The effect of growing media and stem cutting type on rooting and growth of *Bougainvillea spectabilis* plants

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Abstract

The bougainvillea plants (*Bougainvillea spp*) are appraised as decorative plants because of their lovely blossoms that bloom several times throughout the year. It is believed to have originated from South America, but widely cultivated in the tropical and sub-tropical areas of the world. Propagation of these plants can be done by using vegetative methods such as stem cuttings, grafting or tissue culture. The present investigation was carried out with the objective of standardizing a rapid and simple protocol for propagation and sprouting *Bougainvillea spectabilis* plants under fiberglass house conditions. Different types of stem cuttings, viz. terminal, middle and basal cuttings (15-20 cm long), were treated with IBA (Indole butyric acid) at 2000 ppm and cultured in various types of growing media viz. soil, soil +sand (1:1), soil +sand +peat moss (1:1:1), and soil +sand +peatmoss +FYM (1:1:1:1). The results indicated that basal stem cutting realized significantly the highest values of rooting percentage (> 97%) at all growing media used, compared with the terminal and middle cuttings (< 20%) after 60 days of planting. Similarly, the basal stem cutting yielded the greatest values in terms of root length (cm) and number of roots per cutting, with no significant difference among different media and cuttings. The basal cuttings significantly recorded the highest values for all parameters studied irrespective of the type of growing media used. Significantly, the height of rooted cuttings, after 90 days of planting was the greatest (67.66 cm) in the medium containing soil+ sand (1:1), compared to the other media investigated. The number of shoots and leaves per plant at the different media were statistically on a par. The research determined that hard- wood cutting and soil medium is the best cutting and medium for rooting of *bougainvillea spectabilis* plants.

Key words*:* Bougainvillea, propagation, fiberglass house conditions, growing media, type of stem cutting

Introduction

Bougainvillea is a lush evergreen subtropical vine. It has a spreading, round plant habit with a height and spread of up to six meteres (11). It is used in mass plantings as shrubs or bushes and as ground cover (18). The plant is also used as hedges, barriers, and slope coverings. For large and difficult to-maintain areas, Bougainvillea is an excellent ground cover. It can cover a whole hillside and will choke out weed growth. Bougainvillea belongs to the family Nycataginaceae and includes five species: *Bougainvillea glabra*, *Bougainvillea buttiana*, *Bougainvillea peruviana*, *Bougainvillea spectabilis,* and *Bougainvillea spinosa*. The flower of the plant is small and generally white, but each cluster of three flowers is surrounded by three or six bracts with bright colors associated with the plant, including pink, magenta, purple, red, orange, white, or yellow. The fruit is a narrow five-lobed achene (11).

The general practice of multiplication for most of the perennial ornamental plants is by the use of vegetative plant parts including stem, leaves, terminal buds and roots, due to its simplicity and practicability in developing countries (5). Vegetative propagation of ornamental plants through stem cutting is one of the cheapest and, sometimes, is the only method available for multiplication. However, under normal conditions, wide variability is noticed in different cultivars of the same species; while some cultivars root easily, others are either difficult or fail to root. In Bougainvillea, the success of propagation by stem cutting is very limited. Under normal conditions, mostly

growers observed poor rooting percentage. However, the rooting responses vary from one variety to another. It is well known that the success of rooting of the woody stem cuttings, in the majority of ornamental plants and fruit trees, depends mainly on the physiological stage of the mother plant (4), the time of planting of the cutting (9,2) and the type of growth regulators used (14).

Treatment of cuttings for ease in rooting is an old horticultural practice. Various auxins, such as Indole Acetic Acid (IAA), Indole Butyric Acid (IBA), and Naphthalene Acetic Acid (NAA), have been reported to promote rooting in the cuttings of most plant species. Each auxin's concentration varies from one plant type to another of the cuttings used. IBA or NAA, or combination of both is mostly recommended for the rooting of cuttings. IBA at 2000 ppm is recommended for getting the best rooting of hard-wood cuttings of *Bougainvillea spectabilis* var. Alok (13).

