About the Institute

The All India Coordinated Research Project (AICRP) on Floriculture was established in the year 1970-71 of the IV Five Year Plan (FYP) to carry out the nationwide interdisciplinary research on floriculture. Further, during the XI FYP it was upgraded as Directorate of Floricultural Research (DFR) to promote and strengthen floricultural research and enhance the technological base in floriculture. Presently AICRP on Floriculture is an integral part of the DFR, having 22 Centres comprising of 16 Budgetary, four Institutional and two Voluntary centres.

Considering the research needs and potential of floriculture in India, the mandate of the DFR has been revised to provide the technological support to the growers and entrepreneurs that help in providing employment generation and prosperity to the rural youth.

Mandate

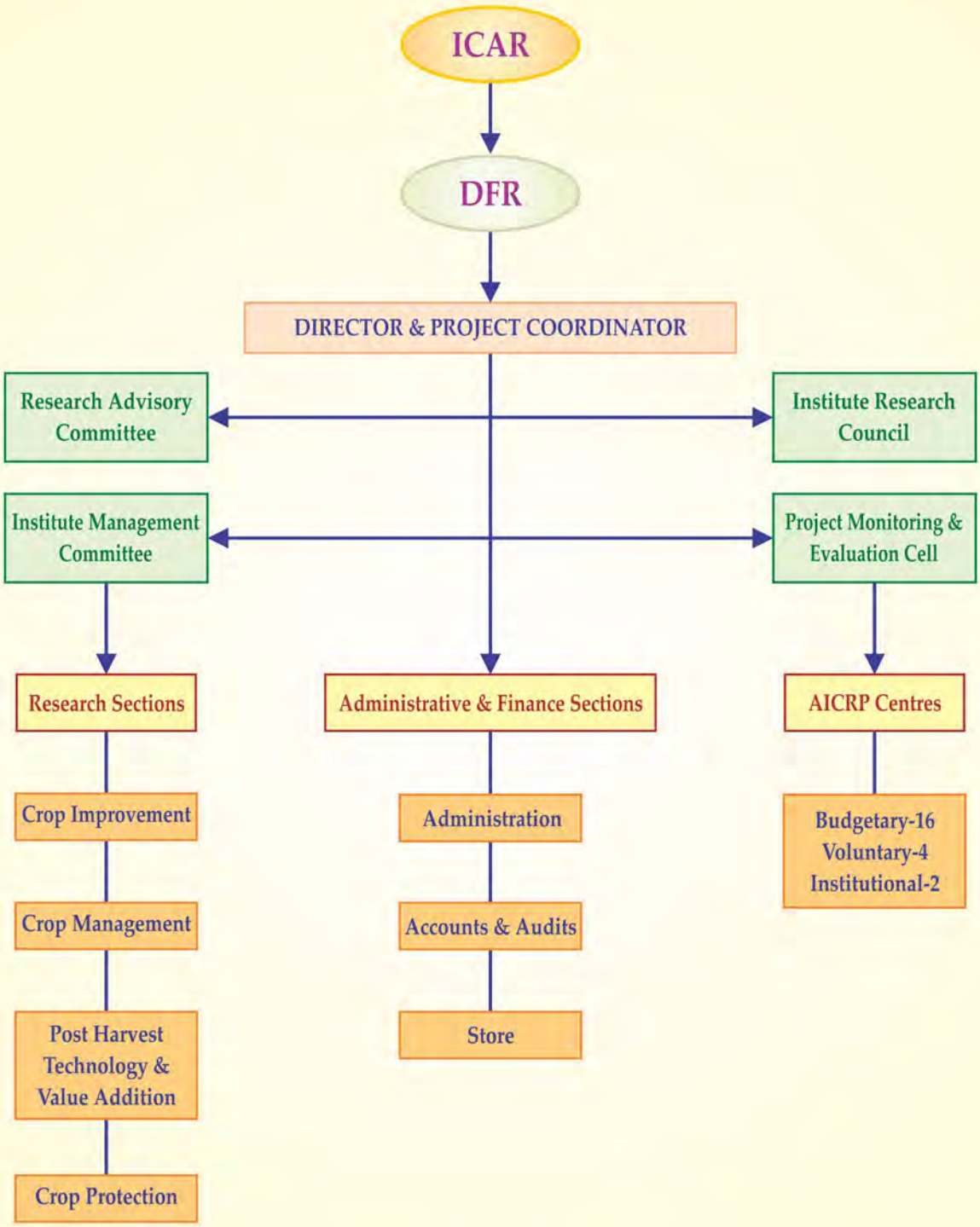
- Effective management, enhancement, evaluation of genetic resources and development of improved cultivars, with high quality characteristics for export, productivity and resistance to pests and diseases.
- To undertake basic, applied and strategic research for addressing national problems, enhance productivity, shelf life, product diversification and value addition.
- To develop technologies for protected cultivation of flowers.
- To act as a repository of scientific technology and information relevant to floriculture and develop region specific technologies.
- To frame policy research and intensify outreach programme. To act as an advanced centre of training for up gradation of scientific manpower in modern technologies flower production.
- To collaborate with relevant national and international agencies to bring synergy between the technologies.

Vision

To harness the research and development activities in flower crops and landscape gardening for promotion of domestic and export markets.

Mission

To carry out research, impart education, conduct out-reach programmes in floriculture and landscaping with national and international partners for enhancing the production, productivity, profitability besides alleviating the rural poverty.



Organizational Setup of DFR

Salient Research Achievements

Crop Improvement

Gladiolus

Germplasm collection and evaluation

The existing gladiolus germplasm (60 entries) was enriched further with the introduction of 20 more varieties (Table 1). These include six varieties namely, Punjab Beauty, Punjab Dawn, Punjab Pink Elegance, Punjab Flame, Punjab Glance and Punjab Lemon Delight of PAU, Ludhiana and 2 varieties namely Phule Ganesh and Phule Neelrekha of MPKV, Ganeshkhind, Pune. All the varieties were evaluated for their growth, flowering and corm/cormel production attributes (Table 2 and Table 3). The varieties like Yellow Stone, Argentina, Jester, Priscilla, Ocilla, Invitatie produces significantly higher number of spikes per plant. Yellow Stone, Argentina, Invitatie were found with maximum spike length as well as number of florets per spike.

Field view of gladiolus germplasm

The post harvest life was also found superior in cultivars Yellow Stone, Argentina, Priscilla and Invitatie. The poor vase life was found in the cultivars Purple Flora, Chemistry and Blues. Cultivars Jester, Ocilla, Priscilla, Yellow Stone and Argentina had maximum multiplication rate of 2-3 flowering size corms and 230-250 cormels. Cv. Argentina was found with maximum number of cormels (320). Cv. Yellow Stone and Invitatie produced maximum number of corms/plant.

Corms and cormels production behaviour in different gladiolus cultivars

The varieties were also screened for resistance/tolerance against the incidence of *Botrytis gladiolorum* and *Fusarium rot*/wilt disease. Some of the introduced varieties (Adagio, Blues, Ovatie, Green Star, *etc*.) did not perform well and were found to be susceptible to fusarium rot. New

Table 1: Maintenance of gladiolus germplasm

1.	Alexander the Great	2.	IIHR G12	3.	Punjab Lemon Delight
4.	Amsterdam	5.	Invitatie	6.	Purple Flora
7.	Adagio	8.	Jackson Ville Gold	9.	Pusa Kiran
10.	Anjali	11.	Jessica	12.	Pusa Shabnam
13.	Argentina	14.	Jester	15.	Pusa Shubham
16.	Ben Venuto	17.	Jester Gold	18.	Pusa Suhagin
19.	Beau Jour	20.	Jyotsna	21.	Red 54
22.	Big Time Supreme	23.	Kum Kum	24.	Red Advance
25.	Blues	26.	Lemon Drop	27.	Red Beauty
28.	Chandani	29.	Mascagni	30.	Punjab Glance
31.	Chemistry	32.	Novalux	33.	Regency
34.	CPG	35.	Ocilla	36.	Rose Supreme
37.	DH-1 (Delhi Hybrid)	38.	Ovatie	39.	Rosebiee Red
40.	DH-2 (Delhi Hybrid)	41.	Peasano	42.	Sagar
43.	Dhanwantari	44.	Peter Pears	45.	Sancerre
46.	Essential	47.	Phule Ganesh	48.	Shagun
49.	Esta Bonita	50.	Phule Neelrekha	51.	Shobha
52.	Eurovision	53.	Pink Friendship	54.	Snow Princess
55.	Fidelio	56.	Plumtart	57.	Solist
58.	Flevo Amico	59.	Praha	60.	Spic – n-span
61.	Flevo Laguna	62.	Princess Margaret Rose	63.	Trader Horn
64.	Flevo Souvenir	65.	Priscilla	66.	Verona
67.	Forta Rosa	68.	Pune Hybrid	69.	White Friendship
70.	Green Star	71.	Punjab Beauty	72.	White Prosperity
73.	Gold Field	74.	Punjab Dawn	75.	Wigs Sensation
76.	Hunting Song	77.	Punjab Elegance	78.	Yellow Stone
79.	IIHR G 11	80.	Punjab Flame		

Table 2: Performance of indigenous varieties of Gladiolus

S. No.	Variety	Days to spike initiation (days)	Days to 1st floret opening (days)	Plant height (cm)	Spike Length (cm)	Rachis length (cm)	Foliage height (cm)	No. of florets per spike	No. of florets opened at a time	Floret dia. (mm)	Stem dia. (mm)	No. of leaves per plant	No. of tillers per plant
1.	Punjab Dawn	52.60	71.00	80.46	70.51	37.34	48.36	15.00	6.10	94.10	11.67	6.70	2.70
2.	Punjab Pink Elegance	49.80	75.50	87.75	76.93	55.53	41.99	21.20	6.90	92.10	12.07	6.80	1.40
3.	Punjab Glance	48.20	72.50	87.41	74.08	51.21	44.04	14.70	5.70	99.82	15.20	6.70	2.60
4.	Punjab Lemon Delight	61.90	83.11	95.36	84.56	53.44	46.10	13.90	5.80	87.62	15.16	6.30	2.40
5.	Punjab Beauty	65.00	81.10	59.85	49.13	23.49	38.70	8.80	5.30	74.26	9.82	5.30	2.90
6.	Punjab Flame	90.50	106.67	87.45	75.20	44.63	41.55	12.00	4.00	78.34	12.51	6.25	1.25
7.	Pusa Kiran	54.20	73.80	90.28	80.20	47.51	49.79	15.20	6.00	92.04	13.31	6.40	2.50
8.	Jyotsana	52.60	72.70	99.64	87.00	52.93	48.69	15.30	6.50	91.70	12.65	6.10	3.80
9.	Pusa Suhagin	74.70	92.20	104.98	94.86	65.40	41.84	17.60	4.90	89.95	13.84	6.90	1.60
10.	Dhanvantri	75.40	93.80	116.00	101.59	56.39	75.73	16.30	5.40	85.68	16.27	7.40	1.90
11.	Shagun	68.70	84.60	71.01	56.53	31.73	50.88	12.30	4.90	85.44	14.70	7.40	2.10
12.	Kum Kum	78.60	93.13	80.40	69.10	44.75	41.26	14.10	5.10	92.56	12.94	7.20	2.50
13.	Sagar	75.00	96.60	44.93	37.05	28.77	27.55	12.20	6.00	67.14	13.15	6.33	2.33
14.	Regency	68.60	86.00	87.97	75.40	45.60	45.28	13.83	6.50	72.54	14.73	6.83	2.00
15.	Shobha	56.29	81.00	67.84	57.49	37.14	36.84	15.78	5.22	66.39	11.18	6.50	2.00
16.	Praha	80.11	97.22	68.61	58.06	36.24	41.89	13.67	5.33	76.43	15.20	7.29	1.71
17.	Pune Hybrid	80.50	94.83	65.04	54.44	35.39	36.46	12.60	5.40	76.60	11.64	6.43	2.14
18.	Delhi Hybrid	72.67	88.50	53.65	44.15	21.15	44.00	7.00	4.00	91.24	10.87	7.00	1.50
19.	IIHR G 11	73.50	87.00	88.81	75.39	49.56	35.43	16.20	5.40	83.64	13.96	6.60	1.90
20.	IIHR G 12	83.30	99.50	78.56	65.20	45.86	39.99	14.20	4.80	83.66	13.65	6.30	2.67
21.	Pusa Subham	79.10	96.80	63.40	49.48	29.63	38.48	10.50	4.50	84.37	11.59	6.25	1.75
22.	Anjali	82.75	102.50	115.49	101.24	64.71	53.66	17.30	5.80	84.05	14.52	6.57	2.71
23.	Pusa Shabnam	94.30	110.30	101.11	89.84	52.07	48.01	15.70	5.10	106.06	13.11	6.57	1.43

collections namely, Yellow Stone, Argentina, Invitatie, Mascagni, Jester, Flevo Laguna, Lemon Drop, Forta Rosa, Beau Jour and Ben Venuto produced good quality spike with attractive colours. These varieties are also good multiplier and can be grown successfully in Delhi conditions.

Breeding

In order to reduce the time span, the seeds of previous season's crosses were collected and sown at IARI, Regional Station Katrain. The cormels formed were replanted to get the flowering size corms. These hybrids will be evaluated for agronomic traits, flower quality and other abiotic stresses.

Promising hybrids in gladiolus

Table 3: Performance of exotic varieties of gladiolus

S. No.	Variety	Days to spike initiation	Days to 1st floret open	Plant height (cm)	Spike Length (cm)	Rachis length (cm)	No. of florets per spike	Floret dia. (mm)	No. of florets opened at a time	No. of leaves per plant	No. of tillers per plant	Stem thick-ness	Floret colour
1.	Gold Field	119	142.5	110.9	99.92	60.52	12.4	101.94	7.2	9.4	1.6	16.5	Yellow
2.	Red Beauty	110.8	127.4	86.5	70.84	44.74	17.6	82.02	5.4	8.4	1.2	17.93	Red
3.	Alexander The Great	100.6	115.6	115.12	100.9	67.98	15.2	82.7	6.8	8.0	1.2	17.48	White
4.	Purple Flora	80	103.6	89.92	74.46	45.96	16.6	76.01	7.4	7.6	2.6	15.95	Purple
5.	Esta Bonita	101.6	117	92.96	78	50.45	14.6	82.34	4.8	7.6	1.4	15.88	Apricot orange
6.	Verona	120.8	128.4	105.08	94.56	62.38	18	91.82	5.8	7.8	1.4	15.79	Dark pink
7.	Blues	99	118	80.22	69.16	40.88	13.2	78.89	5.4	7.6	1.4	12.06	Light blue
8.	Invitatie	123.6	138.2	118.52	106.2	58.72	16.6	94.04	5.6	8.6	2.6	15.79	Pink
9.	Essential	115.2	131.6	97.22	86.42	58.74	16.6	94.99	5.8	7.8	1.2	15.89	White
10.	Mascagni	107.2	120.8	88.04	80.54	52.72	17.4	75.94	5.8	8.0	2.0	15.8	Red
11.	Snow Princess	96.2	113.6	100.64	89.18	60.12	17.8	76.65	5.2	7.6	2.0	16.13	White
12.	Chemistry	84.6	109.6	88.82	79.84	49.68	15	87.24	5.8	7.4	1.4	16.53	Light purple
13.	Priscilla	101.6	114.8	88.58	78.4	55.18	15.6	82.89	5.8	7.4	1.4	15.91	Pink
14.	Trader Horn	99.8	116.6	114.04	101.3	53.2	15.6	80.53	6.0	8.0	1.4	14.9	Red
15.	Pink Friendship	100.4	115.6	93.78	80.56	50.04	15	84.86	6.6	7.6	1.2	13.09	Light pink
16.	Amsterdam	94.8	118.4	111.22	89.24	60.95	18.4	89.4	8.2	8.2	1.4	18.83	White
17.	Rose Supreme	99.6	119.8	101.94	86.76	47	15.8	105.8	6.8	9.0	1.6	20.33	Rose pink
18.	Flavor Souvenir	93.6	112.2	87.83	76.46	54.08	16.6	76.06	5.8	8.2	1.8	17.55	Yellow
19.	Fidelio	110.8	123.4	103.12	89.56	52.96	14.2	93.26	5.6	8.0	2.0	17.35	Dark pink
20.	Jester Gold	102	117.8	76.44	65.8	39.66	13.2	94.54	5.4	7.8	1.2	11.88	Yellow
21.	Hunting Song	84.8	103.4	64.62	54.36	26.96	9.4	73.74	5.6	7.0	1.0	12.54	Red
22.	Argentina	94	106.8	99.36	83.72	52.68	17.2	91.93	6.2	6.2	1.4	13.92	Soft red
23.	Rosibee Red	118.2	132	92.66	80.28	44.12	12.4	84.2	7.4	9.0	1.0	16.29	Red
24.	Princess Margaret Rose	87.6	105.2	78.44	68.08	40.72	12.6	73.21	5.4	8.0	1.0	11.16	Orange
25.	Forta Rosa	95.75	115.75	97.38	85.76	59.36	16.4	86.5	6.8	8.4	1.0	15.26	Soft pink
26.	Flavo Amico	99	120.4	67.48	59.94	40.62	14.6	46.59	5.2	7.2	1.2	7.46	Yellow with dark pink border
27.	Flavo Laguna	113.8	126.4	75.62	65.08	41.28	15.8	57.78	5.8	7.4	1.6	11.96	Pink
28.	Yellow Stone	114.6	126.6	119.38	104.38	56.52	14.6	86.18	6.4	7.2	5.2	14.93	Yellow
29.	Novalux	114	128.6	107.38	94.12	49.16	14.2	78.02	7.6	6.6	2.6	15.53	Yellow
30.	Eurovision	109.4	124.6	100.76	92.5	59.04	18.2	89.66	6.2	6.6	2	15.3	Pink

31.	Peasano	103.4	117.4	102.4	89.14	44.28	13.2	72.73	7.8	8.6	1.6	20.34	Orange
32.	Ocilla	103	120.2	113.12	100.68	69.93	16.6	80.18	5.2	8.2	2.6	18.08	Cream white
33.	Solist	114.8	130.4	86.92	74.78	47.34	15.2	81.07	5.8	7.6	1.0	19.88	White
34.	Jessica	103.6	113.2	74.496	65.18	48.94	17.2	72.94	5.4	7.2	1.0	15.14	Peach (salmon)
35.	Limoncello	86.2	99.4	86.52	77.04	50.06	13.6	107.43	6.2	7.4	1.2	13.65	Yellow
36.	Jester	-	121.8	106.74	95.5	63.6	15.4	91.33	7.8	7.4	1.2	15.9	Yellow
37.	Wigs Sensation	-	130	113.88	97.8	67.82	14.2	89.63	4.2	7.6	2.6	17.64	Red
38.	Lemon Drop	113.6	130.8	93.76	78.3	53.86	13.8	87.51	8.6	6.8	2.4	14.24	Yellow
39.	BTS	97.8	119	118.32	102.36	56.02	13.2	110.25	5.8	7.2	3.2	18.34	Pink
40.	White Prosperity	98.4	119.2	123.74	106.64	62.22	14.6	94.02	6.2	6.8	1.2	-	White

Based on the performance during the previous year the varieties such as Yellow Stone, Ocilla, Lemon Drop, Invitatie, Verona, Argentina, Purple Flora, Princess Margaret Rose have been identified as better female parents. The male parents were selected based on the colour preference in market, multiplication rate and tolerance to fusarium wilt. In all possible combinations large number of crosses (100) were attempted within selected parents (Table 4). Most of the crosses have been observed to set seeds. Besides, open pollinated seed of the varieties Yellow Stone, Invitatie, Ocilla, Priscilla, Purple Flora, Verona, Chemistry, Eurovision, Flevo Souvenir, Novalux and Rosibee Red were also collected. The seed has been harvested and sown at IARI, Regional Station, Katrain.

