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RESPONSE OF PLANE TREE *(PLATANUS ORIENTALIS*) TO CUTTINGS AND PLANTING DATES

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ABSTRACT

Field experiment was carried out at Ornamental Nursery, Department of Horticulture, Khyber Pakhtunkhwa (KP) Agricultural University Peshawar, during 2009 to study "the response of plane tree cuttings to different planting dates". Three types of cuttings (hardwood cuttings, semi-hardwood cuttings, Softwood cuttings) and three dates (6th January, 21st January and 5th February) were studied. The experiment was laid out in Randomized Complete Block Design (RCBD) with split plot arrangement. Sprouting percentage (%), survival percentage (%), plant height (cm), number of leaves plant^{-1}, stem thickness (cm), Stem weight (g), Number of roots plant^{-1}, Root length (cm) and Root weight (g) were significantly affected by types of cuttings and different planting dates. Hardwood cuttings showed that maximum sprouting percentage (57.56%), survival percentage (44.78%), plant height (182.64cm), number of leaves plant^{-1} (26.47), stem thickness (1.26cm), stem weight (95.58g), number of roots plant^{-1} (12.55), root length (47.25cm) and root weight (28.12g), while in case of planting dates maximum sprouting percentage (48.56%), survival percentage (40.56%), number of leaves plant^{-1} (25.33), stem thickness (1.07cm), stem weight (88.00g), number of roots plant^{-1} (10.55) and root weight (19.89g) were observed in cuttings planted on 6th January. The results of interactions showed that maximum sprouting percentage (75.67%), survival percentage (65.67%), plant height (195.50cm) and maximum number of leaves plant^{-1} (29.77) were observed in hardwood cuttings planted on 6th January. Hardwood cuttings performed best in most of the parameters while Semi-hardwood and Softwood cuttings showed poor performance. It may be concluded that planting hardwood cuttings enhances sprouting percentage (%), percent survival and other physiological parameters. Among planting dates 6th January is recommended for hardwood cuttings propagation of plane tree.

Key words: Chinar/Plane tree (*Platanus orientalis)*, cutting types, planting dates and growth percentage

INTRODUCTION

Platanus orientalis (Chinar, Plane tree) belongs to family *Platanacea*. It is especially popular in Europe, Asia and North America. It is a large deciduous tree, native to temperate regions, 20 to 25m tall with diameter of 1 to 3 meter. The tree shape is variable, it sometimes forms a single tall trunk, but more commonly it branches low above ground with many branches from this height and no clear leader. Plane tree does not grow in the shade (Huxley, 1992). The male flowers are densely crowded rounded heads and the tree is monoecious in nature. The female flowers are similar to the male flowers and bloom between March and May. The seed mature from June through August (Sheikh, 1993). Plane trees are generally propagated through cuttings (Gordienko, 2000). Hardwood cuttings were a best technique for plane tree propagation when practiced in dormant season (Eldeen and Elgimabi, 2009). High sprouting, percent survival and vigorous growth were observed for basal (hardwood) cuttings of America sycamore planted earlier in winter (Yong and KiSum, 1996). The dormant cuttings of Arizona sycamore planted in fall rooted easily and vigorously as compared to spring planted hardwood and semi- hardwood cuttings. The dormant cutting had sufficient food reserves as compared to the newly developed shoots during spring (Catherine *et al*., 1993). Plane tree is very important ornamental tree, in most of the areas it is planted as shade tree. For avenue and street plantation it is very useful because it is tolerant to air pollution. Under the climatic conditions of Peshawar valley, Pakistan plane tree (Chinar) is propagated through cuttings, but the common nurserymen and other growers are not familiar with the type of cuttings to be used and proper planting date. Keeping in view the importance of vegetative propagation in the development and growth of different ornamental and fruit plants the present research was therefore designed to find out the proper planting date and type of cuttings to be used for plane tree vegetative propagation under the agro climatic conditions of Peshawar.

