr Arshdeep Singh (CoA) got the third position in 200 m. Another team secured the first position in 4 x 100 m Relay. The members of the team were Mr Jobanjit Singh (CoA), Mr Pardeep Singh (CoA), Mr Gurdeep Singh (CoA) and Mr Arshdeep Singh (CoA).
- In Athletics (W), Ms Harmeet Kaur (CoBS&H) got the first position in 800 m and 1500 m Races. She was declared the Best Athlete in women category.

Inter Varsity Tournaments

The teams of PAU participated in the North Zone Inter-Varsity Tournaments in Handball (M&W), Table Tennis (M&W), Basketball (M&W), Volleyball (M&W), Football (M), Kabaddi (M), Cricket (M), Badminton (M&W), Hockey (M&W) and Lawn Tennis (M).

Inter District Tournaments

- Mr Arshdeep Singh (CoA) and Mr Gurminder Pal Singh Kang (CoA) got the first position in Handball in Punjab State Games U-25 (M), held at Patiala from November 23-25, 2019.
- Ms Aditi Sewak (CoCS) bagged the second position in Senior Women Category during the 54th Punjab State Shooting Championship, held at PAP, Jalandhar from August 5-11, 2019.
- Mr Taranveer Singh (CoA), Mr Rassanpreet Singh (CoA), Mr Tushaan Singh Randhawa (CoA), Mr Gurnoor Singh (CoA) and Mr Satmeet Singh (CoA) participated in the 54th Punjab State Shooting Championship, held at PAP, Jalandhar from August 5-11, 2019.

Tournament/Events Organized

Inter College Tournament

The teams from constituent colleges of PAU participated in Inter-College Tournament for 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 Khaira of IoA, Gurdaspur and Ms Lovedeep Kaur of CoA were declared Best Cyclists in male and female category, respectively. Mr Akashveer Singh Grewal of CoA was declared Best Hockey Player, and Mr Shahbaj Singh Bhullar and Ms Garima Jindal of CoA were declared Best Swimmers in men and women category, respectively.

Annual Athletic Meet

The 54th Annual Athletic Meet of PAU for the session 2019-20 was held at PAU Athletic Track on February 13, 2020. Mr Jobanjit Singh (CoA), Mr Pardeep Singh (CoA) and Mr Arshdeep Singh (CoA) were declared the first, second and the third Best Athletes in men category, respectively. Ms Harmeet Kaur (CoBS&H), Ms Simranjot Kaur (CoA) and Ms Harleen Kaur (CoCS) were declared the first, second and the third Best Athletes in women category, respectively.

International Yoga Day

In view of COVID-19 pandemic, the videos of yoga *asanas* were sent to the students so that they could perform the same with their family members at home. This step was taken as per the guidelines issued by the Directorate of Ayurveda, Punjab.

Sports Coaching Camps/NSO Activities

Before the 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 total, 202 students of PAU were registered for NSO programme in various games during Semester I, 2019-20 from which about 45 NSO trainees participated in Inter College, Inter Varsity and Inter Agri Tournaments.

Merit Certificates/University Colour/Roll of Honour

The PAU Sports and Youth Activities Council in its 56th meeting held on December 18, 2019 awarded 37

Students receiving trophy for march past during Annual Athletic Meet

Merit Certificates, 19 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 2019-20. The students were awarded these honours during the 54th Annual Athletic Meet of the University.

National Service Scheme (NSS) Activities

- Ms Megha Singh was selected for Pre Republic Day Camp at Chitkara University, Rajpura, Punjab from November 15-24, 2019.
- Awareness camps for the upliftment of SC population were organized in 52 villages of Ludhiana covering different blocks *viz.* Doraha, Sahnewal, Mangat, Sudhar, Jagraon, Sidhwan and Samrala, where NSS volunteers under the guidance of different Programme Officers threw light among Scheduled Caste population on various SC schemes, namely, *Shagun* Scheme, Post-Matric Scholarship, Pre-Matric Scholarship, award to SC sports students, etc. available for their support and upliftment. They were also apprised of their legal rights and special rights provided under the Constitution of India. Awareness was created through rallies, lectures, interactive sessions and dramatization by the NSS students in each village. The SC/ST families were also provided information needed to prepare nutritive and safe meals. Besides, they were made aware of judicious use of water; importance of cleanliness; self-employment avenues like beekeeping, animal husbandry, poultry, nursery production, preservation of off season vegetables, preparation of cost effective educational play material for children, etc.
- Six students of PAU participated in National Youth Convention on "Next Generation Agri Innovations: Challenges and Opportunities for Sustainable Employment Generation in Agri and Allied Sector," held at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, from January 20-21, 2020.
- Above 100 camps were organized on various issues by NSS volunteers.

Cultural Activities

Achievements/Participation

- The PAU students clinched Gold Medal in Group Song Indian, Patriotic Group Song, Light Vocal Solo and On the Spot Painting during the 20th All India Inter-University Youth Festival 2019-20, organized by Indira Gandhi Krishi Vishwavidyala, Raipur, Chhattisgarh in collaboration with Indian Council of Agricultural Research (ICAR), New Delhi from February 8-12, 2020.
- The students of PAU participated in mimicry event during the 35th National Inter University Youth Festival for the session 2019-20, organized by Amity University, Noida, Uttar Pradesh in collaboration with Association of Indian Universities, New Delhi from February 3-7, 2020.
- The students of PAU won Bronze Medal in Mimicry, fourth position in Collage Making, and fifth position in Group Song Indian and Rangoli during the 35th North Zone Inter-University Youth Festival, organized by Guru Nanak Dev University, Amritsar, Punjab in collaboration with Association of Indian Universities, New Delhi from December 25-29, 2019.
- The PAU students clinched Gold Medal in Mono Acting and *Pirri* Making; Silver Medal in *Giddha* and *Chhikku* Making; and Bronze Medal in Debate, Collage Making, Quiz, *Bhangra*, Mime, *Mehandi*, *Nala Bunna* and *Phulkari* during the Punjab State Inter-University Youth Festival 2019-2020, organized by Director Youth Services, Government of Punjab, at Chandigarh University, Mohali from January 30-31, 2020.

Events Organized

- Independence Day and Republic Day were celebrated in the University on August 15, 2019 and January 26, 2020, respectively. Dr Baldev Singh Dhillon, Vice Chancellor, PAU, unfurled the national flag and inspected the parade of NCC cadets.
- A week-long PAU Inter-College Youth Festival for the session 2019-20 was organized from November 1-8, 2019 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.
- A *Rozgar Mela* was organized by the Placement Cell of PAU in which 16 companies participated.

Republic Day celebrations at PAU

Students performing giddha and bhangra during Inter-College Youth Festival at PAU

The initiative was taken to provide gainful employment to the students of the University. As many as 150 students who passed out from the University joined the placement drive by exhibiting their hard and soft skills. Three students of PAU, namely, Mr Vinod Yadav, Mr Shubham Minhas and Mr Samarpan Singh got selected by a reputed company JOHN DEERE with the highest package of Rs 7,50,000/-. Besides, 12 budding entrepreneurs of PAU were honoured during the fair for their creative endeavours.

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 on 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, PAU *Doots*, *Kisan* Club/ committee meetings, sale of farm literature, digital newspaper, WhatsApp groups, *Kisan* Mobile Advisory Service, farmer portal, TV/radio talks and PAU Live Programme (Facebook and YouTube). The University also plays a vital 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. Nine *Kisan Melas* were organized during the period under report. Seven *Kisan Melas* were organized during September 2019 with one each at the main campus of PAU, Ludhiana (September 21 and 22); *Krishi Vigyan Kendras* at *Rauni* (Patiala) and *Nag Kalan* (Amritsar); Regional Research Stations at Ballowal Saunkhri, Bathinda, Faridkot and Gurdaspur. The theme of the *melas* in September 2019 "*Pawan guru pani pitta mata dhart mahat*" (Use air, water and soil wisely) marked the 550th birth anniversary of Sri Guru Nanak Dev Ji. The Chief Minister of Punjab Captain Amarinder Singh was the chief guest. Two *Kisan Melas* were organized during March 2020 with the theme "*Veera saarr na parali, mitti-pani vi sambhal, apne Punjab da tu rakh le khiyal*" (Dear Brother, don't burn paddy straw, conserve soil and water, take care of your Punjab).

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 crop 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 and implements was also put up on these occasions.

Huge rush of farmers at PAU Kisan Mela, Ludhiana

A farmer reading PAU literature (L) and a farmer carrying seed bags, purchased during the Kisan Mela (R)

Awards to progressive farmers

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 21, 2019, four progressive farmers including one woman entrepreneur were honoured. Sardar Rubash Singh Jakhar, a resident of village Patrewala, district Fazilka, was conferred with **Sardar Dalip Singh Dhaliwal Award**; Sardar Jagtar Singh Sran, a resident of village Mandi Khurd, district Bathinda, was awarded **Parwasi Bharti Award**; Sardar Dalip Singh, a resident of village Kothe Ramsar Dhilwan, district Faridkot, was conferred with **Sardar Ujagar Singh Dhaliwal Award** and Smt Paramjit Kaur, a resident of village Ajitwal, district Moga, was awarded **Sardarni Jagbir Kaur Grewal Memorial Award**. Besides, **Bhai Babu Singh Brar Best Pond Award** was bestowed on Panchayat Haripur, tehsil Nakodar, district Jalandhar. The ***Rajpal* Punjab *Sarvotam* Award** was presented to village Todarpur, district Hoshiarpur.

FIELD DAYS

The University holds field days in order to popularize specific recommendation among farmers. In all, 281 field days were organized in different villages to promote direct seeded rice technique; mechanical transplanting of paddy; straw management technologies; integrated pest management in *rabi* and *kharif* crops; PAU fruit fly traps; cultivation of maize, pulses (lentil, soybean, gram, etc.), sunflower and *gobhi sarson* (canola day); 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 850 ARTs were conducted at different locations to evaluate new crop varieties, and production and protection technologies. Based on these trials, 63 recommendations were made, out of which 20 were of new varieties (13 field crops, 4 vegetables and 3 fruit crops), 19 of production technologies, 21 of plant protection technologies, one of post-harvesting and handling processing, and two 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. As many as 107 OFTs were conducted by KVK scientists. Salient findings of some of the important OFTs are listed below:

- **Comparative evaluation of various methods of DSR:** Three treatments *viz.* T_1- wet sowing, T_2- dry sowing and T_3- manual transplanting were planned. T_2 showed good performance in terms of plant height (91.4 cm) as compared to T_1 (88.6 cm), whereas, in terms of number of plants/m^2 and yield, T_1 showed good results. Yield in case of wet sowing was 14.76 q/acre as compared to dry sowing i.e. 10.66 q/acre.
- **Productivity of different rice cultivars:** To compare the productivity of different rice cultivars, different rice varieties were grown, such as RIL 666, PR 126, HKR 47, Arize 6444, Diksha and PR 121. PR 121 gave the highest grain yield.
- **Comparative evaluation of different methods of sowing wheat:** Three treatments *viz.* T_1- wheat

sowing with Happy Seeder (recommended), T_2- with Super Seeder (intervention) and T_3 - with roto seeder drill (farmer's practice) were compared. Overall yield obtained in T_1 was 23 q/acre as compared to 18.5 q/acre in T_3.

- **Effect of post emergence herbicides on control of *Phalaris minor* in wheat:** To compare the efficacy of different herbicides, six treatments *viz.* T_1 - ACM-9 (9:20) @ 240 g/acre, T_2 - Axial 5 EC @ 400 ml/acre + 50 g Metribuzin/acre, T_3 - Axial 5 EC @ 600 ml/acre + 50 g Metribuzin/acre, T_4 - Leader @ 13 g/acre + 50 g Metribuzin/acre, T_5 - Leader @ 20 g/acre + 50 g Metribuzin/acre (FP) and T_6 – Control were compared. ACM-9 herbicide (T_1) gave the best *P. minor* control and highest productivity of wheat.

- **Management of yellow rust of wheat:** Comparative efficiency of PAU recommendation and farmers' practice for management of yellow rust of wheat was planned. Three different treatments involved *viz.* T_1 - spray of Tilt 25 EC @ 200 ml/acre in 200 litres of water (R), T_2 - spray of 10 days old fermented buttermilk (100 ml per litre of water) @ 100 litre spray solution/acre (FP) and T_3 - spray of Tilt 25 EC @ 100 ml/acre + 10 days old fermented buttermilk (50 ml per litre of water) @ 200 litre spray solution/acre (I). The T_1 gave the maximum control of yellow rust in wheat, whereas, in terms of average yield, T_3 (20.5 q/acre) performed the best. T_3 was at par with the T_1 in terms of disease control.

- **Management of whitefly in cotton:** Three treatments *viz.* T_1 - unrecommended insecticide (farmers' practice) (Monocrotophos and mixtures), T_2 - recommended insecticide (recommended practice) (Achook, Lano and Ulala) and T_3 - homemade *dhraek* extract and low-cost yellow traps were compared. Recommended practice was the best and had higher B: C ratio.

- **Effect of feeding vitamin E on incidence of mastitis in cattle:** To check the effect of feeding vitamin E on incidence of mastitis in cattle, two treatments *viz.* T_1 - basal diet (green fodder + concentrate mixture) (farmers' practice) and T_2 - basal diet + vitamin E (1,000 IU/d – 30 days before parturition) (intervention) were planned. Three animals (60%) developed mastitis in control T_1 whereas one animal developed mastitis in T_2 (20%).

- **Assessment of different techniques of *warri* preparation:** Three treatments *viz.* T_1 - urd *dal* paste 50% + potato paste 50% + spices (recommendation), T_2 - urd *dal* paste 70% + potato paste 30% + spices (intervention) and T_3 - urd *dal* paste + spices (common practice) were compared. The best results in terms of appearance, taste and shelf life were recorded for T_2 followed by T_1.

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 5,363 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 control of foot rot 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, Super Straw Management System (SMS), Chopper; and use of 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 treatment of wheat, low tunnel technology for vegetable crops, bulb set technique

Experts from PAU explaining rooftop vegetable cultivation (L) and low tunnel cultivation of vegetables (R)

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. In total, 2,590 method demonstrations were conducted on the collection of soil and water samples, seed treatment, *Rhizobium* inoculation in different crops, spray techniques of agro-chemicals, 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 across Punjab to promote adoption of different technologies. Thirty villages in different districts of the state were made zero burning villages.
- **Whitefly management:** 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, farm literature, 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.
- **Yellow rust management:** Regular surveillance and monitoring was done 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.

TRAINING AND EXHIBITIONS

Trainings

The *Krishi Vigyan Kendras* and Advanced Centre of Training at PAU organized 1,426 training programmes (970 short, 286 vocational, 107 in-service and 63 sponsored) for the farmers, farm women and extension functionaries to enhance their knowledge and skills 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, dairy, piggery, goatry, value addition of agricultural produce (preparation of pickles/*murabbas*/ketchup and other recipes), tie and dye, stitching, embroidery, etc. In all, 55,441 farmers, 65,550 farm women and 10,100 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, 690 exhibitions were put up wherein important production, protection and resource conservation technologies; live and

Farmers receiving training in Beekeeping at PAU

preserved plant specimens; farm machinery; models of various important technologies including drip irrigation; processing equipment and farm literature were displayed. 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 21-22, 2019); State Level Workshop on Climate Resilient Agriculture (September 30, 2019); Research and Extension Specialists' Workshop for Horticultural Crops (winter) (January 23-24, 2020); State Level Training and Planning Workshop (February 17, 2020) and Research and Extension Specialists' Workshop for *Kharif* Crops (February 18-19, 2020).

FARMERS' ORGANIZATIONS

The meetings of various farmers' organizations were organized to share the latest technological advances 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. Besides, 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

Dr Baldev Singh Dhillon, Vice Chancellor, PAU, having a look at pomegranates during the Research and Extension Specialists' Workshop for Horticultural Crops. Also seen is Ms Shailender Kaur, Director of Horticulture, Punjab

and 589 farmers, respectively. Four trainings camps each were organized for the members of PAU Tree Growers Association, and PAU Soybean Producers and Processors Club, from which 384 and 269 farmers, respectively, benefited. One training camp was organized for the members of PAU Flower Growers Club in which 235 growers participated.

