



ANNUAL REPORT

2017-18



Punjab Agricultural University
LUDHIANA



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
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RESEARCH

Research is a core mandate of Punjab Agricultural University (PAU). The University pursues a dynamic research agenda in response to emerging situations and challenges in agriculture of the region. The current research focus includes crop improvement, climate adaptive technologies, conservation of natural resources, crop residue management, integrated pest and disease management, high input use efficiency, and farm mechanization. Efforts are also being made towards value addition and income enhancement through post-harvest handling and processing technologies, subsidiary occupations, strengthening and exploring value chains and market analysis to help farmers make informed decisions.

CROP IMPROVEMENT

The crop improvement programmes addressed a wide spectrum of target traits including productivity, tolerance to abiotic and biotic stresses besides nutritional and processing quality. Varieties of field crops including sugarcane, pulses, oilseeds and forages, important for diversification, were released. Notably, fruits, vegetables and ornamentals accounted for a substantial share of new varieties. Besides productivity and resistance, vegetable breeding programmes aimed at capturing off season premium market and high quality produce under protected cultivation.

The University developed/approved 25 varieties of different crops (13 of field, 4 of fruit, 6 of vegetable and 2 of ornamental crops) which were recommended for cultivation in Punjab. Five varieties developed by PAU, namely CoPb 92 (sugarcane); OL 11, OL 12, and OL 1769 (oats); and PMH 12 (maize) were released at national level, three of them in zones which do not include Punjab state.

FIELD CROPS

- **PR 127 (Rice):** This variety combines high yield, earliness and resistance to all the 10 prevalent bacterial blight pathotypes in the Punjab state. It carries a novel bacterial blight resistance gene from *Oryza glaberrima*. Its plants are 104 cm tall and it matures in about 107 days after transplanting. On an average, PR 127 yields 30.0 q/acre.



PR 127



- **Pusa Basmati 1637 (Basmati rice):** It has been developed by Indian Agricultural Research Institute (IARI), New Delhi. It is a blast tolerant version of Pusa Basmati 1. Blast resistance introgressed *Pi 9* gene would help reduce pesticide residue issues. It matures in 108 days after transplanting and attains plant height of 109 cm. Average paddy yield of this variety is 17.5 q/acre.
- **Unnat PBW 550 (Wheat):** This variety is a rust resistant version of PBW 550 variety and has been developed through Marker Assisted Selection (MAS). It has been recommended for cultivation in Punjab under medium - late sown irrigated conditions (second to fourth week of November). On account of its short duration, Unnat PBW 550 can extend window available for rice residue management and facilitate timely sowing of summer *moong*. It has good grain and *chapatti* quality. It has an average plant height of 86 cm and matures in about 145 days. It yields on an average 23.0 q/acre.
- **LD 1019 (Desi cotton):** It is a shattering tolerant variety of *Desi* cotton, i.e., it can retain seed cotton in the opened bolls for a longer time. As a result, it requires two to three pickings only (as compared to about 5 in other *Desi* cotton varieties), thereby reducing labour costs. Its average seed cotton yield is 8.6q/acre. It is tolerant to jassid, whitefly, *Fusarium* wilt and bacterial blight.
- **CoPb 92 (Sugarcane):** It is an early maturing variety that attains sucrose content of 16.2-17.4 per cent during November-December and yields *gur* of very good quality. Average cane yield of CoPb 92 is 335 q/acre. It has medium thick, tall, purple-green coloured canes with high tillering, and is resistant to frost and most of the prevalent pathotypes of red rot disease. It has lesser susceptibility to borer complex than the check varieties. It is a good ratooner.
- **CoPb 93 (Sugarcane):** It is a mid-late maturing variety that attains 17.1-19.6 per cent sucrose content at maturity (January-February) and gives an average cane yield of



Pusa Basmati 1637



Unnat PBW 550



CoPb 92

390q/acre. *Gur* quality is also good. It is a good ratooner with tall, medium thick and yellowish-white canes. It is tolerant to prevalent pathotypes of red rot disease.

- **CoPb 94 (Sugarcane):** It is a mid-late maturing variety with average cane yield of 400 q/acre and sucrose content 16.4-19.2 per cent (January-March). It has tall, thick, cylindrical and yellowish-green canes. It is tolerant to prevalent pathotypes of red rot and smut.
- **AL 882 (Pigeonpea):** This is a short statured (160-180 cm tall) and early maturing (132

days) variety with determinate growth habit. Its early maturity enables timely sowing of succeeding wheat crop and compact architecture facilitates effective pest management with chemicals. Pods are borne at the top of the plant in multiple clusters. It yields 5.4 q/acre on an average.

- **Giriraj (Raya):** It has been developed by Directorate of Rapeseed and Mustard Research, Bharatpur, Rajasthan and is recommended for cultivation in Punjab, Haryana, Delhi and parts of Rajasthan. It is a bold seeded variety with tolerance to terminal heat stress. It is moderately resistant to white rust. It matures in 144 days, has 40.3 per cent oil and yields on an average 7.7 q/acre.
- **TG37A (Groundnut):** This mutant variety has been developed by Bhabha Atomic Research Centre, Mumbai. Each pod bears 2-3 kernels. It matures in 101 days, has 48.6 per cent oil content, 5.8 per cent soluble sugar content and gives an average yield of 12.3 q/acre. This early maturing bunch type spring groundnut variety is suitable for sowing after potato/pea.
- **OL 11 (Oats):** OL 11 (released as OL 1760 in Southern zone) is a single cut variety recommended for irrigated areas of Punjab state. Its fodder quality is superior to OL 9 and Kent. On an average, it yields about 245 quintals of green fodder and 8.5 q of seed per acre.
- **OL 12 (Oats):** OL 12 (also known as OL 1802-1) is a single cut variety of oats recommended for North West Zone (Punjab, Haryana, Rajasthan, Uttarakhand and Western Uttar



AL 882



Giriraj



TG37A



OL 11



OL 12



BL 43

Pradesh). Its average green fodder yield is 215 q/acre with seed production of 8.6 q/acre.

- **BL 43 (Berseem):** It is a quick growing variety with more number of tillers. It has superior fodder quality. It has better tolerance to stem rot (*Sclerotinia sclerotiorum*). Average green fodder yield of this variety is 390 q/acre up to first week of June. Higher yield share of the first and the last cuts can help overcome lean period fodder shortage. Seed yield (1.61q/acre) of the crop receiving last cut at the end of March is also good.

Varieties of field crops identified/released in other zones

- **OL 1769 (Oats):** It is a single cut variety of oats recommended for Central Zone (Uttar Pradesh, Maharashtra, Gujarat, Chhattisgarh and Madhya Pradesh). On an average, it yields 200q of green fodder per acre.
- **OL 1760 (Oats):** It is a single cut variety of oats recommended for Southern Zone (Tamil Nadu, Telengana, Andhra Pradesh and Karnataka). On an average, it yields 145q of green fodder per acre in this zone. Its fodder quality, by way of higher crude protein content and lower nitrate content, is better than the check varieties OS 6 and Kent. Plants of this variety are tall, having more leafiness and tillering ability.
- **PMH 12 (Maize):** It is a *Kharif* season medium maturity maize hybrid that has been identified for Zone III (Bihar, Jharkhand, West Bengal, Odisha and Eastern Uttar Pradesh). It has 28.4 q/acre average grain yield. It is



OL 1760

Varieties of field crops released/identified at national level

Variety (Crop)	National Zone
CoPb 92 (Sugarcane)	North Western Zone
OL 1802-1 (Oats)	North Western Zone
OL 1769 (Oats)	Central Zone
OL 1760 (Oats)	Southern Zone
PMH 12 (Maize)	Eastern Zone

moderately tolerant to *Maydis* leaf blight, *Erwinia* stalk rot, brown stripe downy mildew and post flowering stalk rot.

HORTICULTURAL CROPS

Fruit Crops

- **Punjab Safeda (Guava):** Fruits of this variety are medium to large in size, round with smooth creamy-white skin, white flesh and have firm texture. Fruits have 13.4% TSS and 0.62% acidity. This variety has 28 kg/tree average yield. This variety surpasses the popular Allahabad Safeda variety in yield, TSS and fruit weight.



Punjab Safeda

- **Punjab Kiran (Guava):** Fruits of this variety are medium in size, round to oblong, and pink fleshed. This variety is unique among pink fleshed guavas on account of smaller and softer seeds. Fruits have 12.3% TSS and 0.44% acidity. Its average yield is 48 kg/tree.
- **Early Gold (Sweet Orange):** It has low seed number (2-6 seeds/fruit) and high juice content (47.2%) with attractive golden yellow colour (compared to light coloured juice and flesh of *Mosambi*), and a good blend of sugar and acidity. Fruit ripens during last week of October to mid of November. Average fruit yield of this variety is 45 kg/ tree.
- **Carrizo (New rootstock for Kinnow mandarin):** This rootstock is tolerant to *Phytophthora* disease and Kinnow fruits produced on it possess higher TSS (11.3%) and fruit weight (211.2g) as compared to plants raised on rough lemon. As this rootstock is suitable for soils having pH less than 8.0, it is recommended for sub-mountainous and central zones of Punjab. Kinnow on Carrizo rootstock yielded 7.3 per cent higher than that on rough lemon. Daisy and W. Murcott mandarin varieties in sub-mountainous and central regions are also thriving well on this stock.

Vegetable Crops

- **PAU Magaz Kadoo-1 (Pumpkin):** It is the first hull-less seed pumpkin variety of the country. Its seeds are hull-less (without testa) and suitable for use as 'Magaz'. Immature fruits can be used as vegetable also. Its fruits are medium sized and round which turn golden yellow at maturity. Its seeds have 32 per cent omega-6 fatty acids, 3 per cent protein and 27 per cent oil content. Its seed yield is 2.9 q/acre.
- **Punjab Kheera-1 (Cucumber):** It is suitable for cultivation under protected conditions. Flowers are parthenocarpic and fruits are dark green, seedless, bitter free, medium sized (125 g), 13-15 cm long and do not require peeling. September and January sown crops are ready for picking after 45 and 60 days, with



Punjab Kiran



Early Gold



PAU Magaz Kadoo -1



Punjab Kheera-1



Punjab Swarna



Kufri Ganga



Punjab Raunak

cumulative yield of 30 0q/acre and 370 q/acre, respectively. The variety will help harness off-season as well as premium quality cucumber market.

- **Punjab Tinda-1 (*Tinda*):** It is an early maturing variety (ready for first picking 54 days after sowing) and suitable for raising in spring season. Fruits are round, shining, green, pubescent, white fleshed and weigh on an average 60g (immature stage). Average yield of this variety is 72 q/acre.
- **Punjab Swarna (*Tomato*):** It is suitable for cultivation under protected conditions. Fruits are medium in size, oval and orange in colour. Fruits, borne in clusters of 8-10, have 4% TSS and carotene content of 14mg per 100g of fresh weight. First picking, ready 120 days after transplanting, gives early yield of 166 q/acre. The average cumulative yield is 1,087 q/acre.
- **Kufri Ganga (*Potato*):** This table purpose variety has compact and vigorous plants with light green foliage. Its tubers are large, oval creamy white with shallow eyes and white flesh. This variety gives an average tuber yield of 187 q/acre.
- **Punjab Raunak (*Brinjal*):** It is an early maturing variety of long fruit group. The fruits, borne in clusters, are attractive with shining deep-purple colour and green calyx. Average yield of this variety is 242 q/acre.

Flowers and Ornamentals

- **Punjab Shingar (*Chrysanthemum*):** It is a mid- to late-season variety suitable for loose flower production that requires 122 days for



Punjab Shingar



Punjab Mohini

flowering. Plants are about 62 cm tall, compact and with upright growth habit. Flowers are white in colour and decorative type. Flower yield of this variety is 71.8 q/acre.

- **Punjab Mohini (Chrysanthemum):** It is an early- to mid-season variety that requires 93 days for flowering. Plants are compact and about 15 cm tall. Flowers are single, Korean type, white with yellow centre and 3.1 cm wide. The variety is suitable for pot culture without staking and pinching, and produces 331 flowers per plant with flowering duration of 30 days. It is moderately resistant to *Septoria* leaf spot disease.

GERMPLASM ACQUISITION AND UTILIZATION

The university continues to liaise with agencies like National Bureau of Plant Genetic Resources (NBPGR), New Delhi to augment germplasm resource base for use in crop improvement programmes. To this purpose, a total of 10,638 germplasm accessions were sourced.

- A total of 5,017 accessions of minor millets with the aim of exploring their potential as summer crops (between *Rabi* and *Kharif* seasons) and keeping in view their nutritive value and heat/drought tolerance were obtained during 2017 from NBPGR and evaluated (See Table).
- For resistance to whitefly, cotton leaf curl virus (CLCV) and especially to jassid, 770 accessions of cotton were sourced from NBPGR. Glabrous types with jassid tolerance hold promise as non-hairy foliage does not favour whitefly oviposition.

Crop	No. of Accessions
Finger millet (<i>Eleusine coracana</i> Gaertn.)	1,505
Barnyard millet (<i>Echinochloa frumentacea</i>)	1,002
Foxtail millet (<i>Setaria italica</i> L.)	1,002
Proso millet (<i>Panicum miliaceum</i> L.)	1,000
Little millet (<i>Panicum sumatrense</i> Roth.)	508
TOTAL	5,017

- With focus on phyllody resistance and earliness, 2,669 entries of sesame were acquired.
- The other acquired cereal, millet and forage crop materials comprised wheat (997), rice (1194); pearl millet (30), cowpea (5), guar and fodder maize (1 each).
- In wheat, explorations and collections of *Elymus* and *Thinopyrum* grasses as potential donors of drought and cold tolerance have been made from Lahaul-Spiti region of Himachal Pradesh.
- In case of pulses, oilseeds and mint oil crops the entries comprised chickpea (280), pigeonpea (60), rajmash (22) and mungbean (13); soybean (250) and sunflower (139); and mentha (4).
- The germplasm material of vegetable crops included chilli (12); potato, tomato and brinjal (10 each); onion (8); pumpkin (6); snapmelon and watermelon (5 each); cucumber and bittergourd (4 each); and pea, muskmelon and wild melon (2 each).
- The fruit tree germplasm acquisitions included mango (24), ber (4), peach and plum (2 each); guava, pear, dragon fruit and pecan nut (1 each).
- In case of trees, ornamental plants and flowers, germplasm acquisitions included neem (38), gladiolus (3), bougainvillea (4), annual flowers (10), rose (2) and chrysanthemum (3). Seeds of 25 genotypes of neem were collected (from Western Rajasthan, Eastern Rajasthan, Haryana,

Punjab and Gujarat). These were used for nursery raising and for evaluation of azadirachtin content. The content ranged from 0.59-2.03 per cent (>0.60 % azadirachtin content considered 'high').

- In-house germplasm development in American cotton has led to identification of a new plant type suitable for high density planting and machine harvesting (See picture)

BIOTECHNOLOGY

The School of Agricultural Biotechnology has been partnering closely with the crop breeding groups for development of varieties through use of various biotechnological tools aimed at precise and accelerated gene transfer.

Field Crops

Wheat

- The SSR/SNP (simple sequence repeat/single nucleotide polymorphism) markers, appropriate for Marker Assisted Selection (MAS), have been developed for leaf rust and stripe rust resistance genes introgressed from wheat wild species *Aegilops geniculata* and *Ae. peregrina*. Six new stripe rust resistance genes from *Ae. tauschii*, *Ae. speltooides*, *T. dicoccoides*, *T. araraticum* and *Ae. triuncialis* have been transferred to cultivated wheat background.
- Karnal bunt resistant introgression lines derived from *Ae. triuncialis* and *T. monococcum* have been selected for further utilization in wheat breeding programme.
- High grain weight and high grain protein traits have been pyramided with stripe rust resistance genes in elite varietal backgrounds and agronomic evaluation is under progress.
- Genome editing is being used for developing high resistance starch and low acrylamide wheat lines.

Rice

- New genes for brown plant hopper resistance were identified from *O. nivara* (Bph 34) and *O. rufipogon* (Bph R) and transferred to PR122.
- *O. glaberrima* accessions have been



identified for high level of resistance against root knot nematode (RKN). Three accessions are being used to transfer RKN resistance to PR122 background. Neck blast resistance genes have been identified from two introgression lines derived from *O. glumaepatula* and *O. glaberrima* and are being transferred to Punjab Basmati 5 variety.

- A putative QTL for sheath blight resistance from *O. nivara* has been mapped on chromosome 1 of rice.

Maize

- Mapping of heat tolerance QTL/genes using SSR and gene based markers in F_{2:3} population derived from cross of LM11 and CML 25 genotypes of maize is in progress.
- *Matrilineal* gene, responsible for haploid induction capability of maize Stock 6, has been analysed through sequencing in maize inbred lines LM13, LM14, LM23 and LM24. *Matrilineal* gene will be knocked down through CRISPR/Cas9 in lines of maize as well as rice to develop haploid inducer lines.

Pulses and oilseeds

- The SSR and SNP markers have been developed from *Vigna mungo* and *V. radiata* genome sequence and *in silico* polymorphic markers have been validated in a set of 48 diverse *Vigna* genotypes.
- Marker assisted selection has been deployed for mobilizing *Cry1Ac* gene to elite chickpea backgrounds. About 100 BC₂F₂ plants positive for *Cry1Ac* have been identified.
- *Ascochyta* blight resistance is being transferred from exotic germplasm to kabuli chickpea background and molecular mapping



to this effect is in progress.

- MAS is being applied in breeding programmes of *Brassica* oilseeds for oil quality and white rust resistance.
- Aphid resistance is being transferred from *Brassica fruticulosa* to *Brassica* oilseeds.

Horticultural Crops

- Guava genome has been assembled, and SSR and SNP markers have been developed for mapping traits important for processing and nutritional quality.
- In muskmelon, male sterility and *Fusarium* wilt resistance genes have been mapped on chromosome 6 and 5, respectively, using SSR markers.
- Yellow vein mosaic virus resistance is being transferred from wild okra *Abelmoschus moschatus* to cultivated okra genotypes.
- *Phytophthora* resistant F₁ hybrids, developed from crosses of rough lemon with resistant rootstocks, have been identified under laboratory conditions. Confirmatory field screenings are underway.
- The CRISPR/Cas9 is being used for knocking out pectate lyase gene in tomato for enhancing shelf life.

SEED TECHNOLOGY

The University has been rigorously implementing the seed production programmes to make available seed of high genetic integrity and physical purity to farmers. During 2017-18, the University produced 59,137q seed of field crops and 9,296q seed of vegetable crops. Research on effectiveness of seed treatment with Vitavax Power (carboxin+thiram), a broad spectrum fungicide against a host of seed- and soil-borne diseases, led to recommendation of seed priming with Vitavax Power @ 0.25% as seed treatment for seed production of *kabuli* chickpea.

CROP PRODUCTION TECHNOLOGIES

Crop production technologies complementing varietal component are being developed consistently for harnessing potential productivity while conserving natural resources. These interventions attempt to raise farm incomes through ecologically sound approaches involving use of biofertilizers; more efficient fertilizers and application methods; crop residue mulching for integrated nutrient, water and weed management; improved planting methods; legume-based cropping systems; etc. Research work of the University led to the recommendation of following production technologies:

Seed production (q) during 2017-18

Season	Breeder	Foundation	Certified	Truthfully labelled	Total
Kharif 2017	891	1,649	8,230	14,451	25,221
Rabi 2017-18	4,708	7,446	16,118	5,644	33,916
Total	5,599	9,095	24,348	20,095	59,137

Vegetable seed production (q) during 2017-18

Season	Breeder	Foundation	Certified	Truthfully labelled	Total
Summer 2017	1.73	-	5.63	33.32	40.68
Turmeric	40.00	-	-	229.00	269.00
	41.73		5.63	262.32	309.68
Winter 2017-18	22.74	103.49	107.86	335.50	569.59
Potato	-	1,665.00	4,945.50	1,806.29	8,416.79
	22.74	1,768.49	5,053.36	2,141.79	8,986.38
Total	64.47	1,768.49	5,058.99	2,404.11	9296.06



Field Crops

Biofertilizers

- *Rhizobium* biofertilizer (LUR6 strain) has been recommended for summer and *Kharif* urdbean. The inoculation of seed with *Rhizobium* enhances grain yield by 1.4-3.8% and 2.1-6.2% in *Kharif* and summer seasons, respectively and imparts soil health benefits (higher bacterial count and dehydrogenase activity).
- Inoculation with *Azospirillum* culture, free living N-fixing bacteria, was recommended for increasing paddy yield besides improving microbial flora and plant available NPK content in soil.
- Integrated application of biofertilizers and inorganic fertilizers (at 75% and 100% of recommended nitrogen and phosphorus levels) improved plant growth parameters of poplar and *eucalyptus* under nursery environment.

Residue Management

- Paddy straw compost in maize @ 4.5 q ha⁻¹ along with standard dose of fertilizers was recommended as a substitute of farmyard manure (FYM), thereby helping in paddy residue management and tiding over shortage of FYM.
- Incorporation of paddy straw or its retention through Happy Seeder for more than three years increased wheat productivity (by 11.9% over conventional rice-wheat system) and improved soil health diagnostics of organic carbon, infiltration rate and macro-nutrient base.

Nutrient management

- Soil test-based urea dose in rice has been revised downward to 90 kg urea per acre from 110 kg urea per acre due to higher efficiency of neem-coated urea in comparison to ordinary urea. This will help in saving nitrogen (N) fertilizer without compromising crop yield.
- Use of PAU-Leaf Colour Chart technology has been extended to direct seeded rice and Bt cotton for need-based fertilizer N application.

- For better yield gains in direct seeded rice, the existing timings of fertilizer N application (130 kg urea/acre in three equal splits 2, 5, and 9 weeks after sowing) have been changed to 4, 6 and 9 weeks after sowing.
- Nutrient indexing of 20 benchmark sites in Gurdaspur district under rice-wheat system indicated that over a six-year period, available iron (Fe) decreased from 31 to 26 and manganese (Mn) from 29 to 18 mg kg⁻¹ soil, suggesting thereby about the impending micronutrient deficiencies consequent upon continuous rice-wheat cropping.

Irrigation water management

- Use of canal water in cyclic mode with sodic water for irrigating cotton was recommended in the event of scarcity of canal water. Occasional pre-sowing irrigation with sodic water can be safely given to avoid delay in sowing.
- In soils irrigated with water containing residual sodium carbonate (RSC) higher than 6.5 meq/L, wheat cultivar PBW 621 should be preferred to HD 2967 for obtaining acceptable yield levels without compromising grain quality.

Other production technologies for field crops

- Two sprays of Salicylic acid @ 7.5 g or KNO₃ (2%) in 100 litres of water/acre at flower initiation and one week after the first spray help enhance seed yield (by 20-23%) of *berseem*, which is often challenged by reduced seed setting due to high temperature and low relative humidity.
- Maize-pea-spring maize and maize-potato-spring maize cropping systems gave 7.1 and 7.7 t/ha more maize equivalent yield than rice-wheat system, besides conferring soil health and crop diversification advantages.
- Earlier released short duration rice variety PR126 has also been identified for direct seeding. The variety surpassed PR 115 in yield by 12.1 per cent while taking same period for maturity.
- Optimum seedling age for transplanting short



duration paddy varieties PR 124 and PR 126 has been recommended to be 25-30 days while for PR 121 and PR 122, optimum seedling age should be 30-35 days. In short duration varieties, prolonging nursery age reduces tillering and thus yield.