The potential of the existing germplasm including newly introduced ones was evaluated for seed set behaviour both under natural and artificial pollination.

Table 4: Gladiolus Parents used in Hybridization Programme

S No.	Seed Parent	Pollen Parent	S. No.	Seed Parent	Pollen Parent
1.	Argentina	Flavo Amico	51.	Novalux	BTS
2.	Argentina	Gold Field	52.	Novalux	Priscilla
3.	Argentina	Jester Gold	53.	Ocilla	Invitatie
4.	Argentina	Pusa Suhagin	54.	Ocilla	Mascagni
5.	BTS	Lemon Drop	55.	Ocilla	Plumtart
6.	BTS	Navalux	56.	Ocilla	Purple Flora
7.	BTS	White Prosperity	57.	Ocilla	Verona
8.	Chemistry	Priscilla	58.	Plumtart	Amsterdam
9.	Chandni	BTS	59.	Plumtart	Ocilla
10.	Chandni	Priscilla	60.	Plumtart	Peasano
11.	Chandni	Purple Flora	61.	Plumtart	Yellow Stone
12.	Chemistry	Haunting Song	62.	Priscilla	Haunting Song
13.	Chemistry	Mascagni	63.	Priscilla	Yellow Stone
14.	Flavo Amico	Flavo Laguna	64.	Princess Margaret Rose	Snow Princess
15.	Flavo Amico	Novalux	65.	Princess Margaret Rose	Jester Gold
16.	Flavo Amico	Ocilla	66.	Princess Margaret Rose	Punjab Down

17.	Flavo Amico	Yellow Stone	67.	Purple Flora	Fidelio
18.	Flavo Laguna	Flavo Amico	68.	Purple Flora	Haunting Song
19.	Flavo Laguna	Ocilla	69.	Pusa Suhagin	Jester Gold
20.	Flavo Laguna	Priscilla	70.	Pusa Suhagin	Ocilla
21.	Flavo Laguna	Rosibee Red	71.	Pusa Suhagin	Yellow Stone
22.	Flavo Laguna	Yellow Stone	72.	Rosibee Red	Yellow Stone
23.	Flavo Sovenior	Haunting Song	73.	Rosibee Red	Amsterdam
24.	Flavo Sovenior	Trader Horn	74.	Rosibee Red	Gold Field
25.	Fota Rosa	Ocilla	75.	Rosibee Red	Novalux
26.	Fota Rosa	Amsterdam	76.	Rosibee Red	Ocilla
27.	Fota Rosa	Plum tart	77.	Snow Princess	Fidelio
28.	Fota Rosa	Priscilla	78.	Snow Princess	Mascagni
29.	Fota Rosa	Snow Princess	79.	Snow Princess	Plumtart
30.	Fota Rosa	Yellow Stone	80.	Verona	Novalux
31.	Hunting Song	Ocilla	81.	Verona	Ocilla
32.	Invitatie	Novalux	82.	Verona	Yellow Stone
33.	Invitatie	Ocilla	83.	White Prosperisty	Navalux
34.	Invitatie	Yellow Stone	84.	White Prosperity	BTS
35.	Jester	BTS	85.	White Prosperity	Purple Flora
36.	Jester	Purple Flora	86.	White Prosperity	Rosibee Red
37.	Jester	Rosibee Red	87.	Yellow Stone	Blues
38.	Jester	BTS	88.	Yellow Stone	Flavo Amico
39.	Jester	IIHR-G-11	89.	Yellow Stone	Flavo Laguna
40.	Jester	Priscilla	90.	Yellow Stone	Invitatie
41.	Jester	Pusa Suhagin	91.	Yellow Stone	Pink Friendship
42.	Lemon Drop	BTS	92.	Yellow Stone	Plum tart
43.	Lemon Drop	Purple Flora	93.	Yellow Stone	Priscilla
44.	Limoncello	Invitatie	94.	Yellow Stone	Purple Flora
45.	Limoncello	Priscilla	95.	Yellow Stone	Pusa Suhagin
46.	Limoncello	Verona	96.	Yellow Stone	Rosibee Red
47.	Limoncello	Purple Flora	97.	Yellow Stone	Verona
48.	Mascagni	Invitatie			
49.	Mascagni	Ocilla			
50.	Mascagni	Verona			

Mutation breeding

Corms of 21 varieties of gladiolus were irradiated with physical mutagens at 50 Gy, 75 Gy and 100 Gy doses. Varieties namely, Purple Flora, Rosibee Red, Yellow Stone and Verona responded to the treatment. Chimeras for petal colour,

Chimeras observed in vM1 generation in Gladiolus

deformed petal shape, increased and deformed anther and style numbers, and increased petal number which resembles double type flower were observed. The same corms will be evaluated in vM2 generation for stability of traits.

Chrysanthemum

Germplasm collection and evaluation

Chrysanthemum genotypes (standard and spray) collected from various centres (AICRP, ICAR and Private Nurseries), were evaluated for different purposes including their suitability as parents in breeding programme.

Chrysanthemum Germplasm: A field view

Breeding in chrysanthemum

The standard types were planted in pots for evaluation and were exhibited during the functions and activities of the institute.

Standard chrysanthemum

In addition to the existing germplasm, 82 more were collected from various sources for evaluation of their performance under Delhi conditions. The cultivars Anmol, Himanshu and Flash Point were suitable for pot culture. The cultivars, Lucido, Red Stone, Cloverleaf Star, Spacer, Autumn Eyes and Flash Point were found to be of very early flowering type whereas, the cultivar Coffee, Dark Eyes, Maghi were late bloomers. The no-pinch and no-stake cultivars were Bindiya, Bi-colour Bonsai, Valerie, Miko, Kotoi No Kaori, Yellow Charm and Gum Drop. The spray type cultivars were grouped as per their colour (Table 5).

Table 5: Colour wise Grouping of Spray type chrysamthemum cultivars

S. No.	Group	Varieties
1	Red	Shyamal, Lucido, Red Stone, Miko, Fireball, Shin Otome, Bindiya, Merlot, Red Devil, Pot Black, Jaya, Heritage, Rekha, Red Gold, Jublee, Flirt, PAU-41, Sabita, Lalima, Melody, Rivel City, PAU-1,Christmas Carol, Flash Point
2	White	Cloverleaf Star, Apsara, Mother Teresa, Spacer, Crystal Fall, Kalpana, Royal Prince, Meera White, Baggi, Ratlam Selection, Purnima, Tomiko, PAU-30, Little Hemant, UHFS Chry 77, White Star, White Bouquet, Chrystal Fall, Amalfi, Setons Lace, Chandani, PAU-D-1, Y-59, PAU-VII, H-6
3	Yellow / cream	Kelvin Tattoo, Statesman, Autumn Eyes, Preet Shringar, Moharaj, Bicolour Bonsai, Statesman-Improved, Yellow Charm, Gum Drop, Yellow Delight, Anmol, Chandrika, Punjab Anuradha, Chandi, PAU-66, Fitonia, Yellow Star, PAU-13, PAU-78, Lalima, Vijay, UHFS Chry-44, Ajay, Nanako, AC-157, PAU-38, Autumn Eyes
4	Pink	Pinki, Kelvin Victory, Dark Eyes, Wisp of Pink, Royal Purple, PAU-8, PAU-42, PAU-20, PAU-47-4, M-12, Jessica, Pooja, Little Pink, Koshoo, Tata Century, Amity, Seema, Dark Eyes, Mauve Sarah, A-64-1, PAU-B-43, PAU-43, PAU-42, PAU-32, PAU-90, H-1, PAU-66, PAU-55
5	Orange/saffron	Kelvin Mandarin, Anney, Dolly Orange, Yellow Coin, Kirti, PAU-24, PAU-91
6	Bronze	Kotoi No Kaori, Thai Chen Queen, Agnishikha
7	Brown	Coffee
8	Bi-colour	Flash Point, Jubilee, Winter Queen

Mutation breeding

Five genotypes namely Flirt, Anmol, Star White, Yellow Coin and Thai Chen Queen (rooted and bare-rooted) were irradiated with physical mutagen at the dose of 8, 10 and 14 Gy. The bare rooted cuttings showed cent per cent mortality at all doses. However in the rooted one, except Thai Chen Queen, none survived at 14 Gy irradiation dose. The maximum survival (18-25%) were observed in the plants irradiated with 8Gy gamma rays followed by 10 Gy (5-15%) (Table 6). The irradiated plants are being maintained for second year observation. Natural mutation has been found in cultivar Kalpana.

Table 6: Effect of different doses of Physical mutagen on chrysanthemum cuttings

Cultivars	Rooted Cuttings (Survival%)			
	Control	8 Gy	10 Gy	14 Gy
Flirt	94	15	8	—
Anmol	95	20	5	—
Star White	92	18	10	—
Yellow Coin	93	25	10	—
Thai Chen Queen	95	20	15	5

Natural Mutation in Chrysanthemum cultivar Kalpana

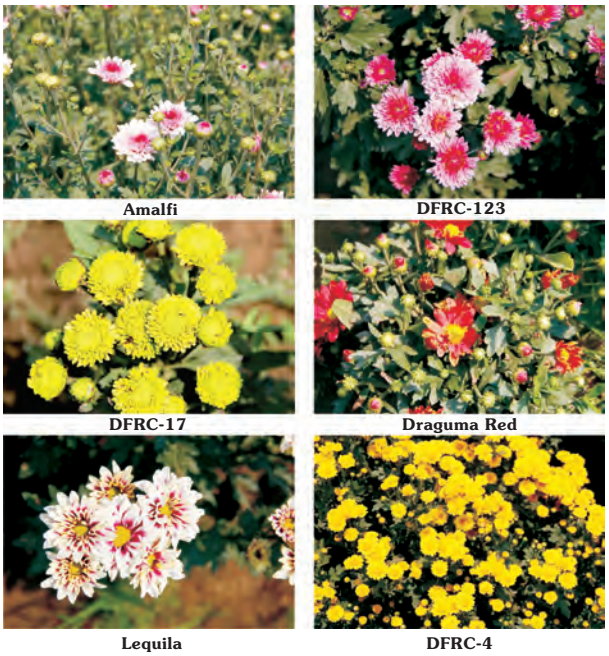
Breeding

Based on the performance of desirable traits, the seeds from promising parents were collected. The germination behaviour of open pollinated (OP) seeds from 142 chrysanthemum varieties collected during 2012-13 is being tested for further evaluation.

Promising selections from OP population

In evaluation block, promising types from the raised seedlings of 2010-11 and 2011-12 were identified for desirable growth and flowering traits.

Beside these, the genotypes found suitable for summer flowering are Gumdrop, Moira, Mother Teresa, Shyamal, IAH-Red, Aprajita, Royal Prince, Red Devil, Autumn Joy, Cindrella Yellow, Vasanthika, Vanity Pink, Kaul, Khoshoo, Sharad Mala, Shova, BC-1-123, Thai-Chen Queen, White Star, White Bouquet, Tera Red, Amalfi, PAU-49, PAU-42, Vienna Cream, Lamu Elmmira, Hanshu Zamba, Mindamo, Preveto, Snowdon, Gometo, Olymp Yellow. The cultivars/ lines Calimaro Sunny Yellow, Calimaro Sunny Pink, Punch White, Vanity Pink, White Bouquet, Tera Red, Amalfi, Lequila, Laguna White, Sunny Punch Yellow, Yukari, Ronilla Red, Sparkle White, Ahulo Yellow, DFR P-26, DFR S-21, DFR Y-12, DFR A 19, DFR E-11 are very good cut sprays. The evaluation of genotypes for summer flowering characters have been presented in Table 7.



Thermo-photo insensitive Chrysanthemum genotypes

Flowering annuals

Germplasm of winter annuals like calendula, sweet alyssum, sweet sultan, sweet william, lupin, saponaria, *Chrysanthemum multicaule*, dimorpotheca, gazania, larkspur, aster, Coreopsis, Cosmos, nasturtium, metrocaria, wall flower, Mesembreanthemum, Petunia, pansy, Antirrhinum, hollyhock and annual chrysanthemum and dry flowers-statice, lagurus, bells of ireland, Brumus,

Field view of winter annuals

Breesa, Acroclinum, Helichrysum were maintained. Beside these *Chrysanthemum coronarium, C. carinatum, C. lucida, C. Paludosum* and *C.*

TABLE 7: Evaluation of chrysanthemum genotypes for summer flowering

S. No.	Variety	Plant Height (cm)	Plant Spread (cm)	No. of Branches	No. of Buds / Branch	Total Buds / Plant	Flower Diameter (cm)	Duration of Flowering (Days)
1	Gundrop	13.96	89.02	10	80	476.4	2.6	6.8
2	Moira	47.5	99.12	5.8	14.4	77.2	7.62	8.4
3	Mother Teresa	64.88	137.78	8	23.6	197.6	2.66	5.6
4	Shyamal	45.14	66.28	5	12.6	48.4	5.72	5
5	IAH-Red	48.86	75.6	14.6	19.6	133	6.18	6.4
6	DFR C 17	54	78.8	7.6	12.2	46.6	3.74	4.4
7	DFR C 86	50.2	81.12	7.6	14.2	71	4.84	5.4
8	DFR C 94	50.42	71.68	6.6	9.8	38.6	3.78	8.8
9	DFR C 128	97.34	160.78	20.8	9	84.8	4	6
10	DFR C 25	76	132.66	8.2	22.2	61	4.34	6.8
11	DFR C 87	67.56	114.98	11.8	9.8	26.2	4.44	7.4
12	S-33	68.56	68.2	9	27	129	4.24	6.8
13	Aprajita-2	57.2	81.9	9.4	20.2	165.8	5.2	10.4
14	DFR C 81	57.2	121.1	13.4	12.6	98.6	6.44	8.4
15	DFR C 125	38.48	101.22	11	9.6	56.8	4.72	7.6
16	DFR C 123	60.74	105.72	31.8	14	153.8	4.36	6.6
17	Royal Prince	70.56	156.76	16.8	33.4	413.6	2.8	10.4
18	Red Devil	54.94	76.36	13.6	17.4	111.6	2.34	4.6
19	Autumn Joy	54.34	123.18	10.8	24.4	245.2	7.34	5
20	Cindrella Yellow	64.06	57.5	3.4	7.4	25	6.32	11
21	Vasanthika	53.38	100.6	43.4	24.8	538.4	2.34	9.6
22	Vanity Pink	66.78	76	10	29.8	117.8	5.3	4.4
23	Anmol	54.16	81.2	8.6	30.2	324.2	4.42	4.6
24	Kaul	57.12	145.8	11	25.6	134.2	4.44	9.2
25	Khoshoo	68.08	146	13.4	31.8	246.8	4.54	8.2
26	Sharad Mala	48.64	105.34	13	43.6	386.8	5.38	10
27	Shova	81.94	103.6	7.6	27.4	110.4	7.5	7.8
28	BC-1-123	40.72	86.2	10	15.6	85.2	4	10
29	Thai-Chen Queen	42.74	64.1	6.4	29.8	151.6	5.42	9.2
30	White Star	33.8	66.5	2.5	13	32.5	4.1	7
31	White Bouquet	41.82	80.8	8.4	20.4	197.6	4.06	7
32	Tera Red	93.08	78	4.4	32.4	50.2	4.52	10.8
33	Amalfi	75.24	67.6	10.8	20.8	144	5.1	5.8
34	PAU-49	81.58	120.6	10.8	54.2	177.2	3.36	7.4
35	PAU-42	20.2	72.4	23.4	31	467	2.88	6.8

36	Vienna Cream	53.96	91.4	4.4	59.8	197	11.04	4
37	DFR C 121	53.5	114	10	32	51	8.2	5.6
38	Lamu Elmmira	29.12	68.8	3.2	86	124.8	4.78	6
39	Hanshu Zamba	66.52	98	15.6	36.2	166.4	4.34	8.4
40	Mindamo	32.26	76.2	5.8	38.6	111.2	4.86	6.4
41	Preveto	34.34	90.6	11.6	18.6	97.6	4.74	6.6
42	Snowdon	68.48	110.2	3.2	50.2	120.6	7.6	5.6
43	Gometo	37.16	77.8	8.4	46.4	167.2	5	6
44	Olymp Yellow	38.6	89.8	4.4	43.2	219	4.66	6.8
45	Lecise Impr.	39.58	81.4	6.8	32.8	147.6	3.32	5.2

multicaule are also maintained. The third year selfed seeds of annual chrysanthemum (*Chrysanthemum coronarium*) having yellow and white type in single, double and semi-double showed that there was progressive decrease in the plant height, except white flowering single type. Further, the percentage of white flowering type plants observed was more as compared to yellow type. In Petunia research efforts are also being made for inbred line development.

