

Morphological description of *Bougainvillea* varieties based on DUS Test characters

Shilpi Singh*, R.K. Roy, Rajat R. Rastogi, Satish Kumar and S. Chandra¹

Botanic Garden, CSIR-National Botanical Research Institute, Lucknow (U.P.). ¹SSJ Campus (Almora), Kumaun University, Nanital (Uttarakhand). *E-mail: ss_lifescience@yahoo.com

Abstract

The experiment was carried out during 2012-13 and 2013-14 to estimate the morphological variability of 25 Indian *Bougainvillea* varieties at Botanic Garden, CSIR-National Botanical Research Institute, Lucknow for 28 morphological traits. The variegated varieties viz., Dr. P.V. Sane, Abhimanyu and Los Banos 'Variegata' showed a unique tertiary leaf blade colour. Out of the 25 varieties, seven varieties had elliptic leaf blade shape while 13 varieties had medium ovate. Nine varieties had variegated leaves and rest were non-variegated. Only three varieties viz., Los Banos 'Variegata', Los Banos Variegata 'Silver Margin' and Pallavi had multiple bracts and flowers were absent. Bracts colour also had a wide variation from light colour (white) to dark colour (magenta). The results suggest that the characterization data of these varieties can be used as a reference for registration of other new varieties under PPV&FR Act, 2001. This investigation may also be helpful to the researchers with respect to breeding of *Bougainvillea* varieties for particular traits. Moreover, ornamental plant growers can also get benefited with regards to selection of suitable varieties of their interest.

Key words: *Bougainvillea*, characterization, DUS Test, evaluation, varieties

Introduction

The genus *Bougainvillea* (family - Nyctangineace) is a native of tropical and sub-tropical regions of South America (Golby, 1970). *Bougainvillea* is a most popular ornamental plant and used for landscaping in various ways. They are grown all over the world mainly for their colourful bracts. Due to the high popularity and intense use in the tropical countries, they are called 'Glory of the Tropics' (Pal and Swarup, 1974). The *Bougainvillea* have eighteen species but mainly four species namely *B. glabra*, *B. buttiana*, *B. spectabilis* and *B. peruviana* are used for ornamental purpose as garden plant.

In India, use of *Bougainvilleas* in ornamental gardening beside as a plant for decoration of avenues is very rampant. However, the season of flowering and intensity vary with a great magnitude. *Bougainvilleas* adorn every region of India with their colourful bracts and mass blooming. Southern India comprising of Bangalore, Mysore, Chennai and Hyderabad have favourable agro-climatic seasons. Profuse blooming takes place during February to April and August to October in succession and profusion. Similarly, Pune, Nasik, Nagpur, Bombay regions of Western India usually have extended blooming in flashes round the year due to the prevailing moderate climate in that region. As a whole, Eastern, Western and Southern India usually have extended blooming period in comparison to Northern India. Mass flowering of *Bougainvilleas* in Northern India (Delhi, Chandigarh, Patiala, Agra, Lucknow, Kanpur) and in adjoining areas usually takes place during March to May followed by pre-winter blooming in November to December. During very cool period (December end to January) due to low temperature and less availability of sunshine, *Bougainvilleas* remain almost dormant. The performance of *Bougainvilleas* with regard to growth and flowering is also appreciable in hilly regions. They

can be grown at a height of 1500-2000 metre above the sea level. Good flowering has been found in Solan, Shimla, Almora, Nanital and other northern hilly areas.

Bougainvillea is a hardy shrubby plant which has an alternate arrangement of leaves. Flowers are inconspicuous, tubular structure and attached to the showy heart-shaped bracts. Morphological characterization of 25 Indian *Bougainvillea* varieties was done on the basis of DUS (Distinctiveness, Uniformity and Stability) test guidelines. The characterization results will be useful for identifying the varieties and their use in ornamental gardening on the basis of morphological parameters (Zadoo *et.al.*, 1975; Zadoo *et.al.*, 1976; Sharma and Roy, 2000).

