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Assessment of pruning management and effect of organic and chemical fertilizers on growth pattern of *Melia Dubia* Malabar Neem a fast-growing tree for short rotation forestry

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Abstract
Melia dubia is a fast-growing tree and is used for commercial cultivation purposes. It is a good soft wood tree mostly used for plywood and pulp industries. *Melia dubia* plantation as an opportunity for the people as it generates income in the field of plywood industry, pulpwood industry etc. The experiment was carried out on Assessment of Pruning Management and Effect of Organic and Chemical Fertilizers on Growth Pattern of *Melia dubia* Malabar Neem a Fast-Growing Tree for Short Rotation Forestry, at Research & Extension farm of Forest department of Bastar region, Dhondhrepal village near Jagdalpur, during 2021-2022. The experiment was conducted in Randomize block design with Ten treatment and three replications for both unpruned trees and pruned trees where unpruned trees are considered as T_1 (unpruned tree no fertilizer), T_2 (FYM @ 3 Kg/tree), T_3 (vermicompost 1 Kg/tree), T_4 (FYM 1.5Kg + vermicompost 0.5Kg/tree), T_5(N 50gm + P 100gm + K 50gm/tree), whereas pruned trees include T_6 (pruning 1/3 crown of the tree no fertilizer), T_7 (FYM @3Kg/tree), T_8 (vermicompost 1Kg/tree), T_9 (FYM 1.5Kg + vermicompost 0.5Kg/ tree), T_{10} (N 50gm + P 100gm + K 50gm/tree) and the spacing of experimental site is 6 × 6 m between tree and row. The findings of the present study revealed that tree height of *Melia dubia* was found maximum in T_5 and minimum in T_4 for unpruned trees, whereas for pruned tree in T_{10} treatment tree height was found maximum and minimum in T_9 for pruned trees Diameter at breast height was recorded maximum in T_3 and minimum in T_4 for unpruned trees, whereas for pruned tree in T_8 treatment, DBH was found maximum and minimum in T_6 Basal area was recorded maximum in T_3 and minimum in T_4 for unpruned trees, whereas for pruned trees in T_{10} treatment, basal area was found maximum and minimum in T_6.

Keywords: *Melia dubia*, Growth pattern, manure and Fertilizers, short rotation forestry

Introduction
Melia dubia is a fast-growing tree and is used for commercial cultivation purposes which belongs to Meliaceae family and is locally known as Malay vembu (Tamil), Malaveppu (Malayalam), Ghora neem (Hindi), Kadbevu or Hebbevu (Kannada) and Munnatikaraka (Telugu). The species occurs naturally thus, found in Western Ghats of Kerala, Karnataka and Tamil Nadu, Eastern Ghats, Deccan Plateau, Upper Assam, Khasi Hills. Its leaf oil is prepared to exhibit bacteriostatic, Fungistatic and antifeedant activity. Malabar Neem is naturally found in the tropical moist deciduous and semi evergreen forest of South and Central Western Ghats, Eastern Ghats and North East India up to an altitude of 1500-1800 meter and is common in moist deciduous forests of Kerala, and is becoming very popular in Southern states of India for its fast growth and wide adaptability in diverse edaphic and climatic conditions.*Melia dubia* is a large deciduous tree, attains a height of 20 m with a spreading crown, wide spreading branches and a cylindrical straight trunk with girth bark about 6-8mm thick. It grows on variety of soils, however, deep fertile sandy loam soils show optimum growth, while shallow gravelly soils shows stunt growth. The ideal period of sowing seeds is march-April; it takes nearly 90 days to germinate drupes. Flowering period of this tree is January-March and fruiting period is November – February. *Melia dubia* is a good agroforestry tree species and supports a variety of crops throughout its cultivation period. About, 400 trees can be planted in an acre which fetches about Rs. 10-20 lakhs in 6-8 years' time. The crops such as, ground nut, chili, turmeric, black gram, papaya, banana, melon, and sugarcane etc., are cultivated as intercrops. The farmers of South India, Maharashtra, Gujarat and Rajasthan usually like this species very much to get big amount through its cultivation.