Breeding in Annual Chrysanthemum

Hybridization in Petunia

In seed production studies the plants were planted at two different transplanting dates. Among all the winter annuals evaluated, calendula, cosmos, poppy, sweet alyssum, nasturtium, corn flower and acroclinum were observed to be early bloomer (45-60 days after transplanting). Pansy, sweet alyssum, brachycome, metrocaria were possessing very short duration of flowering (30-45 days). The flowers of Sweet Sultan, Sweet William and *Chrysanthemum carinatum* were found to be used as cut flower. The data on seed production were recorded and the trial on seed germination under seed germinator is in process. Calendula, gaillardia, Helichrysum, nasturtium, verbena and coreopsis were good seed yielder.

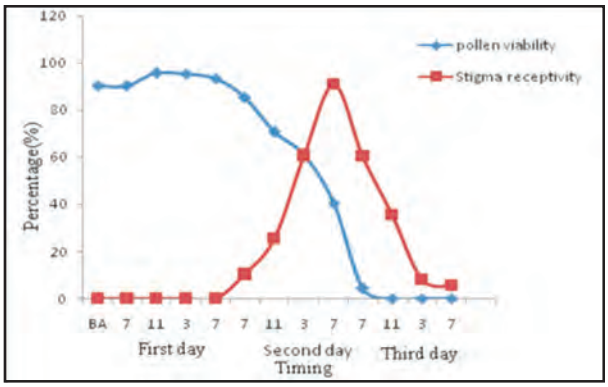
In annual chrysanthemum controlled pollination have been attempted in the third year in single, semi-double and double white and yellow types. These plants exhibited high degree of instability for colour and flower type. However the population of white flowering plants have become almost uniform. Also there is progressive decrease in plant height in almost all types of flowers.

To produce novel colour and forms of annuals through mutation breeding, imbibed calendula seeds were irradiated with Gamma rays at the rate of 25 Gy, 50 Gy and 75 Gy. Some flower deformations have been observer in first generation.

Mutational changes – flower deformation in calendula

Malva sylvestris

Studies on phenology in *Malva sylvestris* revealed that anthers dehisce before the flowers open; the pollen viability reached maximum at 11 am (95.71%) at first day and declined thereafter. Approximately 40% pollen remained viable till the evening of second day. However, it reached at negligible levels on third day. In contrast to pollen viability, stigma was non receptive during first day after anthesis and it was found maximum (90.85%) at afternoon of second day and declined thereafter. The pollen viability reached maximum during first day whereas the stigma receptivity was recorded maximum on the second day which leads to chances of cross pollination. The style began to curl enough down and comes in contact with own dehisced anthers. When curvature of style branches touch their own anthers at that time pollen viability is considerably reduced. In case of scarcity of pollinators the remaining viable pollen from same flower leads to delayed self pollination in these curved style branches.



Pollen viability and stigma receptivity in *Malva sylvestris* (BA: before anthesis)

Tuberose

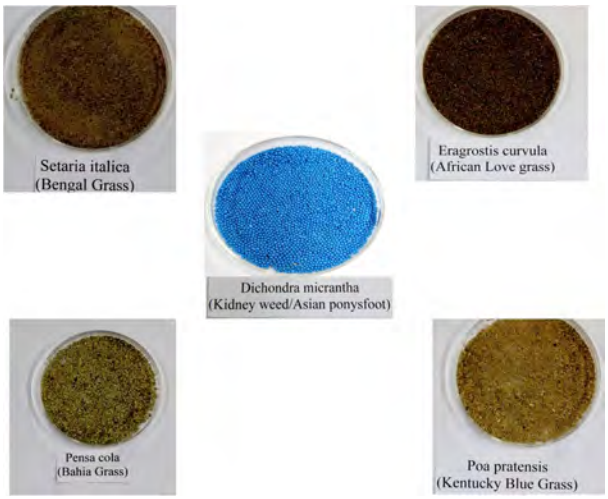
The bulbs of cultivars Prajwal and Vaibhav were treated with various doses of physical mutagen (Co_{60} gamma irradiation) and chemical mutagens (Colchicine, EMS, MMS) prior to planting. The observations were recorded during the current year and it can be said that 10.0 Gy was found to be the LD_{50} for both the cultivars. Though vegetative growth was high in high dose of irradiations however flowering got reduced. One vegetative variant was found in Prajwal at 2.5 Gy. Besides two varieties namely, Arka Nirantara and Phule Rajni were also treated and their performance is being evaluated.

Field view of Tuberose germplasm

Lawn grasses

The following turf glasses have been collected, to identify abiotic stress tolerant species and to study their suitability as turf for different purposes.

1. *Cynodon dactylon (*Doob grass or Bermuda grass)
2. *Eragrostis cummingii (African Love grass)*
3. *Lolium perenne (*Perennial ryegrass)
4. *Poa pratensis (*Kentucky bluegrass)
5. *Pensa cola, (Bahia Grass)*
6. *Dichondra micrantha(Kidney Weed)*
7. *Setaria italica (Bengal grass)*



Seeds of introduced species of grasses

To generate variability for selection of genotypes for above mentioned purposes seed and stolons of these species were treated with Gamma rays (25Gy, 50Gy and 75Gy). The observations are being recorded.

Crop Production

Gladiolus

Staggered planting

Seventeen varieties (Gold Field, Purple Flora, Verona, Blues, Snow Princess, Priscilla, Amsterdam, Flavo Souvenir, Jester Gold, Hunting Song, Rosibee Red, Princess Margaret Rose Flavo Laguna, Yellow Stone, Novalux, Ocilla and Limoncello) were planted during October and November to find their suitability to varied time of planting. The data (Table 8.) revealed that except four varieties (Gold Field, Flevo Laguna, Limoncello, Blues), all others performed better during November planting in respect of plant height, spike length

Table 8: Effect of planting dates (Oct-Nov) on growth and flowering in gladiolus

Sr. No.	Variety	Days to 1st floret opening		Plant height (cm)		Spike length (cm)		Rachis length (cm)		No. of florets/spike		Floret diameter (mm)		No. of tillers		Stem thickness (mm)	
		Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov
1	Gold Field	142.5	128.4	110.9	81.36	99.92	68.10	60.52	44.66	12.4	12.0	101.94	88.48	1.6	1.0	16.50	15.72
2	Purple Flora	103.6	115.8	89.22	79.18	74.46	64.44	45.96	37.94	14.8	12.6	76.01	76.47	2.6	1.4	15.95	15.96
3	Verona	128.4	124.8	105.08	107.02	94.56	91.7	62.38	56.74	18.0	15.4	91.82	99.65	1.4	1.4	15.79	15.79
4	Blues	118.0	116.8	80.22	70.7	69.16	59.28	40.88	41.24	13.2	18.6	78.89	81.48	1.4	1.0	12.06	12.09
5	Snow Princess	113.6	118.6	100.64	109.98	89.18	94.92	60.12	66.38	17.8	18.4	76.65	87.87	2.0	2.8	16.13	16.14
6	Priscilla	114.8	123.2	88.58	110.18	78.40	93.82	55.18	63.44	15.6	18.4	82.89	91.84	1.4	2.6	15.91	15.94
7	Amsterdam	118.4	116.0	111.22	107.92	89.24	92.2	60.95	64.58	18.4	17.0	89.40	95.12	1.4	1.8	18.83	18.82
8	Flavo Souvenir	115.6	117.0	87.83	95.94	76.46	81.94	54.08	59.94	16.6	18.2	76.06	82.24	1.8	1.6	17.55	16.20
9	Jester Gold	117.8	119.4	76.44	79.38	65.80	64.96	39.66	40.62	13.2	11.2	94.54	93.42	1.2	1.2	11.88	11.68
10	Hunting Song	103.4	102.6	64.62	65.02	54.36	53.50	26.96	31.30	9.4	10.2	73.74	74.11	1.0	1.0	12.54	12.55
11	Rosibee Red	132.0	133.2	92.66	82.22	80.28	70.38	44.12	42.26	12.4	12.0	84.20	90.78	1.0	1.0	16.29	16.30
12	Princess Margaret Rose	105.2	112.0	78.44	65.76	68.08	55.2	40.72	32.02	12.6	10.2	73.21	83.19	1.0	1.0	11.16	11.25
13	Flavo Laguna	126.4	132.6	75.62	67.60	65.08	54.64	41.28	37.20	15.8	14.2	57.78	61.01	1.6	1.4	11.96	11.97
14	Yellow Stone	126.6	123.6	119.38	118.88	104.38	102.44	56.52	55.92	14.6	16.2	86.18	85.27	4.8	3.2	14.93	14.71
15	Novalux	128.6	121.2	107.38	107.66	94.12	91.74	49.16	48.86	14.2	12.6	78.02	91.19	2.6	2.4	15.53	15.15
16	Ocilla	120.2	118.6	113.12	114.52	100.68	99.04	69.93	73.74	16.6	18.4	80.18	83.71	2.6	2.8	18.08	18.17
17	Limoncello	99.4	116.0	86.52	86.68	77.04	72.28	50.06	49.42	13.6	13.0	107.43	108.85	1.2	1.0	13.65	16.39

Late planting in gladiolus

and rachis length. Number of florets and leaves did not show marked variation. In November planting, number of tillers increased but the stem thickness decreased in most of the varieties.

Three varieties (Snow Princess, Beau Jour and Bean Benton) were plated in December and January to evaluate the effect of planting date on growth and flowering (Table 9). The varieties performed reasonably well and availability of flowers can be extended up to the end of April which is quite remunerative because by this time supply of gladiolus flowers in market gets considerably reduced. However, during this period most of the crops gets matured and incidence of borers concentrates on small emerging spikes. The borers and other sucking pests during the season were recorded and complete pest complex will be recorded in the ensuing season to carry out the cost economics.

Method of Planting

Three gladiolus varieties, White Prosperity, Big Time Supreme and Novalux were evaluated for corm and cormels production by planting them in raised and flat beds. It was found that the method of planting did not affect corms diameter, corms and cormels weight except for the number of corms and cormels which was recorded higher in the raised beds (Table 10).

Chemical Weed Control

The weedicide treatments were applied preemergence. The lowest total weed count was recorded in Atrazin (@1.5 kg a.i./ha) at 25 DAP (11.83/m^2) and at 50 DAP (29.50/m^2). Whereas,

Table 9: Effect of planting dates(Dec-Jan) on growth and flowering in gladiolus

Sr. No.	Variety	Days to spike initiation			Plant height (cm)			Spike length (cm)			Rachis length (cm)			No. of floret /spike			No. of leaves per plant			No. of tillers per plant		
		26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan	26 Dec	10 Jan	21 Jan
1	Beau Jour	73.2	71.5	68.8	95.4	94.5	71.8	78.7	79.2	54.2	46.4	44.0	26.80	13.6	13.2	11.6	6.4	6.0	6.6	1.0	1.0	1.0
2	Ben Venuto	84.6	85.2	71.0	90.0	87.6	93.4	72.3	70.7	70.4	41.0	39.9	38.88	15.6	15.2	13.8	7.0	7.8	8.0	1.0	1.0	1.0
3	Snow Princess	96.2	77.0	-	100.6	113.4	-	89.1	91.4	-	60.1	66.0	-	17.8	18.2	-	7.6	6.2	-	2.0	1.8	-

Table 10: Effect of method of planting on the production of corms and cormels

S.No.	Variety	Novalux		Big Time Supreme		White Prosperity	
	Planting Method	Raised	Flat	Raised	Flat	Raised	Flat
1	No. of corms	3.4	2.0	3.2	2.4	1.2	1.0
2	Av. corm weight (g)	56.75	71.8	44.6	38.6	48.96	44.5
3	Diameter of corms (mm)	64.08	63.85	60.13	55.76	30.4	54.43
4	Number of cormels	47.75	31.6	14.4	11.8	31.0	27.75
5	Weight of cormels (g)	15.5	8.6	4.0	3.3	13.2	15.75

Table 11: Effect of different weedicides on weed population, fresh and dry weight of weeds in gladiolus var. White Prosperity

Sr. No.	Treatment	Weed count/ m^2	Fresh weight of weeds (g)	Dry weight of weeds (g)	Weed count/ m^2	Fresh weight of weeds (g)	Dry weight of weeds (g)	Weed control efficiency (25 DAP)	Weed control efficiency (50 DAP)
	At 25 days after planting	**At 50 days after planting**							
1	Atrazin-1.0 kg a.i./ha	21.16	13.60	4.17	47.16	17.00	4.74	60.32	52.12
2	Atrazin-1.5 kg a.i./ha	11.83	5.17	1.87	29.50	9.67	2.99	82.21	69.80
3	Metribuzin-0.25 kg a.i./ha	33.83	13.33	3.73	37.33	12.00	3.53	64.51	64.34
4	Metribuzin-0.50 kg a.i./ha	25.50	14.82	4.73	33.17	11.50	3.71	54.99	62.52
5	Butachlor-1.0 kg a.i./ha	43.33	14.78	3.84	41.83	14.00	4.24	63.46	57.17
6	Butachlor-1.5 kg a.i./ha	38.50	19.75	5.97	40.17	16.17	4.77	43.20	51.82
7	Pendimethalin-0.75 kg a.i./ha	28.83	18.85	6.04	41.00	15.33	4.89	42.53	50.61
8	Pendimethalin-1.0 kg a.i./ha	25.67	13.83	4.93	31.00	13.17	3.64	53.09	63.23
9	Control (weedy)	153.17	32.38	10.51	180.67	33.29	9.90	-	-
10	Control (weed free)	19.67	7.80	2.41	51.50	15.58	5.09	-	-
	C.D. at 5%	30.41	9.32	3.04	20.14	8.40	2.65	-	-

the highest weed count was recorded in the weedy control at both these stages of crop growth. Significantly higher weed dry weight (10.51 g/m^2) was recorded in weedy control followed by Pendimethalin (6.04 g/m^2), whereas, lowest value was recorded in Atrazin 1.5 kg a.i./ha (1.87) (Table 11).

Plant height was significantly more (112.90 and 107.38cm) under pre-emergence application of Pendimethalin @ 1.0 and 0.75 kg a.i./ha respectively and in weed free control (111.50cm). The spike length and rachis length were significantly affected and were maximum in Pendimethalin 1.0 kg a.i./ha (98.27 and 58.83 cm respectively). The number of florets per spike was significantly higher in weed free control (13.98) followed by Pendimethalin 1.0 kg a.i./ha (13.40). The lowest number of florets were recorded in Butachlor 1.5 kg a.i./ha (9.63). Number of leaves per plant, floret diameter and days to first floret opening was not affected by the application of different pre-emergence herbicides (Table 12).

Pre-emergence application of herbicides did not have any significant effect on the diameter and weight of corm. However, the number of cormels (78.23) and weight of cormels (8.08 g) were maximum in Pendimethalin @ 1 kg a.i./ha and Atrazin 1.5 kg a.i./ha respectively (Table 13).

Chrysanthemum

Growing medium

An experiment with cultivars Anmol and Mother Teresa was laid out to evaluate different potting media compositions for pot mum production. The treatment differed significantly with respect to plant height, number of branches per plant, days to flowering, number of flowers per plant and plant spread whereas flower size and duration of flowering showed non-significant differences. The data presented (cv Anmol) in Table 14 showed that the treatment T_7 (Cocopeat + Sand + FYM + Vermicompost (2:1:0.5:0.5)) gave maximum number of branches per plant (40.26), flower diameter (3.68 cm), number of flowers per plant (213.55), plant spread (21.63cm) and took minimum number of days for flowering (124.63). The minimum number of branches per plant(22.05), number of flowers per plant (143.22),

Table 12: Effect of different weedicides on vegetative and floral characters in gladiolus var. White Prosperity

Sr. No.	Treatment	Plant height (cm)	Spike Length (cm)	Rachis length (cm)	Days to first floret opening	Floret diameter (mm)	No. of florets / spike	No. of florets open at a time	No. of leaves/ plant
1	Atrazin-1.0 kg a.i./ha	95.67	79.12	43.11	122.02	97.76	12.63	5.23	6.23
2	Atrazin-1.5 kg a.i./ha	106.36	90.71	52.25	121.08	97.17	11.53	5.10	6.33
3	Metribuzin-0.25 kg a.i./ha	103.01	93.23	49.33	122.00	93.87	12.03	5.37	6.37
4	Metribuzin-0.50 kg a.i./ha	87.78	75.55	37.98	126.70	95.97	9.76	5.20	6.27
5	Butachlor-1.0 kg a.i./ha	98.38	83.79	37.92	124.90	97.18	11.00	4.88	6.53
6	Butachlor-1.5 kg a.i./ha	88.39	75.44	40.50	126.55	90.40	9.63	5.27	6.22
7	Pendimethalin-0.75 kg a.i./ha	107.38	94.78	52.88	125.57	96.94	12.10	5.30	6.55
8	Pendimethalin-1.0 kg a.i./ha	112.90	98.27	58.83	122.72	92.47	14.13	5.23	6.30
9	Control (weedy)	76.68	79.34	36.26	122.51	99.04	9.06	4.83	6.27
10	Control (weed free)	111.51	91.88	57.06	117.13	93.82	14.20	5.20	6.50
	C.D. at 5%	22.31	15.07	14.35	4.14	12.06	4.29	0.52	0.33

Table 13: Effect of different weedicides on corm characters in gladiolus var. White Prosperity

Sr. No.	Treatment	No. of corms per plant	Diameter of corm (mm)	Weight of corm (g)	No. of cormels per plant	weight of cormels per plant (g)
1	Atrazin-1.0 kg a.i./ha	1.53	42.08	19.10	6.88	2.43
2	Atrazin-1.5 kg a.i./ha	1.03	40.03	21.25	27.23	8.08
3	Metribuzin-0.25 kg a.i./ha	1.00	37.71	12.48	18.50	3.48
4	Metribuzin-0.50 kg a.i./ha	1.07	30.62	8.40	21.49	6.75
5	Butachlor-1.0 kg a.i./ha	1.10	36.30	17.75	14.19	5.48
6	Butachlor-1.5 kg a.i./ha	1.03	34.64	9.93	19.23	4.09
7	Pendimethalin-0.75 kg a.i./ha	1.00	36.88	14.98	18.02	5.74
8	Pendimethalin-1.0 kg a.i./ha	1.07	37.21	12.68	28.60	6.32
9	Control (weedy)	1.00	34.68	17.06	10.52	4.98
10	Control (weed free)	1.14	33.47	11.52	18.29	4.29
	C.D. at 5%	0.46	9.28	12.62	15.01	3.06

plant spread(14.22cm) and flower diameter (2.96 cm) were recorded with treatment T_4 (Cocopeat).

