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A review: Multiplication of *Bougainvillea* species through cutting

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Abstract

Propagation by cutting is very popular method of multiplication of several ornamental plants. But it has a limited success in the propagation of bougainvillea because most of its cultivars are hard-to-root. Plant bioregulators has been used extensively for initiation of rooting in cuttings of bougainvillea. Hardwood cuttings showed better growth than softwood cuttings. Profuse rooting and maximum survival in hardwood cuttings were found in Blondie, Elizabeth, Pixi and Sundari cultivars of Bougainvillea. Survival and rooting percentage was higher in July and September cuttings than in February cuttings.

Keywords: bougainvillea, propagation, IBA, cutting

Introduction

Bougainvillea, belonging to the family Nyctaginaceae, It is one of the most important climbing flowering shrub of tropics and sub-tropics. Bougainvillea is propagated by cuttings, layering, and budding. The methods to be employed for propagation would largely depend on the cultivar and agro-climatic condition prevailing at particular location. Those which are difficult to root need proper tenderization of propagation, time and concentration of plant bioregulators. Macdonald (1986) [25] showed that the vegetative propagation by stem cuttings has the ability to produce a large number of young plants from a single parent plant, thus it is a useful technique in conservation of endangered plants and rapid propagation of new cultivars. There are several factors that can affect the rooting potential of stem cuttings including species and specific cultivar needs, the source, position, and type of cutting taken; juvenility and condition of stock plant; wounding or leaf removal; stock plant etiolation and girdling; cutting date (Hartmann *et al.*, 2002) [18].

Plant bioregulators has been used extensively for initiation of rooting in cuttings of different ornamental plants. The synthetic root promoting chemicals that have been found most reliable in stimulating adventitious root production in cuttings are indole-3-butyric acid (IBA), indole-3-acetic acid (IAA) and naphthalene acetic acid (NAA). Indole-3-butyric acid has been used more widely because it is non toxic to plants over a wide concentration range (Singh 2002 and Chadha and Choudhry, 1980) [38]. Ahmad *et al.* (2002) [1] observed the significant influence of indole-3-butyric acid on the root production of *Bougainvillea glabra* variegata. The success in rooting has been found to be affected by the position and type of cutting material selected for propagation. Tip cuttings of *B. spectabilis* and *B. glabra* cv Alexandra rooted better than those taken for lower parts of the stem (Beel and Schelhtraete, 1981) [3]. Hardwood cutting of bougainvillea when planted in open sunlight have been found better in terms of percentage of rooting and survival (Mishra, 1971) [24], while softwood cuttings rooted better under intermittent mist (Singh and Motial, 1979) [45]. Hardwood cutting of bougainvillea cv. Mary Palmer showed 75 percent rooting when treated with 1500 ppm IBA, as compared to control (Kale and Bhujbal, 1972) [20]. Usha cultivar of bougainvillea was also reported to root better (80 %) when treated with IBA at 4000 and 6000 ppm (Bhattacharjee and Balakrishna, 1983) [4].

1. Effect of IBA on the rooting of cutting

Propagation by cutting is very popular method of multiplication of several ornamental plants. But it has a limited success in the propagation of bougainvillea because most of its cultivars are hard-to-root. A considerable work has been done to improve rooting of cuttings in bougainvillea and other ornamental plants. The main sources of growth hormones widely used in the promotion of rooting cuttings are the indolic-3-butyric acid (IBA), 1-naphthalene acetic acid (NAA), indole-3-acetic acid (IAA), and commercialization of the root promoter such as

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ABT root powder. Indole acetic (IAA), produced in the meristem of a tissue, is the most commonly occurring natural auxin and it causes plasticity of the cell wall causing it to elongate. It is responsible for phototropism, geotropism, and apical dominance. The successful formation of adventitious roots is an obligatory phase of vegetative propagation in many woody plants; this is related to the presence of auxin (Kim *et al.*, 1998) [22]. Rooting of gardenia micro-cuttings has achieved high percentages *in vitro* with the use of IBA (Pontikis, 1983) [34].

Auxin application enhances the historical features like formation of callus tissue and differentiation of vascular tissues (Mitra and Bose, 1954) [29]. It also activates the production of roots in several evergreen ornamentals. *Bougainvillea spectabilis* when dipped for 15 second in solution of IBA at 8000 ppm, rooting percentage was found to be significantly increased and roots were found thin, fibrous and branched (Rao, 1967) [35]. *Bougainvillea* and other ornamental shrub species which do not show any sign of rooting in the untreated cuttings were found to produce large number of roots, weight of fresh and dry root when treated with IBA at 3000-6000 ppm (Bose *et al.*, 1968) [5].