Materials and methods

A total of 25 Indian *Bougainvillea* varieties, viz. Abhimanyu, Aida Variegata, Aruna, Begum Sikander, Chitra, Dr. H.B. Singh, Dr. P.V. Sane, Dr. R.R. Pal, Gopal, Krumbiegel, Los Banos 'Variegata', Los Banos Variegata 'Silver Margin', Mahatma Gandhi, Manohar Chandra 'Variegata', Mary Palmer Special, Palekar, Pallavi, Partha, Parthasarthy, Shubhra, Shweta, Tetra Mrs. McClean, Vishakha, Wajid Ali Shah and Zakiriana 'Variegata' were evaluated at experiment site of Botanic Garden, CSIR-National Botanical Research Institute, Lucknow during 2012-13 and 2013-14.

These varieties were selected and tagged from the well grown specimen plants of the germplasm collection planted at a spacing of 3×5 m. The morphological characters identified for the study were - growth habit, young shoot colour, internodes length, thorn length, thorn curvature, thorn strength, leaf blade length, leaf blade width, leaf blade shape, leaf blade apex shape, leaf blade base shape, leaf blade main colour, leaf blade secondary colour, leaf blade pattern of secondary colour, leaf blade tertiary

colour, inflorescence length, arrangement of bract clusters in inflorescence, density of bract clusters in inflorescence, presence or absence of flowers, type of bract, bract length, bract width, bract shape, bract apex shape, bract base shape, bract main colour, bract secondary colour in inner side and star colour of upper side, (Roy and Sharma, 2002; Sharma, 1996). The observations were recorded on three plants in each replication at specific growth time. All the observations were recorded and interpreted according to DUS Test guidelines (Roy *et al.*, 2013).

Results and discussion

Morphological characterizations of 25 Indian *Bougainvillea* varieties was done following DUS Test guidelines. A considerable variation was observed for all the important traits under studies.

Growth habit, shoot and thorn characters: The growth habit, shoot and thorn characters are presented in Table 1. Growth habit was studied and categorized as semi-upright, upright,

spreading and drooping. Out of 25 varieties, eleven varieties of *Bougainvillea* had semi-upright type, eight varieties had spreading type, five varieties had drooping and one variety had upright growth habit. Young shoot colour varied from light green to reddish-green. Among the variegated varieties, five had light green, one had medium-green, three had reddish, fourteen had reddish-green colour besides one variety having pinkish green ('Dr. P.V. Sane') and one yellowish green with reddish blush (Zakiriana 'Variegata'). The length of internodes also varied from long to short. Three varieties had long, five varieties had short and seventeen varieties had medium internode length.

The thorn length, curvature strength and its density were studied. Out of 25 varieties, seven varieties had thorns of short length, fourteen varieties with medium length and four varieties showed long thorns. With respect to curvature, twenty varieties had straight and five varieties had slightly curved thorns. Thorn strength also had a variation from weak to strong. Four varieties

Table 1. Growth habit, shoot, thorn characters of *Bougainvillea* varieties as per DUS test guidelines

Varieties	Growth habit	Young shoot colour	Length of internodes	Thorn		
				Length	Curvature	Strength
Abhimanyu	3	1	5	7	1	2
Aida Variegata	3	3	3	3	1	2
Aruna	4	3	5	5	1	2
Begum Sikander	2	3	3	7	1	3
Chitra	2	4	7	7	1	3
Dr H.B. Singh	4	1	7	7	1	3
Dr. P.V. Sane	1	5	5	5	3	2
Dr. R.R. Pal	3	3	5	5	1	2
Gopal	2	3	5	3	3	2
Krumbiegel	3	3	5	3	1	1
Los Banos Variegata	4	1	3	3	3	1
Los Banos Variegata Silver Margin	3	4	5	5	1	1
Mahatma Gandhi	3	3	5	5	3	3
Manohar Chandra Variegata	2	3	5	5	1	3
Mary Palmer Special	2	3	5	5	1	2
Palekar	4	3	5	3	1	2
Pallavi	3	1	5	5	1	2
Partha	3	3	5	5	1	2
Parthasarthy	2	3	5	5	1	2
Shubhra	2	1	3	5	1	2
Shweta	4	2	5	3	1	2
Tetra Mrs. McClean	2	4	5	3	1	2
Vishakha	2	3	3	5	3	2
Wajid Ali Shah	2	3	5	5	1	2
Zakiriana Variegata	2	5	7	5	1	1
States	1 Upright 2 Semi-upright 3 Spreading 4 Drooping 5 Climbing	1 Light green 2 Medium green 3 Reddish green 4 Reddish 5 Pinkish green	3 Short 5 Medium 7 Long	3 Short 5 Medium 7 Long	1 Straight 3 Slightly curved 5 Fully curved	1 Weak 2 Medium 3 Strong

