



**Effect of Application of Different Levels of Single Super Phosphate on Growth Of Poplar (*Populus deltoids* bartr. Ex Marsh.) Under Nursery Conditions**

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**ABSTRACT**

The field experiment is carried out in February to June 2017 and conducted in Doon (PG) College, Dheradun, to explore the growth performance of *Populusdeltoides* under nursery condition. The experiment was laid accordingly on G-48 variety with the application of inorganic fertilizer i.e. Single Super Phosphate (SSP) which resulted in better plant height, root length and other growth attributes. The plant showed increased growth factors and the productivity rate increased drastically from day 75 till day 90 and onwards. The experiment was conducted in randomized block design with six treatments and four replication. Agroforestry systems based on poplar (*Populus deltoides*) are becoming popular in eastern and northern parts of India. Therefore studies on the structure and function of the systems are very important. Among all treatments  $T_5$  (150 gm SSP) and  $T_6$  (200 gm SSP) was found consistence in all the growth parameters i.e. plant height, diameter, leaf area, etc., so these treatments were considered the best of all the six treatments.

**Key Words:**

G-48, Single Super Phosphate

**INTRODUCTION**

In recent years poplars (*Populus deltoides*) received popularity among farmers in northern and eastern India due to their fast growth and ability to attain substantial biomass production in short rotations of upto 9 years. Poplar mostly occurs in low lying, moist alluvial ground, and tolerates flooding for a short time during the rainy season, and can be propagated vegetatively. In the inter-space of poplar plantation, several seasonal crops are cultivated for enhancement of overall productivity of the land and generation of

supplementary income (Jaiswal et al. 1993; Singh et al. 1993; Jain and Singh 1999). Poplar's attributes such as high propagation potential through cuttings, easy establishment, and rapid growth, straight cylindrical bole and high volume returns make this species suitable for cultivation under agroforestry systems. However, no systematic studies are available on the structure and function of these agroforestry systems in eastern India.

Poplar belongs to the family Saliaceae. It is a very important taxonomical group of tree species in plantation forestry because it is a deciduous fast

growing multipurpose tree species and can be harvested at a short rotation of 7-8 years. The branches are more or less angled or almost winged, the side branches borne of large branches are shed early. Outer bark forms early, furrowed by cork like ridges and deep fissures. The leaves are fairly large, deltoid on short shoots and very large and cordate on long shoots, light green in color. The tree crown intercept rains, acts as wind breaks and thus checks soil erosion and minimizes the effects of wind on associated crops. Poplar is a large tree reaching well over 25 m height and 100 -130 cm in girth (at breast height) in a period of 10 -12 years. It is shallow rooted and the root system spreads widely. The tree develops a tall straight bole. The tree is deciduous; the leafless period varies from 3 - 4 months. Flowering is normally in the dry season; these species are light demanding plants and are susceptible to drought. Though they grow well on sites with higher water table but they cannot withstand water logging conditions. *Populus deltoides* is large tree growing 20 to 40m (67-130 ft) tall and with a trunk up to 1.8m (5.9 ft) diameter, one of the largest North American hardwood trees. The bark is silvery white, smooth or lightly fissured when young, becoming dark grey and deeply fissured on old trees. The twigs age grayish yellow and stout, with large triangular leaf scars. The winter buds are slender, pointed, 1 -2 cm long, yellowish brown and resinous. The leaves are large, deltoids (triangular), 4-10 cm long and 4-11 cm broad with a truncated (flattened) base and petiole 3-12 cm long. The leaf is coarsely toothed, the teeth are curved and gland tipped, and the petiole is flat; they are dark green in the summer and turn yellow in the fall, (but many cotton woods in dry locations drop their leaves early from the combination of drought and leaf rust, making their fall color dull or absent). Due to the flat stem of the leaf, the leaf has the tendency to shake from even the slightest breeze. This is one of the identifying characteristics. It is dioecious, with the flowers (catkins) produce on single sex trees in early spring. The male (pollen) catkins are reddish purple and 8-10 cm. The female catkins are green, 7-13 cm long at pollination, maturing 15-20 cm

long with several 6-15 mm seeds capsules in early summer, which slit open to release the numerous small seeds attached to cotton like strands.