Horticultural Crops

Various production technology interventions recommended for fruits, vegetables and flowering plants are as under:

- Paddy straw compost @ 20 kg per guava tree applied during the month of May can substitute 50 kg FYM per tree. Likewise, in chilli crop, paddy straw compost @ 6q/acre can be used to substitute FYM. Vermicompost prepared using paddy straw and sugarcane bagasse performed significantly better than FYM in enhancing growth and yield of vegetable crops. These interventions can help diversify paddy residue management options and overcome limited availability of FYM.
- Three foliar applications of potassium nitrate @ 1.5% - 15, 30 and 45 days after full bloom - improved the fruit size and yield in semi-soft pear.
- Cyclic use of saline-sodic water and canal water with or without mulch has been recommended for obtaining higher potato and okra yields and enhancing soil health.
- To obtain better fresh rhizome yield, harvesting of turmeric should be done from end of December onwards. Curcumin content (3.82%) of the crop harvested at the end of December was higher than the curcumin content (3.05%) in the crop harvested in mid-November.
- To enable the use of tractor operated machinery, the existing recommended row spacing (60 cm) has been revised upward to 65 or 75 cm in potato and 67.5 cm in brinjal, capsicum, cabbage, *arvi*, turmeric and sweet potato.
- For early flower production, gladiolus varieties 'Punjab Glance' and 'Punjab Lemon Delight'

should be planted during first week of July to third week of August. This practice will help capture premium lean period market.

About 4.75 lakh high quality nursery plants of various fruits were provided to the growers during the report period.

CROP PROTECTION TECHNOLOGIES

Protection technologies broadly aim at managing pests and diseases through environmentally-benign technologies like biocontrol/biopesticides, green chemistry formulations, and through integrated pest/disease management approaches.

Field Crops

Disease, pest and weed management in wheat

- An integrated management approach for yellow (stripe) rust in wheat recommended deployment of resistant varieties and avoiding early sowing of crop particularly under poplar plantation in disease prone sub-mountainous areas of the state followed by monitoring of the crop beginning from second week of December.
- Aphid in wheat can be managed with foliar application of Taiyo (thiamethoxam 25WG).
- Post-emergence application of pre-mix (Shagun 21-11) of metribuzin + clodinafop propargyl at 500 g/ha + surfactant 1250 ml/ha at 30-35 days of sowing provides effective control of mixed weed flora in wheat. Its novel mode of action, different from its existing counterparts, will help tackle resistance in weeds like *Phalaris minor*. Similarly, pre-emergence application of Zakiyama (pendimethalin) 30EC within two days of sowing provides effective control of *P. minor* in wheat. This recommendation will broaden choice of brands of pendimethalin and competition will extend monetary and quality advantages to the farmers. Post-emergence application of Makoto (metsulfuron methyl) 20WP at 35 days after sowing effectively manages broadleaf weeds in wheat.

Disease and pest management in rice

- In rice-wheat sequence, the population of *Rhizoctonia solani*, a causal agent of rice

sheath blight, reached 5100 cfu/g of soil in the rice season. However, in rice – *Brassica* systems, its population was significantly lower at 4100 cfu/g soil. The data suggest that rotation with *Brassica* can help manage sheath blight severity in rice.

- Plant hoppers in Parmal and *basmati* rice can be controlled by using Chess 50 WG (pymetrozine) @ 120 g/acre without leaving any measurable residue in crop and soil system. The recommendation will augment insecticide base for the management of plant hoppers in rice.
- Natural enemies in IPM-handled and organic fields of rice were significantly higher (1.45 & 1.43 spiders/hill and 1.98 & 2.20 green mirid bugs/hill, respectively) than their respective populations in conventional counterparts.
- Bio-intensive integrated pest management (BIPM) module comprising integration of *Trichogramma* spp. (30, 44, 58 and 72 days after transplanting) and Bt sprays (37, 51 and 65 days after transplanting) significantly reduced the incidence of stem borer (60.7% reduction over control) and leaf folder (70.0% reduction over control), besides providing higher yield (15.41% increase over control) advantages in organic *basmati* rice.
- Comparative economics indicated the highest cost of production under conventional *basmati* farmer's field (Rs 25,206/acre) followed by that

under organic field (Rs 21,066/acre) and under integrated pest management (Rs 17,874/acre). The cost: benefit ratio was the lowest (1:2.67) under IPM conditions, followed by that under farmer's field (1:1.94) and organic (1:1.22) conditions.

- Bacterial foot rot or *Erwinia* rot has been identified as an emerging disease of rice in Punjab. Accordingly, varietal and chemical interventions are being devised.

Pest management in cotton

- Ten species of natural enemies of whitefly of cotton were recorded during survey in cotton growing areas of Punjab. Out of these, *Chrysoperla* was the predominant species. *Encarsia lutea* (Masi) and *Encarsia sophia* (Girault & Dodd) were the two parasitoids that emerged from whitefly pupae. Parasitization of whitefly by *Encarsia* spp. averaged over different cotton growing areas of Punjab was 5.2 per cent (range 1.5 to 9.1%).
- Molecular analysis (mitochondrial cytochrome oxidase I gene) identified whitefly populations from different regions of Punjab (Bakainwala, Fazilka; Ludhiana; and Jhunir, Mansa), Haryana (Moriwala; Sirsa, Fatehabad) and Rajasthan (Sri Ganganagar and Hanumanagarh) as *Asiall_1* species.
- Bio-intensive integrated pest management (BIPM) practices involving cultivation of Bt cotton crop following recommended



Erwinia rot in rice



agronomic practices, clean cultivation, installation of yellow sticky traps @ 100/ha, and two releases of 2nd instar of *Chrysoperla* larvae @ 10,000/ha along with two sprays each of neem oil (1%) and *Lecanicillium lecanii* resulted in 38.3 percent reduction of whitefly infestation over untreated control as compared to 78.2 per cent reduction in chemical control.

- 'Thrips' were included among sucking pests of cotton in Package of Practices. The insecticides, namely Curacron 50EC (profenophos), Polo 50WP (diafen-thiuron), and Fosmite 50EC (ethion) against thrips in cotton were recommended.
- A new systemic insecticide, Osheen 20SG (dinotefuran), can be used to manage jassid and whitefly in cotton.

Pest management in maize

- Stem borer in fodder maize can be managed with two releases – first on 10-day old crop and second a week thereafter, of biocontrol agent, *Trichogramma chilonis* @ 50,000 per acre. The approach can help in the production of organic fodder maize, and extend health advantages to dairy animals and human beings.

Rodent and bird management

- For managing rodent pests in wheat crop sown with Happy Seeder, double burrow baiting (baiting twice at 10-15 days interval) with 2% zinc phosphide during November-December and then during February-March was recommended.
- Application of micro - encapsulated 2.5% methyl anthranilate on small stacks of wheat bags prevented rodent attack for 28 days.
- Use of jute rope as physical barrier around the germinating mustard crop was found 100 per cent effective in averting the damage caused by Indian peafowl.

Pesticide residue assessment

- Out of 960 samples of different food commodities (vegetables, basmati rice, red

chilli powder, milk and surface water) analyzed, 106 samples were found to be contaminated with pesticide residues and 27 samples were found to be above their respective maximum residue limits (MRLs). Of the vegetable samples, 1.7 per cent had residues of ethion, chlorpyrifos and monocrotophos above their respective MRL values.

Horticultural crops

Pest and disease management in fruit trees

- Traps are effective non-chemical measures against pests. Burying earthen pots (having 24 holes) filled with threshed maize cobs (*Gul*) in orchards of pear, ber, peach, grape and *amla* during first week of April and again during first week of September provides effective management of termites.



Termite trap

- Application of sodium hypochlorite 5% (@ 50 ml per tree in 10 litres of water) in the foot and basin region of the trees during February-March and again during July-August effectively manages citrus footrot/gummosis. Sodium hypochlorite application has provided an eco-friendly and inexpensive alternative to conventional pesticide formulations, which were finding extensive use due to spread of this disease.
- Seven new mutant strains of *Trichoderma* showed higher potential against foot rot of citrus in terms of control of seedling mortality in nursery. Mutant strain of *T. viride* (TvA) reduced footrot by 60-75 percent. It also had a positive effect on the growth of kinnow.

Pest, disease and weed management in vegetable crops

- Integrated application of amendments, namely mustard cake @1t/ha + neem cake@1t/ha + FYM @ 2.5t/ha was found to be an effective eco-friendly measure against root knot nematode in cucumber grown under protected environment.
- In okra, significantly lower cumulative fruit infestation by shoot and fruit borer, *Earias* spp., on number and weight basis, and higher marketable yield and economic returns were recorded at ETLs (economic threshold levels) of 2 and 4 per cent fruit infestation.
- Fruit borer in tomato can be managed with chlorantraniliprole 18.5SC. Brinjal shoot and fruit borer can be managed with emamectin benzoate 5SG and chlorantraniliprole 18.5 SC. These interventions will broaden menu of insecticides and chlorantraniliprole will provide a green chemistry alternative to vegetable growers for effective management of borers.
- Jassid in okra can be effectively controlled with systemic insecticides imidacloprid 17.8SL and thiamethoxam 25 WG. Short waiting period (one day) at the recommended dose of the two insecticides is another advantage. Diamondback moth in cole crops can be controlled with new brand EGAO (emamectin benzoate 5SG).
- Management of fruit rot of chilli, caused by *Colletotrichum capsici*, with contact fungicides like mancozeb and Blitox (copper oxychloride) continues to be a challenge under wet/humid conditions. Folicur 25 EC (Tebuconazole 25.0%), a systemic fungicide, was found to be effective in managing fruit rot of chilli.
- Pre-emergence application of Tanoshi 70WP (metribuzin) within two days of sowing provides effective weed control in potato.

FOOD SCIENCE AND TECHNOLOGY

Technologies for development of various products from farm produce were standardized and recommended.

Fruit vinegar production

- Sugarcane juice blended apple vinegar (1:1 ratio), prepared by packed bed fermentation at 25L scale, was recommended. The process gets completed in 15 days with 70 per cent recovery efficiency.
- The *jamun* vinegar production technology was successfully validated at 25L scale with a volatile acidity of 5.8% (w/v) and 6.2% (w/v) in 28 and 11 days, respectively.

Potato products

- Technology has been standardized for the development of *Aloo bhujia* (a deep fat fried,



Aloo Bhujia



Aloo Wari



Aloo Chakli



salted and spiced snack), *Aloo chakli* (rice based and deep fat fried snack product) and *Aloo wari* (partly fermented legume based savoury) from common purpose potato varieties. These dehydration based post-harvesting interventions can help diversify the product basket and remove marketing bottlenecks.

Honey based products

- Honey-based value added products such as multigrain honey cookies, groundnut muffins, groundnut cookies, ginger lemon drink, and cereal health bar were developed.
- Technology was standardized for preparing honey-based ginger lemon drink with a shelf life of two months under ambient conditions and four months in refrigerated conditions.



Other products

- Sugarcane juice *Kheer* was prepared using rice, sugarcane juice and water in the ratio 1:4:5. *Kheer* was processed and packed in cups and refrigerated (4-7°C). On the basis of sensory evaluation, cup packed sugarcane juice *Kheer* was found to stay acceptable for two months.

- Gluten free cookies were developed from blends of rice flour, baby corn (field and industry waste) powder, and gram flour (*besan*) in the ratio of 45:35:20.

Food testing kit

- The rapid, inexpensive Bacteriological Food Testing Kit (BFTK) has been developed. It can detect indicator and emerging pathogens in dairy products within 16-24 hours.

POST-HARVEST TECHNOLOGIES

Research in developing post-harvest technologies primarily targeted improvement of packaging and storage of farm produce for extending shelf/storage life.

Storage structures

- A mechanically ventilated onion storage structure was developed. Onion bulbs can be stored upto five months with minimal losses due to rotting (8%) and sprouting (6%).

Drying technologies

- Technology for drying of freshly harvested onion was developed. The technology involves pre-treatment by dipping red onion for 45 minutes in 10% NaCl solution and white onion in 10% NaCl solution + 0.1% KMS (potassium metabisulfite), followed by two stage drying i.e. at 70 °C for three hours and 55 °C for 7 hours.
- A turmeric dryer of 50 kg capacity, using solar energy through evacuated tube type solar collector during sunshine hours and electric energy through four electric heaters (one KW each) during off sunshine hours, was developed. The technology obviates the limitations of time consuming process of open sun drying having vulnerabilities of discoloration, contamination by dust and insects, and susceptibility to damage by rodents and birds.
- Dried or dehydrated flowers/plant parts are natural, relatively inexpensive and available throughout the year, thereby, enjoying considerable marketing potential. The flowers of *Gomphrena*, panicles of Goldenrod (*Solidago*) and peduncles of Golden Rain Tree



(*Koelreutria*) can be dried best by hanging in inverted position in well-ventilated dark room for 4-5 days and can be preserved upto six months.

Packaging technologies

- Packaging of potato in leno (interwoven netted fabric with warp ends twisted partly around weft ends) bags, made of virgin polypropylene (weight, 50g; capacity, 50 kg), reduced the packaging material cost by 70 per cent and storage losses by 50 per cent as compared to hessian bags.
- Shelf life of fresh seedless cucumber could be enhanced to 24 days when packaged in 150-gauge non-perforated LDPE (low density polyethylene) films and stored at 10°C temperature and 85±1% relative humidity. Shelf life of yellow bell pepper can be extended up to 28 days by active packaging with oxygen absorber in 150-gauge LDPE films and storage at 10°C. These technologies will help overcome the losses due to respiration and transpiration during storage and transportation and thus extend monetary advantages.
- Technology related to modified atmosphere packaging of black carrot (cv. Punjab Black Beauty) was developed. Fresh black carrots packaged in non-perforated 150-gauge LDPE can be stored safely for 21 and 15 days at a temperature of 5°C and 10°C, respectively, with relative humidity of 85±5%. Unpackaged black carrot can be stored in open crates at 5°C and 85±5% relative humidity.
- Corrugated fibre boxes (CFB) of varying dimensions for packaging of litchi and Kinnow fruits for local and distant retail/ wholesale markets were developed.

Aloe vera gel extraction machine

- A machine to extract gel from fresh Aloe vera leaves was developed. The mean value of the maximum gel recovery (55.2%), minimum residue gel level, and maximum expulsion efficiency (94.1%) were recorded at 75 rpm for leaves thicker than 20 mm.

AGROFORESTRY

- To augment diversification and farm income sources, 1.22 lakh plants of different tree species mainly poplar, *eucalyptus*, *dek*, *shisham*, *sohanjna* and neem were provided to farmers.
- In eight year old Burma dek (*Melia composita*) progeny evaluation trial (20 progenies) conducted at two locations, 4 progenies were found to be promising with superiority (50-90%) in timber production over the mean. 16 varieties of wheat and 7 varieties of potato were evaluated under different spacing of poplar block plantation. Amongst these, two wheat varieties (PBW 725 and PBW 677) and two potato varieties (Kufri Pukhraj and Kufri Badshah) performed better.

BEEKEEPING

Research pursuits in beekeeping emphasized on quantifying/elucidating yield advantages resulting from pollination facilitated by honey bee workforce.

- Pollination of African *Sarson* (*Brassica carinata*) by *Apis mellifera* is responsible for 80-95 per cent of the seed set as indicated by yield and yield components in isolated net chambers. Honey production potential of African *Sarson* was 8.9 kg per ha.

MUSHROOMS

New mushrooms for Punjab conditions

- Seven wild mushrooms were collected and accessioned.
- Seven new strains, IVT17-01 to IVT17-07, of white *Agaricus bisporus* were evaluated and IVT17-01 demonstrated the highest yield (16.25 kg/q compost).
- Cultivation of *Pleurotus eryngii*, an aromatic fleshy textured mushroom, was standardized under Punjab conditions using locally sourced farm residues.

Composting technology

- Pasteurized compost preparation, using Short Method based on wheat straw and poultry manure formulation, was recommended for the cultivation of *Agaricus bisporus*. The



method prepares compost in 15-20 days as against 3-4 weeks taken by the Long Method. Also, it yields higher compost (16.4 kg/q) than the Long Method (9.5kg/q).

- Supplementation of compost with neem powder @ 0.5%, use of *Azotobacter* in casing mixture @ 50ml (10^7 - 10^8 cfu mL⁻¹) in 5 kg and spray of indole-3-acetic acid @10 µg L⁻¹ at the time of first and second flush enhanced the button mushroom yield up to 30 per cent.

FARM MECHANIZATION

Mechanization of tilling, planting and weeding operations in orchards, vegetable crops and agro-forestry systems; energy conservation and crop residue management solutions constituted major research output in farm machinery and power engineering.

New machinery

- A hydraulic power side shift offset rotavator was designed and developed for primary tillage and interculture operations in orchards and agro-forestry systems. This 1.8 meter wide rotavator with 370 mm offset facilitates tilling under canopy as rotavator automatically shifts away from tree trunk. Plant damage due to abrasion of tree stem remained restricted to 1.5-3.5 per cent.
- Tractor operated Rotary Weeder (capacity one acre/hour) with 50 cm wide tilling strips whose distance from each other can be adjusted, was recommended for wider row crops, especially, sugarcane. It provides monetary, time saving and mulching (with removed weed biomass) benefits.
- Axial flow thresher, for paddy, equipped with conveyor belt type feeding system was further modified by placing additional roller at the periphery of the threshing cylinder. This helped in achieving higher feed rate without modifying threshing cylinder parameters.
- A tractor operated mounted type wheat straw collector (field capacity 0.26 ha/hour, straw collection capacity 1.04 q/h) was developed. The machine harvests and collects left over wheat straw. Field capacity of the wheat straw

collector is 10 times the capacity of the manual method. Dust percentage in left over straw was 34.8 per cent.

- A two row semi-automatic vegetable planter having cup type metering mechanism for cell feed nursery was developed. A manually operated gladiolus planter for planting gladiolus corms was also developed.
- An air pressure brake system for trolley to enhance road safety was developed. Evaluation of on-road performance under various loads is in progress.

Upgradation/modification

- PAU Happy Seeder has been recommended for seeding and simultaneous application of inter-row mulch in fodder oats. The thick mulch left by the machine counters weed pressure and, thus, enhances fodder quality. The intervention will broaden utilization window of the Happy Seeder.
- PAU Multipurpose High Clearance Sprayer was modified to Self-propelled High Clearance Sprayer with four-wheel drive (4-WD) system having narrow width tyres. It has two types of spraying arrangements, namely boom type and drop up type nozzles which are operated by a single pump. The 4-WD sprayer is being evaluated for cotton crop.

Precision agriculture applications

- First prototype of the machine for installing drip laterals at subsurface was developed. It lays two subsurface drip rows by using two subsoilers. Multi-location trials have been conducted in cotton and paddy crop.
- Drone mounted near-infrared camera was used to monitor lodging in wheat crop. Aerial images obtained from drone were in good agreement with ground based sensors.

Testing for quality control

- The University is authorized to test farm machinery/equipment by the central government. A total of 37 agricultural machines/equipment including 12 paddy straw chopper/mulchers, six seed-cum-fertilizer drills, five Happy Seeders, two pruning secateurs, two chaff cutters, two



Side shift offset rotavator



Sub-surface drip laying machine



Rotary weeder



Two row Semi-automatic Vegetable Planter

subsoilers, one each of rotavator/rotary tiller, knapsack sprayer, maize thresher, forage harvester-cum-chopper-cum-loader, zero till multi crop raised bed planter, zero till multi crop planter, rake and rotary harrow were tested for their conformance to laid out standards.

BIOMASS BASED ENERGY PRODUCTION

- Bio-digested slurry derived from poultry droppings was employed for production of protease enzyme using fungus *Humicola fuscoatra* MTCC 1409.
- The mixed biomass briquette sample of different feedstocks (paddy straw, water hyacinth, maize stalk, maize cob, cotton stalk, Napier bajra and sawdust) in varying proportions was standardized for no ash slagging/ clinker formation, when the sample residence time in furnace was kept less than 30 minutes at 1100 °C.
- Paddy straw bale combustor geyser has been installed at 11 locations of KVKs/ FASC/ farmers' fields (Bahawal, Bathinda, Faridkot, Ferozepur, Kila Raipur, Langroya, Moga, Mansa, Nurmahal, Patiala and Samrala) for popularization and adoption of technology among farmers.

GROUNDWATER USE AND RECHARGE

- A study on carbon footprint of groundwater pumping in Punjab revealed that carbon emissions went up from 590 thousand tons in 1998 to 2317 thousand tons in 2014. Fall of groundwater level by one meter can raise GHG emission rate by 2.67 g/m³.
- The technology of employing abandoned wells for recharging groundwater by using canal water rendered surplus during rainy/off season and agricultural runoff has been recommended for District Irrigation Plan.

AGRICULTURAL ECONOMICS AND SOCIOLOGY

- A study titled "Economics of Farming and the Pattern of Income and Expenditure Distribution in Punjab" undertaken to analyse the cropping and investment pattern, structure of land holdings, income and



expenditure pattern and their distribution along with the resource structure and employment on the Punjab farms suggested average farm size 4ha, family size 5.78 members and the number of workers per farm 1.87. The employment was estimated at 72.64 man days per ha per annum. Punjab agriculture is highly tractorized with 69 per cent of the farmers in the state owning tractors; even about 16 per cent marginal and 47 per cent small farmers possess tractors. Crop agriculture shared the better part (74.52%) of family income followed by dairy farming (16.31%), the rest being non-farm income (9.17%). The net farm income from these two ventures was estimated at Rs 1.19 lakh and Rs 2.02 lakh for marginal and small farmers, respectively; whereas large farmers earned Rs 6.54 lakh. The dairying enterprise was found to be more popular with the marginal farms where it shared 31.85 per cent of the total farm family income. Farm expenditure, per farm basis, varied widely across the state. The average domestic expenditure was found to be Rs 1,80,212 during the study period. The per capita domestic expenditure had a direct bearing on farm size.

- A sociological study on rural youth in Sangrur district of Punjab revealed that 68 percent of the respondents had the education up to school level, out of which, only half could make it to higher secondary level. The reasons for drop out at various levels were either lack of usefulness of education as perceived by youth, expensive education, or inability to get admission in college due to poor academic performance. The study concluded that skill based high quality education leading to occupational opportunities may help solve problems confronted by rural youth. It came out from the study that psychological issues of the youth can be managed by setting up youth counselling cells and youth clubs so as to channelize youth energy into social and economic development activities.

BIOCHEMISTRY

- The activity of cell wall degrading enzymes polygalactouronase and cellulase was higher in cracked Kinnow fruit peels as compared to healthy peels. The calcium and potassium content of cracked peel was, however, lower than that of the healthy ones.
- Stress tolerance transgene Zat 12 (Zinc finger protein gene) was found to regulate various responses to abiotic stress in wheat plants.
- Biochemical profiling of Punjab Mehak 1, an aromatic rice variety, revealed that its foot rot resistance can be ascribed to higher antioxidant potential, starch, and sucrose to hexose ratio in roots as compared to susceptible check Pusa Basmati 1121. Pusa Basmati 1121 also showed improvement in tolerance after application of abscissic acid (ABA) and salicylic acid.

FOOD AND NUTRITION

- A study aimed at assessing the antioxidant potential of turnip, radish, cauliflower and carrot revealed that radish leaf powder had the highest antioxidant activity (87.0%) at 40°C. The ascorbic acid content per 100 g of vegetable leaf powder was, however, the highest in turnip leaves (33.1 mg). Cauliflower leaves had the highest chlorophyll (641mg) level. Flavonoids were the highest in carrot leaves (1337 mg QE [Quercetin Equivalent]). Total phenols were the highest in turnip leaves (784 mg GAE [Gallic acid equivalent]).

APPARELS AND TEXTILES

- Fibre obtained from Himalayan Nettle (*Girardinia diversifolia*) was used to develop cushion cover, jacket and table runner.
- Rechargeable thermo jackets, based on the principle of heating gel packs, were developed for potential use by patients complaining of upper quadrant pain. The cost of the jacket worked out to be Rs 3,655/-.
- A study aimed at examining the ultraviolet properties of dyed mercerized cotton fabric showed that the highest ultraviolet protection factor (UPF) rating was achieved for sample dyed with Reactive Red 120 dye in



combination with Benzophenone-6. Fourier-transform infrared spectroscopy (FTIR) analysis showed incorporation of new –OH ions on cotton fabric surface.