Table 2. Leaf blade characters of *Bougainvillea* varieties as per DUS test guidelines

Varieties	Leaf Blade								
	Length	Width	Shape	Shape of apex	Shape of base	Main colour	Secondary colour	Distribution of secondary colour	Tertiary colour
Abhimanyu	5	5	4	1	4	6	3	2	9
Aida Variegata	5	5	2	2	3	5	5	5	1
Aruna	5	5	2	2	3	5	1	1	1
Begum Sikander	7	5	2	2	2	5	1	1	1
Chitra	7	7	5	2	3	6	1	1	1
Dr H.B. Singh	7	5	4	1	2	5	1	1	1
Dr. P.V. Sane	7	5	2	2	4	5	2	5	9
Dr. R.R. Pal	5	5	2	2	3	5	1	1	1
Gopal	7	5	2	2	3	5	1	1	1
Krumbiegel	5	5	4	2	2	5	1	1	1
Los Banos Variegata	5	5	3	2	3	6	3	3	9
Los Banos Variegata Silver Margin	5	7	3	2	3	5	5	2	1
Mahatma Gandhi	7	5	2	2	3	5	1	1	1
Manohar Chandra Variegata	7	5	2	2	4	5	5	4	1
Mary Palmer Special	5	7	3	2	3	6	1	1	1
Palekar	5	5	4	1	2	5	1	1	1
Pallavi	5	5	2	1	2	5	7	3	1
Partha	5	5	4	2	2	5	1	1	1
Parthasarthy	7	5	4	1	3	5	3	5	1
Shubhra	7	5	2	1	3	5	1	1	1
Shweta	7	5	1	1	2	6	1	1	1
Tetra Mrs. McClean	7	5	2	2	3	5	1	1	1
Vishakha	5	5	4	2	2	5	1	1	1
Wajid Ali Shah	5	5	2	2	4	4	1	1	1
Zakiriana Variegata	7	5	2	2	4	5	3	6	1
States	3 Short 5 Medium 7 Long	3 Narrow 5 Medium 7 Broad	1 Lanceolate 2 Medium ovate 3 Broadly ovate 4 Elliptic 5 Circular	1 Acuminate 2 Acute 3 Obtuse 4 Others	1 Attenuate 2 Acute 3 Obtuse 4 Others	1 Yellowish white 2 Yellow 3 Yellowish green 4 Light green 5 Medium green 6 Dark green 7 Very dark green 8 Grey green	1 None 2 White 3 Yellowish white 4 Yellow 5 Light green 6 Medium green 7 Dark green 8 Very dark green 9 Grey green	1 Absent 2 Narrow-marginal 3 Broad 4 Around midrib 5 Speckled 6 Irregular	1 None 2 White 3 Yellowish white 4 Yellow 5 Light green 6 Medium green 7 Dark green 8 Very dark green 9 Grey green

Table 3. Inflorescence, bract and flower characters of *Bougainvillea* varieties as per DUS test guidelines