MATERIALS AND METHODS

Field studies were conducted to record the response of plane tree cuttings to different planting dates" at Ornamental Nursery, Department of Horticulture, Khyber Pukhtoonkhwa (KP) Agricultural University

Peshawar, during 2009. The cuttings were taken from terminal (softwood), middle (semi-hardwood) and base (hardwood) of one year old shoots and planted in Randomized Complete Block Design (RCBD) with split plot arrangement replicated thrice. Cuttings were allotted to sub plots while different dates were kept in main plots. Sub plot size of 1.6 m^2 was used. There were twenty seven cuttings in each treatment. Plant to plant distance was kept 10 cm and there were 10 cuttings in each row. The soil of the experimental site was analyzed in the department of soil and environmental sciences, KP agricultural university Peshawar. The soil samples were taken at the depth of 25 cm which has Electric Conductivity (0.1dS m^{-1}), Organic Matter (0.75 %), Nitrogen (N) (1.00 mg kg^{-1}), P_2O_5(0.085 %), K_2O (69.26 mg kg^{-1}), Ph (8.2), Iron (Fe) (5.61 mg kg^{-1}), Copper (Cu) (3.46 mg kg^{-1}), Zinc (Zn) (2.39 mg kg^{-1}), and Manganese (Mn) (6.22 mg kg^{-1}). All cultural practices like hoeing, weeding, irrigation etc were carried out uniformly. The growth parameters studied were number of cuttings sprouted (%), survival percentage (%), plant height (cm), number of leaves $plant^{-1}$, stem thickness (cm), number of roots $plant^{-1}$ and root weight (g). The numbers of sprouted cuttings were counted for all treatments in each replication and the percentage was calculated by the following formula:

$$\text{Sprouting percentage (\%)} = \frac{\text{No. of cuttings sprouted}}{\text{Total No. of cuttings planted}} \times 100$$

The survival of cuttings was worked out with the help of the following formula.

$$\text{Survival percentage (\%)} = \frac{\text{No. of plants survived}}{\text{Total No. of cuttings sprouted}} \times 100$$

Plant height was measured in the month of October when the growth seized in centimeters with the help of measuring tap from the point of sprouting to the apex of the highest shoot. The number of leaves $plant^{-1}$ of each type of cutting was randomly counted for all treatments in each replication and average was calculated. Stem thickness was measured with the help of vernier caliper for all treatments in each replication and average was calculated. For the number of roots $plant^{-1,}$ the plants were uprooted carefully with soil ball, the root system was gently washed and the roots $cutting^{-1}$ was counted. All the roots were cut off from the stem, washed and dried and then weight was measured with the help of electronic balance and average was calculated for all treatments in each replication. The data recorded for each trait were individually subjected to the ANOVA Technique by using MSTATC computer software and means were separated by using Fisher's LSD test (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Number of Cuttings Sprouted (%): The data presented in table 1, revealed that types of cuttings, different planting dates as well as their interaction significantly affected sprouting percentage. Different types of cuttings showed that maximum sprouting (57.56%) was recorded in hardwood cuttings, followed by semi-hardwood cuttings (42.67%), while minimum sprouting (37.44%) was recorded in softwood cuttings. In case of planting dates maximum sprouting (48.56%) was found in cuttings planted on 6th January, followed by cuttings planted on 21st January (45.89%) while minimum sprouting percentage (43.22%) was recorded in cuttings planted on 5th February. The interaction effects were statistically significant, the maximum sprouting (75.67%) was observed in hardwood cuttings planted on 6th January, while minimum sprouting (30.67%) was recorded in softwood cuttings planted on 6th January (Figure 1). Generally hardwood cuttings sprouted more than semi-hardwood and softwood cuttings which may be attributed to the environmental conditions as well as to the reserved food in the cuttings and quick water loss from the soft tissues (Yong and KiSum, 1996). The planting dates significantly influenced the growth and yield components of wheat (Baloch *et al.,* 2010).

Survival percentage (%): The analysis of data showed significant difference for survival percentage (%). The maximum survival percentage (44.78%) was observed in hardwood cuttings, followed by semi-hardwood cuttings (31.11%), while minimum survival percentage (26.89%) was recorded in softwood cuttings (Table 1). The mean values of different planting dates indicated highly significance, where maximum percent plant survival (40.56%) was recorded in cuttings planted on 6th January followed by cuttings planted on 21st January (32.22%) while minimum percent plant survival (30.00%) was obtained in cuttings planted on 5th February. In case of interaction, maximum percent plant survival (65.67%) was observed in hardwood cuttings planted on 6th January. While minimum percent plant survival (22.67%) was recorded for semi-hardwood wood cuttings planted on 5th February (Figure 2). As percent sprouting was more in hardwood cuttings and minimum in softwood cuttings, which collaborates with maximum and minimum percent plant survival in hardwood and softwood cuttings respectively. Which means that survival is in direct relation with sprouting and is possible that the hardwood cuttings having more sprouting would have a higher survival as well. Because improved and faster sprouting, created cooperated competition among the plants for light, water and nutrients and resulted in increase percent plant survival. The soft and hard wood cutting of *C. Canadensis* rooted best with application

plant growth regulator which subsequently enhanced the plant survival percentage (Woodridge *et al.,* 2007)