Poplar can be economically harvested in 6-8 years thus provide substantial wood over a short rotation and it has been reported that 60,000 hectares equivalent plantations of *P. deltoides* exists in India (Prakash Singh and Lodhiyal 2009). G3, G48, L34, S7, C15, Uday, Kranti and Bahar are superior clones of Poplar that are suitable for different agro climatic conditions of northern Indian states like Punjab, Haryana, Uttar Pradesh, and Uttarakhand. Poplar mostly occurs in low-lying, moist alluvial ground, and tolerates flooding for a short time during the rainy season, and can be propagated vegetatively. In the interspaces of poplar plantation, several seasonal crops are cultivated for enhancement of overall productivity of the land and generation of supplementary income. Poplar's attributes such as high propagation potential through cuttings, easy establishment, and rapid growth straight cylindrical bole and high volume returns make this species suitable for cultivation under agroforestry systems. However, no systematic studies are available on the structure and function of these agroforestry systems in eastern India. The present study aims to estimate the influence of various methods of (SSP) inorganic fertilizer application on the growth of (*Populus deltoides* Bartr. ex Marsh) under nursery conditions. Phosphorus is a major element constraining the growth of fast-growing species, particularly in phosphorus-poor soils (Elser et al. 2007, Vitousek et al. 2010). Applying phosphorus fertilizer is a common practice to overcome the phosphorus limitation and to promote the successful establishment and productivity of tree species (Bown and Van den Driessche 2005, DesRochers et al. 2006, Singh and Singh 2011).

## MATERIALS AND METHODS

The experiment was laid out in the nursery of Doon (PG) College of Agriculture Science and Technology, Dehradun from February to June

2017 for a period of four months. The observation for the different parameters like Number of branches, Diameter of the branch collar, Number of Leaves, Sprouting Height (cm) etc. at successive stages of growth was recorded after 30 DAP, 45 DAP, 60 DAP, 75 DAP, 90 DAP and 120 DAP lastly the cuttings were uprooted from the beds after 120 days of planting and the observations of number of roots and root length were recorded. The experiment was conducted following RBD and each treatment was replicated four times (R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and R<sub>4</sub>) and has six treatments viz. T<sub>1</sub> – Local control, T<sub>2</sub> – 50 gm of Single Super Phosphate/plant, T<sub>3</sub> – 75 gm of Single Super Phosphate/plant, T<sub>4</sub> – 100 gm of Single Super Phosphate/plant, T<sub>5</sub> – 150 gm of Single Super Phosphate/plant, T<sub>6</sub> – 200 gm of Single Super Phosphate/plant.

The data recorded during the course of observation was subjected to statistical analysis by Analysis of Variance (ANOVA) technique (Fisher, 1950) the significant and non – significant of treatment effect was judged with the help of 'F' (variance ratio) table. The significant difference between the mean were tested against the critical difference at 0.05% level.

## RESULTS AND DISCUSSION

The result on different parameters like Height of the Sprouting (cm), Diameter of the Branch Collar (mm), No. of leaves, No. of Branches, were analyzed after 30, 45, 60, 75, 90, 105, 120 DAP. Post-Harvest parameters like Length of the Root (cm) and No of roots were also taken into account and analyzed at 120 DAP. It was observed that almost all the parameters of the growth and development attributes produced great extent due to different treatments.

### Height of the sprouting

The Table 1 presents average Height of the Sprouting with different Day after planting (DAP) and revealed the effect of different doses of SSP. Among all treatments, T<sub>5</sub> found significance with 9.315 cm followed by T<sub>4</sub> with 9.06, however

minimum with 5.06 was recorded in T<sub>1</sub>. T<sub>2</sub>, T<sub>3</sub> and T<sub>6</sub> are having similar results. The average Sprouting Height after 45 DAP was reported maximum in T<sub>5</sub> with 17.25 followed by T<sub>2</sub> with 16.065 however minimum 9.62 were recorded in T<sub>1</sub>. T<sub>3</sub> and T<sub>6</sub> are having similar results. (Table 1). The average Sprouting Height after 60 DAP reported maximum in T<sub>6</sub> with 20.565, however minimum with 8.43 was recorded in T<sub>1</sub>. The average Sprouting Height after 75 DAP reported maximum in T<sub>6</sub> with 26.62, however minimum with 12.31 was recorded in T<sub>1</sub>. The average sprouting in 75 DAP was significantly double than the Local control with more or less similar results with T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> while T<sub>5</sub> and T<sub>6</sub> is slightly 3 cm more. Here T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> are having similar results as recorded in T<sub>5</sub>, T<sub>6</sub> respectively.