INFORMATION AND COMMUNICATION TOOLS (ICTs)

- **PAU Live Programme:** The 'PAU Live Programme' (every Wednesday on Facebook and YouTube) was started to apprise and guide the farmers, farm women and rural youth regarding improved crop varieties and their production-protection technologies, allied agriculture occupations, weather forecast, etc. The programme received an overwhelming response from the farming community. More than 40,000-50,000 farmers are connected with it. Four live programmes were organized during the report period.
- **Digital Newspaper:** *Kheti Sandesh*, a weekly digital newspaper, was started for the dissemination of latest technologies among farmers. More than 9.4 lakh farmers have been receiving this digital newspaper on their WhatsApp.
- **Weather Based Agro-advisory SMS:** Five lakh farmers have subscribed for weather based agro-advisory.
- **WhatsApp Group:** In total, 1,111 WhatsApp groups were formed by the scientists of KVKs/

Agricultural experts speaking at PAU Live Programme

FASCs and 10,636 messages were sent for the transfer of latest technology to the end users.

- **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, 240 PAU *doots* were enrolled and 87 messages were sent to them by ATIC. Various KVKs enrolled 1,145 *doots* and sent 940 messages; 7,488 PAU *doots* have been enrolled till date.
- ***Kisan* Mobile Advisory Service (KMAS):** During the year, a total of 88,995 farmers were included in KMAS and 1,145 messages were sent for transfer of latest technology.

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 660 press releases (360 in English and 300 in Punjabi). The Centre also sent more than 300 articles in English and Punjabi, authored by PAU scientists, for publication in regional and vernacular newspapers and magazines. The Centre provided TV coverage to different events and also produced *Kisan Mela* reports for telecast from Doordarshan. It coordinated with Doordarshan Kendra, Jalandhar for 132 TV talks and AIR, Jalandhar for 102 radio talks of PAU scientists. In addition, it prepared 115 documentaries.

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 1,38,700 during 2019-20**.** 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 10 farm bulletins in English and 22 in Punjabi. New and revised editions of Agro-processing, Organic Farming, Citrus Greening, Mushroom Growing, *Falan Di Kashat Layee Sifarshan, Sabzian Di Kashat Layee Sifarshan*, etc. were brought out by the Centre.

HUMAN RESOURCE, FINANCE AND INFRASTRUCTURE DEVELOPMENT

NEW APPOINTMENTS, PROMOTIONS AND RETIREMENTS

New appointments

During the period under report, following new appointments were made. Besides, 64 Assistant Professors and equivalent were directly recruited.

Name	Appointed as	Date of appointment
Dr Gurvinder Singh Kocher	Head, Department of Microbiology	21.11.2019
Dr Neena Singla	Head, Department of Zoology	28.8.2019 (AN)
Dr Deepika Vig	Head, Department of Human Development and Family Studies	7.11.2019

Promotions and retirements

During the period under report, 23 Assistant Professor level teachers having grade pay of Rs 6,000/- in the pay scale of Rs 15,600-39,100 were placed in the grade pay of Rs 7,000/- and 24 Assistant Professor level teachers having grade pay of Rs 7,000/- were placed in the grade pay of Rs 8,000/-; and 57 Assistant Professor level teachers having grade pay of Rs 8,000/- were promoted to the post of Associate Professor and equivalent in the grade pay of Rs 9,000/- in the pay scale of Rs 37,400-67,000. Ten 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. Eleven teachers retired/resigned from the University service.

Faculty strength (as per budget estimate 2020-21)

Category	Sanctioned posts	Posts in position
State	1,053	525
ICAR	157	154
KVK	126	120
Others	26	25
Total	**1,362**	**824**

AWARDS, DISTINCTIONS AND RECOGNITIONS

- The Punjab Agricultural University was ranked 192nd in the 6th Annual US News Best Global Universities rankings for the year 2020. The PAU is the only University from India to have made it to the prestigious list in the field of agricultural sciences.

College of Agriculture

- Drs Rahul Kapoor, Ashlesha Singla, Maninder Kaur and Meenakshi Goyal (Department of Plant Breeding and Genetics) received an **Appreciation Award** for the All India Coordinated Research Project on Fodder Crops and Utilization (AICRP-FCU), during the National Group Meet *Rabi* 2019-20, held at Central Agricultural University, Imphal, Manipur fromAugust 30 and 31, 2019.
- The Punjab Agricultural University's Centre of All India Network Programme on Organic Farming was awarded the **Best Centre Award 2018-19**

during the Annual Group Meeting, held at Port Blair from November 12-14, 2019.

- Dr Inderjit Singh Yadav (School of Agricultural Biotechnology) was awarded **ICAR Netaji Subash Chander Fellowship** for pursuing Ph.D at Univeristy of Maryland, USA.
- Dr Rajni (Agronomy) bagged the first position in oral presentation during the UGC sponsored National Conference on "Food Safety, Nutritional Security and Sustainability," organized by Shyama Prasad Mukherji College, University of Delhi from March 6-7, 2020.

College of Agricultural Engineering and Technology

- Dr Arun Kaushal (Soil and Water Engineering) received **Bharat Ratna Dr Radhakrishnan Gold Medal Award 2020** from Global Economic Progress and Research Association.
- Dr Rajan Aggarwal (Soil and Water Engineering) received **Prof Manjeet S Chinnan Distinguished Professor Chair Award 2020** from PAU.
- Drs GS Manes, Baldev Dogra, Anoop Dixit, Aseem Verma and Er Arshdeep Singh (Farm Machinery and Power Engineering) were honoured by AICRP on FIM, Bhopal for 'outstanding' performance of All India Coordinated Research Project (AICRP) on Farm Implements and Machinery (FIM), PAU, Ludhiana Centre in 2019.
- Drs Manjeet Singh, Manpreet Singh, Rajesh Goyal and HS Sidhu (Farm Machinery and Power Engineering) got **NRDC Meritorious Invention Award 2019**, carrying a cash prize of Rs 3.00 lakh, from National Research Development Corporation (NRDC), Karnal, Haryana.
- Drs Ruchika Zalpouri and Preetinder Kaur (Processing and Food Engineering) received **Innovative Student Projects Award 2019** at master level from Indian National Academy of Engineering.
- Dr Sandhya (Processing and Food Engineering) received **Women Scientist Award 2019** during the 2nd National Conference on "Technological and Emerging Aspects in Agriculture and Community Science," organized by Society for World Environment, Food and Technology, New Delhi at Lucknow from February 7-8, 2020.
- Dr Anoop Dixit (Farm Machinery and Power Engineering) won the **Best Paper Award** during the 8th Asian-Australasian Conference on "Precision Agriculture 2019," held at PAU, from October 14-17, 2019.
- Drs Borse Sudarshan Murlidhar and Manpreet Singh (Processing and Food Engineering) bagged the **Best Paper Presentation Award** (oral) during the National Seminar on "Ensuring Food and Nutritional Security in India," organized by Regional Institute of Management and Technology (RIMT) University, Mandi Gobindgarh, Punjab, on October 16, 2019.
- Dr Samanpreet Kaur (Soil and Water Engineering) got the **Best Poster Research Paper Award** and Dr Aseem Verma (Farm Machinery and Power Engineering) received **ISAE-JAE Best Reviewer Award 2019** during the "54th Annual Convention of Indian Society of Agricultural Engineers," held at Pune, Maharashtra from January 7-9, 2020.
- Drs Sandhya and Mahesh Kumar (Processing and Food Engineering) received the **Best Paper Presentation Award** during the 2nd National Conference on "Technological and Emerging Aspects in Agriculture and Community Science," organized by Society for World Environment, Food and Technology, New Delhi at Lucknow from February 7-8, 2020. They were awarded for the paper presentation titled "Application of machine vision system for grading of fruits and vegetables."

College of Basic Sciences and Humanities

- Dr Richa Arora (Microbiology) got **Young Scientist Award 2020** from Association of Microbiologists of India.
- Dr DK Kocher (Zoology) received **Dr VP Sharma Award** in the field of Medical Entomology from the Society of Medical Arthropodology, Kolkata during the 12th National Conference on "Vector-Borne and Zoonotic Diseases-Identification to Management," organized by Zoological Survey of India, Kolkata from November 25-26, 2019.
- Dr Prinka Goyal (Botany) got the second best poster prize during the National Symposium on

"Trends in Plant Biotechnology and Agriculture," held at Thapar University, Patiala, Punjab from February 6-8, 2020.

College of Community Science

- Dr Sandeep Bains and Mrs Rajdeep Kaur (Apparel and Textile Science) won **Dile Ram Banyal Memorial Best Paper Award** from Society for Advancement of Human and Nature, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh in 2019.
- Drs Ritu Mittal Gupta and Preeti Sharma (Extension Education and Communication Management) secured third position in poster presentation during "National Incubators Colloquium," organized by Agri Business Incubation Centre, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, from January 15-16, 2020.

Directorate of Extension Education

- The *Krishi Vigyan Kendra*, Sangrur was conferred with the **Best KVK Award 2018** during the "Annual Zonal Workshop of KVKs" of Zone-1, held at GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand from August 3-5, 2019.
- The *Krishi Vigyan Kendra*, Bathinda received the **Best National Innovations on Climate Resilient Agriculture (NICRA) KVK Award 2019** from Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad.
- The *Krishi Vigyan Kendra*, Jalandhar was conferred with **Braja Gopal Sharma Memorial All India Outstanding Agricultural Extension Award 2019** by Society of Advancement of Human and Nature (SADHNA), YS Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh. It also received the **Best KVK Award 2020** of Punjab from ICAR-Agricultural Technology Application Research Institute (ATARI), Ludhiana, Zone-I.
- Dr Balkarn Singh (*Krishi Vigyan Kendra*, Muktsar) got **Dr Satwant Kaur Memorial Award 2019-20** from PAU.
- The *Krishi Vigyan Kendra*, Moga got the **Best Presentation Award** during the "Annual Zonal Workshop of KVKs" of Zone-I, held at GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand from August 3-5, 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:

- Thapar Institute of Engineering and Technology, Patiala, Punjab on July 31, 2019 for exchange of scientists, technologists and students; exchange of scientific literature, information and methodology; exchange of scientific equipment as available and required in programmes of common interest as may be mutually agreed upon; and development and implementation of collaborative research education and extension projects in the identified areas and methodology to be used as mutually agreed upon.
- John Deere (India) Private Limited, Pune, Maharashtra on August 30, 2019 for integral exposure and training of the students, to complement theoretical and practical learning, and to establish a learning centre in the premises of the University.
- California State University, Fresno, USA, on September 19, 2019 for exchange of scientists and technologists; exchange of research material; exchange of scientific literature, information and methodology; and exchange of scientific equipment available and required in common interest.
- Guru Nanak Dev University, Amritsar, Punjab on October 16, 2019 for exchange of scientific and technical information; joint supervision of postgraduate and Ph.D. students; undertaking collaborative research activities; jointly organizing events such as seminars, workshops, etc.; and training of students of both institutions.
- International Fertilizer Development Centre, USA on November 26, 2019 for exchange of scientists, technologists and students; exchange of fertilizer molecules and technology; exchange of scientific

literature, information and methodology; and exchange of scientific equipment.

- India Meteorological Department, Ministry of Earth Sciences, New Delhi, on December 10, 2019 for the development of relevant agromet advisories for the stressed crops/livestock, etc.; development of regional/local-specific agromet predictive models; development of crop-weather relationships and crop calendar; and development of forewarning models for weather and climate based pests and diseases, etc.
- Jamia Millia Islamia University, New Delhi on January 8, 2020 for exchange of scientists, technologies and students; exchange of scientific literature, information and methodology; exchange of scientific equipment as available and required in the programme of common interest; and development and implementation of collaborative teaching, research and extension projects in the identified areas and methodology to be used as mutually agreed upon (subject to IPR clause in Article IV).
- Indian Institute of Food Processing Technology, Thanjavur, Tamil Nadu on January 13, 2020 for joint consultancy for industries and student research projects/in-plant trainings; coordination of joint research projects and lectures; new product development and incubation services with research institutes and industries; and exchange of documentation and research materials in fields of mutual interest.
- M/s Pagro Frozen Foods Private Limited, Sadhugarh, Fatehgarh Sahib, Punjab on March 2, 2020 to conduct research and development on processing varieties of vegetables at University Seed Farm, Naraingarh.
- International Rice Research Institute, Manila, Philippines, on March 9, 2020 for F1 seed generation by crossing six donors with recipient (PR 126 and MTU 1010), F1 advancement to F2 seed, and field screening of F2 for DSR relevant traits and selection of lines with better seed vigor and establishment from deeper soil depth.

Eminent visitors

- Prof SS Marwaha, Chairman of Punjab Pollution Control Board, visited PAU on September 3, 2019 to deliberate on the issue of paddy straw burning and seek support of NSS volunteers to create motivational awareness among farmers against the practice.

Prof Serge Haroche, Nobel Prize Winner in Physics (2012), delivering a lecture at PAU as a part of Nobel Prize Series India 2019

- Mr Suresh Kumar, Chief Principal Secretary to Chief Minister of Punjab, visited PAU on September 6, 2019 to deliver his inaugural address at the "13th Indo-Japanese Dialogue on Indian Economic Development."
- Ms Juleen Zierath, Professor of Clinical Integrative Physiology and Member of Nobel Assembly; Prof Serge Haroche, Nobel Prize Winner in Physics (2012); Ms Laura Sprechmann, CEO, Nobel Prize Media Committee; and Dr Renu Swarup, Secretary, Department of Biotechnology, Government of India, visited PAU on September 12, 2019 to deliver talks at Nobel Prize Series India 2019. On the initiative of Punjab government, National Agri-Food Biotechnology Institute (NABI), Mohali and PAU, Ludhiana along with Dr Gurdev Singh Khush Foundation; Department of Biotechnology, Government of India, and Nobel Foundation, Sweden had organized the Nobel Prize Series India 2019.
- Dr RS Awasthi, Principal, Shivaji Mahavidyalaya, Renapur, Maharashtra and Dr PS Wakte, Head, Department of Microbiology, Dnyanopasak College, Prabhani, Maharashtra, visited PAU on October 18, 2019 to deliver lectures on "Innovative Approaches in Microbial Science" and "Human Gut Microbiome," respectively.
- A two member delegation comprising Dr Leon Husson, Coordinator, PUM Netherlands and Dr

Dr RS Paroda, Chairman, Trust for Advancement of Agricultural Sciences, speaking at Regional Workshop on "Motivating and Attracting Youth in Agriculture (MAYA)"

KR Jain, a representative of PUM, Punjab, visited PAU on October 24 to interact with the members of PAU Kisan Club, start-ups of Punjab Agri Business Incubator (PABI), and members of other associations and organizations.

- Dr Priti Krishna, Professor and Foundation Chair in Sustainable Agriculture at Western Sydney University, Australia, visited PAU on November 19, 2019 to deliver a talk on "Brassinosteriod and other Hormones Revolution towards a Greener Agriculture."
- A delegation of nine farmers from Australia visited PAU on December 6, 2019 to learn about latest advancements in Punjab's agriculture.
- A delegation from California State University, Fresno, US, led by Dr Joseph I Castro, President, California State University, visited PAU on December 7, 2019 to collaborate with PAU in mutually beneficial areas.
- A four-member delegation from Britain Agriculture Mission visited PAU on December 9, 2019 to gain knowledge about latest agricultural technologies. The delegation comprised members Mr Nicola Yates, Programme Manager, Rothamsted Research; Mr Chris Dalph, Manager, Crop Health and Protection; Mr Mark German, Head, Agriculture, Satellite Applications Catapult; and Ms Swati Saxena, Senior Science and Innovation Adviser, British High Commission.
- A 13-member delegation from countries like Mozambique, Ethiopia, Kenya, Tanzania and Rwanda visited PAU's *Krishi Vigyan Kendra*, Fatehgarh Sahib, on December 10, 2019 to gather information about agricultural techniques and technologies.
- Dr Carlos A Montoya, Senior Scientist at AgResearch, New Zealand, visited PAU on December 11, 2019 to deliver a lecture on "Protein Quality and Digestion."
- Dr Talwinder Singh Kahlon, Senior Research Scientist at US Department of Agriculture, California, USA, visited PAU on February 17, 2020 to deliver a lecture on "Recent Advances in Nutrition."
- Dr Chetan Sharma, Post Doc Fellow, University of Lincoln, New Zealand and PAU alumnus, visited PAU on February 18, 2020 to deliver a lecture on "Career and Future Prospects of Food Science and Allied Disciplines in Present Scenario."
- Dr Davinder Saroj, one of the co-founders of the Promotion of Science and Technology Foundation and Head of Centre for Environmental and Health Engineering, University of Surrey, United Kingdom, visited PAU on February 26, 2020 to discuss the scope of collaboration and attend a workshop-cum-interactive session.
- Delegates from Australia and United Kingdom visited PAU on February 27 and 28, 2020 to attend the Second Workshop on "Food Supply Chains: Improvement and Innovation through Collaboration" and launch of "Food-SCAN (Food Supply Chain Advancement Network)."
- Padma Bhushan Awardee Dr RS Paroda, Chairman, Trust for Advancement of Agricultural Sciences, visited PAU on February 28, 2020 to inaugurate the two-day Regional Workshop on "Motivating and Attracting Youth in Agriculture (MAYA)."

