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Role of All India Coordinated Research Project in Development of Floriculture in India

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Abstract

India, the land of flowers is clearly depicted from the ancient civilization and is intricately associated with right from birth till death. Here, hardly any function is complete without flowers. However commercial floriculture is of recent origin. India's varied agro-climate, ample sunshine and proximity to the markets of Middle-East and South Asian countries offer great opportunities to harness potential in floriculture and ornamentals. The systematic research in floriculture started with the establishment of All India Coordinated Research Project (AICRP) on Floriculture during 1970-71 by linking the ICAR Institutes with the State Agricultural Universities (SAU's) to carryout nation-wide interdisciplinary research. The AICRP on Floriculture 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. It also 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. At present the AICRP on Floriculture with its 22 coordinated centres (16 Budgetary, 4 institutional and 2 voluntary) are working on 13 ornamental crops viz. Rose, Gladiolus, carnation, Chrysanthemum, marigold, orchid, anthurium, tuberose, Gerbera, lilium, alstroemeria, tulip and daffodils consisting of 68 different research projects focusing on development of new and improved varieties, standardization of production technology including improved measures for control of insect pests and diseases and post harvest technologies, extraction of essential oils, flower drying and identification and agro-techniques for unexplored flowers.

1. Introduction

India has an ancient heritage of floriculture. Commercial floriculture however is of recent origin. Still 98.5% of flowers are grown under open cultivation and hardly 1.5% flowers are grown under greenhouse. The traditional flowers like marigold, jasmine, chrysanthemum, china aster, crossandra, tuberose, rose petals occupy nearly two thirds of the total area and forms the backbone of Indian floriculture, which is mostly in the hands of small and marginal farmers (Sindhu and Saha, 2010). The commercial floriculture is now recognized as an important sector with the potential for generating employment and earning valuable foreign exchange. For any country to diversify its agriculture towards export, the ornamental industry presents one of the most interesting and viable options. Its varied agroclimate, ample sunshine and proximity to the markets of Middle East and South Asian countries offer great opportunities to harness potential in floriculture and ornamentals (Kumar et al., 2011).

2. Present status

There are nearly 145 countries involved in floriculture business. India's contribution in the global floricultural export market is negligible (0.6%) as compared to the Netherlands (58%), Columbia (14%), Equador (7%), Kenya (5%), Israel (4%), Italy (2%), Spain (2%) and others (10%). Europe continues to be the largest destination for Indian floriculture exports. According to the latest estimates from Associated Chamber of Commerce and Industry of India, the floriculture industry in India is poised at about ₹ 37 billion with a share of a meager 0.61% in the global trade which is likely to reach 0.89% by 2015. It is growing at a compounded annual growth rate of about 30% and is likely to cross ₹ 80 billion mark in terms of value by 2015. With a share of about 65%, rose alone accounts for over ₹ 24

billion of the overall floriculture industry. About 0.4 Billion cut roses are produced in India every year and Karnataka alone accounts for about 75% followed by Maharashtra, Tamil Nadu. The rising demand from tier II and III cities apart from urban centres have spurt the demand for roses particularly during Valentines' Day. The rising input costs, high fuel and freight costs, tough competition from major rose producing countries like Israel, Kenya and Ethiopia are constantly hurting the margins of the domestic rose industry.

3. Export Potential of Floricultural Products

India is endowed with proximity to market in Japan, Russia, South-East Asia and Middle-East countries. Floricultural exports from India comprise fresh cut flowers (to Europe, Japan, Australia, Middle East and USA), loose flowers (for expatriate Indian in the Gulf), cut foliage (to Europe), dry flowers (to USA, Europe, Japan, Australia, Far East and Russia) and potted plants (limited to very few countries). Out of thee components, dry flowers contribute a major share to the total export. The other associated activity of flower growing in India include the essential oil industry. India is the second largest exporter of essential oil in the world after the USA. India's exports of essential oil stood at US$ 298.7 million in 2007-08. India is the largest exporter of jasmine oil in the world accounting for over 40% of total world exports in jasmine oil (Prahalatan and Sarkar 2012).