TECHNOLOGIES COMMERCIALIZED

To promote technology dissemination and entrepreneurship, PAU offered non-exclusive rights for vegetable hybrids, crop residue management machinery, processing and other agricultural technologies, developed by it. Memoranda of Agreement (MoAs) were inked with 136 entrepreneurs:

Technology/variety	MoA (no.)
CH-27 (chilli hybrid)	6
PMH-1 (maize)	1
PPH 1 (pumpkin)	1
PAU Super Straw Management System (SMS)	110
Sugarcane Juice Bottling Technology	1
PAU Straw Cutter-cum-Spreader	5
Straw Chopper-cum-Spreader/Mulcher Technology	1
PAU Happy Seeder with Press Wheel Technology	4
Apple Cider (Vinegar)	1
PAU Leaf Colour Chart	1
Bacteriological Water Testing Kit Technology	1
PAU Punjabi Mixed <i>Tadka</i> Technology	1
PAU Quinoa Bars Technology	1
Probiotic Beverage from Black Carrots	1
Fermented Beverage from Fruit and Vegetable Juices	1
Total	136



EDUCATION

Academic programmes of the University are run through its four 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 Home Science

(CoHSc) and two Institutes of Agriculture at Gurdaspur and Bathinda.

During 2017-18, the University offered 9 Undergraduate, 44 Master's, 29 Doctorate and two Diploma programmes as per following details:-

Programme	Number of seats		Number of students admitted
Class/Programme	General & Reserved/ Additional	ICAR	
UNDERGRADUATE			
B.Sc. (Hons) Agri. 4-year	84	14	98
B.Tech.(Biotechnology) 4-year	62	-	62
B.Tech. Food Tech. 4-year	63	-	63
B.Tech. Agril Engg. 4-year	74	12	86
B.Sc. (Hons) Community Science 4-year	53	9	41
B.Sc. Nutrition & Dietetics 4-year	63	-	63
B.Sc. (Hons) Fashion Designing 4-year	63	-	35
B.Sc. (Hons) Home Science 6-year	-	-	-
B.Sc. (Hons) Agri. 6-year (2+4) at Institutes of Agriculture, Bathinda & Gurdaspur	127	-	127
B.Sc. (Hons) Agri. 6-year at Ludhiana	-	-	-
POSTGRADUATE			
M.Sc. Agriculture	170	33	188
M.Sc. Home Science	59	10	23
M.Sc. Basic Sciences	140	25	124
5-year Integrated M.Sc. (Hons)	80	-	76
M.Tech. including Remote Sensing & Geographic Information System (GIS) and Master in Journalism and Mass Communication (MJMC)	66	7	24
MBA	50	-	38
MBA (Agribusiness)	30	10	20
MCA 3-year and MCA (Lateral entry) 2 -year	60	-	28
Ph.D	98	27	111
DIPLOMA			
Diploma course in Hybrid Seed Production Technology (two semesters)	40	-	10
Diploma in Agriculture 2-year	30	-	30

**EXAMINATION CELL**

The Examination Cell conducted entrance tests for admitting students to various academic programmes of PAU. Besides, it conducted competitive exams, recruitment tests and Higher Standard Departmental Examination. Details are given below:

Entrance Tests (Academics)

- Common Entrance Test (CET) for admission to B.Sc. Hons. (Agri.) 4-year, B.Tech. (Biotechnology) 4-year, B.Tech. Food Tech. 4-year, B.Sc. (Hons) Community Science 4-year, B.Sc. (Hons) Nutrition & Dietetics 4-year and 5-year Integrated M.Sc. (Hons) programmes was conducted in June 2018 for which 3,530 candidates applied. Entrance test for admission to B.Sc. Hons. (Agri.) 6-year programme was also conducted in June 2018 for which 832 candidates applied.
- A total of 10 Masters' Entrance Tests (MET) for admission to M.Sc./MBA/MBA (AB)/ MJMC/ M.Tech. programmes during June-July 2018 were conducted, for which 1,108 candidates applied.
- Entrance tests for admission to 29 Ph.D programmes were conducted during November-December 2017.

Recruitment Tests/Competitive Examinations

The Examination Cell conducted:

- Written tests for recruitment to the posts of tractor drivers at *Krishi Vigyan Kendras*, drivers at *Krishi Vigyan Kendras* (SC category) and jeep/car drivers (SC category) in August 2017.

NEW COURSES**College of Agriculture**

Course title	Course number	Credit hours
Fundamentals of Agronomy	Agron.101	3+1
Principles of Agronomy	Agron.102	1+1
Crop Production Technology	Agron.103	2+1
Crop Production Practices	Agron.105	2+1
Production Technology for Kharif Crops	Agron.201	1+1
Production Technology for Rabi Crops	Agron.202	1+1
Farming System and Sustainable Agriculture	Agron.203	1+0
Molecular Approaches in Entomological Research	Ent. 611	2+0

- Written test for recruitment to the posts of clerks (SC/BC/PH categories) in September 2017 for about 800 candidates, and typewriting test in English and Punjabi in October 2017.
- Written test for recruitment to the post of clerk on compassionate grounds in September 2017 and March 2018.
- Written test for recruitment to the posts of *Up Voids* on behalf of Subordinate Services Selection Board, Mohali, in November 2018 for 2,684 candidates.
- Shorthand dictation test in English for recruitment to the post of Stenographer (Grade-III) in January 2018 for 29 candidates.
- Written tests for recruitment to the posts of General Assistant (10 candidates) for College of Agricultural Engineering and Technology, and Office Assistant (146 candidates) for College of Basic Sciences and Humanities in May 2018.
- Written test for recruitment to the post of Networking-cum-Programme Assistant (SC category) in May 2018.
- Written test for recruitment to the posts of clerks in May 2018 for 3,235 candidates.

Higher Standard Departmental Examination

- Six papers of Higher Standard Departmental Examination were conducted for the PAU employees in December 2017.

The results of all the tests were prepared and submitted to the Registrar, PAU/ concerned quarters for further necessary action.

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Production Technology for Ornamental Crops and Landscaping	Flori. 202	1+1
Agricultural Heritage	Ext. 101	1+0
Fundamentals of Agricultural Extension Education	Ext. 201	2+1
Production Technology of Horticultural Crops	Hort. 201	2+1
Production Technology of Fruits and Plantation Crops	Hort. 202	1+1
Principles of Horticultural Crops and Plant Protection	Hort. 203	1+1
Principles of Integrated Pest and Disease Management	Ent.-Pl.Path 202	2+1
Fundamentals of Crop Protection	Ent.-Pl.Path 203	2+1
Diseases of Field and Horticultural Crops and their Management-I	Pl. Path 301	2+1
Diseases of Field and Horticultural Crops and their Management-II	Pl. Path 301	2+1
Food Science and Processing	FT 101	2 (1+1)
Food Chemistry of Macroconstituents	FT 102	3 (2+1)
Fundamentals of Food Processing	FT 201	2 (1+1)
Processing Technology of Liquid Milk	FT 202	2 (1+1)
Food Additives and Preservatives	FT 203	2 (1+1)
Food Chemistry of Microconstituents	FT 204	3 (2+1)
Processing Technology of Meat and Poultry Products	FT 205	3 (2+1)
Technology of Bakery, Confectionery and Snack Foods	FT 206	3 (2+1)
Processing Technology of Legumes and Oilseeds	FT 207	3 (2+1)
Processing Technology of Spices and Plantation Crops	FT 208	2 (1+1)
Processing Technology of Fruits and Vegetables	FT 301	3 (2+1)
Processing Technology of Cereals	FT 302	3 (2+1)
Processing Technology of Dairy Products	FT 303	3 (2+1)
Sensory Evaluation of Food Products	FT 304	3 (2+1)
Instrumental Techniques in Food Analysis	FT 305	3 (1+2)
Food Plant Sanitation	FT 306	2 (1+1)
Processing Technology of Fish and Marine Products	FT 307	2 (1+1)
Processing Technology of Beverages	FT 308	3 (2+1)
Food Quality, Safety Standards and Certification	FT 309	2 (2+0)
Food Packaging Technology and Equipment	FT 310	3 (2+1)
Principles of Food Science and Nutrition	FT 311/313	2 (2+0)
Food Safety and Standards	FT 312/314	3 (2+1)
Entrepreneurship Development	*FT 491	3 (2+1)
Student READY - Experiential Learning Programme – I	FT 493	7 (0+7)
Student READY - Experiential Learning Programme – II	FT 494	7 (0+7)
Student READY - Research Project	FT 495	3 (0+3)
Student READY – Seminar	FT 496	1 (0+1)
Student READY - Industrial Tour	FT 497	2 (0+2)
Student READY - In-Plant Training	FT 498	20 (0+20)
Production Technology for Vegetables and Spices	Veg. 202	1+1
Vegetable Breeding	Veg. 301	2+1
Protected Cultivation	Veg.302	1+1



College of Agricultural Engineering and Technology

Course title	Course number	Credit hours
Building Construction and Cost Estimation	CE 306	2+0
Design of Structures	CE 307	2+1
Unit Operations of Food Processing-II	PFE 202	3 (2+1)
Food Refrigeration and Cold Chain	PFE 203	3 (2+1)
Engineering Properties of Agricultural Produce	PFE 204	3 (2+1)
Food Process Equipment Design	PFE 301	3 (2+1)
Food Storage Engineering	PFE 302	3 (2+1)
Protected Cultivation and Secondary Agriculture	PFE 303	2 (1+1)
Agricultural Structures and Environmental Control	PFE 304	3 (2+1)
Post Harvest Engineering of Cereals, Pulses and Oilseeds	PFE 305	3 (2+1)
Post Harvest Engineering of Horticultural Crops	PFE 306	3 (2+1)
Dairy and Food Engineering	PFE 307	3 (2+1)
Development of Processed Products	PFE 401	3 (2+1)
Food Quality and Control	PFE 402	3 (2+1)
Process Equipment Design	PFE 403	3 (2+1)
Food Plant Design and Management	PFE 404	3 (2+1)
Food Packaging Technology	PFE 405	3 (2+1)
Waste and By-products Utilization	PFE 406	3 (2+1)
Farm Machinery and Power	FMP 102	1+1
Farm Machinery and Equipment-I	FMP 203	2+1
Tractor and Automotive Engines	FMP 302	2+1
Farm Machinery and Equipment-II	FMP 306	2+1
Tractor Systems and Controls	FMP 307	2+1
Tractor and Farm Machinery Maintenance	FMP 311	0+1
Tractor Design and Testing	FMP 411	2+1
Farm Machinery Design and Production	FMP 412	2+1
Mechanics of Tillage and Traction	FMP 413	2+1
Ergonomics and Safety	FMP 414	2+1
Hydraulic Drives and Controls	FMP 415	2+1
Precision Agriculture and System Management	FMP 416	2+1
Machinery for Crop Residue and Fodder Management	FMP 417	2+1
Farm Power and Machinery Management	FMP 418	2+1
Renewable Energy and Green Technology	EST 202	1+1
Renewable Power Sources	EST 301	2+1
Bioenergy Systems: Design and Applications	EST 302	2+1
Web Designing and Internet Applications	CSE 205	1+1
Artificial Intelligence	CSE 402	3+0
Electronics and Instrumentation	EE 206	2+1
Instrumentation and Process Control in Food Industry	EE 304	2+1
Fluid Mechanics and Open Channel Hydraulics	ME 202	2+1
Theory of Machines		ME 207
2+0		
Machine Design	ME 302	2+0



Fluid Mechanics	ME 305	2+1
Mechatronics	ME 404	2+1
Soil and Water Conservation Engineering	SWE 202	3 (2+1)
Sprinkler and Micro Irrigation System	SWE 203	2 (1+1)
Water Harvesting and Soil Conservation Structures	SWE 301	3 (2+1)
Drainage Engineering	SWE 302	2 (1+1)
Watershed Planning and Management	SWE 303	3 (2+1)
Groundwater Wells and Pumps	SWE 304	3 (2+1)
Floods and Control Measures	SWE 401	3 (2+1)
Wasteland Development	SWE 402	3 (2+1)
Information Technology for Land and Water Management	SWE 403	3 (2+1)
Remote Sensing and Geographic Information System	SWE 404	3 (2+1)
Design and Management of Canal Irrigation System	SWE 405	3 (2+1)
Minor Irrigation and Command Area Development	SWE 406	3 (2+1)
Precision Farming Techniques for Protected Cultivation	SWE 407	3 (2+1)
Water Quality and Management Measures	SWE 408	3 (2+1)
Landscape Irrigation Design and Management	SWE 409	3 (2+1)
Plastic Applications in Agriculture	SWE 410	3 (2+1)
Floor and Floor Coverings	FRM 303	2+1

College of Basic Sciences and Humanities

Course title	Course number	Credit hours
Advanced Organization Psychology	Mgt. 618	2+0
Organizational Development	Mgt. 619	3+0
International Human Resource Management	Mgt. 620	3+0
Advances in Business Ethics	Mgt. 621	3+0
Introduction to Intermediary Metabolism	Biochem. 209	3+0

STUDENTS' ACADEMIC ACCOMPLISHMENTS

College of Agriculture

- Ms Simranpreet Kaur (L-2016-A-50-M) visited China Agricultural University, Beijing, China, from April 1-10, 2018 to carry out her research work on rearing of fruit flies.
- Ms Heena (L-2017-A-50-M) was selected for Khorana Program for Scholars by Indo-US Science and Technology Forum (IUSSTF). Under this, she visited Entomology Laboratories of Dr Jason L. Rasgon, Pennsylvania State University, USA, from May 21 to July 31, 2018.
- Ms Ramandeep Kaur (L-2016-A-13-M) and Ms Saloni (L-2016-A-49-M) received Bayer Crop Science Fellowship from Bayer Crop Science Pvt. Ltd. in 2017.

Awards by PAU:

- Ms Rajwinder K. Sandhu (L-2013-A-33-M) got Dr Sardar Singh Medal in 2017.
- Mr Sajjan Grover (L-2013-A-35-M) received Dr G.S. Dhaliwal Medal in 2017.
- Mr Manmohan Dhakal (L-2013-A-93-M) was awarded Dr Avtar Singh Atwal Gold Medal in 2017.
- Mr Ankit Ghorai (L-2014-A-113-M) got "Shashya Surakshya M.Sc. Dissertation Award 2017" from Association for Advancement in Plant Protection Society.
- Ms Jagriti Gupta (L-2013-A-29-D) received "Best Oral Research Paper Award" during National Symposium on "Recent Advances on Floriculture and Urban Horticulture in Global Perspective (NASRAFUH-18)" organized at



Bidhan Chandra Krishi Viswavidyalaya (BCKV), Kalyani, Nadia, West Bengal, from January 4-5, 2018.

- Mr N. Kharkwal (L-2015-A-57-M), Ms A. Kaur, Ms J. Kaur and Mr A.B. Khatkar bagged “Best Poster Prize” at the “26th Indian Convention of Food Scientists and Technologists (ICFoST), Food and Nutrition Challenges: Role of Food Science and Technology” organized by Council of Scientific and Industrial Research (CSIR) - Indian Institute of Chemical Technology, Hyderabad, from December 7-9, 2017. They were awarded for the poster entitled “Technological evaluation of jaggery, honey and stevia powder as sugar replacer in bakery products”.
- Mr Mudasir Yaquob (L-2015-A-22-D) and Dr Poonam Aggarwal got “Best Poster Award” during an International Conference on “Innovations and Translational Dimensions: Food, Health and Environmental Biotechnology” organized by Department of Biotechnology, Motilal Nehru National Institute of Technology, Allahabad, from March 9-11, 2018. They were awarded under the industrial section entitled “Extraction and identification of novel bioactives from kinnow (*Citrus reticulata*) peel - An agro waste.”
- Mr Prashant Sahni (L-2016-A-32-D), Dr Savita Sharma and Dr Baljit Singh bagged “Best Poster Award” during National Conference on “Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector” held at ICAR - Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana, from March 16-17, 2018. They were awarded for the poster entitled “Evaluation and quality assessment of defatted microalgae meal of *Chlorella* sp. (Abca-17) as alternate food ingredient in cookies.”
- Mr Pawandeep Singh (L-2014-A-12-BTFT), Mr Rupinder Singh and Dr Poonam A. Sachdev received national award for start up idea “Utilization of sugarcane juice in production of kheer” during National Start Up Summit, organized by Agri Business

Incubation Centre at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, from June 1-2, 2018.

College of Agricultural Engineering and Technology

- Yashima Jindal (L-2013-AE-61-BIV) was awarded Gold Medal by PAU for meritorious performance in academics.

College of Basic Sciences and Humanities

- Ms Jupinder Kaur (L-2013-BS-76-D) got “Young Scientist Award” from Punjab Science Academy.
- Ms Sheenam Saxena (L-2014-BS-278-M) cleared Joint Entrance Screening Test (JEST) and Graduate Aptitude Test in Engineering (GATE), conducted by Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Tamil Nadu.

College of Home Science

- Ms Ashpreet Kaur (L-2014-HSc-4-BFD) and Ms Divyansha Malhotra (L-2016-HSc-8-BFD) received “Best Start Up Idea Award” during National Start Up Summit, organized by Agri Business Incubation Centre at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, from June 1-2, 2018.
- Two Ph.D. students, namely Ms Manisha Verma (L-2015-HSc-93-D) and Ms Shipra Saklani (L-2014-HSc-116-D) were invited to present research paper during the “6th International Agriculture Student Symposium (IASS)” held at University Putra, Malaysia, from February 4 - 13, 2018. Ms Sloney Sachar (L-2015-HSc-95-D) also attended the symposium.

SCHOLARSHIPS AND FINANCIAL ASSISTANCE

College of Agriculture

- Fifty one students received ICAR - National Talent Scholarship, seven ICAR- Senior Research Fellowship, 34 ICAR/UGC - Junior Research Fellowship, one ICAR - Foreign Scholarship and 27 Innovation in Science Pursuit for Inspired Research (INSPIRE)



Fellowship (Department of Science and Technology-DST).

- Twenty two students got Dr Gurdev Singh Khush Merit Scholarship, 112 University Merit Fellowship, three Mrs Jaswant Kaur Bindra Scholarship, nine Piara Singh Parmar Memorial Fellowship, two Shri Bal Krishan Vaid Merit Scholarship and six COA Alumni Association Scholarship.
- Two students were awarded Rajiv Gandhi National Fellowship (UGC) and six Maulana Azad National Fellowship for Minority Students (UGC).
- One student each received Indian Council of Social Science Research (ICSSR) -Senior Research Fellowship and National Fellowship for Scheduled Caste (UGC).
- One student each got Dr H.S. Pruthi Scholarship, Professor Gurcharan Singh Sohi Memorial Scholarship and S. Dalbir Singh Jassar Merit Scholarship.
- A total of 194 students received Student READY Stipend and 166 Punjab Mandi Board Stipend.
- Eight students qualified ICAR - National Eligibility Test (NET).

College of Agricultural Engineering and Technology

- Fifteen students got ICAR - National Talent Scholarship and six ICAR/UGC - Junior Research Fellowship.
- Two students received Dr Gurdev Singh Khush Scholarship, 48 University Merit Fellowship, four Piara Singh Parmar Memorial Fellowship and one Professor R. N. Kaul Memorial Scholarship.
- Seventeen students were awarded Merit-cum-Means Scholarship for professional and technical courses (Government of India) and four were awarded CLAAS India Scholarship (Undergraduate).
- Five students got Central Sector Scheme of Scholarship from Ministry of Human Resource Development, Government of India.

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

College of Basic Sciences and Humanities

- Twenty one students were awarded ICAR - National Talent Scholarship, five ICAR - Senior Research Fellowship, eight ICAR/UGC - Junior Research Fellowship and six INSPIRE Fellowship (DST).
- Five students got Rajiv Gandhi National Fellowship (UGC), eight Maulana Azad National Fellowship for Minority Students (UGC) and three Indian Council of Social Science Research (ICSSR) - Senior Research Fellowship.
- Six students received Dr Gurdev Singh Khush Merit Scholarship, 117 University Merit Fellowship and four Piara Singh Parmar Memorial Fellowship.
- Two students were awarded India - Afghanistan Fellowship (ICAR), two Indian Council of Medical Research (ICMR) - Junior Research Fellowship and two Post Matric Fellowship (Punjab Government).
- One student each was awarded Joint CSIR-UGC Senior Research Fellowship, CBSE Scholarship, CBSE Merit Fellowship and PSEB Merit Fellowship.
- In total, 21 students qualified National Eligibility Test (NET), conducted by ICAR and by Council of Scientific and Industrial Research (CSIR), New Delhi.

College of Home Science

- Five students got ICAR - National Talent Scholarship, two ICAR - Senior Research Fellowship, 24 ICAR/UGC - Junior Research Fellowship and three Innovation in Science Pursuit for Inspired Research Fellowship (DST).
- Six students were awarded Dr Gurdev Singh Khush Merit Scholarship and 54 students were awarded University Merit Fellowship.
- One student each received Sardarni Gurbachan Kaur Memorial Scholarship, Mai Tej Kaur Memorial Scholarship, Vidyawati Saini Scholarship and Indian Council of



Dr (Mrs) Parveen Chhuneja receiving "Dr G.S. Khush Distinguished Professor Award" from Mr Suresh Kumar, Chief Principal Secretary to Punjab Chief Minister, during Convocation of College of Agriculture, PAU.

Medical Research (ICMR) Fellowship.

- Fourteen students received Student READY Stipend.
- Three students qualified UGC - National Eligibility Test (NET).

CONVOCATION

- The Convocation-cum-Prize Distribution function of the College of Agriculture, PAU, was held on November 11, 2017. Mr Suresh Kumar, Chief Principal Secretary to Chief Minister, Punjab, was the chief guest while Dr Baldev Singh Dhillon, Vice Chancellor, PAU, presided over the convocation. In total, 240 students of B.Sc. Agriculture (Hons), B.Sc. Biotechnology (Hons) and B.Tech Food Technology (Hons) programmes of the academic year 2016 were awarded degrees. In addition, Merit Certificates, Gold Medals and Medals were presented to students.
- The Annual Convocation of PAU was held on December 15, 2017 where 61 students received Ph.D degree and 397 Master's (M.Sc., M.Tech, MCA, MBA, MBA (Agri business) and MJMC) degree. A total of 117 students were awarded Merit Certificates besides Gold Medals and Medals. Dr T. Mohapatra, Director General, ICAR and Secretary, Department of Agricultural Research and Education (DARE), New Delhi, was the chief guest while Dr Baldev Singh Dhillon, Vice Chancellor, PAU, presided over the convocation.



Dr T. Mohapatra, Director General, ICAR and Secretary, DARE, awarding Gold Medal to PAU student during Annual Convocation of PAU.

- The Convocation-cum-Prize Distribution Function of the College of Home Science, PAU, was held on January 29, 2018 where 198 students of B.Sc (Hons) Home Science (4-year and 6-year), B.Sc (Hons) Fashion Designing and B.Sc (Hons) Nutrition and Dietetics programmes (academic sessions 2014-15, 2015-16 and 2016-17) were awarded degrees. Smt Aruna Chaudhary, Former Education Minister, Punjab, was the chief guest while Dr Baldev Singh Dhillon, Vice Chancellor, PAU, presided over the convocation. Besides, students were awarded Merit Certificates, Gold Medals and Medals for excellence in academics.

STUDENTS' WELFARE ACTIVITIES

Important Sports Achievements

Inter-Varsity Tournaments

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

University Level Tournaments

The teams from constituent colleges of PAU participated in Inter-College Tournaments 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), Cricket (M), Kabaddi (M), Table Tennis



Inter-varsity Tournament and Annual Athletic Meet at PAU.

(M&W), Shooting (M&W) and Cycling (M&W). Mr Ajay Kumar (CoA) was declared Best Cyclist while Mr Manveer Singh Grewal (CoA) was declared Best Hockey Player. Mr Shahbaj Singh Bhullar (CoA) and Ms Harleen Kaur (CoA) were declared Best Swimmers in men and women category, respectively.

