



# Annual Report 2017-18



**ICAR-Directorate of Floricultural Research**  
College of Agriculture Campus, Shivajinagar  
Pune-411005, Maharashtra, India



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## Preface

I have great pleasure in presenting the Annual Report 2017-18 of ICAR-Directorate of Floricultural Research, Pune. During this year ICAR-DFR made significant progress in research and outreach programmes. In crop improvement, promising gladiolus hybrids were identified and evaluated for morphological traits. Four hybrids were found promising on the basis of morphological and flowering characters. In tuberose selections from open pollinated populations, PR-9 (Phule Rajani), AN-3 (Arka Nirantara) and SS-26 (Sikkim Selection) were found to be dwarf and would be useful as pot plants and vertical gardens to introduce fragrant flowers. In crop production alternate media substances were tested. Fly ash and press mud individually as potting medium components and together support plant growth well as compared to control. In case of crop protection efforts are made to develop quick diagnostic tools based on serological lateral flow assay technique and Recombinase Polymerase Amplification technique RT-RPA assay for detection of Plantagoasiatica mosaic virus (PIAMV), a major pathogen of Liliums in association with USDA under Norman Borlaug International Fellowship for agriculture and technology programme. Deploying nested PCR with 16srRNA based primers, manifestations of phytoplasma infection were investigated. The amplicons were sequenced and the sequence in BLAST showed 99% sequence similarity with C. Phytoplasma aaurantifolia group of phytoplasma.



**K.V. Prasad**  
Director

In Postharvest Management and Value Addition, total pigment content and antioxidant properties in chrysanthemum, rose were investigated. In chrysanthemum 22 accessions of chrysanthemum were analysed for determinations of total phenol content and total anthocyanins. Similarly 17 rose accessions were analysed for total phenol content and total anthocyanins. Volatile compound profiling of tuberose cultivars with HPLC indicated that ethyl benzene, ethyl benzoate, methyl benzoate, indole, farnesene, p-xylene, benzyl benzoate, n-octadecane, benzyl salicylate, 1, 8-cineole were the major fractions besides an number of minor fractions.

In our endeavour to mechanize floriculture operations we have developed a pedal operated rose grafting machine with stainless steel and mild steel material. The grafting machine consist of four parts namely main grafting assembly, rootstock and scion cutting and reunion assembly, Pedal to operate the machine and wooden table to support the whole assembly of machine. The machine is being tested for its efficacy. A prototype of loose flower plucker was designed, developed and tested for harvesting of loose flowers like marigold, chrysanthemum and gaillardia. The field trials indicated high degree of operational convenience.

The average time required for drying of rose petals was 19 hours in hot air oven and 20 min in microwave oven method. In both the methods, initial drying rate was higher and decreased gradually with time. The drying characteristics of rose petals indicated that the microwave oven method was better for preparation of dried rose petals as compared to hot air oven.

In order to minimise the transportation cost of the loose flowers, we have designed and developed foldable Poly-propylene boxes for packaging of loose flowers. The foldable nature of the crates would bring down the cost of transportation while bringing the crates back from the markets.

DFR was privileged to receive Honorable Secretary, DARE and DG, ICAR, Dr. Trilochan Mohapatra during April and December 2017. His towering presence was a great inspiration to all the members of the DFR. Hon'ble DG has reviewed the progress of work carried out by the scientific staff and offered very valuable suggestions for improvement. ICAR-DFR was equally benefited by the visits of Hon'ble DDG Horticulture Dr. A.K. Singh and Dr. T. Janakiram ADG (HS-I) who had reviewed the progress made by ICAR-DFR.

ICAR DFR organized a number of outreach programmes that included Celebration of National Productivity Week, International Soils day, *Mera Goan Mera Gaurav*, *Swaatch Bharat* Mission, *Hindi Pakhwada*, Hindi Workshop and National Science Day.

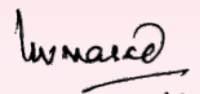
ICAR-DFR places on record its deep sense of gratitude in honour of Dr. T. Mohapatra, Hon'ble Secretary-DARE and Director General, ICAR for his constant support and encouragement in all its endeavours.

I take this opportunity to profusely thank Dr. A.K. Singh Honble DDG (Horticultural Science) for his overall leadership, guidance and encouragement from time to time. ICAR-DFR is immensely benefited by his proactive support while steering research agenda of ICAR.

Constant guidance and encouragement from Dr. T. Janakiram, ADG (HS) has been a boon for ICAR-DFR. We place our sincere acknowledgments for his untiring efforts to help ICAR DFR to re-establish itself at Pune.

The editorial team comprising of Dr. D.V.S. Raju, Dr. Tarak Nath Saha, deserve special appreciation for their involvement and commitment in bringing out this publication.

My sincere appreciation goes to all my colleagues Dr. P. Naveen Kumar, Dr. D.V.S. Raju, Dr. Tarak Nath Saha, Dr. Prashant G. Kavar, Dr. Prabha. K, Dr. Nitika Gupta, Er. Rahul Yadav, and Dr. Shilpashree. K.G for discharging various responsibilities while organizing the events and preparing the document. The support and cooperation received from the administrative and finance staff of ICAR-DFR is duly acknowledged.

  
(K.V.Prasad)

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# Executive Summary

## Crop Improvement

Promising gladiolus hybrids were identified and evaluated for morphological traits. The hybrids Yellow Stone x Blues, Lemon Drop x Purple Flora, Hunting Song x Ocilla, Invitatie x Novalux, were found promising in respect of morphological and flowering characters.

Among single type, the cultivars, Prajwal, Shringar, Bidhan Snighdha, GKTC-4, Arka Nirantara and Mexican Single were found to be promising in respect of flowering parameters. Whereas, Hyderabad Double and Suvasini were found better among double types.

The tuberose selections from open pollinated populations, PR-9 (Phule Rajani), AN-3 (Arka Nirantara) and SS-26 (Sikkim Selection) were found to be promising in respect of dwarfness, whereas lines such as AN-7, AN-18, AN-23, AN-26, AN-27, AN-28, AN-32, AN-37, PR-15 and MX-19 are suitable for both cut and loose flower.

## Crop Production

Fly ash ( $T_1$ :10%,  $T_3$ :20%) and press mud ( $T_4$ :25%,  $T_5$ :35%) individually as potting medium components and together ( $T_7$ :10%FA & 25%PM,  $T_8$ :12.5%FA & 37.5%PM and  $T_9$ :15%FA & 35%PM), support plant growth well as compared to control.

## Crop Protection

On field quick diagnostic tools based on serological lateral flow assay technique and Recombinase Polymerase Amplification technique RT-RPA assay for detection of *Plantago asiatica mosaic virus* (PIAMV), a major pathogen of Liliums has been developed in association with USDA under Norman Borlaug International Fellowship for agriculture and technology programme. The work was undertaken at USDA, Beltsville, Maryland, USA.

To identify the etiology of phyllody in gerbera plants observed during survey of Ahmednagar district, the infected plants were collected and established in glasshouse. The total DNA was isolated from the leaf petioles and detection of the probable cause *i.e.* phytoplasma was done by nested PCR using 16srRNA based primers. The amplicons were sequenced and the sequence in BLAST showed 99% sequence similarity with *C. Phytoplasma aurantifolia* group of phytoplasma.

## Postharvest Management and Value Addition

Among 22 accessions of chrysanthemum analysed for determinations of total phenol content variety Dimond Jubilee has noted highest phenolics content (47 mg/100gm GAE) followed by Silk Borocate (47 mg/100gm GAE) and PUV (44 mg/100gm GAE) while the lowest was noted in Bidhan Sabita (-2mg/100gm GAE). In case of total anthocyanins contents variety Mauve Sarah recorded the highest (65.04 mg/l) followed by Bidhan Pratima (58.7 mg/l) whereas lowest was noted in Mini Jessie (0.3 mg/l).

Among the 17 rose accessions analysed for total phenol content variety Pusa Pitamber recorded highest total phenol content (25.47 mg/100gm GAE) followed by Pusa Gaurav (24.33 mg/100gm GAE) and Summer Snow (23.64 mg/100gm GAE) whilst lowest was noted in variety Midas Touch (11.15 mg/100gm GAE). In case of total anthocyanins content variety Charisma recorded highest anthocyanin content (210.3 mg/l) followed by Pusa Pitambar (189.5 mg/l) while lowest was recorded in Midas Touch (2.5gm/l).

Volatile compound profiling of tuberose cultivars Shringar, Hyderabad Single, Phule Rajani, Bidhan Ujjwal, GKTC-4, Prajwal, STR-505 and Bidhan Snigdha indicated that ethyl benzene, ethyl benzoate, methyl benzoate, indole, farnesene, *p*-xylene, benzyl benzoate, n-octadecane, benzyl salicylate, 1, 8-cineole were the major fractions besides minor fractions.

The pedal operated rose grafting machine was designed and developed with stainless steel and mild steel material. The grafting machine consist of four parts namely main grafting assembly, rootstock and scion cutting and reunion assembly, Pedal to operate the machine and wooden table to support the whole assembly of machine.

A prototype of loose flower plucker was designed, developed and tested for harvesting of loose flowers like marigold, chrysanthemum and gaillardia. The field trials indicated high degree of operational convenience.

The average time required for drying of rose petals was 19 hours in hot air oven method and 20 min in microwave oven method. In both the methods, initial drying rate was higher and decreased gradually with time. The drying characteristics of rose petals indicated that the microwave oven method was better method for preparation of dried rose petals as compared to hot air oven method.

Designed and developed foldable Poly-propylene boxes for packaging of loose flowers. The developed foldable PP boxes have different sizes and percentage of ventilation. Freshness of tuberose floret was significantly influenced by box size and percentage of ventilation. The flowers stored in all the boxes except boxes without ventilation maintained maximum ( $\geq 85\%$ ) freshness till 4<sup>th</sup> day however wilting was observed from 5<sup>th</sup> day. The percentage of wilting had varied as per the size of PP box and ventilation percentage. The flowers packed in A2B1 box had less physiological loss in weight (PLW) and maintained higher freshness up to 5<sup>th</sup> day of storage.

# Introduction

The main stay of Indian floriculture is to grow traditional loose flowers mostly for worship, personal adornment and traditional decorations. With the evolving culture of 'saying it with flowers' the cut flowers sector made significant inroads in recent times. Today the traditional flowers are grown in area of 3.09 lakh hectare producing 22.46 lakh tonnes of loose flower and 4.84 lakh tones of cut flowers (NHB 2016). India also has significant proportion of trade in potted flowering plants, ornamentals foliage plants for landscaping, turf grasses, cut foliage, dry flowers, specialty flowers, annual flower seeds and fillers.

India exported floricultural produce worth Rs 570 cores (APEDA 2017) that comprises fresh cut flowers (to Europe, Japan, Australia, and Middle East, USA), loose flowers (for expatriate Indians in the Gulf and Europe), cut foliage (to Europe), dry flowers (To USA, Europe, Japan, Russia, and Australia) and potted plants (Middle East) besides seeds and planting material. The major market for domestic flowers is in Delhi, Mumbai, Calcutta, Chennai, Pune, Bangalore, Hyderabad etc. With limited infrastructure the amount of trade that takes place in the major markets varies from season to season. The market value of the traditional flowers is not well documented leaving mostly to speculations. Estimates suggest that the domestic trade of flowers is more than Rs.10000 cores.

In order to sustain the growth of the floriculture industry, tailor made technologies are essential that offer solutions to the farmers. In a multifaceted industry like floriculture novel technologies in each sub sector are quite essential. In this endeavour, ICAR-DFR is striving to develop relevant technologies for the benefit of the stakeholders. Efforts are underway to develop novel varieties that are dwarf in tuberosity which are ideal for pot culture and vertical walls. Similarly efforts are under way for developing technologies for vertical gardening. Investigations are on to identify alternate media components by incorporating the farm waste and industrial by products.

Nutraceutical properties of pigments isolated from rose, marigold and chrysanthemum are being determined besides the volatile profiling of essential oils from tuberosity is being done. To reduce the drudgery in farm operations tools and gadgets are being developed. A flower plucker is developed that is ergonomically designed and tested for its efficacy in the farm. Similarly foldable crates are developed for packing the flowers to reduce the transportation cost and to improve the shelf life.

## About The Directorate

ICAR-Directorate of Floricultural Research (DFR), as an Institute under Indian Council of Agricultural Research was formally launched on 10<sup>th</sup> December, 2009 during the XIX Group Meeting of All India Coordinated Research Project on Floriculture held at Indian Agricultural Research Institute (IARI), New Delhi to promote and strengthen floricultural research and enhance the technological base in floriculture. The Directorate is the first of its kind in the country. Initially it was established in IARI campus on temporary basis. The Directorate has been relocated to College of Agriculture Campus, Shivajinagar, Pune. Presently AICRP on Floriculture is an integral part of the ICAR-DFR, having 25 Centres comprising of 15 budgetary, five institutional and five voluntary centres.

Considering the research needs and potential of floriculture in India, the mandate of the ICAR-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.



### Vision

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

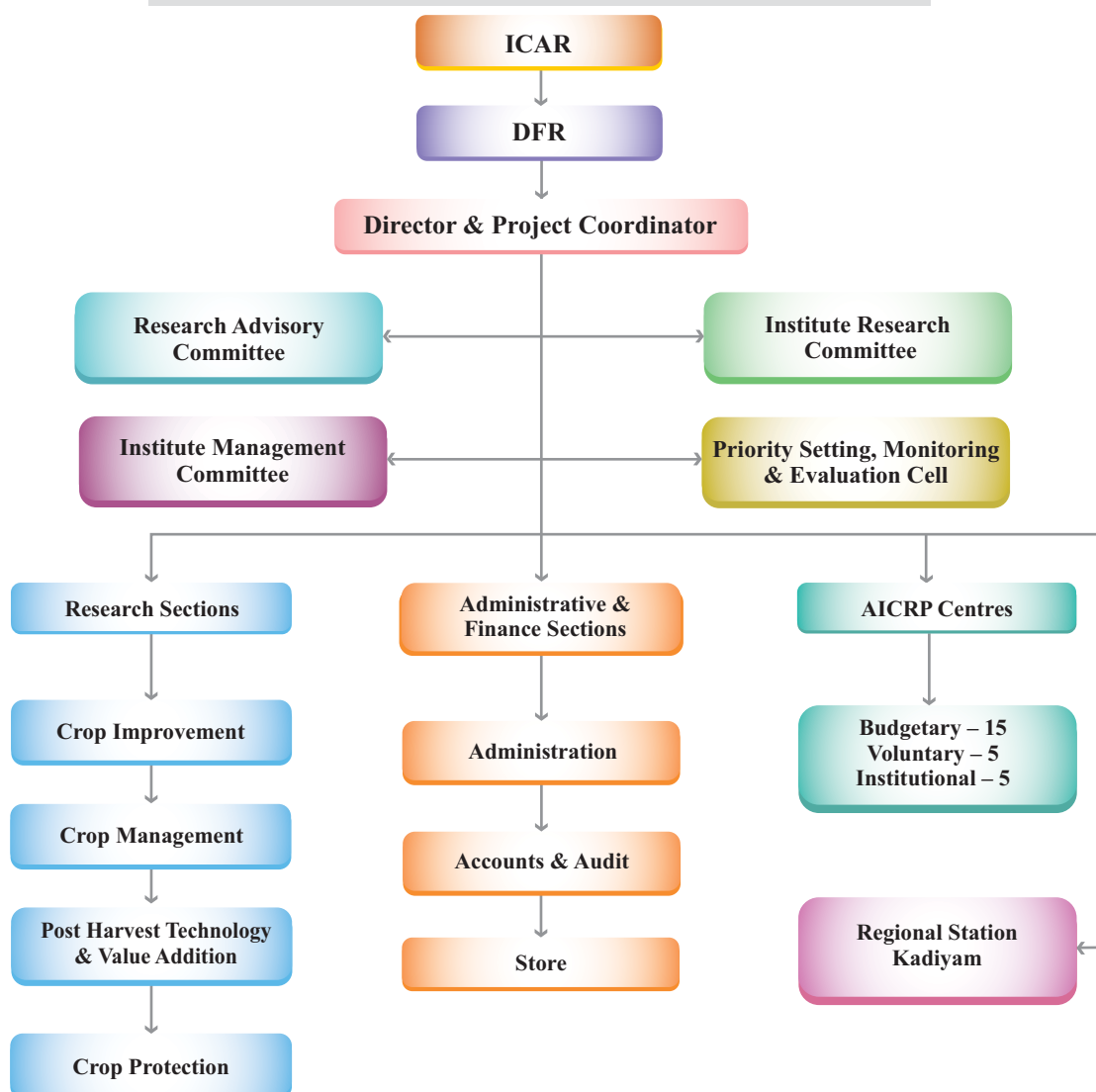
### Mission

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.

### Mandate

- Basic, strategic and applied research to enhance sustainable productivity, quality and utilization of ornamental crops.
- Repository of genetic resources and scientific information on ornamental crops.
- Transfer of technology, capacity building and impact assessment of technologies.
- Coordinate research and validation of technologies through AICRP on Floriculture.

### Organizational Structure of ICAR-Directorate of Floricultural Research, Pune





# Research Achievements

## 1. Crop Improvement

### 1.1. Project 01 (ICAR Project Code: IXX 14257) Improvement of Gladiolus for Quality and Yield

#### 1.1.1 Germplasm Collection

The existing gladiolus germplasm was enriched with more varieties viz., Red Ginger, Magistrate, Summer Sunshine, Smoky Lady, American Beauty, African Star, Soul Biscuits, Candyman, Vicky Lin, Cheops, Magma, etc. The varieties viz., Pusa Kiran, Pusa Srijana, Pusa Shubham, Arka Amar, Arka Kesar, Arka Naveen, Shubhangini, Shweta, Urmi, Swarnima, Surya Kiran, Phule Ganesh, Phule Neelrekha, developed from different institutes were also collected. About 69 gladiolus varieties were evaluated for floral traits during 2017-18 for their performance under Pune conditions. The germplasm evaluated and maintained in ICAR-DFR is listed in Table 1.1.

**Table: 1.1 Gladiolus Germplasm at ICAR-DFR, Pune**

S. no	Name of varieties	S.no	Name of varieties	S. no	Name of varieties
1.	Access	26.	Jester	51.	Red Ginger
2.	Acc No 7	27.	Jester gold	52.	Red Majesty
3.	African Star	28.	Limoncello	53.	Rose Supreme
4.	Algrove	29.	Magma	54.	Smoky Lady
5.	American Beauty	30.	Melody Open	55.	Sancerre
6.	Arka Amar	31.	Novalux	56.	Shabanam
7.	Arka Kesar	32.	Panibica Beauty	57.	Shahanoda
8.	Arka Naveen	33.	Phule Ganesh	58.	Snow Princess
9.	Aarti	34.	Phule Neelrekha	59.	Solist
10.	Bindiya	35.	Pink Lady	60.	Soul Biscuits
11.	Candyman	36.	Priscilla	61.	Subhangani
12.	Chandani	37.	Ps hybrid 40	62.	Suchitra
13.	Cheops	38.	Psittalinus Hybrid	63.	Summer Sunshine
14.	Darshan	39.	Punjab Dawn	64.	Surya Kiran
15.	Dhanvantari	40.	Punjab Glance	65.	Swarnima
16.	Eurovision	41.	Punjab Gold-1	66.	Shweta
17.	Flavo Amico	42.	Punjab Lemon Delight	67.	Tambri
18.	Flavo Souvenir	43.	Punjab Morning	68.	Trader Horn
19.	Friendship	44.	Punjab Pink Elegance	69.	Uhfs g105hb-11-10
20.	Gulal	45.	Purple Flora	70.	Urmi

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S. no	Name of varieties	S.no	Name of varieties	S. no	Name of varieties
21.	Gunjan	46.	Pusa Kiran	71.	Vicky Lin
22.	Hy AC No.7	47.	Pusa Srijana	72.	Welding Creamby
23.	IIHR-G-11	48.	Pusa Subham	73.	White Prosperity
24.	IIHR-G-12	49.	Pusa Suhagin	74.	White Chiffon
25.	Intrepid	50.	Pusa Urmil	75.	Yellow Stone

### 1.1.2. Evaluation of Germplasm

A total of 69 genotypes were evaluated for the floral traits under Pune condition (Fig 1.1). The perusal of data (Table 1.2) revealed that the maximum plant height was observed in varieties viz., Welding Creamby (141.73cm), Suchitra (126.60 cm), Panibica Beauty (123.54 cm), Ac No.-7 (122.06), Red Majesty (119.60 cm), Arka Amar (119.24 cm), Jester Gold (118.76 cm), Jester (111.66 cm), Phule Ganesh (110.82 cm), Summer Sunshine (108.80 cm), Pusa Urmil (108.52 cm), Phule Neelrekha (108.50 cm) Sweta (106.35 cm) and Pusa Suhagan (104.65). The varieties viz., Pusa Urmil (19.55), Pusa Suhagan (19.55), Yellow Stone (19.44), Flavo Amico (19.33), Subhangani (18.99), Suryakiran (18.99), Phule Neelrekha (18.10), Jester (17.44), Punjab Pink Elegance (17.22), Panibica Beauty (16.88), Suchitra (16.77), Arka Amar (16.55) and Limoncello (16.44) produced significantly higher number of florets per spike. The florets colour, number of florets and spike length are the most preferred economic traits in market. The maximum spike length was observed in varieties viz., Welding Creamby (133.06 cm), Panibica Beauty (118.00cm), Suchitra (113.18 cm), Arka Amar (110.73 cm), Jester Gold (105.17 cm), Jester (103.28 cm), Phule Ganesh (102.84 cm) and Phule Neelrekha (102.54 cm), These varieties are also good multiplier and can be grown successfully in Pune conditions.



Fig 1.1 Field View of Gladiolus

**Table 1.2 Evaluation of gladiolus germplasm under Pune conditions**

Sr No.	Name of Genotype	Plant Height (cm)	Number of Florets per Spike	Number of Leaves	Spike Length (cm)	Rachis Length (cm)	Leaf Length (cm)	Leaf Width (cm)	Florets Dia. (cm)	Internodal length (cm)
1.	Ac No 7	122.06	14.33	9.77	113.40	55.28	49.65	4.19	8.27	5.20
2.	African Star	84.54	13.33	7.00	74.64	46.98	41.85	2.92	8.60	5.21
3.	Allgrove	100.53	12.88	7.00	92.12	56.70	47.90	4.49	9.49	4.95
4.	American Beauty	101.73	13.22	7.89	93.51	61.50	43.08	4.72	9.60	5.30
5.	Arka Amar	119.24	16.55	10.45	110.73	56.79	51.33	4.16	8.94	5.55
6.	Arka Kesar	99.19	15.22	9.11	86.35	49.00	43.63	4.48	9.83	4.25
7.	Arka Naveen	103.04	15.99	8.00	93.73	46.96	46.68	4.23	8.83	5.23
8.	Aarti	99.33	15.88	8.33	88.31	44.88	49.85	4.88	10.94	6.07
9.	Bindiya	82.35	14.32	6.99	72.90	58.17	52.57	3.19	9.05	3.66
10.	Candyman	103.23	15.22	7.77	96.90	65.03	54.63	3.81	9.82	6.53
11.	Chandani	99.07	14.88	6.33	87.89	45.16	44.84	3.87	8.72	4.61
12.	Cheops	75.97	11.44	7.11	66.20	46.47	44.63	3.36	7.60	4.71
13.	Darshan	87.90	13.33	8.77	76.28	49.66	42.26	3.16	6.60	6.38
14.	Dhanvantari	94.57	13.77	8.22	82.38	56.24	45.26	3.17	9.38	4.87
15.	Eurovision	89.57	15.11	6.77	81.56	55.17	54.88	3.62	7.49	4.59
16.	Flavo Amico	108.34	19.33	7.55	92.25	62.13	49.69	4.88	9.72	5.05
17.	Flavo Souvenir	87.26	16.44	7.66	80.44	52.53	48.41	4.09	8.83	4.37
18.	Gulal	78.62	11.33	7.22	72.13	43.37	40.24	3.97	8.38	5.14
19.	Gunjan	87.99	13.33	8.33	78.36	44.46	44.31	4.87	9.60	3.64
20.	HYAC No.7	89.70	15.44	7.11	79.54	44.87	47.81	4.84	8.50	6.47
21.	Jester	111.66	17.44	8.11	103.28	83.29	49.56	4.66	9.38	4.56
22.	Jester Gold	118.76	14.21	8.44	105.17	72.35	65.72	5.27	6.83	5.02
23.	Limoncello	87.74	16.44	8.00	81.59	52.29	52.77	4.56	8.38	4.50
24.	Magma	94.70	14.77	7.66	85.53	59.04	48.66	4.70	9.38	5.79
25.	Melody Open	114.16	14.33	6.99	105.50	71.05	52.43	4.51	10.49	6.43
26.	Novalux	75.18	9.66	7.11	67.55	40.82	41.68	3.63	7.38	4.19
27.	Panibica Beauty	123.54	16.88	7.11	118.00	78.51	41.57	3.01	10.94	4.82
28.	Phule Ganesh	110.82	16.11	8.66	102.84	67.59	48.56	5.31	10.83	6.74
29.	Phule Neelrekha	108.50	18.10	11.01	102.54	64.38	48.74	3.99	8.60	6.14
30.	Pink Lady	90.78	14.22	7.44	83.58	50.63	47.08	5.05	8.38	4.32



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Sr No.	Name of Genotype	Plant Height (cm)	Number of Florets per Spike	Number of Leaves	Spike Length (cm)	Rachis Length (cm)	Leaf Length (cm)	Leaf Width (cm)	Florets Dia. (cm)	Internodal length (cm)
31.	Priscilla	88.72	15.77	7.99	79.96	48.73	52.77	4.03	10.10	5.01
32.	Ps Hybrid 40	98.68	18.22	7.44	87.74	40.69	40.05	4.03	9.16	5.78
33.	Psittalinus hybrid	67.79	14.55	8.44	63.04	44.20	37.17	3.26	6.38	4.98
34.	Punjab Dawn	89.74	14.66	7.33	78.74	45.32	46.13	4.27	8.72	4.77
35.	Punjab Gance	88.66	14.88	7.11	79.07	46.58	55.71	4.58	8.38	6.01
36.	Punjab Gold-1	100.03	15.10	8.11	88.19	43.29	48.60	4.11	9.49	5.88
37.	Punjab Lemon Delight	87.04	13.55	7.00	79.38	45.53	37.65	4.59	9.60	6.03
38.	Punjab Morning	94.97	13.99	6.77	86.56	49.39	45.65	3.85	8.72	5.04
39.	Punjab Pink Elegance	100.81	17.22	7.89	90.91	40.57	42.40	3.98	8.38	5.75
40.	Purple Flora	94.98	13.77	7.33	83.55	57.28	49.79	3.97	7.27	5.30
41.	Pusa Kiran	88.70	12.66	8.00	79.65	62.21	47.12	4.03	5.83	3.96
42.	Pusa Srijana	70.80	8.55	6.11	57.68	48.13	34.74	2.96	8.83	3.44
43.	Pusa Subham	78.09	13.33	7.11	68.06	35.07	33.82	3.98	8.49	5.95
44.	Pusa Suhagan	104.65	19.55	7.66	91.94	43.55	49.50	3.95	8.61	5.78
45.	Pusa Urmil	108.52	19.55	6.44	95.95	50.20	47.13	3.91	9.60	5.80
46.	Red ginger	103.22	13.44	8.00	96.85	64.55	42.74	3.70	10.38	6.16
47.	Red Majesty	119.60	13.22	9.22	77.65	63.76	49.76	3.86	11.55	7.27
48.	Rose Supreme	97.96	14.44	8.11	87.78	46.52	50.64	4.98	9.94	6.25
49.	Smoky Lady	94.27	16.10	8.44	84.99	55.52	48.85	4.15	7.72	4.75
50.	Sancere	98.33	13.88	7.22	87.96	56.18	45.88	4.98	9.05	6.04
51.	Shabnam	94.653	12.77	8.55	85.67	47.08	37.25	3.29	6.94	4.52
52.	Shahanoda	85.62	15.55	8.33	77.52	50.81	49.63	3.86	6.49	4.40
53.	Snow Princess	103.81	16.10	7.44	96.28	59.63	44.15	5.55	6.38	5.01
54.	Solist	93.72	14.44	6.77	84.98	53.52	45.75	3.51	9.50	4.24
55.	Soul Biscuits	96.23	12.33	7.77	88.53	55.28	47.28	3.28	9.72	5.94
56.	Subhangani	101.75	18.99	7.22	89.05	49.41	49.18	4.84	9.38	6.06
57.	Suchitra	126.60	16.77	10.56	113.18	65.92	49.14	3.82	9.44	6.71
58.	Summer Sunshine	108.80	15.55	8.33	94.87	59.91	51.35	5.15	8.60	5.29

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Sr No.	Name of Genotype	Plant Height (cm)	Number of Florets per Spike	Number of Leaves	Spike Length (cm)	Rachis Length (cm)	Leaf Length (cm)	Leaf Width (cm)	Florets Dia. (cm)	Internodal length (cm)
59.	Suryakiran	99.93	18.55	8.00	88.18	42.38	45.63	4.07	9.86	5.86
60.	Swarnima	79.67	13.44	6.55	69.67	51.96	37.64	3.63	7.94	3.84
61.	Shweta	106.35	13.66	7.66	84.00	68.32	46.36	3.83	10.05	4.82
62.	Tambri	101.57	15.77	7.00	91.54	50.14	53.38	4.72	10.61	5.64
63.	Trader Horn	89.60	12.88	6.99	84.96	53.35	44.79	4.76	7.16	5.10
64.	UHFS G105HB-11-10	99.88	15.33	8.33	89.65	46.97	41.70	4.99	8.60	5.91
65.	Urmi	99.68	15.99	7.55	89.75	66.25	46.95	4.20	10.05	4.88
66.	Vicky Lin	82.81	12.77	7.44	72.18	56.88	32.86	3.42	8.16	4.73
67.	Welding Creamby	141.73	15.00	8.00	133.06	87.66	42.93	3.10	11.83	9.93
68.	White Chiffon	93.16	14.66	8.88	83.16	47.82	43.25	3.65	9.38	5.89
69.	Yellow Stone	99.77	19.44	9.11	89.55	62.14	46.92	4.15	8.08	4.98
	CV	6.32	9.201	7.87	10.76	8.17	5.99	9.08	8.56	8.55
	CD (0.05)	9.81	2.19	0.99	14.96	7.10	4.40	0.60	1.22	0.73

### 1.1.3. Hybridization

Hybridization was carried out among the promising varieties of gladiolus. A total of 51 crosses were attempted on 10 plants in each cross. Some of the crosses attempted are given in the Table 1.3. The seeds from the successful crosses were harvested and sown.

