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Effect of Canopy Management Practices on Growth Characteristics of *Melia composita*

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***Abstract*:** Due to increase in population, the demand for tree products is increasing rapidly in India, necessitating imports of timber, paper, pulp, and wood products from other countries. Growing trees outside the forests is an option in the form of agroforestry. *Melia composita* is an upcoming agroforestry tree for agroforestry plantations in India. A study was conducted to underline the effect of early debranching and pollarding (canopy management) on growth characteristics of *Melia composita*. Tree height was maximum in unpollarded treatments compared to pollarded treatments. There was no significant effect of canopy management practices (pollarding) on dbh during both the years. Crown spread and number of branches per tree also varied significantly with management practices (treatments). Maximum aboveground biomass was recorded in unpollarded treatments. Light transmission ratio of *Melia composita* was significantly affected by different treatments. The effect of different treatments on the leaf area of *Melia composita* was statistically non-significant. The findings indicate that debranched trees showed a minor decline in few of the growth characteristics both in pollarded and unpollarded treatments. However, this reduction is temporary or permanent, needs to be explored further.

Keywords: *Melia composita*, Debranching, Pollarding, Canopy management

Due to increase in population, the demand for tree products is increasing rapidly in India. Over 40% of India's forest and tree cover are degraded as a result of anthropogenic activities (ISFR 2021). Until a ban on green felling was implemented, the demand for timber was partially met by the forests. Focus thereafter shifted towards on and off farm planted trees for catering the needs of modern forest-based industries. Even then, the forest based industries have been hindered by a lack of long-term sustained wood supply, necessitating imports of timber, paper, pulp, and wood products from other countries. In order to produce more wood, integration of trees on farms in the form of agroforestry was initiated. Now, in agroforestry and other afforestation programmes, planting of fast-growing, short-rotation tree species is preferred. One such promising agroforestry species is *Melia composita*. The tree is found in India, Africa, China, Malaya and Australia. In India *Melia composita* occurs in tropical moist deciduous forests of Sikkim Himalayas, North Bengal and Upper Assam, the Khasi hills of Orissa, Deccan and the Western Ghats, at altitudes of 1,500-1800 meters. It grows up to 20-25 meters tall, with a cylindrical bole up to 9 meters long and 1.5 meters wide (Saravanan et al 2013). It has a high calorific value of 5043-5176 calories (Tripathi and Poonia 2015). The wood is moderately hard and is used to make packing cases, ceiling boards, building materials, agricultural equipment, pencils, match boxes, splints, musical instruments, and tea boxes (Swaminathan et al 2012). *Melia composita* has pulp recovery higher than that of Eucalyptus and superior bleachability, indicating its feasibility as an alternate pulpwood species (Chaturvedi et al 2017). It has become a preferred tree for forestry plantations in the states of Punjab, Haryana, and Uttar Pradesh due to its rapid growth and diverse uses (Chavan 2022). In order to make full use of the species in agroforestry, it is important to understand the tree growth characteristics as well as its ability to withstand management practices. There have been scanty studies on effect of canopy management practices like pruning, lopping and pollarding on growth and development of *Melia composita* under sub-tropical climates of north India. Study was therefore conducted to underline the effect of early debranching and pollarding on growth characteristics of *Melia composita*.

MATERIAL AND METHODS

The research was conducted at the Experimental Farm, Division of Agroforestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, located at 320-40′ N latitude and 740-58′ E longitude at 332 metres above mean sea level. The study site is a subtropical region with maximum temperature up to 45 °C during summer and minimum falls to 1°C during winter. The average annual temperature in Jammu is 21.3 ºC and average annual rainfall ranges from 1000 - 1250 mm, 75-80 % of which is received during July to September.Status of soil was ascertained by collecting a composite soil sample from the experimental field at the beginning of the experiment in order to analyse the soil properties. The texture of the soil was sandy loam with organiccarbon (4.11 %), available nitrogen (243.25 kg/ha), available phosphorus (17.02 kg/ha) and available potassium (134.85 kg/ha), respectively. In July, 2015 planting of *Melia composita* was done in 2 blocks at a spacing 6m × 4m in a randomized block design). After six months of planting, no tree management practice was carried out in the first block (T_1) whereas, in the second block, debranching was done by removing all the branches except top 4 in all the saplings (T_2) which shall be referred to as initial debranching throughout the text. After two years in December 2017, marked trees were pollarded by cutting off the main stem at 3.50 m height in both the blocks. Treatment T_3 refers to the pollarded trees in the first block (T_1) whereas, treatment T_4refers to the pollarded trees (T_2) in the second block. The data was collected on various growth parameters like tree height, diameter at breast height (dbh), crown spread, number of branches per tree and crown spread. Above-ground biomass of tree was estimated using a non-destructive method by multiplying volume and wood specific gravity (Shah et al 2014). Light transmission ratio (LTR) was recorded with a digital illuminance metre (Model: TES-1332A). The measurements were taken to determine the amount of light blocked by the *Melia composita*canopy. The content of leaf chlorophyll was determined using a SPAD-502 plus chlorophyll metre and expressed as the average chlorophyll content of leaves in percent (Ling et al 2011).The entire data generated from the present investigations were analysed statistically using the technique of analysis of variance for Randomized Block Design (RBD) design using the technique of analysis of variance (ANOVA) at 0.05 level of significance.

