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EFFECT OF PRUNING INTENSITIES ON TURMERIC IN *DALBERGIA SISSOO* BASED AGRISILVICULTURE SYSTEM IN CENTRAL INDIA

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ABSTRACT: -*Dalbergia sissoo* is a medium to large sized tree belonging to family – Leguminosae and subfamily *Papilionioideae.* It attains a height upto 30 m. This genus has about 300 species of tropical and sub-tropical timber tree species. It is having multiple uses such as fuel, wood, fodder, shade, and nitrogen fixing ability .The Present investigation was conducted in a *Dalbergia Sissoo* turmeric agrisilviculture system to find out Pruning effect on Turmeric yield and various growth characters of turmeric plants, respectively. The turmeric crop was sown in the interspace of a 16 year old *Dalbergia sissoo* plantation, planted at a spacing of 5mX5m. The effect of different pruning on fresh yield was found significant. The maximum fresh yield of rhizomes (3385.9 kg/ha) was measured under 25% pruning followed by 50% pruning (3221.3 Kg/ha), no pruning and open conditions. Whereas, the lowest fresh yield of rhizomes (2960.6 kg/ha) was recorded under 75% of pruning.

Keywords: - Agrisilviculture, turmeric*, D. Sissoo,* Pruning intensities.

INTRODUCTION

Agrisilviculture is an ideal land use option to increase its productivity, expand tree cover outside forests and reduce anthropogenic pressures on natural forests. It is also a viable option for mitigation of an adaptation to climate change. Many Agrisilviculture systems involving various combinations of woody perennials and agricultural crops has been evolved and successfully tried in field with increased economic and ecological benefits. *Dalbergia sissoo* based Agrisilviculture system are also some of these successful popular agrisilviculture models.

Madhya Pradesh is the second largest state of the country having geographical area of 30.83 million hectares out of which 49% is under cultivation but arable land is shrinking day by day. Madhya Pradesh is blessed with climatic variability's and diverse soil type. This provides

unique opportunity to the farmer to grow multipurpose tree species in the field and wasteland to obtain maximum benefits from them.

Pruning is a common Silvicultural practice to increase wood production, improve tree shape and potentially uses to obtain poles and firewood without decrease in wood productivity. It involves removal of live or dead branches or multiple leaders from the tree. Pruning of tree component is a powerful approach to regulate light, nutrients and other resource competition (Frank and Eduaro, 2003).The pruning treatment can effectively change the micro-climate under canopy (such as

increased air temp, soil water content and decrease the relative humidity). Many scientists reported the effect of height and intensity of pruning on biomass production (Das and Dalvi, 1981).Trees has been given different pruning treatments so the differences in growth and development may be observed. It improves wood quality and tree stem shape. Pruning decreased the tree taper and increases the volume and medium pruning intensity has highest volume increment.

Dalbergia sissoo is a medium to large sized tree belonging to family – Leguminosae and subfamily Papilionioideae. It attains a height upto 30m.This genus has about 300species of tropical and sub-tropical timber tree species. It is having multiple uses such as fuel, wood, fodder, shade, and nitrogen fixing ability .The species occur throughout the Sub-Himalayan tract and outer Himalayan valleys from Indus to Assam, usually upto 900m and occasionally ascending to 1500m.

Turmeric (*Curcuma longa L.)*belongs to the family Zingiberaceae is native to South Asia particularly India Curcuminiodes the active principles in turmeric rhizomes is known to have some medicinal properties and has been used efficiently in many medicine and ointment. Itis one of the important species grown for its underground rhizomes which are used as condiment dye stuff , drug and cosmetic, volatile oil of the flavouring ingredient of turmeric makes it an indispensable part of every Indian kitchen and is often prescribed against infection of liver, jaundice, and disorder of blood (Subramanian *et al.,*2004).

Despite its adaptability to varied agro-climatic condition, its monoculture may be somewhat risk prone. Intercropping of suitable agriculture crops with *Dalbergia sissoo* can, therefore, be a better option as it not only reduces the economic risks associated with monoculture by generating extra income but it also results in improved productivity per unit area as a result of more efficient utilization of solar radiation and available soil nutrients.