**Table 1.3 Promising Cross Combinations in Gladiolus (2017-18)**

Sr no.	Female parent	Male parent	Sr no.	Female parent	Male parent
1.	Allgrove	Snow Princess	27.	Red Ginger	Panibica Beauty
2.	American Beauty	Punjab Dawn	28.	Red Ginger	Welding Creamby
3.	American Beauty	Yellow Stone	29.	Red Ginger	Arka Amar
4.	Arka Amar	Welding Creamby	30.	Red Ginger	Melody Open
5.	Arka Naveen	Yellow Stone	31.	Red Ginger	Panibica Beauty
6.	Candyman	Summer Sunshine	32.	Red Ginger	Phule Neelrekha
7.	Candyman	Melody Open	33.	Red Majesty	Snow Princess
8.	Candyman	Panibica Beauty	34.	Red Majesty	Welding Creamby

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Sr no.	Female parent	Male parent	Sr no.	Female parent	Male parent
9.	Flavo Souvenir	Yellow Stone	35.	Snow Princess	Red Majesty
10.	Gunjan	Snow Princess	36.	Snow princess	Gunjan
11.	Gunjan	Punjab Dawn	37.	Snow Princess	Yellow Stone
12.	Melody Open	Candy Man	38.	Snow Princess	Algrove
13.	Melody Open	Yellow Stone	39.	Soul Biscuits	Phule Neelrekha
14.	Melody Open	Red Ginger	40.	Summer Sunshine	Welding Creamby
15.	Panibica Beauty	Urmi	41.	Suryakiran	Panibica Beauty
16.	Panibica Beauty	Suryakiran	42.	Urmi	Panibica beauty
17.	Panibica Beauty	Snow Princess	43.	Vicky Lin	Snow Princess
18.	Panibica Beauty	Red Majesty	44.	Welding Creamby	Sovit Bieucts
19.	Phule Neelrekha	Red Majesty	45.	Welding Creamby	Red Ginger
20.	Phule Neelrekha	Summer Sunshine	46.	Welding Creamby	Vicki Lin
21.	Priscilla	Purple Flora	47.	Welding Creamby	Red Majesty
22.	Priscilla	American Beauty	48.	Welding Creamby	Phule Ganesh
23.	Priscilla	Limoncello	49.	Yellow Stone	Red Ginger
24.	Priscilla	Chandani	50.	Yellow Stone	Snow Princess
25.	Priscilla	Flavo Souvenir	51.	Yellow Stone	Arka Naveen
26.	Punjab Dawn	Snow Princess	52.		

#### 1.1.4 Evaluation of hybrids

Promising gladiolus hybrids were identified and evaluated. Some of the hybrids Yellow Stone x Blues, Lemon Drop x Purple Flora, Hunting Song x Ocilla, Invitatie x Novalux, were found promising in respect of morphological and flowering characters. The data for two seasons were also collected and presented in Table 1.4

Hybrid Hunting Song x Ocilla (Fig 1.2) produces more number of florets per spike (19.45) having pale yellow coloured florets (18C as per R.H.S colour chart). Reddish spots at the base of inner tepals on background of pale yellow coloured florets make it more attractive. The hybrid starts producing longer spikes (>97.0 cm) after 93.5 days with more number of florets per spike (20.67). In addition, it is a very good multiplier producing 2.0 corms and about 40.70 cormels which makes it more suitable for commercialization.

Hybrid Yellow Stone x Blues (Fig 1.3) produces strong reddish orange coloured florets (31A RHS colour chart) with 15.7 florets per spike and long spike length (79.2 cm). It is an early season hybrid and takes 78.6 days for flowering with robust and compact spikes in addition being a good multiplier making it suitable for cut flower production.

Table: 1.4 Morphological data of promising hybrids of gladiolus collected during last two seasons.

2016-17											
Hybrid	Plant height (cm)	Days required for spike initiation	Days to flowering	Spike length (cm)	Rachis length (cm)	No of florets /Spike	Dia. of 2nd floret (cm)	No. of spike /plant	No. of florets open at a time	Florets texture	Florets colour
No.31 (Hunting Song x Ocilla)	124.97	81.80	94.56	92.26	63.83	18.70	10.13	2.06	5.33	Medium	18C (Pale Yellow)
No.87 (Yellow Stone x Blues)	101.96	56.33	78.53	80.46	56.23	15.63	11.55	1.86	6.80	Medium	31A (Strong reddish orange)
No.39 (Invitatie x Novalux)	129.80	70.57	87.73	97.06	78.66	18.63	11.87	3.73	5.60	Thin	162D (Bicoloured, dark yellow blotch on pale yellow florets with pink stripes on borders )
No.43-5 (Lemon Drop x Purple Flora)	129.03	71.33	94.33	100.73	76.43	18.20	12.43	1.63	4.06	Medium	62D (Strong Purplish Pink)
CD (0.01)=	1.99	3.64	2.20	3.75	4.48	0.72	1.45	0.41	0.64		
2015-16											
No.31 (Hunting Song x Ocilla)	139.10	79.67	92.86	99.53	72.83	20.67	10.33	1.06	4.00	Medium	18C (Pale Yellow)
No.87 (Yellow Stone x Blues)	104.96	63.53	82.10	74.10	63.93	17.03	9.80	2.23	6.23	Thick	31A (Strong reddish orange)
No.39 (Invitatie x Novalux)	121.87	75.53	87.60	94.87	73.00	19.60	12.33	3.10	5.16	Thin	162D (Bicoloured, dark yellow blotch on pale yellow florets with pink stripes on borders )
No.43-5 (Lemon Drop x Purple Flora)	108.60	64.07	89.07	95.60	72.06	18.00	11.40	2.46	4.23	Medium	62D (Strong Purplish Pink)
CD (0.01)=	5.22	4.78	3.84	9.88	3.98	1.89	0.80	0.62	0.60		

Hybrid Invitatie x Novalux (Fig 1.4) produces bicoloured florets of deep yellow coloured blotch and pale yellow coloured florets having pink strips on borders (162D RHS colour chart). Deep yellow blotch on background of pale yellow florets makes it more attractive. Hybrid starts producing spikes in 86.65 days with robust and compact florets arrangement having a spike length of more than 97.00 cm. The hybrid produces more number of florets per spike (19.60) and is also a very good multiplier with more than two (3.0) corms and 35.7 cormels per plant.

Hybrid Lemon Drop x Purple Flora (Fig 1.5) produces light pink coloured florets (62D RHS colour chart) with 18.3 florets per spike. Widely arranged larger florets on spike with medium texture make it attractive. Longer spikes (96.5 cm), early flowering (91.0 days) and 4-5 florets remain open at a time making it suitable for cut flower production. In addition, it is a very good multiplier which makes it more suitable for commercialization. Two season's morphological data of evaluation of these gladiolus hybrids is presented table 1.4.



Fig 1.2 DFR-G-Hy-31

#### DFR-G-Hy-31 (Hunting Song x Ocilla)

- A hybrid of Hunting Song x Ocilla produces more number of florets per spike (20.67) having pale yellow (18C as per R.H.S colour chart).
- Reddish spots at the base of inner tepals on background of pale yellow coloured florets make it more attractive.
- The hybrid starts producing longer spikes (99.53 cm) after 92.86 days and 4-5 florets remains open at a time.
- A very good multiplier producing 2.0 corms and about 40.70 cormels which makes it more suitable for commercialization



Fig 1.5 DFR-G-Hy-87

#### DFR-G-Hy--87 (Yellow Stone x Blues)

- A hybrid of Yellow Stone x Blues. Produces strong reddish orange coloured florets (31A RHS colour chart)
- Longer spikes (80.46 cm) with more than 17.03 florets per spike
- Its early season hybrid takes 63.55 days for spike initiation with robust and compact spikes making it suitable for cut flower production.
- 6-7 florets remain open on spike at a time which is aesthetically appealing.
- It is also a good multiplier making it suitable for cut flower production.





Fig 1.4 DFR-G-Hy-39

#### DFR-G-Hy-39 (Invitatie x Novalux)

- A hybrid of Invitatie x Novalux which produces bicoloured florets of deep yellow coloured blotch and pale yellow coloured florets having pink strips on borders (162D RHS colour chart).
- Deep yellow blotch on background of pale yellow florets makes it more attractive.
- It starts producing spikes in 70.75 days with robust and compact florets arrangements having spike length more than 97.06 cm.
- It produces more number of florets per spike (19.60) with more than 5-6 florets remain open at a time.
- It is also a very good multiplier with more than two (3.0) corms and 35.7 cormels per plant.



Fig 1.5 DFR-G-Hy-43-5

#### DFR-G-Hy-43-5 (Lemon Drop x Purple Flora)

- A hybrid of Lemon Drop x Purple Flora. It produces light pink coloured florets (62D RHS colour chart)
- It is an early hybrid produces spikes in 64.07 days with more than 18.20 florets per spike.
- Widely arranged larger florets on spike with medium texture make it attractive.
- Longer spikes (100.73 cm), with 4-5 florets remain open at a time making it suitable for cut flower production.
- In addition, it is a very good multiplier which makes it more suitable for commercialization.

## 1.2 Project 02 (ICAR Project Code : 14261) Breeding of Tuberose for Quality and Yield

### 1.2.1. Evaluation of tuberose germplasm

Tuberose germplasm consisting of single (10 nos.) and double type (3 nos.) were planted at Hadapsar research farm during June 2017 for their evaluation (Fig 1.5). Data indicated that among single types, the cultivars, Prajwal, Shringar, Bidhan Snighdha, GKTC-4, Arka Nirantara and Mexican Single were found to be promising in respect of flowering parameters (Table 1.6). Whereas, Hyderabad Double and Suvasini were found better among double types.

**Table 1.5 Evaluation of tuberose germplasm at ICAR - DFR, Research Farm, Hadapsar during 2017-**

S. No.	Variety/genotype	PL Height (cm)	Spike Length (cm)	Rachis Length (cm)	Leaf Length (cm)	Leaf Width (cm)	Number of florets per spike	Floret Diameter (cm)	Floret Length (cm)	Plant Spread (cm)	Wt of 10 open florets (g)	Wt of 10 unopened florets (g)
<b>Single Type</b>												
1	Prajwal	105	83.6	45.2	52.6	2.9	45	3.8	6.4	96	22.6	8.8
2	Shringar	83.4	69.2	36.8	42.8	2.2	39	2.6	5.4	75.6	12.4	7.2
3	Phule Rajani	78.8	67.6	37	38.2	2.8	27.2	3.8	6	78.4	13	6
4	Bidhan Snigdha	95.4	82	47.4	45	2.8	35.8	4.2	5.2	68	17.6	7.8
5	Bidhan Ujjwal	60.6	47.2	26.6	29.4	2.8	25.6	4.4	5.8	72.4	13	7.6
6	GKTC-4	67.6	58.4	32	30	2.4	34.4	4.4	5.6	76.8	17.2	8.4
7	Hyderabad Single	80.4	70.4	34.4	48.8	2	30.6	3	5.4	88	12	7.6
8	STR - 505	86.2	75.4	40.2	49.4	2.1	32.8	3	5.8	86	17.4	11.4
9	Mexican Single	121.2	111.2	54.8	56.2	1.3	34	3	4.2	92.2	14.2	8.6
10	Arka Nirantara	87.8	77	33.4	50.4	2	33	3.3	6	81.6	13.8	8.2
<b>Double Type</b>												
11	Suvasini	86.2	75.8	33.8	43.2	1.5	28.4	3	5	79.6	38.8	14
12	Kolkata Double	89.6	78.6	42.2	42.4	2.5	25.6	3.8	6.4	74.6	34.8	12
13	Hyderabad Double	96.2	85.65	41.05	48.05	1.825	30.25	3.275	5.4	82	25.4	10.7



**Fig 1.6 Field View of Tuberose Germplasm**



### 1.2.2. Conventional and Mutation Breeding

Tuberose (*Polianthes tuberosa* L.) has extremely narrow genetic base and offers a little scope for its improvement. Efforts were made to attempt conventional (open pollination) and mutation (gamma ray irradiation) breeding for its improvement (Fig 1.7). Open pollinated seed from single type varieties (Phule Rajani, Mexican Single and Shringar) was collected for further sowing and assessment of variability. Crosses attempted among single varieties couldn't result in seed setting. Breeding material developed in the last year both from open pollinated seed and through gamma ray irradiation was evaluated.

### 1.2.3. Screening of Open Pollinated Population

Screening of OP population of tuberose varieties, Arka Nirantara, Phule Rajani and Sikkim Selection has resulted in few promising lines which were found to be dwarf. Available number of varieties in tuberose is very limited and most of them are medium to tall in plant height. Hence, dwarfness is a desirable trait which makes tuberose suitable as potted plant, bedding purpose as well as for landscape uses. Therefore an attempt has been made to isolate and evaluate the dwarf types as well as for cut and loose flowers from these OP population during 2017-18 (Fig 1.8a-t).

Among the sixteen OP population of cultivar Phule Rajani evaluated, the lines namely PR-1 (Greenish tinge buds), PR-3 (Greenish tinge buds), PR-4 (Greenish tinge buds), PR-9 (Greenish tinge buds), PR-11 (Greenish tinge buds), PR-13 (Pinkish tinge buds) and PR-30 (Greenish tinge buds) were found to exhibit dwarf



Fig 1.7 Breeding Block of Tuberose

**Brief description of identified promising tuberose lines (Fig 1. 8a-t)**



**AN 4**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for Pot Culture
- Plant height: 59.81 cm
- Spike length: 54.81 cm
- Rachis length: 26.90 cm
- No. of flowers per spike: 22.56
- Length of flower: 5.22 cm
- Diameter of Flower: 4.15 cm
- Pinkish tinge on flower bud



**AN 7**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 92.5 cm
- Spike length: 87.6 cm
- Rachis length: 36.47 cm
- No. of flowers per spike: 52.69
- Length of flower: 5.31 cm
- Diameter of Flower: 3.44 cm
- Pinkish tinge on flower bud



**AN 18**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 77.82 cm
- Spike length: 72.82 cm
- Rachis length: 32.33 cm
- No. of flowers per spike: 34.58
- Length of flower: 5.48 cm
- Diameter of Flower: 3.27 cm
- Pinkish tinge on flower bud



**AN 19**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut flower
- Plant height: 191.5 cm
- Spike length: 186.5 cm
- Rachis length: 84.64 cm
- No. of flowers per spike: 42.25
- Length of flower: 7.56 cm
- Diameter of Flower: 5.15 cm
- Full pink flower bud
- Black dot at tepal end



**AN 23**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 78.5 cm
- Spike length: 73.5 cm
- Rachis length: 34.8 cm
- No. of flowers per spike: 54.85
- Length of flower: 5.66 cm
- Diameter of Flower: 3.75 cm
- Pinkish tinge on flower bud
- Narrow tepals and jasmine type flowers



**AN 26**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 73.6 cm
- Spike length: 68.6 cm
- Rachis length: 38.84 cm
- No. of flowers per spike: 48.96
- Length of flower: 6.28 cm
- Diameter of Flower: 5.81 cm
- Greenish pink tinge on flower bud



**AN 27**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 67.9 cm
- Spike length: 62.9 cm
- Rachis length: 25.24 cm
- No. of flowers per spike: 42.65
- Length of flower: 5.23 cm
- Diameter of Flower: 3.55 cm
- Pinkish tinge on flower bud

**AN 28**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 95.6 cm
- Spike length: 90.6 cm
- Rachis length: 41.11 cm
- No. of flowers per spike: 48.54
- Length of flower: 5.73 cm
- Diameter of Flower: 3.32 cm
- Pinkish tinge on flower bud

**AN 30**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for Pot Culture
- Plant height: 50.42 cm
- Spike length: 45.42 cm
- Rachis length: 20.91 cm
- No. of flowers per spike: 42.56
- Length of flower: 4.97 cm
- Diameter of Flower: 4.54 cm
- Pinkish tinge on flower bud

**AN 32**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 83.44 cm
- Spike length: 78.44 cm
- Rachis length: 43.81 cm
- No. of flowers per spike: 73.4
- Length of flower: 5.77 cm
- Diameter of Flower: 4.42 cm
- Slight pinkish tinge on flower bud

**AN 36**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 94.34 cm
- Spike length: 89.54 cm
- Rachis length: 44.21 cm
- No. of flowers per spike: 50.45
- Length of flower: 5.2 cm
- Diameter of Flower: 4.1 cm
- Pinkish tinge on flower bud

**AN 37**

- Half-sib progeny from Cv. Arka Nirantara
- Suitable for cut & loose flower
- Plant height: 70.9 cm
- Spike length: 65.9 cm
- Rachis length: 22.23 cm
- No. of flowers per spike: 40.42
- Length of flower: 4.81 cm
- Diameter of Flower: 3.37 cm
- Slight pinkish tinge on flower bud



**PR1**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 49.51 cm
- Spike length: 44.51 cm
- Rachis length: 23.54 cm
- No. of flowers per spike: 28.89
- Length of flower: 4.42 cm
- Diameter of Flower: 3.42 cm
- Greenish pink tinge on flower bud



**PR3**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 43.50 cm
- Spike length: 38.50 cm
- Rachis length: 23.41 cm
- No. of flowers per spike: 43.50
- Length of flower: 3.24 cm
- Diameter of Flower: 4.13 cm
- Greenish tinge on flower bud



**PR9**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 43.38 cm
- Spike length: 38.38 cm
- Rachis length: 27.72 cm
- No. of flowers per spike: 36.65
- Length of flower: 5.70 cm
- Diameter of Flower: 3.66 cm
- Greenish pink tinge on flower bud



**PR11**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 46.33 cm
- Spike length: 40.33 cm
- Rachis length: 26.64 cm
- No. of flowers per spike: 40.66
- Length of flower: 4.33 cm
- Diameter of Flower: 5.12 cm
- Greenish pink tinge on flower bud



**PR15**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for cut and loose flower
- Plant height: 83.80 cm
- Spike length: 78.80 cm
- Rachis length: 34.61
- No. of flowers per spike: 40.44
- Length of flower: 5.7 cm
- Diameter of Flower: 3.80 cm
- Greenish tinge on flower bud

**MX2**

- Half-sib progeny from Cv. Mexican Single
- Suitable for Pot Culture
- Plant height: 47.8 cm
- Spike length: 42.8 cm
- Rachis length: 26.2 cm
- No. of flowers per spike: 38.4
- Length of flower: 4.7 cm
- Diameter of Flower: 3.5 cm
- Greenish tinge on flower bud

**MX3**

- Half-sib progeny from Cv. Mexican Single
- Suitable for Pot Culture
- Plant height: 55.2 cm
- Spike length: 50.2 cm
- Rachis length: 20.4 cm
- No. of flowers per spike: 41.5
- Length of flower: 4.8 cm
- Diameter of Flower: 3.8 cm
- Greenish tinge on flower bud

**MX19**

- Half-sib progeny from Cv. Mexican Single
- Suitable for cut and loose flower
- Plant height: 64.8 cm
- Spike length: 59.8 cm
- Rachis length: 32.1 cm
- No. of flowers per spike: 40.3
- Length of flower: 6.2 cm
- Diameter of Flower: 3.5 cm
- Greenish tinge on flower bud

**PR4**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 52.33 cm
- Spike length: 46.66 cm
- Rachis length: 28.33 cm
- No. of flowers per spike: 31.33
- Length of flower: 4.0 cm
- Diameter of Flower: 3.0 cm
- Greenish tinge on flower bud

**PR13**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 65.33 cm
- Spike length: 57.33 cm
- Rachis length: 28.66 cm
- No. of flowers per spike: 29.66
- Length of flower: 5.00 cm
- Diameter of Flower: 4.00 cm
- Greenish tinge on flower bud

**PR30**

- Half-sib progeny from Cv. Phule Rajani
- Suitable for Pot Culture
- Plant height: 53.20 cm
- Spike length: 46.40 cm
- Rachis length: 25.00 cm
- No. of flowers per spike: 50.20
- Length of flower: 4.80 cm
- Diameter of Flower: 4.40 cm
- Greenish tinge on flower bud

**SS26**

- Half-sib progeny from Cv. Sikkim Selection
- Suitable for Pot Culture
- Plant height: 48.5 cm
- Spike length: 40.5 cm
- Rachis length: 19.55 cm
- No. of flowers per spike: 49.4
- Length of flower: 6.1 cm
- Diameter of Flower: 3.4 cm
- Greenish tinge on flower bud



character. Analysis of data on plant height revealed that PR-13 was tall among the selected lines, followed by PR-30 (53.2cm), PR-4(52.33cm), PR-1 (46.50 cm), PR-1 (46.33 cm), PR-3 (43.5) and least in PR-9 (39.66 cm). Maximum spike length was found in PR-13 (57.33cm), followed by PR-4 (46.66cm), PR-30 (46.40cm), PR-1 (41.0 cm), PR-3 (38.5cm) and PR-9 (32.2 cm). Rachis length is an important parameter for judgement of quality flowering spike. In the present study, PR-13 was found to bear maximum rachis length (28.66 cm), followed by PR-4 (28.33 cm), PR-11 (26.66 cm), PR-1 (25.50 cm), PR-30 (25.00 cm), PR-3 (23.00 cm) and least in PR-9 (22.20 cm). Number of florets was found maximum in PR-30 (25.1), followed by PR-1 (22), PR-3 (21.75), PR-11 (20.33), PR-9 (19.80) PR-4 (15.66) and PR-13 (14.83). The OP lines PR-1 and PR-13 exhibited maximum flower length, and flower diameter in PR-11 (11.0 cm), PR-30 (4.4 cm).

Among the thirty seven Open Pollinated population of Arka Nirantara, AN-3 (Greenish tinge buds), AN-4 (Pinkish tinge buds) and AN-30 (Pinkish tinge buds) were found promising for pot culture as they exhibited dwarf character. The data revealed that AN-3 showed dwarfness with only 46.80 cm plant height, followed by AN-4 (47.4 cm) and AN-30 (54.40cm). For spike length AN-30 exhibited appreciable length (46.20 cm), AN-4 (42.80 cm) and AN-3 (41.80 cm). Similarly rachis length followed the same pattern with 24.2 cm, 22.2 cm and 18.20 cm length, respectively. Maximum number of florets were found in AN-30 (26.6), followed by AN-3 (19.0) and AN-4 (15.7). In respect of floret length, both the lines AN-4 & AN-30 recorded maximum whereas diameter (size) was maximum in AN-30 (5.0cm) followed by AN-4 (3.2 cm) and AN-3 (2.4 cm).

Among 118 OP lines evaluated of Sikkim Selection, only SS-26 (Greenish tinge buds) was dwarf with plant height (48.5 cm), spike length (39.5 cm), rachis length (19.5 cm), number of flowers (24.5), flower length (6.0 cm) and flower diameter (3.0 cm).

The lines, PR-9 (Phule Rajani), AN-3 (Arka Nirantara) and SS-26 (Sikkim Selection) were found to be promising in respect of dwarfness.

#### 1.2.4. Mutation Breeding in Tuberose

Bulbs of tuberose varieties namely Prajwal, Arka Nirantara, Phule Rajani, Mexican Single, Vaibhav and Swarna Rekha were irradiated with gamma rays (10 and 15 Gy) at irradiation facility (source of  $^{60}\text{Co}$ ) of the Bhabha Atomic Research Centre (BARC), Trombay during 2017 and planted at research farm of ICAR - DFR (Fig 1.9-1.12). Evaluation of irradiated material indicated that the bulbs of cvs. Arka Nirantara, Phule Rajani and Mexican Single sprouted 37 days after planting, followed by Vaibhav, (40 days), Prajwal & Swarna Rekha (45 days). The cultivar Mexican Single was first to induce spike at 81 days after planting, followed by Phule Rajani (93 days). Significant variation was observed in spike length, rachis length, flower length, flower diameter. The treatment of 15 Gy of gamma irradiation resulted in minimum spike length (28.6 cm), followed by the treatment 10 Gy (31.65 cm). The length of rachis was also significantly reduced at 15 Gy. Higher dose caused significant reduction in plant height. The florets of the Phule Rajani and Mexican Single were found morphed, fused with altered openings at both 10 and 15 Gy. Also the length of florets decreased with the increased dose of irradiation.

Fresh irradiation of tuberose bulbs (varieties, Phule Rajani, Arka Nirantara, Hyderabad Single, Hyderabad Double, Pearl Double, Mexican Single and Suvasini) with varied doses (10, 15, 20, 25, and 30 Gy) was attempted using the afore-mentioned facility at BARC, Trombay during February 2018 and the evaluation of irradiated material is in progress.





Uneven Opening of Buds



Uneven Bud Size



Compact Rosette  
Inflorescence

Fig. 1.9 Variability in Mutated  
Population of Tuberose  
Cultivar Phule Rajani at 10Gy

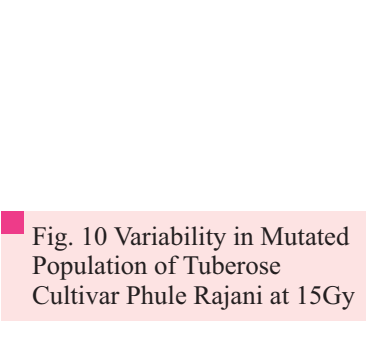


Fig. 10 Variability in Mutated  
Population of Tuberose  
Cultivar Phule Rajani at 15Gy



Fused Rachis



Crinkled Leaf



Irregular Bud Arrangement



Stunted Growth



Basipetal Opening  
of Florets



Crooked Spike

Fig. 1.11 Variability in Mutated  
Population of Tuberose Cultivar  
Mexican Single at 10Gy

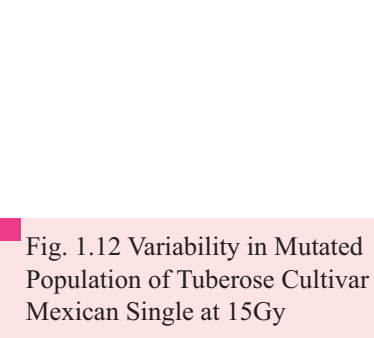
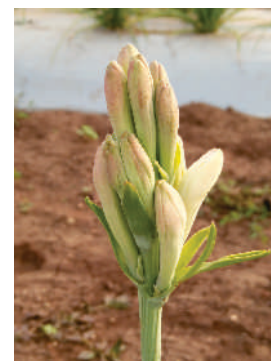


Fig. 1.12 Variability in Mutated  
Population of Tuberose Cultivar  
Mexican Single at 15Gy



Leafless Spike



Bundled Florets



Malformed Buds

### 1.3 Project 03 (ICAR Project Code: IXX14254): Improvement of Chrysanthemum for Commercial Traits.

#### 1.3.1: Evaluation of Chrysanthemum for Commercial Traits

In addition to the existing 107 cultivars (77 spray type, 21 standard type and 9 pot mums) of chrysanthemum, the directorate added following germplasm from BCKV, Kalyani, PAU, Ludhiana, UHS, Bagalkot and SKLTSHU, Hyderabad centres of AICRP on Floriculture. Besides above five cultivars were also collected from farmers field (Fig. 1.13).

BCKV, Kalyani	Ajoy, Bidhan Ajay, Bidhan Antara, Bidhan Agnisikha, Bidhan Agnidev, Bidhan Gold, Bidhan Jayanti, Bidhan Lalima, Bidhan Mallika, Bidhan Madhuri, Bidhan Monami, Bidhan Mums, Bidhan Puja, Bidhan Pradut, Bidhan Protim, Bidhan Rajat, Bidhan Sabita, Bidhan Shova, Bidhan Tarun, Bidhan Swapna, Big Violet, Classic, Delight, Debi, Dignity, Draguma, Flute, Fire Ball, Heritage, House Stone, Little Pink, Magenta, Mini Jessie, NC Pink, Punch White, Puja, Sadbhawna, Sensation, Shyam, Vijay, Veena, Yellow Baby, Yellow Coin and White Big Giant.
SKLTSHU, Hyderabad	HYDC-2, HYDC-3, HYDC-9, HYDC-12, HYDC-13, HYDC-16, HYDC-23, HYDC-25, HYDC-29, HYDC-32, HYDC 34, HYDC-35, HYDC-40, HYDC-41, HYDC-42, HYDC-47, HYDC-55, HYDC-56, HYDC-59 and HYDC Local Yellow.
PAU, Ludhiana	Anmol, Akitha, Autumn Joy, Bravo, Bindiya, Basanti, Garden Beauty, Kundan, Karnal Pink, Maya, Purnima White, Salara, Shintoms, Shiora, Shyamal, Punjab Shyamli, White Prolific, Winter Queen, PAU D1, PAU D 11, PAU 38, PAU 55, PAU-58, PAU 66, PAU 66-2, PAU A-43, PAUB 46 and PAUB107.
UHS, Bagalkot	Dundi, Dhal White, Karnool and Marigold
Farmers Field	Aishwarya, Jayshree, Mansi, Mauli White, Mauli Yellow and Raja.

#### Standard Cultivars

Twenty standard cultivars evaluated for growth and flowering under Pune conditions and significant differences were noticed among the traits studied (Table 1.6). The cultivar Purnima Purple was tallest (77.32 cm) followed by Holiday Purple (73.70 cm) and Harvest Home (72.17 cm); whereas the cultivars Winson (39.50 cm) and Sover Glow (54.10 cm) recorded least plant height. The plants of Poornima (45.38 cm) and Pusa Kesari (45.31 cm) have maximum spread. The cultivar Poornima exhibited good plant spread with good number of primary branches (4.56), number of secondary branches (7.83) and produced highest number of flowers per plant (71.15). Similarly the cultivar White Big Giant produced higher number of flowers per plant (63.10), good flower size (6.99cm) with maximum number of primary braches (6.09) and secondary braches (14.43). The cultivar Ajina Purple took least number of days for flower bud initiation (85.67) followed by Pink Star (87.59). Also cultivar Ajina Purple (85.67 days), Pink Star (87.59 days) and Harvest Home (87.96 days) are early in flowering. While cultivars Mahatma Gandhi (107.73 days), Winson (106.35 days) and Silk Brocate (106.00 days) are late in flowering. The cultivars Poornima, White Big Giant and Purnima Purple produced maximum number of flowers per plant; while Winson and Sover Glow produced less number of flowers per plant. Largest diameter was recorded in cv. Mahatma Gandhi (8.40cm) followed by Silk Borket (7.73cm) and White Big Giant (6.99 cm). On the basis of evaluation the cultivars Poornima, Purnima Purple, Silk Brocate, White Big Giant were found suitable for Pune agro-climatic conditions.

