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The rooting response of silvery (*Leucophyllum frutescens)* cuttings to different growing conditions and planting dates

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Abstract

An investigation was carried out to ascertain the rooting response of various growing conditions and planting dates of Silvery cuttings at Ornamental Nursery Department of Horticulture The University of Agriculture Peshawar, Khyber Pakhtunkhwa Pakistan during 2011. The softwood cuttings of Silvery were planted on five different planting dates with an interval of 15 days viz. January 15th, January 31st, February 15th, March 2nd and March 17th, 2011, in two different growing conditions i.e. open field growing conditions and under plastic tunnels. The experiment was laid out in a Randomized Complete Block Design (RCBD) with split plots arrangement replicated four times. The growing conditions were assigned to main plots, while the planting dates to the sub plots. Findings revealed that under plastic tunnels the planted cuttings produced excellent results in number of root cuttings^{-1}(43.51), root length (13.34 cm), root thickness (0.08 cm^2) and root weight (0.20 g). While the cuttings planted in open field showed poor results in the mentioned parameters. Among the planting dates the March 17th plantation gave the best results in all parameters followed by March 2nd plantation. On the other hand, January 31st plantation produced the poorest results in all parameters. According to the current research number of roots plant^{-1}and root length showed comparativelythe best results under plastic tunnels as compared to the open field growing condition. Cuttings planted on March 17thshowed the best performance as compared to the other planting dates.

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Introduction

Leucophyllum frutescens belonging to family *Scrophulariaceae* is a medium-sized shrub with compact growth and delicate silvery to gray-green leaves. Itis one of themost outstanding native plants having stunning displays of prolific purple blooms from summer to fall and also known as "barometer bush". *Leucophyllum frutescens* normally grows up to a height of 0.9-2.4 m with a canopy of 0.9-1.8 m. It bears 1.3-2.5 cm alternate leaves, roofed with silver pubescence. It bears 1.3-2.5 cm purple solitary axillary flowers having five lobed with spotted throats. It fully blooms for a glorious week long display after summer rains, because flowering is triggered by humidity or high soil moisture after rains (Duever, 2000).

It is a fashionable ornamental plant and commonly used for edge and area plantation in warmer and drier areas. Its water requirement is less and easily shaped into hedges, and blooms over the inclusive surface (Johnst 2008).It alsoplayan important role in beautifyingthe natural or desert gardens and also has high values in planting as a foundation plant and shrubbery border. It is a popular plant in xeriscape design.

Recently department of Horticulture, The University of Agriculture Peshawar, Khyber Pakhtunkhwa Pakistan successfully usedthis species as topiary on main campus. Once established, it requires little to no water but care should be taken during the root establishment stage. It grows well in hot environmental conditions. Due to its colorful flowers and low maintenance itis fit for any landscape design. It prefers well-drained soil and usually will rot out if watered excessively. Plants become leggy as a result of excess fertilizer, water and shade (Papp, 2007).

The dried leaves and flower of *L. frutescens*have some medicinal values as well. Mexican Indians brewed these into a pleasant herbal tea and used for the treatment of chills and common cold fever (Vines, 2004). The extraction of *L. frutescens* has hepatoprotective effect in carbon chloride (CCl_4) induced liver damage. Oxidative stress markers and molecular assays determination is important for conformation of this claim. It is also necessary to find out the isolation and purification principle involved in hepatoprotective activity and its mechanism of action (Isaias *et al.* 2007).

Favorable environment to the underground root system establishment plays a vital role in the nourishment and development of aerial shoot system of the plant. Inappropriate time plantations slow down the growth rate and also reduce the survival percentage. Low night temperature significantly enhances optimum growth, flowering and fruiting. Many plants grown well in the full bright light, while other lead to death (Whitecomb, 1983). It is extremely drought and heat tolerant and maintenance-free when established.

