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ALL INDIA CO-ORDINATED FLORICULTURE IMPROVEMENT PROJECT

ANNUAL PROGRESS REPORT

(2015-2016)

DEPARTMENT OF FLORICULTURE AND LANDSCAPE ARCHITECTURE

Dr. Y. S. Parmar University of Horticulture and Forestry,
Nauni- Solan (HP) – 173 230

1. BACKGROUND INFORMATION

i) Name of Centre : Solan (H.P.)

ii) Name and Address of Officer Incharge : Dr Y.C. Gupta, Professor & Head
Department of Floriculture & Landscaping,
Dr Y.S. Parmar University of Horticulture & Forestry, Nauni, Solan-173 230 (HP).
Email: ycgupta2006@yahoo.co.in

2. STAFF POSITION:

Sr.No.	Name, Designation and E.mail	Approved Scale	Present Scale
1.	Dr S.R. Dhiman Floriculturist sitaramdhiman@yahoo.co.in	37400+10000-67000	37400+10000-67000
2.	Dr Puja Sharma Assistant Floriculturist pujasharma03@gmail.com	15600+6000-39100	15600+7000-39100
3.	Dr Bharati Kashyap Assistant Floriculturist sullhanb@gmail.com	15600+6000-39100	15600+7000-39100
4.	Sh. Babu Ram, Mali	5910+1900-20200	5910+1900-20200
5.	Sh. Hari Chand, Mali	5910+1900-20200	5910+1900-20200

3. BUDGET DETAILS (Rs):

Opening balance as on 1.04.2015	Receipt	Total of 1 and 2	Expenditure for 2015-16	Council's share of expenditure (75 %)	Closing balance as on 31-03-2016
(1)	(2)	(3)	(4)	(5)	(6)
(-)7,45979	29,00,000	(-)21,54,021	38,51,541	28,88,656	(-)7,34,635

4. SUMMARY OF RESEARCH ACHIEVEMENTS DURING 2015-16

Solan Centre of AICFIP is working on different aspects like crop production, crop improvement, post harvest handling of ornamentals, turf grasses, native ornamentals, drying of flowers and foliage and value addition. The salient results are summarized as follows:

Gladiolus

Germplasm collection consists of 48 cultivars. Evaluation trial conducted during 2015-16 showed that cultivars 'Vink's Glory' and 'Red Beauty' can be recommended for cut flower production and 'Pacifica', 'Pascal', 'Interpid', 'Punjab Dawn', 'Vink's Glory' and 'Darshan' for corm and cormel production.

As far as testing of newly evolved genotypes is concerned, 'UHFSGla 11-10' was found to be the most superior for early flowering, number of florets/spike, number of florets open at a time, size of floret, corm multiplication and size of the corm.

Carnation

Germplasm collection consists of 74 cultivars. During 2015-16, nine newly introduced cultivars were evaluated and found that 'Jurano', 'Bizet' and 'Ambrose' can be recommended for commercial cultivation.

Studies conducted on staggered planting of carnation revealed that flowering could be regulated successfully through staggered planting.

As far as post harvest studies on carnation are concerned, stock solutions, both holding and pulsing, are being prepared and stored under refrigerated and normal room temperature for further use to test their effectiveness.

Tulip

Germplasm collection consists of 6 cultivars. During 2015-16 six cultivars of tulip were evaluated for growth, flowering and bulb parameters. Out of these, cultivars 'Red Impression', 'Benja Luka' and 'Golden Oxford' are found to be the most superior for stem length, flower size, duration of flowering and bulb/bulblet parameters.

Daffodils

In year 2015-16 a total of 14 cultivars namely; 'Yellow Cheerfulness', 'Replete', 'Blues', 'Pipet', 'White Lion', 'Fortissimmo', 'Cum Laude', 'Falconet', 'Golden Ducat', 'Lemon Beauty', 'Obdam', 'Mon Dragon', 'Dick Wildon' and 'Puebello' were introduced from RHRTS, Bajaura and out of these; only 6 cultivars flowered . Based upon one year evaluation data, conclusion can not be drawn and hence these will be again evaluated durig 2016-17.

Lilium

Out of 14 lilium cultivars evaluated for growth and flowering parameters, cultivars; 'El Divo' 'Brunello' and 'Frans Hals' are found to be superior for producing more stem length, number of leaves/plant and number of flower buds/plant.

In experiment on standardization of growing media for Lilium LA hybrids, for obtaining earliest flowering, more number of flowers/spike, better stem length and vase-life, growing of bulbs in a medium containing Sand+Soil+FYM (1:1:1, v/v) + (Vermicompost + Cocopeat) (2:1:1, v/v) is found most suitable. However, for bulb multiplication growing of bulbs in a medium containing Sand+Soil+FYM (1:1:1, v/v) is most suitable.

Propagation studies in LA hybrid lilies shows that maximum number of bulblets/scale (2.53) was obtained in cultivar 'Jazz it Up'. In case auxins, scales treated with NAA 500 ppm produced maximum number of bulblets/scale (2.68). Among media, cocopeat was found to give maximum number of bulblets /scale (2.67).

Alstroemeria

Germplasm collection consists of 10 cultivars. Evaluation trial conducted on 9 cultivars revealed that 'Serena' and 'Cinderella' can be recommended on the basis of plant height, number of flowering shoots and number of flowers followed by cultivars 'Capri' and 'Pink Panther'.

Standardization of growing mediumfor growth and flowering performance of alstroemeria cv. 'Capri', revealed thatSand+ Soil + FYM(1:1:1; v/v) + Vermicompost + Cocopeat (2:1:1; v/v)was found best for number of stems per plant, number of flowering stems per plant, number of days taken to bud formation, number of days taken to flowering, length of cut stem, duration of flowering and weight of cut stem.

Bird of Paradise

The centre is maintaining one species of Bird of Paradise i.e. *Strelitzia reginae.*

Native Ornamentals

Solan Centre is harbouring almost 20 number of native ornamental plants in its native plant block. In the year 2015-16 four new ornamental plants ie *Onychium contiguum, Parthenocissus himalayana, Anaphalis margaritacea* and *Celosia argentea*were added to it.

For glycerinization studies, cut foliages like; *Euonymous japonicus, Ruscus hypoglossus, Grevillea robusta, Aglaonema modestum, Buxus sempervirens, Araucaria cookii, Podocarpus* were taken and glycerine drying was done by uptake method. Preliminary studies indicated that all the cut-foliages responded well to glycerine and were elastic and glossy in appearance.

Turf Grass

Solan centre is maintaining six species of lawn grasses namely: *Agrostis stolonifera, Lolium perenne, Eragrostis curvula, Zoysia japonica, Poa pratensis* and *Paspalum dilatatum*. Based on evaluation studies and *Loliumperenne* are recommended for mid hill zone of Himachal Pradesh.

Chrysanthemum

Under the experiment on testing of new genotypes during 2015 - 16, variable results were obtained with respect to different parameters under study. As regards number of flowers per plant, genotypes'PAU-1' and 'PAU-A-64' were found superior whereas, for obtaining longer duration of flowering 'UHFSChr-77', 'Little Pink', 'Pusa Anmol', 'Autumn King 'and 'UHFSChr-44' are found suitable.

Marigold

During 2015-16, four newly evolved genotypes were evaluated for their growth and flowering performance. Among these, 'IIHRMO-2' resulted in maximum flower yield / plant, whereas largest flower diameter was recorded in 'Arka Bangara'.

China Aster

During 2015-16, ten cultivars of China aster were evaluated for growth and flowering performance. Among these, 'Phule Ganesh Purple' recorded maximum loose flower yield, whereas 'Arka Archana' resulted in maximum shelf life. For cut flower production, 'Arka Archana' and 'Arka Adhya' resulted in highest yield and vase life also.

5. List of projects (Programme of work allotted):

S. No.	Project No.	Title of the project
I. Germplasm conservation and evaluation		
1.	Project No. 1.2.1	Collection, evaluation and maintenance of gladiolus germplasm
2.	Project No. 1.3.1	Collection, evaluation and maintenance of germplasm of carnation
3.	Project No. 1.9.1	Collection, evaluation and maintenance of tulip germplasm
4.	Project No. 1.10.1	Collection, evaluation and maintenance of daffodils germplasm
5.	Project No. 1.11.1	Collection, evaluation and maintenance of lilium germplasm
6.	Project No. 1.12.1	Collection, evaluation and maintenance of germplasm of alstroemeria
7.	Project No. 1.13.1	Collection and evaluation of underexploited ornamentals (Heliconias, Ginger lily, Bird of Paradise) etc.
8.	Project No. 1.14.2	Survey, collection and evaluation of native ornamentals for commercial cultivation
9.	Project No. 1.15.2	Collection and evaluation of turf grasses
II. Crop Improvement		
10.	Project No. 2.1.1	Testing of new genotypes of gladiolus
11.	Project No. 2.2.1	Testing of newly evolved genotypes of chrysanthemum
12.	Project No. 2.4.1	Testing of new genotypes of marigold for loose flower
13.	Project No. 2.6.1	Testing of new genotypes of China Aster
III. Crop Management		
15.	Project No. 3.6.1	Studies on staggered planting of carnation for extending flower availability
16.	Project No. 3.7.1	Standardization of propagation technology for hybrid lilies
17.	Project No. 3.7.2	Standardization of growing media for Lilium

18.	Project No. 3.8.1	Standardization of growing media for alstroemeria
IV. Post Harvest Technology and Value Addition		
18.	Project No.5.1.2	Studies on effect of storage of pulsing stock solutions of carnation on their efficacy
19.	Project No 5.1.3	Studies on effect of storage of holding stock solutions of carnation on their efficacy
20.	Project No. 5.4.1	Identification of ornamental species for preparation of value added dried Products
21.	Project No. 5.5.1	Standardization of glycerinization for increasing shelf life of cut foliages

6. Salient Research Achievements:

I. Germplasm conservation and evaluation

Project No.1.2.1: Collection, evaluation and maintenance of gladiolus germplasm

Solan centre is maintaining a germplasm collection of 48 cultivars of gladiolus. However, evaluation studies during 2015-16 were conducted on 22 cultivars. These cultivars were evaluated for growth; flowering and corm parameters and data are presented in Table 1a and Table 1b. Among different cultivars, maximum plant height recorded in case of 'Red Beauty' (102.67 cm) which was found to be at par with 'Candyman' (101.67 cm), 'Shagun' (99.33 cm), 'Applause' (98.00 cm), 'Solan Mangla' (97.67 cm) and 'Nova Lux' (96.67 cm). On the other hand, minimum plant height was found in cv. 'Pascal' (67.33 cm)(Table 1a).

Table 1a. Growth and flowering parameters of gladiolus cultivars during 2015-16

Cultivar	Plant height (cm)	Days taken for spike emergence	Days taken for flowering	Spike length (cm)	Rachis length (cm)	No. of florets/spike
Peter Pears	88.33	86.83	98.83	55.67	28.33	13.00
Pascal	67.33	89.42	100.17	43.00	28.00	13.00
Candyman	101.67	101.42	108.67	57.67	34.33	13.33
Interpid	78.33	91.33	100.83	45.67	31.00	14.00
Red Beauty	102.67	94.67	104.42	69.67	50.00	17.00
Pacifica	93.00	110.00	121.83	47.67	25.00	14.33
Punjab Dawn	84.33	102.47	106.50	52.00	27.67	14.33
Vink's Glory	87.67	99.60	105.42	48.00	34.00	18.00
Shagun	99.33	100.67	103.53	54.67	35.00	13.00
American Beauty	92.33	100.20	104.83	57.00	36.33	13.00
Her Majesty	89.67	86.33	94.50	59.33	40.00	13.67
Red Ginger	86.67	111.50	124.60	39.00	27.00	13.00
Suchitra	84.67	98.75	107.83	52.00	34.33	15.00
Applause	98.00	99.33	106.80	61.00	43.00	15.00
Shobha	95.00	88.75	101.50	60.00	43.67	15.00
Arka Kesar	91.00	97.50	109.03	59.33	43.00	13.67

Super Star	82.00	108.50	127.13	49.67	36.67	13.00
Snow Princess	88.67	89.42	100.87	57.33	31.67	13.33
Gulal	94.00	106.47	114.82	60.00	40.33	13.33
Nova Lux	96.67	102.33	106.00	54.67	37.00	14.67
Darshan	80.00	101.50	117.20	48.00	32.67	13.00
Solan Mangla	97.67	105.67	115.67	58.33	39.67	15.33
$CD_{0.05}$	7.50	1.83	0.86	6.24	6.33	1.46

Earliest spike emergence was observed in cv. 'Her Majesty' (86.33 days) which was found to be at par with 'Peter Pears' (86.83 days). In contrast, maximum days taken for spike emergence was observed in cv. 'Red Ginger' (111.50 days). Earliest flowering was observed in cv. 'Her Majesty' (94.50 days). However, flowering was delayed to maximum in cv. 'Super Star' (127.13 days).

Data in Table 1balso shows that maximum number of florets per spike observed in cultivar 'Vink's Glory' (18.00) was found to be at par with 'Red Beauty' (17.00). In contrast, it was recorded minimum (13.00) in cultivars 'Peter Pears', 'Pascal', 'Shagun', 'American Beauty', 'Red Ginger', 'Super Star' and 'Darshan'.

As regards spike length, it was recorded maximum in cv. 'Red Beauty' (69.67 cm) and minimum in cv. 'Red Ginger' (39.00 cm). As regards rachis length, it was recorded maximum (50.00 cm) in cv. 'Red Beauty'. However, it was recorded minimum in cv. 'Pacifica' (25.00 cm).

Data presented in Table 1b depicts that var 'Candyman' showed maximum number of florets open at a time (6.00) which was found to be at par with 'Arka Kesar', 'Suchitra' and 'Darshan' (5.00). The cultivars showing 4 florets open on stem at a time include 'Peter Pears', 'Vink's Glory' and 'Gulal'.

Table 1b. Flowering and corm parameters of gladiolus cultivars during 2015-16

Cultivar	No. of florets open at a time	Floret size (cm)	Number of corms/plant	Size of corm (cm)	Weight of corm (g)	Number of cormels/ plant
Peter Pears	4.00	7.13	1.67	5.43	35.00	11.00
Pascal	3.33	6.83	2.33	4.47	30.00	5.33
Candyman	6.00	8.30	1.33	4.53	25.00	4.67
Interpid	3.67	6.67	2.33	4.83	31.67	10.33
Red Beauty	3.33	7.30	1.67	5.07	38.33	6.00
Pacifica	3.33	6.80	2.67	3.92	40.00	11.67
Punjab Dawn	3.33	6.23	2.33	3.65	15.17	7.33
Vink's Glory	4.00	7.37	2.33	4.30	25.17	11.00
Shagun	3.67	6.77	1.67	5.72	38.33	14.00

American Beauty	3.33	7.13	1.33	4.93	41.67	12.33
Her Majesty	3.33	6.73	1.67	4.57	33.33	7.67
Red Ginger	3.33	6.07	1.00	4.48	25.00	4.00
Suchitra	5.00	7.23	1.00	4.58	41.33	6.67
Applause	3.33	6.73	1.33	3.98	26.67	3.00
Shobha	3.67	7.57	1.67	4.87	43.33	17.00
Arka Kesar	5.00	6.97	1.67	3.63	20.00	5.00
Super Star	3.33	7.40	1.00	4.32	26.67	3.67
Snow Princess	3.67	6.37	1.00	3.18	15.00	4.33
Gulal	4.00	7.00	1.00	3.92	28.33	5.00
Nova Lux	3.67	6.77	1.67	3.97	41.17	4.67
Darshan	5.00	6.53	2.00	4.93	30.00	5.33
Solan Mangla	3.67	7.63	1.33	4.00	24.64	9.33
$CD_{0.05}$	**1.25**	**0.93**	**0.75**	**0.40**	**6.91**	**3.27**

Largest floret size (8.30 cm in diameter) was observed in cv. ‘Candyman’. The cultivars showing similar floret size include, ‘Solan Mangla’ (7.63 cm), ‘Shobha’ (7.57 cm) ‘Super Star’ (7.40 cm) and ‘Vink’s Glory’ (7.37 cm). Other cultivars having floret size 7 cm and more include ‘Gulal’ (7.00 cm), ‘Peter Pears’ and ‘American Beauty’ (7.13 cm), ‘Red Beauty’ (7.30 cm) and ‘Suchitra’ (7.23 cm). As regards number of cut stems/plant, all the cultivars under study produced one stem per plant.