**Table 1.6 Morphological characteristics of Standard Cultivars of Chrysanthemum**

Variety	Plant Height (cm)	Plant Spread (cm)	Number of primary branches	Number of Secondary branches	Days to flower bud initiation	Days to Flowering	No. of flowers per plant	Flower Diameter (cm)
Ajina Purple	60.37	36.16	3.80	7.19	74.00	85.67	42.02	5.41
Harvest Home	72.17	40.83	2.97	5.87	76.52	87.96	43.71	5.26
Holiday Purple	73.70	36.76	3.00	4.59	87.81	99.41	43.00	4.62
John Webber	56.80	38.55	3.18	6.45	77.99	89.39	39.76	3.75
Mahatma Gandhi	65.10	31.82	2.60	5.78	93.47	107.73	23.00	8.40
Pink Star	66.27	36.56	2.82	4.83	73.29	87.59	38.84	4.58
Poornima	67.43	45.38	4.56	7.83	83.15	96.69	71.15	5.29
Purnima Purple	77.32	32.04	3.50	6.94	88.48	105.09	61.19	5.20
Pusa Anmol	72.83	39.64	4.24	8.36	83.86	93.76	47.86	5.89
Pusa Centenary	63.67	40.58	3.38	7.21	87.49	98.25	52.10	6.74
Pusa Kesari	55.70	45.31	3.30	7.51	91.34	103.21	47.92	5.17
Silk Brocate	67.67	38.00	3.20	7.17	93.51	106.00	42.05	7.73
Sover Glow	54.10	39.13	3.33	6.95	86.20	98.07	36.52	4.97
Tata Centenary	55.80	29.81	3.33	6.09	86.44	99.17	38.51	5.18
Thai Chen Queen	59.37	31.47	2.41	5.75	87.89	99.63	37.14	6.91
White Big Giant	64.70	38.69	6.09	14.43	80.08	92.00	63.10	6.99
White Star	52.80	29.76	2.61	5.93	80.59	93.29	43.04	6.20
Winson	39.50	26.47	3.37	5.92	93.78	106.35	16.14	4.35
Yellow Reflex	54.50	33.15	2.70	4.65	81.04	94.86	42.45	4.01
Yellow Star	58.97	37.38	4.19	6.14	88.57	102.86	46.81	5.71
C.V. (%)	4.069	6.474	14.027	77.433	3.971	3.230	8.631	8.791
CD (p<0.05)	4.246	3.921	0.822	9.430	5.582	5.213	6.341	0.823

### Pot Mums

Twelve genotypes of pot chrysanthemum were evaluated under Pune conditions for their suitability (Table 1.7). Based on statistical analysis all the cultivars exhibited significant differences for the traits studied. The cultivars Nanako (37.60 cm), Mini Jessie (37.20 cm) and Kalpana (35.88 cm) exhibited maximum tallness, while Liliput (18.32 cm), Local Button (21.07 cm) and Little Orange (24.27 cm) exhibited extreme dwarfness. The plants of Liliput are very dwarf, compact and with good spread (40.57 cm). However the plant spread in Pancho is 23.27cm followed by Sadbhawna (28.20 cm) and Little Pink (28.60 cm). The number of primary branches were maximum in Nanako (2.89), Little Pink (2.45) and Little Orange (2.36), whereas the numbers of secondary branches were more in Nanako (4.33) followed by Little Pink, Mini Jessie, Mother Teresa and Little Orange (4.0). Least number of primary branches per plant was recorded in Pancho (1.67)

and Pink Cloud (2.33), whereas cultivar Liliput (19.67), Local Button (18.67) and Kalpana (17.67) recorded maximum number of secondary branches. The Cultivars Liliput is late and took 143.67 days to flower. The number of flowers per plant recorded was maximum in Liliput (70.00) followed by Amity (61.67) and Mother Teresa (145.00), whereas least number of flowers were recorded in Mini Jessie (42.33), Sadbhawna (42.33) and Pancho (44.00). The flowers of cultivars Little Pink and Pink Cloud were larger in size (2.63 cm) followed by Little orange (2.60 cm), whereas Liliput and Local Button Exhibited Smaller flower size 1.43 cm and 1.53 cm respectively. Thus dwarf plants with more number of small sized flowers are suitable for pot mums. Therefore based on the evaluation pertaining to plant height, compactness, number and size of flowers per plant the cultivar Liliput, Local Button, Little Orange, Mother Teresa and Amity are suitable for pot mums production.

**Table 1.7 Morphological Traits of Pot-Mum Cultivars of Chrysanthemum**

Variety	Plant Height (cm)	Plant Spread (cm)	Number of primary branches	Number of Secondary branches	Days to flower bud initiation	Days to Flowering	No. of flowers per plant	Flower Diameter (cm)
Amiti	25.43	37.07	2.67	14.00	124.00	134.67	61.67	2.00
Kalpana	35.88	32.63	3.33	17.67	98.00	105.33	52.67	2.53
Liliput	18.32	40.57	2.33	19.67	143.67	150.00	70.00	1.43
Little Pink	35.98	28.60	4.00	17.33	133.00	140.00	53.67	2.63
Local Button	21.07	35.60	2.67	18.67	142.33	149.00	47.33	1.53
Mini Jessie	37.20	35.67	4.00	16.00	132.33	139.33	42.33	2.33
Mother Teresa	26.97	28.63	4.00	15.00	121.00	127.67	53.67	2.53
Nanako	37.60	30.63	4.33	17.33	128.67	136.00	52.33	2.23
NBRI Little Orange	24.27	34.77	4.00	13.00	122.67	129.67	48.67	2.60
Pancho	32.10	23.27	1.67	16.33	138.67	145.00	44.00	2.37
Pink Cloud	30.43	35.33	2.33	10.67	127.67	135.33	52.67	2.63
Sadbhawna	29.37	28.20	2.67	11.00	131.33	139.00	42.33	2.43
C.V. (%)	6.08	4.60	20.38	8.66	13.31	1.67	4.82	4.19
CD (p<0.05)	3.04	2.54	1.09	2.28	29.67	3.85	4.22	0.16

### Spray Type

In addition to the existing 77 cultivars, the Directorate added 68 genotypes from different sources and planted at the Hadapsar Research Farm. The perusal of data (Table 1.8) revealed that the cv. Coffee exhibited maximum plant height (129.02 cm) followed by Akitha (127.2 cm) and Bidhan Purna (121.99 cm); while the least plant height was observed in HYDC – 13 (36.62 cm) and HYDC – 23 (38.38 cm). Also the cv. Coffee recorded maximum plant spread (72.23 cm) followed by Akitha (71.57 cm) and Aishwarya (70.51 cm). Similarly the cvs. HYDC – 23 (20.72 cm) and HYDC – 13 (21.08 cm) recorded least plant spread. The number of primary branches per plant was found maximum in cv. Beauty (6.66) followed by Bidhan Lalima (6.33) and Bidhan Rajat (5.66). Also the secondary branches were found maximum in Akitha (18) followed by Autumn Eyes (17.33) and Aparajitha (17.00). The cultivars Maghi White and Maghi Orange recorded



maximum number of days for flower bud initiation (121.33 and 119.0 days respectively). Similarly, the cvs. Maghi White (136.33 days) and Maghi Orange (132.33 days) were also found very late in flowering. The number of flowers per plant were recorded maximum in Pusa Chitraksha (126.66) followed by Red Stone (126) and Daity White (120.66); whereas least number of flowers were recorded in HYDC – 42 (35.00), Honey Comb (35.33) and Bindiya (35.66). The flower of Honey Comb Purple are larger in size (6.0 cm diameter) followed by Honey Comb (5.83 cm) and Sensation (5.66 cm). Thus based on evaluation following recommendations were made.

Early Flowering	Aishwarya, Autumn Joy, Autumn Eyes, Bidhan Antra, Bravo, Charlie, HYDC-3, HYDC-25, HYDC-32, Kundan and White Andaman
Late Flowering:	Bidhan Agnisikha, Bidhan Jayanti, Bidhan Protim, Bidhan Purna, Bidhan Rajat, HYDC-23, HYDC-59, Kushoo, Maghi Orange, Maghi White, Pusa Chitraksha, Punjab Shyamli and Red Gold
Tall Plant:	Aishwarya, Akitha, Bidhan Agnipath, Bidhan Madhuri, Bidhan Purna and Coffee
Short Plant:	Basanti, Charlie, HYDC- 13, HYDC-16, HYDC-23 and Lalit
High Yield:	Crocon Small, Daity White, Pusa Chitraksha, Red Gold, Shanti, Shyama, Texas Gold, Vijay, White Prolific and Yellow Gold
Large Flower:	Honey Comb, Honey Comb Purple, Gulmohar, HYDC- 9, HYDC-29, HYDC-35, Jyotsna, PAU-55, Ravikiran and Red Stone.
Small Flower:	Anmol (PAU), Bindiya, Basanti, Bidhan Neeta, Crocon Small, Kundan and Maghi White

**Table 1.8 Morphological Traits of Spray Cultivars of Chrysanthemum**

Variety	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches per plant	No. of secondary Branches	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per plant	Diameter of Flower (cm)
Agni	94.41	48.58	5.00	12.00	94.66	107.00	69.00	4.10
Agnipath	110.84	65.68	5.33	13.33	85.33	97.66	51.66	4.80
Aishwarya	118.29	70.51	4.33	16.00	74.33	89.33	70.00	3.86
Akitha	127.2	71.57	5.66	18.00	83.00	98.00	74.66	4.03
Anmol PAU	75.407	52.58	3.33	13.66	76.00	92.66	60.67	3.10
Aparajita	88.25	63.17	4.33	17.00	86.66	105.00	76.66	4.06
Autumn Eyes	75.18	48.65	5.00	17.33	71.00	85.33	46.66	3.36
Autumn Joy	67.44	40.72	4.66	13.33	74.00	89.33	46.00	4.43
Baidhan Lali	73.08	53.56	5.66	12.66	87.33	103.66	50.00	3.83
Basanti	69.39	46.87	5.00	11.00	81.00	96.66	58.66	2.90
Basantika	83.80	59.91	6.00	11.00	80.00	96.33	55.66	3.56
Beauty	74.72	38.75	6.66	12.66	76.33	93.00	67.33	4.13
Bidhan Agnidev	85.87	53.28	5.66	12.66	85.33	104.66	55.00	4.50
Bidhan Agnisikha	104.44	62.11	3.66	11.66	94.66	111.66	47.00	3.33
Bidhan Ajoy	98.58	65.62	4.33	9.66	68.00	83.00	42.66	3.26
Bidhan Antara	94.56	62.55	5.33	12.00	75.33	87.66	59.00	3.80

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Variety	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches per plant	No. of secondary Branches	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per plant	Diameter of Flower (cm)
Bidhan Gold	106.37	68.70	5.33	12.33	86.00	99.66	75.66	4.33
Bidhan Jayanti	109.68	67.84	4.66	13.33	84.00	99.33	44.33	4.06
Bidhan Lalima	94.37	57.71	6.33	11.00	73.33	90.00	69.66	5.03
Bidhan madhuri	118.06	70.28	5.33	13.66	87.00	102.33	83.33	4.40
Bidhan mallika	87.47	70.06	4.33	10.33	83.00	100.00	66.00	3.53
Bidhan Monami	98.85	59.48	2.66	8.66	80.33	96.66	53.00	4.43
Bidhan Mum	84.22	67.69	3.66	9.33	94.33	108.66	43.66	3.90
Bidhan Neeta	88.59	57.19	3.66	11.00	84.66	99.33	67.00	3.33
Bidhan Purna	109.29	68.22	2.66	6.66	74.66	92.33	76.66	4.16
Bidhan Pradut	98.743	57.00	5.33	11.00	83.33	97.33	64.66	3.26
Bidhan Protim	109.13	68.89	5.00	11.66	89.33	110.00	83.00	4.36
Bidhan Puja	94.717	57.40	3.33	10.33	77.00	92.66	69.66	3.66
Bidhan Purna	121.99	66.93	4.33	9.33	87.00	103.00	53.33	4.23
Bidhan Rajat	109.82	68.00	5.66	11.33	94.33	113.33	85.33	3.76
Bidhan Red	95.34	55.67	5.00	11.00	88.33	104.66	79.66	4.40
Bidhan Sabita	83.00	55.28	4.00	9.33	78.66	94.33	72.66	3.83
Bidhan Shova	85.04	58.67	5.00	11.00	84.66	97.66	49.00	3.26
Bidhan Swarna	105.41	69.71	3.00	6.66	88.00	107.33	55.33	4.30
Bidhan Tarun	93.19	55.11	3.66	8.00	82.00	98.66	64.00	4.56
Bindiya	51.48	36.54	3.00	6.33	75.00	89.00	35.66	2.73
Bravo	58.17	34.08	3.33	6.66	67.33	80.33	37.66	3.66
Chandi	78.02	51.56	4.00	14.00	79.00	96.00	45.00	4.23
Chandni	88.27	58.81	3.33	8.00	93.66	110.66	53.33	3.70
Charlie	67.57	46.38	3.33	12.00	69.00	85.33	84.00	4.23
Cherabu	87.75	44.47	3.66	12.00	88.00	104.33	72.33	3.50
Coffee	129.02	72.23	4.00	13.66	76.66	93.00	82.33	3.66
Crocon Small	58.00	40.14	4.00	12.00	73.33	88.66	96.66	3.16
Dabam	86.06	51.58	5.00	15.00	98.66	113.66	79.66	5.26
Daity White	88.75	56.78	4.00	12.33	75.66	92.33	120.66	3.80
Debi	95.39	65.74	5.00	15.00	89.00	104.00	86.66	2.73
Flirt	58.16	44.48	4.33	16.00	75.33	91.00	69.33	5.10
Garden Beauty	83.88	60.95	5.00	15.66	88.66	102.66	77.00	4.70
Gauri	83.61	62.73	4.33	10.66	77.00	92.33	78.66	4.76

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Variety	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches per plant	No. of secondary Branches	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per plant	Diameter of Flower (cm)
Geetanjali	106.4	68.99	3.33	12.66	91.66	107.33	64.00	4.26
Gulmohar	82.87	57.42	4.33	16.00	85.66	100.66	59.66	5.56
Honey Comb	95.55	56.27	3.33	11.00	78.66	94.66	35.33	5.83
Honey Comb Purple	87.62	63.94	3.33	12.00	76.66	90.33	38.33	6.00
HYDC 2	65.52	44.62	2.33	6.33	75.66	90.66	43.33	3.63
HYDC 3	76.22	51.04	3.33	10.00	71.00	85.33	52.66	4.46
HYDC 9	53.62	37.07	3.00	10.00	77.00	92.00	63.67	5.33
HYDC 12	47.07	25.25	3.66	14.00	80.66	95.00	45.33	4.46
HYDC 13	36.62	21.08	3.00	11.66	86.00	102.00	56.00	5.30
HYDC 16	41.22	27.89	3.33	11.66	93.66	108.00	60.33	4.23
HYDC 23.	38.38	20.72	4.33	14.66	97.66	114.33	67.66	3.90
HYDC 25	66.98	35.47	5.33	14.33	68.66	84.33	50.33	3.70
HYDC 28	57.63	34.18	5.66	14.66	77.00	94.33	51.66	4.43
HYDC 29	68.22	42.18	3.33	11.33	84.66	100.33	59.33	5.46
HYDC 32	68.12	40.37	3.33	12.00	69.00	84.66	52.33	3.50
HYDC 34	58.51	31.96	3.66	11.66	79.00	95.33	65.33	3.60
HYDC 35.	80.02	49.31	3.00	9.00	85.00	99.00	53.33	5.33
HYDC 40	77.48	57.82	4.66	14.33	91.33	109.66	64.66	4.60
HYDC 41.	55.37	31.11	5.33	15.66	83.33	100.00	58.00	3.73
HYDC 42	79.18	40.92	3.33	11.66	77.00	93.00	35.00	4.30
HYDC 47	88.66	61.04	4.00	13.33	91.66	110.33	44.33	3.36
HYDC 55.	67.71	35.19	3.00	10.66	77.00	95.00	65.00	3.73
HYDC 56	62.92	34	3.33	10.66	86.00	101.33	63.33	4.26
HYDC 59	87.73	52.15	3.66	13.33	95.00	113.33	73.33	4.53
HYDC Local Yellow	63.00	46.26	3.00	9.33	69.66	86.66	75.00	3.93
Jaya	78.04	52.19	4.33	13.66	78.33	96.33	54.66	3.56
Jayanti	75.56	45.76	5.33	13.00	85.00	106.00	72.66	5.13
Jyotsna	64.11	45.88	5.33	16.00	91.00	109.66	54.00	5.46
Karnal Pink	60.99	40.85	5.00	15.33	79.00	96.66	63.66	3.73
Kiran	76.59	47.24	4.33	14.00	78.00	96.33	44.33	4.43
Kundan	88.45	55.11	2.66	12.00	86.00	75.66	66.66	3.29
Kushoo	83.71	53.95	2.66	11.00	88.33	116.00	53.33	4.26

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Variety	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches per plant	No. of secondary Branches	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per plant	Diameter of Flower (cm)
Lal Pari	65.48	45.53	3.00	11.33	74.33	90.66	59.00	5.36
Lalit	51.92	35.03	3.33	11.33	79.66	99.00	84.66	4.40
Little Orange	57.85	38.66	2.66	9.66	86.33	102.33	55.00	3.53
Little Pink	58.25	30.37	3.00	11.00	91.00	105.66	64.00	3.90
Magenta	74.71	46.63	3.00	13.33	96.33	114.00	71.66	4.70
Maghi Orange	94.19	49.23	3.33	9.00	119.00	132.33	66.00	3.40
Maghi White	97.92	45.45	4.66	15.00	121.33	136.33	69.33	3.36
Melody	67.81	45.37	3.66	11.33	87.33	105.00	77.333	4.73
Mountainer	73.82	47.59	3.00	12.00	78.66	95.33	90.33	5.03
NBRI Jayanti	77.03	42.99	2.00	7.00	87.00	103.33	63.33	5.30
NBRI Little Kusum	67.58	52.66	2.33	8.33	84.66	101.33	57.66	4.80
Nightangle	76.82	47.88	4.00	14.00	81.00	95.33	84.00	4.73
PAU 38	64.07	41.37	4.33	13.66	88.00	105.33	56.33	4.93
PAU 55	52.22	34.89	4.66	14.66	91.66	105.66	64.66	3.60
PAU 66	66.7	44.8	4.33	16.33	85.00	99.33	74.00	4.73
PAU 66-2	78.10	58.18	4.00	11.66	81.00	98.33	54.66	4.53
PAU A-43.	67.40	53.41	5.00	14.66	91.00	106.00	46.33	5.10
PAU B 46	78.91	48.55	4.00	13.33	78.00	94.33	55.33	4.60
PAU B107.	88.72	48.30	4.00	12.66	87.66	104.00	64.00	3.70
PAU D 11.	91.23	62.3	3.66	13.33	77.00	96.33	77.66	4.46
PAU D1	83.34	64.52	4.00	12.33	74.00	90.00	62.33	4.30
PAU-55	58.43	41.37	5.00	13.33	92.66	110.00	73.00	5.43
PAU-58	73.66	49.49	4.33	13.00	89.33	109.00	65.66	4.80
Pink Cloud	95.67	52.67	3.00	9.00	96.66	448.00	55.00	3.83
Pink Princess	77.54	52.15	2.33	8.00	81.66	99.00	75.00	4.80
Preet Shringar	64.00	41.67	2.33	8.00	88.66	106.66	67.00	4.70
Punjab Shyamli	93.22	55.34	2.33	6.66	97.33	113.00	57.66	3.56
Pusa Aditya	64.81	44.43	3.66	13.00	87.33	105.66	77.66	4.30
Pusa Chitraksha	76.66	52.88	5.66	17.00	93.33	110.66	126.66	3.86
Ragini	87.26	49.45	5.66	14.00	86.00	104.66	93.00	4.46
Rajani	67.42	45.62	3.66	14.66	81.66	99.00	52.66	4.63
Ravi Kiran	66.44	46.29	3.66	11.00	91.33	111.33	59.00	5.73
Reagan White	92.9	58.54	4.33	12.33	82.00	101.66	59.66	5.16

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Variety	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches per plant	No. of secondary Branches	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per plant	Diameter of Flower (cm)
Red Ball	63.03	48.07	2.66	9.00	83.66	103.33	61.33	3.76
Red Gold	68.82	45.63	3.00	9.00	95.33	113.66	55.00	4.40
Red Stone	66.44	46.04	2.66	9.66	86.33	104.00	126.00	5.73
River City	56.82	35.26	2.00	6.00	73.00	91.33	41.66	4.56
Royal Princess	80.55	52.23	3.00	9.66	87.00	102.00	62.66	5.36
Rupanjali	67.98	46.00	5.00	14.33	82.00	97.66	47.66	4.767
Sabita	72.70	56.02	5.00	15.33	89.66	108.66	65.00	3.73
Sadwin	67.52	52.63	5.00	15.00	89.33	107.00	48.66	4.23
Salmon	76.23	45.35	4.33	13.66	78.33	98.00	68.00	3.40
Sensation	94.29	44.70	4.33	12.66	88.33	103.00	72.66	5.66
Shanti	75.05	52.81	4.00	13.33	77.33	92.00	117.00	3.63
Shyama	76.60	42.23	3.00	9.00	82.33	96.33	105.66	3.76
Shyamal	65.73	51.62	2.66	9.66	87.66	103.66	79.33	4.23
Sover Girl	58.25	44.9	2.33	6.33	80.00	95.00	37.00	5.00
Sunny	53.30	47.01	4.00	13.00	86.00	104.00	61.66	3.56
Swapna	66.88	46.33	3.00	10.33	91.33	105.66	72.66	4.40
Swet Shringar	74.63	49.39	3.33	13.66	80.00	96.33	90.66	4.73
Sweta	65.44	54.19	2.33	9.33	87.00	102.33	72.33	3.66
Tarama	73.74	54.37	3.00	11.00	81.66	96.00	56.66	4.46
Teri	75.07	48.80	2.66	8.33	88.00	103.66	62.33	3.96
Texas Gold	87.04	54.68	5.00	13.00	91.66	107.33	92.33	4.36
Vasanthika	78.15	56.76	4.00	14.33	83.00	98.33	78.00	3.90
Vienna	66.85	43.96	4.00	14.00	81.66	98.00	63.00	4.33
Vijay	85.00	55.21	2.66	9.00	89.33	105.667	90.66	4.40
White Andaman	74.11	52.03	4.00	13.66	92.66	76.00	63.00	4.73
White Prolific	83.34	58.48	6.00	15.00	86.33	104.33	96.66	3.66
White Queen	66.45	52.26	4.00	12.66	94.66	110.66	86.66	4.83
White Quill	65.33	39.64	5.00	14.66	90.00	102.66	80.00	3.63
Winter Queen	65.41	42.41	5.33	15.33	95.00	108.33	55.33	5.30
Yellow Coin	75.37	41.55	3.00	9.33	90.33	104.33	42.66	4.73
Yellow Gold	62.43	45.74	2.00	6.33	94.33	108.33	116.66	4.80
C.V.(%)	3.86	7.68	22.08	19.50	1.90	47.26	5.61	5.24
CD (p<0.05)	4.84	6.21	1.40	3.72	2.57	NS	5.91	0.35



Fig. 1.13 Field View of Chrysanthemum germplasm at Hadapsar Farm

### 1.3.2: Evaluation of Promising Chrysanthemum Lines

Among the nineteen lines (Table 1.9) evaluated for growth and flowering under Pune conditions consecutively for two years, the lines namely DFR C 4-6-13-14 (68.10cm), DFR C 16 - 5 – 1213 (67.53cm) and DFR C 12 - 4 – 1213 (67.07cm) exhibited maximum plant height, whereas DFR C 26 - 1 - 1112 (37.47cm) and DFR C 30 - 1 – 1112 (37.50 cm) are of short height. The plants of DFR C 9 - 4 – 1011 (55.90cm), DFR C 4 - 6 - 1314. (53.70 cm) and DFR C 10 - 1 - 1011. (52.13 cm) are spreading in nature. The plants of DFR C 9 - 4 – 1011 and DFR C 10 - 1 – 1011 are bushy and vigorous in nature as they have maximum primary and secondary branches per plant. The lines DFR C 12 - 7 - 1112, DFR C 20 - 1 - 1112 and DFR C 7 - 5 - 1011 are early in both bud initiation (90.33, 90.67, 92.67 days) and flowering (93.00, 97.00, 98.33 days) respectively. However the lines DFR C 5 - 2 – 1011 and DFR C 25 - 3 – 1112 are late in flowering. Regarding flower yield per plant the lines namely DFR C 9 - 4 – 1011 (181.00), DFR C 10 - 1 – 1011 (170.67) and DFR C 26 - 7 – 1314 (166.33) are heavy yielder, whereas DFR C 3 - 6 – 1314 (46.33) and DFR C 30 - 1 – 1112 (47.67) are poor yielder. The line DFR C 5 - 1 – 1011 (8.10 cm) produces larger flower followed by DFR C 12 - 7 – 1112 (7.93cm) and DFR C 2 - 4 – 1011 (7.27cm). Among all lines tested DFR C 5 - 2 – 1011 produced smallest flower (3.73cm). On the basis of evaluation the lines namely DFR C 10 - 1 - 1011., DFR C 26 - 7 - 1314., DFR C 12 - 6 - 1213., DFR C 9 - 4 – 1011 and DFR C 26 - 1 – 1112 performed well under the mid-season group, whereas DFR C 20 - 1 – 1112, DFR C 12 - 7 – 1112 and DFR C 5 - 2 - 1011, DFR C 9 - 2 – 1011 in early and late group respectively. The lines DFR C 9-4-1011 and DFR C 25-3-1112 are suitable for loose flower production, whereas DFR C 10-1-1011 is suitable for pot flower production (Fig 14a-g).

**Table 1.9 Evaluation of Promising Chrysanthemum Lines under Pune Conditions. (2017-18)**

Lines	Plant Height (cm)	Plant Spread (cm)	No. of Primary Branches Per Plant	No. of Secondary Branches Per Plant	Days to Flower Bud Initiation	Days to Flowering	No. of Flowers per Plant	Flower Diameter (cm)
DFR C 10 - 1 - 1011	60.50	52.13	16.00	29.00	107.67	117.67	170.67	7.03
DFR C 26 - 7 - 1314	52.10	43.53	6.00	10.00	115.00	123.67	166.33	5.80
DFR C 12 - 2 - 1213	59.00	49.97	8.00	11.33	108.33	116.00	119.33	6.13
DFR C 12 - 6 - 1213	67.07	51.27	7.00	9.67	109.00	117.67	137.00	5.03
DFR C 12 - 7 - 1112	48.17	41.47	5.33	10.67	90.33	93.00	114.33	7.93
DFR C 16 - 5 - 1213	67.53	48.73	8.00	13.00	97.67	100.00	114.67	6.27
DFR C 17 - 1 - 1112	55.40	47.97	5.00	8.67	116.67	125.33	161.33	5.97
DFR C 2 - 4 - 1011	61.47	43.33	7.00	13.00	104.00	112.67	85.33	7.27
DFR C 20 - 1 - 1112	52.97	41.87	11.00	19.67	90.67	97.00	135.67	6.03
DFR C 25 - 3 - 1112	45.30	42.27	5.33	9.33	130.00	136.67	98.00	5.50
DFR C 26 - 1 - 1112	37.47	36.40	6.00	12.33	114.67	121.67	138.00	4.20
DFR C 3 - 6 - 1314	59.90	49.47	3.67	6.67	116.00	122.33	46.33	5.57
DFR C 30 - 1 - 1112	37.50	32.53	4.33	8.00	103.67	108.33	47.67	7.07
DFR C 4 - 6 - 1314	68.10	53.70	5.33	9.67	94.33	101.33	95.33	6.03
DFR C 5 - 1 - 1011	62.50	28.83	6.00	10.00	105.67	115.67	96.00	8.10
DFR C 5 - 2 - 1011	41.63	30.73	8.00	13.00	131.33	137.00	114.00	3.73
DFR C 7 - 5 - 1011	44.33	23.23	7.67	12.33	92.67	98.33	75.33	5.73
DFR C 9 - 2 - 1011	59.67	49.77	3.67	8.00	129.67	136.00	131.33	5.47
DFR C 9 - 4 - 1011	65.93	55.90	17.00	30.33	96.00	102.00	181.00	6.83
CV	4.41	5.96	17.49	21.21	4.43	5.142	5.53	7.52
CD (p<0.05)	4.03	4.27	2.14	4.52	7.93	9.77	10.74	0.75

**Brief description of identified Chrysanthemum Lines (Fig. 14a-g)****DFR C 9-4-1011**

The genotype is suitable for loose flower production. The flowers are cream in colour, with no visible disc and possess mild fragrance. The average plant height is 65.93 cm, plant spread 55.90 cm, flower diameter 6.83 cm and bears approximately 181.00 flowers per plant.

**DFR C 25-3-1112**

It is late flowering and is suitable for loose flower production. It bears pink colour flower and falls in double Korean group. The average plant height is 45.30 cm, plant spread (42.27 cm), flower diameter (5.50 cm) and bears approximately 98.00 flowers per plant.





#### DFR C 5-2-1011

It is suitable for garden display and bears red coloured flowers. The disc is dark yellow and flower type is double Korean. The average plant height is 41.63 cm, plant spread (30.73 cm), flower diameter (3.73 cm) and bears 114.00 flowers per plant.



#### DFR C 7-5-1011

The genotype is tall, early in flowering and suitable for garden display. It possesses yellow coloured spoon type florets. The average plant height is 44.33 cm, plant spread 23.23 cm, flower diameter 5.73 cm and bears 75.33 flowers per plant.



#### DFR C 9-2-1011

This genotype is suitable for garden display and bears white colour flowers. The flowers are double Korean type and florets are narrow and long. The average plant height is 59.67 cm, plant spread 49.77 cm, flower diameter 5.47 cm and bears 131.33 flowers per plant.



#### DFR C 10-1-1011

It is suitable for pot mums and appears like a ball when in full bloom. The flower type is semi-quilled and possesses yellowish reddish-orange coloured florets. The average plant height is 60.50 cm, plant spread (52.13 cm), flower diameter (7.03 cm) and bears 170.67 flowers per plant.



#### DFR C 26-7-1314

It is highly suitable for pot mums and appears like a ball when in full bloom. It is single Korean type and bears yellow coloured ray florets. The whole plant appears like a leafless yellow ball in peak bloom. The average plant height is 52.10 cm, plant spread (43.53 cm), flower diameter (5.80 cm) and bears 166.33 flowers per plant.

## 1.4 Project 04 (ICAR Code No. : IXX 14255): Improvement of Rose for Commercial Traits

### 1.4.1. Germplasm collection

In the project germplasm collection was initiated. The following varieties were collected from different places and secondary sources.

Source	Varieties
IARI, New Delhi	<p>Pink Montezuma, Pusa Mohit, Dr. M. S. Randhawa, Oklahoma, Arjun, Bonne Nuit, Pusa Ajay, Raktagandha, Nehru Centenary, Pusa Arun, Pusa Shatabdi, Lalima, Homage, Raja Surendra Singh of Nalagarh, Raktima, Pusa Bahadur, Abhisarika and Rose Sherbet .</p> <p>In addition, bud wood of the following varieties was collected</p> <p>Pink Parfait, Woods of Windsor, Kiss of Fire, Queen Elizabeth, Twin Wald, Montezuma, Konrad Henkel, Lynn Anderson, Sandra Frau Karl Druscki, barabra, Louisiana, Happiness, Krishna, Bewitched, Karen Blixen, French Perfume, Surabhi, Dr. Bharat ram, Ganga, Nurjehan, Delhi Princess and Jogan</p>
Kharagpur, West Bengal	<p>Netajee, Double Helix, Radhanath, Bicolette, Veteran's Honour, Jacaranda, Queen Elizabeth, Crimson Glory, Moonstone, Mainau Perle, American Heritage, Red Devil, Blue Moon, Bronze Star, President Pranab, Azure Sea, Ave Maria, Montreal, Jaleswari, Sentaaur Royal, Bahurupi, Fire Light, Friendship, Newzealand, High Esteem, Fragrant Plum, Swami Ranganathananda, Big Chief, Night time, Harmonie, Christian Dior, First Prize, Mr. Lincoln, Alec's Red, Holstein Perle, A. K. Mishra, Tiffany, Country Girl, Stainless Steel, Neptune, Belami, Mabila, Inge Hiorstman, Apricot Candy, Avon , Bugatti, Scarlet knight, Sweetness, Diamond Jubilee, Radharani, Karl Herbst, Blue Pefrfume, Inspiration, Black Delight, Etoile de Hollande, Show Piece, Camara, Matgod, Akebono, Fragarnt Gold, Summer Fragrance, Anmol and American Pride.</p>
Pune	<p>Peter Frankenfeld, Double Delight, Brandy, Black Lady, Hot Cocoa, Sunsation, Paradise, Doris Tysterman, Picture, Folklore, Scentimental, Charisma, Kashmir Velvet, International Herald Tribute, Echo, Summer Snow, Little Gem, Granada, Sophia, John F Kennedy, Gladiator, Tequila Sunrise, Tenacious, Strawberry, Cherry Parfait, Candy Stripe, and Barkarole</p>

In addition rootstocks of *R. indica*, *R. bourboniana*, and Natal briar were collected.

