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Effect on Monetary Return in Various Pruning Intensities and Agronomical Management on *Dalbergia sissoo* Biomass Production under Agrisilviculture System

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A B S T R A C T

The experiment was carried out at dusty acre farm, Department of Forestry, College of Agriculture, J.N.K.V.V. Jabalpur during the year 2014- 2015. Manipulation in agronomical practice like higher seed rate, fertilizer dose with different pruning intensities which can compensate the yield reduction to shade under agrisilviculture system. The experiment consists of four pruning intensities *viz.*, no pruning, 25% pruning, 50% pruning and 75% pruning and one open condition (no tree crop only) in main plot and three levels of fertilizer doses and seed rate *viz.*, T_1 recommended dose of fertilizer and seed rate, T_2 - T_1 + 25% more nitrogen than recommended dose of fertilizer and T_3- T_1 + 25 % more seed rate than recommended dose of seed rate in sub plot replication in 5 times. 75% pruning recorded significantly higher yield attributing characters as compared no pruning. Different pruning treatment showed significant effect on net monetary return. 25% pruning recorded significantly higher monetary return (Rs 2,47,566.3 ha $^{-1}$) at par with 50% pruning (Rs 218854.5 ha^{-1}) but significantly superior to 75% pruning (Rs 1,25,151.9 ha^{-1}). Under managed agroforestry system i.e. *D. sissoo* in 25% pruning recorded higher monetary return (Rs 2,47,566.3 ha^{-1}) then tree alone (Rs 2,01,217.425 ha^{-1}) and unmanaged agroforestry system i.e. no pruning (Rs 2,11,111.4 ha^{-1}). Agronomical management T_2 i.e. 25% more nitrogen than recomended dose gave significantly higher monetary return (Rs 2,05,650.7 ha^{-1}) and compare to recommended dose of nitrogen and seed rate i.e T_1 (Rs 1,97,791 ha^{-1}) but at par with T_3. The maximum biomass percent increased by 25% pruning, no pruning, 50% pruning as compare to 75% pruning.

Introduction

Agroforestry is one of the best options to increase the tree cover outside the forest area. Growing of fast growing trees in association with arable crops will not only improve the sustainability of farming systems, but also diversify farmer's income, provide new products to the wood based industry, meet increasing energy requirements, generate employment and create novel landscapes of high value for the generations in posterity.

Shisham is classical example of a pioneer species in the riverian succession of the Gangetic alluvium in India. The species

occurs naturally on sandy and gravelly alluvial ground along the banks of rivers and stream. There is remarkable variation in growth pattern and the yield per unit area due to the wide adaptability of the tree in different ecological sites. The leaf fall begins in November-December and also depending upon the climatic conditions. The mean temperature and humidity play an important role than rainfall in controlling leafing and flowering.

In Madhya Pradesh, as traditional agroforestry system, tree legumes (e.g. *Acacia nilotica*, *Butea monosperma* and *Dalbergia sissoo*) were found growing respectively for fuel, fodder and small timber purpose in both extensive grazing system and in association with field crop (Fujimori and Waseda, 1972).

The most suitable trees for agroforestry system are those having less spread canopy, fast growing in nature, clean bole, nitrogen fixing capacity and protein rich fodder. *Dalbergia sissoo* Roxb. (Shisham), is one of them a moderately fast growing and nitrogen fixing tree has an advantage to include in agroforestry system.

Materials and Method

Experimental field

The field experiment was conducted at New Dusty Acres Area Research Farm, Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during Rabi season of 2014-15.

Climatic and soil condition

The climate of the region is semi arid and area receives an average rainfall of about 1350 mm. annually. The mean monthly minimum temperature varies between 5.3 to 6.1°C in December and January, and maximum temperature varies between 40 to 42°C during May and June, respectively. The soil of the experiment site was clay loam in nature with medium in available Nitrogen (288.1 kg ha^{-1}), high in texture Phosphorus (8 kg ha^{-1}) and very low in texture K (1170.45 kg ha^{-1}).The soil was acidic in nature with 5.93 pH.

Recorded Observation

The tree growth parameters such as Height(m), Diameter at breast height (cm.), Pruned biomass (Kg ha^{-1}), Crown spread (N-S, E-W), Cylindrical volume of the tree (m^3 ha^{-1}) and Stand biomass (Kg ha^{-1}) were recorded to know the effect of various pruning intensities and agronomical management on *D. sissoo* biomass production under agrisilviculture.

Height

The height of individual tree in each block was measured from the ground level to the tip of the main stem with the help of a measuring tape. It is expressed in meter.

Diameter at breast height (dbh in cm)

Diameter at breast height (dbh) of individual tree of each block was measured with the help of diameter tape at 1.37 m above ground level. It is expressed in cm.

Pruned biomass (Kg ha^{-1})

Trees were pruned (cutting of branches) as per treatment. Pruned materials were weighed accurately to calculate pruned biomass per ha by multiplying with factor i.e. 400 (400 plants/ha).

Cylindrical volume of the tree (m^3 ha^{-1})

It was estimated by using quarter girth formula i.e. Log volume= $(g/4)^2$ X L

Volume = Basel diameter × height of tree

Stand biomass of trees (Kg ha^{-1})

Stand biomass of trees was estimated by using formula i.e. Weight = Volume of tree x specific gravity of tree (0.77)

Canopy spread (N-S, E-W)

Canopy spread of the trees was measured with the help of measuring tape.

First of all East-West direction was marked with a wooden stick at last shoot tip of each direction.