Data on various corm parameters is also presented in Table 1b. As regards corm multiplication, cultivar ‘Pacifica’ recorded maximum number of corms/plant (2.67). It was, however, found to be at par with number of corms/plant obtained in cv. ‘Pascal’, ‘Interpid’, ‘Punjab Dawn’, ‘Vink’s Glory’ (2.33) and ‘Darshan’ (2.00). Development of one daughter corm from one mother corm i.e. least number of corms/plant were found in cvs ‘Red Ginger’, ‘Suchitra’, ‘Super Star’, ‘Snow Princess’ and ‘Gulal’.

As regards size of corm, maximum corm diameter recorded in cv. ‘Shagun’ (5.72 cm) was found to be at par with corm size in ‘Peter Pears’ (5.43 cm). In contrast, smallest corms were obtained in cv. ‘Snow Princess’ (3.18 cm).

Maximum corm weight (43.33 g) recorded in cv. ‘Shobha’ was found to be at par with weight of corms observed in cvs ‘Red Beauty’ (38.33 g**),** ‘Pacifica’ (40.00 g), ‘Shagun’ (38.33 g), ‘American Beauty’ (41.37 g), ‘Suchitra’ (41.33 g) and ‘Nova Lux’ (41.17 g). Corm weight was however, recorded minimum in ‘Snow Princess’ (15.00 g).

As regards production of cormels, maximum number of cormels/plant (17.00) recorded in cv. 'Shobha', was found to be at par with 'Shagun' (14.00). Number of cormels/plant were found to be minimum in cv. 'Red Ginger' (4.00).

Based on performance data of these gladiolus cultivars during 2015-16, cultivarsVink's Glory and Red Beauty are recommended for cut flower production and cultivars like Pacifica, Pascal, Interpid, Punjab Dawn, Vink's Glory and Darshan for corm and cormel production.

Project No. 1.3.1 : Collection, evaluation and maintenance of germplasm of carnation

Germplasm collection consists of 74 cultivars. Under the project, nine new cultivars of carnation were introduced during 2015-16 (Plate 1). Data presented in Table 2a shows that maximum plant height (94.20 cm) was recorded in cv. 'Gaudina'. In contrast, it was recorded minimum (66.59 cm) in cv. 'White Liberty'.

As regards, flower bud formation, it was observed earliest (62.26 days) in cv. 'Farida' which was found to be at par with 'White Liberty' (62.36 days). However, flower bud formation was delayed to maximum (106.54 days) in cv. 'Bizet'.

Flower bud size was found maximum (31.35 mm) in cv. 'Gwen'. In contrast, flower bud size was recorded minimum (27.48 mm) in cv. 'White Liberty'. Earliest flower formation (103.81 days) was observed in cv. 'Irene' which was found to be at par with cv. 'Jurano' (104.36 days). However, it was delayed to maximum (132.64 days) in cv. 'Gaudina'.

Table 2a: Growth and flowering performance of carnation cultivars during 2015-16

Cultivars	Plant height (cm)	Days for bud formation	Bud size (mm)	Days for flowering	Flower diameter (cm)	Stem diameter (mm)	Number of flowers /plant
Jurano	79.12	81.95	30.42	104.36	6.47	4.85	4.38
Irene	80.36	83.54	28.88	103.81	6.67	4.01	4.33
Gwen	74.00	106.51	31.35	124.14	5.99	5.24	4.37
Bizet	91.61	106.54	28.82	125.51	6.58	4.38	4.08
Harvey	92.09	84.09	28.44	124.53	6.89	4.46	4.38
White Liberty	66.59	62.36	27.48	118.35	6.25	4.55	5.33
Farida	87.42	62.26	28.84	123.27	6.70	5.08	4.57
Ambrose	87.89	95.09	28.45	131.98	6.85	4.95	4.60

Gaudina	94.20	104.48	28.28	132.64	6.61	4.19	4.46
CD $_{0.05}$	**1.77**	**0.92**	**0.38**	**2.05**	**0.13**	**0.08**	**0.24**

As regards flower diameter, it was recorded maximum (6.89 cm) in cv. 'Harvey' which was found to be a par with cv. 'Ambrose' (6.85 cm). In contrast, cultivar 'Gwen' produced flowers of minimum size (5.99 cm).

Cultivar 'Gwen' produced cut stems having maximum thickness (5.24 mm). However, cut stems having minimum thickness (4.01 mm) was observed in cv. 'Irene'. Maximum number of flowers per plant (5.33) was recorded in cv. White Liberty. In contrast, plants cv. 'Bizet' produced minimum number of flower (4.08).

Data (Table 2b) shows that cultivar 'Gaudina' produced cut stems having maximum length (74.79 cm) which was found to be at par with stem length recorded in 'Harvey' (73.29 cm). In contrast, it was recorded minimum (52.49 cm) in cv. 'White Liberty'.

As regards, number of flowers/m^2, it was also recorded maximum (133.33) in cv. 'White Liberty'. However, it was observed minimum (101.91 flower/m^2) in cv. 'Bizet'. Number of petals/flower was recorded maximum (99.31) in cv. 'Jurano'. In contrast, cultivar 'White Liberty' produced flowers having minimum number of petals. Duration of flowering was recorded maximum (81.49 days) in cv. 'Irene' which was found to be at par with cv. 'Jurano' (80.18 days). However, it was recorded minimum (42.25 days) in cv. 'Gaudina'.

Table 2b: Growth and flowering performance of carnation cultivars during 2015-16

Cultivars	**Stem length (cm)**	**Number of flowers/ m^2**	**Number of petals /flower**	**Duration of flowering (days)**	**Strength of cut flower stem**
Jurano	61.29	109.36	99.31	80.18	**A**
Irene	62.07	108.30	85.45	81.49	**A**
Gwen	59.07	109.18	80.67	57.25	**A**
Bizet	71.65	101.91	52.55	52.12	**A**
Harvey	73.29	109.53	75.68	56.65	**A**
White Liberty	52.49	133.33	44.20	51.19	**A**
Farida	68.99	114.26	83.27	58.72	**A**
Ambrose	70.20	115.11	75.78	49.22	**A**
Gaudina	74.79	111.42	93.63	42.25	**A**
CD $_{0.05}$	**1.35**	**6.05**	**3.66**	**1.86**	

Data presented in Table 2c shows the stem quality parameters of newly introduced cultivars of carnation varied significantly from each other. Maximum percentage (99.90 %) of A grade flowers were produced by cv. 'Gaudina', whereas minimum A grade flowers were produced by cv. 'White Liberty' (25.17 %).

Data also shows that maximum B grade flowers (74.65 %) were obtained in cv. 'White Liberty', whereas it was found minimum (0.50 %) in 'Gaudina'. Data with respect to C grade flowers was found to be non-significant.

Although data on percent A grade flowers with respect to stem strength was found to be non-significant yet maximum A grade flowers (99.90 %) were obtained in all the cultivars except 'Harvey' (99.79 %) which also recorded minimum percent A grade flowers with respect to stem strength.

Data on B grade cut stems on the basis of stem strength was found to be non-significant. Data related to C grade flowers shows that all the cultivars resulted in 0.50 % C grade cut stems except 'Farida' recording 0.52 % C grade cut stems.

Data pertaining to calyx splitting shows that minimum calyx splitting was recorded in cv. 'Gwen' (0.50 %) was found to be at par with cv. 'Bizet' (2.20 %). In contrast, maximum calyx splitting was found in cv. 'Farida' (26.91 %) which was found to be at par with 'Harvey' (19.97 %).

Table 2c: Stem length (% grade flower), stem strength (% grade flowers) and calyx splitting (%)of carnation cultivars during 2015-16

Cultivars	Stem length (% grade flowers)			Stem strength (% grade flowers)			Calyx splitting (%)
	A grade	B grade	C grade	A grade	B grade	C grade	
Jurano	77.92 (67.41)	22.22 (23.30)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	10.72 (17.27)
Irene	77.36 (70.30)	22.90 (21.16)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	17.71 (24.45)
Gwen	73.21 (66.75)	26.68 (24.32)	0.81 (1.31)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	0.50 (4.05)
Bizet	97.32 (83.95)	2.98 (7.70)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	2.20 (6.10)
Harvey	89.34 (77.36)	10.92 (14.10)	0.50 (1.23)	99.79 (10.04)	0.50 (1.23)	0.50 (1.23)	19.97 (26.37)
White Liberty	25.17 (28.58)	74.65 (61.19)	0.63 (1.27)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	2.90 (8.21)

Farida	91.26 (78.04)	8.97 (13.23)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.52 (1.23)	26.91 (31.06)
Ambrose	87.44 (75.59)	12.79 (15.69)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	3.55 (9.34)
Gaudina	99.90 (88.15)	0.50 (4.05)	0.50 (1.23)	99.90 (10.05)	0.50 (1.23)	0.50 (1.23)	27.95 (31.79)
CD $_{0.05}$	(3.61)	(3.51)	(N.S.)	(N.S.)	(N.S.)	(0.003)	(3.33)

Based on the performance of carnation cultivars during 2015-2016, 'Jurano', 'Bizet' and 'Ambrose' are recommended for commercial cultivation.

Project No. 1.9.1: Collection, evaluation and maintenance of tulip germplasm

During 2015-16 six cultivars of tulip were evaluated for growth, flowering and bulb parameters (Table 3). Data shows that plant height recorded maximum in cv. 'Red Impression' (44.50 cm) was found to be at par with 'Christmas Negrita' (43.00 cm). In contrast, plant height was recorded minimum in cv. 'White Dream' (24.33 cm). As regards number of leaves per plant, it was recorded maximum (6.75) in cv. 'Golden Oxford'. On the other hand, minimum number of leaves per plant was recorded in 'White Dream' (3.83).

It is also evident from the data that earliest coloured bud formation and subsequently earliest flowering was observed in cv. 'Red Impression' (134.83 and 141.12 days, respectively). In contrast, days to coloured bud formation and flowering was delayed to maximum in cv. 'Bleeding Heart' (160.25 and 165.25 days, respectively).

Data reveals that scapes of maximum length were observed in cv. 'Red Impression' (25.40 cm). Other cultivars recording more than 20 cm scape length include 'Benja Luka' (21.50 cm), 'Christmas Negrita' (23.33 cm) and 'Bleeding Heart' (20.50 cm). On the other hand, scape length was recorded minimum in cv. 'White Dream' (11.25 cm.).

As regards flower diameter, it was recorded maximum (9.15 cm) in cv. 'Christmas Negrita' and was found to be at par with flower size in 'Golden Oxford' (9.03 cm). However, smallest flower size (3.72 cm) was observed in cv. 'White Dream'.Flower height was found maximum in cv. 'Red Impression' (8.50 cm) and it was recorded minimum in cv. 'White Dream' (4.55 cm).

Although, cultivars did not differ significantly from one another for duration of flowering yet, flowers of 'Christmas Negrita' lasted longest (12.54 days) whereas cv. 'Bleeding Heart' showed minimum flowering duration (11.50 days).

As regards bulb parameters of tulip cultivars under study, largest sized bulbs (4.20 cm in diameter) were obtained in cv. 'Red Impression'. On the other hand, bulb size was found minimum in cv. 'Bleeding Heart' (1.89 cm). Data on weight of bulbs shows that maximum bulb weight was found in cv. 'Red Impression' (33.90 g). On the other hand, bulb weight was recorded minimum (6.85 g) in cv. 'Bleeding Heart'.

Data on bulblet size and weight shows that maximum bulblet diameter (1.48 cm) was recorded in cv. 'Golden Oxford' with a corresponding weight of 2.48 g/ bulblet. It is however, found to be at par with bulblet diameter recorded in cv. 'Christmas Negrita, (1.47 cm) with a corresponding weight 2.43 g/ bulblet. Minimum bulblet diameter and weight were, however, obtained in cv. 'Bleeding Heart' (1.17 cm and 1.35 g, respectively).

During 2015-16 six cultivars of tulip were evaluated for growth, flowering and bulb parameters. Out of these, cultivars Red Impression, Benja Luka and Golden Oxford are found to be the most superior for stem length, flower size, duration of flowering and bulb/bulblet parameters.

Project No.1.10.1:Collection, evaluation and maintenance of daffodils germplasm

During 2015-16 fourteen new cultivars namely; 'Yellow Cheerfulness', 'Replete', 'Blues', 'Pipet', 'White Lion', 'Fortissimmo', 'Cum Laude', 'Falconet', 'Golden Ducat', 'Lemon Beauty', 'Obdam', 'Mon Dragon', 'Dick Wildon' and 'Puebello' were introduced from RHRTS, Bajaura making a total collection of 28 and planted in the research farm for studying various growth and flowering characters. It was found that out of 14 cultivars only 6 cultivars flowered **(**Plate 2a). The data pertaining to various growth parameters has been given in Table 4.

Table 4: Growth and flowering performance of newly introduced cultivars of daffodil during 2015-16

Cultivars	Number of leaves/plant	No. of days to bud formation	No. of days to flowering	Scape length (cm)	Flower size (cm)	Flower Colour/Type
Yellow Cheerfulness	8.00	60.00	63.33	22.33	8.16	Dull Yellow, double flowered
Blues	10.33	49.00	53.33	25.66	9.16	Cream petals, yellowish inside, double type
Pipet	6.33	48.66	52.33	18.83	4.80	Lemon yellow, small florets

Fortissimmo	5.67	40.66	43.00	43.33	6.73	Yellowish outside, cup orange
Falconet	6.33	48.66	52.66	23.66	5.13	Lemon yellow outside, corona orange, larger than cv. Pipet
Puebello	8.67	51.33	53.33	21.33	4.83	Cream outside , peach cup, , multiple florets/stem
$CD_{0.05}$	1.86	2.03	2.35	2.44	0.73	

Maximum number of leaves was obtained in cultivar 'Blues' (10.33) which was at par with that of cultivar 'Puebello' (8.67) whereas, minimum number of leaves was obtained in cultivar 'Fortissimmo' (5.67).It was found that minimum number of days taken for bud formation was observed in cultivar 'Fortissimmo' (40.66 days), whereas maximum days for bud formation was observed in cultivar 'Yellow Cheerfulness' (60.00 days). Minimum number of days taken for flowering was found in cultivar 'Fortissimmo' (43.00 days), where as maximum days for flowering was observed in cultivar 'Yellow cheerfulness' (63.33days).