Similarly in cultivar Mother Teresa T_7 (Cocopeat + Sand + FYM + Vermicompost (2:1:0.5:0.5)) gave maximum plant height (37.23), number of secondary branches per plant (18.14), flower diameter (3.64 cm), number of flowers per plant (137.00), plant spread (26.89cm), duration of flowering (27.14 days) and also days taken to flowering(131.2days) followed by T_6 (Cocopeat + Sand + Vermicompost (2:1:1)) and T_3 (Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5) (Table 15).

Table 14: Effect of media composition on pot mum production in cultivar Anmol

Treatment	Plant height	No. of branches per plant	Days to flowering	Flower Size (cm)	Duration of flowering	No. of Flower per plant	Plant Spread
T1=Soil+Sand+FYM (2:1:1)	15.52	26.23	131.33	2.98	18.45	194.26	14.25
T2=Soil+Sand+ Vermicompost (2:1:1)	18.45	40.10	126.17	3.38	22.42	196.15	19.56
T3=Soil+Sand+FYM+ Vermicompost (2:1:0:5.0.5)	20.31	38.66	125.95	3.29	23.38	206.34	20.23
T4=Cocopeat	16.69	22.05	129.60	2.96	21.02	143.22	14.22
T5=Cocopeat+Sand+ FYM (2:1:1)	13.28	25.62	128.66	3.41	19.84	149.56	15.89
T6=Cocopeat+Sand+ vermicompost (2:1:1)	17.68	22.23	127.07	3.56	20.55	165.47	18.66
T7=Cocopeat+Sand+ FYM+Vermicompost (2:1:0.5.0.5)	18.88	*40.26*	*124.63*	*3.68*	*22.13*	*213.55*	*21.63*

Table 15: Effect of media composition on pot mum production in cultivar Mother Teresa

Treatment	Plant Height (cm)	No. of Secondary branches/ plant	Days taken to flowering	Flower diameter (cm)	Duration of flowering (days)	No. of flower/ plant	Plant spread (cm)
T1 = Soil+Sand+FYM (2:1:1)	27.21	15.36	122.5	2.56	20.61	130.67	17.45
T2 = Soil+Sand+Vermicompost (2:1:1)	31.45	15.98	124.31	2.98	21.14	126.27	20.25
T3=Soil+Sand+FYM+ Vermicompost (2:1:0:5.0.5)	31.68	14.52	127.36	3.02	22.05	127.57	23.67
T4=Cocopeat	30.74	16.55	127.34	2.23	18.66	124.03	21.42
T5=Cocopeat+Sand+ FYM (2:1:1)	32.22	15.83	125.31	2.99	23.61	123.00	17.68
T6=Cocopeat+Sand+ Vermicompost (2:1:1)	35.41	16.48	126.32	3.15	24.32	129.83	24.39
T7=Cocopeat+Sand+ FYM+Vermicompost (2:1:0.5.0.5)	27.23	18.14	131.2	3.64	27.14	137.00	26.89

Growth Regulation

The effect of plant growth regulators on *Chrysanthemum morifolium,* variety Dolly Orange was studied. Treatments C- Control, T1- GA3 (50 ppm), T2- GA3 (100 ppm), T3- IBA (50 ppm), T4- IBA (100 ppm), T5- Ascorbic Acid (100 ppm) and T6- Ascorbic Acid (200 ppm) were applied at 15 days interval (10th Oct-10th Nov), as foliar spray. Morphological parameters like plant height, number of primary and secondary branches, no. of flowers and bud growth rate was observed. Almost all the treatments showed positive results.

Tuberose

Eight Single petalled cultivars of tuberose namely Mexican Single, Shringar, Prajwal, Arka Nirantara, Phule Rajani, Sikkim Selection, Hyderabad Single and GKTC-4 were evaluated for

their suitability for vegetative, floral and bulbous characters. In Double petalled tuberose, six cultivars namely Pearl Double, Suvasini, Vaibhav, Swarna Rekha, Hyderabad Double and STR-505 were evaluated for growth, flowering and bulb parameters. Among these cultivars Swarna Rekha performed poorly and only a few (10%) plants produced spikes. Among these cultivars, Prajwal and Arka Nirantara in single type and Suvasini and Vaibhav in double types performed better over others in terms of vegetative, floral and bulb characteristics.

Weed management

Four herbicides namely, Atrazine, Pendimethalin, Butachlor and Metribuzin were tried separately and in combinations as pre-emergent application in tuberose. Metribuzin or Pendimethalin proved effective in controlling weed population.

Other ornamentals

The directorate has also undertaken experiments to study the growth, flowering and bulb production behaviour in some temperate ornamentals such as Lilium, Ranunculus, Iris, anemone, chinchirinchee and daffodil/narcissus. In lilium and ranunculus encouraging results have been obtained in the experiments on second year old bulbs on growth and flowering. Iris and daffodil

Cut flower production in Iris

Bulbous ornamentals : Ranunculus

Experimental field view in Lilium

exhibited poor flowering. The above bulbs have been harvested and stored in cold storage for further evaluation.

Post Harvest Management

Gladiolus

In gladiolus, 27 varieties (Table 16) were evaluated for their vase life (days) in distilled water and were classified into three different categories

Post harvest studies in gladiolus

Table 16: Post-harvest studies in different varieties of gladiolus

Sr. No.	Variety	No. of florets open at a time when 1st floret started wilting	Vase life (days)	Water uptake (ml)
1	Invitatie	6.00	13.80	126.00
2	Argentina	7.00	14.50	125.25
3	Plum Tart	5.25	13.25	124.50
4	Purple Flora	5.60	8.20	108.00
5	Verona	5.25	12.75	133.25
6	Pink Friendship	4.75	12.25	113.00
7	Pricilla	4.67	14.00	123.67
8	Blues	3.50	8.50	109.50
9	Limoncello	5.00	10.8	119.50
10	Forta Rosa	5.75	14.00	128.75
11	Amasterdam	6.25	12.00	127.50
12	Fidelio	5.33	10.75	104.75
13	Ocilla	4.75	11.75	114.25
14	Snow Princess	3.33	11.75	125.00
15	Novalux	6.50	12.25	116.25
16	Yellow Stone	6.40	11.75	123.50
17	Chemistry	5.25	7.00	109.50
18	Lemon Drop	5.00	11.25	118.25
19	Big Time Supreme	5.25	13.00	123.75
20	Jester	4.25	11.00	121.25
21	Rosibee Red	5.75	11.00	115.00
22	White Prosperity	6.00	13.50	120.50
23	Gold Field	7.00	11.75	118.75
24	Flavo Sovenior	5.25	13.25	117.25
25	Chandni	5.00	11.25	90.00
26	Flavo Amico	3.75	11.50	35.75
27	Flavo Laguna	4.25	11.00	49.25

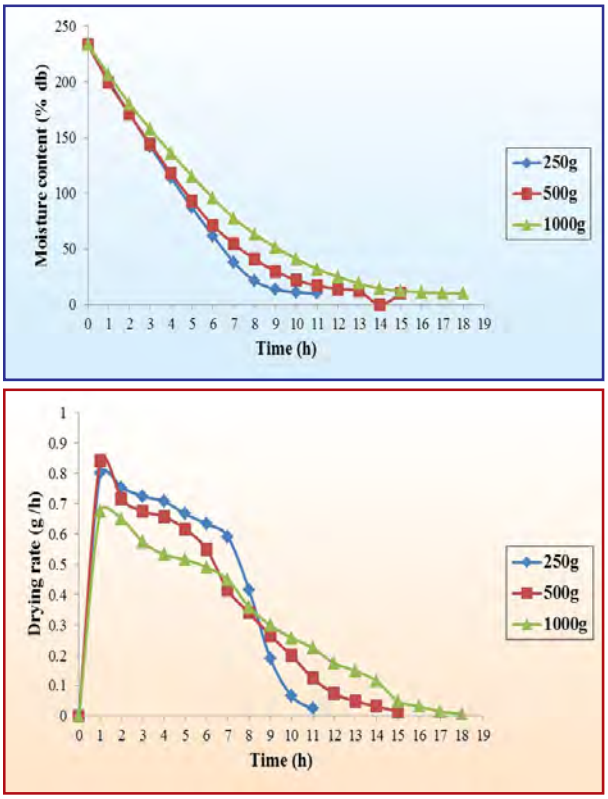
i.e. longer (12-14 days), medium (9-11 days) and short (< 9 days). Among different varieties Invitatie, Flevo Souvenir, Argentina, Plum Tart, Amsterdam, Priscilla, Verona, Pink Friendship, White Prosperity, Big Time Supreme had longer vase life (i.e. 12-14 days of vase life); whereas, varieties Fidelio, Ocilla, Snow Princess, Yellow Stone, Lemon Drop, Jester, Rosibee Red, Gold Field, Chandani recorded 9-11 days of vase life and Blues, Purple Flora and Chemistry showed poor vase life (4-6 days).

Besides, for formulating ready to serve floral preservatives, chemical preservatives such as sugars (glucose, fructose, and sucrose); mineral/metallic salts (Aluminium sulphate, Cobalt chloride, Calcium nitrate, Zinc sulphate etc.) individually and along with biocide (HQC), and acidifier (Citric acid) were

evaluated in gladiolus cv. Gold Field for vase life studies under laboratory conditions.

Dry Flowers

The drying kinetics of Limonium under convection drying was analysed at 60°C. To reduce the drying time the fully matured flower stage was taken for the analysis. The flowers along with 20cm stem were tied into bundle of 250g, 500g and 1000g and were inverted inside the convective drier.



Drying kinetics - limonium

The kinetics of drying was analysed with moisture loss and drying rate curves.

The final moisture content was maintained as 15 per cent (db) to avoid shattering of flowers and the bundle size of 500g has been optimized as per the drying time. Apart from flowers, trials on the drying characteristics of florist greens like Asparagus and ferns have also been undertaken.

The dried flowers of acroclinum, helichrysum and brumus were packed in LDPE 200 gauge bags

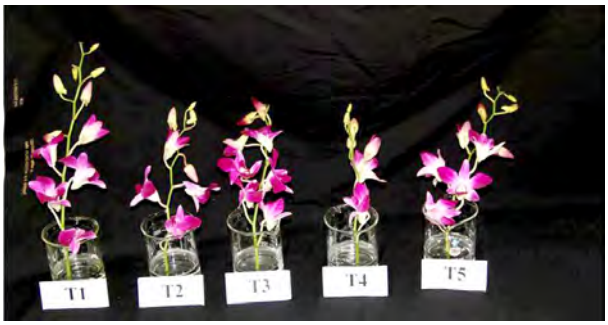
Floral crafts from dry flowers

and stored in carton boxes for one year. The quality retention of these flowers during storage was visually compared with the freshly dried samples for colour change with the help of colour charts. The colour

Dry flowers: Pre and Post storage colour comparison

retention of Helichrysum flowers was better than others whereas slight discoloration was observed in limonium and brumus and in acroclinum the disc portion turned black in storage.

Trials on wet drying of flowers were also conducted using glycerol as the medium of drying for orchids. Different concentrations of glycerol were taken and the experiment was carried out at two different solution temperatures, *viz.*, room temperature and at 45°C. It has been found that 30 per cent glycerol was better in terms of solution uptake and drying time. At 45°C solution temperature the flower shattering was more. Other parameters like lowering the solution pH, addition of sucrose and plant growth regulators did not show significant effect on the drying process. Addition



Glycerol drying of orchids

of Sodium sulphate reduced the colour change during drying.

Nutraceutical studies in flower crops

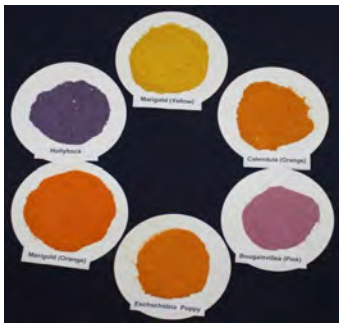
Nutraceutical Analysis

Five Marigold cultivars namely, Pusa Narangi Gainda, Pusa Arpita, Serakal, Inca Orange and Sunset orange were screened for the carotenoid extraction and analysis in uv-vis spectrophotometer. It was found that cultivar Pusa Narangi Gainda contains higher amount of carotene (863 mg/100g) among others. Besides marigold, the nutraceutical analysis was also carried out in Nasturtium. A comparative study was done with the marigold and nasturtium on different parameters (Table 17).

Marigold cultivars evaluated for pigment content

Natural Dye Extraction

In place of synthetic colours, the importance of natural colour in a greener world is of paramount



Natural colours from different ornamentals

Natural Dye tested on silk fabric

Table 17: Comparative biochemical study in Marigold and Nasturtium

S.No	Parameter	Marigold (*Tagetes erecta* L.)	Nasturtium (*Trapaeolum majus* L.)
1.	Mosture content(%)	91.3%	92.9%
2.	TSS (Brix)	2.3	8.7
3.	Total Chlorophyll in Petal (mg/100g)	0.024	0.049
4.	Total Carotenoid (mg/100g)	716.0	431.5
5.	Lycopene (mg/100g)	58.0	40.8
6.	Anthocyanin	120.2	924.8
7.	CUPRAC (mol/trolox/g)	63.77	19.91
8.	Vit. C (mg/100g)	98.3	125.4

importance and therefore, some natural dye in powder and aqueous form has been extracted. Preliminary observations have been made on ornamentals such as Marigold, Calendula, Eschscholzia, Poppy, Corn Flower, Hollyhock, Nasturtium, Phlox, Pansy, Bougainvillea, *Antigonon leptopus*, Gulmohar and Amaltas. These natural colours are stored in various conditions to observe the colour retention and the liquid dyes are being tested in different fabrics.

Plant Protection

An unidentified leaf scraper/ defoliator was recorded infesting late planted gladiolus germplasm, though the incidence level was low. Bud borer (*Helicoverpa armigera*) incidence though at low

Bud borer damage in gladiolus buds

Thrips damage in tuberose plants

level was recorded on flower buds of some gladiolus cultivars. Gladiolus thrips damage was also recorded during February to March. In tuberose, grubs were

Grubs damage in tuberose

recorded to be feeding on the roots of c.v. Vaibhav, however no visual symptoms were noticed. Low level of thrips infestation was also recorded during February to March. Both spray and standard type chrysanthemum were infested with insects in varying proportions. Standard type chrysanthemum

Aphid infestation in chrysanthemum flower

Spodoptera litura infestation

have more insect damage. The insects along with their level of incidence are given in Table 18.

Flowering Annuals

Among the different pollinators recorded on flowering annuals, honey bees were the major flower visitors followed by hover flies and other hymenopterans. The activity of pollinators on different flowering annuals is given in the Table 19.

Pollinators in flowering annuals

Table 18: Insect recorded on chrysanthemum

Insect	Incidence level	Plant part affected
Spray type chrysanthemum		
Bihar hairy caterpillar, *Spilosoma obliqua*	Moderate	Leaves and flowers
Lacewing bug	Low	Growing tips
Mirid bug	Low	Foliage
Whitefly	Low	Foliage
Standard type chrysanthemum		
Aphid (unidentified)	Severe	Flower buds
Aphid, *Macrosiphoniella sanborni*	Moderate	Growing tips
Bud borer, *Helicoverpa armigera*	Moderate	Flower buds
Grasshopper	Low	Older leaves
Leaf folder	Moderate	Growing tips
Mealy bug, *Phenacoccus solenopsis*	Moderate	Growing tips
Mirid bug	Low	Foliage
Tobacco caterpillar. *Spodoptera litura*	Moderate	Leaves

Table 19: Pollinator activity on different flowering annuals

Crop	Honey bee			Hover fly	Other pollinators
	Apis dorsata	*A. cerena*	*A. mellifera*		
Annual chrysanthemum	High	Moderate	Moderate	Low	Low
Antirrhinum	High	Low	Moderate	—	Low
Bells of Ireland	High	High	Low	—	Low
Calendula	Low	High	Low	Moderate	Low
California poppy	Low	High	—	Moderate	—
Coreopsis	Low	High	—	—	—
Cosmos	High	High	Moderate	—	Low
Cornflower	High	—	Low	Low	—
Dimorphotheca	—	Moderate	—	Low	Low
Gaillardia	High	High	—	—	—
Nasturtium	High	Moderate	Moderate	—	Moderate
Pansy	Low	High	—	—	Moderate
Sweet sultan	Moderate	High	Low	—	Low

Externally Funded Projects

Validation of DUS testing guidelines in gladiolus (*Gladiolus* (Tourn) L.) and tuberose (*Poliantheus tuberosa*)

The work has been initiated at DFR to develop the DUS test guidelines. Work has been initiated with 25 varieties (Table 20) of gladiolus and 15 varieties of tuberose (Table 21).

