INFLUENCE OF FERTILIZATION AND SPACING ON GROWTH AND NUTRIENT UPTAKE IN POPLAR (*POPULUS DELTOIDES*) NURSERY

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Introduction

Poplar (*Populus deltoides*) is a promising tree species and it has gained great importance in farm forestry due to its fast growth, short rotation, vegetative propagation and multiplicity of uses of its wood. Its wood is used for making plywood, packing cases, match boxes, pulp and paper. Farmers have adopted *Populus deltoides* on their agricultural fields as block or boundary plantation with crops. But, for raising field plantations of *Populus deltoides* successfully, healthy and vigorous planting stock (entire transplants or ETPs) is required. Therefore, present investigations were undertaken to standardize fertilizer and spacing requirement of *Populus deltoides* for producing quality nursery stock and to study utilization of nutrients by Poplar nursery.

Material and Methods

The experiment consisted of four levels of fertilizers viz. No fertilizers ($N_0P_0K_0$); 100:50:25 kg N, P_2O_5 and K_2O ha^{-1}, respectively ($N_{100}P_{50}K_{25}$); 200:100:50 kg N, P_2O_5 and K_2O ha^{-1}, respectively ($N_{200}P_{100}K_{50}$) and 400:200:100 kg N, P_2O_5 and K_2O ha^{-1}, respectively ($N_{400}P_{200}K_{100}$) with three spacings viz. 35 cm x 35 cm, 50 cm x 50 cm and 65 cm x 65 cm. Experiment was laid out in split plot design with four replications having spacing in the main plots and fertilizer levels in sub-plots. Surface soil of study site had sandy loam texture, pH 8.2, EC 0.20 dS/m and contained 247 kg ha^{-1} available nitrogen, 18.2 kg ha^{-1} available phosphorus (P) and 315 kg ha^{-1} available potash (K) at the time of starting the experiment.

Cuttings of uniform size of clone were planted in the second week of February, 1999. Nitrogen was applied in the form of urea (46 per cent N), P as di-ammonium phosphate (46 per cent P_2O_5 and 18 per cent N) and K as muriate of potash (60 per cent K_2O). Complete doses of phosphorus, potash and half of nitrogen were applied one month after setting out cuttings and remaining half nitrogen during first week of July. Nitrogen added from di-ammonium phosphate was deducted from the dose of nitrogen being supplied as urea. Cultural operations, like irrigation and weeding were carried out from time to time. The observations on growth parameters (plant height and collar diameter) and biomass production were recorded in the month of January, 2000. For biomass and nutrient uptake studies, two representative plants were excavated in each replication of all treatments and their fresh shoot and root

weight was observed. Samples were taken from freshly weighed shoots and roots of plants, dried and their dry matter was determined by dry weight of plants. At different spacings, number of plants per hectare were calculated and their total dry weight was calculated. Contents of nitrogen, phosphorus and potassium was determined by Kjeldahl method, Vanadomolybdophosphoric yellow colour method and Flamephotometer, respectively (Jackson, 1973) and their total uptake on dry weight basis was estimated.

Results and Discussion

Effect of fertilization : Application of fertilizers to *P. deltoides* resulted in significant increase in growth characteristics i.e. plant height and collar diameter. The mean height and collar diameter increased significantly with increasing level of nutrients upto $N_{100}P_{50}K_{25}$ (Table 1). Other findings are also available that application of fertilizers increased growth of poplars. Gangoo *et al.* (1997) observed that maximum growth in plant height and collar diameter in *P. deltoides* and *P. nigra* was with the application of 150 kg N ha^{-1} and 120 kg P_2O_5 ha^{-1}. The increase in growth of some other tree species by application of fertilizers has been reported by Mohan *et al.* (1990) in *Azadirachta indica*, *Eucalyptus tereticornis* and *Tamarindus indica* seedlings. The highest dose ($N_{400}P_{200}K_{100}$) of fertilizers used in the study did not increase collar diameter and height of plants. This may be attributed to the fact that the maximum amount of fertilizers applied might have lead to the nutrient status of the site, over and above the requirement of plants. Koul *et al.* (1995) found that height and collar diameter of *Bauhinia variegata* seedlings did not increase with highest level of fertilizers applied in his study i.e. at 90 kg N ha^{-1} and 80 kg P_2O_5 ha^{-1}.