Plant Height (cm): The data given in table 1 showed that plant height was significantly affected by the types of cuttings. The maximum plant height (182.64cm) was gained by hardwood cuttings, followed by semi-hardwood cuttings (124.63cm), while minimum plant height (119.54cm) was recorded in softwood cuttings. The enhanced plant height in hardwood cuttings may be due maximum number of leaves plant^{-1}, roots plant^{-1} and roots length which resulted in more photosynthesis and more nutrients and water absorption. The maximum height gained by the hardwood cuttings can be attributed to the fact that plant got maximum aerial as well as under ground growth which was favored by optimum environmental conditions and also helped in improved and faster sprouting, which created cooperated competition among the plants for light, water and nutrients and resulted in taller plants. While minimum height attained by the softwood cuttings can be attributed to less favourable environmental conditions. The results are in agreement with the work of (Eldeen and Elgimabi, 2009) who reported that basal cuttings have been shown to improve plant stand.

Number of Leaves plant^{-1}: The data pertaining to number of leaves plant^{-1} presented in table 1 showed that different types of cuttings and different planting dates had significant effect regarding this parameter. Maximum number of leaves plant^{-1} (26.47) was counted in hardwood cuttings followed by semi-hardwood cuttings (22.51), while softwood produced minimum number of leaves plant^{-1} (18.70). Different planting dates had also significant effect on the number of leaves plant^{-1}, as it is clear from the table that maximum number of leaves plant^{-1} (25.33) were recorded for cuttings planted on 6th January, followed by cuttings planted on 21st January (22.66), while minimum number of leaves plant^{-1} (19.70) was recorded for cuttings planted on 5th February (Table 1). As it is evident that more height was gained by hardwood cuttings and less plant height was noted for softwood cuttings similarly maximum and minimum number of leaves were also recorded for the same cuttings respectively, which show that height and leaves are in direct relation to each other. The different mean values for different times of plantation revealed that maximum number of leaves were produced by the cuttings, planted on 6th January while minimum were produced by the cuttings, planted on 5th February (Figure 3), which can be justified as, 6th January plantation produced maximum plant height and more number of roots which ultimately resulted in more number of leaves because they received the optimum environment. While the plantation on 5th February produced minimum plant height and less number of roots which resulted in less number of leaves as they might get less favourable environmental conditions. The results are supported by the work of Yong and Kisum, (1996) who reported that types of cuttings had a significant effect on propagation of America sycamore in terms of sprouting percentage (%), percent survival (%) and vigorous growth, and hence more leaves plant^{-1} were observed for basal cuttings planted earlier in winter.

Stem Thickness (cm): Stem thickness was significantly affected by types of cuttings and different planting dates. Hardwood cuttings had maximum stem thickness of (1.26cm), followed by semi-hardwood cuttings (0.92cm), where as softwood cuttings had minimum (0.81cm) stem thickness. The dates effect is also significant and cuttings planted on 6th January had (1.07cm) stem thickness, followed by 21st January (1.03cm) plantation, while minimum stem thickness (0.89cm) (Table 1) was recorded in cuttings planted on 5th February. The maximum stem thickness of hardwood cuttings, may be attributed to the tallest plant height, more number of roots and leaves plant^{-1}. Mean values for different planting dates revealed that maximum stem thickness was recorded in hardwood cuttings, planted on 6th January the probable reason may be the environmental factor. As hardwood cutting produced more number of leaves and gained more height so greater exposure to the sun is permitted and hence more food is available for the plant that is why stem thickness is more in hardwood cuttings as compared to semi-hardwood and softwood cuttings. *C*ommelin elm (*U.hollandica)* can be propagated by hardwood cutting in late winter placed in a bin for 6 weeks before planting, which ultimately increased the stem diameter with the passage of time (Whalley, 1975).

