Annual Report 2016-17

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ICAR

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

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Preface

K.V. Prasad
Director

I have great pleasure in presenting the Annual Report 2016-17 of ICAR-Directorate of Floricultural Research, Pune. The Annual Report highlights the significant achievements in research and outreach programmes.

Under Crop Improvement Programme a total of 44 hybrids were identified with promising traits in gladiolus and in case of chrysanthemum, 77 cultivars were evaluated for their suitability.

In Crop Protection, survey was undertaken to study the incidence of insect pests affecting the commercial flower crops grown in Maharashtra, Goa and Karnataka. Among the insect pests affecting the commercial flower crops, bud borer was the most prevalent on the crops grown under open field condition. In crops grown under polyhouse, leaf miner, whitefly, thrips and red spider mite were found to infest the commercial flower crops.

The extent of occurrence of phytoplasma in different ornamental crops at different locations are documented besides the leafhopper vectors of phytoplasma diseases. Phytoplasma causing phyllody in saponeria has been identified as *Candidatus phytoplasma trifolii i.e.* Clover proliferation phytoplasma based on 16srDNA sequence. To understand the effect of phytoplasma infections on plant metabolome of chrysanthemum, comparative metabolome profiling was done using Orbit Trap High Resolution LC-MS using healthy vs phylllody plants. Chlorophyll dynamics and relative water content during various symptom expression of viral and phytoplasmal diseases were determined in case of marigold.

Fungal pathogens from infected samples of tuberose, gerbera, chrysanthemum and amaryllis were isolated and have been identified up to genus level.

Nematode manifestations in major commercial flower crops are documented and strategies for the management of root-knot nematode in tuberose and chrysanthemum have been attempted.

Efforts have been made to understand the etiology of various virus infections like symptoms observed in Chrysanthemum, Gerbera, Tuberose, Gladiolus, Duranta, Petunia and Crossandra, the leaves were subjected to ELISA for Cucumber mosaic virus with positive signals from some.

Plant pigments are extensively used as nutraceuticals owing to their therapeutic properties. Floricultural crops offer wide range of pigments that possess unique neutraceutical properties. A large number of value added products are made from grapes. However the consumer preference is more for value added products from coloured grapes. In order to fortify the products from green grapes an inter-institutional project was developed in collaboration with ICAR-National Research Centre on grapes. As part of the new initiative, Flavonoids, total phenolics, carotenoids from Rose, Chrysanthemum and Marigold are estimated and their antioxidant properties were established.

For Post Harvest Management of flowers, innovative foldable crates have been designed and tested for their suitability for Jasmine and Tuberose.

Owing to the fact that floriculture is a small sector; the extent of mechanization in floriculture is minimum. To address this critical gap, ICAR DFR started a new project on Development of gadgets and Tools for Floricultural Crops. Under the project a bulb planter that is suitable for any bulbous planting material is designed and tested.

ICAR DFR organized a number of outreach programmes that included Celebration of World Soil Day, Field Day -cum-Training Programme on Chrysanthemum, Celebration of National Productivity Week, National Science Day and On-Farm Training on Phytoplasma Diseases under Mera Gaon Mera Gaurav.

ICAR DFR participated in a number of outreach programmes that included Dutch Floral Design Workshop: Stakeholders Meet on Mechainization in Horticultural Crops organized by CIAE, Bhopal; International Agrobiodiversity Congress (IAC) 2016, New Delhi; Regional Agricultural Fair 2016 at Muzaffarnagar; and Kisan Diwas at IARI Regional Station, Pune.

DFR was privileged to receive Dr.Trilochan Mohapatra, Honorable Secretary, DARE and DG, ICAR, during October 2016 on his maiden visit to ICAR institutes in Pune. 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. Team DFR has initiated three inter institutional projects to address some of the action points suggested by Hon'ble DG, ICAR. DFR is indebted to Hon'ble DG, ICAR for his constant encouragement and support extended from time to time. The support and cooperation received from the Secretary, ICAR and FA (DARE) are gratefully acknowledged.

ICAR-DFR was equally benefited by the visits of Dr.A.K. Singh,Hon'ble DDG (Agril. Ext. and Hort. Sci.) and Dr.T. Janakiram ADG (HSII) who reviewed the progress made by ICAR-DFR during July and October 2016, respectively. ICAR-DFR places on record its gratitude for Dr.A.K.Singh, DDG (HS) for support and encouragement.

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 reestablish itself at Pune.

Help rendered from time to time by Dr. B.K.Pandey, Dr. Manish Das, Dr. Ranvir Singh and Dr. Vikramaditya Pandey from SMD is sincerely acknowledged. Support and help received from other members from SMD like Ms. Sunitha Sharma, Mr. P.K. Srivastava Mr.Rajneesh Rajput, is duly acknowledged.

The editorial team comprising of Dr.Tarak Nath Saha, Dr.P.Naveen Kumar and Dr.Shilpashree, deserve special appreciation for their involvement and commitment in bringing out this publication.

Support and timely help from all the scientific, administrative and finance staff is fittingly acknowledged.

Pune
25th June 2017

(K.V.Prasad)

Contents

Executive Summary

Crop Improvement

Gladiolus hybrids, Flavo Laguna x Ocilla, Invitatie x Yellow Stone, White Prosperity x Purple Flora and Yellow Stone x Purple Flora were found to be promising among the eleven hybrids evaluated in terms of vegetative growth and spike quality.

In Chrysanthemum, the cultivars Basanti, Pusa Chitraksha, Seema, Anmol, Ramlal Dada and the OP lines, OPCh 10-1-1011 and OPCh 9-4-1011 were found to ideal as spray type; cvs. Liliput, Little Orange and Amity are found to be ideal as pot mums; cvs. Thai-Chen-Queen, Pusa Centenary, Silk Broket, Pusa Kesari and Yellow Star are suitable as standard types.

Tuberose cvs. Prajwal, Arka Nirantara and Phule Rajini performed better in respect of spike length, rachis length, number of florets per spike and floral diameter among single type tuberose cultivars.

Evaluation of open pollinated seedlings of tuberose cv. Arka Nirantara indicated that plant nos. AN 3 and AN 28 were found to be better in respect of vegetative and floral characters.

Crop Protection

Survey of insect pests affecting flower crops Rose (polyhouse and open field), Chrysanthemum (perennial and annual), Carnation, Gerbera, Marigold, China aster, Jasmine, Gaillardia and Golden rod was carried out in farmer fields at various locations (Alandi, Charholi, Dhanore, Nirgudi, Sandborwadi, Arvi, Vadagaon Sahani, Kusur, Malegaon, Chambali, Sorpatwadi and Shindavane in Pune Dist.; Warvandi, Shivnai and Janori, in Nasik Dist.; Satara in Satara Dist., Maharashtra; Satari North, Budruk and Nirankal in Goa; and Bhadravati in Karnataka). Insect pests affecting different flower crops were listed out along with their incidence levels.

Similarly, the incidence of phytoplasma disease and its vectors in commercial flower crops was also recorded from different locations (Alandi, Charholi, Dhanore, Nirgudi, Sandborwadi, Vadagaon Sahani and Kusur) in Pune Dist., Maharashtra.

Chrysanthemum leafhopper, *Eupteryx* sp. incidence was recorded on forty five genotypes of chrysanthemum during September – March and population ranged from 1.95 – 3.25 hoppers per leaf. Whereas incidence of leaf bug, *Taylorilygus apicalis* was recorded (0.50 – 1.25 bugs per flower) at the flower bud initiation stage of chrysanthemum with symptoms of discoloration and uneven opening of flowers.

In China aster, the leafhoppers (2.25 – 12.50 per sweep net) were noticed from August – October and it was found that population is more during the vegetative stage and gradually reduced during flowering stage. Incidence of leaf bug, *Taylorilygus apicalis* was recorded (0.45 – 1.20 bugs per flower) at the flower bud initiation stage of China aster with symptoms of discoloration and uneven opening of the flowers.

In gladiolus, incidence of aphids, *Aphis gossypii* (5.25 – 15.00 aphids per leaf) and common cutworm, *Spodoptera litura* (less than 5% damage) was recorded at initial stage of the crop. Leaf bug, *Creontiades* sp. incidence was recorded (0.75 – 1.50 bugs per spike) on the spikes of gladiolus. The economic importance of the bugs on chrysanthemum, China aster or gladiolus is yet to be established.

Marigold thrips, *Neohydatothrips samayunkur* were recorded on cv. *Pusa Narangi Gainda* (0.50 – 2.75 thrips per top three leaves). The incidence of thrips was noticed from seedling till flowering stage during October, 2016 – March, 2017. However, damage was more during November – December, 2016.

In tuberose, incidence of mealybug, *Phenacoccus solenopsis* on seven tuberose genotypes (Vaibhav, Suvasini, Swarn Rekha, Prajwal, Shringar, Arka Nirantara and Phule Rajani) was recorded. The incidence varied from 35 – 70 per cent across the genotypes tested. Mealybug parasitoid, *Aenasius bambawalei* was recorded on the mealybugs with 70 per cent parasitization in all the genotypes. Minor incidence of less than 5 per cent damage by bud borer, *Helicoverpa armigera* and scale insect, *Coccus hesperidum* was recorded on tuberose genotypes. Scale insect infestation was found in the seedling/early stage of the plant. The central shoot of the infested plants died due to infestation by the scale insect.

Biology of cutworm, *Spodoptera litura* on chrysanthemum was studied**.** The total life cycle varied from 43.0 – 46.0 days from egg to adult stage. The egg, larval and pupa period were found to be 4.5, 25.5 and 7.9 days, respectively.

Survey of the farmer's field, protected units and nurseries was continued to assess the incidence of various diseases in China aster (Phyllody, 50%); Gerbera (leaf mottle mosaic 30%); Golden rod (rust, 30%); marigold (stunting & witches broom, 60%); and in annual chrysanthemum (stunting & witches broom, 8%) along with their incidence levels in different locations of Maharashtra.

Etiological studies on various virus infection like symptoms observed in Chrysanthemum (Mosaic and ringspots), Gerbera (Yellowing and vein banding), Tuberose (Mottling), Gladiolus (leaf streak and flower colour break), Duranta (Leafcurl and little leaf), Petunia (yellowing and mild mosaic) and Crossandra (Leaf yellowing) through ELISA screening for the presence of Cucumber mosaic virus revealed that Marigold, Gladiolus and Petunia samples have tested positive with a higher absorbance value (three times or more) than the healthy value.

Identified Phytoplasma causing phyllody in Saponaria as *Candidatus phytoplasma trifolii* (Clover proliferation phytoplasma).

Study of physiological and biochemical changes during virus infection indicated that chlorophyll, relative water content and other metabolites have been found to be different among infected and healthy looking plants.

Studies on rhizosphere of marigold crop indicated that the population of *Pratylenchus* spp., *Hoplolaimus* spp., *Tylenchorhynchus* spp., *Helicotylenchus* spp. and *Longidorus* spp. decreased due to marigold crop but the population of *Xiphinema* spp. was increased.

Soaking of tuberose bulbs in carbosulfan at 2000 ppm for 2 hr before the planting was found to be effective in reducing the initial root-knot nematode multiplication rate and root-galling in tuberose.

Application of 2.5 tons of FYM enriched with 2 kg/ha each of *Trichoderma viridae*, *Pseudomonas chlamydosporia* and *Pseudomonas flurescens* followed by application of 1 tonne of FYM enriched with

above bio-formulations per ha six times at 30 days interval was found to be effective in reducing nematode population and root galling in tuberose.

Twenty-one chrysanthemum cultivars and six tuberose genotypes were evaluated for their resistance reaction to root-knot nematode, *Meloidogyne incognita*. Among them, two chrysanthemum cultivars, Pusa Chitraksha and Mallika Yellow were found moderately tolerant to root-knot nematode.

Post-harvest Management and Value Addition

Packaging, Foldable crates (FC) and Polypropylene (PP) boxes with or without inner lining of cotton and various levels of ventilation for tuberose loose flowers (unopened stage) of single type were designed and tested. Preliminary results showed that florets packed in PP box showed lesser decline of physiological loss in weight compared to FC.

Hand held bulb planter has been designed and developed for planting of bulbous flower crops (gladiolus, tuberose, etc). This makes a hole in the soil, facilitates planting of bulb/corm/tuber and filling of the soil after planting.

For making value added products from grapes by incorporating the natural pigments from flower crops, the biochemical parameters *viz*., total phenols, flavonoids and antioxidant activity were estimated in powdered flower samples (oven/shade dried) of marigold (8 accessions), rose (19 varieties) and in chrysanthemum (120 accessions) and found that there was significant difference among the accessions.

Introduction

Floriculture sector got its due prominence in recent times in the tweets released by the Department of Agriculture and Cooperation, Minstry of Agriculture and Farmers Welfare, Government of India which highlighted the establishment of Directorate of Floriculture at Pune as one of the initiatives to strengthen the research on floriculture besides a number of central sector developmental schemes that support and promote floriculture sector through specific interventions.

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 2.48 lakh hectare producing 16.58 lakh tonnes of loose flower and 4.84 lakh tones of cut flowers (NHB 2015). India also has significant proportion of trade in potted flowering plants, ornamental foliage plants for landscaping, turf grasses, cut foliage, dry flowers, specialty flowers, annual flower seeds and fillers.

India exported floricultural produce worth Rs 475 cores (APEDA 2016) 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 demand for flowers picks up during the major festivals, cultural and religious events, across the country. However, many times the farmers have to face declining prices due to following reasons:

a. Planting of same crop and same variety by large numbers of farmers results in glut in market causing price crash.

b. Inadequate knowledge on using different varieties that could mature in different periods of time.

c. Prejudiced belief that only white and yellow coloured flowers are more preferred by the consumers and therefore over producing the same flowers and colors

d. Inadequate knowledge about staggered planting to minimize the threat of glut.

e. Lack of on farm storage facility for storing the flowers for a short period to overcome the glut.

f. Inadequate infrastructure for processing and value addition.

Owing to the above mentioned constraints very often the farmers tend to lose even minimum expected returns from the harvested flowers. The Research and Development network in the country responded to the clarion call by the Government of India to double the horticulture production from 150 million tons to 300 million tones, during 2007 – 2012. The horticulture production surpassed the food grain production during 2013-14 to cross 280 million tones. The country is equally prepared for a similar call by Honorable Prime Minster of India to double the farmer's income by 2022. ICAR DFR is part of the committee constituted by the ICAR to develop sector specific strategies for the western part of India.

Mechanization in Horticulture acquired attention owing to two brainstorming sessions organized by ICAR-CIAE Bhopal at Pune and Bhopal. ICAR-DFR actively participated in both the events to highlight the mechanization needs of floriculture sector. An inter institutional project has been finalised between ICAR-CIAE and DFR to address the critical gap.

Team DFR also organized a brainstorming session on Nursery Standards in association with the Maharastra Nurserymen Association to address one of the major grey areas in the nursery trade.

Occurrence and spread of phytoplasma diseases among floricultural crops has been on the rise in recent times. ICAR DFR has been documenting the manifestation in different flower crops and also organizing awareness programmes in the adopted village on management strategies. ICAR-DFR in association with Dr. Y.S.R Horticultural University, Venkataramannagudem and Indian Nurserymen Association, Kadiyam (Kadiyapulanka) has successfully organized a Farmers-Academia Interface on Phytoplasma Diseases in Horticultural Crops: Current Scenario and Future Challenges on June 29, 2016 at Rajamahendravaram during the XXV Group meeting of the AICRP on floriculture.

About The Directorate

ICAR-Directorate of Floricultural Research (DFR), as an Institute under Indian Council of Agricultural Research was formally launched on 10th 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.

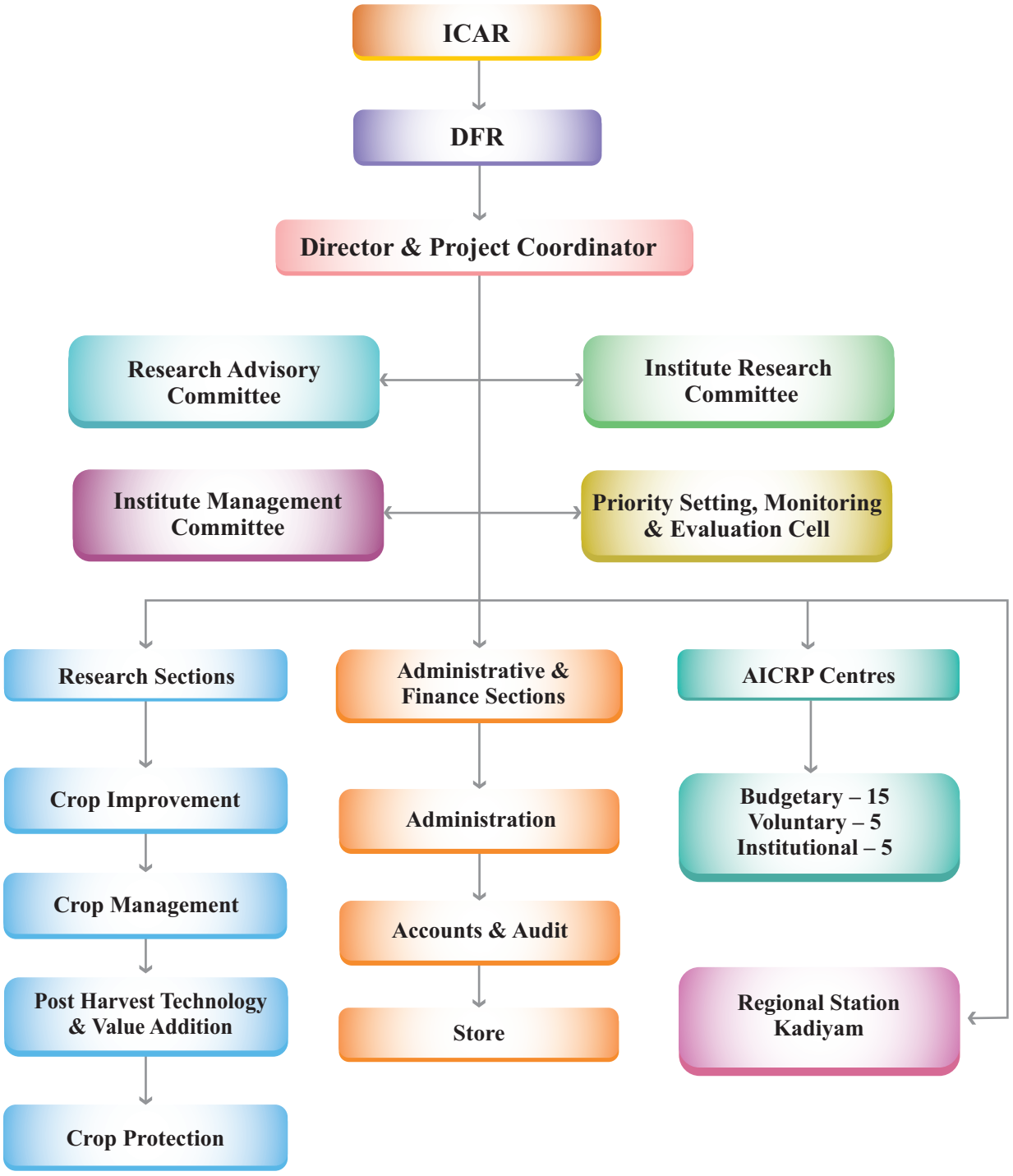
Mission

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: IXX07529): Breeding of Gladiolus for Quality and Yield

1.1.1. Germplasm Collection and Evaluation

The existing collection of gladiolus germplasm was enriched by collection of seven hybrids *viz*., Dhanvantari, Mohini, Urvashi, Shabnam, Melody Open, Pusa Srijan and Smoky Lady x Oscar developed by IARI, New Delhi. About thirty gladiolus varieties were evaluated during 2016-17 for their performance under Pune conditions. Data on morphological traits were recorded. The germplasm evaluated and maintained under Pune conditions is presented in Table 1.1.

Table 1.1 Germplasm maintenance at ICAR-DFR, Pune

Sl. No.	Name of Varieties	Sl. No.	Name of Varieties	Sl. No	Name of Varieties
1.	Amsterdam	11.	Melody Open	21.	Pusa Srijan
2.	Chandni	12.	Mohini	22.	Rosiebee Red
3.	Chemistry	13.	Novalux	23.	Smoky Lady x Oscar
4.	Dhanvantari	14.	Ocilla	24.	Shabnam
5.	Eurovision	15.	Plumtart	25.	Snow Princess
6.	Flavo Amico	16.	Priscilla	26.	Solist
7.	Flavo Souvenir	17.	Punjab Dawn	27.	Trader, Horn
8.	Jester	18.	Punjab Flame	28.	Urvashi
9.	Jester Gold	19.	Purple Flora	29.	Yellow Stone
10.	Limoncello	20.	Pusa Kiran	30.	Big Time Supreme

1.1.2. Evaluation of Hybrids

Systematic breeding programme in gladiolus resulted in development of adequate breeding material. Evaluation of this material resulted in identification of promising gladiolus hybrids. The hybrids, Invitatie x Yellow Stone, Yellow Stone x Purple Flora, White Prosperity x Purple Flora, Flavo Laguna x Ocilla, Flavo Sovenior x Hunting Song, Yellow Stone x Invitatie, Invitatie x Yellow Stone (5), Yellow Stone x Pricilla and OP seedlings of Peter Pears were found promising in respect of morphological and flowering characters (Table.1.2). The hybrid, Invitatie x Yellow Stone (Fig. 1) produced pinkish white coloured florets (13.7 per spike) with long spike length (84.5 cm). Hybrid Yellow Stone x Purple Flora produced purple coloured florets (14.3 per spike) with long spikes (76.1 cm). Another hybrid White Prosperity x Purple Flora produced a spike length of 91.6 cm with light pink coloured florets (14.3 per spike) and recorded early flowering (86.5 days). Hybrid Flavo Laguna x Ocilla produced dark red coloured florets (15.1 per plant) with long spikes (80.2 cm),

making it suitable for cut flower production. Hybrid Invitatie x Yellow Stone (5) produced more number of whitish yellow coloured florets (17.3 per plant) with long spikes (86.0 cm), making it suitable for cut flower production. Some of the hybrids and open pollinated seedlings were also found promising in terms of spike length, number of florets per spike and floret colour (Table 1.2).

Table 1.2 Evaluation of promising gladiolus hybrids

Hybrid No.	Spike length cm)	Days to flowering (days)	No. of florets per spike	No. of florets remain open at a time	No. of corms	No. of cormels	Flower colour
Invitatie x Yellow Stone	84.5	90.5	13.7	5.0	100.0	726.0	Pinkish white
Yellow stone x Purple flora	76.1	98.5	14.3	4.0	58.0	87.0	Magenta / Purple
White Prosperity x Purple Flora	91.6	86.5	14.3	5.0	75.0	338.0	Light pink
Flavo Laguna x Ocilla	80.2	97.5	15.1	4.5	54.0	412.0	Red /Maroon
Flavo Sovenior x Hunting Song	84.0	82.6	13.0	5.0	84.0	380.0	Orange Red
Yellow Stone x Invitatie	87.0	81.9	16.0	4.0	79.0	486.0	Yellow
Invitatie x Yellow Stone (5)	86.0	90.2	17.3	4.5	43.0	126.0	Whitish Yellow
BTS x Novalux	76.3	93.0	14.5	5.0	30.0	60.0	Pink
Pusa Suhagin x Yellow Stone	88.0	83.2	14.5	5.0	60.0	58.0	Pink
Yellow Stone x Pricilla	77.3	81.5	16.5	6.0	66.0	242.0	Yellow
Peter Pears (OP)	86.6	84.2	14.6	4.0	77.0	612.0	Orange Red

Invitatie x Yellow Stone

Yellow Stone x Purple Flora

Flavo Sovenior x Hunting Song

Flavo Laguna x Ocilla

Peter Pears (OP)

Invitatie x Yellow Stone (5)

Fig. 2 Fig.1. Promising gladiolus hybrids at ICAR - DFR, Pune

Hybrid seed from crosses attempted during 2011-12, 2012-13 and 2013-14 were sown at IARI Regional Station, Katrain for reducing the breeding cycle and for further evaluation. Promising hybrids among this breeding material were identified based on spike quality (number of florets and spike length) and floret colour. Overall 70 hybrids from controlled crosses and few OP seedlings were found to be promising based on flowering traits. Data was collected on morphological traits also. These hybrids are in advanced stage of multiplication and evaluation. (Table 1.3)

Table 1.3 Morphological and floral characteristics of gladiolus hybrids/OP lines

Sr. No.	Hybrid	Plant height (cm)	Days to spike emergence	Days to flowering	Spike length (cm)	Rachis length (cm)	Corm diameter (cm)	No. of florets open at time	No. of florets/ spike	No. of spikes/ plant	Floret colour
1.	No. 34	117.00	71.67	78.66	74. 67	59.00	5.03	3.50	13.17	1.67	Yellow
2.	No. 1(5)	130.50	67.00	75.00	90.83	73.97	5.03	2.66	13.66	1.00	Pinkish White
3.	Yellow Stone x Purple Flora	106.83	68.00	78.67	62.00	47.5	5.43	4.33	11.83	1.00	Yellow/ Purple
4.	No. 32	125.00	71.00	75.33	76.16	60.83	5.43	5.16	12.16	1.33	Pink
5.	No. 36	126.67	70.33	78.00	81.00	65.33	4.30	4.66	11.83	1.00	Pinkish White
6.	No. 56	128.33	69.50	77.33	79.00	61.66	4.43	4.16	13.83	1.00	Pinkish White
7.	No. 36	115.17	69.33	76.66	70.50	52.66	4.90	3.83	14.33	1.33	Light Pink
8.	No. 31	127.17	65.50	75.33	86.16	70.83	4.76	3.00	16.50	1.83	Light Yellow
9.	Eurovision (OP)	108.33	70.83	79.00	76.00	60.33	3.93	3.83	15.00	1.5	Yellowish Red
10.	No. 35	102.17	67.16	77.66	71.00	54.83	4.33	3.66	13.00	1.16	Red Orange