The average plant height after 90 DAP reported maximum in T<sub>5</sub> with 39.31 followed by T<sub>6</sub> with 38.75, however minimum with 17.18 was recorded in T<sub>1</sub>. The height of sprouting here was also twice more than the local control and T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> are varying with  $\pm 1$  cm. (Table 1). The average plant height after 105 DAP reported maximum in T<sub>6</sub> with 58.851 followed by T<sub>5</sub> with 57.065, however minimum with 25.31 was recorded in T<sub>1</sub>. The height of sprouting here was similar in T<sub>5</sub> and T<sub>6</sub> (Table 1). Finally in 120 DAP drastic growth was seen with almost 10-20 cm of increase in height of the sprouting compared to 105 DAP. The average plant height after 120 DAP reported maximum in T<sub>6</sub> with 71.93 followed by T<sub>5</sub> with 70.68, however minimum with 35.81 was recorded in T<sub>1</sub>. The height of sprouting here was similar in T<sub>5</sub> and T<sub>6</sub>. The average plant height after 90 DAP reported maximum in T<sub>5</sub> with 39.31 followed by T<sub>6</sub> with 38.75, however minimum with 17.18 was recorded in T<sub>1</sub>. The height of sprouting here was also twice more than the local control and T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> are varying with  $\pm 1$  cm (Table 1). The average plant height after 105 DAP reported maximum in T<sub>6</sub> with 58.85 followed by T<sub>5</sub> with 57.06, however minimum with 25.31 was recorded in T<sub>1</sub>. The height of sprouting here was similar in T<sub>5</sub> and T<sub>6</sub> (Table 1). Finally in 120 DAP drastic growth was seen with almost 10-20 cm of

increase in height of the sprouting compared to 105 DAP. The average plant height after 120 DAP

reported maximum in T6 with 71.93 followed by T5 with 70.68, however minimum with 35.81 was recorded in T1. The height of sprouting here was

**Table 1.** Effect of Single Super Phosphate on the Height of the Sprouting of *Populus deltoids* at 30, 45, 60, 75, 90, 105 & 120 days.

	Height of the sprouting (cm)						
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP
T1	5.065	9.625	8.435	12.315	17.185	25.315	35.815
T2	8.435	16.065	17.435	23.065	34.315	49.565	63.500
T3	8.185	14.875	18.250	23.565	35.435	48.500	61.435
T4	9.065	15.250	18.625	23.875	36.000	54.375	68.250
T5	9.315	17.250	20.065	26.565	39.315	57.065	70.685
T6	8.065	14.435	20.565	26.625	38.750	58.851	71.935
F- test	S	S	S	S	S	S	S
S.Ed ±	1.097	1.582	1.699	1.764	2.136	3.009	2.5
C.D.							
(P=0.05)	2.337	3.373	3.624	3.755	4.555	6.415	5.408

### Diameter of the Branch Collar

Average diameter of the branch collar after 30 DAPS showed significance differences with maximum in T<sub>2</sub> with 3.86 followed by T<sub>5</sub> with 3.75, however minimum with 1.71 was recorded in T<sub>1</sub>. The average diameter was similar to all the treatments however more than the local control. T<sub>2</sub> and T<sub>3</sub> are similar whereas T<sub>5</sub> and T<sub>6</sub> are also similar. The average diameter after 45 DAP was reported maximum in T<sub>2</sub> with 6.25 followed by T<sub>3</sub> with 6.15, with minimum 3.13 was recorded in T<sub>1</sub>. The average diameter here also was similar with 2 - 3 mm higher from T<sub>1</sub>. Here T<sub>2</sub>, T<sub>3</sub>, T<sub>5</sub> was similar and T<sub>4</sub>, T<sub>6</sub> was also similar (Table 2).