The distance between North-South and East-West shoot tip was measured as crown length with measuring tape.

Results and Discussion

All the morphological characters (except tree height) were significantly affected by pruning treatment. 25% pruning recorded significantly higher dbh (23.98), cylindrical volume (217.27 m^3ha^{-1}) and stand biomass (1,67,301 Kg ha^{-1}) as compared to 75% pruning (Table 1).

Canopy spread in both N-S and E-W direction was maximum in no pruning (7.83 & 7.24) whereas lowest in 75% pruning (3.95 & 4.11).

Significantly highest cylindrical volume and stand biomass was recorded in 25% pruning intensities and lowest in 75% pruning (100.87 m^3 ha^{-1} & 77,671 Kg ha^{-1}) (Muhairwe, 1994).

Net monetary return (Rs/ha/year)

Different pruning treatment showed significant effect on net monetary return. 25% pruning recorded significantly higher monetary return (Rs 2,47,566.3 ha^{-1}) at par with 50% pruning (Rs 2,18,854.5 ha^{-1}) but significantly superior to 75% pruning (Rs 1,25,151.9 ha^{-1}). Under managed agroforestry system i.e. *D. sissoo* in 25% pruning recorded higher monetary return (Rs 2,47,566.3 ha^{-1}) then tree alone (Rs 201217.425 ha^{-1}) and unmanaged agroforestry system i.e. no pruning (Rs 2,11,111.4 ha^{-1}).

Pruning treatment showed no significant effect on tree height. A similar result was also reported by (Couto and Gomes, 1995), 25% pruning recorded highest dbh (23.98cm)

(Bredenkamp *et al.*, 1980; Pinkard and Beedle, 1998; Pires *et al.*, 2002; Pinkard *et al.*, 2004), N-S (5.93) and E-W (6.08), cylindrical volume (217.27 m^3 ha^{-1}) and stand biomass (167301 kg ha^{-1}) but at par with no pruning, 50% but significantly superior to 75% pruning (Bhargava., 2003).

D. sissoo in 25% pruning recorded significantly higher monetary return (Rs 2,47,566.3 ha^{-1}) at par with 50% pruning (Rs 2,18,854.5 ha^{-1}) but significantly superior to no pruning (Rs 2,11,111.4 ha^{-1}), 75% pruning (Rs 1,25,151.9 ha^{-1}), and tree alone (Rs 40,243.5 ha^{-1}).

Different pruning treatment showed significant effect on net monetary return (Koshta *et al.*, 2011) (Table 2).

Suggestions for further work

The economics should be workout for large period with different timber tree in different climatic and edaphic condition.

Experiment should be carried out with some important MPTS tree species like Siris, Babul, Khamer, which is also important species of Madhya Pradesh.

Carbon sequestration, carbon storage, carbon budgeting etc studies should be carried out.

Table.1 Morphological growth characters and biomass of *D. sissoo* as influenced by different pruning intensities and agronomical management under agrisilviculture system at the age of 16 years

Treatment	Tree Height (m)	dbh-1.37 (cm)	Canopy spread (m)		Pruned biomass (Kg ha^{-1})	Cylindrical Volume (m^3 ha^{-1})	Stand biomass (Kgha^{-1})
			N-S	E-W			
Pruning Intensities							
P_0 - No pruning	10.56	24.05	7.83	7.24	-	192.55	**1,48,262**
P_1 - 25% pruning	11.92	23.98	5.93	6.08	1668	217.27	**1,67,301**
P_2 - 50% pruning	11.31	22.71	5.21	5.05	1864	187.22	**1,44,160**
P_3 - 75% pruning	10.06	17.28	3.95	4.11	2010	100.87	**77,671**
SEm±	0.59	1.67	0.81	0.64	141.2	26.78	**20,619**
CD (P=0.05)	NS	5.34	2.61	2.06	NS	85.65	**65,949**
Agronomical Management							
T1- [Recommended dose of SR and FD (control)]	10.9	22.2	6.1	6.3	1422	177.7	**1,36,864**
T2 - [T1+ 25% more nitrogen than recommended dose]	11.0	22.0	5.5	5.2	1386	172.0	**1,32,410**
T3- [T1+25% more seed rate than recommended dose]	11.0	21.8	5.6	5.7	1450	171.3	**1,31,885**
Tree only- no crop	11.0	22.0	5.8	5.3	1284	176.	**1,36,235**
SEm±	0.18	0.63	0.88	1.03	95	8.85	**6,818**
CD (P = 0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table.2 Net monetary return (Rs. ha^{-1}) as influence by different pruning intensities in *D.sissoo*

Agronomical Management / Pruning Intensities	T1 [Recommended dose of seed rate and fertilizer]	T2 [T1 + 25 % more nitrogen than recommended dose]	T3 [T1 + 25% more seed rate than recommended]	Mean	Grand Mean	Tree alone
P_0 - No pruning	2,25,361.9	1,88,325.4	2,19,647.1	2,11,111.4		1,93,303.9
P_1- 25% pruning	2,44,344.0	2,69,279.5	2,29,075.4	2,47,566.3	4,66,413.1	2,69,734.3
P_2- 50% pruning	1,95,560.8	2,41,872.7	2,19,130.2	2,18,854.5		2,30,839.8
P_3- 75% pruning	1,25,897.6	1,23,125.5	1,26,432.6	1,25,151.9		1,10,991.7
Mean	**197791**	**205650.7**	**198571.3**	**402587.6**		**201217.4**

	SEm±	CD (P = 0.05)
Pruning intensities	5973	19105
Agronomical management	2299	7353

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