STUDIES ON THE EFFECT OF SPACING ON THE WOOD QUALITY IN SOME CLONES OF *POPULUS DELTOIDES*

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Introduction

Large plantations of different clones of *Populus deltoides* have been raised in northern parts of India to step up production of industrial wood. Being light coloured and having light to medium density, the wood has been found suitable for variety of end uses such as veneer and plywood, packing cases, match splints, pulp and paper, sport goods and for light structural uses.

Certain cultural practices such as spacing and application of fertilizers, irrigation and also the site variability affect growth pattern of tree and influence the wood properties (Hans and Burley, 1972; Markovic, 1975; Keller *et al.*, 1976; Polge, 1975; Murphy *et al.*, 1979; Phelps *et al.*, 1982). Climate also has been found to have a significant effect on wood specific gravity (Howe, 1974). *P. deltoides* is a diffuse porous wood with tendency to semi-ring-porosity showing distinct growth rings. The wood of mature trees is reported to have an average specific gravity of 0.37 to 0.43 (oven-dry), vessel frequency of 30-145 per mm^2, vessel diameter 75-150µm and fibre diameter of 23-40µm (Panshin and De Zeeuw, 1980). The present study was undertaken to assess the effect of spacing on tree size (height and girth), wood specific gravity and on selected anatomical parameters. The results of this aspect of study on 9-10 year old plantations of three clones of *P. deltoides* viz., G3, G48 and D121 raised at Forest nursery, Lalkuan, Haldwani and Chandain Farm, Rudrapur (Uttaranchal) have been presented here.

Material and Methods

The material for study was collected from experimental plantations from Forest nursery Lalkuan, Haldwani and Chandain Farm, Rudrapur (Uttaranchal) laid out in 1988 and 1989 respectively. In the former plantation the spacing adopted was 4m x 3m and in the latter plantations spacing kept was 5m x 5m.

Two trees of three clones G3, G48 and D121 were selected at random for each clones and 4 cm wide discs were removed at breast height. A 3 cm wide strip was taken from each disc at the longest radii. The growth rings were demarcated and sample pieces were cut for each entire ring. One

*Statistical Branch

half of sample piece was kept for determining specific gravity and the other half was kept for preparing sections and macerations. The specific gravity was determined by green volume/oven-dry method. Macerations were prepared according to Franklin's method using 1:1 solution of acetic acid and hydrogen peroxide (30%) and 60°C for 48 hours. Thirty measurements were taken for fibre length, fibre diameter, lumen diameter and vessel length. Vessel frequency and vessel tangential diameter were determined from cross sections of about 30µm thickness prepared for each growth rings Twenty measurements were taken for each of these two parameters. Mean values were determined for each parameter from the values for all rings and the data analysed to see the influence of different spacing.

Results

Analysis of variation for different characters is given in Table 1 with the different components, which are causing variation in the responses. The components are main effects (clone and spacing) and interaction effect (clone x spacing).

(a) *Variation in height and girth of the trees* : From Table 1, it is observed that height and girth differ significantly for clones, spacing and their interactions. The means of interaction effect together with different main effects are given in Table 2. It is apparent from Table 2 that the performance of clone G48 is maximum for height and girth whereas it is minimum for clone D121. The effect of spacing is higher in Lalkuan for height however for girth it is higher in Rudrapur.

(b) *Variation in specific gravity* : From Table 1, it is observed that specific gravity differs significantly for clones and with different spacings and non-significant for their interactions. The means of interaction effect together with different main effects are given in Table 3. The specific gravity is maximum for clone G48 whereas it is minimum for clone G3, which is statistically homogeneous with clone D121. The effect of spacing for specific gravity is higher in Rudrapur i.e. due to wide spacing.

(c) *Variation in anatomical characteristics*: ANOVA of anatomical parameters viz. fibre length, fibre diameter, wall thickness,

Table 1

ANOVA of different morphological and anatomical characters of poplar clones

Source	df	MSS							
		Height	Girth	Sp.gr.	Fibre length	Fibre diameter	Wall thickness	Vessel diameter	Vessel area
Rep	1	0.1	3.0	0.0001	3300.1	0.52	0.0001	93.52	258.8
Clone	2	6.24*	312.3*	0.003*	23769*	0.19	2.18*	116.95*	2014343*
Spacing	1	2.80*	320.33*	0.01*	43802.1*	20.02*	0.750	92.41*	2265231*
Clone x sp.	2	8.37*	110.33*	0.0008	10741.1*	6.271*	0.04	174.92*	146666.5
Error	5	0.06	1.40	0.0002	1236.28	0.921	0.174	13.55	77907.69

*Shows significance at 5%

Table 2

Mean values of Height and Girth of trees of the two plantations

Characters	Clone	Plantations		Mean
		Lalkuan	Rudrapur	
Height (m)	G3	24.90	25.80	25.35b
	G48	25.70	26.20	25.95c
	D121	25.70	21.40	23.55a
	Mean	25.43b	24.47a	
Girth (cm)	G3	75.00	96.00	85.50b
	G48	87.00	87.00	87.00b
	D121	66.00	76.00	71.00a
	Mean	76.00a	86.33b	

Same alphabets represent statistically homogeneous group.

vessel diameter and vessel area is given in Table 1. All parameters differ significantly among the clones except fibre diameter. The effect of spacing and performance with clone are significant for all characters except wall thickness and vessel area. There is an increase in fibre length, fibre diameter and wall thickness with close spacing, whereas for vessel diameter and vessel area the increase is due to wide spacing (Table 4). Fibre length is maximum in clone D121, and minimum in clone G3, which is statistically at par with clone G48. Wall thickness is maximum in clone G3 and minimum in clone D121, which is statistically at par with G48. For the parameters vessel diameter and vessel area the values of G3 is maximum and while that of G48 is minimum (Table 4).

