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Editorial

Greetings from Roy's Greens and Gardens Foundation, Lucknow, India.

It is my extreme pleasure to write editorial comments for this issue (Vol. 2, No. 4). The journal is now a mouth piece for the researchers and scientific communities. Scientists and researchers from various leading institutes have expressed their interest to the journal and have submitted papers. We are expecting many contributions for the next issues from prestigious research institutes around the globe. In the recent times, major developments have taken place in the field of Floriculture and Landscape gardening around the world. In view of the shifting of targets and focus, the approaches of gardening also need reorientation of strategies.

Requirement of new plant species for landscaping in view of changed agro-climatic conditions is absolute necessity. There is a need for global shift in research and breeding in floriculture. New techniques for gardening and greening of the urban areas are the new target for planning future developments considering dearth of horizontal space. Popularization of vertical gardening techniques and green building concept is a prime priority to obtain clean urban environment.

Due to rapid urbanization, the environmental pollution level is increasing at alarming rate. Therefore, the need proper greening plan of the cities and towns is most important. The requirement of plants, new techniques of gardening, irrigation systems will be much more in near future.

We are very pleased to publish this issue of the journal which includes various important research topics. I wish to record my sincere gratitude to the contributors for submission of research papers and the support we received from various quarters. On behalf of the editorial team and board members, I wish all the readers a very fruitful reading of the journal.

Place: Lucknow
Date: January 31, 2020

Dr. R.K. Roy
Chief Editor

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Review Paper

Indian rose breeders and new varieties developed: A review

B.K. Banerji

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ABSTARCT

Rose has occupied a unique place among the all flowers and valued much for its beauty. It has draws attention of gardeners, growers, nurserymen, floriculturist, plant breeders, tissue culturist and molecular biologist due to its attractive colour, shape, fragrance and medicinal properties. In this paper, contribution of some important Indian Rose breeders has been discussed including names of the important varieties developed by them. Brief description of the rose breeder and the newly developed varieties and their mode of origin have also been provided. Many of the rose cultivars have been devolved as a bud sport or spontaneous mutation. It has been observed that majority of new varieties developed as a hybrid belongs to hybrid tea group of rose. Indian Agriculture Research Institute (IARI) is pioneer Institution in rose breeding and contributed significantly in development of new and novel varieties.

Key words: Rose, breeders, hybrid tea, floribunda, hybridization.

Introduction

Roses have been used in many ways as an interesting research material by different groups of researchers, which resulted into development of many new. According to Dr. B. P. Pal, first Indian bred rose is cultivar 'Dr. S. D. Mukherji'. This cultivar of rose has been developed as a hybrid of 'Hadely' x 'Fascination' by Late Binoy Krishna Roy Chaudhury from Bengal. This was the first successful attempt in the history of rose breeding in our country. Rose breeding has become a passion among the rose growers in India. The breeding of roses in India was pioneered by late Dr. B. S. Bhattacharjee. Dr.B.P.Pal (1972) reported about the Indian rose breeders and rose cultivars developed by them. His list includes the name of following breeders- Mr. J. P. Agarwal, Mr. B. Arora, Mr. S. Banerji, Mr. A. M. Bhattacharji, Mr. B. S. Bhattacharji, Mr. S. M. Bhattacharji, Mr. R. K. Deshpande, Ms. K. S. G. Nursery, Mr. R. S. Malik, Mr. M. R. Munuswamy, Mr. A. K. Roychaudhury, Mr. B. K. Roychaudhury, Mr. D. D. Soman and Mr. M. L. Vasisht. Dr. B. P. Pal again wrote in Indian rose annual 1985 an article on a brief survey of Rose Breeding in India. In this article 12 new names have been given.

1. Mr. P. L. Airum
2. Mr. Braham Datt
3. Mr. S. C. Das
4. Doon Valley Rose Nursery
5. Mr. K. D. Gupta
6. Mr. Y. K. Hande
7. Mr. M.N. Hardikar
8. Mr. R. S. Jagtap
9. Lovelena Roses
10. Mr. P. Saxsena
11. Telco Nursery
12. Mr. M. S. Viraraghvan

Review of Work Done

On the basis of available literature, various nursery booklets, catalogues and Rose Annuals, names of the rose breeders and their contribution have been listed which are as follows:

Dr. B.S. Bhattacharjee

He was pioneer rose breeder and produced more than 80 new varieties. Newly released varieties of rose by Mr. Bhattacharjee are as follows:

Hybrid Tea: Ambica, Basanti, champa, Deshbandhu Rev Andrews, Deepak Rag, Deepti, Dr. Budhan, Dr.K.Biswas, Gourth, Gulabi Atar, His Highness, Jimutban, Kamala, Kanchanjangha, Karunamoy, Kattambomman, Kishori, Madam Emma, Magenta Queen, Mahasweta, Pitambar,

Radha Rani, Rakth Beej, Ram Krishna Dev, S. Percy Lancaster, Tamralipta and Vidyapati.

Floribunda : Shimantak

Polyanthas: Rishi Balmiki and Tarapunj.

Mr. A. M. Bhattacharya

He developed many new rose cultivars. Details of the cultivar have been explained in Indian Rose chapter. New rose varieties released by Mr. Bhattacharya are given below:

Hybrid Tea: Avra, Bapuji, Bharat, Dilkhus, Heart Throb, Kailash, Kalima, Kamalini, Krishna Bhattacharya, Michael Madhusudan, Netaji Subhas,Parijat, Patliputra, Purabee, Raja Ram Mohan Roy, Rajaji, Rajendra Prasad, Rana Pratap, Rani Jhansi, Samrat Ashok, Sarojini Naidu, Shanti, Shyma Prasad, Sri Babu, Sri Ma, Sthal Kamal, Surva, Swami Vivekanand, Tamishra, Tansen, Tapan, Tilottama, Tulsidas, and Zakir Hussain.

Floribunda: Afrat, Agni Veena, Bahar, Gurudev Tagore, Jai Hind, Jharna, Kazi Nazrul, Kasum Pur, Meenakshi, Menaka, Orange Vicitra, Pandit Nehru, Sharbari, Sir Jagadish Bose, Soor Das, Sundaram, Timir and Vichitra.

Mr. S. M. Bhattacharjee

He has developed many new varieties of rose as follows.

Hybrid Tea: Baju Babara, Bidhan Babu, Birat, Chittaranjan, Chocolate, Ferzaan, Garik, Harida, Joy, Jyotish, Kajjal, Lal Bahadur, Lal Kamal, Lalima, Megh Mallahar, President Radha Krishnan, Shakuntala, Sir Ashutosh, Sir Aurobindo, and Sugandha.

Floribunda: Ashawaree, Bahurupee, Balaka, Laxmi, Lalit, Manjula, Niharika, Peet Manjari, Sudha Rani, and Toohin.

Dr. B. P. Pal

Dr. B. P. Pal released many new and novel cultivars of rose by applying various breeding techniques at IARI, New Delhi. Following new varieties have been released:

Hybrid Tea: Akash Sundari, Apsara, Aruna, Ashirwad, Belle of Punjab, Cham di Kali, Dark Boy, Delhi Airport, Delhi Debutante, Delhi Pestel, Dil Ki Rani, Dilruba, Diva Swapna, Dr.Homi Bhabha, Dr.Randhawa, Dr.R.R.Pal, Dulhan, Eastern Princess, Golcoda, Golden Afternoon, Gulbadan, Homage, Indian Princess, Jawani, Kanakaugi, Kullu Belle, Lal Mahal, Lalima, Madhushala, Mechak, Meghdoot, Mrs K. B. Sharma, Nandini, Nayika, Nazneen, Nishda, Pahari Dhun, Palehand, Pat Rani, Poornima, Raja Sunder Singh Of Nalagarh, Raj Hans, Rumpa Pal, Ranjana, Rosy Evening, Sandeepni, Scented Bowl, Shanti Pal, Sharmili, C. V. Raman, Surkhab, Sweet Innocense, Uma Rao, and White Nun.

Floribunda: Akash Nartaki, Azeez, Banjaran, Belle of Punjab,Chamba Princess, Chingari, Chit Chor, Deepak, Delhi Brightness, Delhi Maid, Delhi Pink Powerpuff, Delhi Prince, Delhi Princess, Delhi Sharbet, Fugitive, Janki, Kumkum, Loree, Madhina, Madhura,Man Matha, Nut Khut, Orange Cup, Paharan,Punchu, Parwana, Ragini, Raj Bala, Rose Sherbet, Sandhya Bela, Saroj, Stanza, Suhashini, Surya Kiran, Tarang, and Temple Flame.

Miniature: Delhi Scarlet, **Climbing Rose:** Delhi White Pearl

I.A.R.I.

Indian Agriculture Research Institute (IARI), New Delhi is the pioneer and main research organization of rose breeding in our country. Following new varieties have been developed by IARI:

Hybrid Tea - Charugandha, Chitra, Chitralekha, Chitwan, Dr.Benjamin Pal, Dr.B.P.Pal, Ganga, Gulzar, Hans, Hassena, Jhawahar, Madhosh, Mother Teresa, Mridula, Mrinalini, Nehru Centinary, Nurjehan, Preyasi, Priyadarshini, Pusa Christina, Pusa Sonia, Pusa Sonara, Rat Ki Rani, Raj Kumari, Rakth Gandha, Raktim, Rangh Sala, Ratnaar, Soma, Sugandhani, Sujata, Surabhi, Surekha, Uttam, and Vasant

Floribunda- Arunima, Chandrama, Deepika, Deepsikha, Dr. S. S. Bhatnagar , Hemangini, Kavita, Lahar, Manasi, Mohini, Nav Sadabahar, Navneet, Neelambari, Prema, Rupali, Sadabahar, Shabnam, Shola, Shringar, Sindoor, Suchitra, and Suryodaya.

Polyanthas - Swati, **Climbing Rose:** Climbing Sadabahar

Mr. M. S. Viraraghavan

Fallowing new varieties has been released:

Hybrid Tea - Achanta, Ahimsa, Annapurna, Bodhi Sattawa, Chitralekha, Dharampuri, Kanchi, Kovlam, Nefertiti, Our India, Priyatma, Rajani, Rose Avil, Soma Sila, Tambra barani, Tipu's Flame, and Vanamali.

Floribunda - Amarapali, Bhagmati, First Offering, Kadambari and Nayantara

Climbing Rose- Climbing Kanya Kumari

Kasturi Rangan, Sri Ram and KGS (sons) :

Kasturi Rangan and his group at KGS (sons) nursery have evolved many new and beautiful roses at their center.

Hybrid Tea: Aditya, Ambika, Anupam, Arati, Archana, Ashwini, Baairavi, Bhanu, Bhargav, Bhawani,Blue Delight, Cauveri, Chitra, Chitrangini, Chitttaranjini, City of Panjim, Classic, Diversity, Godavery, Gomathi, Harangi, Jayat Sen, Kaladi, Kavini, Kalpana, Kalyani, Kanchani, Kanva, Komala etc.

Floribunda: Ahalya, Arkavati, Devdasi, Hemvathi, Jambun, Jwala, Kamini, Kolar Princess, Kushal, Mahadev, Narmada,Netravathi, Prakash, Priya, Rare Edition, Salmon Splash, Sharvathi, Sushma, Swapna, Varsha, Veena.

Polyanthas: Anjani, Bherani, Nartaki, Pink Spray, Prite, Rashmi.

Miniature: Kasturi KSG, Chandrika, Dazzler, Dazzling, Flame, Push Kala,

Climbing Rose: Climbing Koren burg, Climbing Tata Centinary.

Mr. C. R. Chiplunkar

Mr. Chiplunkar has evolved many new varieties of rose.

Hybrid Tea: Aba Saheb, Anna Saheb, Ahena, Anant, City of Ichalkaranji, Datta ji, Decan Delux, Die Della, Double Delight Supreme, Dr. Kidwai, Dr.Nosurwadia, G.K.Rose, Ichal Karanji 100, Jaslok, Mohak, Piroja, Polybag Joshi, and Rang Tarang,

Floribunda: Akash Deep, Decan Delight, Indramani, Neel Kanti, Pushkarni, and Shatdhara

Climbing Rose: Climbing Matangi

Mr. B. K. Patil

Hybrid Tea: Balaji, Ico Ambassadar, Ico Beauty, Ico Delux, Ico Tripati, Invention, Mahalaxmi, Malkar Siddha, Panch Ganga, Pride of Ichal Karanji, Satvika, Savkar, ShriSwamy, Samrath, Speckled Delight, Tenth Rose Convention, Yeshwant.

