Print : ISSN 0970 – 7662
Online : ISSN 2455 – 7129

Journal of Tree Sciences

online available at www.ists.in

Volume 39 No. 2 December, 2020

Effect of Branch Pruning and Topping On Poplar Tree Growth

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DOI: 10.5958/2455-7129.2020.00020.5

Key Words:

Bole height, DBH, G 48 clone, prunning

ABSTRACT

Four year old trees of PL5 (G 48) clone grown at 6 x 3 m spacing were pruned *i.e.*, 50 % pruning of stem; 75 % pruning of stem; Lateral pruning (1.5 m on both sides), Topping 2 m from top and no topping. The highest DBH was recorded in 75% pruning with topping (40.98 cm). The highest bole height was observed in 75% pruning without topping (6.72 m and 7.26 m in year 2015 and 2016, respectively. The diameter increment was recorded during study period was higher 4.03 m in 50% pruning with topping

INTRODUCTION

Populus deltoides based agroforestry system is one of the viable alternative land use system to diversify the rice-wheat rotation, avert further degradation and obtain biological production on sustainable basis in the irrigated agro-ecosystem. Replacing the wheat and paddy crop rotation, Poplar (*Populus deltoides*), because of its fast growth, straight growing stem, short rotation, quality wood production and profitability, has been planted at large scale in north-western states of India-Haryana, Punjab, Uttrakhand and Uttar Pradesh (Chauhan and Mangat 2006). This species has been grown by farmers as boundary or block plantation, which supports the physio-chemical properties of soil through addition of organic matter in the soil and provides alternate sources of income and employment to the rural poor. A large scale area is already under poplar boundary plantation in Punjab and adjoining states (a ratio of 1:3 in block to bund plantations), which supports the vision "*Har med pe ped*" of Hon'ble Prime Minister of India

Shading by poplar canopies decrease crop growth roughly in direct proportion to the reduction in absorbed radiations (Fischer 1985).The tree shade lessens the wind velocity as well as soil temperature and results in reduced evapo-transpiration in the shaded crop (Basavaraju and Rao 2000). To regulate the shade in agroforestry system at optimum level, trees are normally pruned during the cropping period to avert the competition for light. Pruning is a silvicultural practice comprising the careful removal of parts of a plant, such as buds, branches, or roots. Prune branches in agroforestry involve giving shape to tree

stands and canopy growth keep under control, make better or maintaining health, improve light availability to inter-cultivated crop, etc besides facilitate tree growth. Hence, it is critical to examine the effect of pruning regime on the growth of poplar stem. A study was conducted with the objective to record relationship of poplar tree canopy volume with diameter.

MATERIALS AND METHODS

The present investigation was carried out at the PAU Seed Farm at Ladhowal, Ludhiana during the year 2015-16. Four year old trees of PL5 (G 48) clone growing at 6 x 3 m spacing were pruned *i.e.*, 50% pruning of stem; 75% pruning of stem; Lateral pruning (1.5 m on both sides), Topping 2 m from top and no topping. The observations were recorded twice at the end of 4th year and 5th year of growth of the trees for tree height, diameter, bole height and canopy spread. Statistical analysis of data was carried out in Completely Randomized Design with three replications besides establishing correlation between diameter and crown spread.

RESULTS AND DISCUSSIONS

Tree growth is an irreversible increase in size and shape of the tree and is influenced by the genetic composition of the tree species as well as the prevailing environmental factors. The data recorded on different tree growth parameters are presented in three table and correlation depicted in a figure.

