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Study on performance of poplar clones in relation to soil condition and growth regulator application in nursery

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ABSTRACT

The experiment was conducted to investigate the response of two types of soils (Sandy loam and Sandy clay loam) and foliar application of growth regulator i.e. Triacontanol at three levels (0ppm, 3ppm, 5ppm on nine poplar clones (PL-1 to PL-7, L-47/88 and L-48/89) at nursery stage, at experimental area of department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana. Various attributes like growth characteristics, physiological parameters and nutrient content in leaves were recorded at different interval of growth. The results of the study revealed that Triacontanol showed non-significant and soil types showed significant results for morphological characters viz. Plant height, collar diameter, no. of branches/plant, no. of leaves/plant and leaf area. Sandy clay loam soil showed good response than sandy loam soil for all morphological characters.

Keywords: Physiological parameters, Poplar clones, Triacontanol.

INTRODUCTION

The state of Punjab, with only 1.5 per cent geographical area of the country contributed 33.64 per cent of the share of wheat and 29.25 per cent of rice to the central pool during crop year 2012-13[1]. However, intensive cultivation of extensively followed traditional paddy-wheat rotation is creating many complications in the agro-ecosystem of the state as it has leads to declining in the water table, formation of the tight layer just below soil surface in addition to the nutrient unevenness and is thus no longer ecologically sustainable although economically profitable. The situation is at an alarming stage, which calls for a need to diversify rotation through appropriate and sustainable land use system while maintaining the status as well as increasing the production of agricultural crops in the state.

To magnify the financial rise according to per unit cultivated area in India, rapidly proliferating non native exotic species have been imported. Poplar (*Populus deltoids Bartr. Ex Marsh*) is a winter deciduous tree and easy to propagate through stem cuttings. For irrigated agro-ecosystem, popular tree justify itself to provide better results not only in Punjab but also in its neighbouring states by cultivating it in field boundaries or as block plantation. Cultivation of poplar regarded as one of the applicable substitute for land use system in order to avoid subsequent deterioration of agro-ecosystem. It is beneficial to get continuous biological production as well as improving the environment. During the past three decades, there has been fast growing in the field of poplar based agro forestry system in Punjab as well as its neighbouring states. It can grow at an altitude of 1000 m. It grows well in a temperature ranging from 8°C to 44^0C with annual rainfall ranging from 600-1500 mm and prefers fertile alluvial soils. Poplar trees are known to prevail in the clayey, infertile sand and sandy loamy soil in addition to better flourished in fine, humid rich, fine drained or areas close to water resources with pH of 6.5-8.0. In India, *P. deltoides* known to be cultivated in the 312,000 hectare, out of which around 60% of block plantation and 40% of boundary plantation. The tree ready to harvest for a short period of 7-10 years results in 150-200 m^3ha^{-1} along with annual increment of 20-25 m^3ha^{-1} ^{yearly} by mean of block plantation and 12-20 m^3ha^{-1} ^{by} mean of boundary plantation along with annual increment of 2-3 m^3ha^{-1} yearly [2].

The wood obtained from the tree is chiefly practised in plywood manufacturing in India. Furthermore, in the plywood industries, the branches, roots, tops additionally provide a source to reduce the use of fossil fuel because of its high growth rate and broad flexibility. The tree also has high capability to sequester and thus reduce the CO_2 from the environment. Therefore, present experiment was planned to study the performance of poplar clones in relation to soil condition and growth regulator application in nursery.

MATERIAL AND METHOD

The examination was carried out in the experimental area of Department of Forestry and Natural Resources, Punjab Agricultural University, Ludhiana. From the sea level the study area is at 247 m above along with 30° 45' N latitude and 75° 40' E longitude having mean annual rainfall 704 mm. Climate is varied from sub-tropical - tropical recognised by arid condition from September to June and humid from July to September. The planting of cutting of nine poplar clones viz. PL-1 to PL-7, L-47/88 and L-48/89 (recommended by PAU) were carried out during 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 0 ppm (control), 3 ppm and 5 ppm concentration were done. Nursery was maintained for one year. Measurement was taken during July and September 2014. This manuscript shows the effect of Triacontanol on different clones of poplar in four months July, august, September, October and we generally described first July and last October, first and last month of trail showed varied results. The experiment was conducted in split plot design.

RESULTS AND DISCUSSION

Height, Diameter, No. of leaves and No. of branches of different clones of poplar:

(a) July

The data recorded on height of poplar plants during July-2014, presented in Table. 1 revealed that the poplar grown in nursery on different types of soil had recorded significant differences in height. Height of poplar plants significantly increased from sandy loam soil (90.24 cm) to sandy clay loam type soil (203.35 cm) height of different clones of poplar indicates significant difference and clones PL-4 recorded maximum mean value of 156.17 cm and L-47/88 had minimum value of 136.89 cm for height among all clones studied. Height of plants at different levels of Triacontanol, irrespective of different clones and soil types indicates non-significant difference.

