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Influence of Rooting Substrate and Cutting Type on Rooting of Cuttings in *Schefflera arboricola* L. Plants

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Authors' contributions

This work was carried out in collaboration between both authors. Author BF wrote the protocol, managed the statistical analyses and wrote the manuscript. Author ZM managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Foliage plants production represents an important agricultural industry. *Schefflera arboricola* L. is an evergreen shrub in the family *Araliaceae*. The aim of the study was the evaluation of the effect of the substrate and the cutting type on the rooting process of schefflera.
Study Design: The rooting test of cuttings involved 2 factors (rooting substrate and type of cutting) randomized block design with 4 replications plot with 9 cuttings.
Place and Duration of Study: This trial was performed in the greenhouse of research Institute of Zabol University on May 2013.
Methodology: Applique rooting beds were consisting of: R_1: 100% perlite, R_2: 50% perlite+ 50% cocopeat and R_3: 100% sand. Three sorts of cutting were used in the experiment with different types of cutting (D_1:4-7 mm as softwood, D_2:8-11mm as semi-hardwood and D_3:12-15mm as hardwood cuttings) for study type of cutting effect on rooting of cuttings.
Results: The result of this test showed the effect of rooting substrate on all measured parameters

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(number of rooted cuttings, number of root in each cutting, total length, fresh and dry weight of roots) was significant; whiles the effect of type of cutting wasn't significant on any characteristics. Interaction of rooting substrate and type of cutting was significant in 2 parameters (number of rooted cutting and number of root in each cutting). Perlite substrate was better than perlite-cocopeat and sand. Interaction of substrate and cutting type was significant between 3 substrates and 3 types of cutting, the best suitable treatment in interaction was for second type of cutting in perlite substrate, whiles it had significant difference to second type of cutting in perlite-cocopeat and sand substrate in number of rooted cuttings characteristics. So this trial eventuated that perlite substrate is better than the other substrates in rooting of schefflera cuttings in number of rooted cuttings, number of root in each cutting and length of roots.

Keywords: Rooting, substrate, cutting type, schefflera plant.

1. INTRODUCTION

Schefflera arboricola L. is flowering plant in the family *Araliaceae*; it is also goes by the common name "Dwarf umbrella tree". It is an evergreen shrub growing to 3-4 m height, often trailing stems scrambling over other vegetation. The leaves are palmately compound, with 7-9 leaflets, the leaflets 9-20cm long and 4-10cm broad (though often smaller in cultivation). The flowers are produced in a 20cm panicle of small umbels, each umbel 7-10mm diameter with 5-10 flowers. It is commonly grown as houseplant, popular for its tolerance of neglect and poor growing condition [1]. Required temperature and humidity of this plant to growth is normal (middle) and it needs sun- shade conditions [2].

Cutting position within the mother plant and stem length affected the rooting of leaf-bud cuttings of *Schefflera arboricola* L. Results showed that cuttings from sub-apical positions rooted more slowly produced fewer roots and had a lower rooting percentage than cuttings from the more basal regions. Furthermore, the number of roots and rooting percentage increased with the length of the stem below the node. The subsequent axillary bud break and shoot growth was improved considerably in cuttings from sub-apical to basal positions, and by increasing the length of the stem below the node [3].

The effects of topophysis on the number of roots per plantlet and on root fresh weight were inconsistent. Double node cuttings against single node cuttings showed a delayed but more uniform bud breaks and as a result a reduced heterogeneity in shoot growth. Double node cuttings of *Schefflera* were shorter in length, had fewer leaves, a smaller leaf area and lower dry weight at harvest. Double node cuttings with a larger leaf area produced larger plants [4].

The unequal growth of chrysanthemum plantlets during in vitro micro propagation can be an effect of topophysis, and this phenomenon is cultivar-specific in Chrysanthemum [5]. Combinations of various media have become especially popular in cutting production of ornamentals [6].

The major growing media currently in use in Kuwait are perlite and peat moss. The interest to explore other relatively inexpensive substrates is of great importance in the country. In order to reduce cost of using imported expensive organic materials to be used in growing media in protected production, it is recommended to extend to a wide range of plant species with even higher ratios of sand in the growing media [7].

Each cutting should have one or two nodes. One of the nodes should be in soil. One leaf must be there in each cutting. Since the leaf is responsible for photosynthesis and transpiration the area of the leaf may be kept in a comfortable size by trimming to maintain a balance between transpiration, photosynthesis and respiration [8].

