Research Paper

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Response of Poplar Clones to Triacontanol Application and Different Types of Soils on Nutrient Content and Physiological Character At Nursery Stage

Forestry

KEYWORDS : Poplar clones, nutrient content, chlorophyll content, Triacontanol.

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ABSTRACT

The present investigation was aimed to study the response of poplar clones toward physiological parameter and nutrient contents in leaves of Poplar grown on different types of soils and Triacontanol (growth regulator) application at nursery stage. The effect of two types of soils (Sandy loam and Sandy clay loam soil) and foliar application of growth regulator i.e. Triacontanol at 0ppm, 3ppm, 5ppm was investigated on nine poplar clones (PL-1, PL-2, PL-3, PL-4, PL-5, PL-6, PL-7, L-47/88, L-48/89). Various attributes were recorded at different interval of growth. The results of the study revealed that physiological characters like chlorophyll content, soil types showed non-significant results and growth regulator showed significant results. Triacontanol at 5ppm concentration showed higher chlorophyll content during July and October 2013 by 30.88 and 36.21 SPAD units respectively. For nutrient content analysis like nitrogen, potassium and phosphorus in leaves of poplar clones, growth regulator and different soil types showed significant results.

Introduction

Eastern cottonwood (*Populus deltoides*) Bartr. Ex. Marsh, one of the largest eastern hardwoods, is short-lived but the fastest-growing commercial and multi use forest species. The north-south distribution extends from latitude 28° N to 46° N, absent from the higher Appalachian areas and from much of Florida and the Gulf Coast except along rivers. Important countries undertaking poplar plantations are Australia, France, Germany, Hungary, India, Italy, Japan, Korea, Netherland and Romania.

There are 35 species of poplar currently recognized in the world. Out of these, six Populus species are indigenous to India- *Populus alba, P. ciliata, P. euphratica, P. gamblei, P. glauca and P. Laurifolia. Populus deltoides* is the main exotic Poplar, which is widely grown in the Indo-Gangetic plains of North West India. Individual plants in the genus Populus are either male or female. Improved clones of poplar (*P. deltoides*) were introduced in India as early as 1950s. *Populus deltoides* survives on deep, infertile sands and clays but makes its best growth on moist, well drained, fine sandy or silt loams close to streams. The soils of most cottonwood growing sites are in the soil orders Entisols and Inceptisols (Albertson and Weaver, 1945).

Triacontanol (TRIA) is a long chain primary alcohol ($C_{30}H_{61}OH$) known to be a potent plant growth promoting substance for many agricultural and horticultural crops (Ries, 1985, 1991). Keeping all this in mind, the present investigation was undertaken to find out whether the foliar spray of TRIA on different types of soil could augment the nutrient content in leaves and chlorophyll content of poplar clones.

MATERIALS AND METHODS

The study was carried out in the Research farm area of Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana. The study area is at 247 m above sea level and lies at 30° 45' N latitude and 75°40' E longitude, represents, with mean annual rainfall 704 mm. Climate is sub-tropical to tropical with a long dry season from late September to early June and wet season from July to September. The planting of cutting of nine poplar clones viz. PL-1, PL-2, PL-3, PL-4, PL-5, PL-6, PL-7, L-47/88 and L-48/89 (recommended by PAU) were carried out at second fortnight of February, 2013 in the nursery on the both sandy loam and Sandy clay loam soil. Split plot design with three replications and plot size of fifteen cuttings on two different type soils was used. After 70 ± 2 days of planting of these cuttings, foliar application of growth regulator (Triacontanol) with treatment of 0ppm (control), 3ppm and 5ppm concentration were done. Nursery was maintained for one year. The observations of nitrogen content (%), potassium content (%), phosphorus content (%) and chlorophyll content (SPAD unit) were taken. All nutrient content parameters were recorded during July 2013 and October 2013 whereas chlorophyll content was recorded during July 2013 and September 2013 and whole data was analyzed with OPSTAT software using split plot design.

Leaf samples from each treatment were digested for the estimation of leaf- N, P and K content. The leaves were dried in a hot air oven at 60-70^{0}C for 24 hr. Dried leaves were powdered using a mortar and pestle and the powder was passed through a 72 mesh. The sieved leaf-powder was used for N, P and K content. Plant material (0.5 g) was digested in concentrated H_2SO_4 with digestion mixture consisting K_2SO_4, $CuSO_4$, Se and HgO. After digestion, the extract obtained was analyzed for N using a micro-Kjeldhal assembly according to procedure outlined by Jackson (1973). The plant samples were digested using diacid (3 HNO_3: 1 $HClO_4$) according to the procedure detailed by Piper (1966). The P in the digests was estimated spectro-photometrically by Vanado-Molybdo phosphoric acid method (Sparks *et al.* 1996) and K content was analyzed with the help of flame photometer (Pratt, 1982).