Phytohormones are increasingly employed to improve rooting and vegetative propagation of plants and it helps in quick multiplication of such plants and increase roots availability (Swamy *et al.*, 2009) [46]. Panwar *et al.* (1994) [31] reported that IBA at 2000 ppm was the best treatment, resulting significantly more sprouting of cuttings, more roots, longer roots length and higher percentage of rooting of cutting of *bougainvillea* cv. Alok than the other treatments. Hardwood cuttings showed better growth than semi-hardwood cuttings. Mishra and Sharma (1995) [27] observed that IBA concentration of 2000 ppm significantly increased the rooting performance of stem cuttings of *Bougainvillea* cv. Dr. R. R. Pal and Mrs. H.C. Buck which are difficult to root. Kamruzzaman and Quadir (1998) [21] reported that the cuttings treated with 6000 ppm IBA gave 56.0 percent rooting with corresponding survival rate of 64.3 percent which was significantly better than other IBA concentrations. The diameter and position of cutting from where these have been taken are reported to affect the rooting percentage. The largest diameter (9 mm) of cuttings and higher IBA concentration (6000 ppm) resulted in the highest rooting percentage in *Bougainvillea glabra* (Awed *et al.*, 1988).

The *Bougainvillea* cuttings were collected from November 15 at monthly interval upto February 15. The 15 cm long cuttings were prepared and treated with different concentration of IBA solutions by quick dip method. The maximum (100.00%) rooting and sprouting in cutting was observed at IBA 2000, 2500 and 3000 mg.L⁻¹. The maximum length of sprout/cutting (18.77 cm) and number of roots/cutting (21.22) were found in 3000 mg.L⁻¹ concentration of IBA (Singh *et al.* 2011) [40]. Early sprouting and higher shoot parameters in early stages might have brought early and better rooting. Further stored food materials with the aid of growth regulators have hastened the sprouting thereby enhancing the utilization of carbohydrates at the base of cuttings through photosynthesis (Chandramouli, 2001) [7].

Experiments have been conducted by various workers on the effect of various concentrations of Bioregulators treated with different combinations in cuttings on the rooting percentage, number of roots, promoting better shoot characters and observed better performance on the root as well as shoot characteristics (Rao, 1967; Lai *et al.* (1971); Maurya *et al.* branches and number of leaves per plant, sprouted cuttings and plant survival were recorded in hardwood cuttings (Mahros, 2002) [26].

1974: Gandotra *et al.* 1975: Bose *et al.* 1975: Mukherjee *et al.* 1976: Singh and Motilal, 1979: Philip and Gopalkrishna, 1981: Philip and Gopalkrishna, 1982: Singh, 1982: Joshi *et al.* 1989: Gupta and Kher, 1991: Harris and Singh, 1991: Singh, 1993: Chovatia *et al.* 1995: Mishra and Sharma, 1995: Singh, 2001: Gupta, 2002: Gupta, 2005: Thumar *et al.* 1998: Satish Chand, 2006: Deshmukh and Barad, 2006: Parmar *et al.* 2010: Singh *et al.* 2017) [38, 39, 40, 41, 42, 35, 30, 27, 13, 14, 31, 47, 32].

2. Effect of media on the rooting of cutting

The quality of rooting medium is essential in root development of plants. Though there is no universal rooting mix, appropriate propagation medium is dependent on; the cutting types, season of propagation, cost and availability of medium component, etc. A good rooting medium should hold the cuttings in place during rooting period, provide moisture, permit exchange and provide appropriate light penetration. Kamruzzaman and Quadir (1998) [21] observed that the maximum sprouting percentage (70.83 %), plant survival (51.16 %) and plant height (19.03 cm) was recorded in silt. Similarly, the maximum root length (10.33cm) and root number (9.33) was noted in sand. The maximum plant height (3.50cm) was recorded in sawdust whereas the maximum root length (3.33) and root number (2.66) was recorded in mixture of sand, silt and clay (1:1:1). Rahman *et al.* (1999) [62] reported that the maximum sprouting percentage (70.83%), plant survival (51.16%) and plant height (19.03 cm) was observed in silt. The maximum root length (10.33 cm) and root number (9.33) was recorded in sand. Similar experiments have been carried out by different workers in *Bougainvillea species* on various parameters of cuttings and root formations with minimum time with respect to the various rooting media (Mukherjee *et al.* 1976; Bhattacharjee and Balakrishna 1983; Heiching, 1999; Singh *et al.* 2011).