The data for the height of the poplar trees were recorded during October 2015 and September 2016 and presented in Table 1. It can be observed from the data that the tree height between different treatments did not differ significantly. More height was observed at 50% pruning without topping and lowest height observed at no pruning without topping during 2015. During 2016, after crop harvesting same result of highest and lowest height were recorded in both the above mentioned treatments. Tree height of 12.20 m (2015) and 12.97 m (2016) was highest in 50% Pruning without topping in agroforestry system and height of 9.73 m (2015) and 10.93 m (2016) was lowest in no pruning without topping. Significant differences were noticed between different treatments for diameter as well. The highest DBH was recorded in 75% pruning with topping (40.98 cm) in 2015, that was not statistically par with other values and also in 2016, highest observations for DBH were recorded in the same treatment. The site seems quite favourable for poplar growth, DHB recorded was much higher than recorded by Chauhan et al. (2012). It is apparent from the data that the canopy spread varied from 16.29 m^2 in lateral pruning topping to 26.17 m^2 in 50% pruning with topping during 2015 (among pruning treatments but significant less than unpruned treatments) and 18.90 m^2 in lateral pruning without topping to in 50% pruning with topping during 2016 (27.05 m^2). Significant differences were observed between different treatments for bole height as well. The highest bole height was observed both times in 75% pruning without topping (6.72 m and 7.26 m in 2015 and 2016, respectively). In both cases, it was statistically at par with 75% pruning with topping. The lowest bole height was recorded at both the times in same treatment in no pruning without topping 2.85 m in 2015 and 3.31 m in 2016. In the case of lowest value, it was statistically at par with all values except 75% pruning with topping and 75% pruning without topping.

Table 1. Different observation of poplar tree recorded in 2015 and 2016

Treatment Parameter	2015				2016			
	Height (m)	Bole height(m)	DBH (cm)	Crown spread (m^2)	Height (m)	Bole height (m)	DBH (cm)	Crown spread (m^2)
No pruning with topping	11.29	2.86	37.98	34.33	12.42	3.30	41.92	45.38
No pruning without topping	9.73	2.85	37.10	35.47	10.93	3.31	41.06	45.68
50% pruning with topping	11.56	3.80	35.36	26.17	12.47	4.18	39.39	27.05
50% pruning without topping	12.20	4.13	38.06	25.21	12.97	4.49	41.38	26.08
75% pruning with topping	10.64	6.60	40.98	24.82	11.81	7.11	44.77	25.83
75% pruning without topping	12.21	6.72	37.67	25.61	12.94	7.26	41.31	26.47
Lateral pruning with topping	11.22	2.89	34.94	14.29	12.92	3.33	38.80	19.11
Lateral pruning without topping	12.15	2.79	37.18	14.34	12.45	3.17	41.18	18.90
LSD (*P*=<0.05)	N S	0.17	1.71	0.91	NS	0.16	1.87	0.94
SE (m)	0.781	0.05	0.56	0.30	0.67	0.05	0.61	0.31

Many studies revealed that poplar grow better in agroforestry system than sole plantation. The poplar tree utilizes the inputs supplied to the inter cultivated crops. Verma et al (2013) recorded better height growth under agroforestry plantation owing to the management operations such as weeding, fertilization, irrigation, etc. for the inter cultivated crops. Mishra et al (2006) also observed enhancement in poplar height in agroforestry system. They reported 3.3 to 6.2 per cent rise in poplar height, when inter cultivated with soybean. Rivest et al (2005) reported improved in poplar height intercropped with agricultural crops. Considerably, additional increase in height (17.2%) in one year old poplar plantation intercropped with fodder-wheat rotation was also observed by Singh and Sharma (2007). Dhillon et al (2011) also revealed the high economic returns in poplar with intercropping, also due to higher productivity of the poplar owing to the benefits derived by trees from crop inputs and cultural operations than without inter cultivation, which operates on hypothesis of using resources beyond the reach of agricultural crops.

The maximum diameter growth was recorded in 50% pruning with topping (4.03cm). In this treatment, the epical dominance gets restricted resulting in diameter growth against height growth. The lowest diameter increment was 3.64 cm in 75% pruning without topping after one year of observation (Table 2). However, the relationship of canopy spread and diameter at breast height was found very weak (Fig. 1). Since the treatments were imposed during 2015 only, therefore, the lower R^2 value of 0.117 after one year was obvious. There is need to observe this relationship in subsequent years to check the influence of pruning intensity on collar/breast height diameter. Hurst *et al* (2006) emphasized that during initial two years only the pruning should be done to maintain the leader and after words 50% pruning of side branches up to 50% height is appropriate.