Floribunda: Ico, Ico Pearl, Ico Talk, Thornless Beauty. **Climbing Rose** : Climbing Pussata, Delhi Pink Pearl.

Mr. R. S. Singh

Mr. R. S. Singh has produced few new varieties of hybrid tea and floribunda roses.

Hybrid Tea: Chanderi, Ghaza, Heer, Kurwal, Nazre-e-Nazar, Rukhsaar, Yamini, Krishna Murthi**.**

Floribunda: Gopika, Kessi, Patasha, Patiala Darbar, Saroor.

Mr. Shivprasad Banerji

Mr. S. Banerji is an Eminent Horticulturist and good rose breeder of his time and released Hybrid Tea and floribunda roses that were very beautiful.

Hybrid Tea: Argha, Chamak, Chitra, Bhanu, Sugandha, Sushama, Uday Bhanu,

Floribunda: Bijoy Krishna, Jyoti.

Mr. Hardikar

Following varieties of rose has been evolved by Mr. Hardikar:

Hybrid Tea

Cynosure, First Rose Convention, Narmada, Lahari, Shreyasi, Sada Ranga, Shree Dayanand.

Floribunda: Bright Garbs.

Late Sri. K. P. Mukherji

Hybrid Tea or large flowered rose:

Akasboni, Agnisikha, Bijoya, Dr.Bidhan Chandra, Indraneel, Kumkum, Pink Merigold, Rajarshi.

Capt. Subimal Chandra Dey

Following important new varieties of rose has been evolved:

Arena 92, Arena 93, Arena 94, Arena 95, Colour Wonde, Fragrant Mauve, Red Vatertag.

Sekhar Datta

He has evolved many rose cultivars of rose which are as follows.

Touch of Heart, Asha, Sudha, Master.

Mr. and Mrs. Subroto Ghosh

Details of the release varieties by Mr. and Mrs. Ghosh till 2004 are follows :

Hybrid Tea Rose (Large Flowered)

Akash, Andromeda, Colour Harmony, Durgapur Jubille, Fragrant Beauty, Glamour Girl, Melody Queen, Memory of D.M. Roy, Santa Claus, Shalimar, Silky Petal, Suman, Sunanda, Suprabhat, Viola, Week End, Nilima etc.

Clustered Flowered Rose hybrid cultivars developed

Planet Mars, Cutie, Kajal, My Love, Green Light, Ree Pirate, Divine Perfume, Scarlet Queen Pink Perfume, Kali The Goddess.

Horticultural Arena, Jhargram, Midnapore, West Bengal

All the rose cultivars which have been developed and released from Horticultural Arena, Jhargram, Midnapur, West Bengal are as foloows.

Arena 91, Arena 92, Arena 93, Arena 94, Arena 95, Binapani, Blue Bird, Brahmajee, Colour Wonde, Fragrant Mauve, Fraternity, Martin Luthar King, New Hearld, Red Purfume, Red Vatertag, Salmon Queen, Sun God.

Dr. Kalyan Chakrabarty

Hybrid Tea

Anusuya Aroop Ratan, Aristocrat: Beauty Temple, Birendra Nath, City of Joy, Classic Calcutta,

Lady's Choice, Lavender Deu, Long March, Rangol, Roop Bani, Shubham, Saraswaty, Silver Toss, Tribute, Tropic Snow, Viswakalyan.

Floribunda

Assembly's Jubilee, Paper Flower, Ramtanoo, Willam Carey.

Pushpanjali Nursery, Jakpur

The Maity brothers of Pushpanjali Nursery have bred several

classic cultivars. They have bred more than 30 cultivars, as follows.

A. K. Mishra,Baba Jhogewar,Begam Kidwai, Blood Beauty, Candle Light, Comrade Sukumarda, Elfin Bush, God Gift, Governor Kidwai, Hey Day, Jamuna, Kansavati, Kshudiram, Midnapur Delight, Mrs Daves etc.

Nemai Mukherji

He has released two excellent varieties of rose - Mukerjee, K. P., Pride of Mukherjee.

Mr. Gouri Shankar Mandal - First Class, Las Vegas, Carmousine,

Biswas Nursery - Kamlakanta

Doon Valey

Hybrid Tea : Ajanta, Banaras Dawn, Saharadhara, **Floribunda :** Rangoli

Dr. N. C. Sen – Supriya

Swamy Vinayananda and Mr. K. Bhattacharjee - Calcutta 300

Mr. Sanatan Mukherjee – Lakshmishree.

Diby's - Surya Sikha, Good News.

Friend Rosary

Hybrid Tea : Girija, Kasturi Rangan, Manu Mukherji, Mrinalini lite Maharishi , Sweet India **Floribunda :** Anand Rao, City Of Lucknow. Tej Ganga

Climbing Rose : Climbing Ole, Climbing Show Biz

Telco Nursery

Hybrid Tea : Tata Centinary

Mr. Chandra Kant More

Hybrid Tea : Courageous India, **Miniature :** Jimmy

Mrs. P.L. Airum

Hybrid Tea : Devine Light .**Floribunda :** Golden Ray, Mahak **Miniature**: Dark Beauty

Mr. A. K. Roychaudhery

Hybrid Tea : Bagha Jotin, Dr.P.Banerji,Dr.S.D.Mukherji, and Muzibur

Dr. N. V. Shastri

Hybrid Tea : Brahm Datt, Golden Biotech, Prof. Madhab Chandra Nath, Shankar Jaikishan

Mr.Hardikar

Hybrid Tea: Cynosure, First rose convention, Narmada Lahri, Sadaranga, Shree Dayanand and Shreyasi.

Brahm Datt

Hybrid tea: Marie Palit, Pride of Nagpur and Sugandha Raj
Miniature Rose : Twinkler

Conclusion

Breeding roses in India had a glorious past and a very significant work for development of new varieties was done. Most of the varieties were unique with their characteristic and attractivity besides commercial importance. This documentation work is a record of the work done on rose breeding in India.

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Research Paper

Distribution of street trees in urban areas of Punjab, India

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ABSTRACT

Avenue trees are vital part in urban green infrastructure which provide environmental, ecological, social and health benefits to the residents. Being near to the source of vehicular pollution, they are most effective in reducing particulate and gaseous pollution. The benefits of avenue trees are directly proportional to their population density, distribution and health status which are affected by the characteristics of avenues in which they are growing. The streets of urban areas of Punjab have been surveyed to ascertain these characteristics together with the number of trees growing along roads. It has been found that stoking level is low in representative cities of all major regions with a scope to double the street tree cover if all the spaces suitable for planting are utilized. Width of streets, available root space and land use affected the tree cover in streets. Areas developed by government agencies had a better tree cover than those developed by private agencies. Urban planners need to consider the factors affecting tree growth in cities for sustainable benefits of urban greenery and creating an ambient atmosphere in cities.

Key words: Urban tree, stoking, distribution, land use, environment.

Introduction

The rate of urbanization in India is very fast. Infrastructural growth coupled with migration from rural areas has been increased a lot and the urban areas are expanding beyond the existing city limits. By 2031, India's urban population is expected to nearly double, reaching 600 million (United Nations 2011). The burgeoning urban population expects and demands amenities but usually the grey infrastructure gets a better deal in terms of resource allocation and priority over greenery. Sustainability and regeneration strategies of older cities also focus mainly on built up components and the consideration for natural components and the green spaces is still poor, particularly in India despite of the government's Urban Greening Guidelines in 2000 and again in 2014. Green spaces and trees are yet to be given due importance and weightage by municipal administrators despite of the growing scientific evidence for its benefits.

Urban greenery provides important environmental services like cleansing air and water, noise filtering and microclimate amelioration. They also provide significant social and psychological benefits besides contribute in enhancing livability of cities and the residents' wellbeing (Chiesura, 2004). Marked improvement in microclimate of tree lined avenues of Bangalore was recorded by Vailshery *et al* (2013). Ambient air temperature in afternoon was 5.6° C lower and road surface temperature was 27.5° C lower in street segments with trees as compared to roads with no trees. In addition, SO_2 levels were 65% lower and Suspended Particulate Matter (SPM) level on 80% of the tree lined roads was within prescribed limits. The roads devoid of trees mostly had SPM levels twice the permissible limit. Similar reduction in PM_{10} concentrations inside a row of roadside houses was reported with temporary installation of a curbside line of young Birch trees in Lancaster. (Maher *et al*, 2013). Street design has profound effect on the microclimate in conjunction with tree canopies. The cooling effect of tree canopies is higher in shallow and broad street canyons. This needs to be weighted while planning and managing the tree resources (Coutts *et al,* 2016). Sustainable city development is possible only with a greater understanding of ecosystem benefits provided by urban greens and inculcating this knowledge in development of sound policies with well-informed participation of decision makers as well as general public (Chaudhary and Tewari, 2011).

The urban ecosystem undergoes temporary and special changes as the city grows. This is particularly evident in Indian cities where residential land use often matures to mixed or commercial with time and generally leads to shrinkage in green cover. Berland (2012) also recorded

highest canopy cover at intermediate levels of urban development in Minnesota's Twin Cities Metropolitan Area.

Variety of land use in urban areas translates to great variation in available planting spaces, landscaping objectives and decision makers (*i.e.* residents, commercial property owners, municipal authorities, foresters). Understanding these variations is very important to formulate strategies targeting all type of land owners to ensure that the whole city contributes to green infrastructure, creating a better living space for all socio-economic groups. Various studies have recorded a correlation between tree cover of an area with socio-economic status of the residents. Areas with low income residents have been observed to have a significantly lower proportion of tree cover on streets in the city of Tampa, Florida. These results hold significance for policy makers and urban green managers in terms of fair distribution of green amenities to underprivileged people (Landry and Charkraborty 2009). The social and cultural values of green infrastructure space or street trees have been well documented in the west. Appraisal of the peer-reviewed research articles revealed that almost 80 % of work was being done in the developed nations (Shackleton, 2012). Gathering scientific information on urban forests for creation of a knowledge repository is crucial in Indian context. Baring a few studies in Bangalore, Delhi, Chennai, Gandhinagar and Chandigarh there has been negligible systematic work done on street or park trees in India. Most major cities of India, except Gandhinagar and Chandigarh, have low tress cover as compared to European/Australian/American cities (Chaudhry *et al*, 2011).

Trees are the important element of the urban nature and in streets, they are usually the only vegetation type that can increase comfort level of pedestrians and being near to the source, can act as effective sink for carbon and pollutants. Abundance and distribution of trees within cities were inferred as basic factors affecting efficiency of their ecosystem services by Manes *et al.* (2012). Data on the characteristics of streets and trees growing alongside them is very essential for making effective decisions regarding selection of species for new plantation and maintenance of existing tree resources for sustained ecosystem services. This study was undertaken to get basic information about stocking level of street trees, potential planting sites and the street characteristics determining the distribution of trees in urban areas of Punjab state.

Materials and Methods

One city each from the three major agro-climatic areas of Punjab state was selected for the survey of Avenue trees. First one was Pathankot from Sub-mountain region characterized by low hills receiving higher rainfall than other regions and slightly lower average temperature. Second one was Bathinda from South western arid region characterized by lower rainfall and higher average temperature than the other regions and lastly, Ludhiana from Central region with intermediate rainfall and average temperature. The selected cities are the largest urban centers in their respective region.

Random sampling has been regarded as the most economical way of determine characteristics of urban tree resources (Mohai *et al.*,1976). Representative samples can be drawn by small random sample as percentage of number of streets or their length could be used to estimate population characteristics with an accuracy of about 10% . The other approach for sampling is from the city tree inventory. In the absence of tree inventory for all the selected cities, simple random sampling of street length was the viable option for this survey. The minimal sample size to achieve this level of accuracy has been proposed as three to six % by Bond and Buchanan (2006). Using this approach, sample size for Ludhiana was taken as 5 % of total street length and due to relatively small size of the other two cities; sample size was increased to 10 % for Bathinda and 20 % for Pathankot for obtaining greater accuracy.