Mr Suresh Kumar, Chief Principal Secretary to Punjab Chief Minister, speaking at "Stakeholders Consultation on Policy and Technological Interventions for Development of Farmer-Producer Organizations in Punjab" during his visit to PAU. He is flanked by Sh Viswajeet Khanna, Financial Commissioner Development, Punjab and Padma Shri Dr Baldev Singh Dhillon, Vice Chancellor, PAU

- Mr Suresh Kumar, Chief Principal Secretary to Punjab Chief Minister, visited PAU on March 5, 2020 to preside over the "Stakeholders Consultation on Policy and Technological Interventions for Development of Farmer-Producer Organizations in Punjab."

Trainings and visits abroad

College of Agricultural Engineering and Technology

- Er Shiv Kumar Lohan (Farm Machinery and Power Engineering) visited Washington State University, USA, to attend the five-month training under Centre for Advanced Agricultural Science and Technology (CAAST) project of ICAR from March 15 to August 15, 2020.

College of Basic Sciences and Humanities

- Dr Kamal Vatta (Agricultural Economics and Sociology) visited Centre for Southeast Asian Studies, Kyoto University, Japan, to participate in International Seminar on "Rural Finance and Economy in South Asian and Land Tenancy Development in South Asia" from November 3-5, 2019. He also visited University of Cambridge, United Kingdom, for exchange programme as a part of the TIGR2ESS (Transforming India's Green Revolution by Research and Empowerment for Sustainable Food Supplies) project from November 9-19, 2019.
- Dr Priya Katyal (Microbiology) visited Agricultural Technology Research Institute, Taiwan, to attend training on "Syntrophic Microbes for Accelerated Paddy Straw Decomposition" from November 18 to December 15, 2019.

College of Community Science

- Ms Renuka Aggarwal (Food and Nutrition) was a visiting scientist at The Riddet Institute, Massey University, Palmerston North, New Zealand, from July 24 to August 23, 2019.

College of Horticulture and Forestry

- Dr Ranjit Singh (Floriculture and Landscaping) visited The Netherlands under PUM, Netherlands programme for business linkage in flower cultivation from November 11-21, 2019.

IMPORTANT EVENTS ORGANIZED AT PAU

Dean, Postgraduate Studies

Event and Date	Organizing/Sponsoring Agency
Orientation programme of postgraduate students (September 10, 2019)	PAU Science Club
Lecture by Mr John Clohesy, lecturer from Leicester College, UK, on "Teaching, Methodologies - Some Tips for Effective Teaching" (October 3, 2019)	
Consultative workshop on "Academia - Industry - Government Linkages for Quality Agricultural Education" (January 28-29, 2020)	PAU under National Agricultural Higher Education Project component 2A in collaboration with National Academy of Agricultural Research Management (NAARM), Hyderabad

College of Agriculture

Event and Date	Organizing/Sponsoring Agency
Training programme on "Biotic and Abiotic Stress Tolerance in Plants under Changing Climatic Conditions" (August 6-26, 2019)	Department of Plant Breeding and Genetics, PAU
Refresher course on "Identification, Bioecology, Monitoring and Management of Fall Armyworm in Punjab" (August 19, 2019)	Department of Entomology, PAU
Regional Stakeholders' Workshop on "Alternate Agricultural Production Pathways in Changing Climates for North-Western Region"(September 4, 2019)	PAU in association with Indian Agricultural Research Institute (IARI), New Delhi
Training programme on "Assessing Soil Plant Atmosphere Continuum for Enhanced Input Use Efficiency" (October 1-21, 2019)	Department of Soil Science, PAU under Centre of Advanced Faculty Training (CAFT) programme/ scheme
Winter School on "Ecological Perspectives in Arthropod Pest Management for Sustainable Crop Production" (November 19 to December 9, 2019)	Department of Entomology, PAU
Stakeholders' Workshop on "Assessment and Management of Groundwater Resources under Changing Climatic Conditions" (February 6, 2020)	Departments of Climate Change and Agricultural Meteorology, Soil Science, and Soil and Water Engineering, PAU under the aegis of National Agricultural Higher Education project
National Seminar on "Maize for Crop Diversification under Changing Climatic Scenario" (February 9-10, 2020)	Maize Technologists' Association of India, Indian Institute of Maize Research and PAU, Ludhiana
Hands-on-Training Workshop on "Assessment Methods for Soil Carbon and Greenhouse Gas Emissions in Agriculture" (February 12 to 19, 2020)	Department of Soil Science, PAU under World Bank sponsored National Agricultural Higher Education Project-Centre of Advanced Agricultural Science and Technology (NAHEP-CAAST) project
Seminar on "Paddy Straw Management Issues in Intensive Agriculture" (March 3-4, 2020)	Directorate of Research, Department of Soil Science, and Department of Farm Machinery and Power Engineering, PAU under the auspices of ICAR-NAHEP-CAAST-SNRM project
Webinar on "Desert Locust: Current Situation and Future Perspectives" (May 31, 2020)	PAU, Ludhiana
Webinar on "Desert Locust in Indian Context - Retrospects, Current Status and Threat Imminence" (June 6, 2020)	PAU, Ludhiana
Online national training programme on "Drip Irrigation and Management" (June 15-23, 2020)	Department of Soil Science, and Department of Soil and Water Engineering, PAU under ICAR-NAHEP-CAAST-SNRM project

College of Agricultural Engineering and Technology

Event and Date	Organizing/Sponsoring Agency
- Training course on "Groundwater Recharge" for civic officials, Municipal Corporation, Ludhiana (July 24, 2019) - Training course on "Groundwater Recharge using Passive Technologies: Green Infrastructure Best Management Practices" (August 19, 2019)	Department of Soil and Water Engineering, PAU
Training course on the "Establishment of Agro Based Industries at Small Scale Level" (August 5-8, 2019)	Department of Processing and Food Engineering and Directorate of Extension Education, PAU
Mock Campus Placement Drive in collaboration with experts from Bull's Eye, Ludhiana (September 26, 2019)	Training and Placement, College of Agricultural Engineering and Technology, PAU and Bull's Eye, Punjab

Event and Date	Organizing/Sponsoring Agency
Guest lectures by:- - Er Ranveer Singh Malhotra, Assistant General Manager, Jain Irrigation System Limited, Chandigarh on "Status of Micro Irrigation and Polyhouses and Its Opportunity in India, and Marketing and Dealership Aspects Associated with the Micro Irrigation Industry"(September 28, 2019) - Mr Rajeev Singh, General Manger (Operations), Mrs Bectors Food Specialists Limited (Cremica), Rajpura on "Production Technologies in Food Processing Industry and Decision Making" (October 1, 2019) - Mr Shiv Pal Kohli, Vice President (Exports), Hero Cycles, Ludhiana on "International Job Opportunities for Agricultural Engineers and Career Planning" (October 3, 2019) - Er Pawan Sharma, Former Vice President, Preet Tractors and Former Zonal Manager, Mahindra and Mahindra on "Orientation for Tractor Marketing and Network Development" (October 3, 2019) - Mr Vishal Mahly, Area Manager, John Deere India Private Limited, Mohali on "Emerging Technologies in Tractor and Farm Machinery Industry and Serving in Corporate Sector" (October 3, 2019) - Er Mangesh Wange, Chief Executive Officer, Swades Foundation, on "Career Options for Agrineers and Journey from CoAE&T to Corporate World" (November 18, 2019) - Er Amarjit Singh Riat, Former Deputy Director and Chief of Capital Projects, County of Fairfax, VA, USA in Solid Waste Management Programme on "Solid Waste Management - Landfill Construction, Operation and Maintenance" (November 26, 2019) - Er Rajeev Gupta, Business Head, Reliance Retail, New Delhi on "Opportunities in Food and Retail Sector" (January 28, 2020) - Mr Naresh Kumar, Inspector, Income Tax, Jalandhar on "Preparations for Civil Services Examination" (February 4, 2020) - Mr Anil Menon, Head (Marketing), CLAAS Agricultural Machinery Private Limited, Faridabad on "Potential of Entrepreneurship in Fodder Chain Management and Advances in Grain Combine Harvesters" (February 26 and 27, 2020) - Er Ranveer Singh Malhotra, Director, General Manager (Sales), Jain Irrigation System Limited, Chandigarh on"Career Planning in Micro Irrigation and Polyhouse Sector, and Challenges Associated with Micro Irrigation and Polyhouse Industry"(February 28, 2020) - Mr Amol Deshpande, Manager (HR) by Mahindra and Mahindra, Mumbai on "Career Prospects in Tractor and Farm Machinery Industry" (March 4, 2020) - Er Deepak Patil, Alumnus of the CoAE&T and IIM (Ahmedabad) and Motivational Trainer on Soft Skills, Mumbai on "Communication and Organizational Skills and Personality Development of Budding Agricultural Engineers"(March 6, 2020) - Er Pradeep Chaudhary, Former Vice President, Omaxe Autos, Gurgaon on "Product Development and Management, and Organizational Skills Needed at Corporate Sector" (March 13, 2020)	Training and Placement Cell, and Alumni Association, College of Agricultural Engineering and Technology
8th Asian Australasian Conference on "Precision Agriculture" (October 14-17, 2019)	PAU, Ludhiana
Food Industry and Craft *Mela* (October 20, 2019)	Department of Processing and Food Engineering, PAU

Event and Date	Organizing/Sponsoring Agency
Regional study tour on "Integrated Straw Management" (November 8-9, 2019)	Centre for Sustainable Agricultural Mechanization (CSAM) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Indian Council of Agricultural Research (ICAR), and PAU
Training course on "Safe Processing of Sugarcane Juice into Jaggery" (November 28, December 18 and 20, 2019 and January 28 and February 11, 2020)	Department of Processing and Food Engineering, PAU and Department of Agriculture, Punjab
Technology and Machinery Demonstration *Mela* (February 14, 2020)	Department of Farm Machinery and Power Engineering, PAU under the aegis of ICAR, New Delhi
Guest lectures by: - Dr Prashant Garg, Assistant Professor, Department of Civil Engineering, Guru Nanak Dev Engineering College, Ludhiana on "Geotechnical Analysis" (February 14, 2020) - Dr Anil Nanda, Professor, Department of Civil Engineering, Regional Institute of Management of Technology (RIMT) University, Mandi Gobindgarh, on "Importance of Sites in Agricultural Engineering" (February 17, 2020) and "Uses of Retaining Wall in Construction" (March 2, 2020) - Dr Jagbir Singh, Professor, Department of Civil Engineering, Guru Nanak Dev Engineering College, Ludhiana on "Design of a Low Cost Reinforced Cement Concrete Building" (February 18, 2020) - Mr Sarang, Revenue Patwari, District Complex, Moga on "Advance Land Measurement Techniques" (February 24, 2020) - Dr RK Setia, Scientist, Punjab Remote Sensing Centre, Ludhiana on "Role of Geographic Information System (GIS) in Agricultural Engineering" (March 9,2020) - Er Manmeet Kaur Panesar, Assistant Professor, Department of Civil Engineering, Guru Nanak Dev Engineering College, Ludhiana on "Building Materials" (March 13,2020)	Department of Civil Engineering, PAU
Training courses on: - "Bigdata Natural Language Processing" (February 19, 2020) - "Network Science: Cyber and Infrastructure Security" (February 20, 2020) - "Image Processing, Artificial Intelligence and its Applications in Engineering" (February 20, 2020)	Department of Electrical Engineering and Information Technology, PAU under ICAR scheme Scheduled Caste-Sub Plan (SC-SP)
Second Workshop on "Food Supply Chains: Improvement and Innovation through Collaboration and Launch of Food-SCAN (Food Supply Chain Advancement Network" (February 27-28, 2020)	Centre for Global Business, Monash University, Australia, in collaboration with PAU, Ludhiana; Newton Bhabha Fund and Global Value Chain Research Network, University of Lincoln, UK under the aegis of Punjab Chapter of the Indian Society of Agricultural Engineers

College of Basic Sciences and Humanities

Event and Date	Organizing/Sponsoring Agency
One-day workshop on "Contemporary Social Issues and Punjab Agriculture" (October 22, 2019)	PAU, Ludhiana
One-day training workshop on "Quantitative Techniques for Impact Assessment" (December 16, 2019)	
"27th Annual Conference of Agricultural Economics Research Association" (December 17-19, 2020)	

(From left to right) Dr Kamal Vatta, Head, Department of Economics, PAU; Dr PK Joshi, President of AERA; Dr SS Johl, Chancellor, Central University of Punjab, Bathinda; Dr YK Alagh, Vice Chair and Professor Emeritus, Sardar Patel Institute of Economic and Social Research; Mr Bishow Parajuli, Country Representative, United Nations Development Programme; and Dr RS Sidhu, Registrar, PAU, releasing a publication during the 27th Annual Conference of Agricultural Economics Research Association (AERA) at PAU

College of Community Science

Event and Date	Organizing/Sponsoring Agency
- Orientation course on "Effective Teaching, Research and Extension" for newly recruited faculty of PAU (July 9-19, 2020) - Workshop on "Photography" (October 29-31, 2019) - Workshop on "Web Designing and Multimedia Production" (November 20-22, 2019) - Workshop on "Gender Sensitization" to celebrate International Women's Day (March 13, 2020)	Department of Extension Education and Communication Management, PAU
- Celebration of National Nutrition Month (September 5-6, 2019) - National programme on "10 Years Nestle Healthy Kids Journey" (October 1, 2019) - World Diabetes Day (November 14, 2019)	Department of Food and Nutrition, PAU
- Workshop on "Positive Approaches to Discipline Young Children for Parents" (February 28, 2020)	Department of Human Development and Family Studies, PAU

Directorate of Extension Education

Event and Date	Organizing/Sponsoring Agency
Quinquennial Review Team (QRT) meeting of KVKs and Agricultural Technology Application Research Institute (ATARI) (October 8-11, 2019)	PAU, Ludhiana
Training-cum-Workshop on "Online Data Management and Information Sharing by the KVKs through New PAU-KVK Portal" (October 24, 2019)	
Training course on "GeM (Government-e-Marketplace) Online Portal" (December 17, 2019)	
Winter School on "ICT and Social Media Use" (January 30 to February 19, 2020)	

ESTATE ORGANIZATION

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

FACULTY PARTICIPATION IN NATIONAL EVENTS

The University faculty participated in various national seminars, conferences, symposia, workshops, etc. Details are given below:

National participation

Name of the College	No. of faculty members participated
College of Agriculture	14
College of Agricultural Engineering and Technology	32
College of Basic Sciences and Humanities	40
College of Community Science	27
College of Horticulture and Forestry	2
Directorate of Research	25
Directorate of Extension Education	65

SALIENT NEW EQUIPMENT ACQUIRED

College of Agriculture

Equipment/Instrument	Cost (in lakh)	Utility
GCMS-MS	82.67	For quantification and confirmation of pesticide residues
Pressure plate apparatus	28.98	For research
Spectrophotometer	16.99	
Straw baler and raker	11.91	
Automatic particle size analyser	9.66	
Profile probe moisture meter	8.95	For moisture measurement
In situ CO_2 analyzer	8.22	For research
Biosafety cabinet class A2	7.0	For cell culture maintenance
Hot air oven	6.67	For research
Hydraulic conductivity meter	5.88	To measure saturated hydraulic conductivity
Hardware conversion kit	5.88	For research
Automatic promoter	5.5	
Double stage distillation unit	5.1	
Plant stress kit	4.98	To measure plant water status
Gulf permeameter	4.94	For research
Refrigerated centrifuge	4.9	
Root scanner	4.83	
Sun scan plant canopy	4.49	
Plant canopy analyser	4.49	To measure photosynthetically active radiation and leaf area index

Equipment/Instrument	Cost (in lakh)	Utility
Vertical electrophoresis	4.45	For research
Weather station	3.99	
Digital penetrometer	3.78	
Automatic paddy nursery sowing machine	3.7	
Chlorophyll content meter	3.59	To measure leaf chlorophyll content
Rice polisher	3.5	For research
ENVI software	3.44	
Yoder apparatus	3.32	For soil aggregates
Kubota paddy planter	3.2	For research
Hydrus 3D software	3.18	
Soil case sampler	3.12	

College of Agricultural Engineering and Technology

Equipment/Instrument	Cost (in lakh)	Utility
Briquetting plant	17.55	For preparation of briquettes from chopped paddy straw
UV-Vis Spectrophotometer	4.30	For biochemical analysis

College of Community Science

Equipment/Instrument	Cost (in lakh)	Utility
Body composition analyser	2.97	For research work

Directorate of Extension Education

Equipment/instrument	Cost (in lakh)	Utility
Happy Seeder (60)	62.40	For farm operations and management of crop residue
Mulcher (24)	26.88	
Digester of biogas plant	26.09	For biogas
Rotavator (35)	24.15	For farm operations and management of crop residue
Hydraulic MB Plough (14)	13.57	
Zero Till Seed-cum-Fertilizer Drill (16)	6.26	
Seed processing plant (Grader)	5.02	For seed grading
Commercial oil expeller	3.70	For training on processing and processing of farmers' produce
Self-propelled fodder harvester	2.57	For fodder harvesting
Turbo Seeder	2.30	For popularization of technology

NEW LABORATORIES AND INFRASTRUCTURE CREATED AND UPDATED

College of Agriculture

- Meteorology laboratory-cum-Seminar room in the Department of Climate Change and Agricultural Meteorology was renovated.
- Water Management laboratory in the Department of Agronomy was strengthened with the addition of new equipment like Plant stress kit, Plant canopy analyser, Chlorophyll content meter, Automated porometer, Digital penetrometers, Profile soil moisture probe, Multiparameter water quality analyser and WinRhizotron/Root scanner.

