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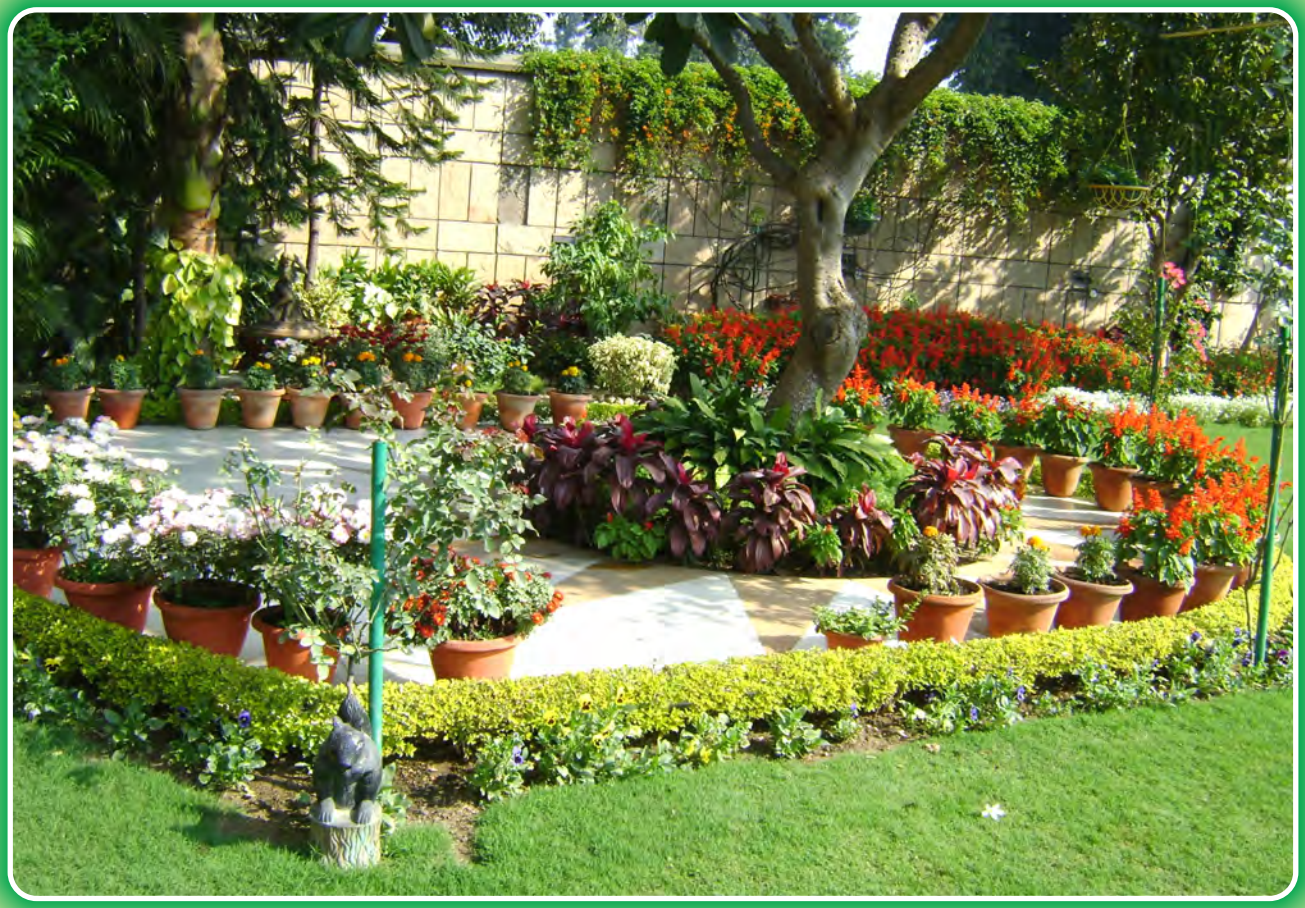

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Editorial

It is my absolute pleasure to inform the readers of the journal that over the years it has become a popular research journal for the scientific community of India and abroad. The current issue is combined one of two volumes 2021 & 2022. Our efforts are to include both review and research papers so that readers can have information on both the categories. With the growing demand of tailor made products in horticulture, the focus of research should now be demand oriented to fulfill the societal need in view of challenges ahead. The out put of research should be more practical than academic for the benefit of end users in the field of floriculture and landscaping. New varieties, technologies together with improved irrigation system for using minimum water in horticulture, considering scarcity of water in near future, should be the target.

This issue contains variety of research topic of wide interest. I congratulate contributors for their submissions and taking interest to the journal. Editorial board did a good job for screening of the papers and publication.

We have made an announcement for a **'Memorial Award'** from 2022 to recognize best research paper published in the Journal of Greens & Gardens by Roy's Greens & Gardens Foundation, Lucknow. This will boost good research work in the field of floriculture and landscaping.

I am grateful to every body who are directly and indirectly associated with the Foundation and the Journal. All The best.

Place: Lucknow
Date: March 10, 2022

Dr. R.K. Roy
Chief Editor

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Review Paper

Role of *Lal Bagh* Botanic Garden, Bangalore, India: Collection and development of *Bougainvillea* cultivars

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ABSTRACT

Lal Bagh Botanic Garden, Bangalore has played vital role for the collection of Bougainvillea cultivars from different countries to increase germplasm, as a first step. Development of new cultivars by isolating bud sports, seedling selection and hybridisation were undertaken in the next step. The present paper deals with the detail information of Bougainvillea cultivars collected as a germplasm in the botanic garden including cultivars developed by the Scientists with particular reference to their morphological characters.

Key words: Bougainvillea, collection, bud sport, seedling selection, hybridisation

INTRODUCTION

Bougainvillea cultivars being grown in India are either exotics introduced from abroad (Africa, USA, U.K., South America, Australia, Philippines, Sri Lanka, Jamaica, Canary Iceland, Seychelles Iceland, Singapore, Java, West Indies and a few others) or developed by Nurserymen, individuals, or organisation in India (Swarup and Singh,1995). Lal Bagh Botanic Garden, Bangalore; The Agri-Horticultural Society, Madras; Indian Institute of Horticultural Research, Hassarghtta, Bangalore; National Botanical Research Institute, Lucknow, Indian Agricultural Research Institute, New Delhi and Bhabha Atomic Research Institute, Bombay, nurseries and amateur growers have developed and released many new cultivars of Bougainvillea. Role of Lal Bagh Botanic Garden, Bangalore, in collection and development of new and elite Bougainvillea cultivars has been mentioned in this paper (Marigowda, 1960a; 1960b; Swarup and Singh, 1995 and Singh *et.al*., 1999).

MATERIALS & METHODS

Germplasm Collection of Lal Bagh Botanic Garden, Bangalore - Following cultivars have been collected from various sources and maintained as live collection.

Alba, Asia, Brilliant, Brilliant Variegata, Charles Wilson, Elizabeth, Floribunda, Glabra var. Variegata, Glady's Hebum, Golden Glow, Isabella Green Smith, Jennifer Fermi, Kayata, Killie Campbell, Killie Campbell Variegata, Lady Mary Baring, Lady Richards, Machakos, Mahara, Margery Lloyd, Mariel Fitzpatrick, Million Dollar, Natalii, Nirmal Chandra - 2, Philips No.1, Poultoni, Poultoni Special, Refulgence, Rhodamine, Roseville's Delight, Ruarka, Splendence and Sydney.

Morphological characters of the above cultivars have been studied and documented as descriptor of the newly introduced cultivars of bougainvillea along with their use.

Alba:

This cultivar of bougainvillea was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Cultivar possesses long green leaves with thick texture and its nature is recurved. Thorns are short and bent down. Bract colour white, 4.1 x 3.0 cm, recurved. Newly formed tender bracts are greenish in colour which turns into white as they mature. Bracts are persistent and retain on plant even at their dried stage. Cultivar blooms profusely and sets seeds**.** It looks similar to Bougainvillea cultivar 'Snow Queen'. Cultivar is ideal for pot culture and landscaping. It can be exploited as a female parent in a big way in bougainvillea breeding programme.

Asia:

This was introduced in India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. It is a hybrid seedling of B. x buttiana. Plant is dwarf and its growth habit is compact due to short internodes.

Leaves are dark green, ovate, glabrous, 8.0 x 4.0 cm. Bract shape is ovate with acute tip and cordate base. Bracts are small, 3.5 x 2.8 cm, Cyclamen purple (30) in colour. Young bracts are Crimson in colour. Cultivar blooms on short stalks and borne all along the branches in a compact mass. It is a beautiful bright variety and can be used as potted plant.

Brilliant:

This cultivar was introduced in India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. It is a hybrid seedling of B. x buttiana. Plant growth habit is vigorous. Thorns are long and stout. Leaf shape is ovate with acute tip and cordate base. Leaf size is 8.2 x 4.7 cm. Leaf colour is dark green and its surface is glabrous. Bract shape is ovate and its size is 4.7 x 3.9cm. Bract colour is brilliant Flame. Bracts are non-persistent. Star is prominent. A stamen enclosed within the flower tube .This cultivar is a heavy and profuse bloomer. Plant is used in general landscaping and rockery.

Brilliant Variegata:

This cultivar of bougainvillea was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Peter Green Smith, Nurseries, Kenya. Plant growth is vigorous. Cultivar evolved as a bud sport from B. X buttiana var 'Brilliant'. This variegated cultivar has deep green centre surrounded by creamy white tissues in the margin. Colour of young shoot is pink. Bract colour is same as in Brilliant.

Charles Wilson:

This cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr.H.P. Greensmith, Park Superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Leaves are light green, long and its shape is elliptic with acute tip. Thorns are long, thin green and tender. Bracts are small and their size is 3.5 x 2.5 cm. Bract colour is hot pink. Star colour is yellow. Cultivar sets seed. Plant is used for landscaping and hedge.

Elizabeth:

This cultivar was developed by W.E. Atwill in Nairobi, Africa. Bougainvillea spectabilis cv. 'Elizabeth' was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Thorns are stout and short. Colour of tender shoots and spine are pinkish. Leaf colour is dark green and its surface is glabrous. Leaf shape is ovate and its size is 9.0 x 6.2 cm. Bracts are small and its size is 4.3 x 3.5 cm. Bract shape is ovate with acute tip and cordate base. Bract colour is Dianthus Purple (730/1). Cultivar blooms profusely at the end of the branches. Cultivar is ideal for landscaping.

Floribunda:

This cultivar of *Bougainvillea glabra* cv. 'Floribunda' was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. This has vigorous growth with profuse flowering. Thorns are short and stout. Leaf size is medium, thick and its colour is light green. Blooms are borne in branches with thick dens clusters. Tender leaves have pinkish edge. Bract shape is elliptic with narrow apex. Bract colour is purple with prominent mid rib with green colour. Bract size is 4.5 x 3.0 cm. Star is prominent, big and its colour is green. Cultivar is ideal for landscaping.

Glabra var. Variegated:

This cultivar of Bougainvillea glabra var. 'Variegated' was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Cultivar developed as a bud sport of *B. glabra*. Plant growth is bushy and compact. Thorns are tender and small. Leaves are small, elliptic and closely arranged on short internodes. Variegated leaves have whitish or cream tissues along the margin with two shades of green which is very attractive. Bract colour is whitish-purple when tender and turns purple similar to *B. glabra* var. 'Sanderiana' when mature. Plant is ideal for topiary work and landscaping.

Glady's Heburn:

Developed as a seedling selection. Cultivar was rerecorded by W. Poulton from South Africa. Unfortunately its parentage was not recorded. Introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr.H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous and erect. Thorns number is high but size is small and bent at the tip. Leaves are long. Bract size is 5.0 x 4.0 cm, Tyrian Rose (24/1) in colour. At juvenile stage bract colour is greenish. Flower tube slender, colour light green. Star is prominent and their size is big. Stalk of the flower is green, not a continuous bloomer. It is widely used as pot plant.

Golden Glow:

This cultivar developed as bud sport of *B. x buttiana* in Cuba in 1949. The cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr.H.P. Greensmith, Park superintendent and Sri, M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant vigorous, leaf shape ovate with acute tip and obtuse base. Leaf colour is green and its surface is glabrous. Leaf size is 9.0 x 6.2 cm. Bract is ovate with acute tip and cordate base. Bract colour is yellow shaded Spanish orange (010).Bracts are non-persistent. Flower tube is small. Star is not prominent. Cultivar is used for landscaping and as hedge.

Isabel Greensmith:

A hybrid seedling and was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is erect and vigorous growing. Thorns are large and straight. Leaf size is 9.1 x 7.6 cm. Leaf shape is ovate with acute tip and cordate base. Leaf colour is green and its surface is glabrous. Bracts are non-persistent. Bract shape is ovate and its colour is Rose Pink (126). It is a free flowering cultivar, ideal for pot plant.