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Sr. No.	Hybrid	Plant height (cm)	Days to spike emer gence	Days to flowering	Spike length (cm)	Rachis length (cm)	Corm diameter (cm)	No. of florets open at time	No. of florets/ spike	No. of spikes/ plant	Floret colour
11.	No. 4(7)	107.83	65.00	79.33	74.16	60.00	5.76	3.50	12.50	1.00	Yellowish Pink
12.	No. 58 (Yellow)	128.00	68.50	78.66	82.66	67.16	4.70	3.33	14.16	1.16	Pinkish Yellow
13.	No. 26(8)	104.17	67.66	77.33	71.83	58.16	4.50	3.33	13.00	1.50	Yellow Purple
14.	No. 36	106.00	67.00	77.66	71.83	57.50	4.60	3.50	13.33	1.00	Pink/ Red
15.	Rose Supreme	124.33	70.16	78.66	87.50	70.83	4.56	4.33	13.33	1.00	Off White
16.	No. 20(3)	121.00	69.00	78.33	80.16	64.83	4.56	5.0	18.50	1.66	Yellowis h Pink
17.	No. 87	118.67	60.16	72.33	84.33	70.66	5.90	2.83	12.83	1.00	Orange Red/ Red
18.	No. 80	121.50	67.33	75.00	85.50	70.33	4.93	4.33	11.66	1.50	Light Yellow
19.	No. 7(6)	110.83	67.66	79.33	85.33	68.33	4.93	4.33	15.83	1.33	Yellow
20.	No. 1 (5)	120.83	74.16	78.66	82.33	67.33	4.70	3.83	16.16	1.50	Yellow
21.	No. 93	118.33	76.33	80.16	88.50	71.33	4.33	3.33	13.33	2.0	Purple
22.	No. 104	95.67	75.00	79.66	65.00	50.00	3.86	4.33	13.33	1.0	Purple
23.	No. 39	109.33	77.00	84.66	71.66	56.83	4.73	3.50	11.33	1.0	Reddish range
24.	Novalux OP	114.5	73.66	80.83	73.50	58.16	2.70	4.33	15.00	1.33	Yellow
25.	No. 105 (OP)	81.67	75.00	83.66	42.00	27.66	2.60	1.83	10.83	1.00	Purple
26.	No. 100	117.33	69.66	77.00	80.50	62.66	3.43	3.66	16.50	1.16	Light Orange
27.	No. 89	90.67	66.66	76.33	61.50	45.83	2.96	3.50	13.33	1.00	Orange Yellow
28.	Purple Flora x Flavo Amico	98.83	74.00	79.83	65.00	49.33	3.50	3.33	12.16	1.00	Purple Yellow
29.	No. 54	106.00	75.00	81.83	73.50	58.00	3.33	3.50	11.66	1.33	Pink
30.	No. 96	84.17	65.66	76.16	50.33	36.66	2.26	3.00	12.00	1.00	Orange Red
31.	No. 43(5)	100.00	68.66	76.83	66.00	51.83	4.26	4.00	12.50	1.50	Pink

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Sr. No.	Hybrid	Plant height (cm)	Days to spike emergence	Days to flowering	Spike length (cm)	Rachis length (cm)	Corm diameter (cm)	No. of florets open at time	No. of florets/ spike	No. of spikes/ plant	Floret colour
32.	Flavo Souvenir (OP)	87.33	72.50	79.33	50.66	35.66	4.10	3.50	12.50	1.00	Yellowish Orange
33.	Ocilla x Purple Flora	105.50	74.00	81.33	73.00	56.80	2.90	3.00	15.66	1.00	Purple
34.	No. 43(5)	113.67	69.66	78.16	73.66	61.50	2.83	3.16	14.16	1.16	Red/ Yellow
35.	Yellow Stone (OP)	95.17	75.83	83.16	56.16	43.50	2.33	3.83	13.50	1.00	Yellow
36.	No. 46 (Yellow)	100.17	66.33	78.66	70.16	54.83	3.76	4.00	15.50	1.00	Yellow
37.	Purple Flora x Estabonita	85.00	71.33	78.33	54.00	40.33	2.66	3.83	12.33	1.00	Purple
38.	No. 36	92.17	69.16	77.00	63.33	49.83	3.40	3.83	10.66	1.16	Orange
39.	No. 39	95.00	68.16	76.00	63.33	49.50	4.46	3.83	14.16	1.00	Creamish
40.	No 90	120.00	73.66	80.00	84.83	68.66	4.16	2.83	13.50	1.16	Reddish Orange
41.	Peter Pears (OP)	116.00	67.83	77.33	82.16	65.50	4.86	3.83	14.66	1.00	Yellow
42.	No. 85	125.83	73.16	79.50	90.00	74.66	4.23	3.66	14.83	1.00	Pink
43.	No. 39	131.83	67.16	76.33	95.33	78.00	4.96	4.16	17.66	1.00	Light Pink
44.	No. 90	112.33	70.50	79.00	77.16	61.00	4.63	3.00	14.00	1.00	Pink
45.	No. 78	96.00	70.33	78.16	63.33	48.66	4.23	3.33	12.00	1.00	Orange
46.	No. 40	97.17	74.50	79.66	67.50	53.16	3.33	4.00	12.33	1.00	Light Yellow
47.	No. 39	105.00	65.16	76.16	73.83	57.16	4.50	2.83	14.33	1.16	Creamish
48.	No. 2(7)	117.17	75.16	81.16	80.83	64.66	4.36	4.16	15.00	1.16	Pinkish
49.	No. 121 (OP)	102.17	66.83	73.83	67.00	51.50	3.33	3.83	16.50	1.00	Pink
50.	Purple Flora (OP)	125.50	68.83	77.66	89.16	73.33	4.16	4.33	20.00	1.33	Purple
51.	No. 14	108.33	70.00	80.16	71.50	55.33	4.43	3.66	14.33	1.00	Off White

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Sr. No.	Hybrid	Plant height (cm)	Days to spike emer gence	Days to flowering	Spike length (cm)	Rachis length (cm)	Corms diameter (cm)	No. of florets open at time	No. of florets/ spike	No. of spike/ plant	Floret colour
52.	Purple Flora x Rosiebee Red	108.00	75.50	82.83	73.83	59.00	3.73	4.16	19.83	1.00	Purplish
53.	No. 28	101.00	69.66	77.00	66.66	51.16	3.23	4.16	15.00	1.50	Light Pink
54.	Ocilla x Mascagni	100.83	74.00	78.83	67.33	52.00	3.96	4.16	10.33	1.33	Pink
55.	Palam Trate x Forta Rosa	106.00	73.83	79.66	72.16	56.83	2.76	4.00	9.33	1.00	Orange
56.	No. 34	108.17	71.50	80.66	77.50	61.83	4.60	4.33	16.33	1.16	Light Orange
57.	No. 15 (OP)	113.50	75.33	83.00	79.66	64.50	4.23	4.16	14.33	1.00	Yellow
58.	No. 23	106.83	70.83	78.50	75.00	60.00	3.93	4.33	13.00	1.00	Pinkish Yellow
59.	No. 93	123.83	73.66	81.33	88.33	72.16	4.46	3.83	16.33	1.00	Purple
60.	No. 80	95.50	77.33	83.33	61.66	48.16	3.33	4.16	10.66	1.16	Light Pink
61.	Yellow Stone x Rosibee Red	95.50	75.17	85.00	61.50	46.66	3.66	4.66	14.33	1.00	Pinkish Yellow
62.	No. 51	102.00	76.33	82.33	68.00	53.50	4.63	3.33	13.00	1.00	Yellow
63.	No. 43(5)	88.33	78.83	87.33	56.00	40.66	4.16	3.50	8.66	1.00	Pinkish Yellow
64.	No. 97	104	73.33	79.83	69.83	55.83	3.70	3.16	15.16	1.16	Yellow
65.	No 103 (OP)	117.83	73.83	81.66	81.83	67.33	4.66	4.66	11.33	1.00	Yellowis h Pink
66.	Snow Princess x Rosiebee Red	99.67	77.50	84.00	66.16	51.66	3.73	3.50	14.50	1.16	Light Red
67.	No. 25(8)	100.83	78.33	81.33	64.00	49.50	4.03	4.33	13.00	1.16	Pinkish White
68.	No. 93	105.67	76.00	84.16	71.66	57.00	4.76	3.16	17.66	1.00	Yellow
69.	No. 74	106.33	69.50	78.33	73.83	57.16	4.03	4.16	13.50	1.16	Yellow
70.	No. 4	114.67	73.67	83.50	80.16	65.83	4.53	4.83	16.00	1.16	Light Yellow

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1.2 Project 02 (ICAR Project Code: IXX07506): Breeding of Chrysanthemum for Quality Flowering and Pot Mums

1.2.1. Germplasm Enrichment and Evaluation

The Directorate is maintaining 110 cultivars of chrysanthemum. These cultivars were maintained by planting of rooted cuttings from the mother stock. All these cultivars were planted in the Research Farm located at Shivajinagar during 2016-17 using plastic mulch (25 µ). Chrysanthemum germplasm were evaluated for growth and flowering parameters and to identify suitable cultivars for different purposes (spray, pot mums and standard) under Pune condition.

1.2.1.1 Spray Type

About 77 cultivars of spray type were evaluated for various growth and flowering traits at Shivajinagar farm. The results (Table 1.4) revealed that the cv. White Prolific (86.45cm) exhibited maximum plant height followed by Punjab Anuradha (80.23cm) and Texas Gold (78.84cm), while least plant height was observed in Himanshu (29.36 cm). The cv. White Queen recorded maximum bushiness with good plant spread (66.50 cm) followed by Kundan (54.00 cm) and Mallika Yellow (51.33 cm). The number of primary and secondary branches were maximum in OPCh 9-4-1011 (12.36 & 22.23) followed by Aparajitha (7.69 & 168.44). The number of loose flowers recorded was maximum in cultivars Basanti (168.44), OPCh 10-1-1011 (160.54) and OPCh 9-4-1011 (138.45), Pusa Chitraksha (135.42) and Seema (130.25). Whereas least number of flower was recorded in Discovery (40.56). Size of flower was highest in Purnima (6.11 cm), Dabam (6.10 cm), OPCh 10-1-1011 (5.67 cm) and Ravi Kiran (5.54 cm), whereas least in Discovery (2.23 cm). Based on evaluation, the cultivars Basanti, Pusa Chitraksha, Seema, Anmol, Ramlal Dada and the OP lines, OPCh 10-1-1011 and OPCh 9-4-1011 were found suitable as spray type cultivars under Pune conditions (Fig. 2).

Table 1.4. Evaluation of spray type chrysanthemum cultivars under Pune conditions

Sl. No.	Variety	Plant height (cm)	Plant spread (cm)	Primary branches (number)	Secondary branches (number)	Flowers per plant (number)	Flower diameter (cm)
1.	Ajay	66.45	38.26	4.58	12.56	68.45	3.86
2.	Anmol	41.21	44.56	6.58	13.74	120.68	2.68
3.	Aprajitha	70.59	41.26	7.69	19.65	83.66	3.61
4.	Arka Ravi	57.54	39.61	3.68	12.48	26.54	4.87
5.	Autumn Joy	45.33	26.35	3.56	9.66	38.65	3.45
6.	Baggi	49.25	30.15	4.36	11.45	44.21	2.56
7.	Basanti	53.63	39.54	3.65	12.56	168.44	2.68
8.	Beauty	49.65	26.61	4.58	6.78	88.35	3.69
9.	Birbal Sahni	68.59	39.55	5.69	11.69	68.63	3.65
10.	Charlie	61.23	34.26	5.69	15.36	75.33	4.56
11.	Classic	52.32	26.38	3.44	7.59	41.22	2.36
12.	Crocon Small	41.26	29.52	2.53	6.56	95.23	2.95
13.	Dabam	57.36	34.23	3.45	7.86	65.35	6.10

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Sl. No.	Variety	Plant height (cm)	Plant spread (cm)	Primary branches (number)	Secondary branches (number)	Flowers per plant (number)	Flower diameter (cm)
14.	Daity White	69.35	39.56	5.69	10.44	120.56	3.51
15.	Discovery	38.61	20.26	2.56	8.41	40.56	2.23
16.	Dolly Orange	36.56	25.33	2.55	6.35	55.14	3.12
17.	Flirt	45.65	30.21	3.58	16.56	65.45	5.24
18.	Garden Beauty	65.98	44.57	4.56	14.57	76.45	4.44
19.	Gauri	63.52	46.74	2.58	9.57	76.11	4.57
20.	Gaity	75.96	45.64	6.54	12.51	66.38	3.23
21.	Gulmohar	69.68	43.25	3.59	16.54	53.12	5.54
22.	Haldighati	67.35	38.98	3.67	15.62	89.65	4.01
23.	Himanshu	29.36	36.56	7.11	19.36	96.87	4.44
24.	Himani	56.58	30.21	2.36	6.34	44.59	4.26
25.	Jayanti	44.56	35.36	5.69	10.25	66.51	4.89
26.	Jessica	64.35	31.22	3.56	14.36	42.30	4.81
27.	Jubilee	68.84	34.25	4.56	11.54	60.10	4.64
28.	Jyotsna	66.53	39.50	2.30	15.67	44.00	5.20
29.	Kamhil	67.36	42.00	2.33	12.67	95.33	3.60
30.	Kundan	65.31	54.00	1.67	17.00	65.00	2.56
31.	Lal Pari	44.12	26.67	1.33	11.33	56.00	5.10
32.	Lalit	67.25	36.67	2.56	11.67	81.67	4.17
33.	Maghi Orange	49.15	36.50	3.48	6.67	66.35	3.50
34.	Maghi White	67.58	27.00	2.33	15.33	68.66	5.36
35.	Mallika Yellow	58.78	51.33	2.56	13.00	87.00	2.40
36.	Mayor	44.56	23.29	2.45	12.36	57.59	3.56
37.	Melody	66.39	35.24	3.26	10.12	66.56	4.42
38.	Mother Teresa	44.36	27.36	3.53	9.54	66.10	3.11
39.	Mountaineer	68.21	35.24	4.56	10.25	86.56	4.23
40.	Neelima	41.25	35.27	2.45	7.56	56.24	3.67
41.	Nightingale	66.89	32.56	3.59	12.46	80.12	4.32
42.	Pink Princess	70.69	34.16	4.56	8.98	68.59	4.56
43.	Phillis	77.59	35.63	5.45	13.33	56.25	3.64
44.	Punjab Anuradha	80.23	45.65	5.96	15.47	89.65	4.96
45.	Purnima	70.71	42.32	5.69	18.65	65.32	6.11
46.	Pusa Aditya	66.35	31.25	3.35	12.04	75.64	4.12

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Sl. No.	Variety	Plant height (cm)	Plant spread (cm)	Primary branches (number)	Secondary branches (number)	Flowers per plant (number)	Flower diameter (cm)
47.	Pusa Chitraksha	64.21	39.24	5.34	15.48	135.42	3.44
48.	Ramlal Dada	56.56	34.28	2.89	16.35	120.35	3.56
49.	Ragini	78.18	35.69	5.36	12.34	90.81	4.32
50.	Ravi Kiran	56.32	35.88	3.54	10.24	56.34	5.54
51.	Red Stone	56.89	44.51	3.89	15.46	118.18	3.12
52.	Roja	66.21	31.58	5.45	10.12	99.56	4.56
53.	Sadwin Yellow	54.85	45.58	3.84	10.26	67.50	3.44
54.	Seema	68.45	43.56	5.69	15.57	130.25	4.01
55.	Shanti	71.56	35.22	6.35	12.45	110.24	3.45
56.	Shyama	66.24	26.56	4.44	12.23	64.56	3.58
57.	Shyamal	50.12	36.35	4.56	15.35	79.54	3.89
58.	Solan Shringar	66.35	34.25	5.36	12.49	53.21	3.86
59.	Sunny	45.25	31.23	2.35	5.36	56.54	3.24
60.	Surf	66.35	34.26	3.56	6.35	68.54	3.43
61.	Swet Shringar	68.65	35.60	5.67	12.45	89.69	4.43
62.	Sweta	70.12	35.65	5.46	15.36	68.23	3.25
63.	Teri	68.69	30.12	2.45	6.39	56.34	3.45
64.	Texas Gold	78.84	35.84	5.69	10.25	86.56	4.15
65.	Vasanthika	71.45	39.68	4.69	11.26	76.35	3.58
66.	Vijay Kiran	69.64	41.25	5.88	12.36	78.68	4.11
67.	White Prolific	86.45	41.25	6.86	15.42	90.19	3.25
68.	White Quills	56.24	25.31	5.46	12.45	77.75	3.58
69.	White Anemone	78.56	38.21	4.56	11.255	78.56	3.56
70.	White Queen	55.67	66.50	4.50	12.23	81.33	4.56
71.	Yellow Gold	54.36	40.12	3.69	13.35	110.32	4.10
72.	OPCh 9-4-1011	70.56	49.56	12.36	22.23	138.45	5.67
73.	OPCh 25-3-1112	36.45	31.25	4.36	8.63	81.23	4.52
74.	OPCh 5-2-1011	36.35	24.36	3.58	8.65	91.56	2.89
75.	OPCh 7-5-1011	35.69	27.35	4.86	8.68	51.23	4.89
76.	OPCh 9-2-1011	44.56	36.52	3.58	7.66	97.56	4.44
77.	OPCh 10-1-1011	42.36	35.26	2.56	12.24	160.54	5.12
	S.E.M.	4.56	4.43	0.42	1.65	7.86	0.24
	CD ($p<0.05$)	11.59	12.38	0.95	3.81	22.12	0.59

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1.2.1.2. Pot Mums

Nine genotypes of pot chrysanthemum were evaluated under Pune conditions for their suitability (Table 1.5). Based on statistical analysis all the cultivars exhibited significant differences for the traits studied. The cultivars Liliput and Little Orange exhibited extreme dwarfness with 16.23 cm and 17.56 cm of plant height respectively. Among all the cultivars Nanako was tallest with 35.26 cm plant height. In respect of plant spread, the cultivars Liliput (45.36 cm) exhibited maximum spread followed by Amiti (35.45cm) and Pink Cloud (34.26). The number of primary branches was maximum in Nanako (2.89), Little Pink (2.45) and Little Orange (2.36), whereas the number of secondary branches were more in Liliput (17.49), Nanako (15.63) and Little Pink (15.20). The number of flowers per plant recorded was maximum in Liliput (66.85) followed by Pink Cloud (60.23), Amiti (59.56) and Little Orange (55.67). The flower diameter was maximum in Nanako (3.10cm) followed by Pink Cloud (3.05) and least in Liliput (1.34cm) and Amiti (1.80cm). In pot mums dwarf plants with small sized flowers with maximum number is suitable. Therefore based on the evaluation pertaining to plant height, compactness, number and size of flowers per plant the cultivar Liliput, Little Orange and Amity are suitable for pot mums production.

Table. 1.5 Morphological traits of pot mum cultivars of chrysanthemum

Sl. No.	Variety	Plant height (cm)	Plant spread (cm)	Primary branches (number)	Secondary branches (number)	Flowers per plant (number)	Flower diameter (cm)
1	Amiti	22.27	35.45	1.56	14.89	59.56	1.80
2	Liliput	16.23	45.36	1.89	17.49	66.85	1.34
3	Little Orange	17.56	31.24	2.36	10.46	55.67	2.12
4	Little Pink	28.34	28.65	2.45	15.20	51.37	2.56
5	Nanako	35.26	30.17	2.89	15.63	48.98	3.10
6	Panchoo	32.14	25.58	1.98	14.56	48.69	2.95
7	Pink Cloud	28.56	34.26	2.35	9.56	60.23	3.05
8	Pusa Sona	27.28	26.35	1.56	8.43	43.26	2.11
9	Sadbhawna	26.35	22.33	1.81	9.56	51.26	2.56
	S.E.M.	2.46	6.23	0.56	1.15	5.25	0.15
	CD ($p<0.05$)	5.82	17.56	1.26	3.65	17.95	0.36

1.2.1.3. Standard Type

Among the twenty one standard cultivars evaluated for growth and flowering under Pune conditions (Table 1.6), significant differences were noticed among the traits studied except for the number of primary and secondary branches per plant. Holiday Purple exhibited maximum plant height (70.26cm) followed by Harvest Home (68.59cm) and Pusa Anmol (68.26cm). While the least plant height was recorded in Winson (28.68cm). Maximum plant spread was recorded in Pusa Kesari (42.35cm) with good number of secondary branches (10.58), number of flowers per plant (56.45) and optimum flower diameter (4.95cm). Appreciable plant spread was also observed in cultivars John Webber (38.68cm) and Harvest Home (38.66cm). As far as number of flowers per plant is concerned, cultivar Thai-Chen-Queen recorded highest number of flowers per

plant (65.45) and least in Winson (16.56). Largest diameter was recorded in cv. Silk Borket (7.45cm) followed by Thai-Chen-Queen (6.45 cm) and Pusa Centenary (6.35cm). On the basis of evaluation the cultivars Thai-Chen-Queen, Pusa Centenary, Silk Broket, Pusa Kesari and Yellow Star were found suitable for Pune agro-climatic conditions (Fig 2).

Table 1.6. Morphological characteristics of standard cultivars of chrysanthemum

S. No.	Cultivar	Plant height (cm)	Plant spread (cm)	Primary branches (number)	Secondary branches (number)	Flowers per plant (number)	Flower diameter (cm)
1	Ajina Purple	56.25	32.46	3.04	8.56	33.24	5.6
2	Harvest Home	68.59	38.66	3.54	11.25	40.12	5.68
3	Holiday Purple	70.26	36.21	2.55	12.59	36.45	4.36
4	Johan Webber	54.58	38.68	2.87	10.53	31.56	3.58
5	Pink Star	62.56	34.75	1.50	8.85	36.58	4.64
6	President Wiser	56.65	30.20	2.32	8.56	33.45	3.68
7	Pusa Anmol	68.26	38.56	3.45	8.96	38.65	5.67
8	Pusa Centenary	41.63	38.52	2.00	16.24	56.45	6.35
9	Pusa Kesari	38.69	42.35	2.21	10.58	51.25	4.95
10	Rose Hostus	46.35	26.86	2.12	9.58	35.24	3.12
11	R. Venkat Raman	42.30	26.36	2.35	5.89	34.68	4.56
12	Silk Brocket	66.58	35.14	2.33	8.45	36.45	7.45
13	Sover Glow	35.65	33.24	2.15	6.58	31.24	4.55
14	Star Pink	40.21	34.26	2.22	8.78	30.23	4.52
15	Sun-Men-Get-Shu	38.52	28.56	2.24	8.69	25.12	6.10
16	Tata Century	38.45	25.36	2.42	5.58	31.24	4.24
17	Thai-Chen-Queen	44.25	31.26	2.54	9.55	65.45	6.45
18	White Star	30.22	26.54	1.89	7.56	22.56	5.22
19	Winson	28.68	20.56	2.59	5.74	16.56	3.44
20	Yellow Reflex	48.65	30.56	1.68	8.69	40.56	3.05
21	Yellow Star	56.32	35.21	3.56	9.45	55.45	5.26
	S.E.M.	4.35	4.86	0.44	1.72	8.86	0.26
	CD ($p<0.05$)	12.45	13.56	NS	NS	24.36	0.75

Anmol

Autumn Joy

Basanti

Flirt

Jafri

Kalpana

Mother Teresa

Puncho

Red Stone

Thai Chen Queen

Yellow Coin

Purnima

Fig. 2 Promising cultivars (spray and standard) of chrysanthemum

1.3. Project 03 (ICAR Project Code: IXX07530): Breeding of Tuberose for Novel Colour and Oil Recovery

1.3.1. Germplasm Maintenance

Eleven germplasm namely Phule Rajani, Prajwal, Arka Nirantara, Hyderabad Single, Swarna Rekha, Sikkim Selection, Mexican Single, Pearl Double, Hyderabad Double, Vaibhav and Rajat Rekha are being maintained at DFR Research Farm.

1.3.2. Evaluation of Tuberose Germplasm

Seven germplasm namely Phule Rajani, Prajwal, Arka Nirantara, Hyderabad Single, Shringar, Sikkim Selection and Mexican Single were evaluated (Table 1.7) for their performance at Shivajinagar farm. The cultivar Prajwal produced significantly taller plants (62.27 cm) followed by Arka Nirantara (60.27 cm). Sikkim Selection recorded maximum spike length (108.43 cm) followed by cv. Prajwal (104.41 cm). Cv. Prajwal recorded significantly higher rachis length (34.70 cm), fresh weight of cut spikes (121.67 g), diameter of open floret (4.36 cm) and weight of 20 open (37.00 g) and mature (27.33 g) floret when compared with rest of the tested genotypes. Cultivar Arka Nirantara produced maximum number of florets per spike (57.60), followed by cv. Prajwal (53.33) and Shringar (52.87). Non-significant difference was observed for rachis length among the cvs. Prajwal (34.70 cm), Shringar (34.10 cm), Arka Nirantara (32.63 cm) and Phule Rajani (30.39 cm). Significantaly lowest spike length (57.77 cm) and fresh weight of cut spike (51.60 g) were recorded in cv. Hyderabad Single. On the other hand, significantly lowest rachis length (23.58 cm), number of florets per spike (39.07) and diameter of open florets (3.17 cm) were recorded in Sikkim Selection. Cv. Mexican Single produced significantly lowest weight of 20 open (16.33 g) and mature (12.66 g) florets. On the basis of second year evaluation the cultivar Prajwal and Arka Nirantara performed better in respect of spike length, rachis length, number of florets per spike and floral diameter compared to other cultivars under Pune conditions.