- Insect Molecular Biology laboratory in the Department of Entomology was updated by creating a facility for cell culture.
- Multimedia laboratory, PG Teaching laboratory and UG Teaching laboratory in the Department of Entomology were upgraded.

College of Agricultural Engineering and Technology

- Demonstration area for postgraduate research was bounded by plastered wall in the Department of Processing and Food Engineering.
- Sensor based naturally ventilated polyhouse was constructed at the research farm of the Department of Soil and Water Engineering.
- Micro irrigation park, costing Rs 19,65,000, was established at the demonstration site of the Department of Soil and Water Engineering.
- Biomass utilization shed in the the Department of Renewable Energy and Engineering was extended.

College of Basic Sciences and Humanities

- Lecture room in the Department of Biochemistry was upgraded to a smart class room.
- Tissue culture laboratory in the Department of Biochemistry was renovated and Departmental Library was upgraded to the College Book Bank.
- Teaching and research laboratories were upgraded in the Department of Microbiology.
- The FIST laboratory, PG and UG laboratory and Biodiversity laboratory in the Department of Zoology were repaired and renovated.

Directorate of Extension Education

- The following Units / Sheds / Stores were constructed, installed and established at various places in Punjab:
  - Bypass Fat Production Unit at KVK, Pathankot
  - Minimal Processing Unit at KVK, Amritsar
  - Beekeeping Unit at KVK, Ropar
  - Dairy Unit at KVK, Ropar
  - Goatry Unit at KVK, Ropar
  - Poultry Unit at KVK, Ropar
  - Goatry Unit at KVK, Sangrur
  - Poultry Unit at KVK, Sangrur
  - Implement shed at KVK, Sangrur
  - Implement Shed at KVK, Samrala
  - Implement Shed at KVK, Ferozepur
  - Seed Store at KVK, Mansa
- Seed grader was installed and threshing floor was constructed at KVK, Mansa.

FINANCES

The Board of Management in its 296th meeting held on March 30, 2020 (through circulation) approved the budget estimates of the Punjab Agricultural University for the year 2020-21 amounting to Rs 74,370.49 lakh. Details of these schemes, budget allocation for research, teaching, extension and for administrative and miscellaneous activities are as under: -

Sr. No.	Scheme	Estimates of budget (2020-21) (Rs in lakh)	Estimates of budget (2019-20) (Rs in lakh)	2019-20	
				Actual grant received (Rs in lakh)	Allocation (%)
1	**State Schemes**				
i)	PAU Schemes	-	26,507.93	16,109.09	32.13
ii)	Research and Education Schemes	58,170.46	27,252.63	21,851.28	43.58
2	***Rashtriya Krishi Vikas Yojana* (RKVY)**		-	-	
3	**ICAR Schemes** (AICRP/KVK/Adhoc and Development Grant)	10,803.90	9,887.54	9,043.30*	18.03
4	**Central Government Funding** (University Grants Commission and Centrally Sponsored Schemes, Department of Biotechnology, Department of Science and Technology)	1,776.14	1,625.24	1,945.47	3.88

Sr. No.	Scheme	Estimates of budget (2020-21) (Rs in lakh)	Estimates of budget (2019-20) (Rs in lakh)	2019-20	
				Actual grant received (Rs in lakh)	Allocation (%)
5	**Other Schemes** {National Horticultural Mission/ Misc. Schemes (Private Companies)/ Misc. (Foreign Contribution)}, etc.	2,710.67	1,478.66	1,194.75	2.38
6	Self-financing Schemes	620.12	6,17.58	-	-
7	Revolving Fund Schemes	289.20	2,70.50	-	-
	Total	**74,370.49**	**67,640.08**	**50,143.89**	**100**

*includes Rs 651.82 lakh for strengthening and development of PAU and Rs 32 lakh for strengthening of library services.

As compared to the Budget Estimates amounting to Rs 67,640.08 lakh for the year 2019-20 approved by the Board of Management in its 290th meeting held on March 29, 2019, the actual grants received during the financial year 2019-20 were Rs 50,143.89 lakh. The University raised Rs 7,811.09 lakh through tuition fee and other sources/ services.

Allocation of funds for various activities

Budget allocation	2020-21 As per Budget estimates		2019-20 As per Actual grant received	
	Amount (Rs in lakh)	Allocation (%)	Amount (Rs in lakh)	Allocation (%)
Research	38,488.41	51.75	17,719.99	30.96
Teaching	18,537.79	24.93	9,513.25	16.62
Extension	9,853.50	13.25	5,901.09	10.31
General administration and others	7,490.79	10.07	24,099.61	42.11
Total	**74,370.49**	**100**	**57,233.94**	**100**

During 2019-20, the actual allocation was 30.96% on research, 16.62% on teaching, 10.31% on extension and 42.11% on general administration and others.

MS RANDHAWA LIBRARY

Mohinder Singh Randhawa Library plays a pivotal role in supporting ongoing research, study, teaching and extension activities of the University. It caters to the informational needs of the academia of PAU by keeping pace with digital technologies. It renders automated services to its users in order to facilitate expeditious, exhaustive, easy and efficient access to scientific literature. The library made rapid progress and worked effectively during the period under report:

Membership: The library registered 3,808 active members during this period as compared to 3,205 members during the previous period. There was around 20 per cent increase in membership of library during this period. In addition, 10,970 books were issued to the library members.

Documents procured and subscribed: The library procured 4,041 books which include books purchased for the main library, departmental libraries, Research Stations and books received as gratis. It also procured 419 theses in print form and 419 Theses Compact Discs (CDs). At present, library is subscribing to 28 online journals and 30 print journals through Department of Soil Science. In addition, library received 4 print journals against life membership and 9 as gratis. The library also provided access to 5 online databases and 336 e-books. Thus, the total collection of library as on 30-06-2020 stood at 4,14,058.

New infrastructure developed: The library has successfully implemented Radio Frequency Identification (RFID) System for faster check-in and check-out of library documents. The RFID system will help in preventing the pilferage of library documents and provide security to the documents carried in unauthorized manner. Further this system will help in easy tracing of misplaced documents, thus, resulting in overall improvement of library operations and services.

New reading hall facility: The library provides outer reading hall facility to its users. It has two night reading halls, namely, Saxena Reading Hall and Dr Kulbir Singh Gill Reading Hall, which remain open 24X7 throughout the year. Following persistent demand of the readers, one more reading room with six reading tables and 35 chairs was set up as an extension to the existing Saxena Reading Hall.

Library services during pandemic period: The library made special efforts to reach out to its users during the pandemic period. It provided electronic services to faculty, researchers and students of the University. Remote access to all the electronic resources like Consortium for e-Resources in Agriculture (CeRA), e-journals, e-books and statistical databases was also provided so that research, teaching and extension activities of the University should not suffer. Besides, the library organized online webinars for faculty and students of the University for effective utilization of online resources. It provided essential services like issue/return of the books, issue of no due certificates, etc. to its members during COVID-19 times as and when required by taking all the precautionary measures.

Book stalls: The library organized five book stalls during this period, whereas, three book stalls were organized in the previous year. Thus, there was around 67 per cent increase in book display activity of the library which helped the teachers, students and the researchers of PAU in selecting good books for the library during the report period.

Online services: The library is providing online access to scholarly material through various online databases, namely, Consortium for e-Resources in Agriculture (CeRA) for journal articles and Krishikosh for theses submitted at PAU as well as other State Agricultural Universities and ICAR institutes. It also uploaded 408 theses in Krishikosh database during the period under report. All printed publications of PAU, such as Agricultural Research Journal, *Changi Kheti*, Progressive Farming, Package of Practices for various crops, theses, etc. available in the library are now accessible online to PAU fraternity from library webpage through PAU institutional repository. Indiastat.com, online statistical database 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 and all PAU print publications as well as old print theses are now digitally accessible campus wide 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.

Awards: Mohinder Singh Randhawa Library received **CeRA Highest User Profile Registration Award** from ICAR.

Library usage: Books - 3,08,615; Theses - 26,470; Bound periodicals - 19,905; Current periodicals -17,165; Reference books - 11,655; Textbooks - 10,065; Abstracts and Indexes - 5,630; Newspapers - 1,860 and Rare books - 2,457.

IMPACT

Productivity of major crops

- During *Rabi* 2019-20, Punjab with 50.08 q/ha yield led the nation in wheat productivity. Almost entire wheat acreage (96.3%) is under recommended wheat varieties.
- A record cotton productivity of 806 kg lint/ha was witnessed in 2019.
- Average paddy productivity of 6,022 kg/ha (6,489 kg/ha of *parmal* rice and 4,321 kg/ha of *basmati*) during 2019-20 was recorded in the state. Short duration *parmal* rice varieties had 70 per cent share in *parmal* rice acreage. These varieties confer water saving and residue management advantages due to their short duration and low biomass characters.
- During 2019-20, potato productivity in Punjab touched a record high of 27.1 tonne/ha and potato growers realized higher profits.

Shift in area under direct seeded rice (DSR)

- Large scale research and farmer field experiments in *Kharif* 2019 formed the basis of *Tar-wattar* DSR technology, recommended to the farmers ahead of 2020 rice season. The new technology has a water saving potential of 15-20 per cent besides saving labour. Area under DSR went up from 60 thousand ha in 2019 to estimated 5 lakh ha in 2020 largely in response to COVID-19 induced labour shortage.

Eco-friendly pest and disease management

- Increased emphasis on non-chemical, especially, biopesticides, economic threshold level (ETL) based pesticide use, and integrated approaches for pest and disease management has helped reduce agro-chemical use considerably. Pesticide use in Punjab has been declining over the years (from 5,843 tonnes in 2016-17 through 5,835 tonnes in 2017-18 and 5,543 tonnes in 2018-19 to 4,930 tonnes in 2019-20).
- Use of biopesticides has increased from 134 tonnes in 2016-17 to 246 tonnes in 2018-19. Effectiveness of neem-based aqueous extract for control of pests has been validated for many crops (e.g. control of mites in capsicum under protective cultivation and of pod sucking bug in pigeonpea); the use is likely to increase further.
- Integrated pest management, especially, for whitefly in cotton in Punjab helped save Rs 2,532 per ha besides yielding record productivity of 806 kg lint/ha during 2019.
- Out of 592 vegetable samples collected from market and farmgate, 2.22 per cent of market samples and 1.34 per cent of farmgate samples contained pesticides above the maximum residue limit (MRL). In case of *basmati* rice (319 samples), six samples had pesticide residue above MRLs.

Soil health management

- Fertilizer consumption (NPK) in the state has been decreasing consistently from 247 kg/ha in 2015-16 through 246 kg/ha in 2016-17 and 240 kg/ha in 2017-18 to 232 kg/ha in 2018-19.
- Consumption of phosphatic fertilizer has been decreasing consistently from 53.1 kg/ha in 2015-16 through 52.7 kg/ha in 2016-17 and 45.9 kg/ha in 2017-18 to 42.7 kg/ha in 2018-19.

- The University prepared and provided biofertilizers for 16 crops, which were enough for more than 63 thousand acres.

Management of COVID-19 driven challenges

- The University helped the state in devising effective wheat harvest and procurement, and other farm operation plans. The agencies were able to procure 127 lakh metric tonnes of wheat despite a variety of logistical and other challenges.
- The University took innovative measures in seed movement to ensure almost doorstep delivery to the farmers, especially through Farm Inputs App. This ensured timely sowing of *Kharif* crops.
- In order to make up for disruptions in conventional modes of extension, a weekly (every Wednesday) 'PAU Live Programme' was started on Facebook and YouTube. About 40,000 - 50,000 farmers are connected with it. Four programmes were organized during the report period.
- All skill development trainings continue to be delivered uninterruptedly through the online mode.
- Submission, evaluation and final oral examination of theses are being conducted successfully through online mode.

Crop diversification and microirrigation

- Area under *basmati* rice has increased over the years from 5.11 lakh ha in 2018 through 6.29 lakh ha in 2019 to estimated 6.60 lakh ha in 2020. *Parmal* acreage has come down from 25.92 lakh ha in 2018 through 22.91 lakh ha in 2019 to estimated 21.76 lakh ha in 2020.
- Area under cotton has risen steadily from 2.68 lakh ha in 2018 through 3.92 lakh ha in 2019 to estimated 5.01 lakh ha in 2020.
- Area under maize crop has also risen from 1.09 lakh ha in 2018 through 1.60 lakh ha in 2019 to estimated 2.43 lakh ha in 2020.
- Sugarcane acreage continues to remain stable (97 thousand ha in 2017-18, 95 thousand ha in 2018-19, 96 thousand ha in 2019-20 to estimated 95 thousand ha in 2020-21). Intercropping recommendations and mechanization interventions like sugarcane planter will help improve economic viability of sugarcane.
- *Kharif* pulses with a coverage of 11.7 thousand ha in 2019-20 mark some increase in area over 7.5 thousand ha in 2018-19 and 8.2 thousand ha in 2017-18. High density planting method recommended for AL 882, a short duration and early maturing variety of *arhar*, is expected to drive pulses productivity and consequently acreage. Newly recommended spring urdbean variety Mash 1137 for sub-mountainous region will help sustain niche area under pulse crops.
- Area under oilseeds went up by 19.3 per cent (48.9 thousand ha) after staying stable at 41-42 thousand ha in 2016-2019; especially, rapeseed-mustard acreage increased considerably by 26.6 per cent (38.6 thousand ha) over 2018-19.
- Area under vegetable crops in the state has risen at compounded annual growth rate (CAGR) of 5.4 per cent over the last decade.
- Area under fruit crops (90.4 thousand ha) has surmounted the earlier peak of 85.5 thousand ha reached during 2015-16. *Kinnow* acreage witnessed a CAGR of 3.64 per cent over the last decade. Newly recommended technologies like on-tree fruit bagging in guava to avoid fruit fly infestation in rainy season crop and higher productivity under drip irrigation and fertigation technology have expanded future prospects of the guava crop, the second largest fruit crop after *Kinnow*.

Crop residue management

- Paddy straw continues to be managed increasingly without burning (16% in 2017, 50.6% in 2018 and 62.6% in 2019; though a slideback to 52.1% has been observed in the post report period of 2020). Increasing *in situ* management of paddy straw over the years will help substantially in improving key soil health diagnostics and reducing fertilizer use.
- Increased area under DSR (which has lower biomass) and *basmati* rice (with higher use as dry fodder) would facilitate paddy straw management.