Tree architecture plays an important role in deciding the growth and performance of under storey crops. Crown spread affects not only the soil properties and micro environment but also performance and yield potential of associated agricultural crops. There is ever increasing need to integrate fast growing multipurpose tree species on farmland to overcome fuel and fodder crisis. The components of the system interact with one other to influence the microclimate and soil conditions (Harper, 1977).The quality of solar radiation transmitted by tree canopy decides growth and productivity potential of the field crops (Fischer and Palmer, 1984). Major agricultural crops grown under trees are shade sensitive, so are bound to be adversely affected on account of shading. Shade intensity and duration both will have strong negative effects on the performance of under storey crops (Singh, 1994).

The present investigation has been carried out at New Dusty Acre area, Department of Forestry, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during Kharif season of 2014-15 in well established 16 years old *Dalbergia sissoo* plantation. The facilities required to conduct the experiment are available on the research farm.

MATERIAL AND METHODS

The present study was conducted in a 16 year old *Dalbergia sissoo* plantation raised at an initial spacing of 5mX5m in a research farm Jawaharlal Nehru Krishi Vishwa Vidhyalaya,

Jabalpur, located in Mahakoshal region of Madhya Pradesh state in central India. It is situated at 23.1815^0 North latitude and 79.9864^0 east longitude with an altitude of 411.78 m above mean sea level (msl). The climates dry subtropical with hot dry summers and cold dry winter. The mean annual rainfall is 1315 mm, mostly (about 90%) received during south west monsoon period (mid June to September) with occasional winter rains. June is the hottest month of the year with varying from 26.3^0C to 41.8^0C and January is the coldest month with temperature varying from 5.6^0C to 23.7^0C. The area falls in Kymore plateau and Satpura hills from 5.6^0C to 23.7^0C agro-climatic region and in the wheat-rice crop zone. The soil of the experimental area is clay loam in texture and almost neutral in reaction, the available nitrogen (N), phosphorous (P) and potash (K) in the soil were 207 (medium), 16.26 (medium) and 172 (very low) kg/ha, respectively.

Experimental detail:

Treatments:

A. Main treatment	**Tree pruning management**
P_0	Un pruned
P_1	25% (pruned *Dalbergia sissoo)*
P_2	50% (pruned *Dalbergia sissoo)*
P_3	75%(pruned *Dalbergia sissoo)*
Open condition	-No tree (Crop only)
Design	- Strip Plot Design
Replication	- 4
Total No. of plots	-76
Number of tree per plot	- 1
Gross plot size	- 4 m X 4 m
Net plot size	- 3 m × 3 m
Distance between row to row	- 50 cm
Distance between plant to plant	- 15 cm
Variety of turmeric	- Suroma
Seed rate of turmeric	- 2000 kg/ha
Tree species	: *Dalbergia sissoo*
Tree spacing	: 5 m x 5 m
Row direction	: East – West
Year of plantation of shisham	: Kharif, 1998

Recommended doses of fertilizers:

For plot (tree +crop) - 300 : 550 : 100 NPK g/plot
For open - 900 : 1600 : 250 NPK g/plot

Observation on turmeric

Plant- height

Height of all tagged plants in each plot was measured with the help of meter scale from ground level to the top of newly emerged leaf in each treatment at 30 DAP and at interval of 30 days during the entire growth period of crop. Then mean was computed for observation.

Leaf area

The length and width of 5 randomly selected leaves from marked plants of each plot were measured in cm from the base to the tip of the leaf with the help of plastic scale and then leaf area was determined as per formula. After this, mean leaf area was determined.

Number of shoot /hill

The numbers of shoot/hill were counted by counting the shoots of five selected plant from each plot.

Number of leaves/shoot

The numbers of leaves/shoot were counted from five selected plant of each plot.

Stem diameter

The diameter of all tagged plant of each plot was measured with the help of digital vernier calliper at the same time when plant height was measured and the mean was determined for all the observation.

Length and width of leaf

The length and width of 5 leaves from marked plants of each plot were measured in centimeter from the base to the tip of the leaf with the help of plastic scale and then mean values of both the parameter were determined for all the observations.

Post harvest observations

Yield per plant

Rhizomes yield from all 5 tagged plant of each plot was measured on double pan balance and the mean yield per plant was determined.

