Online www.hortflorajournal.com ICV: 27.39; GIF: 0.364

HortFlora Research Spectrum, 2(2): 139-144 (April-June 2013) ISSN : 2250-2823

MULTIPLICATION OF BOUGAINVILLEA CV. TORCH GLORY THROUGH SHOOT TIP CUTTING UNDER MIST CHAMBER

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ABSTRACT: The experiment was conducted under mist chamber at Horticulture Research Centre, HNB Garhwal University, Chauras Campus Srinagar (Garhwal), Uttarakhand. The different length stem cuttings (20, 35 and 50 cm) of Bougainvillea cv. Torch Glory treated with IBA solutions at 3000, 4000 and 5000 mg L^{-1} by quick dip method were planted carefully in the root trainers. Among all the treatments, maximum number of sprouted cuttings (90.0%) and maximum number of sprouts per cutting (30.22) were observed under C_1L_2 (35 cm long cuttings treated with 3000 ppm IBA) treatment, maximum length of sprout per cutting (3.25 cm) and maximum height of plant (63.86 cm) was found under C_1L_3 (50 cm long cuttings treated with 3000 ppm IBA), maximum diameter of sprouts per cutting (0.74 cm) was recorded under C_3L_1 (35 cm long cuttings treated with 5000 ppm IBA). Number of leaves on new growth (7.48) was found maximum under C_3L_3 (50 cm long cutting treated with 5000 ppm IBA), length of longest root (9.90 cm) was maximum under C_2L_3 treatment (50 cm long cutting treated with 4000 ppm IBA), profuse callus formation (77.77%) was found in C_1L_1 treatment (50 cm long cutting treated with 3000 ppm IBA) and secondary rooting (77.77%) was found better under C_1L_2 and C_1L_3 (35 cm and 50 cm long cuttings treated with 3000 ppm IBA) treatments.

Keywords: *Stem cutting, IBA, bougainvillea, rooting percentage, mist chamber.*

Bougainvillea, a native of South America, was discovered in 18th century by the French botanist Commerson, at Rio de Janeiro, Brazil, who named it after Lois Antoine de Bougainvillea, the French navigator with whom he went on a voyage round the world during 1766-1769. Now it has dominated in Indian gardens from northern hilly region to southern parts of the country and from east to west in short span of time due to its floriferous nature, recurrent blooming and least incidence of insect and diseases (Stoltz and Andersen, 23). Bougainvillea, belonging to the family Nyctaginaceae, has ten species (Heimerl, 10) but only three species, i.e; *B. spectabilis, B. glabra* and *B. peruviana* are of floricultural importance. Holttum (11), in his comprehensive account of *Bougainvilleas*, has described four species, which have arisen as a result of bud sports, or as seeding variation as a result of chance crossing in nature. The flowers of *Bougainvillea* are self incompatible and in the ordinary course of events seed is rarely produced (Awad *et al.,* 1).

Bougainvillea is a versatile plant and rich in its varietal wealth which can be used in different ways like bush, standard shrub, climber, hedge, pot plant, bonsai, and ground cover for sloppy lands and to make the garden colorful for most part of the year. It is known for wide adaptability to various soils and climatic conditions and therefore, needs very little care for growing (Simon, 20). *Bougainvillea* grows well in around the cities in the plains, while few species like *B. glabra* grow at higher altitude from 650 to 1500 m above the sea level and even up to 2000 m. It is grown successfully in the Nilgiri hills in south India. *Bougainvillea* is generally propagated by cutting. However, the success in propagation by cutting is very limited in most of the varieties (Mishra and Singh, 13).

Apical cutting had better rooting and survival percentage as compared to basal or middle cuttings. Bougainvillea cultivation has very bright scope in the lower valleys of hills showing sub tropical climate. To promote Torch Glory growing in hill

Received : 27.12.2012 Revised : 16.2.2013 Accepted : 25.2.2013

region, it is essential to multiplying it through suitable method of propagates in at right time.

MATERIALS AND METHODS

The experiment was conducted under mist chamber at Horticulture Research Centre, Chauras Campus, Srinagar, Garhwal. Geographically Srinagar valley is spread between latitude 30° 12' 0" to 30° 13' 4" North and longitude 78° 0' 45" to 78° 0' 50" East. The valley is about 6 km long and 1 to 1.2 km wide located on both side of famous Alaknanda river at an elevation 540 m above MSL and about 132 km from Haridwar in Himalayan region. The valley shows a semi-arid and sub-tropical climate. Except during rainy season rest of months are usually dry with exception occasional showers during winter or early spring. The average minimum and maximum temperature, relative humidity and rainfall vary from 7.65°C to 36.5°C, 39.24% and 2.50 to 235.24 mm, respectively.