Jennifer Fernie:

This cultivar is a hybrid seedling and was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant is vigorous and is a profuse flowering cultivar. Thorns are long and straight. Leaf size is 8.3 x 7.0 cm. Leaf colour is green and its surface is glabrous. Bracts are non-persistent, 4.5 x 3.5 cm., ovate, white and broader than cv. Alba. Bracts resembles with cv. 'Muddana'. Bracts are persistent. It is a free flowering cultivar. Seed setting is profuse. Cultivar is ideal for pot plant and topiary work.

Kayata:

A hybrid seedling cultivar and was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Cultivars parentage is not known. Plant is not vigorous growing. Stem is tender and hairy. Leaves are medium size, ovate, deep green, glabrous. It is a profuse flowering cultivar. Bracts are non persistent, 4.5 x 3.5 cm. Bract shape is ovate and its colour is Neyron Rose (623). Flower tube is greenish and hairy. Bracts are persistent. A free flowering cultivar ideal for topiary work.

Killie Campbell:

A seedling of *B. x buttiana* raised by W. Poulton, Durban, South Africa. Cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. It is a free bloomer. Thorns are many stout and long. leaves are ovate, long somewhat wavy and recurved along the margin. Bract size is 6.0 x 4.5 cm and its texture is thick. In early stage, bract colour is coppery-red maturing to bright red and fade in to cerise. Star wise and prominent and looking like wax flower. Cultivar is ideal for pot culture.

Killie Campbell Variegata:

This cultivar of bougainvillea evolved as a Bud sport of *B. buttiana* reported by Peter Green Nurseries, Nairobi, Kenya, Africa. Cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Kaimba Road, Nairobi, Kenya, Africa. Plant growth is vigorous. Inflorescence appears at the end of branches. The variegation is irregular along the margin of the leaves. The margins are more creamy white in comparison to Brilliant variegata. It is a free blooming cultivar and is Ideal for topiary work.

Lady Mary Baring:

A Bud sport of *B. x buttiana* var 'Golden Glow' by H. P. Greensmith, City Park Nursery Nairobi, Kenya, Africa. The cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant is vigorous growing. Thorns are straight. Leaves are green, glabrous and their shape is ovate with acute tip and cordate base. Leaf size is 9.6 x 7.0 cm. Bracts are small, 4.0 x 3.5 cm. Indian Yellow (6) with prominent green veins on its surface. Flower tube is slender, tinged with orange colour on its surface. Blooms are borne in huge trusses more at the end of the branches. Cultivar is a free bloomer. Cultivar is ideal for landscaping and pot culture.

Lady Richards:

The cultivar belongs to *B. glabra,* raised in Jamaica and imported to Kenya by H.A. Delap. The cultivar was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H. P. Greensmith, Park Superintendent and Sri M.V. Patel of

Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Leaf shape is ovate and its texture is thick. Bracts small, 3.8 x 2.5 cm, light rose madder (23/2). Mid rib of the bracts are prominent green. Corolla tube is green and it bears hairs. Cultivar sets seeds easily. Used for rockery and landscaping.

Machakos

The bougainvillea cultivar 'Machakos' was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Bracts colour is orange red, non-persistent. Cultivar is ideal for pot culture.

Mahara:

This cultivar of Bougainvillea evolved as a bud sport of *B. x buttiana* var .'Mrs. Butt'. It was raised by Mrs. Marietta H. Raymundo, Malabon Rizal Philippines and reported by Dr. J.V. Pancho in 1961 from college of Agriculture, Laguna, Philippines. This cultivar was introduced in India by Lalbagh Botanic Garden, Bangalore, India in 1963. It is multi-bracted.A bract appears in bunches at the end of the branches. Bract colour is Rhodamine Red. Bracts are persistent. Cultivar is ideal as potted plant and Landscaping.

Margery Lloyd:

This cultivar was developed by H. Grahame Bel, Kenya, Africa and introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Stem, shoots and leaves are hairy. Hairs are clearly visible on mid rib and veins on the lower surface of the leaves, margin pinkish coloured and it is more conspicuous in the young leaves. Bracts are long, 4.5 x 2.8 cm., brick coloured which resembles with rust. Bract colour is similar to 'Lateritia'. Plant is used in Landscaping.

Mariel Fitzpatrick:

Bougainvillea var. 'Mariel Fitzpatrick' was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri, M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Thorns are many, short and bent downward. Leaves are long and elliptic. Bracts are long, 4.8 x 3.0 cm, Pink-Lilac in colour, similar to the bracts 'Sachidananda'. Flower tube is stout and its colour is greenish. Cultivar sets seeds. It is used in landscaping and for hedge purpose.

Million Dollar:

This cultivar of Bougainvillea was raised by Mrs. Marietta, H Raymundo, Malabon, Rizal Philippines. The cultivar has been reported from College of Agriculture, Laguna, Philippines by Dr. J.V. Pancho (1961). The cultivar was introduced in India in 1963 by Lal Bagh Botanic Gardens, Bangalore, India. A multi-bracted cultivar, growth vigorous. Leaves green, ovate with acute tip and cordate base. Bract colour is mallow purple, non-persistent. Flowers are totally absent. Hybridization is not possible. Plant is multiplied by vegetative propagation. Bracts usually appears in bunches at the end of branch. Cultivar is used as a potted plant.

Natalii:

A hybrid seedling, reported by W. Poulton and S. Durban from Africa. Cultivar was introduced in Lalbagh Botanic Garden, Bangalore, India in 1961. Plant grows with the development of drooping branches, mostly fragile. Thorns are less in number and curved. Leaves are light green in colour both in dorsal and ventral side. Bract size is 4.8 x 3.0 cm, slightly twisted, ranges from Spinel Pink (0625) to Dawn Pink (523), mid rib of the bract is green. The cultivar can be exploited in breeding programme, as sets seeds easily.

Nirmal Chandra No.2:

Developed as hybrid seedling and introduced by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya, Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Thorns are straight with high density. Leaves long, ovate with acute tip and obtuse base, green in colour. Bract shape ovate with acute tip, base cordate, 4.5 x 3.5 cm, Phlox Purple (632/1). Star size is big and it is prominent. Flowering appears at the end of branches. Dried bracts are persistent in nature. Cultivar sets the seed freely and can be utilised in breeding (Hybridisation) for development of new and novel cultivars.

Philip No.1:

This hybrid seedling of *Bougainvillea spectabilis* was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Mr. M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Bract size is large. Colour of the bract in young stage is Garnet Brown and it changes into Rose Opal

(0211) to Fuschia Purple (281), non-persistent. Suitable for Landscaping.

Poultoni:

This hybrid seedling of *Bougainvillea x buttiana* reported by W. Poulton, Durbon from South Africa. It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa.

Plant growth is erect, vigorous and compact. Thorns are small, thin and straight. Leaf shape is ovate with acute tip and cordate base, dark green in colour, surface glabrous, 8.6 x 4.9 cm. Bract shape is ovate with acute tip, cordate base, 3.8 x 3.3 cm, dark Cardinal Red (822) in the beginning and changes to Peony Purple (729/1) in mature stage, margin wavy, non -persistent. This is the uniqueness of this cultivar. Star is prominent and large in size. Cultivar with wavy margin trait can be exploited in a trait specific breeding programme.

Poultoni Special:

This hybrid seedling of *Bougainvillea x buttiana* reported by W. Poulton, Durban, South Africa. It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is erect, vigorous and compact. Thorns are thick and slightly bent. Leaf shape is ovate with acute tip, base cordate, colour dark green, surface glabrous, size 10.0 -11.2 cm x 5.5 - 6.0 cm. In fact, it is one of the largest bracted cultivar. Bract colour is Sulferino Purple (26/1) which twisted and clasping each other. Cultivar is ideal for landscaping.

Refulgence:

Belongs to *B. spectabilis,* originated in Brazil and named by M/S Willium Bull in 1987. It was introduced by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park Superintendent and Sri M.V.Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth habit is climber with drooping branches and long pendulous inflorescence. Leaf shape is elliptical with acute tip, dark green, surface glabrous. Upper surface is rough and densely pubescent and lower surface is smooth. Bract shape is ovate with acute tip and cordate base, reflex with prominent incision. Flower tube is twisted at apical region, constricted in the middle and slightly pubescent. Bract size is 4.2 x 2.6 cm, Cyclamen Purple (30/1) to deep Purplish Mauve in colur, star is prominent. Cultivar blooms almost continuously throughout the year. Cultivar is suitable for growing in pots and as 'standard'.

Rhodamine:

It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H .P. Greensmith, Park superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant is dwarf, thorn medium and curved. Leaf size is 7.7 x 4.0 cm, elliptic, dark green. Bract size is 5.7 x 4.9 cm, ovate with acute tip and cordate base, Rhodamine Purple (29) in colur, non-persistent. It is a semi free flowering and ideal for landscaping.

Roseville's Delight:

This cultivar of Bougainvillea developed as a bud sport of *B. x buttiana* var. 'Mrs. McClean'. The cultivar was raised by Mrs. Lolita, Malabon Rizal, Philippines in 1962. It was first reported by J.V. Pancho in 1963 from College of Agriculture, Laguna, Philippines. It was introduced by Lal Bagh Botanic Garden, Bangalore, Karnataka, India. Plant is vigorous growing. Leaf size is 9.0 x 6.0 cm, ovate with acute tip and cordate base, green in colur. It is a multibracted cultivar with persistent bracts. There are 20-40 bracts present in a cyme. Bract colour is Burnt Orange (Apricot Orange to Vinacious Orange). Flower tube is absent. It is a free flowering cultivar, ideal for landscaping.

Ruarka:

It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka from Kenya, Africa in 1961 through Mr. H .P. Greensmith, Park Superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Thorns are many, long and straight. Leaf shape is ovate with acute tip and cordate base, green and glabrous, 10.0 x 5.30 cm in size. Bract shape is ovate. Young bracts colour is Jasper Red (016) and mature bract colour is Cyclamen Purple (30). Bract size is 4.3 x 3.0 cm, non-persistent. Cultivar is used as a hedge and potted plant.

Splendence:

Bougainvillea glabra var. 'Splendence' is one of the most beautiful cultivar and exhibited in London in 1861. It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, from Kenya Africa in 1961 through Mr. H.P. Greensmith, Park superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous and semi-drooping. Leaves and young shoots are hairy. Leaf colour is green. Bracts are long and its shape is ovate with acute tip and cordate base, Magenta

Rose (027). Bracts appear all along the branches, non-persistent. Cultivar looks very beautiful and ideal for Landscaping.

Sydney:

Bougainvillea glabra var. 'Sydney' is developed by H. Grahame Bell from Kenya, Africa. It was introduced in India by Lal Bagh Botanic Garden, Bangalore, Karnataka, India from Kenya Africa in 1961 through Mr. H .P. Greensmith, Park superintendent and Sri M.V. Patel of Gardens & Plants, Nurserymen, Nairobi, Kenya, Africa. Plant growth is vigorous. Leaves are green and oblong. Bract size is 4.8 x 3.0 cm. Bract colour is Pale Purple with green veins. Mid rib on bract is prominent, thick and its colour is green. Length of the flower tube is more than the length of the bract. Bracts are non-persistent. Cultivar is ideal for pot culture.

Bougainvillea Cultivar Developed by Lal Bagh Botanic Garden, Bangalore

Following Bougainvillea cultivars were developed:

Bhabha, Gagarin, Gangaswamy, Marigowda, Mrs. Fraser, Sharma, Thimma, Trinidad, Vellayani, Yellow Queen and Zakir Hussain.

Morphological description of the cultivars along with their special feature have been recorded as descriptor.

Bhabha:

This cultivar of bougainvillea was reported in 1960. The name 'Bhabha' was given in honour of Dr. H.J. Bhabha, the famous atomic Scientist of BARC, Trombay, Bombay, India. Developed as a bud sport of *B. x buttiana* cultivar 'Louise Wathen'. It is a chlorophyll variegated cultivar and no change in bract colour. Central portion of the leaf is green which is surrounded by creamish- white tissues. Bract colour is Empire Rose (0621). It is one of the profuse flowering cultivar of bougainvillea.Bracts are non-persistent. Cultivar is ideal for pot culture.

Gagarin:

This single bracted cultivar of bougainvillea was evolved as a seedling of *B.glabra* var. 'Trinidad' in Lal Bagh Botanic Garden, Bangalore in 1960. Plant growth is vigorous. Leaf size is 9.2 x 3.0 cm, reen and its surface is shiny. Bract colour is Mallow Purple and not touches each other. Bracts are separate from the base, 5.0 x 3.5 cm, tip narrow. Blooms appear as a huge truss at the end of the branches. Cultivar is ideal for Landscaping.

