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Studies on growth and floss yield of *Ceiba pentandra* (L) Gaertn. stands in sub humid tropics

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ABSTRACT

A field experiment was conducted at Indira Gandhi Agricultural University, Raipur Chattisgarh India to evaluate the growth and floss yield of Ceiba pentandra (L.) Gaertn. Stands in sub humid tropics. The experiment consisted of 24 treatments combination of three tree spacing treatments (4×4 m, 4×6 m and 4×8 x 4) , two pruning regimes . The experiment was laid out in a randomized block design and it was replicated four times. After 9 years, Growth parameter of Ceiba tree stands revealed that the tree height, diameter at breast height, crown width and length, Number of pod tree^{-1}, Pod length, seed and floss yield decreased numerically from the lower tree density to higher density. The results suggested that C. pentandra should be planted either at a wider spacing (4×8 m) or silvicultural (lopping, pruning) practices under a narrow tree spacing (4×4 m) should be adopted to obtain higher yields of wheat in an agri-silvicultural system.

Keywords: Growth, yield, leaf area index, *Ceiba pentandra*, pruning, agrisilviculture system

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INTRODUCTION

Ceiba pentandra originated in the American tropics. Its natural distribution has been obscured by its widespread introduction after about 1500. Although it has been described as introduced by humans in tropical Africa, there is no historical evidence of such introduction, and there is strong ecological, botanical and cytological evidence that the tree is native to western and central Africa. The dispersal mechanism by which the tree may have crossed the Atlantic Ocean is uncertain, but the fruits float and might have been transported by ocean currents. It has been argued that the tree was domesticated in West Africa, from where it spread to East Africa and Asia. It is now cultivated all over the tropics, but mainly in South-East Asia, especially in Indonesia and Thailand. In addition, there are records of the species in 13 other countries in East and southern Africa (including South Africa) and the Indian Ocean islands, but the tree has probably been planted in all other tropical African as well as Asian countries. In India, *Ceiba pentandra* (L.) Gaertn., (Bombacaceae) is one of the dominant tall, deciduous multipurpose tree generally propagated through seeds, and can also be raised by cuttings. The fruit is collected for the valuable kapok floss and used for stuffing pillows, mattresses and cushions. Due to its water repellent and buoyant, making it ideal for life jackets, lifeboats and other naval safety apparatus. It is an excellent material for insulating iceboxes, refrigerators, cold-storage plants, offices, theatres and aeroplanes. It is a good sound absorber and is widely used for acoustic insulation; it is indispensable in hospitals, since mattresses can be dry sterilized without losing original quality. The flowers are important honey source for beekeepers. The seed contains 20-25 percent non-drying oil, used as a lubricant and in soap manufacturing. The pressed cake is used as cattle feed containing about 26 percent protein. . Kapok is soft wooded trace nature to tropical Africa and common along West cost of India (Mumbai). *Ceiba pentandra* wood is variable in colors from white to light brown. The wood is very light with specific gravity 0.25g/cc. The principal components of wood are cellulose 40-55%, lignin 15-35%, hemicelluloses 20-35%, in addition to this the wood contains some minor components which vary with species. The wood is very light, with specific gravity of 0.25 g cc^{-1} and is used for preparation of plywood, packaging, lumber core stock, light

construction, pulp and paper products, match splint, canoes and rafts, etc. Because of its wide range of uses, it has been cultivated in the boundaries of farmlands and social forestry plantations [1]. However, the potential of this tree species to grow and survive in the sub humid environment is not well known. Therefore, the present investigation was carried out to understand the growth and floss yield of *Ceiba pentandra* (L.) Gaertn. Stands