4. Advantage of India over other Flower Producing Countries

India is bestowed with rich bio-diversity of ornamental crop. Its varied agro-climate, ample sunshine and proximity to the markets of Middle East and South Asian countries offer great opportunities to harness potential in floriculture. A number of export oriented units have been set up in the floriculture. Here are the following advantages for India in Promoting Export Oriented Floriculture. (Bhattacharjee and De, 2003)

- The climatic conditions at different locations in India are suitable for growing flowers throughout the year. During the winter months, which is a peak season for export, there is ample sunlight and hence no need for artificial lighting.
- Export of flowers will not affect the domestic market, as the demand and need of both are different. Besides, our domestic market for flowers is huge and the export surplus flowers can easily find entry in the market.
- Easy availability of land and cheap technical manpower.
- India has locational advantage and is situated centrally for export to European and South-East Asian countries.

5. Constraints in the Floriculture Sector

Exports of modern floricultural products are on the rise in the last 7 to 8 years. But the industry is not performing well and many units have become sick. In the last few years, most of the units have lost their fragrances and a large number of units have been closed down. The factors that have contributed to this situation are as under (Thippaiah, 2005).

5.1. Transport constraints

Efficient, more reliable and direct flights to different destination are the pre-requisite for the quick disposal of the product and better realisation. There are no direct flights to international markets such as Amsterdam, and Copenhagen. In Karnataka, the exporters have to transport flowers through Mumbai or Chennai airports, where connection to international flights is available. Even, in the available flights, adequate space is not accommodated for flowers.

The high freight charges are affecting the viability of the floricultural units. It was reported that the freight charges for transporting 1 kg of flower was ₹ 100. It had been worked out that the minimum freight per stem of roses was ₹ 2.30 to 3.50. To ease the matter, subsidy on airfreight to the extent of the 25% of IATA rates are provided to the exporters. But the airline rates are much higher than the IATA rates.

5.2. Constraints at airports

There was lack of post-harvest infrastructure such as cold storage facilities at Airports. This led to the exposure of the flowers to open conditions.

The procedure followed at the airport in checking the quarantine element before transit takes lot of time. At the destination also, some countries conducted phyto-sanitary tests for flowers. For Instance, Japan fumigated all flowers at their ports which could spoil the quality of flowers as they were using Methyl Bromide.

5.3. Destination problems

Most of the shipments were sent to agents who were acting as middlemen. In these procedures nobody knew how the realisation were made.

There are no secured buy back arrangements in the case of modern flowers as in the case of many exportable commodities like gherkin and grapes in Karnataka. This led to uncertainty of the prices and export orders.

5.4. High cost of production and high duties

The modern floriculture is incurring losses due to high overheads and high establishment costs compared to small units. This is evident from the production cost. In the small unit, the production cost per flower was ₹ 0.80 which was less compared to production cost per flower which was as high as ₹ 2.10.

European countries did not charge any import duty on floricultural inputs from Israel, African countries (except