Table 1.7. Growth and flower attributes of tuberose cultivars under Pune condition

S. No.	Genotype	Plant height (cm)	Spike length (cm)	Rachis length (cm)	Fresh weight of cut spike (g)	No of florets per spike	Open floret diameter(cm)	Open floret length (cm)	Weight of 20 open florets (g)	Weight of 20 mature florets (g)	Weight of individual open floret (g)	Weight of individual mature floret (g)
1	Mexican Single	55.84	96.45	23.59	57.53	48.87	3.47	5.45	16.33	12.66	0.81	0.63
2	Sikkim Selection	49.90	108.43	23.58	65.53	39.07	3.17	5.59	17.66	14.66	0.88	0.73
3	Shringar	55.06	66.69	34.16	55.67	52.87	3.32	5.50	17.33	13.00	0.86	0.65
4	Phule Rajani	50.21	76.17	30.39	69.81	51.40	3.64	5.77	18.33	14.33	0.91	0.71
5	Hyderabad Single	49.93	57.77	29.37	51.60	50.27	3.49	5.68	18.33	13.33	0.91	0.66
6	Prajwal	62.27	104.41	34.70	121.67	53.53	4.36	6.05	37.00	27.33	1.85	1.36
7	Arka Nirantara	60.27	83.17	32.63	75.13	57.60	3.46	5.82	22.00	15.66	1.10	0.78
	SEm. +	1.95	1.32	1.57	3.42	2.21	0.07	0.13	0.53	0.46	0.02	0.02
	CD (P=0.05)	6.07	4.00	4.75	10.67	6.71	0.20	N.S.	1.65	1.44	0.83	0.07

1.3.3. Evaluation of Open Pollinated (OP) Lines

The open pollinated seedlings of Arka Nirantara, Phule Rajani, Sikkim Selection and Mexican Single which were planted in pots during last year were evaluated for growth and flowering traits. The OP plants of Arka Nirantara (Table 1.8) produced earliest flowering. Among the evaluated plants (AN 1,2,3, 4, 28 and 34), AN 34 and AN 5 recorded maximum plant height (64cm) followed by AN 2 (59cm). Maximum number of leaves were produced by plant AN 3 (30) and AN 28 (29). The spike of AN 2 was observed to be of maximum length (178 cm) followed by AN 1 (130cm), AN 28 (125cm). Also the rachis length was observed to be maximum in AN 2 (64 cm) followed by AN3 (39cm) and AN 28 (36cm). Number of flowers per plant was maximum in AN 3 (64) followed by AN 28 (52), AN2 (48). Flower diameter was maximum in AN28 (3.8cm) followed by AN 4 (3.5cm) , AN3 (3.2cm) and AN 5 (3.2cm). On the basis of observations, though the plant no AN 2 exhibited maximum spike length and rachis length, but it produced maximum internodal length between florets, which makes it unsuitable for selection. Based on the other vegetative and floral characters, plant no AN 3 (Fig. 3) and AN 28 were found suitable for further evaluation.

Table 1.8. Growth and flower attributes of promising open pollinated population of tuberose (Arka Nirantara).

Plant No.	No. of Leaves	Plant Height (cm)	Leaf Length (cm)	Leaf Width (cm)	Spike Length (cm)	Rachis Length (cm)	No. of buds per plant	No. of Flowers per plant	Flower diameter (cm)	Floret length (cm)	Internode length
1	12.24	57.22	54.32	1.82	130.11	18.21	18.32	17.33	2.90	5.84	Optimum
2	11.33	59.43	58.21	2.51	178.45	64.33	50.41	48.47	3.12	5.96	Very long
3	30.22	56.54	60.51	2.22	120.42	39.41	64.40	64.32	3.23	6.20	Optimum
4	16.43	57.81	55.60	2.83	85.51	34.52	42.32	38.11	3.55	7.44	Long
5	24.32	64.17	61.23	2.51	107.33	35.51	25.12	22.13	3.23	6.53	Medium
28	29.12	56.91	54.51	1.87	125.50	36.33	52.10	52.21	3.81	7.12	Optimum
34	25.27	64.43	63.21	2.44	116.30	30.23	18.12	18.24	1.83	6.17	Medium

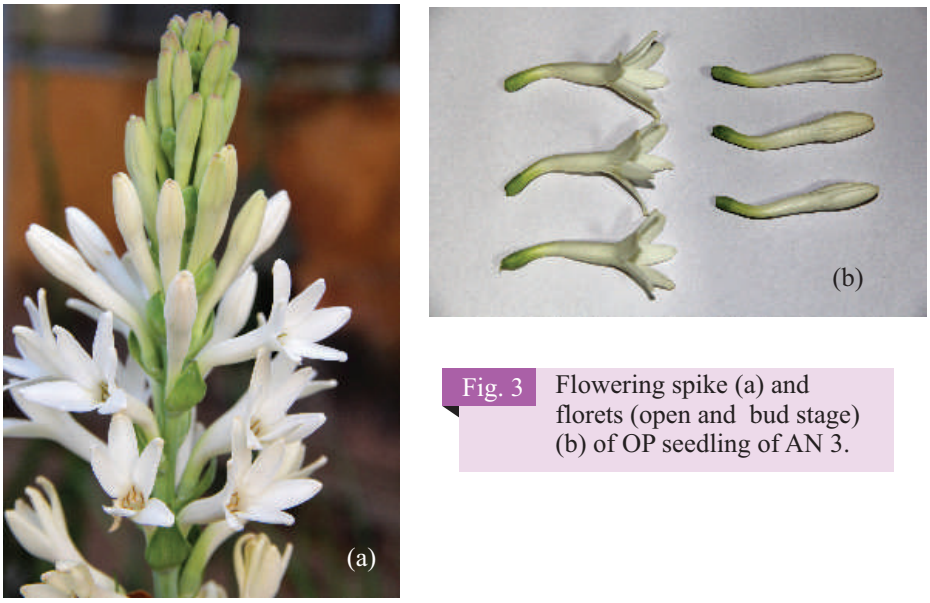

Fig. 3 Flowering spike (a) and florets (open and bud stage) (b) of OP seedling of AN 3.

2. Crop Protection

2.1 Project 01 (ICAR Project Code IXX08410): Insect-Pest Management in Commercial Flower Crops

Survey was undertaken to study the incidence of insect pests affecting the commercial flower crops grown in Maharashtra, Goa and Karnataka. Among the insect pests affecting the commercial flower crops, bud borer, *Helicoverpa armigera* was recorded on most of the crops surveyed under open field condition. Among crops grown under polyhouse, leafminer, *Liriomyza trifolii*, whitefly, *Bemisia tabaci*, thrips, *Scirtothrips dorsalis* and red spider mite, *Tetranychus urticae* were found to infest the commercial flower crops.

- Leafhoppers *viz*., *Balclutha* sp., *Maiestas* sp. and *Stirellus indra* were recorded on China aster.
- Leafhoppers *viz*., *Empoasca motti*, *Emposca* sp., *Exitianus nanus*, *Kola paulula*, *Memnonia bifida* and *Orosius albicinctus* were recorded on chrysanthemum.
- Leafhoppers *viz*., *Amrasca biguttula biguttula*, *Empoasca motti*, *Empoasca terminalis* and *Empoasca* sp. were recorded on gladiolus.
- Leafhoppers *viz*., *Deltocrphalus* (*Deltocephalus*) *vulgaris*, *Exitianus indicus*, *Maiestas* sp., *Stirellus indra*, *Stirellus lahorensis* and *Stirellus* sp. were recorded on lawn grass, *Cynodon dactylon.*
- The leafhopper vectors of phytoplasma disease *Hishimonus phycitis*was recorded on China aster, marigold and *Duranta erecta. Orosius albicinctus* was recorded on China aster and chrysanthemum.
- Leaf bug, *Taylorilygus apicalis* were found to be feeding on flower buds of annual chrysanthemum, chrysanthemum, China aster, golden rod and marigold.
- Bud borer, *Helicoverpa armigera* and scale insect, *Coccus hesperidum* were found to be infesting tuberose.
- Biology of cut worm, *Spodoptera litura* was worked out on chrysanthemum under laboratory condition. The total life cycle varied from 43.0 to 46.0 days from egg to adult stage. The egg, larval and pupa period was 4.5, 25.5 and 7.9 days, respectively.
- Among the insecticides tested against chrysanthemum aphid, *Macrosiphoniella sanborni*, insecticides dimethoate 30 EC and monocrotophos 36 SL provided 100 per cent mortality of aphids.

2.1.1. Survey of Insect Pests Affecting Flower Crops

Roving survey was undertaken to study the incidence of insect pests affecting the commercial flower crops grown in Maharashtra, Goa and Karnataka. Annual chrysanthemum was found to be infested with bud borer, *Helicoverpa armigera* (1.5 – 2.5%) and leaf bug, *Taylorilygus apicalis* (10.0/ plant). China aster was found to be infested with leafhoppers (3.5 – 5.0/ plant) and bud borer, *Helicoverpa armigera* (5.0%). Marigold was found to be infested with leafhoppers (2.5 – 5.0/ plant), bud borer, *Helicoverpa armigera* (1.5 – 2.5%) and red

spider mite, *Tetranychus urticae* (2.0%). Rose grown under open field condition was found to be infested with thrips, *Scirtothrips dorsalis* (10.0 – 40.0%) and bud borer, *Helicoverpa armigera* (15.0 – 25.0%). Golden rod grown in Dhanore and Nirgudi (Pune, Maharashtra) were found to be infested with Leaf bug, *Taylorilygus apicalis* (10.0 bugs/ plant) (Table 2.1)

Among the insect pests recorded on flower crops grown under polyhouse, gerbera was found to be infested with leafminer, *Liriomyza trifolii* (10.0 – 60.0%), whitefly, *Bemisia tabaci* (10.0 – 30.0 %), thrips (5.0 – 15.0%) and red spider mite, *Tetranychus urticae* (5.0%) among different locations under study. High incidence of leafminer, *Liriomyza trifolii* (60.0%) and whitefly, *Bemisia tabaci* (30.0 %) was recorded in Budruk, Goa and Bhadravati, Karnataka, respectively (Table 2.2)

On rose grown under polyhouse, higher incidence of thrips, *Scirtothrips dorsalis* (40.0%) and res spider mite, *Tetranychus urticae* (35.0%) was recorded in Janori, Nasik, Maharashtra. Lower incidence of red spider mite, *Tetranychus urticae* (3.0%), leafminer, *Liriomyza trifolii* (5.0%) and whitefly, *Bemisia tabaci* (5.0 %) was recorded on chrysanthemum grown under polyhouse in Nirankal, Goa.

Table No. 2.1 Survey of insect pests affecting flower crops grown under open field condition

Location	Crops	Pests	Incidence (%) or per plant
Alandi, Pune, Maharashtra	China Aster	Bud borer, *Helicoverpa armigera*	5.0 %
	Marigold	Bud borer, *Helicoverpa armigera*	1.5 %
	Marigold	Leafhoppers	5.0/plant
	Gaillardia	Aphids, *Uroleucon carthami*	15.0%
Charholi, Pune, Maharashtra	China Aster	Bud borer, *Helicoverpa armigera*	5.0 %
	China Aster	Leafhoppers	3.5/plant
	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	2.0 %
	Annual Chrysanthemum	Leaf bug, *Taylorilygus apicalis*	10.0/plant
	Rose	Thrips, *Scirtothrips dorsalis*	25.0 %
Dhanore, Pune, Maharashtra	Golden Rod	Leaf bug, *Taylorilygus apicalis*	10.0/plant
	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	2.0 %
	Annual Chrysanthemum	Leaf bug, *Taylorilygus apicalis*	10.0/plant
	Marigold	Leafhoppers	5.0/plant
Nirgudi, Pune, Maharashtra	Golden Rod	Leaf bug, *Taylorilygus apicalis*	10.0/plant
	Marigold	Leafhoppers	5.0/plant
Sandborwadi, Pune, Maharashtra	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	2.5 %
	China Aster	Bud borer, *Helicoverpa armigera*	5.0 %

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Location	Crops	Pests	Incidence (%) or per plant
Arvi, Pune, Maharashtra	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	1.5 %
VadagaonSahani, Pune, Maharashtra	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	1.0 %
	Marigold	Bud borer, *Helicoverpa armigera*	2.5%
	Marigold	Leafhoppers	2.5/plant
Kusur, Pune, Maharashtra	Annual Chrysanthemum	Bud borer, *Helicoverpa armigera*	1.5 %
	China Aster	Leafhopper	5.0/plant
	Marigold	Bud borer, *Helicoverpa armigera*	2.5%
	Marigold	Leafhopper	4.0/plant
Malegaon, Pune, Maharashtra	Marigold	Thrips (unidentified)	5 %
		Red spider mite, Tetranychus urticae	2 %
Chambali, Pune, Maharashtra	Rose	Bud borer, Helicoverpa armigera	25 %
		Thrips, *Scirtothrips dorsalis*	10 %
		Scale insects (unidentified)	5 %
Sorpatwadi, Pune, Maharashtra	Rose	Thrips, *Scirtothrips dorsalis*	30 %
		Bud borer, *Helicoverpa armigera*	25 %
Shindavane, Pune, Maharashtra	Rose	Thrips, *Scirtothrips dorsalis*	40 %
		Bud borer, *Helicoverpa armigera*	15 %
	Jasmine	Web worm, *Hendecasis duplifascialis*	< 2 %
Shivnai, Nasik, Maharashtra	Rose	Thrips, *Scirtothrips dorsalis*	25.0 %

Table No. 2.2 Survey of insect pests affecting flower crops grown under polyhouse

Location	Crops	Pests	Incidence (%) or per plant
Sorpatwadi, Pune, Maharashtra	Rose	Thrips, *Scirtothrips dorsalis*	5 %
	Gerbera	Leaf miner, *Liriomyza trifolii*	10 %
		Red spider mite, *Tetranychus urticae*	5 %
		Thrips (unidentified)	5 %

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Location	Crops	Pests	Incidence (%) or per plant
Shindavane, Pune, Maharashtra	Carnation	Thrips (unidentified)	30 %
		Bud borer, *Helicoverpa armigera*	5 %
	Gerbera	Leaf miner, *Liriomyza trifolii*	10 %
		Thrips (unidentified)	15 %
Warvandi, Nasik, Maharashtra	Gerbera	Leafminer, *Liriomyza trifolii*	10.0%
		Whitefly, *Bemisia tabaci*	10.0%
Janori, Nasik, Maharashtra	Rose	Thrips, *Scirtothrips dorsalis*	40.0 %
		Red spider mite, *Tetranychus urticae*	35.0%
Satara, Satara, Maharashtra	Gerbera	Leafminer, *Liriomyza trifolii*	10.0%
SatariNarth, Goa	Gerbera	Whitefly, *Bemisia tabaci*	20.0%
		Leafminer, *Liriomyza trifolii*	10.0%
Budruk, Goa	Gerbera	Leafminer, *Liriomyza trifolii*	60.0%
Nirankal, Goa	Chrysanthemum	Whitefly, *Bemisia tabaci*	5.0%
		Leafminer, *Liriomyza trifolii*	5.0%
		Red spider mite, *Tetranychus urticae*	3.0%
Bhadravati, Karnataka	Gerbera	Whitefly, *Bemisia tabaci*	30.0%

2.1.2. Identification of Insect Pests of Commercial Flower Crops

Aphid, *Aphis gossypii* was recorded on chrysanthemum & gladiolus and the aphid was identified by Dr. Sunil Joshi, ICAR – NBAIR, Bengaluru.

Aphid, *Aphis spiraecola* was recorded from the flowers of *Tabernaemontana coronaria*. Aphids, *Toxoptera aurantii* and *Toxoptera citricidus* were also recorded on flower of *Tabernaemontana coronaria*. Scale insect, *Saissetia coffeae* was recorded from the twigs and leaves of *Tabernaemontana coronaria*. All these insects were identified by Dr. Sunil Joshi, ICAR – NBAIR, Bengaluru

On China aster leafhoppers *viz*., *Balclutha* sp., *Maiestas* sp. and *Stirellus indra* were recorded. On chrysanthemum leafhoppers *viz*., *Empoasca motti*, *Emposca* sp., *Exitianus nanus*, *Kola paulula*, *Memnonia bifida* and *Orosius albicinctus* were recorded. On chrysanthemum leaf bugs *viz*., *Campylomma livida*, *Creontiades* sp., *Dortus primarius* and *Taylorilygus apicalis* belonging to family Miridae were recorded. On gladiolus *Amrasca biguttula biguttula*, *Empoasca motti*, *Empoasca terminalis* and *Empoasca* sp. were recorded. On marigold *Hishimonus phycitis* was recorded. On lawn grass, *Cynodon dactylon* leafhoppers *viz*., *Deltocrphalus* (*Deltocephalus*) *vulgaris*, *Exitianus indicus*, *Maiestas* sp., *Stirellus indra*, *Stirellus lahorensis* and *Stirellus* sp. were recorded. On hedge plant *Duranta erecta* leafhoppers like *Hishimonus*

phycitis, *Ianagallia bifurcate*, *Kola paulula* and *Nirvana pallida* were recorded. A Psyllid, *Macrohomotoma geniculata* was recorded on *Ficus* sp. All these insects were identified by Dr. C. A. Viraktamath and Dr. H. M. Yeshwanth from UAS, Bengaluru.

2.1.2.1. Incidence of Insect Pests on Chrysanthemum

Incidence of leafhoppers was recorded on chrysanthemum (Fig. 4). The leafhoppers were noticed from August, 2016 to January, 2017 and population ranged from 2.05 to 10.50 hoppers per sweep net. The leafhopper population was more during the vegetative stage and gradually reduced during flowering stage.

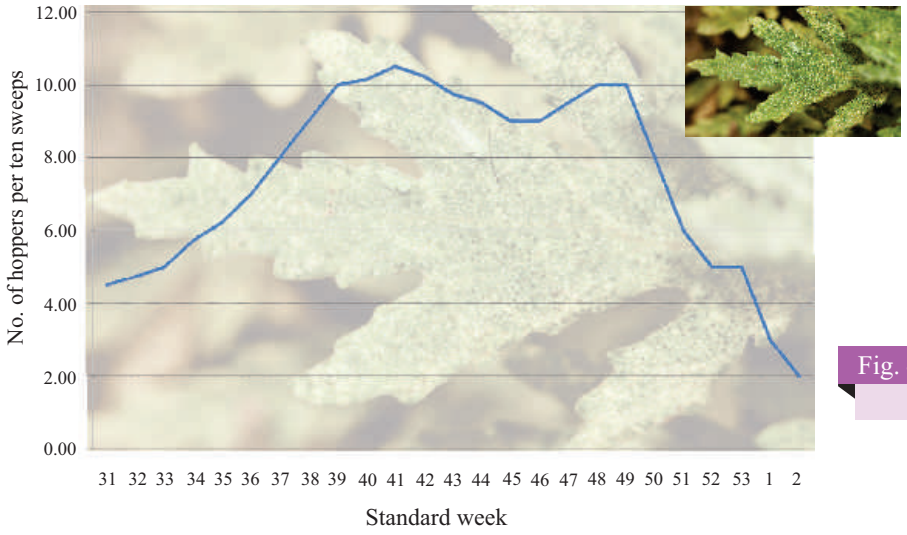

Fig. 4 Incidence of leafhopper on Chrysanthemum

Incidence of chrysanthemum leafhopper, *Eupteryx* sp. (Fig. 5) was recorded on forty five genotypes of chrysanthemum from September – March and population ranged from 1.95 – 3.25 hopper per leaf.

Fig. 5 Leafhopper *Eupteryx* sp. on chrysanthemum

Incidence of leaf bug, *Taylorilygus apicalis* (Fig. 6a&b) was recorded at the flower bud initiation stage of chrysanthemum. The population of bugs ranged from 0.50 – 1.25 bugs per flower. Infested flowers showed discolouration and uneven opening of the flowers. However, the economic importance of these bugs on chrysanthemum is yet to be established.

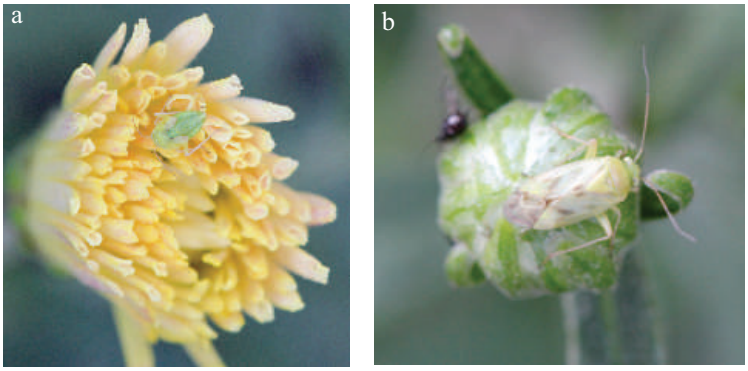

Fig. 6a &6b Leaf bug *Taylorilygus* apicalis feeding on flower bud

2.1.2.2. Incidence of Insect Pests on China Aster

Incidence of leafhoppers (Fig. 7) on China aster was noticed from August – October and population ranged from 2.25 to 12.50 hoppers per sweep net. The leafhopper population was more during the vegetative stage and gradually reduced during flowering stage.

Incidence of leaf bug, *Taylorilygus apicalis* was recorded at the flower bud initiation stage of China aster. The population of bugs ranged from 0.45 to 1.20 bugs per flower. Infested flowers showed discolouration and uneven opening of the flowers. However, the economic importance of these bugs on China aster is yet to be established.

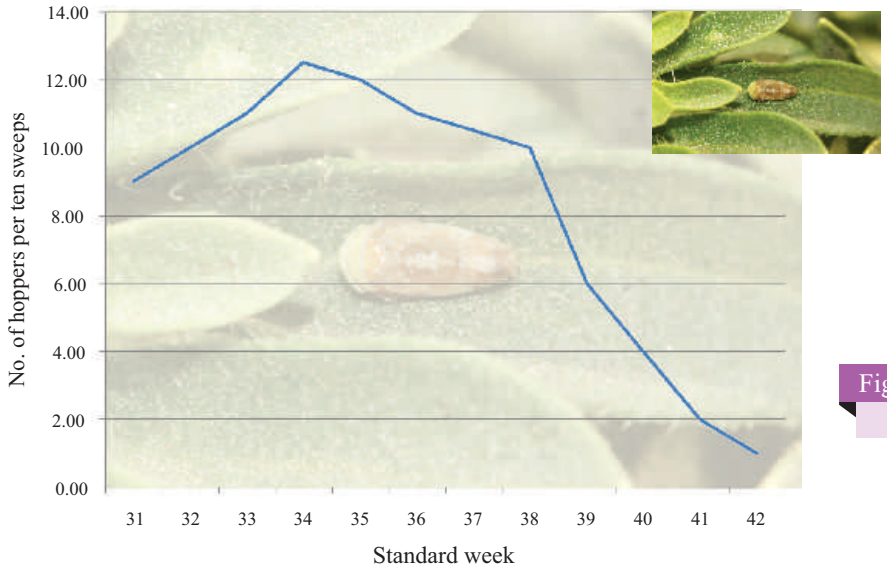

Fig. 7 Incidence of leafhopper on China aster

2.1.2.3. Incidence of Insect Pests on Gladiolus

Incidence of aphids, *Aphis gossypii* was recorded on gladiolus at initial stage (one month). The aphids population was 5.25 to 15.00 aphids per leaf. Minor incidence of less than 5 per cent damage by common cutworm, *Spodoptera litura* (Fig. 8 a & b) was recorded at initial stages of crop growth.

Incidence of leaf bug, *Creontiades* sp. was recorded on the spikes of gladiolus. The incidence was to the tune of 0.75 – 1.50 bugs per spike. However, the economic importance of these bugs on gladiolus is yet to be established.

Fig. 8a & 8b Cutworm *Spodoptera litura* on Gladiolus

2.1.2.4. Incidence of Insect Pests on Marigold

Incidence of marigold thrips, *Neohydatothrips samayunkur* (Fig. 9) was recorded on marigold cv. *Pusa Narangi Gainda*. The incidence of thrips was noticed from seedling till flowering stage. The incidence ranged from 0.50 – 2.75 thrips per top three leaves from October, 2016 – March, 2017. However, damage was more during November – December, 2016.

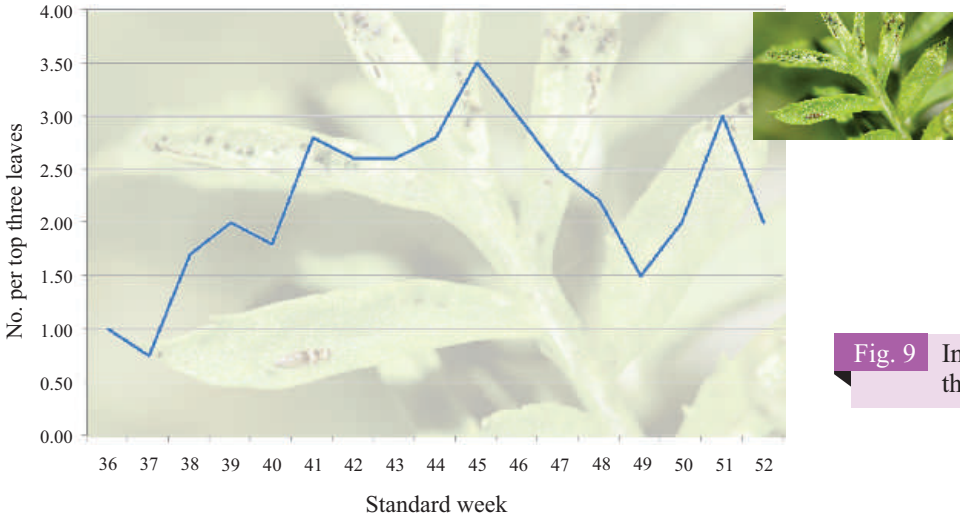

Fig. 9 Incidence of marigold thrips on marigold

2.1.2.5. Incidence of insect pests on tuberose

Incidence of mealybug, *Phenacoccus solenopsis* on seven tuberose genotypes (Vaibhav, Suvasini, Swarn Rekha, Prajwal, Shringar, Arka Nirantara and Phule Rajani) was recorded. The incidence varied from 35 – 70 per cent across the genotypes tested. Mealybug parasitoid, *Aenasius bambawalei* was recorded on the mealybugs. Upto 70 per cent parasitization was recorded in all the genotypes.

Minor incidence of less than 5 per cent damage by bud borer, *Helicoverpa armigera* was recorded on tuberose genotypes.

Minor incidence of less than 5 per cent damage by scale insect, *Coccus hesperidum* (Fig.10 a & b) was recorded on tuberose. The infestation was found in the seedling stage/ early stage of the plant. The central shoot of the infested plants died due to infestation by the scale insect.

