Print : ISSN 0970-7662

Journal of Tree Sciences
online available at www.ists.in

Volume 31 No.1&2 June & December, 2012

Rooting Behavior of Different Poplar (*Populus deltoides* Marsh.) Clones With Respect to Cutting Size and Source

Sanjeev K Chauhan, Narinder Singh Thakur and R Sharma

Department of Forestry and Natural Resources ; Punjab Agricultural University, Ludhiana –141 004
chauhanpau@pau.edu

ABSTRACT

The introduction of new clones and nursery stock quality has assumed significance due to increased adoption of poplar in agroforestry in north-western states in India. Majority of farmers have been raising monoclonal plantations (G3/G48), which may be economical in short term but poses risk in long term due to narrow genetic base. The nursery stock has significant effect on the productivity of plantations and rooting behavior plays significant role in above ground growth, therefore, two separate experiments were conducted to record the clonal behavior for rooting. The source of cuttings was additional component included in the experiments for their integrated behavior with clones. It was recorded that the big size cuttings (length and diameter) taken from basal portion resulted in better rooting than the small size cuttings from terminal portion of donor plants.

Keywords:

Clones, cutting **P**oplar, rooting, size, source

INTRODUCTION

Six species of poplar are indigenous and species is grown since Mugal era in Kashmir valley. Poplar along the Srinagar – Baramulla road remained attraction of many old Bollywood movies. But *Populus detloides,* an exotic species became an integral component of onfarm planting from last thirty five years in north-western states of India, primarily for the diversification of traditional farming crop rotations, meet industrial/domestic timber requirements, avoid encroachment on absentee lands, employment generation, higher income, etc. This deciduous fast growing tree provides congenial conditions for the crops during winter season and better income than traditional crop rotations. The shifting of plywood industry from north eastern states due to shortage of raw material to north western states encouraged poplar cultivation. Over the years, new fast growing, disease free clones with enhanced industrial demands have encouraged the farmers to adopt poplar. It's high productivity and harvesting at short rotation has encouraged more plantations and presently approximate three lakh hectares area is under poplar in Punjab, Haryana, Uttar Pradesh and lower hills in Uttrakhand and Himachal Pradesh (Kumar and Singh, 2012). Large portion of Poplar wood is used in plywood industry, however, the diversified products from poplar wood has encourages the demand.

A large number of private nursery growers, Agricultural Universities and State Forest Departments provide the nursery plants to the growers. Poplar witnessed drastic growth during last one decade. Dhiman (2012) reported that approximately 48million nursery plants were

produced during 2011-12, which reflects the huge demand of poplar. It is important to mention that majority of poplar is grown on fertile agricultural land and very little on forest land. The selection of suitable clone and propagule is utmost important for the good quality nursery stock for the success of plantation. The size of the cuttings in plant from where the cuttings are taken, play a great role on rooting, growth and development of the nursery plants. Therefore, the present experiment was conducted to study the rooting behaviour in different recommended clones with variable cutting sizes.

MATERIALS AND METHODS

The study on rooting behavior of seven clones of different size cuttings was carried out in the Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana to The climate of the site is sub-tropical to tropical and 80 per cent of 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), medium in 0.5N $NaHCO_3$-extractable P (11.5kg/ha) and medium in NH_4OAc-extractable K (165kg/ha).

Clones 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 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) taken from one year old plantable nursery stock. Sixteen cuttings per treatment per replication were raised in the month of February at 45x45cm^2 row x plant distance. The two separate experiments were laid-out in split plot design in three replications with clones in main plot and cutting length x cutting diameter/position 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. All the recommendations as suggested by Chauhan and Mahey (2008) for raising poplar nursery including irrigation, fertilization, etc. were followed. Observations on different rooting parameters were taken after three and half month. The plants were uprooted cautiously to avoid any damage to the roots and after washing, number, length and weight was measured. The data were suitably analyzed after following the procedure described by Gomez and Gomez (1984). Significant differences were tested with critical difference test at 5% level. Only significant interaction effects on different parameters have been discussed here.