The average diameter after 60 DAP was reported maximum in T<sub>3</sub> with 6.91 however minimum with 4.02 was recorded in T<sub>1</sub>. The average diameter was more or less within 6 mm in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, hence variation was not found in the diameter at 60 DAP (Table 2)

The average diameter after 75 DAP reported maximum in T<sub>3</sub> with 7.48, however minimum with 4.58 was recorded in T<sub>1</sub>. The average change in diameter in 75 DAP was also not observed, with a little variation from T<sub>4</sub> and T<sub>2</sub>, T<sub>3</sub>, T<sub>5</sub>, and T<sub>6</sub> was similar. The average sprouting diameter after 90 DAP was reported maximum in T<sub>6</sub> with 8.650 followed by T<sub>5</sub> with 8.635, minimum was recorded in T<sub>1</sub>. The sprouting diameter here was also similar to T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub> and little variation with the control. The average sprouting diameter after 105 DAP was reported maximum in T<sub>6</sub> with 9.365 followed by T<sub>5</sub> with 9.350, minimum was recorded in T<sub>1</sub>. The sprouting diameter here was also similar in T<sub>2</sub>, T<sub>3</sub>, T<sub>5</sub> and T<sub>6</sub> and little variation with T<sub>4</sub>.

The average sprouting diameter after 120 DAP was reported maximum in T<sub>6</sub> with 10.117 followed by T<sub>5</sub> with 9.965, minimum was recorded in T<sub>1</sub>. The sprouting diameter here was also similar to T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and little variation with

T6. From the above observation it is evident that the growth in the diameter of the sprouting increased drastically from 30 DAP to 45 DAP with

3 mm increase in the diameter and after 45 DAP to 90 DAP the growth was just 1mm per further reading (Table 2)

**Table. 2** Effect of Single Super Phosphate on the diameter of the branch collar of *Populus deltoids* at 30, 45, 60, 75, 90, 105 and 120 days in soil.

	Diameter of the Branch Collar (mm)						
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP
T1	1.715	3.132	4.025	4.585	5.847	6.347	6.925
T2	3.865	6.250	6.865	7.375	8.547	9.247	9.85
T3	3.600	6.150	6.915	7.485	8.600	9.315	9.835
T4	2.852	5.450	6.267	6.847	8.025	8.785	9.317
T5	3.752	6.075	6.882	7.432	8.635	9.350	9.965
T6	3.417	5.775	6.650	7.235	8.650	9.365	10.117
F- test	S	S	S	S	S	S	S
S.Ed ± C.D.	0.321	0.194	0.231	0.250	0.295	0.309	0.284
(P=0.05)	0.690	0.401	0.480	0.545	0.625	0.657	0.618

### Number of branches per cuttings

The average sprouting of branches from the cuttings after 30 DAP showed significance with maximum branches in T5 with 1.685 followed by T3 with 1.565, however minimum with 1 was recorded in T1. The average sprouting was similar to all the treatments. The average branches after 45 DAP were reported maximum in T6 with 2.750 followed by T3 with 2.685, with minimum 1.250 was recorded in T1. The average sprouting of branches was similar with 1-3 branches in every replicate (Table 3)

The average branches after 60 DAP was reported maximum in T6 with 4.185, however minimum with 2.315 was recorded in T1. The average branches were more or less within 2-4 branches/cutting. The average branches after 75 DAP reported same as the results that were replicated in 60 DAP with maximum in T6 with 4.375 however minimum with 2.315 was recorded in T1. The average branches after 105 DAP reported same as the results that were replicated in 60 DAP and 90 DAP with maximum in T6 with 4.435 followed by T5 with 3.815 however

minimum with 2.5 was recorded in T1. The average sprouting of new branches was not observed may be due to the length of the cutting, with no variation in the sprouting of new branches same results was also observed in 120 DAP. From the above observation it was concluded that the maximum number of branches were 5 sprouting/cutting and minimum was 1 sprouting/cutting during the initial growing stages (Table 3)

### Number of leaves

Average number of leaves from the cuttings after 30 DAP was maximum in T2 with 5.31 followed by T5 with 4.75 however minimum with 2.68 was recorded in T1. The average count of leaves was 3-4 leaves per branch to all the treatments however maximum leaves were found in cuttings with maximum branches. The average number of leaves increased after 45 DAP which was reported maximum in T6 with 12.32 followed by T5 with 11.75, with minimum 5 was recorded in T1. The average leaf seen in each branch was 4-6 leaves in every treatment. The average number of leaves after 60 DAP was reported maximum in T5



with 24.435 however minimum with 14.68 was recorded in T1. The average leaves in each branch were more or less 6-8.