Fig.10a & 10b Scale insect *Coccus hesperidum* on Tuberose

2.1.3. Biology of Cutworm, *Spodoptera litura* on Chrysanthemum

Preliminary studies on the biology of cutworm, *Spodoptera litura* (Fig. 11a & b) on chrysanthemum was undertaken under laboratory condition (26.0 ±1.0 ^{o}C). The total life cycle varied from 43.0 – 46.0 days from egg to adult stage. The egg, larval and pupa period was 4.5, 25.5 and 7.9 days, respectively (Table 2.3).

a

b

Fig. 11a & 11b

Cutworm *Spodoptera litura* on chrysanthemum Late instar

Table 2.3. Biology of *Spodoptera litura* on chrysanthemum

Stage of the insect	Days (Avg. ±S.d.)
Incubation period	4.5 ± 0.856
Larval period	
1st instar	3.0 ± 0.050
2nd instar	3.7 ± 0.552
3rd instar	4.7 ± 0.474
4th instar	4.8 ± 0.574
5th instar	7.5 ± 0.443
6th instar	1.5 ± 0.540
Total larval period	25.5 ± 1.00
Pupal period	7.9 ± 1.025
Adult period	
Male	5.6 ± 0.135
Female	9.2 ± 0.155
Total life period	
Male	44.2 ± 0.152
Female	46.5 ± 0.00
Fecundity	285.5 ± 0.54

2.1.4. Evaluation of Insecticides against Chrysanthemum Aphid, *Macrosiphoniella sanborni*

Different insecticides were evaluated for their efficacy against chrysanthemum aphid, *Macrosiphoniella sanborni* on chrysanthemum grown in pots (Table 2.4). The aphids were released on growing shoots and allowed to establish on the chrysanthemum shoots. After proper establishment of the aphids on chrysanthemum shoots, the insecticide concentrations were prepared and sprayed on the plants using hand sprayer. The mortality of aphids was recorded after 48 hours of treatment. Among the synthetic insecticides dimethoate 30 EC and monocrotophos 36 SL provided 100 per cent mortality of aphids. The botanicals like neem soap and pongamia soap were also effective in controlling the aphids.

Table 2.4. Effect of synthetic insecticides and botanicals against chrysanthemum aphid, *Macrosiphoniella sanborni*

Sl. No.	Insecticide	Concentration (%)	No. of test insects	Per cent mortality
1	Dimethoate 30 EC	0.06	100	100.00 (90.00)
2	Imidacloprid 17.8 SL	0.005	100	92.00 (73.57)
3	Monocrotophos 36 SL	0.054	100	100.00 (90.00)
4	Neem soap	0.05	100	95.00 (75.82)
5	Pongamia soap	0.05	100	90.00 (71.56)
	Control	-	100	0.00 (2.50)

2.2 Project 02 (ICAR Project code IXX11705): Investigations on Virus and Phytoplasma Diseases of Commercial Flower Crops

2.2.1. Incidence of phytoplasma disease and its vectors in commercial flower crops

The extent of occurance of phytoplasma in different ornamental crops at different locations are summarised in Table 2.5.

Table. 2.5. Occurance of phytoplasma at various location in different crops

Name of the village	Crop	Pest	Incidence (%) or number per plant
Alandi, Maharashtra	China Aster	Phytoplasma	5.0 %
	China Aster	Leafhopper, *Hishimonus phycitis*	3.5/plant
	Marigold	Phytoplasma	5.0 %
	Marigold	Leafhopper, *Hishimonus phycitis*	5.0/plant
Charholi, Maharashtra	China Aster	Aster yellow phytoplasma	10.0 %
	China Aster	Leafhoppers	3.5/plant
Dhanore, Maharashtra	Marigold	Leafhopper, *Hishimonus phycitis*	5.0/plant
Nirgudi, Maharashtra	Marigold	Phytoplasma	10.0 %
	Marigold	Leafhopper, *Hishimonus phycitis*	5.0/plant
Sandborwadi, Maharashtra	China Aster	Aster yellow phytoplasma	10.0 %
	China Aster	Leafhoppers	3.5/plant
Vadagaon Sahani, Maharashtra	Marigold	Phytoplasma	10.0 %
	Marigold	Leafhopper, *Hishimonus phycitis*	2.5/plant
Kusur, Maharashtra	China Aster	Phytoplasma	10.0 %
	China Aster	Leafhopper	5.0/plant
	Marigold	Phytoplasma	10.0 %
	Marigold	Leafhopper, *Hishimonus phycitis*	4.0/plant

2.2.1.1. The leafhopper vectors of phytoplasma diseases in commercial flower crops

The leafhoppers *viz*., *Hishimonus phycitis* (Fig. 12a & b) and *Orosius albicinctus* (Fig. 13) were recorded on China aster, chrysanthemum, marigold and *Duranta erecta*. Among the leafhoppers *Hishimonus phycitis* was recorded on China aster, marigold and *Duranta erecta. Orosius albicinctus* was recorded on China aster and chrysanthemum

Fig. 12a & 12b

Leafhopper *Hishimonus phycitis* on China aster and *Duranta erecta*

Fig. 13

Leafhopper *Orosius albicinctus* on chrysanthemum

2.2.2. Disease Incidence Survey

Survey of the farmer's field, protected units and nurseries was continued to assess the incidence of various diseases and the observations made is given below (Table 2.6)

Table 2.6: Estimation of level of incidence of diseases in farmers' field and protected cultivation

Village	Crop and stage	Disease /Symptoms observed	Incidence
Rajgurunagar (August)	China Aster (flowering)	Phyllody	50%
Ahmed Nagar (October)	Gerbera (from Rise n Shine) 10 months old	Leaf mottle, mosaic and necrosis	30%;white>orange >pink>red>yellow
		Phyllody	<1%
	Annual Chrysanthemum (3 months)	Yellows	<1%
	Marigold (flowering)	-	0%
	China Aster (2 month)	Yellows	1%

Continued on next page.....

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Village	Crop and stage	Disease /Symptoms observed	Incidence
Alandi (September)	Golden Rod (3 months)	Rust	30%
	Marigold (flowering)	Flower bud blight	1%
Kusur (July)	Marigold (flowering)	Stunting, Witches broom	60%
Kusur (November)	Marigold (flowering)	Phyllody, Little leaf, Stunting, Witches broom	50%
	China Aster (Seed production)	-	0%
	China Aster (2 months)	Yellows	<1%
	Annual Chrysanthemum	Stunting, witches broom, virescence	8%

2.2.2.1. Detection of Cucumber Mosaic Virus from Marigold, Gladiolus and Petunia

To study the etiology of various virus infection like symptoms observed in Chrysanthemum (Mosaic and ringspots), Gerbera (Yellowing and vein banding), Tuberose (Mottling), Gladiolus (leaf streak and flower colour break), Duranta (Leafcurl and little leaf), Petunia (yellowing and mild mosaic) and Crossandra (Leaf yellowing), the leaves were subjected to ELISA for Cucumber mosaic virus and the result is represented in the figure 14.

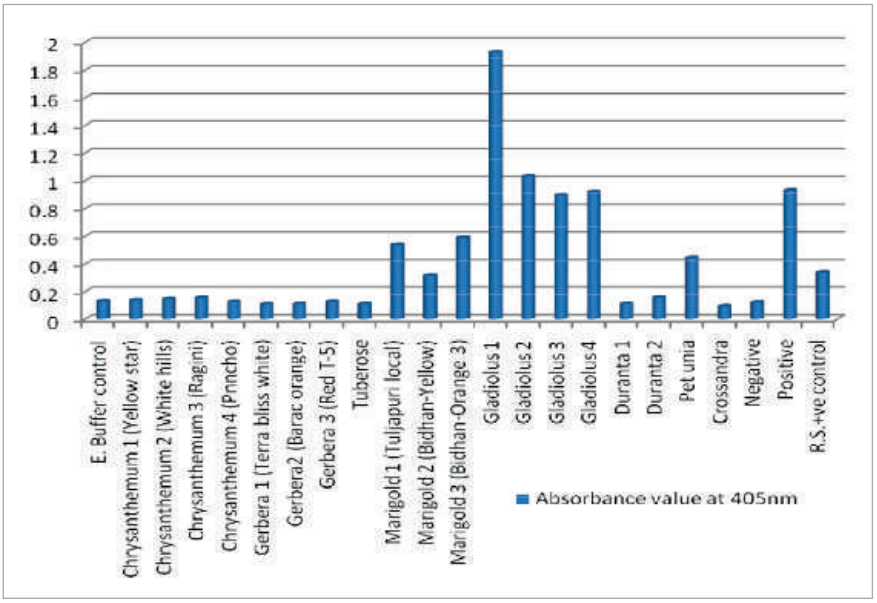


Fig. 14

Average absorbance value at 405nm to detect viral infection.

Marigold, Gladiolus and Petunia samples have tested positive for *Cucumber mosaic* virus with a higher absorbance value three times or more than the healthy value. The symptoms in other crops may be due to other species of viruses which needs to be investigated. Cucumber virus is found to be a common virus infecting many of the herbaceous ornamentals and to clearly understand the strain level information, further molecular studies are required.

2.2.2.2. Molecular Characterization of Phytoplasma infected Saponeria

Molecular characterization of Phytoplasma infected Saponeria is done in collaboration with IARI. Phytoplasma causing phyllody in saponeria has been identified as *Candidatus phytoplasma trifolii* i.e. Clover proliferation phytoplasma based on 16srDNA sequence.

2.2.2.3. Evaluation of Chlorophyll Dynamics and Relative Water Content during Phytoplasma Infection

In order to understand the level of chlorophyll in yellowing and other symptoms caused by viruses and phytoplasmal diseases on chrysanthemum (Fig. 15a) and Marigold (Fig.15b), chlorophyll levels were estimated through spectrophotometer.

Fig. 15a. Chrysanthemum samples showing little leaf, vein necrosis, yellows and bleaching of leaves

Fig. 15b. Marigold leaves showing little leaf, leaf yellowing, yellow mosaic and witches broom

Total chlorophyll was estimated based on the formula Total chlorophyll = 0.0202 A663 + 0.00802 A645. The observation is given in figure 16.

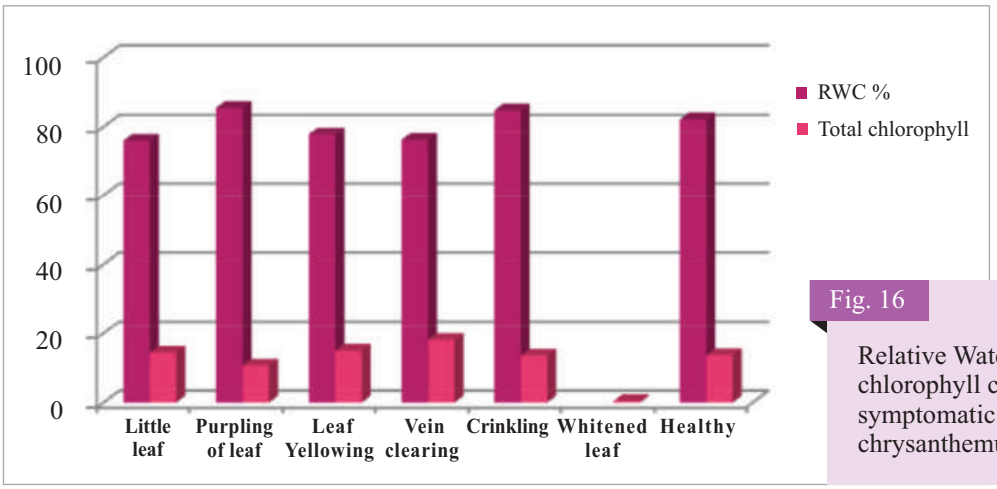


Fig. 16 Relative Water Content and total chlorophyll content of various symptomatic leaves of chrysanthemum.

In chrysanthemum, it has been observed that the level of chlorophyll is correlated with the severity of the symptoms, as the chlorophyll levels are higher in the initial stages of symptom expression *i.e.* in vein clearing (only vein yellow interveinal portion green) higher even compared to healthy, later the level became lower in yellow leaves and even lower in purple leaves which turns necrotic and falls off. In other symptoms like little leaf and leaf crinkling the chlorophyll levels were lower than healthy. It indicates the interference with the chlorophyll biosynthetic pathway during symptom expression of phytoplasma infections. Relative water content was lower in the vein clearing stage where the vascular system may be affected compared to other symptoms. Similar study was conducted in marigold and the following pattern was observed (Figure 17).

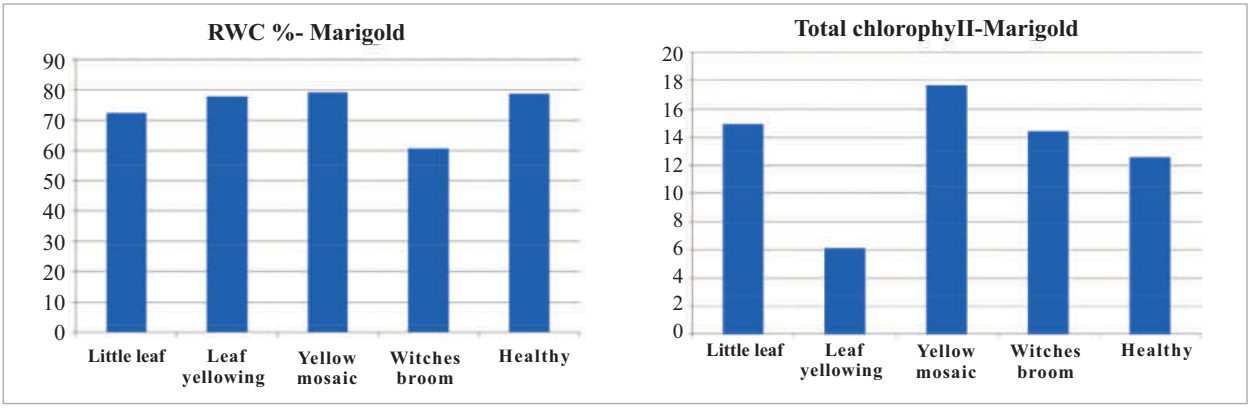


Fig. 17. Estimation of chlorophyll dynamics and relative water content during various symptom expression of viral and phytoplasmal diseases on Marigold

The observations are similar to chrysanthemum, as the chlorophyll level was higher in early symptoms which reduced considerably in the advanced stages.

2.2.3. Study on effect of Phytoplasma Infection on Chrysanthemum Through Metabolome Profiling

To understand the effect of phytoplasma infections on plant metabolome of chrysanthemum, comparative metabolome profiling was done using Orbit trap High resolution LC-MS using healthy vs phylllody plants (Fig. 18).

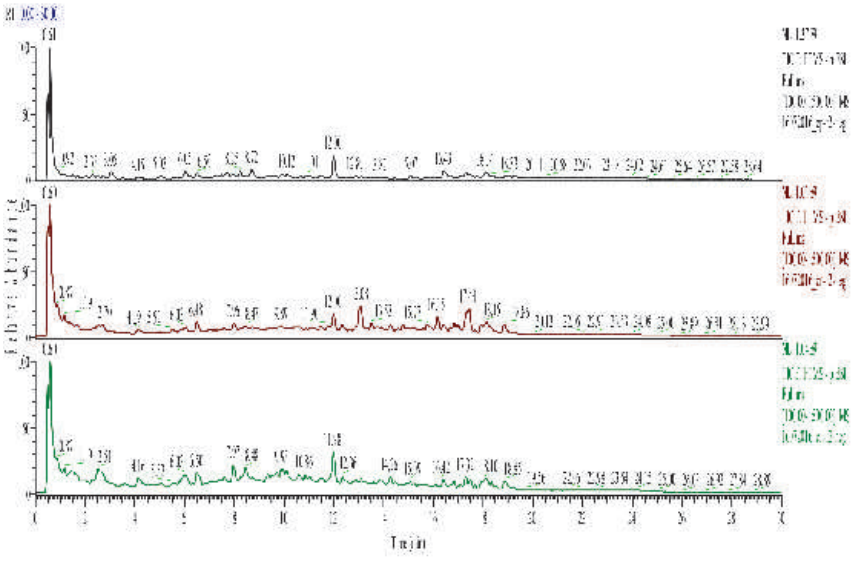


Fig. 18 Relative abundance of metabolites in Phyllody, Normal plants with little leaf symptoms in chrysanthemum

Approximately 2000 metabolites have been found to be produced differentially among infected and healthy looking plants. Further analysis of the differentially expressed metabolites against the Plant metabolome database for identification is in progress.

2.3. Project 03 (ICAR Project Code: IXX11708): Assessment of Nematode Infestation in Major Commercial Flower Crops and Management of Root-Knot Nematode in Tuberose

2.3.1. Identification of Root-Knot Nematode Species Associated with Flower Crops

Two populations of root-knot nematodes were collected from Maharashtra. One from the tuberose field of DFR Research Farm, Pune and another from gerbera grown under protected cultivation in Ahemednagar District. Mature female were isolated from the infested roots. The morphology of perineal pattern in the posterior region of the female comprising of tail terminus, lateral lines, anus, and vulva surrounded by cuticular lines or striae were used for identification. Based on perineal pattern (Fig. 19), associated species of root-knot nematodes affecting tuberose in open field condition and gerbera under protected cultivation was identified as *Meloidogyne incognita*. The above two populations cultured from single egg mass and multiplied and submitted to ICAR-Indian Institute of Pulse Research, Kanpur for identification of race.

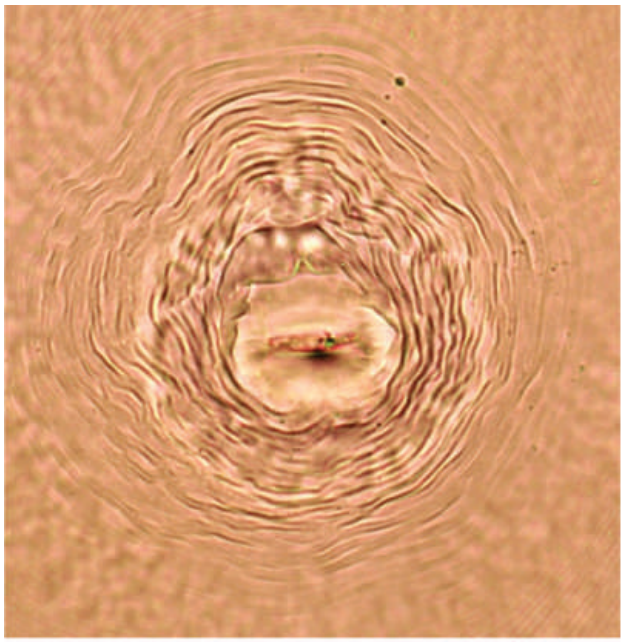


Fig. 19. Perineal pattern of root-knot nematode, *Meloidogyne incognita*

2.3.2. Population Dynamics of Plant Parasitic Nematodes in Tuberose

Population dynamics of eight genera of plant parasitic nematodes were studied in tuberose. The population of root-knot nematode, *Meloidogyne* spp. increased during the first six months starting from May and reached highest population density (352 nematodes / 200 cc soil) in the month of October followed by decline. However, population density of reniform nematode, *Rotylenchulus* spp. reached highest (245 nematodes/ 200 cc soil) in the month of August. The low population density (9-56 nematodes / 200 cc soil) of lesion nematode, *Pratylenchus* spp. was also observed from the month May to February. The ectoparasitic nematode population (*Hoplolaimus* spp., *Tylenchorhynchus* spp., *Helicotylenchus* spp. and *Xiphinema* spp.) were not detectable during the initial period, however, low density was observed during later months (Fig. 20). The saprophytic nematode population was also observed and found more abundant (420-700 nematodes /200 cc soil) during August to October.

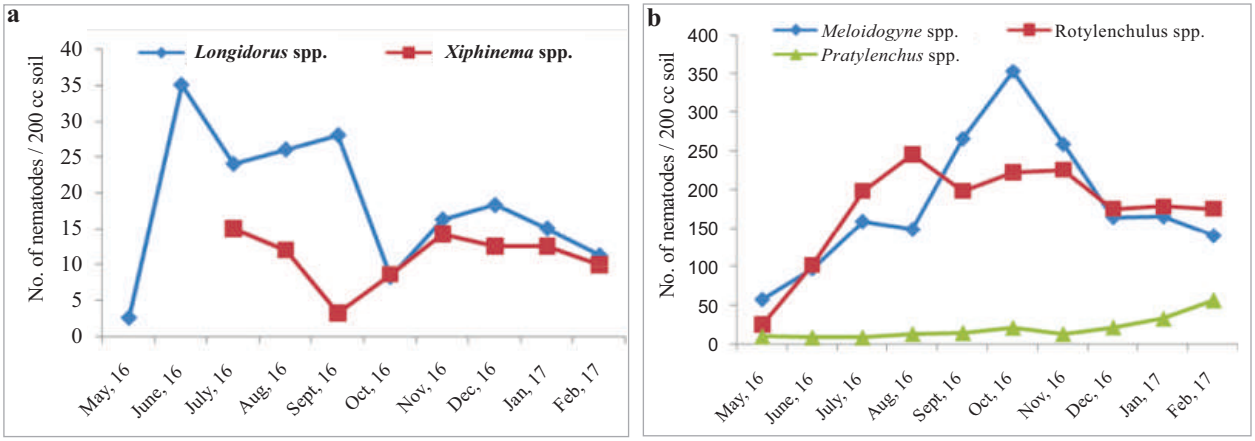


Fig. 20. Nematode Population dynamics of plant parasitic nematodes (a, b and c) in tuberose

2.3.3. Changes in plant parasitic nematode populations in the rhizosphere of marigold crop

Changes in population density of six genera of plant parasitic nematodes in the rhizosphere of marigold were studied. Population density of all the plant parasitic nematodes except, dagger nematode, *Xiphinema* spp. decreased in the presence of marigold crop. However, the population of dagger nematodes, *Xiphinema* spp. was not affected and population was stable during initial months and increased in the presence of marigold crop (Fig 21).

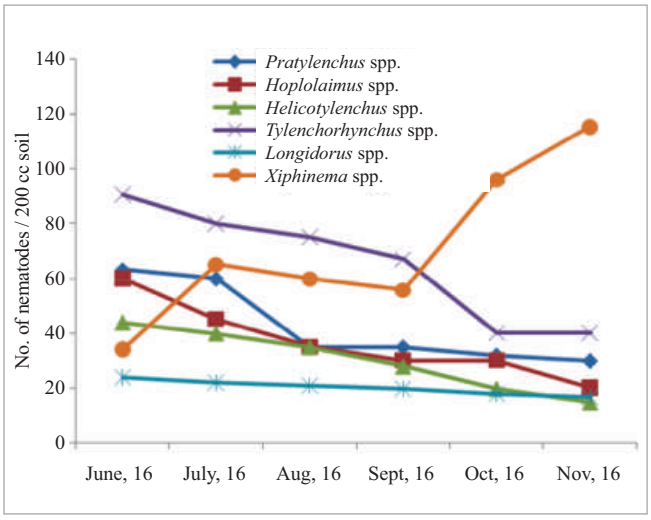


Fig. 21. Nematode population density in rhizosphere of marigold crop

2.3.4. Management of Root-knot Nematode in Tuberose

In pot experiment, synthetic pesticides such as imidachloprid, thiomethoxon, carbosulfan were evaluated as seed soaking for management of root-knot nematode, *Meloidogyne incognita* infecting bulbs of tuberose.

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 of galls were observed in the treatment with carbosulfan at 2000 ppm (15-23 galls/plant) followed by 1000 ppm (25-38 galls/plant) compared to untreated control (72-85 galls/plant). No significant reduction in number of galls was observed in the treatment with either imidachloprid or thiomethoxon in any of the concentrations. The nematode multiplication rate (1.9-fold) was also lowest in carbosulfan (2000 ppm) compared to 3.8-, 4.2- and 4.6-fold multiplication rate in imidachloprid (2000 ppm), thiomethoxon (2000ppm) and untreated control respectively.

2.3.5. Evaluation of Bio-formulations for Management of Root-knot Nematode in Tuberose

The experiment was conducted to standardise the efficacy of bio-formulations such as *Trichoderma viridae*, *Pochonia chlamydosporia*, *Pseudomonas flurescens* in tuberose field naturally infested with root-knot nematode, *Meloidogyne incognita.* The treatment consisted of application of 2.5 tons of FYM enriched with 2 kg each of *T. viridae, P. chlamydosporia* and *P. flurescens* per hectare followed by application of 1 ton of FYM enriched with above bio-formulations per hectare six times at 30 days interval and three times at 60 days interval. The untreated control and application of carbofuran @ 2 kg a.i / ha (60 days interval) served as a control. The nematode population density was recorded up to eight months at 60 days interval. The root galling was recorded at the end of the experiment (*i.e.* after 8 months).

2.3.5.1. Effect of Bio-formulations on Nematode Population Density

The study revealed significant decrease in nematode population in the treatment with bio-formulations and carbofuran compared to untreated control. The decrease in nematode population was slow and gradual during the entire study period. Only 7.2% of the nematode population decreased after 60 days and which increased to 15.8% at 120 days, 25.3% at 180 days and 51.4 % at 240 days in the treatment with bio-formulations applied at 30 days interval compared to untreated control. The decrease in nematode population in the treatment with bio-formulations applied at 60 days intervals was 4.1% at 60 days, 12.3% at 120 days, 18.5% at 180 days and 43.4% at 240 days compared to untreated control. However the application of carbofuran @ 2 kg a.i / ha at 60 days intervals resulted in decrease in nematode population of 15.2% at 60 days, 31.3% at 120 days, 46.4 % at 180 days and 61.3% at 240 days.

2.3.5.2. Effect of Bio-formulations on Root-galling in Tuberose

Application of FYM enriched bio-formulations at 30 days interval resulted in 60.3% reduction in root-galling after 240 days compared to 40.4% in the treatment with bio-formulations applied at 60 days interval. The reduction in root-galling in carbofuran treatment was 72.4%.

2.3.6. Evaluation of Tuberose Cultivars for Their Resistance to Root-Knot nematode, *Meloidogyne incognita*

In the second year trial, genotypes, GKT-C4, Shringar, Arka Nirantara, Bhidhan Rajani-2, Suvasini and Hyderabad Double were screened for their response to root-knot nematode, *Meloidogyne incognita*. Disease reaction of these genotypes for root-knot nematode was recorded on the basis of number of root-galls on each genotype per plant and plant growth characteristics. All the genotypes recorded the root galling in the range of 48 - 75 and were found susceptible. Observations on plant height, spike length and rachis length were taken 70 days after planting and found significantly reduced.