The fast growing, multipurpose and short rotation trees are generally used in agroforestry and commercial forestry/ industrial forestry as well other afforestation programmes. The species performs exceedingly well attaining the harvestable size in 6-8 years and is ready for sell. Now, the species is becoming popular among farmers in Southern and Northern parts of India for cultivation along with crops under various agroforestry systems. This tree species is commonly found in plains 750 m above sea level and grows well in areas with a rainfall of 625 mm to 875 mm. It needs a well-drained fertile soil with ample moisture supply to grow up to 25 m in height (Gopal *et al.*,2015) [4]. Every portion of the plant is used to make traditional herbal remedies for conditions including cholelithiasis, acariasis, leprosy, eczema, asthma, malaria, fevers, and venereal illnesses. (Govindachari T. R.,1992) [5]. *Melia dubia* Cav., an indigenous tree species of India, is being adopted by famers owing to its fast-growing nature allowing harvest at short rotation. It possesses excellent termite- and fungus-resistant wood that is used to build houses, fuel wood for agricultural tools, furniture, and plywood as an alternative species. It is an ideal species for plywood and pulp wood industry apart from being extensively used in afforestation. **(**Partiban *et al.*, 2009).

This tree has excellent medicinal properties. It has been utilized for a variety of bacterial skin infections as well as various conditions affecting the gastrointestinal system. (Purushothaman *et al.*1984) [13]. The wood from this tree is used to make musical instruments, tea boxes, packing cases, cigar boxes, ceiling boards, construction materials, agricultural equipment, and pencils wood for fuel and plywood. (Calorific value, 5.043-5, 176 cal.) The creation of planting stock is still heavily reliant on traditional techniques in India, despite the fact that the system for producing forest tree seedlings has been revolutionized in many other nations. All afforestation programs need the help of forest nurseries to succeed. It takes technical expertise to raise excellent seedlings, including careful preparation for the selection of quality seeds, adequate growth material, containers, nursery cleanliness, and protection. *Melia dubia* systematic cultivation has grown increasingly important as a result of its increased significance. (Anand B., *et al*. 2012) [1].

Materials and methods

Experimental site and methods

The present investigation was accomplished in Research & Extension farm of Forest department of Bastar region, Dhondhrepal village near Jagdalpur, Chhattisgarh. The experimental site is located at 19°10' N latitude and 81°95' E longitude. The region is dominated by the Loam soil, the mean annual temperature ranges maximum temperature recorded was 40-41 °C-41-42.8 °C while the minimum temperaturewas10.5 °C-11.6 °C and average rainfall of this area is 1410.2 mm to 1600 mm. The experiment was conducted in Randomize Block Design with Ten treatment and three replications included are for unpruned trees and pruned trees in which unpruned trees include T_1 unpruned tree no fertilizer, T_2 FYM @ 3 Kg/tree, T_3 vermicompost 1Kg/tree, T_4 FYM 1.5Kg + vermicompost 0.5Kg/ tree, T_5 N 50gm + P 100gm + K 50gm/tree, where as pruned trees include T_6 pruning 1/3 crown of the tree no fertilizer, T_7 FYM @ 3 Kg/tree, T_8 vermicompost 1Kg/tree, T_9 FYM 1.5Kg + vermicompost 0.5 Kg/tree, T_{10} N 50gm + P 100gm + K 50 gm/tree and the spacing of experimental site all the trees are spaced at 6 × 6 m between tree and row.

Experimental design

The experimental design was laid out using Random Block Design (RBD) with Ten treatments and three replications. These details are represented in Table 1.

Table 1: The Details of treatments are given as follow

Treatment No	Manures and fertilizer application
Unpruned*	
T1	Unpruned tree no fertilizer
T2	FYM @3Kg/Tree
T3	Vermicompost 1Kg/tree
T4	FYM 1.5Kg + vermicompost 0.5Kg/tree
T5	N 50gm + P 100gm + K 50gm/tree
Pruned**	
T6	Pruning 1/3 crown of the tree no fertilizer
T7	FYM @3Kg/tree
T8	Vermicompost 1Kg/tree
T9	FYM 1.5Kg + vermicompost 0.5Kg/tree
T10	N 50gm + P 100gm + K 50gm/tree

*Unpruned Saplings of 1 year old *Melia dubia*
**Pruned Saplings of 1 year old *Melia dubia*

Statical analysis of data

Tree parameters were tabulated and analysed statically using Random block design (RBD). Tree parameter (Morphological) Height, DBH, Basal area, of sapling tree were tabulated and analysed statically using Random block design. Studies were subjected to statistical analysis as per the procedure laid down by Gomez and Gomez (1984) [3].