Table 20: Preliminary descriptors list in gladiolus

1.	Plant: height (5 states)	27	Inner tepal: length of stripe
2.	Foliage: height	28	Inner tepal: width of stripe
3.	Leaf: Width (3 states)	29	Inner tepal: colour of stripe
4.	Leaf: curvature of distal half	30	Inner tepal: macule
5.	Inflorescence: lateral branches	31	Inner tepal: position of macule
6.	Spike : length	32	Inner tepal: size of macule in relation to size of inner tepal
7.	Spike : number of flowers	33	Inner tepal: shape of macule
8.	Spike : number of open flowers	34	Inner tepal: main colour of macule
9.	Spike : length of internodes	35	Inner tepal: secondary colour of macule
10.	Spike : arrangement of flowers	36	Inner tepal: margin of macule
11.	Bract : shape of apex	37	Inner tepal: different colour of marginal zone
12.	Bract : anthocyanin colouration	38	Inner tepal: width of marginal zone
13.	Flower : shape in front view	39	Inner tepal: border of marginal zone
14.	Flower : attitude	40	Inner tepal: colour of marginal zone
15.	Flower: width	41	Median inner tepal : attitude
16.	Flower : main colour	42	Only varieties with flower: shape of upper part in front view: triangular: median inner tepal : attitude of apex
17.	Flower: shading of main colour (excluding multicoloured varieties)	43	Filament : main colour
18.	Perianth tube: length	44	Filament : small spots at base
19.	Perianth tube: number of spots on inner side	45	Filament : colour of apex compared to main colour
20.	Perianth tube : distribution of spots on inner side	46	Anther : colour of connective tissue
21.	Perianth throat : number of spots on outer side	47	Anther : colour of stomium
22.	Perianth throat: colour of spots on outer side	48	Style: main colour (excluding base)
23.	Outer tepal: shape of blade	49	Style: colour of base
24.	Outer tepal: undulation of margin	50	Style: colour of branches
25.	Inner tepal : undulation of margin	51	Corm : colour of flesh
26.	Inner tepal: Stripe	52	Time of beginning of flowering

TABLE 21: Preliminary descriptors list in Tuberose (*Polianthes tuberosa*)

1	Leaf colour	16	Flower opening – Bold, shy
2	Leaf type: Green/variegated/Non Variegated	17	Stigma – Prominent/Inconspicuous
3	Flower type: single/double	18	Seed setting-Profuse, Scanty, No seed set
4	Fragrance: present/absent	19	Days taken for flowering
5	Bud colour:	20	Plant height
6	Tepal – Acute, obtuse, ovate, obovate	21	Length & Breadth of leaf
7	No. of tepals	22	Spike length
8	Perianth – broad, medium, narrow	23	Spike diameter
9	Spike – straight/bent	24	No. of florets/spike
10	Lateral branches in spike – present/absent	25	No. of florets open at a time
11	Floret arrangement – compact/sparse	26	Density of florets
12	Flower length and breadth	27	Arrangement of florets
13	Bud length and breath	28	Tepal length
14	Flower tube-Bent/Straight/Upright	29	Tepal Breadth
15	Anthers – Number	30	Floret shape

Institutional Building

Foundation Day Celebration

The Directorate celebrated its 3rd foundation day on January 9, 2013 in its research farm. The chief guest of the function was Dr. Umesh Srivastava, ADG (Hort.), ICAR. Besides, a number of dignitaries including Dr. W.S. Dhillon ADG (Hort-I), Dr. R.L. Misra, Former Project Coordinator, Dr. S.P.S. Raghava, Former Project Coordinator, Dr. T. Janakiram, Head, Floriculture and Landscaping, Dr. Pritam Kalia, Head, Division of Vegetable science, and other Head of the Divisions of IARI, Unit In-charges of FOSU, CPCT, Scientists, press & media representative were present to mark the occasion. The guests and visitors appreciated the efforts made by DFR in the collection of large germplasm of Chrysanthemum and gladiolus within a short span of time.

Agricultural Education Day

To create awareness among the public with regard to opportunities in agriculture an agricultural education day was organised on 7th March 2012 during Pusa Krishi Vigyan Mela. A large number of students, farmers and other stakeholders attended the event. The visitors were exposed to latest technologies related to cut flower production.

Hindi Diwas

To promote Hindi as official language, Hindi Pakhwada/Hindi Divas/Hindi official language week was organised from 14th September to 30th

Hindi Diwas Celebration

Foundation Day Celebrations






September 2012. The Director, DFR inaugurated the event and encouraged the staff members to use Hindi as official language to carry out the official activities for the better understanding and smooth functioning. The events were presided by Mr. A.K. Maithani, AO.

During the Hindi language week various competitions such as official noting and drafting, essay writing, debate, poem citation, quiz competition etc. were organized among all the scientific and administrative staff members of the Directorate. The winners were awarded with prizes and certificates to augment the interest on Hindi as official language.

Vigilance week

Vigilance awareness week was celebrated in the Directorate from 29th October 2012 to 3rd November 2012. The observance of the vigilance week commenced with the pledge taken by all the staff members to bring integrity and transparency in all aspects of work and work unstintingly for eradication of corruption in all aspects of life and work to bring reputation to our organisation. The theme of the awareness week was to bring transparency in public procurement.

Renovation of Laboratories/Office/ Farm store

The Directorate of Floricultural Research is functioning at the erstwhile Post Harvest Division building of IARI, New Delhi. The cabins of the scientists were renovated and two laboratories were made with granite top centre and side tables. The office room was also renovated and proper flooring was made. A store room has been renovated and converted in a committee room. Besides this, the ground floor has been earmarked as administrative block. A common room facility and a library is also being developed within the building. In the research farm, efforts were made for keeping the farm items properly with the renovation of store. Iron racks, boxes were procured for safe keeping of propagating materials (bulbs, seeds, etc.,) implements, tools, etc.

Procurement of Equipments

In order to strengthen the research at the Directore, efforts were made during 2012-13 to procure various equipments such as Digital Camera, High speed refrigerated centrifuge – Table top, Gel documentation system, Environmental Test kit, Stereo Binocular Microscope, Double distillation Unit, Humidifier, Electronic balance, Deep freezer (-20°C), BOD Incubator, Seed germinator, Freezer cum humidity chamber, Water Bath, DSLR Camera, Color chart, Hot Air oven, Cabinet drier, Refrigerators, UV-Vis Spectrophotometer, Insect cabinets, pH meter, Conductivity meter and Magnetic stirrer with hot plate.

Laboratory facility at Directorate

XXII Annual Group Meeting of AICRP on Floriculture

The XXII Annual Group Meeting of AICRP on Floriculture was organized at YASHADA, Raj Bhawan Complex, Pune, Maharashtra, during 29 – 31 January, 2013. The meeting was organized to review the performance of various activities at different

Lighting of Lamp

centers and also to reorient the ongoing programmes and activities to meet the present challenges. Besides the presentation of work done by the centers under the different sections, experts on plant health management, production system, crop improvement and post harvest technology were also invited during

Partricipants in the group meeting

the session to give their inputs for development of technical programme in a manner which addresses the emerging needs and takes care of the task earmarked in the 12th plan. Close to vicinity of Pune many private Hi-Tech floriculture projects have emerged and few of them were visited by the participants during the Group Meeting.

Dr. Ramesh Kumar, Director, DFR, presented project coordinator's report by giving brief account of activities undertaken during the last year. He informed the house that all centers have performed well during the reporting period. He reported the development of cultivars at PAU, Ludhiana; MPKV, Pune; IIHR, Bengaluru and IARI, New Delhi centers. Dr. P. Das, Chairman of Research Advisory Committee, DFR discussed the development of floriculture in the country and emphasized that much more efforts are needed to make floriculture a vibrant enterprise for stakeholders.

Dr. T.A. More, V.C., MPKV, addressing the participants

Dr. T. A. More, Vice-Chancellor, MPKV, Rahuri and Chief Guest of the meet, gave the overview of floricultural industry in Maharashtra. He suggested the commercial floriculture should have industrial approach to meet the growing demands of flowers and landscape materials. He emphasized the importance of hi-tech floriculture units in meeting

Visit to Hi-Tech Floriculture Unit

the growing needs. Dr. Umesh C. Srivastava, ADG (Hort–II), ICAR and The Guest of Honour in his address mentioned the role of floriculture in the coming years considering the changing lifestyles, rapid urbanization, increasing population and thereby emphasized upon the challenges faced by

Technical Session in progress

floriculture due to declining land and water resources and climate change. He also briefed about the historical perspective of All India Coordinated Projects for their unique research mechanism developed by ICAR and desired that AICRP on Floriculture must reorient its research programmes to address the present challenges. He also emphasized on the focus given to horticulture particularly to floriculture in the XII Five Year Plan. Dr. Srivastava also appreciated the efforts made by MPKV, Rahuri and YASHADA, Pune in providing necessary facilities for smooth conduct of the group meeting.

Three technical bulletins namely, "Status of Floriculture in Maharashtra", "Quality Rose Production under Protected Condition" and "Post Harvest Technology of Cut Flowers" were released by the chief guest during the inaugural session.

Release of Publications

The achievements made during the last year were reviewed under 6 different technical sessions chaired by Floricultural experts from across the country.

Brainstorming and Interactive Session for Streamlining of Futuristic Research in Floriculture

On the basis of the recommendations of RAC meeting held on 29/06/2012, the Brainstorming and Interactive Session for Streamlining of Futuristic Research for the Directorate of Floricultural Research (DFR) was held under the Chairmanship of Prof. P. Das on 29th January 2013 at YASHADA, Raj Bhawan Complex, Pune. A large number of resource persons/stakeholders from various research institutes/floriculture industry attended the session and shared their views.

Brainstorming Session in progress

The various issues were deliberated at length during the session. The session concluded with the recommendation that efforts should be focussed to provide:

- Disease free quality planting materials at affordable price.
- Scientific support to the farmers from planting to marketing to ensure better returns.
- Considerable value for farmers produces through market networking and auction centres.

Meetings of RAC/ IRC/ IMC

Institute Management Committee (IMC)

Directorate of Floricultural Research conducted its second Institute Management Committee meeting on 14.08.2012. The IMC approved the procurement of spill over equipment of the XI FYP and also approved the procurement of new equipment amounting to Rs. 25 lacs. The list of members of IMC is given as under.

Institute Management Committee

1. Dr. Ramesh Kumar, Director, Directorate of Floricultural Research, New Delhi	Chairman
2. Joint Director, Govt. of Delhi, New Delhi	Member
3. Dr. S. P. Joshi, Joint Director, Deptt. of Horticulture and Food Processing, Govt of UP, Lucknow	Member
4. Dr. Satya Prakash, Prof and Head, Dept. of Horticulture, Sardar Vallabh Bhai Patel University of Agrl. & Tech, Modipuram, Meerut	Member
5. Mrs. Megha Borse, President, Floriculture Association, Nasik	Member
6. Mr. Jaffar N. Nagvi, Chief editor (Floriculture Today) & Director, Media Today, New Delhi	Member
7. Dr. R.C. Srivastava, Joint Director, Botanical Survey of India, Kolkatta	Member
8. Dr. M. Jawaharlal, Prof. & Head, Horticulture College & Research Station, Tamil Nadu Agriculture University, Coimbatore	Member
9. Dr. T. Jankiram, Head, Division of Floriculture and Landscaping, IARI, New Delhi	Member
10. Dr. N. Ramachandra, PS, IIHR, Bangalore	Member
11. FAO, IASRI, New Delhi	Member
12. Mr. Anil Maithani, Administrative Officer, DFR	Member secretary

Research Advisory Committee

The 2nd meeting of the Research Advisory Committee (RAC) of the Directorate of Floricultural Research (DFR) was held under the Chairmanship of Prof. P. Das on 29th June 2012 in the Committee Room of the Directorate of Maize Research (DMR),

IARI Campus, Pusa, New Delhi. The list of RAC Members is given under:

Prof. P. Das, Chairman, RAC while appreciating the achievements desired the DFR to work harder to fulfil the aspirations of the flower growers of the

country. He strongly felt the need for basic and strategic research on flower crops. Since the general aspects on cultivation, post harvest handling etc is being entrusted to the participating centres of the AICRP (Floriculture) to address the regional

Research Advisory Committee

S. No.	Name	Designation	Committee
1.	Prof. P. Das	Chairman, The Science Foundation for Tribal and Rural Development, C-122 (HIG), Odisha Housing Colony, Baramunda, Bhubaneshwar-751003 (Odissa)	Chairman
2.	Prof. V. P. Ahlawat	Professor, Department of Horticulture, Chaudhary Charan Singh Haryana Agricultural University, Hisar -125004 (Haryana)	Member
3.	Prof. S. P. Vij	NASI Senior ScientistHouse No. 1458, Sector – 15 Panchkula-134113 (Haryana)	Member
4.	Dr. R. C. Upadhyaya	Former Director, National Research Centre for Orchids, Pakyong. House No. 431, Sector-46, Faridabad (Haryana)	Member
5.	Dr. J. S. Arora	Former Head, Department of Floriculture, PAU, Ludhiana	Member
6.	Sh. Sanotsh Attawar	CEO, Indo-American Hybrid Seeds Pvt. Ltd.	Member
7.	Dr. Ramesh Kumar	Director, Directorate of Floricultural Research, IARI Campus, Pusa, New Delhi-110012	Member
8.	Dr. Umesh C. Srivastava	Assistant Director General (Horticulture-II), ICAR, KAB-II, Pusa, New Delhi-110012	Member
9.	Ms. Megha Borse	President, Flower Growers Association (Maharashtra), First Floor, Nadkarni Chambers (Annex), Vakilwadi Nasik-422001 (Maharashtra)	Member
10.	Mr. Jaffar S. Naqvi	Chief Editor (Floriculture Today), T-30, First Floor, Khirki Extension, Malviya Nagar, New Delhi-110078	Member
11.	Dr. K. P. Singh	Principal Scientist, Directorate of Floricultural Research, IARI Campus, Pusa, New Delhi-110012	Member-Secretary

problems; the DFR should take the leadership role in basic research but , not to repeat the work already done or being done at the participating centres under AICRP (Floriculture).

Some of the salient recommendation made by the RAC for streamlining research activities are as under:

- To complete database of total research work done on various commercial ornamental crops need to be taken up.
- Efforts may be made in crop improvement for breeding varieties through mutagenesis.
- Year round production of flowers through photoperiodic regulation need to be taken up in chrysanthemum.
- The national repository of germplasm of commercial flower crops need to be made at DFR.
- Research need to be undertaken on important diseases and pests under hi-tech greenhouse units.
- A large collection of Bougainvillea, Hibiscus, Palms, Cactus and succulents may be made in the begining and later research on landscape components need to be initiated.
- Marigold varieties need to be evaluated for Xanthophyll content.
- DFR need not to repeat AICRP (Floriculture) projects.
- A brainstorming session may be organised to refine research programmes.

Institute Research Council (IRC)

The Directorate of Floricultural Research organized its 2nd IRC meeting on 18th April 2012 to review the progress of the ongoing research projects. The meeting was chaired by Dr. Ramesh

Kumar, Director DFR and Dr. J.S. Arora and Dr. R.L. Mishra were the experts and reviewed the progress made by the Scientists in their respective

IRC meeting in progress

projects. Dr. Naveen Kumar, Incharge, PME Cell presented the overall status of the ongoing in-house and externally funded projects and shared the previous RAC recommendations. The experts appreciated the progress made by the scientists despite the availability of limited resources.

List of In-House Research Projects at DFR

S.N	Mega Projects	PI	Co-PI
01	**Improvement of commercial flower crops**	**Dr. Gunjeet Kumar**	
	Project 01		
	Breeding of gladiolus for quality and yield	Dr. Ganesh B. Kadam	Dr. Gunjeet Kumar Dr. T. N. Saha Dr. A. K. Tiwari
	Project 02		
	Breeding of chrysanthemum for quality flower and pot mum production	Dr. T. N. Saha	Dr. Gunjeet Kumar Dr. Ganesh Kadam Dr. Puja Rai
	Project 03		
	Breeding of tuberose for novel colour and oil recovery	Dr. Jayoti Majumder	Dr. K. P. Singh Dr. A. K.Tiwari
	Project 04		
	Improvement of flowering annuals	Dr. Gunjeet Kumar	Dr. T. N. Saha Dr. Jayoti Majumder
	Project 05		
	Improvement of lawn grasses for turf	Dr. A. K. Tiwari	Dr. K. P. Singh Mr. Girish, K. S.
02	**Standardization of production technology in commercial flower crops**	**Dr. K. P. Singh**	
	Project 01		
	Standardization of agro-techniques for improving quality production in gladiolus, chrysanthemum & annuals	Dr. Gunjeet Kumar	Dr. T.N. Saha Dr. Ganesh B. Kadam Mrs. Sellam, P. Dr. Babita Singh Mr. Girish, K.S.
	Project 03		
	Production technology of tuberose	Dr. Krishan Pal Singh	Dr. Gunjeet Kumar Dr. Babita Singh
03	**Post-harvest management and value addition**	**Dr. A. K. Tiwari**	
	Project 01		
	Development of ready to serve floral preservatives for commercial flowers	Dr. Babita Singh	Dr. A.K. Tiwari Mrs. Sellam, P. Dr. Puja Rai
	Project 02		
	Standardization of drying techniques for flowers and greens	Ms. P. Sellam	Dr. Jayoti Majumder
	Project 03		
	Nutraceuticals studies on flower crops	Dr. Jayoti Majumder	Dr. Babita Singh Dr. Puja Rai Mrs. Sellam, P.
04	**Plant protection of commercial flower crops**	**Mr. Girish, K.S.**	
	Project 01		
	Insect pest management of commercial flower crops	Mr. Girish, K.S.	Dr. Ganesh B. Kadam

Externally Funded Projects

S.No	Project Title	Sponsored by	PI	Co-PI
1	Validation of DUS Testing Guidelines For Tuberose (*Polianthes tuberosa* L.)	PPV&FRA	Dr. Gunjeet Kumar	Dr. T.N. Saha
2	Validation of DUS Testing Guidelines For Gladiolus (*Gladiolus* (Tourn) L.)	PPV&FRA	Dr. Ajai Kumar Tiwari	Dr. Gunjeet Kumar Dr. Ganesh B. Kadam

Transfer of Technology

Participation in Pusa Horticulture Show

The Directorate of Floricultural Research participated in the annual Pusa Horticulture Show on March 4-5, 2013 organized by Delhi Agri-Horticulture Society at IARI, New Delhi. On this occasion, flower exhibits of different varieties of

Mrs. Gupta, wife of Director, IARI and Dr. Malavika Dadlani, Joint Director (Res.), IARI visiting DFR stall

bulbous ornamentals such as gladiolus, iris, daffodils, etc and various flowering annuals; marigold and potted plants; literature on technical information; etc. were displayed. The information on germplasm collection, new varieties and latest technologies in flower cultivation developed by different centres of AICRP on Floriculture were put on display. The live specimens of flowers and ornamentals were highly appreciated by the distinguished visitors and flower lovers. The stall was visited by large no. of dignitaries flower growers, nurserymen, amateurs, scientists and students.

