

वार्षिक प्रतिवेदन
Annual Report
2010-11



पुष्प अनुसंधान निदेशालय
Directorate of Floricultural Research
(भारतीय कृषि अनुसंधान परिषद)
(Indian Council of Agricultural Research)

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Preface



India is bestowed with rich bio-diversity of ornamentals. Its varied agro-climatic conditions, ample sunshine during flowering and proximity to the markets of the Middle East and South East Asian countries offer great opportunities to harness potential in floriculture and other ornamentals. India ranks second in area of flower cultivation next to China. About 1,91,600 ha of area is under floriculture producing 10,31,000 metric tonnes (MT) of loose flowers and 69,027 lakh numbers of cut-flowers during 2010-11, The overall exports of floricultural produce from India touched Rs. 294.4 crore by the end of 2009-10.

The Directorate of Floricultural Research, an Institute established through the up-gradation of Project Coordinator's cell of All India Coordinated Research Project (AICRP) on Floriculture during the XI Plan has successfully completed by 2010-11. The AICRP on Floriculture was established during the IV Five-Year Plan in the year 1970-71 to carryout nation-wide interdisciplinary research by linking the ICAR Institutes with the State Agricultural Universities (SAU's) remains an integral part of the DFR with its 23 Coordinated Centers including 16 budgetary and 7 voluntary Centres.

The Directorate has a mandate to coordinate floricultural research on genetic resource utilization, crop improvement, standardization of production technology, focus on resource utilization such as productive use of water, developing repository of data bank, plant architecture engineering and management, generating the need-based technology for crop protection and value addition. The Directorate aims at development of environment-friendly, cost-effective and user friendly technologies apt for variable agro-climatic conditions, thereby reducing the dependence on cost-intensive extraneous technologies.

I wish to express my gratitude to Dr. S. Ayyappan, Hon'ble Secretary, Department of Agricultural Research & Education (DARE) and Director General, ICAR; Dr. H.P. Singh, Deputy Director General (Horticulture) for their valuable guidance and support extended to the Directorate. The physical facilities and support provided by Dr. H.S. Gupta, Director, IARI is duly acknowledged. We also acknowledge the help and co-operation extended by Dr. Umesh Srivastava, Dr. S. Rajan, Assistant Director Generals (Hort.), Dr. S.K. Malhotra and Dr. P.L. Saroj, Principal Scientists (Horticulture Division) of ICAR from time to time.

I am grateful for the efforts of my colleagues, Dr. P. Naveen Kumar, Dr. Gunjeet Kumar, Dr. Tarak Nath Saha and Ms. Sellam P. from the Directorate and Dr. J.S. Dhiman, PAU, Ludhiana for their role in compilation, editing and vetting of the maiden Annual Report of the Directorate.

June 24, 2011
New Delhi


(Ramesh Kumar)
Director

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विशिष्ट सारांश

11वीं योजना के दौरान अखिल भारतीय पुष्पविज्ञान समन्वित अनुसंधान परियोजना के परियोजना समन्वयक सैल का उन्नयन करते हुए पुष्पविज्ञान अनुसंधान निदेशालय की स्थापना एक संस्थान के रूप में की गई, जिसने वर्ष 2010 तक अपनी स्थापना का एक वर्ष सफलतापूर्वक पूरा कर लिया है। राज्य कृषि विश्वविद्यालयों के साथ भारतीय कृषि अनुसंधान परिषद संस्थानों का संपर्क बनाये रखते हुए राष्ट्रीय स्तर पर अंतर-विषयी अनुसंधान करने के उद्देश्य से वर्ष 1970-71 में चौथी पंचवर्षीय योजना के दौरान अखिल भारतीय पुष्पविज्ञान समन्वित अनुसंधान परियोजना की स्थापना की गई थी, जो कि 23 समन्वित केन्द्रों जिसमें 16 वित्तीय और 7 स्वैच्छिक केन्द्र शामिल हैं, के साथ पुष्पविज्ञान अनुसंधान निदेशालय का आन्तरिक हिस्सा बनी रही।

चूंकि यह एक नई स्थापना है, अतः इसमें नवीन अनुसंधान परियोजनाओं का निरूपण तथा बुनियादी सुविधाओं का विकास किया जाना एक अविलंब आवश्यकता थी। सीमित स्टाफ एवं संसाधनों के साथ, हालांकि, पुष्पविज्ञान अनुसंधान निदेशालय (अखिल भारतीय पुष्पविज्ञान समन्वित अनुसंधान परियोजना सहित) द्वारा की गई अनुसंधान प्रगति उल्लेखनीय है।

विभिन्न पुष्पीय फसल जननद्रव्य का एक राष्ट्रीय संग्रहणकर्ता बनाने की दिशा में निदेशालय में ग्लेडियोलस, गुलदाउदी, कंदाकार तथा विभिन्न पुष्पीय फसलों में बड़ी संख्या में किस्मों/प्राप्तियों का संकलन किया गया। ग्लेडियोलस तथा गुलदाउदी में प्रजनन कार्यक्रम के प्रथम वर्ष में क्रमशः सफल क्रॉस संयोजनों तथा खुले परागण से पर्याप्त मात्रा में बीज उत्पन्न किया गया।

प्रजनन कार्यक्रम के अंतर्गत 6 नई किस्मों, ग्लेडियोलस में चार (पंजाब कृषि विश्वविद्यालय, लुधियाना से पंजाब फ्लेम, पंजाब ऐलिगेंस, पंजाब लेमन डिलाइट तथा पंजाब ग्लांस) तथा गुलदाउदी में दो (एन. बी. आर. आई., लखनऊ से कौल एवं खुशौ) को अखिल भारतीय पुष्पविज्ञान समन्वित

अनुसंधान परियोजना के अंतर्गत विकसित किया गया और अनेक आशाजनक संकरो/वंशक्रमों का बहुस्थानिक परीक्षण कार्य प्रगति पर है। पुष्पीय फसलों की विभिन्न देशी एवं विदेशी किस्मों के मूल्यांकन के आधार पर विभिन्न क्षेत्रों के लिए गुलाब, ग्लेडियोलस, गुलदाउदी, कार्नेशन, एन्थूरियम, जरबेरा, कंदाकार, आल्स्ट्रोमेरिया, आइरिस और डैफोडिल में उपयुक्त किस्में पायी गईं। अखिल भारतीय पुष्पविज्ञान समन्वित अनुसंधान परियोजना के समन्वित केन्द्रों में उत्पादन, संरक्षण, कटाई उपरांत रख-रखाव तथा मूल्य संवर्धन में कुछ उल्लेखनीय अनुसंधान परिणामों को नीचे दर्शाया गया है।

गुलदाउदी में विभिन्न बढ़वार मीडिया में कोकोपीट (हेसरगट्टा), मिट्टी + रेत + वर्मीकम्पोस्ट @ 2:1:1,v/v (लुधियाना एवं सोलन), कोकोपीट + रेत + गोबर की खाद + वर्मीकम्पोस्ट @ 2:1:0.5:0.5,v/v (पंतनगर एवं कोयम्बटूर) तथा मिट्टी + रेत + गोबर की खाद (हैदराबाद) गमला मम उत्पादन के लिए सर्वश्रेष्ठ पाये गये।

जरबेरा प्रजाति "डेबोरा" (हेसरगट्टा), "रोजालिन" (पुणे), "रेड मोनार्च" (काहीकुचि) तथा "एलेगेंट" (कल्याणी) में उर्वरकों की सुझाई गई मात्रा (75 प्रतिशत) + 1 किग्रा. प्रति वर्ग मीटर की दर से गोबर की खाद + 300 ग्रा. प्रति वर्गमीटर की दर से वर्मीकम्पोस्ट + 2 ग्रा. प्रति पौधा प्रति वर्ष की दर से एजोस्प्रिलम + 2 ग्रा. प्रति पौधा प्रति वर्ष की दर से पी एस बी सम्मिलित समेकित पोषक पदार्थ प्रबंधन सर्वश्रेष्ठ पाया गया। काहीकुचि में डेन्ड्रोबियम प्रजाति सोनिया में एजोस्प्रिलम और पी एस बी के साथ 0.2 प्रतिशत की दर से एन पी के (20:10:10) का अनुप्रयोग करने से वृद्धि एवं पुष्प उत्पादन में सुधार हुआ। इस उपचार के अतिरिक्त कल्याणी में जड़ क्षेत्र में 2 ग्राम/पौधा की दर से वी ए एम का अनुप्रयोग लाभदायक पाया गया।

ग्लेडियोलस में खरपतवार नियंत्रण परीक्षणों में यह पाया गया कि पंतनगर, श्रीनगर, एवं रांची में रसायनों में, पेंडीमिथालिन (1.0 kg a.i./ha); लुधियाना में मैट्रीबुजिन @

0.50 kg/ha; काहीकुचि में एट्राजिन 1.5 kg a.i./ha; पूसा बिहार में पेंडीमिथालिन @1.0 kg a.i./ha अथवा एट्राजिन @1.5 kg a.i./ha या मैट्रीबुजिन @ 0.25 kg a.i./ha; और हैदराबाद में मैट्रीबुजिन @ 0.25 kg a.i./ha एवं @ 0.50 kg a.i./ha की बढ़ी हुई मात्रा में समान रसायन के अनुप्रयोग उपचार संबंधित क्षेत्रों में प्रभावी पाए गए। इसी प्रकार लुधियाना, पुणे, रांची और पंतनगर में गुलाब की खेती में खरपतवार जनसंख्या को नियंत्रित करने में काली पॉलीथिन (200 माइक्रोन) के साथ पलवार करना भी प्रभावी सिद्ध हुआ।

जरबेरा में पाद विगलन/मूल विगलन बीमारी आवर्ती की रोकथाम के लिए 500 ग्रा./वर्गमीटर की दर से ट्राइकोडर्मा हार्जेनम द्वारा नीम केक उपनिवेशन एवं 0.3 प्रतिशत की दर से कैपटॉन (9.67 पी डी आई) या 0.3 प्रतिशत की दर से मेटालेक्सल एम जेड 72 डब्ल्यू पी (10.67 पी डी आई) अथवा 0.3 प्रतिशत की दर से कॉपर ऑक्सीक्लोराइड (11.33 पी डी आई) के साथ भिगोकर एवं पर्णाय छिड़काव तथा साथ ही पत्ती धब्बा/अंगमारी सघनता के नियंत्रण हेतु 0.1 प्रतिशत की दर से एजोक्सिट्रोबिन (9.33 पी डी आई), आइप्रोडिन + 0.2 प्रतिशत की दर से कार्बेन्डाजिम (9.57 पी डी आई) एवं 0.05 प्रतिशत की दर से डाइफेनोकोनाजोल (10.27 पी डी आई) के अनुप्रयोग पुणे में प्रभावी पाए गए।

ग्लेडियोलस में फ्यूजेरियम मुरझान बीमारी के प्रबंधन हेतु गर्म जल (30 मिनट के लिए 50 डिग्री सेल्सियस) में घनकंद का भंडारण-पूर्व उपचार एवं इसके तुरंत पश्चात 0.2 प्रतिशत की दर से कैपटॉन तथा कार्बेन्डाजिम में कंदों को डुबोने और 30 मिनट के लिए 10 ग्रा./लीटर की दर से ट्राइकोडर्मा हार्जेनम में कंदों को रोपाई पूर्व डुबोने का उपचार पुणे में न्यूनतम बीमारी आवर्ती (3.33 पी डी आई) के साथ प्रभावी पाया गया।

गेंदा कली अंगमारी (0.2 प्रतिशत की दर से आइप्रोडिन कार्बेन्डाजिम प्रत्येक का पर्णाय छिड़काव) और अल्टरनेरिया अंगमारी मेन्कोजेब का पर्णाय छिड़काव (डाइथेन एम-45), आइप्रोडियोन कार्बेन्डाजिम (क्विंटल) एवं डाइफेनोकोनाजोल (स्कोर) का क्रमशः 0.2, 0.2 और 0.1 प्रतिशत की दर से उपचार क्रमशः पुणे एवं लुधियाना में किए गए। महामारीविज्ञान सर्वे में यह पाया गया कि पुणे के चरौली जिले में गोल्डन रॉड किस्म में 55 प्रतिशत रतुआ सघनता

देखी गई जबकि राजगुरुनगर में कंदाकार में 20 प्रतिशत पत्ती अंगमारी सघनता के साथ 15 प्रतिशत तना सड़न आवर्ती और गेंदा में 15 प्रतिशत पत्ती अंगमारी सघनता प्रदर्शित हुई। सतारा में रबी मौसम के दौरान पॉलीहाउस जरबेरा किस्म में 25 प्रतिशत पत्ती अंगमारी सघनता और अस्तागांव जिला अहमदनगर में गुलदाउदी में 25 प्रतिशत पत्ती अंगमारी सघनता प्रदर्शित हुई।