Digital SPAD 502 meter was used to calculate chlorophyll content of selected plants for all clones under study at each level of growth regulator at both type soils. Measurement was taken during July and September 2013.

RESULT AND DISCUSSION

Nutrient content in leaves:

The significant variation in relation to content of Leaf Nitrogen (N) in poplar due to soil types, clones and triacontanol in the months of July. Maximum values of leaf N content in PL-2 at 3ppm of TRIA on sandy loam soil by 2.09% during July (Table 1) whereas maximum N content in PL-7 at 5ppm on sandy loam during October (Table 2). During July N content in leaves higher at 3ppm dose of TRIA (Table-1) while during October higher at 0ppm dose ((Table 2). Enhancement in leaf-nutrients, particularly nitrogen, due to TRIA application could be attributed to the compositional or chemical change in plants leading to alterations in nitrogen concentration (Knowles and Ries, 1981).

Potassium (K) content in poplar leaves influenced by soils, different clones and level of triacontanol was found significant for both July and October, yet no clear cut trend of increase or decrease in K content in leaves was witnessed during study. The maximum and minimum K content was recorded in PL-2 clone at 3ppm on sandy clay loam soil by 1.80% and PL-5 at 0ppm on sandy loam soil by 0.50% respectively during July (Table 1). The maximum and minimum K content was recorded in PL-1 at

5ppm on sandy loam soil by 1.52% and PL-2 at 3ppm on sandy clay loam soil by 0.52% respectively during October 2013 (Table 2). From July to October there is decrease in K content in the leaves of various clones. Similar result reported for decrease in K content in leaves by Barker and Blackmnon (1977) that this decrease in K content in leaves during December may be attributed to retranslocation of nutrients from leaves to other parts of tree during senescence.

Phosphorus (P) content in poplar leaves showed significant result for various poplar clones, different soil types and triacontanol at different concentration during July and October Critical review of data in table 1 and table 2 reveals that maximum and minimum P content in PL-3 at 5ppm on sandy loam soil by 0.35% and PL-5 at 3ppm on sandy clay loam soil by 0.16% respectively during July and maximum of P content in PL-2 at 3ppm level in sandy loam soil by 0.40% during October. The variation in P uptake of Poplar leaves in present study is explained, reported that differences in soil resource availability lead to changes in leaf quality (leaf nutrient concentration) (Barbosa *et al.* 2014). The significant variation in P concentration due to clones in the present study observed, these results are in line with the results reported by Khosla and Deol (1984).

Table 1: Poplar leaf nutrient content (%) during July 2013 influenced by Soils, different clones and levels of Triacontanol

Soil types	July 2013												
		N (%)			Mean	K (%)			Mean	P (%)			Mean
	Clones To	Triacontanol				Triacontanol				Triacontanol			
		T1	T2		T0	T1	T2		T0	T1	T2		
Sandy loam	PL-1	1.76	1.80	2.08	1.88	0.99	0.95	0.59	0.84	0.19	0.25	0.18	0.21
	Pl-2	1.69	2.09	1.68	1.82	0.58	0.98	0.60	0.72	0.25	0.28	0.20	0.24
	PL-3	1.99	1.51	1.92	1.81	0.83	0.92	0.97	0.91	0.22	0.28	0.35	0.28
	PL-4	1.57	1.59	1.70	1.61	0.77	0.54	0.63	0.65	0.23	0.18	0.30	0.24
	PL-5	1.72	1.61	2.05	1.80	0.51	0.64	0.44	0.53	0.27	0.21	0.20	0.23
	PL-6	1.61	2.03	1.89	1.84	0.55	0.93	0.81	0.76	0.28	0.26	0.23	0.26
	PL-7	1.72	1.80	1.55	1.69	0.75	0.77	0.73	0.75	0.25	0.24	0.18	0.22
	L-47/88	1.36	1.55	1.60	1.50	0.52	0.83	0.54	0.63	0.25	0.24	0.23	0.24
	L-48/89	2.04	1.32	1.92	1.76	0.64	0.56	1.03	0.74	0.16	0.26	0.22	0.21
Mean		1.71	1.70	1.82		0.68	0.79	0.70		0.23	0.24	0.23	
Sandy clay loam Pl-2 PL-3 PL-4 PL-5 PL-6 PL-7 L-47/88 L-48/89	PL-1	1.52	1.51	0.76	1.26	1.63	1.40	1.27	1.43	0.27	0.31	0.25	0.28
	1.92	1.40	1.43	1.58	1.63	1.80	1.50	1.64	0.24	0.26	0.18	0.23	
	1.52	1.64	1.61	1.59	1.37	1.67	1.27	1.43	0.27	0.33	0.19	0.26	
	0.99	1.84	1.23	1.35	1.67	1.27	1.47	1.47	0.21	0.28	0.24	0.24	
	1.36	1.87	1.56	1.60	1.50	1.20	1.60	1.43	0.32	0.16	0.35	0.28	
	1.05	1.44	0.87	1.21	1.63	1.80	1.47	1.63	0.29	0.22	0.20	0.24	
	1.76	1.68	1.92	1.79	1.70	1.40	1.53	1.54	0.22	0.29	0.33	0.28	
	1.60	1.60	1.80	1.67	1.40	1.73	1.20	1.44	0.17	0.22	0.18	0.19	
	0.91	1.50	0.87	1.09	1.60	1.40	1.37	1.56	0.18	0.23	0.19	0.20	
Mean		1.40	1.61	1.34		1.57	1.52	1.41		0.24	0.26	0.23	
Overall mean		1.56	1.65	1.58		1.13	1.15	1.05		0.24	0.25	0.23	
C.D. (0.05) for													
Soils = 0.22 Clones = 0.14 TRIA = 0.01 Soils× Clones = 0.02 Soils × TRIA = 0.01 Clones × TRIA = 0.02 Soils ×Clones × TRIA = 0.03					Soils = 0.02 Clones = 0.04 TRIA = 0.02 Soils× Clones = 0.05 Soils × TRIA = 0.03 Clones × TRIA = 0.06 Soils ×Clones ×TRIA = 0.09				Soils = 0.004 Clones = 0.007 TRIA = 0.004 Soils× Clones = 0.010 Soils × TRIA = 0.006 Clones × TRIA = 0.013 Soils ×Clones × TRIA =0.018				