The data on collar diameter of poplar plants was recorded during July-2014, was presented in table. 1. It was observed that the collar dia of poplar grown on different types of soil recorded significant differences. Collar diameter of poplar plants significantly increased from sandy loam soil (6.63 mm) to sandy clay loam soil (13.88 mm). Collar diameter of different clones of poplar had indicates significant difference. Clones PL-1 recorded maximum mean value of 11.36 mm and L-47/88 had minimum value of 9.90 mm among all clones studied. Collar diameter of plants at different levels of Triacontanol was not significant irrespective of different clones.

The data on number of leaves per plant presented in table.1 in the month July-2014, revealed that number of leaves per plant of poplar was significantly influenced by different types of soil. Significantly more number of leaves (60.50) were observed under sandy clay loam as compared to sandy loam soil (56.22). Number of leaves per plant of different clones of poplar irrespective of soil types on which they were grown and levels of Triacontanol indicates significant difference. Clones PL-7 (74.17) had maximum and PL-3 (47.94) had minimum value for average number of leaves per plant among all clones studied. Number of leaves per plant at different levels of Triacontanol irrespective of different clones and soil types had significant difference. The average number of leaves per plant at 3ppm dose was (56.28) when we increase Triacontanol application dose i.e. 5pprn then average value for number of leaves per plant (59.12) also increased with increase of dose. Whereas at control conditions highest significant value (59.69) number of leaves per plant with respect to application of Triacontanol at different levels.

The data on number of branches per plant presented in table.1 in the month July- 2014 was observed that the number of branches per plant of poplar grown on different types of soil had not significantly different. Number of branches per plant of different clones of poplar irrespective of soil types on which they were grown and levels of Triacontanol showed significant difference. Clones PL-7 (5.39) and PL-1 (5.28) had maximum and PL-3 (3.11) L-47/88 (3.33) and L-48/89 (3.33) had minimum value for average number of branches per plant among all clones studied. Number of branches per plant at different levels of Triacontanol, irrespective of different clones and soil types had significant difference. The average number of branches per plant at 3ppm dose was 3.83 and when we increase Triacontanol application dose i.e. 5ppm then average value for number of branches per plant (3.82) in poplar. Whereas at control conditions highest significant value (4.41) number of branches per plant with respect to application of Triacontanol at different levels.

(b) October

The data recorded on height of poplar plants during October-2014 presented in table 2 reveals that the height of poplar grown on different types of soil recorded significant difference. Height of poplar plants significantly increased from sandy loam soil (315.44 cm) to sandy clay loam soil (438.05 cm). Height of different clones of poplar had indicates significant difference. Clone PL-7 had recorded maximum value (400.69 cm) and PL-2 display minimum value (355.94 cm) for average height of plants among all clones studied. Height of plants at different levels of Triacontanol, irrespective of different clones and soil types had not indicates significant difference. Height of the poplar on soils under study differed significantly and different clones differed in height growth significantly on each soil recorded during July-October 2014. Similar results were also observed for different clones of Poplar for height growth on usher soils[3]. Poplar is highly influenced by soil quality, texture and pH, Nitrogen, Phosphorus and organic content of the soil[4]. Highly significant differences for height growth among 32 clones of *P. deltoids* in Australia[5]. The effect of varied concentrations (used in study) of Triacontanol on height of Poplar was non-significant during July-October. On the contrary to our results, Triacontanol (TR1A) application of 3ppm in leaf treatment on I-69 poplar (*Populus deltoides Bartr.cv. "lux"* (I -69-55) stimulated photosynthesis and growth of poplar in the lower concentrations, but suppressed them in the high concentration[6]. This may be due to differences in the clones genetic makeup used in our study which might not responded to Triacontanol concentrations of 3ppm and 5ppm.

The data on collar diameter of poplar plants was recorded during October-2014 was recorded presented in table.2 and observed that the collar diameter of poplar grown on different types of soil had recorded significant. Collar diameter of poplar plants significantly increased from sandy loam soil (18.33 mm) to sandy clay loam type soil (26.48 mm). Collar diameter of different clones of poplar indicates significant differences. Clones PL-1 recorded maximum mean value of 24.21 mm and L -47/88 had minimum value of 20.85 mm among

all clones studied. Collar diameter of plants at different levels of Triacontanol, irrespective of different clones and soil types had not indicates significant difference. The fast growing nature of tree can be regarded from the rapidity of leaf expansion along with the rapid height and diameter[7][8]. Genetic and site factors governed the dynamic growth pattern of *Populus* by regulating its annual growth cycle. Collar diameter of the poplar on sites under study differed significantly and different clones differed in collar diameter growth significantly on each site recorded during July-October 2014. Poplar is highly influenced by soil quality, texture and pH, Nitrogen, Phosphorus and organic content of the soil[4]. These results indicate that there were genetic differences for collar diameter among the clones and expression of genetic potentiality of the studied clones was expressed on different site differently. Different clones of poplar revealed significant differences for collar diameter growth in nursery[9]. Genetic differences for collar diameter in a hybrid clone and *P. delioides* clones were significant in nursery[10]. Clone G-3 was fast growing and significantly better in growth characteristics as compared to clone IC in nursery[11].