Not so long ago, there was single selection of *L. frutescence*. It is normally propagated through seed and cutting but rooting of this plant was difficult under the agro environmental conditions of Peshawar, and the nurserymen faced difficulties in propagation of this species. Keeping that in consideration, the project was designed to observe the response of *L. frutescens* softwood cuttings under different growing conditions i.e. open field and under plastic tunnels. The study was aimed atdiscovering the best planting date and growing condition for the successful root initiation under agro ecological conditions of Peshawar Pakistan.

Material and methods

Field trial

A field experiment was conducted in a randomized complete block design (RCBD) with split plot arrangement replicated four times to test different growing conditions i.e. open field and under plastic tunnels and five different planting dates with 15 days of equal interval i.e. 15th January, 31st January, 15th February, 2nd March and 17th March. The experiment was conducted at Ornamental Nursery, Department of Horticulture, The University of Agriculture Peshawar, Pakistan during 2011. The soil texture of

experiment was silt loam having a pH 7.92 with electrical conductivity 1.19, organic matter 3%, total nitrogen 0.045%, Phosphorous 0.02 mg kg^{-1} and potassium 43.4 mg kg^{-1}.The growing conditions were assigned to main plots, while the planting dates were subjected to sub plots

Long tip cuttings & Plastic tunnels

Long tip cuttings of 15cm were taken from healthy and vigorous plants. Each cutting had six leaves at the tip and four buds, the lower leaves were removed. At the lower end a slanting cut was given for easy insertion in media and exposing the maximum cambium for rooting. Leaf mold, silt and garden soil at the ratio of 2:1:1 was mixed to prepare the media. Perforated polythene bags of 7" x 5" size were filled with this media mixture. Proper drainage was managed to prevent fungal infection of the roots. The bags were placed on a plastic sheet, in order to prevent the roots from touching the ground soil. All the cuttings were inserted up to two third portionsin the media filled bags while one third was left above the media. From 7th March, 2011 plastic cover from the entire plastic tunnels were partially removed due to rise in temperature above 50°C under plastic tunnels in the day time, while covered in the evening.

Root length, weight, thickness & Number of roots plant-1

Root system of the survived plants were dug out and gently washed through tap water and then roots per plants were counted in each treatment.Root length was measured from the base to the tip of root and mean was evaluated. Root thickness was measured at a point three centimeters from the base of root by using vernier caliper. Properly washed separated root from the plants than weighted with the help of electrical balance.

Statistical analysis

Collected data during experiment were statistically analyzed in terms complete randomized block design with split plot arrangement to study the difference between treatments and also observed their interactions. In case of significant difference among the parameters means were further analyzed for difference through least significant difference (LSD) test. MSTATC (Michigan State University, USA) statistical computer software was functional for computing analysis of variance (ANOVA) as well as LSD test. (Jan *et al.* 2009).

Results and discussions

Number of roots plant-1

The data concerning number of roots $plant^{-1}$in Table 1 showed that both growing conditions and planting dates had significant influence ($P \leq 0.01$) on number of roots $plant^{-1}$. The interaction of growing conditions and planting dates for number of roots $plant^{-1}$ was non significant. According to the mean values, higher number of roots $plant^{-1}$ (43.51) was observed in cuttings under plastic tunnel growing conditions than in open field conditions (27.04). Among the planting dates, maximum number of roots $plant^{-1}$ (48.54) was recorded in cuttings of March 17th plantation, followed by 43.91in March 2nd plantation while minimum number of roots $plant^{-1}$(19.58) was noted in January 15th plantation.

Table 1. Influence of growing conditions and planting dates on number of roots $plant^{-1}$.

Planting dates	Growing conditions		Mean
	Open field	Plastic tunnel	
January 15th	12.75	26.42	19.58 C
January 31st	14.75	35.75	25.25 C
February 15th	33.47	44.75	39.11 B
March 2nd	35.41	52.41	43.91 AB
March 17th	38.83	58.25	48.54 A
Mean	27.04 B	43.51 A	

LSD value for Dates at 1% level of probability = 6.901Means followed by same letters are not significantly different by using LSD at 1 % (upper cases) level of significance.