Table 2: Poplar leaf nutrient content (%) during October 2013 influenced by Soils, different clones and levels of Triacontanol

Soil types	October 2013												
		N (%)			Mean	K (%)			Mean	P (%)			Mean
	Clones	Triacontanol				Triacontanol				Triacontanol			
		To	T1	T2		T0	T1	T2		T0	T1	T2	
Sandy loam	PL-1	1.24	0.43	0.37	0.68	1.36	1.03	1.52	1.30	0.35	0.29	0.30	0.31
	Pl-2	0.99	1.27	1.34	1.20	0.82	0.91	1.23	0.99	0.32	0.40	0.39	0.37
	PL-3	2.84	0.70	0.26	1.27	1.05	1.31	0.89	1.09	0.30	0.30	0.33	0.31
	PL-4	0.15	0.31	0.41	1.29	1.41	1.50	1.00	1.30	0.33	0.28	0.38	0.32
	PL-5	0.75	1.33	0.15	0.74	1.30	1.16	0.93	1.13	0.29	0.32	0.38	0.33
	PL-6	2.05	0.26	0.48	0.93	0.99	1.00	1.05	1.02	0.31	0.34	0.32	0.32
	PL-7	1.79	2.30	2.91	2.33	1.46	0.87	0.90	1.08	0.35	0.34	0.38	0.36
	L-47/88	0.40	1.25	0.25	0.63	0.94	1.18	0.97	1.03	0.33	0.30	0.34	0.33
	L-48/89	0.65	0.95	0.20	0.60	1.04	0.94	1.35	1.11	0.29	0.30	0.32	0.30

Mean		1.20	0.98	0.70		1.15	1.10	1.09		0.32	0.32	0.34	
Sandy clay loam	PL-1	1.96	1.88	2.08	1.97	0.82	0.73	0.90	0.82	0.20	0.20	0.20	0.19
	Pl-2	1.53	1.44	2.10	1.69	0.80	0.52	0.96	0.76	0.22	0.22	0.21	0.22
	PL-3	1.45	1.84	1.65	1.65	0.99	0.71	0.81	0.83	0.22	0.22	0.17	0.20
	PL-4	1.57	1.80	1.67	1.68	0.78	0.98	0.71	0.82	0.20	0.21	0.17	0.20
	PL-5	0.99	1.92	2.08	1.66	0.90	0.71	0.53	0.71	0.20	0.20	0.22	0.21
	PL-6	1.76	1.66	1.78	1.73	0.92	0.73	0.97	0.87	0.17	0.20	0.18	0.18
	PL-7	1.84	1.72	1.63	1.73	0.82	0.82	0.92	0.85	0.21	0.21	0.21	0.21
	L-47/88	2.20	1.66	2.10	1.99	0.76	0.81	0.55	0.70	0.17	0.22	0.23	0.20
	L-48/89	1.81	2.23	1.48	1.84	0.79	0.70	0.85	0.78	0.19	0.20	0.21	0.20
Mean		1.68	1.79	1.84		0.84	0.74	0.80		0.20	0.21	0.20	
Overall mean		1.44	1.39	1.27		1.00	0.92	0.95		0.26	0.26	0.27	
C.D. (0.05) for													

