

Review Article

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Novel Innovations in Floriculture Industry

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ABSTRACT

There are several innovations in floricultural industry such as value addition in flowers, vertical garden, drying of flowers, hydroponics, aeroponics, bonsai, flower arrangement these add beauty in nature. Value addition in flowers not only help the producer to get a good price for its produces but also helps the consumer as they get a good quality as well quantity added products. Hydroponics is a technology for growing plants in nutrient solutions with or without the use of an artificial medium to provide mechanical support. Dry flowers and plant material have tremendous potential as substitute for fresh flowers and foliage for interior decorations. Methods of drying are sun drying, saw dust drying, pressing, polset polymer, silica driers. Flower arrangement is beautiful form of flower display. Flower arrangement is an organization of design and color towards creating an ambience using flowers, foliage and other floral accessories. Vertical garden are becoming popular in agro tourism centers. Trellises attached to the ground or to large space than traditional gardening requires. Floriculture is an emerging field in Indian Agriculture. Several innovations are emerging and becoming popular. These help to generates employment besides improving the quality of production. The innovation like vertical garden is becoming necessity to stop pollution and helps for cooling fresh air. However, this technique is highly specialized and requires systematic hands on treating for capacity building of agriculture graduate for rural use.

Keywords

Innovation, Novel
and Industry

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Introduction

Floriculture is one of the most important branches of ornamental horticulture. It is the fastest growing sector in Indian horticulture with annual export of 20703.46 MT of 507.31 crores in 2017- 18 (APEDA) About 98 thousands ha was under cultivation in 2001-02 with a production of 556 thousand tonnes of loose flowers and 804 million number of cut flowers, which has been increased to

1,659 thousands loose flowers and 484 thousand tonnes cut flowers covering an area of 248.51 thousands ha. during 2015-16 (Indiastat). Cut greens refer to ornamental foliage and branches with or without decorative fruits, seed pods etc. to be used as fillers. Softening floral arrangements, provide contrast in floral arrangements. Complement the beauty of flowers. Fills voids or gap in floral designs used in bouquet making and flower arrangements to the extent of 20 to 25

percent. In Global Status Europe is leading exporter in the world. Netherland is important trade hub for cut flowers and foliage. In foliage in Europe share about 60% (CBI market informations Database 2013). The major cut foliage exporters in the world market are the Netherlands, USA, Costa Rice, Italy, Israel, Guatemala, Mexico, Germany, Canada, etc., The major importers are Norway, Germany, Denmark, USA, France, UK, Holland, Italy, Austria, and Japan (AIPH 2012).

In Indian status In terms of area of production, China and India have large total area is under flower cultivation More than 50% of the floriculture units are based in Karnataka, Andhra Pradesh, and Tamil Nadu. India is leading supplier of dry flower, dry and fresh foliage to Europe India's total export of floriculture was Rs. 507.31 crores/78.73 USD Millions in 2017-18The floral export from India comprises of dry flowers (71%), fresh cut flowers (18%), live plants (9%), fresh bulbs (1%).

Varietal innovations

Use of molecular breeding for novelty

Important ornamental character such as flower color, fragrance, and flower shape are clarified through isolation and analysis of related genes. Modification technology for these characters by genetic transformation is also developed. Basic breeding technologies that lead to improved breeding efficiency,

Novelty in flower form

Different strategies are being applied like hybridization, mutation, polyploidy, genetic engineering to bred the cultivars with new flower forms. Single, semi-double, and double types of flower are genetically controlled either by a single gene or multiple

genes similarly, by induced mutagenesis, the mutant can be easily with modified visible characters such as flower shapes, size, or leaf form and growth habit.

Novelty in flower color

Color determined by four classes of pigments viz., Flavonoides, carotenoids, betalains and chlorophylls. Creation of novel flower colors employing genetic manipulation techniques. Transgenic carnation and roses accumulating delphinidin as a result of avonoid 3'5' hydroxylase gene expression and having novel blue hued flowers which have been commercialized.

Among various transgenic floricultural crops only roses and carnation have been commercialized. This indicates developed so far only colour by genetic engineering is still very challenging due to technical and economic difficulties

Novelty in floral fragrance

Flowers of many plant species emit floral scent to attract pollinators. Such sect are mixture aliphatic molecules (terpenoid, phenyl propanoid, benzenoid) (Pichersky and Dudareva, 2007). Chemical composition is varies according to species (Kundson *et al.*, 1993). Several physiological and ecological studies have examined the floral functions of floral scent compounds in plant biology (Vainstein, 2002). Numerous cytological studies have been performed to determine scent glands and scent production and emission process (Bergougnoux *et al.*, 2007).

Available functional geometric tools for Genetic engineering of floral scent

RNAi technology
Transgenics
Expressed sequence stage

Recent innovations

(Glow in the dark) Orchid

The world's first genetically modified bioluminescent is of Orchid. Successfully developed by Prof. Chia from the National Institute of Education (NIT).