Annual Athletic Meet

The 52nd Annual Athletic Meet of PAU for the session 2017-18 was held at PAU Athletic Track during February 12-13, 2018. Mr Sahejdeep Singh Sran (CoA) was declared Best Athlete in men category while Ms Mehakpreet Kaur Randhawa (COA) was declared Best Athlete in women category.

University Colour/Merit Certificates

The PAU Sports and Youth Activities Council in its 54th meeting held on December 18, 2017 awarded 46 Merit Certificates, 15 University Colour and six Roll of Honour to the outstanding sportspersons/artists of PAU for their proficiency in sports, games, cultural and literary events for the session 2016-17. The students were awarded these honours during the 52nd Annual Athletic Meet of the University.

Sports Coaching Camps

The Annual National Sports Organization (NSO) coaching camp was organized at PAU for the session 2017-18. As many as 250 trainees enrolled under NSO programme including officials attended the camp.

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 also organized in the University.

Sports Scholarships

The Sports Scholarship Committee in its meeting held on March 26, 2018 approved nine (two major and seven minor games) sports scholarships of the value of Rs 550/- per month for the outstanding sportspersons for their proficiency in sports and games during the academic session 2017-18.

Outstanding Players

The Punjab Agricultural University was declared Runners Up in Team Games (M) during the XVIII All India Inter-Agricultural University Sports and Games Meet, held at University of Agricultural Sciences, Bengaluru, from January 30 to February 3, 2018. The University clinched one Gold Medal and one Silver Medal in Team Games (M&W).

- The Basketball (M) team won Gold Medal. It comprised students, namely Amandeep Singh, Harpreet Singh, Karan Brar, Karan Bawa, Angadjit Singh Brar, Jasjeet Singh, Harsangeet Singh Mann, Amritpal Singh, Khushpreet Singh and Harsimran Singh.
- The Volleyball (M) team won Silver Medal. Milapdeep Singh, Amanpreet Singh, Shehbaz Singh, Jagmanjot Singh, Rajwinder Singh, Rajeev, Jatinder Singh, Sunil Kumar, Balwinder Singh and Sundharalingam were



PAU students performing Yoga.

the team members.

- Mr Tejinder Pal Singh (CoA) got first position in Discus Throw and second in Shot Put.
- Mr Harmandeep Singh (CoBSc&H) won second position in Discus Throw and third in High Jump.
- Ms Mehakpreet Kaur Randhawa (CoA) got second position in 800M and 1500M races.
- Mr Beant Singh (CoA) won third position in Senior National Power Lifting Championship, held in Kerala on August 14-19, 2017.
- Mr Beant Singh (CoA) and Mr Akamjot Singh (CoA) participated in Federation Cup National Power Lifting Championship, held in Jharkhand, from March 16-19, 2018.
- Mr Sanpreet Singh (CoA) participated in Enerzal National Race Walking Championship, held in New Delhi on February 17-18, 2018.
- Ms Nimrat Kaur Sekhon (CoA) participated in the 61st National Shooting Championship, held in Kerala, on December 10-15, 2017.
- Mr Vikramdeep Singh (CoA) got first position in North Zone Senior National Handball Championship, held at Baddi, Himachal Pradesh, from September 5-7, 2017.
- Mr Arshdeep Singh (CoA) won third position in Senior State Men's Handball Championship, held at Kapurthala, Punjab, from February 14-16, 2018. He also participated in the 46th Senior National Handball Championship (M), held at Gwalior, Madhya Pradesh, from March 6-11, 2018.
- Mr Puneetinder Singh Grewal (CoA) got second position in Mixed Doubles and third position in Men Doubles during the Punjab State Senior Ranking Tournament, held at Jalandhar, Punjab, from August 10-13, 2017.
- Mr Tejinder Pal Singh, Mr Sanpreet Singh and Ms Mehakpreet Kaur Randhawa participated in the 92nd Open Punjab Athletics Championship, held at Sangrur, Punjab, from September 8-10, 2017.

National Service Scheme (NSS) Activities

- Ms Harjot Kaur, a PAU student, was the first NSS volunteer who participated in Republic Day Parade in New Delhi on January 26, 2018.
- As per the directions of Punjab Government, the volunteers were educated on "Drug Abuse Prevention Officer (DAPO) Programme."
- A special drive on "Beat Plastic Pollution - Awareness-cum-Cleanliness" was launched in slum areas and other localities of Ludhiana in association with Punjab Pollution Control Board.
- Ten NSS volunteers participated in Swachh Bharat Hackathon, organized by Punjab Government in Chandigarh on August 16, 2017.
- Twenty NSS volunteers participated in marathon, organized by District



Administration to create awareness on exercising franchise during elections.

- Under the mission of Save Water, Save Punjab, a one-day workshop on “Rally for Rivers” was organized in collaboration with Esha Foundation at PAU.
- Five special donation drives were organized for the collection of old useable clothes, shoes, stationery, school bags, old books, blankets, toys, etc. and their distribution among needy in the adopted slums/labourers of construction sites.
- Blood donation camp was organized by the NSS Cell of PAU under the supervision of the team of doctors from Dayanand Medical College and Hospital, Ludhiana, during the *Kisan Mela* from September 22-23, 2017. In all, 218 blood units were collected and donated by NSS volunteers, staff and faculty of PAU.
- Twenty one-day regular activity camps were organized by each NSS unit as per the themes given by the Ministry of Youth Affairs and Sports, Government of India. Volunteers also participated in campus beautification, playground cleanliness, village health care camps, yoga camps, etc.

Cultural Activities

- Independence Day and Republic Day were celebrated on August 15, 2017 and January 26, 2018, respectively.
- The PAU Inter-College Youth Festival 2017-18 was organized from October 25 to November 2, 2017. Nearly 400 students from constituent colleges and outstation institutes of PAU participated in literary, fine arts, music, theatre, dance and heritage events. The overall running trophy was bagged by the College of Agriculture.
- Mr Palwinder Singh (L-2016-A-83-M) got first prize in bhangra, cultural procession and *haas* rass; and second in poem, skit, *bhand* and one-act play during PAU Inter-College Youth Festival 2017-18.
- The PAU students clinched Gold Medal in group song (Indian), Bronze Medals in poster making and light vocal, and got fourth position in mime and cartooning during the “18th All India Inter Agricultural Universities Youth Festival” organized by Indian Council of Agricultural Research, (ICAR), New Delhi, at Shri Venkateswara Veterinary University, Tirupati, Andhra Pradesh, from February 16-18, 2018.
- The students of PAU won consolation prizes in debate and skit during the “33rd North Zone Inter-University Youth Festival 2017-18” organized by Association of Indian Universities (AIU), New Delhi, at Maharishi Markandeshwar University, Mullana, Ambala, Haryana, from January 12-16, 2018.
- A PAU contingent of four members participated in the 11th International Cultural Festival “SAUFEST 2018” held at Ganpat University, Mehsana, Gujarat, from March 2-6, 2018.
- The students of PAU participated in essay writing competition on September 14, 2017 to spread the message of cleanliness and Swachhta Pakhwada (from September 1-15, 2017) under the mission of Swachh Bharat Abhiyaan.
- The University students participated in poetic recitation competition and interactive session with poets on March 27, 2018.
- A photo walk competition was organized for PAU students on April 21, 2018 to hone their photographic skills.
- An exhibition and art event “Shades of Youth” was organized on May 2, 2018 in which students got a chance to showcase their talent through live paintings.



Sh. V.P. Singh Badnore, Governor of Punjab and Chancellor of PAU, addressing huge gathering of farmers during Kisan Mela at PAU, Ludhiana on March 23, 2018.

EXTENSION

The Punjab Agricultural University transfers 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, video capsules, farmer portal and TV/radio talks. 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. A total of 14 *Kisan Melas* were organized during the period under report. Seven *Kisan Melas*

were organized each during September 2017 and March 2018 at the main campus of PAU, Ludhiana; KVK *Rauni* (Patiala); KVK Nag Kalan (Amritsar); Regional Research Station (RRS) Faridkot; RRS Ballawal Saunkhri, RRS Bathinda and RRS Gurdaspur. The theme of the mela in September 2017 was "Simple weddings, simple ceremonies; no tension, no worries." The theme of the *mela* in March 2018 was "Cut farm expenses, use water and fertilizers judiciously; adopt subsidiary occupations and increase farm profit substantially." A large number of farmers from Punjab and adjoining states participated in these *melas*. Live demonstrations on field crops with improved varieties, production and protection technologies; straw management techniques; beekeeping; mushroom cultivation; nutrition gardening; protected cultivation, etc. were arranged for the visiting farmers. The seed of improved crops and vegetable varieties, planting material of vegetables/fruit/forest/ornamentals, biofertilizers and farm literature were sold to the farmers during these *melas*. An agro-industrial exhibition of farm inputs including fertilizers, pesticides, and farm machinery was also put up on these occasions.

Awards to Progressive Farmers

The progressive farmers from various parts of Punjab are honoured during the *Kisan Melas* for their outstanding contributions to agriculture, horticulture and allied enterprises. During PAU

Kisan Mela on September 21, 2017, five progressive farmers including one woman entrepreneur were honoured. S. Jagtar Singh Gill (Bathinda) was awarded “Parwasi Bharti Award 2017” while “S. Ujagar Singh Dhaliwal Memorial Award 2017” was conferred on S. Harpreet Singh (Fatehgarh Sahib). S. Satvir Singh Saran (Bathinda) was awarded “S. Surjit Singh Dhillon Award 2017” while “Sardar Dalip Singh Dhaliwal Memorial Award 2017” was conferred on S. Sukhdev Singh Bhullar (Kapurthala). Kumari Rekha Sharma (Hoshiarpur) was awarded “Sardarni Jagbir Kaur Memorial Award 2017.”

During PAU *Kisan Mela* on March 23, 2018, S. Hardeep Singh (Patiala) was honoured with “Chief Minister Award 2018” S. Gurvinder Singh Sohi (Fatehgarh Sahib) with “Sardarni Prakash Kaur Sra Memorial Award 2018” and S. Jagmohan Singh (Moga) and S. Tarsem Singh (Hoshiarpur) with “CRI Pumps Award 2018.”

SPECIAL CAMPAIGNS

- **Paddy straw management:** Campaigns on paddy straw management were organized across Punjab to promote adoption of different technologies such as PAU Super Straw Management System (SMS), PAU Happy Seeder, Paddy Straw Baler, Paddy Straw Cutter-cum-Spreader, mulcher, etc. A total of 36 villages in different districts of Punjab were made zero burning villages.
- **Whitefly management in cotton:** A special campaign on whitefly management in cotton was initiated from February 2017 onwards by adopting integrated pest management strategies. Whitefly population was monitored and managed on weeds and alternate crop host plants like brinjal, cucurbits (cucumber, long melon, *chappan kaddu*, etc.), tomato, okra and chilli before sowing of cotton crop.

Farmers were advised about clean cultivation, cultivation of recommended Bt cotton hybrids, timely sowing, proper nutrient management, use of non-chemical (yellow sticky traps) and chemical approaches based on economic threshold level through training camps, farm literature, advertisements in newspapers,



PAU experts holding press conference on whitefly control in cotton at Regional Research Station, Bathinda.

WhatsApp, TV/radio talks, etc. For regular surveillance of whitefly on cotton and other alternate hosts in each village of the cotton belt of Punjab, 500 students were engaged. Under the chairmanship of PAU Vice Chancellor, four 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.
- **Recommended varieties:** Campaigns conducted during 2017-18 before sowing of *rabi* and *kharif* crops helped increase the area under recommended wheat varieties to 97.7 per cent during 2017-18 in comparison to 96.9 per cent during 2016-17. While in rice, the area under recommended varieties increased to 68.7 per cent in 2017 in comparison to 61.6 per cent in 2016.
- **Eradication of Parthenium:** Campaigns were organized against *Parthenium* (Congress grass) and 47 villages in different districts of the state were made *Parthenium* free.
- **Popularization of biofertilizers and bioagents:** Campaigns were conducted for



the use of biofertilizers and the area under wheat biofertilizer increased from 52,000 acres (2016-17) to 56,000 acres (2017-18). Besides, 12,003 acres of sugarcane, rice and maize crops during last year was under *trichocards*. *Trichoderma* for control of foot rot in basmati rice covered an area of 500 acres during 2017-18.

FIELD DAYS

The University holds field days in order to popularize specific recommendation among farmers. In all, 300 field days were organized in different villages to promote direct seeded rice technique; mechanical transplanting of paddy; crop residue management techniques; integrated pest management in *rabi* and *kharif* crops; PAU fruit fly trap; cultivation of pulses (lentil, soybean, gram, etc.), maize, sunflower and *gobhi sarson*; nutrition garden, etc.

ADAPTIVE RESEARCH TRIALS

Adaptive Research Trials (ARTs) are conducted at farmers' fields under different agro-climatic conditions to test new technologies generated by research system. A total of 542 ARTs were conducted at different locations to evaluate new crop varieties and production and protection technologies. Based on these trials, 67 recommendations were made, out of which, 22 were of new varieties (12 field crops, 5 vegetables, 3 fruit crops and 2 flowers), 22 of production technologies, 17 of plant protection technologies, five of post-harvesting handling and one of farm machinery.

ON FARM TRIALS

On Farm Trials (OFTs) are conducted to test a new technology/idea under farmer's field conditions in comparison to PAU recommended practice and farmer's own practice. As many as 139 OFTs were conducted by KVK scientists. The salient findings of some of the important OFTs are listed below:

- **Phosphorus management in potato:** Farmers are applying excess dose of P fertilizer to potato in the absence of farm yard manure (FYM). Hence, experiment was conducted using 137.5 kg/ha DAP with 50 t FYM (recommended), 275 kg DAP

(intervention) only and 500 kg DAP (farmer's practice) only. These treatments gave potato tuber yields of 350.0 q/ha, 348.0 q/ha and 351.5 q/ha, respectively. The results indicated that in the absence of FYM, 275 kg DAP gave equivalent yield to recommended dose of 137.5 kg/ha DAP with 50 t FYM.

- **Judicious use of nitrogen fertilizer in Pusa Basmati 1121:** Generally, farmers apply 100-120 kg urea to Pusa Basmati 1121 for deriving higher yield benefits against the PAU recommendation of 36 kg urea/acre. Farmer's practice (110 kg/acre urea) was tested against recommended dose (36 kg/acre urea) and intervention (50 kg/acre urea). The results indicated that all the treatments gave statistically similar yield. Hence, the recommendation of 36 kg/acre urea was found to be the best.
- **Efficacy of different herbicides in summer mash:** Two hand weedings at 15 and 40 DAS and new herbicide like premix of imazethapyr + imazamox 70% WG were evaluated in OFT against recommended pendimethalin 30% EC. Highest reduction in weed population (8.2/m²) was observed with the application of imazethapyr + imazamox 70 WG @ 100 g/ha (20 DAS) and it recorded higher grain yield (10.5 q/ha) than two hand weedings (9.35 q/ha) and recommended practice of pendimethalin 30 EC @ 2.5 l/ha (pre-emergence application) which yielded 8.5 q/ha.
- **Control of Foot rot in basmati:** To manage Foot rot in basmati, seed and nursery treatment is recommended. In general, farmers only treat the seed and skip the dipping of nursery roots in fungicide solution. A trial was conducted with seed treatment along with application of Bavistin 500 g/acre in nursery and field after transplanting. Root dip in Bavistin solution (0.2%) (recommended practice) yielded 51.2 q/ha, broadcasting of Bavistin in nursery two days before uprooting of nursery (intervention) yielded 48.7 q/ha and farmers' practice, broadcasting of Bavistin in *basmati* field one week after transplantation,



yielded 47.0 q/ha. Thus, the recommended practice is better than other practices.

- **Techniques for cultivation of *kharif* onion:** In *kharif* season, onion cultivation through bulb on bed planting, on three 15 cm apart rows, is recommended. An OFT was conducted with 4 rows per bed (with the objective of yield enhancement) along with farmers' practice (flat sowing 15 × 7.5 cm spacing). The bed planting gave better results as compared to flat sowing; however, the difference between 3 rows and 4 rows was not statistically significant.
- **Low tunnel technology in chilli:** Chilli nursery is raised in December by farmers. Low tunnel technology for raising nursery is recommended to get healthy nursery. Early nursery raising in October in poly house and transplantation at the end of November gave more yield (225q/ha) as well as higher benefit-cost (BC) ratio (2.2) than the nursery transplanted in February-March (220 q/hayield and 1.6 BC ratio).
- **Effect of feeding Vitamin E on incidence of *Mastitis* in cows:** Mastitis is a very common problem in cross bred cows. For the management of Mastitis, a trial was conducted involving supplementation with Vitamin E (1000 I.U /day) against farmer practice of feeding only fodder along with cattle feed. Forty per cent less (than under farmer practice) infection of *Mastitis* was recorded with Vitamin E supplementation.
- **Reduction in age at first calving (AFC) in buffalo heifers:** To reduce AFC in buffalo heifers, a trial was conducted on balanced nutrition and management practices. The treatments included feeding balanced diet supplemented with 50 g mineral + Dewormer; balanced diet supplemented with 50 g mineral + Dewormer + Uromin licks (300 g daily for one month) and farmer practice of feeding green fodder only. Age at first calving reduced by 3.5 months due to feeding of balanced diet and Uromin lick as compared to farmer practice of feeding dry and green fodder alone.
- **Removal of ink stain:** Efficiency of removal of

ink stain (fresh and old) of ball pen from coloured fabric (67% polyester and 33% cotton), commonly used for school uniforms, was evaluated. Commercial stain removal (Vanish) was found to be most efficient followed by borax solution (recommended practice) and salt or lemon juice (for removing fresh or old ink stain, respectively).

DEMONSTRATIONS

For the promotion of crop production, protection and other improved agricultural technologies developed by PAU, demonstrations are conducted at farmers' fields and KVK farms. A total of 3,156 cluster front line demonstrations (CFLDs) were conducted on improved varieties of oilseed crops (groundnut, sesame, gobhi sarson, raya and sunflower), pulses (summer *moong*, *kharif moong*, mash, soybean, gram and lentil), wheat, 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 P application in rice, cotton and maize when grown after wheat supplied 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 biofertilizers; soil test based fertilizer use; management of maize borer using *Trichoderma harzianum*; weed control in maize and direct seeded rice; management of stem borer/leaf folder in rice and *basmati* rice; and use of rice transplanter were some of the other thrust 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 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 all, 2,191 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.

TRAININGS AND EXHIBITIONS

Trainings

The *Krishi Vigyan Kendras* and Advanced Centre of Training at PAU organized 1,469 training programmes (1,047 short, 267 vocational, 120 in-service and 35 sponsored) for the farmers, farm women and extension functionaries to enhance their knowledge for increasing agricultural productivity and farm income. Vocational trainings were given on precision farming, hybrid seed production, protected cultivation of vegetables, pruning of fruit plants, mushroom cultivation, apiculture, poultry, dairy, piggery, goatry, value addition of agricultural produce (preparation of pickles/*murabbas*/ketchup and other recipes), tie and dye, stitching, embroidery, etc. In all, 20,163 farmers, 7,801 farm women and 2,129 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, 803 exhibitions were put up where important production, protection and resource conservation technologies; live and preserved plant specimens; farm machinery; models of various important technologies including drip irrigation; processing equipment and farm literature were displayed. In

these exhibitions, farmers were also enrolled for the monthly magazines *Progressive Farming* and *Changhi Kheti* of PAU.

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, six workshops were organized:

Workshop	Date(s)
Research and Extension Specialists' Workshop for <i>Rabi</i> Crops	31.08.2017-01.09.2017
Training-cum-Workshop on Formation of Farmer Producer Organizations	20.11.2017
Research and Extension Specialists' Workshop for Fruits, mushroom, Agro-forestry along with Post-harvest Management, Farm Power and Machinery, Food Technology and Agricultural Economics	11.01.2018-12.01.2018
State Level Training Planning Workshop	06.02.2018
Research and Extension Specialists' Workshop for <i>Kharif</i> Crops	21.02.2018-22.02.2018
Research and Extension Specialists' Workshop for Vegetable Crops	10.05.2018-11.05.2018

FARMERS' ORGANIZATIONS

The meetings of various farmers' organizations were organized to share the latest technological advancements in various disciplines. Ten monthly training camps were organized for the members of PAU *Kisan Club* in which 4,474 farmers and farm women participated. Besides, 10 monthly training camps were held for the members of Progressive Beekeepers Association in which 863 farmers participated. Three training camps each were organized for the members of PAU Seed Producers and Nursery Growers Association, PAU Tree Growers Association and PAU Organic Farming Club, benefiting 213, 85 and 182 farmers,

respectively. One training camp was organized for the members of PAU Flower Growers Club in which 59 growers participated.

INFORMATION AND COMMUNICATION TOOLS (ICTs)

- **Digital Newspaper:** *Kheti Sandesh*, a weekly digital newspaper, was started for the dissemination of latest technologies among farmers. So far, more than 5 lakh farmers are receiving this digital newspaper on their WhatsApp.
- **Weather Based Agro-advisory SMS:** A total of 3,03,361 farmers were enrolled for weather based agro-advisory.
- **WhatsApp Group:** In total, 121 WhatsApp groups were formed by the scientists of

KVKs/FASCs 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 religious places for faster dissemination of technologies. During the period under report, 764 PAU doots were enrolled and 72 messages were sent to them. A total of 5,873 PAU doots have been enrolled till date.
- **Farmer Portal:** The University has developed a 'Farmer Portal' which has been put on PAU website (www.pau.edu) for the benefit of stakeholders.



Dr Baldev Singh Dhillon, Vice Chancellor, PAU (second from right); and agriculture officers interacting with PAU expert during Research and Extension Specialists' Workshop for Rabi Crops at PAU on August 31, 2017.



Farmers learning beekeeping practices during Beekeeping Training Camp at PAU.



Farm women attending training camp at Krishi Vigyan Kendra, Bathinda.



- **Video Capsules:** A total of 22 video capsules for mobile phones were developed on improved agricultural technologies including crop varieties, integrated pest management technologies, straw management techniques, etc. for the benefit of farmers.

COMMUNICATION THROUGH MASS MEDIA

The Communication Centre maintains a constant liaison with the print and electronic media including Doordarshan and All India Radio (AIR), Jalandhar, to publicize the activities of PAU. It issues press releases to different newspapers and news channels on regular basis. During the period under report, the Centre issued 876 press releases (450 in English and 426 in Punjabi). The Centre also sent several articles in English and Punjabi, authored by PAU scientists, for publication in vernacular newspapers and magazines. The Centre provided TV coverage to different events and also produced 14 *Kisan Mela* reports for telecast from Doordarshan. It coordinated with Doordarshan Kendra, Jalandhar, for 340TV talks and with AIR, Jalandhar, for 352 radio talks of PAU scientists. It also prepared six documentaries and two advertisements.



Kheti Sandesh, a weekly digital Whatsapp newspaper

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 1,79,800 during 2017-18. 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 25 farm bulletins in English and 29 in Punjabi. Revised editions of Package of Practices for *Rabi* and *Kharif* Crops (in English and Punjabi), *Field Problems of Important Crops* (in English), etc. were published by the Centre. In addition, new editions of *Statistics of Agriculture, Chrysanthemum, Waterlogging and Agriculture: Issues and Challenges in South-Western Punjab, Dalan di Kasht, Khumbhan di Kasht, Madhumakhian di Sambh Sambhal, Matran di Kasht*, etc. were brought out by the Centre.



S. Manpreet Singh Badal, Finance Minister, Punjab, inaugurating PAU Kisan Mela at Ludhiana on September 22, 2017 (left) and seeing cotton crop (right).



HUMAN RESOURCE, FINANCE AND INFRASTRUCTURE DEVELOPMENT

NEW APPOINTMENTS, PROMOTIONS AND RETIREMENTS

New appointments

During the period under report, following new appointments were made. Besides, 50 Assistant Professors & equivalent and five Associate Professors & equivalent were directly recruited.