The average number of leaves after 75 DAP was reported maximum in T5 with 30.875 and with similar results from T2, T3, T4 and T6 with average 28 leaves. The average number of leaves after 90 DAP was significantly higher than the pattern observed in 30, 45, 60, and 75 DAP with T5

with maximum average figure of 36.065 and minimum of 23.75 in T1. The average number of leaves after 105 DAP was maximum in T5 with 41.065 followed by 40.12 all the treatments showed variation. The average number of leaves after 120 DAP was average than which was observed in 90 DAP to 105 DAP T5 with maximum average figure of 45.68 leaves followed by T<sub>6</sub> with 45.06 and minimum of 31.81 leaves in T1 respectively.

**Table. 3.** Effect of Single Super Phosphate on the number of branches per cuttings of *Populus deltoids* at 30, 45, 60, 75, 90, 105 and 120 days.

	Number of branches per cuttings						
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP
T1	1.000	1.250	2.315	2.375	2.315	2.500	2.500
T2	1.435	2.185	3.815	3.875	3.815	3.815	3.815
T3	1.565	2.685	3.685	3.375	3.750	3.750	3.750
T4	1.435	2.185	3.435	3.625	3.565	3.685	3.685
T5	1.685	2.435	3.685	3.685	3.750	3.815	3.815
T6	1.435	2.750	4.185	3.935	4.375	4.435	4.435
F- test	S	S	S	S	S	S	S
S.Ed ± C.D.	0.594	0.382	0.360	0.360	0.604	0.325	0.325
(P=0.05)	0.328	0.825	0.781	0.781	0.731	0.691	0.691

**Table. 4.** Effect of Single Super Phosphate on the number of leaves of *Populus deltoids* at 30, 45, 60, 75, 90, 105 and 120 days.

	Number of leaves						
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP
T1	2.685	5.000	14.685	18.935	23.750	27.875	31.815
T2	5.315	11.315	22.565	28.000	33.625	39.185	43.250
T3	4.375	11.000	21.815	28.185	33.125	37.435	43.500
T4	4.375	10.565	22.250	28.935	34.435	39.500	43.685
T5	4.750	11.750	24.435	30.875	36.065	41.065	45.685
T6	4.250	12.625	21.625	28.500	34.000	40.125	45.065
F- test	S	S	S	S	S	S	S
S.Ed ± C.D.	0.365	1.260	1.894	1.848	1.721	1.929	2.081
(P=0.05)	0.781	2.680	4.036	3.937	3.667	4.114	4.437

### Area of the leaf

Average area of leaf from the cuttings after 30 DAP was maximum in T5 with 25.37 followed by T3 with 23.68 however minimum with 4.62 was recorded in T1. The average area of the leaf showed great variation with the local control whereas it was observed that other treatments gave similar results to one another.

The average area of the leaf increased after 45 DAP which was reported maximum in T5 with 33.5 followed by T3 with 32.87, with minimum 10.73 was recorded in T1. The average leaf area of the leaf showed great variation compared to the local control and similar results were seen in remaining treatments. The average area of the leaf after 60 DAP was reported maximum in T5 with 42.87 however minimum with 17.68 was recorded in T1. The average area of leaf was double the average area in the control treatment. (Table 5)

The average area of the leaf after 75 DAP was reported maximum in T6 with 57.31 and with similar results from T2, T3, T4 and T5 whereas the local control T1 had the minimum of 24.37. The average area of the leaf after 90 DAP was significantly higher than the previous observation in 75 DAP with T6 with maximum figure of 78.75 and minimum of 36.75 in T1.

The average area of the leaf after 105 DAP was reported maximum in T5 with 112.06 followed by T6 with 111.75 however minimum with 58.43 was recorded in T1. The average area of leaf was increasing as growth of the plant increased. The average area of the leaf after 120 DAP was reported maximum in T6 with 140.25 followed by T5 with 139.81 however minimum with 17.68 was recorded in T1. The average area of leaf was increasing very rapidly. From the above observation it was observed that there is a significant increase in the area of the leaf from the time interval between 90 DAP to 120 DAP.