The quality of rooting medium is essential in the root development of plants. Though there is no universal rooting mix, appropriate propagation medium depends 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. For propagating of Bougainvillea, (17) the culture medium used contained sand and perlite with average texture for inducing roots from Bougainvillea. (4) worked in an experiment for propagating *Simmondsia chinensis,* by using stem cuttings on different media, such as soil, soil + sand, and soil +peat moss. A significant result was obtained by (12) in the rooting percentage and sprouting of Bougainvillea when stem cuttings cultured in a medium containing sandy loam in texture with 75% sand, 16% clay and 7.5% silt. (17) determined semi – hard wood cutting as the best cutting for rooting of *Bougainvillea glabra*.

The objective of this study is to assess the effect of different growing media and types of stem cuttings on rooting parameters and growth of *Bougainvillea spectabilis* plants under fiberglass house conditions, ultimately to make an efficient, rapid, cheap, and simple protocol for propagating these plants by the use of stem cuttings.

Materials and Methods

Plant material

An experiment was carried out at the green house (fiberglass house) of the Department of Plant Production, College of Agriculture and Veterinary Medicine, Ibb University, Yemen, during spring season (April) 2013. In this experiment, branches were collected from *Bougainvillea spectabilis* 9-year-old field-grown mother-stock orchard with a length of 30 cm. They were prepared by removing the whole leaves with retaining 4-5 nodes, with a length of 15-20 cm for middle and basal cuttings. Cuttings were of three types; terminal, middle and basal according to its position in the branch of plant**.**

Treatment cuttings with auxin

All three types of cuttings were submerged in the solution of IBA (Indole butyric acid) at a concentration of 2000 ppm for 10 sec. IBA solutions were prepared by adding 1 g of IBA powder to 500 ml distilled water, after dissolving IBA powder initially in some drops of 1N NaOH (Sodium Hydroxide), and made up the required volume of distilled water.

Growing media

Different types of rooting media were used for this purpose individually or in combinations; they were listed below:

i. Soil
ii. Soil + sand (1:1)
iii. Soil + sand + peat moss (1:1:1)
iv. Soil + sand + peat moss + FYM (1:1:1:1)

The three types of cuttings such as terminal, middle and basal were planted in the polythene bags (15 x 30 cm) in size contained growing medium after treating with IBA plant hormone (2000 ppm). Then, they were kept under fiberglass house conditions. Watering cutting was used when the rooting medium surface looks like dry.

Parameters studied

Different parameters of Bougainvillea cuttings were evaluated 60 days after planting in the rooting medium. The parameters were rooting percentage, number of roots per cutting and root length (cm). Vegetative growth parameters; viz., plant height (cm), number of shoots and leaves per cutting, were also evaluated for basal rooted cuttings after 90 days of planting.

Experimental design and data analysis

The experiment was conducted in a randomized completely block design (CRBD) with three replicates, each with 10 cuttings per replicate. Different parameters studied of rooting and growth of cuttings were subjected to statistical analysis according to (6,15). ANOVA values were obtained with Opstat1 software (O.P Sheron, Programmer, Computer Section, CCS HAU, Hisar, India) and means were separated with least significant difference (LSD) at P = 0.05.

Results and Discussion

The effect of different rooting media and type of stem cuttings (terminal, middle, and basal) treated with fixed concentration (2000 ppm) of IBA plant hormone in Bougainvillea plants under fiberglass house conditions, after 60 days of planting the cuttings, were studied. In general, significantly, which is in close conformity to the finding of (12) , the best growing media was the soil and the poorest one was the medium consisting of soil + sand +peat moss +FYM (1:1:1:1) rooting percentage; 44.11% and 32.56% respectively , irrespective of the type of cutting used . On the same trend, significantly, the ideal type of stem cuttings was the basal cutting with respect to rooting percentage (97.33%), number of roots per cutting (24.66) and root length (14.33 cm), and the poorest one was the terminal cutting with terms of rooting percentage (5.48%), number of roots per cutting (2.77) and root length (1.68 cm), regardless of the type of growing medium (Fig. 1 and Table 1). The results are in agreement with the findings of (17) investigated. Pertaining to the auxin used, it was IBA at 2000 ppm. Auxin often plays an important role in inducing roots on the cuttings at suitable concentration. In the present experiment, IBA, at 2000 ppm concentration, was used. It participated by its effective role on hard-wood cuttings when cultured in soil medium for promotion of roots.