RESULTS AND DISCUSSION

The data in Table 1 depicting significant difference in root biomass. PL2 clone has maximum biomass but at par with PL4, PL6 and PL 7. Arya (1993) also recorded wide variability in rooting in different clones. The differences in clones for root weight may be due to the differences in genetic makeup of the clones. Good rooting is an essential criteria for the selection of clones, which help in better shoot growth. Bhrot (1995) also reported great variability in root characteristics among the different genotypes of poplar.

The effect of cutting length, diameter and their interaction on root parameters was also found significant (Table 2). Cuttings of 20cm length had highest number of roots, root length and biomass. Similarly root number, length and biomass increased with increase in cutting diameter and these effects were reflected in interaction as well. The higher root parameter values in thicker cuttings with more length may be due to more reserve food material (sugars) in comparison to small cuttings. The starch, which is more in longer and thicker cuttings might have resulted in more root length and number and ultimately the mass in longer and thicker cuttings.

Data in Table 3 shows significant effect on the rooting of cuttings in terms of source of cutting, whether they have been obtained from basal/middle/top portion of donor plant. The number of roots, root length, fresh and dry root weight found maximum in the basal portion in comparison to other positions (middle and top) 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).

Table 1: Rooting behavior of different poplar clones

Clone	Number of lateral roots per plant	Average rot length (cm)	Fresh root weight (g)	Dry root weight (g)
PL1	20.17	7.02	0.61	0.37
PL2	16.17	7.21	0.96	0.58
PL3	16.47	7.49	0.74	0.45
PL4	16.92	8.31	0.92	0.56
PL5	15.56	6.21	0.79	0.48
PL6	16.56	7.38	0.89	0.50
PL7	12.61	7.28	0.88	0.53
CD (0.05)	NS	NS	0.09	0.06

NS=non-significant

Table 2: Cutting length and diameter interaction on rooting behavior

Cutting length (cm)	Cutting diameter (cm) 1.0-1.75	1.76-2.50	2.51-3.25	Mean	CD (0.05)	
Root length (cm)					Cutting length	= 1.08
5	5.15	5.93	8.10	6.39	Cutting diameter	= 0.94
10	6.84	6.00	7.13	6.65	Cutting length x	
15	7.61	9.06	7.83	8.18	diameter	= 1.09
20	7.90	7.24	8.45	7.86		
Mean	6.87	7.06	8.12			
Lateral roots per plant						
5	10.86	11.19	16.43	12.83	Cutting length	= 2.33
10	14.00	13.29	15.38	14.22	Cutting diameter	= 2.02
15	18.33	18.76	14.81	17.30	Cutting length x	
20	17.90	20.81	24.43	21.05	diameter	=2.80
Mean	15.27	16.01	17.76			
Fresh root weight (g)*						
5	0.34 (0.20)	0.42 (0.25)	0.54 (0.33)	0.43 (0.26)	Cutting length	= 0.07 (0.04)
10	0.67 (0.40)	0.73 (0.44)	0.89 (0.54)	0.76 (0.46)	Cutting diameter	= 0.06 (0.04)
15	0.80 (0.48)	0.91 (0.55)	1.05 (0.63)	0.92 (0.56)	Cutting length x diameter	= 0.08 (0.08)
20	0.93 (0.56)	1.15 (0.70)	1.45 (0.88)	1.17 (0.71)		
Mean	0.68 (0.41)	0.80 (0.49)	0.98 (0.59)			

*Dry root weight in parentheses

Table 3: Rooting behavior of cuttings from different positions in a donor plant

Cutting source	Number of lateral roots per plant	Average rot length (cm)	Fresh root weight (g)	Dry root weight (g)
Basal	19.85	10.82	0.94	0.56
Middle	17.64	9.36	0.84	0.50
Upper	14.45	7.33	0.54	0.32
CD (0.05)	2.07	2.24	0.06	0.03