Table 1

Growth parameters and biomass production of Poplar nursery as influenced by fertilization and spacing

Treatments	Plant height (m)	Collar diameter (cm)	Fresh weight (g/plant)		Total dry weight	
			Shoot	Root	g/plant	q/ha
Fertilizers (kg/ha) :						
$N_0P_0K_0$	4.09	2.79	752.0	198.0	429.0	183.5
$N_{100}P_{50}K_{25}$	4.46	3.17	898.0	284.0	534.0	225.4
$N_{200}P_{100}K_{50}$	4.53	3.22	990.0	325.0	601.0	252.1
$N_{400}P_{200}K_{100}$	4.49	3.19	982.0	327.0	594.0	248.4
CD (P=0.05)	0.19	0.14	94.4	46.3	69.2	34.2
Spacings :						
35 x 35 cm	4.05	2.59	613.0	182.0	360.0	284.0
50 x 50 cm	4.46	3.20	967.0	302.0	575.0	232.3
65 x 65 cm	4.67	3.49	1137.0	367.0	684.0	165.8
CD (P=0.05)	0.15	0.17	138.2	43.2	102.8	45.3

Shoot and root biomass was also affected significantly with application of fertilizers (Table 1). Minimum shoot (752 g/plant fresh weight) and root biomass (198 g/plant root weight) was produced without application of any fertilizer ($N_0P_0K_0$), which increased significantly up to $N_{100}P_{50}K_{25}$. Prasad and Rawat (1991) observed the maximum biomass of *Acacia nilotica* seedlings was with application of 100 ppm N, 100 ppm P_2O_5 and 25 ppm K_2O. Increase in above and below ground biomass by application of fertilizers has also been reported by Mohan *et al.* (1990) in *Azadirachta indica, Eucalyptus tereticornis* and *Tamarindus indica.*

The total uptake of N, P and K increased significantly with increase in fertilizer levels up to $N_{200}P_{100}K_{50}$ (Table 2). The uptake of nutrients was maximum at the highest level of fertilizers applied ($N_{400}P_{100}K_{50}$) and minimum without the application of fertilizers. The increase in nutrient uptake with fertilizer application is due to higher biomass and nutrient content in plants with increasing level of fertilizers. Increase in the nutrient content and uptake by roots and shoots of *Bauhinia variegata* seedlings have been reported by Koul *et al.* (1995).

Effect of spacing : Spacing had significant influence on plant height and collar diameter. Wider spacing (65 x 65 cm) increased the collar diameter by 34.7 per cent and height by 15.3 per cent over the closer spacing (35 x 35 cm) (Table 1). Less collar diameter and height under closer spacing and their increase with increase in spacing may be due to the reason that the competition among plants for space and nutrients decreases under wider spacing. Singh and Sharma (1984) in *Abies pindrow* reported that collar diameter of seedlings decreased as the seedling density increased.

Shoot and root biomass increased significantly and gradually with widening the spacing of plants from 35 x 35 cm to 65 x 65 cm (Table 1). The fresh shoot and root biomass produced at 35 x 35 cm spacing was 613 g/plant and 182 g/plant, respectively which increased to 1137 g/plant and 367 g/plant, respectively under 65 x 65 cm spacing. The space allowed to plants control their growth and development. This increase is attributed to the availability of more space and more amount of nutrients to individual plants under wider spacing. Increase in plant biomass at wider spacing has been reported by Singh and Sharma (1984) in *Abies pindrow.* Plant growth parameters like height, plant spread, number of branches/plant produced in Roselle (*Hibiscus sabdariffa*) were higher under the wider row spacing of 120 cm (Sree Ramu and Farooqi, 1996).

