EFFECT OF PRUNING ON GROWTH OF HYBRID POPLAR

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Abstract

Pruning of trees is common practice for the production of knot-free timber. However, it may lead to reduction in growth rate of the tree. *Populus euramericana* cv-1-214 is a hybrid poplar that has been planted on a large scale in Pakistan for the production of low to medium quality timber. This long term study, covering almost the complete rotation length of the Hybrid poplar, was conducted to find out the effects of three different intensities of pruning i.e. pruning upto ½ height, pruning upto ⅓ height and no pruning, on its diameter and height growth rate. The Randomized Complete Block Design was used. Data were analysed using the Analysis of Variance procedure and the Duncan multiple range test. Results reveal that at 5% level of significance there were significant differences between the three treatments as far as diameter growth was concerned. As regards the effect on height growth, no significant differences between the three treatments were observed. It is concluded that pruning of hybrid poplar may result in the production of good quality knot-free timber but it may reduce its volume considerably if the intensity of pruning is high.

Introduction

Hybrid poplar was introduced in Pakistan in the 1950s. Among the various clones tried in the country, *Populus euramericana* cv-1-214 gave better result and was thus planted on a large scale in different parts of the country (Hussain *et al.*, 1981). Farmers of the Peshawar valley have extensively planted it and compact plantations were also raised in the Punjab.

Hybrid poplar has emerged as the premier short rotation plantation timber for industrial use. The match industry is the major user of poplar wood (Sheikh, 1985). Poplar logs are also being exported to Afghanistan where they are extensively used in house construction.

After its introduction in the country, a number of scientific field experiments were conducted at different sites to develop suitable planting techniques and management practices for hybrid poplar (Hussain *et al.*, 1981). In traditional poplar cultivation high pruning has been an important operation to prevent knots in the wood except near the core (Jobling, 1990). On the other hand pruning may reduce growth in trees. Neilson and Pinkard (2003) reported a reduction in diameter increment of *Pinus radiata* at higher intensities of pruning. In order to find out the effects of pruning on growth of *Populus euramericana* cv-I-214, a study laid out in a 3 years old crop in the Daphar Plantation, district Gujrat, Punjab in 1976. The study continued till 1982 when the plants had reached a mature age of about 10 years covering almost the complete rotation length of hybrid poplar (Engindeniz, 2003). For some unknown reasons the data collected from this study were not analyzed and hence the results could not be produced or published.

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Material and Methods

An area of about 4 acres that supported 3 years old crop of *Populus euramericana* cv-I-214 at 18×18 feet spacing was selected in the Daphar Plantation for laying out the study in early 1976. The study was laid out under the Randomised Complete Block (RCB) Design with four replications (R1, R2, R3 and R4) and three treatments (T1, T2 and T3) as explained below:

T1 = Pruning up to ½ of total tree height
T2 = Pruning up to ⅓ of total tree height
T3 = No pruning (Control)

The total number of plots was thus 4×3 = 12. Initially there were 36 plants in each plot.

The layout of the design is given in table 1.

Table 1. Layout of RCB Design

Replications	Treatments		
R1	T2	T1	T3
R2	T2	T3	T1
R3	T1	T2	T3
R4	T3	T1	T2

The treatments were assigned to each replication at random and pruning, flush with the stem was done up to the height specified for each treatment. A + mark and a number was painted on every tree. Diameter at breast height (dbh) and total height of every tree were measured with the help of a diameter tape and Haga altimeter respectively, and recorded. Diameters were measured in inches and heights in feet. Diameter at breast height and height measurements of all trees present in the plots were recorded once every year till 1982 and plot averages calculated at the time of every annual measurement, fresh pruning of trees was carried out as prescribed for each treatment.

The data on average plot dbh and height corresponding to three years old (March 1976) and about ten years old (December, 1982) crops of hybrid poplar were used to calculate the total increment in dbh and heights per plot over the period. The data were analysed using the analysis of variance procedure and the Duncan Multiple Comparison Test (Le Clerg *et al.*, 1972).

Results and Discussion

Diameter growth

The data on growth in diameter at breast height of hybrid poplar under each treatment and replication for the study period are given in table 2.

Table 2.   Diameter growth data of hybrid poplar

Replications	Diameter growth (inches) treatments			Average
	T1	T2	T3	
R1	3.9	4.0	5.2	4.37
R2	4.4	4.3	4.4	4.37
R3	5.0	5.5	6.3	5.6
R4	4.9	5.8	6.0	5.57
Average	4.55	4.90	5.475	

The Analysis of Variance (ANOVA) procedure was applied to the above data to find out if there were significant differences in diameter growth rates for the different treatments at 5% level of significance. Results of the ANOVA are given in table 3.

Table 3.   ANOVA table for diameter growth

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-ratio	P value
Treatment	2	1.745	0.872	6.12	0.036
Replication	3	4.442	1.481	10.39	0.009
Error	6	0.855	0.142		
Total	11	7.042			

The results of ANOVA indicate that at 5% level of significance there are statistically significant differences between the different treatments as well as replications. In other words pruning intensities do effect diameter growth of hybrid poplar. Duncan multiple range test was then applied to compare all pairs of treatment means. Comparison of T1 with T2 and T2 with T3 revealed that the differences between the means of both these pairs were less than the shortest significant range of 0.652 as computed from the Duncan test. However, comparison of T1 with T3 revealed that the difference in their means was greater than the shortest significant range of 0.676 computed from the Duncan test. These results indicate that there are significant differences between T1 and T3 as regards diameter growth. In other words pruning up to ½ of the total tree height does reduce diameter growth significantly as compared to no pruning (control). It is probably due to the removal of almost half of the tree canopy resulting in reduced amount of chlorophyll available for manufacturing food for the plant.

Height growth

The data on growth in height of hybrid poplar under each treatment and replication for the study period are given in table 4.

Table 4.   Height growth data of hybrid poplar

Replications	Diameter growth (feet) treatments			Average
	T1	T2	T3	
R1	30	35	36	33.67
R2	31	30	27	29.33
R3	42	44	46	44.00
R4	38	41	42	40.33
Average	35.25	37.5	37.75	

The Analysis of Variance (ANOVA) procedure was applied to the above data to find out if there were significant difference in height growth rates for the different treatments at 5% level of significance. Results of the ANOVA analysis are given in table 5.

Table 5.   ANOVA table for height growth

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-ratio	P value
Treatment	2	15.17	7.58	1.48	0.301
Replication	3	389.67	129.89	25.28	0.001
Error	6	30.83	5.14		
Total	11	435.67			

The results of ANOVA indicate that at 5% level of significance there are no statistically significant differences between the three different treatment but the replications show significant differences. In other words pruning intensities did not have a significant effect on the height growth of hybrid poplar.

Conclusion

Pruning upto ⅓ height does not affect diameter and height growth of hybrid poplar. However, pruning upto ½ total height does affect diameter growth. As the volume of timber obtained from a tree depends to a larger extant on its diameter, high intensity pruning may result in lower timber production in hybrid poplar. However, the quality of the timber may be better because of its being largely knot free. So pruning may be carried out in hybrid poplar upto ⅓ of the total of the tree to get knot free timber.

References

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