कंदाकार में 0.1 प्रतिशत की दर पर एजोक्सिट्रोबिन के पर्णाय छिड़काव के उपचार से पत्ती अंगमारी आवर्ती उल्लेखनीय रूप से कम हुई तथा लुधियाना में नीम बीज पाउडर, कार्बुफुरान, ट्राइकोडर्मा हार्जेनम एवं पीसिलोमाइसीज़ लिलेसिनस ट्राइकोडर्मा हार्जेनम उपचारित मृदा में कंदाकार किस्म "सिंगल लोकल" में मेल्वॉयडोगाइन की अंतिम जनसंख्या और जड़ पिटिका सूचकांक की मात्रा सांख्यिकीय दृष्टि से कम दर्ज की गई।

गुलाब में संक्रमण-पूर्व घोल (एल्युमिनियम सल्फेट @300 ppm), ग्लेडियोलस में भंडारण - पूर्व स्पंदन घोल (सुक्रोज (20 प्रतिशत) + एल्युमिनियम सल्फेट@300 ppm + GA₃ @50 ppm), जोत घोल (सुक्रोज@2% + AOA@45 ppm + एलार @90 ppm) + ट्रिटॉन@100 ppm + GA₃ @1 ppm + काइनेटिन@0.2 ppm; सुक्रोज (2%) टारटैरिक एसिड@3.00 ppm; सुक्रोज@2% एल्युमिनियम सल्फेट@100 ppm; एवं सुक्रोज@2% + 8-HQC@100 ppm + GA₃@150 ppm) उपचार क्रमशः कार्नेशन, जरबेरा, डैफोडिल किस्म ट्रम्पेट तथा लिली किस्म सिलेस्टा किस्म ट्रम्पेट तथा लिली किस्म सिलेस्टा में संबंधित फूलों के फूलदान जीवन को उल्लेखनीय रूप से बढ़ाने में प्रभावी पाए गए। संबंधित फूलों की गुणवत्ता बनाए रखने में सुधार लाने हेतु संबंधित फसलों में प्री-कूलिंग (कंदाकार में 4 डिग्री सेल्सियस) एवं पैकेजिंग (पॉलीप्रोपाइलीन स्लीवस में गुलदाउदी के तनों अथवा प्लास्टिक क्रेट में गेंदा के फूलों को लपेटना) लाभदायक पाया गया।

सिल्वर ओक, थुजा एवं कैमेलिया की पत्तियों, सिलोशिया एवं जरबेरा के फूलों तथा अकेशिया ऑरी-कुलीफार्मिस एवं टर्मीनेलिया अर्जुन के फलों के लिए शुष्कन विधि का मानकीकरण किया गया। जैस्मिनम सम्बक किस्म रामनाथपुरम् गुंडुमल्ली से सुगंधित तेल की वसूली बढ़ाने के प्रयास में यह पाया गया कि जैव-उत्प्रेक छिड़काव (ह्यूमिक एसिड + पंचगव्य) लाभकारी थे।

Executive Summary

The Directorate of Floricultural Research (DFR), an Institute established through the up-gradation of Project Coordinator's cell of All India Coordinated Research Project (AICRP) on Floriculture during the XI Plan has successfully completed a year by 2010. The AICRP on Floriculture which was established during the IV Five-Year Plan in the year 1970-71 to carryout nation-wide interdisciplinary research by linking ICAR Institutes with State Agricultural Universities (SAU's) in a network mode remains as an integral part of the DFR with 23 Coordinated Centers which includes 16 budgetary and seven voluntary Centres.

Being a new establishment, formulation of need-based research projects and development of infrastructural facilities have been the immediate concerns. Even with limited staff and resources, the progress of research at DFR including the AICRP on Floriculture is significant.

The collection of large number of varieties/accessions in gladiolus, chrysanthemum, tuberose and flowering annuals was made in the direction of establishing a national repository of flower crops germplasm. The first breeding cycle in gladiolus and chrysanthemum yielded reasonable seed from successful cross combinations and open pollination, respectively.

The breeding program resulted in development of six new varieties including four in gladiolus (Punjab Flame, Punjab Elegance, Punjab Lemon Delight and Punjab Glance) at Punjab Agricultural University (PAU) Ludhiana center and two in chrysanthemum (Kaul and Khoshoo) from National Botanical Research

Institute (NBRI), Lucknow centre under the AICRP on Floriculture in addition to several promising hybrids/lines through the multilocal testing. Evaluation of range of indigenous and exotic varieties of flower crops (rose, gladiolus, chrysanthemum, carnation, anthurium, gerbera, tuberose, alstroemeria, iris, daffodils, etc) was identified for different regions in the country.

Salient Findings

Salient research findings of the coordinated centres of AICRP on Floriculture pertaining to production, protection, post harvest handling and value addition of floriculture produce are mentioned below.

- In chrysanthemum, cocopeat (IIHR), soil + sand + vermicompost (2:1:1v/v) {Ludhiana and Solan}, cocopeat + sand + FYM + vermicompost (2:1:0.5:0.5 v/v) {Pantnagar and Coimbatore} and soil + sand + FYM {Hyderabad} were found to be optimum potting mixture for pot mum production.
- In gerbera cvs. 'Debora' (Hessarghatta), 'Rosaline' (Pune), 'Red Monarch' (Kahikuchi) and 'Elegant' (Kalyani), integrated nutrient management in terms of recommended doses of fertilizers (75%) + FYM (1 kg/m²) + vermicompost (300g/m²) + *Azospirillum* (2g/plant/year) + Phosphate Solubilizing Bacteria (PSB) (2g/plant/year) was found to be the best. Application of NPK (20:10:10) (0.2%) alongwith *Azospirillum* and PSB resulted in the improved growth and flower production in *Dendrobium* cv. Sonia at Kahikuchi. In addition to this treatment,

application of VAM (2g/plant) in the root zone was found beneficial at Kalyani.

- The results of the weed control trials in gladiolus, revealed that the chemicals, Pendimethalin (1.0 kg a.i./ha) at Pantnagar, Srinagar and Ranchi; Metribuzin (0.5 kg/ha) at Ludhiana; Atrazine 1.5 kg a.i./ha at Kahikuchi; Pendimethalin (1.0 kg a.i./ha) or Atrazine (1.5 kg a.i./ha) or Metribuzin (0.25 kg a.i./ha) at Pusa Bihar; Metribuzin (0.25 kg a.i./ha) followed by the same chemical at higher dose of 0.50 kg a.i./ha at Hyderabad were effective. Mulching with black polythene sheet (200 micron) also proved superior for checking weed population in rose plantation at Ludhiana, Pune, Ranchi and Pantnagar centres.
- In gerbera, for controlling foot rot/root rot disease at Pune, Neem cake colonized by the disease bio-control agent *Trichoderma harzianum* (500 g/m²) followed by drenching and foliar spray either with captan (0.3%) or Metalaxyl MZ 72 WP @ (0.3%) or Copper oxychloride (0.3 %) and for the checking the leaf spot/blight intensity, Azoxystrobin (0.1 %), Iprodione + Carbendazim (0.2 %) and Difenoconazole (0.05%) were found effective.
- For the management of *Fusarium wilt* in gladiolus, the pre-storage treatment of corms with hot water (50°C for 30 min) followed by bulb dip in captan and carbendazim @ 0.2% and pre-planting bulb dip treatment in *Trichoderma harzianum* @ 10 g/l for 30 min was found effective with least disease incidence at Pune.
- Foliar sprays for the control of marigold bud blight (Iprodione + Carbendazim @ 0.2% each) at Pune and alternaria blight (Mancozeb-Dithane M-45), iprodione + carbendazim (Quintal) and difenconazole (Score), @ 0.2, 0.2 and 0.1%, respectively) were found effective at Ludhiana. An Epidemiological survey conducted in different areas revealed that at Charoli Dist Pune, the Golden rod showed 55% intensity of rust, at Rajgurunagar the tuberose showed 15% incidence of stem rot with 20% intensity of leaf blight and 15% intensity of leaf blight. In rabi season at Satara, the polyhouse gerbera and at Astagaon Dist Ahmednagar, the chrysanthemum showed 25% intensity of leaf blight.
- In tuberose, incidence of leaf blight was significantly less with the foliar spray of Azoxystrobin @ 0.1% whereas, the final population of *Meloidogyne* and the root galling index in cv. "Single Local", was significantly less in case of treatment with neem seed powder, carbofuran, *Trichoderma harzianum* and *Paecilomyces lilacinus* + *T. harzianum* treated soils at Ludhiana.
- Pre-transit solution (aluminium sulphate @ 300 ppm) in rose, pre-storage pulsing solutions in gladiolus (20% sucrose + 300 ppm aluminium sulphate + 50 ppm GA₃), holding solutions (2% sucrose + 45 ppm Amino Oxy Acetic acid + 90 ppm Alar + 100 ppm Triton + 1 ppm GA₃ + 0.2 ppm Kinetin), in carnation (2% sucrose + 300 ppm tartaric acid), in gerbera (2% sucrose + 100 ppm aluminium sulphate), and in daffodil cv. Trumpet and lily cv. Cilesta (2% sucrose + 100 ppm 8-HQC + 150 ppm GA₃) extended the vase life of flowers significantly. Pre-cooling (at 4°C in tuberose) and packaging (wrapping of stems of chrysanthemum stems in polypropylene sleeves and marigold flowers in plastic crates were found to be beneficial in improving the keeping quality of the respective flowers.
- Drying methods were standardized for the leaves of silver oak, thuja and camellia, flowers of *Celosia* and gerbera; and fruits of *Acacia auriculiformis* and *Terminalia arjuna*. To increase the recovery of essential oils from *Jasminum sambac* var. Ramanathapuram Gundumalli, it was found that bio stimulant spray (Humic acid + Panchagavya) was beneficial.

About the Institute

Directorate of Floricultural Research (DFR), an Institute established by up-grading the Project Coordinator's Cell of All India Coordinated Research Project (AICRP) on Floriculture during the XI Plan has successfully completed a year by 2010. AICRP on Floriculture which was established during the IV Five-Year Plan in the year 1970-71 to carryout nation-wide interdisciplinary research by linking ICAR Institutes with State Agricultural Universities (SAU's) remains as an integral part of the DFR with 23 Coordinated Centers which includes 16 budgetary and seven voluntary Centres.

The Indian Council of Agricultural Research (ICAR)'s decision to start an independent

enormously in materializing the efforts made in the direction of having a full fledged Institute for floriculture. Considering the research needs and dimension-less potential of floriculture in India, providing crucial technological support to the growers and entrepreneurs, besides providing employment generation to rural youth is entrusted in its mandate.

DFR was established to harness the huge potential of floriculture in India considering the ever increasing demand in the domestic and international flower trade. The commercial floriculture has changed rapidly in the last two decades. For the new and much required areas such as protected



Inauguration and Launching of Directorate of Floricultural Research

'Directorate of Floricultural Research' was the much needed act in the direction of strengthening floricultural research and augmenting the technological base in this area. The dynamic leadership and vision of Dr. H.P. Singh, Deputy Director General (Horticulture) contributed

cultivation, crop improvement through biotechnology, the country was largely dependent on exotic technology that incur huge outflow of precious foreign exchange.

To address the emerging areas of floriculture, DFR will act as a torch bearer and play a lead role

in standardizing technologies/ protocols for flower drying, extraction of essential oils, pharmaceutical and nutraceutical compounds, natural dyes, plant pigments, production of potted and plug plants, etc. Emphasis will be given to bring more areas especially hilly and tribal dominated pockets under floriculture thereby benefiting rural and tribal youth including women. Further, the focus will be on the development of cost-effective technologies, suitable to different agro-climatic conditions and thereby reducing the dependence on costly and often

variable exotic technologies. To realize the rapid gain, the DFR focuses on conducting interdisciplinary research in flower crops which is meager at the moment. It would strive to develop the need-based region specific technologies and outreach programmes involving its coordinated centers spread in different locations of the country. Strengthening of outreach programmes will help the floriculture industry to bridge the gaps in realized and potential productivity by way of faster adoption of generated technologies.