To create bioluminescent orchid, Tissue are transformed from the *Dendrobium* genus using firefly luciferase gene. Using a method called "particle bombardment" The bioluminescent orchids will produce constant light. Light emit from roots, stem, leaves, and petals. Light intensity ranging from 5,000 to 30,000 photos per second.

Bougainvillea – the source of grapheme

Well known ornamentals. Have ability to resist pollutant in the air. Group of scientist of Pune found that high quality grapheme from these flowers by drying followed by chemical treatment. 30gm/kg flower of bougainvillea. This discovery may make the batteries cheaper and long- lasting in near future.

Aeroponics

Aeroponic is the process of growing plants in the mist environment without the use of soil or an aggregate medium. The word "aeroponic" is derived from the Greek meaning of *aero*-(air) *ponos* - (labour) Aeroponic and soilless cultivation of A. and reanum was carried out in a climatic conditioned greenhouse. The aim to evaluate the productive and qualitative differences of the two growing systems. Aeroponic culture produced the highest number of leaves (29.7 vs. 17.9 per plant), with the maximum leaf size and petiole length. Soilless Anthuriums provided flowers with the widest spathe. Plants with cut roots showed lower values for all considered parameters than those with

whole roots but evidenced a higher rhythm of root elongation during the experiment. Preliminary Results of Aeroponic Cultivation of Anthurium and reanum for Cut Flower Production

Vertical garden

A 'Green Wall', also commonly referred to as a 'Vertical Garden', Green wall technologies may be divided into two major categories: Green Facades and Living Walls. Vertical garden was invented by Stanley Hart White who patented a green wall system in the late 1930s.

As a bio filtration

An 'active' living wall is intended to be integrated into a building's infrastructure and designed to bio filter indoor air and provide thermal regulation. It is a hydroponic system fed by nutrient rich water which is re-circulated from a manifold, located at the top of the wall, and collected in a gutter at the bottom of the fabric wall system. Plant roots are sandwiched between two layers of synthetic fabric that support microbes and a dense root mass. These root microbes remove airborne volatile organic compounds (VOCs), while foliage absorbs carbon monoxide and dioxide. The plants' natural processes produce cool fresh air that is drawn through the system by a fan and then distributed throughout the building. A variation of this concept could be applied to green facade systems as well, and there is potential to apply a hybrid of systems at a large scale.

As a green building technology

Vertical garden attached to exterior or interior walls of a building. They differ from green facades (ivy walls) as green walls have growing media supported on the face of the wall (Table 1–6).

Novelty in flower form

No.	Breeding methodology	Crop	Characteristics	Reference
1.	Hybridisation	Stock	Double flowers	Debener (1999)
2.	Mutation-Gamma rays	Chrysanthemum	Spoon shaped, tubular and irregular ray florets with reduced flower head size	Singh and Bala, 2015
3.	Mutation- Heavy ion beams	Carnation	Serrate to round petals	Okamura <i>et al.</i> , 2003
4.	Mutation – gamma rays	Bougain veillea	Variegated flower	Srivastva, 2002
5.	Mutation- gamma rays	Gerbera	Change in flower morphology	Jain <i>et al.</i> , (1998)
6.	Polyploidy breeding (colchicine induced)	Anthurium	Stronger petioles, thicker and deeper green leaves, and thicker and longer lived spathes in tetraploides	Chen <i>et al.</i> , 2011
7.	Rna-mediated interference	Petunia hybrida	Double flower formation	Noor <i>et al.</i> ,(2014)
8.	Mutation-Ion beams	Rose	Change in number of petals, shape and size	Yamaguchi <i>et al.</i> , (2003)
9.	Chimeric Repressor gene-Silencing Technology (CRES-T)	<i>Torenia chysanthemum</i> , morning glory, Cyclamen, Rose	Modification of the flower shape	Shikata <i>et al.</i> , 2011 Narumi <i>et al.</i> , 2011 Tanaka <i>et al.</i> , 2011

RNAi Technology

Gene silenced	Scent compounds	Reference
PhBSMT Petunia hybrid benzyl Salicylate methyl Transferase	1. Lack the major scent component methyl benzoate 2. Minimal changes in the emission of other volatiles	Under wood <i>et al.</i> , (2005)
(PhPAAS) Pheny acetaldehyde Synthase	1. Complete elimination of the emission of phenyl acetaldehyde 2. 2-phenyethanol (Pheyl acetaldehyde-precursor) (Precursor of PAA)	Kaminaga <i>et al.</i> , (2006)
(CFAT), Coniferyl alcohol acyltransferase	1. Complete elimination of sioeugenol 2. Little effect on the emission of other Phelpropanoid / benzenoids volatiles	Dexter <i>et al.</i> ,(2007)