Number of fingers per rhizomes

The number of developed fingers in rhizomes of all five marked plant was counted in each plot after removing the rhizomes and then mean was calculated.

Length of fingers

The length of all fingers was measured in centimeter with the help of plastic scale from the middle point of the fingers and the average of the fingers was determined.

Width of fingers

The width of fingers was measured in centimeter with the help of plastic scale from the middle point of the fingers and then average of the fingers was determined.

Fresh yield/ha

After harvesting the rhizomes of net plot area from each plot, the weight of clean rhizomes was recorded treatment wise on double pan balance and then the values were converted in to yield per hectare by multiplying with appropriate factor.

Leaf area index

The leaf area per plant was calculated by the following formula as suggested by Sestak *et al.,* (1971):

$$LA/plant = L\times W\times K\times \text{Number of leaves/plant}$$

Where

K = constant (0.654)

L = length

W =width

The leaf area index was calculated by using the following formula (Watson, 1952)

$$LAI = \frac{A}{P}$$

Where

A = Leaf area

P = ground area

RESULT

Plant height

Data pertaining to plant height as affected by different treatments at successive growth intervals are given in. Table 01 .It is obvious that plant heights gradually increased at a steady rate up to 180 DAP under all treatment and then slightly reduced as the crop reaches towards maturity.

Pruning intensities

Effect of different pruning intensities on plant height was found significant in all successive observation recorded at 30, 60, 90,120,150,180 DAP and at harvest. Observations noted

at 30, 60, 90,120,150,180 days after planting and at harvest showed that 25% pruning recorded significantly higher plant height (19.5,40.5,62.5,73.6,75.6,81.1,and 74.7cm) closely followed by 50% pruning (17.3,37.5,60.2,71.1,72.4,79.5,68.8and 68.8 cm) whereas in open conditions recorded significantly lowest plant height (18.5,39.1,54.7, 64.4,70.1,75.2,61.4), respectively. Among pruning treatment, 25% pruning produced significantly higher plant height and was superior to other pruning intensities. This is found in all the observation recorded at 30, 60, 90,120,150,180 DAP. At harvest 25% pruning recorded significantly higher plant height than 50% and 75% pruning as compared to the open conditions.

Table 01. Effect of different pruning intensities in *D. sissoo,* on plant height (cm) at 30, 60, 90,120,150,180 days after sowing and at harvest under agrisilviculture system

Treatment	Interval (DAP)						
Pruning intensities	**30**	**60**	**90**	**120**	**150**	**180**	**At harvest**
P_0-No pruning	18.1	34.8	56.3	66.9	72.3	78.9	65.9
P_2-25%pruning	19.5	40.5	62.5	73.6	75.6	81.1	74.7
P_3-50%pruning	17.3	37.5	60.2	71.1	72.4	79.5	68.8
P_4-75%-pruning	18.3	38.8	59.2	68.3	72.8	78.2	68.0
Open condition	18.5	39.1	54.7	64.4	70.1	75.2	61.4
SEm±	0.5	1.1	0.9	1.0	0.7	0.8	1.5
CD(P=0.05)	1.6	3.5	2.8	3.2	2.3	2.7	4.7

Stem diameter

It was evident that diameter of stem increased at a steady rate up to 180 DAP under all treatment and then slightly reduced as the crop approaches towards maturity.

Pruning intensity

Different pruning intensities showed significant effect on stem diameter in all the successive observations recorded at 30, 60, 90, 120, 150, 180 DAS and at harvest. In all observations, 25% pruning recorded significantly higher stem diameters (4.2, 7.8,14.8, 20.3, 21.3, 21.5, 18.7 mm) whereas open conditions recorded significantly lowest stem diameters (3.6, 6.9, 13.1, 19.4, 19.8, 20.1, 16.8, mm) of crop. Among different pruning intensities, 25% pruning recorded significantly higher stem diameter and was at par with 50% pruning (4.0, 7.0, 13.9, 19.8, 20.2, 20.6, 18.1,mm) which was significantly superior to 75% pruning. Significantly lowest stem diameter was recorded (Table02) under 75% pruning (3.7, 6.7, 13.0, 19.7, 20.0, 17.5, mm) and was at par with no pruning (3.9, 7.1, 12.9, 19.0, 20.4, 20.5, 17.6, mm).