## Project 1.5: Development of Unique DNA Fingerprints of Flower Crops.

### 1.5.1: Standardization of protocols for developing unique DNA finger prints

#### i. Collection of Marigold, Rose, Tuberose, Gladiolus & Chrysanthemum germplasm samples.

- Leaf samples of marigold (8), Tuberose (8), Rose (24), gladiolus (23) and Chrysanthemum (120) were collected and are stored at -20°C.

## ii. Standardization of total genomic DNA isolation and PCR reaction for ISSR primers.

- Total genomic DNA isolation protocol from leaf material of Tuberose and Gladiolus was standardized.
- Total Genomic DNA from eight accessions of tuberose and 23 accessions of gladiolus were isolated, purified and quantified. For developing SRAP and ISSR profiles of these accessions, PCR reactions were standardized.
- SRAP profiles of eight tuberose accessions are developed and scoring for total polymorphic bands is being carried out and variety specific unique polymorphic bands are being identified and sequenced for developing robust marker for varietal identification of Tuberose (Fig. 1.15).

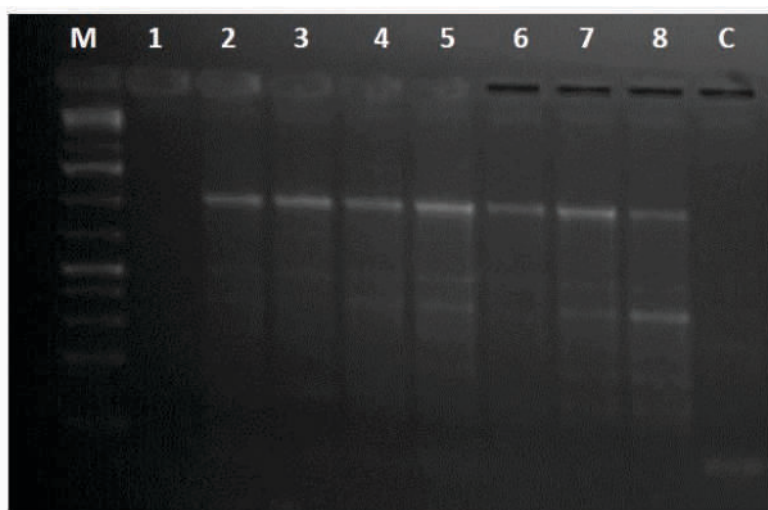


Fig. 1.15 SRAP Profile of Tuberose Varieties with Primer Combinations me3+em1

(M: 1 KB Plus Ladder; Tuberose Varieties L1-Shringar, L2-Prajwal, L3-Phule Rajani; L-4- Bidhan Srigandha; L5-Bidhan Ujwal, L6-GKTC, L7-Kolkatta Double, L8 Suhasini, C-Control Blank.

- ISSR profiles for 23 gladiolus accessions are developed, scoring for polymorphic bands is being carried out. Variety specific unique polymorphic bands are identified and sequence information will be utilized to develop robust variety specific marker (Fig. 1.16).

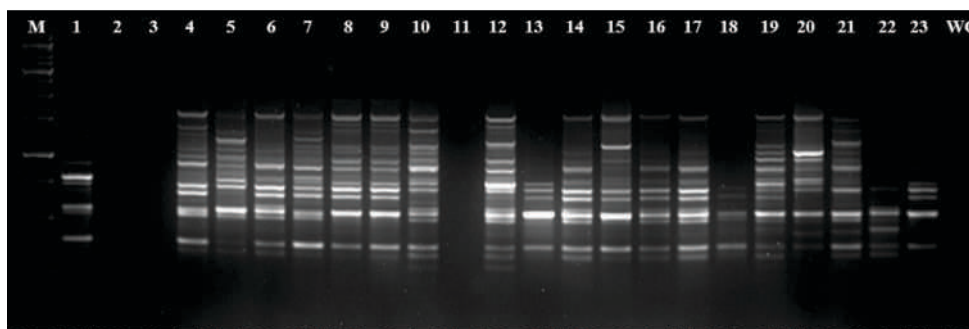


Fig. 1.16 ISSR Profiling of Gladiolus Varieties with UBC\_840 Primer

(M : 1 KB Plus Ladder; Gladiolus Varieties L1 to L23; C –Control Blank.)



### 1.5.2: Amplification and cloning of pathway genes for developing variegated coloring flower crops.

Chalcone Synthase Isomerase (CHI) gene fragment of 600 bp was amplified from cDNA of *Chrysanthemum morifolium* will be further sequenced, cloned and used for developing RNAi construct (Fig. 1.17).

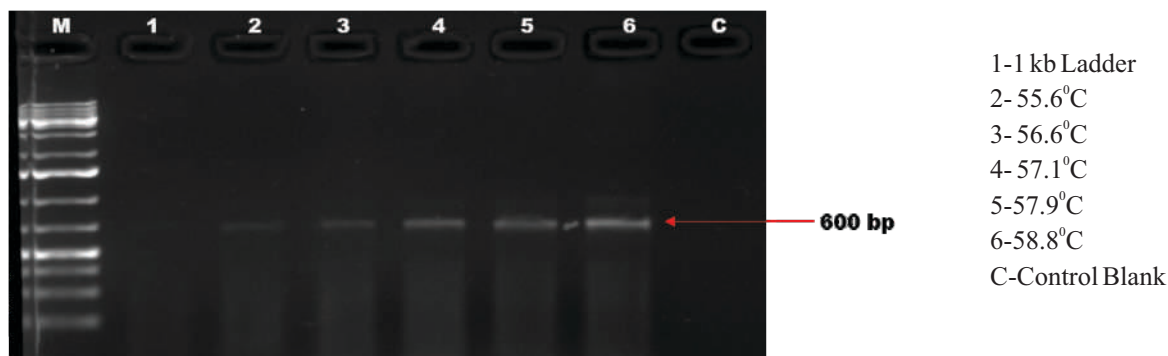


Fig. 1.17 Amplification of *Chalcone synthase isomerase*(CHI) gene fragment from cDNA of *Chrysanthemum morifolium* by gradient PCR

## 1.6 Project 06 (ICAR Code No. : IXX 14262): Utilization of Specialty Flowers, Cut Foliages, Fillers and Aromatic flower Crops to Address various landscape uses

### 1.6.1: Enrichment of germplasm of speciality flowers, cut foliages, fillers and aromatic flower crops

The following speciality flowers like *Heliconia spp*, *Calathea crotalifera* (Rattle snake plant), *Calathea lutea* (Cigar calathea), Torch Ginger (*Etilingera elatior*) pink, Torch Ginger Light pink, *Costus woodsonii* (Red button ginger), *Costus* orange etc. were collected from Thiruvananthapuram, Kerala for enrichment of the germplasm of specialty flowers at ICAR- DFR, Pune. The *Heliconia* germplasm collected from Kerala include 'Fire Flash', 'Parakeet', 'Yellow Parrot', 'Sassy', 'Parrot', 'St. Vincents Red', 'Golden Torch Adrian', 'Golden Torch Sunshine', 'Kenya Red', 'Lady Di', 'Guyana', 'Red Christmas', 'Petra', 'Golden Torch', 'Sexy Pink', 'Tempress', 'Irish', 'Tropics', 'Firebird', 'Andromeda' and 'Allan Carle'.

As an outcome, the planting materials of the following ornamental plants were collected for enrichment of the germplasm from ICAR - Central Coastal Agricultural Research Institute, Goa. The germplasm of ornamental plants collected from Goa include *Acalypha hispida*, *Allamanda cathartica*, *Alpinia purpurata* – Ginger lily, *Butterfly Ginger Lily (Hedychium)*, *Indonesian tall ginger lily*, Shampoo Ginger, *Begonia*, *Caladium*, *Centratherum intermedium*, *Costus*, *Dombeya spectabilis*, *Malvaviscus*, *Hibiscus mutabilis*, *Crotons* (18 types) and *Dieffenbachia* (11 types).

Apart from this, for enrichment of germplasm of cut foliages, different species of ferns with great ornamental value were collected, conserved and their ornamental characteristics are being recorded and evaluated. The ferns under conservation are Boston fern (*Nephrolepis exaltata*), Button fern (*Nephrolepis cordifolia* 'Duffii'), Fish tail fern (*Nephrolepis biserrata furcans*), Hard fern (*Blechnum orientale*), Emerald fern (*Asparagus densiflorus* 'Sprengeri'), Ladder brake fern (*Pteris vittata*), Leather leaf fern (*Rumohra adiantiformis*), Peacock fern (*Selaginella willdenowii*), Silverback fern (*Pityrogramma calomelanos*), Soft fern (*Christella dentata*) and Staghorn club moss (*Lycopodiella cernua*).

Different types / varieties of ornamental coleus (*Solenostemon scutellarioides* syn. *Plectranthus scutellarioides*) viz., Gold Giant, Pistachio Nightmare, Miss Monahan, Antique, Mahogany Giant, Juicy Lucy, Grape Expectations, Private Dancer, Eruption, Trailing Queen, Apple Mint, Kong Scarlet, Dare Devil, Gay Delight, Blusher, Kong Jr, Tilt a Whirl, Wizard Mosaic, Electric Lime, Blackberry Waffle, Green Halo, Freckles, Finger Paint and Indian Summer Coleus were collected and conserved at the Institute farm for further utilization in crop improvement programme. The collected ornamental coleus varieties are also being assessed for their suitability for various landscape uses like beds, borders, edging, hedges, planters, mass planting, hanging baskets, vertical gardens, container plantings and general garden usage under agro climatic conditions of Maharashtra (Table 1.10).

**Table 1.10 Plant growth characteristics of Ornamental coleus cultivars under agro-climatic conditions of Maharashtra**

Treatments	Plant height (cm)	No.of leaves	No.of branches	Stem girth (cm)	Leaf length (cm)	Leaf stalk length (cm)	Leaf width (cm)
Gold Giant	50.17	14.50	1.17	0.76	14.92	4.17	7.83
Pistachio Nightmare	35.33	28.72	2.17	0.65	10.21	1.91	3.29
Miss Monahan	57.61	16.16	1.33	0.66	11.44	3.08	5.17
Antique	45.89	21.44	2.56	0.64	13.19	2.72	3.68
Mahagony Giant	52.27	12.82	1.22	0.48	15.33	4.47	6.67
Juicy Lucy	35.56	22.00	2.56	0.25	11.48	2.31	5.37
Grape Expectation	60.57	13.97	1.44	0.79	14.83	3.77	6.04
Private Dancer	50.22	14.33	1.67	0.49	15.61	4.16	8.38
Eruption	47.79	17.78	1.56	0.39	12.78	4.88	4.50
Trailing Queen	31.11	48.78	1.78	0.19	9.73	3.10	4.72
Apple Mint	53.00	22.67	2.00	0.48	17.86	3.69	6.33
Kong Sarlet	54.00	22.11	2.28	0.63	17.50	3.12	7.14
Dare Devil	50.44	16.78	1.89	0.53	14.11	3.28	5.83
Gay Delight	29.33	14.83	1.70	0.69	14.31	2.72	2.20
Blusher	37.67	9.33	1.33	0.22	15.00	4.00	8.34
Kong Jr	47.44	35.33	3.89	0.54	15.83	2.78	7.79
Tilt a Whirl	14.39	23.67	2.44	0.46	4.83	0.94	2.61
Electric Lime	36.12	20.00	2.89	0.56	11.44	2.31	3.36
Green Halo	45.56	25.11	2.22	0.56	11.89	2.59	6.49
Indian Summer	35.67	19.22	2.00	0.58	10.67	2.54	5.23
Blackberry Waffles	40.72	19.22	1.56	0.58	12.00	1.99	5.18
Mosaic Wizard	36.50	11.33	1.44	0.50	13.11	3.10	6.32

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Treatments	Plant height (cm)	No.of leaves	No.of branches	Stem girth (cm)	Leaf length (cm)	Leaf stalk length (cm)	Leaf width (cm)
Freckles	65.00	14.00	1.33	0.48	17.11	4.89	8.67
Finger Paint	64.33	13.33	1.33	0.54	16.78	5.44	8.22
Sem±	0.95	1.23	0.19	0.02	0.28	0.27	0.14
CD(0.05)	2.86	3.69	0.59	0.05	0.84	0.82	0.41

Other speciality ornamental crops collected from Goa include different varieties of *Heliconia* viz., 'Adrian', 'Alan carle', 'Golden Torch', 'Guyana', 'Kenya Red', 'Lady Di', 'Lobster claw', 'Sassy', 'St. Vincents Red', 'Temptress', *Petra Orange*, *Heliconia hirsute*, *Heliconia latispatha*, *Heliconia lobster claw 1*, *Heliconia rostrate*, *Heliconia rostrata* cv. *Ten Days*, *Heliconia 'Tropics'*, 'Choconiana', 'Kawauchi', *Heliconia 'Rauliniana'* upright, *Heliconia caribaea*, *Heliconia 'Jacquini'*, *Heliconia 'Pedro Ortiz'* and two types of Torch Ginger (*Etilingera elatior*) viz., Pink and Red.

For enrichment of germplasm of aromatic flower crops at the Institute, different Jasmine accessions belonging to *Jasminum sambac* (10 types), *Jasminum auriculatum*, *Jasminum grandiflorum* and *Jasminum multiflorum* (3types) were collected and conserved. Different Nerium varieties viz., Single Red, Single Rose /Pink, Single Tall White, Single Dwarf Peach, Double White, Double Red, Single White with Yellow Centre were also collected and conserved at the Institute.

### 1.6.2: Evaluation of different ornamental plant species in the vertical landscape system for improvement of air quality

Vertical landscaping is a relatively new concept of urban gardening which are suitable for small spaces, mostly for adorning the walls and roofs in various styles. This is a distinctive method of gardening by expanding the possibility of growing ornamental plants in a vertical space wherever space is a constraint. In the present era of rapid urbanization, the horizontal space left for outdoor gardens is very limited. Here comes the importance of vertical landscaping. Vertical green walls are aesthetically appealing, refresh the ambiance and improves the air quality. With this background the present experiment was initiated with objectives to evaluate different ornamental plant species for their performance in the vertical landscape system and to estimate the Air Pollution Tolerance Index of different ornamental plant species used in vertical landscape system.

The present experiment is aimed at developing sustainable cost effective package for vertical landscaping. The experiment is initiated at Hadapsar farm, ICAR-DFR, Pune. The experiment has been laid out in Randomized Block Design with 18 treatments and 3 replications. Eighteen different species of ornamental plants viz., T<sub>1</sub>: *Syngonium podophyllum* green, T<sub>2</sub>: *Alternanthera* Green, T<sub>3</sub>: *Syngonium podophyllum* light pink, T<sub>4</sub>: *Chlorophytum comosum* variegatum, T<sub>5</sub>: *Syngonium podophyllum* dark green, T<sub>6</sub>: *Rhoeo discolor* (Moses in the cradle) Sitara Gold, T<sub>7</sub>: *Syngonium podophyllum* purplish pink, T<sub>8</sub>: *Peperomia magnoliifolia* variegata, T<sub>9</sub>: *Syngonium podophyllum* dark pink, T<sub>10</sub>: *Syngonium podophyllum* green variegated, T<sub>11</sub>: *Syngonium podophyllum* greenish white, T<sub>12</sub>: *Alternanthera* White, T<sub>13</sub>: *Peperomia obtusifolia*, T<sub>14</sub>: *Philodendron* Ceylon gold, T<sub>15</sub>: *Tradescantia spathaceae* variegata, T<sub>16</sub>: *Alternanthera* Red, T<sub>17</sub>: *Philodendron Imperial Green*, T<sub>18</sub>: *Chlorophytum comosum* green are being evaluated under the study for estimation of air pollution tolerance index (Table 1.11).

**Table 1.11 Plant growth characteristics of different ornamental plant species in the Vertical landscape system (3 MAP)**

Treatments	Plant height (cm)	No. of leaves	Leaf length (cm)	Stalk length of the leaf (cm)	Leaf width (cm)
T- 1	8.23	7.44	9.89	3.44	4.67
T - 2	15.64	41.56	3.50	1.28	1.39
T - 3	12.13	8.67	11.43	5.84	4.76
T - 4	8.81	8.89	11.74	0.53	2.07
T- 5	13.63	8.11	11.97	5.33	5.82
T- 6	11.82	15.44	14.89	1.52	2.57
T - 7	7.77	6.67	11.11	4.58	5.11
T- 8	8.48	4.67	8.61	1.61	4.86
T- 9	8.97	10.33	11.02	4.28	3.56
T- 10	10.00	16.67	12.42	6.22	4.18
T- 11	8.76	11.22	11.00	4.52	4.67
T- 12	10.63	29.22	4.92	1.14	1.81
T- 13	8.39	6.72	11.22	3.02	4.66
T- 14	8.78	5.89	13.58	4.20	5.42
T- 15	4.12	10.67	12.94	0.37	2.42
T-16	12.90	63.22	4.23	1.72	1.52
T - 17	7.31	7.22	11.80	3.69	3.50
T - 18	9.70	13.94	15.66	0.63	2.37
Sem±	1.67	2.17	0.59	0.58	0.31
CD(0.05)	5.031	6.507	1.785	1.744	0.934

## 2. Crop Production

### Project 2.1 (ICAR Code: IXX13991) Evaluation of Industrial and Agricultural by-products as Potting Media Components for Production of Potted Ornamental Plants

2.1.1a. An experiment was initiated on screening of five different ornamental plant species viz., dracaena, ribbon grass, salvia, money plant and spathiphyllum (Fig 2.1) for their growth as influenced by varied levels of fly ash containing potting medium. There were six treatments and four replications in the experiment containing 0 %, 10 %, 15 %, 20 %, 50 % and 100 % fly ash. At initial stage, plant growth was comparatively good in treatments containing 10 % and 15 % fly ash when compared to 0 and 100 % fly ash.

2.1.1b. A pot experiment was initiated to evaluate the suitability of fly ash and press mud as potting media components for growth and development of *Epipremnum aureum* (Fig 2.2). There were 11 treatments in the experiment having varied proportions of press mud and fly ash along with vermicompost and cocopeat.

The treatments were as follows

T<sub>1</sub>: Fly ash + Vermicompost + Cocopeat (10:30:60)

T<sub>2</sub>: Fly ash + Vermicompost + Cocopeat (15:35:50)

T<sub>3</sub>: Fly ash + Vermicompost + Cocopeat (20:30:50)

T<sub>4</sub>: Press mud + Vermicompost + Cocopeat (25:25:50)

T<sub>5</sub>: Press mud + Vermicompost + Cocopeat (35:20:45)

T<sub>6</sub>: Press mud + Vermicompost + Cocopeat (45:15:40)

T<sub>7</sub>: Fly ash + Press mud + Cocopeat + Vermicompost (10:25:25:40)

T<sub>8</sub>: Fly ash + Press mud + Cocopeat + Vermicompost (12.5:37.5:25:25)

T<sub>9</sub>: Fly ash + Press mud + Cocopeat + Vermicompost (15:35:40:10)

T<sub>10</sub>: Fly ash + Press mud + Cocopeat + Vermicompost (20:45:25:10)

T<sub>11</sub>: Cocopeat: Vermiculite: Perlite (1:1:1) (control)

Media of different compositions were prepared by mixing individual components on weight basis as per treatment and then equal quantity of media was transferred to grow bags (4 kg). Growing media components were analyzed for different chemical properties (Table No. 2.1) and treatment combinations were tested for pH and electrical conductivity before planting (Table No. 2.2).

It was observed that fly ash (T<sub>1</sub>:10%, T<sub>3</sub>:20%) and press mud (T<sub>4</sub>:25%, T<sub>5</sub>:35%) individually as potting medium components and together (T<sub>7</sub>:10% fly ash & 25% press mud T<sub>8</sub>:12.5% fly ash & 37.5% press mud and T<sub>9</sub>:15% fly ash & 35% press mud), support plant growth well as compared to control (T<sub>11</sub>).





Fig. 2.1 Suitability of flyash and other media for growth of *Spathiphyllum*



Fig. 2.2 Evaluation of suitability of fly ash and press mud for growth of *Epipremnum*

**Table 2.1 Chemical properties of growing media components**

nd= not detected

Chemical properties	Growing media components			
	Fly ash	Pressmud	Vermicompost	Cocopeat
pH	6.48	8.17	7.37	7.14
EC(dS/m)	0.53	1.12	0.73	0.61
OC (%)	5.93	9.4	34.48	22
N (%)	nd	1.58	1.4	0.124
P (%)	0.27	1.61	0.27	0.028
K (%)	0.03	0.84	0.2	0.682
Ca (%)	0.25	3.95	0.0008	nd
Mg (%)	nd	0.74	0.0002	nd
S (%)	nd	3.18	nd	nd
Fe (ppm)	0.74	nd	21	nd
Cu (ppm)	71.51	0.048	6.2	nd
Zn (ppm)	129.31	0.087	10.5	nd
Mn (ppm)	nd	0.021	9.34	nd
Hg (ppm)	0.98	nd	nd	nd
As (ppm)	31.35	nd	nd	nd
Cd (ppm)	0.2	nd	nd	nd
Cr (ppm)	71.51	nd	nd	nd
Ni (ppm)	59.76	nd	nd	nd
Pb (ppm)	1.96	nd	nd	nd

**Table 2.2 Initial chemical properties of different growing media combinations used in the study**

Treatments	pH	EC (dS m <sup>-1</sup> )
T <sub>1</sub>	6.17	0.325
T <sub>2</sub>	6.83	0.544
T <sub>3</sub>	6.83	0.594
T <sub>4</sub>	7.43	0.917
T <sub>5</sub>	7.41	1.094
T <sub>6</sub>	8.12	1.494
T <sub>7</sub>	7.49	0.725
T <sub>8</sub>	7.64	0.743
T <sub>9</sub>	7.66	0.788
T <sub>10</sub>	7.71	0.993
T <sub>11</sub>	8.42	0.235
SE(m±)	0.051	0.002
CD (0.05)	0.15	0.005



2.1.3 Initiated an experiment on evaluation of suitability of fly ash and press mud as potting media components for growth and development of marble money plant in vertical garden system. 11 treatments used in previous experiment containing different proportions of press mud and fly ash along with vermicompost and cocopeat were used to test their suitability for vertical garden system (Fig. 2.3)

Fig. 2.3 *Epipremnum aureum cv. marble money plant* in vertical garden system



2.1.4 A lab experiment was initiated to assess the effect of various potting media combinations on physical properties of potting media (BD and WHC). Eleven treatments comprising different proportions of press mud and fly ash were kept for incubation to observe changes in bulk density and water holding capacity (Fig.2.4).

Incubation experiment for physical properties of media

### 3. Plant Protection

#### Project 3.1 (ICAR Code : IXX 11705) :Investigations on Virus and Phytoplasma Diseases of Commercial Flower Crops.

##### 3.1.1: Development of quick and grower friendly diagnostics for detection of *Plantago asiatica mosaic virus*

On field quick diagnostic tools based on serological lateral flow assay technique (Fig. 3.1) and Recombinase Polymerase Amplification technique RT-RPA assay (Fig. 3.2) for detection of *Plantago asiatica mosaic virus* (PIAMV), a major pathogen of Liliums has been developed in association with USDA under Norman Borlaug International Fellowship for agriculture and technology programme. The work was undertaken at USDA, Beltsville, Maryland, USA.

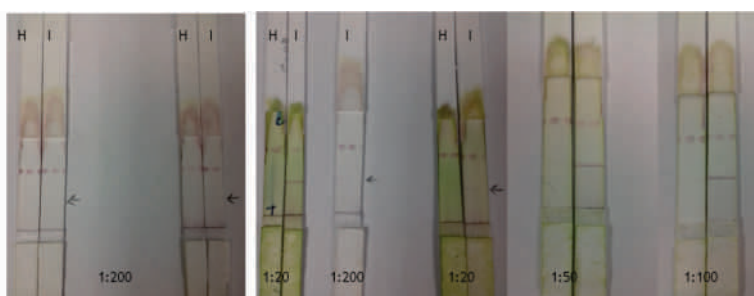


Fig. 3.1: Lateral flow dipsticks developed for detection of PIAMV showing both test and control line in infected and only control line in healthy at various buffers and sample concentrations. (H-Healthy, I-Infected)

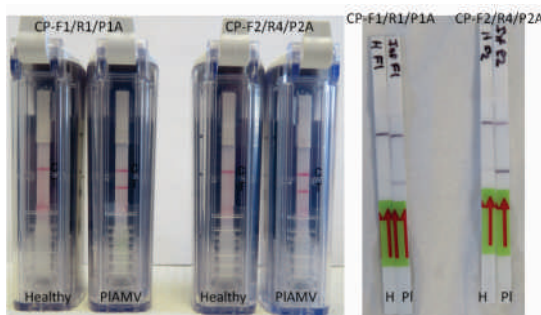


Fig.3.2 RT-RPA assay for detection of PIAMV showing both test and control line in infected and only control line in healthy with two different primer – probe combinations CPF1R1Probe 1A and CPF2R2 Probe 2A.

##### 3.1.2: Identification of etiological agent of gerbera phyllody as phytoplasma belonging to *C. Phytoplasma aurantifolia* group.

To identify the etiology of phyllody in gerbera plants observed during survey of Ahmed Nagar district, the infected plants were collected and established in glasshouse (Fig.3.3). The total DNA was isolated from the leaf petioles and detection of the probable cause ie phytoplasma was done by nested PCR using 16srRNA based primers. The amplicons were sequenced and the sequence in BLAST showed 99% sequence similarity with *C. Phytoplasma aurantifolia* group of phytoplasma.



Fig. 3.3 Gerbera showing phyllody in glasshouse

### 3.1.3: Study of concept of usage of commercial lateral flow dipsticks for detection of viruses in ornamental plants for phytosanitary certification

The feasibility of dipstick or lateral flow diagnostics for detection of viruses in ornamental plants for phytosanitary certification was studied. 37 systematic samples of various ornamental plants showing virus infection like symptoms were subjected to dipstick diagnostics using lateral flow systems purchased from Agdia International for Potyvirus, Tomato spotted wilt virus, Impatiens necrotic spot virus and Cucumber mosaic virus. From the study it has been inferred that sample buffer ratio and concentration of virus particles are the critical factors to determine the accuracy of lateral flow diagnostics. Once it is used in routine diagnostics, periodic validation of results with other methods of detection like ELISA or PCR is required (Fig 3.4).

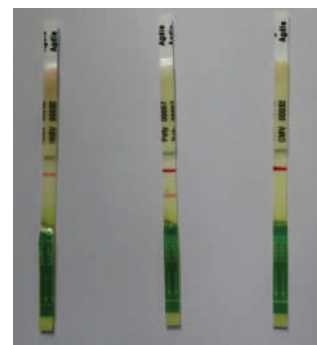


Fig 3.4 Lateral flow detection of INSV, Potyvirus and CMV and in Chrysanthemum

Survey of the farmer's field, protected units and nurseries continued to assess the incidence of various diseases and the observations made is given below in the table 3.1 & 3.2 ( Fig. 3.5).

**Table 3.1 Estimation of level of incidence of diseases in farmers' field and protected cultivation**

Village	Crop	Disease /Symptoms observed	Incidence
Loni	Tuberose	Bud necrosis	10%
Kusur	Marigold	Phyllody	30%
	China aster	-do-	30% Economic loss

**Table 3.2 Incidence of virus and Phytoplasma Diseases in Nursery**

Sr.no	Nursery	Crops	Disease/ symptoms observed	Incidence (%)
1.	PSN-I	Golden bamboo	Mosaic	1-2%
2.		Areca palm	Yellowing	10%
3.		Ixora	Flower colour breaking	5-7%
4.	PSN-II	Euphorbia	Virescence and yellowing	1-2%
5.		Bougainvillea	Yellowing and mosaic	5-10%
6.		Chrysanthemum	Yellows	20-30%
7.		Hibiscus	Mosaic flower malformation	10-15%
8.	PSN-III	Dahlia	Stunting and witches broom	10%
9.			Mosaic, Necrosis, vein yellowing	5-7%
10.		Jasmine	Yellow ringspot	10%
11.		Jasmine	Phyllody	30%
12.		Chrysanthemum	Vein necrosis and yellowing	20%

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Sr.no	Nursery	Crops	Disease/ symptoms observed	Incidence (%)
13.	PSN-IV	Rose	Shoe lace symptoms, Mosaic, Variegations	2-4%
14.	PSN-V	Impatiens	Necrotic ringspots	1-2%
15.	PSN-VI	Begonia	Mosaic and ringspots	20%
16.		Dahlia	Shoe lace symptoms	2%



Golden bamboo mosaic



Areca palm yellows



Ixora flower color breaking



Euphorbia virescence



Bougainvillea yellowing



Chrysanthemum yellowing



Hibiscus yellowing (flower malformation)



Dahlia Witches broom



Dahlia mosaic and vein necrosis



Jasmine yellow ring spot



Jasmine phyllody



Chrysanthemum vein necrosis

Fig. 3.5 Symptoms of virus and phytoplasma diseases observed in nursery plants



## Project 3.2 (ICAR Code: IXX 14260) : Etiology and Integrated Management of Fungal Diseases of Flower Crops :

### 3.2.1. Isolation of fungal pathogens from infected samples of Tuberose, Gerbera, Chrysanthemum, Rose and foliage plants (Pothos, Dieffenbachia, Syngonium)

Samples of tuberose, gerbera, chrysanthemum, rose and foliage plants (Pothos, Dieffenbachia, Syngonium) were collected from Research Farm of ICAR-DFR.. Fungal pathogens showing characteristic visible symptoms like spots, blights, anthracnose, wilts, rots etc. were isolated in PDA media supplemented with Tetracycline or Chloramphenicol (antibiotics), at the rate of three to five pieces of tissues per petriplate and incubated at room temperatures (25–27°C) that may favour the pathogen development. A portion of mycelium developing on the nutrient medium was transferred to the agar slants for purification and storage for further examination. Pure culture of isolated pathogens have been maintained and subcultured every month.

#### Identification of the pathogens based on morphological characters

Morphological characteristics of fungal pathogens were studied at both asexual and sexual stages for the identification of these pathogens. Some fungal pathogens which were identified on the basis of morphological characters are discussed below.