It was found that maximum scape length was obtained in cultivar 'Fortissimo' (43.33 cm) whereas, minimum scape length was observed in 'Pipet' (18.83 cm). Flower sizewas foundmaximum in cultivar 'Blues' (9.16 cm) whereas, minimum flower size was observed in cultivar 'Puebello' (4.83 cm**).**

In year 2015-16, a total of 14 cultivars namely; 'Yellow Cheerfulness', 'Replete', 'Blues', 'Ice King', 'Pipet', 'White Lion', 'Fortissimmo', 'Cum Laude', 'Falconet', 'Golden Ducat', 'Lemon Beauty', 'Obdam', 'Mon Dragon', 'Dick Wildon' and 'Puebello' were introduced from RHRTS, Bajaura and out of these; only 6 cultivars flowered . Based upon one year evaluation data, conclusion cannot be drawn and hence these will be again evaluated during 2016-17.

Project No 1.11.1: Collection, evaluation and maintenance of lilium germplasm

In year 2014-15 newly introduced 10 cultivars of lilium were planted in a randomized block design; data pertaining to growth and flowering parameters has been given in annual report of 2014-15 and data pertaining to their bulb characters is being presented in Table 5a.

Maximum weight of bulbs/plant (31.20 g) was observed in cultivar 'Jazz It Up' where as minimum weightof bulbs/ plant (8.11) was recorded in cultivar 'EI Divo'. Diameter of bulbs was

also recorded maximum in cultivar ‘Jazz It Up’ (43.47 mm) which was found to be at par with cultivar ‘Salmon Classic’. Whereas, minimum diameter of bulbs (28.70mm) was recorded in cultivar ‘El Divo’.

Maximum weight of bulblets/plant (2.42 g) was observed in cultivar ‘Batistero’ where as minimum weight of bulblets/plant (1.27 g) was recorded in cultivar ‘El Divo’. Diameter of bulblets was recorded maximum in cultivar ‘Frans Hals’ (16.15 mm) whereas, minimum diameter of bulblets (10.76 mm) was recorded in cultivar ‘Pollyana’.

Table 5a: Bulb/bulblet parameters of Lilium cultivars during 2014-15

Variety	Weight of bulbs/plant	Diameter of bulbs(mm)	Weight of bulblets/plant	Diameter of bulblets(mm)	Number of bulblets/plant
Frans Hals	19.44	32.37	2.27	16.15	2.67
Jazz It Up	31.20	43.47	1.97	12.06	1.33
El Divo	8.11	28.70	1.27	12.01	1.33
Batistero	16.91	29.48	2.42	15.88	1.67
Pollyana	20.78	32.46	2.04	10.76	1.33
Bright Diamond	10.32	29.22	1.75	12.70	2.33
Salmon Classic	23.76	38.45	2.17	14.61	2.33
Red Alert	22.47	33.74	1.77	14.36	0.67
Brunello	16.65	32.47	1.97	15.15	0.67
C.D $_{0.05}$	6.02	8.75	NS	NS	1.06

Number of bulblets was recorded maximum in cultivar ‘Frans Hals’ (2.67) which was found to be at par with cultivar ‘Bright Diamond’ and ‘Salmon Classic’ (2.33) and ‘Batistero’ (1.67) whereas, minimum number of bulblets (0.67) was recorded in cultivar ‘Red Alert’ and ‘Brunello’.

Based upon performance data, cvs ‘Frans Hals’, ‘Bright Diamond’ and ‘Salmon Classic’ are found most suitablefor bulb/bulblet multiplication.

In the year 2015-16, eight cultivars of lilium consisting of two Asiatic andsix LA hybrids were planted to observe various growth and flowering characteristics and the data pertaining to these parameters is given in Table 5b**.** Maximum plant height was observed in cultivar ‘Frans Hals’ (79.83 cm). It was however, found to be at par with ‘Brunello’ (79.00 cm), ‘Bright

Diamond' (78.50 cm) and 'El Divo' (78.17 cm). In contrast, minimum plant height was found in cultivar 'Red Alert' (68.33 cm).

It was observed that plants of cv. 'Brunello' produced maximum number of leaves/plant (43.33) which were found to be at par with number of leaves produced by cvs 'Jazz It Up' (43.08), 'El Divo' (41.83) and 'Bright Diamond' (40.53). As regards leaf length, it was recorded maximum in cv. 'El Divo' (10.49 cm) and was found to be at par with cv. 'Frans Hals' (10.42 cm), 'Pollyana' (9.85 cm), 'Bright Diamond' (9.81 cm) and 'Batistero' (9.53 cm) . In contrast, length of leaf was recorded minimum in cultivar 'Red Alert' (7.82 cm).

Table 5 b. Growth and flowering parameters of Lilium cultivars during 2015-16

Cultivar	Plant height (cm)	No. of leaves/ plant	Leaf length (cm)	Days to coloured bud	Days to flowering	Stem length (cm)	No. of buds /plant	Length of bud (cm)	Flower size(cm)
Frans Hals	79.83	35.67	10.42	139.67	145.33	75.08	3.17	10.83	16.27
Red Alert	68.33	37.17	7.82	126.33	132.67	61.92	2.61	9.20	16.55
Brunello	79.00	43.33	8.28	136.00	140.33	73.55	3.33	9.07	16.45
Bright Diamond	78.50	40.53	9.81	142.00	146.00	73.17	2.17	9.90	17.22
Jazz It Up	70.67	43.08	9.16	142.67	145.67	64.82	3.22	8.20	15.40
El Divo	78.17	41.83	10.49	142.33	145.67	72.33	3.50	10.22	16.27
Pollyana	73.00	31.67	9.85	140.67	145.67	67.75	2.00	8.83	18.23
Batistero	69.50	32.50	9.53	135.33	139.67	63.75	2.50	9.30	16.72
$CD_{0.05}$	5.41	4.51	0.96	1.51	1.16	4.81	0.57	0.70	0.73

Data shows that earliest coloured bud formation and flowering were recorded in cultivar 'Red Alert' (126.33 and 132.67 days, respectively). In contrast cv. 'Jazz It Up' took maximum days to coloured bud and cv. 'Bright Diamond' (146.00 days) for flowering. Other cultivars showing at par results with that of 'Bright Diamond' for flowering were 'Frans Hals' (145.33 days), 'Jazz It Up' (145.67 days), 'El Divo' (145.67 days) and 'Pollyana' (145.67 days).

As regards stem length, it was recorded maximum of 'Frans Hals' (75.08 cm) which was found to be at par with cvs 'Brunello' (73.55 cm), 'Bright Diamond' (73.17 cm) and 'El Divo' (72.33 cm). However, stem length was recorded minimum in cv. 'Red Alert' (61.92 cm).

Data shows that maximum number of buds per plant was recorded in cultivar 'El Divo'(3.50) and was found to be at par with cvs 'Brunello' (3.33), 'Jazz It Up' (3.22) and 'Frans Hals' (3.17). In contrast, minimum number of buds per plant (2.00) was found in cultivar

‘Pollyana’. Data also shows that maximum bud length was recorded in cultivar ‘Frans Hals’ (10.83 cm) was at par with ‘El Divo’ (10.22 cm). However, minimum bud length was recorded in cultivar ‘Jazz it Up’ (8.20 cm). It is evident from the data that maximum flower size was recorded in cultivar ‘Pollyana’ (18.23 cmin diameter). In contrast, minimum flower size was recorded in cultivar ‘Jazz It Up’(15.40 cm in diameter).

Out of 14 lilium cultivars evaluated for growth and flowering parameters, cultivars; 'El Divo' ‘Brunello' and 'Frans Hals' are found to be superior for producing more stem length, number of leaves/plant and number of flower buds/plant.

Project No. 1.12.1: Collection, evaluation and maintenance of germplasm inAlstroemeria

During 2015-16 two year old plantation of nine cultivars was evaluated for growth and flowering characters (Table 6).

It was found that maximum plant height was obtained in cultivar ‘Serena’ (156.33 cm) and minimum in ‘Tiara’ (87.66 cm). Maximum number of leaves was obtained in cultivar ‘Aladdin’ (39.33) which was at par with that of ‘Pluto’ (35.66), whereas minimum number of leaves was recorded in cultivar ‘Riana’ (26.00). Maximum number of side shoots was recorded in cultivar ‘Serena’ (47.66), which was found at par with ‘Pink Panther’ (44.00) whereas, minimum number of shoots was recorded in ‘Tiara’ (13.66). Leaf width was recorded maximum in cultivar ‘Piantum’ (3.50 cm) whereas, minimum leaf width was recorded in ‘Pink Panther’ (1.36 cm). Maximum leaf length was recorded in cultivar ‘Piantum’ (14.43) whereas, minimum leaf length was recorded in cultivar ‘Cinderella’ (9.23cm). Maximum number of buds was recorded in cultivar ‘Cinderella’ (21.66) which was at par with that of ‘Serena’ (21.33) and ‘Pink Panther’ (18.66) whereas, minimum number of buds was recorded in cultivar ‘Pluto’ (11.00). Maximum bud size was observed in cultivar‘Aladdin’ (5.16 cm) whereas, it was observedminimum in cultivar ‘Cinderella’(4.33 cm). Maximum floret size was recorded in cultivar ‘Pink Panther’ (6.86 cm)which was at par with that of ‘Aladdin’ (6.66 cm) whereas, minimum floret size was recorded in cultivar ‘Piantum’ (4.60cm).

Table 6. Growth and flowering performance of alstroemeria cultivars in 2015-16

Cultivars	Plant height (cm)	No.of leaves/ stem	No.of shoots /plant	Leaf width (cm)	Leaf length (cm)	No. of buds	Size of bud (cm)	Flower size (cm)
Aladdin	118.00	39.33	24.00	1.93	12.00	15.66	5.10	6.66

Capri	113.00	30.66	38.00	2.30	11.86	18.00	4.90	5.16
Cinderella	141.33	34.33	40.66	1.60	9.23	21.66	4.33	5.43
Pink Panther	116.66	28.00	44.00	1.36	10.53	18.66	4.66	6.86
Pluto	100.33	35.66	20.66	2.23	9.90	11.00	4.93	5.63
Piantum	95.33	32.33	14.33	3.50	14.43	16.00	4.93	4.60
Riana	88.00	26.00	35.66	2.60	11.26	16.00	4.70	5.03
Serena	156.33	27.66	47.66	1.96	10.70	21.33	4.80	5.03
Tiara	87.66	28.33	13.66	1.90	9.73	15.33	4.86	5.63
CD $_{0.05}$	13.05	3.96	6.31	0.33	0.93	3.53	0.20	0.27

Based upon the performance of these cultivars 'Serena' and 'Cinderella' can be recommended on the basis of plant height, number of flowering shoots and number of flowers followed by cultivars 'Capri' and 'Pink Panther'.

Project No. 1.13 : Collection and evaluation of underexploited ornamentals (Bird of Paradise).

The centre is maintaining one species of Bird of Paradise i.e. *Strelitzia reginae.*

Project No. 1.14.2: Survey, collection and evaluation of native ornamentals for commercial cultivation

Under this experiment, explorations were made to different areas like Shoghi, Taradevi of Shimla district and Kotla, Ser Baneda and Barog areas of Solan district. List and photographs of some of the newly identified plants has been given in Table 7 (Plate 2b).

Other plants like, *Shefflera venulosa*, *Iris lactea*, *Eranthemum pulchellum*, *Phlogacanthus pubinervius* and *Hypericum oblongifolium* planted in the 'Native plant block' of the Department are performing well.

Table 7. Description of native ornamentals foundand maintained during 2015-16

S. No.	Name of the plant	Family	Description	Probable use
1.	*Anaphalis margaritacea*	Asteraceae	A herbaceous perennial with greyish white leaves, usually associated with chir pine forests, white flowers in corymbs appear in September	As afiller in fresh and dry flower arrangements, beds, borders
2.	*Celosia argentea*	Amaranthaceae	A herbaceous perennial of dry localities, whitish-pinkish, shiny flowers crowded in simple racemes appear from summer to autumn.	As afiller in fresh and dry flower arrangements
3.	*Parthenocissus himalyana*	Vitaceae	Climbing plants over tall trees,	For autumn gardens

			leaves digitately compound shows emerging and fall leaf red colouration	
4.	*Onychium contiguum*	Cryptogrammaceae	A light greenish fern with very delicately divided leaves, with creeping rhizomes, found in moist temperate forests	Near moist areas

Solan Centre is harbouring almost 20 number of native ornamental plants in its native plant block. In the year 2015-16, four new ornamental plants i.e.*Onychium contiguum, Parthenocissus himalayana, Anaphalis margaritacea* and *Celosia argentea*were added to it.

Project No. 1.15.2 : Collection and evaluation of turf grasses

Under the project four temperate lawn grass species viz. *Agrostis stolonifera, Lolium perenne, Paspalum dilatatum, Zoysia japonica, Poa pratensis* and *Eragrostis curvula* were evaluated. It is evident from the data in Table 8 that maximum number of shoots /10 cm^2, it was recorded maximum in *Lolium perenne* (485.20) followed by *Zoysia japonica* (399.40).

Table 8: Evaluation of lawn grass species during 2015-16

Species	**Number of shoots/10 cm^2**	**Shoot length (cm)**	**Number of Roots/ 10 cm^2**	**Root length (cm)**	**Colour**
Lolium perenne	485.20	4.85	660.20	10.60	Green Group 136(A)
Agrostis stolonifera	180.20	4.05	980.00	11.22	Green Group 141(B)
Paspalum dilatatum	150.20	3.98	308.60	14.97	Green Group 138(B)
Zoysia japonica	399.40	4.03	210.40	5.55	Green group 137(C)
Poa pratensis	119.72	3.50	391.80	8.59	Green Group 139(A)
Eragrostis curvula	138.02	8.82	161.78	6.76	Green Group 140(B)
CD $_{0.05}$	5.36	0.31	11.33	2.92	-

Number of shoots/10 cm^2 was however recorded minimum in *Poa pratensis* (119.72). As regards shoot length, it was found maximum in *Eragrostis curvula* (8.82 cm) and minimum in *Poa pratensis* (3.50 cm).

Data reveals that number of roots/10 cm^2 were recorded maximum in *Agrostis stolonifera* (980.00) followed by *Lolium perenne* (660.20). In contrast, it was recorded minimum (161.78) in

Eragrostis curvula. Maximum root length was found in *Paspalum dilatatum* (14.97 cm) followed by *Agrostis stolonifera* (11.22 cm). Root length was, however, recorded minimum in *Zoysia japonica* (5.55 cm).

Based upon evaluation, lawn grasses *Agrostis stolonifera* and *Lolium perenne* are recommended for mid hill conditions of Himachal Pradesh.

II. Crop Improvement

Project No. 2.1.1: Testing of new genotypes of gladiolus

Under this project, six newly evolved genotypes of gladiolus, namely; UHFS Gla 2-24, UHFS Gla 11-10, G.K.G.L 96/01,G.K.G.L 96/02, G.K.G.L 96/03 and G.K.G.L 96/04 were evaluated for their growth and flowering performance during 2015-16. Observations like plant height, days to spike emergence, days to flowering, spike length, rachis length and number of florets/ plant are presented in Table 9a.

It is evident from the data that the different hybrids under study varied significantly from each other with respect to plant height. It was recorded maximum in UHFS Gla 2-24 (86.33 cm). On the other hand, minimum plant height was found in G.K.G.L 96/01 (55.33 cm).