Composts, after being appropriately mixed with sphagnum peat and pine bark, could be used as container substrates for rooting foliage plant cuttings. The development of compost-formulated rooting substrates would further expand compost use in the foliage plant industry [9].

Schefflera actinophylla was grown commercially from seed by Robert Scully Sr. of Hogshead Nurseries in Apopka, Florida. The use of S. actinophylla and S. arboricola as small interior trees has elevated the genus Schefflera to the status of the second most important interior tree genus next to Ficus [10].

The aim of the study was the evaluation of the effect of the substrate and the cutting type on the rooting process of schefflera.

2. MATERIALS AND METHODS

This experiment was carried out in the greenhouse of Research Institute of University of Zabol in 2013. On May 2013 cuttings were taken from insect- and disease-free plants with 15-20 cm length, 3-4 nodes and 2-3 leaves from greenhouse Schefflera plants with gardening secateurs. For investigation of type of cutting on rooting of schefflera cuttings, Three types of cuttings were prepared i.e. hard wood, semi hard-wood and soft wood with 3 different diameters (D_1: 4-7mm as softwood cuttings, D_2: 8-11mm as semi hard-wood cuttings and D_3: 12-15mm as hard-wood cuttings) were selected. The hard wood cutting was prepared from basal portion of the branches, whiles the semi hard wood cutting was prepared from the mid portion, and the soft wood cuttings was prepared from terminal portion of current growth. To study the effects of growing substrate on rooting, 3 substrates were prepared: perlite, 50% perlite+ 50% cocopeat and sand. Before transplanting cuttings were dipped for 5 s in 4000 $mg.L^{-1}$ rooting hormone solution Indol-3-Butyric Acid (IBA).

Cuttings were placed under mist (each 0.5 hours, 1 minute mist) and watered as needed in a greenhouse with no bottom heat. Parameters to be measured were number of rooted cuttings, number of roots in each cutting, total roots length, fresh and dry weight of roots. A 3 × 3 factorial experiment in randomized block design with 4 replications was initiated (each replication had 9 cuttings). Analysis of variance was conducted using the Statistical Analysis software SPSS with significance at P≤0.05 and average comparison had done by Duncan method.

3. RESULTS AND DISCUSSION

Approximately 2 months after transplanting the cuttings into the substrates, the measurements of parameters were commenced. Data analyzed showed that the effect of substrate on number of rooted cuttings was significant (P≤0.01). Various types of cutting of schefflera cuttings didn't have significant effect, but interaction of substrate and type of cutting were significant (P≤0.01).

The application of various rooting substrates on the number of rooted cuttings (Fig. 1) showed that perlite was the best substrate and sand was the worst. there isn't any significant differences between perlite-cocpeat and sand substrates.

According to the diagram (Fig. 2), the interaction between substrate and cutting type showed that the most number of rooted cuttings were obtained in second cutting type of Schefflera cuttings in perlite substrate and the worst treatment was second type of cutting of cuttings in sand substrate. It didn't observe significant differences between other treatments. Comparisons of means between different treatments (substrates and type of cuttings) are in Table 1 and 2.

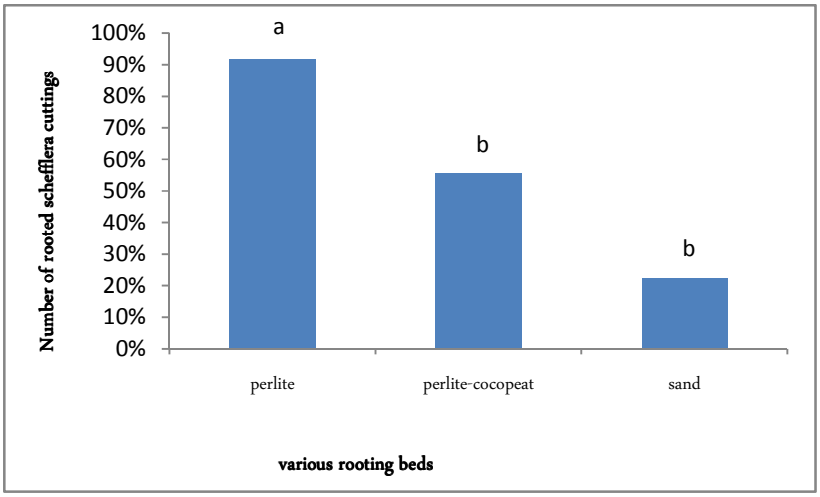

Fig. 1. Effect of different substrates on the number of rooted schefflera cuttings