Promotions and retirements

During the period under report, 30 Assistant Professor level teachers having grade pay of Rs 6,000/- were placed in the grade pay of Rs 7,000/- in the pay scale of Rs 15,600-39,100; 21 Assistant Professor level teachers having grade pay of Rs

7,000/- were placed in the grade pay of Rs 8,000/- in the pay scale of Rs 15,600-39,100; nine Assistant Professors having grade pay of Rs 8,000/- in the pay scale of Rs 15,600-39,100 were promoted/designated to the post of Associate Professor & equivalent in the grade pay Rs 9,000/- in the pay scale of Rs 37,400-67,000; and 17 Associate Professors having grade pay of Rs 9,000/- were promoted to the post of Professor & equivalent in the grade pay of Rs 10,000/- in the pay scale of Rs 37,400-67,000. A total of 16 teachers retired/resigned from the University service.

Name	Appointed as	Date of appointment
Dr J.S. Mahal	Director of Extension Education	22.01.2018 (AN)
Dr (Mrs) R.K. Dhaliwal	Director Students' Welfare	22.01.2018 (AN) (second term)
Dr K.S. Thind	Additional Director of Research (Crop Improvement)	14.09.2017
Dr P.P.S. Pannu	Additional Director of Research (Natural Resource & Plant Health Management)	14.09.2017
Dr D.S. Bhatti	Additional Director of Extension Education	14.09.2017
Dr Ashok Kumar	Additional Director of Research (Farm Mechanization & Bioenergy)	22.01.2018 (AN) (second term)
Dr M.I.S. Gill	Additional Director of Research (Horticulture & Food Science)	22.01.2018 (AN)
Dr P.K. Chhuneja	Head, Department of Entomology	01.07.2017
Dr Shammi Kapoor	Head, Department of Microbiology	29.07.2017
Dr (Mrs) Sucheta Sharma	Head, Department of Biochemistry	13.09.2017
Dr G.S. Mangat	Head, Department of Plant Breeding & Genetics	01.11.2017
Dr Harminder Singh	Head, Department of Fruit Science	27.11.2017
Dr Prabhjyot Kaur	Head, Department of Climate Change & Agricultural Meteorology	27.02.2018
Dr Paramjit Singh	Director, Regional Research Station, Kapurthala	01.11.2017
Dr P.K. Arora	Director, Regional Research Station, Abohar	01.11.2017 (second term)
Dr P.K. Rathore	Director, Regional Research Station, Faridkot	16.11.2017 (second term)
Dr C.S. Aulakh	Director, School of Organic Farming	24.11.2017



Category	Sanctioned posts	Posts in position
State	1,054	462
ICAR	156	155
KVK	126	124
Others	23	17
Total	1,359	758

AWARDS, DISTINCTIONS AND RECOGNITIONS

- The PAU was ranked number one among the State Agricultural Universities and third among research institutes as per the ranking of agricultural universities and research institutes, conducted by the ICAR, New Delhi, in 2017.
- The University was adjudged one of the Icons of Modern India by India Today Magazine in its special issue on 70 years of Independence (August 2017). Under the title "Harvest of Riches" PAU was highly acknowledged for "its pivotal role in ringing in the Green Revolution that made India self-sufficient in food grains."

Directorate of Research

- The Regional Research Station, Kapurthala, was recognized as an "Excellent Sugarcane Research Centre 2017-18" under All India Coordinated Research Project (AICRP) on Sugarcane.
- The PAU's Centre of All India Coordinated Research Project (AICRP) - National Seed Project (Crops) was recognized for best performance in breeder seed production in 2018.
- Dr Satnam Singh (Regional Research Station, Faridkot) was awarded Nuffic Fellowship by Dutch government to attend a training course on "Integrated Pest Management (IPM) and Food Safety" at Wageningen, The Netherlands, in June 2018.
- Dr K.K. Sharma (Regional Research Station, Ballawal Saunkhri) was awarded "Young Scientist Award 2017" by Society for Scientific Development in Agriculture and Technology, Jhansi.

- Dr Prakash Mahala (Regional Research Station, Ballawal Saunkhri) got "Young Scientist Award" from All India Agricultural Students Association (AIASA), New Delhi. Besides, he received "Best Ph.D. Thesis Award 2017" from Society for Scientific Development in Agriculture and Technology.
- Drs Satnam Singh and Suneet Pandher (Regional Research Station, Faridkot) won "Best Poster Award" during Indo-US Whitefly Symposium, held at PAU from December 4-5, 2017.
- Drs K.K. Sharma, D.S. Rana, and M.J. Singh (Regional Research Station, Ballawal Saunkhri) secured first prize in poster presentation during the 3rd National Convention "AgriVision 2018" held at National Agriculture Science Complex, ICAR, New Delhi, from March 24-25, 2018.

College of Agriculture

- Drs RIS Gill, Baljit Singh and Navneet Kaur (Forestry and Natural Resources) received "Best All India Coordinated Research Project Centre (on Agroforestry) Award 2017" from Central Agroforestry Research Institute, Jhansi.
- Dr A.S. Dhatt and all faculty members (Vegetable Science) got "Best Network Centre Award 2017-18" from ICAR-Directorate of Onion and Garlic Research, Pune, for PAU's All India Coordinated Research Project Centre on Onion and Garlic.
- Drs N.S. Bains, V.S. Sohu, Kuldeep Singh, Parveen Chhuneja and G.S. Mavi (Plant Breeding and Genetics) were honoured with "Gene Stewardship Award 2018" by Borlaug Global Rust Initiative (BGRI).
- Dr Sarwan Kumar (Plant Breeding and Genetics) was awarded Australian Government's Endeavour Research Fellowship by Department of Education and Training, Australia, in 2018.
- Dr Mehak Gupta (Plant Breeding and



- Genetics) received “Young Scientist Award 2018” from Indian National Science Academy (INSA), New Delhi.
- Dr Ashok Kumar Dhakad (Forestry and Natural Resources) got “Junior Scientist of the Year Award - 2017” from National Environmental Science Academy, New Delhi.
 - Drs Ravinder Singh and Gaurav Kumar Taggar (Plant Breeding and Genetics) were enrolled as Fellows of Indian Society of Pulses Research and Development, Kanpur, in 2017.
 - Drs Virender Sardana and Satwinder Kaur Dhillon (Plant Breeding and Genetics) were enrolled as Fellows of Indian Society of Oilseeds Research, Hyderabad, in 2017.
 - Dr Guriqbal Singh (Plant Breeding and Genetics) received “ISPRD Excellence Award 2017” of Indian Society of Pulses Research and Development (ISPRD), Kanpur. He also received “Dr Harcharan Singh Sandhu Memorial Award 2014-15” from PAU in 2017.
 - Dr Shayla Bindra (Plant Breeding and Genetics) was awarded Gold Medal by Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur, in 2017.
 - Drs A.S. Dhatt and M.K. Sidhu (Vegetable Science) received Dr Harbhajan Singh Gold Medal from Indian Society of Vegetable Science for best publication in 2017.
 - Dr M.I.S. Gill (Fruit Science) got “Hans Raj Pahwa Award 2017” from PAU.
 - Dr Harminder Singh (Fruit Science) was awarded “Gurcharan Singh Nihal Singh Wala Award 2017” by PAU.
 - Dr Gaurav Kumar Taggar (Plant Breeding and Genetics) was appointed as Editor, Journal of Insect Science by Indian Society for the Advancement of Insect Science, Department of Entomology, PAU, in 2017. He also received “Best Oral Presentation Award” during International Conference on “Agriculture and Crop Science” held at Gurugram, Haryana, from October 9-11, 2017.
 - Drs Sarvjeet Singh and Ravinder Singh (Plant Breeding and Genetics) were elected as President and Secretary, respectively, of Indian Society of Pulses Research and Development, Kanpur (North Zone Chapter).
 - Dr Ravinder Singh (Plant Breeding and Genetics) was elected as Councillor of Indian Society for the Advancement of Insect Science, Department of Entomology, PAU, in 2017.
 - Dr Vikas Jindal (Entomology) got “P. Kameswara Rao Award” for best oral presentation during the “XVI AZRA International Conference” organized by Applied Zoological Research Association (AZRA) from February 9-11, 2018.
 - Drs S.P. Sharma, S. Devi, A. Kalia and S.S. Dhaliwal (Soil Science) got “Best Poster Award” during International Symposium on “Horticulture: Priorities and Emerging Trends” held at ICAR-Indian Institute of Horticultural Research, Bengaluru, from September 5-9, 2017.
 - Drs Prabhjyot Kaur, Vijay Kumar, Harpreet Singh, Sandeep Singh Sandhu and O.P. Gupta (Climate Change and Agricultural Meteorology) bagged “Best Oral Paper Award” during National Seminar AGMET-2017 on “Agrometeorology for Sustainable Development with Special Emphasis on Agrometeorological Practices for Climate Resilient Farming and Food Security” held at Haryana Agricultural University, Hisar, Haryana, from October 12-14, 2017. They were awarded for the research paper titled “Prediction of whitefly (*Bemisia tabaci* (Gennadius)) incidence in cotton (*Gossypium hirsutum*) using a weather based decision support system”.
 - Drs Atin Majumder, R. Setia, P.K. Kingra, Prionath Adhikary, Som Pal Singh and B. Pateriya (Climate Change and Agricultural



Meteorology) won “Best Paper Award” during National Conference on “Role of Geospatial Technologies to bridge the Rural and Urban Divide” held at Punjab Remote Sensing Centre, Ludhiana, from February 22-23, 2018. They were awarded for the paper entitled “Spatio-temporal dynamics of surface urban heat island in Bathinda city, India.”

College of Agricultural Engineering and Technology

- Dr A.K. Jain (Soil and Water Engineering) was granted copyright for mobile app by Copyright Office, Ministry of Commerce and Industry, Government of India, in 2018.
- Dr M.S. Alam (Processing and Food Engineering) was awarded International Fellowship by Nuffic, Holland under Netherlands Fellowship Programme and Commendation Medal by Indian Society of Agricultural Engineers in 2018.
- Dr Anoop Dixit (Farm Machinery and Power Engineering) received “Fellow Award 2017-18” from Indian Society of Agricultural Engineers.
- Dr Manpreet Singh (Renewable Energy Engineering) got “Best Trainee Award 2017” from Punjabrao Deshmukh Agricultural University, Akola, Maharashtra.
- Dr Manjeet Singh (Farm Machinery and Power Engineering) received an Appreciation Certificate from Birla Soft India Limited for the year 2017-18 for generous support and guidance towards ‘Shodhan’ Birla Soft CSR initiative targeted for reduction of crop residue burning in selected villages of Punjab. He was also enrolled as Fellow for Agriculture Division of Institution of Engineers (India), Kolkata, during 2017-18.
- Drs G.S. Manes, Anoop Dixit, Arshdeep Singh, Aseem Verma and Abhishek Bhardwaj (Farm Machinery and Power Engineering) bagged “Best Poster Paper Award” during the 52nd Annual Convention of Indian Society of

Agricultural Engineers, held at Anand Agricultural University, Anand, Gujarat, on January 8, 2018. They received the award for the paper entitled “Development and evaluation of tractor operated loose straw chopper for paddy straw management”.

College of Basic Sciences and Humanities

- Dr Rajeev Kumar (Math, Stat and Physics) received “Early Career Research Award 2018” from Department of Science and Technology (DST) - Science and Engineering Research Board (SERB).
- Dr Priya Katyal (Microbiology) was awarded “Dr G.S. Khush Travel Grant 2018” by PAU. She also bagged “Best Data Representation Award” during Winter School on “Technological Innovations in Processing and By-products Utilization of Agricultural Produce” organized by ICAR-Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana, from December 4-24, 2017.
- Dr Parminder Kaur (Economics and Sociology) got “Best Paper Award” from Indian Dairy Association, New Delhi, for the paper published in Indian Journal of Dairy Science in 2018.
- Dr Baljinder Kaur Sidana (Economics and Sociology) bagged “Best Paper Presentation Award” during the 5th National Seminar on “Towards Sustainable Agriculture: Role of Technology, Policy Planning and Implementation” organized by Society of Economics and Development, PAU, on April 5, 2018.

College of Home Science

- Dr Kiran Bains (Food and Nutrition) received “Best Poster Presentation Award” during the “XXXII Biennial Conference of Home Science Association of India (HSAI)” held at Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, from February 1-3, 2018.



- Dr Neerja Singla (Food and Nutrition) got “Best Presenter Award” during the “6th International Agriculture Studies Synopsis” held at University Putra, Malaysia, from February 4-13, 2018.
- Mrs Rajdeep Kaur and Dr Sandeep Bains (Apparel and Textile Science) were awarded first prize in paper presentation during the 5th National Seminar “Towards Sustainable Agriculture: Role of Technology, Policy Planning and Implementation” organized by Society of Economics and Development, PAU, on April 5, 2018.

NATIONAL AND INTERNATIONAL LINKAGES

Memoranda of Understanding (MoUs) signed

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

- Industrieprojekt GmbH (IPRO) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany, on July 12, 2017 for exchange of scientists and technologies, and development and implementation of a collaborative project.
- Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, on September 26, 2017 for exchange of Ph.D students.
- ICAR - Indian Institute of Maize Research (IIMR), Ludhiana, on October 16, 2017 for promotion of students’ teaching and quality postgraduate research in cutting edge areas.
- ICAR - Central Institute of Post-harvest Engineering and Technology (CIPHET), Ludhiana, on December 16, 2017 for exchange of scientists, technologists, students and their proper placement; and mutual relation between teaching, research and extension.
- Department of Industries and Commerce, Chandigarh, on May 16, 2018 to facilitate food processing sector and promote new scheme of infrastructure for agro processing clusters.
- International Centre for Agricultural Research in the Dry Areas (ICARDA) on June 14, 2018 for cooperation in agricultural research and teaching with thrust on exchange of scientists, technologists and students; exchange of germplasm and breeding material; and exchange of scientific literature, information and methodology.

Eminent Visitors

- Mr Ajay Vir Jakhar, Chairman, Punjab State Farmers’ and Farm Workers’ Commission, visited PAU on July 12, 2017; October 26, 2017 and January 4, 2018 to discuss agricultural policy and extension services being provided to farmers in Punjab.



Mr Ajay Vir Jakhar, Chairman of Punjab State Farmers’ and Farm Workers’ Commission, speaking at PAU. He is flanked by Dr B.S. Sidhu, Agriculture Commissioner, Punjab and Dr Baldev Singh Dhillon, Vice Chancellor, PAU.

- Dr Raj Khosla, Robert E. Gardener Professor of Precision Agriculture, Colorado State University, USA, visited PAU on July 17, 2017 to explore collaborative areas and deliver a talk on “Precision Agriculture and Big Data: The Future of Farming.”
- The House Committee of Kerala Legislative Assembly visited PAU on July 20, 2017 to have an overview of Punjab’s agricultural scenario and PAU’s research, teaching and extension programmes.
- Dr P.K. Aggarwal, an expert from International Maize and Wheat Improvement Centre (CIMMYT), and a Regional Programme Director, Consultative Group on International



Agricultural Research (CGIAR), visited PAU on August 11, 2017 to deliver a talk on "Managing Climatic Risks in Agriculture: Big Data provides New Opportunities."

- Dr T. Mohapatra, Director General of ICAR and Secretary, Department of Agricultural Research and Education (DARE), New Delhi, visited PAU on October 18, 2017 to review research and extension activities of all ICAR centres functional in the university premises. He was accompanied by Dr S.K. Dutta, Former Vice-Chancellor, Visva-Bharati Central University, West Bengal.
- A two-member delegation comprising Mr Nagesh Singh, Additional Secretary and Mr Atal Dullo, Joint Secretary, Ministry of Rural Development, Government of India, visited PAU on November 27, 2017 to gather information on machines being adopted by farmers for straw management and subsequent sowing of wheat and potato.
- A three-member delegation from Cyprus visited PAU from December 6-8, 2017 to discuss possibility of joint venture. The delegation comprised Dr Dionysia Fasoula, Agricultural Research Officer, Agricultural Research Institute (ARI), Cyprus; Dr Sozos Sozou, Director, Heart 4 India Organization, Cyprus; and Dr Gladuin P. Singh, Dean of the school, Oversees of Heart 4 India.
- Dr C. Roul, Joint Secretary, Department of Agricultural Research and Education (DARE), New Delhi, visited PAU on December 11, 2017 to review paddy straw management options being provided to farmers.
- Drs Swarn Singh Dhaliwal and Harjinder Singh Sandhu, experts from USA, visited PAU on January 5, 2018 to deliver their talk on "Success through Collaboration in Digital Age."
- A four-member delegation of Agriculture Extension Officers from Chhukha, Bhutan, visited PAU from January 15-22, 2018 to attend seven-day training programme on mushroom cultivation. The Bhutanese delegation comprised Sonam Choki, Kinzang Wangchuk, Thinley Gyetts Hen and Damber Singh Mongar.
- The Quinquennial Review Team (QRT) of ICAR, New Delhi, visited PAU on February 2, 2018 to review the work done (research, administration, funding and other related matters) in the Department of Fruit Science, PAU, under the ICAR-All India Coordinated Research Project (AICRP) on Fruits during the period 2011-2017. The team was headed by the Chairman Dr K.L. Chadha, Former Deputy Director General (Horticulture Science), ICAR, and President, Horticulture Society of India, New Delhi. It comprised five members, namely Dr BMC Reddy, Former Vice-Chancellor, Dr YSR Horticultural University, West Godavari, Andhra Pradesh; Dr V.S. Thakur, Former Vice-Chancellor, Dr YS Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh; Dr S. Maiti, Former Director ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat; Dr H.K. Senapati, Ex-Dean PGF-cum-DRI, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha; and Dr Prakash Patil, Project Coordinator, ICAR-All India Coordinated Research Project on Fruits and Secretary QRT, Indian Institute of Horticultural Research, Bengaluru, Karnataka.
- The Chairman of Commission for Agricultural Costs and Prices (CACP) Dr Vijay Paul Sharma visited PAU on February 9, 2018 to deliberate on paddy straw management issue with special thrust on providing incentives to farmers who said no to straw burning and managed it using various technologies. He was accompanied by his Advisor Dr D.K. Pandey.
- A 30-member delegation comprising farmers and finance experts of South Dakota State



Ms Harinder Sidhu, Australian High Commissioner to India, interacting with Dr Baldev Singh Dhillon, Vice Chancellor, PAU.



Sh Sunder Sham Arora, Minister for Industries, Punjab, seeing PAU produced seed.

University, USA, visited PAU on February 19, 2018 as a part of their ongoing 18-month leadership programme. The delegation was led by Dr Lori Cope, Executive Director, South Dakota Agricultural and Rural Leadership Programme.

- Ms Harinder Sidhu, Australian High Commissioner to India, visited PAU on February 19, 2018 to discuss areas of mutual interest. She was accompanied by three-member Australian delegation comprising Dr Nora Galway, Ms Vanessa Voss and Dr Kuhi Chatterjee.
- S. Arvinder Singh Bains, Registrar of Cooperative Societies, Punjab, visited PAU on February 19, 2018 to chalk out strategy on stubble burning issue.
- Dr M. Elangovan, Principal Scientist (Genetic Resources), ICAR- Indian Institute of Millets Research (IIMR), Hyderabad, visited PAU on March 15, 2018 to deliver a talk on "Digital Field Book."
- Dr K.S. Khokhar, Former Vice Chancellor, CCS Haryana Agricultural University, Hisar, Haryana, visited PAU on March 16, 2018 to deliver the first Dr A.S. Atwal Memorial Lecture on "Insects as Food and Feed Source."
- Dr R.S. Ghuman, Professor of Economics, Centre for Research in Rural and Industrial Development, Chandigarh, visited PAU on March 21, 2018 to deliver a talk on "Rural Economy of Punjab: Issues and Challenges."
- Dr Ahmed Awany, Director, Central Laboratory for Agricultural Climate, Egypt, and Dr Mohamed Abdrabou, Professor, Central Laboratory for Agricultural Climate, Egypt, visited PAU from March 22-23, 2018 to deliberate on water conservation.
- A 10-member delegation comprising officials from the Ministry of Agriculture, Irrigation and Livestock, Kabul, Government of Afghanistan, visited PAU from April 9-18, 2018 to attend 10-day international training programme on "Crop Protection Chemicals for Food Security, Safety and their Residue Management." The training programme was organized by the Department of Entomology, PAU, under the aegis of Environmental and Culture Society, Hisar, Haryana.
- A delegation from Yezin Agricultural University (YAU), Myanmar, visited PAU on April 17, 2018 to gather know-how of food processing technologies.
- Sh Sunder Sham Arora, Minister for Industries and Commerce, Punjab, visited PAU on May 16, 2018 to inaugurate Agri and Food Conclave, jointly organized by Department of Industries and Commerce, Punjab; Confederation of Indian Industry; and Punjab Agricultural University, Ludhiana, at PAU.
- A two-member delegation from University of Melbourne, Australia, visited PAU on June 6,



2018 to explore possibility of joint venture in agricultural research and education. The delegation comprised Dr Said Ajlouni, Associate Professor and Jonty Hall, Recruitment Coordinator.

- A delegation from United Kingdom visited PAU on June 14, 2018 to discuss collaborative project "Development and Optimization of Fresh Produce Supply Chain and Storage System." The Punjab Agricultural University is a partner in this international project which focuses on post-harvest management of fruit and vegetables. Companies, namely Coveris Flexibles Limited, ECH Engineering Limited, and educational institutions comprising University of Lincoln and Grimsby Institute from UK and Sangha Innovation Private Limited, Jalandhar; Centre of Innovative and Applied Bioprocessing (CIAB), Mohali and Punjab Agricultural University, Ludhiana, from India are partners in this collaborative project. The project will be funded by UK-India Newton-Bhabha Fund.

TRAININGS AND VISITS ABROAD

College of Agriculture

- Dr Amandeep Mittal (School of Agricultural Biotechnology) visited University of Western Australia, Australia, to attend three-month training programme on "Guava Genome Assembly and Mining of Useful SNPs to design a SNP Chip for High Throughout Linkage Mapping and Gene/QTL Identification" from December 12, 2017 to May 11, 2018.
- Dr Navneet Kaur (Forestry and Natural Resources) visited the University of Gothenburg, Sweden, to attend a seven-day training programme on "Agriculture Food Security Research-Policy Linkages" from January 21-27, 2018. Earlier, she presented a paper during the "26th Asian-Pacific Conference on Weed Science," held at Kyoto, Japan from September 19-22, 2017.
- Dr R.K. Dhall (Vegetable Science) visited

MATC-MASHAV's International Agricultural Training Center, Shefayim, Israel, to attend a training programme on "Intensive Vegetable Production and Modern Irrigation Technologies" from January 29 to February 16, 2018.

- Dr Sarwan Kumar (Plant Breeding and Genetics) visited The University of Queensland for post doctoral research from April 1 to August 1, 2018.
- Dr S.K. Jindal (Vegetable Science) visited Wageningen University, The Netherlands, to attend an international training course on "Contemporary Approaches to Genetic Resources Conservation and Use" from April 9-27, 2018.
- Drs RIS Gill and K.S. Sangha (Forestry and Natural Resources) visited Kathmandu, Nepal, for oral presentation during an "International Agro-forestry Conference" from April 27-29, 2018.
- Dr Ritu Rani (Plant Pathology) visited Ohio State University, USA, to attend advance training course from May 11 to August 11, 2018.
- Dr Sumita Chandel (Soil Science) visited Tel Aviv University, Israel, to attend summer training programme on "Food Safety and Security" from June 27 to July 29, 2018.

College of Agricultural Engineering and Technology

- Dr Nilesh Biwalkar (Soil and Water Engineering) visited Galilee International Management Institute, Nahalal, Israel, to attend a training programme on "Irrigated Agriculture in Times of Climate Change" from March 13-26, 2018.
- Dr M.S. Alam (Processing and Food Engineering) visited Wageningen University, The Netherlands, to attend a training programme on "Horticulture Sector Development in Emerging Markets" from May 14 to June 1, 2018.



