

SUITABLE SPACING FOR PLANTING OF POPLAR IN AGROFORESTRY SYSTEMS

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ABSTRACT

In view of popularity of the Poplar tree with the farmers, it was desired to work out a suitable pattern of planting Poplar (*Populus deltoides*) in AF system for intercropping with agricultural crops. A replicated experiment involving agricultural crops (maize and wheat) and silvicultural crop. (Poplar) was initiated

during 1990-91 at PFRI Research Garden. Poplar was planted in rows 6.1 m, 9.2 m, and 12.2 m apart with a uniform distance of 1.5 m from tree to tree within the rows. Maize and wheat was intercropped with the Poplar crop. The result available upto September, 1993 has shown that pattern of planting in rows 9.2 m or 12.2 m apart is a good system to allow intercropping upto 5th or even 6th year age of

Data regarding yield of agricultural crops and growth of Poplar was collected regularly.

RESULTS AND DISCUSSION

Maize Fodder

The data regarding maize fodder is given in table-1.

Table 1. Yield of maize fodder intercropped with Poplar.

Sr.No.	Treatments (Poplar spacing)	Yield in Kg/ha			Gross returns (Rs.)
		1991	1992	1993	
1.	1.5x6.1 m	23654	13504	10402	10128
2.	1.5x9.2 m	23654	14934	18774	13842
3.	1.5x12.2 m	27220	13669	23210	15330

The above yield figures show that during first two years various Poplar spacings did not have any effect on the yield of maize fodder. However, during 3rd year the effect of various Poplar spacings on the yield of maize fodder is apparent. At this stage the distance between the crowns of trees between two lines was on an average 0.9 m, 3.05 m, and 6.1 m in case of treatment No.1, 2, and 3 respectively. The position of crowns in the field also indicated

that intercropping could be continued for at least another two years in case of 2nd treatment and another three years in case of 3rd treatment, i.e. upto 5th or 6th year age of the Poplar.

Wheat Crop

Two wheat crops were raised and data regarding grain and straw-yield was collected. The grain yield data is given in Table 2.

Table 2. Yield of wheat grain intercropped with Poplar.

Sr.No.	Treatments (Poplar spacing)	Grain yield in Kg/ha			Gross returns (Rs.)
		1991	1992	1993	
1.	1.5m x 6.1m	-	2883	2356	16901+2817*=19718
2.	1.5m x 9.2m	-	2177	2384	14875+2471*=17346
3.	1.5m x 12.2 m	-	2695	2302	16148+2668*=18816

* From sale of wheat 'bhoosa' for 2 years

The figures of wheat yield indicate that different spacings of Poplar have not affected the grain yield of wheat. Similar results regarding wheat yield are expected during spring 1994. This is mainly because of the fact that Poplar trees are leafless during the period when wheat is intercropped with it. In view of these results and the position of crowns, it is

expected that wheat crop could be grown with Poplar upto 4th, 5th, and 6th year of the Poplar age under treatments 1st, 2nd, and 3rd respectively.

Poplar Crops

The growth data of Poplar collected by yearly interval is given in table-3.

Table 3. Poplar Growth under different spacings.

Sr.No.	Treatments (P.spacing)	GROWTH DATA			
		Height(m)	Dia. (cm)	Height (m)	Dia. (cm)
		December 1992		September 1993	
1.	1.5mx6.1m	8.3	8.8	11.3	11.8
2.	1.5mx9.2m	7.5	7.5	12.0	12.9
3.	1.5mx12.2m	7.9	8.3	10.2	13.1

Different spacings do not appear to be having any effect on the growth of Poplar trees so far.

Width of crown and clear bole length measured during the last week of September, 1993 is given in table-4.

Table-4. Crown width and clear bole length.

S.No.	Treatments (P.spacing)	Crown width (m)	Clear bole length (m)	Spacing between crowns within two rows.(m)
1.	1.5mx6.1m	5.2	2.5	0.91
2.	1.5mx9.2m	6.0	2.5	3.05
3.	1.5mx12.2m	5.9	2.3	6.10

Poplar crop. The experiment is in progress.