Georeferenced digital maps of the cities are not available in public domain. Therefore, the city boundaries were digitized from latest city development plans from the respective urban authorities and all the street segments within these boundaries were digitized using Google Earth. Streets falling within these boundaries were digitized in form of segments, each extending from one junction to another. Street junctions were taken as reference points since these are easy to identify and can be located precisely on a map. Open source GIS software – QGIS was used for processing of digitized maps and sampling.

Table 1. Details of sample of street segments

City	Area (sq. km)	Total number of street segments	Total length of street segments (km)	Number of sample segments	Length of sample segments (km) and percentage
Ludhiana	147.81	16501	2802.28	787	148.1 (5.28%)
Bathinda	45.27	2791	553.18	280	55.71 (10.07%)
Pathankot	18.79	541	123.31	112	25.37 (20.57%)

Field data was recorded for street characteristics and number of trees planted on right of way including the property strips *i.e* area between road edge and boundary of adjoining property being maintained by the property owner.

Wherever it was not possible to determine the property line due to lack of development, trees within 5 m from road edge were considered as street trees.

Results and Discussion

Existing Stocking Level of Street Trees

The stocking level is the relationship between total available planting area and planted area. Urban Greening Guidelines (2014) by Town and Country Planning Organization, Government of India recommend planting distance of 10-12 m for avenue trees. Accounting for the presence of many obstacles to planting such as curb cuts, above and below ground utilities, building entries etc, planting distance of 15 meter was taken as standard for calculating potential stocking levels. McPherson and Rowntree (1989) have also recommended a distance of 15 meter between stems for calculating a 100 per cent stocking level. Existing stocking level of the trees was the highest in Bathinda (34.18%) followed by Ludhiana (33.68%) and Pathankot (27.10%) had the least stocking level (Table 2). Taking into account the number of saplings, stocking level came out to be 40.85 % in Bathinda, 40.13 % in Ludhiana and 28.96 % in Pathankot. Streets in all the three cities had lower stocking level than the well-stocked US cities like 74 % in New York (Rae *et al,* 2010) and 92 % of Davis (Maco, 2004) but near to average stocking level of 36.3 % for 50 California cities (McPherson *et al,* 2016). Proportion of street length devoid of trees and saplings was higher in Pathankot (35.19%) as compared to Bathinda (29.71%) and Ludhiana (18.75%). Plantable space was available on majority of the streets in Bathinda (87.06%) and Ludhiana (82.96%). Pathankot had the lowest proportion of street length (60.74%) where space was available for planting of trees. Streets without any trees have also been reported in Shenyang by Ning *et al.* (2008) and Rio de Janerio by Dos Santos *et al.* (2010).

Table 2. Existing stocking level of street segments

Stocking Level	Ludhiana	Bathinda	Pathankot
Total sample length (km)	148.10	55.71	25.38
Number of trees at 100% stocking	19746	7428	3384
Number of trees recorded	6650	2539	917
Stocking level of trees	33.68%	34.18%	27.10%
Number of trees and saplings	7925	3034	980
Total stocking level	40.13%	40.85%	28.96%
Length of streets without any tree or sapling (km)	27.78 (18.75%)	16.55 (29.71%)	8.93 (35.19%)
Length of streets with plantable space	122.87 (82.96%)	48.5 (87.06%)	15.42 (60.74%)

Potential Stocking Level of Street Segments

Potential stocking level of Ludhiana streets was 3,09,969 trees at 100 % stocking level but extrapolated tree and sapling population was 1,66,163 with availability of 1,43,806 trees planting sites. Potential stocking level for Bathinda was 64,213 but extrapolated tree and sapling population was 30,451 with availability of 33,672 tree planting sites. Similarly, potential stocking level for Pathankot was 9,987 but extrapolated tree and sapling population was 5,038 with availability of 4,949 tree planting sites.

Table 3. Potential stocking level of street segments

Stocking Level	Ludhiana	Bathinda	Pathankot
Total street length (km)	2802.28	553.18	123.31
Street length without plantable space	17.04%	12.94%	39.26%
Street length with plantable space (km)	2324.77	481.60	74.90
Potential Number of trees	309969	64213	9987
Projected existing tree population	139430	25308	4429
Projected existing sapling population	26733	5143	609
Projected number of spaces occupied by tree/sapling	166163	30451	5038
Number of potential plantable sites	143806	33672	4949

Plantable spaces were available in 87.06 % of Bathinda street length and 82.96 % of Ludhiana street length. Pathankot had relatively lower availability of plantable space with 39.26 % street length paved up to property line, but special provisions like tree pits with grates could be used to make these streets green. Street tree cover could be increased to almost double in all the cities with estimated 1,43,806 planting spaces in Ludhiana, 33,672 in Bathinda and 4,949 in Pathankot. The road network of the Bathinda city has also been reported to be deficient in vegetation cover with large scope for growth along major and minor avenues by Singh (2018).

Distribution According to Width of Street Segments

Width of the street had a profound effect on distribution of trees. Street width ranged from 2.3 to 50 m and streets were grouped according as presented in Table - 4. Majority of the streets were less than 6 m in all the cities with Pathankot having 76.41 % , Ludhiana having 67.79 % and Bathinda having 67.17 % streets less than 6 m wide. About 90 % of the street length in all cities was less than 12 m wide. Narrow streets had relatively smaller number of trees in all the cities, whereas, 6-12 m class had relatively more number of trees.

Narrow streets are bound to have smaller root and canopy space, restricting the number of suitable species as well as the growth of trees. The cooling capacity of trees is also reduced in narrow roads as observed by Coutts *et al*, (2016).

Table 4. Distribution of trees according to width of street segments

Segment width (m)	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
<6	100.4 (67.79%)	37.42 (67.17%)	19.39 (76.41%)	3403 (51.17%)	1171 (46.12%)	590 (64.34%)
6-12	39.5 (26.67%)	16.27 (29.2%)	3.42 (13.47%)	2121 (31.89%)	1184 (46.63%)	235 (25.63%)
12-18	2.93 (1.98%)	0	1.59 (6.28%)	381 (5.73%)	0	40 (4.36%)
18-24	3.58 (2.42%)	2.02 (3.63%)	0 0	679 (10.21%)	184 (7.25%)	0
24+	1.70 (1.14%)	0	0.97 (3.84%)	66 (0.99%)	0	52 (5.67%)

Distribution of Trees According to Width of Side Strips

Side strip is usually the readily available planting space in streets. Many streets were metaled to the ends without leaving any bare soil. Strip width on streets ranged from zero to twenty meters. The data was grouped into classes as given in Table 5. for easy interpretation. The largest proportion of side strips were less than 1 m in width in all the cities with Ludhiana having 45.60 percent, Pathankot 40.26 per cent and Bathinda having 34.60 per cent of the street length falling in this class. Side strip width of more than two meters supported more trees due to better root space availability. Narrow strip width obviously reduces the availability of root space to trees and thus limits choice of species as well as survival rate of trees. Restricted root space was reported to be single most important cause of conflict between tree roots and hardscape (McPherson, 2000) and it had also been observed that more rooting space the trees had, the less likely they were to fall in strong winds (Gilman and Partin, 2007). Mullaney *et al* (2015) have also inferred that root growth is affected by the volume of root-penetrable soil available to the urban trees.

Table 5. Distribution of trees according to width of side strips

Width of side strip (m)	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
<1	67.53 (45.6%)	19.27 (34.60%)	10.22 (40.26%)	1119 (16.83%)	142 (5.59%)	235 (25.63%)
1-2	32.69 (22.07%)	14.81 (26.59%)	6.59 (25.98%)	1247 (18.75%)	624 (24.58%)	222 (24.21%)
2-3	22.83 (15.42%)	6.43 (11.55%)	2.09 (8.24%)	1643 (24.71%)	385 (15.16%)	74 (8.07%)
3-4	6.08 (4.10%)	4.15 (7.45%)	1.54 (6.06%)	395 (5.94%)	284 (11.19%)	39 (4.25%)
4-5	8.57 (5.78%)	4.22 (7.57%)	1.43 (5.64%)	862 (12.96%)	536 (21.11%)	114 (12.43%)
5+	10.41 (7.03%)	6.82 (12.25%)	3.51 (13.81%)	1384 (20.81%)	568 (22.37%)	233 (25.41%)

Distribution According to Paving Type of Side Strips

Larger proportion of side strips in streets of Ludhiana (51.30%) and Bathinda (39.37%) were irregularly paved, whereas, largest proportion of streets (55.21%) in Pathankot had impervious paving or tar without any bare soil on side strips. Bathinda had larger proportion of streets with bare sides (27.54%) as compared to Ludhiana (15.84%) and Pathankot (18.65%). The largest proportion of trees (53.76%) was found on streets with bare soil on sides in case of Bathinda, whereas, in case of Ludhiana more trees (60.93%) were found on streets with irregularly paved soils. Pathankot had largest proportion of trees on streets with impervious paving or tar along the entire width of right of way. In all the cities, streets with bare soil on side had relatively larger proportion of trees as evident from Table 6.

Table 6. Distribution of trees according to paving type of side strips

Paving Type on sides	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
Bare soil on sides	23.46 (15.84%)	15.34 (27.54%)	4.73 (18.65%)	1697 (25.52%)	1365 (53.76%)	253 (27.59%)
Porous pavers on sides	5.34 (3.60%)	6.15 (11.03%)	0	291 (4.38%)	312 (12.29%)	0
Impervious paving or tar	43.33 (29.25%)	12.29 (22.06%)	14.01 (55.21%)	610 (9.17%)	220 (8.66%)	399 (43.51%)
Irregularly paved	75.98 (51.30%)	21.93 (39.37%)	6.63 (26.14%)	4052 (60.93%)	642 (25.29%)	265 (28.90%)

Side strips with bare soil had relatively larger proportion of trees due to more space available for planting as well as better growing conditions. Spaces in between the trees were paved by property owners in many streets for parking vehicles and in many cases the maximum portion of right of way was paved by the municipal bodies to extend the carriage way and ease the traffic flow. Sufficient root space is vital for survival and proper growth of trees and more so in harsher growing conditions of urban areas where heat island effect raises moisture requirement of trees. Increased impermeable areas intensifies the stresses on urban trees which often lead tree roots to spread in areas that provide better growing conditions, but increase conflict with infrastructure causing damage to buildings and pavement uplift (Mullaney *et al* (2015). Increasing population and number of vehicles is consistently mounting pressure for wider roads, however, in order to strike a balance between space for survival of trees and optimum utilization of space,

porous pavers could be a viable alternative to impervious paving or metaled road on entire right of way as evident from the results of streets with porous pavers on side strips having relatively more number of trees..

Distribution According to Actual Land Use of Street Segments

Major proportion of the streets in Ludhiana (42.22%) and Bathinda (62.73%) cities was under medium density residential land use, whereas, in Pathankot the largest proportion of streets (43.88%) was under high density residential land use (Table 7). Tree distribution usually followed the distribution of land use classes. As compared to other two cities, Bathinda had a higher proportion of trees (22.02%) in case of low density residential land use. Government/ institutional areas also had relatively more number of trees. Industrial area in Ludhiana had lower relative proportion of trees.