Table 02. Effect of different pruning intensities in *D. sissoo,* on stem diameter of crop at 30, 60 and 90 days after planting under agrisilviculture system

Treatment	Interval (DAP)						
Pruning intensities	**30**	**60**	**90**	**120**	**150**	**180**	**At harvest**
P_0-No pruning	3.9	7.1	12.9	19.0	20.4	20.5	17.6

P_2-25%pruning	4.2	7.8	14.8	20.3	21.3	21.5	18.7
P_3-50%pruning	4.0	7.0	13.9	19.8	20.2	20.6	18.1
P_4-75%-pruning	3.7	6.7	13.0	19.7	20.0	20.4	17.5
Open condition	3.6	6.9	13.1	19.4	19.8	20.1	16.8
SEm±	0.2	0.1	0.3	0.3	0.3	0.2	0.2
CD(P=0.05)	0.6	0.5	0.9	0.9	1.0	0.8	0.7

Leaf Area Index

It is evident that leaf area index also gradually increased at a steady rate up to 180 days after planting (DAP) under all treatments and then slightly reduced towards maturity of the crop.

Pruning intensity

Different pruning intensities showed significant effect on leaf area index in all the successive observations recorded at 30, 60, 90, 120, 150, 180 DAP and at harvest. In all observations, significant increase in leaf area index was noted at 25% pruning (0.7, 1.4, 2.5, 2.6, 2.8, 3.3, 3.2) whereas, open conditions recorded significantly lowest leaf area index (0.5, 1.1, 2.1, 2.2, 2.3, 2.5, 2.7). Among different pruning intensities, 25% pruning gave significantly highest leaf area index and was at par with 50% pruning (0.6, 1.2, 2.3, 2.3, 2.5, 3.0, 2.8). Significantly lowest LAI (Table 03) was recorded under 75% pruning (0.5, 1.2, 1.9, 2.3, 2.4, 2.8, 2.3 cm) and was at par with no. pruning (0.5, 1.3, 2.2, 2.2, 2.4, 2.9, 2.8).

Table 03.Effect of different pruning intensities in *D. sissoo,* on leaf area index on crop at 30, 60 and 90 days after planting on turmeric under agrisilviculture system

Treatment	**Interval (DAP)**						
Pruning intensities	**30**	**60**	**90**	**120**	**150**	**180**	**At harvest**
P_0-No pruning	0.5	1.3	2.2	2.2	2.4	2.9	2.8
P_2-25%pruning	0.7	1.4	2.5	2.6	2.8	3.3	3.2
P_3-50%pruning	0.6	1.2	2.3	2.3	2.5	3.0	2.8
P_4-75%-pruning	0.5	1.2	1.9	2.3	2.4	2.8	2.3
Open condition	0.5	1.1	2.1	2.2	2.3	2.5	2.7
SEm±	**0.0**	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**
CD(P=0.05)	**0.1**	**0.2**	**0.3**	**NS**	**NS**	**0.7**	**0.7**

Number of fingers per rhizome

Pruning intensity

Effect of different level of pruning intensities showed a significant effect on number of fingers per rhizome. The maximum number of fingers were noted at 25% pruning (5) that was

at par with 50% pruning (4.8) and no pruning (3.7) whereas lowest number of fingers was recorded under open conditions (3.6) (Table 04).

Length of fingers (cm)

Pruning intensity

Effect of different level of pruning intensities showed a significant effect on number of fingers per rhizome. The maximum number of fingers was recorded at 25% pruning (4.9) which were at par with 50% pruning (4.1) and significantly superior to other treatments whereas, the lowest number of fingers was recorded under open conditions (3.3).

Width of fingers

Pruning intensity

Different pruning intensities showed significant effect on width of fingers. Significantly maximum width of fingers (14 mm) was measured in 25% pruning which was at par with 50 % pruning (13.7mm) but significantly superior to other treatments and the minimum was recorded under open conditions (12.5).(Table 04).

Fresh turmeric yield (Kg/ha)

The ultimate produce i.e. yield is the final assessment of different treatment under any investigation.

Data pertaining to fresh turmeric yield (kg/ha) were obtained from the data of fresh yield (kg/plot) as influenced by different pruning intensities and time of planting, are presented in Table 04.

