

Suggested Citation

Chauhan, A.S; Naithani, S; Balodi, K; Singh, A. and Khan, R.A. (2015). Effects of Plant Growth Hormones on *Populus deltooides* Bartram ex Marshall: An Important Species Having Potential in Agro-forestry. *Journal of Studies in Dynamics and Change (JSDC)*, 2(1), Pages. 01-06

Effects of Plant Growth Hormones on *Populus deltooides* Bartram ex Marshall

An Important Species Having Potential in Agro-forestry

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ABSTRACT

Populus deltooides is grown in a significant scale in India and an important plant species in the terms of economic and ecological value commonly known as Poplar. It supports the socio-economic stability among the household in irrigated plain of northern India. It grows at very fast rate and consisting fine wood properties for paper making as well as a timber species important to increase the total forest cover outside the forest. Also, support a number of micro-organism and other biodiversity in living as well as decaying stage of the life span. The present study was conducted to examine the vegetative propagation and effects of maturation in *Populus deltooides* and to find a suitable hormone for large scale cultivation of *Populus deltooides* to proliferate the economy of Indian farmer. To achieve the following objectives, the stems were cut down and treated with different concentration of the different Hormones which were further grown on the vermiculite medium and the effect of different hormone was examined. In this process the rooting from stem was observed and analyzed. The activity of hormones on the plant stem was resulted into various inferences. The study revealed that Indole Butyric Acid (IBA) was most effective in the plant growth than the other growth hormone such as Indole Acetic Acid and Gibberelic Acid, etc. It was also observed during the study that Indole Butyric Acid shows maximum leaves formation (55.63±6.4), sprouting (42.0±2) and average root height (10.20±9.0) at 1500 ppm concentration while increasing the concentration of IBA more than 1500 ppm, inhibit the plant growth rate in this plant species.

Keywords; *Agro-forestry, Populus, Growth Hormones, Stem cuttings*

Abbreviations; IAA-Indole acetic acid, IBA- Indole butyric acid and GA-Gibberelic acid

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Introduction

The family Salicaceae consists of hundreds of species of woody trees, shrubs, and subshrubs but contains only 2 genera: the willows (*Salix* spp. L.) (Zasada *et al.* 2003) and the poplars, cottonwoods, and aspens

(*Populus* spp. L.) (Wycoff and Zasada, 2003). This plant family is important because of several reasons: 1) individual plants are dioecious (Rowland *et al.* 2002; Zasada *et al.* 2003); 2) members of the Salicaceae are keystone species in many riparian



plant communities; and 3) they are commonly propagated by cuttings rather than seeds.

Species of the genus *Populus* (Salicaceae) are widely distributed throughout the northern hemisphere (Eckenwalder, 1977). The number of species ranges from 22 to 85 plus hundreds of hybrids, varieties and cultivars, because within the genus occur extensive interspecific hybridization and high morphological variation (Eckenwalder, 1996). *Populus deltoides* tolerates frost, heavy soil, sand, slope, and water logging. Because of its intolerance to competition and the absence of suitable seedbeds under existing stands, it does not usually succeed itself. It is estimated to range in forest life zones from warm temperate dry to moist through cold temperate dry to moist (Duke, 1983).

Populus deltoides showed better adaptation to our ecological conditions than other species and hybrids (S. Cortizo, J. Bozzi, and V. Mema 2008). Generally *Populus* perform best on fertile loam or clayey loam soils, rich in organic matter. Saline and alkaline soils are not suitable. It prefers porous soil with adequate moisture.

Populus deltoides is the only species of poplar that is planted on a significant scale in India. *Populus deltoides*, hereafter called poplar, constitutes the backbone of agroforestry in irrigated plains of Northern India (Kumar *et.al.*, 1999.). The poplar-based agro-forestry land use option has not only contributed significantly to increase in the tree cover outside natural forests but has also proved to be a potential resource for socio-economic development, ecological restoration and diversification of agriculture (Chauhan *et.al.*2012). It has generate a multiplier outcome in the economy of the rural areas through establishment of poplar woodlots, expansion of wood-based industries, generation of employment and revenue collection to Government in the form of taxation (Dhiman, 2012).The improvement of soil fertility, enhancement of bio-diversity and carbon sequestration have been the ecological attributes of the poplars being grown on farm lands outside the forests (Gulshan kumar, 2008). Vegetative propagation is an integral part of tree improvement programmes, as it is needed for establishing clonal seed orchards. Also, mass vegetative multiplication of selected genotypes offers the promise of quick productive gains. In most tree species exogenous application of natural and synthetic auxins facilitates adventitious root production from branch cuttings (Kevers *et al.* 1997; Henrique *et al.* 2006). In present study the *Populus* were grown on the vermiculite medium instead of sand or soil because vermiculite is

natural inorganic mineral and porous in nature, have good amount of nutrients, Less weight, more cation exchange capacity and more water holding capacity than soil. Therefore the current study was to examine the effect of different concentration of growth hormone *viz.*, indole-3- butyric acid (IBA), indole-3-acetic acid (IAA), naphthalene acetic acid (NAA), gibberellic acid and kinetin on the *Populus deltoides*. The aim was to find a suitable hormone for large scale cultivation of *Populus deltoides*.

Materials and Methodology

Collection of planting Material

Populus deltoides cuttings for propagation were collected from agroforestry plantation of farmer fields from Maansingh village , Mohand (latitude 30° 07'56.83'N and Longitude 77°51'35.06'E), Dehradun ,Uttarakhand (India).