Softwood cuttings of *Bougainvillea* cv. Torch Glory were collected from 4 to 5 year old plants and 20 cm, 35 cm and 50 cm long stem cuttings with apical portion were used for experiment. For preparing the rooting media, sandy soil and farm yard manure (FYM) in ratio of 1:1 by v/v were mixed thoroughly, cleaned for stones and grasses, then the mixture was filled in root trainers. The basal ends of the cuttings were dipped in dilute solutions (3000 ppm, 4000 ppm and 5000 ppm) of indole-3-butyric acid by quick dip method for 10 seconds before planting them in the rooting medium. The treated cuttings were planted carefully in the root trainers. After the treatment, the cuttings were immediately planted in 10x5 cm size of root trainer and inserted 7.5 cm in the rooting media, twenty root trainers were fitted in one frame. The size of frame was 30x24 cm. The experiment was replicated thrice with 10 cuttings in each treatment and a total of 360 cuttings were tested. Experiment was conducted in the mist house which had the arrangement for intermittent misting to 60 seconds at every 30 minutes interval between 8 am and 8 pm. The data recorded were subjected to statistical analysis for least significant difference (RBD) as described by Cochran and Cox (6).

RESULTS AND DISCUSSION

The rooting response of *Bougainvillea* cuttings treated with different concentrations of IBA (Table 1 and 2) revealed that maximum number of sprouted cuttings (90.0%) was observed under C_1L_2 (35 cm long cuttings treated with 3000 ppm IBA) treatment confirming to findings of Deo *et al.* (7) who reported the highest number of sprouted cuttings under 3000 ppm concentration of IBA in bougainvillea cv. Refulgence. 35 cm length of cuttings containing more food stuff than 20 cm long cuttings gave the higher sprouting percentage in combination with 3000 ppm concentration of IBA while 50 cm long cuttings could not perform better in combination with 3000 ppm concentration of IBA. IBA concentrations could not show best result in case of unsprouted cuttings, while 50 cm and 35 cm long cuttings showed good results due to the presence of large reserved food material with large diameter of cuttings and minimum loss of minerals, nutrients and reserved food with large diameter of cuttings in comparision of 20 cm long cuttings. Haising (9) postulated that lack of sprouting of cutting was mainly due to lack of root initiation in response to applied auxin.

The maximum length of sprout per cutting (3.25 cm) was found under C_1L_3 (50 cm long cuttings treated with 3000 ppm IBA). The present findings are similar to the findings of Rahman *et al.* (17) in olive var. Cortiana and Iqbal *et al.* (12) in apple cuttings with respect to average length of sprouts per cutting. 50 cm length of cutting had a maximum diameter in lower portion which determines the availability to reserve food material than 20 cm and 35 cm long cuttings and it generate maximum length of sprout in combination of 3000 ppm concentration of IBA. The maximum average diameter of sprouts per cutting (0.74 cm) was recorded in 35 cm long cuttings treated with 5000 ppm IBA which is in line of findings of Niaz and Muhammad (16)

with respect to average diameter of sprout per cutting in *Bougainvillea* glabra var. Variegata. 35 cm length of cuttings produced maximum diameter of sprouts in combination of 5000 ppm concentration of IBA, which occurred due to sprouting behaviour of stem cutting which varies with the age, genotype and physiological status of mother plants which may also be one of the reasons for good performance of the medium sized cuttings. The maximum number of sprouts per cutting (30.22) was observed with 35 cm long cuttings treated with 3000 ppm IBA. The better number of sprouts per cutting with optimum time and IBA treatments might be ascribed due to better root growth which augmented absorption and translocation of nutrients from soil which take active part in various plant metabolic processes. The findings of present study are similar to the findings of Iqbal *et al.* (12) in apple cuttings, Singh (21) in *Euphorbia pulcherrima* cv. Eckes and Deo and Pal (7) in respect of average number of sprouts per cutting in bougainvillea cv. Refulgence. Medium size cuttings produced more number of sprouts which may be due to sufficient food material and hormones for induction of root and shoot.