Agribusiness incubation, technology commercialization and subsidiary occupations

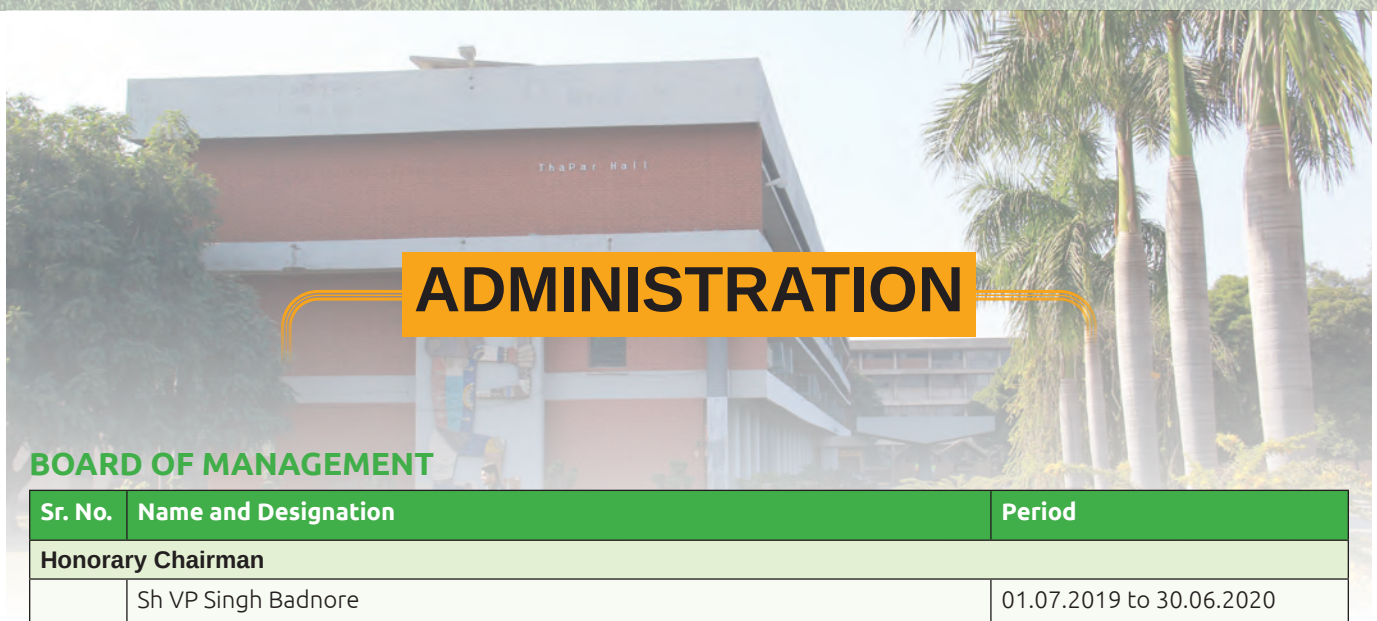
- Food Industry Business Incubation Centre, established by the University, provided incubation facilities to six entrepreneurs.
- Seven new agro-processing complexes and 10 jaggery processing plants were provided handholding by the University.
- During the report period, 13 MoAs were signed to commercialize a range of varietal, farm machinery and processing technologies.

Education

- The Punjab Agricultural University and its constituent colleges were accredited for five years from April 2019 to 2024 with overall A+ grade.
- A total of 37 students from different colleges went abroad in reputed colleges for higher studies.
- In total, 105 students cleared ICAR/CSIR/UGC (NET); 144 students were awarded ICAR National Talent Scholarship, 108 ICAR/UGC (JRF) and 53 ICAR/UGC (SRF).
- A number of students bagged Maulana Azad UGC Fellowship, Innovation in Science Pursuit for Inspired Research Fellowship from Department of Science and Technology, Rajiv Gandhi National Fellowship from UGC and University Merit Scholarship. Students also participated in International Conferences and training programmes. Many students also got awards and medals in seminars and conferences at national level.

Global rankings

- The Punjab Agricultural University was ranked 192nd in the 6th Annual US News Best Global Universities rankings for the year 2020. The PAU is the only University from India to have made it to the prestigious list in the field of agricultural sciences.



ADMINISTRATION

BOARD OF MANAGEMENT

Sr. No.	Name and Designation	Period
Honorary Chairman		
	Sh VP Singh Badnore Hon'ble Governor, Punjab and Chancellor of the University	01.07.2019 to 30.06.2020
Working Chairman		
	Dr Baldev Singh Dhillon Vice Chancellor	01.07.2019 to 30.06.2020
Members		
1	Sh Karan Avtar Singh, IAS Chief Secretary to Government of Punjab Chandigarh – 160 001	01.07.2019 to 25.06.2020
	Ms Vini Mahajan Chief Secretary to Government of Punjab Chandigarh – 160 001	26.06.2020 to 30.06.2020
2	Sh Viswajeet Khanna, IAS Addtional Chief Secretary (Development) Department of Agriculture and Farmers' Welfare, Government of Punjab Chandigarh – 160 001	01.07.2019 to 07.06.2020
	Sh Anirudh Tewari, IAS Additional Chief Secretary (Development) Department of Agriculture and Farmers' Welfare, Government of Punjab Chandigarh – 160 001	08.06.2020 to 30.06.2020
3	Sh Anirudh Tewari, IAS Principal Secretary Department of Finance, Government of Punjab Chandigarh – 160 001	01.07.2019 to 07.06.2020
	Sh KAP Sinha, IAS Principal Secretary Department of Finance, Government of Punjab Chandigarh - 160 001	08.06.2020 to 30.06.2020
4	Sh Sutantar Kumar Airi Director of Agriculture, Punjab Kheti Bhawan (Near Dara Studio) Phase-VI, Mohali - 160 055	01.07.2019 to 30.06.2020

Sr. No.	Name and Designation	Period
5	Dr Sujay Rakshit Director, Indian Institute of Maize Research PAU Campus, Ludhiana	01.07.2019 to 30.06.2020
6	Dr SS Gosal Former Director of Research, PAU Opposite State Bank of India, Sugandh Vihar, Pakhowal Road, Ludhiana	01.07.2019 to 30.06.2020
7	Dr DS Brar Adjunct Professor, PAU 30, Flower Dale Colony, Barewal Road, Ludhiana	01.07.2019 to 11.03.2020
	Dr Balwinder Singh Former Director of Research, PAU 434-G, Bhai Randhir Singh Nagar Ludhiana - 141 012	11.06.2020 to 30.06.2020
8	Sh Kulwant Singh Ahluwalia VillageChhauni Kalan, PO Ram Colony District Hoshiarpur	01.07.2019 to 30.06.2020
9	Sh Devinder Singh Chahal Village Kishangarh, Post Office Barsat Tehsil and District Patiala – 147 002	01.07.2019 to 30.06.2020
10	Sh Anoop Bector Managing Director Mrs Bector's Food Specialties Limited Theing Road, Phillaur – 144 410	01.07.2019 to 30.06.2020
11	Mrs Manjit Kaur VPO Sehjomajra, Block Machhiwara, Tehsil Samrala, District Ludhiana – 141 121	01.07.2019 to 30.06.2020
Secretary		
	Dr RS Sidhu Registrar	01.07.2019 to 30.06.2020

ACADEMIC COUNCIL

Designation	Name
Vice Chancellor	Dr Baldev Singh Dhillon
Dean, Postgraduate Studies	Dr (Mrs) GK Sangha
Dean, College of Community Science	Dr (Mrs) Sandeep Bains
Director of Research	Dr Navtej Singh Bains
Dean, College of Agriculture	Dr SS Kukal
Dean, College of Agricultural Engineering and Technology	Dr Ashok Kumar
Director of Extension Education	Dr Jaskarn Singh Mahal
Dean, College of Basic Sciences and Humanities	Dr SS Kukal (Addl. Charge)
	Dr Shammi Kapoor
Dean, College of Horticulture and Forestry	Dr MIS Gill
Head, Department of Zoology	Dr SS Hundal
Head, Department of Botany	Dr (Mrs) Seema Bedi
Head, Department of Biochemistry	Dr (Mrs) Sucheta Sharma
Head, Department of Vegetable Science	Dr AS Dhatt
Head, Department of Extension Education	Dr Jaswinder Singh Bhalla
Director, School of Agricultural Biotechnology	Dr (Mrs) Parveen Chhuneja
Head, Department of Farm Machinery and Power Engineering	Dr Manjeet Singh
Head, Department of Human Development and Family Studies	Dr (Mrs) Tejpreet Kaur Kang
Head, Department of Home Science Extension and Communication Management	Dr (Mrs) Kiranjot Sidhu
Head, Department of Family Resource Management	Dr (Mrs) Jatinderjit Kaur Gill
Head, Department of Fruit Science	Dr Harminder Singh
Registrar, Secretary	Dr RS Sidhu

IMPORTANT DECISIONS OF THE BOARD OF MANAGEMENT

During the period under report, the Board of Management held five meetings (293rd to 297th). The important decisions taken by the Board are as under:

Concession to Staff

- The Board approved the revision of rates of remuneration for conducting tests for recruitment of staff. B-3/294th
- The Board allowed the reservation for economically weaker sections for non-teaching posts in direct recruitment. C-8/294th

Budget

- The Board noted the creation and inclusion of new Revolving Fund Scheme "Experiential Learning Programme (Food Technology), RF-14 (PC-3112)." B-1/294th
- The Board noted the creation and inclusion of new Revolving Fund Scheme "Production of Fruits, Vegetables and Nursery Seedlings under Brackish Water Project at Regional Research Station, Bathinda, RF-15 (PC-3113)." B-2/294th
- The Board noted the creation and inclusion of new Revolving Fund Scheme "Entrepreneurship Development in Commercial Plant Tissue Culture, RF-16 (PC-3114)." B-1/295th
- The Board approved the Budget Estimates of the Punjab Agricultural University for the year 2020-21 through email circulation. 1/296th
- The Board noted the creation and inclusion of new Revolving Fund Scheme "Production of Value Added Convenience Foods at Punjab Agricultural University, Ludhiana, RF-17 (PC-3116)." B-1/297th

Other Decisions

- Dr Shammi Kapoor was appointed to the post of Dean, College of Basic Sciences and Humanities, PAU. A-3/293rd
- The Board approved the appointment of Dr Manav Indra Singh Gill to the post of Dean, College of Horticulture and Forestry, PAU. A-4/293rd
- Dr RS Sidhu was re-appointed as Registrar, PAU. C-2/293rd
- The Board approved the appointment of Dr Ajmer Singh Dhatt to the post of Additional Director of Research (Horticulture ad Food Science). A-3/294th
- The Board approved the appointment of Dr Gursahib Singh Manes to the post of Additional Director of Research (Farm Mechanization and Bioenergy). A-4/294th
- Sh Kulwant Singh Ahluwalia was nominated as non-official member of the Finance Committee of PAU. C-1/294th
- The Board ratified the action taken by the Vice Chancellor, under his emergency powers, in allowing Punjab Small Industries and Export Corporation Limited (PSIEC) to lay an underground pipeline through the PAU University Seed Farm, Nabha. C-10/294th
- The Board approved the draft of Annual Report of PAU for the year 2018-19. C-11/294th
- The Board approved the issuance of no objection certificate in respect of 11.50 acre land belonging to State Government but cultivated by PAU Seed Farm, Nabha for the project of doubling of Rajpura-Bathinda Section of Northern Railway of Ambala and construction of goods platform at Nabha. C-1/297th

IMPORTANT DECISIONS OF THE ACADEMIC COUNCIL

During the period under report, six meetings (402nd to 407th) of the Academic Council were held. The important decisions taken by the Academic Council are as under:

- Approved the starting of five University Gold Medals for Ph.D. programme in different disciplines. C-2/402nd
- Approved Devinder Singh Bansal Memorial Cash Prize of Rs 2,500/- for the Best Cyclist (Men/ Women) of the University. C-5/402nd
- Approved Sardarni Apinder Kaur Grewal Scholarship of Rs 1,500/- per month for M.Sc. (Food and Nutrition) student. C-9/402nd
- Approved grant of merit-cum-means fellowship of Rs 1,000/- per month per student under Self-financing academic programmes. C-1/403rd
- Approved the institution of Dr TS Thind Medal for the Best M.Sc. student in Plant Pathology. C-2/406th
- Approved the institution of award in the name of Dr Ranjit Singh Dhanda Medal for the overall Best Masters' student of the Department of Forestry and Natural Resources. C-3/406th
- Approved the institution of medal in the name of Sardar Kishan Singh Dhaliwal Memorial Medal for the student of M.Sc. in the discipline of Entomology. C-4/406th
- Approved the award of Post-doctoral Fellowship of Rs 35,000/- per month + fee hostel accommodation to be given to Ph.D. students of all the constituent colleges of the University. C-8/406th
- Approved the grant of fee concession to the students of self-supporting programmes on the basis of achievements in sports and co-curricular activities. C-2/407th

PUBLICATIONS

The University scientists published 511 publications which included research papers, 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:

Projects	Cost (Rs in lakh)
Construction of first floor of Hostel No. 14 (West Block) at PAU, Ludhiana	77.17
Construction of mess of Hostel No. 13 at PAU, Ludhiana	44.09
Repair/renovation and painting of Hostel No. 2 at PAU, Ludhiana	43.68
Construction of class rooms over the existing building of Experiential Learning Unit, College of Community Science at PAU, Ludhiana	39.46
Roof Truss for the College of Agricultural Engineering and Technology at PAU, Ludhiana	26.39
Extension of Seed Sale Centre at Gate no. 1 at PAU, Ludhiana	23.64
Remaining work (first floor, brick work, lintels, columns and slab) of Bio Laboratory at Regional Research Station, Gurdaspur	21.19
Repair/Renovation of roof of PAU Indoor Gymnasium Building at PAU, Ludhiana	18.00
Construction of sheds (three) for farm labour at field areas at PAU, Ludhiana	12.33
Construction of house (80 sqm) at KVK, Muktsar	12.11
Installation of one deep tubewell at Regional Research Station, Ballowal Saunkhri	11.07
Construction of first floor roof cover office-cum-lab building at KVK, Fatehgarh Sahib	10.67
Installation of one submersible pump set 12.5 HP at KVK, Pathankot	10.66
Construction of Mushroom Unit at KVK, Amritsar	8.04
Construction of Beekeeping Unit at KVK, Amritsar	5.01
Total	**363.51**

ANNEXURE II

PUBLICATIONS

COLLEGE OF AGRICULTURE

Research Papers in Indian and Foreign Journals

1. #Bala R, Kalia A and Dhaliwal SS (2019). Evaluation of efficacy of ZnO nanoparticles as remedial zinc nanofertilizer for rice. *J Soil Sci Plant Nutr* **19:** 379-389. **(8.01)***
2. Behere GT, Tay WT, Firake DM, Kunz D, Burange PS and Ramamurthy VV (2019). Characterization of draft mitochondrial genome of guava trunk borer, *Aristobia reticulator* (Fabricius, 1781) (Coleoptera: Cerambycidae: Lamiinae) from India. *Mitochondrial DNA Part B* **4:** 1592-1593. **(6.93)**
3. Bhalla JS, Mohapatra L and Singh J (2019). Perception of growers regarding farmers' fair. *Agric Res J* **56:** 783-785. **(4.71)**
4. Bhowmik A, Kukal SS, Saha D, Sharma H, Kalia A and Sharma S (2019). Potential indicators of soil health degradation in different land use-based ecosystems in the Shivaliks of North-Western India. *Sustainability* **11:** 3908. **(8.08)**
5. Chahal RK, Dhillon SK, Kandhola SS, Kaur GG, Kalia V and Tyagi V (2019). Magnitude and nature of gene effects controlling oil content and quality components in sunflower (*Helianthus annuus* L.). *Helia* **42:** 73-84. **(6.42)**
6. Chandi AK(2019). EthoVision detection of larval movements of *Spodoptera litura* (Fabricius) populations from different regions of Punjab. *Agric Res J* (accepted). **(4.71)**
7. Chandi AK and Kaur A (2019). Influence of temperature on spinosad toxicity in different populations of *Plutella xylostella* (Linnaeus). *J Agrometeorol* **21:** 499-503. **(6.56)**
8. Chandi AK and Kaur R (2019). Ultra structural studies of the ovaries of susceptible and insecticide-resistant *Plutella xylostella* (Linnaeus). *Agric Sci Digest* (accepted). **(4.21)**
9. Chandi AK, Kaur A and Chandi RS (2019). Evaluation of toxicity of insecticides towards tobacco caterpillar, *Spodoptera litura* (Fabricius) populations from Punjab. *J Insect Sci* **32:** 56-61. **(4.72)**
10. Deepti, Bhalla JS and Mohapatra L (2019). To identify the problems faced by the medicinal and aromatic plants growers in Hoshiarpur district of Punjab. *Adv in Res* **19:** 1-4. **(4.80)**
11. Deosi KK, Suri KS and Chandi AK (2019). Effect of selection pressure of novel insecticides on brown planthopper, *Nilaparvata lugens* (Stål.) in fesing rice. *J Exp Zool* **23:** 71-75. **(5.51)**
12. Dhaliwal LK, Buttar GS, Kingra PK, Kaur S and Singh J (2020). Growth, yield and water use efficiency of wheat (*Triticum aestivum*) under different sowing dates, planting methods and irrigation treatments**.** *Indian J Agric Sci* **90:** 519-523. **(6.25)**
13. Dhaliwal SK, Dhillon SK,Gill BS, Kaur G, Sirari A and Sharma S (2020). Effect of genetic elimination of kunitz trypsin inhibitor on agronomic and quality traits in soybean [*Glycine max* (L.) Merril]. *Legume Res* (accepted). **(6.34)**
14. Jaidka M, Deol JS, Kaur R and Sikka R (2020). Source-sink optimization and morppho-physiological response of soybean (*Glycine max*) to detopping and mepiquat chloride application. *Legume Res* **43:** 401-407. **(6.23)**
15. Kalia A, Kaur J, Kaur A and Singh N (2020). Antimycotic activity of biogenically synthesised metal and metal oxide nanoparticles against plant pathogenic fungus *Fusarium moniliforme* (*F. fujikuroi*). *Indian J Exp Biol* **58:** 263-270. **(6.93)**