Gangaswamy:

Developed as a bud sport of *B. x buttiana* var. 'Lady Mary Baring' and reported from Lal Bagh Botanic Garden, Bangalore in 1974. Plant growth is vigorous with drooping habit. Leaves are variegated. Centre of the leaf is green surrounded with white tissues. Leaf size is small and its surface is glabrous. Leaf shape is cordate with acuminate tip and acute base. Flowering is sparse. Bracts are non-persistent. Cultivar is ideal for potted plant.

Marigowda:

This cultivar was developed as a bud sport of var. 'Glady's Hepburn' from Floriculture Division, Department of Horticulture, Lal Bagh Botanic Garden Bangalore. Plant growth is intermediate. Leaves are light green in colour and their surface is slightly hairy. Leaves are small and their shape is ovate. Flowering is medium and appears all along the branches. Bracts colour is flesh which turns to bluish Pink in mature stage. Bract shape is ovate with acute tip. Margin is normal. Bracts are non-persistent. Cultivar is used in landscaping.

Mrs. Fraser:

Developed as a hybrid seedling of *B. spectabilis* raised by Mr. B.S. Nirody, Lal Bagh Botanic Garden, Bangalore in 1932. Leaf shape is ovate with acute tip and cordate base. Hairs are present on leaf and young shoots. Leaf size is 8.0 x 7.0 cm. Blooms best in a warm and dry situation. Bract colour is Terra-cotta. Bracts are non-persistent. Cultivar is ideal for potted plant.

Sharma:

This cultivar of bougainvillea was evolved as a bud sport of *B. spectabilis* var. 'Mrs. Fraser' from Floriculture Division, Department of Horticulture, Lal Bagh Botanic Garden Bangalore. The name Sharma was coined in honour of Mr. M.D. Sharma, Floriculturist, Lal Bagh Botanic Garden, Bangalore in1961. Plant growth is vigorous. Leaves are variegated. Cream colour irregular patches of different size are scattered on the surface of green leaf. Bracts colour is terracotta. Star is prominent. Bracts are non-persistent. Cultivar is used in landscaping.

Thimma:

This cultivar of bougainvillea was developed as a bud sport of *B. peruviana* var. 'Mary Palmer' from Lal Bagh Botanic Garden Bangalore. Plant growth is vigorous. Young stem is yellow in colour. Leaf size is 7.2 x 4.5 cm, ovate with acute tip and cordate base. This variegated cultivar has wide yellow patches on the centre (Yellow Green Group 144A, Fan-3) the green leaves. Thorn 1.4 cm long slightly curved. Tender stem colour is cream and pink. Bract size is 4.5 x 1.9 cm. Bract colour is of three types i) Red-Purple Group 72 B, Fan-2, ii)

Orange-white Group 159 B, iii) Fan-4 and Orange-White Group 159B, Fan-4. Bract shape is ovate with acute tip and cordate base. It is a very beautiful and attractive cultivar even when it is not in bloom. Easy to propagate by budding and air layering but it is difficult to propagate it by stem cutting. Bracts are non-persistent. Star 0.7 cm and its colour is Green Yellow Group 1D, Fan-1. Cultivar is used for hedge and landscaping.

Trinidad:

Evolved as a hybrid seedling of *B. glabra* var. 'Snow Queen' raised by Mr. M. H. Marigowda in 1960, from Lal Bagh Botanic Garden, Bangalore in 1932. Plant growth is vigorous. Leaves size is 10.5 x 4.6 cm. Leaf shape is elliptic with acute tip, dark green. Bract size is 4.0 x 2.5 cm, Mauve (633/3), shape is elliptic and its nature is persistent. Flower tube has swollen base. It is a free flowering cultivar. Cultivar. This cultivar can be included for breeding programme in bougainvillea, as easily sets seeds. Ideal for landscapng.

Yellow Queen:

This cultivar of bougainvillea was evolved as a bud sport of *B. x buttiana* var. 'Mrs. McClean' reported by Mr. M. H. Marigowda from Lal Bagh Botanic Garden Bangalore. Plant growth is vigorous. Bract size is 3.0 x 2.5 cm and its colour is Empire Rose (0621). Cultivar resembles with 'Mrs. McClean'. Bracts are non-persistent. Cultivar is ideal for potted plant.

Vellayani:

This cultivar of bougainvillea was developed as a bud sport of *B. x buttiana* and reported by Mr. M. H. Marigowda from Lal Bagh Botanic Garden Bangalore. A similar bud sport occurred at Agricultural College, Vellayani, Kerala. Plant growth is vigorous. Leaves are variegated. Bract colour is Purple, non-persistent. Cultivar is easily propagated by air layering and is widely used in landscaping.

Zakir Hussain:

This chlorophyll variegated cultivar was developed as a bud sport of *B. spectabilis* var. 'Maharaja of Mysore' and reported from Floriculture Division, Department of Horticulture, Lal Bagh Botanic Garden, Bangalore in 1963. Plant growth is intermediate. Young shoots are Pinkish. Thorn size is medium. Leaf size is medium and its shape is acuminate. It is a profuse blooming cultivar. Bract colour is Cyclamen Purple (30). Bracts are non-persistent. Plant is ideal for landscaping and as potted plant.

REFERENCES

Marigowda, M.H. 1960a. Short notes on Bougainvillea in Lal Bagh. *Lal Bagh*, Journal of Mysore Horticultural Society, 5: 25-28.

Marigowda, M.H. 1960b. Three outstanding varieties of Bougainvillea in Lal Bagh. *Lal Bagh*, Journal of Mysore Horticultural Society, 5 (3): 8-11.

Singh, B., Panwar, R.S. Voleti, S.R., Sharma, V.K. and Thakur, S. 1999. The new International Bougainvillea Check List, Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi-110012. Pages 1-76.

Swarup, V. and Singh, B.1995. Genetic resources of Bougainvilleas. Advances in Horticulture Vol.12, Ornamental Plants. Eds. K. L. Chadha and S.K. Bhattacharya. Malhotra Publishing House, New Delhi. Pages: 133-152.

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Research Paper

Studies on pigment development in bracts of *Bougainvillea* cultivars and genetic analysis of formation

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ABSTRACT

Bougainvillea (Commers.) is an important ornamental plant in Taiwan both as pot plant and in landscaping. Attractive bract colours in various forms make Bougainvillea the most popular flowering plants of the tropical countries. People are amazed to see their diversity of bract colour and massive display during flowering season. Each cultivar showing a define colour of bracts necessarily developed from a particular genetic group they belong. The paper highlights the pigment formation of bracts and its genetic roots linking its development.

Key words: Pigment, trait, mutation, hybridization, genotype, phynotypic

INTRODUCTION

In *Bougainvillea*, there are numerous cultivars with showy and colorful bracts. The development of bi-colored cultivars in India, such as 'Mary Palmer'and its mutant 'Thimma' with particular bract colors have created a sensation and added attraction to bougainvillea lovers around the world. Color of magenta or pale magenta and white in the 'Mary Palmer' group have developed many forms of combination in a single or different flowers. This may be white bract color changing to bi-colored subsequently. On other hand, bi-colored may change to magenta or white next time. Furthermore, bicolor itself also has various overall arrangements. Bracts lipstick-like and 'Red Heat' like colors are the two main types of combinations. Instability and unpredictable colour combinations are the unique characteristics for cultivars in 'Mary Palmer' group.

The reasons or factors influence the display of bract color in a particular group is not fully known. It is presumed by bougainvillea lovers/breeders that difference of day and night temperature, sun light and season influence colour development. However, it really difficult to quantify the influence of environmental factors. It is a matter of further research.

MATERIALS & METHODS

Pigments of Bougainvillea Bracts - The eyes-catching bracts coupled with nectar also attract pollinators. Bracts is a modified leaf, its leaf-like structure include epidermis, palisade and spongy tissues and vein.

There are water-soluble and fat-soluble pigments in leaf. In Bougainvillea, the former mainly are betacyaninand betaxanthin, and the latter are chlorophyll and carotenoid. The water-soluble pigments are stored in vacuole of epidermal cell, and the fat-soluble pigments are mainly in palisade tissue for bracts and leaves. If we look color of leaf from young to mature stages, water-soluble pigments generally appeared at early stage. Furthermore, if it is compared and link color of young leaf to color of bract, one may see a very rough rule in that reddish or bronze young leaf often coupled with red, pink, orange or yellow bracts of cultivars, and only case of pure green of young leaf goes to white bract cultivar. Of course, for purpose of photosynthesis, concentration of fat-soluble pigments ought to be much more than water-soluble pigments in leaf, and that is the reason why leaf always is green most of time.

Contrary to photosynthesis in leaf, bract plays an important role on sexual breeding. In order to attract pollinators, it is needed to enhance the colorful water-soluble pigments and suppress the fat-soluble pigments. It comes to volume of water-soluble pigments are much more than fat-soluble pigments in bracts. Lots of evidences to prove this view, cultivars with white colored bract are referred. Does it always show you a green color of bracts from young to middle stages, and the green will gradually faded away at middle to late phases? It is fact that white color usually contain very low or no pigment in bract.

RESULTS & DISCUSSION

This is a seedling developed by composite hybridization, (Chitra x Tetra Imperal Delight) x Tetra Lipstick.

It showed a reddish young leaf and reddish young bract as in image. It should come to a pink or pinkish-white or lipstick-liked color in normal situation, but it eventually went to a white bract. Same outcomes also happened last year from other seedlings. The reasons are to be ascertained yet. After studying all cultivars in collection, it is Mary Palmer group from where clarification was got.

The reddish young leaf coupled with white bracts in cultivar 'Shubra' and Magic Ice Cream', as referring above images, is contrary to the aforementioned rules that red leaf usually coupled with red or pink or orange bract. Therefore, we might find the answer by having a study on cultivars in 'Mary Palmer' group.

Shubra' is a bud sport from 'Mary Palmer', with white bracts in major, lipstick-liked bracts sometimes. 'Magic Ice Cream', which is a bud sport of Thimma, with a beautiful variegated leaf in that golden tissues in centre and green at margin of leaf, and a more irregular distribution of bi-colored bracts than that of cultivar 'Ice Cream' and others, it belongs to red heard bracts if any. 'Magic Ice Cream'and its golden variegation highly depend on sun light and season, under less sun light environment, leave will remain green and less variegation.

Mary Palmer Group

Those bicolored cultivars directly or indirectly mutated from 'Mary Palmer', named "Mary Palmer Group" here. It roughly classified overall arrangement of magenta and white in the family into 5 categories, according to the observation.

1. Magenta only: Mrs. H C Buck
2. Magenta with white dots: Odisee
3. Magenta, white, lipstick: Mary Palmer, Thimma
4. White, lipstick: 'Lipstick', Shubhra

    4.1. Mostly white, a few or few lipstick

    4.2. Mostly lipstick, few white

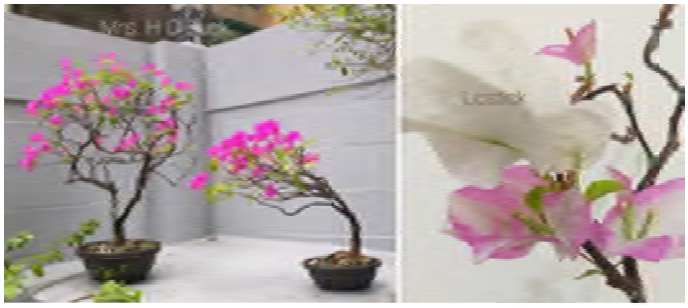
5. White, red-heart: Icecream (akared heart sakura flower in Mainland), Magic Icecream

    5.1. Mostly white, a few or few red-heart

    5.2. Most red-heart, a few or few white

It has been observed that there are different shades of magenta (magenta or pale magenta) and white on cultivars in Mary Palmer group, it may be on one or different bracts. Keeping aside single color magenta or white bracts cultivars, the fascinating bi-colored bracts can roughly be divided into two main groups, i.e. Lipstick-liked' and 'Red Heart' color of bracts. In this case, so-called lipstick-liked bract refers magenta or pale magenta only appeared at upper margin and with white in center area of the bract. Opposite to 'Lipstick, 'Red Heart' here represents white at margin and magenta in center area of the bract. Now situation is that 'Lipstick' trait is independent to trait 'Red Heart', that means the two traits are having less chance to be mixed one with the other. This phenomenon is really a matter of study. Consider that there are two different scenarios at least, i.e. more or less on quantity of white flowers vs. lipstick or red heart flowers, sometimes lipstick /red heart flowers are significant more than white flowers, sometime white more

than bi-colored flowers. Considering above, it is very difficult to predict which colour combination will appear for every bloom. Instability and unpredictable characters with regard to bract colour formation is always unique and exclusive for cultivars in Mary Palmer group. Apparently, Bougainvillea growers consider it as effects of day and night temperature difference.