- Pestalotiopsis* sp. was observed and identified from the Chrysanthemum leaf sample and pure culture isolated from infected Chrysanthemum leaf (Fig. 3.6).
- Diplocarpon rosae* was observed and identified from Rose black leaf spot and pure culture isolated from infected Rose leaf sample (Fig.3.7).
- Alternaria* sp. was observed and identified from Gerbera leaf sample and pure culture isolated from infected Gerbera leaf sample (Fig. 3.8).
- Septoria* sp was observed and identified from Chrysanthemum leaf spot and pure culture isolated from Chrysanthemum leaf spot. (Fig.3.9)

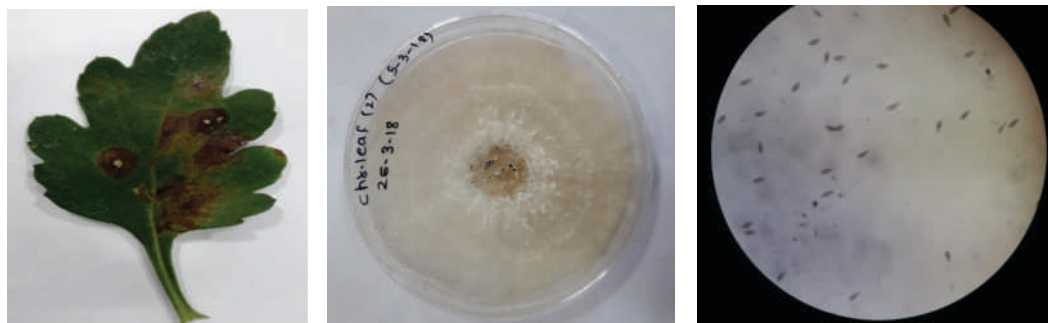


Fig. 3.6 Chrysanthemum leaf spot,

Pure culture

*Pestalotiopsis* spores

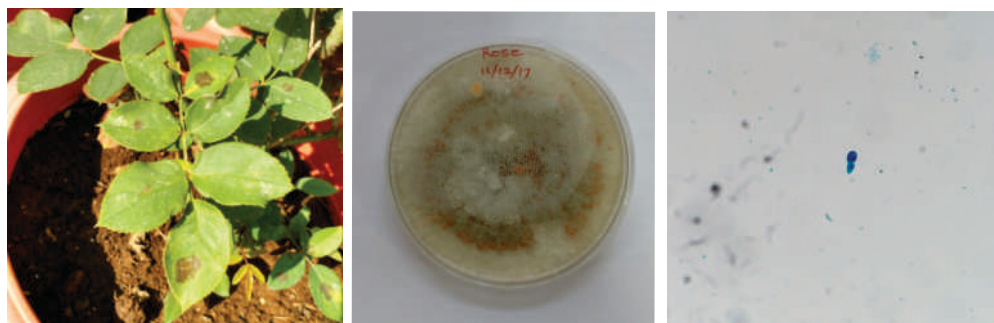


Fig 3.7 Rose Black leaf spot

Pure culture

*Diplocarpon rosae*

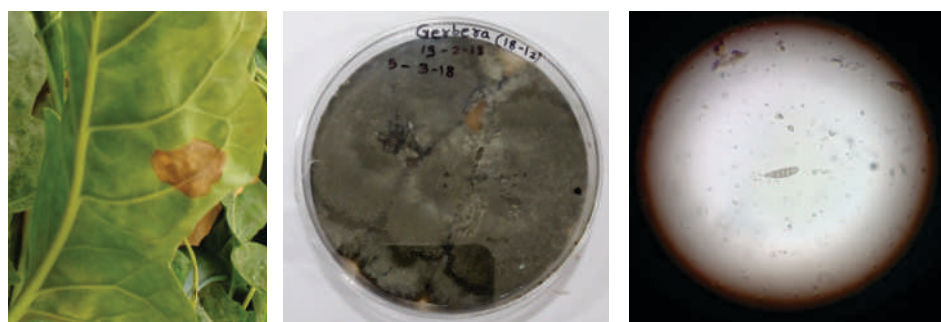


Fig 3.8 Leaf spot of Gerbera

Pure culture

*Alternaria* spore

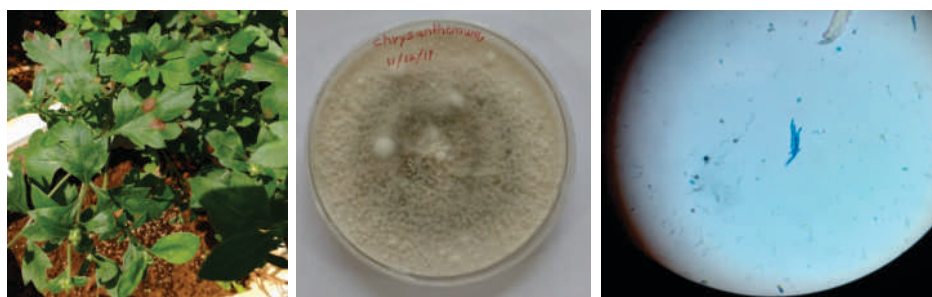


Fig 3.9 Chrysanthemum leaf spot

Pure culture

*Septoria* spores

The pure cultures of fungal pathogens of Rose, Tuberoses and Chrysanthemum were also sent to NFCCI,ARI, Pune for proper identification and cataloguing and the results are given below.

Sr.	Culture	Identification of Causal Agent Remarks	Family
1.	Rose	<i>Colletotrichum</i> sp. aff. <i>C. gloeosporioides</i> * (Penz.) Penz. & Sacc.	<i>Glomerellaceae</i>
2.	Tuberoses	<i>Nodulisporium gregarium</i> (Berk. & M.A. Curtis) J.A. Mey. *	<i>Xylariaceae</i>
3.	Chrysanthemum	<i>Nigrospora</i> sp. aff. <i>N. sacchari</i> (Speg.) E.W. Mason	<i>Incertae sedis</i>
4.	Chrysanthemum	<i>Myrothecium roridum</i> Tode	<i>Incertae sedis</i>

Note: The identity was confirmed solely based on morphological characters in in-vitro culture.

### Brief Description of *Myrothecium roridum* isolated from Chrysanthemum

**Symptoms:** Upper part of leaf/surface has shown symptoms like spot dark tan brown to dark brown 7x7 mm, globose, later coalescing to form irregular spots (Fig 3.10).

**Morphological Characters of isolated pathogen:** *Sporodochia* sessile, up to 1.5 mm. diam., often confluent, at first green, later black with a white margin, without setae. *Phialides* 10-12 x 1-2  $\mu$ m. *Conidia* cylindrical with rounded ends, colourless to pale olive, green to black in mass, mostly 6-8 x 2-3  $\mu$ m (Fig 3.11 to 3.13)



Fig 3.10 Leaf spot of Chrysanthemum

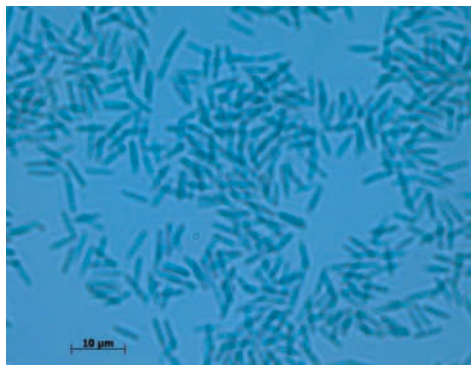


Fig 3.11 Conidia of *Myrothecium roridum*

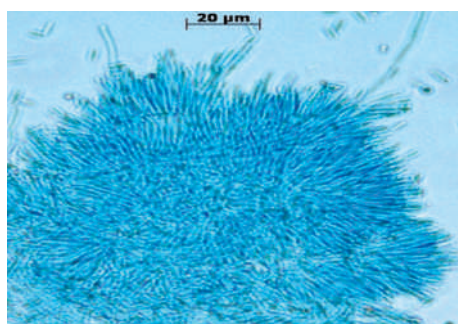


Fig 3.12 Sporodochia (low magnification)

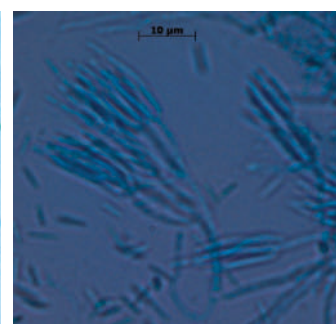


Fig 3.13 Conidiophores (higher magnification)

### Identification of *Myrothecium roridum* based on molecular characters

The Genomic DNA was isolated in pure form, from the pure culture. The ITS region of rDNA was successfully amplified using fungal universal primers ITS4 & ITS5. The sequencing of PCR product was done and the raw sequence obtained from ABI 3100 automated DNA sequencer was manually edited for inconsistency. The sequence data was aligned with publicly available sequences & analyzed to reach identity. The Results of Molecular Identification revealed that the tested fungal strain showed 100 % sequence similarity with *Paramyrothecium roridum* and *Myrothecium roridum*.

Permanent slides of fugal pathogens have been prepared from the isolated fungal pathogens from Tuberos, Gerbera, Rose, Chrysanthemum.

Top five hits upon BLASTn analysis are as follows

Gene Bank Accession No.	Description	Max score	Query cover	Query coverage	E value	Identity (%)
KY264167.1	<i>Paramyrothecium roridum</i> isolate KP10087	1020	1020	100%	0.0	100%
JF724153.1	<i>Myrothecium roridum</i> strain MA-73	1020	1020	100%	0.0	100%
MF401397.1	<i>Paramyrothecium roridum</i>	1014	1014	100%	0.0	99%
JF724156.1	<i>Myrothecium roridum</i> strain 782	1014	1014	100%	0.0	99%
MF579531.1	<i>Paramyrothecium roridum</i> isolate MyroTeca02	1011	1011	99%	0.0	99%

*Trichoderma* was isolated from *Trichoderma* talc powder (Pant bio agent-1) and pure culture has been maintained in PDA. Its efficiency to be checked against all the pure cultures of fungal pathogens isolated from flower crops. (Fig. 3.14, 3.15)

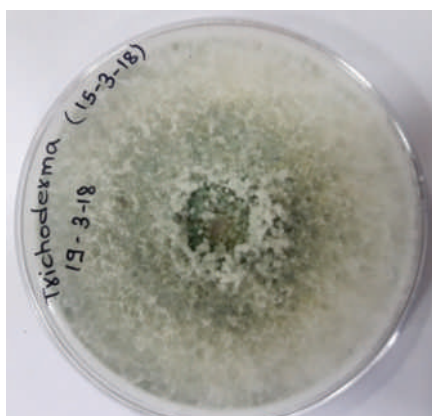


Fig.3.14 *Trichoderma* pure culture

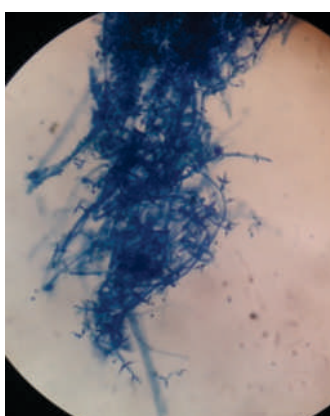


Fig.3.15 Microscopic view of *Trichoderma* spores

### Project 3.3 (ICAR Code: IXX 11708) : Assessment of Nematode Infestation in major Commercial Flower Crops and Management of Root-knot Nematode in Tuberose

#### 3.3.1 Management of root-knot nematode, *M. incognita* in tuberose

Synthetic pesticides such as imidachloprid, thiomethoxon, carbosulfan were evaluated as bulb treatment for the management of root-knot nematode, *Meloidogyne incognita* infecting tuberose under pot condition. Soaking of tuberose bulbs was done in 500, 1000 and 2000 ppm for 2 hr. Seventy days after planting, number of galls per plant and nematode multiplication rate was recorded. Significantly lower number galls were recorded in the treatment with carbosulfan at 2000 ppm (14-26 galls/plant) followed by 1000 ppm (31-42 galls/plant) compared to untreated control (83-98 galls/plant). The nematode multiplication rate (1.8-fold) was also significantly lowest in carbosulfan (2000 ppm) treatment compared 4.9-fold multiplication rate in untreated control. No significant reduction in number of galls and nematode multiplication rate was recorded in the treatment with either imidachloprid or thiomethoxon in any of the concentration.



## 4. Postharvest Technology and Value Addition

### Project 4.1: Harnessing Natural Pigments from Flower Crops for Making Value Added Products from Grapes

#### 4.1.1 Development of Protocols for Isolation, Characterization & Utilization of Natural Pigments from Flower Crops

- Collected fresh flower samples of 24 Rose and 120 chrysanthemum accessions. Rose flower samples were subjected to three conditions of drying viz. Sun drying, Shade drying and Oven drying, while chrysanthemum samples were shed dried. All the flower samples were powdered and stored in airtight containers at room temperature.
- For determination of total phenolics, flavonoids and antioxidant activities of chrysanthemum and rose flowers, crude methanol extracts were subjected to total phenol, total flavonoids and antioxidant assays.
- Among 22 accessions of chrysanthemum analysed for determinations of total phenol content variety Dimond Jubilee recorded highest phenolics content (47 mg/100gm GAE) followed by Silk Borocate (47 mg/100gm GAE) and PUV (44 mg/100gm GAE) while the lowest was noted in Bidhan Sabita (-2mg/100gm GAE). In case of total anthocyanins contents variety Mauve Sarah noted the highest (6504 mg/L) followed by Bidhan Pratima (58.7 mg/L) whereas lowest was noted in Mini Jessie (0.3 mg/L) (Fig. 4.1).

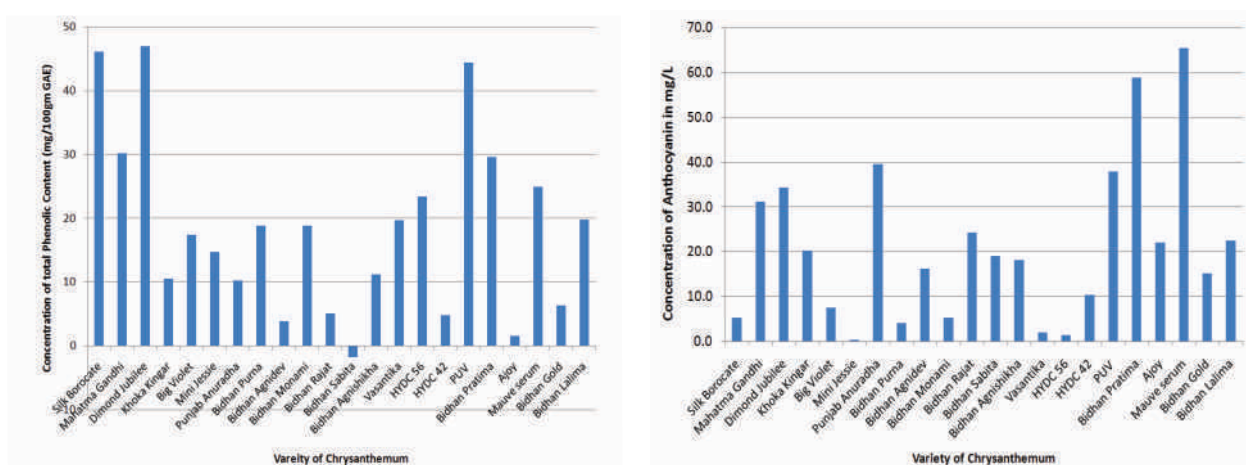


Fig 4.1 Total Phenolic and Anthocyanin Content of Chrysanthemum Varieties



- Among the 17 rose accessions analysed for total phenol content variety Pusa Pitamber recorded highest total phenol content (25.47 mg/100gm GAE) followed by Pusa Gaurav (24.33 mg/100gm GAE) and Summer Snow (23.64 mg/100gm GAE) whilst lowest was noted in variety Midas Touch (11.15 mg/100gm GAE). In case of total anthocyanins contents variety Charisma noted highest anthocyanin content (210.3 mg/L) followed by Pusa Pitambar (189.5 mg/L) while lowest was recorded in Midas Touch (2.5gm/L) (Fig. 4.2).

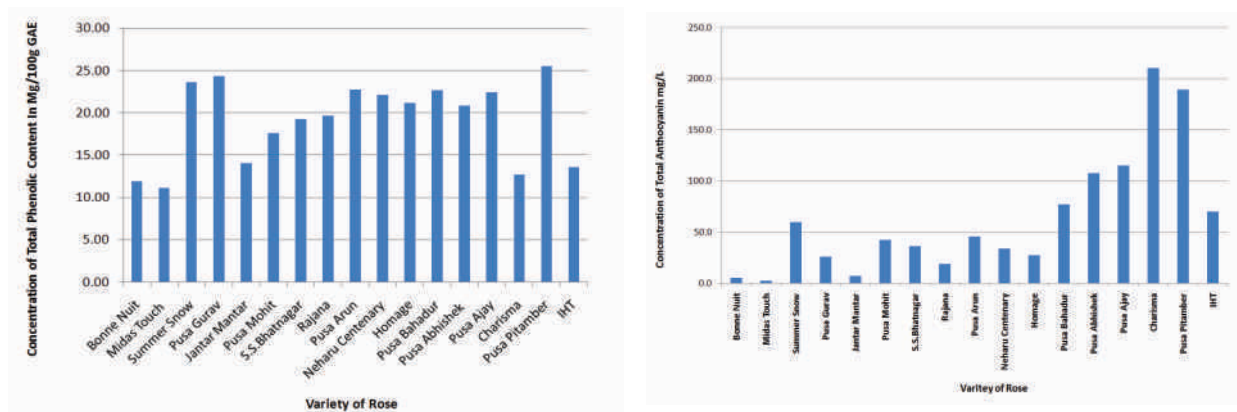


Fig 4.2: Total Phenolic and Anthocyanin Content of Rose varieties

- DPPH assays were carried out to determine antioxidant capacity of 22 Chrysanthemum accessions among them Bidhan Agnishikha has shown highest antioxidant activity followed by Bidhan Sabita whilst lowest activity was observed in Bidhan Lalima (Fig. 4.3).

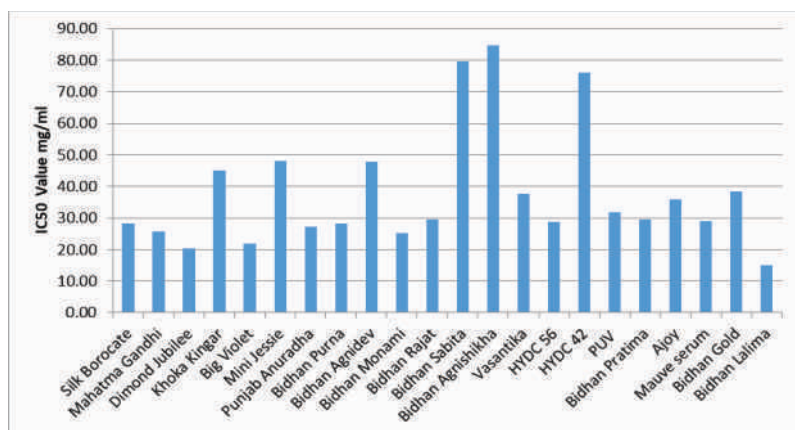


Fig 4.3: DPPH Assay of Chrysanthemum Varieties

#### 4.1.2: Profiling of volatile components from commercial flower crops

The process (stage of the flower, sample preparation method, time/temperature) of volatiles profiling in fragrant rose and tuberose varieties through HPLC was optimized. Volatile compounds such as ethyl benzene, ethyl benzoate, methyl benzoate, indole, farnesene, *p*-xylene, benzyl benzoate, n-octadecane, benzyl salicylate and 1, 8-cineole from tuberose flowers were identified (Fig. 4.4).

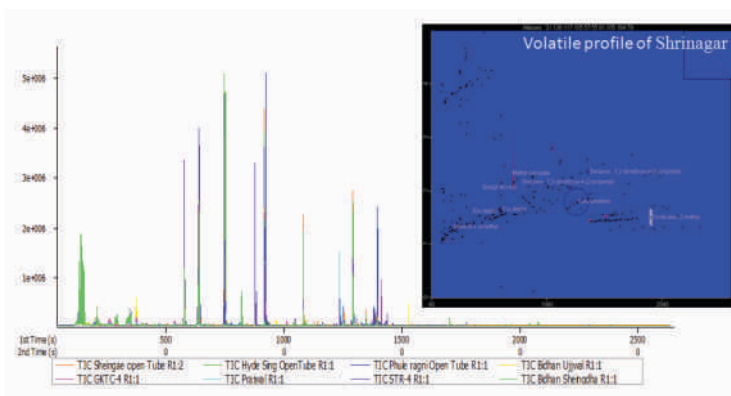


Fig 4.4 Volatile profiles of different varieties of tuberose

Profiling of rose varieties for volatile compounds was accomplished in five varieties (Fig. 4.5 and 4.6). It was found that profile of volatiles is unique to individual variety and could be considered as a varietal characteristic. This can be utilized for classification/characterization of fragrant varieties of roses.

Fig 4.5 Volatile compounds in different varieties of Rose

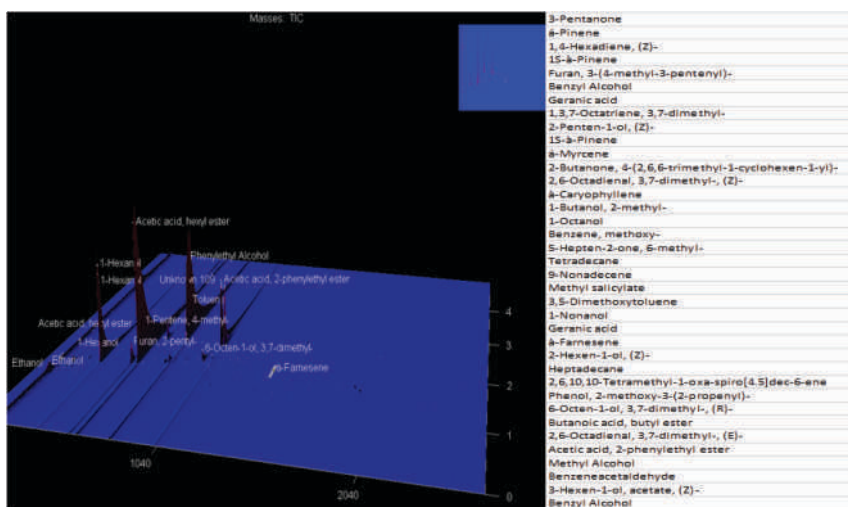
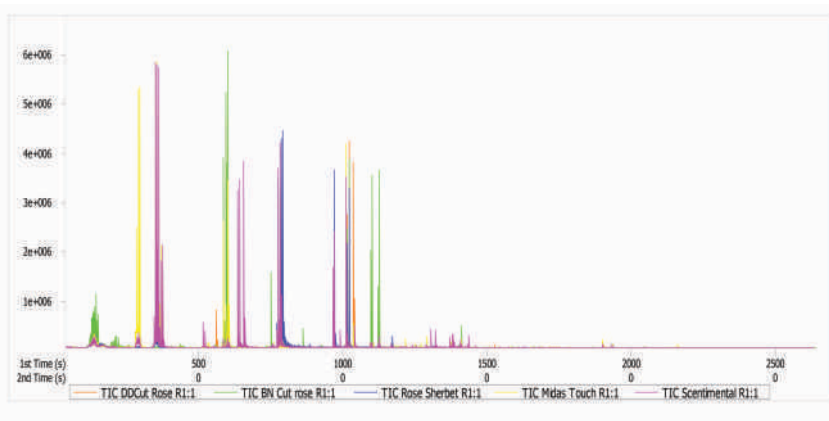


Fig 4.6 Volatile profile of rose variety Double Delight

## Project 4.2 (ICAR Code: IXX 14263): Standardization of Post-harvest Technology and Value addition of Ornamental Crops.

### 4.2.1: Standardization of Drying Technology for Rose Flower Petals

Different varieties of rose flowers (Jantar Mantar, Pusa Bahadur, Bonne Nuit, Pusa Gaurav, Midas Touch, Kashmir Velvet, Pusa Arjun, Pink Montezuma, Surkhab) were dried by employing two different drying methods such as hot air oven drying and microwave oven drying to find out the most suitable drying method and parameters for dried rose flowers. The fresh rose flowers of different varieties without any bruising were selected for the research work. The moisture content of fresh rose petals was determined by hot air oven method and it was observed to be 81 % on wet basis. The experiment was carried out with pre-determined drying parameters. Before starting the actual drying experiment, the dryer was started to attain preset temperature.

For hot air oven drying, the fresh rose petals were spread in the stainless steel trays of hot air oven, set to pre-decided temperature (60°C) and drying was continued till the final mass reached to pre-decided level of moisture content (3-4 %). The rose petals were stirred intermittently. The weight loss of rose flowers was recorded at one hour interval.

For microwave oven drying, the fresh rose petals (30 g) were placed inside the microwave oven chamber. The oven was set to operate at medium low mode of power. Initially the weight loss was recorded at 3 min interval till the final mass reached to pre-decided level of moisture content (3-4 %). It was observed that intermittent stirring is required while drying of rose petals in microwave oven to avoid burning of bottom layer petals (Fig. 4.7).



Fig. 4.7 Microwave oven dried rose petals

The results indicated that the average time required for drying of rose petals was 19 hours in hot air oven method and 20 min in microwave oven method. In both the methods, initial drying rate was higher and decreased gradually with time. The drying characteristics of rose petals indicated that the microwave oven method was better method for preparation of dried rose petals as compared to hot air oven method.

#### 4.2.1: Standardization of process for Rose Syrup preparation

The process of rose syrup preparation was standardized on the basis of selected physico-chemical properties and sensory evaluation. The rose varieties selected for preparation of rose syrup are Rosa damascene, Noorjahan, Double delight and Local. For standardization, the rose syrup was prepared by three different methods of rose extract preparation. In first method, the syrup was prepared by adding cleaned whole rose petals to boiling sugar syrup, heating under boiling condition for 2-3 min and then cooling. In second method, the rose syrup was prepared by addition of crushed rose petals to boiling sugar syrup, heating under boiling condition for 2-3 min and then cooling. However, in third method, the rose syrup was prepared by adding water extract of rose petals in sugar syrup. The TSS and acidity of rose syrup was maintained as per the FSSAI standards for syrup/sharbat i.e. TSS $\geq$ 65°Brix and acidity  $\leq$ 3.5 %. The prepared rose syrup was analyzed for pH, Reducing sugars, Total sugars, Total Phenols, Antioxidant activity and organoleptic evaluation by trained panelist using 9.0 point hedonic scale. In preliminary trials, the prepared rose syrup was analyzed for organoleptic evaluation and results indicated that the rose syrup prepared by first method scores good organoleptic quality as compared to other two methods (Fig. 4.8). This method retains more taste and flavor of rose in prepared syrup. The research work is under progress and further trials will be carried out to study the physico-chemical properties and for optimization of standardized method of rose syrup preparation. The response variables were Acidity, pH, Reducing sugars, Total sugars, Total Phenols and Antioxidant activity of developed rose syrup.



Fig. 4.8 Rose Syrup made from rose petals

### Project 4.3 (ICAR Code: 12322): Standardization of Postharvest Packaging Technology for Tuberose and Jasmine

#### 4.3.1. Design and Development of Foldable Poly-propylene boxes for Packaging of loose Tuberose flowers

Considering the preliminary study of packaging of loose tuberose flowers, we designed and developed three different Foldable Poly-Propylene (PP) boxes for different loads of flowers (with dimensions of 50cm x 30cm x 20cm, 60cm x 40cm x 20cm and 60cm x 40cm x 25cm) and with a range of ventilation (0, 4 & 6%). For testing of these developed PP Boxes study the effect of packaging and storage on keeping quality of loose flowers of tuberose, fully developed unopened buds of locally grown single tuberose cultivar were collected from farmers field and were brought to laboratory early in the morning. The harvested buds were packed in various sizes of Poly-propylene (PP) box provided with different ventilation percentage with inner lining of cotton. The average moisture content recorded for fresh tuberose flowers was observed to be 87.94 %. The treatment details for various combinations of box size and ventilation percentage were as presented in Table 4.1.



**Table 4.1 Treatment details for storage of loose tuberose flowers**

Treatment	Box Size	Ventilation percentage
A1B0	50 cm × 30 cm × 20 cm	0
A1B1	50 cm × 30 cm × 20 cm	2
A1B2	50 cm × 30 cm × 20 cm	4
A1B3	50 cm × 30 cm × 20 cm	6
A2B0	60 cm × 40 cm × 20 cm	0
A2B1	60 cm × 40 cm × 20 cm	2
A2B2	60 cm × 40 cm × 20 cm	4
A2B3	60 cm × 40 cm × 20 cm	6
A3B0	60 cm × 40 cm × 25 cm	0
A3B1	60 cm × 40 cm × 25 cm	2
A3B2	60 cm × 40 cm × 25 cm	4
A3B3	60 cm × 40 cm × 25 cm	6

### Ambient conditions

The average temperature and relative humidity of ambient conditions in the laboratory were measured by digital thermometer and hygrometer respectively which were presented in Table 4.2. The average daily temperature and relative humidity varied between 31.48 to 34.18°C and 43.60 to 48.60 % respectively during experiment.

**Table 4.2 Ambient conditions during storage of loose tuberose flowers**

Date	Temperature (°C)	Humidity (%)
1 <sup>st</sup> day	31.48	47.00
2 <sup>nd</sup> day	32.40	45.14
3 <sup>rd</sup> day	32.74	48.60
4 <sup>th</sup> day	34.18	43.60
5 <sup>th</sup> day	31.60	54.50

### 4.3.2 Effect of packaging size and ventilation on Physiological Weight Loss (PLW %) of Loose Tuberose Flowers

The physiological weight loss of loose tuberose flowers was significantly influenced by individual effect of packaging box size and ventilation percentage and also with their interaction effects. Data presented in Table-4.3 revealed that the physiological loss in weight of loose tuberose flowers decreased with PP box size. However the PLW increased with increased percentage of ventilation of boxes. It was probably due to the higher relative humidity in packing boxes with higher size and without ventilation. The PP boxes without ventilation reduced the permeability to moisture and air, thereby reducing the weight loss probably due to a



Table 4.3 Average physiological weight loss (PLW %) of loose tuberose flowers during ambient storage

Treatment	Average physiological weight loss (PLW %) of Loose tuberose flowers																	
	6 hour	12 hour	18 hour	24 hour	30 hour	36 hour	42 hour	48 hour	54 hour	60 hour	66 hour	72 hour	78 hour	84 hours	90 hours	96 hours	102 hours	
A1B0	0.97	1.01	2.35	3.27	3.92	4.60	5.92	7.20	8.46	9.42	11.22	12.74	0.00	0.00	0.00	0.00	0.00	0.00
A1B1	2.26	3.10	4.76	6.46	8.16	8.90	10.90	11.48	12.94	13.73	15.19	16.32	17.13	18.20	19.00	19.86	0.00	0.00
A1B2	2.40	3.33	5.18	6.66	8.19	9.10	11.23	12.40	13.17	14.36	15.96	16.96	17.84	19.62	20.12	20.92	0.00	0.00
A1B3	2.64	3.65	5.26	6.87	8.52	9.54	11.55	13.18	14.08	15.92	16.62	17.37	18.10	19.86	20.90	21.58	0.00	0.00
A2B0	0.67	0.91	1.80	2.97	3.64	4.36	5.30	6.91	7.64	8.84	10.43	11.54	0.00	0.00	0.00	0.00	0.00	0.00
A2B1	1.80	2.43	3.03	4.23	5.43	6.44	8.45	9.74	10.43	11.72	12.78	13.60	14.42	15.34	0.00	0.00	0.00	0.00
A2B2	2.25	2.43	3.51	5.14	6.22	7.32	9.12	10.36	11.32	12.54	13.35	14.06	15.18	16.06	0.00	0.00	0.00	0.00
A2B3	2.54	2.73	4.66	6.40	7.23	8.27	9.77	11.00	12.40	13.67	14.56	15.44	16.54	17.44	18.20	18.94	19.76	0.00
A3B0	0.41	0.78	1.38	2.18	2.77	3.36	5.17	6.30	7.09	8.14	9.72	10.38	0.00	0.00	0.00	0.00	0.00	0.00
A3B1	1.45	2.22	2.93	4.15	5.52	6.37	8.40	9.24	10.20	10.98	11.73	12.50	13.45	14.28	0.00	0.00	0.00	0.00
A3B2	1.78	2.39	3.34	5.05	6.15	7.28	8.54	10.04	10.96	11.51	12.64	13.74	14.66	15.56	0.00	0.00	0.00	0.00
A3B3	2.21	2.59	4.19	5.36	6.77	7.38	9.56	10.72	11.90	12.88	13.94	15.04	15.98	16.80	0.00	0.00	0.00	0.00
SE(m)(±)	0.021	0.02	0.023	0.023	0.038	0.049	0.027	0.098	0.027	0.022	0.016	0.02	0.014	0.016	0.01	0.009	0.003	0.003
C.D.	0.061	0.06	0.067	0.069	0.113	0.145	0.079	0.287	0.08	0.065	0.048	0.059	0.042	0.047	0.03	0.025	0.01	0.01

reduction in the moisture loss and respiration rate. At the end of 3<sup>rd</sup> day, the minimum physiological weight loss was observed in tuberose flowers stored in A3B0 whereas maximum physiological weight loss was observed with A1B3. However, on 3<sup>rd</sup> day, freshness was maximum in A1B3 as compared to A3B0.