Number of Roots plant^{-1}: Numbers of roots plant^{-1} were significantly affected by different planting dates as well as types of cuttings. Maximum number of roots plant^{-1} (10.55) was recorded in cuttings planted on 6th January , followed by cuttings planted on 21st January(8.37), while minimum number of roots plant^{-1} (7.07) was observed in cuttings planted on 5th February. Mean values for cuttings showed that maximum number of roots plant^{-1} (12.55) was found in hardwood cuttings, followed by semi-hardwood cuttings (8.07), while minimum number of roots plant^{-1} (5.37) was recorded in softwood cuttings (Table 1). More number of leaves plant^{-1} in hardwood cuttings may be attributed to the maximum aerial growth like plant height, stem thickness and weight, which lead to maximum photosynthates accumulation and ultimately resulted in maximum number of roots. The minimum number of roots in softwood cuttings may be attributed to the minimum values of the above mentioned parameters. As far as the dated effects are concerned the maximum roots were produced by cuttings, planted on 6th January and the minimum were recorded for the cuttings, planted on 5th February, because the 6th January plantation got maximum survival, plant height, stem weight, thickness

and number of leaves plant^{-1} due to favorable environment which finally resulted into maximum aerial as well as under ground growth, while the minimum number may be attributed to the minimum values of the above mentioned parameters due to unfavorable environmental condition received by the cuttings, planted on 5th February.

Table 1: Effect of planting dates and cutting types on growth of plane tree (Chinar) cuttings.

Cutting Dates (D)	Sprouting percentage (%)	Survival percentage (%)	Plant height (cm)	Number of leaves plant^{-1}	Stem thickness (cm)	Number of roots plant^{-1}	Root weight (g)
Jan. 6th	48.56 ^{a}	40.56 ^{a}	144.69	25.33 ^{a}	1.07 ^{a}	10.55 ^{a}	19.89
Jan. 21st	45.89 ^{ab}	32.22 ^{b}	133.27	22.66 ^{a}	1.03 ^{a}	8.37 ^{ab}	17.74
Feb. 5th	43.22 ^{b}	30.00 ^{b}	148.87	19.70 ^{b}	0.89 ^{b}	7.07 ^{b}	18.52
LSD	3.322	5.402	NS	2.75	0.12	2.309	NS
Cutting types (C)							
Hardwood	57.56 ^{a}	44.78 ^{a}	182.64 ^{a}	26.47 ^{a}	1.26 ^{a}	12.55 ^{a}	28.12 ^{a}
Semi-hardwood	42.67 ^{b}	31.11 ^{b}	124.63 ^{b}	22.51 ^{b}	0.92 ^{b}	8.07 ^{b}	15.28 ^{b}
Softwood	37.44 ^{c}	26.89 ^{b}	119.54 ^{b}	18.70 ^{c}	0.81 ^{b}	5.37 ^{c}	12.76 ^{c}
LSD	4.663	4.766	16.92	4.10	0.23	1.140	2.074
Interaction	**Level of Significance**						
D × C	*	*	NS	*	NS	NS	NS

Means followed by the same letter are not significantly different using LSD at 5% level of probability.

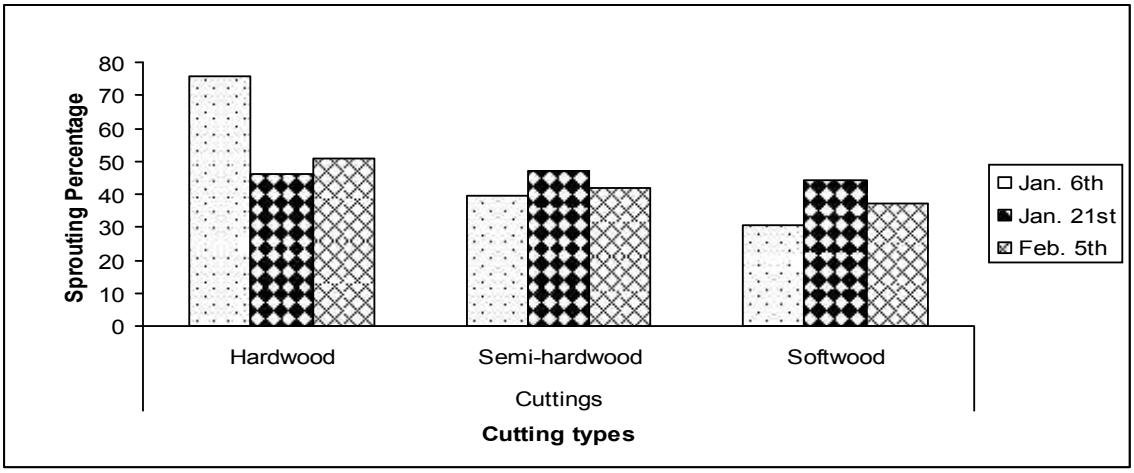

Figure 1. Effect of planting dates and cutting types on sprouting percentage of plane tree