2.3.7. Evaluation of Chrysanthemum Cultivars for their Disease Reaction to Root-Knot Nematode, *Meloidogyne incognita.*

Twenty one chrysanthemum cultivars were evaluated for their disease reaction to *Meloidogyne incognita.* Resistance reaction of these genotypes for root-knot nematode was recorded on the basis of number of root-galls on each genotype per plant. Based on root-gall rating, resistance reaction is categorised as follows. Susceptible genotypes (root-knot index 4 with number of galls ranges from 31 to 100): Pusa Chitraksha, DFR-CH-74, DFR-CH-89, DFR-CH-95, DFR-CH-91, Ravi Kiran and Red Stone. Moderately susceptible genotypes (root-knot index 3 with number of galls ranges from 11 to 31) DFR-CH-F-16, DFR-CH-D-59, DFR-CH-D-45, Vasantika, DFR-CH-D-66, DFR-CH-D-17, Haldighati, DFR-CH-L-80, Sadwin Yellow, Anmol, Mallika Yellow, Pusa Aditya , Lal Pari and Dolly Orange. Moderately resistant genotypes (root-knot index 2 with number of galls ranges from 3 to 10): Pusa Chitraksha and Mallika Yellow.

2.4 Project 4. Etiology and Integrated Management of Fungal Diseases of Flower Crops

2.4.1. Isolation of Fungal Pathogens from Infected Samples of Tuberose, Gerbera, Chrysanthemum and Amaryllis

Tuberose, Gerbera, Chrysanthemum and Amaryllis samples were collected from ICAR-DFR field. Fungal pathogens showing characteristic visible symptoms like spots, blights, anthracnose, wilts, rots etc. were isolated in PDA media supplemented with Tetracycline or Chloramphenicol, at the rate of three to five pieces of tissues per petriplate and incubated at room temperatures (25–27°C) that favor 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.

The fungus has been subcultured at regular intervals to maintain its vigor for various studies. The petridishes were incubated at temperatures that favour spore germination. The dishes were examined under the microscope at regular intervals and the locations of germinating spores were marked using a glass marking pencil. The marked germinating spores along with a small amount of medium were individually transferred to agar slants for development of colonies from the germinating spores (Fig. 22)

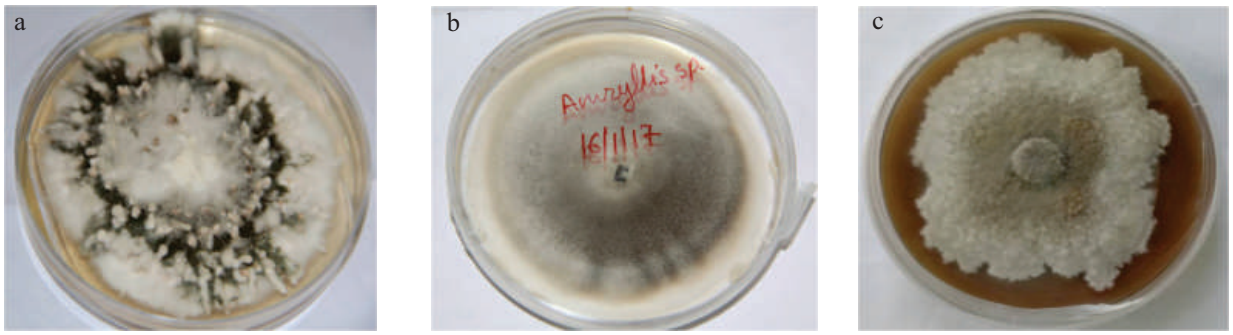


Fig. 22. Pure culture of fungal pathogens isolated from Tuberose (a), Amaryllis (b) and Gerbera (c).

2.4.2. Identification of Pathogens Based on Morphological Characters

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

a) *Colletotrichum* sp. was identified from the Amaryllis leaf sample and pure culture was isolated from infected Amaryllis leaf (Fig: 23).

b) *Cercospora* sp. was identified from Gerbera leaf sample and pure culture was isolated from infected Gerbera leaf sample (Fig: 24).

c) *Alternaria* sp. was identified from Chrysanthemum leaf sample and pure culture was isolated from infected Chrysanthemum leaf sample (Fig: 25).

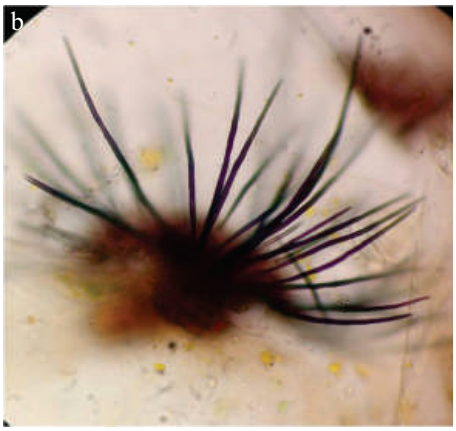


Fig. 23.

Symptoms of fungal pathogen incidence
a. Amaryllis leaf scorch
b. *Colletotrichum sp.*

Fig. 24.

c. Gerbera leaf spot
d. *Cercospora sp.*

Fig. 25.

e. Chrysanthemum leaf spot
f. *Alternaria* sp.

3. Post Harvest Management

3.1 Project 1 (ICAR Project Code: IXX12322): Standardization of Post-Harvest Packaging Technology for Tuberose and Jasmine

The fully developed unopened florets (buds) of locally grown single tuberose cultivar were packed in Foldable crates (FC) with inner lining of cotton, Poly-propylene (PP) box with inner lining of cotton and Foldable crates without ventilation and with inner lining of cotton. All the packages containing buds were stored at room temperature. The Data presented in Table 3.1 indicated that florets packed in PP box showed lesser decline of physiological loss in weight (PLW %) compared to FC. The freshness index was better and at par in case of flower buds packed in Foldable crates with inner lining of cotton.

Three different 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%) were designed and are being tested

Table 3.1 Effect of packaging material on physiological loss in weight (PLW %) of tuberose loose flowers

Packaging Boxes	Duration (h)						
	12	24	36	48	60	72	Mean
Perforated Foldable Crate	1.85	3.44	4.54	6.63	8.75	12.4	6.26
Un-foldable Crate	2.35	6.12	10.54	15.24	18.34	20.17	12.12
PP Box without ventilation	0.60	1.09	2.21	4.31	6.54	8.91	3.95

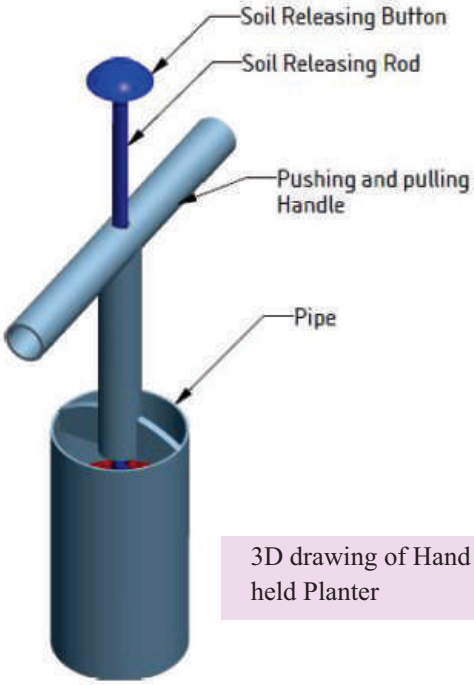
3.2 Project 2: Design and Development of Tools and Gadgets for Floriculture (an Inter-institutional Collaborative Research Project between ICAR-DFR, Pune and ICAR-CIAE, Bhopal)

3.2.1 Design and Development of Hand Held Bulb Planter

Bulbs/Corms of flower crops like Gladiolus, Tuberose, etc are planted on raised beds or ridges. The depth and spacing between the bulbs depends on variety and type of flower crop. In general, the planting depth of bulbs is double the diameter of bulb. It is to be ensured that the bulbs/corms are planted deep enough (approx. 10 cm.). Planting of these bulbs or corms is often done manually wherein proper depth of planting is not maintained. Also for planting of bulbs or corms require manpower. Cheap labour would no longer be assured in years to come due to acute shortage of labour owing to migration and availability of more lucrative avenues for skilled labour. Inadequate mechanization and availability of labour are the major constraints to carry out

planting of bulbs or corms in India. To overcome the constraints (huge manpower requirement, improper maintenance of uniform planting depth), to simplify the planting process and to reduce the cost of planting, ICAR-DFR has designed and developed a prototype of bulbs/corms planter.

The hand held bulbs planter has mainly three parts (Fig. 26), cylindrical shaped shaft which goes through (enters into) the soil to make a hole for planting of bulbs or corms, soil releasing system and handle for pushing and pulling of planter into soil (Fig. 27). Diameter and height of cylindrical shaft is 8 cm and 15 cm respectively. The soil releasing system consists of handle with concave shaped plate attached at bottom of this handle. The length of handle is 15 cm and diameter of concave shaped plate is 7 cm. The length and diameter of top handle is 22.5 cm and 2.5 cm respectively. The overall height of planter is 32.5 cm. The method of working with hand held bulb planter is very simple. Firstly push the planter down into the ground, twist the planter 3 to 4 times. After that lift and remove from the ground and place your bulb in the hole, then simply press the soil releasing button to eject the soil from the planter back into the hole. This planter will save the time and money.



3D drawing of Hand held Planter

Fig. 26 Prototype of Hand held Bulb Planter

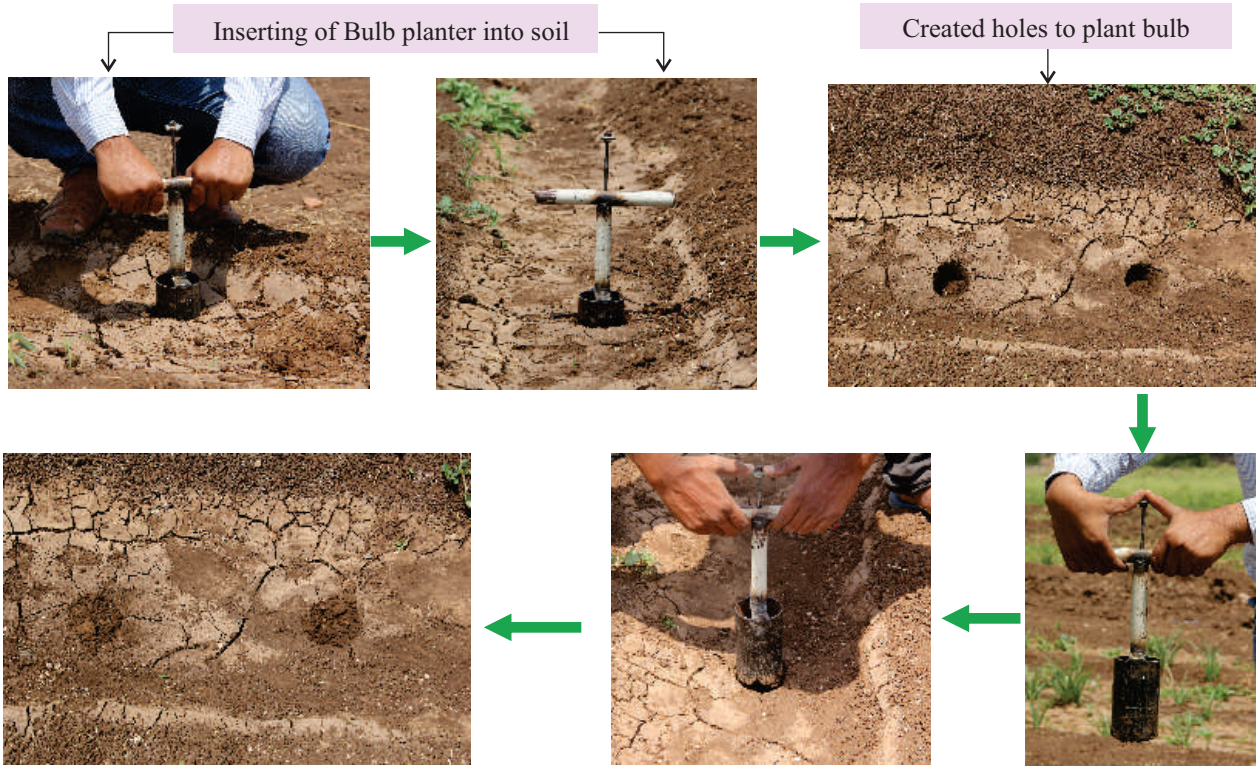


Fig. 27 Working of Hand Held Bulb Planter

3.3 Project 3. Harnessing Natural Pigments from Flower Crops for Making Value Added Products from Grapes (Collaborative Project with ICAR-NRCG, Pune)

Plant pigments are extensively used as nutraceuticals owing to their therapeutic properties. Floricultural crops offer wide range of pigments that possess unique neutraceutical properties. A large number of value added products are made from grapes. However, the consumer preference is more towards value added products from coloured grapes. In order to fortify the products from green grapes an inter-institutional project was developed in collaboration with ICAR-National Research Centre on Grapes.

3.3.1. Collection of Flower Samples and Processing

Fresh flower samples of eight marigold accessions from ICAR-DFR and MPKV Ganeshkhind farms; 24 rose varieties from farmer's field; and 120 chrysanthemum accessions from ICAR-DFR research farm were collected. All the flower samples were shade dried and powdered. The powdered samples were stored in air tight containers at room temperature.

3.3.2.Determination of Total Phenolics, Flavonoids and Antioxidant Activity

Flower samples from marigold and rose were processed for extraction of natural pigments in 80% methanol by 2-3 hours shaking at room temperature. After centrifugation at 14000g, the crude extracts were separated and stored at -20°C. Crude methanol extracts of both rose and marigold were subjected to total phenol, total flavonoids and antioxidant assays.

Phenols

In case of Marigold, freshly collected flowers of seven accessions were dried in two conditions (a) Oven dried at 40-45°C (b) Shade dried and were analysed separately for total phenol content. It was observed that shade dried marigold samples have shown higher levels of total phenolics content in comparison with oven dried samples. Among the shade dried samples of marigold, accession Arka Alankara (229.3 µg/mL GAE) contained highest total phenolic content followed by Agni (220.91 µg/mL GAE) and Arka Bangara (210.3 µg/mL GAE) while lowest was found in BMG-1 (145.3 µg/mL GAE; Fig. 28).

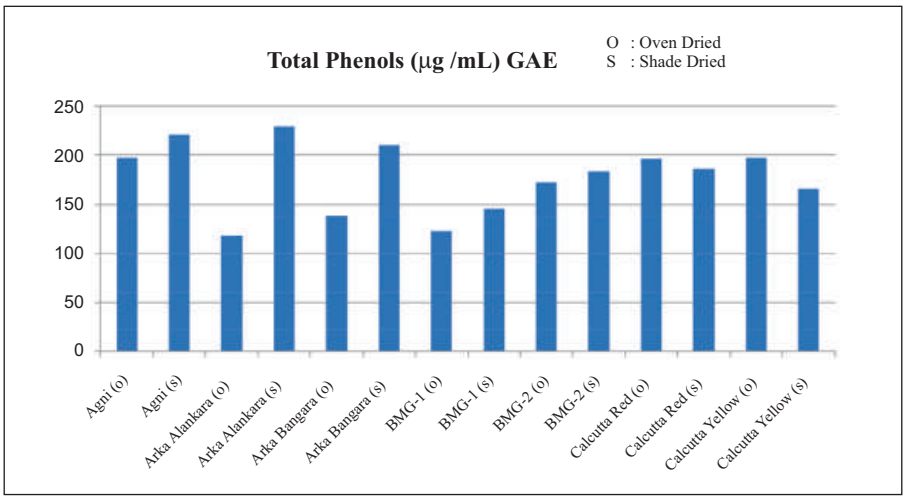


Fig. 28 Total phenolics content in seven marigold accessions.

Screening of flower petals from different rose accessions (19 nos.) revealed that the hybrid Nimhan Pink recorded maximum phenol content (487.98 µg/mL GAE) followed by Papa Meilland (469.46 µg/mL GAE), Double Delight (434.62 µg/mL GAE) and Yodha (411.53 µg/mL GAE). Whereas Jay Malhar (123.69 µg/mL GAE) contained the lowest phenolics content (Fig.29).

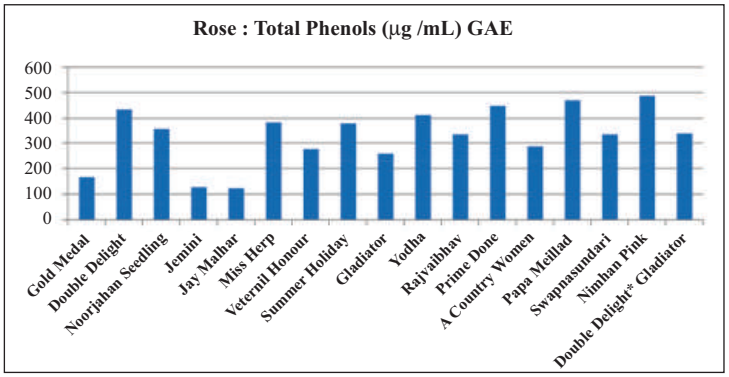


Fig. 29 Total phenol content in 17 rose accessions

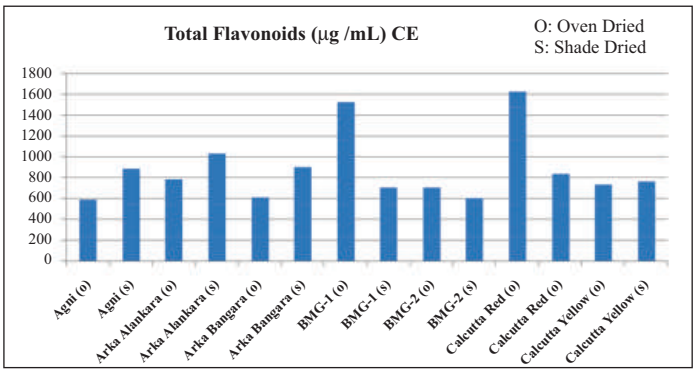


Fig. 30 Total flavonoid content in seven marigold accessions

Flavonoids

Oven dried marigold samples of Calcutta Red (1621.71 µg/mL CE) and BMG-1 (1519.64 µg/mL CE) have shown highest levels of total flavonoids. Among the shade dried samples, Arka Alankara (1027.6 µg/mL CE) recorded maximum total flavonoids followed by Arka Bangara (893.89 µg/mL CE) and Calcutta Red (833.27 µg/mL CE) while lowest total flavonoids was found in oven dried Agni (585.89 µg/mL CE) (Fig. 30).

In rose, shade dried flower samples were analysed for total flavonoids and highest flavonoid content was observed in Double Delight (1571.32 µg/mL CE) followed by Swapna Sundari (1369.77 µg/mL CE) and Papa Meilland (1068.62 µg/mL CE) while lowest was observed in Rajvaibhav (504.12 µg/mL CE) (Fig.31).

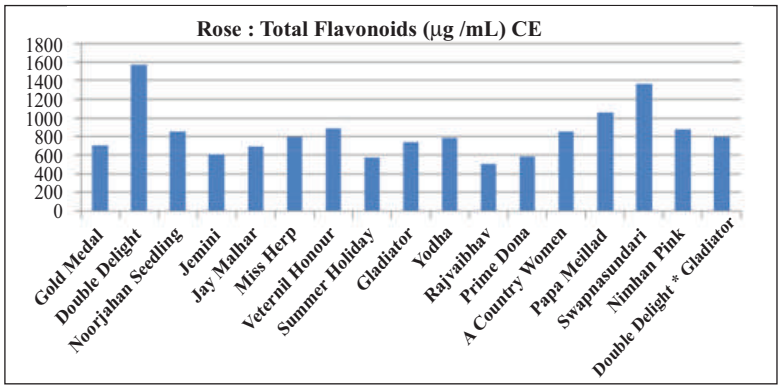


Fig. 31 Total flavonoid content of 17 rose accessions

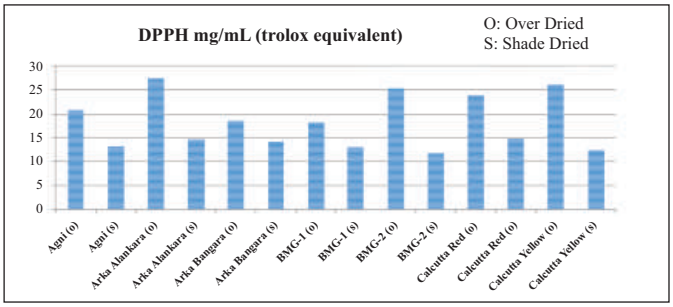


Fig. 32 DPPH assays of seven marigold accessions to access antioxidant capacity

Antioxidant assay

Antioxidant assay namely 2, 2 Diphenl-1-picrylhydrazyl (DPPH) was carried out with crude extracts of seven marigold accessions. It was found that oven dried marigold samples have shown higher readings in comparison with shade dried samples (Fig. 32). Further, Cupric assays are being carried out to ascertain the antioxidant activity of marigold flower crude methanol extracts.

4. Externally Funded Projects

4.1 Project 1: Consortia Research Platform (CRP) on Borers in Network Mode

Survey was undertaken in Maharashtra, Andhra Pradesh, Goa and Karnataka for the incidence of bud borer (*Helicoverpa armigera*) (Figure 33); cutworm (*Spodoptera litura*) and jasmine bud borer (*Hendecasis duplifascialis*) both under polyhouse and open field conditions. Incidence of bud borer (*Helicoverpa armigera*) was very less during the period of survey. The incidence in rose (10 – 15%), followed by China Aster (10 – 15%), carnation (5 – 10%), marigold (5 – 10%), gaillardia (5 – 10%), and tuberose (3 – 5%) was recorded (Figure 34 a-f).

Common cutworm (*Spodoptera litura*) was found to be damaging flowers of gerbera under polyhouse in different polyhouses surveyed in Maharashtra. The damage was to the tune of 25 – 30 per cent in gerbera affecting the commercial production (Figure 35).

Minor incidence (< 1%) of Jasmine bud borer (*Hendecasis duplifascialis*) was recorded in one field (Shindawane, Pune district).

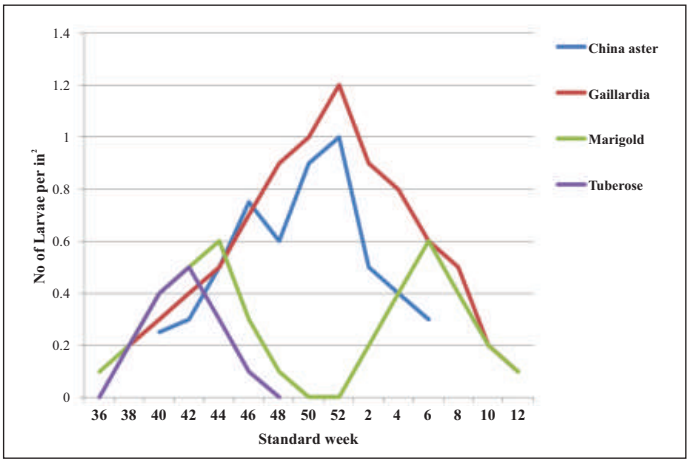


Fig. 33 Incidence of bud borer, *Helicoverpa armigera*

Fig. 34 a Eggs of bud borer on China aster

Fig. 34b. Eggs of bud borer on rose

Fig. 34c. Bud borer damage in China Aster

Fig. 34d. Bud borer damage in rose

Fig. 34e. Bud borer damage in tuberose

Fig. 34f. Bud borer damage in gaillardia

Fig. 35 Cutworm, *Spodoptera litura* damage in gerbera

4.2 Project 2: New Initiative Project on Protected Horticulture

To standardise the media composition in gerbera cv. Stanza under protected cultivation seven treatments namely T_1 (Cocopeat + Sand+ FYM @2:1:1), T_2 (Cocopeat + Sand + FYM + Leaf mould @2:1:0.5:0.5), T_3 (Cocopeat + Sand + Vermicompost @2:1:1), T_4Cocopeat + Sand + Rice husk @2:1:1), T_5 (Cocopeat + Sand + Rice husk+ Leaf mould @2:1:0.5:0.5) and T_6 (Cocopeat + Perlite + Vermiculite @2:1:1) were imposed with T_7 as control (soil). Out of seven treatments, T_1 was found to be the best for improving vegetative and floral characteristics.

4.3 Project 3: Studies on Male Sterility Systems to Increase the Efficiency of F1 Hybrids in Horticultural Crops (Marigold)

4.3.1 Anther Dehiscens Pattern in Marigold

The pattern of anther dehiscence based on visual observations (Table 4.1) at different stages (Bud stage, half opened and full opened flowers) of flower development was recorded in all the genotypes. None of the genotypes recorded anther dehiscence at bud stage. However, the genotypes Local Selection 2, Local Selection 3, Thuljapur Local A and Thuljapur Local B showed anther dehiscence at half opened stage. Stigma receptivity was not noticed in initial two stages of anther dehiscence.

Table 4.1 Anther dehiscence (visual observation) at flower development stages

Sl. No.	Genotypes	Stage		
		Bud	Half Open	Fully Open
1	Pusa Narangi Gainda (African Marigold)	x	*	**
2	Pusa Basanti Gainda (African Marigold)	x	*	**
3	Bidhan Marigold 1 Yellow	-	-	-
4	Bidhan Marigold 2 Orange	-	-	-
5	Local Selection 1 (French Marigold)	x	**	***
6	Local Selection 2 (French Marigold)	x	***	-
7	Local Selection 3 (French Marigold)	x	***	-
8	Thuljapur local A (French Marigold)	x	***	-
9	Thuljapur local B (French Marigold)	x	***	-
10	Thuljapur local C (French Marigold)	x	**	***
11	Thuljapur local D (French Marigold)	x	**	

x : No dehiscence; *: Anther dehiscence observed in 1/3 of the flowers
** : Anther dehiscence observed in 2/3 of the flowers; ***: Anther dehiscence observed in all the flowers

Crossing was attempted among 11 genotypes of marigold (Table 4.2). Seed setting was observed in all the cross combinations except Bidhan Marigold 1 and Bidhan Marigold 2. The crossed seeds so collected were further evaluated for germination. But the seeds from cultivars Bidhan Marigold 1 and Bidhan Marigold 2 failed to germinate. It may be due to non-viability of seeds.