Earliest spike emergence was observed in UHFS Gla 11-10 (89.40 days). In contrast, maximum days taken for spike emergence (115.00 days) was observed in G.K.G.L 96/04. Earliest flowering was observed in UHFS Gla 11-10 (102.80 days). However, flowering was delayed to maximum (123.80 days) in G.K.G.L 96/03 and G.K.G.L 96/04.

Table 9a: Performance of newly evolved genotypes of gladiolus during 2015-16

Genotypes	Plant height (cm)	Days to spike emergence	Days to flowering	Spike length (cm)	Rachis length (cm)	Number of florets/ spike
UHFSGla2-24	86.33	91.20	104.20	53.67	38.33	11.00
UHFSGla11-10	79.33	89.40	102.80	39.67	29.33	15.00
G.K.G.L 96/01	55.33	103.40	110.20	31.67	18.67	10.00
G.K.G.L 96/02	59.00	113.40	121.80	30.67	20.67	9.00
G.K.G.L 96/03	60.33	113.40	123.80	30.00	20.50	10.00
G.K.G.L 96/04	57.33	115.00	123.80	31.33	20.00	10.00
CD $_{0.05}$	**5.52**	**0.63**	**0.38**	**3.36**	**5.27**	**2.15**

As regards spike length, it was found maximum in UHFS Gla 2-24 (53.67 cm). It was, however, found to be minimum in G.K.G.L 96/03 (30.00 cm). Data reveals that rachis length was also recorded maximum in UHFS Gla 2-24 (38.33 cm), whereas it was recorded minimum in G.K.G.L 96/01 (18.67 cm). Number of florets per spike also varied significantly among the hybrids. Maximum number of florets per spike was found in UHFS Gla 11-10 (15.00). On the contrast, number of florets per spike was recorded minimum in G.K.G.L 96/02 (9.00).

Data pertaining to observations; number of florets open at a time, floret diameter, number of corms per plant, corm size, weight of corm and number of cormels/plant is presented in Table 9b. It is also evident from the datathat maximum number of florets open at time on a spike did not differ significantly among the hybrids under study. However, it was recorded maximum in UHFS Gla 11-10 (4.00 cm). In contrast, it was recorded minimum (3.33) in G.K.G.L 96/01, G.K.G.L 96/02, G.K.G.L 96/03 and G.K.G.L 96/04.

Newly evolved hybrids varied significantly from each other with respect to size of florets. It was recorded maximum in UHFS Gla 2-24 (7.88 cm) and was at par with floret size in UHFS Gla 11-10 (7.37 cm). On the other hand, size of the floret was recorded minimum in hybrid GKGL 96/01 (5.82 cm).

Data on corm parameters shows that maximum corm multiplication was observed in G.K.G.L 96/04 which recorded 2.40 number of corms/plant. It was, however, found to be at par with number of corms/plant obtained in UHFS Gla 2-24 and UHFS Gla 11-10 (2.20). Development of one daughter corm from one mother corm i.e. least number of corms/plant were found in G.K.G.L 96/01, G.K.G.L 96/02 and G.K.G.L 96/03.

Table 9b: Performance of newly evolved genotypes of gladiolus during 2015-16

Genotypes	No. of florets open at a time	Floret diameter (cm)	Number of corms/ plant	Corm size (cm)	Weight of corm (g)	Number of cormels/ Plant
UHFSGla2-24	3.67	7.88	2.20	4.67	28.00	16.00
UHFSGla11-10	4.00	7.37	2.20	5.33	33.00	10.80
G.K.G.L 96/01	3.33	5.82	1.00	4.75	26.00	1.40
G.K.G.L 96/02	3.33	5.95	1.00	4.14	21.00	4.20
G.K.G.L 96/03	3.33	5.95	1.00	2.87	10.00	2.00
G.K.G.L 96/04	3.33	6.62	2.40	3.97	17.00	5.80
CD $_{0.05}$	**NS**	**0.69**	**0.62**	**0.55**	**5.19**	**2.26**

As regards size of corm, it was recorded maximum in UHFSGla11-10 (5.33 cm in diameter). Size of corm was, however, recorded minimum in G.K.G.L 96/03 (2.87 cm in diameter).

As regards corm weight, it was found maximum in UHFS Gla 11-10 (33.00 g) which was found to be at par with UHFS Gla 2-24 (28.00 g). In contrast, minimum corm weight was observed in G.K.G.L 96/03 (10.00 g).

Data also reveals that number of cormels per plant were observed maximum in UHFSGla11-1' (16.00). Minimum number of cormels/plant were found in G.K.G.L 96/01 (1.40).

Under this project, six newly evolved genotypes of were evaluated for their growth and flowering performance during 2015. Out of these UHFS Gla 11-10 was found to be the most superior for earliest flowering, number of florets/spike, number of florets open at a time, size of floret, corm multiplication and size.

Project No. 2.2.1: Testing of newly evolved genotypes of chrysanthemum

Among different genotypes of chrysanthemum evaluated during 2015-16, observations on various growth & flowering parameters are presented in Table 10. It was found that maximum plant height was recorded in cv. 'Garden Beauty' (61.45 cm). Other genotypes showing statistically similar plant height were 'Pusa Centenary' (58.56 cm), 'UHFS Chr-81' (56.62 cm), 'Royal Purple' (55.07 cm) 'UHFS Chr-77' (54.06 cm) and 'Autumn King' (52.92 cm), whereas, minimum plant height was recorded in 'UHFS Chr- 44' (23.53 cm). Other genotype showing statistically similar plant height was 'Vijay Kiran' (32.12 cm). It was observed that maximum plant spread was found in 'PAU-A-64' (42.55 cm), which was found to be at par with 'Little Pink' (42.40 cm), 'Royal Purple' (42.30 cm), 'PAU-1' (37.25 cm) and 'UHFS Chr- 77' (35.62 cm). Maximum number of side shoots per plant was recorded in 'Garden Beauty' (3.25), and the minimum number of side shoots was found in 'Pusa Anmol' (1.86) was found to be at par with 'Vijay Kiran' (1.93).

Earliest Bud formation was observed in 'Pusa Anmol' (58.20 days) and the maximum number of days for bud formation was observed in 'UHFS Chr-77' (106.32 days). Earliest Bud opening was observed in' Pusa Anmol' (74.20 days), which was found to be at par with 'UHFS Chr-44' (81.32 days) and 'PAU-3' (83.13 days). Maximum days taken for bud opening was observed in 'Garden Beauty' (120.65 days). Other genotypes showing statistically similar days to

bud opening were ‘UHFS Chr-110’ (116.40 days), ‘Winter Queen’ (112.85), and ‘UHFS Chr-77, (112.65 days). Maximum size of flower was observed in genotype ‘Pusa Centenary’ (11.84 cm). In contrast, minimum flower size recorded in genotype ‘PAU-A-64’ (3.45 cm) was found to be at par with ‘UHFS Chr-44’ (3.65 cm), ‘PAU-1’(3.72 cm) and ‘Winter Queen’ (3.73 cm). Maximum number of flowers per plant was observed in ‘PAU-1’ (143.82), which was found to be at par with ‘PAU-A-64’ (117.72). Minimum number of flowers found in ‘Pusa Centenary’ (19.22), was found to be at par with ‘UHFS Chr-83’ (20.55), ‘Anmol’ (32.50), and ‘Pusa Anmol’ (37.13). Maximum duration of flowering was found in ‘UHFS Chr-77’ (47.97 days),which was found to be at par with ‘Little Pink’ (46.33 days) ‘Pusa Anmol’ (45.53 days), ‘Autumn King’ (44.93 days) and ‘UHFS Chr-44’ (44.15 days). Minimum duration of flowering was found in ‘UHFS Chr-110’ (24.10 days).

Out of different chrysanthemum cultivars evaluated during 2015-16, variable results were obtained w.r.t. different characters. As regards number of flowers per plant, genotypes‘PAU-1’ and ‘PAU-A-64’ were found superior whereas, for more duration of flowering ‘UHFS Chr-77’, ‘Little Pink’,‘Pusa Anmol’, ‘Autumn King’and ‘UHFS Chr-44’ are found suitable.

Project No. 2.4.1: Testing of new genotypes of marigold for loose flower

Under evaluation of newly evolved genotypes of marigold, four genotypes namely ‘IIHR FM-1 IIHR MO-2, IIHR MO-4, Arka Bangara’ were evaluated for growth and flowering performance.

Data presented in Table 11 shows that variation in plant height due to cultivars was found to be significant. Maximum plant height was observed in ‘Arka Bangara’ (55.74cm). In contrast, minimum plant height was observed in ‘IIHRFM-1’ (27.23cm). It was found to be at par with ‘IIHRMO-4’ (29.23 cm).

Data also shows that maximum plant spread was recorded in ‘IIHRMO-4’ (34.07cm), which was found to be at par with ‘IIHRMO-2’ (30.58 cm) and ‘Arka Bangara’ (32.68 cm). In contrast, minimum plant spread was recorded in ‘IIHRFM-1’ (25.18 cm).

Number of side shoots per plant was observed maximum in ‘Arka Bangara’ (5.10). In contrast, minimum number of side shoots per plant was observed in ‘IIHR MO-2’ (3.14), which was found to be at par with ‘IIHR MO-4’ (3.56) and ‘IIHR FM-1’ (3.48).

Data also reveals that earliest bud formation was found in 'IIHRMO-4' (20.40 days), which was found at par with 'IIHRMO-2' (21.40 days). On the other hand, maximum days to bud formation were taken by 'IIHRMO-2' (35.70 days).

Similarly, earliest bud opening was observed in 'IIHRMO-4' (34.85 days), which was found to be at par with 'IIHRFM-1' (35.36 days). In contrast, maximum days taken for bud opening was observed in 'IIHRMO-2' (48.34 days). It was found at par with 'Arka Bangara' (43.16 days).

Table 11: Growth and flowering performance of newly evolved genotypes of marigold during 2015- 16

Genotypes	Plant height (cm)	Plant spread (cm)	No. of side shoots/ plant	Days to bud formation	Days to bud opening	No. of flowers / plant	Flower diameter (cm)	Individual flower weight (g)	Flower weight/ plant (g)
IIHR FM-1	27.23	25.18	3.48	21.40	35.36	83.80	3.63	1.85	172.65
IIHR MO-2	37.42	30.58	3.14	35.70	48.34	111.32	4.40	1.60	209.90
IIHR MO-4	29.23	34.07	3.56	20.40	34.85	67.16	4.31	2.66	153.06
Arka Bangara	55.74	32.68	5.10	26.20	43.16	32.32	5.02	4.92	138.15
$CD_{0.05}$	**2.98**	**3.49**	**0.85**	**1.97**	5.85	**8.59**	**0.17**	**0.27**	**25.32**

Number of flowers per plant was observed maximum in 'IIHRMO-2' (111.32). On the other hand, minimum number of flowers per plant was observed in 'Arka Bangara' (32.32). As regards size of flower, it was observed maximum in genotype 'Arka Bangara' (5.02 cm). In contrast minimum size of flower observed in 'IIHRFM-1' (3.63cm).

Individual flower weight was found maximum in 'Arka Bangara' (4.92 g). In contrast, minimum individual flower weight was found in 'IIHRMO-2' (1.60 g). It was found to be at par with 'IIHRFM-1' (1.85 g). Data also shows that maximum flower weight per plant was found in 'IIHRMO-2' (209.90 g). On the other hand, minimum flower weight per plant was observed in 'Arka Bangara' (138.15 g), which was found to be at par with flower weight observed in 'IIHRMO-4' (153.06 g).

Out of the four newly evolved genotypes of marigold, IIHRMO-2 resulted in maximum flower yield / plant, whereas largest flower diameter was recorded in 'Arka Bangara'.

Project No. 2.6.1: Testing of new genotypes of China Aster

During 2015-16 ten cultivars of China aster (Plate 3) were evaluated for growth and flowering parameters. Observation on various growth parameters are presented in Table 12a. Data shows that plant height was recorded maximum in cv. 'Phule Ganesh Violet' (102.25 cm). In contrast, plant height was recorded minimum in cv. 'Kamini' (41.15 cm).

As regards plant spread , it was recorded maximum in 'Phule Ganesh Pink' (55.70 cm). It was however , found to be at par with plant spread observed in cv. 'Arka Aadhya' (54.37 cm). In contrast minimum plant spread was observed in cv. 'Kamini' (23.79 cm), which was found to be at par with cv. 'Shashank' (24.37 cm).

Table 12a : Vegetative growth and flowering parameters of different China aster cultivars during 2015 -16

Cultivars	Plant height (cm)	Plant spread (cm)	No. of primary branches / plant	Stalk length (cm)	Days to first flower opening	Days to 50% flower opening	No. of harvests of loose flower
Phule Ganesh Purple	93.75	45.29	12.80	24.99	99.00	111.85	10.50
Phule Ganesh Violet	102.25	50.44	11.70	22.83	101.75	116.25	9.50
Phule Ganesh White	63.88	30.58	11.65	32.03	106.25	123.20	7.25
Phule Ganesh Pink	94.78	55.70	13.45	23.25	97.50	113.35	11.25
Arka Aadhya	46.58	54.37	17.30	24.05	79.25	94.05	15.75
Arka Archana	43.16	42.24	18.70	26.13	84.00	99.85	13.25
Poornima	61.05	28.58	12.90	21.93	104.75	119.45	8.75
Kamini	41.15	23.79	16.20	31.15	84.75	100.05	14.25
Shashank	53.82	24.37	19.00	32.60	77.25	92.45	15.00
Violet Cushion	63.13	36.82	15.80	23.55	94.50	109.90	12.25
$CD_{0.05}$	**3.46**	**4.40**	**1.72**	**1.87**	**4.26**	**5.04**	**2.00**

Data also reveals that number of primary branches per plant were recorded maximum in 'Shashank' (19.00), which was found to be at par with 'Arka Aadhya' (17.30) and 'Arka Archana' (18.70). However, minimum number of primary branches was recorded in 'Phule

Ganesh White' (11.65), which was found to be at par with 'Phule Ganesh Purple' (12.80), 'Phule Ganesh Violet' (11.70) and 'Poornima' (12.90).

It is also evident from the data that maximum stalk length was observed in 'Shashank' (32.60 cm). Which was found to be at par with 'Phule Ganesh White' (32.03 cm) and 'Kamini' (31.15 cm). In contrast, minimum stalk length was observed in 'Poornima' (21.93 cm), which was found to be at par with cv. 'Phule Ganesh Violet' (22.83 cm), 'Phule Ganesh Pink' (23.25) and 'Violet Cushion' (23.55).

Data also shows that minimum days taken for first flower opening was recorded in 'Shashank' (77.25 days), which was found to be at par with cv. 'Arka Aadhya' (79.25 days). Maximum days taken for first flower opening was, however, recorded in cv. 'Phule Ganesh White' (106.25 days), which was found to be at par with cv. 'Poornima' (104.75 days).

Minimum days for 50% flower opening was recorded in cv. 'Shashank'(92.45 days), which was found to be at par with cv. 'Arka Aadhya' (94.05 days). On the other hand, maximum days for 50% flower opening was recorded in cv. 'Phule Ganesh White' (123.20 days), which was found to be at par with cv. 'Poornima (119.45 days).