Table 2

Nutrient uptake (kg/ha) by poplar nursery at different levels of fertilizers and spacings

Treatments	Nutrient uptake (kg/ha)		
	N	P	K
Fertilizers (kg/ha) :			
$N_0P_0K_0$	103.0	14.9	74.4
$N_{100}P_{50}K_{25}$	144.6	25.2	104.9
$N_{200}P_{100}K_{50}$	171.5	33.8	127.4
$N_{400}P_{200}K_{100}$	174.6	36.5	128.5
CD (P=0.05)	21.4	4.2	18.5
Spacings :			
35 x 35 cm	184.5	32.4	131.3
50 x 50 cm	153.7	28.9	114.9
65 x 65 cm	106.9	21.6	80.1
CD (P=0.05)	35.3	3.1	24.4

The uptake of nutrients increased significantly as the spacing become closer. However, the uptake by individual plant was higher at wider spacing, but as the plant population was higher under closer spacing; thus, increasing the total biomass (Table 1) and nutrient uptake (Table 2). The uptake of N, P and K increased to the extent of 72.6, 50 and 63.9 per cent respectively, as the spacing was reduced from 65x65 cm to 35x35 cm. Similar observations were reported by Sree Ramu and Farooqi (1996) in *Hibiscus sabdariffa*.

SUMMARY

An experiment was conducted to determine the effect of four fertilizer levels ($N_0P_0K_0$, $N_{100}P_{50}K_{25}$, $N_{200}P_{100}K_{50}$ and $N_{400}P_{200}K_{100}$ kg ha^{-1}), and three spacings (35 cm x 35 cm, 50 cm x 50 cm and 65 cm x 65 cm) on growth parameters, biomass production and uptake of nutrients by *Populus deltoides* in nursery. Fertilizer application increased significantly the collar diameter, height, shoot biomass and nutrient uptake. Wider spacing (65 cm x 65 cm) produced plants having significantly higher biomass and growth parameters. The uptake of nutrients was significantly higher at closer spacing of 35 cm x 35 cm than at wider spacing (65 cm x 65 cm) but uptake per plant was lower.

पोपलर (*पोपुलस डेल्टायडिस*) रोपणी में पोष्याहार उद्ग्रहण पर उर्वरीकरण और फासला छोड़ने के प्रभाव

बलजीत सिंह

साराशं

पोपुलस डेल्टायडिस द्वारा रोपणी में चार उर्वरक स्तरों (ना$_0$का$_0$पो$_0$ना$_{100}$,फा$_{50}$,पो$_{25}$,ना$_{200}$,फा$_{100}$,पो$_{50}$ और ना$_{400}$,फा$_{200}$,पा$_{100}$ किग्रा प्रति हेक्टे०) तथा तीन पौधों के मध्य छोड़े फासलों (35 x 35 सेमी, 50 x 50 सेमी और 65x65 सेमी) को रखने का पोष्याहारों के उद्ग्रहण पर पड़ने वाले प्रभावों को विनिश्चित करने के लिए एक संपरीक्षण किया गया । उर्वरक दिया जाने से मूलसंधि पर व्यास, ऊंचाई, प्ररोह जैवपुंज और पोष्याहार उद्ग्रहण में सार्थक वृद्धि हुई । पौधों के मध्य अधिक चौड़ा फासला (65 x 65 सेमी) छोड़ने पर पौधों के जैवपुंज और अन्य वृद्धि परिमापों में सार्थक वृद्धि हुई । पोष्याहारों का उद्ग्रहण भी अधिक फासला (65 x65 सेमी) रखने की तुलना में कम फासला (35 x35 सेमी) रखने पर सार्थकत: अधिक हुआ परन्तु प्रति पौधा उसके उद्ग्रहण में कमी आई ।

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