Table. 4.2 Crossing among the marigold genotypes

S. No.	Genotypes	Pusa Narangi Gainda	Pusa Basanti Gainda	Bidhan Marigold 1	Bidhan Marigold 2	Local Selection 1	Local Selection 2	Local Selection 3	Thuljapur local A	Thuljapur local B	Thuljapur local C	Thuljapur local D
1	Pusa Narangi Gainda	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Pusa Basanti Gainda	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Bidhan Marigold 1	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓
4	Bidhan Marigold 2	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓

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S. No.	Genotypes	Pusa Narangi Gainda	Pusa Basanti Gainda	Bidhan Marigold 1	Bidhan Marigold 2	Local Selection 1	Local Selection 2	Local Selection 3	Thuljapur local A	Thuljapur local B	Thuljapur local C	Thuljapur local D
5	Local Selection 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Local Selection 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	Local Selection 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Thuljapur local A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	Thuljapur local B	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	Thuljapur local C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Thuljapur local D	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓: Viable seed setting observed & x: Non-viable seed setting

4.4 Project 4. Phytonematode in Floriculture: Identification, Occurrence, Distribution and GIS Mapping

Survey was undertaken during 2016-17 and seventy-five soil and/ root samples were collected from flower crops grown in protected and open field conditions. The surveyed region includes 4 districts in Maharashtra (Pune, Ahmednagar, Nashik and Satara), 4 districts in Karnataka (Davanagere, Shimoga, Dharwad and Belgaum) and 2 districts in Goa (North and South Goa). About 15 soil and root samples were also collected from the nursery units of Kadiyam Mandal in East Godavari District of Andhra Pradesh. The absolute and relative density, absolute and relative frequency, and prominence value of each nematode were determined. The GPS location of some of the sample, variety, previous crops/cropping system were also recorded. The salient achievements were given below.

4.4.1 Incidence and Severity of Root-Knot Nematode, Meloidogyne spp. in Flower Crops

The studies revealed variations in the incidence and severity of root-knot nematodes in different flowers grown in different districts. Based on above ground symptoms like stunted growth with patchy appearance and reduced plant growth characteristics and number of galls on the roots (Fig. 36), the incidence and severity was recorded. The root-knot nematode incidence ranged from 15-45 % with severity range of 50-80% in tuberose grown in Maharashtra. Up to 15% incidence of root-knot nematode was recorded in gerbera grown under protected cultivation and severity ranged from 10-30 % in Ahmednagar, Pune (Maharashtra), Shimoga, Davanagere (Karnataka) district and Goa region. About 2-3 % incidence was also recorded in crossandra with severity range of 15-30% in Shimoga district of Karnataka.

Fig. 36 Galls due to root-knot nematodes on the roots of a) Gerbera, b) China aster, c) Crossandra and d) Tuberose e) Different life cycle stages of root-knot nematode recovered from the roots of tuberose

4.4.2. Occurrence and Distribution of Plant Parasitic Nematodes Associated with Ornamental Crops Grown in Nursery Units

In nursery units of Kadiyam, plant parasitic nematodes such as *Meloidogyne* spp., *Rotylenchus* spp., *Pratylenchus* spp., *Helicotylenchus* spp., *Hoplolaimus* spp., and *Tylenchorhynchus* spp. were found in the rhizosphere of ornamental crops such as rose, crossandra, fern, jasmine and croton. In case of croton, fern and jasmine, higher population density of lesion nematode (*Pratylenchus* spp.) (65-121 nematodes / 100 cc soil) was recorded followed by root-knot nematode (34-109 nematodes/100 cc soil). In case of crossandra higher population density of root-knot nematode (98-115 nematodes/100 cc soil) was recorded. The results indicate that ornamental crops harbor economically important nematodes which may spread to uninfected area if strict control measures were not adopted at nursery level in order to make nematode free planting material.

4.4.3. Occurrence and Distribution of Plant Parasitic Nematodes Associated with Flower Crops Cultivated under Protected and Open field Conditions

Under protected cultivation, in case of gerbera and carnation, root-knot nematode is the predominant one followed by reniform nematodes irrespective of the region. In case of tuberose, crossandra and gaillardia grown under open field condition root-knot nematode is most predominant one followed by lesion nematode. In case of rose grown under both protected and open field conditions, the ectoparasitic nematode (*Xiphinema* spp.) was most abundant and also predominant one. In cut flower crops, such as rose, gerbera, carnation, chrysanthemum and gypsophila grown under protected units, the most frequently occurring nematode is root-knot nematodes with relative frequency value of 18.7 followed by reniform nematode and lesion nematode having relative frequency value of 14.3 and 15.0 respectively.

The absolute and relative density, absolute and relative frequency, and prominence value of each nematode were also determined in important crops (rose, tuberose, chrysanthemum, China aster, jasmine, marigold, golden rod, lily and gaillardia) grown in open field condition. The study revealed that lesion nematode (*Pratylenchus* spp.) ranked first in mean density/site and prominence value, although it was not found as frequently as many other nematodes. Root-knot nematode was the most dominant in tuberose and chrysanthemum. The ectoparasitic nematodes (*Tylenchorhynchus* spp., *Helicotylenchus* spp. and *Xiphinema* spp.) were dominant nematodes in golden rod, lily and gaillardia. The study indicates the association of important plant parasitic nematodes such as *Pratylenchus* spp., *Meloidogyne* spp., *Rotylenchulus* spp., *Xiphinema* spp. in flower crops that may cause severe economic yield loss to flower crops.

4.5 Project 5. Indian Floriculture Industry: Production, Marketing and Export Dynamics

In India, the traditional flower marketing is relatively unorganized when compared to the marketing of the cut flowers. Owing to the highly perishable nature of the flowers the traditional flowers are often marketed in the nearby cities and towns of production centers. Very often the loose flowers are sold in the road side markets with poor infrastructure facilities. Data on month wise and area wise arrivals of different flowers were recorded in Pune, Mumbai, Delhi and Nashik markets. The socio-economic aspects of the markets are documented. Similarly the spike in prices, the demand and glut periods in these markets were documented.

4.6 Project 6. Characterization and Natural Spread Sources of Phytoplasmas Affecting Major Floricultural Crops of India

- To affirm the role of *Cuscuta* observed near chrysanthemum fields spreading phytoplasma to chrysanthemum, total DNA from *Cuscuta* vines were isolated and subjected to PCR diagnostics based on 16srDNA primers. The PCR has given positive results and sequencing of the same is done. Virtual RFLP of the sequences to assign group identity of the phytoplasma is in progress.
- Nested PCR and molecular characterization of gerbera Phyllody phytoplasma has been done successfully.
- Symptomatic samples of phytoplasma infection suspected samples were collected from marigold, chrysanthemum and parthenium were sent for identification to Delhi University.
- The weeds occurring in Marigold were recorded and survey and observation revealed old and abandoned Marigold fields nearby the commercial cultivation act as reservoirs of the phytoplasma and the vector leafhoppers which act as major pathway for infection of the marigold in cultivation.

4.7 Project 7. Studies on Phytoplasma and Viroids in *Duranta erecta*: Maladies Induced in Orchards and Landscapes. (Inter-institutional collaborative project)

Duranta samples from six different locations around Pune *i.e.* Narayngaon, Kusur, Rajgurunagar, Loni, Shivajinagar and Manjri farm showing various symptoms like crinkling, little leaf, necrosis and yellowing were collected and subjected to PCR based identification of Phytoplasma based on 16srDNA sequence based primers and ELISA based identification of Cucumber mosaic virus. The results were negative in both of the studies. Further survey and collection of the samples is in progress.

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 2016-17, a course on "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 are also involved as members of Research Advisory Committe of Post-Graduate students of College of Horticulture, Pune.

Outreach Programmes

Dutch Floral Design Workshop

Team ICAR-DFR has actively participated in *Dutch Floral Design Workshop* organized by the Embassy of Netherlands, New Delhi in association with Mahratta Chamber of Commerce Industries & Agriculture, Pune on April 29th, 2016. The workshop began with a flower arrangement competition and followed by lectures and demonstrations of floral designing by experienced faculties from Wageningen University and Research, Holland.

Interacting with the Dutch floral expert

Stakeholders Meet on Mechainization in Horticultural Crops

ICAR-DFR actively participated in one day stakeholders meet on Mechainization in Horticultural Crops organized by CIAE, Bhopal at College of Agriculture, Pune on October 27th, 2017.

Stakeholders meet in progress

1st International Agrobiodiversity Congress (IAC) 2016

ICAR-DFR participated in the 1st International Agrobiodiversity Congress during November 6-9th, 2016. The Congress was inaugurated by Shri. Narendra Modi, Honorable Prime Minister, Government of India on November 6th, 2016 at Vigyan Bhawan, New Delhi. The ICAR-DFR has put-up a stall in the adjoining exhibition showcasing the diversity in traditional flowers and exhibited fresh traditional flower samples, value added floral products like *veni*, garlands, bunches, floral crowns, floral plaits, etc. that were sourced from Pune, ICAR-DFR Regional Station at Vemagiri, Kadiyam, Andhra Pradesh and various AICRP (Floriculture) centres.

Prof. M.S. Swaminathan visited ICAR-DFR stall during the 1st International Agrobiodiversity Congress on November 6-9th, 2017 at NASC complex, New

Dr. A. K. Singh, DDG (Agril. Ext & Hort.Sci.), Dr. T. Janakiram, ADG (HS-II), ICAR visited ICAR-DFR stall during the 1st International Agrobiodiversity Congress on November 6-9th, 2017 at NASC complex, New Delhi.

Regional Agricultural Fair 2016 at Muzaffarnagar

ICAR-DFR actively participated in Regional Agricultural Fair 2016 held at Muzaffarnagar during November 27th to December 1st, 2016 by putting-up a stall with various flower and floricultural products. The Regional Agricultural Fair 2016 was inaugurated by Dr. Sanjeev Kumar Balyan, Hon'ble Minister of State for Water Resources, River Development & Ganga Rejuvenation. The stall was appreciated by all the stakeholders who paid the visit and it was the biggest farmers fair in Muzaffarnagar ever organized.

Dr.Tarak Nath Saha, Scientist explaining the exhibits at DFR stall to visitor

ICAR-DFR participates in "Kisan Diwas" at IARI Regional Station, Pune

ICAR-DFR participated and organized a stall in the agriculture fair organized as part of "Kisan Diwas" at IARI Regional Station, Baner, Pune on October 15th, 2016. Dr. Mrs. Ravinder Kaur, Director & Dr. J.P.Sharma, Joint Director (Extension), IARI, New Delhi visited and appreciated the DFR stall. All the Scientists of ICAR-DFR participated in the mela actively and interacted with the farmers.

Dr. Mrs. Ravinder Kaur, Director & Dr. J.P. Sharma, Joint Director (Extension), IARI, New Delhi visited DFR stall during Kisan Diwas organized at IARI RS, Pune

Training/Seminar/Symposia/Workshop Organized

Sensitization Workshop on IPR

The ITMU of the institute has organized a sensitization workshop to sensitize about the ITMU, ITMC and intellectual property rights and technology management in ICAR on May 23rd, 2016. Ms. Shephalika Amrapali incharge ITMU made a presentation on ITMU and its role and Dr. K.V. Prasad delivered lecture on IPR Issues in Floriculture.

Sensitization Workshop in progress

Brainstorming Session on: Phytochemicals and Nutraceuticals

ICAR-DFR & NRC-Grapes jointly organized a brainstorming session on Phytochemicals and Neutraceuticals on June 17th, 2016 at NRC-Grapes. Dr. N.K. Krishna Kumar, DDG (HS), ICAR was the Chief Guest of the function. Many experts working on phytochemicals and neutraceuticals across the country delivered lectures on various aspects of neutraceuticals and their applications.

Dr. N.K. Krishna Kumar, DDG (HS) addressing the delegates

Farmers-Academia Interface on Phytoplasma Diseases in Horticultural Crops: Current Scenario and Future Challenges

ICAR-DFR in association with Dr. Y.S.R Horticultural University, Venkataramannagudem and Indian Nurserymen Association, Kadiyam (Kadiyapulanka) has successfully organized a *Farmers-Academia Interface on Phytoplasma Diseases in Horticultural Crops: Current Scenario and Future Challenges* on June 29th, 2016 at Rajamahendravaram. The objective was to impart awareness about the importance of phytoplasma diseases in horticultural crops in the nursery hub of Kadiyapulanka. Dr. K.V.Prasad, Director, ICAR-Directorate of Floricultural Research, welcomed distinguished guests and all the delegates, and briefed about the purpose of the event. The interface was graced by Dr. B.M.C. Reddy, Vice Chancellor and Dr. Srinivasulu, Registrar from Dr. Y.S.R.H.U; Dr. Damodar Reddy, Director, ICAR-Central Tobacco Research Institute, Dr. R.K.Mathur, Director, ICAR-Indian Institute of Oil Palm Research, Pedavegi. The event was a big success as more than 300 farmers and 100 scientists participated and interacted with the

Release of base paper by the Chief Guest

academia. The experts from all spheres of horticulture and crop protection answered the queries of farmers. Followed by the interface, experts in phytoplasma research delivered lectures on multifaceted aspects of phytoplasma diseases of horticultural crops ranging from taxonomy, diagnostics, phytobiosecurity aspects to management. The presentations were well appreciated by the farmers as well as scientific fraternity. A base paper on 'Phytoplasma Diseases in Horticulture Crops: Current Scenario and Future Challenges' covering up-to-date aspects of phytoplasma was prepared and released in CD format. Also a leaflet on "Know About Phytoplasma" with pictorial explanation about symptoms, vectors and spread printed in both English and Telugu for the information of farmers was distributed in the event.

Brainstorming on Mechanization in Agriculture

Dr. K. V. Prasad, Director, ICAR-DFR and Er. Rahul S. Yadav, Scientist, ICAR-DFR, Pune attended brainstorming session-cum Interaction meet on "Engineering Interventions for Production and Processing of Horticultural Crops" organized at ICAR-Central Institute of Agricultural Engineering, Bhopal on October 24-25th, 2016. Dr. W.S. Dhillon, Additional Director General (Horticulture), ICAR was the chief guest of the inaugural programme of brainstorming session. The objective of this programme was to address the urgent requirement of engineering intervention and interdisciplinary R&D efforts in unit operations in value chain of horticultural crops.

Celebration of World Soil Day

The ICAR-DFR celebrated the World Soil Day on December 5th, 2016 and the Soil Health Cards were distributed to farmers at KVK, Narayangoan. The programme was jointly organized by ICAR-DFR, Pune and KVK Narayangaon. About 100 farmers were invited from various places and soil health cards were distributed.

Dr. K.V. Prasad, Director, ICAR-DFR distributing soil health card to farmers.

Field Day -cum-Training Programme on Chrysanthemum

Chrysanthemum Day was organized at Shivajinagar Research farm of ICAR – DFR on December 20th, 2016 with the aim of showcasing the improved varieties and production technologies developed by the ICAR-

Visit of Farmers from Kusur and Pimpalwandi villages during Chrysanthemum day organized on December 20, 2016.

Farmers interacting with Director and Scientists in the field

DFR, State Agricultural Universities (SAUs) as well as other ICAR institutions under AICRP on Floriculture for the benefit of farmers and other stakeholders. Chrysanthemum growers from Villages Kusur & Pimpalwandi, Tal-Junnar, Dist Pune participated in the field day-cum-training programme on chrysanthemum. Chrysanthemum varieties were planted under drip irrigation; and mulching system was the main attraction to farmers. About 150 varieties in flowering stage were on display during the field day.

Celebration of National Productivity Week (February 12-18th, 2017)

National productivity week with a theme 'From Waste to Profits through Reduce, Recycle and Reuse' was celebrated from February 12-18th, 2017 at ICAR-DFR, Pune, in order to increase the awareness on enhancing the productivity through modern methods, technologies, better materials and applying waste minimizing techniques. On February 16th , 2017 essay and painting competitions were organized on the theme of National Productivity Week-2017 for the students of College of Agriculture, MPKV, Pune. About six students participated in the essay and four students participated in the painting competition.

Participants during the Productivity Week

On February 17th, 2017, open discussion on "Enhancing the Productivity of Farming Sector Through Integrated Approach" was organised. The programme started with a brief introduction of National Productivity Week and its objective by Dr. K. V. Prasad, Director followed by an open discussion. The scientific staff from ICAR-IARI, Regional Station, Pune, ICAR-IVRI, Regional centre, Associate Dean College of Horticulture, AICRP staff from MPKV, all the scientists, SRFs, Young professionals and Assistants of ICAR-DFR, Pune actively participated in this event. The salient points that emerged in the discussion include market and price regulation of agriculture produce including flower crops; Post-harvest management and value addition of flowers; Utilisation and management of floricultural waste; and Diversification of farming systems through agriculture, animal husbandry and fishery.

On February 18th , 2017, ICAR-DFR organized a guest lecture on the theme "From Waste to Profits-through Reduce, Recycle and Reuse" with special emphasis on Waste to Wealth: Making of Petal and Leaf Embedded Handmade Paper by Mr. Sanjiv Shewale, Director of Handmade Paper Institute, Maharashtra State Khadi Development Board. He explained the rich heritage of the paper recycling institute and the science behind the recycling. He dwelt in detail the process involved in paper making and also exhibited various samples that are made by the paper recycling institute. During the valedictory function certificates were given to the winners of the essay and painting competitions.

National Science Day Celebrated

National Science Day with a theme 'Science and Technology for Specially Abled Persons" was celebrated at ICAR-DFR, Pune on February 27th , 2017, essay writing competition was conducted on the topic "Designing a Garden for Specially Abled Persons". Eight participants from ICAR-DFR, College of Agriculture and College of Horticulture, MPKV, Pune participated in the competition.

On February 28th , 2017 Science Day was celebrated at Mukh-Vadhi Sikshan SansodhaVikas Kendra, Apte Road, Pune for specially abled persons. The organization specializes in imparting skills in repairing of electrical

appliances, computers, DTP, handy craft, paper bag making etc to adolescent dumb and deaf children of 16-17 years. Team DFR explained about 40 students about the possibility of skill development in floriculture. The director and staff of ICAR-DFR welcomed each student with rose flower. Thereafter, Director briefed about the history and importance of National Science Day. He mentioned that every year February 28th is celebrated as science day to commemorate the discovery of the Raman Effect by the great Indian physicist Sir C.V. Raman on the same day in 1928. For this, he was awarded and honoured with the Nobel Prize in the Physics in 1930. He also made brief pictorial presentation on opportunities and scope in floriculture sector for skill development.

Bouquet making

Mera Gaon Mera Gaurav

Under the prestigious Mera Gaon and Mera Gaurav programme of Government of India, ICAR-DFR has adopted a village and completed the benchmark survey of Kusur village in the lap of Shivneri hill fort under Junnar taluka in Pune district where more than 50% of the farmers are involved in floriculture. It is one of the major villages that contribute significant quantity of loose flowers to Mumbai market. Scientists from ICAR-DFR make regular visits to this village on every last Saturday and provides training and technical guidance to farmers.

On 3rd September 2016, an "On-Farm Training on Phytoplasma Diseases" was organized at Kusur village. A full day interaction session on phytoplasma diseases of flower crops was organized where Scientists of ICAR-DFR, Dr. Ganesh Kadam, Mr. Girish, K.S. and Dr. Nitika Gupta delivered lectures on various aspects of phytoplasma diseases and flower production. Farmers were explained about nematodes infesting flower crops and they were shown the nematodes through microscope from the root sections.

Meeting of scientists and farmers at Kusur village

On- Farm Training on Phytoplasma Diseases in Kusur village

Farmers at Kusur observing nematodes through microscope

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

Institute Management Committee

The 4th meeting of Institute Management Committee (IMC) of ICAR-Directorate of Floricultural Research was conducted on June 4th , 2016 in the Conference Hall, Department of Entomology, College of Agriculture (MPKV), Pune. Dr. K. V. Prasad Director, ICAR-DFR & Chairman, IMC welcomed all the members of IMC and subsequently all the members visited the research field at Shivajinagar campus. The Chairman briefed about the initiatives being taken and the members appreciated the efforts of the scientists in maintaining the research material. Dr. Prasanna Holajjer (Scientist) presented the agenda of the IMC meeting. Director also presented the initiatives being taken for developing and proposing a vibrant website, dynamic logo and a futuristic master plan for the physical infrastructure to be developed by ICAR-DFR, Pune.

IMC members at ICAR-DFR

Institute Research Committee

The IRC meeting of ICAR-DFR was held on May 12th, 2016 at 11.00 AM. Dr. S. B. Gurav, Associate Director of Research, NARP, College of Agriculture (MPKV), Pune was invited as the External Expert. In his opening remarks, Dr. K. V. Prasad, Director, DFR informed the house that IRC is an introspection of what we have done in the last year and formulation of future programme based on the learnings from last year. He added that IRC is a platform for each scientist to celebrate their research achievements and introspect their shortcomings. For this the individual presentations will boost self confidence of the scientists. All the scientists presented their work done in the last year and proposed technical programme for the next year.

IRC meeting of ICAR-DFR on 23rd November 2016

Second IRC meeting of ICAR-DFR was held on November 23rd, 2016 to undertake midcourse corrections in the on-going research projects. All scientists presented the work done during the year and proposed technical programme for next six months.

Institutional Activities

International Yoga Day

ICAR-DFR and ICAR- IVRI Training and Education and Center (TEC), Pune jointly organized 2nd International Day of Yoga on June 21th, 2016. Yoga experts, Dr. Rajalaksmi and Dr. Sindhu from BKS Iyengar Institute of Yoga, Pune were invited as guest faculty to guide on this occasion. Dr. K.V. Prasad, Director, ICAR-DFR welcomed the yoga experts and requested them to deliver a talk on Yoga and also organize a mass yoga practice session. All the scientific, administrative and temporary staff of ICAR-DFR and ICAR-IVRI (TEC), Pune together performed yoga on this occasion.

Yoga class by faculty members from BKS Iyengar Institute of Yoga

Dr. K.V. Prasad, Director, DFR hoisting the National Flag

ICAR-DFR Celebrated 70th Independence Day

ICAR-DFR celebrated 70th Independence day with full zeal and happiness along with the staffs of IVRI and IARI regional station, Pune. Dr. K.V.Prasad, Director, ICAR-DFR hoisted the national flag and gave his Independence Day message to all ICAR staffs to be the pillars of support to keep our nation self sufficient in agriculture. Dr. Naik, former Director, ICAR-IIVR was also present. All the family members of the DFR staffs actively participated in the programme.

70th Independence Day celebrations at ICAR-DFR

DFR Foundation Day

ICAR-DFR celebrated its 7th Foundation day on December 12th, 2016. Dr. S.K. Malhotra, Agriculture and Horticulture Commissioner, Ministry of Agriculture and Farmers Welfare, Government of India was the Chief Guest and delivered the 7th Foundation Day Lecture on "Accreditation of Indian Nurseries: The Way Forward". Dr. Malhotra discussed about the importance of nursery standards and the need for nursery accreditation to ensure quality planting materials for both domestic and export market. Dr. T.A. More, former Vice Chancellor,

Dr. S.K.Malhotra, Agriculture and Horticulture Commissioner, Min of Agri & Farmers Welfare, GoI delivering the foundation day lecture

Dr. T.A. More, Ex-Vice-Chancellor, MPKV delivering the presidential address

MPKV, Rahuri, presided over the function. Dr. S.D.Sawant, Director, ICAR-National Research Centre for Grapes, Dr. V. Mahajan, Director (In charge), ICAR-Directorate of Onion and Garlic Research, Dr. R.S.Patil, Director (Research), MPKV, Rahuri and Dr.S.K. Sharma, Head (In Charge), IARI Regional Station, Pune, representatives from nursery industry, Maharashtra Nurserymen Association and Indian Nurserymen Association graced the occasion. Two progressive farmers from the ICAR-DFR adopted village, Kusur, were felicitated for their pro-active role in accepting latest technologies and for motivating other farmers.

The foundation day lecture was followed by a Brainstorming Session on "Nursery Standards for Ornamental Plants" chaired by Dr. S. K. Malhotra, Agriculture and Horticulture Commissioner, with Dr. K. V. Prasad, Director, ICAR-DFR as co-chairman. Mr. Devendra Jagtap, CEO Jagtap Nurseries and Gardens and representative of Maharashtra Nurserymen Association made a presentation on "Nursery Standards for Ornamental Flowering Trees and Palms: Where Do We Stand". He presented various requirements of proper standards in trees and ornamental palms. Dr. Ganesh Kadam, Scientist (Floriculture), ICAR-DFR made a brief presentation on "Global Nursery Standards". Dr. Ashish Hansoti, CEO, Tropica nursery discussed various areas of nursery and floriculture industry where policy interventions are required. Dr. Prabha K, Scientist (Plant Pathology) and Mr. Girish K S, Scientist (Entomology) made a detailed presentation on "Quarantine Pathogens and Pests in Nurseries and Bio-security Issues". The presentations followed discussions on various aspects like "Bringing plants in to country: Dos and Don'ts.

Dr. S. K. Malhotra, Agriculture and Horticulture Commissioner, interacting with Mr. Devendra Jagtap, CEO, Jagtap Nursery

Nursery representatives actively involved in the brainstorming session

Swaach Bharat Abiyan

The ICAR-DFR organized Swaach Bharat Pakhwada from May 16-31th, 2016. All the staff members including scientific, administrative, SRF's, YP-I's of the directorate actively took part. After brief remarks by the Director all the staff actively participated in the cleanliness drive of office premises and adjoining areas.

Swaach Bharat Abiyan around ICAR-DFR campus

Swachhta Pakhwara

The ICAR-Directorate of Floricultural Research organized *Swachhta Pakhwara* during October 16-31th, 2016. *Swaachta Pledge* was administered on October 16th, 2016 to all the staff of DFR and also to the staff of IVRI, Regional station, Pune. Various cleanliness activities were initiated. On October 21th, 2016, Dr. Trilochan Mohapatra, Honorable Secretary, DARE and Director General of ICAR; Dr. T. Janakiram, ADG (Hort. Sci.-II), ICAR; Dr. K. D. Kokate, Director, Extension Education, MPKV, Rahuri; Dr. Jai Gopal, Director, ICAR-DOGR, Rajgurunagar; Dr. S. K. Sharma, In-charge, ICAR-IARI, RS, Pune; Dr. K. N. Bhilegaonkar, In-charge, IVRI, RS, Pune and Dr. K. V. Prasad, Director, DFR, Pune along with all the staff of DFR and IVRI, RS involved in cleanliness programme. The surroundings of DFR and the adjoining area of Agriculture College, MPKV were cleaned. *Swachhta Kits* were also distributed to housekeeping staff of DFR by DG, ICAR.