Table 7. Distribution of trees according to actual land use of street segments

Actual Land use of Segment	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
High density - Commercial	1.63 (1.10%)	2.82 (5.06%)	1.11 (4.36%)	175 (2.63%)	182 (7.17%)	25 (2.73%)
High density – Mixed	10.26 (6.92%)	0.40 (0.71%)	1.26 (4.98%)	255 (3.83%)	0	34 (3.71%)
High density – Residential	16.4 (11.07%)	3.61 (6.49%)	11.14 (43.88%)	342 (5.14%)	18 (0.71%)	297 (32.39%)
Medium density - Commercial	6.83 (4.61%)	0.44 (0.8%)	0.95 (3.76%)	563 (8.47%)	12 (0.47%)	118 (12.87%)
Medium density – Mixed	20.38 (13.76%)	5.34 (9.59%)	2.55 (10.06%)	644 (9.68%)	50 (1.97%)	90 (9.81%)
Medium density – Residential	62.53 (42.22%)	34.95 (62.73%)	5.44 (21.45%)	3557 (53.49%)	1434 (56.48%)	227 (24.75%)
Low density – Residential	2.93 (1.98%)	4.74 (8.52%)	1.85 (7.28%)	198 (2.98%)	559 (22.02%)	74 (8.07%)
Government / Institutional	1.45 (0.98%)	1.12 (2.01%)	0	175 (2.63%)	208 (8.19%)	0
Industrial	24.82 (16.76%)	0	0	737 (11.08%)	0	0
Open space	0	0	0.97 (3.84%)	0	0	52 (5.67%)
Agricultural	0.14 (0.09%)	0	0.10 (0.40%)	0	0	0
Uninhabited colony	0.75 (0.51%)	2.29 (4.11%)	0	4 (0.06%)	76 (2.99%)	0

Land use has been observed to be a dominant factor influencing urban tree cover within a city (Nowak *et al.*, 2006) and its effect was visible in all the three cities. Low density residential, medium density residential, and government/ institutional areas had a higher relative proportion of trees due to availability of larger plantable spaces and lesser conflict with utilities. Higher density in residential areas is usually associated with low socio-economic level of the residents and such areas have been observed to have lower proportion of street trees by Landry and Chakraborty (2009). The mixed use areas and high density residential areas had lower proportion of trees mainly due to higher volume of traffic and lesser availability of parking spaces which often led to reduction in green spaces to accommodate other facilities. High density commercial areas also had higher relative proportion of trees in Ludhiana and Bathinda primarily because many of them were situated on wider roads with service lanes having strips for plantation. Inverse relationship of tree cover and housing density was also reported by Hal *et al.* (2012) in UK.

Distribution According to Development Agency of Street Segments

Larger proportion of the streets in all the cities was in areas developed by private developers. Government developed streets were relatively more in case of Ludhiana (23.16%) and Bathinda (23.52%) than in Pathankot (11.36%). Bathinda had highest proportion of trees (50.33%) in streets developed by government agencies. Although, more number of streets were privately developed, government developed areas had higher relative proportion of trees in all the cities as shown in Table 8.

Table 8. Distribution of trees according to development agency of street segments

Development agency of Segment	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
Government	34.31 (23.16%)	13.10 (23.52%)	2.88 (11.36%)	3109 (46.75%)	1278 (50.33%)	181 (19.74%)
Private	113.28 (76.49%)	41.42 (74.34%)	22.18 (87.38%)	3540 (53.23%)	1201 (47.30%)	735 (80.15%)
Undeveloped	0.52 (0.35%)	1.19 (2.14%)	0.32 (1.26%)	1 (0.02%)	60 (2.36%)	1 (0.11%)

Lower tree cover in privately developed areas is a significant issue pertaining to regulation of green cover in such areas indicating a need for more stringent regulations and their strict implementation since most of the new development is being done by private sector. Areas owned and developed by government had a higher tree density in Melbourne as well (Dobbs *et al.*, 2013).

Distribution According to Development Level of Street Segments

Largest proportion of streets was fully developed and rarely had vacant spaces, followed by areas with mid-level development which were well occupied, in all the cities (Table

9). Bathinda had relatively higher proportion of streets (11.39%) with old type of development. Majority of the trees were also found in fully developed streets in Ludhiana (59.53%), Pathankot (54.83%) as well as Bathinda (47.34%). In Pathankot, newly developed areas and those with mid-level development had higher proportion of trees as compared to Ludhiana and Bathinda.

Table 9. Distribution of trees according to development level of street segments

Development level of Segment	Length of Segments (km)			Number of Trees		
	Ludhiana	Bathinda	Pathankot	Ludhiana	Bathinda	Pathankot
Old development	12.00 (8.10%)	6.35 (11.39%)	2.11 (8.33%)	276 (4.15%)	242 (9.53%)	9 (1.02%)
Fully developed - rarely vacant	87.30 (58.95%)	24.04 (43.16%)	13.25 (52.2%)	3959 (59.53%)	1202 (47.34%)	498 (54.83%)
Mid-level development - well occupied	36.56 (24.69%)	15.99 (28.70%)	5.20 (20.50%)	1989 (29.91%)	590 (23.24%)	281 (31.42%)
Newly developed - some occupied	10.58 (7.15%)	6.59 (11.82%)	4.39 (17.30%)	359 (5.40%)	304 (11.97%)	128 (12.60%)
Newly developed - no construction yet	1.66 (1.12%)	2.75 (4.93%)	0.42 (1.66%)	67 (1.01%)	201 (7.92%)	1 (0.13%)

Development level of an area also affected the number of trees. Old city areas were generally unplanned and densely populated with lower number of trees. Older city areas tend to have a lower tree cover in most parts of the world as observed by Dobbs *et al.* (2013) and Kabischa and Haase (2014). Planned development of most of the cities is not an old phenomenon in India and most of the older areas are congested with few green spaces. In Ludhiana, newly developed uninhabited areas (1.12%) had almost equivalent proportion of trees (1.01%), however, relative number of trees initially decreased in areas with some occupancy and then increased with increase in level of development. It is likely that the developers planted trees during initial phases which were not subsequently maintained and further plantation was done either by increasing number of residents or by the municipal authorities on subsequently taking over the area which led to increase in tree cover and as a result, fully developed areas (58.59%) had an equivalent proportion (59.53%) of trees. The situation was little different in Bathinda where newly developed areas had higher proportion of trees compared to areas with mid-level development. This might be due to late initiation of planned development in the city which got status of Municipal Corporation much later than Ludhiana. Pathankot on the other hand had proportionately lower number of trees in newly developed areas but tree cover was equivalent or higher in developed areas. The city has recently been upgraded to Municipal Corporation and planned development has not yet been taken up in proper manner. Municipal corporations have a separate horticulture department for development of green spaces which is usually not the case with municipal councils.

Conclusion

Distribution of street trees was influenced by the characteristics of streets in which they are growing. The streets of urban areas of Punjab had low stocking level with a scope to double the street tree cover. Width of streets, available root space and land use affected the tree cover in streets. Areas developed by government agencies had a better tree cover than those developed by private agencies. Urban planners need to consider the factors affecting tree growth in cities for sustainable ecological, social and health benefits from urban greenery.

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Research Paper

Studies on sterility, recombination and development of hybrids of Bougainvillea (*Bougainvillea* Commers.) by colchicine treatment

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ABSTRACT

Bougainvillea (*Bougainvillea* Commers.) is one of the important flowering plants for tropical and sub-tropical countries and in high demand in nursery trade. Development of new hybrids / varieties is a thrust area for research considering trade value. Sterility of some of the varieties under different species is a bottleneck for the development of new varieties and recombining parents for better results. Restoring fertility with some treatment is a primary requirement for hybridization and other breeding methods. The present paper studied in depth the fertility status, ploidy level and cholchicine treat treatments for development of new hybrids.

Key words: Sterility, cholchicine, Allodiploid, tetraploid, hybrids

Introduction

Bougainvillea (*Bougainvillea* Commers.) belongs to the family Nyctagenaceae and considered as glory of the tropics due to its colourful bracts. The plant is very popular in nursery trade as flowering plant in the tropical and sub-tropical gardens of various countries (Roy, 2015; Roy, 2019). Development of new hybrids with attractive floral characters and suitable for landscape use is prime requirement (Pal, 1960). However, there are some problems with sterility and consequently recombining different parents for yielding desirable characters (Ohri and Zadoo, 1975). Treatment with cholchicine is very effective method for restoring fertility and creating new variation with new genotypic make up (Pancho *et al*., 1960).

Some studies and observation recorded are furnished below.

A. Fertility of Allopolyploid vs. Autopolyploid

(Hypothesis A, B, C represents three basal species in bougainvillea)

Interspecific Hybrid: (parents from different species)

1. **Allodiploid -** The combinations of AB, BC and AC will normally be sterile. Eg. cultivars in *B. buttiana* and *B. spectoperuviana* group. In some cases pollens are fertile and seed are sterile (mainly in *B. glabra x spectabilis*)

2. **Allotetraploid -** The combinations of AABB, AACC, BBCC will regain fertility. Eg. 'Dr. B P Pal' and 'Tetra Mrs. McClean'.

B. Intraspecific Hybrid: (Parents from same species)

1. **Autodiploid -** The combinations of AA, BB, CC will normally be fertile, such as 'Mrs. Eva' and 'Formosa' in *B. glabra*,' Splendens' and 'Lateritia' in *B. spectabilis*.

2. **Autotetraploid** - The combinations of AAAA, BBBB, CCCC will decrease Fertility significantly.

In Bougainvillea, there are three basal species, i.e. *B. glabra*, *B. spectabilis* and *B. peruviana*. The possible interspecific hybrids are as follows.

1. Glabra x *Spectabilis* - Mostly these are sterile, e.g. 'Sanderiana', in some cases pollen fertile & seed sterile.

2. Glabra x *Peruviana* (*buttiana*) - Mostly these are sterile, e.g. 'Mrs.Butt', 'Miss Manila' , 'Califonia Gold' and 'Lady Mary Baring' etc.

3. Spectabilis x *Peruviana*: Mostly are sterile, such as 'Mrs. H C Buck', 'Mary Palmer' and 'Thimma' etc.

Material and Methods

Based on the preliminary studies above, for conducting colchicine treatments, it is suggested that the selection of

cultivars should be from the *B. buttiana*, *B. spectoperuviana* group or other interspecific hybrids. It must be anallodiploid instead of autodiploid. The purpose of colchicine induction in Bougainvillea is mainly for restoring fertility from sterility. Cultivars from intraspecific hybrids, means both parents of a hybrid are of same species and they are normally fertile in diploid level. It has already normal gametes in hybridization and not necessary to do an induction and restore fertility again. If intraspecific hybrids are selected as material for chochicine induction, its autotetraploid (AAAA or BBBB) combination is normally face pairing trouble in meiosis, and lead to significant decrease on fertility. It is an important concept to know (Ohri and Zadoo, 1979).

Colchicine Induction - Effects of induction vary by species, variety, sorts and status of buds, concentration, duration, penetration enhancers, ways of treatment, free time, caring etc. All factors are in a highly dynamic and interactive relationship. There is no fixed formula, rules or steps that can be followed. Rather, breeder's own discretionary measures on the basis of knowledge and experience. Of course, lots of failures surely happen with no guarantee of achieving desired results and need repeated trial. The main factors involved are given below.

X1= Mutagens and penetration enhancer

X2= Concentration

X3= Duration of time

X4= Material plant

X5= Methods of treatment

X6= Buds selection

X7= Free time

X8= Background knowledge

X9= Care and experience

X10= Personality, characteristics of yourself

X11= Others

Survival/Lethal Dose vs. Conversion Rate

1. The higher concentration /under certain duration of time — —the lower survival rate / higher lethal rate and higher conversion rate.
2. The longer duration of time / under certain concentration— —the lower survival rate / higher lethal rate and higher conversion rate.
3. The longer times of solution touching the bud / the lower concentration needed.

Apical Meristem - Area L1/L2/L3

Tips of rapidly growing shoots have active cell duplication and division. It should be ensured that mutagens could penetrate area L1 and finally reach L2 and L3. The cell differentiation of pollen grains locate at area L2. If any success was got, it was commonly just was a partial effect only, difficult to be a complete effect of colchicine treatment in Bougainvillea. A chimera or mixploid will happen in case of partial effects.

Cell Cycle of Mitosis in Somatic Cell

Mutagens mainly function at certain period (interphase) in cell cycle of mitosis, influence and inhibit the mitotic spindle. Antimitotic agents must completely penetrate into L1/L2/L3 during an appropriate period of time. Otherwise, it will lead to ineffectiveness or partial effects, and would be difficult to be isolated to a complete tetraploid mother plants (Ninan *et al*., 1959).

Result and Discussion

No.1 Seedling of 'Tetra Imperial Thai Delight' x 'Tetra Sunvillea Cream'

Female parent of the seedling tetraploid and regaining fertility came from spontaneous mutation in Taiwan. The fertile pollens of male parent derived from a partial success, seemed just a flower has regained its fertility, in the beginning stage of colchicine induction conducted in late 2017. Just a seed collected in this hybridization.

Characteristics of the seedling inherited were compact, short inter-node and upright traits from male parent. The red color of the bract was not included in both color of parent, might be a throwback to ancestral trait of parent. Size of leaves shows character of tetraploid, larger than that of male parent. Most important thing was that the seedling still owned a good fertility and it was a fertile tetraploid. These were used in breeding in the current year and produced 20 seedlings having compact trait (Zadoo and Khoshoo, 1975).