INTRODUCTION

Poplar (*Populus deltoides*) is an important commercial tree of the Punjab and it is frequently grown in the agricultural fields. Recently, the agroforestry system of growing Poplar with agricultural crops on the farmlands has become very popular among the farmers. In order to standardize the pattern and spacing of planting Poplar with agricultural crops an experiment was designed and initiated during 1990-91 at PFRI Research Garden.

Sheikh *et al.* (1984) determined the effect of poplar shade on the yield of wheat at Changa Manga and reported that even the close distance of 0.75 and 2.75 meter from poplar trees had no significant effect. It was indicated that 4 years old poplars planted at 5.5 x 5.5 m did not depress grain or straw yield within the rows and the practice could be safely adopted by the farmers in the country. Li (1985) reported an increase and decrease in wheat (and the yield of trees themselves) recorded from the windward and sheltered side of a belt of *Populus nigra* var. *italica*. Overall results showed 17% increase in agri. crops by the shelterbelt. Sheikh and Khalique (1982) conducted a study to find out the effect of tree rows of *Eucalyptus camaldulensis* on the yield of agricultural crops and indicated that when the trees were 5-6 m in height and wheat was sown, the yield was not depressed. However, in case of cotton, when the height of tree belts was upto 7 m, the yield was comparatively less within a distance of 15-30 m on either side of the belt.

Sheikh and Cheema (1976) surveyed wheat fields having single tree rows on different sides of their boundary for determination of the effect of trees on the yield of wheat grain and

observed a beneficial effect. This effect varied with distance from the tree rows in individual fields while among different fields the magnitude of this effect changed with orientation of tree rows. It is indicated that an overall improvement in the yield of wheat can be brought about if properly oriented wind-breaks are planted. Vasilev (1980) reported that shelterbelts increased the grain yield by 0.7-0.8 t/ha by improving the soil structure and reduction in physical evaporation by 5-6%. He also concluded that combination of shelterbelts with "flat" tillage (i.e. discing) gave higher yields than cultivation by mould board ploughing. Dense shelterbelts due to shade reduced grain yields by 0.24 - 0.26 t/ha and proved effective with any type of cultivation.

METHODS AND PROCEDURE

An experiment with spacing of 1.5x6.1 m, 1.5x9.2 m, 1.5x12.2 m for Poplar was designed in 1990 and laid out during February, 1991 in the Research Garden, PFRI Faisalabad. The distance between Poplar rows was kept 6.1 m, 9.2 m, and 12.2 m, whereas distance from plant to plant within the rows was 1.5 m in all the treatments. Randomised Complete Block Design was used and the experiment was replicated three times. Experimental unit was a plot of 43.6x27.7 m, i.e. 0.12 hectare. The number of tree rows per plot were 4, 5 and 7 in plots having line to line distance of 12.2 m, 9.2 m, and 6.1 m respectively.

Poplar plants from 2nd stage nursery were planted at the prescribed spacing during February, 1991. Maizer crop was raised for fodder during "kharif" 1991. It was followed by wheat crop during "rabi" season. The same rotation was followed throughout, and upto September 1993 three crops of maize fodder and two crops of wheat have been obtained.

Table 5. Number, Volume and Weight of Poplar Trees under various treatments.

Sr. No.	Treatments (P.spacing)	No. of trees per ha.	Av.Dia (cm)	Av.Ht. (m)	Av.Vol. (m ³)	Vol/ha (m ³)	Av.wt/m ³ (kg.)	Wt./tree (kg)	Weight per ha. (kg) (mds) 40 kg = 1 md)		Sale rate/md. (40 kg.)	Income per ha. (Rs.)		Income per ha @ Rs.80/- per tree (Rs.)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	1.5mx6.1m	1074	11.7	11.3	0.058	62.93	720	42.80	46005	1150	80	90240	92008	85920
2.	1.5mx9.2m	716	12.9	11.9	0.067	47.97	720	48.96	35083	877	80	68792	70168	57280
3.	1.5mx12.2m	536	13.2	10.1	0.067	35.91	720	48.96	26251	656	80	51495	52504	42880

5. Data regarding volume and weight of Poplar trees under various spacings is given in Table

Expenditure per hectare

6. Values have been compounded at the rate of 10% upto 1993.

The yearly expenditure incurred on the experimental plots per hectare is given in table-

Table 6. Expenditure incurred on the experimental plots.