Varieties	Inflorescence				
	Length	Arrangement of bract clusters	Density of bract clusters	Presence of flowers	Type of bract
Abhimanyu	3	2	5	9	1
Aida variegata	3	1	7	9	1
Aruna	5	3	5	9	1
Begum Sikander	3	2	3	9	1
Chitra	5	2	5	9	1
Dr H.B. Singh	7	2	7	9	1
Dr. P.V. Sane	5	2	5	9	1
Dr. R.R. Pal	5	2	5	9	1
Gopal	5	3	7	9	1
Krumbiegel	5	2	3	9	1
Los Banos Variegata	3	1	7	1	3
Los Banos Variegata Silver Margin	5	2	7	1	3
Mahatma Gandhi	5	2	5	9	1
Manohar Chandra Variegata	3	2	7	9	1
Mary Palmer Special	5	3	5	9	1
Palekar	3	1	5	9	1
Pallavi	5	2	7	1	3
Partha	3	1	5	9	1
Parthasarthy	5	2	3	9	1
Shubhra	7	3	5	9	1
Shweta	7	3	7	9	1
Tetra Mrs. McClean	3	2	3	9	1
Vishakha	7	3	5	9	1
Wajid Ali Shah	3	1	5	9	1
Zakiriana Variegata	3	2	3	9	1
States	3 Short 5 Medium 7 Long	1 Terminal 2 Axillary 3 Axillary and Terminal	3 Sparse 5 Medium 7 Dense	1 Absent 9 Present	1 Single 3 Multiple 5 Double

showed weak strength, sixteen varieties had medium and five varieties showed strong strength.

Leaf characters: The leaf characters *viz.*, leaf blade shape, size and colour are presented in Table 2. The leaf blade length was medium in thirteen varieties whereas long leaf blade was recorded in twelve varieties. None of the varieties had small leaves. Similarly, leaf blade width showed variation in which three varieties had broad and twenty two varieties had medium width. Shape of leaf blade also showed variation from lanceolate to circular. Shweta had lanceolate leaves, while Chitra had circular. Three varieties had broadly ovate shape, seven varieties had elliptic and thirteen varieties were medium ovate. Apex shape of leaf blade in seven varieties had acuminate and eighteen had acute and none was found obtuse and other type shapes. Base shape of leaf blade in eight varieties had acute, twelve varieties obtuse and five varieties had other and none had attenuate base shape.

Leaf colour of the all 25 varieties was studied and recorded. The colour of the leaves ranged from light green to very dark green while some varieties had yellowish-green leaves. Light green leaf

colour was found in Wajid Ali Shah, while Abhimanyu had grey green colour. Four varieties showed dark green leaf colour namely Chitra, Los Banos Variegata, Manohar Chandra 'Variegata' and Shweta and nineteen varieties showed medium green colour. Secondary colour of leaf blade was found only in nine varieties in which four varieties had yellowish white colour, three varieties had light green in colour, one had white colour and one variety had dark green colour. The distribution patterns of secondary colour in these nine variegated varieties were narrow marginal in Abhimanyu and Los Banos Variegata 'Silver Margin'. Broad Marginal pattern was observed in Los Banos 'Variegata' and Pallavi while around mid-rib in Manohar Chandra 'Variegata'. Aida Variegata and Dr. P.V. Sane had speckled pattern while Zakiriana 'Variegata' had irregular. Tertiary colour of leaf blade (Grey green) was found in three varieties Abhimanyu, Dr. P.V. Sane and Los Banos 'Vareigata' (Datta and Banerji, 1990).

Inflorescences characters: The inflorescences characters *viz.*, length, arrangement of bract clusters, density of bract cluster, types of bracts and presence of flower are presented in Table 3. Length of inflorescence also varied from short to long. Ten

Table 3. Inflorescence, bract and flower characters of *Bougainvillea* varieties as per DUS test guidelines