#### 4.3.2: Effect of packaging size and ventilation on freshness of loose tuberose flowers

Freshness of tube rose floret was significantly influenced by box size and percentage of ventilation. The flowers stored in all the boxes except boxes without ventilation maintained maximum ( $\geq 85\%$ ) freshness till 4<sup>th</sup> day which had started wilting from 5<sup>th</sup> day. The percentage of wilting had varied as per the size of PP box and ventilation percentage. The boxes without ventilation showed unacceptable level of freshness on 4<sup>th</sup> day thus flowers from these boxes had discarded on 4<sup>th</sup> day. Maximum freshness was retained in flowers stored in A2B3 treatment followed by A2B2 and A2B3 on 4<sup>th</sup> day. On 5<sup>th</sup> day, flowers stored in A2B3 treatment had maximum freshness which was followed by treatment A1B2 and A1B3 respectively. The flowers stored in A2B3 box had less physiological loss in weight (PLW) and maintained higher freshness up to 5<sup>th</sup> day (Fig. 4.9). This was probably due to the modified atmosphere condition of gaseous composition and high relative humidity created by the size and ventilation of the box.



Fig. 4.9 Fresh loose flowers of tuberose

#### 4.3.4 Effect of packaging size and ventilation on inside temperature of loose Tuberose flowers

To study the effect of size of PP box and ventilation percentage on inside temperature of tuberose flowers, the temperature was recorded at two locations, namely, at middle and at bottom of the florets. The observations recorded indicated that, temperatures, both at middle as well as at bottom were increased with size but decreased with increased percentage of ventilation. The probable reason for increased temperature with increased size may be increased amount of respiration heat with increased quantity of florets. The temperature inside the florets decreased with ventilation due to removal of respiration heat through ventilations.

#### 4.3.5 Effect of packaging size and ventilation on temperature and relative humidity of packaging headspace

The temperature and relative humidity of air in package headspace increased with size of PP box but decreased with increased percentage of ventilation. This might be due to increased quantity of florets with higher sizes of boxes, which produces higher heat of respiration. However with increased percentage of ventilation, the rate of removal of respiration heat increases which results in the lowering of temperature of packaging headspace (Fig. 4.10)



Fig 4.10. Foldable Poly-Propylene Boxes for packaging of loose flowers

## Project 4.4: Design and Development of Tools and Gadgets for Floriculture

### 4.4.1: Design and Development of Grafting Machine

Grafting of rose is being done manually but due to the shortage of agricultural labor and the deficiency of skilled rose grafters make more necessary the need of a mechanization in rose grafting process is essential. Rose is one of the most common garden plants all over the world. Due to its long history of cultivation and popularity, vast information exists on propagation and rootstock selection. Grafting of horticultural crop is a very old horticultural technique that is indispensable to modern horticulture. There is a need of grafting for many modern roses like the Hybrid Teas (HTs) and Floribundas to achieve a reliable rate of success and production of high quality planting material. The pedal operated rose grafting machine was designed and developed with stainless steel and mild steel material (Fig. 4.11). The grafting machine consist of four parts namely main grafting assembly, rootstock and scion cutting and reunion assembly, Pedal to operate the machine and wooden table to support the whole assembly of machine. The rootstock and scion cutting and reunion assembly have different sized four springs having different size and tension capacity, omega shaped cutting blades to cut the rootstock and scion and rootstock and scion reunion assembly. The omega shaped cutting blade was made of stainless steel material. The shaft connected to the cutting assembly can be operated with the help of pedal. There is an arrangement of three different sized springs which provides required cutting force during rootstock and scion and restoring force to regain its original position so the cut stock and scion easily reunion with each other. The main grafting assembly was installed on a wooden table. The size of wooden table used for installation of grafting machine would be 4 x 3 x 3 feet. This rose grafting machine can be operated by only one man (Skilled or Unskilled). The rootstock and scion are kept manually in cutting and reunion assembly. Preliminary trial shows that this grafting machine can takes approximately 08-10 seconds for grafting of single rose.

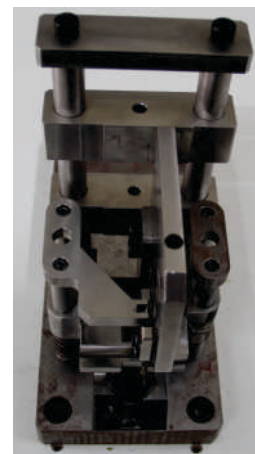


Fig. 4.11 Pedal operated Grafting Machine

### 4.4.2: Design and Development of Loose Flower Plucker:

In India Loose flowers are used for making garlands for worship, religious function and extraction of pigments. Generally these flowers are harvested manually and are a labour intensive process. There is need for mechanization in harvesting of flowers to minimize the dependence on limited resources such as labor, time and reducing the cost of production for enhanced farm income. So considering all these factors we have designed and developed manually operated loose flower plucker (Marigold, China aster, chrysanthemum etc.) Dimensions of the loose flower plucker are 4x2.5x2cm. The prototype of loose flower plucker was developed by 3D printing. The loose flower plucker consist of blade holder assembly made of plastic material, cutting blade made of stainless steel, fixing belt and thumb protector (Fig. 4.12). It was designed according to the size of index finger of men and women. The thickness of blade was 0.1mm. The developed



Fig 4.12 Fig: DFR Flower plucker for harvesting of loose flowers

loose flower plucker was demonstrated on farmers field (MGMG Goan Kusur, Junnar Tahsil, Pune). The factors like comfort, design, efficiency, speed of operation, damage to flower and plant during harvesting, injury to figure were considered during testing. It was tested with both men and women. Duration of plucking was 30 min per person and compared 30 min hand plucking v/s 30 min plucking with the help of loose flower plucker. During testing of plucker we recorded the data of total weight of plucked flowers (Grams), plucking rate (g/min), Flower quality (Score/5), Pain Experience (Score/5) and Plucking Efforts (Score/5). The factors for evaluating the pluckers were scored on a scale of 0 to 5. The loose flower plucker had higher plucking rate than hand plucking, minimum damage to flowers and plant during harvesting of flowers, no injury to fingers (thumb and index finger ) It can reduce the damage to the plant during harvesting like uplifting of plants, breaking of branches of plant etc. From Table 4.4 &4.5, it is evident that the pain experience and plucking efforts during hand plucking of loose flowers were more than Plucking with the help of ICAR-DFR Flower Plucker. It was also observed that the flower quality during both the methods of plucking was good. The rate of flower plucking in DFR flower plucker was slightly higher than hand plucking in case of marigold and aster loose flowers.

**Table 4.4 Plucking of loose flowers for 30 Minutes by ICAR-DFR Plucker**

S. No.	Name M/F	Age (Years)	Experience	Plucking with ICAR-DFR Plucker (30 Min)			
				Plucking rate (g/Min)	Flower quality score (/5)	Pain experience(/5)	Plucking effects Score (/5)
1	Nitin Deshmukh (M)	27	07	125	4	4	5
2	Paresh Bochare (M)	36	10	138	5	3	4
3	Chakrapani D. Bochare (M)	24	05	125	5	5	5
4	Jaya P. Dongare (F)	36	11	120	4	4	4
5	Rupali S. Dongare (F)	27	07	121	5	4	5
6	Santosh S. Dongare (M)	31	10	122	5	4	5
7	Pravin G. Dongare (M)	45	20	130	4	5	4
8	Kishan K. Bochare (M)	57	30	118	5	4	3
9	Shrada G. Bochare (F)	27	07	120	4	3	5
10	Santosh A. Chilap (M)	21	05	120	5	5	5

**Table 4.5 Plucking of loose flowers by Hand Plucking (30 min)**

Sr. No.	Name	Age (Year)	Experience (Year)	Hand Plucking of Loose Flowers ( 30 min)			
				Plucking rate (g/min)	Flower quality (Score/5)	Pain Experience (Score/5)	Plucking Efforts (Score/5)
1.	Nitin D Deshmukh (M)	27	07	125	4	4	5
2.	Paresh N Bochare (M)	36	10	138	5	3	4
3.	Chakrapani D Bochare (M)	24	05	125	5	5	5
4.	Jaya P Dongare (F)	36	11	120	4	4	4
5.	Rupali S Dongare (F)	27	07	121	5	4	5
6.	Santosh S. Dongare (M)	31	10	122	5	4	5
7.	Pravin G. Dongare (M)	45	20	130	4	5	4
8.	Kisan K. Bochare (M)	57	30	118	5	4	3
9.	Shradha G Bochare (F)	27	07	120	4	3	5
10.	Santosh A Chilap (M)	21	05	120	5	5	5



## Post Graduate Education

ICAR-DFR has been recognized as a part of Post-Graduate Education Programme of MPKV Rahuri. Dr. Ganesh B. Kadam and Dr. Tarak Nath Saha have been identified as the faculty for Post-Graduate teaching and research guidance in College of Horticulture, Pune. During 2017-18, a course on “FLA-506: Value Addition in Flowers (2+1 Credit offered in semester-II) was offered by Dr. Tarak Nath Saha, Scientist, ICAR-DFR and Breeding of Ornamental and Flower Crops” (2+1 Credit offered in I semester) was offered by Dr. Ganesh B. Kadam, Scientist, ICAR-DFR. ICAR-DFR Scientists Dr. Tarak Nath Saha, and Dr. Ganesh B. Kadam are also involved as members of Research Advisory Committee of Post-Graduate students of College of Horticulture, Pune.

## Outreach Programmes/Exhibitions

### Implementation of Flagship Programme of the Government of India “Mera Gaon Mera Gaurav”

The flagship programme of the Government of India titled "Mera Gaon Mera Gaurav", is a scheme to make scientists adopt villages to promote the best farming practices. An innovative initiative “Mera Gaon Mera Gaurav” is helping to have direct interface of scientists with the farmers to hasten the lab to land process. The objective of this scheme is to provide farmers with required information, knowledge and advisories on regular basis by adopting villages. Various outreach activities were planned and executed in the adopted villages. ICAR-DFR has given major emphasis on promotion of flower crops in the region and providing the scientific and technical support to the farmers. The improved varieties and technologies developed under ICAR/SAU for flower and other horticultural crops are being promoted and farmers are motivated to adopt these technologies for better returns. Tuberose, marigold, chrysanthemum, gladiolus, aster, annual chrysanthemum, balsam, etc. are the major crops grown by the farmers. The Directorate is making efforts to develop some model village wherein all the technologies can be demonstrated and nearby flower growers shall be benefitted. ICAR-DFR is trying to provide the simple solutions to various issue faced by the farmers in cultivation of flower and other horticultural crops. The scientists are also visiting other villages whenever farmers are facing specific problem of flower cultivation and other horticultural crops. For that ICAR-DFR has made



Providing solutions to problems of other horticultural crops



Interaction with farmers and understanding the problems faced

two teams of scientist who are visiting adopted villages on regular basis. Need based intervention have been planned and on a continuous basis our teams are providing technical support to the farmers to adopt improved technologies for cultivation of flower crops. We have also issued soil health cards to various farmers. The Directorate has organised training programmes, demonstrations and other general social up-liftment programmes like Swachh Bharat Abhiyan in those adopted villages. The farmers from adopted as well as other villages were nominated for the IARI Innovative Farmers Award-2018 given during Krishi Unnati Mela-2018 at ICAR-IARI, New Delhi. Mr Sameer Hundare Village-Kusur, Tal-Junnar, Dist-Pune have been awarded with the Innovative Farmers Award-2018 for the adoption of innovative practices for flower cultivation.



Understanding the problems of marigold cultivation



Monitoring of marigold and strawberry intercropping



Meeting with farmers



Creating awareness about the Swachh Bharat Mission at nearby villages



Understanding the packaging need of horticultural crops



Demonstration of soil sampling procedures at farmers field.



### Participation of ICAR-DFR at North Zone Regional Farmers Fair 2017 held at Varanasi

ICAR-DFR actively participated in the North Zone Regional Farmers Fair 2017 held at Trade Facilitation Centre, Varanasi from 23-25 Feb., 2018. The Directorate exhibited banners, charts, technical bulletins, live flower sample, on the spot consultancy related to cultivation and other aspects of flower cultivation which attracted thousands of visitors during the three days Farmers fair. The Fair was inaugurated by Hon'ble Union Cabinet Minister Mr. Radha Mohan ji and attended by Mr. Surya Pratap Shahi the Minister of Agriculture, Agriculture Education and Agriculture Research(Uttar Pradesh). The stall was visited by Hon'ble Union Cabinet Minister Mr. Radha Mohan ji. The stall was appreciated by all the persons who paid the visit and it was the biggest farmers fair in the region. The stall was also visited by Dr. Gautam Kaloo, Former DDG (HS), ICAR & Former Director, IIVR and appreciated the display besides, Dr. B. Singh, Director, ICAR-IIVR, Varanasi. There were many enquiries about the loose flowers, cut flowers, dry flower products and all queries were duly attended/replied.



Participation of ICAR-DFR in Regional Farmers Fair 2017

### Participation of ICAR-DFR in the Technology Expo during International Symposium on Horticulture: Priorities and Emerging Trends Sept 4-8, 2017 at IISC, Bengaluru.

ICAR-DFR actively participated in the Technology Expo during International Symposium on Horticulture: Priorities and Emerging Trends from Sept 4-8, 2017 at IISC, Bengaluru. The Technology Expo was inaugurated by Sh. Vajubhai Valaji, HE, Governor of Karnataka; Sh. Ananth Kumar, Hon'ble Minister of Chemicals & Fertilizers, GoI. Also Dr. A. K. Singh, DDG (HS), ICAR & Dr. M. R. Dinesh, Director, IIHR graced the occasion and visited the stall of ICAR-DFR. ICAR-DFR team visited a floriculture unit in Tubagere, Dodaballapur, Karnataka. This unit Om Sri Sai Flowers is producing rose, gerbera, carnation and few filler/foilage plants (Gyposphila, Asparagus, xenado, etc) in an area of 32 ha under protected structures. The cut flowers are in general marketed in Delhi, Kolkata and to some extent in local market (Bengaluru).



Participation of ICAR-DFR in Technology Expo, Bengaluru



### **ICAR-DFR Exhibited stall at AGRIFEST-2017 Organized by College of Agriculture, Pune**

ICAR-DFR exhibited stall at AGRIFEST-2017 organized by College of Agriculture, Pune at College of Agriculture Ground Shivajinagar, Pune from September 10-12, 2017. The Directorate prominently displayed vertical garden, container garden besides foliage and flowering plants in pots. Seeds and planting materials were also distributed to the farmers. ICAR-DFR stall was visited and appreciated by Shri Sharad Pawar Ji, former Union Minister of Agriculture, GOI.



■ Participation of DFR in ICAR-DFR Stall



■ Honble Shri Sharad Pawar Ji Visited DFR stall

### **ICAR-DFR Exhibited stall at *Kisan Adhar Sammelan*, September, 25-29 at MPKV Rahuri**

ICAR-DFR exhibited stall at *Kisan Adhar Sammelan*, September, 25-29 at MPKV Rahuri. ICAR-DFR showcased banners, charts, technical bulletins, live flower sample. ICAR-DFR team provided solutions to the problems of farmers related to the aspects of flower cultivation, which attracted thousands of visitors during five days of *Kisan Adhar Sammelan*. The stall was appreciated by all who paid a visit.

### **ICAR-DFR Exhibited stall at KVK, Narayangaon**

The Directorate put a live stall at "Global Farmers- Live Demos, Agri Exhibition and Crops Conference" held at Krishi Vigyan Kendra, Narayangaon from 4-7 January, 2018. All the Scientific staff attended the exhibition. The farmers/ visitors were provided with the live interaction and necessary remedy were explained to them on various issues related to improved varieties, cultural practices, fertilizers & soil health issues, crop protection measures, postharvest technology, etc.

### **Participation of ICAR-DFR in KRISHI Exhibition, Moshi**

The Directorate actively displayed its stall in one of the largest farmers' fair KRISHI-2017 at Moshi from 13-17 December, 2017. Live samples of large number of chrysanthemum varieties (for loose and cut flower), tuberose varieties, China aster, marigold, potted plants were prominently displayed in the stall. The stall was visited by thousands of visitors. Besides attending various issues of the farmers, planting materials of tuberose, gladiolus and marigold were also distributed to the farmers.

### **Participation of ICAR-DFR in KRUSHIK Expo 2018 at KVK, Baramati**

The ICAR-DFR actively participated and exhibited stall at "KRUSHIK- Live Demos & Agri Expo." held at Krishi Vigyan Kendra, Baramati from 19-22 January, 2018. The four days fair had a unique attraction of live demonstration, technology solution, farm equipments & agri inputs. The stall was attended by several farmers who were directly and indirectly attached with cultivation of ornamental crops. The planting materials of tuberose were given to some progressive farmers as well to KVK for demonstration. The stall was visited by several dignitaries and Directors of ICAR institutes.



## Training/Seminar/Symposia/Workshop Organized

### ICAR-DFR Observed Vigilance Awareness Week 2017

As per directive of the Vigilance cell ICAR and Central Vigilance Commission, Vigilance Awareness Week 2017 was observed at ICAR-Directorate of Floricultural Research, Shivajinagar, Pune from 30<sup>th</sup> October to 4<sup>th</sup> November 2017 with the theme “My Vision: Corruption Free India”. The observance of vigilance awareness week began with the staff of ICAR-DFR taking Integrity and Organizational Pledge both in English and Hindi on 30<sup>th</sup> October 2017, along with the students and teachers of College of Horticulture, GKVK, Bengaluru who visited ICAR-DFR on a study tour. Dr. K.V. Prasad, Director, ICAR-DFR outlined the purpose, theme and sensitized the students about the importance of achieving a corruption free India. He instilled the students with the knowledge of the strength of young India to achieve our vision “Corruption Free India”. It was followed by an interactive session with the students on the ills of corruption plaguing our society. About 30 employees of the institute have taken the pledge.

On 31<sup>st</sup> October, ICAR-DFR along with ICAR-National Research Centre for Grapes organized a panel discussion on “Corruption Free India” with active involvement from the staff of both the institutes. Senior officers from the Anti-corruption Bureau cell, Maharashtra, Director, ICAR-DFR, Director, ICAR-NRCG and Director, ICAR-ATARI were the panelists. Lively interaction took place among the panelists and the participants.

On the third day a quiz competition was organized for the staffs of ICAR-DFR on “Vigilance” and all the staff members actively participated in the same. An essay writing competition in Hindi on “मेरा लक्ष्य: भ्रष्टाचार मुक्त भारत” was also organized for the ICAR-DFR staff on the next day.

On 3<sup>rd</sup> November, the staff of ICAR-DFR visited Ghule Vidyalaya, Manjri village and organized a vigilance awareness campaign for higher secondary students undergoing vocational higher secondary course. About 60 students participated in this programme. Dr. D V S Raju, Officer Incharge -Vigilance cell, ICAR-DFR gave the introduction and overview of the programme to the audience. Dr. Naveen Kumar moderated an interactive session of staffs and students. During interaction, the teachers pointed out the importance of introduction of “Vigilance” in the teaching curriculum as many are not well aware of the system. A lecture on “मेरा लक्ष्य: भ्रष्टाचार मुक्त भारत” was delivered by Dr. Prasanth Kavar. The programme concluded with an official vote of thanks by Dr. Prabha K, Member Vigilance cell, ICAR-DFR. The entire week was very successful as each day all the staffs of the ICAR-DFR were involved in various programmes organized as a part of the observance of vigilance awareness.

### ICAR-DFR Celebrated Chrysanthemum Week (25<sup>th</sup> November 2017 to 1<sup>st</sup> December, 2017)

ICAR-Directorate of Floricultural Research celebrated chrysanthemum week to showcase the technologies specific to chrysanthemum for the benefit of all the stakeholders at its Hadapsar farm. The celebrations were successful with the active participations of academicians, farmers, nurserymen, traders and people associated with various arenas of floriculture. Dr. K. V. Prasad, Director, ICAR-DFR welcomed all to the occasion on different days of the week. The experimental farm has around 140 named varieties from National Agricultural Research and Education System, promising selections and mutated populations developed by ICAR-DFR. Celebrations began on 25<sup>th</sup> November 2017 with the visit of members from sister institutes of ICAR. Directors, Dr. S. D. Sawant (ICAR-NRCG) and Dr. Lakhan Singh (ATARI), Heads of Regional Stations, Dr. G.K. Mohapatra (IARI-RS), Dr. S. Bilegonkar (IVRI-RC) along with the staff of their institute visited the farm and gave their impressions and inputs for improvement. Nurserymen from the various nurseries in and around Pune visited the chrysanthemums on the second day. Some of them showed their interest in the dwarf types of chrysanthemums like Anmol, Lilliput, Ajay, Pusa Sona, Sadbhawna etc as they have good scope for



pot mums. The most important day of chrysanthemum week was the third day (28<sup>th</sup> November 2017) where the farmers were invited and a farmer-scientist interactive session was organized. Almost 60 farmers from villages Kusur, Narayangaon, Nirgudi, Vaishnavgad visited the farm and interacted with the scientists. Interactive session covered various aspects of chrysanthemum cultivation from propagation techniques, nursery management to plant protection measures. Farmers were requested to evaluate each variety according to their criteria and give inputs for incorporation in further varietal advancement programme. The officer in charge from KVK Baramathi Mr. Syed Ali, KVK Narayangaon, Mr. Temkar and representative from KVK Jalna also participated with farmers. A demonstration on establishment of beehives in flower field was organized in association with KVK, Baramathi with an objective of integrating bee farming system for doubling farm income. Members of AICRP on floriculture in Maharashtra at MPKV Gneshkhind visited the farm on 29<sup>th</sup> November and interacted with the scientists on varietal preferences and scope of chrysanthemum cultivation in Maharashtra. On 30<sup>th</sup> November students and faculty from College of Agriculture and Horticulture Pune including Dr. Rasal, Associate Dean, College of Agriculture, Pune and Dr. S. Masalkar, Associate Dean, College of Horticulture visited the farm to explore the possibility of taking up some basic studies for the PG students. Flower traders and members of Agriculture Produce Marketing Committee, Pune also visited the research plots of chrysanthemum. They gave valuable inputs on the market preferences of flower types and discussed with the scientific staffs regarding the issue of waste management of flower produce in the market. The Director DFR, enlightened them with various options to reduce flower waste with emphasis on value addition through essential oil, pigment and dye extraction. He suggested APMC, Pune to develop the proposed flower auction centre at Pune as an Integrated Auction Centre with facilities for essential oil, pigment and dye extraction. The event also attracted media coverage in Maharashtra. Over all the celebrations were 'flowerfull' with positive feedback from the stake holders in Floriculture. Directors and staff of ICAR institutes cherished the chrysanthemum carpet spread over Hadapsar farm.



Field Day with Framers from adopted villages



Field day with farmers from adopted villages



Farmers interacting with ICAR –DFR scientists regarding chrysanthemum cultivation



### ICAR-DFR Celebrated Agricultural Education Day

The ICAR- Directorate of Floricultural Research, College of Agriculture Campus, Shivajinagar Pune celebrated Agriculture Education Day on 03<sup>rd</sup> December 2017 at Hadapsar Research Farm. Students of K K Ghule Vidyalaya, Manjri, Pune were invited to the ICAR-DFR Research farm. More than 70 students of IX, XI and XII standard along with teachers participated in the event. An orientation programme followed by visit to experimental fields of ICAR-DFR was conducted for these students. Dr. D. V. S. Raju welcomed the students and teachers for this event. Dr. P. Naveen Kumar, Principal Scientist, ICAR-DFR, Pune appraised students about the importance of floriculture, organizational set up of ICAR as well as DFR and also its role in research, education and development activities. He also informed about the role of ICAR-DFR. Dr. K V Prasad, Director, ICAR-DFR, Pune in his address explained about the significance of Agricultural Education Day. He emphasized the importance of agriculture and floriculture in day-to-day life of human beings. Importance of agricultural science and education to the state and country were briefly explained to the students by him. He also briefed about the NARS and motivated the students to put in their best efforts in shaping their career. He explained the career path, academic requirements different options in agriculture, veterinary, dairy, horticulture and fishery specialization available, employment potential and encouraged the students to seriously consider agriculture as their first choice of their career. The event resulted in creating awareness about the career avenues in agricultural science among the participated students. After the awareness programme, the scientists along with the teachers took them to the field to expose the students to different flower crops of the season like chrysanthemum, tuberose, China aster, annuals and explained about their uses, cultural practices and different varieties. The chrysanthemum varieties were in full bloom and the students were able to witness more than 100 varieties of chrysanthemum. The students interacted with the scientists about varieties, botany, growing techniques and other aspects.



Explaining the Scope of Agriculture to the students



School children visiting the Research farm

### ICAR-DFR celebrated World Soil Day

ICAR-DFR celebrated World Soil Day on 5<sup>th</sup> December, 2017 in association with KVK, Narayangaon. 54 Soil Health Cards were prepared for distribution to farmers of Kusur village on the occasion of World Soil Day. About 150 farmers were invited from various places and soil health cards were distributed.



Shri. Sharadrao Lende, Member-ZP, Pune distributing Soil Health Card to farmer

### Live Webcast / Telecast speech of Hon'ble Prime Minister on 17.03.2018

ICAR- Directorate of Floricultural Research, Pune (jointly with COA, MPKV, Pune) organized the live webcasting/telecasting of Hon. PM's speech on 17.03.2018 at Shirname Hall, College of Agriculture, Pune. Sh. Vijay Jaywant Kale, Honble MLA, Shivajinagar, Pune; Dr. P. Rasal, Associate Dean, COA; Dy. Registrar & Faculty from COA, MPKV, Pune & all staff from ICAR - DFR were present. Also students of College of Agriculture, Pune and farmers were present to listen the webcasting/telecasting of Hon. PM's speech. Total 350 number of participants were present in the event.



A view of webcast in progress



# Meetings of Research Advisory Committee/ Institute Research Committee/Institute Management Committee

## Institute Research Committee

The Institute Research Council Meeting of ICAR – Directorate of Floricultural Research, Shivaji Nagar, Pune was held in the Training Hall of the ICAR-IVRI Regional Station, Pune on 14<sup>th</sup> September 2017 to review the progress of work done in different ongoing research projects. At the outset, Dr. D.V.S. Raju, Principal Scientist (Floriculture and Landscaping) welcomed Dr. K. V. Prasad, Director of the Institute cum Chairman of IRC and all the members of IRC. Chairman of IRC, in his opening remarks informed the house that BARC is keen to support and collaborate projects with ICAR- DFR on mutation breeding. It was suggested to initiate research works on mutation breeding in ornamental crops. Emphasis has also to be laid to explore funding of projects from external agencies. He also briefed regarding research project planning with foresight of high expectations from ICAR- DFR, Pune. It was also decided that Scientists of Plant Protection and Soil Science will be associated with all the Institute Projects. The address of the Chairman was followed by presentation of work done reports in different ongoing research projects of the Institute and new project proposals. All scientists presented the work done during the year and proposed technical programme for next six months. The presentations was deliberated under different sessions viz. Improvement of Commercial Flower Crops, Post- Harvest Management and Value Addition, Plant Protection of Commercial Flower Crops, ICAR Inter Institutional Projects and New Project Proposal Presentations.

## Research Advisory Committee

The 6<sup>th</sup> RAC meeting of ICAR-DFR, Pune was held on 22<sup>nd</sup> March, 2018 at the Conference Hall of ICAR-NRC for Grapes, Pune under the Chairmanship of Padma Shri. Dr. Brahma Singh. Dr. T. Janakiram, ADG (HS-I), ICAR, Ex Officio member, Dr. R. L. Misra, Member, Dr. B. Satyanarayana Reddy, Member, Dr. Promila Pathak, Member, Dr. Najam A. Shakil, Member, Dr. K. V. Prasad, Director, ICAR-DFR, Ex Officio member were present along with scientific staff of the Institute. The programme started with a brief visit to ICAR-DFR research farm at Hadapsar. The Chairman and members of RAC visited the research plots at Hadapsar farm and lauded the efforts of Team DFR in developing the research infrastructure in spite of several constraints. Dr. Brahma Singh, Chairman, RAC and Dr. T. Janakiram ADG (HS-I) inaugurated the renovated old civil structure to be used as Transit Office of ICAR-DFR at Hadapsar.



Release of Publication



RAC Meeting in Progress



Hon'ble RAC members Interacting with Scientist



Hon'ble RAC Members at Hadapsar Farm

Agenda wise meeting of the RAC commenced from 10.00 a.m. The publications of ICAR-DFR were released during the occasion. Dr. Brahma Singh released Flori News-ICAR-DFR, News Letter (Volume 3) and Dr. T. Janakiram, ADG (HS-I) released a Profile of ICAR-DFR on the occasion. Dr.K.V. Prasad appraised the RAC about the various developmental and Institute building activities and outreach programmes. The Director briefed the RAC about the various issues being faced by the Institute and how the institute is resolving them one by one. He made a brief presentation on Master Plan of ICAR-DFR for the information of RAC members, which was appreciated by the RAC members.

## Institutional Activities

### International Day of Yoga Celebrated at ICAR-Directorate of Floricultural Research, Pune

ICAR – Directorate of Floricultural Research, Pune celebrated International Day of Yoga on 21<sup>st</sup> June 2017 (Wednesday). A “Yoga Workshop” was organized in the premises of ICAR-DFR, College of Agriculture Campus, Shivaji Nagar, Pune in association with Agricultural Technology Application Research Institute, Pune and TEC-Indian Veterinary Research Institute, Regional Station, Pune. The International Day of Yoga Celebrations, 2017 was attended by Scientists, Technical staff, Administrative staff and Project Assistants from ICAR–Directorate of Floricultural Research, Pune, Agricultural Technology Application Research Institute, Pune and Indian Veterinary Research Institute, Regional Station, Pune. Yoga expert Mr. S. S. Wange from Regional Station, Indian Agricultural Research Institute, Pune, conducted the “Yoga Workshop” and also demonstrated important Asanas for the benefit of all the participants. The programme commenced with Common Yoga Protocol followed by Mass Yoga Performance. Shri S. S. Wange, explained the importance of yoga, benefits of different Asanas, how the different Asanas have to be performed and science behind each Asana. All the staff performed various Aasanas, such as Tadasana, Chakratadasana, Makarasana, Praanayams, Anulom, Vilom etc. Later Dr. Lakhan Singh, Director, Agricultural Technology Application Research Institute, Pune, urged the employees to perform Yoga regularly and adopt healthy lifestyle for better health and wellbeing. Dr. K. V. Prasad, Director of ICAR–Directorate of Floricultural Research, Pune enlightened the gathering about the unique contribution of India to the mankind in terms of its contribution to Yoga, Mathematics, Astronomy and many more scientific fields. Dr. Naveen Kumar, Principal Scientist (Floriculture and Landscaping), ICAR- DFR, Pune, proposed formal vote of thanks.