Genetic Traits of Bicolor

Which can be a genetic trait by sexual reproduction for the 5 categories of bract color listed above? Dr. Zadoo reported restoration of fertility of Mary Palmer' and Shubhra' by chochiploidy. All diploid cultivars in this family are an interspecific hybrid, has lost fertility.

- Hybridization conducted by Dr. Zadoo reorted that 260 seeds with tetra Mary Palmer did not generate a seedling that inherited bicolored traits of Mary Palmer. The author speculated that traits of Mary Palmer are difficult to be a genetic trait. Only asexual breeding / multiplication can pass the trait to the next generation.
- There are 3 bicolored seedlings – 'Mary Palmer Special', 'Belgum Sikander' and 'Wajid Ali Shah' were developed by Dr. Zadoo, all with lipstick traits, key is the tetra 'Shubhra' ('Dr. B P Pal'). One more bicolored cultivar with 'Lipstick' trait named 'Chitra' was developed by Dr. Ohri 10 years after, by using 'Dr. B P Pal'. Obviously, the traits combined white and a few Lipstick can be a genetic trait, and reproduce seedlings inherited the traits by sexual breeding. Again, lipstick-liked bracts here also independent to Red Heart bracts and didn't show out a 'Red Heart' type of bracts together with.
- Besides the two sorts of traits category, what about the others? that's my original motivation conducting colchicine induction, intend to know can the red-heart type of trait be a genetic trait ?
- The author, Mr. Larrychen, restored fertility of 'Mrs. H C Buck', Lipstick', 'Icecream', 'Magic Icecream' by chochiploidy which is a great achievement.

Colour of the Bracts:

The phenotypic expression of colour of the bracts in Bougainvillea is the result genotype and environmental factors (phenotype = genotype + environment). A trait we see is the result of related genes and influences of environment factors.

Synthesis of Water-soluble Pigment -

1. Synthesize betacyanin (purple red) first.
2. Degrade betacyanin to betaxanthin (yellow).
3. Concentration and ratio of the two pigments decide color of the bract.

Factors Affect Bract Color

Pigments + ph+ copigmentation color enhancement and stability (phenolics, metal ions)

Abiotic Stresses

Such as high or low temperature, water deficit, Ultraviolet light (UV), can theoretically enhance synthesis of betaine. Cultivar 'Imperal Delight' is the typical evidence to prove that stresses from direct sun light and UV, leads to add pigments of betacyanin at margin of the bracts and change color from white to pinkish white, particularly during middle to matured stage of bractss. However, these sorts of stresses seem don't work on 'Mary Palmer' group especially 'Shubra' since appearance of floral bud and tiny young bracts.

The possible reasons could be as follows. The genes responsible for the synthesis of betacyanins have been suppressed in 'Mary Palmer', a mutant of Mrs. H.C. Buck'. They are, however, partially activated by light and high temperatures. This potentiality is almost lost in Shubra, in which no bands of betacyanins were described (Kochhar and Ohri 1977). It is a matter of pigment synthesis, caused by genes response and influence of environmental factors for cultivars in this group.

Issues:

A: Genes responsible for the synthesis of betacyanins have been suppressed or not ?

Yes, except cultivar Mrs. H C Buck, bicolored cultivars in Mary Palmer family have been suppressed.

B: Rreactivated by environmental factors or not ?

Not significant for cultivar 'Shubra', 'Lipstick', 'Icecream' and 'Magic Icecream'. Obviously, not limited to 'Shubra' lost potentiality only.

C: Reactivating completely or partially?

Partially for all bi-colored cultivars in the family

D: What does mean partially ?

- Eearly or late or whole stage on growing of bract.
- Locate at margin, centre or irregular area of bract.
- Concentration of pigment, heavy vs. light two cases.

There are more scenarios than that of Mary Palmer.

Aapical/Lateral Meristem:

Which step in meristem determine the color of bract?

- Cells in peripheral zone.
- Cell division.
- Floral bud differentiation.
- Physiological differentiation:
- Induction and evocation, transform from leaf bud to floral bud
- Morphological differentiation

Formation and development all kinds of floral primordia, bract, pistil, stamens.

As per study, it is noted that the genes related to color of bracts should have been determined at or before certain step of floral differentiation, maybe earlier, no matter what kinds of bract color. And influence from those environmental factors, if any, theoretically should be at stage of floral differentiation or during development of bract. But in practice, it seems less or no influence on the bracts from young to mature for cultivars in the family. However, it is obvious that environmental factors may enhance concentration of color.

Bud Sport

Something related to certain trait in cells of bud has been changed, it may due to change on number or interchange of chromosome or certain gene. This issue will provide us a good chance to clarify and give a logical speculation of view points.

- What kinds of bud: leaf bud and floral bud. It will be determined by certain mechanism and factors at stage of differentiation after cell division of meristem
- What kinds of sport?

(1) **Leaf:** Malformed or different kinds of variegated leaf, variegation related to change of plastid in cells of palisade tissue.

(2) **Bract:** Malformed or different color of bract, the latter related to vacuole in epidermal cells.

(3) **Internode:** Short internode, defective gene suppressed synthesis of gibberellins.

CONCLUSION

Bract is a modified leaf on the basis of structure, tissues and sorts of pigments. Therefore, bracts and leaves are closely related.

If genes related to synthesis of betaines work in normal condition in the leaves, the color of young leaves ought to be reddish and bracts also. Morever, if the synthesis is normal and without changes, color of the bracts will be stable and predictable. However, it is not rue in all cases.

Development of bract color has really showed an instable and unpredictable performance on 'Mary Palmer'family coupled with reddish leaf. This signifies that something in cells had happened and been changed during the process of transformation from leaf bud to floral bud in apical or lateral meristem.

It is known that deficit of gibberellin leads to development of short internodes of plant. In bract also, it is speculated that certain kinds of materials exists and might influenced performance of the suppressed genes in cultivars of 'Mary Palmer' family.

Different form of variegation are formed ranging from yellow or white at margin or in centre or irregular at different area of leaf and in extreme case of variegation is developed as albino. Similarly in bracts, color may change from red to white or b-colored while in extreme condition white. As in cases, Lipstick-liked color is magenta at margin and white in centre. On the other hand Red Heart' color is magenta in centre of bract and white at margin, irregular case of color layout also existed. Therefore, leaf and bract, in cell performance of the two are quite similar each other. If all sorts of variegation derived from a mutation in cells of apical

meristem, it is safe to say, the suppressed genes of bracts mutation existing in the bicolored family should also do happen and exist in cells of apical/lateral meristem.

By that, it is concluded that category of white, lipstick-liked and 'red heart', the three cases of suppressed genes in 'Mary Palmer' family have been determined at apical/lateral meristem. And as to the instability on color layout, i.e. more or less on ratio between white and bi-colored bracts, may be determined at stage of floral bud differentiation, especially the moment transform from leaf bud to floral bud. And as to influence of pigments from environmental factors, if any, may happened at induction/evocation stage (physiological differentiation) too. After floral bud has been developed, environmental factors had less influence on performance of bract color because related genes have been decided, no matter at meristem or primordia.

REFERENCES

Azeredo, H.M.C. 2009. Betalains: properties, sources, applications, and stability – a review, *Int. J. Food Sci. Technol*., 44 (2009): 2365-2376.

DeSouza, R.F.V., E.M. Sussuchi, W.F. De Giovani. 2003. Synthesis, electrochemical, spectral, and antioxidant properties of complexes of flavonoids with metal ions. *Synth. React. Inorg. Met. Org. Chem*., 33, pp. 1125-1144.

Hackett, W.P. and Sachs, R.M. 1965. Factors affecting flowering of Bougainvillea. California Agriculture 19 (9):13.

Heuer, S., S. Richter, J.W. Metzger, V. Wray, M. Nimtz, D. Strack. 1994. Betacyanins from bracts of *Bougainvillea glabra, Phytochemistry,* 37 pp. 761-767.

Hossain, A.B.M. Sharif and Musamma M. Uddin. 2019. Bougainvillea bract, chlorophyll fluorescence, anthocyanin and antioxidant development as affected by aoa, sucrose and phloem cut. *Journal of Applied Sciences, 19: 31-38.*

Kochar, V.K. and Ohri, D. 1977. Bio-Chemical analysis of bract mutations in Bougainvilleas –I: 'H.C.Buck' family. Z. Pflarizenzuchiq, 79:47-51.

Narayan, Shiv, Amit Kumar, Sunil Kumar, Ritesh Govindasamy, G. Sharmila, Chandrasekaran Muthukumaran, 2017. Extraction, optimization and characterization of water soluble red-purple pigment from floral bracts of *Bougainvillea glabra. Arabian Journal of Chemistry*, 10(2): S2145-S2150.

Roy, R.K. 2019. Bougainvillea – A Colour Handbook, Astral International Pvt. Ltd., New Delhi, India, pp.161.

Thiruchelvi, R, Jasmin Monisha, R, Arul Gayathiri, K Rajakumari, 2020. Extraction optimization and characterization of pigment from floral bracts of B*ougainvillea spectabilis*., *Research Journal of Pharmacy & Technology*, 13 (3): 20-25.

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Research Paper

Importance of potting media in flower crops

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ABSTRACT

Use of right potting media is an important factor to increase the yield of horticultural crops and quality. Moreover, water retention capacity, aeration and nutrient absorption are more. High-quality growth media plays important role of obtaining good vegetative growth and large number of flowering in various ornamental crops. Several growing media are used such as sand, peat, perlite, rock wool, sawdust, cocopeat, compost etc. It has been observed that theses components used alone or in combination, is recommended for growing high-value flower crops viz. Gerbera, Carnation, Rose, orchid, Alstroemeria, Lily etc.

Key words: Potting media, growth, nutrients, quality, flowering.

INTRODUCTION

Growing media is the material, organic or inorganic, which provides anchorage to the plants by holding the root system. It provides basic phyto-nutrients needed for plant metabolism, growth and development. The growing media is an integral part of most horticultural production systems. There are many types of media that can be used. This paper deals with the purpose of planting media and the qualities that growers should know when choosing media for different purposes. (Kaushal and Kumari, 2020).

Growing media for use in container nurseries is available in two basic forms: soil based and organic based. Compared with soil based media that has field soil as a major component, organic based media (a base of organic materials that may be compost, peat, cocopeat or other organic materials) promotes better growth and root development. The growing media are - cocopeat, peat, perlite, vermiculite, vermicompost, sphagnum moss, sand and rockwool etc.

Growing media is one of the most important factors required for the production of good quality pot plants. The selection of a good media is compulsory as it serves reservoir for plant nutrients besides provide support for plant growth, hold water for availability. This also facilitate exchange of gases between roots and atmosphere above the root medium. The presence of sufficient nutrition, good water holding capacity, porosity and plug formation ability of media increases the root and shoot growth, which ultimately leads to early and high yield of the crop (Padhiyar *et al.,* 2017). A best growing media should have proper aeration, water holding capacity and adequate nutrition supply when applied in combination with soil (Khobragade *et al*., 1997).

Potting media is rich source of nutrients with high organic matter content. Different growing media can be used to grow flowering crops, while the physical and chemical properties of media, like structure, texture, Ph as well as nitrogen, phosphorus and potassium are the dominant factors for the growth and development of plants (Sardoei *et al*., 2014). The growing media should be porous, uniform in texture, hold sufficient moisture and should be well drained. When selecting media, the grower needs to find the optimum balance between their requirements and those of the plants to be grown.

MATERIALS & METHODS

Criteria for Selecting Media:

- Serves as reservoir of plant nutrients.
- Sufficiently firm enough to encourage or support the plants.
- Provides aeration for exchange of gases.
- Should have good drainage, porosity, aeration, etc.
- Should be easily available and economic.
- Free from pathogens, pests and weed seeds etc.

Types of Growing Media:

Cocopeat:

A byproduct of processing coconut husks is known as coir dust, cocopeat, or simply coir. This material has proven to be an excellent organic component for container growing media. Cocopeat is growing acceptance as a growing medium because of its excellent aeration, durability, lightness and water holding characteristics (Nazari *et al*., 2011).

Vermicompost:

It is a type of composting in which certain species of earthworms are used to enhance the process of organic waste conversion and produce a better end product. It contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It possesses characters like, fertility, pH, water use efficiency, substrate physical properties microbial activity and organic matter components that may be responsible for increased growth.

Vermiculite:

It is a common component and is a hydrated aluminum-iron-magnesium silicate material that has an accordion-like structure. Vermiculite is used to increase the water-holding capacity of a growing medium. It can hold 3–4 times its weight of water. Vermiculite has a very low bulk density and an extremely high water-holding capacity, approximately five times its weight. This material also has a neutral pH, a high CEC and contains small amounts of potassium and magnesium.