IMPORTANT EVENTS ORGANIZED

COLLEGE OF AGRICULTURE

Event and Date	Organizing/Sponsoring Agency
National Symposium on “Biorational, Approaches in Plant Diseases Management” (October 27-28, 2017)	Indian Society of Plant Pathologists, Department of Plant Pathology, PAU and Himalayan Society of Plant Pathology, Dr Y.S. Parmar University of Horticulture and Forestry (YSPUHF), Nauni, Solan, at YSPUHF
Centre for Advanced Faculty Training (CAFT) on “Conservation Agriculture and Soil Health”(November 1-21, 2017)	Department of Soil Science, PAU, under the aegis of ICAR
Training Workshop on “Simulation Modeling in Agricultural Research: Modeling Plant Disease Epidemics and Yield Losses” (November 13-15, 2017)	Indian Society of Plant Pathologists, Department of Plant Pathology, PAU
5 th Workshop/Coordination Committee Meeting of Network Project on “Conservation of Lac Insect Genetic Resources” (November 14-15, 2017)	Biocontrol Section, Department of Entomology, PAU
Four training courses: <ul style="list-style-type: none"> • Basic Beekeeping Training for farmers/farm women (November 20-27, 2017) • Basic Beekeeping Training Course under National Horticulture Mission (January 8-12, 2018) • Beekeeping Training Course for scheduled castes (January 15-19, 2018) • Advance Training Course in Beekeeping for Agricultural and Horticultural Development Officers, and scientists of <i>Krishi Vigyan Kendras</i>(February 6-9, 2018) 	Department of Entomology, PAU
Indo-US Symposium on “Curbing Whitefly-Plant Virus: The Departure from Pesticides to Genomics Solutions” (December 4-5, 2017)	Punjab Agricultural University, Ludhiana and The University of Arizona, Tucson, USA
Pre-season training on “ <i>South Asian Association for Regional Cooperation (SAARC)</i> Surveillance Tool Box” (December 12, 2017)	Department of Plant Breeding and Genetics, PAU, in collaboration with Indian Institute of Wheat and Barley Research (IIWBR), Karnal and Sathguru Management Consultants Pvt. Ltd., Hyderabad
Training course on “Mass Production and Utilization of Biocontrol Agents” for the technical staff of Nawanshaher Co-operative Sugar Mills Ltd., Nawanshaher, Shaheed Bhagat Singh Nagar; Morinda Co-operative Sugar Mills Ltd. Morinda, Roopnagar; and Biocontrol Laboratory, Regional Station, Abohar (March 6-7, 2018)	Biocontrol Section, Department of Entomology, PAU
Punjab Agri and Food Conclave: From Food Bowl of India to Food Processing Hub of India (May 16, 2018)	Confederation of Indian Industry, Government of Punjab and Punjab Agricultural University, Ludhiana
IX th All India Network Research Project on Onion and Garlic Group Meeting (June 8-10, 2018)	Department of Vegetable Science, PAU and ICAR - Directorate of Onion and Garlic Research, Pune



College of Agricultural Engineering & Technology

Event and Date	Organizing/Sponsoring Agency
Turnkey Workers/Self Employed Workers Training Courses (August 16 to September 4, 2017 and October 23 to November 6, 2017)	Department of Civil Engineering, PAU, sponsored by Ministry of New and Renewable Energy, New Delhi, under the scheme "Regional Biogas Development and Training Centre (CSS-60)"
Construction-cum-Maintenance Training Course (September 5-17, 2017 and November 21-30, 2017)	
Quinquennial Review Team (QRT) meeting of the scheme "Farm Implements and Machinery" organized for eight centres (Punjab Agricultural University, Ludhiana; Haryana Agricultural University, Hisar; Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad; Indian Grassland and Fodder Research Institute, Jhansi; Indian Institute of Sugarcane Research, Lucknow; Indian Agricultural Research Institute, Delhi; <i>GB Pant University of Agriculture and Technology</i> , Pantnagar and Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur) (November 6-8, 2017)	Department of Farm Machinery and Power Engineering, PAU
Collaborative Agriculture Extension Training Programmes for field engineers and executives (December 9-10, 2017; December 18, 2017; February 8-10, 2018 and February 26, 2018)	Training Unit, College of Agricultural Engineering and Technology with Mahindra and Mahindra and Department of Farm Machinery and Power Engineering, PAU
Two training courses on: <ul style="list-style-type: none"> Machinery and Its Safety for Different Farming Operations (January 11-12, 2018) Precision Technologies for Water Saving and its Recharging (February 15-16, 2018) 	Training Unit in collaboration with Directorate of Extension Education and Department of Farm Machinery and Power Engineering, PAU
In-house training programme T2 on "Agricultural Engineering" (February 23 to May 11, 2018)	Training Unit in association with all departments of College of Agricultural Engineering and Technology, PAU
Training course on "Storage and Processing of Agricultural and Horticultural Produce" (May 24-25, 2018)	Training Unit in collaboration with Directorate of Extension Education and Department of Processing and Food Engineering, PAU

College of Basic Sciences and Humanities

Event and Date	Organizing/Sponsoring Agency
21 st Punjab Science Congress "Scientific Advances for Inclusive Development and Environmental Protection" (February 7-9, 2018)	Organized by PAU and sponsored by Punjab Academy of Sciences
World Suicide Prevention Day (September 10, 2017)	PAU under National Agricultural Science Fund (ICAR) project
National Seminar on "Reproductive Health Advances for Adolescents" (September 7-8, 2017)	Department of Zoology, PAU



College of Home Science

Event and Date	Organizing/Sponsoring Agency
-Orientation course on “Effective Teaching, Research and Extension” (November 7-17, 2017) - Four Workshops on: <ul style="list-style-type: none"> - Photography (March 5, 2018) - Desktop Publishing (March 7, 2018) - Personality Development (March 9, 2018) - Engaging Public through Effective Communication (May 4, 2018) 	Department of Extension Education and Communication Management, PAU
Two Workshops on: <ul style="list-style-type: none"> - Nutritious Biscuits and Cookies (March 28, 2018) - Glazed Icing and Chocolate Making (April 4, 2018) 	Department of Food and Nutrition, PAU
A Workshop on: <ul style="list-style-type: none"> - Equipping Children for 21st Century (May 10-11, 2018) 	Department of Human Development and Family Studies, PAU
Two Workshops on: <ul style="list-style-type: none"> - Making Artifacts of Worli Art (May 24, 2018) - Advance Quelling Techniques (May 25, 2018) 	Department of Family Resource Management, PAU

PAU Science Club

Talk on “Are Physiologists, with their Obsession with Photosynthesis and Water Relations, any Use to Crop Breeders?” by Prof Howard Griffiths, Department of Plant Sciences, University of Cambridge, UK (October 11, 2017)	PAU Science Club
Visit of experts for preparation of proposal of PAU for Institute of Eminence (November 24-26, 2017)	
Lecture on “How to be Heart Smart” by Dr H.S.Bedi, Heart Specialist (December 7, 2017)	



FINANCES

The Board of Management in its 285th meeting held on March 26, 2018 approved the budget estimates of Punjab Agricultural University for the year 2018-19 amounting to Rs 633,90.20 lakh. The details of these schemes, budget allocation for research, teaching, extension, administrative and miscellaneous activities are as under: -

Schemes	Budget Estimates (2018-19) (Rs in lakh)	Budget Estimates (2017-18) (Rs in lakh)	2017-18	
			Actual grant received (Rs in lakh)	Allocation (%)
State Schemes				
Non Plan Agriculture Schemes	263,91.37	244,63.07	140,81.37	29.4
Plan Agriculture Schemes	239,64.02	227,66.63	221,04.00	46.1
Rashtriya Krishi Vikas Yojana (RKVY)	-	-	300.00	0.6
ICAR Schemes (AICRP/KVK/Adhoc & Development Grant)	9,183.13	96,34.09	81,71.24*	17.0
Central Govt. Funding (University Grants Commission and Centrally Sponsored Schemes, Department of Biotechnology, Department of Science & Technology)	17,05.70	13,35.54	20,37.33	4.3
Other Schemes [National Horticulture Mission/ Misc. Schemes (Private Companies)/ Misc. (Foreign Contribution), etc.]	14,05.85	10,66.05	12,42.29	2.6
Self-financing Schemes	5,38.51	5,17.53	-	-
Revolving Fund Schemes	2,01.62	1,30.51	-	-
Total	633,90.20	599,13.42	479,36.23	100

*includes Rs 7,16.81 lakh for strengthening and development of PAU and Rs 53.94 lakh for strengthening of library services.

As compared to the Budget Estimates amounting to Rs 599,13.42 lakh for the year 2017-18 approved by the Board of Management in its 280th meeting held on March 29, 2017, the actual grants received during the financial year 2017-18 were Rs 479,36.23 lakh. The University raised Rs 79,12.58 lakh through tuition fee and other sources/services.

Allocation of funds for various activities

Budget Allocation	2018-19		2017-18	
	As per Budget Estimates		As per actual grant received	
	Amount (Rs in lakh)	Allocation (%)	Amount (Rs in lakh)	Allocation (%)
Research	329,57.21	51.99	261,73.18	54.6
Teaching	147,21.07	23.22	104,02.16	21.7
Extension	87,10.22	13.74	63,27.58	13.2
General administration and others	70,01.70	11.05	50,33.30	10.5
Total	633,90.20	100	479,36.23	100

During the year 2017-18, actual allocation was 54.6% on research, 21.7% on teaching, 13.2% on extension and 10.5% on general administration and others.



ESTATE ORGANIZATION

Estate Organization looks after the construction and maintenance of University buildings. A total of 17 projects were completed by the Engineering Unit during the period under report. (Annexure I)

FACULTY PARTICIPATION IN NATIONAL AND INTERNATIONAL EVENTS

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

INTERNATIONAL PARTICIPATION

College of Agriculture

Name	Event and Organizing Agency	Date and Place
Dr Sanjula Sharma (Plant Breeding and Genetics)	Indian National Science Academy (INSA) Bilateral Exchange Programme-2017	August 15 to November 10, 2017 Göttingen University, Germany
Drs M.S. Bhullar and Simerjeet Kaur (Agronomy)	"26 th Asian-Pacific Weed Science Society Conference" by Asian-Pacific Weed Science Society	September 19-22, 2017 Kyoto, Japan
Dr Hari Ram (Agronomy)	Harvest Zinc Fertilizer Project meeting	December 13-16, 2017 Germany
Dr Dharinder Pathak (Plant Breeding and Genetics)	International Cotton Advisory Committee (ICAC) -13th meeting of Inter-Regional Cooperative Research Network on Cotton for the Mediterranean and Middle East Regions by ICAC, Washington DC, USA	February 2-6, 2018 Luxor, Egypt
Drs G.S. Mangat and Jagjeet Singh Lore (Plant Breeding and Genetics)	"International Hybrid Rice Symposium 2018" by International Rice Research Institute (IRRI), Philippines	February 27 to March 1, 2018 Indonesia
Dr Varinderpal Singh (Soil Science)	Cambridge-India Network for Transitional Research in Nitrogen (CINTRIN) Project	April 22 to September 24, 2018 National Institute of Agricultural Botany, UK
Drs Sarvjeet Singh and Jagmeet Kaur (Plant Breeding and Genetics)	"7 th International Food Legume Research Conference"	May 6-8, 2018 Marrakech, Morocco

College of Agricultural Engineering and Technology

Name	Event and Organizing Agency	Date and Place
Dr Manjeet Singh (Farm Machinery and Power Engineering)	"7 th Asian-Australasian Conference on Precision Agriculture (ACPA)"	October 15-18, 2017 Claudelands Conference and Exhibition Centre, Hamilton, New Zealand
	Seminar on "Non-energy Application of Atomic Power in Agriculture" by Dr (Ms) Elena Igorevna Sarapultseva, Professor, Department of Biotechnology, Obninsk Institute of Nuclear Power Engineering, National Research Nuclear University, Russia	November 30, 2017 National Research Nuclear University, Russia



Name	Event and Organizing Agency	Date and Place
	"14 th International Conference on Precision Agriculture (ICPA)"	June 24- 27, 2018 Montreal, Quebec, Canada
Dr V.P. Sethi (Mechanical Engineering)	As Keynote Speaker at the 2 nd International Conference on "Materials Manufacturing and Mechanical Engineering (MMME-2017)"	December 28-30, 2017 Advance Science and Technology Application Research Centre, Phuket, Thailand
Dr Rakesh Sharda (Soil and Water Engineering)	Meeting regarding Indo-Egypt Project sponsored by Department of Science and Technology, Government of India	February 25 to March 11, 2018 Egypt
	Agritech-2018	May 8-11, 2018 Tel Aviv, Israel
Dr Preetinder Kaur (Processing and Food Engineering)	Quarterly project review meeting and work with Dr Deborah Rees on "Bio-based Packaging for Fresh Food (BioFreshPak)"	June 16 – July 13, 2018 Natural Resources Institute, University of Greenwich, Kent, UK
Drs Satish Kumar and Mahesh Kumar (Processing and Food Engineering)	Review meeting and visit to partner institutes and industry	June 26 to July 05, 2018 Sheffield and Nottingham Universities, UK

NATIONAL PARTICIPATION

Name of the College	No. of faculty members participated
College of Agriculture	112
College of Agricultural Engineering and Technology	32
College of Basic Sciences and Humanities	56
College of Home Science	26

NEW EQUIPMENT ACQUIRED (above Rs 2.0 lakh)

College of Agriculture

Equipment/instrument	Cost (in lakh)	Utility
Bench Top CO ₂ Incubator	6.80	For research under controlled conditions
Phytotron	20.00	
Electronic Weighing Balance	2.00	To carry out research work
BOD Incubator with humidifier	4.90	
Tractor MM 241	5.95	For field operations
Growth Chamber	8.97	To rear maize stem borer
Gas Chromatograph	35.00	For the analysis of greenhouse gases in air samples
UV Visible Spectrophotometer	3.75	For the analysis of sulphur and phosphorous in soil and plant samples
Cone Penetrometer	3.55	To measure soil strength under different land management practices
Thermocycler	5.93	For marker assisted transfer of <i>ms10</i> gene from hot pepper to bell pepper
Rotary Shaker	7.98	For microbial growth at defined temperature
Electrophoresis System with power supply	2.20	To separate charged molecules, like DNA, according to size
Purchase of PCR (Polymerase chain reaction)	5.98	To make multiple copies of a specific DNA segment
Cooling Incubator	2.00	To provide congenial temperature to microbes
Total	115.01	



College of Agricultural Engineering and Technology

Equipment/instrument	Cost (in lakh)	Utility
Gas Mixing and Packaging System for modified atmosphere packaging	16.0	Gas flushing and sealing of flexible and rigid packages
Headspace analyzer	7.5	Gas monitoring and analyses
Total	23.5	

College of Basic Sciences and Humanities

Equipment/instrument	Cost (in lakh)	Utility
Probe Sonicator - CSS-102	2.10	For research work of M.Sc./Ph.D students
FTIR Spectrometer - CSS-102	19.85	
Rotronic HC2 AW water activity meter	2.45	
Total	24.4	

NEW LABORATORIES AND INFRASTRUCTURE CREATED AND UPDATED

College of Agricultural Engineering and Technology

- Portal for online semester registration of undergraduate students was developed.

College of Basic Sciences and Humanities

- The Department of Biochemistry converted a room into a lecture room with multimedia facility for postgraduate teaching.



M.S. RANDHAWA LIBRARY



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

Membership

The library has 1,951 active members which include PAU students and staff. In addition, 13,932 books were issued to the library members.

Documents procured and subscribed

During this period, the library procured 2,775 books, 481 theses and 527 Compact Discs (CDs). Presently, the library is subscribing to 17 print journals (national and international), 26 online journals, 7 online databases and providing access to 336 e-books. Thus, the total collection of library as on June 30, 2018 stood at 4,04,825.

New reading hall

Apart from Saxena Night Reading Hall, library has established a new reading hall named as Dr Kulbir Singh Gill Reading Hall which remains open 24X7 for the users. This hall is being used extensively by the students for study purpose.

Digitization

The library digitized theses, PAU publications and other rare documents which are accessible from the library web page.

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. Indiatat.com, online statistical database subscribed by the library, provides statistical information pertaining to agriculture and allied areas. The CMIE ProwessIQ database provides information about financial performance of various companies. In addition, ISO standards provide access to various standards on food products.

Library web page

The library web page provides complete information about the 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 M. S. Randhawa are also accessible to the users. All the e-resources like e-journals, e-books, e-theses, e-standards, etc. are accessible campus wide from the web page. Access of only Indiatat.com database is restricted to library premises.

Library usage

Books – 3,31,635; Theses – 40,305; Bound periodicals – 25,990; Current periodicals – 25,660; Abstracts and Indexes – 5,435; Newspapers – 2,671; Reference books – 12,695; Textbooks – 9,200 and Rare books – 3,036.



IMPACT

Productivity of rice and wheat

- Short duration rice varieties recommended by PAU occupied 68.7% of the *Parmal* rice acreage, signifying a major shift in varietal pattern. Record paddy productivity (6932 kg/ha) and production (180.15 lakh metric tons) were achieved in the state during *Kharif* 2017. Low biomass, early maturing and disease resistant features of these varieties helped manage crop residue besides saving irrigation water and pesticides.
- Area under recommended wheat varieties reached 97.7%. Release of varieties like Unnat PBW 550 during the period under report and Unnat PBW 343 and PBW 1 Zn during the previous year has helped in expanding the coverage besides extending nutritional (PBW 1 Zn) and residue management (short duration of PBW 550) advantages. A high wheat productivity of 5090 kg/ha and production of 179.4 lakh metric tons were attained during 2017-18.
- The average food grain productivity (rice-wheat) in the state has reached 12 t/ha/ annum threshold. A similarly productive area extending over 3m ha may not exist elsewhere.

Residue management

- Machines including Super Straw Management System, Happy Seeder, etc. developed during the recent years along with low biomass, short duration varieties provide a complete solution to residue management.
- Various extension activities including 171 camps, 43 field days, 390 field visits and 20 TV/radio talks were conducted towards effective management of crop residue. A *pakhwara* on not to burn paddy straw was also organized by *Krishi Vigyan Kendras* from October 15-31, 2017. In total, 1,117 field demonstrations on Happy Seeder, mulcher, baler and incorporation/mould board plough

were conducted at farmers' fields.

- About 44% reduction in fire incidents during 2017 was recorded in comparison to 2016 as monitored by Punjab Remote Sensing Centre. Thirty six villages in the state became zero burning villages.

Integrated pest and disease management

- Successful implementation of integrated pest management in cotton has helped save pesticides worth Rs. 2,808/- per ha while attaining second highest record productivity of 750 kg lint per ha during *Kharif* 2017. A range of extension activities, organized in collaboration with line departments, aimed at timely sowing, plant health management through balanced nutrition, clean cultivation and use of pesticides on the basis of economic threshold level (ETL) helped bring in this impact.
- Surveillance starting from high altitude over-summering sites of Jammu & Kashmir and Himachal Pradesh up to foothills as well as adjoining plains of Punjab along with weather based predictions allowed early detection and control of wheat rust foci. As a result, the crop remained largely rust free which translated into higher productivity and substantial curtailing of expenditure on fungicides.

Crop diversification

- Diversifying efforts towards pulse-based cropping systems have led to the development of a sizeable niche of summer moong in central districts of Punjab. The release of AL 882, an early maturing, short-statured and mechanically harvestable variety of Arhar will further aid in diversifying away from paddy.
- Area under fruit crops has been growing consistently in the state registering an increase of 53% over the last decade. Release of highly promising varieties of



guava (Punjab Kiran and Punjab Safeda) and sweet orange (Early Gold) this year along with previously released PAU Kinnow - 1 will help in further increase. Development of new Carrizzo rootstock will help in meeting quality citrus nursery needs.

- Release of varieties of cucumber, especially Punjab Kheera 1 - the first parthenocarpic variety, and tomato suitable for protected cultivation will help harness premium market due to better quality and off-season availability of produce. Punjab Magaz Kaddu-1, first hull-less seeded variety of pumpkin in India, has potential as a nutritive snack food. Release of chrysanthemum varieties (Punjab Shingar for loose flower production and Punjab Mohini for pot culture) will cater to the needs of floriculture entrepreneurs.
- Newly released sugarcane varieties ensure staggered availability of high quality cane and thus enhance viability of mills. Besides, new sugarcane varieties such as CoPb 92 provide greater resistance to top borer compared to the widely grown Co 238.

Soil health

- Extension programmes, carried out by PAU and the state government, focussing on need-based fertilizer use, promotion of biofertilizers, composting technologies, and incorporation of crop residues have contributed towards stabilizing chemical fertilizer use. University provided wheat and rice biofertilizers for 64000 acres during 2017-18 as a soil health promoting measure.

Entrepreneurship development and subsidiary occupations

- Fifteen technologies (farm machinery, improved varieties, processing related and others) were commercialized through 136 entrepreneurs and hand-holding was provided in the setting up of 10 agro-processing complexes.
- Release of forage crop varieties like OL 11 and OL 12 of Oats and BL 43 of Berseem, will

help augment fodder supply and thus help dairy farming.

- Vocational as well as short duration training programmes on dairy farming were organized at KVKs for adoption of technology of deworming. The impact assessment of the trainings reported increase in the production and reproductive efficiency of milch animals.
- During the period under report, 194 beekeeping, 148 dairy farming, 98 mushroom cultivation, 98 goatry, 93 piggery, 93 poultry farming, 56 processing units of fruits and vegetables, and 11 processing units of cereal crops were established by the farmers trained in the subsidiary occupations at the KVKs.
- The self-help groups (SHGs) dealing with processing of a variety of farm products are being trained and supported by PAU. The hand-holding provided in exploring marketing channels involving Co-operative societies, Agricultural Technology Management Agency (ATMA), Kisan Hutt and different departmental stores has helped in raising income. Some of the women were recognized at the district, state as well as national level for their contribution to allied agri-enterprises.

Societal behaviour

- The slogan "*Saade Viah, Saade Bhog, Na Karza, Na Chinta Rog*" coined by PAU has evinced massive response from the farmers of the state. Capacity building initiatives taken under ICAR-NASF project have led to the adoption of resolutions of not spending lavishly on weddings and other social ceremonies by about 200 village panchayats, mainly in cotton belt of Punjab.
- In order to counsel distressed farmers, 232 rural youths have been trained as para - professionals.

Education and human resource development

- Quality efforts in teaching and research enabled 45 students to clear University Grants Commission (UGC)/ICAR/Council of



- Scientific and Industrial Research (CSIR) - National Eligibility Test (NET) examination during the period under report.
- Seventeen postgraduate students successfully competed for international collaboration in research; received prestigious Fellowships and Medals; and earned Best Poster/Presentation Awards.
- Four students including two each from the Departments of Food Science & Technology and Fashion Designing received “Best Start Up Idea Award” during the National Start Up Summit, organized at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, on June 1-2, 2018.