Data also shows that maximum number of harvests of loose flowers was obtained in 'Arka Aadhya' (15.75). It was found to be at par with number of harvests in cv. 'Kamini' (14.25) and 'Shashank' (15.00). On the other hand , minimum number of harvest of loose flower was recorded in 'Phule Ganesh White' (7.25), which was found to be at par with 'Poornima' (8.75).

It is also evident from data that maximum flower diameter (Table 12b, Plate 5) recorded in 'Phule Ganesh Violet' (6.82 cm). It was found to be at par with 'Phule Ganesh Purple' (6.73 cm). In contrast, minimum flower diameter was recorded in 'Shashank' (4.42 cm), which was found to be at par with flower size in 'Kamini' (4.54 cm) and 'Poornima' (4.73 cm).

As regards, number of flowers per plant, it was recorded maximum in 'Arka Archana' (34.35). It was found to be at par with 'Arka Aadhya' (31.90) and 'Phule Ganesh Purple' (33.20). On the other hand , number of flowers per plant was recorded minimum in 'Phule Ganesh White' (19.60) ,which was found to be at par with 'Kamini' (22.20) and 'Phule Ganesh Voilet' (21.80).

Table 12b: Flowering parameters of different China aster cultivars during 2015 -16

Cultivars	Flower diameter (cm)	No. of flowers / plant	Individual flower weight (g)	Flowering duration (days)	Vase life (days)	Shelf life (days)	Weight of flowers per plant (g)
Phule Ganesh Purple	6.73	33.20	5.30	32.05	9.42	5.85	174.42
Phule Ganesh Violet	6.82	21.80	4.33	29.70	8.50	5.38	99.84
Phule Ganesh White	5.46	19.60	4.45	25.65	12.08	6.03	88.25
Phule Ganesh Pink	5.78	27.40	5.05	34.10	8.34	4.58	139.17
Arka Aadhya	5.44	31.90	3.48	41.30	14.08	7.83	111.42
Arka Archana	4.88	34.35	3.63	37.05	14.42	8.30	126.25
Poornima	4.73	29.25	3.55	27.05	9.67	5.55	107.17
Kamini	4.54	22.20	3.98	38.15	8.42	5.18	87.25
Shashank	4.42	31.25	3.25	40.85	8.25	6.38	102.92
Violet Cushion	5.91	24.50	3.58	35.70	7.42	4.45	84.50
$CD_{0.05}$	**0.35**	**2.80**	**0.31**	**3.64**	**0.98**	**0.41**	**4.30**

Data reveals that individual flower weight was obtained maximum in ‘Phule Ganesh Purple’ (5.30 g), which was found to be at par with ‘Phule Ganesh Pink’ (5.05 g). In contrast individual flower weight was recorded minimum in ‘Shashank’ (3.25 g), which was found to be at par with ‘Poornima’ (3.55 g) and ‘Arka Aadhya’ (3.48 g).

As regards duration of flowering, it was observed maximum in ‘Arka Aadhya’ (41.30 days), which was found to be at par with ‘Kamini’ (38.15 days) and ‘Shashank’ (40.85 days). On the other hand minimum duration of flowering was observed in ‘Phule Ganesh White’ (25.65 days), which was found to be at par with ‘Poornima’ (27.05 days).

Data on vase life shows that it was recorded maximum in cut stems of ‘Arka Archana’ (14.42 days), which was found to be at par with ‘Arka Aadhya’ (14.08 days). In contrast, vase life was recorded minimum in cv. ‘Violet Cushion’ (7.42 days), which was found to be at par with Vase life observed in ‘Phule Ganesh Pink’ (8.34 days) and ‘Shashank’ (8.25 days).

Data also shows that maximum shelf life of loose flowers was recorded in cv. ‘Arka Archana’ (8.30 days). On the other hand, shelf life was recorded minimum in loose flowers of cv. ‘Violet Cushion’ (4.45 days). It was found to be at par with shelf life observed in cv. ‘Phule Ganesh Pink’ (4.58 days).

As regards flower weight per plant, it was recorded maximum in 'Phule Ganesh Purple' (174.42 g). In contrast, minimum weight of flowers per plant was recorded in 'Violet Cushion' (84.50 g). It was, however found to be at par with weight of flowers per plant observed in cvs 'Phule Ganesh White' (88.25) and 'Kamini' (87.25 g).

During 2015-16 ten cvs of China aster were evaluated for growth & flowering performance. cv. 'Phule Ganesh Purple' recorded maximum loose flower yield, whereas 'Arka Archana' resulted in maximum shelf life. For cut flower production cvs 'Arka Archana' and 'Arka Adhya' resulted in highest yield and vase life.

III. Crop Management

3.6.1: Studies on staggered planting of carnation for extending flower availability

An experiment on staggered planting of carnation with the objective of flower regulation was conducted in a split plot design using three cultivars namely; 'Dumas', 'Kiro' and 'Master' with seven planting dates form 15th October to 15th April at monthly intervals (Plate 4). Data shown in Table 13a elucidates that minimum number of days to flower bud formation (127.83 days) was observed in 15th January planted crop whereas, number of days to flower bud formation was found maximum in 15th March planted crop (165.94 days). Similarly, number of days to 1st flowering was observed minimum in 15th January planted crop (154.10 days) which was found at par with all other planting dates except for 15th October and November planted crop. Maximum number of days to 1st flowering (195.79 days) was noted in 15th October planted crop which was found at par with 15th November planted crop (181.89 days).

Table 13a: Effect of different planting dates on growth and flowering of carnation

Planting dates	Number of days to flower bud formation	Number of days to 1st flowering	Plant height (cm)	Bud length (mm)	Bud width (mm)	Flower diameter (cm)
15th October	164.80	195.79	81.24	31.92	18.79	6.59
15th November	155.66	181.89	68.58	29.27	19.47	6.99
15th December	148.12	160.50	62.91	28.03	17.72	6.33
15th January	127.83	154.10	75.50	31.98	19.95	6.63
15th February	143.76	169.49	78.62	31.62	19.87	6.99
15th March	165.94	170.49	85.12	40.93	26.59	8.70

15th April	149.16	170.12	86.09	40.46	25.05	8.12
$CD_{0.05}$	9.74	22.62	6.57	4.69	2.62	0.95

Plant height was recorded maximum in 15th April (86.09 cm) planted crop which was found at par with 15th March (85.12 cm) and 15th October (81.24 cm) planted crop whereas, minimum plant height (62.91 cm) was observed in 15th December planted crop and was at par with 15th November planted crop (68.58 cm). Bud length was observed maximum in 15th March planted crop (40.93 mm) which was found at par with 15th April planted crop (40.46 mm) whereas, minimum bud length (28.03 mm) was recorded in 15th December planted crop and was statistically at par with all other planting dates except15th March and 15th April planting. Bud width was observed maximum in 15th March planted crop (26.59 mm) which was found at par with 15th April planted crop (25.05 mm) whereas, minimum bud width (17.72 mm) was recorded in 15th December planted cropand was statistically at par with all other planting dates except15th March and 15th April. Flower diameter (8.70 cm) was observed maximum in 15th March planted crop which was found at par with 15th April planted crop (8.12 cm), whereas minimum flower diameter (6.33 cm) was observed in December planted crop which was statistically at par with all other planting dates except15th March and 15th April.

Table 13b: Effect of different planting dates on growth and flowering of carnation cultivars

Cultivars	Number of days to flower bud formation	Number of days to 1st flowering	Bud length (mm)	Bud width (mm)	Plant height (cm)	Flower diameter (cm)
Dumas	151.82	169.19	33.44	21.36	75.21	7.16
Kiro	150.76	174.10	34.45	21.10	77.61	7.24
Master	149.66	172.00	32.48	20.72	77.75	7.18
$CD_{0.05}$	NS	NS	NS	NS	1.88	NS

Non-significant results were found among different cultivars for the parameters like number of days to flower bud formation, days to flowering, bud length, bud width and flower diameter(Table 13b). However among different cultivars, bud formation and flowering was earliest in cultivar 'Dumas' (151.82 and 169.19 days, respectively) whereas, maximum number of days to flower bud formation was noticed in cultivar 'Master' (149.66 and 172.00 days, respectively). Length of bud was found maximum in cultivar 'Kiro' (34.45 mm) whereas,

minimum bud length was observed in 'Master' (32.48 mm). Maximum bud width (21.36 mm) was noticed in cultivar 'Dumas' whereas, minimum bud width(20.72 mm) was observed in cultivar 'Master'. Height of plants was found maximum in cultivar 'Master' (77.75 cm) which was found to be at par with cultivar 'Kiro' (77.61 cm) whereas, plant height was found minimum in 'Dumas' (75.21 cm). Flower diameter was found maximum in cultivar 'Kiro' (7.24 cm) whereas, minimum flower diameter was found in cultivar 'Master' (7.18 cm)

Data for number of flowers per plant and number of flowers/m^2 were found non-significant(Table13c). However, maximum flowers per plant (4.48) were obtained in 15th October planted crop whereas, minimum flowers per plant (3.77) were recorded in 15th January planted crop. Flowers/m^2 (111.77) were also obtained maximum in 15thOctober planted crop whereas, minimum number of flowers/m^2 (94.24) was observed in 15th January planted crop. Stem thickness (8.85 mm) was found maximum in 15th March planted crop which was found to be at par with 15th April planted crop (8.28 mm).Whereas, 15th January planted crop resulted into minimum thickness of stem (4.65 mm) and was at par with 15th December planted crop (4.89 cm). Stem length was found maximum in 15th April planted crop (81.18) which was found to be at par with 15th March (80.74) and 15th October (75.38) planted cropwhereas, minimum stem length was observed in 15th December (60.03 cm) planted crop which was at par with 15th November planted crop (62.49 cm). Duration of flowering was found maximum in 15th April planted crop (34.34 days) whereas, minimum duration of flowering was obtained in 15th January planted crop (30.54 days) and was at par with all other planting dates except 15th April planted crop. Vase life of flowers was found maximum in 15th March planted crop (14.38 days) whereas, minimum vase life of flowers was found in 15th December planted crop (9.89 days)which was at par with 15th October and 15th November planting dates.

Table 13c: Effect of different planting dates on flowering parameters of carnation cultivars

Planting dates	Number of flowers per plant	Total no. of flowers / m^2	Diameter of flower stem (mm)	Stem length (cm)	Duration of flowering (days)	Vase life (days)
15th October	4.48	111.77	6.07	75.38	32.25	10.42
15th November	4.22	105.63	6.09	62.49	31.96	10.06
15th December	4.05	101.38	4.89	60.03	31.20	9.89
15th January	3.77	94.24	4.65	71.21	30.54	9.94
15th February	4.33	108.44	5.85	74.14	31.41	11.32
15th March	4.26	106.69	8.85	80.74	32.27	14.38
15th April	4.29	107.40	8.28	81.18	34.34	13.55
$CD_{0.05}$	NS	**NS**	0.90	6.49	1.76	0.72

Non significant differences were observed amongdifferent carnation cultivars for parameters like number of flowers/plant, total number of flowers/m^2 and strength of cut flowers, duration of flowering and vase life(Table 13d).However, maximum number of flowers per plant (4.29) was obtained in cultivar 'Kiro' whereas, minimum number of flowers per plant (4.10) was recorded in cultivar 'Dumas'. Total number of flowers/m^2 (107.37) was obtained maximum in cultivar 'Kiro' whereas, minimum number of flowers/m^2 (102.41) was observed in 'Dumas'. Stem thickness (6.50 mm) was found maximum in cultivar 'Master' which was found to be at par with cultivar 'Dumas' (6.41 mm).Whereas, cultivar 'Kiro' resulted into minimum thickness of stem (6.25 mm). Stem length was found maximum in cultivar 'Master' (73.06 cm) which was found to be at par with cultivar 'Kiro' (72.52) whereas, minimum stem length was found in cultivar 'Dumas' (70.92 cm).

Table 13d: Effect of different planting dates on flowering parameters of carnation cultivars

Cultivars	Number of flowers per plant	Total no. of flowers / meter square / annum	Stem thickness (mm)	Stem length (cm)	Duration of flowering (days)	Vase life (cm)
Dumas	4.10	102.41	6.41	70.92	32.24	11.31
Kiro	4.29	107.37	6.25	72.52	32.30	11.37
Master	4.21	105.46	6.50	73.06	31.45	11.41
$CD_{0.05}$	NS	NS	0.20	1.54	NS	NS

Duration of flowering was found maximum in cultivar ‘Kiro’ (32.30 days) whereas, minimum duration of flowering was obtained in cultivar ‘Master’ (31.45 days). Vase life of flowers was found maximum in cultivar ‘Master’ (11.41 days) whereas, minimum vase life of flowers was found in cultivar ‘Kiro’ (11.37 days).

Studies conducted on staggered planting of carnation revealed that flowering can be regulated successfully through staggered planting.

Project No. 3.7.1: Standardization of propagation technology for hybrid lilies

The experiment on standardization of propagation technology through scaling in Lilium was conducted in a three way factorial design with three LA hybrid lily cultivars (‘Batistero’, ‘Courier’ and ‘Jazz It Up’), four auxin treatments (control, NAA 500 ppm, IBA 500 ppm and NAA 500 ppm+ IBA 500 ppm), three growing media (cocopeat, sand + Soil + FYM and perlite + vermiculite) replicated thrice (Plate 5). The data regarding various growth and bulblet parameters is as follows:

Data in Table 14 shows that there was a significant effect of the different media and auxin concentrations on the per cent sprouting of the different LA hybrid lily cultivars. Among different auxin treatments, maximum per cent sprouting (65.56%) recorded with NAA 500 ppm was found to be at par with IBA 500 ppm (65.19%). In contrast, minimum per cent sprouting (46.30%) noted without auxin treatment was found to be at par with NAA 500 ppm + IBA 500 ppm (46.67%). Among different cultivars, maximum percent sprouting was obtained in cultivar ‘Courier’ (57.50 %) and minimum in ‘Batistero’ (53.61 %). Among different media, maximum per cent sprouting was recorded in cocopeat (66.67%) and minimum in sand + soil + FYM(37.78%).

Interaction data of the cultivars and auxin concentrations shows that maximum per cent sprouting was recorded in cultivar ‘Courier’ (75.56%) when NAA 500 ppm was applied to the scales was found to be at par with ‘Jazz It Up’ treated with IBA 500 ppm (74.44%). In contrast, minimum per cent sprouting was recorded in cultivar ‘Batistero’ (37.78%) without auxin treatment.

It is evident from the interaction data of the cultivars and media, that maximum per cent sprouting was recorded in cultivar 'Batistero' (74.17%) with cocopeat. The minimum per cent sprouting was recorded in cultivar 'Batistero' (20.83%) with sand + soil + FYM.

The interactions; auxin concentrations x media and auxin concentrations x media x cultivars were found to be non-significant.