Result and Discussion

Effect of Organic and Chemical Fertilizers on Growth Parameters of *Melia dubia* Malabar Neem

The present investigation revealed that tree height; DBH and Basal area of 1 year old saplings of *Melia dubia* was significantly influenced by various doses of manure and fertilizer application. Table 2, reveals that different treatments significantly affected the growth parameters (height, DBH, and basal area). The maximum height increment was recorded under treatment Unpruned condition with organic manure and inorganic fertilizer in treatment T_5 (4.34, 4.8, 5.29, and 5.74) m. However minimum height was observed in T_4 (4.45, 4.69, 4.95 and 5.21) m.

Maximum tree height of *Melia dubia* was observed under Pruned condition with organic manure and inorganic fertilizer in treatment T_{10} (4.85, 5.31, 5.78 and 6.25) m followed by T_8 (4.17, 4.69, 5.21 and 5.73) m followed by T_7 (4.18, 4.49, 4.82 and 5.1) m followed by T_6 (4.36, 4.63, 4.9 and 5.18) m. However, minimum tree height was observed in T_9 (4.22, 4.46, 4.72 and 5.02) m. These above results are carried out by Shukla *et al.* (2003) [16], reported that the chemical fertilizers in combination with NPK did not performed well compared with the FYM the growth was better with NPK. The observations found in this experiment confirm the results as reported by above worker. Pradeep and Manjappa (2015) [12] reported that FYM 10 kg showed maximum growth in height and collar diameter in case of *Heavea brasiliensis* plantation. The result of the present investigation did not match with the results reported by this worker this may be the Genus & Species is different because of this it is not similar. Sankanur *et al.* (2011) [14] reported that the poultry manure 33 g/ seedling showed growth in height in case of *Pterocarpus*

santalinus. Shukla *et al.* (2000) [17] also reported that the NPK 30:40:15 kg/ha^{-1} showed growth in height in case of Prosopis *cineraria.* Looking to the results by other worker and present study confirms the results obtained by the above worker that the chemical fertilizer showed better results in case of height Chandana *et al.* (2020) [2] reported that the 75% RDN+25% N through FYM showed growth in height in case of *Melia dubia.* These results are also conformity with the studies of Sharma *et al.* (2006) [15], Luna *et al.* (2007) [10], and Jayakumar *et al*. (2021) [8] similar observations was observed in this investigation.

Diameter at breast height of *Melia dubia* under different treatment was recorded at 2 months interval (60 DAYS) till 180 day three times and their results are present in table 3, diameter at breast height showed statically significant (p<0.05) by organic manure and chemical fertilizer treatments. DBH of *Melia dubia* was significantly increased with the increase in number of days. The DBH of *Melia dubia* was observed under unpruned condition with organic manure and inorganic fertilizer in treatment Maximum T_3 (5.10, 5.35, 5.61 and 5.68) cm followed by T_2 (5.26, 5.48, 5.70 and 5.93) cm followed by T_1 (5.19, 5.35, 5.51 and 5.91) m followed by T_5 (4.51, 4.72, 4.92 and 5.15) cm. However, minimum DBH was observed in T_4 (4.7, 4.86, 5.01 and 5.18) cm.