The higher number of roots plant^{-1} in plastic tunnel growing condition may be due to the excellent development of shoot system like number of sprouts, sprout length, sprout diameter and maximum number of leaves cutting^{-1} were recorded under plastic tunnels, these in turn in more accumulation of photosynthates that triggered more number of roots. The lowest number of roots in open field condition may be due to the poor growth of aerial shoot system. Planting dates mean values produced maximum number of roots on March 17th plantation because of favorable temperature and humidity range for aerial growth, which established strong roots system. These findings are in accordance with Dahab (1992) that plastic tunnel improved roots initiation due to high humidity and optimum temperature, which established proper microenvironment needed for root initiation. Similarly, Gustavsson (1999) reported that cuttings planted inside a covered polyethylene sheet showed enhanced rooting.

Table 2. Influence of growing conditions and planting dates on root length (cm).

Planting dates	Growing conditions		Means
	Open field	Plastic tunnel	
January 15th	08.36	10.92	09.64 BC
January 31st	04.40	11.92	08.16 C
February 15th	10.19	11.23	10.71 B
March 2nd	11.52	15.12	13.32 A
March 17th	09.91	17.49	13.70 A
Mean	08.86 B	13.34 A	

LSD value for Dates at 1% level of probability = 2.083.

LSD value for interaction at 1% level of probability = 2.945.

Means followed by same letters are not significantly different by using LSD at 1 % (upper case) level of significance.

The results are also in agreement with Saranga and Cameron (2007), who stated that keeping hard to root species cuttings in well caring and supporting atmosphere, trigger the rooting ability. Miyajima*et al.* (2004) revealed that 5-10cm long *Jacaranda mimosifolia* soft wood cuttings obtained from young shoot without IBA treatment produced more roots than hard wood cuttings under same conditions. Similarly, the younger shoots have three times more rooting ability than mature ones Munoz *et al.* (2009). The findings are in partial agreement with Hernandez and Leal (1997) who reported best rooting percentage of softwood cuttings treated with 600ppm IBA concentration.

Table 3. Influence of growing conditions and planting dates on root thickness (cm).

Planting dates	Growing conditions		Means
	Open field	Plastic tunnel	
January 15th	0.07	0.07	0.07 ab
January 31st	0.05	0.07	0.06 b
February 15th	0.06	0.07	0.06 b
March 2nd	0.06	0.09	0.07 ab
March 17th	0.07	0.09	0.08 a
Mean	0.04 b	0.08 a	

LSD value for Dates at 5% level of probability = 0.01422.

Means followed by same letters are not significantly different by using LSD at 5 % (lower case) level of significance.

Root length (cm)

The mean data related to root length (cm) showed that growing conditions, planting dates as well as their interaction hada significant effect (P≤ 0.01) on root length of cuttings (Table 2). Greater root length (13.34 cm) was recorded in cuttings under plastic tunnels conditions than in open field conditions (8.87 cm). Among the results of various planting dates, maximum root length of 13.70 cm was observed in March 17th, followed by March 2nd plantation (13.32 cm), while the root length observed in January 31st plantation was minimum (8.16 cm). In case of the interaction of growing conditions and planting dates, maximum (17.49 cm) root length was recorded for cuttings planted under plastic tunnels, grown on March 17th, while the minimum (4.40 cm) root length was recorded for January 31st plantation in open field conditions.

Table 4. Influence of growing conditions and planting dates on root weight (g).

Planting dates	Growing conditions		Mean
	Open field	Plastic tunnel	
January 15th	0.12	0.15	0.14 B
January 31st	0.08	0.18	0.13 B
February 15th	0.12	0.15	0.14 B
March 2nd	0.13	0.24	0.18 A
March 17th	0.16	0.28	0.22 A
Mean	0.12 b	0.20 a	

LSD value for Dates at 1% level of probability = 0.04615.

Means followed by same letters are not significantly different by using LSD at 1 % (upper case) and 5 % (lower case) level of significance.