Variety	Bract			Apex shape	Base shape	Main colour	Secondary colour	Star: Colour of upper side
	Length	Width	Shape					
Abhimanyu	7	5	2	3	3	6	-	2
Aida variegata	5	5	3	2	3	5	-	2
Aruna	5	5	2	1	2	4	-	2
Begum Sikander	7	5	3	2	3	1	6	2
Chitra	5	7	3	2	3	5	2	3
Dr H.B. Singh	5	5	2	1	3	8	-	3
Dr. P.V. Sane	5	5	2	1	3	6	-	2
Dr. R.R. Pal	5	5	2	1	3	6	-	2
Gopal	5	5	2	2	3	5	-	2
Krumbiegel	5	5	3	1	3	5	-	3
Los Banos Variegata	3	5	2	1	2	6	-	-
Los Banos Variegata Silver Margin	3	5	1	1	2	6	-	-
Mahatma Gandhi	7	7	3	2	3	6	-	2
Manohar Chandra Variegata	5	5	2	2	3	6	-	1
Mary Palmer Special	5	5	3	1	2	1	6	3
Palekar	5	5	2	1	2	6	-	2
Pallavi	3	3	1	1	2	4	-	-
Partha	5	5	2	1	3	6	-	2
Parthasarthy	7	5	2	1	2	6	-	2
Shubhra	5	5	2	1	3	1	-	3
Shweta	5	5	1	1	3	1	-	3
Tetra Mrs. McClean	5	7	4	2	3	9	-	7
Vishakha	5	5	2	2	3	6	-	2
Wajid Ali Shah	5	5	2	1	3	1	5	2
Zakiriana Variegata	5	5	2	2	3	9	-	2
States	3 Short 5 Medium 7 Long	3 Narrow 5 Medium 7 Broad	1 Narrowly Ovate 2 Medium Ovate 3 Broadly Ovate 4 Circular	1 Acute 2 Obtuse 3 Others	1 Acute 2 Obtuse 3 Cordate	1 White 2 Yellow 3 Orange 4 Magenta 5 Pink 6 Red 7 Mauve 8 Purple 9 Others	1 White 2 Yellow 3 Orange 4 Magenta 5 Pink 6 Red 7 Mauve 8 Purple	1 White 2 Creamy 3 Greenish yellow 4 Yellow 5 Red 6 Pink 7 Orange

varieties had short length, eleven varieties had medium length and four varieties had long length. Mainly, three types of arrangement of inflorescence on the branches were recorded. Axillary type was found in fourteen varieties, axillary and terminal found in six varieties and terminal found in five varieties. Density of bract cluster in the inflorescence showed variations. As recorded, five varieties showed sparse density, twelve varieties showed medium density and eight varieties showed dense density of bract clusters. In this study, three varieties showed absence of flower due to presence of multi-bracts and twelve varieties produced flowers due to single bract.

Bracts and flower characters: The bracts and flower characters viz., length, width, shape, apex shape, base shape, main colour, secondary colour and star colour are presented in Table 3. Bracts are important characteristic for identification purpose and for

distinguishing a new variety from the parent. Length of bract was long in four varieties while seventeen varieties had medium and three varieties had small length. Width of bract also showed variation: three varieties had broad and twenty two varieties had medium width. Shape of bract also varied from narrowly ovate to circular. One variety had circular shape (Tetra Mrs. McClean), three varieties had narrowly ovate shape, fifteen varieties had medium ovate shape and six varieties were broadly ovate in shape. Apex shape of bract of the fifteen varieties was acute in shape, seven had obtuse apex and one variety was in other category. Base shape of bract in seven varieties had obtuse; eighteen varieties showed cordate base shape and none varieties were found for acute and other category in bract base shape

Bract colour is an important characteristic as the varieties are distinguished on that basis. Bracts colour showed much variation.

Four varieties had double colour and twenty one had single colour. One variety was mauve in colour, two varieties orange in colour, four varieties were magenta in colour, five varieties were white in colour and eleven varieties were pink in colour. Flower star found in only single bracted varieties. It was absent in multi-bracted varieties. Colour of the stars also varied. Creamy colour of star found in fourteen varieties, greenish-yellow colour of star found in six varieties, orange in one variety and white in one variety (Kumar *et.al.*, 2009; Prasad *et.al.*, 2006; Gupta, *et.al.*, 2006).

Morphological characterization is important for establishing true identity of any new or existing variety of ornamental plants for the purpose of registration and deriving commercial benefit as per PPV & FR Act, 2001. Morphological characterization data of 25 Indian *Bougainvillea* varieties will be helpful in DUS testing.

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