Team DFR along with the staff of IVRI RS, Pune taking *Swachatha Pledge*

Dr. T. Mohapatra, Hon'ble Secretary, DARE & DG, ICAR distributing "Swaachta Kits" to housekeeping staff of ICAR-DFR

Vigilance Awareness Week

ICAR-DFR observed Vigilance Awareness Week during October 31st to November 5th, 2016. All the staff members of the institute took the pledge not to involve in or promote corruption in the organization. A quiz competition on vigilance related aspects was conducted as a part of creating awareness; and pamphlets on "Vigilance Angle" were prepared and distributed among the members

of the organization. On November 5th, 2016, ICAR-DFR along with ICAR-NRC for Grapes, organized an interactive session involving officials from Anticorruption Bureau, Maharashtra State. All the staff members of both the institutes actively participated in the programme.

ICAR-DFR staff taking vigilance oath

Hindi Pakhwara

ICAR-DFR organized "Hindi Pakhwara" during September 5-20th, 2016. Different competitions like Essay writing, Hand writing, Word Dictation, General Knowledge, Translation from English to Hindi & Vice versa, English Word Writing were organized in which all the scientific, administrative and temporary staff of ICAR-DFR participated. At the end of the Pakhwara "Hindi Diwas" was celebrated. Dr. J. V. Patil, Associate Dean of College of Agriculture, MPKV, Pune graced the occasion as chief guest and awarded prizes to the winners/participants of various Hindi competitions.

Mr. Rupesh Kumar Pathak receiving prize and certificate for "Hindi-English Shabdalekhan"

Agricultural Education Day

ICAR-DFR celebrated Agricultural Education Day on December 3rd, 2016 at Shri Shiv Chatrapati Mahavidyalay, Junnar, Tal-Junnar, Dist- Pune for promoting the essence of education in agriculture and floriculture among the students. The students of science and commerce discipline participated in the programme. More than 100 students from class XI and XII standards along with their teachers were chosen. Dr. K V Prasad, Director, ICAR-DFR, Pune addressed the gathering and informed the students about the spirit behind celebrating Agricultural Education Day. Scientists from DFR, Drs. Ganesh B Kadam, T N Saha, Prasanna Hollajer and Girish K S highlighted about the various aspects of National Agricultural Research System and opportunities for students in the fields of agriculture in general and horticulture in particular.

Agriculture Education Day on December 3rd, 2016 at Shri Shiv Chatrapati Mahavidyalay Junnar, Tal-Junnar, Dist- Pune

Institution Building

Towards the development of Institute DFR, the milestones achieved so far includes, receipt of all the land records, benchmarking for digital survey of DFR Regional Station at Vemagiri, Kadiyam, Andhra Pradesh, successful completion of Hydrological Survey at Shivajinagar and Hadapsar farms and preparation of master plan of Hadapsar farm. Ground water Geological survey for identification of points/sites for borewell/open-wells at Shivajinagar and Hadapsar was carried out during December 6-9th, 2016 and three and nine locations, respectively were identified in these two farms. The land at Hadapsar was cleared of undergrowth and ploughed and leveled. Also 5.00 acres of land at Shivajinagar campus has been earmarked for the establishment of a new ICAR-ATARI.

Hydrological survey at Shivajinagar farm

Involvement of DFR Scientists as ICAR representatives in Site Selection Committee (SSC) for new Krishi Vigyan Kendra

Dr. K.V. Prasad, Director and Dr. Prashant G. Kawar, Sr. Scientist of ICAR-DFR were ICAR representatives in Site Selection Committee (SSC) for new KrishiVigyan Kendra to be established one each in Sangali and Kolhapur Districts of Maharashtra under the Chairmanship of Dr. S.N. Puri, Ex-Vice Chancellor, MPKV, Rahuri & CAU, Imphal; and Dr. Y.G. Prasad, Director, ATARI, Hyderabad was the member secretary.

Research Projects

In-House Research Projects:

S.N	Mega Projects	PI	Co-PI	Remarks
01	**Improvement of Commercial Flower Crops**	**Dr K. P. Singh (up to 24.06.2016)**		
	Project No 01 (Project IXX07529): Breeding of Gladiolus for Quality and Yield	Dr. Ganesh B. Kadam	Dr. Tarak Nath Saha	Extended up to 31.03.2017
	Project No 02 (Project IXX07506): Breeding of Chrysanthemum for Quality Flower and Pot Mum Production	Dr. Tarak Nath Saha	Dr. Ganesh B. Kadam	Extended up to 31.03.2017
	Project No 03 (Project IXX07530): Breeding of Tuberose for Novel Colour and Oil Recovery	Dr. Tarak Nath Saha	Dr. K. P. Singh (up to 24.06.2016.)	Extended up to 31.03.2017
	Project No 05 (Project IXX09573): Improvement of Lawn Grasses for Turf	Dr. Ganesh B. Kadam (w.e.f. Aug, 2016) Mrs. Shephalika Amrapali on study leave	Mr. Girish, K. S. and Dr. K. P. Singh (up to 24.06.2016)	Running
02	**Standardization of Production Technology in Commercial Flower Crops**	**Dr. K. P. Singh (up to 24.06.2016)**		
	Project No 02 (Project IXX08409): Production Technology of Tuberose	Dr. K. P. Singh (up to 24.06.2016)	Dr. Prasanna Holajjer and Dr. Tarak Nath Saha	Concluded
03	**Post-Harvest Management and Value Addition**	**Dr. K. V. Prasad**		
	Project No 04 (Project IXX12322): Standardization of Post-Harvest Packaging Technology for Tuberose and Jasmine (*w.e.f.* 1st June, 2015)	Er. Rahul S. Yadav	Dr. Tarak Nath Saha (w.e.f. 23rd November, 2016)	Running
04	**Plant Protection of Commercial Flower Crops**	**Mr. Girish, K. S.**		
	Project 01 (Project IXX08410): Insect Pest Management of Commercial Flower Crops	Mr. Girish, K. S.	Dr Ganesh B Kadam and Dr. Prasanna Holajjer	Running
	Project 02 (Project IXX11705): Investigation on Viral and Phytoplasmal Diseases of Major Flowering Crops in India	Dr. Prabha K.	Mr. Girish, K. S., Dr. K. P. Singh (up to 24.06.2016) and Mrs. Nitika Gupta	Running
	Project 03 (Project IXX11708): Assessment of Nematode Infestation in Major Commercial Flower Crops and Management of Root Knot Nematodes in Tuberose	Dr. Prasanna Holajjer	Mr.Girish, K. S. and Dr. K. P. Singh (up to 24.06.2016)	Running

S.N	Mega Projects	PI	Co-PI	Remarks
	Project 04. Etiology and Integrated Management of Fungal Diseases of Flower Crops (*w.e.f.* 23rd November, 2016)	Dr. Nitika Gupta	Dr. Prabha K., Dr. Tarak Nath Saha, Dr. Ganesh. B. Kadam	Running

Externally Funded Projects:

S. N.	Project Title	Sponsored by	PI/ CC PI
1	New Initiative Project on Protected Horticulture	ICAR	CC PI: Dr. Ganesh B. Kadam Co-PI: Er. Rahul S. Yadav
2	ICAR Consortia Research Platform for Management of Borers in Horticulture Crops	ICAR	CC PI: Mr. Girish K. S.
3	Studies on Male Sterility to Increase the Efficiency of F_1 Hybrids in Horticultural Crops (Marigold)	ICAR	CC PI: Dr Tarak Nath Saha
4	Indian Floriculture Industry: Production, Marketing and Export Dynamics	ICAR Extramural Research Project.	PI: Dr. K. V. Prasad Co-PI: Dr. Ganesh B. Kadam
5	Phytonematodes in Floriculture: Identification, Occurrence, Distribution and GIS Mapping	ICAR Extramural Research Project.	PI: Dr. Prasanna Holajjer Co-PI: Mr. Girish K. S.
6	Characterization and Natural Spread Sources of Phytoplasmas Affecting Major Floricultural Crops of India	ICAR Extramural Research Project.	Co-PI: Dr. Prabha K.

ICAR Inter Institutional Project

S. N.	Project Title	Collaborative programme	PI/CoPI
1	Studies on Phytoplasma and Viroids in Duranta erecta: Maladies Induced in Orchards and Landscapes	Collaborative project with ICAR-NRCG, Pune	PI: Dr. Prabha K.
2	Design and Development of Tools and Gadgets for Floriculture	Collaborative Research Project with ICAR-CIAE, Bhopal	PI: Er. Rahul S. Yadav Co-PIs: Dr. Ganesh B. Kadam, Dr. Tarak Nath Saha and one Scientist from ICAR-CIAE, Bhopal
3	Harnessing Natural Pigments from Flower Crops for Making Value Added Products from Grapes	Collaborative project with ICAR-NRCG, Pune	PI: Dr. K. V. Prasad Co-PIs: Dr. Prashant G. Kawar, Er. Rahul Yadav from ICAR, DFR and Dr. Kaushik Banerjee, Dr. A. K. Sharma and Dr.Ahammed Shabeer T. P from ICAR-NRCG, Pune
4	Development of Unique DNA Fingerprints of Flower Crops	Collaborative project with ICAR-NRCPB, New Delhi	PI: Dr. Prashant G. KawarCo-PIs:Dr. Ganesh B. Kadam, Dr. Tarak Nath Saha from ICAR-DFR and Dr. Amolkumar Solanke from ICAR-NRCPB, New Delhi

Publications

Research Papers

Nitika Gupta, Jain, R. K., Rao, G. P. and Baranwal, V. K. (2017). Molecular characterization and phylogenetic analysis of coat protein gene of *Leek yellow stripe virus* infecting garlic in India. *Indian Phytopathology* 70(1): 114-121.

Nitika Gupta, Prabha, K., Kadam, G. B., Sriram, S. and Chandran, N. K. (2017). Yellows and corm rot in gladiolus: Incidence, identification and characterization of *Fusarium oxysporum* f. sp. *gladioli*. *Indian Phytopathology* 69(4s): 51-53.

A. K. Tiwari, G. Kumar, G.B. Kadam and T. N. Saha (2016) Optimization of ISSR-PCR system and assessing genetic diversity amongst turf grass, *Cynodon dactylon*, mutants. *Indian Journal of Agricultural Sciences*, 86 (12): 1571–6.

A. K. Tiwari, G. Kumar, B. Tiwari, G.B. Kadam and T. N. Saha (2017) Genetic diversity among turf grasses by ISSR markers. Indian *Journal of Agricultural Sciences*, 87(2): 251-6.

Kharte SB., Watharkar AD., Shingote PR., Chandrashekharan S., Pagariya MC., Kawar PG., GovindwarSP. (2016) Functional characterization and expression study of sugarcane MYB transcription factor gene PEaMYBAS1 promoter from *Erianthus arundinaceus* that confers abiotic stress tolerance in tobacco, RSC Adv. 6, 19576–19586

Shingote PR., Kawar PG Pagariya MC., Rathod PR., Kharte SB (2016) Ectopic expression of SsMYB18, a novel MYB transcription factor from *Saccharum spontaneum* augments salt and cold tolerance in tobacco, Suger Tech: DOI:10.1007/s12355-016-0466-6)

Upadhyaya C., Bagri D., Chandel Upadhyaya D., Kawar PG (2016) Molecular and biochemical analysis of supplementation of calcium under invitro condition on tuberization in potato (Solanum tuberosum L.) Biocatalysis and Agricultural Biotechnology, DOI: 10.1016/j.bcab.2016.06.004.

Ekta Khasa, Gopala, Aido Taloh, K. Prabha, Madhu Priya and G.P. Rao (2016). Molecular characterization of phytoplasmas of 'clover proliferation' group associated with three ornamental plant species in India. 3Biotech 6:237.10 DOI 10.1007/s13205-016-0558-8.

Reviews

Dutt S., Singh B., Pinky J., Anshul S., Sundaresha S., Patil VU., Kawar PG., Bhardwaj V., Kardile H, (2017). Key players associated with tuberization in potato: Potential candidates for genetic engineering Critical Reviews in Biotechnology. http://dx.doi.org/10.1080/07388551.2016.1274876

Patil VU, Singh R, Vanishree G, Dutt S, Kawar PG, Bhardwaj V, and Singh BP (2016), Genetic Engineering for Enhanced Nutritional Quality in Potato - a review Potato J (2016) 43 (1): 1-21.

Technical/ Popular Articles/Extension folders

Prabha K, Nitika Gupta, Girish, K.S. and Prasad, K.V. (2017). Phytoplasma in nurseries: An imminent threat to Floriculture. Nursery Today. Jan-Feb 2017.pp.30-36.

G.B. Kadam, Satish Jadhav and K V Prasad (2016) "फुलशेतीचे जागतीकरण व विक्री व्यवस्थापन", शेतकरी: 35-40

G.B. Kadam, R S Yadav and P G Kawar (2016) "रजनीगंधा: फुल शेतीतील एक वरदान" Pragati Magazine, Sakal 11 June 2016.

G.B. Kadam, R S Yadav and P G Kawar (2016) "Growing of roses in home gardens". गुलाब मित्र.

Prabha. K, Ganesh Kadam, T.N.Saha, Prasanna Holaljjer and K V Prasad (2016) Prepared and edited 'Flori News' January to June 2016 Issue No.1. Directorate of Floricultural Research, College of Agriculture Shivajinagar, Pune-411005.

Prabha. K, Ganesh Kadam, T.N.Saha, Prasanna Holaljjer and K V Prasad (2016) Prepared and edited 'Flori News' July to December 2016 Issue No.2. Directorate of Floricultural Research, College of Agriculture Shivajinagar, Pune-411005.

Technical Bulletins/Books

Prabha K, Girish, K.S., Nitika Gupta, Prasad, K.V (2016) Base paper on 'Candidatus' Phytoplasma in Horticulture: Present Status and Future Challenges. Published by ICAR-DFR, Pune.1-36pp

Prabha, K., Gupta, N., Girish, K. S., Saha, T. N., Kadam, G. B., Holajjer, P., Kawar, P.G., Shephalika Amrapali, Shilpa shree, K.G., Singh, K.P and Prasad, K. V (2016). Leaflet on "Know about Phytoplasma Diseases". In Farmers Academia interface on Phytoplasma Diseases in Horticultural Crops; Current Scenario and Future Challenges at Anam Kalakendram, Rajahmundry, Andhra Pradesh.

Prasad K. V., Ganesh B Kadam, Tarak Nath Saha, Prasanna Holajjer, Prabha K, Girish K S, Rahul Yadav (2017) 'Standard Operating Procedures for Conducting Field Experiments Under AICRP on Floriculture' Directorate of Floricultural Research, College of Agriculture Shivajinagar, Pune-411005.pp.78.

K V Prasad, Ganesh Kadam and Tarak Nath Saha (2016) Technological interventions in floriculture for doubling farmers income. Advances in Floriculture and landscape gardening In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland, January 13-15, 2017. pp 60-65

Prabha K., Nitika Gupta, Girish K.S, Tarak Nath Saha, Ganesh B. Kadam, Prasanna Holajjer, Prashant G. Kawar, Shephalika Amrapali, Rahul Yadav, Shilpa Shree K.G., K.P. Singh and K. V. Prasad (2016). E-flyer. Farmers Academia Interface on Phytoplasma Diseases in Horticultural Crops Current Scenario and Future Challenges held at Anam Kalakendram, Rajahmundry, Andhra Pradesh on 29th June 2016.

K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Girish K. S. and Ganesh. B. Kadam (2016). Proceedings of the XXV Annual Group Meeting of AICRP on Floriculture, held on 28th June, 30th June & 1st July, 2016 at ICAR-Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh.

Book Chapter

K. V. Prasad, Ganesh Kadam and Tarak Nath Saha (2017) Technological Interventions in Floriculture for Doubling farmers Income. *In*: Advances in Floriculture and Landscaping (*Eds*: S. K. Malhotra and Lallan Ram) Central Institute of Horticulture, Medziphema, Nagaland. Pp321.

Rajiv and Prashant G. Kawar (2016) Enriched Potato for Mitigating Hidden Hunger, In: U. Singh et al. (eds.), Biofortification of Food Crops, Springer India, DOI 10.1007/978-81-322-2716-8_32.

Virupaksh U Patil, Vanishree G., Som Dutt, Hemant B. Kardile, Rajendra Singh, Vinay Bhardwaj, Prashant G. Kawar and SK Chakrabarti (2016). Nutritional Quality in Potato and Biotechnological Approaches for

its Augmentation' In: Eco-friendly Techniques for Enhancing Crop Productivity During Climate Change, Review Committee of Agriculture and Nutrition CRC Press/Taylor & Francis Group.

Presentations in Conferences/ Symposia/ Seminar/Other (Abstracts)

K V Prasad, Ganesh Kadam and Tarak Nath Saha (2017) Technological interventions in floriculture for doubling farmers income (*Key Note presentation*). In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017.

Ganesh Kadam, M R Dhiman, Tarak Nath Saha, and K V Prasad (2017) Evaluation of Novel Hybrids of Gladiolus for Morphological Traits. In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017. Pp:11

Tarak Nath Saha and Ganesh B Kadam (2017) Evaluation of pot mums (*Chrysanthemum morifolium*) under Pune condition In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017. Pp:15

Tarak Nath Saha and Ganesh B Kadam (2017) Evaluation of spray type of chrysanthemum (*Chrysanthemum morifolium*) under Pune condition In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017. Pp:15-16

Tarak Nath Saha and Ganesh B Kadam (2017) Evaluation of standard type of chrysanthemum (*Chrysanthemum morifolium*) under Pune condition In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017. Pp:16

Rahul S Yadav, Ganesh B Kadam, Tarak Nath Saha and K V Prasad (2017) Mechanization for Sustainable Floriculture in India: Problems and Prospects. In: National Conference on Advances in Floriculture Focus on North-East & Hill Region held at Central Instsitute of Horticulture, Dimapur, Nagaland form 13-15th January 2017. Pp:54-55

Prabha K., Nitika Gupta, Girish K.S, Tarak Nath Saha, Ganesh B. Kadam, Prasanna Holajjer, Prashant G. Kawar, Shephalika Amrapali, Rahul Yadav, Shilpa Shree K.G., K.P. Singh and K. V. Prasad (2016) Know About Phytoplasma Diseases. Farmers Academia Interface on Phytoplasma Diseases in Horticultural Crops Current Scenario and Future Challenges held at Anam Kalakendram, Rajahmundry, Andhra Pradesh on 29th June 2016.

Holajjer, P., Girish, K. S. and Saha, T. N. (2017). Influence of Pre-Planting Initial Population Density of the Root-Knot Nematode *Meloidogyne incognita* on China Aster. In: National Symposium on "Climate Smart Agriculture for Nematode Management" held at ICAR-Central Coastal Agricultural Research Institute Ela, Old Goa from 11-13th January 2017.

Holajjer, P. and Girish, K. S. (2017). Incidence of Root-Knot Nematode, Meloidogyne spp on Tuberose and Gerbera in Pune Region of Maharashtra. In: National Symposium on "Climate Smart Agriculture for Nematode Management" held at ICAR-Central Coastal Agricultural Research Institute Ela, Old Goa from 11-13th January 2017.

Prabha K, Nitika Gupta and Girish, K.S. (2016). Fastidious vascular inhabiting prokaryotes in ornamentals; a challenge to Indian phytobiosecurity. In "Global Conference on Perspective of Future Challenges and options in Agriculture" May 28-31, 2016, Jalgaon, Maharshtra, India.

Nitika Gupta, Prabha K and M.K. Reddy. (2016). Tuberose mild mottle an emerging viral disease in Tuberose

in India". In "Global Conference on Perspective of Future Challenges and options in Agriculture" May 28-31, 2016, Jalgaon, Maharshtra, India.

Prabha K. and Nitika Gupta (2016). Phytoplasma and Phytobiosecurity" in "Farmers-Academia Interface on Phytoplasma Diseases in Horticultural Crops: Current Scenario and Future Challenges" on June29th 2016 at Rajahmundry.

Nitika Gupta and V. K. Baranwal (2016). Presentation on "Genome characterization and immuno based diagnosis using synthetic peptides of *Leek yellow stripe virus* (LYSV)". In "National Symposium on Phytopathogenic Mollicutes: Indian scenario of diagnosis, epidemiology and disease management" 17th to 18th December, 2016, Division of Plant Pathology, ICAR- Indian Agricultural Research Institute, New Delhi, India.

Nitika Gupta and V. K. Baranwal (2017). Presentation on "Genome characterization and immuno based diagnosis using synthetic peptides of *Leek yellow stripe virus* (LYSV)". In National Symposium on "Diagnosis and Management of Plant Diseases: Integrated Approaches and Recent Trends" from 9th January to 11th January, 2017, ICAR-Research Complex for NEH Region, Umiam, Shillong, Meghalaya.

Tarak Nath Saha (2017) Evaluation of Different types of Chrysanthemum under Pune Condition during National Conference on Advances in Indian Floriculture with focus on North East and Hill Region held at Central Institute of Horticulture, Medziphema, Nagaland (13-15 January, 2017). (Second Best Poster)

Tarak Nath Saha and Krishan Pal Singh (2017) Pod setting in tuberose germplasm and their seed germination behavior during National Conference on Advances in Indian Floriculture with focus on North East and Hill Region held at Central Institute of Horticulture, Medziphema, Nagaland (13-15 January, 2017). (Invited Oral Lecture)

Shingote PR., Kawar PG(2017). Overexpression of sugarcane MYB18 transcription factors deciphering tolerance to drought and salinity stress in EMBO Conference on Micro and metabolic regulators in plants 01 Feb, 2017 at Thiruvananthapuram, Kerla, India.

Shingote PR., Kawar PG Solanke A.(2016) Comparative Abiotic Stress Tolerances of Saccharum MYB18 Orthologs in Stable Transgenic Tobacco Plants poster presented in Plant and Animal Genome XXIV, January 9-13, 2016 San Diego, CA, USA P0161.

Kardile Hb, Challam C, Sharma NK, Zinta R, Kawar PG, Patil VU1 , Sundaresha S, Vanishree G, Singh D, Tiwari J, Dutt S, Singh B, Bhardwaj V, Chakrabarti SK(2016) In-silico Identification and Expression Analysis of the SWEET Family of Sugar Transporters in Potato. Int. conf. on "Agricultural sciences and food technologies for sustainable productivity and nutritional security" organized by Society for Applied Biotechnology, at UAS, Bangalore held during 25 August 2016.-27

Baranwal VK, Meena RP and Prabha K. (2016). Characterization of Mandariviruses and development of a multiplex RT-PCR for graft transmissible pathogens in citrus. In International citrus congress, September 18-23 September 2016, Foz do Iguaçu, PR – Brazil.

Radio and TV Talk:

Ganesh B Kadam: TV Talk on **"**दररोज फुलांचे उत्पादन आणि प्रक्रिया उद्योग**"** in Krishi Darshan Program on DD Sahyadri telecast on December 16th , 2016 (6.00-6.10 PM)

Prashanth Kawar: Delivered a talk on topic entitled 'फुलशेतीमध्ये जैव तंत्रज्ञानाचे महत्व' in Marathi in the Krishidarshan Program of DD Mumbai aired at 6:10PM on February 10th , 2017.

Rahul S. Yadav: TV Talk on Mechanization in Floriculture in Marathi in Krishi Darshan Program on DD Sahyadri telecast on December 12th, 2016.

Rahul S. Yadav: TV Talk Krishi Darshan- Phone-in-Live programme on DD Sahyadri on Post Harvest Technology and Transportation of Flowers on March 9th, 2017.

Training and Capacity Building

Training Programmes Attended

Dr. Prashant G. Kanwar, Senior Scientistattended training on Genetic Fidelity Testing of Tissue Cultured Plants for Accreditation Testing Laboratory Personnel at ICAR-NRCPB, New Delhi from February 20-26th , 2017.

Dr. Prashant G. KanwarSenior Scientist attended training onBio-active compounds from medicinal plants: A wealth of novelties and opportunities at ICAR-DMAPR, Anand from December 1-21st , 2016.

Er. Rahul S. Yadav,Scientist attended training onTesting and Quality Evaluation of Packaging Material at IIP, Mumbai from August 11-12th, 2016.

Er. Rahul S. Yadav,Scientist attended ICAR sponsored winter school on Manufacturing Technology of Agricultural Equipment at ICAR-CIAE, Bhopal from September 1-21st , 2016.

Er. Rahul S. Yadav, Scientistattended training on Indian Patent Procedures, Patent Search Practice, Patent Specification, Drafting and International Patent Filing Procedure at RGNIIPM, Nagpur from February 13-17th , 2017.

Mr. Girish K. S., Scientist attended training on Taxonomy of Phytophagous Mites at UAS, Bengaluru from January 2-12th, 2017.

Tarak Nath Saha and Ganesh B. Kadam Scientists attended 2nd Botanical Nomenclature Course Under the Course Director Dr. Kanchi N. Gandhi, Senior Nomenclatural Registrar, Harvard University Herbaria, USA. Organized by BSI at IISER, Pune (9-12 February, 2017).

Tarak Nath Saha Scientist underwent training programme on Competency Enhancement Programme for Effective Implementation of Training Functions for HRD Nodal Officers of ICAR at ICAR-NAARM, Hyderabad from 13-15th February, 2017.