Mandate

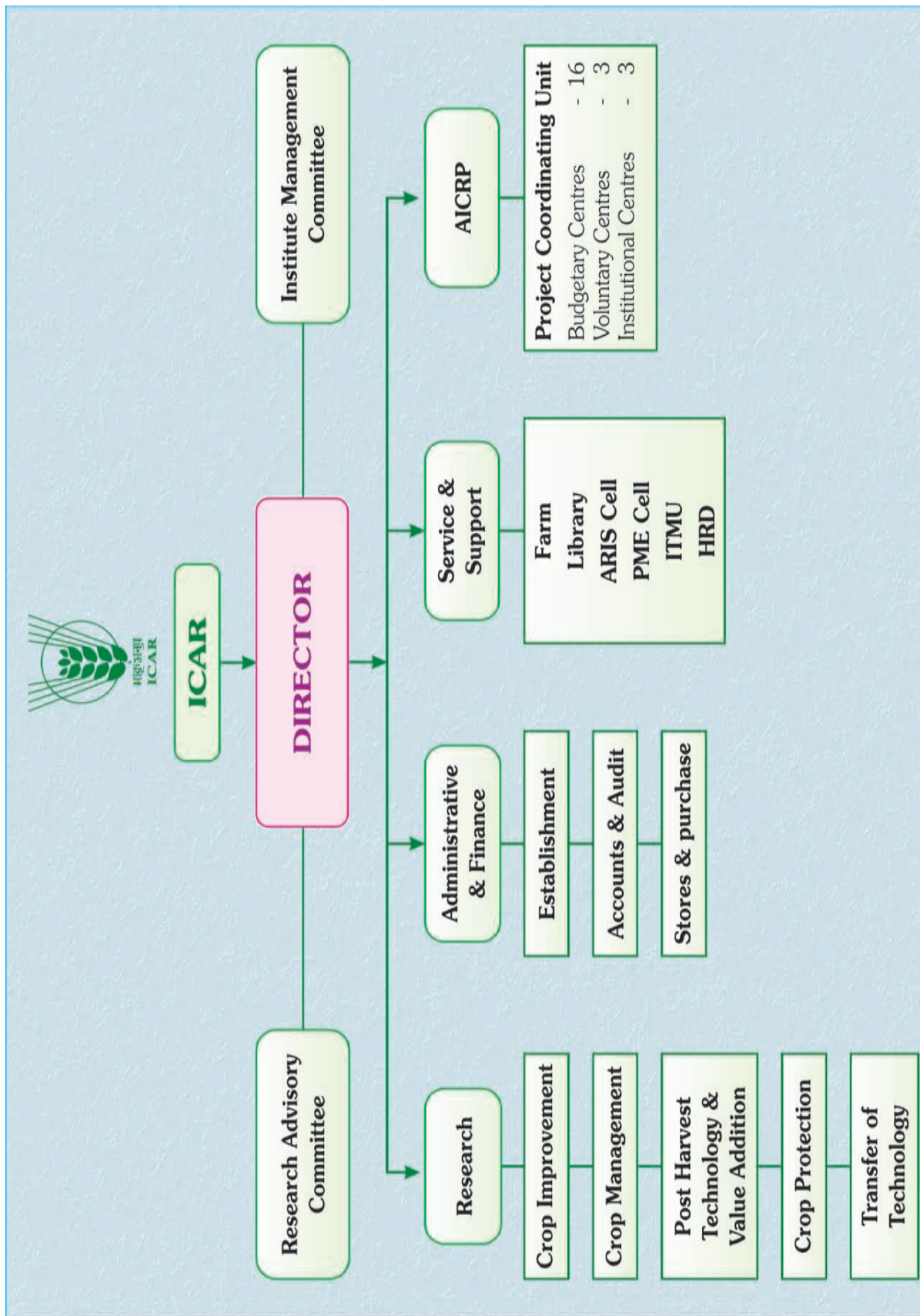
- Effective management, enhancement, evaluation of genetic resources and development of improved cultivars, with high quality characteristics for export, productivity and resistance to pests and diseases.
- To undertake basic, applied and strategic research for addressing national problems, enhance productivity,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

Vision

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

Mission

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



Organizational Setup of DFR

Salient Research Achievements

Crop Improvement

Gladiolus

Germplasm collection and evaluation

Gladiolus varieties (58) comprising of both exotic and indigenous origins were collected (Table.1) and evaluated in the DFR research farm for their growth, flowering and corm/cormel production. Their potential as parents in the breeding programme was studied so that these are involved in the gladiolus improvement programmes.



Some of the collections such as Purple Flora (dark purple), Chemistry (purple), Jessica and Peasano (peach), Yellow Stone (yellow & ruffling florets), Red Advance and Red 54 (bright red) were found to be unique and of high value in research and for commerce.

Breeding

A large number of crossings (H²2000) were attempted in gladiolus between selected promising

parents in different permutation combinations. Seeds from the crosses and also from open pollination were collected for further research. Also, the seed set behaviour both from natural and artificial pollination was recorded. All the varieties were screened for field tolerance against the biotic stresses (attack of *Botrytis gladiolorum* and *Fusarium*).

Chrysanthemum

A total of 94 germplasm collection including 36 varieties were evaluated for their performance under Delhi conditions (Table 2). Rooted cuttings prepared from the existing varieties were planted in the new mother block of chrysanthemum. Open pollinated seed from selected varieties namely A-32, A-43, A-43, A-44, A-64, A-76, Anmol, Aprajita, Autumn Joy, B-107, B-26, B-28, B-43, Baggi, Birbal Sahani, D-1, Dolly White, Dolly Orange, Flirt, Garden Beauty, Gitanjali, Hemant, Himanshu, Jaya, LF- 26, Liliput, Little Kusum, Little Orange, Little Pink, Mallika Yellow, PAU-74, Ratlam Selection, Red Gold, Royal Purple, Sharad Mala, Shukla,



Sunny, White Prolific, Yellow Charm and Yellow Delight were sown for their evaluation. Pot plants were made to evaluate their suitability for pot culture and also for display in events such as the DFR Foundation Day, Flower Show, Kisan Mela, etc., and also for survival of the newly introduced varieties having less number of rooted cuttings.

Tuberose

Twelve varieties of tuberose namely, Arka Nirantar, Calcutta Single, Calcutta Double, Hyderabad Single, Hyderabad Double, Prajwal, Vaibhav, Phule Rajani, Rajat Rekha, Shringar, Suvasini and Sikkim Selection were collected from AICRP – Hyderabad Centre (APHU) and multiplied to obtain adequate number of bulbs for laying out

the trials for their evaluation and also for breeding especially mutation breeding.

Flowering Annuals

Breeding program in flowering annuals has been initiated in selected crops such as petunia, hollyhock and antirrhinum. In order to develop inbreds and to purify the collected germplasm in petunia and pansy selfing was attempted. Inter-specific crosses (including reciprocal) were successfully attempted between hollyhock (*Althea rosea*) and *Malva sylvestris*. The breeding programme will be extended further in other selected annuals in the ensuing season for development of inbred lines.

TABLE 1 : *Gladiolus* germplasm maintained at DFR

1. Aarti	21. Jyotsna	41. Red Advance
2. Alexander the Great	22. Kum kum	42. Red Beauty
3. Big Time Supreme	23. Novalux	43. Regency
4. Chadha Farm -1	24. Ocilla	44. Rose Supreme
5. Chadha Farm -2	25. Overture	45. Sagar
6. Chadha Farm -3	26. Peasano	46. Sancerre
7. Chandini	27. Peter Pears	47. Shagun
8. Chemistry	28. Praha	48. Shakti
9. CPG	29. Priscilla	49. Shobha
10. Darshan	30. Pune Hybrid	50. Snow Princess
11. DH-1 (Delhi Hybrid)	31. Punjab Beauty	51. Solist
12. DH-2 (Delhi Hybrid)	32. Punjab Dawn	52. Sylvia
13. Dhanwantari	33. Punjab Elegance	53. Tilak
14. Eurovision	34. Punjab Flame	54. Trader Horn
15. Fidelio	35. Punjab Glance	55. White Friendship
16. Hunting Song	36. Punjab Lemon Delight	56. White Prosperity
17. IIHR G 11	37. Purple Flora	57. Wigs Sensation
18. IIHR G12	38. Pusa Kiran	58. Yellow Stone
19. Jackson Ville Gold	39. Pusa Suhagin	
20. Jessica	40. Red 54	

TABLE 2: Chrysanthemum germplasm maintained at DFR

1. Anmol	13. Calvin Tattoo	25. Reagan White
2. Aprajita	14. Lal Pari	26. Red Gold
3. Autumn Joy	15. Lalima	27. Royal Purple
4. Dolly Orange	16. Liliput	28. Sharad Mala
5. Dolly White	17. Little Hemant	29. Shyamal
6. Flirt	18. Little Orange	30. Star White
7. Garden Beauty	19. Maghi	31. Sukla
8. Gitanjali	20. Mallika Yellow	32. Sunny
9. Gulmohar	21. Mother Teresa	33. Vijay
10. Jaya	22. Little Darling Kusum	34. White Prolific
11. Himanshu	23. Little Pink	35. Winter Queen
12. Calvin Mandarin	24. Panchu	36. Yellow Delight

Crop Production

Gladiolus

To increase the availability span of gladiolus for longer period, eight varieties namely, Big Time Supreme, Chandini, Eurovision, Novalux, Rose Supreme, Red Beauty, Snow Princess and White Prosperity were planted on staggered dates namely, on 17th July, 31st July and 16th August. The results indicated that the quality gladiolus spikes can be produced in Delhi during the months of October and November thus reducing dependence on the supplies from other parts of Country.

emergence was not much affected but the availability of quality flower spikes was advanced much before the regular planting season, *i.e* September-October (Table 3). It was also found that the quality of the spikes was not affected by earlier planting.

The corm and cormel production was also not affected by advancing the time of planting from the usual September/October. The number of days taken for flowering was not affected by different dates of planting (Varieties Eurovision, Rose Supreme, Novalux and Red Beauty) took 70 & 70, 86 & 90, 97 & 104 and 99 & 104 days

TABLE 3: Effect of staggered planting on the days taken to spike emergence in gladiolus

Date of Planting	White Prosperity	Snow Princess	Chandini	Big Time Supreme
July 17	68 (September 23)	66 (September 21)	66 (September 21)	88 (October 13)
July 31	57 (September 26)	57 (September 26)	63 (October 2)	69 (October 8)
August 16	68 (October 23)	69 (October 24)	68 (October 23)	69 (October 24)

Values in parenthesis are the flowering date of the year.

The varieties namely, White Prosperity, Snow Princess, Chandini and Big Time Supreme were planted at 15 days interval starting from mid July, to study the effect of off -season planting under Delhi conditions. The number of days taken to spike

(Table 4), respectively for spike emergence in the plantings of August 3 and August 16, 2010. The flower availability, however, was advanced to the months of October and November without any adverse effect on the quality of spikes.

TABLE 4: Effect of staggered planting on the days taken to spike emergence in gladiolus

Date of Planting	Eurovision	Rose Supreme	Novalux	Red Beauty
July 17	68 (September 23)	66 (September 21)	66 (September 21)	88 (October 13)
August 3	70 (October 12)	86 (October 28)	97 (November 9)	99 (November 11)
August 16	70 (October 25)	90 (October 15)	104 (November 29)	104 (November 29)

Values in parenthesis are the flowering date of the year.

Flowering Annuals

In the existing collection, 25 annuals have been added from PAU, Ludhiana. The annuals viz., Acroclinum, Antirrhinum, Aster, Brachycome, Breezea, Bromus, Calendula, Candytuft, Cosmos, Corn Flower, Dimorphotheca, Helichrysum, Lagurus, Molucella, Monarda, Nasturtium, Pansy, Petunia, Phlox, Saponaria, Sweet Alyssum, Stock, Sweet Sultan, Verbena, Wall Flower were transplanted and evaluated for various plant growth, flower and seed production behavior under Delhi conditions.

The observations were recorded on plant height, plant spread, number of branches, number of flowers per branch, flowering duration and seed yield. Based on plant height they were classified into three groups, Tall (> 90 cm): Bells of Ireland, *Coreopsis tinctoria*, *Coreopsis lanceolata*, Cosmos, Dimorphotheca, Gaillardia, Helichrysum, Lupin, Poppy, Sweet Sultan and

Statice; Medium (30-90 cm): Acroclinum, Aster, Breezea, Brumus, Calendula, Candytuft, Gazania, Lagurus, Linaria, Nasturtium, Phlox, Saponaria, Sweet William, Verbena and Wall Flower; Dwarf (< 30 cm): Brachycome, Chrysanthemum multicaule, Ice plan, Metricaria, and Sweet alyssum.

The duration of flowering was longer in Gaillardia, Hollyhock, Petunia, Phlox and Statice; whereas Brachycome, Metricaria, Pansy and Sweet alyssum flowered for a short duration.