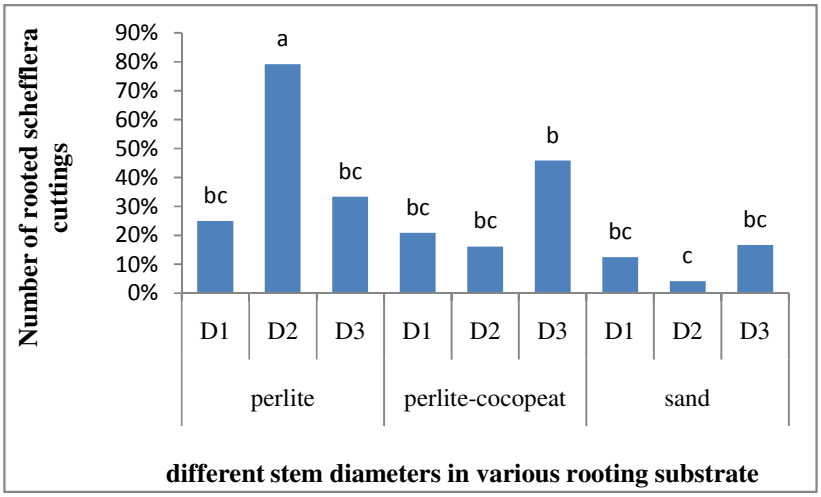

Fig. 2. Interaction between the different cutting type and rooting substrates on the number of rooted cuttings

D_1: first type of cutting; D_2: second type of cutting; D_3: third type of cutting (P<0.05)

Table 1. The effect of different substrates on the Schefflera cutting characterization

Treatments	Rooting (%)	Number of root	Total roots length(cm)	Root fresh weight(g)	Root dry weight(g)
Perlite	92[a]	14.389[a]	66.919[a]	0.7129[a]	0.2767[a]
Perlite+ cocopeat	56[b]	5.611[b]	16.711[b]	0.1861[ab]	0.0878[ab]
Sand	22[b]	1.806[b]	2.408[b]	0.0528[b]	0.0131[b]

Table 2. The effect of different types of cutting on the schefflera cutting characterization

Type of cutting	Rooting (%)	Number of root	Total roots length(cm)	Root fresh weight(g)	Root dry weight(g)
D1	39[a]	4.89[a]	18.867[a]	0.2661[a]	0.0875[a]
D2	64[a]	10.06[a]	45.150[a]	0.4061[a]	0.1644[a]
D3	67[a]	6.86[a]	22.022a	0.2796[a]	0.1256[a]

3.1 Number of Roots

The result of this trial showed the effect of substrate on the number of roots in various substrates was significant.

According to Fig. 3 highest number of root was observed in cuttings rooted in perlite, whiles the lowest was observed in cuttings placed in sand (figure 4). There is not any significant difference between perlite-cocopeat and sand. Number of roots in cuttings rooted in perlite (14.39) was almost eight times higher than it was in cuttings rooted in sand (1.81).

There was no effect of cutting types on the number of roots in schefflera. The interaction between substrate and type of cutting had significant effect on number of roots. The highest number of roots is observed in second type of cutting in perlite. Other treatment didn't have significant differences together.

3.2 Length of Root

The measuring of all of roots length in each cutting showed that the effect of rooting substrate on this characteristic was significant. But the effect of type of cutting and interaction of substrate and type of cutting weren't significant.

In this case perlite substrate was the best too, and there wasn't significant difference between other substrates. According to Fig. 4, the data showed total length of roots in cuttings in perlite substrate were 66.92cm, whiles in perlite-

cocopeat were 16.71 and in sand substrate were 2.41cm that maybe it was due to better aeration in perlite and perlite-cocopeat against sand substrate. Rooting Lengthen in perlite because of more porosity and its weightless. But in sand substrate because it's fine ingredient (granule) and its tenacity, roots didn't have suitable place for elongation.

Although the effect of type of cutting or position of cutting on schefflera plant wasn't significant, the result showed the most length of roots were observed in second type of cutting (D_2: semi-hard wood cuttings) with 45.15cm; while the third type of cutting (D_3) had 22.02cm and first diameter had 18.87 cm total length of roots.