Table 4: Cutting length and cutting source interaction on root weight*

Cutting length (cm)	Cutting source				CD (0.05)	
	Basal	Middle	Upper	Mean		
Fresh root weight (g)						
5	0.42 (0.24)	0.33 (0.19)	0.26 (0.15)	0.33 (0.19)	Cutting length	= 0.06 (0.03)
10	0.92 (0.55)	0.76 (0.45)	0.42 (0.25)	0.70 (0.41)	Cutting position	= 0.06 (0.04)
15	1.08 (0.64)	1.06 (0.63)	0.64 (0.38)	0.93 (0.55)	Cutting length x Cutting source	= 0.08 (0.05)
20	1.38 (0.81)	1.23 (0.73)	0.84 (0.50)	1.14 (0.68)		
Mean	0.94 (0.56)	0.84 (0.50)	0.54 (0.32)			

*Dry root weight in parentheses

Irrespective of clone, the response of cutting collected from three positions to rooting was same, therefore, the clone x cutting position interactions has not explained here. The interactions effect between cutting length and source of cutting was significant on root biomass (Table 4). Biomass in general increased with increase in cutting length with more biomass from basal portion cuttings. 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 ratio in comparison to upper portion, which may have contributed to the best performance of the cuttings from the basal portion (FAO 1979). Stuhlinger and Toliver (1985) reported highly variable rooting ability among primary and secondary ramets in *Populus deltoides.*

It can be concluded that the cuttings taken from basal portion of clones having length of 20 cm with diameter ranging between 2.51-3.25 should be used for producing healthy poplar planting stock for plantations. Chaukiyal *et al.* (1986) and Sharma and Bardoloi (1986) also recommended use of lower and middle one third portion of straight stem for preparing cuttings for multiplication in *P. ciliata and P. deltoides*, respectively.

REFERENCES

Altman A and Klareing PF 1975 The effect of IAA on sugar accumulation and basipetal transport of 14C in *Phaseolus vulgains* cuttings. *Physiol. Plant* **33:** 32-38.

Arya VK 1993 Differential response of selected clones of poplar to nitrogen application in nursery. M.Sc. Thesis, Dr YS Parmar University of Horticulture and Forestry Nauni, Solan (HP).

Bree PJ and Muraoka 1973 Effect of indole butyric acid on distribution of 14C-photosynthate in softwood cuttings of Mariana 2624 plum. *J Am Soc Hort Sci* **98:** 436-439.

Bhrot NP 1995 Rooting behavior of selected clones of poplar. M.Sc. Thesis, Dr YS Parmar University of Horticulture and Forestry Nauni, Solan (HP).

Chauhan SK and Mahey RK 2008 Poplar cultivation (revised edition). Punjab Agricultural University, Ludhiana (India). 36p.

Chaukiyal SP Arya SR and Singh O 1986 Clonal reproduction of *Populus ciliata* -use of most suitable parts. *Ind. For* **112:** 152-156.

Deol GS and Khosla PK 1983 Effect of size of stem cuttings on juvenile growth of *Populus cilialia* Wall ex Royle *Ind J For* **6**: 205-207.

Dhiman RC 2012 Status of poplar culture in India. *Envis Forestry Bulletin* **12(1):** 15-32.

Gomez KA and Gomez KK 1984 Statistical procedure for Agricultural Research. John Wiley and Sons, New York. 680p.

FAO 1979 Poplars and Wlillows. FAO Forestry Series 10.

Haissig BK 1974 Influences of auxins and auxin synergists on adventitious root primodium initiation and development. *NZS.For Sci* **4:** 311-323.

Kumar D and Singh NB 2012 Status of poplar introduction in India. *Envis Forestry Bulletin* **12(1):** 9-14.

Sharma TC and Bardoloi 1986 Observations on propagation and growth of poplar (*Populus deltoides* G3). *Ind. For* **112:** 803-813.

Stuhlinger HC and Toliver JR 1985 Variation in rooting ability among selected clones of eastern cottonwood (*Populus deltoides* Bartr. Ex. Marsh) in southern lousiana. *Tree Planter Notes* **36:** 13-17.