Participation in Pusa Krishi Vigyan Mela

To strengthen the linkage with farmers, The Directorate, participated in Pusa Krishi Vigyan Mela on the theme "Agricultural Technologies for Farmers Prosperity" organized by IARI, New Delhi on 6-8 March 2013. The live specimens of flowers along with copies of publications and other floriculture related literature were displayed during the mela. Many dignitaries like Honourable Ministers Shri. Harish Rawat and Sh. Charan Das Mahant; Dr. N.K. Krishna Kumar, Hon,ble DDG (Horticulture) ICAR; Dr. U.C. Srivastava, ADG

Dr. N.K. Krishna Kumar, DDG (Hort.) and Dr. U.C. Srivastava, ADG (Hort.) visiting Directorate stall

(Hort) ICAR, Dr. W. S. Dhillon, ADG (Hort) ICAR; Director IARI, Director NBPGR, Directors of ICAR institutes, Head of divisions of IARI and many farmers from various states, scientists, students, amateur gardeners, flower lovers and representative of press and media visited the stall. The Directorate bagged the **Best Stall Award** in the Mela among

Mrs. Ayyappan, wife of Hon'ble DG, ICAR visiting DFR stall

Dr. W.S. Dhillon, ADG (Hort-I), ICAR distributing certificate to participants

ICAR institutes. Pusa Krishi Vigyan Mela is one of the largest platforms for dissemination of agricultural technologies.

Farmers Training

The Directorate has conducted two training programmes for the farmers of Uttarakhand and Himachal Pradesh on 1-5 and 7-12 January 2013 respectively. The aim of training was to educate and expose the farmers to the new technologies in the flower production and propagation methods. Scientists from diverse field delivered lectures on different topics including crop production technologies, INM, crop protection, post harvest management, dry flowers *etc*. The farmers have been taken to the DFR research fields to provide a insight on the flowers crops production technologies. The farmers were also taken to the private nurseries located at Delhi to show them the potentiality of floriculture and also visit to the Flower market at Ghazipur, Delhi to demonstrate the market level operations and to show them the status and scope of domestic flower market opportunities.

Farmer sharing his experience in the training programme

Participants of the training programme at DFR Farm

Scientist-farmers interaction

Training cum-awareness programme on PPVFR Act

Training-cum Awareness Programme on "Protection of Plant Varieties and Farmers' Right Act 2001"

A Training-cum awareness programme on "Protection of Plant Varieties and Farmers' Right Act 2001" with special reference to Gladiolus and Tuberose was organized on March 3, 2013 at the Research Farm of Directorate of Floricultural Research, New Delhi. About 100 participants including progressive farmers, NGOs, officials of state Department of Agriculture and Horticulture from Himachal Pradesh participated in programme. Dr J.S. Sandhu (ADG Seeds, ICAR), was the chief guest on the occasion and Dr R.L. Mishra (former PC, AICRP Floriculture) and Dr N.K. Dadlani (Director, National Seed Association, New Delhi) were the guest of honour on the occasion. Dr Ramesh Kumar, Director DFR welcomed the chief guest and participants and outlined the significance of the programme. He also made farmers aware of their right as enshrined in the act on the preservation of Gladiolus and Tuberose varieties.

Dr J.S. Sandhu (ADG Seeds, ICAR) gave information on the registration of farmers' varieties and action plan for submission of application for extinct varieties so that farmers may get benefits and gets recognized through this important PPV&FR Act, 2001. Dr R.L. Mishra (Former PC, AICRP Floriculture) and Dr N.K. Dadlani (Director, National Seed Association, New Delhi) and other experts of Directorate of Floricultural Research also shared their views on several important issues such as essence of PPV&FR Act, 2001 and various other aspects of commercial floriculture.

Participants of the training programme on PPVFR Act

Publications

During the period under report, the scientists of DFR published their work in different research journals, extension bulletin, books, etc. A select list is given below;

Research Papers

- Anirban Roy, Spoorthi, P., Panwar, G., Manas Kumar Bag, Prasad, T. V., Kumar G., Gangopadhyay, K. K. and Dutta, M. (2012) Molecular evidence for occurrence of tomato leaf curl New Delhi virus in Ash gourd (*Benincasa hispida*) germplasm showing a severe yellow stunt disease in India. *Indian Journal of Virology*. DOI 10.1007/s13337-012-0115-y.
- Kumar, P. and Tiwari, A. K. (2012) Evaporation estimation using artificial neural network. *International Journal of Computer Theory and Engineering*. 4(1): 51 – 53.
- Kadam, G. B., Singh, K. P. and Pal M. (2013) Effect of different temperature regimes on morphological and flowering characteristics in gladiolus (*Gladiolus* (Tourn.) L.), *Indian Journal of Plant Physiology* (in press).
- Kadam, G. B., Singh, K. P. And Pal M. (2012) Effect of elevated carbon-dioxide levels on morphological and physiological parameters in gladiolus. *Indian Journal of Horticulture*. 69 (3): 379 – 384.
- Kumar G., Sivraj, N., Kamala, V., Gangopadhya, K. K., Sushil Pandey, Tiwari, S. K., Panwar, N. S., Dhariwal, O. P., Meena, B. L. and Dutta, M. (2013) Diversity Analysis in Eggplant germplasm-DIVA-GIS approach. *Indian Journal of Horticulture* (accepted).
- Kumar, P., Rai, P., Chaturvedi, A. K., Khetarpal, S. and Pal M. (2012) High Atmospheric CO_2 Delays Leaf Senescence and Crop Maturity in Chickpea (*Cicer arietinum* l.). *Indian Journal of Plant Physiology*. 17: 254 – 258.
- Kumar, P., Kumar, D., Jaipaul and Tiwari, A. K. (2012) Evaporation Estimation Using Artificial Neural Networks and Adaptive Neuro-Fuzzy Inference System Techniques. *Pakistan Journal of Meteorology*. 8(16):81-88.
- Arivalgan, M., Gangopadhyay, K. K., Kumar, G. (2013) Determination of steroidal saponins and fixed oil content in fenugreek (*Trigonella foenum-graecum*) genotypes" *Indian Journal of Pharmaceutical Sciences*. Accepted.
- Mishra, S. K. and Tiwari, A. K. (2012) Phenological, quantitative and analytical studies of Pleurotusflabellatus. *African Journal of Biotechnology*. 11(2): 346-354.
- Shyama Kumar, Singh, K. P. And Arora, A. (2013) Screening of cultivars of cut tuberose (*Polianthes tuberosa* L,) flower for longer vase life on the basis of membrane stability index. *Progress Horticulture*. 45 (1) in press.
- Singh, K. P. And Singh, M. C. (2012) Advancing early flowering in tuberose (*Polianthes tuberosa* L.) under low tunnels. *Asian Journal of Horticulture*. 7 (1): 165 – 167.

- Srivastava, R. M. and Tiwari, A. K. (2012) Studies on infestation of brown soft scale (*Coccus hesperidium* Linn.) on different species of Cymbidium Orchid under agro climatic condition of Uttrakhand. *Indian Journal of Applied Entomology*. 25(2): 95–99.
- Tiwari, A. K. and Mishra, S. K. (2012) Effect of colchicine on mitotic polyploidization and morphological characteristics of *Phlox drummondi*. *African Journal of Biotechnology*. 11(39): 9336 – 9342.

Technical Bulletins/Books

- Gurav, S. B., Singh, B. R., Katwate, S. M., Jadhav, S. B., Kadam, G. B., Majumder, J. and Kumar, R. (2013) *Status of Floriculture in Maharashtra*. DFR, Extension Bulletin No. 8. Published by Director, DFR, New Delhi.
- Kushal Singh, Kumar, G., Saha T. N. and Kumar, R. (2013) *Postharvest Technology of cut flowers*. DFR Extension Bulletin No. 6. Published by Director, DFR, New Delhi.
- Singh, B. R., Pawar, B. G., Kakade, D. S., Kumar, G., Saha, T. N., Kadam, G. B. and Kumar, R. (2013) *Quality Rose Production Under Protected Condition*. DFR, Extension Bulletin No. 7. Published by Director, DFR, New Delhi.

Presentations in Conferences/ Symposia/Seminar/Other Fora

- Babita, S., Rai, P. and Kumar, R. (2012) Floral pigment – A new generation additive for industries. Global conference on Horticulture for food, nutrition and livelihood options. 28th – 31st May, 2012, Bhubaneswar (Odisha).
- Girish, K. S, Kumar, R., Saha, T. N., Kumar, P. N. and Kumar, G. (2012) Insect pest complex of potted chrysanthemum. In IV National Symposium on plant protection in horticultural Crops: Emerging challenges and sustainable pest management, held at IIHR, Bengaluru from 25th – 28th April, 2012.
- Kadam, G. B, Saha, T. N., Kumar, P.N., Kumar, G. and Kumar, R. (2012) Vase life studies in newly introduced gladiolus (*Gladiolus* (Tourn) L.). In souvenir and abstract: *5th Indian Horticulture Congress; Horticulture for Food and Environmental Security*. From 6th – 9th November, 2012, PAU, Ludhiana.
- Kadam, G. B., Kumar, R., Kumar, P. N., Kumar, G. and Saha, T. N. (2012) Edible flower arrangements: employment generation through value addition. Abstract and poster in: National workshop on 'floral craft: the art and technique for value addition in flowers (12th – 13thApril, 2012), Navsari, Gujarat.
- Kadam, G. B., Jyothi, R., Saha, T. N., Kumar, R., Tiwari, A. K. and Kumar, G. (2013) Effect of climate change on floriculture. In souvenir and abstract: The First International Conference on Bio-resource and Stress Management held at Science City, Kolkata, India during 6th - 9th February, 2013 (4.9).
- Kadam, G. B., Saha, T. N., Kumar, P. N., Kumar, G. and Kumar, R. (2012) Effect of different methods of planting on the corm and cormel production in gladiolus under Delhi conditions. *In* souvenir and abstract: 5th Indian Horticulture Congress; Horticulture for Food and Environmental Security. 6th–9th November, 2012 PAU, Ludhiana.
- Kumar, R., Majumdar, J., Saha, T. N. and Sellam, P. (2012) Farmer friendly technologies of Directorate of Floricultural Research. 5th Indian Horticulture congress: Horticulture for food and Environmental Security, from 6th – 9th November, 2012 at PAU Ludhian.
- Kumar, R., Tiwari, A. K., Majumder, J., Saha, T. N. and Kadam, G. B. (2012) Research priorities in Floriculture. Invited paper in 5th Indian Horticulture congress: an international Meet from 6th – 9th November, 2012 at PAU Ludhian.pp.37.

- Kumar, R. and Tiwari, A.K. (2012) Genetic Resources of Flowers & Foliage Plants and Their Importance For Enhancing the Island Economy. Proceedings of National Seminar on Innovative technologies for conservation and sustainable utilization of Island biodiversity held on 20th – 22nd December, 2012 at CARI, Port Blair pp.8-15.
- Kumar, R., Chaudhary, N., Saha, T. N, Kadam, G. B. (2012) Effect of different growing media on bulb/bulblets production of two lilium (LA Hybrid and Oriental) types. In souvenir and abstract: 5th Indian Horticulture Congress; Horticulture for Food and Environmental Security. (6th – 9th November, 2012), PAU, Ludhiana (161).
- Majumder, J., Saha, T. N., Kumar, G. and Kumar, R. (2013) Response in media composition and mulching practices in ornamentals. National Seminar on advances in Protected Cultivation Technologies by Indian Society for Protected Cultivation, 21 March 2013.
- Rai, P., Singh, B. and Kumar, R. (2012) Flowers and their importance in human nutrition and health. Global Conference on Horticulture for Food, Nutrition and Livelihood options. 28th – 31st May, 2012, Bhubaneswar, Odisha.
- Saha, T. N., Majumder, J., Kadam, G. B., Tiwari, A. K., Kumar, G. and Kumar, R. (2013) Role of All Indian Coordinated Research Project in Development in Floriculture in India. In souvenir and abstract: The First International Conference on Bio-resource and Stress Management held at Science City, Kolkata, India during 6th – 9 th February, 2013 (48).
- Saha, T.N., Kumar, R., Kumar, P. N., Kumar, G., Majumder, J. and Kadam, G. B. (2012) Effect of extended photoperiod on flowering behaviour of chrysanthemum varieties: Abstract in: Global Conference on Horticulture for Food, Nutrition and Livelihood Options (28th – 31st May, 2012), Bhubaneswar, (Odisha). pp.166.
- Saha, T. N.,. Kadam, G. B., Kumar, G. and Kumar, R. (2012) Seed weight per plant of herbaceous ornamental annuals as affected by various factors. *In* souvenir and abstract: 5th Indian Horticulture Congress; Horticulture for Food and Environmental Security (6th – 9th November, 2012), PAU, Ludhiana (232).
- Sellam, P., Majumder, J., Saha, T. N. and Kumar, R., (2013) Effect of Micronutrients on Orchid production. At National seminar on Advances in Protected Cultivation Technologies held on 21st March, 2013 at NASC complex, New Delhi.
- Singh, B., Singh, H. K. and Kumar, R. (2012) Floriculture industry: Powered by information technology. Global Conference on Horticulture for Food, Nutrition and Livelihood Options. 28th – 31st May, 2012, Bhubaneswar, Odisha.
- Singh, B., Kumar, R. and Kavita Joshi (2012) Arborsculpture: Art of Tree Shaping. *In* souvenir and abstract: 5th Indian Horticulture Congress; Horticulture for Food and Environmental Security (6th – 9th November, 2012), PAU, Ludhiana, pp 80-81.
- Singh, B., Kumar, R. and Rai, P. (2012) Importance of Floral Essential Oils for mankind. International Symposium Agricultural Communication and Sustainable Rural Development from Information to Knowledge to Wisdom – Envisioning a Food Sovereign World in the Third Millennium. Pantnagar, 22-24 November 2012.
- Singh, B., Preetham, S. P., Kumar, R. and Rai, P. (2012) Xeriscape: An Approach of Landscaping the Desert. National Seminar on 'Managing Land Resources for Sustainable Agriculture'. 12th – 13th October, 2012 at National Bureau of Soil Survey & Land Use Planning, Nagpur.
- Singh, B. and Kumar, R. (2012) Modern Floral Arrangement: A Decorative Art. National workshop on Floral Craft. 12-13 April, 2012. Navsari, (Gujarat).

- Yadav, S., Kumar, P. N., Kumar, R. and Singh, S. K. (2012) Effect of protease inhibitors influencing the keeping quality of gladiolus cut flower. *In* souvenir and abstract: 5th Indian Horticulture Congress, Horticulture for Food and Environmental Security. 6th – 9th November, 2012, PAU, Ludhiana, pp 450.
- Tiwari, A. K. and Kumar, R. (2012) Ornamental Orchids (*Cymbidium*) performance under sub humid hills of Uttrakhand. National Dialogue on orchid Conservation & Sustainable Development for Community Livelihood held at Gangtok (Sikkim) from 8th – 9th March, 2013. p. 164.
- Tiwari, A. K. and Kumar, R. (2012) Flowering parameters of *Cymbidium gigantium* orchid as affected by various cytokinins in 5th Indian Horticulture congress: an international Meet from 6th – 9th November, 2012 at PAU Ludhiana.

Compilation/Documentation

- Kumar, R., Saha, T.N., Kumar, P.N., Kumar, G. and Majumder, J. (2012) Annual Report 2011-12 All India Coordinated Research Project on Floriculture. Published by Directore, DFR.
- Kumar, R., Kumar, G., Majumder, J., Kumar, P.N., Saha, T.N. and Sellam, P. (2012) Annual Report 2011-12 Directorate of Floricultural Research. Published by Directore, DFR.
- Saha, T.N., Kadam, G.B., Tiwari, A.K., Girish, K.S., Kumar, G. and Kumar, R. (2013) Proceedings of XXII Annual Group Meeting of AICRP on Floriculture held at YASHADA, Pune, 29-31 January 2013
- Singh, K. P., Kadam, G. B., Saha T. N. and Rai, P., (2013) Training Manual on Improved Technologies for Propagation of Commercial Flower Crops, for farmers and officers training programme (Uttarakhand) on 7th – 11th January, 2013.
- Singh, K. P., Kadam, G. B., Saha T. N. and Rai, P. (2013) A compendium on Improved Technologies for Propagation of Commercial Flower Crops, for farmers and officers training programme (Uttarakhand) on 1st – 5th January, 2013.
- Tiwari, A. K., Kumar, G., Kadam, G. B., Saha, T. N. and Kumar R. (2013) A Training manual on Awareness-cum- Training Programme on Protection of Plant Varieties and Farmers Right.

Technical/Popular Articles

- Kumar, R. and Dhatt, K. K. (2013). Recent trends in seed production of flowering annuals. In: Compendium of Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 1-5 January 2013, pp. 1-7.
- Tiwari, A. K. and Kumar, R. (2012). Indian Floriculture: Problems and Prospects. In: Floriculture Today, October Issue, pp.16-19.
- Kadam, G. B. and Kumar, R. (2013) Nursery management of ornamental crops. Lecture in training manual of Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 7th – 11th January, 2013. Pp. 48 – 57.
- Kadam, G. B., and Rakesh Kumar (2013) Raising of nursery and management techniques for ornamental crops. In training manual of training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3 March 2013 (31-40).
- Kadam, G. B., Saha, T. N., Kumar, G., Tiwari, A. K. and Kumar, R. (2013) Agro-

techniques for successful cultivation of gladiolus. In compendium of Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 1st – 5th January, 2013 (33-41).

- Kadam, G. B., Tiwari, A. K., Saha, T. N., Kumar, G., and Rakesh Kumar (2013) DUS testing guidelines for gladiolus, In training manual of training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at DFR, Pusa Campus, New Delhi on 3rd March, 2013 (4-9).
- Kumar, G., Saha, T. N., Kadam, G. B., and Kumar, R. (2013) *Guldaudi* (Chrysanthemum) (Hindi). In training manual of training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3rd March 2013 (96-107).
- Kumar, G., Saha, T. N., Kadam, G. B. and Kumar, R. (2013) *Guldaudi* (Chrysanthemum) (Hindi). In training manual of Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at DFR, Pusa Campus, New Delhi on 7th – 11th January, 2013 (139-150).
- Singh, B. and Sellam, P. (2013) Dry Flowers. Improved technology for production of commercial flower crops. Five days training programme held at DFR, New Delhi from 1st – 5th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. and Sellam, P. (2013) Dry Flowers. Improved technology for production of commercial flower crops. Five days training programme held at DFR, New Delhi from 7th – 11th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. (2013) Cut Foliage. Improved technology for production of commercial flower crops. Five days training programme held at DFR, New Delhi from 1st – 5th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. (2013) Cut Foliage. Improved technology for production of commercial flower crops. Five days training programme held at DFR, New Delhi from 7th – 11th January, 2013 for farmers and officers of Uttarakhand.
- Tiwari, A. K., Kumar, N. P., Kumar, G., Saha, T. N., Kadam, G. B. and Kumar. R. (2013) DUS testing in gladiolus and tuberose (Hindi). In training manual of training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at DFR, Pusa Campus, New Delhi on 3rd March 2013 (108-111).
- Saha, T.N. (2013) *Gerbera ki unnat kheti*. In: Compendium & Training Manual of Improved Technologies for Production of Commercial Flower Crops for the Farmers and Officers of Uttarakhand held at Directorate of Floricultural Research, New Delhi on 1-5 and 7-11 January 2013 and in training cum awareness programme on PPVFRA 2001 (3rd March 2013).
- Saha, T.N., Kumar, G., Kadam, G.B. and Kumar, R. (2013) *Guldaudi*. In: Compendium & Training Manual of Improved Technologies for Production of Commercial Flower Crops for the Farmers and Officers of Uttarakhand held at Directorate of Floricultural Research, New Delhi on 1-5 and 7-11 January 2013 and in training cum awareness programme on PPVFRA 2001 (3rd March 2013).