Perlite:

It is a siliceous material of volcanic origin which is lightweight and well drained. Perlite is also rigid and does not compress easily, which promotes good porosity. The use of Perlite improved aeration, drainage, optimum moisture retention and nutrient availability. The high porosity helps to control the water-holding capacity and aeration of the substrate.

Sand:

It can be used as a growing medium or as a component of various substrate mixtures in order to improve the drainage properties. Pure sand is widely used in deserts and coastal plains, because it is a cheap, local, natural source.

Peat:

Peat is the most widely used growing media and substrate component in horticulture. Peat has long been used as a component of standardized growing media. However, research in the 1960s showed that it could be used as a growing medium in its own right both for container plants and for vegetable and cut flower production (Puustjarvi, 1973).

Figure 1. Cocopeat

Figure 2. Vermicompost

Figure 3. Perlite

Figure 4. Peat

Figure 5. Vermiculite

Figure 6. Sand

Functions of Growing Media:

Physical Support - The growing medium must be porous yet provide physical support. Young plants are fragile and must remain upright so that they can photosynthesize and grow. With larger nursery stock in individual containers, a growing medium must be heavy enough to hold the plant upright against the wind.

Aeration - Plant roots need a steady supply of oxygen to convert the photosynthesis from the leaves into energy so that the roots can grow and take up water and mineral nutrients. The byproduct of this respiration is carbon dioxide that must be dispersed into the atmosphere to prevent the build up of toxic concentrations within the root zone. This gas exchange occurs in the large pores or air spaces in the growing medium. Because nursery plants grow rapidly, they need a medium with good porosity.

Water Supply - Nursery plants use large amount of water for growth and development, and this water supply must be provided by the growing medium. Therefore, it should be formulated so that they can hold water in the small pores between their particles. Many growing media contain a high percentage of organic matter such as peat moss and compost because these materials have internal spaces that can hold water like a sponge. Therefore, growing media must have adequate porosity to absorb and store the large amounts of water needed by the growing plant.

Supply of Mineral Nutrients - Most of the essential mineral nutrients that nursery plants need for rapid growth must be absorbed through the roots from the growing medium. Most mineral nutrients are electrically charged ions. Positively charged ions (cations) include ammonium nitrogen (NH_4^+), potassium (K^+), calcium (Ca^{+2}), and magnesium (Mg^{+2}). These cations are attracted to negatively charged sites on growing medium particles up to the point when the roots extract the cations. The capacity of a growing medium to adsorb these cations is referred to as cation exchange capacity (CEC). Different media components vary considerably in their CEC, but peat moss, vermiculite, and compost have a high CEC value, which explains their popularity in growing media.

Effects of Growing Media on Flower Crops:

Growth and Development - Growing media play a vital role in growth and quality of pot plants. Flowering plant requires good medium for better growth and quality of flower production. Physiochemical properties of growing media determine the nutritional status, water holding capacity and aeration which determine the rate of growth. A light, rich, porous and well drained media is considered ideal for growing of flowers. For example, growing of rose in soilless media is gaining importance in pot culture.

Good Quality Flower - Different growing media can be used to grow Zinnia while the physical and chemical properties of media like structure, texture, pH as well as nitrogen, phosphorus and potassium are the dominant factors for the growth and development of plant. Composition and nutritional status of the medium is considered to be helpful for the production of good quality flowering plants with more number of flowers and greater size. For quality cut flower production, however a good growing medium should be used.

Nutrients Availability – It plays a vital role in good flower production and thus provision of proper growing media is the pre-requisite for better growth and production of floriculture crops. The plant growing medium must be porous for root aeration and drainage and also capable of water and nutrient retention.

Reduce Risk of Diseases - Growing media can reduce the risk of diseases and it also improves the production of flowering crops. The basic role of growing media is to hold the plants firmly in the pot, to provide nutrition which are ideal conditions for root growth and retaining the soil moisture.

CONCLUSION

Use of growing media is very effective for higher production of floricultural crops due to their good water holding capacity, aeration and more up take of nutrients. Several growing media, such as sand, peat, perlite, rock wool, sawdust, compost, etc. can be used alone or in combination for proper growth and production of potted ornamental plants and other high value crops. Most of the crops gave better result when cocopeat is used alone or in combination due to easy availability and its quality.

REFERENCES

Chavada, J. R., Thumar, B. V., Vihol, A. N., Patel, V. S. and Padhiyar, B. M. 2017. Effect of Potting Media on Growth, Flower Yield and Quality of Rose (*Rosa hybrida* L.) cv. Top Secret under Protected Condition. *International Journal of Pure and applied Bioscience*, 5(5): 821-827.

Kaushal, S. and Kumari, P. 2020. Growing media in floriculture crop. *Journal of Pharmacognosy and Phytochemistry*, 9(2): 1056-1061.

Nazari, F., Farahmand, H., Khosh-Khui, M. and Salehi, H. 2011. Effects of coir as a component of potting media on growth, flowering and physiological characteristics of hyacinth (*Hyacinthus orientalis* L. cv. Sonbol-e-Irani). *International Journal of Agricultural and Food Science*, 1(2): 34-38.

Padhiyar, B. M., Bhatt, Dipal. S., Desai, K. D., Patel, V. H. and Chavda, J. R. 2017. Influence of different potting media on growth and flowering of pot chrysanthem var. Ajina Purple. *International Journal of Chemical Studies*, 5(4): 1667-1669.

Puustjarvi, V. 1997. Peat and its use in Horticulture. p.160.

Sardoei, A. S., Fahraji, S, S. and Fahraji, H. 2014. Effects of different growing media on growth and flowering of zinnia (*Zinnia elegans*). *International journal of Advanced Biological and Biomedical Research*, 2(6): 1894-1899.

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Research Paper

Morphological Characterization of *Bougainvillea* cultivars grown in Fujian Province of China - I

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ABSTRACT

Morphological Characterization is part of taxonomy which deals with recording and documentation of various vegetative and floral characters of the plant to understand its phenotypic characters more precisely. On one hand, it describes the characteristic of the plant and on the other it helps the identification of the cultivars. It also highlights the specific traits morphologically which can be exploited in plant breeding programme. Many of the ornamental plants have got specific diagnostic characters which differ from the other. Lot of work has been done at the National Botanical Research Institute, Lucknow on various ornamental plants which includes Bougainvillea (Banerji *et. al*., 2017; Banerji, 2021), Canna (Roy and Banerji, 2006), Catharanthus (Dwivedi *et. al*., 2011), Annual Chrysanthemum (Banerji *et.al.* 2011) and Gladiolus (Dwivedi *et.al*., 2000, Dwivedi and Banerji, 2008). The present paper deals with the morphological characterization of 13 cultivars of *Bougainvillea* which were grown in germplasm collection of Fu Jian Sheng Hong Zhan Landscape Engineering Company Ltd., China.

Key words: Morphological, characterization, asymmetrical, foliage, bracts

INTRODUCTION

Bougainvilleas are very important flowering plant due to their attractive bract colour, free flowering habit and easy to grow. In China, the plant has enormous popularity both as nursery plants and in landscape use. As a result, extensive work has been done in China and India for the development of new verities, growing techniques and mass multiplication.

New varieties are generally studied for their morphological characters and documented scientifically to give their new identity and to differentiate with the existing one. The present study was conducted to record and document morphological characters of 13 new cultivars, as enumerated below.

MATERIALS & METHODS

Characterization was done both on vegetative and floral plant parts and data recorded as per international guidelines following laid down procedures.

'Red Butterfly':

This cultivar is also known as 'Ratna Red'. Developed as a bud sport of bougainvillea cultivar 'Red Batik'. Plant growth is bushy. Young stem is green which turns into brown with ageing. Spine is insignificant and visible only in young stem. Spine length is 0.7cm, soft and slightly curved. Most of the leaves and bracts are distorted. Two types of foliage have been observed in potted plant viz. green and variegated. Green leaves are growing in few shoots. Leaves are linear and elongated with acute tip. Leaf size is 6.5 x 2.7 cm. Petiole length is 1.5 cm. Many of the leaf lamina has asymmetrical development. Some of the leaf have notch. Margin is entire. On the apical bud region, young growing leaves have closing tendency. Leaf surface is rough and crinkled.

A variegated leaf has been observed in few shoots in a potted plant. Variegations are of two types. In first category, variegation is mainly present on the margin of leaf and its colour is creamish-white. Size of the variegated leaf is 5.5 x 2.8 cm. Petiole length is 1.4cm. In few leaves, it extended towards the central green region. The second category, variegated leaf is very prominent and attractive due to presence of creamish -yellow broad sector on left and right lamina. Leaf size is 4.5 x 2.7cm. Petiole length is 0.8 cm. The central area of the leaf is green. This green area is made up of different shades of green tissues. In early stage of growth, these creamish-yellow area has pinkish tinge in young developing leaf. Leaf morphology is normal and development of lamina is symmetrical. Leaves present near the apical bud

have closing tendency. Bracts colour is red and its size is 3.2 x 1.3 cm. Bracts shape is narrowly ovate and its tip is acute. Many of the bracts growth are asymmetrical. A bract looks very attractive and seems that many small butterflies are taking rest at one place above the branches. Tube length is 1.5 cm and its colour is deep red. Star is white in colour and its size is 0.4 cm.

'Orange Butterfly':

This cultivar is also known as 'Ratna Orange'. Plant growth is bushy. Stem colour is deep brown. Leaves are comparatively broader than Red Butterfly. Leaf size is 6.5 x 4.0 cm and petiole length is 1.5 cm. Leaf surface is rough and lamina growth is asymmetrical. In few leaves notching is clearly visible. On dorsal side of the leaf, small patches of light green and dark green are spread all over the surface. Leaf margin is wavy. Few leaves have creamish-white variegation at the margin. Few olive green patches are also visible on leaf surface. Spines are mostly absent. Bracts mostly develop at the end of branch. Bract colour is orange and resembles with cultivar 'Roseville's Delight'. Bracts of 'Orange Butterfly' are bigger than 'Red Butterfly'. Bract size is 3.5 x 1.7 cm. Size of the bracts varies in a group of three. some are big while others are small. Tip of the buds are deep orange in colour. Flower tube colour is brownish orange and star colour is white, which has closing tendency. Flower tube size varies in different groups of bracts and tube length is 2.1 cm. It has slight constriction in the middle portion. In few cases different size of bracts are present in group of three with different size of flower and flower buds are formed. Some of the buds are short and few of them are abortive mostly present in small size of bracts. Bract shape varies from bract to bract. Star is small and its diameter is 0.3 cm. Star colour is white.

'Cherry Blossom Variegata':

Plant growth habit is bushy. Young stem is maroon in colour while matured stem is brown. Stem have very few spines, less than 0.5 cm in length. Spines are soft and their presence on the stem is insignificant. Leaf shape is broad ovate and its tip is acute. Leaf size is 7.0 x 5.5 cm. Petiole length is 2.0 cm. Margin is entire. Leaves are variegated. Variegation is very prominent in the younger leaf in comparison to the mature leaves where variegation has masking effect due to combination of less contrast green and light green pigments.

Two types of variegated leaves have been observed in 'Cherry Blossom Variegata' potted plants. In first type, background of the leaf lamina is light green while the central region around the mid rib has deeper green colour which emerges out from the mid rib and the cell lineage spread towards the margin side following the track of the side veins. The intensity of green colour in different region on the green sector varies which gives attractive look to the cultivar which is mainly due to number of cell layers of mesophyll, cortical and palisade tissues involved in that particular region. This variegation is prominent on the dorsal side and invisible on the ventral side. Size of the leaf is 7.5 x 5.5 cm. Petiole length is 2.0 cm.

In second type of variegation, leaf morphology remains the same but the distribution of chlorophyll on entire leaf lamina is changed. Light green pigmentation is observed on the laminar surface, which is decorated by different shades of deep green dots of different size. Its gives mosaic type of morphology in some regions of leaf lamina while in other dots of green tissues of different size is observed. Leaf size is 6.8 x 5.0 cm. Petiole length is 1.3 cm. Bract colour remains the same and no change in bract morphology and colour is observed in this cultivar, clearly indicates that spontaneous mutation has only taken place in leaf in the form of chlorophyll variegation. The younger bracts have mallow purple colour while the matured bracts have comparatively lighter colour.

'Snow White':

It is evolved as a bud sport of cultivar 'Mrs. Eva White'. The cultivar is free flowering. According to Percy Lancaster, it came to India from Jamaica and it name has been coined by R.E.Holttum. First mentioned by Jivarajadas at Madras in 1940. Plant growth is semi erect and vigorous. Leaves are dark green, surface glabrous and its shape is elliptical. Leaf tip is acute and margin is entire. Leaf size is 6.8 x 3.2 cm. Petiole is short and its length is 0.9 cm. Bract shape is narrowly ovate and its colour is white. Young bracts are greenish white, while the matured bracts are white. Mid rib of the bract is clearly visible due to its light green colour on white background. Bract shape is ovate and its size is 4.0 x 2.0 cm. Bud tip is prominent and it is white. Flower tube is light green in colour, swollen at the base and has slight constriction in the middle. Flower tube length is 2.5 cm and it is attached to bract with thick green prominent pedicle. Star colour is light greenish white and it has closing tendency. Sepal colour is green. Star diameter is 0.5 cm. Cultivar was originated at Brazil.