Regarding the effect of interaction between the two factors investigated growing media and type of stem cutting , the results were evaluated (Table 2) that the basal stem cutting gained significantly the highest rooting percentage (> 97%) at all growing media used, compared with the middle (<20%) and terminal cuttings (<15%). This may be due to the mature of tissues of woody plants which tend to have less levels of endogenous auxin and are more differentiated and, therefore, more prone to re-differentiated (7, 10) . (8) postulated that phenols in juvenile tissues of certain plants tend to be higher than their mature forms which partially inhibits root formation. (1) concluded that Bougainvillea cuttings should be taken from wood that is mature to the point where it starts to become stiff and gives a better result for rooting. Bougainvillea root is more efficiently by using the type of hard-wood cuttings (16). The rooting medium containing soil + sand + peat moss + FYM (1:1:1:1) recorded the greatest number of roots per cutting (27.66), with basal stem cutting, in comparisons with other rooting media and the two types of cuttings; terminal and middle, whereas the least number of this character (0.00) was observed with medium consisting of soil + sand + peat moss (1:1:1) with the terminal stem cutting and with medium containing soil +sand +peat moss +manure (1:1:1:1) for the terminal and middle cuttings. Despite that the values of the number of roots per cutting had varied differences, but were with no significant effect. Root length (cm) did not differ significantly at all growing media and types of cuttings used, the highest value (18.66 cm) was recorded with basal stem cutting with medium comprising of soil + sand (1:1), whereas the lowest value (0.00 cm) was recorded with the same type of cuttings and growing media as in the rooting percentage character.

After 90 days of planting of basal stem cuttings in different growing media, various parameters were evaluated (Table 3). The highest plant height (67.66 cm) was significantly recorded with medium containing soil+ sand (1:1), whereas the lowest value for this character (34.00 cm) was observed with medium composed of soil only, in comparisons with the other media studied. The

number of branches and leaves per rooted cutting did not differ significantly at all media investigated.

Conclusions

Propagation of *Bougainvillea spectabilis* plants, under fiberglass house conditions was standardized. Among different growing media, soil medium was the best; for the type of stem cuttings, basal cutting was the best; and for plant height, the medium consisting of soil+ sand (1:1) gave marked results.

Fig. 1: Rooting and growth of Bougainvillea cuttings as affected with growing media and type of cuttings: (**A)** quality rooting and growth; root length and number of roots, plant height and no. of leaves and shoots on basal cuttings in the soil medium, (**B)** Poor rooting and growth; root length and number of roots and poor growth on middle cuttings in the medium containing soil+ sand +peat moss + FYM (1:1:1:1)

Table 1: Effect of different growing media and type of cuttings treated with 2000 ppm IBA on the rooting of *Bougainvillea spectabilis* cuttings under fiberglass house conditions after 60 days of planting.

Treatments	Rooting%	No. of Roots/ Rooted cutting	Root length (cm)
Growing media (GM)			
Soil	44.11 a	13.77	6.11
Soil + Sand (1:1)	37.77 b	11.11	8.55
Soil + Sand + Peat moss (1:1:1)	36.22 bc	12.02	7.13
Soil + Sand + Peat moss + Manure (1:1:1:1)	32.56 c	9.22	4.66
Type of Cutting (TC)			
Terminal	5.84 c	2.77 b	1.68 b
Middle	9.83 b	7.16 b	3.83 b
Basal	97.33 a	24.66 a	14.33 a

*Similar letters indicate means which are not significantly different (LSD, P = 0.05, comparisons are made in each column within GM and TC, values represent as means.

Table 2: Effect between different growing media and type of cuttings treated with 2000 ppm IBA on the rooting of *Bougainvillea spectabilis* cuttings under fiberglass house conditions after 60 days of planting.

Growing media	Type of Cutting	Rooting % (Mean)	No. of Roots/ Cutting (Mean)	Root length (cm) (Mean)
Soil	Terminal	15.00 c	9.66	3.66
	Middle	20.00 b	11.33	4.66
	Basal	97.33 a	20.33	10.00
Soil + Sand (1:1)	Terminal	8.33 de	1.33	3.00
	Middle	7.66 e	6.66	4.00
	Basal	97.33 a	25.33	18.66
Soil + Sand + Peat moss (1:1:1)	Terminal	0.00 f	0.00	0.00
	Middle	11.66 cd	10.66	6.66
	Basal	97.00 a	25.33	14.66
Soil + Sand + Peat moss + Manure (1:1:1:1)	Terminal	0.00 f	0.00	0.00
	Middle	0.00 f	0.00	0.00
	Basal	97.66 a	27.66	14.00

[1] Values represent as means ± Standard error (SE).
[2]Means followed by the same letter within columns are not significantly different by the LSD test at 5 % probability level.