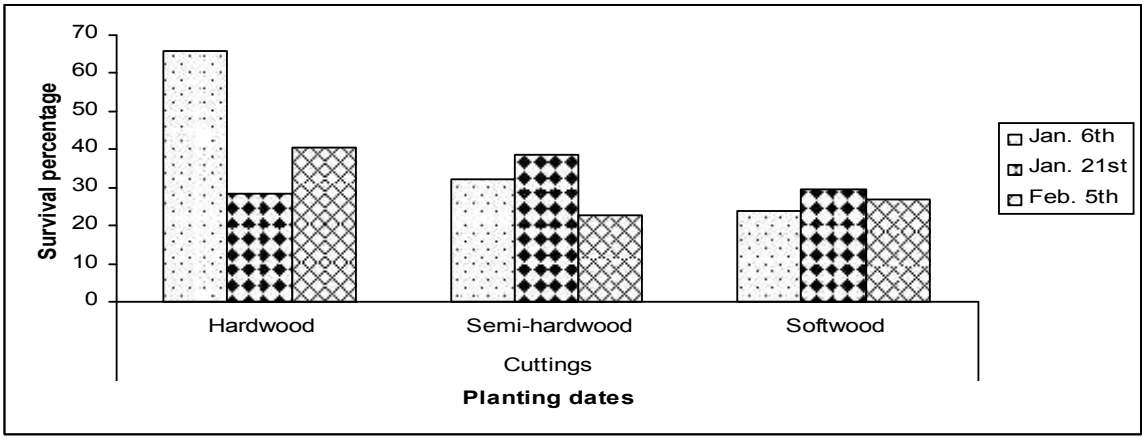

Figure 2. Effect of planting dates and cutting types on survival percentage of plane tree

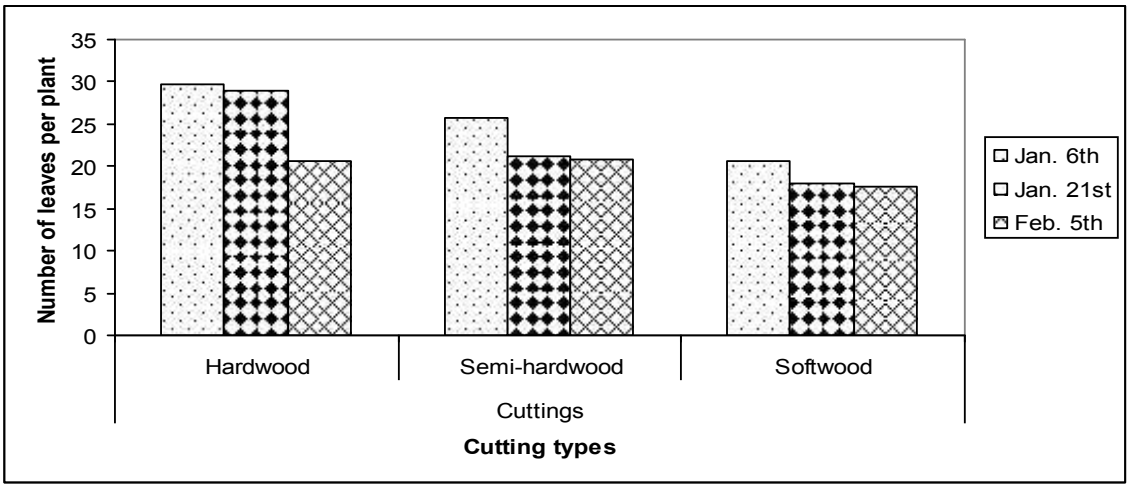

Figure 3. Effect of planting dates and cutting types on number of leaves per plant of plane tree

Root Weight (g): Root weight plant^{-1} was significantly affected by types of cuttings, while planting dates as well as interaction had non significant effect. The results are presented in table 1. Maximum root weight (19.89 g) was observed in the cuttings planted on 6th January, followed by the cuttings planted on 5th February (18.52 g), while minimum root weight (17.74 g) was recorded for cuttings planted on 21st January. Comparing the mean values for cuttings it is clear from the table that maximum root weight (28.12 g) was recorded for hardwood cuttings, followed by semi-hardwood cuttings (15.28 g), while minimum (12.76 g) was noted for softwood cuttings. Maximum and minimum root weight were observed in hardwood and softwood cuttings respectively, which is attributed to the fact that hardwood cuttings, produced more number of roots plant^{-1} and root thickness which resulted in heavier roots while softwood cuttings produced lighter roots as compared to others. This may also be due to the reserved food in the cuttings and their differential response to different environmental conditions.

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