Table 14:Effect of media and auxins on percent sprouting in hybrid lily cultivars during 2015-16

Auxins (conc.ppm)	Cultivars			Mean	Media		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand + Soil + FYM**	**Perlite+ Vermiculite**
Control	37.78 (5.54)	46.67 (6.83)	54.44 (7.41)	**46.30 (6.59)**	54.44 (7.40)	28.89 (4.90)	55.56 (7.48)
NAA -500	64.44 (7.94)	75.56 (8.72)	56.67 (7.53)	**65.56 (8.06)**	80.00 (8.97)	48.89 (6.98)	67.78 (8.24)
IBA - 500	63.33 (7.72)	57.78 (7.62)	74.44 (8.65)	**65.19 (8.00)**	71.11 (8.43)	47.78 (6.77)	76.67 (8.79)
NAA- 500 + IBA-500	48.89 (6.79)	50.00 (7.11)	41.11 (6.02)	**46.67 (6.64)**	61.11 (7.82)	25.56 (4.77)	53.33 (7.33)
Mean	**53.61 (7.00)**	**57.50 (7.57)**	**56.67 (7.40)**	**-**	**66.67 (8.16)**	**37.78 (5.86)**	**63.33 (7.96)**
Cocopeat	74.17 (8.63)	56.67 (7.53)	69.17 (8.31)	**$CD_{0.05}$**	Auxin = 0.53 Media = 0.46 Cultivar = 0.46	Auxin x cultivar = 0.91 Auxin x media = NS Media x cultivar = 0.79	
Sand+Soil+FYM	20.83 (4.25)	50.00 (7.06)	42.50 (6.26)				
Perlite+Vermiculite	65.83 (8.11)	65.83 (8.12)	58.33 (7.65)				

*Figures in parenthesis shows the square root transformed values

Data in Table 15a depicts that there was significant effect of auxin concentrations and media on the number of days taken for sprouting of the different LA hybrid lily cultivars. Among the different auxin treatments, minimum days for sprouting recorded with NAA 500 ppm (66.19 days)whereas, maximum days taken for sproutingwere noted without auxin treatment (98.70 days).Among different cultivars, earliest sprouting were recorded in case of 'Batistero'(77.92 days) and maximum days for sprouting noted in 'Courier' (87.67 days) was found to be at par with 'Jazz It Up'(84.92 days).

Among different media, earliest sprouting recorded in cocopeat (73.36 days) was at par with perlite + vermiculite medium (76.92 days) and maximum days for sprouting days were recorded in sand + soil + FYM(99.22).

Interaction data between auxin concentrations and media depicts that earliest sprouting recorded with NAA 500 ppm (54.00 days) and perlite + vermiculite medium combniation. In contrast, maximum days for sproutingwere recorded without auxin treatment (119.67 days) in sand +soil + FYM. The interactions;auxin concentrations x cultivarsand cultivars x media were found to be non-significant.

Table 15a: Effect of media and auxins on days taken for sprouting in hybrid lily cultivarsduring 2015-16.

Auxins (conc.ppm)	Cultivars			Mean	Media		
	Batistero	Courier	Jazz It Up		Cocopeat	Sand + Soil + FYM	Perlite+ Vermiculite
Control	94.78	102.00	99.33	**98.70**	79.44	119.67	97.00
NAA 500	56.56	76.33	65.67	**66.19**	68.00	76.56	54.00
IBA 500	72.33	81.33	85.00	**79.56**	72.33	97.00	69.33
NAA 500 + IBA 500	88.00	87.00	89.67	**88.22**	73.67	103.67	87.33
Mean	**77.92**	**87.67**	**84.92**	**-**	**73.36**	**99.22**	**76.92**
Cocopeat	66.58	78.25	75.25	**$CD_{0.05}$**	Auxin = 7.31 Media= 6.33 Cultivar =6.33	Auxin x cultivar= NS Auxin x media= 12.66 Media x cultivar= NS	
Sand+Soil+FYM	89.67	103.50	104.50				
Perlite+Vermiculite	77.50	78.25	75.00				

Table 15b depicts the interaction effect of the media and auxin concentrations on the different LA hybrid lily cultivars. Data revealed that LA hybrid lily cultivar ‘Jazz It Up’ (35.00 days) took minimum time for sprouting with NAA 500 ppm auxin treatment and perlite + vermiculite medium combination. In contrast, maximum days for emergence of sprouts from scalesalso observed in cv. ‘Jazz It Up’ (121.00 days) without auxin treatment and sand + soil + FYM combination was found to be at par with ‘Batistero’ (120.00) and ‘Courier’ (118.00) in sand + soil + FYM.

Table 15b: Effect of media and auxin interactions on days taken for sprouting in hybrid lily cultivarsduring 2015-16.

	V_1	V_2	V_3

	M_1	M_2	M_3	M_1	M_2	M_3	M_1	M_2	M_3
T_0	69.33	120.00	95.00	92.00	118.00	96.00	77.00	121.00	100.00
T_1	61.00	46.67	62.00	70.00	94.00	65.00	73.00	89.00	35.00
T_2	67.00	86.00	64.00	75.00	96.00	73.00	75.00	109.00	71.00
T_3	69.00	106.00	89.00	76.00	106.00	79.00	76.00	99.00	94.00

$CD_{0.05}$Auxin concentrationx Cultivars x Media 21.93

Data in Table 16 depicts that there was significant effect of the auxin concentrations and media on the sprout length of the different LA hybrid lily cultivars. Among different auxin treatments, maximum sprout length recorded with NAA 500 ppm treatment (15.83 cm) was found to be at par with IBA 500 ppm treatment(13.33 cm). In contrast, minimum sprout length recorded without auxintreatment (9.72 cm) was found to be at par with NAA 500 ppm + IBA 500 ppm(11.73 cm).

Among different cultivars, maximum sprout length was recorded in cultivar 'Batistero'(16.66 cm). In contrast, minimum sprout length recorded in cultivar 'Jazz It Up' (10.34 cm) was found to be at par with 'Courier'(10.96 cm).

Among different media, maximum sprout length recorded in cocopeat (16.41 cm) was found to be at par with perlite + vermiculite medium (14.09 cm). In contrast, minimum sprout length (7.46 cm) was recorded in sand + soil + FYM.

Table 16:Effect of media and auxins on sprout length in hybrid lily cultivarsduring 2015-16.

Auxins (conc.ppm)	**Cultivars**			**Mean**	**Media**		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand + Soil + FYM**	**Perlite+ Vermiculite**
Control	13.13	8.79	7.24	**9.72**	14.69	3.49	10.97
NAA 500 ppm	20.59	13.92	12.98	**15.83**	18.89	11.61	17.00
IBA 500 ppm	17.08	11.29	10.91	**13.33**	16.49	8.79	14.72
NAA 500 ppm + IBA 500 ppm	15.12	9.85	10.23	**11.73**	15.57	5.96	13.66
Mean	**16.66**	**10.96**	**10.34**	**-**	**16.41**	**7.46**	**14.09**

Cocopeat	18.95	15.90	14.38	**$CD_{0.05}$**	Auxin =2.95 Auxin x cultivar = NS Media =2.56 Auxin x media = NS Cultivar =2.56 Media x cultivar= 4.43
Sand+Soil+FYM	9.51	7.00	5.88		
Perlite+Vermiculite	21.52	9.98	10.76		

It is evident from the interaction data of the cultivars and media, that maximum sprout length recorded in cultivar 'Batistero'(21.52 cm) with perlite + vermiculite medium was found to be at par with'Batistero' (18.95 cm) in cocopeat. In contrast, minimum sprout length recorded in cultivar 'Jazz It Up' (5.88 cm) with sand + soil + FYM was found to be at par with 'Batistero' (9.51 cm) in sand + soil + FYM and 'Courier' (10.76 cm) in perlite + vermiculite.

The interactions; auxin concentrations x cultivars, auxin concentrations x media and auxin concentrations x cultivars x media were found to be non-significant.

Data in Table 17 depicts that there was significant effect of auxin concentrations and media on the number of leaves/scale of the different LA hybrid lily cultivars. Among different auxin treatments, maximum number of leaves/scalerecorded with NAA 500 ppm (2.21).In contrast, minimum number of leaves/scale noted without auxin treatment (1.15).

Among different cultivars, maximum number of leaves/scale was recorded in cultivar 'Batistero'(2.11). In contrast, minimum number of leaves/scale recorded in 'Courier'(1.48) was found to be at par with number of leaves/scale of cv. 'Jazz It Up'(1.49).

Among different media, maximum number of leaves/scalewas recorded in perlite + vermiculite (2.22) andminimum in sand +soil + FYM (1.27).

Interaction data of the auxin concentrations and cultivars shows that maximum number of leaves/scalerecorded in cultivar 'Batistero'(2.90) with NAA 500 ppm treatment was at par with 'Batistero' (2.46) treated with IBA 500 ppm. The minimum number of leaves/scale was recorded in cultivar 'Jazz It Up' (1.11) without auxin treatment was found to be at par with 'Batistero' (1.17), 'Courier' (1.16) without auxin treatment, 'Courier'IBA 500 ppm (1.53) and NAA 500ppm + IBA 500 ppm (1.30), 'Jazz It Up' (91.41) with NAA 500ppm + IBA 500 ppm.

It is evident from the interaction data of the media and cultivars that maximum number of leaves/scale was recorded in cultivar 'Batistero' (3.55)when grown in perlite + vermiculite medium. The minimum number of leaves/scalerecorded in cultivar 'Jazz It Up'(1.18) planted in

sand + soil + FYM was at par with 'Batistero' (1.40) in cocopeat and sand + soil + FYM (1.38),'Courier'(1.25) in sand + soil +FYM and perlite + vermiculite (1.55), 'Jazz It Up' (1.56) in perlite + vermiculite medium.

Table 17: Effect of media and auxins on number of leaves/scalein hybrid lily cultivars during 2015-16

Auxins (conc.ppm)	**Cultivars**			**Mean**	**Media**		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand+Soil +FYM**	**Perlite+ Vermiculite**
Control	1.17	1.16	1.11	**1.15**	1.14	0.74	1.57
NAA 500	2.90	1.93	1.78	**2.21**	2.01	1.66	2.95
IBA 500	2.46	1.53	1.65	**1.88**	1.79	1.38	2.47
NAA 500 + IBA 500	1.90	1.30	1.41	**1.54**	1.43	1.30	1.88
Mean	**2.11**	**1.48**	**1.49**	**-**	**1.59**	**1.27**	**2.22**
Cocopeat	1.40	1.64	1.73	**$CD_{0.05}$**	Auxin =0.27 Auxin x cultivar = 0.47 Media = 0.23 Auxin x media = NS Cultivar =0.23 Media x cultivar = 0.40		
Sand+Soil+FYM	1.38	1.25	1.18				
Perlite+Vermiculite	3.55	1.55	1.56				

The interactions; auxin concentrations x media and auxin concentrations x cultivars x media were found to be non-significant.

Data in Table 18depicts that there was significant effect of the different media and auxin concentrations on the weight of bulblets/scale of the different LA hybrid lily cultivars. Among different auxin treatments, maximum number of bulblets/scale recorded with NAA 500 ppm (2.68). In contrast, minimum number of bulblets/scale noted without auxin treatment (1.16) was found to be at par with NAA 500 ppm + IBA 500 ppm(1.53).

Among different cultivars, maximum number of bulblets/scale recorded in cultivar 'Jazz It Up' (2.53) and the minimum in 'Batistero' (0.98).

Among different media, maximum number of bulblets/scale recorded in cocopeat (2.67) and minimum in sand + soil + FYM (1.05).

It is evident from the interaction data of the cultivars and media, that maximum number of bulblets/scale recorded in cultivar 'Jazz It Up' (4.12) when planted in cocopeat. The minimum number of bulblets/scale recorded in cultivar 'Batistero' (0.06) when planted in sand +soil + FYM.

Table 18: Effect of media and auxins on number of bulblets/scale in hybrid lily cultivars during 2015-16

Auxins (conc.ppm)	**Cultivars**			**Mean**	**Media**		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand +Soil +FYM**	**Perlite+ Vermiculite**
Control	0.61	1.40	1.47	**1.16**	1.80	0.45	1.22
NAA 500	1.51	2.64	3.89	**2.68**	4.00	1.67	2.38
IBA 500	1.08	1.82	2.67	**1.86**	2.71	1.15	1.71
NAA 500 + IBA 500	0.72	1.76	2.11	**1.53**	2.18	0.92	1.49
Mean	**0.98**	**1.91**	**2.53**	**-**	**2.67**	**1.05**	**1.70**
Cocopeat	2.07	1.83	4.12	**$CD_{0.05}$**	Auxin =0.41 Auxin x cultivar =NS Media =0.36 Auxin x media =NS Cultivar=0.36 Media x cultivar =0.62		
Sand+Soil+FYM	0.06	1.28	1.80				
Perlite+Vermiculite	0.82	2.60	1.68				

The interactions;auxin concentrations x cultivar, auxin concentrations x media and auxin concentrations x cultivars x media were found to be non-significant.

Data in Table 19 depicts that there was significant effect of the different media and auxin concentrations on the weight of bulblets/scale of the different LA hybrid lily cultivars. Among different auxin treatments, maximum weight of bulblets/scale recorded with NAA 500 ppm (0.57g) was found to be at par with IBA 500 ppm (0.49g). In contrast, minimum weight of bulblets/scale recorded without auxin treatment (0.34g) was at par with NAA 500 ppm + IBA 500 ppm (0.40g).

Among different cultivars, maximum weight of bulblets/scale was recorded in cultivar 'Batistero' (0.51g) and minimum in 'Jazz It Up' (0.40g) was found to be at par with 'Courier'(0.44g).

Among different media, maximum weight of bulblets/scale recorded in perlite + vermiculite(0.68g) and minimum in sand + soil + FYM(0.22g).

It is evident from the interaction data of the cultivars and media, that maximum weight of bulblets/scale (0.99g) was recorded in cultivar 'Batistero' when planted in perlite + vermiculite.Minimum weight of bulblets/scale (0.07g) was recorded in cultivar 'Batistero' when planted in sand + soil + FYM.

Table 19: Effect of media and auxins on weight of bulblets/scale in hybrid lily cultivars during 2015-16

Auxins (conc.ppm)	**Cultivars**			**Mean**	**Media**		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand + Soil + FYM**	**Perlite+ Vermiculite**
Control	0.38	0.34	0.30	**0.34**	0.35	0.12	0.55
NAA -500	0.68	0.55	0.49	**0.57**	0.60	0.31	0.82
IBA - 500	0.57	0.47	0.43	**0.49**	0.52	0.22	0.73
NAA- 500 + IBA-500	0.41	0.40	0.38	**0.40**	0.38	0.20	0.61
Mean	**0.51**	**0.44**	**0.40**	**-**	**0.46**	**0.22**	**0.68**
Cocopeat	0.47	0.47	0.44	**$CD_{0.05}$**	Auxin =0.09 Auxin x cultivar =NS		
Sand+Soil+FYM	0.07	0.37	0.21		Media =0.07 Auxin x media =NS		
Perlite+Vermiculite	0.99	0.48	0.56		Cultivar =0.07 Media x cultivar =0.13		

The interactions;auxin concentrations x cultivar,auxin concentrations x media and auxin concentrations x cultivars x media were found to be non-significant.

Data in Table 20 depicts that there was significant effect of the different media and growth regulators on the bulblet circumference of different LA hybrid lily cultivars. Among different auxin treatments, maximum bulblet circumference recorded with NAA 500 ppm (9.42

mm). In contrast, minimum bulblet circumference noted without auxin treatment(6.78 mm) was at par with NAA 500 ppm + IBA 500 ppm (7.43 mm).

Among different cultivars, maximum bulblet circumference was recorded in cultivar 'Courier'(8.60 mm) was at par with cultivar 'Jazz It Up'(8.39 mm) and minimum in 'Batistero'(6.93 mm).

