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Effect of Cutting Source and Size on the Poplar (*Populus deltoides* Marsh.) Nursery Performance

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ABSTRACT

There are many factors, influencing the propagation of cuttings, which include age, topophysis, periphysis and cyclophysis, season of collection, size, moisture, nutrient status of cuttings, etc. The size of the cuttings and position of the plant from where the cuttings have to be taken play a great role on the growth and development of the plants. Therefore, in formulating workable procedures for propagating superior poplar clones vegetatively, present study was planned and undertaken in the experimental area of the Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana. Seven recommended clones of *Populus deltoides* were taken for the study. Cuttings from basal, middle and terminal position were taken after dividing the one year old nursery plant in three equal parts. Care was taken to maintain the uniform diameter of the cuttings. Observations on different growth parameters were recorded after one year of the growth in the winter season. Survival per cent was found to be maximum in cuttings taken from basal portion (71.94%) followed by middle portion (66.89%) and upper portion (62.80%). Data on the collar diameter and plant height exhibited non-significant differences. However, the interclonal differences in collar diameter and plant height were found to be non significant. Better performance of the cuttings taken from bottom one third of the plants as compared to those taken from either middle or top one third of the plants can be partly due to an uneven distribution of inhibiting substances in different parts of the shoot (FAO 1979).

Key words:

Nursery, poplar, cutting position, growth

INTRODUCTION

Populus detloides is one of the most widely planted exotic tree species in north-western states of India. It is an extremely fast growing with broad site adaptability. The characteristics like clean bole, leaflessness during winter, multiple uses, compatibility with agricultural crops and high economic returns, make this species most ideal for planting on agricultural fields and around fruit orchards/cattle sheds/farm roads/homesteads, etc. Poplars are contributing immensely towards production of wood for industrial and other commercial purposes, besides maintaining ecological balance and generating on/off-farm employment. There are many factors influencing the propagation of cuttings, which include age, season of cutting collection, size, nutrient status of

cuttings, pre-planting treatment, fungal infection, after planting management, etc. The recommendations of seven new clones (PLI to PL7) for plantation in Punjab has necessitated the standardization of nursery practices for these clones. The size and position of the cuttings in plant from where the cuttings are taken, play a great role on growth and development of the plants. In general, longer cuttings taken from the lower parts of the plant produce better results, but with rise in demand for quality planting stock, the use of longer cuttings from basal portion only is not worthwhile. Therefore, in formulating working procedures for propagating superior poplar clones vegetatively, present study was planned to work out the appropriate cutting source from the donor plants.

MATERIALS AND METHODS

The present studies were carried out in the Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana to standardize appropriate cutting size and position of cutting collection from donor nursery plants. The experimental site is situated at 247m above mean sea level and lies between 30°45'N latitude and 75°40' E longitude. The climate is sub-tropical to tropical and rains are concentrated during July-August. The nursery soil was loamy sand (sand = 82 %, silt =10.8 % and clay = 7.2 %) with low organic carbon (0.15%). The soil was found slightly alkaline in reaction (8.0), low in alkaline $KMnO_4$-extractable N (83kg ha^{-1}), medium in 0.5N $NaHCO_3$-extractable P (11.5 kg ha^{-1}) and medium in NH_4OAc-extractable K (165kg ha^{-1}).

Clones recommended by the Department of Forestry Natural Resources, Punjab Agricultural University, Ludhiana i.e., PL1 (L-39/84), PL2 (L-71/84), PL3 (L-154/84), PL4 (L-313/85), PL5 (G-48), PL6 (L-188/84) and PL7 (113324) were used for the study. One year old nursery plants with four cutting lengths (5cm, 10cm, 15cm and 20cm), three diameters (1.0-1.75cm, 1.75-2.50cm and 2.50-3.25cm) and three cuttings positions (basal, middle and upper) were taken. The sixteen cuttings per treatment per replication were raised in the last week of February at 45x45cm^2 row to row and plant to plant distance with 16 number of observation plants. Two experiments were laid-out separately in split plot design in three replications with clones in main plot and cutting length x cutting position/cutting diameter in sub plots (clone and cutting length were common in both the experiments). Cuttings were cautiously prepared so that the cuttings with variable length had uniform diameter and the cuttings collected from different positions had uniform size. All the recommendations as suggested by Chauhan and Mahey (2008) for raising poplar nursery including irrigation, fertilization, etc. were followed. Observations on different growth parameters were taken after one growing season. The height of the rooted plants was taken with leveling staff and collar diameter with digital caliper. Plants were excavated to record the percentage of rooted cuttings and biomass (shoot as well as root). The data were suitably analyzed after following the procedure described by Gomez and Gomez (1984). Significant differences were tested with critical difference test at five per cent level. Only parameters exhibiting significant differences have been discussed here.

RESULTS AND DISCUSSION

The data in table 1 depicts the effect of cutting length on survival and growth of poplar plants. Survival per cent was maximum (86.31%) in 20 cm long cuttings. Cuttings having 5 cm length showed minimum survival per cent (49.01%). Similar results were obtained with respect to collar diameter, plant height, average root length, fresh root weight and dry root weight with the maximum values of 2.69 cm, 4.6 cm, 12.65 cm, 1.14 g and 0.68 g, respectively in 20 cm long cuttings. Number of roots were found to be maximum (21.30) in cuttings having 15 cm length. Cuttings with 5 cm length exhibited minimum collar diameter (2.04 cm), plant height (4.47 m), number of roots (12.02), average cut length (7.04 cm), fresh weight (0.33 g) and dry root weight (0.19 g).