Table 1: State-wise area and production of flowers

Sl. No.	State/UT's	Area (in '000 ha)					Production (Loose in '000 t and Cut in million numbers)									
		2008-09	2009-10	20010-11	2011-12*	2012-13*	2008-09		2009-10		2010-11		2011-12*		2012-13*	
							Loose	Cut	Loose	Cut	Loose	Cut	Loose	Cut	Loose	Cut
1	Andaman Nicobar	0.035	-	-	0.04	0.04	0.33	-	0.3	-	4.7	6202.0	0.34	-	0.35	-
2	Andhra Pradesh	19.5	21.4	21.4	64.15	34.85	125.0	3	130.3	6202.0	133.7	2860.0	389.01	7099.39	224.41	6909.00
3	Arunachal Pradesh	-	1.2	1.2	1.22	0.02	-	-	-	2860.0	-	-	-	2860.00	0.01	297.00
4	Assam				0.00	1.80	-	-	-	-	-	11.0	-	-	11.70	3750.00
5	Bihar	0.2	0.2	0.2	0.90	1.02	2.3	11	2.3	11.0	2.3	-	8.72	1285.00	10.15	324.00
6	Chhatishgarh	2.4	4.1	6.9	8.41	9.79	6.9		13.5	0.0	27.1	-	32.85	-	37.75	-
7	D & N Haveli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Daman & Diu	-	-	-	-	-	0.007	-	-	-	-	1038.0	-	-	-	-
9	Delhi	5.5	5.5	5.5	5.50	5.50	5.7	1038	5.7	1038.0	5.7	-	5.70	1038.00	5.70	1038.00
10	Goa	-	-	-	-	-	-	-	-	-	-	5063.0	-	-	-	-
11	Gujarat	9.7	12.5	12.5	15.96	17.27	49.5	5063	49.5	5063.0	49.5	1084.0	135.50	-	149.27	-
12	Haryana	5.5	6.2	6.2	6.34	6.47	53.9	929	60.3	1084.0	60.3	605.0	64.15	1269.47	64.72	1270.58
13	Himachal Pradesh	0.6	0.7	0.7	0.86	0.91	3.4	566	0.6	605.0	0.6	66.3	35.29	1948.05	37.71	1760.30
14	Jammu & Kashmir	0.065	0.1	0.1	0.18	0.85	0.011	20	0.2	66.3	0.2	1711.0	1.06	155.92	0.40	222.10
15	Jharkhand	1.600	1.6	1.6	1.60	1.60	22.0	1711	22.0	1711.0	22.0	5860.0	22.03	1711.00	22.03	1711.00
16	Karnataka	26.0	27.0	27.0	29.22	29.70	203.9	5867	203.9	5860.0	203.9	-	211.54	10388.00	207.50	9441.80
17	Madhya Pradesh	3.0	6.6	7.7	15.61	16.52	1.8	-	5.0	-	6.0	7914.0	150.67	-	193.00	-
18	Maharashtra	16.40	17.5	17.5	18.88	22.00	89.4	5728	91.1	7914.0	91.1	-	104.00	7914.00	119.00	7914.00
19	Meghalaya	-	-	-	-	-	-	-	-	-	-	162.0	-	-	-	-
20	Mizoram	0.2	-	-	0.13	0.16	-	168	-	142.0	-	17.0	-	349.01	166.83	605.22
21	Nagaland	-	-	-	0.02	0.01	-	17	-	17.0	-	5911.0	-	15.35	-	96.66
22	Odisha	5.65	7.1	7.4	7.54	7.52	23.4	-	25.3	5356.0	3.7	-	26.08	6020.00	26.16	6040.00
23	Puducherry	0.29	0.3	0.3	0.07	0.08	2.36	-	2.4	-	2.4	-	0.41	-	0.43	-
24	Punjab	1.70	1.7	1.7	2.06	2.11	82.0	-	82.0	-	82.0	-	10.05	0.07	10.45	-
25	Rajasthan	3.35	3.3	5.4	2.49	3.43	4.9	-	4.9	-	9.6	230.0	2.69	-	3.72	-
26	Sikkim	0.15	0.2	0.2	0.21	0.22	-	66	-	200.0	-	-	25.95	209.05	26.50	214.10
27	Tamil Nadu	29.14	32.0	32.0	32.32	28.71	233.7		247.3		247.3	-	332.81	-	312.97	1168.00
28	Tripura	-	-	-	-	-	-	-	-	-	-	2958.0	-	-	-	-
29	Uttar Pradesh	13.53	10.4	10.4	14.49	16.19	24.3	3467	17.6	2958.0	17.6	3416.0	27.05	4194.00	31.49	4908.00
30	Uttarakhand	0.85	1.3	1.3	1.54	1.56	0.6	2056	1.0	3414.0	2.3	23919.0	1.81	3567.56	1.82	3633.00
31	West Bengal	21.07	21.9	23.1	23.92	24.41	52.00	21232	55.2	22170.0	59.2	69027.4	63.91	25042.10	65.14	25429.10
	Total	166.52	182.9	190.9	253.66	232.74	224.0	4794.2	1020.6	6667.14	1031.3	6902.74	1651.61	7506.59	1729.21	7673.18

Source: NHB Database 2011, *NHB Final Estimate 2011-12 & 2012-13

South Africa) and, Latin American countries thus making them competitive for Indian cut-flowers. The European Economic Countries including Holland are imposing 15% during winter and 25% during summer. It is said that 35% of the revenue went to commission agents for handling and clearing the consignment and another 35% went towards freight charges, that left 30% with which they had to meet the operation costs with low profits.