In case of pruned condition with organic manure and inorganic fertilizer in various treatments the Maximum DBH was recorded in T_8 (4.37, 4.59, 4.83 and 5.08) cm followed by T_{10} (5.15, 5.36, 5.58 and 5.81) cm followed by T_9 (4.02, 4.21, 4.41 and 4.62) cm followed by T_7 (4.47, 4.64, 4.81 and 5) cm. However minimum DBH was observed in T_6 (4.38, 4.49, 4.61 and 4.74) cm. However, minimum DBH was observed in T_6 (4.38, 4.49, 4.61 and 4.74) cm. Jayakumar and Sudhakar (2021) [8] also reported that the 200:100:200 NPK ha^{-1}showed growth in DBH in case of *Melia dubia*. Chandana *et al.* (2020) [2] reported that the 100% RDF through neem coated urea showed growth in DBH in case of *Melia dubia*. Similar findings were reported by Sharma and Tripathi (2006) [15] in *Acacia catechu*, Luna and Kumar (2007) [10] in *Acacia nilotica (Linn.).* The results of above workers showed that the chemical fertilizer + organic fertilizer showed better growth however in present investigation the vermicompost treatment performed maximum DBH increment this may be slow release of nutrients to the sapling and it effect the maximum increment in diameter. The 1-year-old plantation of *Melia dubia* saplings responded better growth in DBH but in case of height the chemical fertilizers showed the better result it can be said that there is need to find out the better combination of Chemical fertilizer + organic fertilizer to develop the package of practice of this species with more treatment trails.

Basal area of *Melia dubia* under different treatment was recorded at 2 months interval (60 DAYS) and their results are present in table 4, basal area showed statically significant (p<0.05) by organic manure and chemical fertilizer treatments. The basal area of *Melia dubia* was significantly increased with the increase in number of days. Maximum basal area of *Melia dubia* was observed under Unpruned condition with organic manure and inorganic fertilizer in treatment T_3(22.07, 24.07, 26.14 and 28.52) m^2 followed by T_2 (22.72, 24.82, 26.84 and 29.02) m^2 followed by T_5 (16.78, 18.47, 20.04 and 21.95) m^2 followed by T_1 (22.4, 23.96, 25.41 and 26.88) m^2. However, minimum basal area was observed in T_4 (18.55, 20.19, 21.32 and 22.69) m^2.

The basal area of *Melia dubia* was observed under Pruned condition with organic manure and inorganic fertilizer in treatment T_{10} Maximum (21.87, 23.63, 25.62and 27.7) m^2 followed by T_8 (16.06, 17.51, 19.35 and 21.3) m^2 followed by T_7 (17.54, 18.92, 20.19and 21.86) m^2 followed by T_9 (14.60, 15.85, 17.29 and 18.8) m^2. However, minimum basal area was observed in T_6 (15.90, 16.55, 17.49 and 18.29) m^2. However, minimum basal area was observed in T_6 (15.90, 16.55, 17.49 and 18.29) m^2. Pradeep and Manjappa (2015) [12] also observed that the maximum collar diameter (30.31mm) on young rubber (*Hevea brasiliensis*) plantation on concentration of NPK (150:150:75) g plant^{-1}. Sankanur *et al. (*2011) [14] observed that the maximum collar diameter (4.92 mm) on *Pterocarpus santalinus* (Linn. F) Seedlings on Poultry manure @ 33g/seedlings. Jitendra *et al.* (2003) [9] reported that the maximum collar diameter (558.94%) on *Prosopis cineraria*and where doses of NPK was (30:40:15 kg ha^{-1}) + Hexameal. The basal area in present investigation observed maximum value in Vermicompost in case of unpruned treatment whereas, in pruned treatments it was maximum NPK. The results showed that in unpruned treatment the no of branches were more and maximum leaf resulted the maximum biomass accumulation at basal area level but in case of pruned trees the less no of branches and leaves the biomass accumulation is maximum in NPK due to fast release of nutrient. Therefore, it can be concluded that the biomass accumulation related with the availability of nutrient supply in slow release. Therefore, there is need to go for more treatments and find out the suitable combination of organic and inorganic for better growth and productivity of this species. These results are also conforming to the studies of Hoque *et al.* (2004) [7] in *Michelia champaca* and Gupta *et al.* (2006) [6] *Eucalyptus.*

Table 2: Effect organic manure and inorganic fertilizer treatments on height of *Meliadubia*1 year plantation