Tadasana being performed



Bhramari Pranayama



Bhramari pranayama being performed





### ICAR-DFR Celebrated 8<sup>th</sup> Foundation Day on 10<sup>th</sup> December, 2017

ICAR Directorate of Floricultural Research, Pune celebrated its foundation day on 10<sup>th</sup> December, 2017 at its Hadapsar farm with a gathering of farmers and representatives from ICAR sister institutes. Dr. R.K. Pal, Director, ICAR-NRC for Pomegranate, Solapur was the Chief Guest of the function. Dr. S.D. Sawant, Director, ICAR-NRCG, Mr. Sudhir Hiremath, IPS, DCP Cyber Crime, Pune, Mr. Dilip Khare, Chairman, APMC, Pune and Mr. Ramakanth, Agriculture Officer, Sangli region were guests of honour. Dr. M.T. Patil and Dr. Prakash Kulakarni, Dr. Indu Sawant (ICAR-NRCG) graced the occasion. The foundation day ceremony began with lighting of lamp by all dignitaries and playing ICAR Song. Dr. K.V. Prasad, Director, ICAR-DFR officially welcomed all to the function. He delivered the foundation day report casting the developments and achievements during the 8years of ICAR-DFR. Dr. S.D. Sawant in his address to the farmers stressed the importance of value addition in floriculture and integrating floriculture with grape cultivation for additional income. In his speech Mr. Sudhir Hiramath praised the role of ICAR in general and DFR in particular for the development of floriculture in Maharashtra and elsewhere. In his address Mr. Dilip Khare, APMC Chairman spoke about the importance of marketing of the flower produce and value addition. He sought the help of ICAR-DFR in planning the new flower auction center at Pune, flower market and also help APMC in value addition to provide additional returns to farmers. In his chief guest remarks, Dr. R.K. Pal elaborated on various applications of flowers including medicinal and edible properties. He stressed upon the importance of value chain in floriculture from production to marketing owing to extremely perishable nature. He urged scientists of ICAR-DFR to explore the unexplored areas of floriculture like neutraceutical and essential oils etc., He also pointed light to the potential of flowers for floricultural therapy or Aroma therapy for stress relieving and also to address mental ailments. All dignitaries and farmers visited the research plots of Chrysanthemum, Tuberose and China aster and appreciated the efforts made by Dr. K.V. Prasad and his team. A plantation drive was also conducted during the event.



Director, DFR welcoming the gathering



Visit of Experts to Chrysanthemum field, DFR, Hadapsar farm

### ICAR-DFR organized “Swachhta Hi Sewa” Campaign

In accordance to Council's letter F. No. 21-46/2014 – CDN (Vol.I) dated 13<sup>th</sup> September, ICAR – Directorate of Floricultural Research, Pune organized a cleanliness drive from 15<sup>th</sup> September, 2017 to 2<sup>nd</sup> October, 2017 as part of “Swachhta Hi Sewa” campaign to commemorate the Swachh Bharat Anniversary.

All the staff of the institute administered the *Swachhta Hi Seva* Pledge (*Sapath*) on 24.9.17 whereby the staff resolved to create a clean healthy and new India and celebrated the Samagra Swachhta Diwas. Dr. K. V.



Prasad, Director, ICAR- DFR Pune and all the scientific, technical, supporting staff including contractual staff participated in the cleanliness drive. Dedicated cleaning and sweeping of the premises of ICAR-DFR, Shivaji Nagar campus, Pune was done. Weeding, removal of plastic and parthenium were done as part of the drive. A special training session on Public Financial Management System (PFMS) was organized on 24.09.2017 for effective implementation of the PFMS system in ICAR-DFR which will ensure transparent finances. Staff from ICAR-DFR along with staff from KVK, Baramati attended the training session which was overseen by master trainer Mr. J Mathew, AAO, ICAR-ATARI, Pune. There was active participation of all the officials in the cleanliness drive. All the staff members of the ICAR-DFR, ICAR-ATARI, Pune and KVK Baramati participated in the event.

In accordance to Council's letter F. No. 21-49/2014 – CDN (Vol.1) dated 13<sup>th</sup> September, 2017, ICAR-Directorate of Floricultural Research, Pune continued to observe the 'Swachhta Hi Sewa Campaign' and organized a cleanliness drive at Hadapsar campus of the Institute on 1<sup>st</sup> October 2017. ICAR- Directorate of Floricultural Research conducted the Swachhta Campaign on 1<sup>st</sup> October, 2017 under the dynamic leadership of Dr. K.V. Prasad, Director of the institute to commemorate the Swachh Bharat Mission of Govt. of India.

The cleanliness drive was initiated by cleaning the areas in the Hadapsar campus of ICAR- DFR, Pune on 1<sup>st</sup> October 2017. All the scientific staff of the Institute along with administrative staff, contractual staff and Project assistants wholeheartedly participated in the cleanliness drive. The pathway leading to the experimental plots in Hadapsar campus was cleaned as part of the campaign. Plastics, waste materials, weeds, partheniums etc were removed and the area was cleaned on this day.

Also, tree plantation was undertaken in the Hadapsar campus along the path leading to the experimental plots. Tree plantation was held in the gracious presence of Dr. Mangala Rai, honourable Former Director General, ICAR and Dr. Major Singh, Director, Directorate of Onion and Garlic



Swachh Bharat Abhiyan at Public Place



Removal of Parthenium at Shivajinagar farm



Honouring Freedom Fighter during the Swachhata campaign



Research, Rajgurunagar, Pune. The channels between the experimental plots were also cleaned and weeds were disposed off from the site. Partheniums were also removed and eradicated as part of the campaign.

Further all the staff of the institute, participated in the Shramadaan by removing the weeds from the experimental plots planted with different varieties of chrysanthemums, tuberose, marigold etc. Also weeding was done and mulching sheets were laid for planting of various flower crops at Hadapsar campus. There was active participation of all the officials of ICAR- Directorate of Floricultural Research, Pune in the cleanliness drive.

ICAR-Directorate of Floricultural Research, Pune continued to observe 'Swachhta Hi Sewa Campaign' and organized an Awareness rally on "Swachhta Hi Sewa" on 2<sup>nd</sup> October 2017 also. As per the action plan prepared for 'Swachhta Hi Sewa Campaign', ICAR Directorate of Floricultural Research organised a special campaign on 2<sup>nd</sup> October 2017. The programme started with a detailed deliberation on the importance of cleanliness all around by organizing different activities. The Director of the Institute, Dr. K. V. Prasad in his opening address at Hadapsar campus emphasised on the importance of cleanliness of surroundings and its impact on personal hygiene. The contractual farm labourers working at Hadapsar campus were sensitized about the cleanliness of the office building and its premises. Further "Swacchta kits" (Sanitation kits) were distributed to all the contractual farm labourers at Hadapsar campus of ICAR-Directorate of Floricultural Research, Pune.

Further to show the support for the 'Swachhta Hi Sewa (Cleanliness is Service) Campaign', an awareness rally by wearing T shirts and Caps depicting the importance of Swachh Bharath Mission (Ek Kadam Swachhta Ki Aur) was planned and executed on 2.10.17 at Village Theur. Comprehensive awareness campaign was organised through display of Banners on "Swacchta hi Sewa". As part of Sarwatra Swachhta (Cleaning of public places) the team of ICAR-Directorate of Floricultural Research, Pune



Awareness Rally at Gram Panchyat Office, Theur



Cleaning of Plastic at Hadapsar farm



Cleaning of Office Surroundings



comprising Director, all the Scientific and Administrative staff headed towards Theur, Haveli Taluka, Pune, Maharashtra on 2nd October. Theur is located near the confluence of river Bhima and river Mula- Mutha. At Theur, the team DFR met the Sarpanch, Smt. Surekhathai Dattatreya Kunjir; Deputy Sarpanch, Shri. Appasaheb Ramachandra Kale and other village officials and briefed about the 'Swachhta Hi Sewa' campaign. The team sought the support from the Village officials for the successful implementation of the programme. The team also interacted with the members of Gramasabha. The Sarpanch and her team members appreciated the efforts of team DFR and thanked them for choosing their village for the campaign for spreading Swachhta Awareness.

Further at the water distribution point of Theur, the public were sensitized about the importance of clean water for individuals' health. Then the team headed towards the Shree Chintamani Vinayaka Temple, Theur. It is one of the larger and more famous of the Ashtavinayaka, the eight revered shrines of Lord Ganesha in Maharashtra and is under the administration of Chinchwad Devasthan Trust. The temple is visited by pilgrims from all over India. The ICAR- DFR team cleaned the premises of the temple with the help of trust members and explained to pilgrims the importance of cleanliness. Then the Fruit and Vegetable market at Theur were cleaned and the vendors were sensitized about the importance of cleanliness and urged them to keep the market surroundings neat and clean. During the campaign, the Team DFR was lucky enough to meet a 102-year-old Freedom fighter, Shri. Ranganath Kunjir who was a witness to Freedom movement led by Father of our Nation, Mahatma Gandhi. The team felicitated the freedom fighter with a floral garland and honoured him. Afterwards the nearby shopkeepers were also sensitized about the importance of cleanliness and they were asked to go for segregation of the garbage and waste materials at individual level before handing over to the garbage collecting workers for proper garbage management. The public present at the venue also wholeheartedly participated in the cleanliness drive and there was active participation of all the officials of ICAR-DFR.

### ICAR-DFR, Pune Organized Hindi Karyashala

ICAR-DFR organized “Hindi Workshop” on “*Antarrashtriye Bhasha Aur Rajbhasha Ke Rup Me Hindi Ka Prayog*” on 11<sup>th</sup> July, 2017 at ICAR-DFR, Pune, in which all the scientific, administrative, temporary staff of ICAR-DFR, all the staff from ICAR-IVRI, RS, Pune, Director and other staffs from ATARI, Pune and staffs from ICAR-IARI, RS, Baner, participated. Dr. Swati Chadha, Hindi officer, CSIR-NCL, Pune was invited for delivering the lecture in this workshop.



Director, ICAR-DFR addressing the audience about importance of Hindi Language



Dr. Swati Chadha, Hindi officer, CSIR-NCL delivering Lecture

### ICAR-DFR organized Hindi Pakhwada

Organized and celebrated “Hindi Pakhwada” from 14<sup>th</sup> September, 2017 to 29<sup>th</sup> September, 2017. Different competitions like Essay, Word Dictation, General Knowledge, Poem Recitation and Rangoli Programme were organized in which all the scientific, administrative, temporary staff of ICAR-DFR and students of MPKV, Pune participated. At the end of the day “*Hindi Pakhwada Samapan Samaroh*” was celebrated. Dr. S. D. Mashalkar, Dean of College of Horticulture, Shivajinagar, Pune, and Dr. G. Venkateshwarlu, Assistant Director General (EQA&R), Indian Council of Agriculture Research, New Delhi were chief guests. During this function certificates and prizes were distributed to the winners of the competitions.



Prize distribution during “Hindi Pakhwada” Celebration at ICAR-DFR, Pune

### ICAR-DFR Celebrated Independence Day

ICAR-DFR celebrated the Independence day on 15<sup>th</sup> August 2017 at the Hadapsar Farm. All the scientific, administrative staff members and SRFs, YP I and II attended the function.



Independence day at the Hadapsar Farm



## Institution Building

ICAR-DFR got 75 acres of land from Government of Maharashtra during 2014 at Shivajinagar (25 ac) and Hadapsar (50 ac). Out of which 5 acres of land is allocated for the new ICAR-ATARI in Shivajinagar campus. The revenue records in the name of ICAR for the 50 ac land parcel at Hadapsar farm was obtained in February 2017 as it has the boundaries of three villages.

The farm facilities were developed by taking up the renovation of the existing structures, levelling of land, making of irrigation channels, restoring the old roads, etc. Draft master plan has been prepared by incorporating the inputs from senior officials of the council.



Renovated transit office at Hadapsar Farm



Field infrastructure development

### Field Infrastructure

At Hadapsar research farm, about 10 acres of land was developed during the current year for experimentation. Three acres of research plots of chrysanthemum comprising of 100 varieties, promising mutants/hybrids/seedlings was developed. Similarly three acres of research plot for tuberose comprising of 16 varieties was developed. A new seedling/mutant block for tuberose in an area of one acre was developed. Research plots measuring one acre each for Rose, Gladiolus, China aster, marigold was also developed. A farm pond of 10 lakh litres of water was developed by utilising the existing depression in the farm. 3 shadenet houses are erected for propagation of ornamental crops.



Chrysanthemum research plot of 3 ac



Mutation breeding block of chrysanthemum



Tuberose research plot of 3 ac



China Aster seed production in 1 ac



Gladiolus research plot in 1 ac



Farm pond at research farm

## Research Projects

### In House Research Projects:

S. No.	Projects	PI	Co-PI	Remarks
<b>Crop Improvement</b>				
1	Project No.01 (Project IXX 14257) Improvement of Gladiolus for Commercial Traits	Dr. Ganesh B. Kadam	Dr. Tarak Nath Saha Dr. P. Naveen Kumar Dr. Nitika Gupta	w.e.f. 01.04.2017
2	Project No.02 (Project IXX 14261) Breeding of Tuberose for Quality and Yield	Dr. P. Naveen Kumar	Dr. Tarak Nath Saha, Er. Rahul S. Yadav, Dr. Prashant G. Kaware	w.e.f. 12.06.2017
3	Project No.03 (Project IXX 14254) Improvement of Chrysanthemum for Commercial Traits	Dr. Tarak Nath Saha	Dr. Ganesh B. Kadam, Dr. P. Naveen Kumar, Dr. Shilpashree K.G., Dr. D. V. S. Raju, Dr. K. V. Prasad	w.e.f. 01.04.2017
4	Project No.04 (Project IXX 14255) Improvement of Rose for Commercial Traits	Dr. D. V. S. Raju	Dr. Prashant G. Kaware, Dr. Ganesh B. Kadam	w.e.f 6.7.2017
<b>Crop Production</b>				
1	Project No.01 (Project IXX 13991) Evaluation of Industrial and Agricultural By-products as potting Media Components for Production of Potted Ornamental Plants	Dr. Shilpashree K. G.	Dr. Safeena S. A., Dr. Nitika Gupta	w.e.f 5.6.2017
2	Project No.02 (Project IXX 14262) Utilization of Specialty Flowers, Cut Foliages, Fillers and Aromatic Flower Crops to Address Various Landscape Uses	Dr. Safeena S. A.	Dr. P. Naveen Kumar Dr. Tarak Nath Saha Dr. Shilpashree K. G.	w.e.f 1.4.2017
<b>Crop Protection</b>				
1	Project No.01 (Project IXX 11705) Investigations on Viral and Phytoplasmal Diseases of Major Flowering Crops in India	Dr. Prabha K.	Mr . Girish K. S. and Dr. Nitika Gupta	Running
2	Project No.02 (Project IXX 14260) Etiology and Integrated Management of Fungal Diseases of Ornamental Flower Crops	Dr. Nitika Gupta	Dr. Prabha K. Dr. Tarak Nath Saha Dr. Ganesh B. Kadam	Running
<b>Post Harvest Technology and Value Addition</b>				
1	Project No.01 (Project IXX 12322) Standardization of Post –Harvest Packaging Technology for Tuberose and Jasmine.	Er. Rahul S. Yadav	Dr. Tarak Nath Saha Dr. Ganesh B. Kadam	Running
2	Project No.02 (Project IXX 14263) Standardization of Post Harvest Technology and Value addition Techniques In Ornamental Crops.	Dr. Safeena S. A.	Er. Rahul S. Yadav Dr. D. V. S. Raju	w.e.f 14.9.2017





### ICAR Inter Institutional Projects

S. No.	Projects	Collaborative Programme	PI/Co-PI
1	Design and Development of Tools and Gadgets for Floriculture	Collaborative Project with ICAR-CIAE, Bhopal	Er. Rahul S. Yadav, Dr. Tarak Nath Saha, Dr. Ganesh B. Kadam
2	Harnessing Natural Pigments from Flower Crops for Making Value added Products from Grape	Collaborative Project with ICAR-NRCG, Pune	Dr. K. V. Prasad, Dr. Prashant G. Kavar, Er. Rahul S. Yadav from ICAR-DFR and Dr. Kaushik Banerjee, Dr. A. K. Sharma and Dr. Ahammed Shabeer T.P.
3	Developing Unique DNA fingerprints of flower crops	Collaborative Project with ICAR-NRCPB, New Delhi, Pune	Dr. K. V. Prasad, Dr. Prashant G. Kavar, Dr. Ganesh B. Kadam, Dr. Tarak Nath Saha from ICAR-DFR and Dr. Amol Kumar Solankhe from ICAR-NRCPB, New Delhi.

### Concluded In-House Project

S.N	Mega Projects	PI	Co-PI	Remarks
01	<b>Improvement of Commercial Flower Crops</b>			
	Project IXX07529: Breeding of Gladiolus for Quality and Yield.	Dr. Ganesh B. Kadam	Dr. Tarak Nath Saha	Concluded
	Project IXX07506: Breeding of Chrysanthemum for Quality Flower and Pot Mum Production.	Dr. Tarak Nath Saha	Dr. Ganesh B. Kadam	Concluded
	Project IXX07530: Breeding of Tuberose for Novel Colour and Oil Recovery.	Dr. Tarak Nath Saha	-	Concluded



## Distinguished Visitors

### Padma Shri Dr. K L Chadha, Former DDG (Hort. Science), ICAR visited ICAR-DFR

The ICAR-DFR felt privileged on the maiden visit of Padma Shri Dr. K L Chadha, former DDG (Hort. Science), ICAR to ICAR-DFR, Pune on 07<sup>th</sup> April 2017. On this occasion he first visited the research farm of ICAR-DFR located at Hadapsar. He expressed his satisfaction on the piece of land acquired by ICAR-DFR. Dr. K.V. Prasad, Director, DFR presented an overview of the progress at ICAR-DFR. Dr. K. L. Chadha and Dr. S.D. Sawant, Director, NRCG participated in tree plantation at Hadapsar farm of ICAR-DFR. He shared his experience on how to create new institutions. He emphasized to create separate blocks for ornamentals like flowering trees, avenue trees, climbers, shrubs, edging plants, annuals, bulbs crops etc. He interacted with the Scientists and discussed about the research work carried out by them and gave valuable suggestions and inputs. He suggested to undertake in depth research in ornamental breeding, Post-harvest Technology of flowers, integrated insect-pest and disease management and other areas for bringing excellence in flower production in the country. He released second issue of ICAR-DFR Flori news. He appreciated the progress of various works undertaken at ICAR-DFR.



Padma Shri Dr. K L Chadha along with Team DFR

### Shri. S. K. Singh, Hon'ble Additional Secretary (DARE) & Financial Advisor (ICAR) visits ICAR-DFR, Research Farm, Pune.

Shri. Sunil Kumar Singh, Additional Secretary & Financial Advisor (DARE/ICAR) visited ICAR-Directorate of Floricultural Research, Pune on 13<sup>th</sup> April, 2017. Dr K. V. Prasad, Director, ICAR-DFR briefed about the recent initiatives taken by the institute to operationalize the ICAR-DFR farm at Hadapsar. He explained hon'ble Finance Advisor about the draft master plan. He went round research farm of ICAR-DFR located at Hadapsar, Pune. He expressed his satisfaction on the piece of land acquired by ICAR-DFR. Dr. S. D. Sawant, Director, NRCG and Dr. V. Mahajan, Director, DOGR, Rajgurunagar accompanied him.



Hon'ble Additional Secretary (DARE) & Financial Advisor (ICAR) visits ICAR-DFR, Hadapsar farm, Pune.



## Hon'ble Secretary, DARE & Director General, ICAR Dr. T. Mohapatra visits ICAR-DFR Farm, Pune.

Dr. Trilochan Mohapatra, Secretary, DARE and Director General, Indian Council of Agricultural Research, visited research farm of ICAR-Directorate of Floricultural Research, located at Hadapsar, Pune on 29<sup>th</sup> April, 2017 on way to NRC Pomegranate, Solapur. Dr. K.V. Prasad, Director, ICAR-DFR presented an overview of the progress at ICAR-DFR. Director, ICAR-DFR explained the whole master plan of ICAR-DFR to DG, ICAR. He interacted with all the scientists of ICAR-DFR. He went round research farm recently acquired by ICAR-DFR from MPKV. He advised to test the river water passing through ICAR-DFR land before using for irrigation. He suggested to include water filtration/treatment plant in the master plan. He suggested to cover the research farm by green fencing. He also advised to renovate the old structures located at farm and use for official purpose. He also advised to take picture of all the developments of ICAR-DFR including regional center before and after the development that would be useful for making institute profile documents in future. He encouraged all the scientists to fulfill the action points discussed during his previous visit on 21<sup>st</sup> October 2016. He was accompanied by Dr. R. K. Pal, Director, NRCP, Solapur, Dr. S. D. Sawant, Director, NRCG, Pune. He has enquired about the financial position of ICAR-DFR and plan provisions made in the next three years.



Director, ICAR-DFR explaining to Secretary, DARE and DG, ICAR about the master plan of DFR



Hon'ble DG, ICAR Dr. Trilochan Mohapatra Visited Hadapsar Farm of ICAR-DFR

## “Make Your Presence Felt”: Secretary, DARE and DG, ICAR advises ICAR Institutes

Secretary, DARE and Honorable DG, ICAR Dr. T. Mohapatra visited Pune on 8<sup>th</sup> December 2017 and addressed all the scientists of ICAR institutes at the conference hall of ICAR-NRCG. In his address Honorable DG emphasized the fact that ICAR institutes have made significant contributions in all the spheres of agriculture and congratulated all the ICAR institutes for their contributions. However he expressed that the visibility of these contributions and achievements are low. He called upon all ICAR institutes to go all out to make their presence felt.

He stressed upon the importance of making the technologies developed by ICAR more visible to the nation utilizing all means including Information and Communication Technologies. To achieve the same he instructed all institutes get their technologies communicated to the public through various media in an interactive mode. All the institute portals should highlight their technological achievements so as to reach everyone. He encouraged all the institutes to display all the facilities available at the institute on their respective websites to make them available and accessible to all other sister institutes. He suggested creating a science communication centre at every institute for communicating the science and technologies to academia and common man nationally and internationally. He gave every ICAR institute the task to refine its outcomes systematically by utilizing the communication technologies available. He suggested that the mobile



apps have to be comprehensive and interactive. He also stressed the need to venture in to public private partnership mode of research in ICAR institutes. He instructed all the ICAR institutes to interact with the private stakeholders in their respective areas to address issues plaguing them and to find solutions in PPP mode. He opined that feedback of all the stakeholders and beneficiaries of ICAR technologies are most valuable for the improvement of the programmes of ICAR. He pointed upon technology gaps and suggested to plug the gaps so as to take the technologies from ICAR labs to the farmers.

During his visit to ICAR-DFR farm, he appreciated the initiatives taken by Dr. K.V. Prasad and ICAR-DFR Team to establish the Hadapsar farm. He complimented the team DFR for transforming the otherwise barren fields in to a focal point. He monitored the research initiatives in chrysanthemum, tuberose, marigold and China aster. He cherished the wide hue of colours in the chrysanthemums and advised the scientists study the genetics of colours, to exploit the nutraceutical and aroma potential of the flower crops. He also steered to initiate research programmes in PPP mode and appreciated the collaborative research projects run by ICAR-DFR along with other ICAR institutes. He also stressed upon developing value addition and value chains in different flowers for doubling farmers income. Plantation drive was organized to mark the occasion. He appreciated the initiative of ICAR DFR for integrating floriculture with bee keeping which is one of the focus areas of the Government of India.

### **Hon'ble DDG (Horticultural Science) Dr. A. K. Singh visited ICAR-DFR, Pune**

Hon'ble Deputy Director General Horticultural Science Dr. A. K. Singh visited ICAR-DFR on 16.09.2017. The Director of ICAR-DFR welcomed Dr. A. K. Singh and apprised him of the ongoing research programmes at ICAR-DFR. Dr. A. K. Singh interacted with the scientists and enquired about the individual research projects carried out by each scientist. After the interaction DDG (HS) visited the research farm at Hadapsar and appreciated the efforts made to bring it under cultivation. He advised DFR to intensify the efforts to create a world class institution in ornamental crops. He suggested that the master plan and the



Hon'ble DG, ICAR Dr. Trilochan Mohapatra Visited Hadapsar Research Farm of ICAR-DFR



Hon'ble DG, ICAR Dr. Trilochan Mohapatra with staff of Pune based ICAR institutes at ICAR-DFR, Hadapsar Farm



Dr. K. V. Prasad, Director, ICAR-DFR explaining the Hon'ble DDG (HS) Dr. A. K. Singh about the ongoing activity at Hadapsar Farm



buildings must correspond to the international standards with standalone unique features. He suggested to get some more old structures suitably renovated to create sitting space for the staff till new building is constructed. Hon'ble DDG (HS) heightened the morale of the staff and opined that in spite of the hardships faced by the Institute, progress can be made by enthusiastic participation of all the team members. He promised all possible help from the Council.

### Hon'ble Vice- Chancellor, MPKV, Rahuri visited ICAR-DFR

In order to popularize the varieties and technologies, ICAR-Directorate of Floricultural Research, Pune and ICAR-National Research Centre for Grapes joined hands to launch a common sales counter of various produce in the ICAR-NRCG as it is located on National Highway with significant visibility. Loose flowers of marigold, cut flowers of gladiolus, tuberose and planting material of tuberose (bulbs) and china aster (seeds) were displayed for sale for the farmers and general public. Dr. K. P. Vishwanatha, Hon'ble Vice- Chancellor, MPKV, Rahuri inaugurated the sale counter of ICAR- DFR and ICAR-NRC for Grapes on 24<sup>th</sup> February, 2018. Different produces of ICAR-DFR *viz.*, tuberose flowers of varieties Shringar, Hyderabad Single, Bidhan Ujjwal, Prajwal, Suhasini and Phule Rajani, gladiolus varieties namely Red Ginger, Yellow Stone, Summer Sunshine, Red Majesty and Candyman Red, marigold varieties Arka Agni and Arka Bangara 2 and tuberose bulbs of varieties Phule Rajani, Mixed Double, Pearl Double and Prajwal were kept for sale.



Hon'ble Vice- Chancellor, MPKV, Rahuri inaugurating the sale counter of ICAR- DFR

### Visit of Hon'ble Vice- Chancellor, MPKV, Rahuri to ICAR-DFR farm, Hadapsar

Dr. K. P. Vishwanatha, Vice-Chancellor, MPKV, Rahuri visited research farm of ICAR-Directorate of Floricultural Research, located at Hadapsar, Pune on 24<sup>th</sup> February, 2018.

He was briefed about the efforts made by ICAR-DFR in getting the land transferred in the name of ICAR, renovation works carried out to start the initial office besides developing the field infrastructure like rejuvenation of existing bore wells, power connection, digital survey, contour mapping, hydrological survey and development of master plan etc. Hon'ble Vice- Chancellor witnessed the mutation breeding, hybridization experiments in tuberose, gladiolus and chrysanthemum and took keen interest in the promising mutant/hybrid population being evaluated.



Hon'ble Vice- Chancellor, MPKV, Rahuri witnessing breeding programme of gladiolus at ICAR-DFR farm, Hadapsar

Hon'ble Vice- Chancellor expressed deep sense of appreciation for significant progress made in a short span of about 10 months ever since the work began in Hadapsar farm in May-2017.



### Visit of Former Vice- Chancellors to ICAR-DFR Research Farm, Hadapsar

The research farm of the Directorate was visited by former Vice-Chancellors namely Dr. Kisan E. Lawande, Former Director, ICAR-DOGR, Rajgurunagar & Former Vice-Chancellor, BSKKV, Dapoli; Dr. R. B. Deshmukh, Former Vice-Chancellor, MPKV, Rahuri on 7 December, 2017. Dr. K. V. Prasad, Director, ICAR-DFR explained the ongoing activities undertaken at the farm. Hon'ble Vice-Chancellors also shared their experiences for creation of new facility and appreciated the efforts undertaken in a short span of time. They have also the research activity being carried out in chrysanthemum, gladiolus, rose, tuberose, China Aster, seasonals, marigold.



Interaction of Director, ICAR-DFR with the Hon'ble Vice-Chancellors.

Dr. Y. S. Nerkar, Former Vice-Chancellor, MPKV, Rahuri also visited the research farm and praised the work undertaken in germplasm collection, evaluation of new lines of tuberose & chrysanthemum, mutation breeding in tuberose & chrysanthemum, besides seed production in China aster. He was highly influenced with the gladiolus being grown under Pune condition and urged to take it to the farmers field. He congratulated the Director and Scientists for taking the maiden plantation of the ornamentals at the research farm, which was mainly used for fodder and seed production earlier.



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- K. Prabha, Nitika Gupta, K. V. Prasad (2017). “Changing Tospovirus Incidence, Changing Climate and Ornamental Plants : A Ferret Around”. In International Seminar on “Global Climate Change : Implications for Agriculture and water sectors” from 14-16 December, 2017, Aurangabad, Maharashtra, India. pp. 513.
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- Naveen Kumar, P, Raju, DVS, Kadam, GB, Saha, TN and Prasad, KV (2017). Crop modelling as a tool for mitigation strategy in flower crops, Paper presented in International Seminar on Global Climate Change: Implications for Agriculture and Water Sectors (CCAW2017) December 14-16, 2017, Aurangabad, India, pp 423.
- Nitika Gupta, Prabha K. and M. K. Reddy (2017). “Molecular Detection and Identification of a Potyvirus Infecting Amaryllis in India”. In “International symposium on Horticulture: Priorities and Emerging Trends” from 5-8 September, 2017, ICAR-Indian Institute of Horticultural Research, Bengaluru.
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- Safeena S A , M Thangam and N.P. Singh (2017). Screening of different cultivars of tuberose (*Polianthes tuberosa* L.) under humid agro climatic conditions of Goa during “International Symposium on Horticulture: Priorities and emerging trends” during 4-8 September, 2017 at J. N. Tata Auditorium, National Science Symposium Complex, Sir CV Raman Avenue, Indian Institute of Science, Bengaluru. P.189-190
- Safeena S A and M Thangam (2017). Studies on value addition in floral products through production of potpourri during “International Symposium on Horticulture: Priorities and emerging trends” during 4-8 September, 2017 at J. N. Tata Auditorium, National Science Symposium Complex, Sir CV Raman Avenue, Indian Institute of Science, Bengaluru. P.91
- Safeena S A, M Thangam and N. P. Singh(2018). Diversity in underutilised ornamental plants for landscaping of shady areas under the Theme 'Floriculture and ecological restoration'\_during “International Symposium on Orchids, straw-berry, minor fruits and flowers” January 12-16, 2017 at the Regional Agricultural Research Station ( RARS ), Ambalavayal, Wayanad, Kerala. P.16
- Safeena, S. A., Thangam, M., Singh, N. P. and Saha, T.N. (2018). Value addition in Ornamentals through production of potpourri. Oral Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.
- Safeena, S. A., Thangam, M., Singh, N. P. and Saha, T.N. (2018). Ornamental Coleus: A potential ornamental for urban floriculture. Oral Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.
- Saha, T.N., Holajjer, P., Naveen Kumar, P., Kavar, P. G. and Prasad, K.V. (2018). Identification and selection of plants for dwarf character from Open Pollinated population of tuberose. Oral Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.
- Saha, T.N., Kadam, G.B. and Prasad, K.V. (2018). Performance of spray type of chrysanthemum (*Dendrathera grandiflora* Tzvelve) under Pune condition. Poster Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.
- Saha, T.N., Kadam, G.B. and Prasad, K.V. (2018). Studies on anther dehiscence pattern in marigold. Oral Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.
- Saha, T.N., Naveen Kumar, P., Kavar, P. G. and Prasad, K.V. (2018). Studies on induced mutation by gamma rays in tuberose. Oral Paper presented during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Saha, TN, Naveen Kumar, P. Kadam, GB, Raju, DVS and Prasad, KV (2017). Ornamental floriculture: Impact of climate change. Poster Paper presented in International Seminar on Global Climate Change: Implications for Agriculture and Water Sectors (CCAW2017) December 14-16, 2017, Aurangabad, India, pp 428.