Higher seed set and seed yield were found in Calendula, Coreopsis, Gaillardia, Helichrysum, Nasturtium and Verbena, whereas, Linaria, Pansy and Sweet alyssum set seed poorly and thereby low seed yield. Bells of Ireland, Mesembranthemum, Phlox, Sweet william, and Sweet sultan were medium in seed setting and yield. On the basis of seed production behavior, flowers like Calendula, Coreopsis, Gaillardia, Helichrysum and Phlox were found better.



Other Bulbous Flowers

Besides Gladiolus, other bulbous flowers viz. Iris, Daffodils, Lilium, Ranunculus, Ornithogalum, Freezia has also been introduced for evaluating their growth, flower & bulb production behaviour. The performance of different varieties of Iris, Ranunculus, Ornithogalum and freezia has been rated to be satisfactory in comparison to Daffodils and Lilium varieties, where bulb production has not been found to be satisfactory. The lifted bulbs has been stored in cold storage at 4°C.

Salient Research Achievements from AICRP (Floriculture) Centres

The Directorate of Floricultural Research is providing leadership in coordinating floriculture research and development to address location specific problems through different centres under AICRP on Floriculture. The salient accomplishments from the coordinated centres are summarized as under.

Crop Improvement

The crop improvement work on different crops such as rose, gladiolus, chrysanthemum, carnation, gerbera and anthurium were undertaken at different coordinating centres. Six varieties were developed during this period in gladiolus and chrysanthemum. Besides some promising lines have been identified which are in the advance stage of evaluation.

Under this four new varieties, in gladiolus *viz.*, Punjab Flame, Punjab Elegance, Punjab Lemon



Punjab Flame



Punjab Elegance



Punjab Lemon Delight



Punjab Glance

Delight and Punjab Glance were developed by PAU Ludhiana centre. In chrysanthemum two varieties *viz.*, Kaul and Khoshoo were developed by NBRI, Lucknow centre.



Kaul

Khoshoo

- In gladiolus, newly developed hybrid from IIHR, Hessaraghatta, IIHR-G-1 produced significantly higher plant height (118.37 cm), spike length (96.77 cm). Whereas, variety Phule Neelrekha recorded significantly more florets per spike (17.33), rachis length (58.80 cm) and corms per plant (1.87) at Pune. At Srinagar Centre twelve promising gladiolus hybrids were identified from the previous season's breeding material *viz.*, SK-86-10, SK-86-8, SK-96-4/1, SK-96-4/4, SK-96-5/1, SK-96-5/2, SK-96-5/3, SK-96-5/5, SK-96-5/6, SK-96-8/1, SK-96-7/17, SK-96-4/16.
- Rose cvs. Rakatgandha, Taj Mahal, Papa Meiland in HT Group; Summer Snow, Charleston, Arunima and Banjaran in Floribunda group; Wild Plum, Small Virtue and Centre Piece in miniature group were found promising at Ludhiana. Whereas at Pune, the rose variety Aqua produced more number of flowers per plant (10.4) followed by Upper Class (10.0) and Bordo (9.50).
- In chrysanthemum, evaluation of 200 varieties at Ludhiana led to identification of promising varieties namely, Ajay, Kelvin Mandarin, Kelvin Tattoo, Kermit's, Major

Bosshardt Wit, Nanako, Obsession, Reagan White, Reagan Emperor, Statesman, White Bouquet and White Staphour for cut flowers; Baggi, Birbal Sahni, Basanti, Ratlam Selection for loose flower; and Chiddori, Dolly Pink, Gum Drop, Kotai No Kori, Little Dipper, Mother Teresa, Tomiko and Yellow Charm for pot culture.

- In gerbera, the varieties, Alcatraz, Basic, Cross Road, Rosalin, Prime Rose and Sunway were found promising in respect of number of flowers/plant, Stalk length and flower diameter at Pune.
- New tuberose varieties viz., Arka Nirantara and GK-T-C-4 were evaluated along with Phule Rajani, Shringar, Prajwal and Hyderabad single (local check) at Hyderabad and maximum plant height and number of leaves were observed in Prajwal and Hyderabad single respectively. Early flowering was noticed in Prajwal (68.91 days) while late flowering was observed in GK-T-C-4 (88.20 days). The varieties Prajwal and Hyderabad single produced maximum spike length and spike weight respectively. The variety Arka Nirantara produced maximum number of florets per spike (48.11) and maximum floret size i.e. floret length (6.23 cm) and floret diameter (4.50 cm).
- In tuberose, 10 crosses made at Pune formed bulbs. The numbers of seedlings (bulbs) germinated from open pollinated seeds were more than hand pollination. In respect of growth and flowering characters, the hybrids GKT-C-4 and GKT-C-1 were found promising.
- Anthurium cv. Verdun Red with bright red medium sized spathe was found to be superior in performance. It was found that the production of flower was higher during June–November and March – February except August months under Yercaud conditions. Pollen viability and stigma receptivity was also higher during these months. Compatibility was found to be good in Tropical Red and Verdun Red as female parents and White as male parents in anthurium.
- In alstroemeria, among the seven accessions, Acc. No. 6 and 7 were found to be suitable as cut flowers due to their long rachis at Yercaud. For raising in beds and as fillers, Acc.No. 5 found suitable because of its dwarf stature and more flower length and longevity with double coloured flowers. Whereas at Katrain, the cvs. Aladdin, Cinderella and Pluto were found suitable for cut flowers, whereas cultivars Capri and Serena for pot culture purpose. At Kalimpong, the best varieties performed better were Pluto and Pink Panther.
- Orchid species namely, *Ascocentrum ampullaceum*, *Cymbidium aburneum*, *Cymbidium giganteum*, *Cymbidium devonianum*, *Coelogyne* spp., *Dendrobium nobile*, *Dendrobium densiflorum*, *Paphiopedilum insigne*, *Vanda coerulea*, *Vanda parishii*, *Thunia alba* have been found superior for cut flower production as well as for pot cultivation at Kalimpong. In *Cymbidium*-Golden Girl, Red Star, Kenny Wine, December Gold, Minishara Artision hybrid have been found suitable for cut flower production.

Crop Production

- In roses, the treatment T4 (75 % RDF + FYM (1 kg/m²) + Vermicompost (300 g/m²) + *Azospirillum*@ 2g/pl/y + PSB @ 2g/pl/y) and T1 (2 kg FYM, 140:70:70 g/m²/y) were at par with each other and recorded significantly more plant height (107.71 cm and 106.40 cm), yield per plant (30.33 and 30.13 flowers) and yield/m²/y (212.33 and 210.93 flowers) at Pune. Also, the same treatment showed significantly more plant height (38.53 cm), no. of flowers/ plant (15.60), flower diameter (2.40 cm), flower bud length (0.60 cm) and stem length of flower (22.60 cm) in pot grown roses.

- Mulching with black polythene (200 μ thick) recorded significantly less weed count/ m^2 (100.80), fresh wt. of weed (172.43 g) and dry wt. of weed (28.40 g). For yield and quality parameters, black polythene (100 μ) (T2) was found significantly better in rose cv. Gladiator at Pune and Ludhiana.
- The Carnation variety Liberty planted at a distance of 20x20 cm accommodating 25 plants/ m^2 showed significantly superior results in respect of growth and yield contributing characters at Pune.



- In the micronutrient studies at Coimbatore in var. Co 1 of chrysanthemum, spraying of $FeSO_4$ @ 0.8% at bimonthly interval after planting recorded earliest flowering (100.40 days) with extended flowering duration (50.67 days). It also recorded higher flower yield per plant (133.27 g) compared to control (92.40 g).
- At Coimbatore, application of 50% of fertilizers + 500 g/m^2 of vermicompost twice a year + spray of Panchagavya (3%) was found to be superior in respect of all the desired parameters viz., the least number of days taken for first flower bud appearance after planting (50.26 days), the highest flower yield (109.11 g/plant and 1585.29 g/m^2), the largest flowers (4.55 cm dia) and the longest flowering duration (57.71 days) in chrysanthemum cultivar Co2.
- In chrysanthemum var. Mayuri the application of T_4 (75% RDF+ FYM @ 1kg / m^2 + Vermicompost @ 300 g/m^2) + Azospirillum

+ PSB resulted in maximum plant height (32.47 cm.), number of flowers per spray (21.33) and number of flowers per plant (131.80) at Hyderabad.

- In gladiolus, var. Arka Amar, the application of 75% of recommended dose of fertilizers (NPK@200:75:75 kg/ha) along with FYM @1kg/ m^2 /y+ Vermicompost@300 g/m^2 +Azospirillum @2 g/m^2 +PSB @ 2 g/m^2 resulted in maximum plant height (115.16 cm), spike length (54.12 cm) and number of florets per spike (15.20) at Hyderabad.
- In chrysanthemum cv. Basanti, application of Pendimethalin @ 0.75 kg a.i./ha and 1.0 kg a.i./ha were effective in controlling the weeds recording minimum weed count (g/m^2), fresh weight of weeds (g/m^2) and dry weight of weeds (g/m^2) at Hyderabad.
- In tuberose, cv. Vaibhav, 75% of RDF (200 N, 100 P_2O_5 and 150 K_2O kg/ha) along with FYM (1 kg/m^2 /year) + vermicompost (300 g/m^2) + *Azospirillum* (2 $g/plant$) + PSB (2 $g/plant$) is found superior for increased production of flower spike and bulb yield.



- In gladiolus, among four weedicides (Atrazin, Metribuzin, Butachlor and Pendimethalin) tested, Pendimethalin @0.75 kg a.i./ha or 1.0 kg a.i./ha proved to be most effective in controlling weeds at Hyderabad and Srinagar. Metribuzin and butachlor had detrimental effect on the crop and also exhibited little influence on weeds.

- The micro-nutrient studies were undertaken at different centres using different concentration. The results using Zinc Sulphate (0.6%) application in gerbera resulted in significantly higher plant height (40.20 cm), plant spread (44.60 cm), length of flower stalk (53.96 cm), no. of flowers/plant (40.60) and no. of suckers per plant (10.50) at Pune centre.



- Among the heliconia accessions, Alancarli, Alex Red, Andromeda, Dwarf Jamaica, Gyana, Lady Di, Kenya Red, Petracover Strawberry cream and Tropics performed well under Yercaud conditions and also observed to bloom year round.
- At Katrain in liliium, cultivars Ercolano and Samur were found to be superior in vegetative and floral characters under open field conditions.
- In anthurium, application of Basacote plus 6 m @ 6 g/pot once in six months increased the number of spikes / plant (7.75), suckers/plant (7.45), stalk length (52.65 cm) and longevity of flower on plant (19.50 days) in the variety Red Dragon at Coimbatore.
- Application of 50% of RDF (NPK 30:10:10 @ 0.2% twice a week + FYM spray @ 1:10 ratio once a week) + 3% vermiwash + 3% panchagavya was found to be superior in respect of all the vegetative parameters viz., plant height (49.86 cm), number of leaves / plant (15.61), number of pseudobulbs / plant (12.53), internodal length (5.35 cm) as well as flowering parameters viz., number of spikes/plant (10.71), number of florets/spike (13.14), spike length (49.11 cm), longevity of spikes on plant (47.61 days) and vase life (19.42 days) in Dendrobium orchid cv. Sonia at Coimbatore.
- At Kahikuchi, application of NPK ratio of 20:10:10 @ 0.2% along with *Azospirillum* and Phospho bacterium each of 2 g per plant twice a week is recommended for optimum growth and flower production in *Dendrobium* orchid cv. Sonia.

Crop Protection

- Amongst seven modules tested for the management of *Fusarium* wilt in gladiolus, the pre-storage treatment with hot water (50°C for 30 min) followed by bulb dip in captan and carbendazim @ 0.2% and pre-planting bulb dip treatment in *Trichoderma harzianum* @ 10 g/l for 30 min showed the least disease incidence (3.33 PDI) at Pune.
- The pre-storage treatment of gladiolus corms in hot water combined with Captan (0.2%) and Carbendazim (0.2%) at 50°C for 30 min was found to be effective in reducing *Fusarium* wilt at Ludhiana. It also improved the number of spikes, corms and weight of cormels.
- The use of Neem cake colonized by the disease bio-control agent *Trichoderma harzianum* @ 500 g/m² followed by drenching and foliar spray either with captan @ 0.3% (9.67 PDI) or Metalaxyl MZ 72 WP @ 0.3% (10.67 PDI) or Copper oxychloride @ 0.3 % (11.33 PDI) for foot rot/root rot disease incidence in gerbera was found to be effective at Pune. Also, the fungicides Azoxystrobin @ 0.1 % (9.33 PDI), Iprodine + Carbendazim @ 0.2 % (9.57 PDI) and Difenconazole @ 0.05% (10.27 PDI), recorded significantly least leaf spot/blight intensity in gerbera.
- In Marigold, the fungicide Iprodine + Carbendazim @ 0.2% each recorded

significantly least disease intensity of leaf blight (9.50 PDI) and bud blight (2.13PDI) over the rest of the treatments and also recorded more number of flowers per plant at Pune.