No. 2 Compact Seedlings of No.1 bloomed in this Year

1. Seedling of 'Chitra' x 'No.1'

Chitra was a tetraploid seedling (2n=4x=68) of 'Tetra MrsMcClean' x 'Dr. B P Pal'. Therefore, this was also a tetraploid seedling and upon examination of its pollen grains by magnifier showed a very nice look. It should be fertile. Shape of leaves looks same with pixie, but size was larger. Pink color and elongated shape of bract were unique0

2. Seedling of 'No.1' x 'Tetra Lipstick'

'Lipstick' is a bi-colored, diploid and sterile cultivar in species *spectopruviana* group, isolated from *B. x spectoperuviana* 'Mary Palmer' in China. Fertility of the seedling was regained by colchiploid in 2019.

This is the 2nd in bloom of 20 compact seedlings of No.1. Color of the seedling is magenta, also color of 'Mrs.H.C.Buck'

- the beginner in spectoperuviana group. Shape of leaves are ovate inherited from 'Tetra Lipstick', while, sometime show lobed leaves should have influence from grand parent 'Tetra Imperial Delight'.

No. 3 Colchiploids in Spectopruviana Group

Fertility of four interspecific diploid cultivars in *spectoperuviana* group has been restored by chochiploidy which were developed.

1. Tetra Mrs. H C Buck
2. Tetra Ice Cream/Makris
3. Tetra Magic Ice Cream/Makris
4. Tetra Lipstick

'Mrs. H.C. Buck', is a hybrid of *B. peruviana* 'Princess Margaret Rose' and *B. spectabilis* 'Splendens'. 'Mary Palmer' is a bud sport of 'Mrs. H C Buck'. This was the beginning of bi-colored cultivars in the spectoperuviana group. There are some beautiful bi-colored mutants of 'Mary Palmer', such as 'Thimma', 'Lipstick', Ice Cream' and Shubhra'. There are some different cultivars with lipstick-like trait on bract is isolated from 'Mary Palmer' in different countries. For instance, 'Shubhra' was isolated in India, and my 'Lipstick' was isolated in China. 'Magic Ice Cream' ought to be a mutant of 'Thimma' instead of 'Ice Cream'. The colchiploid Dr. B.P.Pal is developed by Dr. Zadoo in India. 'Chitra' and 'Begum Sikander' are seedlings of it with 'Tetra Mrs.McClean' and 'Jennifer Fernie'. Except 'Dr. B P Pal', all other cultivars in the group are both pollen and seed sterile in breeding. If it is intended to use members of this group for hybridizations, its fertility must be regained first. That's the reason why it was needed to transfer the four cultivars into tetraploid by colchicine induction.

Relations diagram of cultivars in *spectoperuviana* group

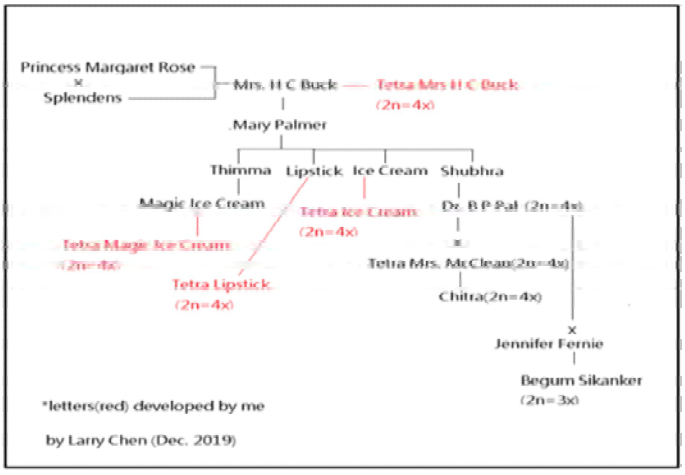

Figure: Four Cholchiploids Developed

As an amateur, who is lacking of precise equipment for ensuring ploidy level, may still make sure level of ploidy by:

1. Regaining of fertility and seed bearing.
2. Size and shape of pollen grains. Fertile tetraploid pollen grains will clearly like fish eggs and be larger than that of the corresponding diploid sterile cultivar.
3. Floral tube and the end of perianth (star).

The larger pollen grains in size will lead to a larger anther and the unopened star, normally the floral tube in size will be larger too (Pancho and Capinpin, 1961).

As to so-called Gigas effects, it's highly influenced by caring and growing in ground or pot, I'm used to grow my seedlings in 4 inches soft plastic pots, it's hard to see gigas effect from leaves.

Seedling of 'Chitra' x 'Tetra Lipstick'

Lots of seedlings were developed by hybridizing the four colchiploids and existing tetraploid cultivars, e.g. 'Chitra' and 'Tetra Imperial Delight'. It took two years, still waiting for blooming. Following two of them with unique traits are shown below (Figure – 1).

Figure – 1. Seedling of 'Chitra'x 'Tetra Lipstick' and malformed seedling

No. 4 New Chochiploid - 'Tetra Blondie'

'Blondie' is also known as 'Hugh Evans', an interspecific hybrid, sterile diploid (2n=2x) cultivar. A new chochiploid was planned which was induced from a sterile diploid cultivar and the diploid cultivar must be derived from seedling and is not a red or mutants from red one, to substitute the role of 'Chitra' in breeding.

After several trials for 2 years, colchicine induction for 'Blondie' was successful (Figure – 2).

Figure – 2. Pollen grains of 'Tetra Blondie'

No. 5 Seedling of 'Tetra Ice Cream' x 'unknown spectabilis'

Magenta color with purple or blue hue of this seedling own a curled leaves (Figure – 3). Its color probably inherited

Figure – 3. Seedling of 'Tetra Ice Cream' x 'unknown *spectabilis*'

from female parent. Male parent is a diploid (2n=2x) cultivar in *spectabilis*. 'Salmon' is its common name in Taiwan. It ought to be a triploid (2n=3x).

No. 6 Seedlings from other Colchiploids

Beside aforementioned chochiploids, some partial success was obtained on colchicine induction. They could provide fertile 2n gametes in breeding only one time but couldn't be isolated to an independent progeny, as given below.

1. *B. x buttiana* 'Monalisa Yellow'
2. Interspecific hybrid ' Poultonii'
3. Interspecific hybrid 'Sunvillea Cream'
4. Interspecific hybrid 'Miss Manila'
5. Interspecific hybrid 'Partha'

Hybridizing these 5 chochiploids with other teraploid cultivars, such as 'Chitra', 'Tetra Imperial Delight' and four cholchiploids in *spectoperuviana*, lots of 4x seedlings were developed. Most of them still to bloom for further studies.

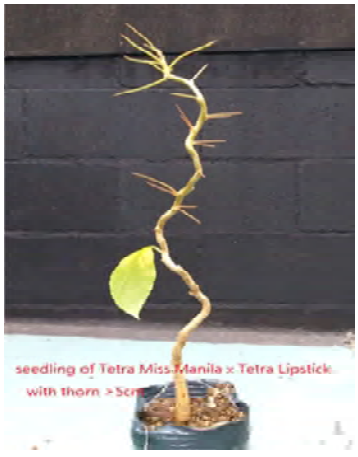

Figure: 4. Seedling of 'Tetra Miss Manila' x 'Tetra Lipstick'

No. 6-1 Seedling of 'Tetra Miss Manila' x 'Tetra Lipstick'

The female parent had partial effect of colchicine treatment. A few flower tubes on it provided fertile pollens and 3 seedlings were produced, two with 'Tetra Lipstick' and one with 'Chitra'. This is one of the three seedlings, with long thorns greater than 5 cm (Figure – 4).

No. 6-2 Seedling of 'Tetra Magic Ice Cream' x 'Tetra Partha'

The male parent in hybridization came from a partial effects, only one flower including three tubes could produce normal and fertile pollen. Total 3 seedlings developed, 2 with 'Tetra Ice Cream' and 1 with 'Tetra Magic Ice Cream' (Figure -5). The hybrid is completely different in shape, growth habit with soft texture of leaves but not yet bloomed.

Figure 5. Seedling of 'Tetra Magic Ice Cream' x 'Tetra Partha'

Conclusion

There is limited space for growing Bougainvillea species and cultivars in a city, specially for amateurs and beginners who like to take up development of new cultivars. It is difficult to collect and maintain too many fertile cultivars for breeding purpose. Furthermore, the choice of female and male parents is limited only to the few relatively fertile, which makes difficult to develop new cultivars. If sterile cultivars are converted into fertile to regain the fertility, this will bring more chances to produce variants. This kind of breeding work requires lot of knowledge about the fertility status of the cultivars, colchicines treatments and growing of plants (Banerji and Datta, 1967).

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Research Paper

Effect of plant growth regulator on flowering of *Bougainvillea*

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ABSTRACT

As an important ornamental flowering plant, the regulation of flowering of *Bougainvillea* is of vital significance. Through the research on the regulation of the flowering of *Bougainvillea*, timely on-demand flowering of *Bougainvillea* can be obtained so as to enhance its landscape value. In this experiment, the effects of different growth regulators on the flowering of *Bougainvillea* were investigated. Results showed that gibberellin (GA), ethrel (ETH) and paclobutrazol (PP333) had significant effects on the flowering time of *Bougainvillea.* Besides, the number of buds was significantly influenced by chlormequat chloride (CCC), mepiquat chloride and GA. These results of the experiment proved the beneficial effect of application of growth regulator for the regulation of the flowering of *Bougainvillea.*

Key words: plant growth regulator; *Bougainvillea*; flowering regulation

Introduction

Bougainvillea is native to Brazil, Peru, Argentina and adjoining countries (Roy *et al*. 2012). It has been introduced into China for more than 100 years, and has been domesticated as a native tropical and subtropical plant (Roy, 1987). *Bougainvillea* is an important ornamental flower and an excellent landscaping plant in tropical and subtropical areas. Therefore, flowering regulation is very important for blooming during festival.

Plant growth regulators can advance and extend flowering period by promoting germination and differentiation (Kende and Zeevaart, 1997; Nitsch, 1952). The commonly used flower regulators of *Bougainvillea* include paclobutrazol (PP333) and gibberellin (GA). These growth regulators can inhibit vegetative growth of plants, transform them into reproductive phase and produce flower buds, which are conducive to flowering. It dose of growth regulator is critical for inducing flowering. A too low dose cannot produce desirable results while a too high dose may cause adverse influence on plants and the environment. Therefore, different kinds of plant growth regulators were adopted in this experiment to observe their effects on the flowering of *Bougainvillea* and explore the optimal conditions for flowering regulation of *Bougainvillea*.

Materials and Methods

Bougainvillea with consistent vegetative growth having no pests and diseases, provided with good management of water and fertilizer, stable flowering for 1-2 years were collected as specimen plants for experiment from the germplasm collection base of Xiamen Botanical Garden. The collected specimens were randomly divided into groups and then numbered for experimental purpose. The flowering of the selected specimen plants was regulated by application of growth regulators.

In the experiment, all 7 groups of experimental materials were subjected to water control treatment. Among them, 6 groups of experimental materials were additionally sprayed with different concentrations of PP333, GA, ethrelÿETH), 6-BA, chlormequat chloride (CCC) and Mepiquat chloride, respectively, once every 7 days, for total 3 times, before observing the influences of growth regulators on flowering of *Bougainvillea*.

Results and Discussion

Effect of GA on Flowering of *Bougainvillea* - As an effective plant growth regulator, GA can promote plant growth and development, advance maturity, improve quality and increase yield (Claus, 2007). However, an excessive dose of GA will cause loss of greenness and excessive vegetative growth of plants, which will have a negative effect on the yield (Coombe, 1960). In order to explore its effect on the flowering of *Bougainvillea*, different concentrations of GA were sprayed on the plants.

The results showed that the spraying of GA can advance the flowering period of *Bougainvillea* but also caused an early withering of bracts / buds (Table -1). According to the statistics on the number of flower buds/ bracts in the

blooming stage, GA of different concentrations had adverse effects on the number of flower buds / bracts (Figure -1).