Data in table 2 shows significant effect on the performance of cuttings in terms of growth parameters. The differences in different growth parameters with respect to cutting diameter may be due to the differences in stored material in the cuttings. As the food material is more in higher diameter cuttings, the performance increased with

Table 1: Effect of cutting length on survival and growth parameters

Parameter	Cutting length (cm)				$CD_{0.05}$
	5	10	15	20	
Rooting per cent*	40.48 (42.96)	56.17 (65.87)	66.40 (78.87)	68.46 (81.04)	5.69
Collar diameter (cm)	2.04	2.25	2.37	2.69	0.21
Plant height (m)	3.47	3.86	4.24	4.64	0.36
Internodal length (cm)	5.11	5.31	5.42	5.54	0.31
Fresh shoot weight (g)	347.6	818.1	970.8	1518.0	234.6
Number of roots	12.02	16.73	21.30	19.22	2.39
Root length (cm)	7.04	8.46	8.52	12.65	2.58
Fresh root weight (g)	0.33	0.69	0.92	1.14	0.06
Dry root weight (g)	0.19	0.41	0.55	0.68	0.03

* Figures in parentheses are original values and outside are arc transformed values

Table 2: Effect of cutting diameter on survival and growth parameters

Parameter	Cutting diameter (cm)			$CD_{0.05}$
	1.00-1.75	1.75-2.50	2.50-3.25	
Rooting per cent*	54.01 (64.36)	63.42 (75.07)	71.75 (84.25)	2.59
Collar diameter (cm)	2.18	2.35	2.70	0.13
Plant height (m)	3.67	3.95	4.42	0.15
Internodal length (cm)	5.32	5.28	5.44	NS
Fresh shoot weight (g)	871.9	853.6	915.2	NS
Number of roots	15.27	16.01	17.76	2.02
Root length (cm)	6.87	7.06	8.12	0.94
Fresh root weight (g)	0.68	0.80	0.98	0.06
Dry root weight (g)	0.41	0.49	0.59	0.04

* Figures in parentheses are original values and outside are arc transformed values

Table 3: Effect of cutting position on growth and root parameters

Parameter	Cutting position			$CD_{0.05}$
	Basal	Middle	Upper	
Rooting per cent*	61.16(71.94)	57.66(66.89)	54.82(62.80)	4.49
Collardiameter (cm)	2.39	2.33	2.30	NS
Plant height (m)	4.12	4.11	3.94	NS
Internodal length (cm)	5.19	5.03	4.89	0.27
Fresh shoot weight (g)	849.7	846.4	810.0	NS
Number of roots	19.86	17.64	14.45	2.07
Root length (cm)	10.82	9.36	7.33	2.24
Fresh root weight (g)	0.94	0.84	0.54	0.06
Dry root weight (g)	0.56	0.50	0.32	0.03

* Figures in parentheses are original values and outside are arc transformed values

increase in cutting diameter. Table 3 shows better survival (71.94%) in cuttings taken from basal position followed by significantly lower value of middle (66.89%) and upper position (62.80%). Collar diameter and plant height exhibited non-significant differences *w.r.t.* the different positions. Number of roots per plant, average root length, fresh root weight and dry root weight were found to be maximum in cuttings taken from basal position having the respective values of 19.86, 10.82 cm 0.94 g and 0.56 g (Table 3). Cuttings taken from upper portion of plant exhibited minimum number of roots per plant (14.45), fresh root weight (0.54 g) and dry root weight (0.32 g).

The interactions being complex to explain have not been included in this paper. The cuttings taken from middle position in clone PL2 had maximum survival (93.23%), whereas, cuttings taken from the upper portion in clone PL6 had minimum survival per cent (24.48%). Cuttings taken from basal portion of clones PL2 and PL3 exhibited statistically at par values (87.5 and 90.10%, respectively) with maximum survival per cent. The data in the Table 5 revealed that fresh root weight was found maximum in 20 cm long cuttings taken from basal portion of donor plant (1.380), whereas, cuttings taken from distal portion with 5 cm length has minimum fresh root weight (0.26 g). In other words, the two extreme interaction combinations exhibited maximum and minimum root biomass. The dry root weight followed the trend similar to fresh root weight.

A large variation observed in survival and growth characteristics among different clones of *Populus deltoides* may be because of genetic properties of the clones. Karnatak et al. (1994) and Toky et al (1996) reported significant variation in survival per cent of *Populus deltoides* clones. The variation in rooting among different clones *w.r.t.* cutting length and position may be due to the reserve food material and C/N ratio. Deal and Khosla (1983) attributed the increased shoot growth with the increase in size of cuttings to the enhanced root and leaf area development. Cuttings taken from basal portion had more C/N ration as compared to upper portion, which may have contributed to the best performance of the cuttings from the basal portion (FAO 1979).

The number of roots, root length, fresh and dry root weight found maximum in the basal portion in comparison to other positions may be

due to the reason that sugar content with basal portion increase because of increased basipetal transport of sugars (Breen and Muraoka 1973; Haissing 1974; Altman and Wareing 1975). Thus, it can be concluded that the cuttings taken from basal portion of clones having length of 20 cm should be used for producing good planting stock in the nursery.

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