- The fungicides, namely mancozeb (Dithane M-45), iprodione + carbendazim (Quintal) and difenconazole (Score), at a concentration of 0.2, 0.2 and 0.1 per cent respectively, reduced severity of *Alternaria* blight of marigold significantly at Ludhiana.
- In a survey conducted by Pune centre during Kharif & Rabi season (2010) at Charoli, Dist Pune, it was found that the Golden rod showed 55% intensity of rust, while at Rajgurunagar the tuberose registered 15% incidence of stem rot with 20% intensity of leaf blight and 15% intensity of leaf blight of marigold. In rabi season at Satara the polyhouse gerbera showed 25% leaf blight intensity and at Astagaon, Dist Ahmednagar the chrysanthemum showed 25% intensity of leaf blight.
- The fungicide Azoxystrobin @ 0.1 % showed significantly least tuberose leaf blight intensity (4.17 PDI) with maximum disease reduction (86.69 %) and was found significantly superior over rest of the treatments and also gave more number of flowers per plant at Pune.
- The final population of *Meloidogyne* in tuberose, cv. Single Local, was recorded to be statistically less in the treatments. The root galling index was found to be significantly lower in neem seed powder, carbofuran, *Trichoderma harzianum* and *Paecilomyces lilacinus* + *T. harzianum* treated soils. Neem cake and carbofuran (1 kg a.i./acre) significantly improved weight of bulbs and bulblets, whereas *T. harzianum* and *P. lilacinus* + *T. harzianum* enhanced weight of bulblets at Ludhiana.

Post Harvest Technology

- The pre-transit and storage treatment, with aluminium sulphate (300 ppm) significantly

improved vase life of cut rose stems at Ludhiana, Pune and Ranchi.

- The holding solution containing sucrose (1.5%) + aluminium sulphate (300 ppm) were most suitable for improving vase life of cut rose stems in cv. First Red at Pune.
- For local marketing, the spikes of gladiolus cv. White Prosperity could be stored at S3 stage when one basal floret was half open (Ludhiana and Srinagar) but for transportation to distant markets, the spikes should be stored at S2 stage *i.e.* when 5-6 florets show colour at Ludhiana.
- Pre-storage pulsing treatments of gladiolus spikes with sucrose (20%) + aluminium sulphate (300 ppm) + GA₃ (50 ppm) was found best for improving keeping quality after dry refrigerated storage (Ludhiana, Hyderabad, Kahikuchi, Pune, Srinagar, UAS Bangalore).
- The varieties of gladiolus differed with regard to their response to wet storage. The suitable varieties for wet storage were Jacksonville Gold (Ludhiana), American Beauty



Spikes of gladiolus cv. Jacksonville Gold in vase for evaluation of keeping quality

(Kahikuchi), White Prosperity (Srinagar) and Phule Neelrekha (Pune). S2 stage (when 5-6 florets showed colour) were more suitable for storage.

- LDPE and polypropylene (PP) 100 gauge thick sleeves were more suitable for modified storage of gladiolus spikes (Ludhiana).



MA storage of cut spikes of gladiolus

- Among the pulsing solutions, sucrose (10%) + STS + aluminium sulphate + kinetin (25 ppm) or BAP (25 ppm) recorded maximum vase life of carnation flowers (Hyderabad).
- Holding solution comprising of sucrose (2%) + AOA (45 ppm) + Alar (90 ppm) + Triton (100 ppm) + GA3 (1 ppm) + Kinetin (0.2 ppm) recorded maximum vase life of cut carnation flowers (Hessaraghatta and Pune).
- The stems of chrysanthemum held in solution of BAP (50 ppm) exhibited delayed wilting of florets as well as yellowing of leaves after storage (Ludhiana and Solan).
- For distant marketing, the stems of chrysanthemum wrapped in polypropylene (PP) sleeves of 100 gauge thickness maintained higher water content and exhibited prolonged vase life. (Ludhiana, Coimbatore and Solan).
- Pulsing treatment for one minute with aluminium sulphate (100 ppm) recorded the maximum vase life of stems of *Dendrobium* orchid cv. Sonia (Kahikuchi).
- Maximum vase life in *Cymbidium* orchid was observed with vase solution comprising of sucrose (5%) + BAP (25 ppm) + aluminium sulphate (300 ppm) (Kahikuchi).
- Pre-transit pulsing treatment of cut stems of anthurium with NaOCl (1000 ppm) for 16 h at 13-15°C significantly improved vase life and delayed blackening of spadix (Kahikuchi and Kalyani).
- Holding solution containing sucrose (5%) + aluminium sulphate (300 ppm) + kinetin (25 ppm) was found most effective for improving vase life of anthurium (Kalimpong and Kalyani).
- Among the three cultivars of anthurium, Eliza exhibited maximum vase life. The spikes harvested when fully mature and pre-cooled at 14-15°C showed the maximum vase life (Kahikuchi)
- Vase solution containing (5%) sucrose + aluminium sulphate (300 ppm) was most effective for increasing vase life of tuberose stems (Hyderabad, Kahikuchi and Ludhiana).
- The cut stems of tuberose when stored under refrigerated condition beyond 3 days, showed considerable reduction in vase life (Hyderabad, Kahikuchi, Kalyani and Ludhiana).
- Polypropylene (PP) sleeves when used as packaging material for 16 h showed increase in vase life of cut tuberose stems (Kahikuchi and Kalyani).
- Pre-cooling of tuberose buds (for garland purpose) at 4°C was beneficial for extending their vase life (Hessaraghatta and Kalyani). The buds could be stored at 4°C for 6 days. Prolonged storage inhibited the opening of buds.
- Paclobutrazol (300 ppm) significantly improved opening of buds and vase life in tulip.



- Vase solution containing sucrose (2%) + tartaric acid (300 ppm) was most effective for increasing vase life of gerbera stems (Pune and Kahikuchi).
- Pulsing treatment with aluminium sulphate (1000 ppm) for one minute was found to be the best for improving vase life and preventing stem break in gerbera (Pune, Hesaraghatta and Kahikuchi).
- Pulsing of daffodil cv. Yunis for 12 h with sucrose (4%) + STS (2mM) recorded the maximum vase life (Srinagar).
- The best holding solution for improving vase life of LA hybrid lily cv. Cilesta was sucrose (2%) + 8-HQC (100 ppm) + GA₃ (150 ppm) (Katrain).
- Best holding solution for maintaining the keeping quality of cut daffodil cv. Trumpet was sucrose (2%) + aluminium sulphate (100 ppm) (Katrain and Srinagar).
- Post harvest packaging of marigold flowers in plastic crates showed maximum vase life whereas packing in gunny bags showed the minimum vase life (Hesaraghatta and Kalyani).

Value Addition

The experiments were undertaken on value addition in different flowers at various centres and the results obtained are as under:

- *Celosia* flowers were found to take instant colour by dyeing. Techniques were developed for drying of fruits of *Acacia auriculiformis* and *Terminalia arjuna* (Kalyani).
- Flowers of six species, foliage of seven species and fruiting structures of nine species



were dried and used for making decoration pieces such as decorative pots, greeting cards, baskets, candles, etc (Solan).



- Six plant species viz. leaves of *Camellia reticulata*, *Grevillea robusta*, *Adiantum venustum*, pods of *Callistemon lanceolatus*, and flowers of *Gerbera jamesonii* and *Plumeria alba* were identified for drying. Shade drying was found to be best for *Callistemon lanceolatus*, silica gel embedding for *Camellia reticulata*, *Gerbera jamesonii* and *Grevillea robusta* and press drying for *Adiantum venustum* (Coimbatore).
- Full bloom stage and silica gel drying was considered most suitable for drying gerberas (Yercaud). For dehydration of leaves of silver oak, thuja and camellia, glycerization was found most suitable (Yercaud).
- Biostimulant sprays (Humic acid + Panchagavya) improved concrete content in *Jasminum sambac* var. Ramanathapuram Gundumalli (Coimbatore).
- While comparing the stages of harvest, the open florets in tuberose showed more concrete content than the unopened florets (Pantnagar).

Institutional Building

Research Farm Development

Land Development

The Directorate got 8 acre of land from IARI. The farm layout was prepared and the whole area was divided into plots, and paths were prepared for movement of farm machinery and other purposes. After layout the whole area was laser leveled. Irrigation channels and drainage facilities were also created. The research farm has been developed in such a way that each and every corner of field is approachable.

Farm Office/Farm Store

A new farm office-cum-store has been built in research field to facilitate research experiments, keeping farm implements, machinery, pesticides, fertilizers and other consumable & non-consumable items. Also the existing old farm shed has been renovated and put to use for research purposes. Besides this, a threshing floor has also been constructed for threshing and cleaning seeds of annual flowers. An over head water storage structure along with treatment tanks has been made for treating corms/bulbs.

Renovation of Nethouse and Polyhouse

The renovation of existing shade-net house and polyhouse was taken up on priority. These structures are being intensively used for raising chrysanthemum cuttings, maintaining potted plants, etc.

Renovation of Office Building

The Directorate has been allotted the old building of Post Harvest Technology Division of

IARI. The handed over space requires substantial renovation. The work has been undertaken on priority and necessary renovation/repairing is underway.

XX Annual Group Meeting of AICRP on Floriculture

All India Coordinated Research Project on Floriculture has the responsibility of reviewing the performance of the Coordinated Centres after every two years by holding biennial group meetings. In the XIX Group Meeting held on 10-12 December, 2009 at IARI, New Delhi, it was recommended to hold the Group Meeting annually. Accordingly, the XX Annual Group Meeting was held on 13-15 November, 2010 at Bidhan Chandra Krishi Vishyavidyalaya, Kalyani, West Bengal. Besides, Inaugural and Plenary Sessions, there were seven technical sessions in the Group Meeting. The XX Group Meeting was blessed with the presence of Sh. Mohanto Chatterjee, Hon'ble Minister Incharge, FPI and Horticulture as Chief Guest, Dr. H. P. Singh, Deputy Director General (Hort), Indian Council of





Participants of the XX Group Meeting of AICRP

Agricultural Research as Guest of Honour, Dr. S. K. Sanyal, Vice Chancellor, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur as Chairman, Dr. P. K. Pramanik, Director, Directorate of Horticulture and FPI, Government of West Bengal, Dr. Bir Pal Singh, Director, CPRI, Shimla, emeritus scientists from CSIR (Dr. S. K. Datta, Dr. Debhasis Mukherjee), etc. All the scientific staff from the coordinated centres, scientists from BCKV, ICAR representatives, representatives from floriculture industry, farmers, etc participated in the meeting.

On this occasion, three publications namely 'Production Manual on Tuberose', 'The Genesis of Directorate of Floricultural Research', and 'Floriculture in West Bengal – Scope and Opportunities' were released by the Chief Guest, Sh Mohanto Chatterjee, Hon'ble Minister, Incharge, FPI and Horticulture, Govt. of West Bengal, Dr. H.P.Singh, DDG (Horticulture), ICAR, New Delhi and Dr. S. K. Sanyal, Vice Chancellor, BCKV, Kalyani, respectively. The progress of ongoing research programmes of the AICRP centres was reviewed and relevant recommendations were given. The technical programme for the next two years (2011-12 & 2012-13) was discussed and finalized.

Foundation Day Celebration

It is needless to mention the huge scope and potential of floriculture in India. But to realize this potential and to encash the enormous

opportunities, it is vital to have a strong R & D in floriculture sector. It is in this direction, the Directorate of Floricultural Research has been established in XI Five Year Plan under Indian Council of Agricultural Research and formally launched on 10 December, 2009. It is indeed good that floriculture is not only an option of crop diversification but a means in itself for higher returns per unit area and increased (round the year) employment. Also, in these modern days where not only the youth, but the traditional farmers are preferring to white-collar jobs, floriculture, under protected conditions, value addition in the form of essential oils, dry flowers, etc. is not less than any officer job. The Directorate of Floricultural Research celebrated foundation day on 10 December, 2010, to commemorate its first year of establishment. Dr. U.C. Srivastava, ADG (Hort-II), ICAR was the Chief Guest of the function. The function was attended by former Project Coordinators (AICRP, Floriculture), Directors of various institutes, Heads of the Divisions (IARI), Scientists, Technical staff, Students, Press & Media. The Chief Guest appreciated the efforts made by the director within a short period of his



Chief Guest Dr. U.C. Srivastava, ADG (Hort-II), ICAR addressing the foundation day gathering

joining and trusted that the directorate will emerge as a premier institute in the field of floriculture in the world in coming future. This day was also celebrated as chrysanthemum day.