The maximum number of leaves on new growth (7.48) was found under C_3L_3 (50 cm long cuttings treated with 5000 ppm IBA). It might be due to wood maturity of cuttings which probably reserve high starch and sugar. The appropriate planting time, application of IBA as well as genetic makeup of genotype may have played some role in augmenting the number of leaves per cutting (Singh and Singh, 22). Siddique and Hussain (19) reported similar results in respect to average number of leaves per cutting in *Ficus hawaii*. 50 cm length of cuttings pre-exits more number of buds and reserve food stuff than the 35 cm and 20 cm long cuttings, which produce more number of leaves on new growth in combination of 5000 ppm concentration of IBA. The maximum height (63.86 cm) of plant was found under C_1L_3 (50 cm long cutting treated with 3000 ppm IBA) treatment. As the maximum shoot growth was associated with the same treatment in this experiment which may be the possible reason for maximum plant height. The maximum number of primary roots (33.00) was found in 50 cm long cutting treated with 3000 ppm IBA, confirming to findings of Bhattacharjee and Balakrishna (2) and Bose *et al.* (3) who reported that cutting of bougainvillea and other ornamental shrub species produced large number of roots, weight of fresh and dry root when treated with IBA at 3000-6000 ppm. The enhanced hydrolytic activity in presence of applied IBA coupled with appropriate planting time might be responsible for the increased percentage of rooted cuttings. High carbohydrate and low nitrogen have been reported to favour root formation (Carlson, 4). The above findings also agree with the finding of Mukharjee *et al.* (15) in 15 cm long tip cuttings of *Bougainvillea gardenia,* hibiscus, nyctanthes and ixora. The maximum average length of longest root (9.90 cm) was found under C_2L_3 (50 cm long cutting treated with 4000 ppm IBA) treatment. Which is similar with the finding of Chovatia *et al.* (5) in *B. peruviana* cv. Mary Palmar cutting, Gupta (8) in *Buddlea asiatica* cutting and Niaz and Nabi (16) with respect to average length of roots per cutting in bougainvillea cv. Variegata. The maximum average diameter of longest root (0.13 cm) was found in 20 cm long cutting treated with 3000 ppm IBA. Diameter of longest root was found significant. The present findings are similar to finding of Singh (21) with respect to average diameter of longest root per cutting in *Euphorbia pulcherrima* cv. Eckes.

The maximum number of cuttings producing profuse callus formation (77.77%) was found in C_1L_1 (50 cm long cutting treated with 3000 ppm) treatment (Table 2). The performance of terminal cutting with respect to percentage of rooting, number of primary roots, percentage of secondary rooting, and callus production was significantly superior over sub terminal cutting (Singh and Singh, 22). The maximum number of cutting (55.55%) showed good callus formation which was found under C_2L_1 (20 cm long cutting treated with

Table1: Effect of IBA concentration and length of cutting on survival performance, vegetative growth and rooting of Bougainvillea cv. Torch Glory cuttings under mist.

Treat-ment combinat ions	Number of sprouted cutting (%)	Number of unsprouted cutting (%)	Number of sprouts per cutting	Av. length of sprouts (cm)	Av. diameter of sprouts (cm)	Av. number of new leaves on new growth	Height of plant (cm)	Number of primary roots	Length of longest root(cm)	Diameter of thickest root(cm)	Fresh weight of root(g)	Dry weight of root(g)
C_1L_1	73.33	3.33	16.89	2.47	0.14	4.18	28.82	22.89	5.60	0.13	0.46	0.10
C_1L_2	90.00	6.67	30.22	2.83	0.14	4.44	46.01	29.22	6.44	0.12	0.87	0.18
C_1L_3	86.67	0.00	23.00	3.25	0.11	5.33	63.86	33.00	7.48	0.10	1.03	0.29
C_2L_1	76.67	10.00	9.55	1.26	0.11	2.18	29.93	20.89	8.12	0.10	0.66	0.12
C_2L_2	86.67	0.00	25.55	3.19	0.13	5.85	49.83	31.22	9.83	0.11	0.87	0.18
C_2L_3	80.00	0.00	29.44	2.39	0.13	5.11	57.86	22.22	9.90	0.12	0.61	0.16
C_3L_1	63.33	36.67	6.00	1.44	0.08	2.18	22.89	18.44	6.52	0.09	0.28	0.07
C_3L_2	86.67	0.00	21.78	2.64	0.74	4.85	43.06	26.00	6.72	0.11	0.71	0.15
C_3L_3	73.33	6.67	27.55	2.69	0.45	7.48	61.36	27.55	9.37	0.10	0.59	0.17
C_0L_1	50.00	16.67	5.77	0.91	0.07	1.70	25.23	12.33	7.89	0.07	0.21	0.05
C_0L_2	83.33	0.00	26.33	2.90	0.35	5.48	43.36	22.55	8.47	0.10	0.78	0.16
C_0L_3	50.00	6.67	22.66	2.49	0.11	5.11	53.38	31.00	7.59	0.10	0.57	0.17
C.D. (P = 0.05)	31.29	17.67	11.96	2.38	7.2	3.39	10.66	13.55	4.98	0.05	0.56	0.90