Table 1. Effect of GA on flowering time of *Bougainvillea*

Time (Days) / Treatments	To Squaring	To Early Flowering	To blooming	To Withering
Mock (Control)	5	13	32	-
50 ppm GA	4	13	25	-
75 ppm GA	4	12	23	-
100 ppm GA	4	12	24	30
200ppm GA	4	14	22	30

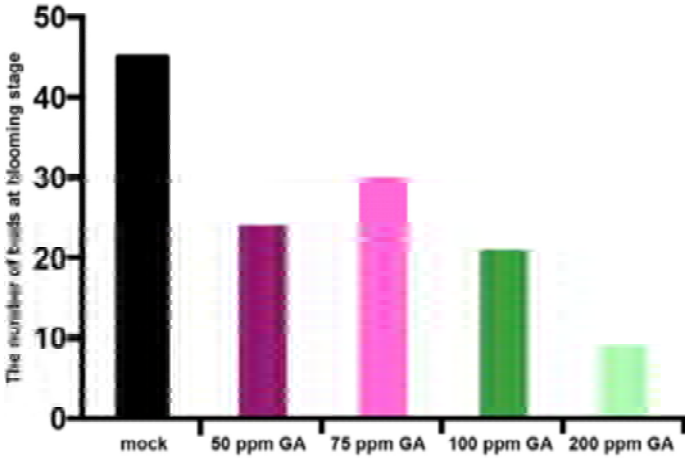

Figure - 1. Effect of GA on buds/ bracts of *Bougainvillea*

Effect of PP333 on Flowering of *Bougainvillea* - PP333 is a kind of growth regulator which can retard plant growth, restrain stem elongation and promote tiller growth (Navarro *et al*. 2007; Özmen *et al*. 2003). By spraying different concentrations of PP333, it was found that 300 ppm of PP333 could advance the flowering period of *Bougainvillea* by about 10 days (Table - 2). In addition, certain concentration of PP333 can promote flower bud differentiation (Figure - 2).

Effect of ETH on flowering of *Bougainvillea* - ETH is a common plant growth regulator, which can promote flowering, maturation, shedding and aging (Abeles *et al*. 1988;

Table 2. Effect of PP333 on flowering time of *Bougainvillea*

Time (Days) / Treatments	To squaring	To early flowering	To blooming
Mock (Control)	5	13	32
100 ppm PP333	4	14	30
200 ppm PP333	4	12	30
300ppm PP333	11	12	22

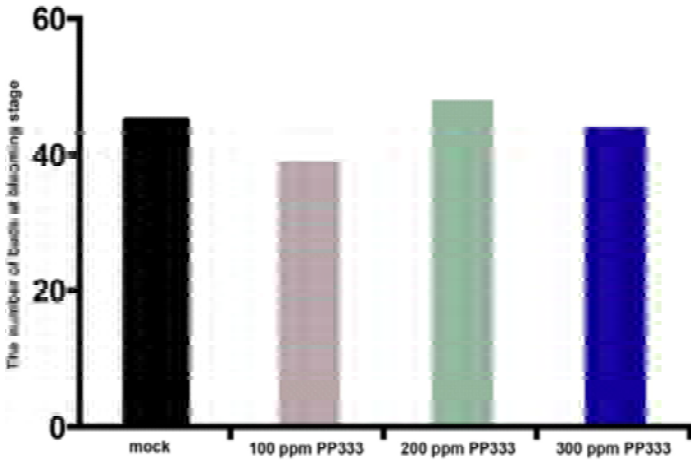

Figure - 2. Effect of PP333 on buds of *Bougainvillea*

Alonso *et al*. 2003; Li*et al*. 2013). By using different concentrations of ETH to treat *Bougainvillea*, it was found that low concentration of ETH could advance the blooming period of *Bougainvillea*, while high concentration of ETH could inhibit flowering, or even eliminating flowering with only vegetative growth (Table - 3). In addition, ETH has a certain inhibiting effect on the differentiation of flower bud of *Bougainvillea* (Figure - 3).

Table 3. Effect of ETH on flowering time of *Bougainvillea*

Time (Days) / Treatments	To Squaring	To Early Flowering	To Blooming
Mock (Control)	5	13	32
50 ppm ETH	4	15	26
70 ppm ETH	5	17	30+
90 ppm ETH	5	22	30+

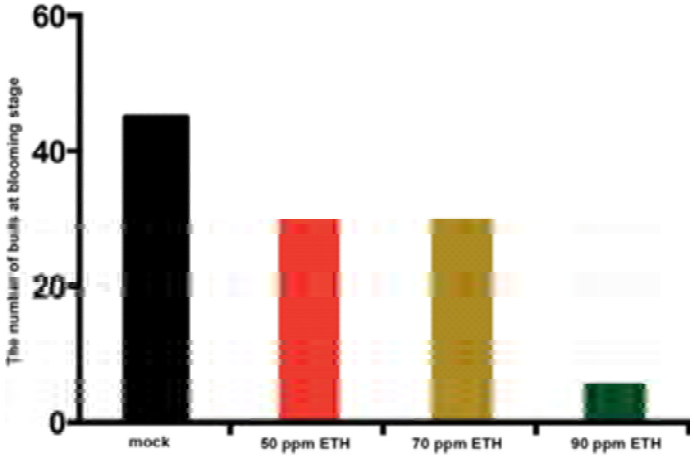

Figure – 3. Effect of ETH on buds of *Bougainvillea*

Effect of CCC on flowering of *Bougainvillea* - CCC is also a kind of plant growth regulator, which can inhibit cell elongation, make the plant shorter, stem thicker, leaves turn green (Welander, 1984). In order to study the effect of CCC on *Bougainvillea*, different concentrations of CCC were sprayed. It was found that the CCC had no significant effect on the flowering time, but a certain dose of CCC could increase the number of flower buds (Table - 4 and Figure - 4).

Table 4. Effect of CCC on flowering time of *Bougainvillea*

Time (Days) / Treatments	To Squaring	To Early Flowering	To Blooming
Mock (Control)	5	13	32
500 ppm CCC	3	12	31
600 ppm CCC	3	11	32
700ppm CCC	3	11	33

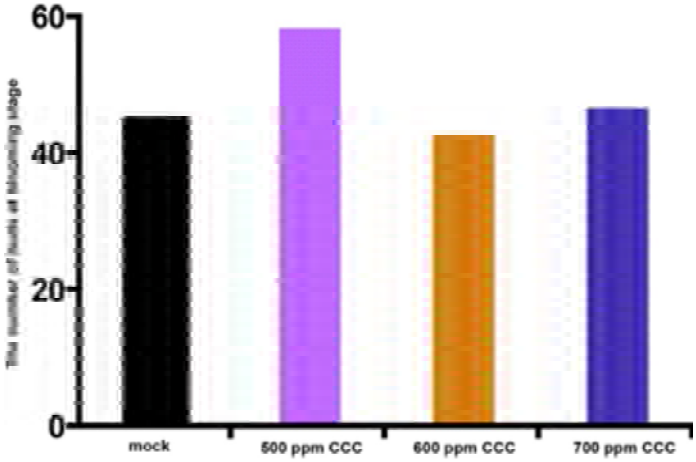

Figure – 4. Effect of CCC on buds of *Bougainvillea*

Effect of 6-BA on flowering of *Bougainvillea* - 6-BA is one of the most commonly used cytokinin growth regulators (Miller*et al*. 1956). By spraying different concentrations of 6-BA on *Bougainvillea*, it was found that 6-BA also had no significant effect on flowering time but inhibited flower bud differentiation (Table - 5 and Figure - 5).

Table 5. Effect of 6-BA on flowering time of *Bougainvillea*

Time (Days) / Treatments	To Squaring	To Early Flowering	To Blooming
Mock (Control)	5	13	32
400 ppm6-BA	4	11	31
500 ppm6-BA	2	13	32
600ppm6-BA	4	10	31

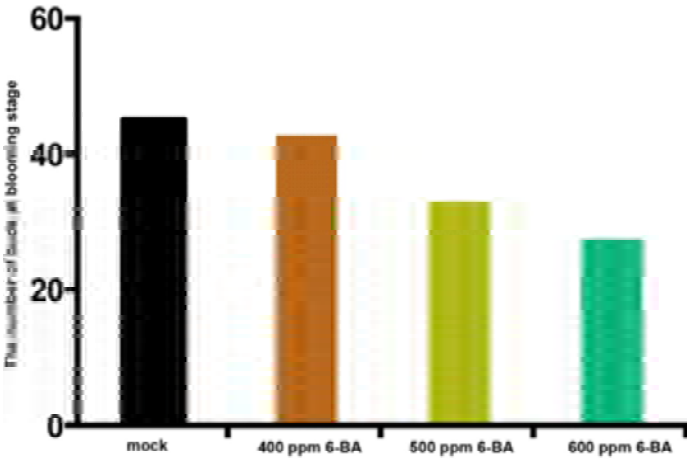

Figure – 5. Effect of 6-BA on buds of *Bougainvillea*

Effect of Mepiquat Chloride on Flowering of *Bougainvillea* - Mepiquat chloride is a newly-developed plant growth regulator. As an internal plant growth retarder, mepiquat

Table 6. Effect of Mepiquat chloride on flowering time of *Bougainvillea*

Time (Days) / Treatments	To Squaring	To Early Flowering	To Blooming
Mock (Control)	5	13	32
200 ppm Mepiquat chloride	5	13	32
300 ppm Mepiquat chloride	2	11	32
400 ppm Mepiquat chloride	4	12	32
500 ppm Mepiquat chloride	3	11	32

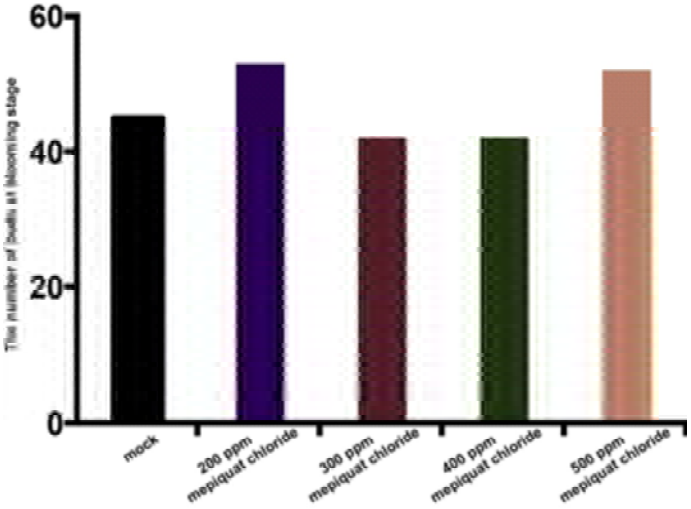

Figure - 6. Effect of Mepiquat chloride on buds of *Bougainvillea*

chloride can inhibit cell elongation, make the plant short and compact (Reddy *et al*. 1992; Zhao and Oosterhuis, 2000). Through spraying Mepiquat chloride, we found that certain concentration of Mepiquat chloride could promote the differentiation of flower buds, but had no obvious effect on the flowering stage of *Bougainvillea* (Table - 6 and Figure - 6).

Discussion and Conclusion

In this paper, the effects of different growth regulators on the flowering stage and the number of flower buds of *Bougainvillea* were investigated. By comparing the flowering time, it was found that GA, PP333 and ETH had a significant effect on the flowering stage of Bougainvillea, while CCC, 6-BA and Mepiquat chloride had no influence. Further analysis showed that the treatments that had significant effects on the flowering time of *Bougainvillea* were GA, PP333 (300ppm), ETH (50ppm) and ETH (> 70ppmÿwhich delayed blooming stage). The treatments that had significant effects on the number of flower buds / bracts of *Bougainvillea* were CCC and Mepiquat chlorideÿincrease the flower amount), GA, and ETH (reduce flower amount). In the next stage, we will further explore the effects of different combinations of regulators on the flowering of *Bougainvillea.*

Flowering regulation is the key technology for ornamental plants. This experiment analyzed the effects of different growth regulators on the flowering of *Bougainvillea*, which provided a possibility for further improving the ornamental value of *Bougainvillea* and offers theoretical basis for the deep analysis of the flowering mechanism of *Bougainvillea*.

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Research Round Up

Department of Floriculture and Landscape Architecture at Navsari Agriculture University, Gujarat, India - An Overview

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The Department of Floriculture and Landscape Architecture is steadily progressing at ASPEE College of Horticulture & Forestry. The major aim is imparting quality education in different aspects of Floriculture and Landscape Architecture, conducting research on different aspects of floriculture besides extension work for helping farming community.