Treatments	Tree height (m)			
	Sapling height 1year old	After 60 Days	After 120Days	After 180Days
Unpruned				
T_1:Control	4.82	5.16	5.53	5.91
T_2:FYM @3Kg/tree	4.84	5.07	5.34	5.62
T_3: VC 1Kg/tree	4.62	5.11	5.59	5.97
T_4: FYM 1.5Kg + VC 0.5Kg/tree	4.45	4.69	4.95	5.21
T_5:N 50gm + P 100gm + K 50gm / tree	4.34	4.8	5.29	5.74
Pruning				
T_6:Pruning1/3 crown of the tree no fertilizer	4.36	4.63	4.9	5.18
T_7: FYM @ 3Kg/tree	4.18	4.49	4.82	5.1
T_8:VC 1Kg /tree	4.17	4.69	5.21	5.73
T_9: FYM 1.5Kg + VC 0.5Kg/ tree	4.22	4.46	4.72	5.02

$T_{10: N}$ 50gm + P 100gm + K 50gm/tree	4.85	5.31	5.78	6.25
SEm (±)	0.15	0.15	0.15	0.14
SE d (±)	0.22	0.21	0.21	0.20
CD (at 5%)	0.47	0.46	0.46	0.43

Table 3: Effect organic manure and inorganic fertilizer treatments on DBH of *Melia dubia* 1 year plantation

Treatments	Diameter at Breast Height (cm)			
	Sapling DBH 1year old	**After 60 Days**	**After 120Days**	**After 180 Days**
Unpruned				
T_1:Control	5.19	5.35	5.51	5.68
T_2:FYM @3Kg/tree	5.26	5.48	5.70	5.93
$T_{3: VC}$ 1Kg/tree	5.10	5.35	5.61	5.88
$T_{4: FYM}$ 1.5Kg + VC 0.5Kg/tree	4.7	4.86	5.01	5.18
T_5:N 50gm + P 100gm + K 50gm / tree	4.51	4.72	4.92	5.15
Pruned				
T_6:Pruning 1/3 crown of the tree no fertilizer	4.38	4.49	4.61	4.74
$T_{7: FYM}$ @ 3Kg/tree	4.47	4.64	4.81	5
T_8:VC 1Kg /tree	4.37	4.59	4.83	5.08
$T_{9: FYM}$ 1.5Kg + VC 0.5Kg/ tree	4.02	4.21	4.41	4.62
$T_{10: N}$ 50gm + P 100gm + K 50gm/tree	5.15	5.36	5.58	5.81
SEm (±)	0.25	0.22	0.22	0.21
SE d (±)	0.35	0.31	0.31	0.30
CD (at 5%)	0.75	0.66	0.66	0.65

Table 4: Effect of organic and chemical fertilizers treatments on basal area of *Melia dubia*1 year plantation

Treatments	Basal area (cm^2)			
	Sapling basal area 1year old	**After 60 days**	**After 120 days**	**After 180 days**
Unpruned				
T_1:Control	22.4	23.96	25.41	26.88
T_2:FYM @3Kg/tree	22.72	24.82	26.84	29.02
$T_{3: VC}$ 1Kg/tree	22.07	24.01	26.14	28.52
$T_{4: FYM}$ 1.5Kg + VC 0.5Kg/tree	18.55	20.19	21.32	22.69
T_5:N 50gm + P 100gm + K 50gm / tree	16.78	18.47	20.04	21.95
Pruned				
T_6:Pruning 1/3 crown of the tree no fertilizer	15.90	16.55	17.49	18.29
$T_{7: FYM}$ @ 3Kg/tree	17.54	18.92	20.19	21.86
T_8:VC 1Kg /tree	16.06	17.51	19.35	21.3
$T_{9: FYM}$ 1.5Kg + VC 0.5Kg/ tree	14.60	15.85	17.29	18.8
$T_{10: N}$ 50gm + P 100gm + K 50gm/tree	21.87	23.63	25.62	27.7
SEm (±)	1.91	1.80	1.82	1.85
SE d (±)	2.70	2.54	2.57	2.62
CD (at 5%)	5.73	5.39	5.45	5.55