Transgenics

Approach	Transgenic species	Gene used	Results obtained	Referances
Single gene	Petunia Carnation Petunia	CbLIS CbLIS RhAAT (Rose)	Linalylglucoside Linalyl oxides Benzyl acetate and phenyethyl acetate	Lucker <i>et al.</i> ,(2001) Lavt <i>et al.</i> , (2002) Guterman <i>et al.</i> , (2006)
Blocking of competitive pathways	Carnation	Anti-DcF30H	INCREASED Methylbenzoate emission	Zuker <i>et al.</i> ,(2002)
Down-regulation of transcription factor	Petunia	PhODO1	Reduced levels of volatile benzenoides	Verdonk <i>et al.</i> ,(2005)

Table.1 “Effect of gamma irradiation on morphological characters of marigold (*Tagetes erecta* L.)”

Sr. No.	Treatment No.	Treatments	Plant height	No.of branches per plant	Days require for flower opening	Diameter of flower	No. of flower per plant	Survival percentage
1.	T1	Control	57.39	4.53	10.80	4.91	31.13	100
2.	T2	25Gy	55.68	6.13	10.40	5.14	37.20	100
3.	T3	50Gy	54.31	5.33	11.00	4.84	34.67	100
4.	T4	75Gy	54.06	5.13	11.40	4.79	30.87	100
5.	T5	100Gy	53.02	4.87	11.47	4.73	29.40	96
6.	T6	125Gy	52.62	4.80	11.67	4.64	28.80	96
7.	T7	150Gy	52.10	4.20	12.07	4.58	27.53	92
S.E±			0.79	0.29	0.16	0.10	0.59	2.54
C.D at 5%			2.45	0.91	0.50	0.31	1.83	NS

Bhusari A.V. 2015.

Table.2 Effect of growing system and root treatment on yield and quality of *Anthurium*

Growing system	Root treatment	Flower stalks/plant (No)	Stalk length (cm)	Flower spathe width (cm)	Leaves/plant (No.)	Leaf petiole length (cm)	Leaf Lamina Size (cm ²)
Aeroponic	Cut roots	1.8	44.6	8.0	2.5	40.9	397.0
	control	2.6	49.7	8.9	3.4	43.5	402.5
Soilless	Cut roots	2.4	37.6	8.8	2.1	32.6	327.9
	control	2.6	45.2	9.4	1.9	39.8	3.47.9
Significance							
System root	Ns	*	*	*	*	*	*
Treatment	ns	*	*	*	*	*	ns
Interaction	ns	*	*	*	*	*	*

ns = not significant, * = significant at P ≤ 0.05 ***= significance at P ≤0.01 (Duuncan’s multiple range test).

G. Fascella and G.V. Zizzo2007.

Table.3 Proposed increment of the amount of green lands and plants after the usage of vertical gardens on hotels and shopping malls in Antalya

Place	Number	Vertical garden	Amount of plants each m ²	Total vertical gardens m ²	Total amount of plants
Hotels	1400	200	60	280,000	16,800,000
Shopping malls	10	450	60	4500	270,000
Total				284,500	17,070,000

Zuhal *et al.*, 2013.

Table.4 Effect of drying method on time taken for drying of silver oak (*Grevillea robusta*), thuja (*Thuja orientalis*) and camellia (*Camellia reticulata*) with different drying agents

Treatment	Duration of drying			Moisture loss (%)		
	Silver oak	Thuja	Camellia	Silver oak	Thuja	Camellia
Air drying	3.6 days	10 days	8.2 days	43.53	44.33	53.12
Sand drying	5.8 days	18 days	14.0 days	38.77	47.38	46.58
Microwave drying	1.36 min	3.36 min	3.29 min	42.56	53.27	61.18
Glycerinization(full dip)	3.4 days	2.0 days	6.0 days	11.62	15.72	19.8
Glycerinization (uptake)	2.0 days	12.0 days	10.2 days	17.3	13.24	15.6
SEm ±	0.379	0.447	0.932	2.5	1.3	1.3
CD (P=0.05)	0.791	0.932	1.08	5.2	2.7	2.9

Jawaharla *et al.*, 2013.

Table.5 Sensory score on overall acceptability of flowers of chrysanthemum (yellow and green), gerbera and plumeria with various drying agents with microwave drying

Treatment	Sensory scores			
	Chrysanthemum (yellow)	Chrysanthemum (green)	Gerbera	Plumeria
Sun drying	0.76	0.78	0.78	0.76
Sand drying	2.83	2.82	2.68	2.8
Silica drying	3.02	3.06	2.77	3.03
borax	0.00	0.0	0.0	0.0
Silica +	3.56	3.57	3.53	3.55
Sand drying				
Borax +	0.0	0.0	0.0	0.0
sand drying				
SEd ±	0.13	0.065	0.09	0.054
CD (P=0.05)	0.06	0.130	0.18	0.12

Jawaharla *et al.*, 2013.