Discussion

The significant increase in specific gravity with wide spacing observed in the present study is in conformity with Crist and Dawson (1975) who found specific gravity to increase as planting density decreases in 2-year old *Populus* hybrids, Geyer (1981) also found that 2 year old hardwoods planted at the widest spacing has the higher specific gravity. Contrary to this Dawson *et al* (1976), Phelps *et al.* (1982) and Murphy *et al.* (1979) did not find any significant difference in specific gravity

Table 3

Mean values of Specific gravity of trees of the two plantations

Clone	Plantations		Mean
	Lalkuan	Rudrapur	
G3	0.354	0.404	0.379a
G48	0.409	0.446	0.427b
D121	0.339	0.429	0.384a
Mean	0.367a	0.426b	

Same alphabets represent statistically homogeneous group.

Table 4

Mean values of anatomical parameters of the two plantations

Characters	Clone	Plantations		Mean
		Lalkuan	Rudrapur	
Fibre length (μm)	G3	1222.50	982.00	1102.25a
	G48	1182.00	1122.00	1162.22a
	D121	1284.50	1222.00	1253.50b
	Mean	1229.67b	1108.83a	
Fibre diameter (μm)	G3	28.00	23.50	25.57a
	G48	26.00	26.25	26.13a
	D121	27.50	24.00	25.75a
	Mean	27.17b	24.58a	
Wall thickness (μm)	G3	5.50	5.10	5.30b
	G48	5.00	4.25	4.63ab
	D121	4.83	3.65	3.83a
	Mean	4.83a	4.33a	
Vessel diameter (μm)	G3	74.20	68.00	71.05b
	G48	51.10	71.00	61.05a
	D121	61.10	64.00	62.55ab
	Mean	62.12a	76.67b	
Vessel area	G3	4848.00	5700.00	5274.03b
	G48	3347.90	4608.00	3977.93a
	D121	3877.70	4372.50	4125.12a
	Mean	4024.55a	4893.50b	

Same alphabets represent statistically homogeneous group.

among the spacing trials of different Poplar clones. No effect was observed in specific gravity by Chauhan *et al.* (1983) in studies on *Eucalyptus tereticornis*.

The decrease in fibre length at wide spacing found in the study is similar to that found by Higgs and Rudmann (1973) in *Eucalyptus regnans*. Markovic (1974) however, found longer fibres at wide spacing than close spacing in poplar. Murphy *et al.* (1979) and Phelps *et al.* (1982) found little effect of spacing on fibre length in poplar clones studied. Significant effect of spacing was also observed in *Eucalyptus tereticornis* (Chauhan *et al.*, 1983).

Since the studies are based on limited spacings trials, therefore, a more detailed study based on more levels of spacing on more clones is needed for better understanding of their effect on wood quality.

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SUMMARY

The results of a study on the effect of spacing on wood specific gravity, selected wood anatomical parameters and tree growth in two 9-10 year old plantations of 3 clones of *Populus deltoides* are reported. Significant effect of spacing was observed on specific gravity, fibre length, fibre diameter, vessel diameter, tree height and girth. While specific gravity shows an increase at wide spacing, fibre length has been found to decrease in the two plantations.

पोपुलस डेल्टायडिस के कुछ कृन्तकों की काष्ठ गुणवत्ता पर वृक्षों के बीच फासला छोड़ने के प्रभावों का विषयक अध्ययन

लक्ष्मी चौहान, संगीता गुप्ता, आर०सी० मधवाल व राजीव पाण्डेय

साराशं

पोपुलस डेल्टायडिस के तीन कृन्तकों के दो 9 - 10 वर्षीय रोपवनों में उगे हुए वृक्षों की लकड़ी के आपेक्षिक गुरूत्व, कुछ चुने हुए शारीर परिमापों पर बीच में फासला छोड़ने से पड़ने वाले प्रभावों के अध्ययन के परिणाम सूचित किए गए हैं । फासला छोड़ने का सार्थक प्रभाव आपेक्षिक गुरूत्व, रेशे की लम्बाई, रेशे का व्यास, वाहिनियों का व्यास, वृक्ष की ऊंचाई और परिधि पर पड़ता पाया गया । अधिक चौड़ा फासला छोड़ने पर इन दोनों रोपवनों में तने के काष्ठ के आपेक्षिक गुरूत्व (= भार) में वृद्धि होती देखी गई परन्तु उसके रेशे की लम्बाई में कमी पड़ती पाई गई ।

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