Foundation Day Celebrations



Meetings of RAC/IRC/IMC

Research Advisory Committee (RAC)

The first Research Advisory Committee of Directorate of Floricultural Research (DFR) was held under the Chairmanship of Prof. P. Das, Chairman & Managing Director, The Science Foundation for Tribal & Rural Resource Development, Bhubaneswar on 12-13 January, 2011 in the Committee Room of the Directorate of Maize Research (DMR), Pusa, New Delhi. It was recommended that necessary infrastructure for research in the field and laboratories to work on plant improvement should be developed expeditiously. Also, it is suggested that the sanctioned scientific manpower need to be deployed early to work on Plant improvement, Production technologies including soil, water management, Post-harvest management (Physiology & Biochemistry), Plant protection (insect pests, diseases including viruses), Dry

flower production technologies, Landscape development, Germplasm introduction, documentation including molecular characterization and conservation and Transfer of technologies. It was also recommended that the AICRP centres should be allotted specific crops depending on climatic advantages and on their competency developed during the past decades, those can work as lead centres for



Members of maiden RAC meeting of Directorate of Floricultural Research

conservation and maintenance of germplasm of these crops. The RAC members also visited the research farm where they were shown the recent

research & developmental activities undertaken. The members appreciated the efforts of the directorate in this regard in a short span of time.

Research Advisory Committee

Name		Designation
Prof. P. Das	Chairman, The Science Foundation for Tribal & Rural Resource Development	Chairman
Dr. V. P. Ahlawat	Professor & Head, CCS, Haryana Agricultural University	Member
Dr. S. P. Vij	NASI, Senior Scientist Fellow	Member
Dr. R. C. Upadhyay	Former Director, NRC Orchids	Member
Shri. Sundaram Raju	Progressive Farmer, East coast Coconut Hybrid Centre	Member
Shri Santosh Attavar	C.E.O., Indo-American, Hybrid Seeds Private Limited	Member
Dr. Ramesh Kumar	Director, Directorate of Floricultural Research	Member
Dr. Umesh Srivastava	Assistant Director General (H-II), ICAR	Member
Mrs. Megha Borse	President, Flower Grower Association, Maharashtra	Member
Shri. Jaffar N. Naqvi	Chief Editor (Floriculture Today) and Director Media Today Pvt. Ltd.	Member
Dr. Krishan Pal Singh	Principal Scientist	Member Secretary

Institute Management Committee (IMC)

The IMC in respect of Directorate of Floricultural Research was constituted as mentioned below:

Institute Management Committee

Name		Designation
Dr. Ramesh Kumar	Director, Directorate of Floricultural Research	Chairman
Jt. Director (Agrl)	Govt. of Delhi, I.P. Estate, New Delhi	Member
Jt. Director	Directorate of Horticulture and Food Processing, Govt. of Uttar Pradesh, Sapru Marg, Lucknow	Member
Prof. and Head	Division of Horticulture, Sardar Vallabh Bhai Patel University of Agriculture & Technology, Meerut	Member
Mrs. Megha Borse	President, Flower Grower's Association, Maharashtra	Member
Mr. Jaffar N. Nagvi	Chief Editor (Floriculture Today), and Director, Media Today	Member
Finance & Account Officer	IASRI, New Delhi	Member
Dr. R.C. Srivastava	Jt. Director, BSI, Kolkata	Member
Dr. M. Jawahar Lal	Prof. and Head, Horticulture College & Research Station, TNAU	Member
Dr. T. Janakiram	Head, Divison of Floriculture & Landscaping, IARI, New Delhi	Member
Dr. N. Ramachandran	Pl. Scientist, Plant Pathology, IIHR, Bangalore	Member
Mr. Anil Kumar Maithani	AO, Directorate of Floricultural Research, New Delhi	Member Secretary

Institute Research Council (IRC)

A meeting of Institute Research Council (IRC) was held on 7 October, 2010 under the chairmanship of Dr. Ramesh Kumar, Director, DFR. The presentations of project proposals (Draft RPF I's) were made by the scientists (Dr. P. Naveen Kumar, Dr. Tarak Nath Saha and Dr. Jayoti Majumdar). The resource person, Dr. S.K. Malhotra, Principal Scientist (Hort), Horticulture division, ICAR and Director, DFR suggested for reducing the proposed work load as the scientific staff and infrastructural facilities are limited.

The second meeting of the Institute Research Council (IRC) was held under the chairmanship of Dr. Ramesh Kumar, Director, DFR and in presence of Dr. A.P. Singh, Former Project Coordinator, AICRP on Floriculture & scientific staff of the DFR was held on 26 March, 2011 to review the progress of the research projects. The work done despite limited staff and other resources was well appreciated. It was suggested to revise the ongoing research projects for enabling the newly joined scientists to associate in the projects. The list of ongoing projects is given below:

List of On-going (in-house) Research Projects

Mega/Sub-project	Programme Leader	Principal Investigator	Co-Principal Investigator	Remarks
Mega Project-1 : Improvement of commercial flower crops				
Sub- Project-1 Breeding of gladiolus for quality and yield	Dr. Ramesh Kumar Director	Dr. P. Naveen Kumar Sr. Scientist	Dr. Tarak Nath Saha Scientist Dr. Jayoti Majumder Scientist	Collaboration may be required from Plant Pathology for screening of parents/hybrid against diseases
Sub- Project-2 Breeding of chrysanthemum for quality flowering and pot mums	Dr. Ramesh Kumar Director	Dr. Tarak Nath Saha Scientist	Dr. P. Naveen Kumar Sr. Scientist Dr. Jayoti Majumder Scientist	Enrichment of germplasm and systematic breeding has to be strengthened
Sub- Project-3 Breeding of tuberose for novel colour and oil recovery	Dr. Ramesh Kumar Director	Dr. P. Naveen Kumar Sr. Scientist	Dr. Tarak Nath Saha Scientist Dr. Jayoti Majumder Scientist	Fresh collection of germplasm has to be initiated
Sub- Project-4 Improvement of flowering annuals	Dr. Ramesh Kumar Director	Dr. Jayoti Majumder Scientist	Dr. P. Naveen Kumar Sr. Scientist Dr. Tarak Nath Saha Scientist	Systematic breeding program in selected annuals has to be taken up
Mega Project-II : Standardization of production technology of commercial flowers				
Sub- Project-1 Gladiolus	Dr. Ramesh Kumar Director	Dr. Tarak Nath Saha Scientist	Dr. P. Naveen Kumar Sr. Scientist	Off season production for extended availability and use of PGRs
Sub- Project-2 Flowering Annuals	Dr. Ramesh Kumar Director	Dr. P. Naveen Kumar Sr. Scientist	Dr. Tarak Nath Saha Scientist	Collection and evaluation of germplasm of different flowering annuals

Transfer of Technology

Participation in Horticulture Show

Directorate of Floricultural Research participated in the Pusa Horticulture Show, 2011 organized by Delhi Agri-Horticulture Society on 26-27 February, 2010 at IARI, New Delhi. On this occasion, fresh flowers of different varieties of bulbous ornamentals such as gladiolus, iris, daffodils, tulip, etc. and flowering annuals; loose flowers of marigold, chrysanthemum, etc;

publications and other technical information; potted plants, etc were displayed in the exclusive DFR stall. Also, information on germplasm collection, new varieties and latest technologies in flower cultivation developed by coordinated centres of AICRP on Floriculture were disseminated. The live specimens as well as the literature offered was highly appreciated by the distinguished visitors and flower lovers.



Participation in Krishi Vigyan Mela

Directorate of Floricultural Research participated in the 'Pusa Krishi Vigyan Mela 2011' organized by IARI, New Delhi on 3-5 March, 2011 with theme 'Farm Technologies for Enhanced Productivity and Income'. The exclusive DFR stall with live specimens of fresh flowers along with copies of DFR publications and other relevant literature displays were visited by Hon'ble Minister, Director, IARI and farmers from various states. Pusa Krishi Vigyan Mela is considered one of the largest platforms for dissemination of technologies.





Farmers & Officials of Jammu & Kashmir visiting research farm during Pusa Krishi Vigyan Mela

TV / Radio Talks

- Dr. Ramesh Kumar delivered TV recording on DFR Foundation Day on 10 Dec., 2010.
- Dr. Ramesh Kumar delivered a radio talk during February, 2011
- Dr. Ramesh Kumar delivered a TV talk during Pusa Krishi Vigyan Mela, 2011 at IARI, New Delhi during 3-5 March, 2011.
- Dr. Ramesh Kumar delivered a Live TV talk on 31 March, 2011.
- Dr. P. Naveen Kumar and Dr. Tarak Nath Saha delivered TV talks from Doordarshan and CNEB about Ornamental Crops and Scope in Floriculture.
- Dr. Tarak Nath Saha delivered Radio talk twice (*bat phule ki*) on AIR.
- Dr. Gunjeet Kumar, delivered talk on flower cultivation on Doordarshan

Participation in other activities

The DFR has participated in the 'National Conference on Horticultural Biodiversity for livelihood, Economic Development and Healthcare & Swadesh Prem Jagriti Sanghosthi 2010', held at UHS Campus, Doddabetthali, Bangalore on 29-31 May, 2010. Along with the exhibits of fresh flowers, publications related to floriculture were displayed in the exclusive stall of DFR.

Training Programmes Organized

The Directorate of Floricultural Research (DFR), Pusa, New Delhi has conducted a training program on Recent Advances in the Production Technology of Commercial Flower Crops on 07-11 February, 2011 to the farmers (46) of the Bihar state. It was sponsored by the Project Directors, Agricultural Technology Management Agency (ATMA) from the Districts of Jehanabad and Madhubani, Bihar. This was the beginning of training programme conducted by the DFR after its establishment in XI Five Year Plan.



In the inaugural session, Dr. T. P. Trivedi, Assistant Director General, AKM & Director, DIPA, ICAR emphasized the need for transfer of technologies in emerging areas of floriculture and the need for imparting trainings in relevant fields. In addition to the faculty from DFR, Scientists from different divisions/units of IARI (Floriculture, Agronomy, Entomology, Nematology and Centre for Protected Cultivation Technology, CPCT) were involved in theory as well as practical classes. Dr. S. Rajan, Asst. Director General

(Hort.I), ICAR graced the valedictory function and congratulated the successful participants and advised them to share the knowledge gained here with all those interested in floriculture in their respective region.



Training was imparted on various aspects of floriculture viz., production technology of commercial flower crops including production under protected conditions, water and nutrient management, post harvest handling, management of insect pests and diseases (integrated pest and disease management), value addition in flower crops (dry flowers, extraction of essential oils, etc.) and marketing. Emphasis was laid on imparting practical knowledge and hands-on experience, and accordingly the trainees were taken to flower markets, nurseries in Delhi and to the research farms of DFR, Centre for Protected Cultivation Technology etc. to enhance their knowledge on flower marketing traits, opportunities and scope so as to promote floriculture at their places.



Publications

Research Papers

- S. Rani, S.K. Chauhan, Ramesh Kumar and K.K. Dhatt (2011) Bioeconomic appraisal of Flowering annuals for seed production under Poplar (*Populus deltoieds*) based agro forestry system”, *Tropical Agricultural Research*. 22(2): 125-133.
- Dhatt K.K. and Ramesh Kumar (2010), “Effect of Temperature and Packaging Material on Seed Germination and Seed Viability of Gaillardia. *Indian Journal of Horticulture*, 67(3): 362 – 371.
- Dhatt K.K. and Ramesh Kumar (2010), “Effect of Storage Temperature and Packaging Material on Seed Germination of Mathiola (*Mathiola incana*). *J Environmental Ecology*, 28(4A): 2632 – 36.
- P. Naveen Kumar and R. L. Misra (2011). Studies on the effect of plant growth regulators on growth, flowering and corm production of gladiolus cv. Snow Princess. Submitted to *Indian Journal of Agricultural Sciences*, New Delhi.
- K.K. Gangopadhyay, R.K. Mahajan, Rajendra Prasad, Gunjeet Kumar, B. L. Meena, Ranjan Kar, Rajeev Gambhir and S.K. Mishra. 2010. Relative Efficiency of Experimental Designs in Evaluation of Plant Genetic Resources. *Journal of Plant Genetic Resources*. 23 (2): 164-167.
- N.S Panwar, Ashok Kumar, S. S. Malik, V. K. Dwivedi, Gunjeet Kumar and P. B. Singh 2011. Assessment of Variability Parameters

for Agro-morphological and Phytochemical Traits in Basil (*Ocimum basilicum*) Germplasm. *Journal of Plant Genetic Resources*. 24 (1): 92-96.