MATERIALS AND METHODS

The experiment was conducted in the fields of Department of Forestry, Indira Gandhi Agricultural University, Raipur Chattisgarh India (21.76 ^{0} N latitude; 81.36^{0}E longitude; 289 m asl) the studies were done on Nine-year-old *Ceiba pentandra* (L.) Gaertn. Trees planted at three spacing, viz, 4 x 4m, 4 x 6 m and 4x 8m. Half of the trees in all spacing were pruned up to 25 % crown height, while reaming half were kept unpruned. Tree growth characters, viz, total height, clean bole height, diameter at breast height, crown length and width, LAI, PAR and at harvesting pod diameter, number of pod per tree , pod length, seed and floss yield of *C. pentandra* in different spacings were estimated. Randomized block design was used for analysis of tree parameters. The significance was tested for all the parameters at 5 % level. All statistical analysis were done using MSTATC programme (Version 1.41)

RESULTS AND DISCUSSION

In the present study, the three planting spacing of *C. pentandra* showed variability with respect to crown closure. The crown closure was seen in the 4 x 4 m spacing only, indicating that the initial rate of growth in trees was same. The narrow spacing is good in early stages because of high total volume accumulation, but narrow spacing usually restrains the growth of individual's trees. Also the narrow spacing leads to competition for resources (light, nutrients, and water). In the present studies although the above ground competition was not evident (as growth rate was same in three spacing), there seems to be below ground competition. Growth in the tree stands of *C. pentandra* revealed that the tree height, clean bole height, diameter at breast height and crown width and length decreased numerically from the lower tree density to higher density. Total tree height, crown length and crown width were significantly influenced by different tree densities of *C.pentandra* while none of the other tree growth parameters show any significant variations. [2] also reported non significant variation in growth character due to different tree densities in the four year old stands *Gemelina arborea* . Both tree heights was higher in dense (4x 4 m) compared to open 4 x 8 m stands. This may be due to less competition among the widely spaced tree especially for light, where inadequate lights conditions provide trees to grow taller in dense stands. The ability of tree to grow taller in dense stands was evident and confirmed with findings of [3], [4], [5] observed that height of trees was significantly increased in high density (800 and 400 tree ha^{-1}) compared to low density (200 tree ha^{-1}) in agrisilviculture stands of *Hardwickia binnata* . DBH was significantly affected by pruning, while total tree height by tree spacing treatment. Pruning had not any significant effect on tree height, while tree spacing did not exhibit any significance influence on DBH. In contrary to height growth, diameter at breast height (DBH) was higher in tree growing under wider spacing while it decreased in narrow tree spacing of *C. pentandra.* This is attributed to lower competition for resources among tree planted in wide spacing compared to narrow tree spacing. The other growth parameter like crown width and crown length were also higher widely spread trees. Sufficient space for crown spread and minimum competition for light increased the growth and proliferation crown in tree under wide spacing where as the insufficient might have restricted crown growth in narrow tree spacing. These findings are line with [6]. Tree spacing showed significant affect both crown length and its width. However pruning treatment had significantly influence the crown length but it did not show any effect on the crown width. Both parameters were significantly higher in 4 x 8 m compared to other tree spacing. Significantly higher crown length 4.9 cm was attained by unpruned stands, where it was almost reduced 30 % in pruned trees. Leaf area index varied significantly in different tree densities while pruning did not show any influence. LAI was significantly higher in narrow tree spacing to wide tree spacing. A reduction of 15 % LAI was observed in 4 x 6 m and 13.6 % in 4x8 m stands as compared to 4 x 4 m stands. Higher PAR was observed in 4 x 8 m and it gradually decreased with decrease in different tree spacing. It ranged from 1208 to 1239 µ mol m^{2}s^{1} in different tree spacing. LAI of *C.pentandra* was significantly higher in tree under narrow compare to wide tree spacing. It reduced by 15 % in 4 x 6 m and 13.6 % 4 x 8 m compared to 4 x 4 m spacing. In contary PAR was significantly higher in wide compared to narrow tree spacing. These findings are similar to reports earlier worker [2] ,[7]. [2] reported significantly higher LAI in stands planted at closer spacing (2 x 2 m and 2x3m) compared to stands at wide spacing . (2x2 m and 2x5 m) in *Gemelina arborea* where as PAR was higher at wide spacing. The study also confirmed the inverse relationship between LAI and PAR which was reported in the past [7]. A pod tree^{-1} was significantly was higher in 4 x4 m and it decreased with an increase in tree spcing. Due to pruning almost 21 % of pods tree^{-1} had reduced. Diameter of pod and its length were significantly influenced by both tree spacing and pruning treatment. Pod diameter was highest 5.2 cm in 4 x 4 m tree spacing, while pod length was maximum 15.2 cm in 4 x 6 m tree spacing. Pod diameter 5.4 cm was highest in unpruned plot whereas pod length was maximum 14.8 cm in pruned plot. Floss and seed yield ranged from 2.75 to 7.62 q ha^{-1} and seed yield 5.37 to 9.62 q ha^{-1} in different tree spacing of *Ceiba* .Highest floss and seed yield was obtained in 4 x 4 m while