Among different media, maximum bulblet circumference recorded in perlite + vermiculite (9.86 mm) and minimum in sand + soil + FYM(5.18 mm).

It is evident from the interaction data of the cultivars and media, maximum bulblet circumference recorded in cultivar 'Batistero' (10.50 mm) when planted in perlite + vermiculite was at par with 'Jazz It Up' planted in perlite + vermiculite (9.97 mm). Minimum bulblet circumference recorded in cultivar 'Batistero' (1.65 mm) planted in sand + soil + FYM.

Table 20: Effect of media and auxins on bulblet circumference in hybrid lily cultivars during 2015-16

Auxins (conc.ppm)	**Cultivars**			**Mean**	**Media**		
	Batistero	**Courier**	**Jazz It Up**		**Cocopeat**	**Sand +Soil + FYM**	**Perlite+ Vermiculite**
Control	5.66	7.74	6.94	**6.78**	7.82	3.43	9.09
NAA 500	9.02	9.68	9.56	**9.42**	10.25	7.33	10.68
IBA 500	6.88	8.88	8.99	**8.25**	9.16	5.35	10.24
NAA 500 + IBA 500	6.15	8.09	8.06	**7.43**	8.25	4.60	9.45
Mean	**6.93**	**8.60**	**8.39**	**-**	**8.87**	**5.18**	**9.86**
Cocopeat	8.63	9.21	8.77	**$CD_{0.05}$**	Auxin= 0.85 Auxin x cultivar = NS Media = 0.73 Auxin x media = NS Cultivar = 0.73 Media x cultivar = 1.27		
Sand+Soil+FYM	1.65	7.46	6.43				
Perlite+Vermiculite	10.50	9.12	9.97				

The interactions; auxin concentrations x cultivars, auxin concentrations x media and auxin concentrations xcultivars x media were found to be non significant.

Propagation studies on LA hybrid lilies shows that maximum number of bulblets/scale was obtained in cv. 'Jazz It Up'. Treatment of scales with NAA 500 ppm resulted in production

of maximum number of bulblets/scale. For multiplication of Lilium through scales cocopeat was found to be best medium.

Project No. 3.7.2: Standardization of growing media for Lilium

This experiment was conducted on LA hybrid cultivars 'Batistero' and 'Courier'(Plate 6a). The uniform sized bulbs were planted in seven growing media i.e. M_1-Sand+Soil+FYM, (1:1:1, v/v), M_2-Sand+Soil+FYM (2:1:1, v/v), M_3-Cocopeat+FYM (1:1, v/v), M_4-Cocopeat+Soil+FYM (1:1:1, v/v), M_5-M_1+Cocopeat (1:1, v/v),M_6- M_1+Vermicompost (2:1, v/v) and M_7- M_1+ Vermicompost + Cocopeat (2:1:1, v/v).

The observations on various growth, flowering and bulb parameters were recorded and presented in Tables 21a-21 e (Plate 6a).

Data in Table 21 a shows that bulbs of cultivar 'Batistero' sprouted earlier (28.94 days) as compared to 'Courier' (29.25 days). Among different growing media, earliest sprouting (27.31 days) was observed when bulbs were planted in growing medium M_7 i.e. [M_1 + Vermicompost + Cocopeat (2:1:1, v/v)]. On the other hand, maximum delay in sprouting (30.32 days) was found when bulbs were planted in M_1 [Sand + Soil + FYM (1:1:1, v/v)]. It is also evident from the interaction data that bulbs of cv. 'Batistero' sprouted at the earliest (26.33 days) when planted in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. In contrast, maximum days for sprouting (30.75 days) were recorded in bulbs of cv. 'Batistero' planted in M_1 [Sand + Soil + FYM (1:1:1, v/v)].

Data also shows that more plant height was recorded in cv. 'Batistero' (92.02 cm) as compared to 'Courier' (83.14 cm). Among different growing media, maximum plant height (89.24 cm) was observed when bulbs of lilium were planted in M_1 [Sand + Soil + FYM (1:1:1, v/v)] which was found to be at par with plant height recorded in M_2 (87.74 cm), M_3 (87.73 cm), M_4 (88.64 cm) and M_7 (87.31 cm). On the other hand minimum plant height (85.80 cm) was observed when lilium bulbs were grown in M_5 [M_1 + Cocopeat (1:1, v/v)]. Interaction between Cultivar x Growing media shows that maximum plant height (93.85 cm) was recorded when bulbs of LA hybrid 'Batistero' were grown in M_1 [Sand + Soil + FYM (1:1:1, v/v)]. It was, however, found to be at par with bulbs of cv. 'Batistero' grown in all the media except M_2. In

contrast, minimum plant height (80.24 cm) was observed when bulbs of cv. 'Courier' were grown in M_5 [(Sand + Soil + FYM) + Cocopeat (1:1, v/v)].

Cultivars showed significant difference among them for number of leaves per plant also. More number of leavesperplant were recorded in cultivar 'Courier' (42.09) as compared to 'Batistero' (40.10). Number of leaves per plant were significantly affected by different growing media. Maximum number of leaves per plant (46.10) was observed in plants grown on M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. It was, however, found to be at par with bulbs which were grown in M_6 (45.69). On the other hand, minimum number of leaves per plant (35.57) were recorded when bulbs were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)].

Interaction data shows that maximum number of leaves per plant (47.76) was recorded when bulbs of cv. 'Courier' were grown in M_7 [M1 +Vermicompost + Cocopeat (2:1:1;v/v)]. It was, however, found to be at par when bulbs of cv. 'Courier' were grown in, M_6 (47.25). In contrast, minimum number of leaves (33.66) was observed when cv. 'Batistero' was grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)].

Data in Table 21a also shows that flower buds of cv. 'Courier' took less time to show colour (121.20 days) as compared to cv. 'Batistero' (122.20 days). Among different growing media, earliest coloured buds (116.72 days) were observed when bulbs were planted in M_7 i.e. growing medium containing M_1+ Vermicompost + Cocopeat (2:1:1, v/v). In contrast, it was delayed to maximum (124.68 days) when bulbs were grown in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)]. It is also evident also from the interaction data that minimum number of days for basal bud to show colour was observed in cv. 'Courier' (115.43 days) when grown in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. On the other hand, maximum days for lower most bud to show colour were taken by bulbs of cv. 'Batistero' (124.75 days) grown in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)].

It is evident from data that bulbs of cv. 'Courier' took less time for flowering (123.94 days) as compared to 'Batistero' (125.42 days). Earliest flowering (123.94 days) was observed when bulbs were planted in growing medium M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)] (Table 1b). It was found to be statistically at par with number of days to flowering observed when bulbs were grown in M_1 (125.17 days), M_2 (124.00 days), M_5(124.67 days)andM_6 (125.30 days). In contrast, maximum delay in flowering (126.52 days) was found when bulbs were grown in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)]. It is clear from the interaction between Cultivar x Growing media that earliest flowering (119.83 days) was recorded in cv. 'Courier'

when grown in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. It was, however, found to be at par with bulbs of 'Courier' grown in M_5 (122.00 days). On the other hand, maximum days taken to flowering were recorded in bulbs of cv. 'Batistero' grown in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)] and M_5[M_1+Cocopeat (1:1, v/v)] (127.53days).

As regards stem length (Table 21 b), it was recorded more in case of 'Batistero' (71.71cm) than 'Courier' (63.74 cm). Maximum stem length (68.82 cm) recorded in M_2 [Sand+Soil+FYM (2:1:1, v/v)] found to be at par noted in M_1 (68.35 cm), M_4 (68.38 cm) and M_7 (68.66 cm). In contrast, minimum stem length (66.32 cm) was observed when bulbs were grown in M_3 [Cocopeat+FYM (1:1, v/v)]. Interaction data shows that maximum stem length (73.62 cm) was found when bulbs of LA hybrid 'Batistero' were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. It was, however, found to be statistically at par with stem length obtained when bulbs of cv. 'Batistero' were grown in M_6(72.66 cm). On the other hand, minimum stem length was recorded when bulbs of cv. 'Courier' (60.91 cm) were planted in medium M_5 [M_1+Cocopeat (1:1, v/v)].

Data also reveals that heavier cut stems were obtained in cv. 'Batistero' (82.23 g) as compared to cv. 'Courier' (50.98 g) (Table 1b). Among growing media, maximum weight of cut stem (73.40 g) was observed in M_6 [M_1+Vermicompost (2:1, v/v)]. It was, however, found to be at par with weight of cut stems obtained when bulbs were grown in M_7 (73.04 g). However, minimum weight of stem (60.10 g) was recorded when Lilium bulbs were planted in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)].

As regards number of flowersperspike, it was recorded more in 'Courier' (4.57) as compared to 'Batistero' (4.20). Maximum flowers per spike (5.59) were observed in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. On the other hand, minimum flowers per spike (3.53) were observed in M_1 [Sand+Soil+FYM (1:1:1, v/v)].

Flower buds having more length were observed in cv. 'Batistero' (12.82 cm) as compared to cv. 'Courier' (9.65 cm) (Table 21c). Among different growing media, maximum bud length (13.94 cm) was observed when bulbs were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. In contrast, minimum bud length (9.95 cm) was found when bulbs were planted in M_3 [Cocopeat+FYM (1:1, v/v)]. Interaction effect of cultivars with growing media shows that maximum bud length (15.32 cm) was observed in 'Batistero' when grown in M_1 i.e.

[Sand+Soil+FYM (1:1:1, v/v)]. In contrast, minimum bud length (8.03 cm) was observed when plants of cv. 'Courier' was grown in M_3 [Cocopeat+FYM (1:1, v/v)].

Data presented in Table 21c shows that larger sized flowers were observed in cv. 'Batistero' (16.15 cm in diameter) as compared to cv. 'Courier' (15.47 cm in diameter). Among different growing media, maximum size of flower (17.64 cm in diameter) was observed in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. In contrast, size of flower was recorded minimum (14.00 cm) when bulbs were grown in M_3 [Cocopeat+FYM (1:1, v/v)]. Interaction between Cultivar x Growing media shows that maximum size of flower (18.12 cm) was obtained when bulbs of cv. 'Batistero' were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)] which was found to be at par with flower size recorded in cv. 'Batistero' planted in M_2 (17.90 cm). In contrast, minimum flower size (13.83 cm) was observed when cv. 'Courier' was grown inM_4 [Cocopeat+Soil+FYM (1:1:1, v/v)] and cv. 'Batistero' (13.83 cm) in M_3 [Cocopeat+FYM (1:1, v/v)] andM_6 [M_1+Vermicompost (2:1, v/v)].

Data also shows that duration of flowering (Table 21c) was recorded more in case of 'Courier' (28.72 days) as compared to 'Batistero' (26.38 days). Among different growing media, maximum duration of flowering (32.00 days) was observed in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1; v/v)]. In contrast, minimum duration of flowering (24.50 days) was recorded when Lilium cultivars were planted in M_4 i.e. [Cocopeat + Soil + FYM (1:1:1;v/v)]. Interaction between Cultivar x Growing media shows that maximum duration of flowering (32.00 days) was found in both cvs, 'Courier' and 'Batistero', when bulbs were grown in M_7 [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. It was, however, found to be at par with flowering duration observed when bulbs of both the cultivars planted in M_6 (30.67 days). However, minimum duration of flowering was observed when cv. 'Batistero' (21.33 days) was grown in M_3 [Cocopeat+FYM (1:1, v/v)].

Data also reveals that vase life of cut stems (Table 21c) was recorded more in cv. 'Batistero' (12.88 days) as compared to cv. 'Courier' (11.93 days). Among different growing media, maximum vase life (15.33 days) was observed in cut stems when bulbs were grown in M_7 i.e. [M_1+ Vermicompost + Cocopeat (2:1:1, v/v)]. It was, however, found to be at par with bulbs grown in, M_6(14.25). In contrast, minimum vase life (10.50 days) of cut stems was recorded when bulbs were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)].

As regards number of bulbs/plant (Table 21d), it was recorded more in cv. 'Courier' (1.05) as compared to cv. 'Batistero' (1.04). Number of bulbs/plant were significantly affected by different growing media. Maximum number of bulbs/plant (1.14) was observed when bulbs were planted in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. It was, however, found to be at par with number of bulbs/plant recorded when bulbs were grown inM_2. In contrast, number of bulbs/plant were recorded minimum (1.00) when bulbs were planted in M_4 Cocopeat+Soil+FYM (1:1:1, v/v). As regards bulb diameter (Table 21d), larger sized bulbs were obtained in case of 'Batistero' (4.75 cm in diameter) as compared to 'Courier' (4.31cm). Among different growing media, maximum bulb diameter (5.19 cm) was observed in M_1 [Sand+Soil+FYM (1:1:1,v/v)]. It was, however, found to be at par with bulb diameter recorded when Lilium bulbs were planted in M_2 (5.08 cm), M_5 (4.73 cm), M_6(4.46 cm)andM_7 (4.73 cm). On the other hand, minimum bulb diameter (3.67 cm) was recorded when Lilium cultivars were grown in M_3 [Cocopeat+FYM (1:1, v/v)].

Data reveals, weight of bulb per plant (Table 21d) recorded more in cv. 'Batistero' (45.88 g) as compared to 'Courier' (34.36 g). Among different growing media, maximum weight of bulb (45.91g) was observed in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. It was however, found to be at par when bulbs were grown in M_2 (44.06 g) andM_7 (44.59 g). On the other hand, minimum weight of bulb (33.15 g) was recorded when bulbs of Lilium cultivars were planted in M_3 [Cocopeat+FYM (1:1, v/v)]. Interaction between Cultivar x Growing media shows that maximum bulb weight (52.86 g) was observed when bulbs of cv. 'Batistero' were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. It was, however, found to be at par with weight of bulb recorded when bulbs of cv. 'Batistero' were planted in M_2 (50.50 g). On the other hand, weight of bulb was recorded minimum (26.02 g) in cv. 'Courier' grown inM_3 [Cocopeat+FYM (1:1, v/v)].

Observations on bulblet parameters; number of bulblets/plant, bulblet diameter and weight of bulblets per plant are presented in Table 21e. As regards number of bulblets/plant, it was recorded more in cv. 'Courier' (1.56) as compared to 'Batistero' (0.87). Among different growing media, maximum number of bulblets/plant (2.13) were observed in M_1 [Sand+Soil+FYM (1:1:1, v/v] which was found to be at par when bulbs were grown in, M_2 (1.64) [Sand+Soil+FYM (2:1:1, v/v)]. In contrast, minimum number of bulblets/plant (0.45) were recorded in M_3 [Cocopeat+FYM (1:1, v/v)].

As regards bulblet diameter , it was recorded more in cultivar 'Batistero' (1.58 cm in diameter) as compared to 'Courier' (1.09 cm). Effect of different growing media on bulblet

diameter was found to be non-significant. Interaction between Cultivar x Growing media shows that maximum bulblet diameter (2.48 cm) was found when bulbs of 'Batistero' were grown in M_1 [Sand+Soil+FYM (1:1:1, v/v)]. It was, however, found to be at par with bulbs of same cultivar grown inM_2 (1.96 cm), M_5 (1.75 cm) and M_7 (1.71 cm). In contrast, minimum bulblet diameter (0.55 cm) was observed when 'Batistero' was grown in M_4 [Cocopeat+Soil+FYM (1:1:1, v/v)].