- Sindhu, S. S. and Saha, T. N. (2011). Present scenario, prospects and challenges in floriculture industry. *Harayana Journal of Horticulture*. Accepted for Publication.

Technical/Popular Articles

- P. Naveen Kumar and Ramesh Kumar (2011). Potted Plants as a Potential Avenue For Higher Income. In: *Horti-Business*, published by Delhi Agri-Horticulture Society, IARI, New Delhi
- P. Naveen Kumar (2011). Improved production technologies of gladiolus. In: *Compendium on ‘Recent Advances in Production Technology of Commercial Flower Crops’*, compilation of lectures of five day training program held on 07-11 February, 2011 for the progressive farmers of the Jehanabad and Madhubani Districts of Bihar. Directorate of Floriculture Research, New Delhi p 5-8.
- P. Naveen Kumar (2011). Post harvest handling of cut flowers. In: *Compendium on ‘Recent Advances in Production Technology of Commercial Flower Crops’* compilation of lectures of five day training program held on 07-11 February, 2011 for the progressive farmers of the Jehanabad and Madhubani Districts of Bihar. Directorate of Floriculture Research, New Delhi p 41-46.

- Saha, T. N., Singh, K. P. and Swati Khan (2010). Minimise the use of Harmful plants in Landscaping- Part I. *Floriculture Today*, 15 (2): 46-52.
- Saha, T. N., Singh, K. P. and Swati Khan (2010). Minimise the use of Harmful plants in Landscaping-Part II. *Floriculture Today*, 15 (5): 38-42.

Technical Bulletins/Books

- Chakraborty, R. Sadhukhan, A. K. Roy, Jayoti Majumder, P. Naveen Kumar, T. N. Saha and Ramesh Kumar (2010). Floriculture in West Bengal: Scope and Opportunities, DFR Extension Bulletin No.2, Directorate of Floriculture Research, New Delhi, p40.
- Ramesh Kumar, P. Naveen Kumar and T. N. Saha (2010). The Genesis of Directorate of Floricultural Research, DFR Extension Bulletin No. 2, Directorate of Floriculture Research, New Delhi, p108.
- Ramesh Kumar, P. Naveen Kumar, Tarak Nath Saha and P. Sellam (2011). Compendium on 'Recent Advances in Production Technology of Commercial Flower Crops' compilation of lectures of five day training program held on 07-11 February, 2011 for the progressive farmers of the Jehanabad and Madhubani Districts of Bihar. Directorate of Floriculture Research, New Delhi.
- K. K. Gangopadhyay, Gunjeet Kumar, and S.K. Yadav (2011) Leafy Vegetables: Genetic Resources and Improvement. In: Biodiversity of Vegetable Crops: Conservation and Management. (eds. D. K. Singh and H. Chaudhury), New India Publishers, New Delhi. p. 62-73

Presentations in Conference/Symposia/Seminar etc.

- Ramesh Kumar, presented the Lead Paper "Orchid research in AICRP" in National Consultation for Production and utilization

of Orchids held on 19-21 February, 2011 at National Research Centre for Orchid, East Sikkim.

- P. J. Singh, K. K. Dhatt and P. Naveen Kumar (2011). Screening of gladiolus hybrids against *Botritis gladiolorum* and high temperature tolerance under semi-arid subtropical conditions of Indian Punjab. Extended summaries, International Conference: Preparing Agriculture for Climate Change, 6-8 February, 2011 held at PAU, Ludhiana, India.
- K. P. Singh, Tarak Nath Saha and P. Naveen Kumar (2011). Off-season flower production in gladiolus (*Gladiolus grandiflora*) cv. Snow Princess. Book of Abstracts, National Conference on Recent Trends and Future Prospects in Floriculture held at S.V.B.P.UAT, Meerut, 5 August, 2011.
- Tarak Nath Saha, K. P. Singh and P. Naveen Kumar (2011). Study on growth and flowering in gladiolus (*Gladiolus* hybrid) cv. White Prosperity as affected by planting dates. Book of Abstracts, National Conference on Recent Trends and Future Prospects in Floriculture held at S.V.B.P.UAT, Meerut, 5 August, 2011.
- P. Naveen Kumar, Ramesh Kumar and Tarak Nath Saha (2011). Present Status and Future Strategies in the Improvement of Flower Crops. Lead paper presented in the National Conference on Recent Trends and Future Prospects in Floriculture conducted at S.V.B.P.UAT, Meerut, 5 August, 2011.
- P. Naveen Kumar and Ramesh Kumar (2011). Genetic engineering for flower crop improvement. Lead paper presented in the National Conference on Recent Trends and Future Prospects in Floriculture conducted at S.V.B.P.UAT, Meerut, 5 August, 2011.
- Ramesh Kumar and P. Naveen Kumar (2011). Recent Advances in the Production of Bulbous Ornamentals under AICRP on Floriculture. Lead paper presented in

National Consultation on production of disease free quality planting material propagated through tubers and rhizomes held at CPRI Modipuram campus, 4-5 March, 2011. Souvenir, p 39-47.

- K.P. Singh, T. N. Saha and P. Naveen Kumar (2010). Off-season flower production in gladiolus cv. Chandini. Book of Abstracts, National congress on emerging trends in agricultural research, 11-12 September, 2010 organized by Hi-Tech Horticultural Society, Meerut, U. P. India, p51.
- T. N. Saha, K.P. Singh and P. Naveen Kumar (2010). Effect of dates of planting on growth and flowering parameters in gladiolus cv. Big Time Supreme. National Congress on emerging trends in agricultural research, 11-12 September, 2010, organized by Hi-Tech Horticultural Society, Meerut, U.P. India, p90.
- Saha, T. N., Singh, K. P. and Swati (2010). Minimize the use of Harmful Plants in Landscaping in National Consultation on Landscape Gardening for Aesthetic Values

and Environmental Services, 29-30 April, 2010, IIHR, Bangalore.

Compilation/Documentation

- Ramesh Kumar, P. Naveen Kumar, T. N. Saha, K. P. Singh and S. Pushkar (2010). Annual Report 2009-10, Directorate of Floricultural Research, Published by Director, DFR, New Delhi.
- Ramesh Kumar, P. Naveen Kumar, T.N. Saha and J. Majumder (2010). Proceedings of the XX Annual Group Meeting of AICRP on Floriculture, Action taken report on the recommendations of XIX Group Meeting of AICRP on Floriculture, Salient Research Achievements 2009-10 and Technical Programme 2011-12 & 2012-13 of AICRP on Floriculture.
- P. Naveen Kumar, T. N. Saha and Jayoti Majumder (2010). A brochure on the significance of Foundation Day - 10 December, 2010 of Directorate of Floricultural Research, New Delhi.

Awards/Recognitions

- Dr. Ramesh Kumar was awarded with 'Lotus Purashkar' by Indian Society of Ornamental Horticulture, for outstanding contribution in the field of floriculture & landscaping in the National consultation at IIHR, Bangalore from 29-30 April, 2010.



- Dr. Ramesh Kumar received best Oral Presentation Award in the National Conference on Production of Quality Seeds and Planting Material- Health Management in Horticultural Crops, New Delhi (11-14 March, 2010).
- Dr. Ramesh Kumar acted as chairman, Awards Committee, Indian Society of Ornamental Horticulture (ISOH) for shortlisting candidates for various awards of the society.
- Dr. Ramesh Kumar acted as chairman of sessions on Commercial Floricultural & Landscaping in the National Symposiums at IIHR, Bangalore (29-30 April, 2010), TNAU, Coimbatore (26-28 Nov., 2010), NRC Orchid, Gangtok (19-21 Feb., 2011) and SVBPUAT, Meerut (4-5 March, 2011).
- Dr. Ramesh Kumar was 'Guest of Honour' at the inaugural function of farmers training organized by Directorate of Extension, Dr. Y.S. Parmar University of Horticulture and Forestry at Solan on 14-15 January, 2011.
- Dr. Ramesh Kumar was 'Guest of Honour' at Honey Festival-cum-Bee keeping workshop held on 22-24 February, 2011 at PAU, Ludhiana.
- Dr. Ramesh Kumar was honoured as 'Guest of Honour' at Kisan Melas organised at RAU, Pusa, Samastipur (13-14 March, 2011), and at PAU, Ludhiana (19-20 March, 2011) respectively.
- Dr. P. Naveen Kumar was conferred with Fellowship of Indian Society of Ornamental Horticulture, New Delhi for the outstanding contributions in the field of Horticulture (5 March, 2011).
- Dr. P. Naveen Kumar received a Certificate of Merit for presentation of Best Paper 'Off-season flower production in gladiolus (*Gladiolus grandiflora*) cv. Snow Princess' in poster session of National Conference on Recent Trends and Future Prospects in floriculture (5-8 March, 2011).
- Dr. P. Naveen Kumar received a Certificate of Merit for presentation of Best Paper 'Study on growth and flowering in gladiolus (*Gladiolus* hybrid) cv. White Prosperity as affected by planting dates' in poster session of National Conference on Recent Trends and Future Prospects in floriculture. (5-8 March, 2011).

- Dr. P. Naveen Kumar was nominated as Assistant Editor of Indian Journal of Horticulture, published by Horticultural Society of India, New Delhi for the year 2011.
- Dr. P. Naveen Kumar acted as Rapporteur of different sessions of National workshop on Urban Horticulture, 26 March, 2011 held at IARI New Delhi; National Conference on Recent Trends and Future Prospects in floriculture, held at SVBPUAT, Meerut, XX Annual Group Meeting of AICRP on Floriculture, 13-15 November, 2010 held at BCKV, Kalyani (5-8 March, 2011).
- Dr. P. Naveen Kumar acted as external examiner (Question paper setting and evaluation) of the floriculture courses in different SAU's (OUAT, SKUAST, YSPUHF, CAU, etc)
- Dr. P. Naveen Kumar reviewed research papers submitted for publication in Journal of Horticulture and Forestry, Journal of Horticulture Science, Indian Journal of Horticulture, etc.
- Dr. Gunjeet Kumar reviewed research papers submitted for publication in Journal of Plant Genetic Resources, Indian Journal of Ornamental Horticulture, etc.
- Dr. Gunjeet Kumar acted as external examiner for conducting *viva-voce* examination of M.Sc. student of SVBPUAT, Meerut.
- Dr. Tarak Nath Saha received the Best Poster Paper Award in National Consultation on Landscape Gardening for Aesthetic Values and Environmental Services, IIHR, Bangalore for "Minimize the use of Harmful Plants in Landscaping" (29-30 April, 2010).
- Dr. Tarak Nath Saha received Best poster "Studies on growth and flowering in gladiolus cultivar White Prosperity" at National Conference on Recent Trends and Future Prospects in Floriculture at SVPUAT, Modipuram, Meerut (5-8 March, 2011).
- Dr. Tarak Nath Saha received Best poster "Off season flower production in gladiolus cultivar Snow Princess" at National Conference on Recent Trends and Future Prospects in Floriculture at SVPUAT, Modipuram, Meerut (5-8 March, 2011).
- Dr. Tarak Nath Saha acted as rapporteur in the technical session during XX Group Meeting of AICFIP at Kalyani.
- Dr. Tarak Nath Saha acted as rapporteur in one of the sessions of National workshop on Urban Horticulture, held at IARI New Delhi (26 March, 2011).
- Dr. Tarak Nath Saha was nominated as Nodal Officer for PIMS-ICAR activity.
- Dr. Tarak Nath Saha was nominated as expert for writing chapter in Horticulture for IGNOU application oriented course curriculum.
- Dr. Tarak Nath Saha acted as reviewer of research articles submitted for publication in Indian Journal of Horticulture.