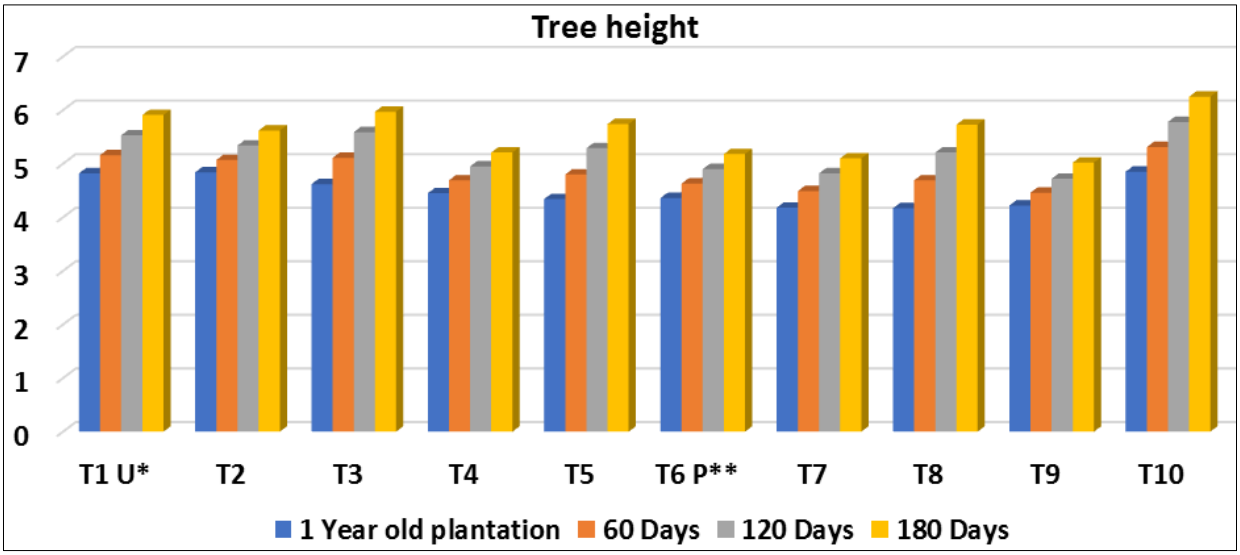

Fig 1: Effect of organic and inorganic fertilizer treatment on height of *Melia dubia* 1 year plantation

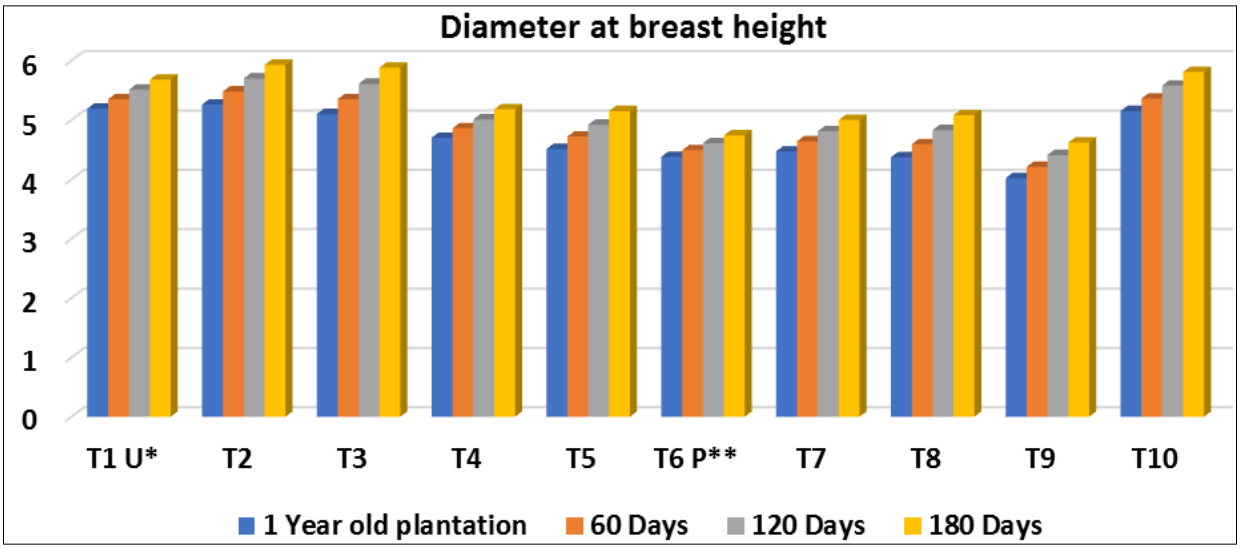

Fig 2: Effect of manure and fertilizer treatments on DBH of *Melia dubia* 1 year plantation