RESULTS AND DISCUSSION

Tree height was maximum (8.08 m) in T_1 in 2018, which was statistically at par with T_2 (7.98 m) but significantly different from T_3 and T_4, respectively (Table 1). In the year 2019, the tree height in T_1 was maximum (11.80 m), which was statistically superior to rest of the treatments. Tree height in treatments T_1 and T_2 was higher in compared to T_3 and T_4 because pollarding T_3 and T_4 at 1.37 m restricted their height. Tree height was more in the trees that were not subjected to debranching (T_1 and T_3) as compared to debranched treatments (T_2 and T_4). It may be due to the fact that initial debranching might have slowed down the growth in the early stage which the trees were unable to make up. Similar results have been reported by Lydie et al (2018). Crown spread showed significant difference in response to different treatments. It was maximum (6.21 m) in T_1, which was

Table 1. Effect of canopy management on growth characteristics of *Melia composita*

Treatments	2018								2019							
	Tree height (m)	Diameter at breast height (cm)	Crown spread (m)	Number of branches tree^{-1}	Above ground biomass (kg tree^{-1})	Leaf rea (cm^2)	LTR (%)	Leaf chlorophyll (%)	Tree height (m)	Diameter at breast height (cm)	Crown spread (m)	Number of branches tree^{-1}	Above ground biomass (kg tree^{-1})	Leaf rea (cm^2)	LTR (%)	Leaf chlorophyll (%)
T_1	8.08	21.58	6.21	33.40	96.04	6.34	29.37	60.80	11.80	22.76	7.12	36.20	111.64	6.56	26.82	63.98
T_2	7.98	19.46	4.60	19.76	94.72	6.50	42.95	57.94	9.94	20.64	5.55	27.44	110.34	6.78	40.19	62.91
T_3	4.20	19.11	0.87	4.60	32.77	6.34	61.70	56.71	5.24	20.40	2.91	25.40	36.43	6.54	76.73	64.73
T_4	3.36	18.68	0.68	4.48	32.68	7.04	64.07	55.10	4.28	20.36	2.46	24.60	35.33	7.38	55.36	63.64
CD (p=0.05)	0.74	N.S	0.34	13.98	4.47	NS	2.99	NS	0.51	N.S	0.44	5.49	6.18	NS	2.76	NS

T_1(no treatment), T_2(initial debranching), T_3(pollarded T_1), T_4(pollarded T_2)

statistically higher than that of T_2, T_3 and T_4 in 2018. The crown spread in T_3 and T_4 was statistically at par. A similar trend was observed in 2019 where, the maximum crown spread was recorded in T_1 which was statistically higher than remaining treatments and was also statistically at par in T_3 and T_4. Crown spread was higher in T_1 and T_2 because these trees were not subjected to pollarding and had undisturbed crown compared to pollarded trees in T_3 and T_4. The number of branches per tree also varied significantly with management practices (treatments) both in 2018 and 2019, respectively. Maximum number of branches (33.40) were observed in T_1 which was statistically at par with T_2 but significantly superior than T_3 and T_4. A similar trend was observed in 2019. The effect of different treatments on the leaf area of *Melia composita* was statistically non-significant. Diameter at breast height was not affected neither by initial debranching nor by pollarding during both the years. In 2018, maximum aboveground biomass was in T_1(96.04 kg) which was statistically at par with treatment T_2. In treatment T_3, aboveground biomass was statistically at par with treatment T_4. During 2019 maximum above ground biomass was recorded in treatment T_1, which was statistically at par with T_2. In T_3 above ground biomass was statistically at par with T_4. Higher above ground biomass was recorded in T_1 and T_2 compared to T_3 and T_4 because, a large portion of tree trunk was removed in treatments T_3 and T_4 due to pollarding. However, the values for aboveground biomass were at par in $T_3$and T_4 during both the years implies that initial debranching did not affect the aboveground biomass. Light transmission ratio in *Melia composita* was significantly affected by different treatments during both the years. Light transmission ratio was maximum for treatment T_4, followed by T_3 and $T_2$and minimum in T_1. In 2019, the light transmission ratio was maximum (76.73 %) for T_3which was followed by T_4. Light transmission ratio in treatment T_2 was statistically at par with T_1. Increased light transmission ratio was observed in pollarded treatments (T_3 and T_4) which may be due to difference in the canopy thickness and crown spread that might have resulted in increased penetration of light through the canopy in the pollarded treatments. Similar results were reported by Sehgal (2011) and McIvor et al (2010). In 2018, maximum chlorophyll content was in T_1 followed by T_2 and T_3, and the minimum chlorophyll content was inT_4. However, during 2019, no particular trend was observed.

CONCLUSION

The debranched trees showed a minor decline in few of the growth characteristics. However, this reduction is temporary or permanent, needs to be explored further. However, pollarding in *Melia composita* (T_1 and T_2) did affect the number of branches, crown spread and above ground biomass. The effect of various treatments on physiological parameters like chlorophyll content and leaf area were non-significant.

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