'China Red': This variegated cultivar of Bougainvillea is also known as 'China Beauty'. Plant growth is upright. Cultivar is very floriferous and healthy. Stem colour is brown and length of the internodes is medium. In young shoots spines are prominent and its length is 2.0 cm. Mature Leaf is dark green and its surface is glossy. Variegation is masked and

faint on the dorsal surface of the matured leaf but on the ventral surface it is visible. The leaf size is 7 x 6 cm. Petiole length is 1.8 cm. Different types of shape of leaf has been observed in this cultivar which includes medium ovate, broad ovate and circular. Leaf tip is acute. Variegation is very prominent in younger shoots and foliage. Central portion of the leaf is light green along the mid rib region which is surrounded by light green colour. Variegation in younger leaves are visible from dorsal and ventral both the side. In young growing shoot coppery leaves are present where variegation is very prominent and clearly visible. The cultivar produces very symmetrical, healthy and soft rosy pink bracts. Bracts are non-persistent in nature. Bracts shape, size and morphology resembles with bougainvillea cultivar Chitra. Bract size is 4.4 x 3.4 cm. Bract colour is deep pink and its shape is medium ovate. Flower tube colour is deep pink like the bract and it has slight constriction in the middle region. Its length is 2.4 cm. Star is prominent and its colour is white. Diameter of star is 0.5 cm. Sepal colour is pink. As weather gets hotter, rosy bracts turns to deeper red. Foliage is variegated.

'Ice Cream'

Plant growth is bushy. Young stem is green and matured stem is brown in colour. Internodes are long and its length varies from 1.5 to 3.0 cm. Spines are visible in young stem. In young stem, spines are green hard and slightly curved at the tip region and its length is 0.7 cm. Leaves are variegated and its shape is medium ovate. The central region of the leaf is green (Moderate Olive green 137B, Fan-3) ,this region has patches of olive green (Moderate yellow green 139C, Fan-3). Leaf size is 5.0 x 3.2 cm. Petiole length is 1.0 cm. Orientation of the leaf on stem is upward. Tip is acute and margin is entire. Central region of the lamina is dominated with different shades of green patches which includes light green, deep green and olive green colour. Marginal area of lamina is creamish yellow (Pale Yellow Green 4D, Fan-1). Combination of these green and creamish yellow colours of the lamina makes the cultivar ornamental and attractive. Bract colour is purple. Bract shape is narrowly ovate and it size is 3.6 x 2.5 cm. Bract tip is acute. Mid rib and veins are prominent and clearly visible on bracts surface. A flower tube is very healthy, hairy and deep purple in colour and has slight constriction in upper side. Flower tube length is 2.2 cm. Star is prominent and its colour is creamish-white. Star diameter is 0.8 cm.

'Blue Moon': Plant growth is bushy. Mature stem colour is brown. Young stem colour varies from green to light brown. Stem has spines which are very fine, pointed and curved at the tip. Spine size is 0.5-0.6 cm. Leaves are broad ovate in shape and its tip is acute. Leaves are variegated. Leaf size is 5.2 x 4.3 cm. and petiole length is 1.1 cm. Wide range of variegated leaves are observed in this cultivar which includes creamish- yellow margin (Pale Yellow 11D, Fan-1), broad creamish-yellow margin (Moderate Yellow Green 138B, Fan-3), half of the leaf is green Moderate Yellow Green 139D, Fan-3) and half of the leaf is variegated and in extreme cases albino leaf. Mostly in young growing shoots 8-10 leaves has light pink colour in their margin which later on turns in to creamish-yellow with ageing. The central green colour of the lamina have different types of colour combination of green which includes small light green patches and olive green patches of different shape and size on dark green background. The length of the internodes ranges from 1- 1.5 cm in young growing shoots. Bract shape is broad ovate and its colour is deep pink (Vivid Purplish Pink N66B Fan-2). Bract size is 3.8 x 3.0 cm. Flower tube length is 1.7 cm. and its colour is deep pink. Flower tube has constriction at the upper side of the tube. Star is small and prominent and its colour is white Star diameter is 0.5 cm.

'Carmencita': Appeared as a bud sports from 'Mahara' under the name Carmencita. The cultivar originated at Philippines and Patented at USA under the name Carmencita R.E. Holttum (1970). Recorded in the Book "Flowering vines of the world" edited by Edwin A. Meninger (pp. 233-245). Bract and foliage morphology is same as Mahara but mutation has taken place in bract colour is carmine which differentiates it from Mahara. Mature leaves are broad ovate in shape and their colour is deep green. Leaf size is 7.4 x 5.2 cm. Petiole length is 1.5cm. Variegation here is completely masked. If one keeps the leaf in front of light source, variegation will be clearly visible. Light green (Moderate olive green 137B, Fan-3) and deep green area can be easily visualised and recognized by unaided eye. In young growing shoot variegation is clearly visible but as the leaf is going through the various stages of growth and ageing. Masking effects can be gradually seen. Stem colour is brown. Spines are straight and pointed and its length varies from 0.5-1.0 cm. Bracts are narrowly ovate to medium ovate. Bract colour is deep carmine (Strong reddish purple MN74A, Fan-2) and they appear in bunch. Flowers are totally absent. Bract is persistent and looks very ugly when they became dry and their colour fades. Bract size is 2.2 x 1.4 cm. This is the minus point of this cultivar.

'Hot Samba': Plant growth is erect. Mature stem colour is brown. Spines are present on old stem. Spines are very hard and strong and slightly curved at the tip. Its colour is brown and its length is 1.3 cm. Young developing shoots have 10-13 fuschia colour leaves followed by coppery and then green leaves. Leaf colour is green (Moderate Olive Green 137A,

Fan-3) and its shape is broad ovate. Leaf tip is acute. Ventral surface of the leaf is light green. Leaf size is 5.8 x 3.0 cm. Petiole length is 1.1 cm. Bract colour is Red Purple Group N57 Vivid Purplish Red N57A, Fan-2). Flower growth is very healthy. Flowers are unique for its expression of petal colour while sepal colour remains the same for all the colours of the petals. The major types of petal colours are yellow, light pink and white which has been observed during study in different bracts groups. In various bracts groups of three, following colour of the star has been observed: 1. Two yellow and one light pink 2. Two light pink and one yellow 3. One light pink, one yellow and one white. In all the cases flower tube colour remains the same i.e. deep orange and its shape is narrowly ovate. The bract tip is acute and its base is obtuse. Bract size is 3.70 x 2.40 cm. Flower tube length is 2.0 cm. Stars are prominent and attractive and along with bracts provide extra beauty to this cultivar. It acts as a specific maker for the identification of this cultivar. Star diameter is 0.8cm.

'Angus': Plant growth is erect and very healthy. Stem colour is brown. Young stem colour is green. The length of the internodes varies from 1.5 cm to 3.5 cm. Spines are absent in young stem. Leaf shape is medium ovate and its tip is acute. Leaf size is 4.3 x 3.3 cm. Petiole length is 1.4 cm. Leaf colour is deep green(Moderate Olive Green 137A, Fan-3) and its surface is glossy. Bract shape is medium ovate, tip acute and its base is obtuse. Bract colour is deep magenta (Strong reddish Purple N78A, Fan-2). Veins and mid rib is clearly visible on bract surface. Bract size is 4.3 x 3.3 cm. Bud tip colour is same as bract colour. Flowers are very healthy and its tube length is 2.5 cm. and its diameter is 0.4cm. Tube colour is deep purple and constriction is present on the tube in the middle region. Star is prominent and its colour is white (Yellow Group 2D, Fan-1). Star diameter is 0.8 cm. This cultivar is widely grown in Yunan Province of China where people liked it very much.

'Lipstick': Plant growth is bushy. Stem colour is deep brown. It bears curved spines in nodal region. Length of the spine is more than 1.0cm. Orientation of the leaf on stem is upward. Internodes are short in length. Leaves are light green (Moderate Olive Green 137B, Fan-3) in colour and its shape is medium ovate. Leaf tip is acute and margin is entire. Leaf size is 6.5 x 4.2 cm. Petiole length is 1.1 cm. It is a very floriferous cultivar and in full bloom stage entire plant is covered with bracts. Bract shape is medium ovate and its tip is obtuse. In this cultivar following types of bracts were observed during recording of the floral data:

1. Complete white bracts
2. Light magenta border on 50% area of the upper side of the bracts
3. Light magenta border on both side of the bracts from tip to base

In potted plant of Lipstick it has been observed that in few branches only white bracts were present while in other branches the true lipstick bracts were observed. Bract colour is Strong Purplish Pink 68B, Fan-2 and very Pale Purple 69C, Fan-2). Flower tube is light green in colour with constriction in the upper portion of the tube. Flower tube length is 2.30 cm. Star colour is white. Star is prominent and its diameter is 0.9 cm.

'Snow Purple'

Plant growth is bushy. Stem colour is deep brown. Spines are very small and its texture is very hard. The length of the spines varies from 0.3-0.5 cm. Internodes length is very short. It is dense at the base. In young developing shoots its length varies from 1.0- 1.5 cm. shorter internodes has been observed in mature stems. Here internodes length is less than 1.0 cm. Leaf shape is Lanceolate and tip is acute Leaf size is 5.5 x 3.40 cm. Leaf colour is green (Moderate olive green 137A, Fan-3) and its surface is glossy. The ventral surface of the leaf is light green. Bracts are narrowly ovate and its tip is acute.. Bract colour is deep mauve (Deep Purplish Pink N 74c, Fan-2 fading in to light purplish Pink 73C, Fan-2) and darker than bougainvillea cultivar Harbhajan Singh. Bract size is 4.20 x 3.0 cm. Veins are prominent on bract surface. Flower tube is healthy and has constriction in the middle. Flower tube colour is deep mauve. Star is prominent and its colour is light yellow. Star diameter is 0.30 cm.

'Miss Manila'

Plant growth is very healthy and its blooming is very floriferous. Matured stems are greyish brown in colour. Spines are present in the node. Spines are hard and pointed. Different sizes of the spines were observed on young green stem and their size ranges from 0.5-1.0 cm in length. Half of the spines on the upper side are coppery in colour while lower side of the spine is green. Length of the internodes varies from 2-4.5 cm. It is a combination of short and long internodes. Leaves are dark green in colour and their shape is medium ovate. Tip is acute. Leaf size is 8.5 x 5.5. Petiole length is 2.5 cm. Young leaves are coppery in colour. Bracts are broadly ovate, very healthy and their colour is Pink. Bract size is 4.6 x 3.7 cm. A flower tube is pink in colour and has constriction in the middle. Flower tube length is 2.2 cm. Star is prominent and its colour is white. Star diameter is 0.6 cm. Petal colour is white. Flowering is visible almost throughout the year.

CONCLUSION

The present investigation (Part–I) includes detail morphological characterization of 13 cultivars of *Bougainvillea* viz. Red Butterfly, Orange Butterfly, Cherry Blossom variegata, Snow White, China Red, Ice-Cream, Blue Moon, Carmencita, Hot Sambha, Angus, Lipstick, Snow Purple and Miss Manila which were grown in germplasm collection of Fu Jian Sheng Hong Zhan Landscape Engineering Company Ltd., Fujian Province China.

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REFERENCES

Banerji, B.K., Dwivedi, A.K. and Atul Batra. 2011. Morphological characterization of Annual Chrysanthemum – A Review, Floriculture Today, August, 2011. Vol. 16 (3): 30-33.

Banerji, B.K. 2021. Origin and expansion of Bougainvillea cultivar 'Mrs.H.C.Buck' family- A Review. The Journal of the greens and Garden, Vol. 4 (8&9):4-9.

Banerji, B.K., Misra, R.L. and Misra, S. 2017. Bougainvillea Chapter 7. Commonly used Ornamental Plant. Pages 137-166. Publishers Kruger Brentt, U.K.

Dwivedi, A.K. and Banerji, B.K. 2008. Morphological Characterization of Gladiolus for hybridization. In 'National Symposium on Recent advances in Floriculture, 4-6 March, N.A.U. Navsari, Gujarat Abstract No.P1-31, Page No.28.

Dwivedi, A.K., Verma, Arvind Kumar and Banerji, B.K. 2011. Morphological and Anatomical studies on Catharanthus roseus (Linn.) Progressive Research, 6(1): 51-55.

Roy, R.K. and Banerji, B.K. 2006. Canna. In Advances in Ornamental Horticulture Vol 3, Bulbous Ornamentals and aquatic plants. pp. 256-269. Edited by Prof. S.K. Bhattacharjee. Pointer Publishers Jaipur (Raj.) India.