ADMINISTRATION

BOARD OF MANAGEMENT

Sr.No.	Name and Designation	Period
	Honorary Chairman Sh V.P. Singh Badnore , Hon'ble Governor, Punjab & Chancellor of the University	01.07.2017 to 30.06.2018
	Working Chairman Dr Baldev Singh Dhillon , Vice Chancellor	01.07.2017 to 30.06.2018
	Members	
1.	Sh Karan Avtar Singh, IAS Chief Secretary to Govt. of Punjab, Chandigarh	01.07.2017 to 30.06.2018
2.	Sh M.P. Singh Addl. Chief Secretary (Development) to Govt. of Punjab, Department of Agriculture, Chandigarh	01.07.2017 to 26.09.2017
	Sh Viswajeet Khanna, IAS Addl. Chief Secretary (Development), Department of Agriculture & Farmers Welfare, Govt. of Punjab, Chd.	26.09.2017 to 30.06.2018
3.	Sh Anirudh Tewari, IAS Principal Secretary Department of Finance, Govt. of Punjab, Chandigarh	01.07.2017 to 30.06.2018
4.	Sh Jasbir Singh Bains Director of Agriculture, Punjab Kheti Bhawan (Near Dara Studio), Phase-VI, Mohali	01.07.2017 to 30.06.2018
5.	Dr R.K. Gupta , Director, ICAR - Central Institute of Post Harvest Engineering & Technology (CIPHET), PAU Campus, Ludhiana	01.07.2017 to 30.06.2018
6.	Sh Kulwant Singh Ahluwalia Village-Chhauni Kalan, P.O. Ram Colony, District Hoshiarpur	01.07.2017 to 30.06.2018
7.	Dr S.S. Gosal Former Director of Research, PAU Opposite State Bank of India ATM, Sugandh Vihar, Pakhowal Road, LDH	01.07.2017 to 30.06.2018
8.	Sh Amardeep Singh Cheema Gobind Nagar, Kahnuwan Road, Batala, District Gurdaspur	24.08.2017 to 30.06.2018
9.	Dr G.S Nanda H.No.1142, Sector 71, Mohali	01.07.2017 to 20.05.2018
	Dr D.S. Brar Adjunct Professor, PAU 30, Flower Dale Colony, Barewal Road, Ludhiana	15.06.2018 to 30.06.2018
10.	Dr A.R. Sharma Chairman & Managing Director, Ricela Group of Companies, Saron Road, Dhuri, District Sangrur (Punjab)	01.07.2017 to 20.05.2018
	Sh Anoop Bector Managing Director Mrs Bector's Food Specialties Ltd., Thein Road, Phillaur	15.06.2018 to 30.06.2018
11.	Mrs Manjit Kaur , W/o Sh Teja Singh V.P.O. Sehjomajra, Block Machhiwara, Tehsil Samrala, Dist LDH	15.06.2018 to 30.06.2018
	Secretary Dr R.S. Sidhu , Registrar	01.07.2017 to 30.06.2018



ACADEMIC COUNCIL

Designation	Name
Vice Chancellor	Dr Baldev Singh Dhillon
Dean, Postgraduate Studies	Dr (Mrs) Neelam Grewal Dr S.S. Kukal (Addl. charge) Dr (Mrs) G.K. Sangha (Addl. charge)
Dean, College of Agriculture	Dr S.S. Kukal
Dean, College of Agricultural Engg. and Technology	Dr J.S. Mahal Dr J.S. Mahal (Addl. charge)
Dean, College of Basic Sciences & Humanities	Dr (Mrs) G.K. Sangha
Dean, College of Home Science	Dr (Mrs) J.K. Gulati
Director of Research	Dr Navtej Singh Bains
Director of Extension Education	Dr Ashok Kumar (Addl. charge) Dr J.S. Mahal
Head, Department of Biochemistry	Dr (Mrs) Bavita Asthir
Head, Department of Economics & Sociology	Dr Sukhpal Singh
Head, Department of Zoology	Dr S.S. Hundal
Head, Department of Fruit Science	Dr M.I.S. Gill
Head, Department of Forestry & Natural Resources	Dr R.I.S. Gill
Head, Department of Processing & Food Engineering	Dr A.K. Singh
Head, Department of Mechanical Engineering	Dr V.P. Sethi
Head, Department of Apparel & Textile Science	Dr Sandeep Bains
Director, School of Climate Change & Agril. Meteorology	Dr (Mrs) L.K. Dhaliwal
Registrar, Secretary	Dr R.S. Sidhu



IMPORTANT DECISIONS OF THE BOARD OF MANAGEMENT

During the period under report, the Board of Management held four meetings (282nd to 285th). The important decisions taken by the Board are as under:

A. Amendment in Statutes

- The Board approved that the interview will not be conducted for the position of Stenotypist/Typist as per the instructions of the Government of Punjab. C-1/284
- The Board approved the amendment in sub clause 3 of clause 7 of chapter-VI of PAU Statutes regarding completion of period of probation in respect of all employees of the University. C-2/284

B. Concession to Staff

- The Board approved the re-revision of pay scale/pay band of the post of Statistical Assistant from Rs 10,300-34,800 + 3,800 GP to that of Rs 10,300-34,800 + 4,400 GP. B-1/283

C. Other decisions

- The Board approved the appointment of Dr D.S. Brar as Honorary Adjunct Professor in the School of Agricultural Biotechnology, PAU, for another period of five years. A-6/282
- The Board approved the appointment of Dr T.S. Thind as Honorary Adjunct Professor (Research) in the Directorate of Research/Department of Plant Pathology for a period of five years. A-7/282
- The Board approved the implementation of 'Right of Persons with Disabilities Act 2016' in the University for both teaching and non-teaching posts w.e.f. 19.04.2017. C-3/283
- The Board approved the transfer of 25 acres of land of PAU's Regional Research Station, Abohar, to the Department of Agricultural Research and Education, Government of

India and cancellation of lease deed of 25 acres taken by PAU at Regional Research Station, Abohar, from the Department of Agriculture, Government of Punjab. C-6/283

- The Board granted the ex-post facto approval for the transfer of 0.0354 hectare area of KVK, Kheri (Sangrur) to the Ministry of Road, Transport and Highways, Government of India, for four-laning of Sangrur - Patran - Khanauri Road, NH-71. C-7/283
- The Board approved the appointment of Dr R.K. Dhaliwal to the post of Director Students' Welfare, PAU. A-5/284
- The Board approved the appointment of Dr J.S. Mahal to the post of Director of Extension Education, PAU. A-6/284
- The Board noted and approved the appointment of Sh Yogesh Chopra to the post of Additional Comptroller. A-3/285
- The Board approved the budget estimates of PAU for the year 2018-19. B-1/285
- The Board approved the establishment of Technology Business Incubator (TBI) at PAU. C-7/285
- The Board approved the transfer of 12 kanal 2 marlas of land by PAU's Regional Research Station, Bathinda, to the Department of Health and Family Welfare, Government of Punjab, for the establishment of AIIMS at Bathinda. C-8/285
- The Board approved the conferment of the degree of Doctor of Science (Honoris causa) on Dr V.L. Chopra and Dr S.S. Johl during the Annual Convocation of the University. C-9/285



IMPORTANT DECISIONS OF THE ACADEMIC COUNCIL

During the period under report, 10 meetings (386th to 395th) of the Academic Council were held. The important decisions taken by the Academic Council are as under:-

- Approved that the post of Associate Director, Technology Marketing and Intellectual Property Rights be filled up on tenure basis for a period of four years by notifying it within the University. Item No.4/386th
- Decided that the applicants with B.Sc. Home Science will not be eligible for admission to M.Sc. Agriculture in Extension Education from 2018-19. Item No.10/386th
- Approved the existing score card for the award of Dr P.N. Thapar Gold Medal with some modifications. Item No. 18/386th
- Approved the starting of Diploma in Agriculture at Regional Research Station, Ballawal Saunkhri, with 30 seats. The Council also increased the number of seats in Diploma in Agriculture at PAU, Ludhiana from 30 to 60. B-6/389th
- Ratified the action taken by the Vice Chancellor in approving the starting of one-year Certificate Course on 'Floriculture and Landscaping' along with its rules. C-5/389th
- Approved the inclusion of Applied Statistics as specialization for M.Sc. Statistics. C-2/391st
- Approved the institution of Dr S.D. Khepar Medal in M.Tech. Soil and Water Engineering. C-7/391st
- Ratified the action taken by the Vice Chancellor in approving the starting of six-month Certificate Course on 'Ornamental Nursery Production.' C-11/391st
- Ratified the action taken by the Vice Chancellor in naming the new auditorium as 'Dr Manmohan Singh Auditorium.' C-14/391st
- Approved the establishment of College of Horticulture and Forestry under Punjab Agricultural University, Ludhiana. Item No.1/394th
- Approved the establishment of College of Veterinary and Animal Science under Punjab Agricultural University, Ludhiana and it will be opened outside Ludhiana. Item No. 2/394th
- Decided to include M.Sc. Dairy Economics in the list of qualification for admission to Ph.D. programme in Agril. Economics. B-20/395th
- Ratified the action taken by the Vice Chancellor in according permission for the starting of four-week skill development courses in Plant Tissue Culture, Molecular Marker Technology and Bioinformatics. C-2/395th

PUBLICATIONS

The University scientists published around 850 publications which included research papers, books, book chapters, manuals, research bulletins, etc. Details are given in Annexure II.



ANNEXURE-I

Important building construction and renovation projects undertaken by the Estate Organization and the Engineering Unit:

Projects	Cost (Rs in lakh)
• Construction of New Girls Hostel (first floor) at PAU, Ludhiana	89.41
• Construction of Bio Control Laboratory, repair of water channel and construction of implement shed for Regional Research Station, Bathinda	80.14
• Construction of office-cum-lab building and Training Hostel at Krishi Vigyan Kendra, Goniana, Muktsar Sahib	36.51
• Repair and renovation of International Students' Hostel, Faculty Club/Guest Houses and Students' Home at PAU, Ludhiana	33.94
• Renovation of Kairon Kisan Ghar (i/c toilets) at PAU, Ludhiana	32.18
• Repair of stores at Regional Research Station, Abohar	30.00
• Construction of pucca water channel and threshing floor at University Seed Farm, Naraingarh	30.00
• Construction of threshing floor along with store and shed & construction of 9 no. tubewell room and haudi at University Seed Farm, Ladhawal	29.00
• Renovation/tile terracing of the roof top of main building and cycle shed of the College of Home Science at PAU, Ludhiana	25.40
• Construction of interlocking tiles road at Regional Research Station, Bathinda	17.81
• Construction of remaining boundary wall around Horticulture Section at Regional Research Station, Bathinda	16.00
• Construction of open pucca (concrete) water channel at University Seed Farm, Nabha (Patiala)	15.53
• Construction of threshing shed at Regional Research Station, Kheri (Sangrur)	14.83
• Replacement of doors, windows and grills of the Hostel No. 4 at PAU, Ludhiana	14.22
• Construction of profile sheet roofing for seating arrangement for athletic track at PAU, Ludhiana	12.90
• Total	477.87

Apart from this, Rs 4,97,34,000/- was spent on the remaining works of Auditorium Block (acoustic treatment, audio-video system, stage lightening system, AC system, fire detection system and internal electrification works) and Rs 3,99,00,000/- on the construction of Lecture Theatre Complex and Examination Hall at PAU, Ludhiana.



ANNEXURE-II

PUBLICATIONS

College of Agriculture

Research Papers in National and International Journals

- Ahmed S, Rattanpal H S, Ahmad E and Singh G (2017). Influence of storage duration and storage temperature on *in-vitro* pollen viability of citrus species. *Chem Sci Rev Lett* **6**: 1841-1849. **(5.21)***
- An R, Suri K S, Jurat Feuntes J and Grewal P (2017). Dynamics of transcriptomic response to infection by the nematode, *Heterorhabditis bacteriophora* and its bacterial symbiont, *Photorhabdus temperata* in *Heliothis virescens* larvae. *Insect Mol Biol* **26**: 584-600. **(8.87)**
- Anand A and Kaur M (2017). Perceived impact of the stakeholders regarding agricultural subsidies in Punjab. *Ind J Ext Edu* **13**: 680-686. **(4.82)**
- Anand A and Kaur M (2018). Stakeholders' perspective on agricultural subsidies in Punjab. *J Comm Mob Sust Dev* **13**: 151-159. **(5.30)**
- Arora M, Kocher S G and Sohu R S (2017). Evaluation of sweet sorghum varieties for their juice characteristics. *J Food Agri Environ* **15**: 61-63. **(4.00)**
- Arora S, Mohanpuria P, Sidhu G S, Yadav I S and Kumari V (2018). Cloning and characterization of limonoid glucosyltransferase from Kinnow mandarin (*Citrus reticulata* Blanco). *Food Technol Biotechnol (Special Issue)* **56**: DOI: 10.17113/ftb.56.02.18.5349. **(6.89)**
- Arora S, Singh N, Kaur S, Bains N S, Uauy C, Poland J and Chhuneja P (2017). Genome-wide association study of grain architecture in wild wheat *Aegilops tauschii*. *Front Plant Sci* **8**: 886. **(10.30)**
- Ashlesha and Paul Y S (2017). Bioefficacy of plant extracts and biocontrol agents against some plant pathogenic fungi. *Ind J Ecol* **44**: 598-603. **(4.96)**
- Atri C, Kumar H and Sharma S (2018). Agro-biochemical based characterization and molecular profiling of Linseed (*Linum usitatissimum* L.) cultivars. *App Biol Res* **20**: 137-145. **(5.07)**
- Aujla I S and Paulitz T C (2017). An improved method for establishing accurate water potential levels at different temperatures in growth media. *Front Microbiol* **8**: 1497. **(10.16)**
- Bains T S, Gill R K, Singh S and Singh I (2017). Variety SML1115. *Ind J Genet* **77**: 326. **(6.28)**
- Bajaj K and Singh S (2017). Performance of different shapes of traps in capturing *Bactrocera* spp. (Diptera: Tephritidae) in peach and pear orchards in Indian Punjab. *Pest Manage Hort Ecosys* **23**: 7-11. **(4.49)**
- Bajaj K and Singh S (2018). Response of fruit flies, *Bactrocera* spp. (Diptera: Tephritidae) to different shapes of methyl eugenol based traps in guava orchards of Punjab. *J Entomol Zoo Stud* **6**: 2435-2438. **(5.52)**
- Bala M (2017). Weed management effect on vegetative growth and flowering parameters of chrysanthemum. *Ind J Weed Sci* **49**: 303-305. **(5.17)**
- Bansal M, Kaur S, Dhaliwal H S, Bariana H S, Chhuneja P and Bansal U (2017). Mapping of *Aegilops umbellulata* - derived leaf rust and stripe loci in wheat. *Plant Pathol* **66**: 38-44. **(8.43)**
- Baswal A K, Rattanpal H S and Singh G (2018). Determination of pollen viability and floral biology in pummelo (*Citrus grandis* Merrill) cultivars under subtropics of Punjab. *Agric Res J* **55**: 351-353. **(4.71)**
- Baswal A K, Rattanpal H S, Sidhu G S and Uppal G S (2017). Studies on pollen viability and floral biology in grapefruit (*Citrus paradisi* Mac Fadyen) cultivars under subtropical conditions of Punjab. *Eco Environ Conserv* **23**: 381-384. **(4.89)**
- Batra N, Kaur K, Kaur H and Singh B (2017). Status of defensive enzymes and contents of total phenols, tannins and nutrients determine aphid resistance in barley. *Proc Natl Acad Sci, India, Sect B Biol Sci* DOI: 10.1007/s40011-017-0899-z. **(5.00)**
- Batth M K, Dhaliwal H S and Sidhu G S (2017). Pollen storage of different citrus rootstock genotypes to facilitate citrus hybridization. *Green Fmg* **8**: 1099-1104. **(4.38)**
- Behere G T, Firake D M, Thubru D P, Burange P S and Ngachan S V (2018). Longhorn beetles (Coleoptera: Cerambycidae) of North-Eastern India. *Ind J Hill Fmg* **31**: 245-257. **(4.39)**

*National Academy of Agricultural Sciences (NAAS) Score



- Bhardwaj R, Sohu R S, Gill B S, Goyal M and Goyal M (2017). Correlation among fodder yield, quality and morpho-physiological traits under contrasting environments in sorghum. *Elect J Plant Breed* **8**: 933-938. **(4.97)**
- Bhatia D, Joshi S, Das A, Vikal Y, Sahi G K, Neelam K, Kaur K and Singh K (2017). Introgression of yield component traits in rice (*Oryza sativa* sp *indica*) through inter-specific hybridization. *Crop Sci* **57**: 1-17. **(7.55)**
- Bhatia D, Wing R A, Yu Y, Chougule K, Kudrna D, Rang A and Singh K (2018). Genotyping by sequencing of rice interspecific backcross inbred lines identifies QTLs for grain weight and grain length. *Euphytica* **214**: 41. **(7.63)**
- Bhullar H S and Gill R S (2017). Food consumption and utilization indices of *Spodoptera litura* (Fabricius) on different Bt cotton cultivars. *J Insect Sci* **30**: 120-125. **(6.65)**
- Bindra S, Mittal R K, Sood V K and Chaudhary H K (2017). Genetic analysis of various quantitative traits in inter-varietal crosses of *Vigna mungo*. *Legume Res* **40**: 795-802. **(6.15)**
- Brar A S, Buttar G S and Sharma R (2018). Water and energy productivity of rice as influenced by duration of cultivars, dates of transplanting and irrigation regime in North –Western India. *Paddy Water Environ* DOI: org/10.1007/s10333-018-0658-7. **(6.92)**
- Brar H S and Singh R (2017). Role of trichomes on leaves and pods for imparting resistance in chickpea [*Cicer arietinum* (L.)] genotypes against *Helicoverpa armigera* (Hübner). *J Appl Nat Sci* **9**: 2193-2198. **(4.84)**
- Brar J S, Gill K S, Arora N K, Gill MIS and Kaur T (2017). Weed management in guava orchards. *Ind J Weed Sci* **49**: 374-377. **(5.17)**
- Brar J S, Gill K S, Kaur T, Arora N K, Gill MIS and Kaur G (2017). Soil temperature and horticultural traits as influenced by different types of mulching materials in guava orchard. *J Agrometeorol* **19**: 318-323. **(6.36)**
- Brar R S, Gill R S, Lore J S and Khanna R (2017). Molecular screening of hybrid rice parental lines for bacterial blight resistance genes. *Ind Phytopathol* **70**: 40-44. **(5.90)**
- Brar S, Kumar P and Kaur P (2018). Problems faced by farmers in direct seeded rice- A case study. *Ind J Eco Dev* **14**: 497-501. **(4.82)**
- Brar T S and Sharma S (2017). Influence of temperature and carbon dioxide levels on growth and development of *Spodoptera litura* Fabricius on cauliflower. *J Agrometeorol* **19**: 306-311. **(6.36)**
- Buttar D S, Singh A and Singh N (2017). Interaction of Arbuscular Mycorrhizae (*Glomus macrocarpon*) and *Macrophomina phaseolina* (Tassi) Goid causing mungbean root rot in spring mungbean. *Plant Dis Res* **32**: 264. **(4.58)**
- Buttar P S, Kingra P K and Singh S P (2018). Effect of sowing dates, irrigation and mulching on growth and yield of wheat. *Agric Res J* **55**: 243-250. **(4.71)**
- Chahal S S, Choudhary O P and Mavi M S (2017). Organic amendments decomposability influences microbial activity in saline soils. *Arch Agron Soil Sci* **63**: 1-14. **(7.12)**
- Chahal S S, Choudhary O P and Mavi M S (2018). Microbial activity is constrained by the quality of carbon and nitrogen under long-term saline water irrigation. *Comm Soil Sci Plant Anal* **49**: 1266-1280. **(6.59)**
- Chandel S and Hadda M S (2017). Assessment of soil loss tolerance. *Int J Farm Sci* **7**: 101-109. **(4.01)**
- Chandel S and Hadda M S (2017). Quantification of surface runoff in Patiala-Ki-Rao watersheds using modified NRCS model: A case study. *J Appl Nat Sci* **9**: 1573-1581. **(4.84)**
- ^sChandel S, Hadda M S and Mahal A K (2018). Soil quality assessment through minimum dataset under different land uses of submontane Punjab. *Comm Soil Sci Plant Anal* DOI: 10.1080/00103624.20181425424. **(6.59)**
- ^sChandel S, Hadda M S, Vaidya Pratima and Mahal A K (2017). Performance evaluation of different runoff estimation methods in North-Western tract of India. *Int J Curr Microbiol Appl Sci* **6**: 649-662. **(5.38)**
- Chandi A K and Kaur A (2017). Impact of different insecticides on locomotory behaviour of *Plutella xylostella* (Linnaeus). *Int J Curr Microbiol Appl Sci* **6**: 47-54. **(5.38)**
- Chandi A K and Singh G (2017). Locomotory behaviour of susceptible and resistant *Plutella xylostella* (Linnaeus) Lepidoptera: Plutellidae. *Phytoparasitica* **45**: 541-548. **(7.03)**
- Chandi R S, Kumar V and Bhullar H S (2017). Pyriproxyfen - An IGR for the management of whitefly, *Bemisia tabaci* (Gennadius) on chilli. *Ind J Entomol* **79**: 406-410. **(5.89)**
- Chandi R S, Singh V, Pathania P C and Kataria S K (2018). First report of oleander aphid, *Aphis nerii* Boyer de Fonscolombe (Hemiptera: Aphididae) on milkweed (*Calotropis gigantea* (L.) W. T. Aiton: Apocynaceae) from Punjab,



India. *J Entomol Zoo Stud* **6**: 296-299. (5.53)

- Chaudhary N and Dhath K K (2017). Varietal response of gladiolus to planting time for off season flower production. *The Bioscan* **12**: 1975-1980. (5.26)
- Choudhary O P (2017). Long term impact of cyclic use of sodic and canal waters for irrigation on soil properties and crop yields in cotton-wheat rotation in a semi-arid climate. *Agric Res* **6**: 267-272. (5.90)
- Chouksey H, Sardana V and Sharma P (2017). Variability in Indian mustard (*Brassica juncea*) genotypes in response to applied phosphorus. *Ind J Agron* **62**: 374-377. (5.46)
- Chugh P, Kaur J, Grewal S K, Singh S and Aggarwal S (2017). Up regulation of superoxide dismutase and catalase along with proline accumulation mediates heat tolerance in lentil (*Lens culinaris Medik.*) genotypes during reproductive stage. *Ind J Agri Biochem* **30**: 195-199. (4.69)
- ^sDar E A, Brar A S, Mishra S and Singh K B (2017). Simulating response of wheat to timing and depth of irrigation water in drip irrigation system using CERES - Wheat model. *Field Crops Res* **214**: 149-163. (8.93)
- Deol J S, Shyam C, Sharma R, Kaur R and Meena S L (2018). Improving productivity of pulses using plant growth regulators: A review. *Int J Micro Res* **10**: 1259-1263. (4.77)
- Deol J S, Rajni and Kaur R (2018). Production potential of cotton (*Gossypium hirsutum*) as affected by plant growth regulators (PGRs) - A review. *Int J Curr Microbiol Appl Sci* **7**: 3599-3610. (5.38)
- Deosi H K (2017). *Varroa destructor* Anderson and Truman in *Apis mellifera* Linnaeus colonies morphometry of the mite and its developmental stages. *J Exp Zool* **20**: 223-226. (5.51)
- Deosi H K and Chhuneja P K (2017). Control strategies for *Varroa destructor* intensity in the worker brood of *Apis mellifera* colonies under Punjab conditions. *J Exp Zool* **20**: 93-95. (5.51)
- Deosi H K and Chhuneja P K (2017). Preferred site of oviposition by *Varroa destructor* Anderson and Trueman in *Apis mellifera* Linnaeus worker brood. *J Exp Zool* **20**: 123-127. (5.51)
- Deosi H K and Chhuneja P K (2017). Some morphometric effects of *Varroa destructor* Anderson and Trueman on *Apis mellifera* Linnaeus adult workers. *J Exp Zool* **20**: 151-152. (5.51)
- Deosi H K and Chhuneja P K (2017). *Varroa destructor* Anderson and Trueman in *Apis mellifera* Linnaeus colonies - development of mite. *J Exp Zool* **20**: 67-70. (5.51)
- Devenda S K, Singh K, Singh D and Kaur P (2017). Screening of basmati rice varieties for their arsenic accumulation in Punjab, North-West India. *Comm Soil Sci Plant Anal* **48**: 2381-2389. (6.53)
- Devi I, Singh H and Thakur A (2017). Embryo rescue of low chill peach hybrids as affected by embryo age and growth regulators. *The Bioscan* **12**: 499-503. (5.26)
- Devi I, Singh H and Thakur A (2018). Effect of developmental stage and medium on embryo culture of low chill peach hybrids. *Curr Sci* **114**: 1771-1775. (6.97)
- Devi K, Joshi N and Sodhi H S (2017). UV-B radiation tolerance in the conidia of *Beauveria bassiana* (Balsamo) Vuillemin. *J Mycol Plant Pathol* **47**: 441-446. (5.79)
- Dhaliwal L K, Sandhu S K, Kaur S and Singh S (2018). Effect of meteorological parameters on incidence of brown leaf spot in rice crop under different planting methods. *J Agrometeorol* **20**: 53-56. (6.40)
- Dhaliwal M S, Sharma S P, Jindal S K, Dhaliwal L K and Gaikwad A K (2017). Growth and yield of bell pepper as influenced by growing environment, mulch and planting date. *J Crop Improv* **31**: 830-846. (6.5)
- Dhaliwal N K, Singh J and Chhuneja P K (2017). Comparative evaluation of Doolittle, Cupkit and Karl Jenter techniques for rearing *Apis mellifera* Linnaeus queen bees during breeding season. *J Appl Nat Sci* **9**: 1658-1661. (4.84)
- Dhaliwal N K, Singh J and Chhuneja P K (2017). Comparative oviposition and hatchability in Karl Jenter and Cupkit apparatus in varied bee strength *Apis mellifera* breeder colonies. *Eco Environ Conserv* **23**: 2068-2071. (4.89)
- Dhawan M and Joshi N (2017). Enzymatic comparison and mortality of *Beauveria bassiana* against cabbage caterpillar, *Pieris brassicae* LINN. *Braz J Microbiol* **48**: 522-527. (6.87)
- Dhillon B S, Sharma P K and Dhillon M (2018). Boron and TIBA induced physiological and anatomical changes in relation to dry matter partitioning in spring sunflower (*Helianthus annuus* L.) under delayed sowing. *Ind J Plant Physiol* **23**: 352-359. (5.18)
- Dhillon B S, Sharma P K and Sardana V (2018). Influence of foliar application of boron and TIBA on photosynthetic



parameters *vis-a-vis* productivity of sunflower (*Helianthus annuus* L.) under variable sowing date. *J Agrometeorol* **20**: 16-21. **(6.40)**

- Dhillon B S, Sharma P K, Sharma S and Sharma S (2017). Oil yield and fatty acid composition of *spring* sunflower as affected by sowing date, intra row spacing and nitrogen. *Ind J Agri Biochem* **30**: 135-140. **(4.69)**
- Dhillon J S, Boora R S, Gill D S and Arora N K (2018). Effect of different chemicals and hand thinning on crop regulation in guava (*Psidium guajava* L.) cv. Shweta. *Agric Res J* **55**: 347- 350. **(4.71)**
- Dhillon S K, Chandra P and Tyagi V (2017). Assessment of phenotypic divergence and association studies in sunflower (*Helianthus annuus* L.). *J Krishi Vigyan* **5**: 8-14. **(4.41)**
- Dhillon W S, Mahajan B V C, Gill P P S, Tandon R and Kumar M (2017). Shelf-life extension of pear with coatings under ambient and super market conditions. *Ind J Hort* **74**: 429-435. **(6.13)**
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*National Academy of Agricultural Sciences (NAAS) Score

[§]Listed more than once, depending upon the affiliation of the author(s)



SUMMARY AND HIGHLIGHTS OF ANNUAL REPORT OF PUNJAB AGRICULTURAL UNIVERSITY (July 2017 – June 2018)

The Punjab Agricultural University (PAU) is mandated to conduct research, teaching and extension activities in agriculture and related disciplines. During the period July 2017 to June 2018, the University made notable contributions in achieving higher farm productivity levels by expanding improved varietal base and leveraging it with continuously upgrading production-protection technologies. The overarching focus was on providing better and sustainable livelihood to rural society with due emphasis on climate adaption, protection of environment and conservation of natural resources. Additional focus was on developing quality human resource to achieve these ends.