Lectures Delivered

- Kadam, G. B. and Kumar, R. (2013) Nursery management of ornamental crops. Lecture in training of Improved Technologies for

Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 7th – 11th January, 2013. Pp. 48 – 57.

- Kadam, G. B., and Rakesh Kumar (2013) Raising of nursery and management techniques for ornamental crops. Lecture in training of training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3 March 2013 (31-40).
- Kadam, G. B., Saha, T. N., Kumar, G., Tiwari, A. K. and Kumar, R. (2013) Agro-techniques for successful cultivation of gladiolus. Lecture on Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 1st – 5th January, 2013 (33-41).
- Kadam, G. B., Tiwari, A. K., Saha, T. N., Kumar, G., and Rakesh Kumar (2013) DUS testing guidelines for gladiolus. Lecture in training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3rd March, 2013 (4-9).
- Saha, T. N., Kumar, G., Kadam, G. B., and Kumar, R. (2013) *Guldaudi* (Chrysanthemum) (Hindi). Lecture in training cum awareness programme for "Protection of Plant Varieties and farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3rd March 2013 (96-107).
- Saha, T. N., Kumar, G., Kadam, G. B. and Kumar, R. (2013) *Guldaudi* (Chrysanthemum) (Hindi). Lecture in Improved Technologies for Production of Commercial Flower Crops for the training of officers and farmers of Uttarakhand held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 7th – 11th January, 2013 (139-150).
- Singh, B. and Sellam, P. (2013) Dry Flowers. Lecture in Improved technology for production of commercial flower crops. training programme held at DFR, New Delhi from 1st – 5th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. and Sellam, P. (2013) Dry Flowers. Lecture in Improved technology for production of commercial flower crops. training programme held at DFR, New Delhi from 7th – 11th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. (2013) Cut Foliage. Lecture in Improved technology for production of commercial flower crops. Training programme held at DFR, New Delhi from 1st – 5th January, 2013 for farmers and officers of Uttarakhand.
- Singh, B. (2013) Cut Foliage. Lecture in Improved technology for production of commercial flower crops. Training programme held at DFR, New Delhi from 7th – 11th January, 2013 for farmers and officers of Uttarakhand.
- Tiwari, A. K., Kumar, N. P., Kumar, G., Saha, T. N., Kadam, G. B. and Kumar. R. (2013) DUS testing in gladiolus and tuberose (Hindi). Lecture in training cum awareness programme for "Protection of Plant Varieties and Farmers' Right Act 2001" held at Directorate of Floricultural Research, Pusa Campus, New Delhi on 3rd March 2013.

Awards and Recognitions

- Directorate bagged "*Best Stall Award*" among ICAR institutes by the organizers during Pusa Krishi Vigyan Mela (6 – 8 March 2013).
- Dr. Ramesh Kumar was invited as guest of honour at inauguration ceremony of state

level "Dr M S Randhawa Flower Show" organized by Department of Floriculture, PAU, Ludhiana on 21st February 2013.

- Dr. Ramesh Kumar received certificate of appreciation from Dr. Abhijit Sen, Member, Planning Commission in recognition of his

outstanding contribution in PAU, Ludhiana on 17th December 2012.

- Dr. Ramesh Kumar acted as member in task force for horticulture development in Haryana, Farmers' Commission of Haryana.
- Dr. Ramesh Kumar acted as member in task force for horticulture development in Rajasthan, Farmers' Commission of Rajasthan.
- Dr. Ramesh Kumar was conferred fellowship of Confederation of Horticulture Association of India (CHAI) at 4th Swedish Prem Jagriti Sangoshti 2012, being organized by ASM Foundation and OUAT, Bhubaneshwar from 28-31 May 2012.
- Dr. Krishan Pal Singh was conferred Founder Fellowship Award – 2012 of Confederation of Horticulture Associations of India, on 30-05-2012, for his contribution and commitment to the furtherance of horticulture.
- Dr. Krishan Pal Singh was conferred Fellow Award – 2013 of Society of Plant Protection Sciences, New Delhi, on 27-01-2013, for his significant contribution in the field of plant protection in flower crops.
- Dr. Ajay Kumar Tiwari was conferred Rashtriya Gaurav Award for meritorious service, outstanding performance by India International Friendship Society New Delhi.
- Dr. Tarak Nath Saha delivered oral presentation entitled "Role of All India Coordinated Research Project in the

Development of Floriculture in India" at the International Conference on Bio-resource and Stress Management held on 06th – 09th February, 2013 at Science City, Kolkata.

- Dr. Tarak Nath Saha was nominated expert for editing practical manual in Hindi for the two year course on "*Diploma in Basic Rural Technology*" of National Institute of Open School (under HRD Ministry), Noida, Uttar Pradesh.
- Dr. Ganesh B. Kadam bagged best poster presentation award on "*Edible flower arrangements: Employment generation through value addition*" authored by Ganesh B. Kadam, Ramesh Kumar, Naveen Kumar, Gunjeet Kumar and Tarak Nath Saha at National workshop on floral craft: The art and technique for value addition in flowers, 12th – 13th April, 2012 Navsari, Gujarat.

Seminar/ Symposia/ Conferences/ Workshops Attended

During the period under report, the scientists of the directorate participated in several seminars, symposia, conferences, workshops, interacted with subject matter specialists/ experts and refreshed their knowledge about the latest developments. A list of various programmes is given below;

Seminars/Symposia/Conferences/ Workshop

- Girish, K. S. has attended IV National Symposium on "Plant Protection in Horticultural Crops: Emerging Challenges and Sustainable Pest Management", held at Indian Institute of Horticultural Research, Bengaluru, Karnataka, from 25-28th April, 2012.
- Kadam, G. B. attended a special lecture by Dr. A. P. J. Abdul Kalam on "84th foundation day of ICAR" held at NASC Complex, New Delhi (16 July, 2012).
- Kumar, R., Singh, K. P., Saha, T. N., Kadam, G. B., Rai., P., Girish K. S. and Tiwari, A. K. has participated in Brain Storming Session for Streamlining of Basic Strategic and Futuristic Research of DFR held on 29th January, 2013 at YASHADA, Raj Bhawan, Pune (Maharashtra).
- Kumar, R., Singh, K. P., Saha, T. N., Kadam, G. B., Rai, P., Girish, K. S. and Tiwari, A. K. has attended "XXII Group Meeting of All India Coordinated Research Project on Floriculture" held from 29th – 31st January, 2013 at YASHADA, Raj Bhawan, Pune (Maharashtra).
- Majumder, J., Sellam, P., Girish, K. S. and Kumar, G. has attended the National Seminar on Advances in Protected Cultivation Technologies organized by Indian Society of Protected Cultivation held on 21st March, 2013.
- Rai, P. has attended National workshop on "Foresight and Future Pathways of Agricultural Research through Youth in India" at NASC Complex, New Delhi from 1st – 2nd March, 2013.
- Singh, K.P. and Saha, T. N. has attended the Global Agri-Connect 2012 held at IARI, Pusa Campus, New Delhi from 2nd – 3rd November, 2012.
- Kumar, P. Naveen and Saha, T. N. has attended the stakeholders meeting on "Efficient Use of Swage and Wastewater", jointly organised by Natural Resource Management Division, ICAR and Central Soil Salinity Research Institute, Karnal, Haryana at NASC Complex, New Delhi on 19th April, 2012.
- Saha, T. N., Majumder, J. has participated in International Conference on Bio-resource and Stress Management held on 06th – 09th February, 2013 at Science City, Kolkata.
- Saha, T. N. has participated in the National Consultation on Management of Genetic Resources of Horticultural Crops held at NBPGR, New Delhi on 18th – 19th December, 2012.

- Singh, K. P., Singh, B. has attended the Global Conference on Horticulture for Food Nutrition and Livelihood Options, held from 28th–31st May, 2012 at Odisha University of Agriculture and Technology, Bhubaneswar (Odisha).
- Singh, K. P. has attended 'National Workshop on Urban and Peri-urban Horticulture – Greening Cities, Utilizing the Waste, Meeting the Needs and Servicing the Environment", held on 2nd March, 2013 at Hotel Windsor Manor, Bangalore (Karnataka).
- Singh, K. P. and Saha, T.N. has attended 'NSFI Global Agri Connect 2012 Conference cum Exhibition-High value Agriculture: A Gateway to Farm Prosperity, held from 2nd – 4th November, 2012 at IARI, New Delhi.
- Singh, K. P. and Saha, T.N. has attended Bilateral Meeting with Dutch delegation under the aegis of Bilateral Cooperation and Memorandum of Agreement signed between Protection of Plant Varieties and Farmers' Rights Authority and Netherlands Inspection Service for Horticulture (NAKTUINBOUW, PLANTUM), held on 03rd December, 2012 at IARI, New Delhi.
- Singh, K. P. has attended a meeting on 'India – US Cooperation in Food and Agriculture: How our Farmers and Agriculture can Benefit? on 19th November, 2012 at India International Centre, New Delhi.
- Singh, K. P. and Saha, T.N. has attended meeting of Project Coordinators and Directors of ICAR Institutes to Streamline and Consolidate the AICRPs and Network Projects for XII Plan on 5th – 6th December, 2012 at NBPGR, New Delhi.
- Singh, K. P. has attended National Workshop cum Exhibition on Promotion of Horticulture development in Uttarakhand, held on 12th – 13th May, 2012 at College of Engineering, Roorkee, Haridwar (Uttarakhand).
- Singh, K. P. has attended SAU – ICAR – CII, Northern Region Meeting held on 4th September, 2012 at CCS Haryana Agricultural University, Hissar (Haryana).
- Saha, T.N. has attended XXII meeting of ICAR Regional Committee No. V, held on 14th–15th December, 2012 at IARI, New Delhi.
- Singh, K. P., Saha, T. N., Kadam, G. B. and Singh, B. has attended National Workshop on Floral Craft: The Art and Technique for Value Addition in Flowers, held from 12th – 13th April, 2012 at Navasari Agricultural University, Navasari (Gujarat).
- Tiwari, A. K. and Kadam, G. B. has attended the "International Congress on Horticulture" from 6th – 8th December, 2012 held at Punjab Agricultural University, Ludhiana, (Punjab).
- Tiwari, A. K. and Saha, T. N. has participated in National Dialogue on Orchid Conservation and Sustainable Development for Community Livelihood organised by NRC Orchids at Chintan Bhawan, Gangtok from 8th – 9th March, 2013.
- Tiwari, A. K. has attended the Annual DUS Projects Review Workshop held from 28th February to 1st March, 2013 at IIVR Varanasi, (Uttar Pradesh).
- Tiwari, A. K. has attended the FD meeting for draft presentation of RFD 2013-14 held at NASC on 16-1-13.
- Tiwari, A. K. attended the Meeting of the Directors', PCs, & HODs of Horticulture SMD held on 12th – 13th March, 2013 at NASC Complex, New Delhi.
- Tiwari, A. K. attended the National Seminar on Innovative Technologies for Conservation and Sustainable Utilization of Island Biodiversity held from 20th – 22nd December, 2012 at CARI, Port Blair (Anadaman & Nicobar Islands).
- Tiwari, A. K. attended the Review Workshop of PME cells of ICAR institutes held on 08th December, 2012 at NDRI, Karnal (Haryana).
- Tiwari, A. K. attended the RFD Nodal Officers meeting of Horticultural Institutes/ Directorates/ NRCs on 22nd November, 2012, in KAB-II at ICAR, HQ to review

monthly progress report from April to October, 2012.

Trainings Attended

- Girish, K. S. attended ICAR Short Course of 10 days from 11th – 20th June, 2012 on "Pest Management in High-Value Crops Under Protected Environment" conducted by the Department of Entomology, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (Himachal Pradesh) and ranked as one of the five outstanding participants of the training.
- Girish, K. S. attended Short-term exposure training on "Recent Advances in Pest Management in Ornamental Crops" at Division of Entomology and Nematology, IIHR, Bengaluru, from 04th – 07th September, 2012.
- Majumder, J. attended winter school on 'Breeding for High Productivity and Industry Suitable food Colorants and Bioactive Compounds in Vegetable Crops' by ICAR at Division of Vegetable Science, IARI, New Delhi from 04th – 24th December, 2012.
- Sellam, P. and Majumder, J. has attended a training course on "Extraction and Analysis of Nutraceuticals from Vegetables, Fruits and Non Food Crops" organized during 22nd - 24th November, 2012 at the Division of Agricultural Chemicals, IARI, New Delhi.
- Sellam, P. was trained at the dry flower industry, Ms. Salem Spice Industry, Trichy (Tamil Nadu) from 27th – 29th March, 2012 on the commercial aspects on dry flower production.
- Kadam, G. B. and Saha, T. N. participated in 4 days National Training Programme on "Conservation of Plant Germplasm including Registered Varieties in Genebank" in the Division of Germplasm Conservation, NBPGR, New Delhi, from 18th – 21st March, 2013.
- Singh, B. has attended training on GC-MS analysis of essential oils at DMAPR, Anand, (Gujarat) from 8th – 12th October, 2012.
- Singh, K. P. has attended training on "Improved Techniques for Flower Production" on 25th October, 2012 in a training programme organized for the benefit of farmers at Krishi Vigyan Kendra, Bagra, Muzaffarnagar (Uttar Pradesh).
- Tiwari, A. K. attended MDP workshop on policy and PME support to consortia- based research in Agriculture e from 11th – 17th September, 2012 at NAARM, Hyderabad (Andhra Pradesh).
- Saha, T. N. attended Winter School on Recent Advances in Micro-Irrigation and Fertigation at Centre for Protected Cultivation Technology, IARI, New Delhi from 05-25 Nov, 2012.

Radio Talk/TV Shows

- Dr. Ramesh Kumar delivered a Radio talk on "Baat Phulon Ki" in All India Radio, New Delhi on 5 September 2012.
- Dr. Ramesh Kumar delivered a TV talk on "*Phulon ki Vyavsayik kheti*" (Krishi Darshan) in Doordarshan, Doordarshan Kendra, New Delhi on 6th September, 2012.
- Dr. Ramesh Kumar delivered a TV talk on "Floriculture – Commercial flower cultivation" in Doordarshan, Doordarshan Kendra, New Delhi on 17th October, 2012.
- Dr. Ramesh Kumar delivered a TV talk on "*Phulon ki Vyavsayik kheti*" in Doordarshan, Doordarshan Kendra, New Delhi on 28th December, 2012.
- Dr. Tarak Nath Saha delivered Radio Programme on Floriculture (*Vidya Mukta Vani*) at National Institute of Open School (under HRD Ministry), Noida (Uttar Pradesh). (26th August, 2012, 11:00 – 12:00 Hrs.)
- Dr. Tarak Nath Saha delivered TV and Radio Talk in DD/AIR. (25th April, 2012, 22nd August, 2012, 11th December, 2012).

Personnel

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Mr. Sudesh Kumar	LDC	sudeshkumar.570@gmail.com
Mr. Pratap Singh	LDC	pratapbisht1979@gmail.com

New Appointments

Scientific

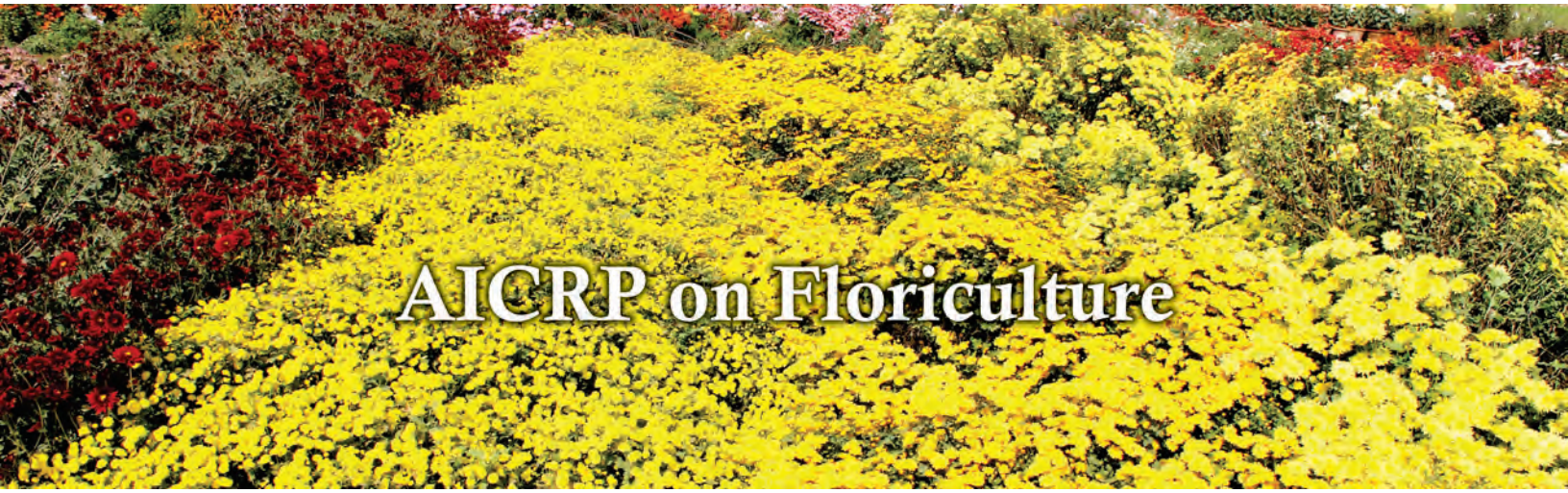
- Dr. AK Tiwari, Senior scientist (Floriculture) has joined DFR on 4th July 2012

Administrative

- Mr. Sandeep Gaur, Assistant joined DFR on 13.06.2012
- Mr. Deepak Verma, Assistant joined DFR on 28.06.2012
- Mr. Rupesh Kumar Pathak, Assistant joined DFR on 10.10.2012 on transfer from CSSRI Karnal
- Mr. Ajay Uniyal, Steno Grade III joined DFR on 04.09.2012 on transfer from ICAR Complex for NEH region Sikkim centre, Tandong
- Sudesh Kumar, LDC joined DFR on 04.06.2012 on transfer from NBAIM, Mau, UP

Transfers

- Dr. Vaibhav Kumar Singh, Scientist, has been transferred from DFR to IARI, New Delhi on 22.05.2012
- Dr. P. Naveen Kumar, Senior Scientist transferred from DFR to DOPR, Pedavegi on 09.8.2012
- Dr. Binod Kumar Singh, Scientist transferred from DFR to IIVR, Varanasi on 22.08.2012



AICRP on Floriculture

All India Coordinated Research Project (AICRP) on Floriculture was established during IV Five-Year Plan in the year 1970-71 to carry out nation-wide interdisciplinary research by linking ICAR Institutes with State Agricultural Universities (SAUs). The necessity of the project has been examined from time to time in view of growing importance and potential for floriculture in different regions of the country and the number of Coordinated Centres as well as the research programmes were modified accordingly. At present the Coordinated Project has 22 Centres which includes 16 budgetary, 4 institutional and 2 voluntary Centres.