Dwivedi AK, Banerji BK, Datta SK, and Sharma SC 2000. Characterization of Gladioluscultivars for conventional breeding, exploring the Gladiolus in India. In: Proceedings of the National Conference on Gladiolus, (Ed. S.K. Datta) 2000, Published by Director, NBRI Lucknow pp. 66-69.

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Research Paper

Importance of different packaging material in vegetable crops

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ABSTRACT

Packaging and the material used is very important post-harvest operation that determines the longevity of farm produce. Adequate packaging and good system of packing of fruits and vegetables will reduce the rate at which fruits and vegetables deteriorate. The correct packaging enables processors to pack fresh, fresh-cut fruit and vegetables and extend their shelf life. Several types of packaging materials are used for packing farm produce such as cardboard boxes, plastic bags, aluminium foil, paper bags, mesh bags etc. It has been found that using different type of packaging material is suitable for extend shelf life of farm produce.

Key words: Packaging, material, farm, produce, shelf-life.

INTRODUCTION

Packaging of vegetables is most important in the long and complicated journey from grower to customer. Packaging is defined as a system by which a fresh produce and fresh product will reach from production centre to ultimate consumer in safe and sound condition at an affordable price. Packaging generally helps to protect and retain the quality of fresh horticultural produce and reduces damage during transport. Packaging can create modified gas atmospheres around the product which slows down the respiratory activity of tomato. Sealing of tomatoes in polyethylene film packages extended the length of time until ripening (Shahnawaz *et al*., 2012). Horticultural produce has limited shelf life of a few hours to few weeks at ambient conditions. Packaging is required for food preservation, protection and for safe transportation of products during storage and handling. The package must protect the product against injuries, have enough holes to facilitate ventilation and fast cooling and be resistant against climatic adversities and attractive for consumers (Castro *et al*., 2005).

Packaging is a technique which slows down the biochemical changes and reducing the moisture loss. Thus, it is increasing the shelf life and quality of fresh produce (Srividya *et al*., 2014). Packing in perforated polyethylene bags prolonged shelf life and maintained quality compared to unpacked fruit. Main objective of packaging is to deliver the product safely with out damage at the different stages and to provide the consumers facilities of their usage. The goal of food packaging is to contain food in a cost effective way that satisfies industry requirements and consumer desires, maintains food safety, and minimizes environmental impact. The key to successful packaging is to select the package material and design that best satisfy competing needs with regard to product characteristics, marketing considerations (including distribution needs and consumer needs), environmental and waste management issues, and cost.

Packaging is one of the important considerations in vegetable and fruit market to reduce post-harvest losses and to make attractive to consumers. The use of properly designed containers for transporting and marketing of fruits and vegetables can maintain their freshness succulence and quality for longer period. The package must be capable of protecting the product from the transport hazards; preventing the microbial and insect damage; minimizing the physiological and biochemical changes and losses in weight. The package must be capable of tolerating long distance transportation, multiple handling and the climate changes of different storage places, transport methods and market conditions (Bala and Kumar, 2018). Packaging can be a major item of expense in produce marketing, so the selection of suitable containers for commercial-scale marketing requires careful consideration. It is essential to minimise physical damage to fresh produce in order to obtain optimal shelf-life (Scetar *et al*., 2010).

MATERIALS & METHODS

Types of Packaging Materials:

1. **Paperboard Boxes:** Paperboard is a paper-based material that is lightweight, yet strong. It can be easily cut and manipulated to create custom shapes and structures. These characteristics make it ideal to be used in personalized packaging. It is made by turning fibrous materials that come from wood or from recycled waste paper into pulp, and then bleaching it. Paperboard packaging comes in various grades, each suitable for different packaging requirements.
2. **Corrugated Boxes:** It consists of 3 layers of paper, an outside liner, an inside liner and a corrugated medium (also known as fluting). The corrugated medium that gives it strength and rigidity. The main raw material that is used to construct the corrugated board is most recycled paper, made on large high-precision machinery known as corrugators. These type of boards can reused and recycled again and again as a source of pulp fiber. Corrugated boards are of different types, single faced, double faced (single wall), twin wall, and triple wall.
3. **Poly Bags:** A poly bag, also known as a pouch or a plastic bag, is manufactured out of flexible, thin, plastic film fabric. Poly bags are durable yet lightweight, reusable and flexible. Since poly bags are structurally simple to make, it can be fully customized in design, style & sizes but still remain cost-effective.
4. **Plastic Bags:** These are easily affordable and excepted by the consumers. It is also called polyethylene film. Film bags are clear, allowing the easily inspection of the materials.
5. **Wooden Crates and Lugs:** These are generally used for costly fruits i.e. apples, stone fruits especially by Himachal Pradesh and Jammu Kashmir. This is very sturdy and durable even for rough conditions.
6. **Nylon Bags:** These are commonly used for consumer packaging with good strength. These can be reused and recycled. These are available in different sizes with different strength and mesh. These are good enough for storage and packaging with less water content i.e. onion, elephant fruit and arbi etc.
7. **Aluminium Foil:** Aluminum foil is made by rolling pure aluminum metal into very thin sheets, followed by annealing to achieve dead folding properties which allows it to be folded tightly. Moreover, aluminum foil is available in a wide range of thicknesses, with thinner foils used to wrap crops.
8. **Paper and Mesh Bags:** Consumer packs of potatoes and onions are about the only produce items now packed in paper bags (Figure 8). The more sturdy mesh bag has much wider use. In addition to potatoes and onions, cabbage, turnips, citrus, and some specialty items are packed in mesh bags. Sweet corn may still be packaged in mesh bags in some markets. In addition to its low cost, mesh has the advantage of uninhibited air flow.
9. **Plastic Stretch Film:** These films are generally used for consumer packaging as they can be stretched retains its elasticity. It protects the package from the lost of moisture and keep it fresh for longer times. These types of films can be used for primary processed products and also helps to give rural employment as the farmer itself will do that packaging and will make available directly to consumers.

Figure 1. Corrugated Fibreboard

Figure 2. Wooden Crates and Lugs

Figure 3. Paper and Mesh Bags

Figure 4. Poly Bags

Figure 5. Nylon Bags

Figure 6. Stretch Shrink Film

Characteristics of Ideal Packaging Material:

- It must have sufficient mechanical strength and should be capable of providing efficient handling unit for customers and dealers.
- It should have convenient ware house or storage unit strength i.e. good compression strength and puncture resistance to tolerate the load of packages above it.
- It should be economical so that the fruit in a package should not become expensive to consumer.
- It should provide adequate ventilation to fruits and vegetables as fruits require aerobic respiration and exchange of gas to avoid decay and to maintain its identity.
- It should reduce the wastage of moisture loss as the freshness of fruits is lost with moisture loss which causes shrinkage of fruits and acceptability of consumers.

RESULTS & DUSCUSSION

Functions of Packaging Material

- To assemble the produce into convenient units of handling
- A properly designed container should contain, protect and identify the produce, satisfying everyone from grower to consumer.

Advantages of Packaging Material

- Protection from oxygen
- Positive control of the moisture content of the product
- Inhibits the growth of aerobic spoilage bacteria
- Longer shelf life for goods
- Larger quantities of food can be purchased and kept over a longer period of time and bulk purchases are often cheaper
- Reduces the post harvest losses.

Importance of Packaging Material on Vegetable Crops

- **Storage of the product -** The package provides container for the product. A proper packaging enables easy storage in shops.
- **Protection of the product -** Package protects the product from heat, sunlight, moisture. It also protects the product from leakage, spoilage and breakage.
- **Transportation of the product -** Transport packaging like jute bags for fruits and vegetables, carton or crates facilitates transportation and handling and avoids damages during transit.
- **Convenience -** Packages can have features which add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, and reuse.

CONCLUSION

The primary purpose of packaging material must continue to be maintaining the safety, wholesomeness, and quality of fresh produce. Packaging of vegetable crops evaluate the effectiveness and reliability of the packaging materials.

REFERENCES

Bala, S. and Kumar, J. 2018. Packaging of Fruits and Vegetables in India: A Review. *Chem Sci Rev Lett*, 7(25): 62-69.

Castro, L. R., Cortez, L. A. B. and Clement, V. 2005. Effect of sorting, refrigeration and packaging on tomato shelf life. *College of Agricultural Engineering, State University of Campinas, Brazil* 1-5.

Scetar, M., Kurek, M. and Galic, K. 2010. Trends in Fruit and Vegetable Packaging – A Review. *Croatian Journal of Food Technology, Biotechnology and Nutrition*, 5(3-4): 69-86.

Shahnawaz, M., Sheikh, S. A., Soomro, A. H., Panhwar, A. A. and Khaskheli, S. G. 2012. Quality characteristics of tomatoes (lycopersicon esculentum) stored in various wrapping materials. *African Journal of Food Science and Technology*, 3(5): 123-128.

Srividya, S., Reddy, P. S. S., Umajyothi, K., Sudhavani, V. and Ramanjaneya, A. R. 2014. Effect of different LDPE packaging material on shelf life and nutrition quality of tomato cv. Lakshmi under ambient conditions. *Plant Archives*, 14(2): 1123-1126.

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Short Communication

Characterization of small flowered Chrysanthemum cultivars developed at CSIR-NBRI, Lucknow, India

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ABSTRACT

Lot of R & D work has been done at CSIR-NBRI, Lucknow towards the enrichment of germplasm collection by introduction and development of new varieties by breeding since 1966. However, in recent past around 33 small flowered chrysanthemum cultivars have been developed at CSIR-National Botanical Research Institute, Lucknow. Presently, the Institute has a status of a 'National Repository for Chrysanthemums' in the country maintaining around 225 germplasm collections of Chrysanthemum cultivars comprising mini, small and large flowered Chrysanthemum which includes almost all bloom types and colors. The present paper deals with thirty three small flowered chrysanthemum cultivars its origin and morphological characterization. Morphological characters include plant height, origin and its nature, its parent, flower colour, flower type, flower diameter; number of flowers/plant along with their uses.

Key words: Characterization, bloom, morphological, parent, flower colour.

INTRODUCTION

Chrysanthemum (*C. morifolium* Ramat) presently known as *Dendranthema grandiflora* Tzvelev, Anderson (1987), Heywood and Hamphries (1977) and Kitamora (1978). It is an important floral crop and cultivated for cut-spray and loose flower throughout the world. In India, it occupies third position, with rose and jasmine stands first and second respectively (Kolavalli *et al.,* 1991). Chrysanthemums are herbaceous perennial plants belongs to the family Asteraceae, the second largest family among flowering plants. The family comprising about 20,000 cultivars with wide range of morphological and floral diversity. The genus chrysanthemum constituting about 30 species, with its own unique shape and variety of colors. Many elemental species viz. C. *sinensis*, C. *indicum*, C. *japonicum*, C. *ornoteum*, C. *satsumense* and C. *boreale* are believed to have contributed towards its development. It is recognized as a potent floral crop in our country and cultivated as a cut flower for interior decoration and as a loose flower for making garlands, wreaths as well as for the religious offerings. The genus constitutes a large polyploidy complex ranging from 2X to 22X, besides a number of aneuploids (Neil Anderson, 2006).