5.5. Heavy dependence on imported technology and lack of experience

• Many of the units heavily depended on the imported technology and materials for installation of units. This had pushed the unit cost.

• Not enough technical support and guidance was received from the government and horticulture departments. As such, many of the operations were carried out as per the directions of the consultants incurring heavy consultation charges.

• The collaborators, mainly the Dutch and Israelis have given technical guidance to flower growers without proper examination of the locations, conditions causing the closure of units. The projected levels of Yields have not been achieved in many places. The yield is just 120 flowers per sq.mt. The units established in such locations resulted in closure.

• Entrepreneurs with industrial and business background have entered the field of floriculture due to three reasons: (a) to make a name in the field as in every field; (b) entered into the field as many of the big industrial concerns are entering into the field; and (c) to diversify their business. However, many of them have entered the field without having any previous experience in the field. As a result, several industries became sick and some of them closed.

5.6. Other constraints

• Lack of transport vans equipped with refrigeration facilities to transport flowers to long distance markets, lack of information about world market and non-availability of planting materials of varieties suitable for export and inadequate promotional campaigns and huge bank debts accounting for several crores have been attributed for bad performance of this sector.

• Information regarding the market trends in terms of opportunities for new varieties, value-added packaging and developments taking place in other parts of the world was also not available to the growers.

6. Establishment of AICRP on Floriculture

The All India Coordinated Research Project on Floriculture (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). The AICRP on Floriculture initially started operating with 60 projects in 25 crops, which were finalized in the first workshop held at IARI, New Delhi in February 1971. The utility and efficiency of these programs were reviewed and the numbers of crops vis-à-vis number of projects were revised accordingly. At present the coordinated centres are working on 12 ornamental crops viz. rose, gladiolus, carnation, chrysanthemum, orchid, anthurium, tuberose, gerbera, lilium, alstroemeria, tulip and daffodils.

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. AICRP remains an integral part of the DFR with its 22 Coordinated Centers including 16 budgetary namely- Assam Agricultural University, Jorhat, Assam; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal; Birsa Agricultural University, Ranchi, Jharkhand; Dr. YSR Horticultural University, Hyderabad, Andhra Pradesh; Dr. Y.S. Parmar University of Horticulture & Forestry, Solan, Himachal Pradesh; G.B. Pant University of Agrilcultural & Technology, Pantnagar, Uttarakhand; Horticultural Research Station, Yercaud (Tamilnadu Agricultural University); Kerala Agricultural University, Vellanikkara, Kerala; Mahatma Phule Krishi Vidyapeeth, Pune, Maharashtra; Odisha University of Agriculture and Technology, Chiplima, Odisha; Punjab Agricultural University, Ludhiana, Punjab; Rajasthan College of Agriculture, Udaipur, Rajasthan; Rajender Agricultural University, Pusa, Samastipur, Bihar; Sher-e-Kashmir University of Agricultural Sciences & Technology, Srinagar, J&K; Tamilnadu Agricultural University, Coimbatore, Tamil Nadu; Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal; two voluntary centres namely- Tamilnadu Agricultural University, Periyakulam, Tamil Nadu; University of Agriculural Sciences, Bengaluru, Karnataka and four institutional centres namely- ICAR Research Complex for NEH Region, Umiam, Meghalaya; Indian Agricultural Research Institute, New Delhi; Indian Agricultural Research Institute, Regional Station, Katrain, Himachal Pradesh; Indian Institute of Horticulture Research, Hessaraghatta, Bengaluru, Karnataka.