Table.6 Visual score on overall acceptability of dried leaves of silver oak, thuja and camellia

Treatment	Sensory score		
	Silver oak	Thuja	Camellia
Air drying	1.99	1.82	0.35
Sand drying	2.50	1.66	1.30
Microwave drying	2.02	1.44	0.76
Glycerinization(full dip)	3.70	3.87	3.70
Glycerinization (up take)	3.18	3.08	2.74
SEm ±	0.15	0.13	0.17
CD (P=0.05)	0.28	0.26	0.35

Jawaharlal *et al.*, 2013.

While green facades have soil only at the base of the wall and support climbing plants on the face of the wall to create the green, or vegetated, facade. The plants receive water and nutrients from within the vertical support instead of from the ground. In vertical gardens, various types of modular panels can be used along with geo-textile fabrics, growing media, irrigation systems, and plants. Living walls are particularly suitable for cities, as they allow good use of available vertical surface areas. The living wall could also function for urban agriculture, urban gardening, or for its beauty as art. Green walls may be indoors or outside, freestanding or attached to an existing wall, and come in a great variety of size.

Analysis of contribution of vertical gardens to urban sustainability: the case study of Antalya city, Turkey

Techniques in dry flower making

Drying: Natural drying, Air drying, Press drying, Freeze drying, Water drying.
 Embedding: Sun drying, Oven drying, Microwave oven drying, solar dryer drying, Vacuum drying.
 Dyeing: Dip dyeing, Spray dyeing, Absorbing.
 Bleaching

Drying

Drying is a process to dry something under artificial produced heat though controlled temperature, humidity and air flow. Dry flower constitute more than two-thirds of total floricultural export. Dry flower constitute nearly 15% of the global floriculture business and form the major share in Indian floricultural exports as well. The demand for flowers is increasing at an impressive rate 8-10%. Drying of flowers does not mean only flower but also includes dried shoots, seeds, pods and bar (Table 4).

Standardization for drying, bleaching and dyeing processes in dried flowers

Embedding

In this method, retention of flower colour and shape is good. After harvesting and preparing, the flower are placed in desiccants like sand, silica gel, boric acid, borax, saw dust, alum powder, aluminium sulphate corn granules etc. Borax mixed with sand or cornmeal. Silica gel is an excellent product for drying flowers.

It is while but some types container blue crystals that act as an indicator of amount of moisture absorbed. Shallow container should be used.

Dyeing

Dyeing of ornamental plant material is considered much as an art. Accordingly, determining the optimum treatment protocol for a particular product is often a matter of systemic trial and error. Immersion dyeing is improved by removing the waxy cuticle with NAOH from dried plant material.

Adding surfactants to improve the contact between the dye bath solution and the plant material. In addition to dyeing, which is properly called staining, the plant material can also be coloured by painting and commonly silver or golden paint is used.

Standardization for drying, bleaching and dyeing processes in dried flowers

Bleaching

Bleached ornamental plant material provides a striking contrast when arranged with dried or dyed flowers. Bleaching also allows the use of dyes for coloring. Oxidative (Hypochlorite, Chlorite and Peroxide) and reductive bleaching chemicals (Sulphite and Borohydride) are used for bleaching ornamental flowers and foliage. Sodium Chlorite is an excellent bleaching agent because it is relatively selective for lignin without damaging fibre. In reductive bleaches, hydrosulphites (Sodium or Zinc Hydrosulphite) are cheap and have maximum bleaching power.

Coloring Dried Flowers Preserving flowers with their natural colour is essential otherwise we have to improve the colour of the product by adding dyes.

A dye is most often added to the glycerin preserving solution to permanently colour the decorative plant materials. Systemic dyes are available for use. They are acidic–

anionic dyes, which are combined with water and glycerin to form a preservation solution that is absorbed by fresh cut flowers and foliage through the stem of the plant. Normally 1.5 ml to 5 ml dye/l of solution is prepared. Color take and preservation will take 28 days.

In conclusion, floriculture thrives on novelty and is the necessity of stimulating processes as prospective means to catch up the global business. The result of the research on flower color, flower form, plant architecture, scent emission, production and post-harvest technologies and value addition lead to the commercialization of novel innovations which are readily utilized in the market.

In fact, the level of understanding in the genetics and molecular mechanisms as well as new approaches were tested which served as a basis for a gradual change from chemical to biotechnological tools in floriculture.

More conscious efforts are the need of the hour to address biotic and abiotic stresses, quality planting material, standardization the propagation techniques, exploiting new ornamentals and pole to post promotion of floriculture of floriculture for socio-economic sustainability.

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