Table2: Effect of IBA concentration and length of cutting on callus formation and secondary rooting of Bougainvillea cv. Torch Glory cutting under mist

Treatment	Callus formation (%)				Secondary rooting (%)			
	Profuse	Good	Poor	Nill	Profuse	Good	Poor	Nill
C_1L_1	33.33	22.22	44.44	0.00	33.33	22.22	33.33	11.11
C_1L_2	55.55	33.33	11.11	0.00	77.77	11.11	0.00	11.11
C_1L_3	77.77	22.22	0.00	0.00	77.77	22.22	0.00	0.00
C_2L_1	11.11	55.55	33.33	0.00	11.11	22.22	66.66	0.00
C_2L_2	66.66	33.33	0.00	0.00	33.33	55.55	11.11	0.00
C_2L_3	55.55	44.44	0.00	0.00	55.55	33.33	11.11	0.00
C_3L_1	11.11	33.33	55.55	0.00	0.00	33.33	33.33	33.33
C_3L_2	55.55	11.11	33.33	0.00	44.44	0.00	44.44	11.11
C_3L_3	33.33	44.44	22.22	0.00	33.33	44.44	11.11	11.11
C_0L_1	11.11	11.11	55.55	22.22	0.00	22.22	33.33	44.44
C_0L_2	22.22	55.55	22.22	0.00	22.22	55.55	22.22	0.00
C_0L_3	44.44	22.22	11.11	22.22	55.55	11.11	11.11	22.22
C.D. (P = 0.05)	39.80	43.84	45.46	20.64	42.44	47.88	43.56	41.58

C_1 = 3000 ppm, C_2 = 4000 ppm, C_3 = 5000 ppm, C_0 = Control, L_1 = 20 cm, L_2 = 35 cm, L_3 = 50 cm.

4000 ppm IBA). The maximum number of cuttings exhibited poor callus formation under C_3L_1 (20 cm long cutting treated with 5000 ppm IBA). Maximum number of cuttings (22.22%), which could not produce callus, was observed under both C_0L_1 and C_0L_3 (20 cm and 50 cm long untreated cutting) while all the other treatments could not produce callus (nil) in any cutting. Auxin application has been found to enhance the histological features like formation of callus and tissue and differentiation of vascular tissue (Mitra and Bose, 14). The above findings are in consonance with Sharma *et al.* (18) with respect to average callus formation per cutting in kiwifruit. The maximum number of cuttings producing profuse secondary rooting (77.77%) was found under C_1L_2 and C_1L_3 (35 cm and 50 cm long cuttings treated with 3000 ppm IBA). The maximum number of cuttings producing good secondary rooting (55.55%) was recorded under both C_2L_2 (35 cm long cutting treated with 4000 ppm IBA) and C_0L_2 (35 cm long untreated cutting). The maximum number of cuttings producing poor secondary rooting (66.66%) was found under C_2L_1 (20 cm long cutting treated with 4000 ppm IBA). The maximum number of cuttings producing nil secondary rooting (44.44%) was found under C_0L_1 (20 cm long untreated cuttings). The enhanced hydrolytic activity in presence of applied IBA coupled with appropriate planting time might be responsible for the increase in number of secondary roots per cutting (Carlson, 4). The above findings also agreed with the finding of Singh (21) in respect of secondary roots per cutting.

The maximum fresh weight of roots per cutting (1.03 g) was recorded in 50 cm long cuttings treated with 3000 ppm IBA. These findings agreed with the reports of Singh (21) in *Euphorbia pulcherrima* cv. Ecke. The maximum dry weight of roots per cutting (0.29 g) was noted in 50 cm long cuttings treated with 3000 ppm IBA. Dry weight of root per cutting was found significant confirming to the findings of Deo *et al.* (7) in bougainvillea cv. Refulgence.

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