GENESIS

- Navsari Agricultural University (NAU) was initiated by the Government of Gujarat with the enactment of GAUs act 2004 *w.e.f.* 1st May, 2004.
- ASPEE College of Horticulture and Forestry was established in November, 1988 at Navsari (Gujarat) under the approval of *Krishi* and *Gram Vikas Vibhag* of the Government of Gujarat.

MANDATE OF THE DEPARTMENT

Teaching

- UG & PG as well as guiding up to Ph.D. level.
- Coaching classes for SRF/JRF/NET Exam.
- Motivation of students for different projects.
- Certificate Course in Turfgrass Managemen.t
- Gardening and Landscaping Training Programme (*Mali Talim*).

Research

- Production technology of flower crops in open field.
- Production technology of flower crops under protected cultivation.
- Crop improvement in different flower crops.
- Varietal evaluation of different flower crops.
- Soilless cultivation of Ornamentals.
- Value addition through dry flower technology.
- Post harvest handling of flowers

Extension

- Participation in *Krishi Mahotsava* - a flagship programme of Govt. of Gujrat.
- Organizing flower exhibition-cum-competition, Farmers' training, *shibir* etc.
- Dissemination of technology / skill through Seminars, training and publications.
- Dissemination of knowledge on various aspects of vegetable crops through TV telecast and radio talks.

Projects of the Department

1. Establishment of Research Project on Floriculture (BH: 12046 – 1)

Objectives

- Collection, maintenance and evaluation of germplasm of ornamental crops
- Introduction of new flower crops
- Crop improvement
- Standardization of agro techniques in different flower crops

2. Establishment of Practical Training Centre Hi-tech Horticulture for Horticulture Students:

Objective

- To impart training to the UG & PG students of Hi tech horticulture

3. **Advanced Technology Centre of Soilless System for Production of Various Crops**

Objectives

- To Standardize Soilless cultivation technology for different flower and vegetable crops

- To obtain quality flowers under soilless system
- To develop grafting technology in various crops for quality production
- To impart training to UG & PG Students on different aspects of hydroponics technology in various horticultural crops

4. Landscaping and Gardening Training Programme (*Mali Talim*)

Objectives

- To impart training for the skilled Gardener

5. Model Nursery for Ornamental plants

Objectives

- Multiplication and maintenance of different flower crops
- To develop production technology for high value and other flower crops.
- Strengthening of P.G. research

6. Experiential Learning Program on Hi- Tech Protected Cultivation of Horticultural Crops

Objectives

- To train the students through experiential learning in crop management under protected cultivation of flowers like gerbera, rose, orchids and their post harvest handling and value addition
- To develop entrepreneurship skill in the students

7. Certificate Course in Turfgrass Management (BH: 9510- N - 83)

Objectives

- Develop professional skill in field of turfgrass management

8. All India Coordinated Research Project on Floriculture

Objectives

- Crop improvement; Development of package and practices for flower crops; value addition in floriculture.

SALIENT ACHIEVEMENTS

Varieties Developed and Released at CVRC

Crop: *Adenium obesum*

G. Ad. - 1

Adenium variety Gujarat Adenium-1 is novel ornamental plant bearing attractive multi-petalous red colored flowers with good flower longevity. It is developed by hybridization followed by clonal selection. It can be propagated by grafting on local pink root stock. The nurserymen dealing with ornamental plants are advised to grow Adenium G.Ad.-1 under polyhouse for higher commercial value.

G. Ad. - 2

Adenium variety Gujarat Adenium-2 is novel ornamental plant bearing reddish purple colored flowers having dual whorls in each flower along with good flower longevity. It is developed by hybridization followed by clonal selection. It can be propagated by grafting on local pink root stock. The nurserymen dealing with ornamental plants are advised to grow Adenium G.Ad.-2 under polyhouse for higher commercial value.

TECHNOLOGY RECOMMENDATIONS

A) Production Technology of Flowers in open field

1. Tuberose

- The tuberose crop cv. Double should be grown at distance of 45 x 15 cm and manured @ 50 FYM/ha as a basal dose.
- Variety Prajwal among single type and variety Suvasini among double type should be planted for quality cut flower production to get 171.22% and 127.29% higher net realization, respectively over local single and double varieties.

- Tuberose should be planted on raised bed of 90 cm width and 15 cm height in 3 rows along with 15 ton FYM/ha/year +. RDF 300-200-100 Kg N, P_2O_5, K_2O / ha. (application of nitrogen in four equal splits at 3 months interval per year) for qualitative as well as quantitative spike production up to three years after planting.

2. Marigold

- Marigold growers are advised to apply 200kg N/ha in two equal splits at basal and at the pinching time which should done 30 days after transplanting. The P and K each @ 50 kg/ha and FYM @ 15 t/ha should be applied as basal.
- French marigold seedlings should be transplanted in first week of July to first week of August for higher flower production, better quality and economic return.
- African marigold seedlings should be transplanted in first week of July to first week of August for higher flower production, better quality and economic return.

3. Rose

- Rose cv. Gladiator and Shew Berry Shows are found superior to other varieties for good quality cut flower production in open field.

4. Spider Lily

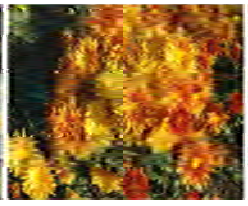
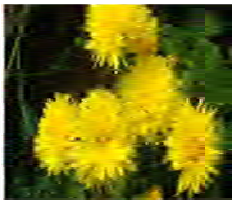
- Spider lily crop should be planted at 75 x 30 cm and fertilized it with 200 kg N/ha in four equal splits i.e. at basal and at 3 months interval thereafter the P and K @ 200 kg/ha and FYM @ 20 t/ha should be applied in the beginning of monsoon.
- The crop should be given 30 t FYM + 300 kg nitrogen + 225 kg phosphorus per hectare per year. FYM should be applied in June while nitrogen and phosphorus should be applied in four equal splits at three months' interval during June, September, December and March.
- The crop should be defoliated in 1st week of May and subsequently applied with 13-00-45 (NPK) @ 1.5 % (15 g/l) through foliar application as first spray when plant attain 30-45 cm height after de-leafing and second spray 15 days after first foliar application along with recommended dose of fertilizers (300:225:200 kg NPK/ ha) should be given for getting higher production of flower buds as well net realization.


5. Jasmine

- The farmers are advised to plant Mogra (*Jasminum sambac*) at 1 x 1 m distance and fertilized with 150 g N/ plant along with 5 kg FYM 60 g P and 60 g K per plant.
- Long budded double flowered Barmasi Mogra should be cultivated for 44.53 % higher flower production as compared to single type Deshi Local variety (Local check).

6. Chrysanthemum

- Chrysanthemum variety Ratlam Selection (white) is recommend for growing for higher market demand due to white colour and good quality. Moreover, there is market demand for yellow and red colour which can be met by growing Red Gold (red) and CS-16 (yellow) varieties which produce better quality flowers.Ratlam Selection Red Gold (red) CS-16
- The farmers growing Chrysanthemum variety ' Ratlam Selection' are advised to apply 150-100-100 kg NPK/ ha along with FYM @ 10 t/ha/ Full dose of phosphorus, potassium and half dose of nitrogen should be applied as basal dose whereas, remaining half dose of nitrogen should be applied after 30 days of transplanting for obtaining maximum return and yield.

Ratlam Selection Red Gold (red) CS-16

7. Gladiolus

- The farmers cultivating flower crops are advised to grow Gladiolus variety Sancerre (white) for qualitative as well as quantitative cut spike production. However, if the farmers wish to grow other coloured varieties according to market demand, varieties like Punjab Dawn (peach with red throat), Pricilla (whitish pink), Shagun (cream)

Psittacinus Hybrid (Saffron with yellow throat), Gunjan (light peach), and American Beauty (pink) are also recommended for quality flower production.

- The farmers growing gladiolus are advised to dip gladiolus corms in microbial consortium solution (10 ml /l water) for one hour and dry under shade then use for planting. Apply 75 % of RDF (150-150-150 kg NPK / ha.), P and K as basal N in two equal splits at 15 days and 45 days after planting which reduce 25% fertilizers cost and gives higher realization.
- The farmers of South Gujarat growing gladiolus are advised to spray Pendimethalin as pre-emergence herbicide @ 0.75 kg ha-1 (one day after first irrigation) + one HW at 50 DAP or follow hand weeding at 25, 50, 75 DAP for effective weed control and getting higher net realization and quality flowers. Sancerre Punjab Dawn Pricilla Shagun Psittacinus HybridAmerican Beauty.
- Fertilizer dose of 250: 150: 200 kg/ha NPK should be applied in gladiolus. Besides, well decomposed FYM @8 t/ha should be applied during bed preparation while half dose of nitrogen should be applied at 40 days after planting to produce maximum quality flower spikes with maximum net realization.

Sancerre | Punjab Dawn | Pricilla | Shagun | Psittacinus Hybrid | American Beauty

8. China Aster

China aster varieties like Arka Archana (white colour) for loose flowers and Phule Ganesh Pink (pink colour) and Phule Ganesh White (white colour) should be cultivated to get higher yield and net realization.

Arka Archana | Phule Ganesh Pink | PG WHITE

B) Production Technology of Cut Flowers under open Field and protected cultivation

1. Rose

- Rose cultivator are advised to grow the rose plants cv. Gladiator can be under 50% shade net and treat the plant with 3/4th dose of nitrogen (56.25 g N/plant) + 2g Azotobacter + foliar spray of BA 100 mg l^{-1} for getting better quality flower and higher economic return during both the winter and summer seasons. *Azotobacter* should be applied just after pruning. Nitrogen should be applied in two equal splits i.e. 7 days after pruning and 1 month after 1st dose. Foliar spray of BA 100 mg l^{-1} should be given 15 days after pruning. Common dose of P and K each at 25 g/plant and FYM 5 kg/plant should also be applied 7 days after pruning. The net should be removed in monsoon every year.
- The farmers cultivating roses under naturally ventilated poly-house are advised to grow Passion and First Red varieties for better quality and more yield.
- Farmers cultivating rose in polyhouse are advised to give foliar application of enriched banana psuedostem sap (Novel O.L.N. @ 2%) 2 times at 15 days interval from second week of November to obtain higher yield with better flower quality for higher net returns.

2. Gerbera

- The farmers growing gerbera under naturally ventilated greenhouse are advised to grow Mademoiselle and Dream varieties for higher yield with better quality and higher economic returns.

3. Heliconia

- Heliconia flowers (spike) cv. Golden Torch should be harvested at three bracts open stage for quality production. Further, florists (wholesalers and retailers) are also advised to spray GA3 100mg/l or BSA 50mg/l one day after harvest (two times at alternate day) to enhance vase life by almost double (two weeks) and better quality in terms of colour and freshness.
- *Heliconia stricta* variety Iris Bannochie (red) should be cultivated for qualitative as well as quantitative cut spike production. In addition, if the farmers wish to cultivate varieties with different colours and forms, according to market demand, varieties like Parrot Beak (red with yellow edges), Lobster Claw-II (orange-red), Pedro Ortiz (cherry red), *H. wagneria* "Red" (red), Orange (crimson) and Golden Torch (yellow) are also recommended for quality flower production. Heliconia

produces good quality flowers up to three years after planting under 50% green shade net.

- Different varieties of heliconia should be cultivated under 25% Agri -shade net house for getting higher yield of good quality cut flowers as well as higher benefit cost ratio.

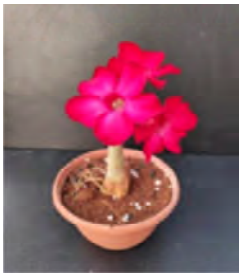
4. Orchid

Dendrobium orchid cultivated under naturally ventilated polyhouse should be given foliar spray of GA3@ 50 ppm at two months interval through out the year for getting higher spike yield better flower quality

C) Potted Ornamentals

5. Adenium

Nurserymen raising adenium as pot culture are advised to propagate by flat method of grafting using 2 cm length of mature scion on local root stock of one year old adenium under naturally ventilated polyhouse to obtain attractive plants.