The AICRP on Floriculture 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. It also aims at development of environment-friendly, cost-effective and user friendly technologies for variable agro-climatic conditions, thereby reducing the dependence on cost-intensive extraneous technologies (Kumar et al., 2010).

Considering the research needs and widening scope of floriculture in India, its mandate has been revised to provide the crucial technological support to the growers and entrepreneurs besides providing employment generation to rural youth.

The major objectives of AICRP on Floriculture are;

- Collection of germplasm, wild species from different parts of the country and abroad, its maintenance and assessment under different agro-climatic conditions.
- Development of new and improved varieties including F_1 hybrids.
- Standardization of agro-techniques for the production of cut flowers, bulbs and plants for domestic and export markets.
- Standardization of propagation techniques including embryo/ tissue/ meristem culture for quicker multiplication.
- Development of suitable pre and post-harvest technology for cut flowers.
- Identification and control of major diseases and pests of the commercial flower crops.

6.1. Activities of AICRP in the development of floriculture

6.1.1. Development of improved varieties

Varieties suitable for domestic and export market (Intensive production), resistant to pests and diseases. Traditional flower crop varieties with high yield potential and % essential oils recovery viz. traditional Rose, tuberose, marigold and Jasmine. Beside this the cut flowers like Rose, carnation, Chrysanthemum, Orchids, Anthurium, Gladiolus, gerbera, alsoroemeria, lilium, etc are covered.

6.1.2. Standardising traditional flower cultivation

In India about 90% area is under traditional flower that is mostly loose flowers, and this sector is highly unorganized and often does not get proper importance. Research on year round production of important flowers like marigold, china aster, chrysanthemum and Jasmine beside focusing on emerging potential crops like annual chrysanthemum, sweet sultan, sweet william etc deserve attention.

6.1.3. Hi-tech/protected cultivation

Protected cultivation is not a common practice in India. The greenhouse designs and structures for the modern floriculture units are mostly imported. In India, there are three types of greenhouse production technologies viz. low-tech units, mid-tech units, and hi-tech units. Studies reveal that income obtained from floriculture is higher than sugarcane (by 4 times), fruits and vegetables (by 5 times), paddy (by 10 times), and ragi (by 20times). However the area under protected cultivation is very less and focusing mostly on roses, gerbera, carnation which can be diversified into orchids, anthurium, chrysanthemums, lilium etc. Therefore, the research needs shall include development of exportable varieties, agro-techniques, growing media, fertigation, improved plant protection measures and Post-Harvest handling, green house design and materials through cheaper alternatives and market database-demand and supply information.

6.1.4. Nursery industry

AICRP on floriculture is giving attention on production of quality planting material (seedlings, budded plants, rooted cuttings, bulbs, annual seed, etc), standardising conventional as well as *in vitro* methods of multiplication, pot plant production and rentals, corporate landscaping (Turf grass, potted plants, etc). Use of PGR's in propagation & seed production methods needs to be standardized.

6.1.5. Value addition

AICRP is addressing issues of deriving higher oil recovery through different distillation and ITK methods from Rose, Jasmine, tuberose, *Michelia champaca*, etc and value added products like rose water, attar, gulkhand, etc. from *R. damascena*. In India more than 70% of the floricultural exports are dry flowers. For dry Flowers, flowers and plant parts can be collected from wild or some flower crops like helichrysum, lotus pods, etc can be exclusively grown for the purpose. Natural dyes from flowers is also another avenue for employment generation among the youth. Isolation of xanthophylls from marigold has been standardized and is widely used in the poultry industry to enhance the color of the meat, egg yolk and in food and textile industry.

6.2. Achievements of AICRP

The AICRP on Floriculture since its inception has made substantial contribution in the development of new and improved varieties of flower crops and in standardization of technologies for flower production, improved plant protection measures, post harvest management etc. Here is a brief report of the work done during the last five year (Kumar et al., 2012).