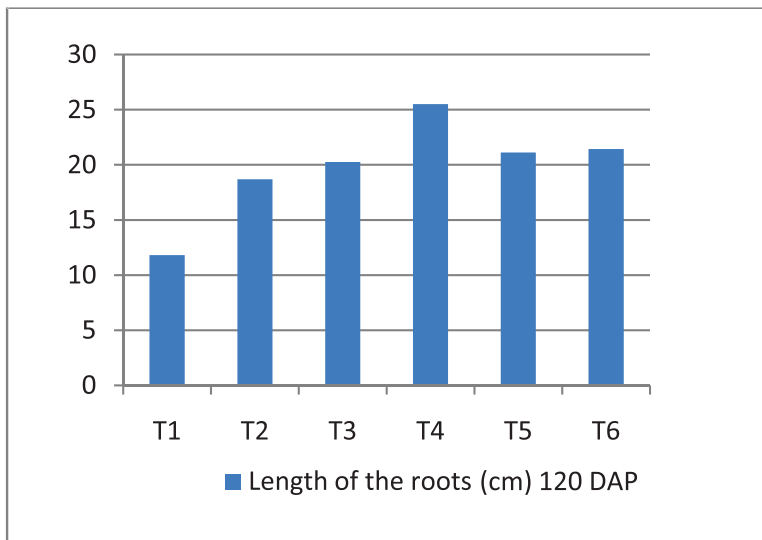
**Table. 5.** Effect of Single Super Phosphate on the area of the leaf of *Populus deltoids* at 30, 45, 60, 75, 90, 105 and 120 days.

	Area of the leaf (cm <sup>2</sup> )						
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP	105 DAP	120 DAP
T1	4.625	10.735	17.685	24.375	36.750	58.435	82.250
T2	22.125	30.000	39.315	54.065	73.065	98.565	129.500
T3	23.685	32.875	41.185	54.815	73.185	101.250	127.375
T4	22.625	30.565	40.815	54.185	72.750	100.750	123.065
T5	25.375	33.500	42.875	56.935	78.315	112.065	139.815
T6	23.185	30.875	42.065	57.315	78.750	111.750	140.250
F- test	S	S	S	S	S	S	S
S.Ed ±	2.506	3.065	3.457	3.495	4.206	7.112	7.303
C.D.							
(P=0.05)	5.340	6.530	7.360	7.441	8.963	15.155	15.562

### Length of the root

The average length of roots was significantly influenced by the different treatments at different stages of growth in the cuttings. After 120 DAP it was found

that the length of the roots was observed maximum in T4 with 25.000 which were statistically at par with T5 (21.12) and T6 (21.43). The average length of the roots were more or less similar in T5 and T6 (Fig. 1).

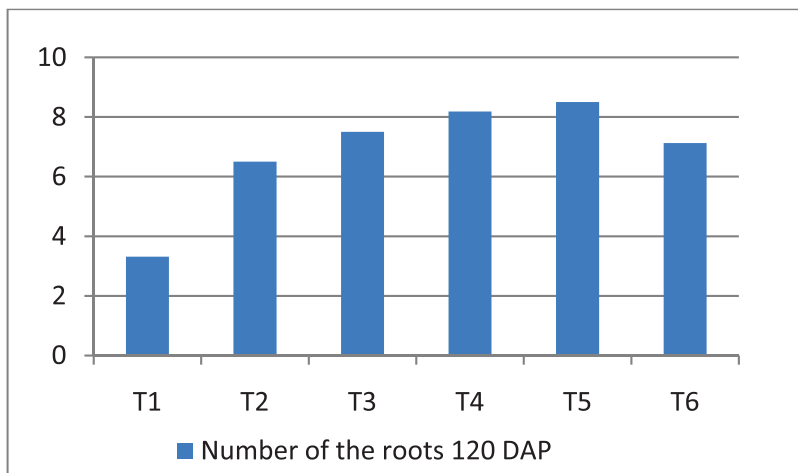


**Fig 1.** Effect of Single Super Phosphate on rooting of *Populus deltoids* at 120 days.

**Number of roots**

The average number of roots that were observed 120 DAP was relatively similar to all the

treatments in T2, T3, T4, T5, T6 with an average of 6-7 roots however less in T1, the rooting was significantly influenced by the treatment. (Fig. 2)



**Fig 2.** Effect of Single Super Phosphate on number of rooting of *Populus deltoids* at 120 days.

**CONCLUSION**

Satisfactory sprouting has occurred on low-cut stumps of trees and Trees planted from conventional 20 to 40 cm cuttings had deep roots and were well anchored against root lodging. The application of SSP nutrient increase the growth significantly in *Populus deltoids*. The present

investigation concluded that application of 150 gm SSP and 200 gm SSP are considered best for the all the growth parameters *i.e.* plant height, diameter, leaf area, etc.

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