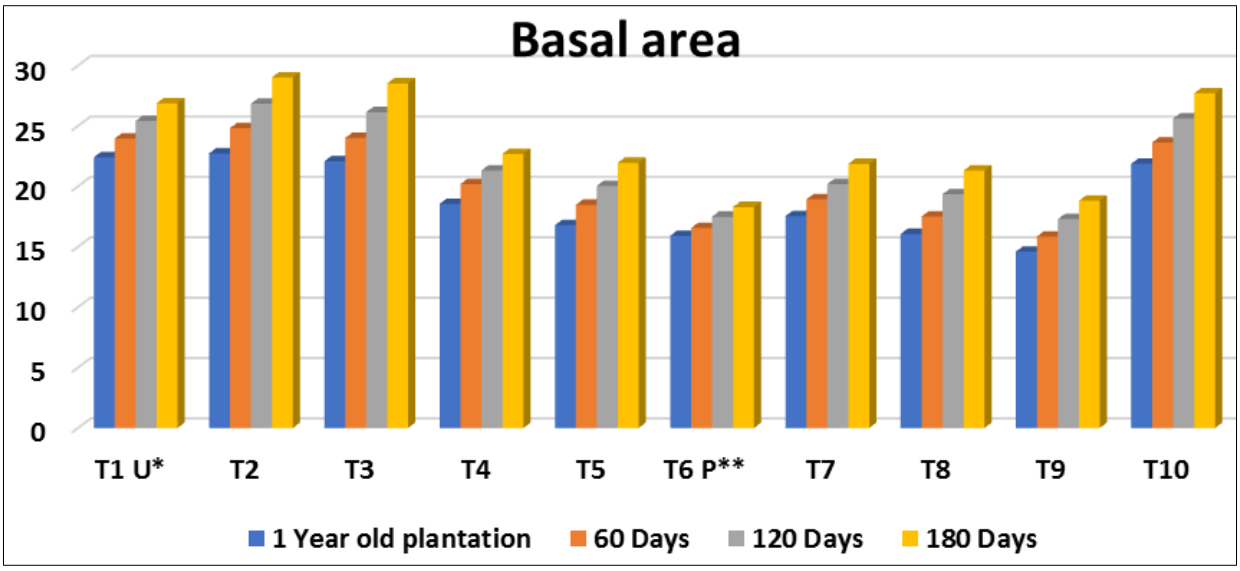

Fig 3: Effect of organic and chemical fertilizers treatments on basal area of *Melia dubia* 1 year plantation

Conclusion

The plywood and pulp industry requires a huge amount of soft wood, therefore, there is need to go for short rotation forestry. The fast-growing tree is used by growers more frequently since it can be harvested when it is just 6 to 8 years old and can be used to make plywood and pulp as well as timber after being grown for more than 10 to 12 years as other species. The *Melia dubia* is found a very fast-growing species in Chhattisgarh also which will full fill the need of the above industries, its potential use with the timber sector also having a significant role for the farmers. It's crucial to educate farmers on the rationale behind and practices involved in raising this tree. It is important to remember that *Melia* has evolved into a highly significant industrial wood and is currently even farmed by farmers under various agroforestry systems. The commercial plantation of this species recommended on the basis of the results of this investigation it can be said that height of 1 year old plantation was maximum in NPK unpruned treatments and Basal area and DBH T3 with vermicompost treatment in unpruned condition was maximum showed that the basal area and DBH excellent performance came due to slow and continues release of nutrient through vermicompost. It can be concluded that the NPK + Vermicompost combination must be workout to check the excellent growth of *Melia dubia* during overall period till the crop mature till harvesting. The pruning of trees in this experiment for the species (*Melia dubia)* is not required.

Plate 1: Picture of 1 year old *Melia dubia* plantation

Plate 2: Picture during measuring the diameter at breast height of *Melia dubia*1 year old plantation

Plate 3: Picture during measuring the basal area of *Melia dubia* 1 year old plantation

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