Preparation of stem cuttings

Mature stem cuttings of *Populus* are collected in the month of February. Using a sharp Secateur two noded cuttings measure 5-6 cm were prepared and transferred to a beaker with distilled water. The cut end of shoot immersed in the water in the bucket and transported to the laboratory, the shoot were also enclosed in a polythene sheet to preventing water loss. The cuttings were subsequently washed with distilled water and treated with root promoting auxins at the basal end (2-3 cm basal prtion) The cuttings received distilled water (control) or treatments of IBA, IAA, NAA, GA, Kinetin individually at different concentrations (1500, 2000 ppm). For a maximum of 10 minutes in each concentration. Subsequently the cuttings were planted in plastic trays containing Vermiculite and kept in the Poly house. The trays were covered with a polythene sheets for retaining moisture (Figure 1 and 2). Water was supplied everyday (3 times) in the trays by the help of sprayer.

Data collection

After the 2nd week the mature stem cuttings of *Populus deltoides* data were recorded for root and shoot traits, *viz.* (1) shoot height, (2) Numbers of leaves, (3) Root length, (4) Numbers of sprouting, (5) Total moisture content.

Result and Discussion

Populus deltoides are very fast growing tree species which having a unique rapid growth under favorable conditions. As a result, there is rapid increase in the demand of *Populus* wood in the country. *Populus*

deltoides is a very popular agroforestry tree species providing good return to farmers and timber to wood-based small scale industries in Punjab and Haryana. Thus there is need to improve the method of *Populus* production so as to meet their market demand. One of such method of rapidly producing *Populus* by the use of vegetative propagation through stem cutting. The study revealed that highly significant differences among the different treatments (Table 1). The survival percentage was higher in case of control followed by IBA @ 1500 ppm concentration and NAA @ 2000 ppm concentration (Table 2). The lowest survival rate was observed in Kinetin @ 2000 ppm concentration. The maximum number of leaves and number of sprouting found in IBA @1500 ppm concentration followed by NAA @ 2000 ppm concentration respectively. In case of root height the IBA hormone @1500 ppm concentration show the maximum height of the root. The root shoot ratio, total crude fiber and total moisture content is significantly higher in IBA hormone treatment while the IAA, NAA, GA and kinetin hormones are not show significant effects.

Conclusion

The study concludes that Stem cuttings treated in various growth hormones at different concentrations had significant effects on all the morphological parameters of *Populus deltoides* cuttings. Stem cutting of populus deltoides treated with IBA and NAA at 1500 ppm concentration showed the best plant height, leaf number, number of sprouting, root shoot ratio respectively. The study reveals that the total crude fiber content is very high in Poplar plant which can be use for fodder for animals and wood properties. So *Populus deltoides* is a very good agroforestry tree providing good return to farmers and timber to wood-based small scale industries.

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Tables and Figures:



(A)



(B)

Figure 1: (A) Stem cuttings of *Populus deltoides* in plastic trays. (B). Plastic trays covered with thin plastic sheets to retaining moisture.



(A)



(B)



(C)



(D)

Figure 2: (a) Cultivation of *Populus deltoides* in Agricultural fields at Maan singh village (Dehradun). (b) Grey bark of *Populus deltoides*. (C) Stem cuttings after treatment with horomes and grown in the Vermiculite. (d) Ovate-lanceolate leaf of *Populus deltoides*

Table 1: Effect of different concentration of growth hormones on populus cuttings. \pm SE- Standard error of mean each of three replicates, each replicate contains 25 cuttings. Bold indicates the best response.

ormones	Conc. in (ppm)	Average no of leaves (\pm SE)	Average no of sprouting (\pm SE)	Root height (\pm SE)	Shoot height (\pm SE)	Root shoot ratio(\pm SE)	Total crude fiber (\pm SE)	Total moisture content (\pm SE)
Control	-	64.7500 \pm 7.81425	21.1250 \pm 3.55788	-	8.4625 \pm 1.07	-	-	-
IAA	1500	33.7500 \pm 14.82608	11.3750 \pm 4.4277	-	8.3375 \pm 1.02	-	-	-
	2000	24.6250 \pm 12.52417	1.7500 \pm .52610	-	4.7500 \pm 1.57	-	-	-
IBA	1500	55.6250 \pm 6.37780	42.0000 \pm 2.09591	10.20\pm.9000	4.4750 \pm 1.42	.2593 \pm .00926	33.5400\pm4.19820	52.54\pm15.42
	2000	6.6250 \pm 2.82803	17.0000 \pm 6.36677	9.3 \pm 2.188	5.5750 \pm 1.39	-	-	-
NAA	1500	39.1250 \pm 15.12146	15.0000 \pm 5.73834	-	5.6500 \pm 1.30	-	-	-
	2000	40.7500 \pm 6.6250	4.2500 \pm .86086	-	10.2250 \pm 1.80	-	-	-
GA	1500	14.0000 \pm 2.95804	15.5000 \pm .7320	-	9.6050 \pm 2.20	-	-	-
	2000	23.2500 \pm 4.83569	.6250 \pm .4199	-	2.6750 \pm 1.45	-	-	-
KINETIN	1500	1.8750 \pm 1.31526	.3750 \pm .1829	-	1.9750 \pm 1.46	-	-	-
	2000	2.3750 \pm 1.51112	-	-	-	-	-	-