Sr.No.	Treatments (P.spacing)	Yearly expenditure/ha				Total expenditure/ha (Rs.)
		1990	1991	1992	1993	
		(Rs.)				
1.	1.5mx6.1m	2278	8517	3627	3172	17594
2.	1.5mx9.2m	2278	6992	3627	3172	16069
3.	1.5mx12.2m	2278	6753	3627	3172	15830

Gross Income

Gross income from the agricultural crops obtained during the experimental period and the

expected total value of Poplar trees during September, 1993 is given in table-7. Values compounded at the rate of 10%.

Table 7. Gross income from agricultural crops and Poplar trees per hectare.

Sr.No.	Treatments (P.spacing)	Maize fodder (Rs.)	Wheat crop (Rs.)	Value of Poplar trees (Rs.)	Total gross income (Rs.)
1.	1.5mx6.1m	10902	22515	85990	119407
2.	1.5mx9.2m	14665	19671	57327	91663
3.	1.5mx12.2m	16152	21463	42896	80511

Net Income

Poplar is given in table-8. Values compounded at the rate of 10%.

Net income per hectare from this agroforestry system at the age of three years of

Table 8. Net income per hectare under various treatments.

S. No.	Treatments (P.spacing)	Gross income (Rs.)	Expenditure (Rs.)	Net income (Rs.)	Net income per year (Rs.)
1.	1.5mx6.1m	119407	17596	101811	33937
2.	1.5mx9.2m	91663	16071	75592	25197
3.	1.5mx12.2m	80511	15831	64680	21560

Net income per year has been derived by dividing the total net income by 3, i.e. the age of Poplar trees.

Table 9. Net income from agricultural component per hectare.

S. No.	Treatments (P.spacing)	Expenditure (Rs.)	Gross returns (Rs.)	Net income (Rs.)	Net income per year (Rs.)
1.	1.5mx6.1m	13019	33417	20398	6799
2.	1.5mx9.2m	13019	34337	21318	7106
3.	1.5mx12.2m	13019	37616	24597	8199

Net income per year has been calculated by dividing the total net income by 3, i.e., the number of years during which 5 agricultural crops have been raised and sold. Only variable costs have been considered.

CONCLUSIONS

The agroforestry system of intercropping wheat and maize with Poplar trees planted in the pattern of widely spaced rows having trees at close spacing within the rows is a good model for practice by the farmers in the irrigated areas. In case of rows 9.2 m and 12.2 m apart, cultivation of agricultural crops is possible up to 5th or even 6th year age of the Poplar. If Poplar is to be grown at 8 years rotation, the Poplar trees can be allowed to grow for 2 years more and then harvested and sold for industrial purpose.

Net income from only agricultural crops (Table-9) is minimum (Rs.6799/-) with high density of Poplar (1.5mx6.1m) and increases with decrease in density. Whereas over-all net income (Table-8) is maximum (Rs.33937/-) with high density of Poplar (1.5mx6.1m) and decreases with decreasing density.

The distance between the rows and plant to plant distance within the rows will be guided further by the priority of tree crop or agricultural component. If the agricultural component is more important, the number of trees per hectare can be reduced, whereas if tree component is more important, the number of trees per hectare can be increased.

If tree component is more valuable, then 1.5mx9.2m or even 1.5mx6.1m spacing pattern should be adopted. If agricultural component is expected to bring higher income, then 1.5mx12.2m or even wider spacing pattern can be

practiced. This final decision depends upon the locality and the expected sale value of various agricultural crops and the tree component.

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