6.2.1. Crop improvement

The crop improvement work on different crops such as rose, gladiolus, chrysanthemum, carnation, gerbera and anthurium was undertaken at DFR and different coordinating centres. So far, about 100 new varieties in rose and gladiolus, more than 150 in chrysanthemum and a good number of improved varieties in tuberose, jasmine and orchid have been released. Recently in gladiolus 6 new varieties namely Punjab Flame, Punjab Elegance, Punjab Lemon Delight and Punjab Glance from PAU, Ludhiana and Pusa Shubham and Pusa Kiran from IARI have been identified. In Chrysanthemum new hybrids Yellow Delight, Anmol, Winter Queen, Garden Beauty, Autumn Joy and Royal Purple from PAU; seedling selections Himanshu, Kaul and Khoshoo from NBRI, Lucknow and two

mutant Pusa Anmol and Pusa Centenary from IARI, New Delhi were found to be promising for growth, floral and quality characteristics and were being tested at different centers. In Tuberose, Arka Nirantara a hybrid at IIHR, Bengaluru and GK-T-C-4 and GK-T-C-1 at MPKV, Pune were developed.

6.2.2. Crop production

In root stock studies, *Rosa indica* var. *odorata* rootstock for Coimbatore, Delhi, Lucknow, Ludhana and Pune conditions; *R. multiflora* and IIHR-Thornless for Bengaluru, Hyderabad and Kalyani conditions; and *R. chinensis* (Titri) for Udaipur conditions were found suitable. Pune centre with cv. Sancerre at 25×10 cm^2 spacing and Hessaraghatta, Kalyani and Ludhiana centres found 4.5-5.0 cm gladiolus corms at 20×20 cm^2 spacing and 8 cm depth quite effective. The Integrated Nutrient Management i.e., 75% RDF+FYM (1 kg m^{-2})+Vermicompost (300 g m^{-2})+*Azospirillum*@ 2 g $plant^{-1}$ $year^{-1}$+PSB @ 2 g $plant^{-1}$ $year^{-1}$) has been found superior and significantly improved the plant and flower quality in almost all the flower crop. For weed control, chemical weedicides, Oxyflurofen at 0.5 kg a.i. ha^{-1} drenching at Kalyani, and 1 kg a.i. ha^{-1} at Ludhiana; Oxyflurofen (1 kg a.i. ha^{-1}) or Diuron (2 kg a.i. ha^{-1}) at Delhi in cvs. Super Star and Raktagandha, and Diuron (2.5 kg a.i. ha^{-1}) or Simazine (3 kg a.i. ha^{-1}) or Round Up (1 kg a.i. ha^{-1}) at Yercaud and Bengaluru conditions, had been found quite effective.

6.2.3. Crop protection

The use of Neem cake colonized by the disease bio-control agent *Trichoderma harzianum* @ 500 g^{-2} 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. Severe powdery mildew in rose during November to March was recorded at Pune and could be controlled by spraying with 0.02%. Sulfex or 0.5% Karathane or 0.1% Bavistin immediately after pruning and thereafter 2 more sprayings at 10 days interval in cv. Gladiator. The pre-storage treatment of gladiolus corms in hot water combined with Captan (0.2%) and Carbendazim (0.2%) at 50°C for 30 minutes was found to be effective in reducing *Fusarium* wilt at Ludhiana. Six sprays of 0.02% Chlorothanonil or Mancozeb fortnightly after disease incidence, control the leaf spot diseases of chrysanthemum (*Alternaria, Colletotrichum* and *Septoria*). In tuberose, Carbendazim (0.01%)+captan (0.02%) and Basamid G (40 g m^{-2}) reduced the disease incidence significantly at Kahikuchi.