Chrysanthemum is native of Asia and South Eastern Europe. In China, chrysanthemum flower was first discovered and cultivated as a flowering herb about 3500 years ago. The plant has adaptability to wide range of environment and suitable for various purposes like pot culture, field culture, bedding purpose, amenability to different attractive training methods, predictable response to the environment and immense number and diversity of shape, size and color displayed by its cultivars. Chrysanthemum is a photosensitive plant. Chrysanthemum blooms during autumn when the days are shorter. It can be forced to bloom year-round by manipulation of natural or artificial short or long day conditions in their various growing stages (Carvalho *et al*., 2005)

Spontaneous mutation has played an important role in the origin and evolution of many Ornamental plants and chrysanthemum is no exception. Wasscher (1956) has reported that 30% of the present day garden Chrysanthemum evolved as a bud sport. During the last few decades, the Chrysanthemum germplasm in our country has been enriched by nursery man, by seedling selections and by Scientist of various Research Institutes through seedling selection, induced mutations and hybridization (Banerji,

Table 1: List of some of the Chrysanthemum cultivars released by CSIR-National Botanical Research Institute, Lucknow

S.N	Name of new cultivar	Ht. of new cultivar (cm ±SE)	Nature of new cultivar	Parent	Flower color of new cultivar	Flower Type	Flower diameter (cm ±SE)	No. of flowers/plant (±SE)	Uses
Small flower									
1.	Birbal Sahni	53.0 ± 2.2	Seedling selection	Open Pollinated	White (White group 155D fan4)	Pompon	5.0±0 .32	26± 3.32	Pot/Commercial in bed
2.	Bindiya	12.5 ± 1.7	Seedling selection	Open Pollinated	Red (Red group 46A fan1)	Double Korean	3.5± 0.12	37± 3.98	Mini culture
3.	Flirt	46.5± 1.6	Seedling selection	Open Pollinated	Red (Red-Purple group 54A fan2	Double Korean	7.0± 0.21	27± 2.90	Pot/Commercial in bed
4.	Jayanti	60.5± 6.3	Seedling selection	Open Pollinated	Yellow (Yellow group 3A fan1)	Single Korean	4.8± 0.91	47± 4.67	Pot/Commercial in bed
5.	Kargil 99	56.2± 2.1	Open pollinated Seedling selection	Open Pollinated	White (White group 155C fan4)	Semi Quilled	5.4± 0.87	58± 6.54	Mini culture
6.	Kundan	54.5± 2.8	Seedling selection	Open Pollinated	Golden Yellow (Yellow group 5A fan1)	Pompon	4.5± 0.34	68 ± 2.41	Pot/Commercial in bed
7.	Lalima Tubular	50.5± 1.4	Gamma ray induced mutant	Lalima	Orange (Greyed-Orange group 170D fan4)	Quilled	6.1± 0.81	49 ± 1.10	Bedding and pot culture.
8.	Maghi	38.0± 0.9	Seedling selection	Open Pollinated	White (Orange-White group 159D fan4)	Pompon	3.1± 0.11	82 ± 3..95	Cut spray/Commercial
9.	NBRI Kusum	52.5± 1.8	Seedling selection	Open Pollinated	Yellow (Yellow-Orange Group 17B, fan1)	Pompon	4.1± 0.32	96 ± 2..91	Pot culture
10.	NBRI Little Darling	18.0± 0.6	Seedling selection	Open Pollinated	Rust (Greyed-Purple group 185A fan4))	Pompon	2.6± 0.13	42 ± 1.97	Mini culture
11.	NBRI Mini Jessie	56.5± 1.6	Seedling selection	Open Pollinated	Purple (Red group 55A fan1)	Cineraria	4.5± 0.20	59 ± 2.01	Mini culture
12.	NBRI Mini Queen	16.0± 0.7	Seedling selection	NBRI Little Darling	Dark terracotta (Yellow group 3B fan1)	Pompon	3.0± 0.18	25 ± 1..81	Mini culture
13.	NBRI Little Pink	51.0± 1.5	Seedling selection	Little Darling	Pink/ Red-Purple group 64A fan2	Decorative	3.7± 0.21	106± 3.7	Mini culture
14.	NBRI Little Kusum	52.0± 1.7	Seedling selection	Little Darling	Yellow (Yellow-Orange Group 17B fan-1)	Single Korean	3.8± 0.15	98 ± 2.3	Mini culture
15.	NBRI Little Hemant	63.5± 1.6	Seedling selection	Little Darling	Yellow (Yellow group 9A fan1)	Pompon	4.0± 0.23	95 ± 1.89	Mini culture
16.	NBRI Little Orange	43.0± 1.1	Seedling selection	Little Darling	Bronze (Orange group 25B fan1)	Pompon	4.1± 0.31	96 ± 2.1	Mini culture
17.	NBRI Himanshu	54.0± 1.8	Seedling selection	Open Pollinated	White (White group 155D fan40	Anemone	8.5± 0.62	84± 2.29	Pot culture, bedding and monochromatic landscaping
18.	NBRI Kaul	53.0± 2.1	Hybridization	Lal Pari (♀) X Vijay (♂).	Purple (Red-Purple group 58A fan2)	Single Korean	5.0± 0.14	88 ± 1.76	Pot culture and bedding
19.	NBRI Khoshoo	56.0± 2.5	Hybridization	Lal Pari (♀) X Vijay (♂).	Greyed-Red (Greyed-Red group 180A fan4)	Single Korean	4.6± 0.13	63 ± 2.23	Pot culture and as cut flower.
20.	Pancho	18.0± 0.6	Seedling selection	Open Pollinated	Brick Red (Orange-Red group 31A fan1)	Single Korean	4.0± 0.20	20 ± 0..92	Mini culture

Contd....Table 1

S.N	Name of new cultivar	Ht. of new cultivar (cm ±SE)	Nature of new cultivar	Parent	Flower color of new cultivar	Flower Type	Flower diameter (cm ±SE)	No. of flowers/plant (±SE)	Uses
21.	Peet Shringar	18.0± 0.7	Seedling selection	Open Pollinated	Yellow (Yellow group 6A fan1)	Decorative	3.7± 0.12	22 ± 0.30	Mini culture
22.	Pooja	49.0± 1.1	Seedling selection	Open Pollinated	Pink (Red-Purple group 65B group fan2)	Decorative	5.8± 0.19	47 ± 1.99	Cut spray/Commercial
23.	Purnima	44.0± 1.3	Gamma ray induced mutant	Otome Zakura	White (White group 155A fan4)	Decorative	6.5± 0.18	30 ± 1.21	Bedding and pot culture
24.	Rangoli	39.0± 1.7	Seedling selection	NBRI Diana	Rust (Orange Red group 34A fan1)	Decorative	4.9± 0.16	57 ± 1.80	Mini culture
25.	Sadbhavna	21.5± 0.9	Open pollinated Seedling selection	Open Pollinated	Red (Red group 46A fan1)	Decorative	4.0±0.12	38 ± 1.77	Mini culture
26.	Shanti	55.5± 1.3	Open pollinated Seedling selection	Open Pollinated	White (White group 155D fan 4)	Cineraria	6.2±0.17	64± 2.45	Cut flower and garland making.
27.	Shwet Shringar	16.5± 1.4	Seedling selection	Open Pollinated	White (White group 155D fan 4)	Decorative	3.5±0.02	24± 1.67	Mini culture
28.	Sizuka	16.5± 0.8	Seedling selection	Open Pollinated	Brick Red (Orange Red group 34A fan1)	Button	3.6±0.11	20± 0.80	Mini culture
29.	Shyamal	47.0± 1.8	Seedling selection	Open Pollinated	Purple (Red-Purple group 64B fan2)	Double Korean	4.7±0.15	72± 1..99	Cut spray/Commercial
30.	Vijay	28.0± 1.1	Seedling selection	Open Pollinated	Bronze (Greyed-Orange group 170A fan1)	Double Korean	4.0±0.17	81± .2.01	Early blooming and Pot culture
31.	Vijay Kiran	23.0± 0.4	Bud sport	Vijay	Bright yellow (Yellow group5A fan1)	Double Korean	4.2±0.13	74 ± 1.61	Early blooming and Pot culture
32.	White Anemone	18.0± 0..3	Seedling selection	Open Pollinated	White (White group 155D fan 4)	Anemone	3.4±0.10	38 ± 0.74	Mini culture
33.	Yellow Baby	27.5± 0.5	Seedling selection	Open Pollinated	Yellow (Yellow group 7A fan1)	Button	0.17±0.01	33 ± 0.04	Mini culture

2014). Chrysanthemum has two types of floret. The small florets present at the centre of bloom are called disc florets. The outer broad florets are called ray florets. Ray florets are unisexual in nature and have only female sex organ, while the disc florets have bisexual flowers and have both male and female sex organs. Chrysanthemum is mainly classified under two categories viz. Large flowered (bloom diameter more than 10 cm) and small flowered (bloom diameter less than 10 cm). Large flowered chrysanthemums are further classified into 8 types (Incurved, Incurving, Reflexed, Intermediate, Quilled, Ball, Irregular and Spider) and small flowered in to 10 types (Anemone, Button, Single Korean, Double Korean, Decorative, Pompon, Semi-Quilled, Quilled, Cineraria and Stellate). CSIR-National Botanical Research Institute, Lucknow, is one of the pioneer institutions where commendable research work has been carried out on various cultivars of chrysanthemum which resulted in to development of many new and novel cultivars. Plenty of research works at CSIR-NBRI, Lucknow has been done towards the enrichment of germplasm by introduction and breeding since 1966.

CONCLUSION

In recent past around 33 small flowered chrysanthemum cultivars have been developed at CSIR-National Botanical Research Institute, Lucknow. Presently, the Institute has a status of a National Repository for Chrysanthemums in the country maintaining around 225 germplasm collections of Chrysanthemum cultivars comprising almost all bloom types and colors. Morphological characters (vegetative and floral) of thirty three small flowered chrysanthemum cultivars *viz*. plant height, nature, parent,

color, type, flower diameter, number of flowers/plant along with their uses were studied and data recorded. This type of study is helpful to know details of the cultivars and their further use.

REFERENCES

Anderson, Y.O. 1987. Reclassification of the genus chrysanthemum L. *Hort. Science* 22(2): 313.

Banerji, B.K. 2014. Mutation breeding and mutants of ornamental plants: Role of NBRI for economic gains. In Mutagenesis: Exploring genetic diversity of crops. Edited by N.B. Tomlekova, M.I. Kozgar and M.R. Vani, Pages 307-328. Wageningen Academic Publishers, The Neitherland.

Heywood, V.H. and Hamphries, C.J. 1977. Anthmideae Systematic review In: The Biology and Chemistry of compositae. V.H. Heywood, J.B. Hartmone and B.L. Turner (Eds.): Academic New York: 851-898

Kitamura, S. 1978. Dendranthema at Nippoanthemum. *Acta Phytotaxonomica et, Geobotanica*, 29:165-170.

Kolavalli, S., Atheeq, L.K. and Jacob X. 1991. Floricultural industry in India. Oxford and IBH Publication Co. Ltd., New Delhi, pp. 11-13.

Carvalho, S.M.P., Abi-Tarabay, H. and Heuvelink, E. 2005. "Temperature affects Chrysanthemum flower characteristics differently during three phases of the cultivation period". *Journal of Horticultural Science and Biotechnology* 8(2): 209–216.

Neil, Anderson. 2006. Chrysanthemum Dendranthema x grandiflora Tzvelv. *Flower Breeding and Genetics* Part II, 389-437.

Wasscher, J. 1956. The importance of sports in some florist's flowers, *Euphytica,* 5: 163-170.

NEWS / VIEWS / EVENTS

Events Organized:

Training Programmes

As a part of ongoing scientific activities organized by the Foundation following training programmes were organized at the training centre.

1. A training programme was organized on Home Gardening & Bonsai Technique on August 28, 2021 at Bagvani, Red Hill School Campus, 23, Gokhale Marg, Lucknow. Seven garden lovers participated in the training programme from different walks of life. The trainees learnt about the techniques of Bonsai preparation besides its maintenance. Technical information on home gardening comprising selection of plants, planting, potting mixture and display techniques were provided followed by demonstration and hands-on training. Dr. B.K. Banerji and Dr. R.K. Roy acted as Resource persons.
2. One Training programme was organized on Home Gardening & Bonsai Technique on October 09, 2021 at Bagvani, Red Hill School Campus, 23, Gokhale Marg, Lucknow. Five ladies (garden lovers) participated in the training programme. Information on home gardening comprising selection of plants, planting, potting mixture and display techniques were provided followed by demonstration and hands-on training on Bonsai technoque. Dr. B.K. Banerji and Dr. R.K. Roy acted as Resource persons.

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An annual award has been instituted on behalf of the

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- Monotti M. 2014. Growing non-food sunflower in dry land conditions. *Italian J. Agronomy* **8**:3-8.
- Singh PK and BD Chaudhury. 1985. Biometrical Methods in Quantitative Genetic Analysis, Kalyani Publishers, New Delhi, India.p.318.
- Withers LA and F Engelman. 1998. In vitro conservation of plant genetic resources .In: A Altman (ed.) *Agricultural Biotechnology*. Marcell Dekker Inc., New York, pp 57-58.

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Roy's Greens & Gardens Foundation is a registered NGO with the following objectives.

- Dissemination of scientific and technical knowledge on greens (plants) and gardens (plantation) among the public in various ways for beautification and amelioration of environment.
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- Organization of awareness / training programmes, workshops, group discussions etc., on various aspects of greens and gardens to sensitize general public for their best use

Greens & Gardens

Greens

Plants are integral part of our daily life. The relationship between plants and human beings is very old. With the passage of time, and modernization of our social life, we have become more dependent on plants for pleasure, aesthetics, food, medicine and environmental amelioration. Therefore, always protect plants (greens) for our own survival.

Gardens

Garden is a place for pleasure and utility. The beauty of flowers and plants in a garden help to reduce our mental stress. Today's modern life is very busy and our involvement to work and profession have increased in manifold. There is hardly any scope for relaxation resulting easy victimization of fatigue and boredom. Here comes the role of greens and gardens. They serve as a true activation of our mind and gradually rejuvenate body by induction of fresh energy. Therefore, the importance of plants, flowers and their influence on our daily life is immense and can't be ignored.

Training Programmes

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