Soils = 0.05 Clones = 0.05 TRIA = 0.03 Soils× Clones = 0.08 Soils × TRIA = 0.03 Clones × TRIA = 0.06 Soils ×Clones × TRIA = 0.08	Soils = 0.03 Clones = 0.01 TRIA = 0.01 Soils× Clones = 0.03 Soils × TRIA = 0.01 Clones × TRIA = 0.03 Soils ×Clones ×TRIA = 0.04	Soils = 0.001 Clones = 0.013 TRIA = 0.007 Soils× Clones = 0.019 Soils × TRIA = 0.010 Clones × TRIA = 0.023 Soils ×Clones × TRIA = 0.032

Physiological characteristic:

Leaf chlorophyll content, which indirectly indicates the health status of a plant, the interaction between clones and soils (C×S) and clones and triacontanol (C×T) showed significant results during both months (July and September). Critical review of data in Table 3 reveals that During July month PL-2 and PL-5 had more chlorophyll content when grown on sandy clay loam soil irrespective of triacontanol and these clones also showed higher chlorophyll content at 5ppm dose of TRIA irrespective of soil types, among all clones studied. During October month PL-2 had more chlorophyll content when grown on sandy clay loam soil and also showed good results at 5ppm dose of TRIA. Foliar application of Triacontanol at 10ppm increased the chlorophyll content in pearl millet (Sivakumar *et al.,* 2002). Similar observation for increase in chlorophyll content of poplar plants was found significant with foliar application of Triacontanol. The soils which have low water holding capacity had greater bad impact on plant health. Similar results have been reported that gravel showed poor plant growth, the leaves were reddish brown with poor chlorophyll content (Garg and Kumar, 2012).

Table 3 Poplar leaf chlorophyll content (SPAD UNIT) during July and September 2013 influenced by Soils, different clones and levels of Triacontanol

July 2013						September 2013			
		Triacontanol				Triacontanol			
Soil types	Clones	0ppm	3ppm	5ppm	Mean	0ppm	3ppm	5ppm	Mean
Sandy loam soil	PL-1	28.27	30.03	30.53	29.61	32.80	32.60	35.60	33.67
	Pl-2	27.20	32.60	27.77	29.19	31.90	37.73	33.17	34.27
	PL-3	28.30	30.07	28.97	29.11	33.43	30.97	32.53	32.31
	PL-4	28.90	28.67	28.33	28.63	33.77	31.10	34.03	32.97
	PL-5	26.47	33.10	25.57	28.38	33.33	36.93	31.47	33.91
	PL-6	27.63	29.77	28.60	28.67	33.73	32.73	35.87	34.11
	PL-7	27.80	30.83	28.80	29.14	31.17	32.07	35.67	32.97
	L-47/88	30.17	31.60	30.03	30.60	34.10	37.37	30.03	33.83
	L-48/89	29.10	28.90	27.73	28.58	32.87	36.27	32.83	33.99
Mean		28.20	28.48	30.62		33.01	33.47	34.20	
Sandy clay loam soil	PL-1	29.17	28.83	30.93	29.64	36.30	35.37	34.80	35.49
	Pl-2	29.47	34.57	30.77	31.60	37.23	43.17	36.43	38.94
	PL-3	29.90	29.23	29.30	29.48	34.53	37.67	36.87	36.36
	PL-4	30.33	30.50	29.93	30.26	37.30	37.03	35.60	36.64
	PL-5	29.53	34.23	29.67	31.14	36.97	41.07	37.03	38.36
	PL-6	29.20	29.67	30.10	29.66	36.47	35.43	35.27	35.72
	PL-7	29.47	30.17	30.60	30.08	36.33	36.87	37.47	36.89
	L-47/88	28.70	33.23	30.07	30.67	37.43	40.47	34.77	37.56
	L-48/89	29.00	29.80	30.83	29.88	38.03	36.93	35.90	36.96
Mean		29.42	30.24	31.14		36.73	36.01	38.22	
Overall Mean		28.81	29.36	30.88		34.87	34.74	36.21	

C.D at 0.05 level		C.D at 0.05 level	
Soils = N.S.*	Soils × Clones = 1.45	Soils = N.S.*	Soils × Clones = 2.27
Clones = N.S.*	Soils × TRIA = N.S.*	Clones = N.S.*	Soils × TRIA = N.S.*
TRIA = N.S.*	Clones × TRIA = 1.78	TRIA =N.S.*	Clones × TRIA = 2.78
Soils × Clones × TRIA = N.S.*		Soils × Clones × TRIA = N.S.*	
*=Non-significant		*=Non-significant	

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