3. Effect of type of cutting on the rooting of cutting

Panwar *et al.* (1994) [31] observed that the Hardwood cuttings showed better growth than semi-hardwood cuttings. Profuse rooting and maximum survival in hardwood cuttings were found in Blondie, Elizabeth, Pixi and Sundari cultivars of *Bougainvillea*, while white flowered and variegata leaf cultivars did not root (Mishra, 1971) [24]. Chen and Chang (1999) [8] observed that rooting ratios of *B. glabra* cv. Purple Flower and Taipei Red were higher in 3-6 mm diameter shoot cuttings of Purple Flower and 3-6 and 6-9 mm diameter cuttings of Taipei Red. The rooting ratios were low in cuttings taken from the tips (<3 mm diameter) and basal cuttings (>9 mm diameter). Kamruzzaman and Quadir (1998) [21] observed that the best rooting was observed in non-leafy cutting with 3 nodes, having a slanting base cut and planted at an angle. The hardwood cuttings produced the highest number (7.1) and the longest (7.6 cm) roots compared to semi-hardwood and softwood cuttings (Kumar *et al.*, 2002). Semi-hardwood cuttings gave the best results in terms of rooting when cuttings were taken from juvenile plants (Koltsov, 1988) [23]. Tip cuttings of *Bougainvillea* (15 cm in length) showed the highest rooting percentage (Mukherjee *et al.*, 1976). Hardwood cuttings proved superior to semi-hardwood cuttings in *Bougainvillea* cv. Thimma (Singh, 1993) [42]. Hardwood cuttings of *Bougainvillea* when planted in open sunlight, have been found better in terms of percentage of rooting and survival while softwood cuttings rooted better under intermittent mist (Singh and Motial, 1979) [45]. The maximum number of roots length, root thickness number of

Table 1: Type of cuttings, Bio-regulators, Survival%, and Rooting % in *Bougainvillea spp.*

Cultivars	Type of cuttings	Bio-regulators and chemicals	*Survival, **Rooting %	References
Mahara	Hardwood cutting	6000 ppm IBA	**100	Philip and Gopalkrishna (1982)
Usha	Softwood cuttings	4000, 6000 ppm IBA, 4000 ppm NAA	**80, *100	Bhattacharjee and Balakrishna (1983) [4]
Torch Glory	Hardwood cutting	4000 ppm IAA	**70.89	Joshi <i>et al.</i> (1989)
Akola, Shubra, Refulgence	Hardwood cutting	100 ppm IBA	**60	Harris and Singh (1991)
Torch Glory	Hardwood cutting	2000, 2500 and 3000 ppm IBA	**100	Singh <i>et al.</i> (2011)
Thimma	Hardwood cutting	2000ppm IBA	**63.33	Sahariya <i>et al.</i> (2013)

4. Effect of planting time on the rooting of cutting

Heavy flushing was also observed during the rainy periods, a time of intense vegetative growth, which may tend to increase rooting percentage. Cuttings do not root normally in the dry season, however, rejuvenated shoots may still have superior root development probably because of higher food reserves and other rooting co- factors (Davis Jr. 1984). Evans, (1992) [11], contended that probably the best time to take cuttings from the field is at the beginning of the rainy season. Harrison-Murray (1991) observed that the seasonal timing, or the period of the year in which cuttings are taken, can play an important role in rooting. Blazich (1987) reported that time of year when cuttings are taken is an important factor influencing rooting of woody plants from stem cuttings. Yadav *et al.* (1978) [48] have also observed the highest percentage of rooting (90%) in hardwood cuttings of bougainvillea planted in August. Poor rooting in the cuttings which were planted during cooler time of the season might be due to the fact that these cuttings might have been carrying higher inhibitor to promote ratio or it might be due to higher nitrogen to carbohydrate ratio. The low rooting percentage during winter may be attributed to temperature level at the time of planting. This may be affected by season and several factors such as temperature, light and nutrient availability to the rooting percentage of cuttings. The low rooting percentage during winter may be attributed to temperature level at the time of planting. The average number of roots per cutting was higher in July and September cuttings than in February cuttings (Singh, 1993) [44]. The rooting behavior of cuttings may have varied with the seasons and low temperature adversely affecting rooting (Shafir and Mendel, 1970) [37].

5. Effect of growing condition on the rooting of cutting

Environmental conditions can influence the ability of stem cuttings to grow and root. The most common external factors are light, seasons, temperature, humidity, moisture level of cutting and rooting medium (Hartman *et al.*, 1997) [17]. In plant propagation, the different environment viz., glass house, poly-house and mist chamber have been widely used for rooting of cutting. Development of mist chamber is a major breakthrough in propagation of plants. Intermittent mist is often used on cuttings because it reduces the temperature of the leaves, lowers respiration, and increases relative humidity around the leaf surface (Langhans, 1955) [55]. Prolings and Therios (1976) [56] and Singh (2018) reported that creating humid atmosphere by means of artificial mist around the planted cuttings either in concealed pot culture house or in open conditions has proved to enhance the process of rooting. On the basis of overall performance, hardwood cuttings excellent result to propagate *Bougainvillea glabra* cv. Variegata under polyethylene sheet in shade house conditions (Mahros, 2002) [26]. The survival of *Bougainvillea* cv. Thimma and Mary Palmer cuttings was observed 54 per cent under shaded polyethylene tents (Singh and Rathore, 1977) [41] while subsequent survival was obtained under intermittent

mist with *Bougainvillea* softwood cuttings (Singh and Motial, 1979) [45].

6. Conclusion

It can be concluded that success in *Bougainvillea* propagation by cutting can be achieved throughout the year with the use of plant bioregulators. Hardwood cuttings showed better growth than softwood and semi hardwood cuttings. The survival of *Bougainvillea* cuttings was observed under green house.

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