Data also reveals that weight of bulblets was recorded more in 'Courier' (3.42 g) as compared to 'Batistero' (2.25 g). Among different growing media, maximum weight of bulblets (4.35 g) was observed when bulbs of Lilium cultivars were planted in M_1 [Sand+Soil+FYM (1:1:1, v/v)] which was found to be at par with weight of bulblets observed when bulbs were grown inM_2 (1.61 g). In contrast, weight of bulblets was observed minimum (1.58 g) in M_3 [Cocopeat+FYM (1:1, v/v)].

In Lilium LA hybrids, for obtaining earliest flowering, more number of flowers/spike, better stem length and vase life, growing of bulbs in a medium containing [Sand+Soil+FYM (1:1:1, v/v) + (Vermicompost + Cocopeat)] (2:1:1, v/v) is recommended. However, for bulb/bulbet multiplication growing of LA hybrids in medium containingSand+Soil+FYM (1:1:1, v/v) is recommended.

Project No. 3.8.1: Standardization of growing media for alstroemeria

During 2015-16, growth and flowering performance of alstroemeria cv. 'Capri' was studied in different growing media (Plate 6b). Perusal of data presented in Table 22a. shows that maximum plant height (125.56 cm) was observed in a growing medium consisting of Cocopeat + FYM (1:1; v/v) i.e. T_5. This medium was found to be at par with all other media except for plants growing in T_4 (115.00 cm)and T_6(110.45 cm). Data in Table also shows that maximum number of stems per plant (45.75) was observed in growing medium consisting of Sand + Soil + FYM(1:1:1;v/v) + Vermicompost + Cocopeat(2:1:1; v/v) i.e. T_9which was found to be at par with growing medium consisting Cocopeat + Soil + FYM (1:1:1; v/v) i.e. T_6 (44.64). Minimum number of stems per plant was recorded in growing medium consisting of Sand+ Soil + FYM (2:1:2; v/v)i.e. T_4(33.67).Data shows that maximum number of flowering stems per plant (31.27) was observed in growing medium consisting of Sand+ Soil + FYM (1:1:1;v/v) + Vermicompost + Cocopeat (2:1:1; v/v) i.e. T_9which was found to be at par with growing media

i.e. T_1 (25.64) and T_6(24.80). Minimum number of stems per plant was recorded in growing mediumconsisting of Sand+ Soil + FYM(2:1:2; v/v)i.e. T_4(17.30). Data shows that maximum stem thickness (6.73 mm) was observedin growing mediumconsisting of Sand+ Soil + FYM(2:1:2; v/v)i.e. T_4. Minimum stem thickness was recorded in growing mediumconsisting of Sand+ Soil + FYM(1:1:2; v/v)i.e. T_3(6.28 mm).

Table 22a: Growth and flowering performance of alstroemeria cv. 'Capri'under different growing media

Growing media	Plant height (cm)	Number of stems/plant	Number of flowering stems per plant	Stem thickness (mm)	Days taken to bud formation	Days taken to flowering	Length of cut stem (cm)
T_1- Sand+ Soil+ FYM(1:1:1; v/v)	120.00	38.34	25.64	6.57	170.67	174.67	95.86
T_2- Sand+ Soil+ FYM(2:1:1; v/v)	118.63	35.03	17.67	6.36	179.00	183.67	95.70
T_3- Sand+ Soil+ FYM(1:1:2; v/v)	119.42	35.28	21.14	6.28	175.67	180.67	100.28
T_4- Sand+ Soil+ FYM(2:1:2; v/v)	115.00	33.67	17.30	6.73	180.00	186.00	91.50
T_5- Cocopeat+ FYM(1:1; v/v)	125.56	34.11	21.56	6.35	174.67	179.00	102.34
T_6- Cocopeat+ Soil+ FYM(1:1:1; v/v)	110.45	44.64	24.80	6.36	168.67	173.33	92.17
T_7- T_1+ Cocopeat(1:1; v/v)	124.18	37.75	24.00	6.30	171.00	175.00	99.36
T_8- T_1+ Vermicompost(2:1; v/v)	119.56	39.42	20.72	6.51	173.00	176.67	98.30
T_9- T_1 + Vermicompost+Cocopeat(2:1:1; (v/v)	124.24	45.75	31.27	6.46	165.00	168.67	104.42
CD $_{0.05}$	8.34	2.84	6.77	NS	2.47	2.94	3.47

Data in Table 22a shows that minimum number of days taken to bud formation (165.00 days) was recorded in growing medium consisting of Sand+ Soil + FYM(1:1:1; v/v) + Vermicompost + Cocopeat(2:1:1; v/v)i.e. T_9. Maximum number of days taken to bud formation was observed in growing mediumconsisting of Sand+ Soil + FYM(2:1:2; v/v)i.e. T_4(180.00 days). Minimum number of days taken to flowering (168.67 days) was recorded in growing medium consisting of Sand+ Soil + FYM(1:1:1;v/v) + Vermicompost + Cocopeat(2:1:1; v/v)i.e. T_9. Maximum number of days taken to flowering was observed in growing mediumconsisting of Sand + Soil + FYM (2:1:2; v/v)i.e. T_4(186.00 days). Data also shows that maximum length of cut stem (104.42 cm) was observed in growing mediumconsisting of Sand+ Soil + FYM (1:1:1; v/v) + Vermicompost + Cocopeat (2:1:1; v/v) i.e. T_9which was found to be at par with growing medium consisting Cocopeat + FYM (1:1; v/v) i.e. T_5 (102.34). Minimum length of cut stem was recorded in growing mediumconsisting of Sand+ Soil + FYM (2:1:2; v/v) i.e. T_4(91.50 cm).

Data also shows that maximum number of florets per stem (16.53) was observed in growing mediumconsisting of Sand+ Soil + FYM(1:1:2; v/v)i.e. T_3(Table 22b). Minimum number of florets per stem was recorded in growing mediumconsisting of Sand+ Soil + FYM(1:1:1;v/v) + Vermicompost + Cocopeat(2:1:1; v/v)i.e. T_9 (14.01). Data in Table 22b shows that maximum size of floret (5.79 cm) was observed in growing mediumconsisting of Sand+ Soil + FYM(2:1:2; v/v)i.e. T_4. Minimum size of floret (5.60 cm) was recorded in growing media T_6 and T_7.

Data shows that maximum duration of flowering (150.67 days) was observed in growing mediumconsisting of Sand+ Soil + FYM(1:1:1;v/v) + Vermicompost + Cocopeat(2:1:1; v/v)i.e. T_9. Minimum duration of flowering was recorded in growing mediumconsisting of Sand+ Soil + FYM(2:1:1; v/v)i.e. T_2(128.00 days). Data shows that maximum weight of cut stem (62.18 g) was observed in growing medium consisting of Sand+ Soil + FYM(1:1:1; v/v) + Vermicompost + Cocopeat(2:1:1; v/v)i.e. T_9. Minimum weight of cut stem was recorded in growing mediumconsisting of Sand+ Soil + FYM(2:1:2; v/v)i.e. T_4(49.04 g).

Data shows that maximum vase- life of flowers in distilled water (14.20 days) was observed in growing mediumconsisting of Sand + Soil + FYM (1:1:2; v/v)i.e. T_3. This mediumwas found to be at par with all other media except for plants growing in T_7(13.07 days), T_1 (13.00 days), T_6(12.80 days) and T_5 (12.67 days). Data also shows that maximum weight of

Table 22b: Growth and flowering performance of alstroemeria

Growing media	Number of florets per stem	Size of floret (cm)	Duration of flowering (days)	Weight of cut stem (g)	Vase life (days)	Weight of rhizome cluster per plant (g)
T_1- Sand+ Soil+ FYM(1:1:1; v/v)	15.17	5.70	141.67	53.84	13.00	612.10
T_2- Sand+ Soil+ FYM(2:1:1; v/v)	15.02	5.77	128.00	52.24	14.00	341.89
T_3- Sand+ Soil+ FYM(1:1:2; v/v)	16.53	5.76	137.00	53.22	14.20	591.73
T_4- Sand+ Soil+ FYM(2:1:2; v/v)	14.92	5.79	134.67	49.04	13.40	544.85
T_5- Cocopeat+ FYM(1:1; v/v)	15.46	5.63	132.67	51.08	12.67	913.87
T_6- Cocopeat+ Soil+ FYM(1:1:1; v/v)	14.23	5.60	146.00	58.08	12.80	631.36
T_7- T_1+ Cocopeat(1:1; v/v)	15.36	5.60	144.33	53.75	13.07	879.54
T_8- T_1+ Vermicompost(2:1; v/v)	15.11	5.72	143.67	58.55	13.60	532.14
T_9- T_1 + Vermicompost+Cocopeat(2:1:1; (v/v)	14.01	5.65	150.67	62.18	13.33	835.63
CD $_{0.05}$	NS	NS	3.26	2.00	0.98	156.65

rhizome cluster per plant (913.87g) was observed in growing medium consisting of Cocopeat + FYM(1:1; v/v) i.e.T_5which was found at par with growing media T_7 (879.54 g) and T_9(835.63 g). Minimum weight of rhizome cluster per plant was recorded in growing mediumconsisting of Sand+ Soil + FYM(2:1:1; v/v)i.e. T_2(341.89 g).

Standardization of growing mediumfor growth and flowering performance of alstroemeria cv. 'Capri', revealed thatSand+ Soil + FYM(1:1:1; v/v) + Vermicompost + Cocopeat (2:1:1; v/v)i.e.$T_9$was found best for number of stems per plant, number of flowering stems per plant, number of days taken to bud formation, number of days taken to flowering, length of cut stem, duration of flowering and weight of cut stem.

IV. Postharvest Technology and Value Addition

Project No. 5.1.: Standardization of postharvest technology of carnation cut flowers.

Experiment 5.1.3: Studies on effect of storage of holding stock solutions of carnation on their efficacy.

For carrying out the experiments on post harvest handling in carnation, stock solutions, both holding and pulsing, are being prepared and stored under refrigerated and normal room temperature for further use to test their effectiveness.

Project No. 5.4.1: Identification of ornamental species for preparation of value -added dried Products

Under this experiment, various types of native and cultivated crops/ ornamental plants were explored for preparation of different value-added products. Among wild materials; *Anaphalis margaritacea, Celosia argentea, Helianthus angustifolius, Phonix sylvestris Verbascum thapsus* and among cultivated plants; *Sesamum indicum, Sorghum bicolor, Pennisetum* sp, *Linum utilissimum*, *Koelreuteria paniculata* were found suitable and details pertaining to these plants have been summarized in Table 23 , various types of value- added products were prepared from the material (Plate 7).

Table 23. Description of plant material found suitable for drying

S. No.	Name of the plant	Plant type	Plant part used	Drying method	Value –added products prepared
1.	*Anaphalis margaritacea*	Herbaceous perennial	Flower heads	Air drying	Flower arrangements, bouquets, hangers
2.	*Celosia argentea*	Herbaceous perennial	Inflorescence	Air drying	Flower arrangements
3.	*Helianthus angustifolius*	Annual	Seed head	Natural drying	Dry flower sticks, pot-pourri
4.	*Phonix sylvestris*	Palm	Leaves	Shade drying	Dry flower sticks
5.	*Verbascum thapsus*	Annual	Fruit capsules	Natural drying	Dry flower sticks
6.	*Koelreuteria paniculata*	Tree	Fruit	Shade drying	Pot-pourri, Dry flower sticks
7.	*Linum utilissimum*	Annual	Fruit capsules	Air drying	Flower arrangements
8.	*Pennisetum* sp	Annual	Panicle	Air drying	Flower arrangements,
9.	*Sesamum indicum*	Annual	Fruit capsules	Natural drying	Flower arrangements
10.	*Sorghum bicolor*	Annual	Fruit	Air drying	Flower arrangements, hangers

Project No. 5.5.1: Standardisation of glycerinization for increasing shelf life of cut foliages

For glycerinization studies, cut foliages like; *Euonymous japonicus*, *Ruscus hypoglossus*, *Grevillea robusta*, *Aglaonema modestum*, *Buxus sempervirens*, *Araucaria cookii*, *Podocarpus* (Plate 11)were taken and glycerine drying was done by uptake method (Control, 10% , 20% and 40% solution of glycerine). Preliminary studies indicated that all the cut-foliages responded well to glycerine and were elastic and glossy in appearance. However, colour change in all the foliages with glycerine drying was noted, but when such foliages were dyed in Brilliant Green dye; the leaves absorbed the colour very uniformly and were acceptable for making value-added products (Plate 8).

In another study *Polystichum squarrosum* (Pahadi patti), a leathery green native fern was utilized for glycerinization studies. Two methods of glycerine drying i.e. full dip method and uptake method along with four treatments (control, 10%, 20% and 40% solution of glycerine) were tested in a randomized factorial design. It was found that drying of leaves in

20% and 40% solution of glycerine resulted in acceptable products with glabrous, elastic and non- brittle leaves with smooth texture. Leaves in dip method (control and 10 % solution of glycerine) were found rotten. However, comparison of methods for better results need a series of experimentation which will be carried out during 2016-17.

Publications:

- Singh A, Sharma BP, Dilta BS, Laishram N, Gupta YC and Bhardwaj SK. 2015. Influence of NPK fertigation and foliar application on flower quality media physic-chemical properties and foliar nutrient content in carnation (*Dianthus caryophyllus L.*) cv. 'Master'. *Indian Journal of Agricultural sciences***85**(11): 85-89.
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- Banswal AK, Dilta BS, Sharma BP, Baweja HS and Gupta YC. 2015. Effect of size, growing substrates and paclobutrazol doses in potted chincherinchee (*Ornithogalum thyrsoides* Jacq.) *Indian Journal of Horticulture***72** (2): 257-261.
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- Lyngdoh A, Gupta YC, Dhiman SR, Dilta BS and Kashyap Bharati. 2015. Effect of substrates on the propagation of hybrid lilies through scaling. *Journal of Hill Agriculture***6**(2):158-162
- Dogra N, Bhalla R and Kashyap B. 2015. Effect of paclobutrazol and B-nine on morphological development of *Primula malacoides* Franch. *International Journal of Farm Sciences***5**(4): 181-185

Symposium / Workshop Attended

- Dr YC Gupta and Dr Puja Sharma attended "**National Conference on Floriculture and Landscaping for Urban & Rural Prosperity**" organized by Division of Floriculture & Landscaping, IARI, New Delhi on 28-29th February, 2016.
- Dr SR Dhiman and Dr Bharti Kashyap attended **"XXIV Annual Group Meeting of AICRP on Floriculture"** at SKUAST, Srinagar from 17-19 April, 2015
- Dr Bharti Kashyap attended and delivered a lecture on value-addition on dry flowers through various techniques in one day workshop on dried flowers, organized by, APEDA, New Delhi at Calcutta on 16th Nov, 2015.

Awards/ Recognitions

- Dr YC Gupta delivered a lead lecture on **"Problems and Prospects of hill floriculture"** and adjudged as best speaker of the session during Silver Jubilee

"**National Conference on Floriculture and Landscaping for Urban & Rural Prosperity**" organized by Division of Floriculture & Landscaping, IARI, New Delhi on 28-29th February,2016.

- Dr Puja Sharma was awarded first prize in oral presentation on reserch entitled '*In vitro* mutagenesis in carnation for the development of new varieties' *during*' **Silver JubileeNational Conference on Floriculture and Landscaping for Urban & Rural Prosperity'**organized by Division of Floriculture & Landscaping, IARI, New Delhi on 28-29th February,2016.