List of coordinating centres of AICRP on Floriculture

S. No.	Centre	Year of Start	Mandate Crops
	Budgetary Centres		
1.	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (upto September 1977 it was at B.S.I. Calcutta)	1972	Carnation, Orchids, Anthurium, Tuberose, Gerbera
2.	Dr.Y.S. Parmar University of Horticulture & Forestry, Solan	1975	Gladiolus, Carnation, Chrysanthemum, Tulip, Daffodils, Lilium, Alstroemeria
3.	Kerala Agricultural University, Vellanikkara	1975	Orchids, Anthurium, Gerbera
4.	Mahatma Phule Krishi Vidyapeeth, Pune	1975	Rose, Gladiolus, Carnation, Chrysanthemum, Tuberose, Gerbera
5.	Punjab Agricultural University, Ludhiana	1975	Rose, Gladiolus, Chrysanthemum, Tuberose, Gerbera, Lilium
6.	Rajasthan College of Agriculture (MPUAT), Udaipur	1980	Rose, Gladiolus, Chrysanthemum
7.	Horticultural Research Station (TNAU), Yercaud	1982	Carnation, Gladiolus, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
8.	Horticultural College and Research Institute (TNAU), Coimbatore	1982	Carnation, Gladiolus, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
9.	Uttar Banga Krishi Viswavidyalaya, Kalimpong	1985	Gladiolus, Carnation, Orchids, Anthurium, Alstroemeria
10.	Agricultural Research Institute (APHU), Hyderabad	1987	Gladiolus, Chrysanthemum, Tuberose
11.	Sher-E-Kashmir University of Agricultural Sciences & Technology, Wadura campus, Sopore	1987	Gladiolus, Chrysanthemum, Tulip, Daffodils, Lilium, Alstroemeria
12.	Horticultural Research Station (AAU), Kahikuchi, P.O. Azara, Guwahati	2001	Gladiolus, Orchids, Chrysanthemum, Anthurium, Tuberose, Gerbera

S. No.	Centre	Year of Start	Mandate Crops
13.	Odisha University of Agriculture and Technology, Chiplima	2011	Rose, Chrysanthemum, Orchids, Anthurium
14.	G. B. Pant University of Agriculture & Technology, Pantnagar	2001	Rose, Gladiolus, Chrysanthemum, Tuberose, Gerbera
15.	Birsa Agricultural University, Ranchi	2001	Gladiolus, Chrysanthemum, Gerbera
16.	Rajendra Agricultural University, Pusa, Samastipur, Bihar	2010	Rose, tuberose, gladiolus and Marigold
	Institutional Centres		
17.	Indian Agricultural Research Institute, New Delhi	1971	Rose, Gladiolus, Chrysanthemum and Tuberose
18.	Indian Agricultural Research Institute, Regional Station, Katrain, Himachal Pradesh	1971	Gladiolus, Carnation, Gerbera, Tulip, Daffodils, Lilium, Alstroemeria
19.	Indian Institute of Horticultural Research, Hessaraghatta, Bangalore	1971	Rose, Gladiolus, Carnation, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
20.	ICAR Research Complex for NEH Region, Barapani, Shillong (Meghalaya)	1971	Orchids, Anthurium, Gerbera
	Voluntary Centres		
21.	University of Agricultural Sciences, Bangalore	1977	Carnation, Anthurium
22.	Horticultural College and Research Institute (TNAU), Periyakulum	2010	Marigold, Tuberose, Chrysanthemum

Distinguished Visitors

The Directorate of Floricultural Research remained abuzz with visitors that include policy planner, administrators, scientists, researcher, students and extension personnel. During the period of report is given herewith:

- Shri Harish Rawat, Honourable Minister of Water Resources, Government of India.

- Shri. Abhijit Sen, Member of Planning Commision, Government of India.

- Dr. Gurbachan Singh, Chairman ASRB, ICAR, New Delhi.

- Dr. N.K. Krishna Kumar, DDG (Horticulture) ICAR, New Delhi.

- Dr. H.P. Singh, Former DDG (Horticulture), ICAR, New Delhi.
- Prof. P. Das, Managing Director, The Science Foundation for Tribal & Rural Resource Development, Bhubaneswar.
- Dr. S.K. Malhotra, ADG (Horticulture-II), KAB II, ICAR, New Delhi.

- Dr. Umesh Chandra Srivastava, Former ADG (Hort-II), ICAR, New Delhi.

- Dr. H.S. Gupta, Director, IARI, New Delhi.
- Dr. A.S. Siddhu, Director, IIHR, Bangalore.
- Dr. Malavika Dadlani, Joint Director (Res) IARI, New Delhi.
- Dr. S.P.S. Raghava, Former Project Coordinator, AICRP (Floriculture).

- Dr. R.L. Misra, Former Project Coordinator, AICRP (Floriculture).

- Dr. W.S. Dhillon, ADG (Hort-I), ICAR, New Delhi.
- Mrs. Ayyappan, W/o DG, ICAR, New Delhi.
- Mrs. Gupta, W/o Director IARI, New Delhi.
- Dr. P.S. Munsi, Dean, Institute of Agriculture, Viswa Bharati (21.02.2013).
- Dr. A.K. Vidyarthy and team from Tata Steel, Jamshedpur (12.12.2013).

Visitors from Foreign Countries

Foreign delegates and trainees from Kenya, Iran, Srilanka, Vietnam, visited our Research Farm.

Beside this, many scientists from ICAR and SAUs, Programme coordinators of ATMA, NHM of different states, students, and press and media persons had also visited the DFR Research Farm.

The details of the budget including AICRP on Floriculture are tabulated as under:

(₹ in lakhs)

S. No.	Head of Account	Plan		Non-Plan	
		Budget	Expenditure	Budget	Expenditure
1.	Establishment of charges	380.00	380.00	135.00	135.00
2.	TA	15.00	15.00	1.00	1.00
3.	HRD	1.00	1.00	0.00	0.00
4.	Other charges	94.00	94.00	17.00	16.89
Total (A)		**490.00**	**490.00**	**153.00**	**152.89**
5.	Equipment	15.00	15.00	0.00	0.00
6.	Furniture	0.00	0.00	5.00	4.99
7.	Loan & Advances	0.00	0.00	10.00	9.95
	Total (B)	15.00	15.00	15.00	14.94
	Grant Total (A+B)	**505.00**	**505.00**	**168.00**	**167.83**

Annual Report
2012 - 2013

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Preface

India being a culturally rich country, flowers have entwined in the life of every Indian. Every social event in India is accomplished with flowers and enrich each occasions. Floriculture is getting attention globally due to change in the lifestyle of people, concern for the protection of environment, conscious efforts towards greening and better purchasing capacity of people. Due to steady increase in flower demand, floriculture has become one of the most important commercial venture. India is bestowed with rich bio diversity and diverse agro-climatic conditions, which provides added scope for scientific exploration of floriculture crops and their value addition. Apart from cut flowers and loose flowers, value added products like dry flowers and foliages, essential oils, nutraceuticals, natural colours, etc. are gaining an uptrend.

It was estimated that 272.01 thousand ha area was under flowers cultivation 2012-13 which is concentrated mainly in Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal (*NHB 2012)*. The production of loose flowers is estimated to be 1.651 million metric tonnes (MT) and cut flowers 47504 million number. The country has exported 3.09 million MT of floriculture products to the world worth of Rs.3653.2 million in 2011-12. (*NHB, 2012*).

To strengthen the research on floriculture, the AICRP on Floriculture, was established during the IV Five Year Plan in the year 1970-71 to carry interdisciplinary research at the national level by linking the ICAR Institutes with the State Agricultural Universities (SAUs). This has been upgraded as Directorate of Floricultural Research (DFR) in December, 2009 during XI Plan (2010-11) to further invigorate the floriculture research in the country. The project aims to address diverse and need-based research and development (R&D) priorities, that include genetic resource utilization, crop improvement, standardization of production technologies, efficiency of resource utilization such as productive use of water, plant architecture engineering and management, technology for crop protection, developing repository of information in the data bank, post harvest technology and value addition. The Annual Progress Report 2012-13 in hand highlights the programmes and achievements made by the DFR during the period from 1st April 2012 to 31st March, 2013

I extend my debt of gratitude to Dr. S. Ayyappan, Hon'ble Secretary, Department of Agricultural Research and Education (DARE) and Director General, ICAR and Dr. N.K. Krishna Kumar, Deputy Director General (Horticulture) for their constant encouragement, support and guidance which was helpful in gaining momentum and moving on fast track. I would like to express my gratitude to Dr. H.S. Gupta, Director, IARI; Dr. Umesh Srivastava and Dr. W.S. Dhillon, Former ADGs (Hort) and Dr. SK Malhotra ADG (Hort-II) at present for their valuable guidance and inputs.

The support provided by the scientific and administrative staff of the Directorate is duly recognised and I place on record my appreciations to all of my colleagues for efforts in compilation, editing and vetting of the Annual Report.

June 27, 2013
New Delhi

(Ramesh Kumar)
Director

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Executive Summary

Crop Improvement

- Besides existing gladiolus germplasm, 20 new varieties have been introduced. Out of these, six cultivars (Punjab Beauty, Punjab Dawn, Punjab Pink Elegance, Punjab Flame, Punjab Glance,Punjab Lemon Delight) of PAU, Ludhiana and two cultivars (Phule Ganesh and Phule Neelrekh) of NARP, Ganeshkhind performed better. Varieties such as, Yellow Stone, Argentina, Invitatie, Mascagni, Jester, Flevo Laguna, Lemon Drop, Forta Rosa, Beau Jour and Ben Venuto produced quality spike with attractive colours amongst all the evaluated cultivars. These varieties also showed better corm and cormel producing potential.
- In gladiolus 21 cultivars of were treated with physical and chemical mutagens. The cultivars Purple Flora, Rosibee Red, Yellow Stone and Verona responded to the mutagens. Deformed petals/anthers which resembles like double type flower and chimeras were observed.
- In the existing collection, 82 new varieties of chrysanthemum were added from various sources and evaluated for their performance. Cultivars like Anmol, Himanshu and Flash Point were suitable for pot culture whereas, Lucido, Red Stone, Cloverlea Star, Spacer, Autumn Eyes and Flash Point were observed to be early flowering in nature. Cultivars Coffee, Dark Eyes and Maghi, were late bloomers and cultivars, Bindiya, Bi-colour Bonsai, Valerie, Miko, Kotoi No Kaori, Yellow Charm and Gum Drop were found to be no-pinch and no-stake type.
- In chrysanthemum, the genotypes Gundrop, Moira, Mother Teresa, Shyamal, IAH-Red, Aprajita, Royal Prince, Red Devil, Autumn Joy, Cindrella Yellow, Vasantika, Vanity Pink, Kaul, Khoshoo, Sharad Mala, Shobha, BC-1-123, Thai-Chen Queen, White Star, White Bouquet, Tera Red, Amalfi, PAU-49, PAU-42, Vienna Cream, Lamu Elmmira, Hanshu Zamba, Mindamo, Preveto, Snowdon, Gometo, Olymp Yellow bloomed during earlier summer season.
- In chrysanthemum, the cultivars/lines namely, Calimaro Sunny Yellow, Calimaro Sunny Pink, Punch White, Vanity Pink, White Bouquet, Tera Red, Amalfi, Lequila, Laguna White, Sunny Punch Yellow, Yukari, Ronilla Red, Sparkle White, Ahulo Yellow, DFR P-26, DFR S-21, DFR Y-12, DFR A 19, DFR E-11 were found suitable as cut sprays.

Crop Production

- In Gladiolus seventeen varieties *viz*. Gold Field, Purple Flora, Verona, Blues, Snow Princess, Priscilla, Amsterdam, Flavo Souvenir, Jester Gold, Hunting Song, Rosibee Red, Princess Margaret Rose, Flavo Laguna,Yellow Stone, Novalux, Ocilla and Limoncello were planted during October and November to find their suitability to varied times of planting. Except four varieties i.e. Gold Field, Flevo Laguna, Limoncello and Blues, all others

performed better during November planting in respect of plant height, spike length and rachis length.

- Three varieties of gladiolus (Snow Princess, Beau Jour and Bean Benton) were planted in December and January and performed well thus extending the availability of flowers up to end of April. The gladiolus varieties namely, White Prosperity, Big Time Supreme and Novalux were evaluated for their performance in respect of corm and cormels production by planting them in raised and flat beds. The method of planting did not affect corm diameter, however, the number of corms and cormels were more in the raised beds.
- The effect of growing media was studied in chrysanthemum. It was found that in cultivars Anmol and Mother Teresa, media composition of Cocopeat + Sand + FYM + Vermicompost (2:1:0.5:0.5) resulted in maximum number of branches, flower diameter, number of flowers / plant, plant spread, minimum number of days taken for flowering followed by media composition Cocopeat + Sand + Vermicompost (2:1:1).
- In gladiolus *Chenopodium album, Cynodon dactylon*, *Cyprus rotundas and Convolvulus arvensis*, were major weeds. The sprouting of corms was not affected significantly by pre-emergence herbicide treatments.
- The lowest weed count and fresh dry weight of weeds were recorded after 25 DAP from weed free plots and with application of pre-emergence treatment of Atrazin @1.5 kga.i./ha. The weed count and fresh and dry weight of weeds increased significantly after 50 DAP. The plant height, spike length, rachis length and number of florets was significantly higher in pre-emergence application of Pendimethalin (1.0 and 0.75 kg a.i./ha), Atrazin (1.0 and 1.5 kg a.i./ha) and Metribuzine (0.25 kg a.i./ha) than weedy control.
- The varieties such as Yellow Stone, Argentina, Jester, Priscilla, Ocilla, Invitatie produced significantly more number of spikes/plant. Yellow Stone, Argentina and Invitatie produced maximum spike length as well as number of florets/spike. The post harvest life was also superior in cultivars Yellow Stone, Argentina, Priscilla and Invitatie. Poor vase life was recorded in the cultivars Purple Flora, Chemistry and Blues.
- In gladiolus cultivars Jester, Ocilla, Priscilla, Yellow Stone and Argentina had maximum multiplication rate of 2-3 flowering size corms and 230-250 cormels. The cultivar Argentina was observed to have maximum number of cormels (320) per mother corm. The Cv. Yellow Stone (5-7) and Invitatie (4) were found with maximum flowering size corms from single mother corm.

Post Harvest Management and Value Addition

- In gladiolus, 27 varieties were evaluated for their vase life (days) in distilled water. These were classified into three categories *viz.*, long (12-14 days), medium (9-11 days) and short (< 9 days). The varieties Invitatie, Flevo Souvenir, Argentina, Plum Tart, Amsterdam, Priscilla, Verona, Pink Friendship, White Prosperity and Big Time Supreme had longer vase life (i.e. 12-14 days). Whereas varieties Fidelio, Ocilla, Snow Princess, Yellow Stone, Lemon Drop, Jester, Rosibee Red, Gold Field and Chandani recorded 9-11 days of vase life.

Blues, Purple Flora and Chemistry varieties showed poor vase life (4-6 days).

- Cultivar Pusa Narangi Gainda of Marigold contains higher carotene content (863 mg/100g).
- In dry flower technology of Limonium, the final moisture content was optimized as 15 per cent (db) to avoid shattering of flowers and the bundle size of 500g has been optimized for the drying time.
- The colour retention of dried Helichrysum flowers was better even after one year whereas slight discoloration has been found in Limonium and Brumus. In the case of Acroclinum the disc portion developed black look during storage.
- In wet drying of orchid, 30 per cent glycerol was better in terms of solution uptake and drying time. Other parameters like lowering the solution pH, addition of sucrose and plant growth regulators does not have significant effect on the drying process.
- Winter flowering annuals *viz*., Sweet William, Sweet Sultan, Antirrhinum and annual chrysanthemum were identified as potential cut flowers based on their performance for the vase life under six different treatments.

Crop Protection

- Among the different pollinators recorded on flowering annuals, honey bees were observed to be the major flower visitor followed by hover flies and other hymenopterans.
- Standard type chrysanthemum were observed to suffer higher insect damage as compared to spray type.
- In standard chrysanthemum mealy bug (*Phenacoccus solenopsis*) incidence was recorded at the early stages of the crop and the infestation lead to stunting of the plants.
- Bihar hairy caterpillar (*Spilosoma obliqua*) early instar larvae fed on the leaves whereas the later instars on petals of spray type of chrysanthemum.
- Gladiolus thrips damage was also recorded during February-March on some gladiolus varieties.