6. Euphorbia

Nurserymen raising Euphorbia milii as pot culture under naturally ventilated polyhouse condition are advised to grow in soilless growing media containing cocopeat + coco chips + styrofoam (4:2:1) for better plant growth and good quality flowering.

D) Post-harvest Technology & Value addition in flowers

1. Tuberose

- Colouring/tinting technique by using edible dyes can be used for inducing different colours in tuberose for value addition. Thus, the treatment of immersion in edible dyes *viz*., carmosine red, sunset yellow and tetrazine blue solution at 0.3% concentration (3 g/l water) for 1 hour in tuberose cut spikes impart different shades of red, yellow and blue. Further, the vase solution treatment of 8-HQ at 300 ppm (300 mg/l) + 4% sucrose (40 g/l) improves floret opening and vase life.

Colouring of white flowers by using edible dyes

- Farmers growing tuberose for loose flower production are advised to dip florets for five seconds (quick dip) in 4 per cent boric acid (40 g boric acid dissolved in one litre warm water and cool it at ambient temperature) for improving postharvest life up to 24 hrs.

- Farmers and florists are advised to use 4 % (40 g/L) lemon yellow food dye with 1 hour immersion time for obtaining yellow colour in tuberose spikes to get additional income by tinting. Moreover, different food dyes viz. kesar yellow, kalakhatta, orange red, rose pink, raspberry red at 4 % concentration with 1 hour immersion time to be used for obtaining desired colour shades by tinting.

Kesar yellow (4%)

2. Rose

- Growers of Dutch Rose are advised to store using dry storage method with PP packaging (24 microns) for maintaining post storage quality and vase life. Using this technique cut roses can be stored for a period of 10 days without any deterioration in flower quality and flower opening as compared to wet storage.

3. Golden Rod

- The flower growers of Gujarat are advised to harvest golden rod panicles at fully mature unopened harvest stage to obtain better vase life. Further, the vase solution treatment of 0.02 % 8-HQ (200 mg/l) with 2 % sucrose

(20 g/l) can be used to further improve the overall flower quality and vase life up to 11 days.

4. Technology of Flower Drying

- Rose drying People interested in cottage industry based on dry flowers are advised to dry roses of variety Top Secret and Gold Strike using silica gel (60-120 mesh size) embedding method (850 g silica for 10 flowers) either with Microwave Oven (900 Watts, 30 L capacity, 1 day –drying time) or under room condition (7 days-drying time) to obtain good quality dry flowers having storage life of about 120 days.

- Drying technology in WeedsPeople interested in cottage industry and entrepreneurs are advised to use weeds for making dry flower products. Leaves of *Argyreia speciosa* can be dried in 7 days, inflorescence of *Celosia argentea and Setaria verticillata* in 5 days, Cyperus rotundus and Dinebra arabica in 4 days and Eragrostis pilosa in 3 days through press drying method at room temperature for use in dry flower products.

Seminars/Symposium/ Conference Organised by the Department

- National Symposium on "Recent Advances in Floriculture", 4-6, March-2008
- National workshop on "Floral Craft : The Art and Technique of Value Addition in Flowers", on 12-13 April, 2012
- National workshop on "Urban Periurban Horticulture" on 21 Dec 2013, NAU, Navsari
- State Level Seminar on "Value addition in Flower crops", December 2015
- International Conference on "Climate Smart Horticulture", held on 28th-31st May 2014, NAU, Navsari
- 2017-National Seminar on 'Awareness and Promotion of Dry Flower Exports and Industry in Gujarat', June 11 2017
- One day workshop on *"Phool Pakoni Aadhunik Kheti Paddhati"* 16 February, 2018

Training Programms Organised

- Winter School on Current Trends in Commercial Horticulture, December 1-21, 2013
- Skill Development Training on Floristry under Agriculture Skill Council of India, dated January 8 to 31 2018
- Skill Development Training on Protected cultivation under Agriculture Skill Council of India , dated August 28 to 30 September 2018

Exhibitions Organized

- Exhibition on Dry Flowers organized By Navsari Agricultural University, Navsari, Gujarat, June 11, 2017
- **Ornamental Plant Exhibition cum Sale** –year 2017, 2018 , 2019, 2020 to boost up students work under Experiential Learning and RAWE programm.

ELP Unit: Cultivation Practices in rose, gerbera and pot plants

Soilless growing system : Adenium, Haworthia and leafy vegetables

Exhibition on value addtion in flowers, 2012

National workshop-Floral craft-art and technique for value additon in flowers, April 12-13, 2012

National workshop on Urban Periurban Horticulture, Dec. 21, 2013

National Seminar 'Dry Flower Exports and Industry in Gujarat', June 11, 2017

Exhibition- Drying technology in Flowers, June 11, 2017

Skill Development Training, Floristy, January 8-31, 2018

Ornamental Plant Exhibition, Feb. 2-3, 2018

Skill Development Training, Protected Cultivation, August 27 to September 20, 2018

Ornamental Plant Exhibition, March 4-5, 2019

Exhibition- Flower Design: Ikebana and Contemporary arts, January 3, 2020

NEWS AND VIEWS

INTERNATIONAL

VIII International Conference on Landscape and Urban Horticulture
Catania (Italy)
February 16-18, 2021

ICAH 2020: 14. International Conference on Agriculture and Horticulture
March 19-20, 2020
Istanbul, Turkey

VIII International Symposium on Rose Research and Cultivation
Davis, CA, United States of America
April 18-22, 2021

14th International Conference on Agriculture and Plant Science
June 22-23, 2020
Sydney, Australia

II International Symposium on Tropical and Subtropical Ornamentals
Bogor, West Java, Indonesia
July 22 -24, 2020

15th International Conference on Agriculture & Horticulture
August 24-25, 2020
Barcelona, Spain

III International Symposium on Germplasm of Ornamentals
Seoul (Korea (Republic of))
October 25-28 , 2020

NATIONAL EVENTS

U.P. State Fruit, Vegetables & Flower Show,
February 23-24, 2020
Raj Bhavan Campus, Lucknow, Uttar Pradesh

Pusa Krishi Mela
February-March, 2020
ICAR-Indian Agricultural Research Institute
Pusa, New Delhi

Bougainvillea Festival by Bougainvillea Society of India
April 4-5, 2020
ICAR-Indian Agricultural Research Institute
Pusa, New Delhi

Bougainvillea Festival
April 13, 2020
CSIR-National Botanical Research Institute
R.P.Marg, Lucknow, Uttar Pradesh

National Horticultural Congress

The 9th Indian Horticulture Congress - 2020 is proposed to be held during this year from November 6-9, 2020 at Rajasthan Agriculture Research Institute, Jaipur of Sri Karan Narendra Agriculture University, Jobner, Rajasthan to be organized by The Academay of Horticultural Science (Formerly The Horticulture Society of India, New Delhi)

Views

"The Journal of Greens & Gardens published by Roy's Greens & Gardens, Lucknow is an excellent journal which covers all aspects of Floricultural research & landscaping. Reputed national and international scientists and researchers have been publishing their research work in this journal. I appreciate the efforts for publication of this journal and wish a grand success".

- Dr. R.P. Singh, Former, Director, Directorate of Food Processing & Horticulture, Govt. of Uttar Pradesh.

"I have gone through the Journal of the Greens & Gardens published by Roy's Greens & Gardens, Lucknow. There is no such journal in India exclusively on Floriculture & Landscaping which publish scientific research papers. The quality of the papers published is excellent contributed by renowned scientists / researchers from India and abroad".

- Dr. Diwakar Kumar, Retd. Principal Chief Conservator of Forests, Uttar Pradesh.

"The Journal of Greens & Gardens published by Roy's Greens & Gardens, Lucknow is a reputed journal in the field of floricultural research & landscaping. The quality of the papers published very good highlighting various aspects. Scientists, researchers and others from relevant field will be benefitted from the journal".

- Prof. R.B.Ram, Dean, School of Agricultural Sciences & Technology, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh.

"This journal has become a leading journal in the field of floriculture and landscaping. Scientists and researchers from India and abroad have been publishing their research results from the related subjects in this journal. Contents and quality of papers are diverse covering important research topics and very informative. I wish all success of the journal."

- Prof. S.K. Barik, Director,
CSIR-National Botanical Research Institute, Lucknow, U.P.

BOOK REVIEW

Ornamental Climbers

The book "Ornamental Climbers" is a comprehensive book on climbers usually grown in the tropical gardens. It contains 8 chapters on various aspects viz. classification on the basis of growth habit, flower and use in the gardens. Moreover, information on climbing mechanism and habit has been provided. Description of 65 genera and 109 species of Climbers belonging to different families highlighting their growth habit, flower colour, season of flowering etc. have been furnished precisely to know the details of each species and varieties. Growing tips detailing soil requirement, pit, planting manuring including care and maintenance have been mentioned. Various ways of using climbers in the garden have also been provided along with illustration and images. A list of 167 species of climbers with proper nomenclature has been included.

The information provided in this book is based on scientific inputs derived from various sources of national and international journals, books, web source supplemented by studies and observations made on live plants by the authors.

Therefore, this book will serve as reference text book on Climbers specially on identification, gardening and landscape use for the students, amateur gardeners and others.

"A Guide Book – Home Gardening

The topic home gardening is very popular among common people and a subject of interest for all. We like to grow ornamental plants in and around our home in various forms for beautification purpose. The Book titled "**A Guide Book – Home Gardening**" is a comprehensive book on home gardening containing technical and practical information. Useful information on various aspects of home gardening has been provided in simple and concise manner. It contains 22 chapters on designing and layout, structures and features, care and maintenance, roof garden and vertical garden, rock garden and pool, hedge and edge, annuals and perennials, bulbous and rhizomatous plants besides other important plant groups *viz*. trees, shrubs, climbers, bougainvilleas, roses, cacti and succulents, chrysanthemums etc. As a whole, the book provides all relevant information required for the development and maintenance of home gardens including source of plants, seeds and sundries.

The information provided in this book is based on scientific inputs obtained from various sources beside practical experience of the author. Efforts made to present the subject in simple way keeping in view its usefulness and practical applicability. Therefore, this book will be useful for amateur persons who likes to develop their own gardens in homes besides all others who are interested in home gardening including students who need a text book on the subject.

GUIDELINES TO AUTHORS

General

'**The Journal of the Greens & Gardens'** is a research journal in the field of Floriculture Science and Landscaping for the publication of research papers from Indian / foreign Scientists / Professors / Research Scholars. In addition, invited research papers / review papers from reputed Scientists from institutes of India / abroad are also included. It is a quarterly journal published in April, July, October and January of every year.

Manuscript

1. Full Length papers (MS Word, 12 font, Arial)

   Title – Should be brief, specific highlighting the work done and results. Each word capitalized and scientific / Botanical names in Latin – italic.

   Name & Address – Name(s) of the author (s) and address of the institute / university should be mentioned below the title followed by E. mail address of the corresponding author.

   Abstract – Clearly written mentioning the objectives, methods, results and conclusion within 150 words**.**

   Key Words – Five key word indicating main content of the paper and abstracting purpose.

   Main Text – This should be well written about the research work done under following headings – INTRODUCTION, MATERIALS & METHODS, RESULTS & DISCUSSIONS, CONCLUSION, ACKNOWLEDGEMENT.

   Tables – In separate page with proper title, headings and sub-headings in numerical data followed by statistical evaluation, if any.

   Figures / Line Drawings / Images – As per requirement of the paper for proper clarification purpose with appropriate captions, units etc.

   References – All references should be arranged/ cited by authors' name and alphabetically. Multiple reference of the same author is to be arranged chronologically. Names of the journal should be abbreviated following the pattern of World List of Scientific Periodicals, London. Following templates should be followed.

   - 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.

2. Short Communications

The format is same as full length papers. The abstract should be restricted to 50 words and rest of the text in summarized form but well communicated about the topic. Illustration as per requirement.

Submission of Manuscript

By E. Mail only, addressed to Chief Editor of the Journal (editorgreensgardens@gmail.com / edtflorisci@gmail.com)

Acceptance of the Paper: The decision of the Editorial Board and Chief Editor is final and binding to the contributors. The papers will be reviewed by experts from the relevant field before acceptance.

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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.
- Publication of scientific journals / books / bulletins on greens and gardens to serve scientific community in wider perspective.
- 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.

Urban Green Space

Flower Markets