Table 2. Diameter (cm) increment in poplar trees

Treatment	Diameter (cm) (2015)	Diameter (cm) (2016)	Increase (cm)
No pruning with topping	37.98	41.92	+3.94
No pruning without topping	37.10	41.06	+3.90
50% pruning with topping	35.36	39.39	+4.03
50% pruning without topping	38.06	41.38	+3.66
75% pruning with topping	40.98	44.77	+3.79
75% pruning without topping	37.67	41.31	+3.64
Lateral pruning without topping	37.18	41.18	+4.00
Lateral pruning with topping	34.94	38.80	+3.86
LSD (*P*=<0.05)	1.71	1.87	+0.16
SE(m)	0.56	0.61	+0.05

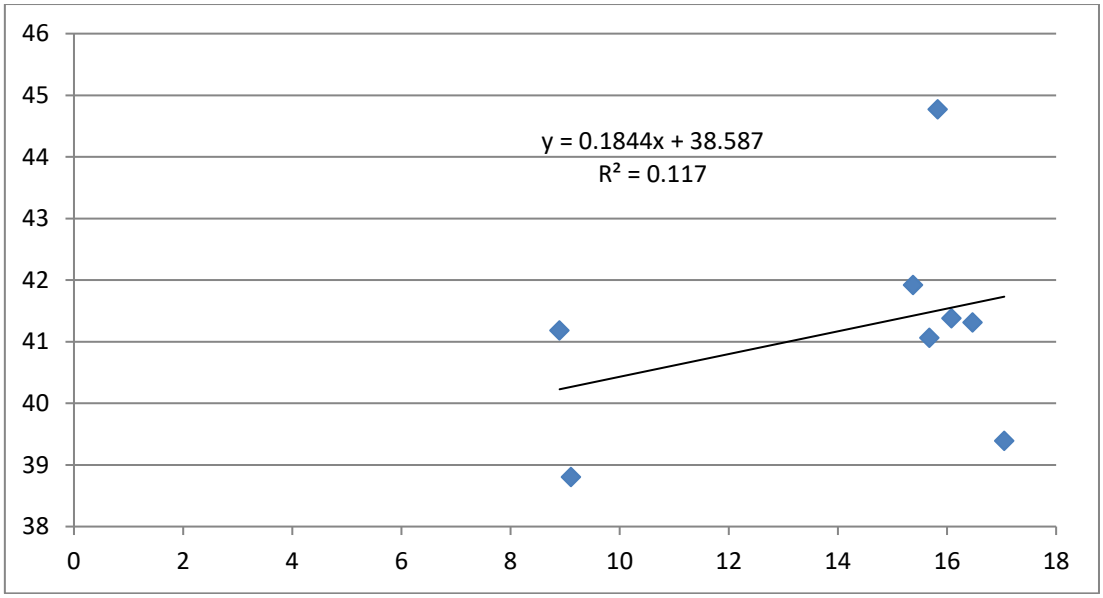

Fig. 1. Relationship of poplar tree canopy spread with diameter (2016)

Significant differences were observed in dry biomass of pruned material from different treatments (Table 3). After pruning and topping of each treatment in 2015, dry weight of pruned and topped material from randomly selected trees from each treatment were observed. The highest dry biomass was recorded (4.69 kg/tree) in 75% pruning with topping and the lowest was recorded (1.18 kg/tree) in no pruning with topping, that was statistically at par with 50% pruning without topping (1.35 kg/tree) and with lateral pruning with topping (1.51 kg/tree).

It was highest in 75% pruning with topping because of highest material pruned from trees, whereas lowest dry biomass obtained in reverse case happened as pruned material was in small amount.

Table 3. Dry biomass of poplar pruning and topping material

Treatments	Dry biomass (kg tree^{-1})
No pruning with topping	1.18
50% pruning with topping	2.11
50% pruning without topping	1.35
75% pruning with topping	4.69
75% pruning without topping	3.89
Lateral pruning with topping	1.51
Lateral pruning without topping	2.49
LSD (P=<0.05)	0.53
SE(m)	0.17

Generally trees with the advancement of age tend to suppress the growth and yield of associated crops due to canopy spread and the associated climate variables. This suppression attributed to both above and below ground competition. To regulate the shade in agroforestry system, trees are usually pruned during the cropping period to avoid the competition for light. In the present study, it was observed that these treatments benefit the tree growth as well therefore trees should be pruned appropriately.

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Received: 10th November, 2020 *Accepted: 23th December, 2020*