Shingote PR., Kavar PG et al., Overexpression of sugarcane MYB18 transcription factors deciphering tolerance to drought and salinity stress in EMBO Conference on Micro and metabolic regulators in plants 1-4 Feb, 2017 at Thiruvananthapuram, Kerla, India.

### Radio and TV Talks

Ganesh B Kadam: TV Talk on “शेवंती आणि निशिगंधाची व्यापारी शेती” in Krishi Darshan Program on DD Sahyadri telecasted on July 10, 2017 (6.10-6.30 PM)

Ganesh B Kadam: TV Talk on “फुलांची व शोभेवंत झाडांची व्यावसायिक रोपवाटिका” in Krishi Darshan Program on DD Sahyadri telecasted on December 04, 2017 (6.10-6.30 PM)

K V Prasad and Ganesh B Kadam: TV Talk on “शेवंती लागवड” in Krishi Darshan Program on DD Sahyadri telecasted on January 09, 2018 (6.10-6.30 PM)

Prashant G. Kavar. Delivered a talk on topic entitled “फुल शेती मध्ये जैव तंत्रज्ञानाचे महत्व” in Marathi in the Krishidarshan Program of DD Mumbai telecasted at 6:10PM on February 10<sup>th</sup>, 2017.

Rahul Yadav: TV Talk “फुलांचे नैसर्गिक रंग व त्यांचा उपयोग” in Amachi Mati Amachi Manas Program on DD Sahyadri telecasted on 30 October 2017 - (6.30-7.00 PM)

# Training and Capacity Building

## Training Programmes Attended

S. No.	Training Programme	Scientists attended
1	Comprehensive Training Programme Covering all Aspects of Essential Oil, Fragrance and Flavour Industry at Fragrance and Flavour Development Centre, Kannauj, Uttar Pradesh from 15-30 November, 2017.	Dr. Tarak Nath Saha, and Er. Rahul Yadav
2	MDP on Leadership Development at NAARM, Hyderabad during 12.12.2017 to 23.12.2017.	Dr. P. Naveen Kumar
2	Joint Workshop on “Principles of DUS Testing of Rose Varieties and Vegetables according to the UPOV System during 14-15 <sup>th</sup> December, 2017 under Bilateral Cooperation between Germany and India on Seed Sector Development at IIHR, Bengaluru.	Dr. D. V. S. Raju
3	Short Course Training Programme on “Techniques for Estimation of Nutraceutical Properties from Crops” 16 – 25 January 2018 Department of Biochemistry, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat.	Dr. Safeena S. A.
4	CAFT Training on “Bio-pesticides for Crop Protection and Improvement: Emerging Technology to Benefit Farmers” from February 02-22, 2018, held at G.B. Pant Univ. of Agric. & Tech. Pantnagar- 263 145 (Uttarakhand) India.	Dr. Nitika Gupta
5	21 days CAFT on Recent advances in “Genetic exploration and Conservation of Genetic Resources in Ornamental Plants” at KRCCH Arabhavi, under UHS, Bagalkot from February 08-28, 2018.	Dr. Prashant G Kaware, and Dr. Ganesh B. Kadam
6	Norman Borlaug International Agricultural Science and Technology Fellowship Programme (USDA-ARS, U.S. National Arboretum Floral & Nursery Plants Research Unit, Maryland from 14.12.2017-14.03.2018)	Dr. Prabha K.
7	Training on PFMS at Office of Comptroller General of Accounts, Ballard Estate, Mumbai on 27 September, 2017	Mr. R. S. Bhatt, Mr. Deepak Verma, Mr. Rupesh Kumar, Mr. Mahadev Walke and Mr. Sudesh Kumar
8	Training on GST organised by MSME at Pune on 12-13 August, 2017	Mr. Rupesh Kumar
9	Enhancing Efficiency and Behavioural Skills at ICAR-CIFE, Mumbai from 3-9 August, 2017	Mr. Ajay Uniyal

## Participation in Conferences/Symposia/Seminar/Others

S. No.	Conference/Seminar/Symposia	Scientists Participated
1	National Conference on “Technological Changes & Innovations in Agriculture for Enhancing Farmers' Income” held at JAU, Junagarh, Gujarat, from May 28-31, 2017.	Dr. Ganesh B Kadam and Dr. Tarak Nath Saha
2	International Symposium on Horticulture: Priorities and emerging trends 4 - 8 September 2017 J. N. Tata Auditorium, National Science Symposium Complex, Sir C.V. Raman Avenue, Indian Institute of Science, Bengaluru	Dr. Safeena, S. A., Dr. Nitika Gupta, Dr. P. Naveen Kumar and Er. Rahul S Yadav
	International Symposium on Horticulture: Priorities and Emerging Trends & put-up the DFR stall in the Technology Expo during Sept 4-8, 2017 at IISC, Bengaluru.	Dr. P. Naveen Kumar and Er. Rahul S Yadav





S. No.	Conference/Seminar/Symposia	Scientists Participated
3	Attended and exhibited stall at AGRIFEST-2017 organised by College of Agriculture, Pune at College of Agriculture Ground Shivajinagar, Pune from September 10-12th, 2017	Dr. K. V. Prasad, Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kaware, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam, Dr. Prabha K., Dr. Rahul Yadav, Dr. Nitika Gupta, Dr. Shilpashree
4	Attended and exhibited stall at Kisan Adhar Sammelan, September, 25-29 at MPKV Rahuri.	Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kaware, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam, Dr. Prabha K., Dr. Rahul Yadav, Dr. Nitika Gupta, Dr. Shilpashree
5	Attended and presentation made in Innovators Meet – Farm Level Stress and Innovations organized by ICAR-ATARI, Pune at KVK, Baramati on October 7, 2017.	Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kaware, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam, Dr. Prabha K., Dr. Rahul Yadav, Dr. Shilpashree
6	AGRISTARTup 1.0 Agricultural Technology Show at ICAR-CTCRI, Thiruvananthapuram during 27-28th October 2017	Er. Rahul Yadav
7	National Workshop on Export Marketing held at Fragrance and Flavour Development Centre, Kannauj, Uttar Pradesh from 16-17 November, 2017	Dr. Tarak Nath Saha and Er. Rahul Yadav
8	KISAN AGRI SHOW-2017 India's biggest farmer's fair held at Moshi, Pune during 13-17 <sup>th</sup> December, 2017.	Er. Rahul B Yadav, Dr. Safeena S. A. and Dr. Shilpashree K. G.
9	International seminar on “Global Climate Change; Implications for Agriculture and Water Sectors” held at Aurangabad from December 14-16, 2017.	Dr. K. V. Prasad, Dr. Tarak nath Saha, Dr. Ganesh B. Kadam
10	Scope and present scenario of floriculture industry. State level workshop on green house technology cultivation practices organised by HAIPTC, Talegaon Dabhade, Pune from October 30 – November 03 <sup>rd</sup> , 2017.	Dr. Ganesh B. Kadam
11	GLOBAL FARMERS -Live Demos, Agri Exhibition and Crop conference at KVK Narayangaon from January 04-07, 2018.	Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kaware, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam, Dr. Rahul Yadav, Dr. Nitika Gupta, Dr. Shilpashree
12	12 <sup>th</sup> Maharashtra State Inter University Research Convention AVISHKAR-2017 organized by Hon'ble Governor Office, Govt. of Maharashtra from January 15-17, 2018 at MPKV Rahuri.	Dr. K. V. Prasad, Dr. Ganesh B. Kadam
13	Attended and exhibited stall at KRUSHAK-Live-Demo and Agri Expo-2018 at KVK Baramati from January 19-22, 2018.	Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kaware, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam, Dr. Rahul Yadav, Dr. Shilpashree
14	National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.	Dr. Tarak Nath Saha

S. No.	Conference/Seminar/Symposia	Scientists Participated
15	Live Demonstration of flower crops held at College of Horticulture, Pune from March 10-13, 2018	Dr. K. V. Prasad, Dr. P. Naveen Kumar, Dr. D. V. S. Raju, Dr. Prashant G Kavar, Dr. Tarak Nath Saha, Dr. Safeena S. A., Dr. Ganesh B.Kadam Dr. Prabha K., Dr. Rahul Yadav, Dr. Nitika Gupta, Dr. Shilpashree
16	Participated in the workshop on 'Microbial Genomics' (5-day workshop) from January 15 to 19 held at Sai Trinity Complex, Pashan- Sus Road, Pashan, Pune 411 021.	Dr. Nitika Gupta
17	Golden Jubilee National Conference in Hindi on "Enhancing Efficiency and Effectiveness of Institutional Administration/ Management and Effective Implementation of Official Language Policy in ICAR System" held on 11 <sup>th</sup> August, 2017 at ICAR-Indian Institute of Horticultural Research, Bangalore, India.	Dr. Nitika Gupta
18	Interactive Session with Agricultural Researchers for Doubling Farm Income by 2022 in Andhra Pradesh and Telangana by His Excellency, Sh. M. Venkaiah Naidu, Hon'ble President of India on 31.03.2018 at IIRR, Hyderabad.	Dr. P. Naveen Kumar

## Awards/Recognition

Second Best Poster entitled “ Population dynamics of some plant parasitic nematodes in the rhizosphere of tuberose and marigold” authored by Holajjer, P., Saha, T.N., Girish, K. S., Singh, K. P., Deepak, E. and Prasad, K.V. during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Invited Oral entitled "Identification and selection of plants for dwarf character from Open Pollinated population of tuberose" presented by T. N. Saha during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Invited Oral entitled "Studies on induced mutation by gamma rays in tuberose" presented by T. N. Saha during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Invited Oral entitled "Evaluation of Chrysanthemum cultivars for their disease reaction to root-knot nematode *Meloidogyne incognita*" presented by T. N. Saha during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Invited Oral entitled "Value addition in Ornamentals through production of potpourri" presented by T. N. Saha during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

Invited Oral entitled "Ornamental Coleus: A potential ornamental for urban floriculture" presented by T. N. Saha during National Conference on Floriculture for Rural Prosperity in the Scenario of Climate Change held at CAE&PHT, Ranipool, Sikkim from 16-18 February, 2018.

## 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 25 Centres which includes 15 budgetary, 5 institutional and 5 voluntary Centres.

S. No.	Centre	Year of Start	Mandate Crops
<b>Budgetary Centres</b>			
1.	Asam Agricultural University, Kahikuchi, Guwahati, Arom	2001	Orchids, Chrysanthemum, Tuberose, Gerbera, marigold, specialty flowers, fillers, native ornamentals, foliage plants, dry flower
2.	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal	1972	Chrysanthemum, orchids, anthurium, tuberose, gerbera, turf grass, gladiolus, marigold, china aster, landscape plants, foliage plants, dry flower
3.	Birsa Agricultural University, Ranchi, Jharkhand	2001	Gerbera, rose, foliage plants
4.	Dr.Y.S. Parmar University of Horticulture & Forestry, Solan, Himachal Pradesh	1975	Gladiolus, carnation, tulip, daffodils, liliun, alstroemeria, specialty flowers, turf grass, marigold, china aster, native ornamentals, dry flower
5.	G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand	2001	Chrysanthemum, tuberose, turf grass
6.	Kerala Agricultural University, Vellanikkara, Kerala	1975	Orchids, anthurium, turf grass, specialty flowers, fillers, native ornamentals, landscape plants, foliage plants, dry flower
7.	Maharana Pratap University of Agricultural Sciences and Technology, Udaipur, Rajasthan	1980	Gladiolus, chrysanthemum, tuberose
8.	Mahatma Phule Krishi Vidyapeeth, Pune, Maharashtra	1975	Rose, gladiolus, carnation, tuberose, gerbera, marigold, crossandra, china aster, specialty flower
9.	Odisha University of Agriculture and Technology, Chiplima, Odisha	2011	Rose, Chrysanthemum, Marigold
10.	Punjab Agricultural University, Ludhiana, Punjab	1975	Rose, gladiolus, chrysanthemum, tuberose, fillers, turf grass, landscape plants, foliage plants
11.	Rajendra Agricultural University, Pusa, Samastipur, Bihar	2010	Tuberose, gladiolus and Marigold
12.	Sher-E-Kashmir University of Agricultural Sciences & Technology, Srinagar, J&K	1987	Gladiolus, tulip, daffodils, liliun, alstroemeria, china aster
13.	Sri Kondalakashman Telangana State Horticultural University, Hyderabad, Telangana	1987	Gladiolus, chrysanthemum, tuberose, turf grass, crossandra, china aster, marigold, carnation, specialty flowers, fillers
14.	Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu Sub-centre: Horticultural Research Station (TNAU), Ooty, Tamil Nadu	1982	Chrysanthemum, anthurium, gerbera, tuberose, china aster, marigold, foliage plants, landscape plants, liliun, alstroemeria, fillers, gladiolus, carnation

S. No.	Centre	Year of Start	Mandate Crops
15.	Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal	1985	Orchids, gerbera, alstroemeria
<b>Institutional centres</b>			
16.	ICAR Research Complex for NEH Region, Barapani, Shillong, Meghalaya	1971	Orchids, gerbera
17.	Indian Institute of Horticultural Research, Hessaraghatta, Bangalore, Karnataka	1971	Rose, gladiolus, carnation, chrysanthemum, anthurium, tuberose, gerbera, specialty flowers, native ornamentals, landscape plants, turf grass, marigold, crossandra, china aster
18.	Indian Agricultural Research Institute, New Delhi	1971	Rose, gladiolus, chrysanthemum, turf grass, foliage plants
19.	Indian Agricultural Research Institute, Regional Station, Katrain, Himachal Pradesh	1971	Gladiolus, tulip, daffodils, liliun
20.	Central Island Agricultural Research Institute, Garacharama, Port Blair, Andaman and Nicobar Islands.	2016	China aster
<b>Voluntary Centres</b>			
21.	University of Agricultural Sciences, Bangalore, Karnataka	1977	Fillers, foliage plants
22.	Horticultural College and Research Institute (TNAU), Periyakulam, Tamil Nadu	2010	Marigold, tuberose, crossandra, native ornamentals
23.	College of Horticulture and Forestry (CAU), Pasighat, Arunachal Pradesh	2016	Gladiolus, Tuberose
24.	Navsari Agricultural University, Navsari, Gujarat	2016	China aster, Marigold, Tuberose
25.	Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhatishgarh	2016	Tuberose, marigold

## XXVI Annual Group Meeting of AICRP on Floriculture

ICAR-Directorate of Floricultural Research, Pune held at IIHR, Hessaraghatta on August 3-5, 2017

The XXVI Annual Group Meeting (AGM) of AICRP on Floriculture was held during August 3-5<sup>th</sup>, 2017 at IIHR, Hessaraghatta, Bengaluru. Review of the research work done during the last year (2016-17) at coordinated centres (25 nos.) and preparation of technical programme for the years 2018-2021 are the major objectives of this AGM. There were eight technical sessions besides inaugural and plenary. In the inaugural session (on August 3, 2017), Dr. T. Janakiram, ADG (HS-II), ICAR was the chief guest, Dr. D. R. Singh, Director, ICAR – NRC for Orchids graced the occasion as guest of honour while Dr. M. R. Dinesh, Director, ICAR – IIHR, Bengaluru presided over the function.



Inaugural event of the Group Meeting



### Release of Variety & Publications

Arka Savi, a rose variety developed at IIHR and few publications, Standard Operating Procedures (SOP) for conducting the experiments in AICRP on Floriculture; Annual Report 2016-17 of AICRP on Floriculture in the form of a CD; current issue of Indian Journal of Ornamental Horticulture and IIHR – Flower Seed Box were released on this occasion.



Release of Publications

### Unveiling of DFR logo

Dr. K. V. Prasad, Director, DFR explained about the idea/concept behind designing and developing a logo for ICAR – Directorate of Floricultural Research which was unveiled by Dr. T. Janakiram, ADG (HS-II) and chief guest of the function.



Unveiling of DFR logo

### Chief Guest's Remarks

Dr. T. Janakiram, ADG (HS-II) while addressing the gathering highlighted the scope of floriculture in India and the importance of providing strong technological base for sustaining the flower cultivation in India. The AICRP on Floriculture with its network of coordinated centres spread all over the country would certainly help not only in promoting floriculture but in enhancing/doubling the net returns from floricultural activities. Dr. Janakiram congratulated the Director & staff of IIHR on the occasion of their **Golden Jubilee year** (1967-2017), appreciated their contributions in floriculture (varieties – Arka Pride; Arka Parimala & Arka Sukanya in rose; Arka Aswa, Arka Krishika in gerbera; Arka Aadhya and Arka Archana in China aster). He also highlighted the recent contributions in floriculture from National Agricultural Research System viz., Varieties from IARI (Pusa Sindhura in gladiolus & Pusa Guldasta in chrysanthemum); Tuberoses varieties from BCKV (Bidhan Rajni 1 & 2 Bidhan Srigda); Turf management course at NAU, Navsari, Value addition work at YSPUHF; etc. He has enumerated some of the **new areas in floriculture** (planting material for landscaping; Tissue Culture protocols, F1 hybrids; soilless media, vertical gardening, role of pollinators, Phytoplasma, indoor air quality, skill development in floral arrangements like Ikebana, etc) which needs to be considered in R & D.

### Salient achievements of AICRP on Floriculture during 2016-17

Dr. K. V. Prasad, Director, DFR made a presentation on salient achievements of AICRP on Floriculture in the year 2016-17. Dr. M. R. Dinesh and Dr. D. R. Singh emphasized the potential of floriculture in India and the need for support both in terms of technologies and infrastructural facilities.

### Technical sessions for review of the work and compilation of technologies

In the first Technical session, Dr. K. V. Prasad, Director, DFR presented action taken report (ATR) on the recommendations of XXV AGM of AICRP on Floriculture held at CTRI, Rajahmundry. Dr. T. Janakiram,

Chairman of the session emphasized that the testing of varieties at Centre of Excellence/KVKs shall be promoted and third-party evaluation of technology may be carried out for better acceptance of technology by the stakeholders and the proposals of identified varieties/advanced lines are to be prepared and submitted by the coordinated centres/breeders to enable their *release through CVRC*. He said that the process of *evaluating the performance of coordinated centres and their impact analysis* (as followed in AICRP on Fruits) has to be initiated in order to motivate the staff and to assess the strengths and weaknesses of the centres. In various technical sessions spread over three days, the deliberations were on the listing of *technologies in pipeline*, measures to improve the performance of centres, *preparation of technical programme* keeping in view the emerging challenges and priorities in floriculture and also the requirements of the industry.

### Interface with the Industry and Farmers

In the technical session on Interface with Industry and farmers, the *success stories of the progressive farmers*, Shri Lakshminarayana, Bengaluru; Shri. P. J. Abraham, Bengaluru, Mr. Vikas Nalawade from Maharashtra and Mr. Siddarthan from Tamil Nadu were really inspiring and endorses that the floriculture is highly remunerative and certainly contributes in doubling the farmers income. These progressive farmers could be brand ambassadors for technologies of IIHR and NARS.

There were special/invited presentations from Dr. Prakash Patil, PC, Fruits (on the AICRP system, its importance and modalities of execution) and Dr. Ms. Hema Patkar (on *Ikebana*, floral arrangement). Dr. T. M. Rao, Head, Floriculture and Medicinal Crops, IIHR and Organizing Secretary of the XXVI AGM proposed formal vote of thanks to all those who have contributed in the successful conduct of the Group Meeting



Participation of the XXVI AGM on AICRP on Floriculture

## Personnel

S. No.	Name	E mail	Date of Joining
1.	Dr. K. V. Prasad	Director	-
2.	Dr. P. Naveen Kumar	Principal Scientist (Horticulture-Floriculture)	12/06/2017
3.	Dr. D V S Raju	Principal Scientist (Horticulture-Floriculture)	06/07/2017
4.	Dr. Prashant G Kavar	Senior Scientist (Genetics and Plant Breeding)	-
5.	Dr. Tarak Nath Saha	Scientist (Horticulture-Floriculture)	-
6.	Dr. A. Safeena	Scientist (Horticulture-Floriculture)	01/04/2017
7.	Dr. Ganesh B Kadam	Scientist (Horticulture-Floriculture)	-
8.	Dr. K. Prabha	Scientist (Plant Pathology)	-
9.	Dr. Nitika Gupta	Scientist (Plant Pathology)	-
10.	Dr. Shilpashree K.G.	Scientist (Soil Science)	-
11.	Er. Rahul S. Yadav	Scientist (Agricultural Structure and Process Engineering)	-
12.	Dr. Shephalika Amrapali	Scientist (Economic Botany)	On Study Leave
13.	Dr. K. S. Girish	Scientist (Agricultural Entomology)	On Study Leave
14.	Sh. R.S. Bhatt,	Assistant Finance and Accounts Officer	-
15.	Sh. Deepak Verma	Assistant	-
16.	Sh. Rupesh Pathak	Assistant	-
17.	Sh. Mahadev B. Walke	Assistant	27/07/2017
18.	Sh. Sudesh Kumar	Upper Division Clerck	-
19.	Sh. Ajay Uniyal	Steno Grade III	-

### Transfers

Sh. Prabhat Ranjan, Administrative Officer, relieved from ICAR-DFR w.e.f. 15/05/2017 (After Noon). Repatriated to his parent Deptt. i.e. CAG.

### Promotions

Dr. Prabha K, Scientist, promoted to Grade Pay 7000 through CAS w.e.f. 01/09/2014.

## Budget (2017-18)

The details of the Budget of ICAR-DFR including AICRP on Floriculture are tabulated as under:

S. N	Head of Account	ICAR-DFR		AICPR on Floriculture	
		Budget	Expenditure	Budget	Expenditure
<b>A. Recurring</b>					
1	Establishment charges	221.50	220.81	627.00	627.00
2	TA	12.88	12.74	8.91	8.91
3	HRD	0.54	0.54	0.00	0.00
4	Other Charges	251.58	251.06	65.09	65.00
	<b>Total (A)</b>		<b>485.15</b>	<b>701.00</b>	<b>700.91</b>
<b>A. Non-Recurring</b>					
5	Equipment	0.00	0.0	0.00	0.00
6	Works	0.0	0.0	0.00	0.00
7	Furniture	1.00	1.00	0.00	0.00
8	Library Books & Journals	1.00	0.94	0.00	0.00
	<b>Total (B)</b>	<b>2.00</b>	<b>1.94</b>	<b>0.00</b>	<b>0.00</b>
	<b>Grand Total (A+B)</b>	<b>488.50</b>	<b>487.09</b>	<b>701.00</b>	<b>700.91</b>



# मांजरीत एकात्मिक फूल प्रक्रिया केंद्र

डॉ. के. व्ही. प्रसाद यांची माहिती; मांजरी बुद्रुक येथे शेवंती सप्ताहाचे आयोजन

मांजरी बुद्रुक, ता. २९ : फुलांचे बाजार कोमळपणे शेतकऱ्यांना फुले फेकून घ्यावे लागतात. त्यामुळे त्यांना मोठा तोंटा घडून बाज्या बाजार असतो. त्यासाठी पुढील काळात पुणे बाजार समितीच्या वतीने एकात्मिक फूल प्रक्रिया केंद्र उभारण्यासाठी राष्ट्रीय पुष्प संशोधन संस्था प्रयत्न करणार आहे, असे संस्थेचे संचालक डॉ. के. व्ही. प्रसाद यांनी सांगितले.

मांजरी बुद्रुक (ता. हवेली) येथील राष्ट्रीय पुष्प संशोधन संस्थेच्या वतीने येथील प्रवेशावर राष्ट्रीय शेवंती दिनानिमित्त शेवंती सप्ताहाचे आयोजन

करण्यात आले होते. त्या निमित्ताने आयोजित शेतकरी मेळाव्यात डॉ. प्रसाद बोलत होते. पुणे बाजार समितीचे उपमुख्यशासक भूषण तुपे, बाळमती कुणी विद्यान केडारे प्रमुख डॉ. सय्यद शाकिरअली, नारायणगाव कुणी विद्यान केडारे बी. जी. टेमकर आदी उपस्थित होते.

डॉ. प्रसाद म्हणाले, "पुष्प संशोधन केंद्राच्या वतीने देशात उपलब्ध असणाऱ्या शेवंतीच्या सुमारे ११० वाणांवर मांजरी येथे संशोधन केले जात आहे. फुलांवर प्रक्रिया आणि मूल्यवर्धनातून नैसर्गिक रंग, अंतर असे प्रक्रिया उद्योग उभारण्याची आवश्यकता

आहे. त्यासाठी पुणे बाजार समितीच्या वतीने उभारण्यात येणाऱ्या आंतरराष्ट्रीय फुलबाजारात प्रक्रिया आणि मूल्यवर्धन केंद्र उभारण्यासाठी आम्ही प्रयत्नशील आहोत."

भूषण तुपे म्हणाले, "पुणे बाजार समितीच्यातील भविष्यातील फुलांची उलाढाल ५०० कोटींहून जाईल आहे. त्यासाठी बाजार समिती १०० कोटी रुपये खर्चून आंतरराष्ट्रीय दर्जाचे फूल मार्केट उभारत आहे. राष्ट्रीय पुष्प संशोधन संस्थेद्वारे केलेले असल्याचे नवेन फुलबाजार शेतकऱ्यांसाठी सुवर्णसंधी ठरणार आहे."

पान २ रत



मांजरी बुद्रुक (ता. हवेली) : राष्ट्रीय पुष्प संशोधन संस्थेच्या आवाहान विकसित करण्यात आलेले शेवंतीचे विविध वाण.

# पुष्पोत्पादनात मोठ्या संधी

के. व्ही. प्रसाद; मांजरी येथे शेवंती सप्ताहाचे आयोजन

**पुणे (प्रतिनिधी) :** फुलांची मागणी वाढत असून, शेतकऱ्यांनी पारंपरिक भाजीपाला पिकांपेक्षा फूल उत्पादनाकडे वळण्याची गरज आहे. तसेच फुलांच्या मूल्यसंवर्धनातूनदेखील अधिकचा नफा मिळत असून, हे क्षेत्रात मोठ्या संधी आहेत, असे प्रतिपादन पुष्प संशोधन संचालनालयाचे संचालक डॉ. के. व्ही. प्रसाद यांनी केले.

पुष्प संशोधन संचालनालयाच्या वतीने मंगळवारी (ता. २८) राष्ट्रीय शेवंती दिनानिमित्त मांजरी (पुणे) येथील प्रवेशावर शेवंती सप्ताहाचे आयोजन करण्यात आले आहे. या निमित्ताने आयोजित शेतकरी मेळाव्यात डॉ. प्रसाद बोलत होते. या वेळी बारामती केव्हीकेचे प्रमुख डॉ. सय्यद शाकिरअली, पुणे बाजार समितीच्या प्रशासकीय मंडळाचे उपाध्यक्ष भूषण तुपे, नारायणगाव केव्हीकेचे विषय विशेषज्ञ बी. जी. टेमकर आदी उपस्थित होते.

डॉ. प्रसाद म्हणाले, की पुष्प संशोधन संचालनालयाच्या वतीने देशात उपलब्ध असणाऱ्या शेवंतीच्या सुमारे ११० वाणांवर संशोधन मांजरी येथील प्रवेशावर सुरू आहे. सध्या केवळ पारंपरिक पिवळ्या आणि पांढऱ्या शेवंतीचेच उत्पादन शेतकऱ्यांकडून घेतले जात आहे. मात्र शहरीकरणामुळे विविध फुलांना मागणी वाढत आहे. यामुळे शेतकऱ्यांनी बाजारपेठेची मागणी आणि गरज लक्षात घेता पारंपरिक शेवंतीच्या वाणांपेक्षा विविधरंगी वाणांचे उत्पादन घेण्याची गरज आहे. तसेच फुलांच्या



**पुणे :** पुष्प संशोधन संचालनालयाच्या वतीने राष्ट्रीय शेवंती दिनानिमित्त मांजरी प्रवेशावर मंगळवारी (ता. २८) शेवंतीच्या विविध ११० वाणांची माहिती शेतकऱ्यांना देण्यात आली.

प्रक्रिया आणि मूल्यवर्धनातून नैसर्गिक रंग, अन्तरेदेखील निर्माण करण्याचे उद्योग उभारण्याची गरज आहे. पुणे बाजार समितीच्या वतीने उभारण्यात येणाऱ्या आंतरराष्ट्रीय फुलबाजारात प्रक्रिया आणि मूल्यवर्धन केंद्र उभारण्यासाठी आम्ही प्रयत्नशील आहोत.

डॉ. सय्यद शाकिरअली म्हणाले, "त्याच त्याच शेतमाल्याच्या उत्पादनामुळे विशिष्ट शेतमालाचे उत्पादन वाढत आहे. परिणामी बाजारपेठेतील मागणीपेक्षा पुरवठा जास्त होत असल्याने टोमॅटो, पोलभाण्या टाकून देण्याची वेळ येते. हे नुकसान टाळण्यासाठी शेतकऱ्यांनी पारंपरिक पिकांपेक्षा फुलशेतीकडे वळण्याची गरज आहे."

भूषण तुपे म्हणाले, "पुणे शहरात फुलांची

बाजारपेठ विस्तारत असून पुणे बाजार समितीची फुलांची सध्याची उलाढाल १२५ कोटींची आहे. फुलांची वाढता व्यापार लक्षात घेता बाजार समिती १०० कोटी रुपये खर्चून आंतरराष्ट्रीय दर्जाचे फूल मार्केट उभारत आहे. या मार्केटद्वारे फुलांची उलाढाल ५०० कोटी रुपयांपर्यंत जाणार असून, शेतकऱ्यांना मोठी संधी निर्माण झाली आहे. पुष्प संशोधन संचालनालयाचे मुख्यालय मांजरी येथे ५० एकरांवर होणार असल्याने पुणे जिल्ह्यातील शेतकऱ्यांना ही सुवर्णसंधी ठरणार आहे.

शास्त्रज्ञ गणेश कदम यांनी सूत्रसंचालन आणि आभार मानले. या वेळी शेवंती आणि गुलछडीच्या विविध वाणांच्या प्रवेशाला शेतकऱ्यांनी भेट देत विविध वाणांची माहिती घेतली.



हॅलो पुणे



पुणे : पुष्पसंशोधन संचालनालयाच्या वतीने मांजरी प्रवेशावर सुमारे ११० विविध वाणांचे संशोधन करण्यात येत आहे. शेवंतीच्या पिवळ्या, पांढऱ्या, राला, हिरव्या आदी मनमोहक रंगांनी परिसर फुलला आहे. राष्ट्रीय शेवंती दिनानिमित्त येथे मंगळवारी (ता. २८) शेवंतीच्या विविध वाणांचे सादरीकरण करण्यात येऊन शेतकऱ्यांना माहिती देताना शास्त्रज्ञ. (कृत् पान ६)



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