RESEARCH

Research is a core mandate of Punjab Agricultural University. Main focus of PAU research is on crop improvement, climate adaptive technologies, conservation of natural resources, crop residue management, integrated pest management, high input use efficiency and farm mechanization. Efforts are also being made

towards value addition through post harvest handling and processing technologies, subsidiary occupations, strengthening and exploring value chains, and market analysis. The salient achievements during the period under report are as under:

Crop Improvement

Twenty five varieties of different crops (13 of field,

	Crops	Varieties
Field Crops	Rice	PR 127
	Basmati Rice	Pusa Basmati 1637
	Wheat	Unnat PBW 550
	Maize	PMH 12*
	Desi Cotton	LD 1019
	Sugarcane	CoPb 92*, CoPb 93 & CoPb 94
	Pigeonpea	AL 882
	Raya	Giriraj
	Groundnut	TG37A
	Oats	OL 11(OL1760*), OL 12 (OL 1802-1*) & OL 1769*
	Berseem	BL 43



Fruits	Guava	Punjab Safeda & Punjab Kiran
	Sweet Orange	Early Gold
	New rootstock for Kinnow mandarin	Carrizo
Vegetables	Pumpkin	PAU Magaz Kadoo-1
	Cucumber	Punjab Kheera-1
	Tinda	Punjab Tinda-1
	Tomato	Punjab Swarna
	Potato	Kufri Ganga
	Brinjal	Punjab Raunak
Flowers	Chrysanthemum	Punjab Shingar & Punjab Mohini

*Released/identified at national level

4 of fruit, 6 of vegetable, and 2 of ornamental crops) developed/approved by the University were recommended for cultivation in Punjab. During the period under report, five varieties were released at the national level.

- To strengthen the genetic resource base, a total of 10,663 germplasm accessions were sourced. As a special initiative, a total of 5,017 accessions of minor millets with the aim of exploring their potential as summer crop; 770 of cotton for resistance to whitefly, cotton leaf curl virus (CLCV) and to jassid; and 2,669 entries of sesame for phyllody resistance and earliness were acquired from National Bureau of Plant Genetic Resources (NBPGR), New Delhi. Twenty five neem genotypes were used for nursery raising and evaluation of azadirachtin content. In-house germplasm development initiatives helped identify new plant type of American cotton that enabled high density plantation and mechanical harvesting.
- Biotechnological advances in wheat included development of SSR (simple sequence repeat)/SNP (single nucleotide poly-morphism) markers, appropriate for MAS, for leaf rust and stripe rust resistance genes introgressed from certain wild

species; use of Karnal bunt resistant alien introgression lines in breeding strategies; pyramiding of high grain weight and high grain protein traits with stripe rust resistance genes in elite varietal backgrounds; and genome editing approaches for developing high resistant starch and low acrylamide wheat genotypes.

- In rice, biotechnological initiatives focussed on identification and subsequent transfer of genes for brown plant hopper resistance (Bph34), root knot nematode resistance, neck blast resistance, and mapping of putative QTL (quantitative trait locus) for sheath blight resistance.
- Biotechnological research in pulses involved development of SSR and SNP markers from *Vigna mungo* and *V. radiata*; use of MAS for mobilizing *Cry1Ac* gene to elite chickpea backgrounds and validation of *in silico* polymorphic markers in 48 *Vigna* genotypes; and transfer of *Ascochyta* blight resistance to chickpea background.
- In *Brassica* oilseeds, MAS was employed for enhancing oil quality and white rust resistance. Aphid resistance gene was transferred from *B. fruticulosa*.
- In fruit crops, biotechnological work involved development of SSR and SNP markers for mapping traits important for processing and nutritional quality in guava; and identification of *Phytophthora* resistant F1 hybrids developed from crosses of rough lemon with resistant root stocks.
- In vegetables, biotechnological research output pertained to employment of SSR markers employed for mapping male sterility and *Fusarium* wilt resistance genes in muskmelon; transfer of yellow vein mosaic virus to cultivated okra genotypes; and initiation of CRISPR/Cas9 approach for knocking out pectate lyase gene, implicated in enhanced shelf life, in tomato.



Focus area	Technology recommended/Salient finding
Biofertilizers	<ul style="list-style-type: none"> - <i>Rhizobium</i> (LUR6 strain) biofertilizer for summer and Kharif urdbean - <i>Azospirillum</i> culture for paddy - Integrated application of biofertilizers and chemical fertilizers in poplar and eucalyptus nursery
Crop residue management	<ul style="list-style-type: none"> - Paddy straw compost as a farmyard manure (FYM) substitute in maize and guava - Incorporation/retention of paddy straw over 3-year period improved wheat yield and soil health parameters.
Nutrient management	<ul style="list-style-type: none"> - Due to higher efficiency of neem coated urea, soil-test based urea dose in rice reduced (from 110 kg to 90 kg/acre) - Use of PAU Leaf colour chart (LCC) in direct seeded rice and Bt cotton - Change in timings (4, 6, and 9 weeks after sowing) of soil test based fertilizer N application in direct seeded rice
Irrigation water management	<ul style="list-style-type: none"> - Use of canal water in cyclic mode with sodic water for irrigating cotton, and along with mulch for irrigating potato and okra - Occasional pre-sowing irrigation with sodic water in cotton to avoid delay in sowing
Other technologies	<ul style="list-style-type: none"> - Foliar application of salicylic acid (7.5%) or potassium nitrate (2%) for better seed-setting in Berseem; and of potassium nitrate (1.5%) for better fruit size and yield in semi-soft pear - Identification of earlier released short duration rice variety PR 126 for direct seeding - Optimum seedling age of 25-30 days prescribed for transplanting PR 124 and PR 126 and 30-35 days for PR 121 and PR 122 rice varieties - Harvesting of turmeric by end of December rather than early for better fresh rhizome yield and curcumin content - Change in row spacing in potato (65 or 75 cm) and brinjal, capsicum, cabbage, arvi, turmeric and sweet potato (67.5 cm) to enable tractor operations

Crop Production Technologies

Crop production technologies generated during the report period aimed at aligning technologies with new varieties besides production of biofertilizers and management of crop residue, nutrients and irrigation water.

Crop Protection Technologies

The focus was on reducing environmental and resistance implications of chemical use for disease, insect-pest and weed control by devising judicious and targeted application of chemicals and integrated measures.

Crop/Focus	Technology recommended/Salient finding
Wheat	<ul style="list-style-type: none"> - Integrated approach for managing yellow rust through deployment of resistant varieties, avoiding early sowing especially under poplar plantations, and timely monitoring of crop - Aphid management with foliar application of Taiyo (thiamethoxam 25WG) - Control of mixed weed flora with post emergence application of pre-mix (Shagun 21-11) of metribuzin and clodinafop propargyl, and pre-emergence application of Zakiyama (Pendimethalin 30EC) for managing <i>Phalaris minor</i>
Rice	<ul style="list-style-type: none"> - Management of broadleaf weeds with foliar application of Makoto (metsulfuron methyl) 20WP - Rotation with <i>Brassica</i> rather wheat can help manage sheath blight - Management of plant hoppers with Chess 50WG (pymetrozine) without any residual effect on crop and soil system - Natural enemies (spiders and green mirid bugs) in IPM-handled organic fields found to be higher than in conventional system - Bio-intensive integrated pest management (BIPM) practices led to 60.7% reduction in incidence of stem borer - Identification of Bacterial foot rot or <i>Erwinia</i> rot as an emerging disease in Punjab



Cotton	<ul style="list-style-type: none"> - Ten species of natural enemies of whitefly, <i>Chrysoperla</i> being the predominant, identified in cotton growing regions of Punjab - Molecular (mitochondrial cytochrome oxidase I gene) identification (as Asiall_1) of whitefly species in different regions of Punjab, Haryana and Rajasthan - BIPM module led to 38.3 % reduction in whitefly population - Thrips as sucking pests, along with the control measures, included in Package of Practices - New systemic insecticide Osheen 20SG (dinotefuran) recommended for controlling jassid and whitefly
Maize	<ul style="list-style-type: none"> - Biocontrol of stem borer with two releases of <i>Trichogramma chilonis</i>
Fruit trees	<ul style="list-style-type: none"> - Traps made of 24-holed earthen pots filled with threshed maize cobs recommended for managing termites - Citrus fruit rot/gummosis can be managed with application of sodium hypochlorite (5%) - Seven new mutant strains of <i>Trichoderma</i> helped control foot rot in citrus nursery
Vegetable crops	<ul style="list-style-type: none"> - Integrated application of mustard cake, neem cake and FYM found effective in containing root knot nematode in cucumber - Fruit borer in tomato can be managed with chlorantaniliprole 18.5SC and shoot and fruit borer in brinjal with emamectin benzoate 5SG and chlorantaniliprole 18.5SC - Control of jassid in okra with imidacloprid 17.8SL and thiamethoxam 25WG and diamondback moth in cole crops with EGAO (emamectin benzoate) 5SG - Fruit rot of chilli especially during challenging (to control with contact fungicides) humid/wet conditions manageable with systemic fungicide Folicur 25EC (Tebuconazole) - Weed control in potato through pre-emergence application of Tanoshi 70 WP (metribuzin)
Rodent and bird management	<ul style="list-style-type: none"> - Control of rodent pests in wheat fields sown with Happy Seeder through double burrow baiting with 2% zinc phosphide - Use of micro-encapsulated 2.5% methyl anthranilate against rodent attack in stored wheat
Pesticide residue assessment	<ul style="list-style-type: none"> - Out of 960 samples of different food commodities collected from Malerkotla, Moga and Ludhiana areas, 106 found to be contaminated with pesticide residues and 27 had residues above respective maximum residue levels (MRLs) - Of vegetable samples, 1.7% had ethion, chlorpyrifos and monocrotophos above their respective MRLs

Seed and Nursery Production

- During 2017-18, the University produced 59,137q seed of field crops and 9,296q seed of vegetable crops.
- About 4.75 lakh high quality nursery plants of fruit trees (citrus, guava, etc.) were produced for the farmers.
- A total of 1.22 lakh plants of different tree species, mainly poplar, *eucalyptus*, *dek*, *shisham*, *sohanjna* and neem, were provided to farmers.

Food Science and Technology

- Two recommended technologies employed sugarcane juice one for making sugarcane-

apple vinegar (1:1 ratio) by packed bed fermentation at 25L scale and the second for Kheer using rice, sugarcane juice and water in the ratio 1:4:5.

- Technology for making *Aloo Bhujia*, *Aloo Chakli*, and *Aloo Wari* from table purpose varieties of potato was standardized.
- The *jamun* vinegar production technology was successfully validated at 25L scale.
- Honey based products, namely multigrain honey cookies, groundnut muffins, groundnut cookies, ginger lemon drink and cereal health bar were developed.



Post-harvest Technologies

- Major post harvest technologies included a mechanically ventilated onion storage structure; drying of freshly harvested onion by pre-treating with NaCl; a solar turmeric dryer of 50 kg capacity; Aloe vera gel extraction machine; alternative economical packaging of potato in leno bags; use of corrugated fibre boxes (CFB) for packaging of litchi and Kinnow fruits; packaging for enhancing shelf life of fresh seedless cucumber, yellow pepper and black carrot by using non-perforated LDPE films; and drying *Gomphrena* flowers, panicles of Goldenrod (*Solidago*) and peduncles of Golden rain tree (*Koelreutria paniculata*).

Beekeeping and Mushroom Production

- Pollination of African Sarson (*Brassica carinata*) by *Apis mellifera* is responsible for 80-95 per cent of the seed set as indicated by yield and yield components in isolated net chambers.
- Research on mushrooms involved collection and characterization of seven wild mushrooms; standardization of cultivation of *Pleurotus eryngii*, an aromatic fleshy textured mushroom, under Punjab conditions using locally sourced farm residues; development of Short method of composting for cultivation of *Agaricus bisporus*; and supplementation of compost with neem powder (0.5%), use of *Azotobacter* in casing mixture and spray of Indole-3-acetic acid at the time of first and second flush for higher (by 30%) button mushroom yield.

Farm Machinery

During the period under report, farm engineers developed, modified and tested several machines.

- Newly developed machinery included a hydraulic power side shift offset rotavator for primary tillage and interculture operations in orchards and agro-forestry plantations; tractor operated Rotary Weeder

for wider row crops, especially sugarcane; a tractor operated mounted type wheat straw collector; a two-row semi-automatic type vegetable planter, and a manually operated gladiolus planter.

- Modifications were effected in Axial flow paddy thresher for achieving higher feed rate and in PAU Multipurpose High Clearance Sprayer to make it Self-propelled High Clearance Sprayer with four-wheel drive (4-WD) having narrow width tyres.
- PAU Happy Seeder was recommended for sowing fodder oats.

Biomass based Energy and Groundwater Recharge

- Research initiatives in energy conservation included production of protease enzyme, having wide-ranging industrial applications, from bio-digested slurry derived from poultry droppings; and standardization for no ash slag/clinker formation, for mixed biomass briquettes.
- Use of abandoned wells for recharging groundwater by using canal water rendered surplus during rainy/off season and agricultural runoff was recommended for District Irrigation Plan.

Apparels and Textiles

- Research output in the field of Apparels and Textiles included use of fibre obtained from Himalayan Nettle (*Girardinia diversifolia*) for developing cushion covers, jackets and table runners. Rechargeable thermo jackets were designed for managing upper quadrant pain condition.

Technologies Commercialized

- The University offered non-exclusive rights to 136 entrepreneurs for commercialization of a total of 15 technologies encompassing diverse aspects like hybrid seed production (8); farm machinery for crop residue management (120), processing techno-



logies (6); nitrogenous fertilizer management through Leaf Colour Chart (1); and drinking water testing (1).

EDUCATION AND HUMAN RESOURCE DEVELOPMENT

- During 2017-18, the University offered 9 Undergraduate, 44 Master's, 29 Doctorate and two Diploma programmes. A total of 3,654 students were enrolled during the academic session 2017-18. Thirty four international students are studying in different academic programmes of the University. Admissions to various undergraduate and postgraduate programmes were made through entrance tests. About 1,050 students in various programmes were awarded scholarships and financial assistance.
- During Annual Convocation of the University held on December 15, 2017, a total of 61 students received Ph.D. degree and 397 Master's (M.Sc., M.Tech, MCA, MBA, MBA (Agri business) and MJMC) degree. In addition, 117 students were awarded Merit Certificates and Medals.
- Forty five students cleared University Grants Commission (UGC)/Indian Council of Agricultural Research (ICAR)/Council of Scientific and Industrial Research (CSIR) - National Eligibility Test (NET) examination during the period under report.
- Seventeen students successfully competed for international collaboration in research; received prestigious Fellowships and Medals; and earned Best Poster/ Presentation Awards.
- In sports, PAU was declared Runners Up in Team Games (M) during the XVIII All India Inter-Agricultural University Sports and Games Meet, held at University of Agricultural Sciences, Bengaluru, from January 30 to February 3, 2018. The University won one Gold Medal and one

Silver Medal in Team Games (M&W). In addition, PAU Sports and Youth Activities Council awarded 46 Merit Certificates, 15 University Colour and 6 Roll of Honour to the outstanding sportspersons/ artists for their proficiency in sports, games, cultural and literary events during the session 2016-17.

- In cultural activities, PAU students received Gold Medal in group song (Indian), Bronze Medals in poster making and light vocal, and got fourth position in mime and cartooning during the "18th All India Inter Agricultural Universities Youth Festival" organized by ICAR, New Delhi, at Shri Venkateswara Veterinary University, Tirupati, Andhra Pradesh. The students of PAU also won consolation prizes in debate and skit during the "33rd North Zone Inter-University Youth Festival 2017-18" organized by Association of Indian Universities (AIU), New Delhi, at Maharishi Markandeshwar University, Mullana, Ambala, Haryana, from January 12-16, 2018.

EXTENSION

The University disseminates new technologies among farmers through a variety of extension approaches. During the period under report:

- The University organized 14 *Kisan Melas* during September 2017 and March 2018. Farmers, farm women and other stakeholders from Punjab and adjoining states of Haryana, Himachal Pradesh, Jammu & Kashmir and Rajasthan participated in these *melas*, received expert advice, purchased improved seed and farm literature, and participated in produce competitions. Nine progressive farmers were honoured during PAU *Kisan Melas* at Ludhiana for their outstanding contributions to agriculture, horticulture and allied occupations.
- The University organized 300 field days;



542 adaptive research trials; 139 on-farm trials; 3,156 cluster front line demonstrations; 2,191 method demonstrations; 1,469 training programmes (1,047 short, 267 vocational, 120 in-service and 35 sponsored); 803 exhibitions and four Research and Extension Specialists' Workshops for the benefit of farmers.

- Special campaigns on crop residue management, whitefly management in cotton, yellow rust management in wheat, promotion of recommended varieties, eradication of *Parthenium* (Congress grass), and popularization of biofertilizers and bioagents were organized. The campaigns resulted in making 36 villages in different districts of Punjab as zero burning villages and 47 villages as *Parthenium* free. Extension activities expanded coverage by improved varieties of rice and wheat to 68.7 and 96.9 per cent area, respectively; reduced use of pest and disease control chemicals in cotton; and increased wheat acreage under biofertilizers to 56,000 acres (2017-18) from 52,000 acres (2016-17).
- *Kheti Sandesh* (digital newspaper) was started for the transfer of latest technology to farmers. More than 5 lakh farmers are receiving this digital newspaper on WhatsApp. Apart from this, 121 WhatsApp groups were formed by the scientists of *Krishi Vigyan Kendras* and Farm Advisory Service Centres to apprise the end users of latest technology.
- The University enrolled 764 PAU doots in various villages of Punjab for quick dissemination of farm technologies through e-mail. Till date, 5,873 farmers have been enrolled as PAU doots.
- In total, 3,03,361 farmers were enrolled for weather based agro-advisory.
- The Communication Centre maintains a constant liaison with the print and electronic media for quick dissemination of agricultural

technologies among farmers. During the period, the Centre published 12 issues each of monthly magazines *Progressive Farming* and *Changi Kheti* with a combined circulation of 1,79,800; new editions of Package of Practices (twice a year of Rabi Crops and *Kharif* Crops); and 54 new/revised bulletins. In addition, it released several articles and press notes (876) in English and Punjabi for publication in various newspapers and magazines. It also organized 692 TV/radio talks of PAU scientists.

- A total of 22 video capsules for mobile phones were developed on improved agricultural technologies including crop varieties, integrated pest management technologies, straw management techniques, etc. for the benefit of stakeholders.

MEMORANDA OF UNDERSTANDING (MOUs)

To strengthen linkages with national and international institutions/organizations, PAU signed six Memoranda of Understanding with the following organizations during 2017-18:

- Industrieprojekt GmbH (IPRO) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany.
- International Centre for Agricultural Research in the Dry Areas (ICARDA).
- Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan.
- ICAR - Indian Institute of Maize Research (IIMR), Ludhiana.
- ICAR - Central Institute of Post-harvest Engineering and Technology (CIPHET), Ludhiana.
- Department of Industries and Commerce, Chandigarh.

AWARDS AND HONOURS

- The Punjab Agricultural University was ranked number one among the State



Agricultural Universities and third among research institutes as per the ranking of agricultural universities and research institutes, conducted by the ICAR, New Delhi, in 2017.

- The University was adjudged one of the Icons of Modern India by India Today Magazine in its special issue on 70 years of Independence (August 2017). Under the title “Harvest of Riches” PAU was acknowledged for “its pivotal role bringing in the Green Revolution that made India self-sufficient in food grains.”
- The Regional Research Station, Kapurthala, was recognized as an “Excellent Sugarcane Research Centre 2017-18” under All India Coordinated Research Project (AICRP) on Sugarcane.
- The PAU’s Centre of All India Coordinated Research Project - National Seed Project (Crops) was recognized for best performance in breeder seed production in 2018.
- The University’s All India Coordinated Research Project Centre on Agroforestry bagged “Best Centre Award 2017.”
- The University was declared “Best Centre for Onion and Garlic Research 2017-18.”
- “Gene Stewardship Award 2018” was conferred on the scientists of the Department of Plant Breeding and Genetics and School of Agricultural Biotechnology.

ANNUAL REPORT

2017-18

The Annual Report of
Punjab Agricultural University, Ludhiana
for the year **2017-18**

Authenticated

Chandigarh, Dated

Signature

Chief Minister, Punjab
Minister incharge,
Department of Agriculture and Farmers's Welfare