Golden pothos nodal position and length of cuttings also determine the root retention for in vivo establishment [11]. Vander and Escobar [5] reported that expanded potato production in developing countries using cuttings as a source of good quality planting material is the simple low cost methods for root induction and establishment of the in vivo propagules for potato cultivation in warm tropical sites of Philippines. He also reported that there were no major differences in root and shoot development from cuttings differing in size and age.

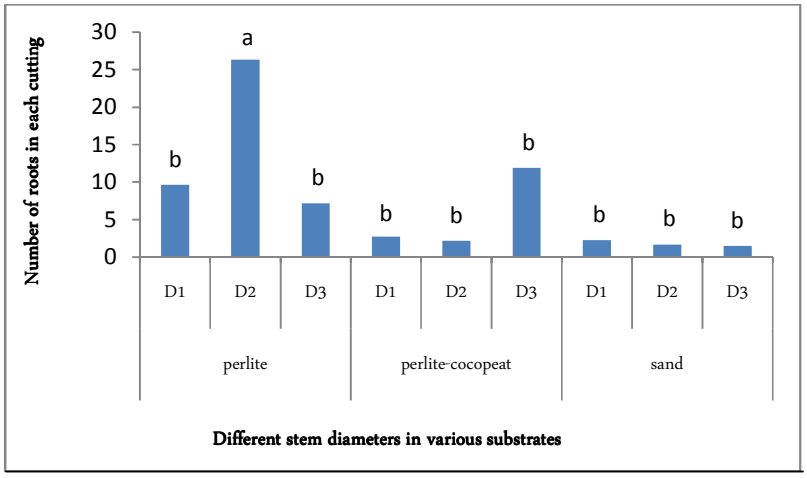

Fig. 3. Interaction between different substrate and cutting type on the number of roots in cutting

D_1: first type of cutting; D_2: second type of cutting; D_3: third type of cutting ($P<0.05$)

Fig. 4. The rooted cuttings that developed in various substrates (left cutting: perlite; middle cutting: Perlite-cocopeat and right cutting is in sand substrate)

Rahman et al. [12] expressed maximum number of roots (59.66) and lengthy shoot (8.24cm) was recorded in softwood cuttings of Guava that it is discordant with result of this experiment on schefflera cuttings.

3.3 Roots Fresh and Dry Weights

Such as above characteristic, the measurement of fresh and dry weight in each treatment showed that the effect of rooting substrate on this characteristic was significant. But the effect of type of cutting and interaction of substrate and type of cutting were not significant.

Although cuttings that rooted in perlite substrate had the most fresh and dry weight, they didn't significant differences to perlite-cocopeat. but perlite and sand substrates had significant differences.

4. CONCLUSION

The result of this experiment displayed that between three various substrates perlite was the best rooting substrates. Perlite-cocopeat was worse than perlite, but it showed better result than sand substrate. Comparison of sand with two other substrates revealed that ponderous substrate such as sand did not show proper rooting in schefflera cutting due to unsuitable aerification. Mixing of cocopeat with perlite decrease the competence of perlite, since number of cuttings that rooted in this substrate was less than perlite alone (As well as the number of roots in cuttings and total length of roots). So notwithstanding mixture of cocopeat to other substrates may has good effects on rooting of different horticulture cuttings and their growth; for rooting of schefflera cuttings in this trial cocopeat-perlite did not have suitable effects against perlite.

Unlike the substrate, effect of type of cutting was not significant on any of specified characteristics. So type of cutting or position of cutting on plant (top, middle or bottom cuttings) did not have meaningful effect on rooting of schefflera plants, Although D_2 and D_3 cuttings had more rooting than D_1 treatment.

Interaction of substrate and meaningful showed that between three substrates and three cutting types, the best interaction was for second type of cutting (D_2) in perlite substrate, whiles it had significant difference to second type of cutting in perlite-cocopeat and sand substrate in number of rooted cuttings characteristics. Also second type of cutting in perlite substrate had most number of roots, but in perlite-cocopeat substrate third type of cutting (D_3) was better than other cutting types. Haply other reason may affect these factors such as weather, sunlight level, temperature etc. But according to this experiment on rooting of Schefflera cutting in Zabol region in Iran, perlite substrate and D_2 (semi-hardwood cutting) and D_3 (hardwood cuttings) showed better result than others.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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