Table 3: Effect of different growing media on the growth of rooted cuttings under fiber glass house conditions after 90 days of planting.

Growing media	Plant height (cm) (Mean±SE)[1]	No. of shoots/ rooted cutting (Means)[1]	No. of leaves/ rooted cutting (Mean±SE)[1]
Soil	34.00±2.08 d[2]	2.66±1.20	26.00±5.50
Soil + Sand (1:1)	67.66±1.85 a	2.66±0.88	46.00±9.00
Soil + Sand + Peat moss (1:1:1)	62.33±1.20 b	3.00±0.00	43.00±9.28
Soil + Sand + Peat moss + Manure (1:1:1:1)	58.33±1.66 c	2.66±0.33	41.00±4.58

[1] Values represent as means ± Standard error (SE).
[2]Means followed by the same letter within columns are not significantly different by the LSD test at 5 % probability level.

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تأثير بيئات النمو و نوع العقلة الساقية على التجذير والنمو لنبات الجهنمية *Bougainvillea spectabilis*

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الملخص

نبات الجهنمية (*Bougainvillea spectabilis*) يستخدم كنبات تزيين نظراً لإزهاره الرائع والمتعدد طوال العام. الموطن الأصلي لهذا النبات هو جنوب أمريكا لكنه على الرغم من ذلك يزرع بشكل واسع في المناطق الاستوائية وشبه الاستوائية من العالم. يتكاثر هذا النبات بالطرق الخضرية مثل العقل الساقية والتطعيم وزراعة الأنسجة النباتية. اتبعت في هذه التجربة طريقة العقل الساقية المأخوذة من شجيرات نامية في المزرعة وخالية من الأمراض بعمر تسع سنوات خلال ربيع 2013 لغرض إكثار هذا النبات. استخدمت ثلاثة أنواع من العقل الساقية (الطرفية والوسطية والقاعدية) بطول 15-20 سم و المعاملة بهرمون التجذير أندول حمض البيوتريك (IBA)عند تركيز 2000 جزء في المليون (ppm) وزرعت في بيئات تجذير مختلفة وهي تربة فقط , خليط من رمل + تربة بنسبة 1:1 و خليط ثلاثي من الرمل + التربة+ البيتموس بنسبة 1:1:1 و خليط من الرمل+ التربة + البيتموس + سماد بلدي بنسبة 1:1:1:1. نفذت التجربة بتصميم قطاعات كاملة العشوائية عاملية (FCRBD) في ثلاثة مكرارت, كل مكرر يحتوي على عشر عقل. أجريت التجربة بهدف إيجاد أسهل وأسرع طريقة لإكثار نبات الجهنمية تحت ظروف البيت المحمي المغطى بالفيبرجلاس. النتائج المتحصل عليها أشارت إلى أنَّ العقل القاعدية أعطت أفضل نسبة تجذير فاقت 97% مقارنة بالعقل الطرفية والوسطية التي أعطت نسبة تجذير أقل من 20% بعد 60 يوم من زراعة العقل.على منوال العقل القاعدية نفسها حققت أعلى النتائج فيما يتعلق بطول وعدد الجذور بالعقلة في كل البيئات المستخدمة مع عدم تسجيل فروق معنوية. بيئة التجذير المكونة من التربة فقط سجلت أعلى النتائج لكل الصفات المدروسة بغض النظر عن نوع العقلة المستخدمة. إرتفاع النبات كان معنوياً بعد 90 يوم من زراعة العقل في البيئة المكونة من التربة والرمل بنسبة 1:1 مقارنة ببقية البيئات تحت الدراسة ، ولم تؤثر بيئات النمو معنوياً على صفة عدد الأفرع وعدد الأوراق بكل نبات. وحددت نتائج هذه الدراسة أنَّ العقل القاعدية العقل وبيئة التربة هي الأفضل في إكثار نبات الجهنمية بطريقة العقلة الساقية.

الكلمات المفتاحية: الجهنمية, التكاثر، البيت المحمي بالفيبرجلاس, بيئات النمو، نوع العقل الساقية.