The data on number of leaves per plant presented in table.2 in the month Aug-2014 was observed that the number of leaves per plant of poplar grown on different types of soil had non-significant. Number of leaves per plant of different clones of poplar irrespective of soil types on which they were grown and levels of Triacontanol indicates significant difference. Clones PL-1 (100.94) had maximum value for average number of leaves per plant and L-48/89 (71.56) and PL-3 (73.22) had minimum value for average number of leaves per plant of poplar among all clones studied. Number of leaves per plant at different levels of Triacontanol, irrespective of different clones and soil types had non-significant difference. The total number of leaves in poplar due to clones was found to be significant from July-October 2014. However, the total number of leaves in poplar due to Triacontanol was significant during July and later on this effect became non-significant. The genotype's effect on number of branches in Poplar was significant[12].

The data on number of branches per plant presented in table.2 in the month October-2014 was observed that the number of branches per plant of poplar grown on different types of soil had not indicates significant differences. Number of branches per plant of different clones of poplar irrespective of soil types on which they were grown and levels of Triacontanol indicates significant difference. Clones PL-1 (9.66) had maximum and PL-2 (5.16) had minimum value for average number of branches per plant among all clones studied. Number of branches in poplar on both soils and Triacontanol concentrations studied differed non- significantly and different clones differed significantly on each soil recorded during July-October 2014. The various genotype of cowpea recorded to differ significantly with respect to number of branches. However there was non-significant result reported for number of branches per plant in cowpea[13].

Table 1: Height, Diameter, No. of leaves and No. of branches of poplar plants during July 2014 as influenced by soils, different clones, levels of Triacontanol and their interaction effect

Treatments		Height (cm)	Diameter (cm)	No. of leaves	No. of branches
Soil Type	**Sandy loam soil**	90.24	6.63	56.22	4.16
	Sandy clay loam soil	203.35	13.88	60.50	3.88
C.D.		13.54	2.12	1.40	N.S.
Clones	**PL-1**	151.35	10.74	65.78	5.28
	PL-2	146.27	9.91	54.11	3.5
	PL-3	150.72	10.51	47.94	3.11
	PL-4	156.17	11.36	64.11	4.72
	PL-5	140.77	9.68	51.5	3.72
	PL-6	143.59	9.98	58.5	3.78
	PL-7	154.07	10.86	74.17	5.39
	L-47/88	136.89	9.39	54.39	3.33
	L-48/89	141.36	9.9	54.74	3.33
C.D.		11.60	0.76	9.92	0.99
Triacontanol	**Control**	139.81	9.84	59.69	4.41
	3 ppm	148.84	10.42	56.28	3.83
	5 ppm	151.75	10.52	59.12	3.82
C.D.		N.S.	N.S.	N.S.	0.57

Table 2: Height, Diameter, No. of leaves and No. of branches of poplar plants during Oct 2014 as influenced by soils, different clones, levels of Triacontanol and their interaction effect

Treatments		Height (cm)	Diameter (cm)	No. of leaves	No. of branches
Soil Type	**Sandy loam soil**	315.44	18.33	76.83	5.63
	Sandy clay loam soil	438.05	26.48	81.67	8.09
C.D.		35.69	4.37	N.S.	N.S.
Clones	**PL-1**	379.14	24.21	100.94	9.66
	PL-2	355.94	21.65	76.83	5.16
	PL-3	377.87	23.74	73.22	5.88
	PL-4	391.21	23.14	82.83	8.16
	PL-5	371.11	20.9	77.39	5.44
	PL-6	378.66	22.72	79.22	6.22
	PL-7	400.69	22.79	76.28	8.88
	L-47/88	368.52	20.85	74.94	6.11
	L-48/89	367.68	21.60	71.56	6.16
C.D.		N.S.	N.S.	15.63	1.26
Triacontanol	**Control**	368.66	21.60	92.09	7.88
	3 ppm	375.22	22.81	68.98	5.92
	5 ppm	386.37	22.79	76.67	6.75
C.D.		N.S.	N.S.	N.S.	N.S.

OCCLUSION

Among different levels of Triacontanol no significant effect were observed on different growth parameters. However, soil types showed significant results for morphological characters *viz*. plant height, collar diameter, no. of branches/plant, no. of leaves/plant and leaf area. Sandy clay loam soil showed significantly better results for all morphological characters as compared to sandy loam soil.

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