6.2.4. Post-harvest technology

Storage of rose cut flower at 4-8^{0}C for 24h followed by simulated transit has been recommended by Ludhiana centre. Delhi centre recommended pre-cooling at 4˚C for 24 h for reduction of respiration rate and increasing vase life of cut roses. Sucrose (15-20%)+8-HQC (200 ppm) as a pulsing treatment for 24 h, and sucrose (4%)+$Al_2(SO_4)_3$ (300 ppm) or NaOCl (50 ppm) or 8-HQC (200 ppm) as holding solution has been found quite effective for floret opening and vase life improvement in gladiolus. Treatment with 4mM STS for 15 min at room temperature before pre-cooling is quite effective for improving vase life of cut carnations. For pulsing, HQ (500 ppm)+sucrose (5%) for 6 h or BA (25 ppm)+carbendazim (0.2%) or $Al_2(SO_4)_3$ (300 ppm) for 24 h, and for holding solution, $AgNO_3$ (25 ppm)+sucrose (5%) or $Al_2(SO_4)_3$ (300 ppm)+kinetin or BA (25 ppm)+sucrose (5%) are quite effective for improving the vase life of cut anthurium.

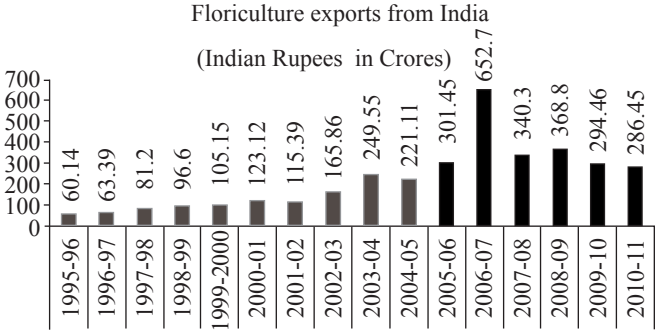
6.2.5. Value addition

Celosia flowers were found to take instant colour by dyeing. Techniques were developed for drying of fruits of *Acacia auriculiformi*s and *Terminalia arjuna* at Kalyani. 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 reticulate*, *Gerbera jamesonii* and *Grevillea robusta* and press drying for *Adiantum venustum* (Coimbatore). 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).

6.3. Extension

The research findings of the Coordinated Project are published as technical/research bulletins from time to time. These include crop specific bulletins giving a profile of the crop along with its genetics and breeding, and the varieties available and the package of practices.

The Coordination Cell as well as the Directorate are actively involved in showcasing the technologies in various platform like Kisan Mela, Flower Show, Horticulture Summit, etc. The farmers/flower growers and all those interested in floriculture



Source: Director General of Commercial Intelligence and Statistics

are guided properly regularly.

6.4. Education

The scientific staff of the Project at different coordinated centres as well as at Coordination Cell are faculty members of the respective university/Institute and are being associated with teaching of UG and PG courses in floriculture and horticulture. Further, they are being involved in organization of various training/seminar/symposia imparted to farmer groups, teachers, scientists, agriculture/horticulture departmental staff, etc.

7. Expected Outcome

The following benefits are expected from the AICRP on Floriculture in the ongoing XIIth Five Year Plan

• Technological support for the existing and future anticipated area under flower crops in terms of new and improved varieties, production technology for open field and hi-tech production of flower crops, plant protection and post harvest management of flower crops.

• Area expansion under flower crops

• The export oriented floriculture will become more competitive and certainly there will be strong boosting for the floricultural exports thereby growth in the foreign exchange.

• The sectors like essential oil, dry flowers, pigments and natural dyes will not only yield higher returns from unit area but also help alleviate rural unemployment.

• Increase in the domestic flower trade and consumption.

• Other avenues like ornamental plant nurseries, consultancy for landscaping, eco-tourism and pot plant business are expected to yield significant returns.

• Breeding for exportable indigenous varieties of commercial flower crops. Molecular breeding for designer flowers and tolerance/resistance to biotic and abiotic stress.

• Identification, domestication and commercialization of native flowers for creating niche markets.

• Agro-techniques, which include growing media, fertigation, improved plant protection measures for both open field and protected cultivation environments. Post harvest management, total quality management and value addition in floriculture

• Greenhouse designs for different regions and their construction with cheaper alternatives

• Isolation of pharmaceutical and nutraceutical compounds from flowers for incurable diseases and cost effective products.

• Provide information's on sound market database of various flower commodities in domestic and international markets.

8. Acknowledgement

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