**National Academy of Agricultural Sciences (NAAS) Score*

#Listed more than once depending upon the affiliation of the author

16. Kalia A, Sharma SP and Devi S (2020). Effect of surface microbiome and osmo-conditioning on restoration of storage-induced losses of viability in muskmelon (*Cucumis melo* L.). *J Agric Sci Technol* **22:** 221-233. **(6.83)**
17. Kaur D, Taggar MS, Kalia A and Singh I (2019). Isolation and biochemical characterization of microalgae from waterlogged areas of South-West Punjab. *Indian J Exp Biol* **57:** 700-707. **(6.93)**
18. Kaur G, Kalia A and Sodhi HS (2020). Size controlled, time-efficient biosynthesis of silver nanoparticles from *Pleurotus florida* using ultra-violet, visible range and microwave radiations. *Inorganic Nano-Metal Chem* **50:** 35-41. **(Impact factor 0.839)**
19. Kaur H, Kaur K and Gill GK (2019). Modulation of sucrose and starch metabolism by salicylic acid induces thermo-tolerance in spring maize. *Russian J Plant Physiol* **66:** 771. **(6.82)**
20. Kaur J**,** Kingra PK**,** Setia R and Singh SP (2019). Relationship among wheat yield, climate and technology variables in different agro-climatic regions of Punjab. *Agric Res J* **56:** 436-443. **(4.71)**
21. Kaur K and Chandi AK (2019). Pyriproxyfen exposure: Physiological changes in reproduction of *Spodoptera litura* (Fabricius). *Pestic Res J* (accepted). **(5.90)**
22. Kaur K, Dhillon SK, Gill BS and Kaur G (2019). Association of SSR based genetic distances with Heterosis in sunflower. *J Env Biol* **40:** 1102-1108. **(6.73)**
23. Kaur P, Jindal S, Yadav B and Gupta OP *et al* (2020). Comparative analysis of chromosome 2A molecular organization in diploid and hexaploid wheat. *Molecul Biol Reports* **47:**1991–2003. **(8.11)**
24. Kaur P, Kaur H, Singh H and Sandhu SS (2019). Effect of elevated temperature regimes on growth and yield of rice cultivars under temperature gradient tunnel (TGT) environments. *J Agrometeorol* **21:** 241-248. **(6.56)**
25. Kaur P, Kumar P, Gill JS, Singh P and Singh J (2020). Popularization of chickpea and canola *sarson* for sustainable agriculture in Punjab. *Indian J Econ Dev* **16:** 552-555. **(4.82)**
26. Kaur S, Kaur P and Kumar P (2019). Awareness of farmers regarding soil health card scheme. *Int J Curr Microbiol Appl Sci* **8:** 2206-2210. **(5.32)**
27. Kaur S, Kaur P and Kumar P (2020). Constraints faced by farmers in the use of soil health card. *Multilogic in Sci* **9:** 487-488. **(5.20)**
28. Kawatra M, Kaur K and Gill GK (2019). Effect of osmo priming on sucrose metabolism in spring maize, during the period of grain filling, under limited irrigation conditions. *Physiol Molecul Biol Pl* **25:** 1367-1376. **(7.51)**
29. Kingra PK, Aatralarasi S, Setia R, Kukal SS and Singh SP (2020). Computation of reference evapotranspiration, its variability and trends in different agro-climatic regions of Punjab. *J Agrometeorol* **22:** 226-232. **(6.64)**
30. Kumar A, Jindal SK, Dhaliwal MS, Sharma A, Jain S and Kaur S (2019). Horticultural evaluation of advance breeding lines possessing different combinations of ty and ph genes in tomato (*Solanum lycopersicum* L.). *Genetika* **51:** 771-788. **(6.46)**
31. Kumar V, Grewal GK and Burange PS (2019). Biopesticides and insect growth regulators against *Bemisia tabaci* (Gennadius) infesting *Bt* cotton. *Indian J Entomol* **81:** 749-752. **(5.89)**
32. Kumar V, Kular JS, Kumar R, Sidhu SS and Chhuneja PK (2020). Integrated whitefly [*Bemisia tabaci* (Gennadius)] management in *Bt* cotton in North India: An agro-ecosystem wide community based approach. *Curr Sci* (accepted). **(6.76)**
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34. Maini C, Tandon R, Kalia A and Kaur H (2019). Chemical characterization and antimycotic potential of *Azadirachta indica* L. leaf extracts against *Penicillium digitatum* of *Kinnow* fruit. *Allelopathy* **47:** 243-246. **(6.71)**
35. Makkar GS, Chhuneja PK and Singh J (2020). Morphometric characterization of *Apis* species (Hymenoptera: Apoidea). *Vegetos* DOI: org/10.1007/s42535-020-00136-3.
36. Manchanda P, Kalia A, Singh G, Rattanpal HS, Kaur K and Kaur S (2020). Multiple plant regeneration from white matricular substance released from wounded ends of different explants of *Citrus jambhiri* (Rough lemon). *Indian J Agric Sci* **90:** 80-85. **(6.23)**

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38. Rajniand Singh P (2019). Impact of balanced nutrition on the yield and economic analysis of rice and wheat agro-ecosystem in Amritsar district of Punjab. *Indian J Ext Edu* **55:** 177-179. **(5.32)**

39. Salaria P, Singh A and Jain S (2020). Impact of predisposing factors on development of stemphylium blight of garlic under Punjab conditions. *Agric Res J* **57:** 190-195. **(4.71)**

40. Sandhu JS, Nayyar S, Kaur A, Kaur R, Kalia A, Arora A, Kaur Y, Thind S and Chhabra G (2019). Foot rot tolerant transgenic rough lemon rootstock developed through expression of β-1,3-glucanase from *Trichoderma* spp. *Plant Biotechnol* **17:** 2023-2025. **(12.31)**

41. Sandhu KS and Kaur P (2020). Satisfaction level of subsidized vegetable growers under National Horticulture Mission in Punjab. *Multilogic in Sci* **9:** 45-47. **(5.20)**

42. Sharma N, Sharma S, Singh B and Kaur G (2019). Stability evaluation of iron and vitamin A during processing and storage of fortified pasta. *J Quality Assurance and Safety of Crops and Foods* **12:** 50-60. **(6.5)**

43. Singh A, Sharma S, Singh B and Kaur G (2019). *In vitro* nutrient digestibility and antioxidative properties of flour prepared from sorghum germinated at different conditions. *J Food Sci Technol* **56:** 3077-3089. **(7.8)**

44. Singh D and Kaur P (2020). Resource conservation technologies in Punjab: Status and problems. *Indian J Econ Dev* **16:** 281-287. **(4.82)**

45. Singh D and Kaur P (2020): An analysis study of prospects of zero till technology in Punjab. *Agric Res J* (accepted). **(4.71)**

46. Singh D, Kaur P and Kumar P (2019). A scale to measure the attitude of farmers towards laser land leveller. *Int J Edu Manage Stud* **8:** 298-301. **(4.79)**

47. Singh D, Kaur P and Kumar P (2020). A scale to measure attitude of farmers towards Happy Seeder technology. *Multilogic in Sci* **9:** 299-301. **(5.20)**

48. Singh J, Sharma VK and Kaur A (2020). Evaluation of barley genotypes for resistance against covered smut disease. *Indian Phytopathol* **73:** 359-360. **(5.90)**

49. Singh VP, Thakur A, Jawanda SK and Singh SP (2019). Harvest maturity and storage temperature affect fruit colour, chilling injury and quality in Indian gooseberry fruit *(Emblika officinalis* Gaertner). *Fruits* **74:** 259-272. **(6.64)**

50. Tyagi V and Dhillon SK (2019). Water use efficient sunflower hybrids having diverse cytoplasmic background. *Helia* https://doi.org/10.1515/helia-2019-0014.

51. Tyagi V, Dhillon SK, Kaur G and Kaushik P (2020). Gene action for oil content and quality in diverse cytoplasmic sources in sunflower under varied moisture environments. *Indian J Traditional Knowl* (accepted). **(6.92)**

52. Tyagi V, Dhillon SK, Kaur G and Kaushik P (2020). Heterotic effect of different cytoplasmic combinations in sunflower hybrids cultivated under diverse irrigation regimes. *Plants* **9:** 465. **(8.76)**

53. Vasmatkar P, Kaur K, Pannu PPS, Gill GK and Kaur H (2019). Unravelling the metabolite signatures of maize genotypes showing differential response towards southern corn leaf blight by 1H-NMR and FTIR spectroscopy. *Physiol Molecul Plant Pathol* **(7.40)**

54. Zada AMW, Mohapatra L and Anand A (2019). Analysis of awareness level of agricultural insurance among the stakeholders in Punjab. *Econ Affairs* **64:** 503-512. **(4.82)**

Book Chapters

1. Dhaliwal R and Mohapatra L (2019). Behavioural drivers in shifting the mindset of farmers to restrict crop residue burning in Punjab. In: *Rice Residue Management*, *Punjab Agricultural Management and Extension Training Institute (PAMETI) - United Nations Environmental Program (UNEP) Project,* PAMETI, Ludhiana. pp. 180-188

2. Kalia A (2019). Nano-revolution in beverage industry: Tailoring nano-engineering to consummate novel processing and packaging panacea. In: *Emerging Trends and Developments in Beverage Science* (Multi Volume Set I-XX), Grumezescu AM (ed), Elsevier, Bucharest, Romania. pp. 163-190

3. Kalia A and Kaur H (2019). Agri-applications of nano-scale micronutrients: Prospects for plant growth promotion and use-efficient micronutrient fortification. In: *Nanoscale Engineering for Agricultural Management*, Raliya R (ed), CRC Press/Taylor and Francis, USA. pp. 81-105
4. Kalia A and Kaur H (2019). Nano-biofertilizers: Harnessing dual benefits of nano-nutrient and biofertilizers for enhanced nutrient use efficiency and sustainable productivity. In: *Nanoscience for Sustainable Agriculture*, Pudake RN, Chauhan N and Kole C (eds), Springer Nature, USA. pp. 51-73
5. Kalia A and Sharma SP (2019). Nano-materials and vegetable crops: Realizing the concept of sustainable production. In: *Nanoscience for Sustainable Agriculture*, Pudake RN, Chauhan N and Kole C (eds), Springer Nature, USA. pp. 323-353
6. Kalia A and Sharma SP (2019). Single-cell omics in crop plants: Opportunities and challenges. In: *Single-Cell Omics, Volume 2: Applications in Biomedicine and Agriculture*, Barh D and Azevedo V (eds), Elsevier Publishing, USA. pp. 341-355
7. Kalia A, Kaur S and Gangwar M (2019). Actinomycete-enabled remediation strategies: Potential tool for pollutant removal from diverse niches. In: *Environmental Contaminants and Natural Products*, Sharma A, Kumar M, Kaur S and Nagpal AK (eds), Bentham Science Publishers, USA. pp. 137-158
8. Kalia A, Sharma SP and Kaur H (2019). Nano-scale fertilizers: Harnessing boons for enhanced nutrient use efficiency and crop productivity. In: *Nanobiotechnology Applications in Plant Protection*, *Volume 2: Series - The Nanotechnology in the Life Sciences*, Abd-Elsalam K and Prasad R (eds), Springer Nature, USA. pp. 191-208
9. Kaur S, Kalia A and Gangwar M (2019). Bioprospecting endophytic actinobacteria of medicinal plants as potential anticancer therapeutic agents. In: *Pollutants and Protectants: Evaluation and Assessment Techniques*, Sharma A and Kumar M (eds), IK Publishing House Private Limited, New Delhi, India. pp. 196-214
10. Misra AK, Yadav SB, Mishra SK and Tripathi MK (2019). Impact of meteorological variables and climate change on plant diseases. In: *Plant Pathogen: Detection and Management In Sustainable Agriculture*, Kumar P, Tiwari AK, Kamle M, Abbas Z and Singh P (eds), Apple Academic Press (Taylor and Francis Group), Canada. pp. 313-327
11. Pandey V, Misra AK and Yadav SB (2019). Impact of El-Nino and La-Nina on Indian climate and crop production. In: *Climate Change and Agriculture in India: Impact and Adaptation*, Mahdi SS (ed), Springer International Publishing AG. pp. 11-20
12. Parmar P, Bobade H, Singh B and Pathania S (2020). Extrusion technologies for pulses. In: *Pulse Foods: Processing, Quality and Nutraceutical Applications*, Tiwari BK, Gowen A and McKenna B (eds), Academic Press, Elsevier.
13. Sikka R, Singh D and Kalia A (2019). Heavy metals and soil contamination: Sources, bioavailability and effects on crop plants. In: *Pollutants and Protectants: Evaluation and Assessment Techniques*, Sharma A and Kumar M (eds), IK Publishing House Private Limited, New Delhi, India. pp. 30-52
14. Singh G and Kalia A (2019). Nano-enabled technological interventions for sustainable production, protection, and storage of fruit crops. In: *Nanoscience for Sustainable Agriculture*, Pudake RN, Chauhan N and Kole C (eds), Springer Nature, USA. pp. 299-322

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1. Dhillon SK, Bhatia D, Gill GK, Singh P and Mangat GS (2019). Instruction Manual on Biotic and Abiotic Stress Tolerance in Plants Under Changing Climatic Conditions, Centre for Advanced Faculty Training, Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana. pp. 356
2. Mohapatra L, Kaur M, Singh D, Kumar P, Garg L, Kaur L and Kaur K (2019). Practical Manual of Rural Agricultural Work Experience Programme, Department of Extension Education, Punjab Agricultural University, Ludhiana. pp. 46
3. Singh H, Sharma R and Singh S (2020). Production Technology for *Rabi* Crops (Agron 202), Department of Agronomy, Punjab Agricultural University, Ludhiana. pp. 37

Research Bulletin

1. Kaur P, Sandhu SS, Kaur H and Kaur J (2020). Climate Change in Punjab - Some Facts, All India Coordinated Project on Agrometeorology (AICRPAM) - National Innovations on Climate Resilient Agriculture (NICRA), Department of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana. 16 p.

COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

Research Papers in Indian and Foreign Journals

1. Ajay A, Gill RS and Singh RP (2020). Performance evaluation of LiBr-H2O vapour absorption system for an office building cooling. *Adv in Res* **21:** 9-21. **(4.8)**
2. Biwalkar N, Kumar R and Sharda R (2020). Characterization of temperature regime under capsicum cropped naturally ventilated greenhouse. *Int J Curr Microbiol Appl Sci* **8:** 1407-1413. **(5.38)**
3. Chawla K, Sekhon KS, Thaman S, Garg N, Satpute S and Choudhary OP (2020). Effect of canal and desalinated water irrigation with varying levels of fertigation growth yield and nitrogen uptake of tomato under polyhouse conditions. *Agric Res J* (accepted). **(4.71)**
4. Dhiman M, Sethi VP, Singh B and Sharma A (2019). CFD analysis of greenhouse heating using flue gas and hot water heat sink pipe networks. *Comput Electron Agri* **163:** 104853. **(9.17)**
5. Dogra, R, Waman, KD, Dogra B and Kumar A (2020). Optimization of parameters of axial flow paddy thresher. *Agric Mechaniz Asia, Africa Latin America* **51:** 22-27. **(6.15)**
6. Gautam A, Khurana R, Manes, GS, Dixit AK and Verma A (2019). Development and evaluation of inclined plate metering mechanism for carrot (*daucuscarota* l.) pelleted seeds. *Int J Biores Stress Manag* **10:** 513-519.**(4.65)**
7. Grewal IK, Singh JP and Singh H (2019). Selection of solid waste dumping site for Ludhiana city using geoinformatics. *Int J Appl Inform Syst* **12:** 8-13. **(6.88)**
8. Kaur M, Garg S, Sharda R and Singh KG (2019). Effect of seasonal variation on the performance of solar photovoltaic pumping system under field conditions. *Indian J Agric Sci* **89:** 37-44. **(6.23)**
9. Kaur S, Raheja A and Aggarwal R (2019). Performance evaluation and optimization studies of border irrigation system for wheat in the Indian Punjab. *Water SA* **45:** 41-47. **(6.78)**
10. Mahal JS, Manes GS, Singh A, Kaur S and Singh M (2019). Complementing solutions and strategies for managing rice straw and their impact in the state of Punjab. *Agric Res J* **56:** 588-593. **(4.71)**
11. Nishtha V, Parminder S and Rakesh S (2020). Evaluation of drip irrigation and fertigation in African marigold (*Tageteserecta* L.). *Agric Res J* **57:**80-85. **(4.71)**
12. Satpute S, Raheja A, Aggarwal R, Kaur S and Sharma S (2019). Groundwater quality assessment for drinking and irrigation. *J Soil Salinity Water Qual* **11:** 186-191. **(4.94)**
13. Sekhon KS, Kaur A, Thaman S, Sidhu AS, Garg N, Choudhary OP, Buttar GS and Chawla N (2020). Irrigation water quality and mulching effects on tuber yield and soil properties in potato (*Solanum tuberosum* L.) under semi-arid conditions of Indian Punjab. *Field Crops Res* (in press) DOI: org/10.1016/j.fcr.2019.06.001. **(9.87)**
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15. Shubham M and Ritesh J (2020). Review on use of waste plastic in concrete. *Int J Innov Eng Technol* **15:** 26-28. **(6.67)**
16. Sidhu RS, Singh NP, Singh S and Sharda R (2020). Foliar nutrition with calcium nitrate in strawberries (Fragaria × ananassa Duch.): Effect on fruit quality and yield. *Indian J Ecol* **47:** 87-91. **(4.96)**
17. Singh AK, Manes GS, Dixit A, Singh SK and Singh M (2019). Development and evaluation of multi nozzle back pack type power sprayer. *Indian J Agric Sci* **89:** 1005-1010.**(6.23)**
18. Singh B, Biwalkar N and Chhina R (2020). Response of sweet pepper under varying fertigation and irrigation application grown in naturally ventilated greenhouse. *J Krishi Vigy* **8:** 236-241. **(4.41)**
19. Singh G, Kumar R, Biwalkar N and Grover J (2019). Evaluation of capsicum varieties under naturally ventilated greenhouse in Faridkot district of Punjab, India. *Int J Curr Microbiol Appl Sci* **8:** 1407-1413. **(5.38)**

20. Singh K and Kumar S (2019). Use of broken toughened glass as a replacement of coarse aggregates in concrete. *Indian J Pure Appl Biosci* **7:** 416-424. **(4.71)**
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23. Singh MC, Singh KG and Singh JP (2019). Nutrient and water use efficiency of cucumbers grown in soilless media under a naturally ventilated greenhouse. *J Agric Sci Technol* **21:** 193-207. **(6.83)**
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25. Singh RP, Haoxin Xu, Kaushik SC, Rakshit D and Romagnoli A (2019). Effective utilization of natural convection *via* novel fin design and influence of enhanced viscosity due to carbon nano-particles in a solar cooling thermal storage system. *Solar Energy* **183:** 105-119. **(10.37)**
26. Singh RP, Kaushik SC and Rakshit D (2020). Performance evaluation of charging process in a cascade latent heat storage system (C-LHSS) based on heat flux DSC results. *Int J Therm Sci* **106274:** 1-14. **(9.476)**
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2. Singh MC (2019). Groundwater pollution, causes, assessment methods and remedies for mitigation: A special attention to Indian Punjab. In: *Contaminants in Agriculture and Environment: Health Risks and Remediation Volume 1*, Kumar V, Kumar R, Singh J and Kumar P (eds), Agro Environ Media, Haridwar, India. pp. 148-172

Manuals

1. Kaur H (2019). Practical Manual on Computer Programming and Data Structures, Department of Electrical Engineering and Information Technology, Punjab Agricultural University, Ludhiana. pp. 57
2. Kumar S and Jain R (2020). Teaching Manual on Water Shed Hydrology, Department of Civil Engineering, Punjab Agricultural University, Ludhiana. pp.57
3. Singh M, Singh A, Verma A, Goyal R, Singh M and Dixit A (2019). PAU Super SMS - A Precursor to *In-Situ* Paddy Straw Management, Department of Farm Machinery and Power Engineering, Punjab Agricultural University, Ludhiana. pp.16

Research Bulletins

1. Aggarwal R, Kaur S, Satpute S, Garg S and Raheja A (2019). Research Digest - 2019 on Irrigation Water Management in Punjab, Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana. 84 p.
2. Singh KG, Singh A and Ashraf A (2019). Development of Slow Sand Filter for Closed Soilless System in Protected Cultivation, Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana. 6 p.

COLLEGE OF BASIC SCIENCES AND HUMANITIES

Research Papers in Indian and Foreign Journals

1. Ahuja R, Sidhu A and Bala A (2019). Synthesis and evaluation of iron sulfide aqua nanoparticles (FeS-NPs) against *Fusarium verticilloides* causing sheath rot and seed discoloration of rice. *Eur J Plant Pathol* DOI: org/10.1007/s10658-019-01758-3. **(7.74)**
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SUMMARY AND HIGHLIGHTS OF ANNUAL REPORT OF PUNJAB AGRICULTURAL UNIVERSITY

(July 1, 2019 to June 30, 2020)

Research, teaching and extension activities of Punjab Agricultural University in agriculture and related fields have helped the state achieve productivity goals and engage with challenges of groundwater management, residue management, pesticide use, soil health and pandemic-related labour shortages and marketing disruptions.

RESEARCH

Improved varieties and enabling technologies related to production-protection, farm machinery, post-harvesting and processing along with interventions related to subsidiary occupations constituted the major research output.

Crop Improvement

Varietal development focused not only on productivity and resistance but also on traits related to longer storage life, premium market segment, nutraceutics and milling quality. Diversification crops had more than 75 per cent share in the varietal output. During the report period, PAU developed/released 14 varieties of different crops (3 of vegetable crops and 11 of other crops including 3 of rice, 2 of barley, and one each of maize, mash, groundnut, wheat, bajra and fodder maize). In addition to these state releases, nine varieties (two each of *Bt* cotton and oat, and one each of chickpea, wheat, barley, Napier Bajra, and ryegrass) were identified at national level, out of which three have been notified by the Central Variety Release Committee.

Crop	Variety
Onion	POH 1
Brinjal	Punjab Bharpoor
Sponge gourd	Punjab Nikhar
Maize	JC 12 and J 1007 (Fodder maize)
Mash	Mash 1137
Chickpea	GL 13001**
Groundnut	J 87
Pearl millet	PCB 165 and PBN 351*
Oat	OL 1861** and OL 1869-1**
Ryegrass	PBRG 2**
Wheat	PBW 752 and PBW 771*
Cotton	PAU *Bt* 2** and PAU *Bt* 3**,
Barley	PL 891* and DWRB 123
Rice	PR 128, PR 129 and HKR 47

* Notified at national level by Central Variety Release Committee

** Identified at national level

GERMPLASM ACQUISITION AND UTILIZATION

In order to expand genetic resource base and tap desirable traits, 7,418 accessions of various vegetable crops (pea, sweet potato, muskmelon, brinjal, cucumber, chilli, Chinese cabbage, tomato, potato, onion, amaranth, bittergourd, cauliflower, fenugreek, turmeric, pumpkin, garlic, spinach, coriander, okra, cowpea and fennel), fruits (citrus, *ber*, mulberry and guava), flower crops (chrysanthemum, gladiolus,

narcissus and Phalaenopsis), oilseeds (sesame, sunflower and soybean), pulses (urdbean, chickpea, fababean and pigeonpea), forages (sorghum and oat), millets (pearl millet, finger millet and little millet) and other cereal crops (maize, wheat and rice) were sourced and evaluated for potential traits.

BIOTECHNOLOGY

Crop	Research activities
Pigeonpea	Transgenic pigeonpea with *cry1Ab* gene for resistance against *Maruca vitrata* was developed.
Wheat	• PBW 771 variety (notified at national level) was developed by introgressing *Lr57-Yr40* gene in DBW 17 background by marker assisted selection (MAS). • High grain weight gene was pyramided with two stripe rust and one leaf rust resistance genes (*Lr57-Yr40+Yr15*) in PBW 550 background.
Rice	• Development of new varieties PR 128 and PR 129, white grained versions of PAU 201, was facilitated by MAS for bacterial blight resistance and grain pigmentation. • Introgression lines of *Oryza nivara* and *O.rufipogon* with brown plant hopper resistance were developed in cultivated rice background.

SEED AND NURSERY PRODUCTION

- During 2019-20, PAU produced 424 q of vegetable crops, 63,279 q seed of other field crops besides providing 5,403 q propagation material of turmeric and potato.
- About 6 lakh fruit nursery seedlings (worth Rs 1.37 crore) were made available to the farmers.
- In case of agroforestry, 93,539 seedlings were provided to the farmers and one lakh poplar cuttings were supplied to the Department of Forests and Wildlife Preservation, Punjab.

CROP PRODUCTION TECHNOLOGIES

Horticultural crops

Microirrigation

- Drip irrigation and fertigation schedules were recommended for guava and bittergourd.
- Mixed use (with fresh water) of poor quality irrigation water was recommended in coarse-textured soils of canal command areas through drip irrigation in potato planted in paired rows on raised beds.

Paddy residue mulching

- Paddy residue mulching (@ 5.5 tons/acre) was recommended in pear, peach and plum for better yields.

Intercropping

- Short duration groundnut TG37A can be grown as an intercrop in *ber* orchards after pruning in May for additional income.

Floriculture

- Prolonged (4 year-long) natural development process of gladiolus cormels into flowering grade corms can be shortened (to 2 years) by treating cormels with GA_3 (gibberellic acid) @ 200 ppm.

Field crops

Cultivation methods

- New DSR (direct seeded rice) technique – *Tar wattar* DSR –was proposed.
- AL 882, a short duration and early maturing variety of *arhar*, can be densely planted from June 15 -25 for higher yields.

Intercrops, relay crops and new cropping sequences

- Two rows of okra can be intercropped in spring sugarcane planted at 90 cm X 30 cm or 120 cm X 30 cm.
- A new diversification oriented cropping system, groundnut-pea-sunflower, was recommended.
- Under certain soil situations (such as waterlogging/ sodicity) which prohibit timely harvesting of *parmal/basmati* rice and use of farm machinery, wheat can be relay cropped by broadcasting wheat seed in standing rice crop just before or immediately after last irrigation to rice during October 10-25.
- Celery can be intercropped in short duration varieties of pea for higher returns. Alternatively, pea can be planted in fields under celery during the previous year; naturally germinated seedlings of celery crop can be retained.

Nutrient management

- Urea @ 45 kg/acre in timely sown wheat and @ 35 kg/acre in late sown wheat should be applied each with first and second irrigation for better nitrogen use efficiency.
- Use of Leaf Colour Chart (LCC) was extended to *basmati* rice. Critical green shade levels vary from 3.5 to 4, depending on the variety.

Biofertilizers

- Liquid microbial inoculant comprising *Burkholderia seminalis* and *Bradyrhizobium* species was recommended for better yield and quality of forage pea.
- The University prepared and provided biofertilizers for 16 crops, which were enough for inoculating more than 63 thousand acres.

Productivity enhancement through growth regulators

- To address low germination in sugarcane, seed cane setts can be soaked overnight in Etherel (2-chloroethyle phosphonic acid) solution @ 100 ppm.
- Foliar application of urea @ 2% in chickpea at flowering and pod formation stages was recommended.
- Foliar application of potassium nitrate @ 1.5% in case of paddy crop at boot stage was recommended for enhancing grain yield.

Abiotic stress management

- Irrigation induced salinity stress in cotton-wheat system can be managed by adding rice residue biochar (@ 4 t/ha) in cotton.

Residue management

- Field trials for *in situ* paddy straw degradation, conducted at five locations with four different microbial preparations developed by PAU and four commercial products suggested that *Delftia* treatment showed higher decrease in total fibre content and C:N ratio at most of the locations.

CROP PROTECTION

Fruits

- To evade fruit fly infestation, mature green and hard guava fruits of rainy season before colour break stage can be covered with white non-woven bags during end of June to middle of July.
- The common brown snail, *Macrochlamys indica*, an important pest of citrus nursery in Punjab can be managed by following integrated measures involving application of metaldehyde (2.5% dust) based bait, cleaning up debris in/around nursery and by spreading papaya leaves or gunny bags to lure and eventually destroy snails.

Vegetable crops

- Use of aqueous neem fruit extract was recommended for eco-friendly management of mites in capsicum under protected cultivation.
- A minimum waiting period of one week, 20 days and 30 days was recommended to be observed in case the rapeseed-mustard crop meant for use as *saag*, is sprayed with thiomethoxam 25WG, dimethoate 30 EC/chlorpyriphos 20 EC and quinalphos 25EC, respectively.
- Purple blotch of onion can be managed by foliar application of Caviet 25WG (tebuconazole 25% w/w).
- Black scurf of potato can be managed by dipping tubers in Emesto Prime (penflufen 22.43% FS) for 10 minutes.
- Whitefly was accorded the status of pest on brinjal. Difenthiuron 50 WP @ 200 g/acre can be sprayed to manage this pest.
- Average life of *Bemisia tabaci* (whitefly) was observed to be shorter during June-July as compared to April-May in brinjal.
- Mites infesting capsicum under protected cultivation can be managed by foliar spray of Omite (propargite) 57EC @ 200ml/acre or Oberon (spiromesifen) 22.9SC @ 100 ml/acre. The latter can also be used (@ 150 ml/acre) to control mites in okra.

Oilseeds and Pulses

- Commercial ***Bt*** formulation, Mahastra 0.5% WP @ 800 g/acre was found effective in reducing pod damage due to *Helicoverpa armigera* in gram.
- Pod sucking bug, *Clavigralla gibbosa* Spinola,

was identified as a pest of pigeonpea in Punjab. Foliar application of home-made neem extract (@ 1250 ml/acre in 100-125 litres of water) was recommended for managing this pest.

- White rust in rapeseed and mustard can be managed by foliar application of metalaxyl M4% + mancozeb 64% WP (Ridomil Gold) @ 250 g/100 litres of water per acre.

Maize

- Biocontrol of maize stem borer using *Trichogramma chilonis,* carried out at farmers' fields, resulted in 53.2 per cent reduction in dead hearts incidence as compared to 82.9 per cent in chemical control.
- Fall armyworm can be managed by foliar application of chlorantraniliprole 18.5SC, emamectin benzoate 5WG or spinetoram 11.7SC in grain maize. In fodder maize, it can be managed by chlorantraniliprole 18.5SC.

Sugarcane

- Biocontrol of sugarcane borers using egg parasitoids, *Trichogramma* spp. reduced their incidence by 53.4-57.9 per cent.
- Early shoot borer, *Chilo infuscatellus* Snellen, can be managed with Takumi 20WG (flubendiamide).
- Sugarcane termite, *Odonto termesobesus* Rhamb, can be managed with Coragen 18.5 SC (chlorantraniliprole).

Cotton

- Thrips can be managed with Celcron 50 EC (profenofos).
- Jassids can be managed with Keefun 15 EC (tolfenpyrad).
- Daita 10 EC (pyriproxyfen) and Sefina 50 DC (afidopyropen) were recommended for managing whitefly.
- Amistar 325 SC (azoxyustrobin 18.2%+ difenoconazole 11.45 SC) was found effective in managing fungal leaf spot and sooty mould.

Wheat

- Foliar application of Opera 18.3SE (pyraclostrobin and epoxyconazole) or Caviet 25WG (tebuconazole 25% WG) was recommended to control yellow rust.
- Neonix (imidacloprid 18.5% and hexaconazole 1.5% FS) was recommended to manage termites and smuts. Seed treatment with Cruiser (thiomethoxam 70WS) was recommended to manage termites.

Rice

- Rice root nematode, *Meloidogyne graminicola*, in nursery beds can be managed in an eco-friendly way by applying mustard cake (@ 40 g/m^2) before sowing of nursery.
- Augmentative releases of *T. chilonis* and *T. japonicum* in organic *basmati* rice resulted in 55.2 per cent and 49.9 per cent reduction in stem borers and leaf folders, respectively.
- Sheath blight can be managed by two foliar applications of Pikapika 25 EC (propiconazole).
- Treating seed with Sprint 75WS (carbendazim 25% + mancozeb 50%) was found effective in controlling seedborne and early soilborne infections of sheath blight, brown spot and blast.