Participation in Conferences/ Symposia/ Seminar/Others

S. N.	Conference/Seminar/Symposia	Scientist(s) participated
1	Dutch Floral Design workshop held by Netherland Embassy in association with Mahratta Chamber of Commerce Industries & Agriculture on April 29, 2016.	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K. Shephalika Amrapalika, Prashanth Kawar, Rahul Yadav, Nitika Gupta
2	One day mini symposium on "Metabolomics and Volatomics towards disease markers" on May 16, 2016 organized by National Centre for Cell Science, Pune.	Prabha, K. And Nitika Gupta
3	Global Conference on "Perspective of Future Challenges and options in Agriculture" during May 28-31, 2016, organized at Jain Hills, JISL Jalgaon, Maharashtra, India.	K. V. Prasad, Girish, K. S., and Nitika Gupta
4	Brainstorming Session on: Phytochemicals and Nutraceuticals on June 17, 2016 at ICAR-NRC for Grapes, Pune.	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Nitika Gupta and Rahul S. Yadav

S. N.	Conference/Seminar/Symposia	Scientist(s) participated
5	XXV Annual group meeting of AICRP on floriculture at ICAR-Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh jointly with Dr. Y. S. R. Horticultural University, Venkataramannagudem, from June 28th, 2016 to July 1st, 2016.	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Shephalika Amrapalika and Nitika Gupta
6	On-Farm Training on Phytoplasma Diseases organized at Kusur village on September 3rd, 2016	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Prashanth Kawar, Rahul Yadav and Nitika Gupta
7	Microscopy Mela held at National Centre for Biological Sciences, Bangalore during September 25-26th, 2016	Prabha, K.
8	1st International Agro-biodiversity Conference at NASC complex, New Delhi from November 6-10th, 2016.	K. V. Prasad, Tarak Nath Saha and Ganesh B Kadam,
9	Brainstorming session-cum Interaction meet on "Engineering Interventions for Production and Processing of Horticultural Crops" organized at ICAR-Central Institute of Agricultural Engineering, Bhopal on October 24-25th, 2016	K. V. Prasad and Rahul S. Yadav
10	One Day Training of RTI Nodal Officers on RTI-MIS" held on November 28th, 2016 at Department of Personnel and Training, GoI, Civil Service Officer's Institute at New Delhi.	Prabha, K.
11	Brainstorming Session on Ornamental Plants Nursery Standards organized at ICAR-DFR, Pune on the occasion of DFR's 7th Foundation day on December 12th, 2016	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Prashanth Kawar, Rahul Yadav, Nitika Gupta
12	National Symposium on Phytopathogenic Mollicutes: Indian scenario of diagnosis, epidemiology and disease management held on December 17-18th, 2016 at Division of Plant Pathology, ICAR-Indian Agricultural Research Institute, New Delhi 110012	Nitika Gupta
13	Global Agri live Demo, Expo and Conference 2017 at Gramonnati Mandal's Krishi Vigyan Kendra, Narayangaon on January 6-8th, 2017.	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Prashanth Kawar, Rahul Yadav, Nitika Gupta
14	National Conference on Advances in Floriculture: Focus on North-East & Hill Region held at Central Institute of Horticulture, Dimapur, Nagaland form January 13-15th, 2017	K. V. Prasad, Tarak Nath Saha, Ganesh B Kadam and Rahul S Yadav
15	National Symposium on "Diagnosis and Management of Plant Diseases: Integrated Approaches and Recent Trends" from January 9-11th, 2017 held at ICAR-Research Complex for NEH Region, Umiam, Shillong, Meghalaya	Nitika Gupta
16	National Symposium on "Climate Smart Agriculture for Nematode Management" held at ICAR-Central Coastal Agricultural Research Institute Ela, Old Goa - 403402 during January 11-13th, 2017.	Prasanna Holajjer

S. N.	Conference/Seminar/Symposia	Scientist(s) participated
17	Open discussion on "Enhancing the Productivity of Farming Sector through Integrated Approach" on the occasion of National Productivity Week on 17th February, 2017 at Training Hall, TEC, and ICAR-IVRI.	K. V. Prasad, Prasanna Holajjer, Ganesh B Kadam, Girish, K. S., Prabha, K., Prashanth Kawar, Rahul Yadav, Nitika Gupta
18	International Conference on Floriculture and Landscape Gardening- Challenges and Opportunities held at Hindustan Antibiotics Exhibition Ground, Pune on February 27-28, 2017.	K. V. Prasad, Tarak Nath Saha, Prasanna Holajjer, Ganesh B Kadam and Rahul Yadav
19	Krishi Unnati Mela-2017 held at ICAR-IARI, New Delhi from 15-17 March 2017.	K. V. Prasad, Ganesh B Kadam and Girish, K. S.

Awards and Recognition

Dr. Nikitha Gupta, Scientist (Pl. Path) was awarded "Commendation Award" during National Symposium on "Diagnosis and Management of Plant Diseases: Integrated Approaches and Recent Trends" held on January 9 -11, 2017 at ICAR-Research Complex for NEH Region, Umiam, Shillong, Meghalaya by Indian Phytopathological Society (IPS Delhi zone).

Prashant Kawar Participated as Expert Judge in technical paper presentation competition namely "Papyrus" at technical event "VORTEX 2016" organized by Institute of Chemical Technology, held on 22-23 October 22-23, 2016 at ICT, Mumbai.

Prashant Kawar participated in 'Hindi Pakhwada-2016' at ICAR-DFR, Pune and won the 3rd prize in Eassy Writing and Shrutlekhan competition.

Tarak Nath Saha received second best poster (Evaluation of Different types of Chrysanthemum under Pune Condition) during National Conference on Advances in Indian Floriculture with focus on North East and Hill Region held at Central Institute of Horticulture, Medziphema, Nagaland (January 13-15, 2017).

Tarak Nath Saha participated in 'Hindi Pakhwada-2016' at ICAR-DFR, Pune and won the 2nd prize in *Sabda Lekhan*, *Samanya Gyan* and 3rd prize in *Shrut-lekh*, *Nibandh Lekhan* competition.

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. N.	Centre	Year of Start	Mandate Crops
Budgetary Centres			
1.	Asam Agricultural University, Kahikuchi, Guwahati	2001	Orchids, Chrysanthemum, Tuberose, Gerbera, marigold, specialty flowers, fillers, native ornamentals, foliage plants, dry flower
2.	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur	1972	Chrysanthemum, orchids, anthurium, tuberose, gerbera, turf grass, gladiolus, marigold, china aster, landscape plants, foliage plants, dry flower
3.	Birsa Agricultural University, Ranchi	2001	Gerbera, rose, foliage plants
4.	Dr.Y.S. Parmar University of Horticulture & Forestry, Solan	1975	Gladiolus, carnation, tulip, daffodils, lilium, alstroemeria, specialty flowers, turf grass, marigold, china aster, native ornamentals, dry flower
5.	G. B. Pant University of Agriculture & Technology, Pantnagar	2001	Chrysanthemum, tuberose, turf grass
6.	Kerala Agricultural University, Vellanikkara	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	1980	Gladiolus, chrysanthemum, tuberose
8.	Mahatma Phule Krishi Vidyapeeth, Pune	1975	Rose,gladiolus,carnation,tuberose,gerbera, marigold, crossandra, china aster, specialty flower
9.	Odisha University of Agriculture and Technology, Chiplima	2011	Rose, Chrysanthemum, Marigold
10.	Punjab Agricultural University, Ludhiana	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	1987	Gladiolus, tulip, daffodils, lilium, alstroemeria, china aster

S. N.	Centre	Year of Start	Mandate Crops
13.	Sri Kondalakshman Telangana State Horticultural University, Hyderabad	1987	Gladiolus, chrysanthemum, tuberose, turf grass, crossandra, china aster, marigold, carnation, specialty flowers, fillers
14.	Tamil Nadu Agricultural University, Coimbatore Sub-centre:Horticultural Research Station (TNAU), Ooty	1982	Chrysanthemum, anthurium, gerbera, tuberose, china aster, marigold, foliage plants, landscape plants, lilium, alstroemeria, fillers, gladiolus, carnation
15.	Uttar Banga Krishi Viswavidyalaya, Kalimpong	1985	Orchids, gerbera, alstroemeria
Institutional centres			
16.	ICAR Research Complex for NEH Region, Barapani, Shillong (Meghalaya)	1971	Orchids, gerbera
17.	Indian Institute of Horticultural Research, Hessaraghatta, Bangalore	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, lilium
20.	Central Island Agricultural Research Institute, Garacharama, Port Blair, Andaman and Nicobar Islands.	2016	China aster
Voluntary Centres			
21.	University of Agricultural Sciences, Bangalore	1977	Fillers, foliage plants
22.	Horticultural College and Research Institute (TNAU), Periyakulum	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

XXV Annual Group Meeting of AICRP on Floriculture

The All India Coordinated Research Project (AICRP) on Floriculture, organized its XXV Annual Group Meeting at ICARCentral Tobacco Research Institute, Rajamahendravaram, Andhra Pradesh jointly with Dr. Y. S. R. Horticultural University, Venkataramannagudem, from June 28th, 2016 to July 1st, 2016 to review the

work done at different centers and to reorganize the ongoing programmes and activities to meet the present challenges in commercial flower production. Besides, the review of work done by the coordinated centers under the different sections, experts on plant health management, production system, crop improvement and post harvest technology and value addition also gave their inputs for development of technical programme in a manner which addresses the emerging needs.

Inaugural programme of the XXV Annual Group Meeting

Participants of the XXV Annual Group Meeting

Personnel

S. N.	Name	Designation	Office Order No.
1.	Dr. K. V. Prasad	Director	-
2.	Dr. K. P. Singh	Principal Scientist (Horticulture-Floriculture)	Upto 24.06.2016
3.	Dr. Prashant G. Kawar	Senior Scientist (Genetics and Plant Breeding)	-
4.	Dr. Tarak Nath Saha	Scientist (Horticulture-Floriculture)	-
5.	Dr. Prasanna Holajjer	Scientist (Nematology)	Upto 30.03.2017
6.	Dr. (Ms.) Prabha K.	Scientist (Plant Pathology)	-
7.	Dr. Ganesh Balkrushna Kadam	Scientist (Horticulture-Floriculture)	-
8.	Mr. Girish K. S.	Scientist (Agricultural Entomology)	-
9.	Ms. Shephalika Amrapali	Scientist (Economic Botany)	On Study leave wef 28.07.2016
10.	Ms. Nitika Gupta	Scientist (Plant Pathology)	-
11.	Er. Rahul Subhash Yadav	Scientist (Agriculture Structure and Process Engingeering)	-
12.	Dr.(Ms.) Shilpashree K. G.	Scientist (Soil Science)	-
13.	Mr. Prabhat Ranjan	Administrative Officer (w e f 18.11.2016)	3-5/2010-Estt.I (Pt.II), dated 04.08.2015
14.	Mr. Sunil Kumar	Senior Administrative Officer (Additional Charge up to 17.11.2016)	3-5/2010-Estt.I, dated 04.08.2015
15.	Mr. Radhey Shyam Bhatt	Assistant Finance and Accounts Officer	-
16.	Mr. Deepak Verma	Assistant	-
17.	Mr. Rupesh Kumar Pathak	Assistant	-
18.	Mr. Sudesh Kumar	Upper Division Clerk	-
19.	Mr. Ajay Kumar Uniyal	Steno Grade III	-

Promotions

Dr. Ganesh. B. Kadam, Scientist (GP6000) got promoted to Scientist Sr. Scale (GP 7000) with effect from April 27th, 2015.

Mr. Ajay Uniiyal promoted as Stenographer with effect from July 22nd, 2016 through MACP.

New Joining

Mr. Prabhat Ranjan, joined ICAR-DFR as Administrative Officer with effect from November, 18th, 2016.

Relinquishing

Mr. Sunil Kumar, SAO, DOGR, Rajgurunagar relinquishing his additional charge of AO, ICAR-DFR on November 18th. 2016.

Transfer

S. N.	Name	Institute	Office Order No.
1	Dr. K. P. Singh, Principal Scientist (Upto 24.06.2016)	ICAR-IARI, New Delhi	File No.2-14/2011 (I)-DFR/382, Dated 24.06.2016
2	Dr. Prasanna Holajjer, Scientist (Upto 30.03.2017)	ICAR-NBPGR, New Delhi	File No. 2-35/2014- DFR/ 1606/8, Dated 30.03.2017

Distinguished Visitors

Hon'ble Secretary, DARE and Director General, ICAR

Dr Trilochan Mohapatra, Hon'ble Secretary, Department of Agricultural Research and Education (DARE) and Director General, Indian Council of Agricultural Research (ICAR), Ministry of Agriculture and Farmer's Welfare, Government of India visited ICAR – DFR on October 21st, 2016. At Directorate of Floricultural Research, he launched the inaugural issue of the *Flori News*, the official news letter of ICAR-DFR and also unveiled the Wall Magazine -Petals in English and *Pankhudi* in Hindi. Dr. K. V. Prasad, Director, DFR briefed about the research programmes and activities related to Institutional building to DG, ICAR. This was followed by DG's interaction with scientists of DFR about their research projects, progress and accomplishments and offered valuable suggestions for further improvement. He inaugurated the refurbished glasshouse and reviewed the experiments being conducted inside the glass house. He took part in the on-going *Swachh Bharat Pakhwara*, presented *Swachh* kits to the staff of DFR and motivated the gathering in keeping the premises neat and clean. He expressed that Floriculture has potential to contribute significantly in doubling the farm income that addresses the aspirations of the Government.

Dr. T. Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR launching the inaugural issue of the *Flori News,* the official news letter of ICAR-DFR and unveiling the Wall Magazine – "Petals"

Dr. T. Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR unveiling the Wall Magazine – "Petals"

Dr. T. Mohapatra, Hon'ble Secretary, DARE and Director General, ICAR reviewing progress of research (a) and experiments in glass house (b)

Deputy Director General (Horticultural Science), ICAR

Dr. A. K. Singh, Deputy Director General (Agricultural Extension & Horticultural Science), ICAR along with Dr. Y.G.Prasad, Director, ATARI, Hyderabad visited DFR Pune to review the ongoing civil works and also to oversee the land allocated to ICAR-ATARI, Pune. Dr. Singh, inaugurated the Aadhar based biometric attendance system of ICAR-DFR during his visit to office of DFR on October 9th, 2016.

Dr. A.K. Singh, DDG (AE & HS), had an overview of the land allocated to ATARI, Pune

Dr. A. K. Singh, DDG (AE & HS) inaugurating the Aadhar based biometric attendance system in the office of DFR

Assistant Director General (HS-II), ICAR

Dr.T. Janakiram, Assistant Director General (HS-II), ICAR visited DFR on July 27th, 2016 to review the progress of research work and other activities at DFR and participated in the meeting of Departmental Promotion Committee of DFR. He interacted with individual scientists and administrative staff and gave assurance of all support from SMD in strengthening of ICAR-DFR by providing administrative support, manpower and funds for Institutional building.

Dr. T. Janakiram, ADG (HS-II) monitoring research experiments at ICAR-DFR.

Director and Joint Director (Extension), ICAR-IARI, New Dehil

Dr. Ravinder Kaur, Director and Dr. J.P.Sharma, Joint Director (Extension), ICAR - IARI visited ICAR-DFR on October 15th , 2016 and considered our request by handing over some more rooms from IARI Regional Station, Pune located in the premises of Agricultural College, Shivajinagar to help us in building-up of DFR.

Dr. K.V. Prasad, Director, DFR welcomes Dr. Ravinder Kaur, Director and Dr. J. P. Sharma, Joint Director (Ext), ICAR-IARI.

Dr. A.P.S. Gill former National Consultant (Floriculture), APEDA,

Dr. A.P.S.Gill, former National Consultant (Floriculture), APEDA, Ministry of Commerce, GoI and Ex-Head, Department of Floriculture and Landscaping, Punjab Agriculture University, Ludhina visited ICAR-DFR as Chairman, Departmental Promotion Committee on July 27th, 2016. He has provided valuable suggestions for the improvement of various activities being undertaken at ICAR-DFR.

Dr. A.P.S. Gill with Team DFR.

Budget (2016-17)

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

Rs. in lakhs

S. N.	Head of Account	Plan		Non-Plan	
		Budget	Expenditure	Budget	Expenditure
	A. Recurring				
1	Establishment Charges	300.00	300.00	176.00	175.82
2	TA	13.00	13.00	2.00	2.00
3	HRD	0.00	0.00	0.00	0.00
4	Other Charges	103.33	103.13	54.00	53.44
	Total (A)	**416.33**	**416.13**	**232.00**	**231.26**
	B. Non-Recurring				
5	Equipment	27.93	27.47	0.00	0.00
6	Works	0.71	0.71	0.00	0.00
7	Furniture	0.00	0.00	0.00	0.00
8	Library Books & Journal	0.03	0.03	2.00	2.00
	Total (B)	**28.67**	**28.21**	**2.00**	**2.00**
	Grand Total (A+B)	**445.00**	**444.34**	**234.00**	**233.26**

Tribal Sub-plan (TSP)

Training on Improved Technologies for Commercial Flower Production

ICAR-Directorate of Floricultural Research (ICAR-DFR), Pune organized three-days training programme under the TSP scheme at KVK, Nashik (Maharashtra) from March 6-8th, 2017. The programme started on March 6th with inaugural function at KVK Nashik training hall. The programme was presided over by Shri Milind Shambarkar, CEO, Zilha Prishad, Nashik, and chaired by Dr. K. V. Prasad, Director, ICAR-DFR, Pune. Shri T. N. Jagtap, District Superintendent Agricultural Officer, Nashik was the Guest of Honour. Shri Milind Shambarkar. He emphasized that this is a wonderful opportunity for the farmers to interact with the scientist of ICAR directly which shall be helpful for the resolving many issues in flower cultivation. Though most of farmers are willing to grow flowers but due to lack of scientific know how of cultivation they hesitate to venture. Shri T. N. Jagtap, DSAO, Nashik appreciated the enthusiasm shown by the farmers in undertaking flower cultivation in the region. Shri D. J. Deore, SDO, Kalvan who was instrumental in mobilizing the farmers from different Tahsils of Nashik was also present and expressed satisfaction with the technical programme of three-day training porgramme.

Dr K. V. Prasad, Director, ICAR-DFR requested farmers to adopt the cultivation of flowers in the region and briefed about the vision of Hon'ble Prime Minister for doubling of farmers income by 2022. He emphasized that the flower crops have the potential to double the farmers income. Different flowers and ornamental crops have wider acceptability in the market with changing lifestyle pattern in the country.

Inaugural function of the TSP training programme

The Programme was organized for the benefit of the farmers selected under the TSP scheme who will be undertaking flower cultivation in the tribal belt of Nashik. Total 33 farmers from various villages of Nashik attended the programme. Total 13 lectures were delivered during the three-day training programme along with visit to KVK research farm and other commercial flower units of Janouri-Mohadi-Ambevani belt.

During the programme awareness on Swachhta Mission of Hon'ble Prime Minister was also created and Swachhta Kits were distributed to the farmers. To get the basic information of various inputs required for flower cultivation another kit comprising of flower seeds, pesticides, fungicides, fertilizers, sticky traps, etc were also distributed for the benefit of farmers.

Dr R B Patil, PC, KVK, Nashik briefed about the role of KVK in promotion of flower crops in the region and also expressed happiness about the training programme conducted by the ICAR-DFR in KVK campus. Entire team of ICAR-DFR has taken lot of efforts to make this training prorgamme a grand success.

TSP: AICRP on Floriculture

The Coordinated centre of AICRP on Floriculture at Birsa Agricultural University, Kanke, Ranchi has conducted one day 'On-Campus Training Programme (2 nos.)' to tribal farmers from Ranchi and Khunti Districts in Jharkhand during 2016-17 in the Department of Horticulture. About sixty tribal farmers from Ranchi (Tilaksuti and Itki villages) and Khunti (Kaparia (Gutjora) and Pundan Toli (Fudi) villages) districts were benefited with the training programme which covered recent advances in technologies pertaining to flower production. About 23 tribal farmers were benefited with knowledge of improved flower production technologies as they were exposed to demonstration plots (1.5 acres) of flower production in the open field.

Compiled the Name and addresses of tribal farmers belonging to three villages viz., Tiliksuti (Village), Kulli (Panchayat), Bindhani (PO), Dist.-Ranchi; Kapariya (Vill), Gutjora (Panchayat), Gutjora (PO), Dist.-Khunti; Pandan Toli (Vill), Fudi (Panchayat & PO), Dist.-Khunti in Jharkhand state for further use in transfer of technologies.




Farmers of Khunti district in the TSP training programme






Farmers of Ranchi Districts in the TSP training programme

Flower Demonstration activities: 23 tribal farmers benefited by the demonstration on Flower Production in an area of 1.5 acres.

Farmers of Itki block with their bumper harvest

Farmers of Khunti block with their bumper harvest

Results Framework Document (Achievement 2016-17)

Name of the Division: Directorate of Floricultural Research, Pune 411005

RFD Nodal Officer: Dr Tarak Nath Saha, Scientist

RFD Co-Nodal Officer: Dr Prasanna Holajjer, Scientist

S. N.	Objective(s)	Weight	Action (s)	Success Indicator(s)	Unit	Weight	Target/Criteria value					Achievements	Performance		% achievements against target value of 90% col.	Reasons for shortfall or excessive achievements if applicable
							Excellent	Very Good	Good	Fair	Poor		Raw	Weighted Score		
							100%	90%	80%	70%	60%					
1.	Development of on-farm Research and infrastructures facilities	40	Development of research farm and office facilities.	On farm Research facilities developed	Acre	20	12	10	08	7	6	19	100	20	190.00	More area was brought under cultivation, which is essential to start the research activity
				Logistic facilities created	Number	20	12	10	08	7	6	15	100	20	150.00	More logistics are required at new location
2.	Collection, Evaluation and Management of genetic resources	30	Collection and evaluation of germplasm for crop improvement/ biotic stress	Germplasm collected	Number	10	100	75	60	50	40	143	100	10	190.66	Germplasm collection is a continues process which is flexible and hence over achievement
				Germplasm evaluated	Number	10	200	150	125	100	80	212	100	10	141.33	Large number of germaplasm were collected and evaluated hence over achievement.
			Production technologies developed	Technologies developed	Number	10	5	4	3	2	1	2	70	3.5	87.5	Due to poor farm infrastructure
3	Plant protection interventions	10	Survey for pest and diseases	Protected units/field survey	Number	5	45	40	35	30	25	57	100	5	142.5	More survey is pre-requisite to understand the gravity of pest and diseases, and good number of plant protection scientists.

S. N.	Objective(s)	Weigh t	Action (s)	Success Indicator(s)	Unit	Weigh t	Target/Criteria value					Achie vemen ts	Performance		% achievements against target value of 90% col.	Reasons for shortfall or excessive achievements if applicable
							Excell ent	Very Good	Good	Fair	Poor		Raw	Weigh ted Score		
							100%	90%	80%	70%	60%					
			Development of diagnostic techniques and plant protection measures	Technology developed	Number	5	5	4	3	2	1	0	0	0	0	Improper laboratory facility and transfer of Scientists.
*	Publication/Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	Number	3	6	5	4	3	2	3	70	4.2	84	Due to inadequate research infrastructure facilities, papers could not be published.
			Timely publication of the Institute Annual Report (2015-2016)	Annual Report published	Date	2	30.06. 2016	04.07. 2016	07.07. 2016	11.07. 2016	16.07. 2016	14.07. 2016	60	1.2	-	Coincided with AICRP Group Meeting
*	Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90	99.85	100	2	104.01	-
*	Efficient Functioning of the RFD System	3	Timely submission of Draft RFD for 2016-2017 for Approval	On-time submission	Date	2	15 May, 2016	17 May, 2016	19 May, 2016	21 May, 2016	23 May, 2016	30.04. 2016	100	2	-	-
			Timely submission of Results for 2015-2016	On-time submission	Date	1	5 May, 2016	7 May, 2016	9 May, 2016	11 May, 2015	13 May, 2015	30.04. 2016	100	1	-	-
*	Enhanced Transparency / Improved Service delivery of Ministry/Department	3	Rating from Independent Audit of implementation of Citizens' / Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80	100	100	2	-	-

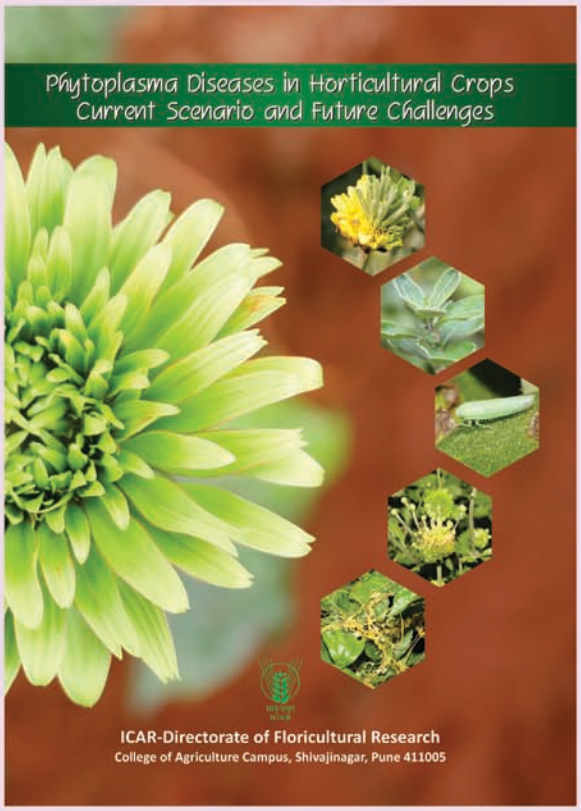
S. N.	Objective(s)	Weigh t	Action (s)	Success Indicator(s)	Unit	Weigh t	Target/Criteria value					Achie vemen ts	Performance		% achievements against target value of 90% col.	Reasons for shortfall or excessive achievements if applicable
							Excell ent	Very Good	Good	Fair	Poor		Raw	Weigh ted Score		
							100%	90%	80%	70%	60%					
			Independent Audit of implementatio n of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80	100	100	1	-	-
*	Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	1 Nov, 2016	4 Nov, 2016	8 Nov, 2016	12 Nov, 2016	14 Nov, 2016	100	100	2	-	-
			Implementatio n of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of implementation	%	1	100	90	80	70	60	100	100	1	-	-
			Implementatio n of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80	100	100	2	-	-
			Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	2	100	90	80	70	60	100	100	2	-	-

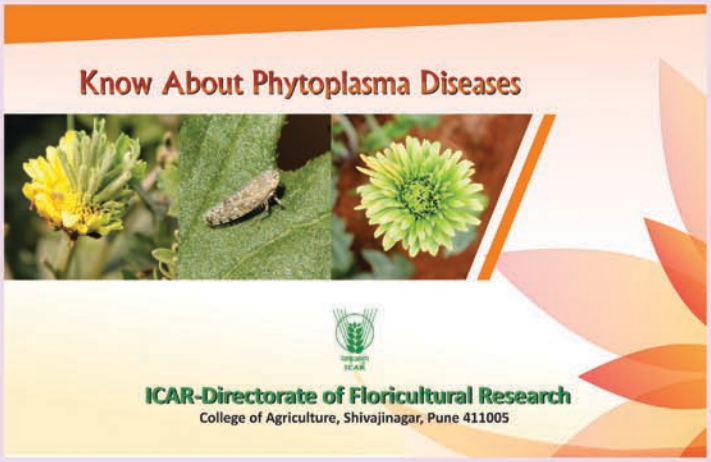
Total Composite Score: 88.90

Procedure for computing the Weighted and Composite Score

1. Weighted Score of a Success Indicator = Weight of the corresponding Success Indicator x Raw Score / 100
2. Total Composite Score = Sum of Weighted Scores of all the Success Indicators

Recent Publications





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