Pruning intensities

The effect of different method of planting on fresh yield was found non-significant. The maximum fresh yield of rhizomes (3385.9 kg/ha) was measured under 25% pruning followed by 50% pruning (3221.3 Kg/ha), no pruning and open conditions. Whereas, the lowest fresh yield of rhizomes (2960.6 kg/ha) was recorded under 75% of pruning.

Table.04. Effect of different pruning intensities on yield attributing characters of turmeric under agrisilviculture system

Treatment	No.of fingers per rhizome	Length of fingers(cm)	Width of fingers (mm)	Fresh turmeric yield (Kg/ha)
Pruning intensities				
P_0-No pruning	3.7	3.6	12.5	3072.8
P_2-25%pruning	5.0	4.9	14.0	3385.9
P_3-50%pruning	4.8	4.1	13.7	3221.3
P_4-75%-pruning	4.3	3.7	13.3	2960.6
Open condition (crop alone)	3.6	3.3	12.5	3012.9
SEm±	0.1	0.1	0.3	74.63

CD (P = 0.05)	0.5	0.5	1.0	229.96

DISCUSSION

Effect of pruning intensity

Growth parameters:

Plant height was significantly influenced due to different pruning intensity of tree. 25% pruned exhibited maximum plant height up to 180 DAP after that the plant height reduced as the crop reaches toward maturity. While the lowest plant height was recorded under 75% pruning. It might be attributed that partial shaded conditions of tree provide favorable physical condition for penetration, proliferation of light to under storey grown crop and ramification of root resulted in better growth and height of plant The stem diameter was also higher in case of 25% of pruning intensity which was significant as compared to other pruning intensities. The results are in conformity with the finding of Meena (2008) and Sundararaj and Tulasidas ,1976)

Physiological Parameters:

The LAI is the most important parameter which determines the crop growth. The effect of time of planting on the leaf area index at different interval of the crop growth was found significant .The maximum leaf area index was recorded at 180 days growth stage period with 25% pruning (3.3) followed by 50% (3.0) and 75% (2.8) and lowest in no pruning. In general, the increased LAI was observed with increasing crop growth under different time of planting upto 180 days crop growth stages after that there was decreasing trend towards maturity of crop. The increased photosynthetic productivity per unit area increased with increasing in assimilatory area in the canopy architecture developed under favorable conditions. The results are in conformity with the finding of Sundararaj and Tulasidas (1976).

Yield parameters

Effect of different pruning intensities on yield per plant was found non-significant. The effect of different time of planting on the number of fingers per rhizomes was found significant. The length of fingers (6.1), number of fingers (5.9) and width of fingers (7.0) were higher in 25% pruning in comparison to other pruning's. The increased length of fingers was due to more favorable conditions for the development of fingers under sufficient moisture availability and better soil aeration. The similar findings were also observed by Latha *et al., (*1995) and Pradhan *et al.,* (2003).

Yield rhizome yield (kg/ha)

The fresh turmeric yield (kg/ha) was maximum under 25% pruning (3385.9 kg/ha) and lowest in 75% pruning (2960.6 kg/ha) .The result was found non-significant (Miah *et al.,*1997; and Dhyani and Chauhan ,1989)

CONCLUSION

Effect of pruning intensity

The maximum plant height and stem diameter was noted under 25% of pruning followed by 50%pruning, while the lowest plant height was recorded at 75% pruning but higher than open conditions at different interval of plant growth. The length of fingers per rhizome was maximum under 25% pruning (4.9 cm) followed by 50% pruning (4.1 cm), while lowest was recorded open condition (3.3 cm).The number of fingers per rhizome (5) and width of fingers (14 mm) were maximum under 25% pruning followed by 50% pruning (4.8) and width is (13.7 mm), while the lowest number of fingers (3.6) and width of fingers (12.5 mm) was recorded open condition of pruning. The LAI gradually increased at steady rate up to 180 days after planting under all treatment then decreased as crop reaches towards maturity.

The maximum fresh yield of rhizomes (2546.9 kg/ha) was recorded under 25% pruning followed by 50% pruning (2460.3/ha) without pruning and open conditions. Whereas, the lowest fresh yield of rhizomes (1896.9 kg/ha) was recorded open condition

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