The highest root length under plastic tunnels growing condition may be attributed to extra vigorous aerial growth and development which resulted in maximum underground growth in the way to keep root-shoot ratio in equilibrium. As far as the influence of planting dates is concerned, the longest root length was observed in cuttings planted on March 2nd and March 17th while the shortest root length was noted in cuttings planted on January 31st. The possible reason for longest roots on March 2nd and March 17th plantation may be the favorable agro environmental conditions received by the cuttings to develop shoot and root system. The favorable conditions also activate root promoting substances, which result in maximum root length. The results are in agreement with Elgimabi (2009) who stated that cuttings under plastic tunnels with mist produced the maximum number and longest roots. Muhabat*et al.* (2006) declared silt media for softwood cuttings to produce longest roots. Asif*et al.* (2013) stated that root length increases in normal condition while, decreases in water stress condition. Likewise Puri and Verma (1996) revealed that softwood cuttings in spring and monsoon treated with auxins (NAA and IBA) at 100 mg^{-1} produced longer roots.

Root thickness (cm)

The growing conditions and planting dates had a significant effect (P≤ 0.05) on root thickness of the planted cuttings, while the interaction of growing conditions and planting dates for the root thickness was non-significant. According to the mean values of experimental findings presented in table 3, thicker roots (0.08 cm) were recorded in cuttings under plastic tunnels growing conditions than in open field growing conditions (0.06 cm). Maximum root thickness of (0.08 cm) was recorded in cuttings of March 17th plantation, followed by March 2nd (0.07 cm) and January 15th (0.07 cm) plantation, while, minimum root thickness of (0.06 cm) was observed in January 31st plantation. Under the plastic tunnels growing conditions, thicker roots of the cuttings were observed as compared to that of open field growing conditions. The cause would be that the cuttings under the plastic tunnels conditions achieved maximum aerial growth. As a result, they produced

thicker roots as compared to that of open field growing conditions, where the aerial growth of the cuttings was not that much vigorous. The current results are partially supported by Sharma and Aier (1989) statement that plum cuttings treated with IBA 3000mgL^{-1} concentration gave thickest and longest primary roots during dormant and autumn seasons.

Root weight (gm)

Root weight was significantly ($P \leq 0.01$) influenced by growing conditions and planting dates, while their interaction was found non significant. Table 4 indicates that cuttings planted inside the plastic tunnel produced more root weight (0.20 gm) as compared to that of cuttings planted in open field conditions (0.12 gm). Table 4 also showed that maximum root weight (0.22 gm) was recorded for cuttings planted on March 17th, followed by (0.18 gm) March 2nd plantation while the minimum (0.13 gm) root weight was recorded in cuttings planted on January 31st followed by January 15th (0.14 gm) and February 15th (0.14 gm) plantation.

The heaviest root weight of the cuttings planted inside plastic tunnels could be credited to the fact that plastic tunnels cuttings produced roots with maximum length, thickness and number of roots plant^{-1} as compared to those of open field cuttings, which had less aerial and underground growth. According to planting dates effect, the maximum and minimum root weights were obtained by cuttings planted on March 17th and January 31st, respectively. This may be because of the availability of reserved food materials in cuttings and the influence of different environmental conditions. March 17th plantations got favorable environmental condition for growth hence, produced maximum, longer and thicker roots. Cuttings planted on January 31st gained lighter roots weight due to less favorable environmental condition. The outcome of the study is in partial agreement with Muhabat*et al.* (2006), who found out that soft wood cuttings produced maximum root weight when planted in silt. Also in partial agreement with research works of Arene and Renoxu (2000), who stated that hardwood cuttings rooted vigorously in terms of root length, thickness and weight, without growth regulators.

Conclusion

On the bases of current research work, it can be concluded that the comparative best results in most parameters were achieved under plastic tunnels as compare to those of open field growing condition. Cuttings planted on March 2nd and March 17thof the season gave statistically similar results in most of the cases to that of other planting dates. However, cuttings planted on March 17th performed the best in all parameters as compared to the other planting dates under the agro environmental condition of Peshawar, Pakistan.

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