Weed control

- New pre-emergence herbicides AWKIRA 85WG (pyroxasulfone) and Platform 385 SE (pendimethalin 35% + metribuzin 3.5%) were recommended to manage *Phalaris minor*.
- Existing recommended dose of pre-emergence herbicide pendimethalin 30EC was revised upward to 1.5 litres/acre to manage likely risk of resistance development against pendimethalin by *P. minor.*
- A selective post-emergence herbicide Hitweed Maxx 10MEC (pyrithiobac sodium 6% + quizalofop ethyl 4%) was recommended for broad spectrum weed control in cotton.

RESIDUE ANALYSIS

- Out of 592 vegetable samples collected from market (149) and farmgate (443), 2.22 per cent of market samples and 1.34 per cent of farmgate samples contained pesticides above maximum residue limit (MRL).
- In case of 319 samples of *basmati* rice, six samples had pesticide residue above MRLs.

FOOD SCIENCE AND TECHNOLOGY

Non-cereal pudding mix	Potato tubers of table purpose variety Kufri Pukhraj were used for making ready-to-cook non-cereal puddings. Due to its non-cereal, gluten free composition, it can cater to special clientele e.g. celiac patients, non-cereal fast keepers, etc.
Kinnow fruit bar	*Kinnow* fruit bars, having shelf life of six months, were prepared from *Kinnow* juice. The bar was microbiologically safe during the entire shelf life period of six months. This value adding technology considerably improves shelf life of otherwise perishable *Kinnow* juice.
Onion products	Low cost technologies were developed for the production of diverse onion products (onion puree, paste and flakes) which can be available for consumption throughout the year.
Lactic acid starter culture	Consortium of ten lactic acid bacterial strains was developed as a starter culture for preparing metabiotic lacto-fermented beverages and pickles from powder and rhizomes of turmeric and *amla*.
New microbes	• Two fungus strains *Aspergillus nomius* and *A. flavus*were were isolated, respectively, from pineapple peel and citrus pulp for their potential use in Kojic acid production. • Four strains of *Pediococcus acidilactici* were isolated from infant faeces for potential application in lactic acid fermented beverage production.
Incubational facilities	Food Industry Business Incubation Centre provided incubation facilities to six entrepreneurs.

FOOD AND NUTRITION

Novel health foods from traditional sources

- Wheatgrass powder prepared from 7-10 days old wheatgrass (shade-or freeze-dried) was found to be suitable for enrichment of frequently consumed foods.
- Six products, namely, jam, *chutney*, crush, syrup, leather and dried mulberry, prepared from three types of otherwise perishable mulberry fruits, exhibited moderate loss in antioxidant activity after four months.
- Eight products, namely, powder, *chutney, murabba*, two types of pickles, candy, jam and syrup were prepared from ripe and green *karonda* (*Carissa* spp.).
- Pumpkin seed flour (from raw or roasted seeds) can be used to supplement (upto 30%) various food products like *panjeeri, matthi* and cookies at commercial scale.

Community health

- The nutritional bars developed with the quality protein maize (QPM) and different ratios of other ingredients like cauliflower leaves, carrots, green chickpea and jaggery were highly acceptable in terms of sensory scores and could be safely stored for about four months.
- Supplementation of carom (*ajwain*) and fennel (*saunf*) seeds significantly improved lipid profile and antioxidant status of adult women.

POST-HARVEST TECHNOLOGY

Solar curing system for *Kharif* onion	The developed and recommended solar curing system allows curing by maintaining room temperature at 30^{0}C and relative humidity at 45±10% for nine days to ensure three-month storage.
Refrigeration system	A prototype of mobile thermoelectric refrigeration system (100L capacity) was designed and developed for retail sale and storage of summer fruits and vegetables.
Tuberose tinting	Tuberose spikes at tight-bud stage can be variably tinted by dipping basal portion (5-7 cm) in the dye solution comprising 1% food dye of desired colour, 2% sucrose solution and 300 mg/L citric acid for two hours.
Handholding for agro-processing	Seven new agro processing complexes and 10 jaggery processing plants were established by farmers with technical guidance from University.

AGRO-FORESTRY

Eucalyptus clone and planting technology for waterlogged areas	Clone PE 11 was found suitable for planting in salt-affected and waterlogged regions of the state. In such areas, *eucalyptus* should be planted on polythene-covered ridges for better survival and growth.
Intercropping	The onion variety PWO 35 recorded significantly higher bulb yield (19.8 t/ha) as compared to Punjab Naroya, PRO 6 and PRSC 10 under three-year old poplar plantation.
Nutrient management of nursery	In case of *Casuarina junghuhniana* under nursery conditions, dual inoculation (phosphorus solubilizing bacteria (PSB) + *Frankia*) resulted in more plant height, collar diameter and root length as compared to uninoculated control and single inoculation of either PSB or *Frankia*.

BEEKEEPING

- During spring, 10-frame hives performed better than 7- and 8-frame hives in terms of brood rearing and bee population build-up.
- Studies on muskmelon (var. Punjab Sunheri) grown under polynet house revealed that fruit set did not take place in polyhouse without bees.

LAC CULTURE

- The life cycle and productivity-linked parameters of lac insects (*Rangeeni* strain) were studied on plants of *Flemingia semialata, Flemingia macrophylla* and *Zizyphus mauritiana*. The *Rangeeni* strain completed all the life stages on these hosts. The duration of Katki crop varied from 105-110 days under Punjab conditions.

MUSHROOM CULTIVATION

- The cultivation technology of king oyster mushroom, *Pleurotus eryngii,* on wheat straw under Punjab conditions was recommended.
- Wheat straw and paddy straw based composts were prepared following the short method. Maximum yield, 18.65 kg/q, of *Agaricus bisporus* was harvested from wheat straw compost in comparison to 13.72 kg/q from paddy straw compost.

FARM MACHINERY

Boom type sprayer on paddy transplanter	A boom type sprayer attachment was developed and mounted on the rear of self-propelled four-wheel drive paddy transplanter, after removing its transplanting unit. The technology improves economics of the machine by minimizing its disuse period.
Sugarcane trench planter	Existing two paired rows sugarcane trencher was modified to single paired row trench planter.
Tractor operated vertical cup type vegetable transplanter	Tractor operated vertical cup type vegetable transplanter developed for cell type nursery was recommended. It is a two-row semi-automatic tractor mounted vegetable transplanter used for transplanting cell type nursery of different vegetable crops.
Happy Seeder refinement	Three flail blade rows, having replaceable sharp edge section of 4 mm thickness mounted on the rotor of Happy Seeder at an angular spacing of 1200 with tines having serrated bit (4 mm replaceable), improved field capacity and fuel consumption of Happy Seeder by 13.7 and 21.5 per cent, respectively, as compared to existing design.
Sanitizing tunnel	Two prototypes of sanitizing tunnel (9'x4'x7.5'), capable of running on electrical and solar energy, were designed and developed.
Quality control	The Farm Machinery Testing Centre tested 28 farm machines.

APPARELS AND TEXTILES

Protective gloves for okra pluckers	Protective full arm length gloves for plucking okra were prepared from the knitted fabric. Double layer of fabric was provided for palms and fingers.
Mosquito repellant fabric	The microencapsulated fabric developed using *eucalyptus* oil (10%) was found effective in repelling mosquitoes.
Waste management	• The knitted fabrics were constructed from a blend of soybean and waste wool fiber. The weft knitted fabrics were found to be suitable for both apparel and upholstery applications like sweaters, cardigans, socks, T-shirts, cushion covers and table linens. • Paddy straw was used for fibre extraction and blending with cotton to develop yarn for blinds, wall hanging and *durrie*.
Plant-based fabric finishes	Functional finishes were developed using plant extracts. Pomegranate, *Mousami* and *Ratanjot* can be effectively used for treating fabric against microbial activity.
Community service	During lockdown period, stitching of face masks, face shields and gloves was initiated to fulfill the requirement of farm labour in University. A video on the development of protective masks was prepared to provide mask preparation skills.

RODENT, BIRD AND VERTEBRATE PEST MANAGEMENT

- Survey of rodent damage in wheat crop fields sown with different technologies like conventional tillage, rotavator or drill machine, Happy Seeder with standing stubbles, and Happy Seeder with paddy mulch in different villages of district Fatehgarh Sahib, Tarntaran, Gurdaspur and Hoshiarpur revealed that rodent damage in these fields is not technology specific but location specific.
- Use of reflective ribbon in tomato and mustard crops was found up to 95-97 per cent effective in bird control. Nylon nets installed in mustard crop during the germinating stage gave 100 per cent protection from bird damage.
- Damage by fruit bats was minimized by using eco-friendly method of artificial light using LED (30W) bulbs in *ber* orchard.

TECHNOLOGIES COMMERCIALIZED

- During the report period, 13 Memoranda of Agreement (MoA) were signed to commercialize a range of varietal, farm machinery, processing and other technologies.

EDUCATION

- During 2019-20, the University offered 9 Undergraduate, 43 Masters, 29 Doctorate and two Diploma programmes. Admissions to various undergraduate and postgraduate programmes were made through entrance tests. Fourteen students from Nepal are studying in different academic programmes of the University. About 850 students in various programmes were awarded scholarships and financial assistance.
- At the Annual Convocation of PAU (on July 24, 2019), 344 students who passed out Ph.D, M.Sc, M.Tech, MCA, MBA and MJMC during 2017-18 were awarded degrees. In addition, 70 students were awarded Merit Certificates and 16 Gold Medals/ Medals. Fourteen scientists were conferred with awards as well as citations.
- At the Graduate Convocation and Prize Distribution Function of PAU (on November 5, 2019), 398 students of various undergraduate programmes were awarded degrees. In addition, 15 students were awarded Gold Medals, two Academic Roll of Honour and 60 Merit Certificates.
- In sports, PAU clinched Silver Medal in Basketball (W) in Team Games (M&W) during the 20th All India Inter-Agricultural Universities Sports and Games Meet, held at Sri Venkateswara Veterinary University (SVVU), Tirupati from March 1 to 5, 2020. In addition, PAU Sports and Youth Activities Council awarded 37 Merit Certificates, 19 University Colour and five Roll of Honour to the outstanding sportspersons/artists for their proficiency in sports, games, cultural and literary events for the session 2019-20.
- In cultural activities, PAU students clinched Gold Medal in Group Song Indian, Patriotic Group Song, Light Vocal Solo and On the Spot Painting during the 20th All India Inter-University Youth Festival 2019-20, organized by Indira Gandhi

Krishi Vishwavidyala, Raipur, Chhattisgarh in collaboration with Indian Council of Agricultural Research (ICAR), New Delhi from February 8-12, 2020. Besides, they bagged Gold Medal in Mono Acting and *Pirri* Making, Silver Medal in *Giddha* and *Chhikku* Making, and Bronze Medal in Debate, Collage Making, Quiz, *Bhangra*, Mime, *Mehandi*, *Naala Bunna* and *Phulkari* during the Punjab State Inter-University Youth Festival 2019-2020, organized by Director Youth Services, Government of Punjab, at Chandigarh University, Mohali from January 30-31, 2020.

EXTENSION

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

- It organized nine *Kisan Melas* during September 2019 (seven) and March 2020 (two). Lakhs of farmers from Punjab and adjoining states participated in these *melas,* discussed their farm issues with experts, purchased improved seed and farm literature, and participated in produce competitions. Four progressive farmers were honoured during PAU *Kisan Mela* at Ludhiana in September 2019 for their outstanding contributions to agriculture, horticulture and allied occupations.
- The University organized 281 field days; 850 adaptive research trials; 107 on farm trials; 5,363 cluster front line demonstrations; 2,590 method demonstrations; 1,426 training programmes (970 short, 286 vocational, 107 in-service and 63 sponsored); 690 exhibitions and three Research and Extension Specialists' Workshops for the benefit of farmers.
- Special campaigns on paddy straw management, whitefly management in cotton and yellow rust management in wheat were organized. The campaigns resulted in making 30 villages in different districts of Punjab as zero burning villages and helped manage whitefly and yellow rust successfully.
- The 'PAU Live Programme' (every Wednesday on Facebook and YouTube) was started to guide the farmers, farm women and rural youths regarding improved crop varieties and their production-protection technologies, allied agricultural enterprises, weather forecast, etc. More than 40,000 - 50,000 farmers are connected with it. Four programmes were organized during the report period.
- More than 9.4 lakh farmers are receiving *Kheti Sandesh* (a digital newspaper which transfers latest technology to farmers) on their WhatsApp. Apart from this, 1,111 WhatsApp groups were formed by the scientists of KVKs/FASCs and 10,636 messages were sent for the transfer of latest technology to the end users.
- The University enrolled 240 PAU *doots* and sent 87 messages. All KVKs enrolled 1,145 *doots* and sent 940 messages. Till date, 7,488 farmers have been enrolled as PAU *doots*.
- Five lakh farmers were enrolled for weather based agro-advisory.
- *Kisan* Mobile Advisory Service (KMAS) involved about 89,000 farmers and 1,145 messages were sent for transfer of latest technology.
- The Communication Centre published 11 issues each of monthly magazines Progressive Farming and *Changi Kheti* (because of complete lockdown due to COVID-19 pandemic, a combined issue of May-June 2020 was brought out) with a combined circulation of 1,38,700; revised editions of Package of Practices (twice a year; *Rabi* Crops and *Kharif* Crops); and 32 new/revised bulletins. In addition, it released several articles (more than 300) and press notes (660) in English and Punjabi for publication in various newspapers and magazines. It also organized 234 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 2019-20 with the following:

- California State University, Fresno, USA.
- International Fertilizer Development Centre, USA.
- International Rice Research Institute, Manila, Philippines.
- India Meteorological Department, Ministry of Earth Sciences, New Delhi.
- Jamia Millia Islamia University, New Delhi.
- Indian Institute of Food Processing Technology, Thanjavur, Tamil Nadu.
- Guru Nanak Dev University, Amritsar, Punjab.

- Thapar Institute of Engineering and Technology, Patiala, Punjab.
- John Deere (India) Private Limited, Pune, Maharashtra.
- M/s Pagro Frozen Foods Private Limited, Sadhugarh, Fatehgarh Sahib, Punjab.

AWARDS AND HONOURS

- The Punjab Agricultural University was ranked 192nd in the 6th Annual US News Best Global Universities rankings for the year 2020. The PAU is the only University from India to have made it to the list in the field of agricultural sciences.
- The PAU's All India Coordinated Research Project on Fodder Crops and Utilization (AICRP-FCU) in the Forage and Millet Section, Department of Plant Breeding and Genetics, was conferred with an **Appreciation Award** during the National Group Meet *Rabi* 2019-20.
- The PAU's Centre of All India Network Programme on Organic Farming received the **Best Centre Award 2018-19** during the Annual Group Meeting.
- Engineers of PAU were honoured by Project Coordinator (ICAR), AICRP on FIM, Bhopal for 'outstanding' rating to All India Coordinated Research Project (AICRP) on Farm Implements and Machinery (FIM), PAU, Ludhiana Centre in 2019.
- The *Krishi Vigyan Kendra*, Sangrur was conferred with the **Best KVK Award 2018** during the "Annual Zonal Workshop of KVKs" of Zone-1, held at GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand (August 3-5, 2019).
- The *Krishi Vigyan Kendra*, Bathinda received the **Best National Innovations on Climate Resilient Agriculture (NICRA) KVK Award 2019** from the Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad.
- The *Krishi Vigyan Kendra*, Jalandhar received **Braja Gopal Sharma Memorial All India Outstanding Agricultural Extension Award 2019** from Society of Advancement of Human and Nature (SADHNA), YS Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh. It also received the **Best KVK Award 2020** of Punjab from ICAR-Agricultural Technology Application Research Institute, Ludhiana, Zone-I.

ANNUAL REPORT

2019-20

The Annual Report of
Punjab Agricultural University, Ludhiana
for the year **2019-20**

Authenticated

Chandigarh, Dated

Signature

Chief Minister, Punjab
Minister Incharge
Department of Agriculture and Farmers' Welfare

Dr Baldev Singh Dhillon, Vice Chancellor, PAU, planting a sapling on the occasion of the 550th birth anniversary of Sri Guru Nanak Dev Ji

Panoramic view of Food Industry and Craft Mela

PUNJAB AGRICULTURAL UNIVERSITY

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