lowest in 4 x 8 m spacing. Seed yield reduced by 63 % and 52 % and floss yield by 44 % and 20 % in 4 x 8 m and 4 x 6 m tree spacing. This is evident from the fact that the trees growing under narrow spacing (4 x 4 m) flowered heavily which ultimately produced more pods and floss .Reduction of 48 % in floss and 33 % seed yield in pruned trees. Floss and seed yield were significantly highest in 4 x4 m spacing trees while both were lowest in 4 x 8 m spacing seed yield reduced by 63 % and 52 % and floss yield by 44 % and 20 % in 4 x 8 m and 4 x 6 m tree spacing respectively compared to 4 x 4 m tree spacing. Floss yield was lower in range compared to that reported [8] where it was 2.7 to 4 Kg tree^{-1}. The difference in yield might to due to the different in age of stands. The lower floss yield in present study might be attributed to lower age of the stand (Nine year old).

Table 1: Effect of different tree spacing and pruning regimes on growth and yield of *Ceiba pentandra*

Treatment	DBH (cm)	Height (m)	Crown length (m)	Crown Width (m)	Leaf area index	PAR µ mol m^2s^1	No. of pod /tree	Pod Diameter cm	Pod Length cm	Seed yield q/ha	Floss Yield q/ha
					Tree Spacing						
4 x 4 m	16.56	8.29	4.18	3.54	3.36	1208.1	190.2	5.23	13.5	9.62	7.62
4 x 6 m	16.28	7.49	3.85	3.98	2.84	1224.6	157.0	5.01	15.2	7.62	3.59
4 x 8 m	17.04	7.55	4.63	5.22	2.9	1239.6	140.6	4.86	14.0	5.37	2.75
CD at 5%	NS	0.7626	0.7410	0.4567	0.362	NS	6.5514	0.0861	0.5132	6.5112	3.5427
					Pruning regimes						
Unpruned	17.60	8.02	4.98	4.40	3.05	1173.0	181.9	5.41	13.6	9.91	6.98
Pruned	15.65	4.09	3.46	4.10	3.03	1275.2	143.3	4.67	14.8	6.63	3.59
CD at 5%	1.273	0.4168	0.6124	NS	NS	45.3824	5.3536	0.0724	0.4202	5.3224	4.0710

CD at 5 % level
NS - Non significant

CONCLUSION

This investigation concludes that the *Ceiba pentandra* Floss and seed yield were significantly highest in 4 x4 m spacing trees while both were lowest in 4 x 8 m spacing seed yield reduced by 63 % and 52 % and floss yield by 44 % and 20 % in 4 x 8 m and 4 x 6 m tree spacing respectively compared to 4 x 4 m tree spacing. However, further studies are needed to screen various tree spacing and pruning regimes for the production of the highest seed and floss yield in early stage of the crop.

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