Seminars/Symposia/Conferences/ Workshops Attended

- P. Naveen Kumar attended workshop of the Otto Warburg Minerva Biotechnology Centre of the Robert H Smith Institute of Plant Sciences, Rehovot (Hebrew University of Jerusalem) at S'de Yaav, Israel (17-18 February, 2010).
- P. Naveen Kumar attended National workshop on Urban Horticulture for Nutritious Food and Environmental Security' held at IARI, Pusa, New Delhi, (22 March, 2011).
- P. Naveen Kumar attended National Conference on Recent Trends and Future Prospects in Floriculture, held at SVBPUAT Meerut jointly organized by Indian Society of Ornamental Horticulture and Department of Horticulture, SVBPUAT, Meerut (5-8 March, 2011).
- P. Naveen Kumar attended National Conference on Plant Diversity for Aesthetic Values and Landscape Gardening, held at TNAU Coimbatore, jointly organized by Tamil Nadu Agricultural University, Coimbatore & Indian Society for Ornamental Horticulture, New Delhi (26-28 November, 2010).
- Tarak Nath Saha, participated at National Conference on Horticultural Biodiversity for livelihood, economic development and healthcare, held at Swadesh Prem Jagriti Sanghosthi 2010, held at UHS Campus, Doddabetthali, Bangalore (29-31 May, 2010).
- P. Naveen Kumar attended workshop of the Otto Warburg Minerva Biotechnology Centre of the Robert H Smith Institute of Plant Sciences and Genetics in Agriculture, Rehovot, Israel (26 June, 2009 to 25 June, 2010).
- P. Naveen Kumar under faculty upgradation program, training on 'CAD for Landscaping' at Division of Floriculture and Landscaping, IARI, New Delhi (23-28 August, 2010).
- P. Naveen Kumar attended NAIP sponsored 'National Training on Bio-informatics and its Applications in Agriculture' at KAU, Vellanikkara(2-16 May, 2011).
- Tarak Nath Saha attended training programme on computer Aided Design Technology for Landscaping at Division of Floriculture and Landscaping, IARI, New Delhi (23-28 August, 2010) and Data Analysis using SAS of the NAIP consortium "Strengthening Statistical Computing for NARS" at IASRI, New Delhi (21-26 February, 2011).
- Tarak Nath Saha, participated in the training on "Creative Writing In Agriculture" at Indian Institute of Mass Communication, Dhenkanal, Orissa (10-15 May, 2010).
- Jayothi Majumder, attended hands on training programme on "Dehydrated flowers and floral crafts" at the Division of Floriculture, NBRI Lucknow during 25-27 January, 2011.
- Sellam, P, attended hands on training programme on "Dehydrated flowers and floral crafts" at the Division of Floriculture, NBRI Lucknow (25-27 January, 2011).

Trainings/ Winter/ Summer Schools Attended

- P. Naveen Kumar undergone advanced training in molecular techniques of flower

Personnel

Name	Designation	E-mail
Dr. Ramesh Kumar	Director	directordfr@gmail.com
Dr. P. Naveen Kumar	Sr. Scientist	naveeniari@gmail.com
Dr. Gunjeet Kumar	Scientist (SS)	kumargunjeet@yahoo.co.in
Dr. T.N. Saha	Scientist	tnsaha@gmail.com
Dr. (Ms.) Jayoti Majumdar	Scientist	jayotisarkar1@gmail.com
Ms. Sellam P	Scientist	chella.perinban@gmail.com
Mr. Anil Kumar Maithani	Administrative Officer	akmaithani61@yahoo.in
Dr. S.M. Trivedi	Tech. Officer (T7/8)	trivedishruti81@gmail.com
Mr. O.P. Singh	Tech. Officer (T-6)	-
Ms. Suchitra Pushkar	Tech. Officer (T-5)	suchi.iari@gmail.com
Mr. S.K. Rai	Tech Asstt. (T-1)	-
Mr. R.C. Paswan	Skill Support Staff	-

New Appointments

Scientific

- Dr. (Ms.) Jayoti Majumdar, selected for the ARS (Hort-Floriculture) has joined as Scientist after undergoing the mandatory Foundation Course in Agricultural Research Service at NAARM, Hyderabad.
- Ms. Sellam P., Scientist (ASPE), NDRI, Karnal has joined DFR, New Delhi on 27 December, 2010.
- Dr. Gujneet Kumar, Scientist (SS), NBPGR,

New Delhi has joined DFR, New Delhi on 23 March, 2011.

Administrative

- Mr. Anil Kumar Maithani, Administrative Officer, NRC for Equines has joined DFR, New Delhi on 4 February, 2011.

Transfers

- Mr. Chetan Swaroop Issar, Assistant Administrative Officer, DFR, New Delhi has been transferred to IARI, New Delhi w.e.f. 14 February, 2011.

AICRP on Floriculture

All India Coordinated Research Project on Floriculture was established during the IV Five-Year Plan in the year 1970-71 to carry out nationwide interdisciplinary research by linking ICAR Institutes with State Agricultural Universities (SAU's). 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 Centers as well as the research programme was modified accordingly. At present the Coordinated Project has 23 Centers which includes 16 budgetary, four institutional and three voluntary Centres.

S. No.	Centre	Year of Start	Crops Dealt
Budgetary Centres			
1.	Agricultural Research Institute (APHU), Hyderabad	1987	Gladiolus, Chrysanthemum, Tuberose
2.	Horticultural Research Station (AAU), Kahikuchi, P.O. Azara, Guwahati	2001	Gladiolus, Orchids, Chrysanthemum, Anthurium,
3.	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (upto September 1977 it was at B.S.I. Calcutta)	1972	Carnation, Orchids, Anthurium, Tuberose, Gerbera
4.	Birsa Agricultural University, Ranchi	2001	Gladiolus, Chrysanthemum, Gerbera
5.	Dr.Y.S.Parmar University of Horticulture & Forestry, Solan	1975	Gladiolus, Carnation, Chrysanthemum, Tulip, Daffodils, Liliun, Alstroemeria
6.	G. B. Pant University of Agriculture & Technology, Pantnagar	2001	Rose, Gladiolus, Chrysanthemum, Tuberose, Gerbera
7.	Kerala Agricultural University, Vellanikkara	1975	Orchids, Anthurium, Gerbera
8.	Mahatma Phule Krishi Vidyapeeth, Pune	1975	Rose, Gladiolus, Carnation, Chrysanthemum, Tuberose, Gerbera,
9.	Uttar Banga Krishi Viswavidyalaya, Kalimpong	1985	Gladiolus, Carnation, Orchids, Anthurium, Alstroemeria
10.	Punjab Agricultural University, Ludhiana	1975	Rose, Gladiolus, Chrysanthemum, Tuberose, Gerbera, Liliun
11.	Rajasthan College of Agriculture (MPUAT), Udaipur	1980	Rose, Gladiolus, Chrysanthemum
12.	Regional Plant Resource Centre, Bhubaneswar	1994	Rose, Chrysanthemum, Orchids, Anthurium
13.	Sher-E-Kashmir University of Agricultural Sciences & Technology, Srinagar	1987	Gladiolus, Chrysanthemum, Tulip, Daffodils, Liliun, Alstroemeria

S. No.	Centre	Year of	Crops Dealt
14.	Horticultural College and Research Institute (TNAU), Coimbatore	1982	Carnation, Gladiolus, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
15.	Horticultural Research Station (TNAU), Yercaud	1982	Carnation, Gladiolus, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
16.	Rajendra Agricultural University, Pusa, Samastipur, Bihar	2010	Rose, tuberose, gladiolus and Marigold
Institutional Centres			
17.	Indian Agricultural Research Institute, New Delhi	1971	Rose, Gladiolus, Chrysanthemum and Tuberose
18.	Indian Agricultural Research Institute, Regional Station, Katrain, Himachal Pradesh	1971	Gladiolus, Carnation, Gerbera, Tulip, Daffodils, Liliun, Alstroemeria
19.	Indian Institute of Horticultural Research, Hesaraghatta, Bangalore	1971	Rose, Gladiolus, Carnation, Chrysanthemum, Orchids, Anthurium, Tuberose, Gerbera
20.	ICAR Research Complex for NEH Region, Barapani, Shillong (Meghalaya)	1971	Orchids, Anthurium, Gerbera
Voluntary Centres			
21.	National Botanical Research Institute, Lucknow	1971	Rose, Gladiolus, Chrysanthemum, Tuberose
22.	University of Agricultural Sciences, Bangalore	1977	Carnation, Anthurium
23.	Horticultural College and Research Institute (TNAU), Periyakulam	2010	Marigold, Tuberose, Chrysanthemum

Distinguished Visitors

Since the inception of the Institute, a large number of dignitaries including eminent scientists, growers, florists, nurserymen etc. visited the Directorate. This facilitated the fruitful interaction with the scientists. The prominent visitors are as follows:

- Dr. S. Ayyappan, Secretary, Department of Agricultural Research & Education (DARE), Ministry of Agriculture and Director-General, ICAR, New Delhi.



- Dr. H.P. Singh DDG (Horticulture), ICAR, New Delhi.



- Dr. H.S Gupta, Director, IARI, New Delhi.
- Prof. P. Das, Chairman & Managing Director, The Science Foundation for Tribal & Rural Resource Development, Bhubaneswar.
- Dr. B. Meenakumari, Deputy Director General (Fisheries), ICAR, New Delhi.



- Dr. K.R. Dhiman, Vice Chancellor, Dr.YSPUHF, Solan.
- Dr. O.M. Bambawale, Director, NCIPM, New Delhi.
- Dr. A.S. Sidhu, Director, IIHR, Bangalore.



- Dr. A.P. Singh, Former Head, FLS, IARI, New Delhi.
- Dr R.L. Misra, Former Project Coordinator, AICRP (Floriculture).



- Dr. S.P.S. Raghava, Former Project Coordinator, AICRP (Floriculture).
- Dr. N.K. Dadlani, President, National Seeds Association, New Delhi



- Dr. S. Rajan, Asst. Director General (Hort II), ICAR, New Delhi.
- Dr. T.P. Trivedi, Asst. Director General (AKM) and Director, DIPA, ICAR, New Delhi.
- Dr. Malvika Dadlani, Joint Director (Research) IARI, New Delhi.
- Dr. T. Janakiram, Head, FLS, IARI, New Delhi.
- Dr. Pritam Kalia, Head, Vegetable Science, IARI, New Delhi.

- Dr. A.K. Singh, Head, FHT, IARI, New Delhi.
- Dr. R.K. Pal, Head, PHT, IARI, New Delhi.
- Dr. T.M. Rao, Head, Division of Ornamental Crops, IIHR, Bangalore.
- Dr. Y.C. Gupta, Head Dept of Floriculture and Landscaping, Dr. YSPUHF, Solan.
- Dr. Balraj Singh, In charge, CPCT, IARI, New Delhi.
- Dr. Man Singh, In charge, FOSU, IARI, New Delhi



- Mr. Le Duc Thao, Deputy Director, Agricultural Genetics Institute, TU LIEU Distt. Hanoi, Vietnam had detailed discussion on seed production.



Besides above, all the members of RAC team, officers of different state development agencies & NGOs, officials of Press and Media also visited the research farm and showed keen interest in the activities.

Budget 2010-11

(₹ in lakhs)

S. No.	State	Centre	Released
1	Delhi	Directorate of Floricultural Research/ PC Cell, New Delhi	92.83
2	Assam	Assam Agricultural University, Kahikuchi	10.98
3	Andhra Pradesh	Andhra Pradesh Horticultural University, Hyderabad	11.48
4	Bihar	Rajender Agricultural University, Pusa, Samastipur	2.66
5	Delhi	Indian Agricultural Research Institute, New Delhi	0.80
6	Himachal Pradesh	Dr. Y.S. Parmar University of Horticulture and Forestry, Solan I.A.R.I. Regional Station, Katrain	11.73 0.80
7	Jammu & Kashmir	S.K. University of Agricultural Sciences and Technology, Srinagar	11.32
8	Jharkhand	Birsa Agricultural University, Ranchi	2.66
9	Karnataka	Indian Institute of Horticultural Research, Bangalore University of Agricultural Sciences, Bangalore	1.05 0.80
10	Kerala	Kerala Agricultural University, Vellanikkara	12.48
11	Maharashtra	Mahatma Phule Krishi Vidyapeeth, Pune	20.55
12	Meghalaya	ICAR Research Complex for NEH Region, Barapani	0.80
13	Orissa	Regional Plant Resource Centre, Bhubaneswar	0.48
14	Punjab	Punjab Agricultural University, Ludhiana	22.45
15	Rajasthan	Maharana Pratap University of Agriculture and Technology, Udaipur	11.32
16	Tamil Nadu	Tamil Nadu Agricultural University, Coimbatore	18.64
17	Uttar Pradesh	National Botanical Research Institute, Lucknow	0.80
18	Uttarakhand	G.B. Pant University of Agriculture and Technology, Pantnagar	2.66
19	West Bengal	Bidhan Chandra Krishi Viswavidyalaya, Kalyani Uttar Banga Krishi Viswavidyalaya, Kalimpong	15.08 7.16
Total			259.53