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Effect of Mycorrhiza Formulation, *Trichoderma viride* and Bio N, P, K on *Melia dubia* seedling growth in nursery

***Aditya Kumar, Subhash Prasad and Ashish Kumar**
Genetics and Tree Improvement Division, Institute of Forest Productivity, Ranchi, Jharkhand, India

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ABSTRACT

Melia dubia is one of the fastest growing, multipurpose, deciduous tree species, found naturally in India. It is being extensively planted under agroforestry systems and used by the plywood industries, toy industries, making light furniture, packing cases etc. Mycorrhiza, bio-N, P, K, Trichoderma and bio-pesticides played significant role in the nursery development of tree species. A healthy seedling is pre-requisite for a productive and healthy plantation. Therefore, in the present study the effect of bio-products viz. Mycozone tablet, Mycozone powder, Monitor, Biofield combo and Metasoft were studied on melia seedlings and found positive and significant effect on seedling growth. The study revealed that application of one Mycozone tablet/plant or 100gm/acre mycozone powder increased seedling growth significantly. 250 gm/acre monitor (*Trichoderma viride*) increased plant growth significantly (plant height 35.12 percent, collar diameter 50.93 percent and volume index 78.65 percent) over the control and prevented soil born pathogens. The doses of bio- N, P, K, were also increased plant growth substantially. In the study 2 Kg/acre of biofield combo (bio-N, P, K,) found most suitable which increased collar diameter and volume index maximum i.e., 44.86 percent and 72.44 percent respectively over control. The tested bio-products were enhanced melia seedling growth substantially; the plant height was increased by 17.26 % to 34.01 %, collar diameter increased by 34.86 % to 50.93 % and volume index increased by 57.74% to 78.65% over control.

Key Words - *Melia dubia*, Mycorrhiza, *Trichoderma*, Bio- N, P, K, Seedling growth

***Corresponding author :** aditya@icfre.org, aditya9678@gmail.com

INTRODUCTION

Melia dubia Cav. *(syn. Melia composita* Benth.*)* is an important money-spinning tree species which grows upto a plant height of 20-25 meter with a cylindrical clear bole upto 9 m and 1.5 m in girth (Kumar *et al*., 2017). It is one of the fastest growing tree species, belongs to the Meliaceae family and indigenous to India. It is found naturally in tropical moist deciduous forests of the Sikkim Himalaya, North Bengal, Upper Assam, Odisha and Western Ghats (Kumar and Singh, 2019). Its wood is used for various purposes like, making packing cases, cigar boxes, ceiling planks, building purposes, agricultural implements, pencils, match boxes, ply boards, paper and pulp etc. (Kumar and Das, 2013). It's wood having anti-termite property and mean fiber length of 716.72 µm in six-year-old plants (Kumar *et al*., 2018). Fast growing nature and economical importance attracted farmers to plant it under agroforesyry and farm forestry. *Melia dubia* also did not have any significant inhibitory effect on germination and growth of agricultural crops (Kulkarni, 2017, Sharma *et al.* 2019). It was also reported that the *Melia dubia* along with *Trichoderma viride* have potential to degrade endosulfan, a commonly occurring hazardous pesticide residue in soil (Subashini *et al*., 2007) and can be utilized for restoration of degraded soil.

Mycorrhiza is a symbiotic association between a green plant and a fungus. Plants provide food material such as sugars produced through photosynthesis and the fungus improves availability of water and mineral nutrients, such as phosphorus (Ibanez and Newman, 2016). These are located in the roots of vascular plants. The most common association between these two is arbuscular type which is present in 70% of plant species. It increases absorption of minerals through physical and chemical processes. Physically, most mycorrhizal mycelia are much smaller in diameter than the smallest root or root hair, and thus can explore soil material that roots and root hairs cannot reach, and provide a larger surface area for absorption (Al-Hmoud and Al-Momany, 2017). Chemically, the cell membrane chemistry of fungi differs from that of plants, they may secrete organic acids that dissolve or chelate many ions, or release them from minerals by ion exchange. Mycorrhizae are especially beneficial for the plant partner in nutrient-poor soils (Ortas, 2010). Apart from this Mycorrhiza increases tolerance to disease, insect-pests, drought and salinity (Diagne *et al.,* 2020). It also augments the colonization of barren land and hence growth of plants planted in barren land.

Trichoderma is a fungus belonging to the family Hypocreaceae, it is present in all soils, where they are the most prevalent culturable fungi. *Trichoderma* species have ability to form mutualistic endophytic relationships with several plant species. It is generally utilized as biocontrol agent and found on root surfaces (Zivanov *et al.,* 2020). It affects root diseases particularly but also prevents the foliar diseases in some cases (Marin-Guirao *et al.,* 2016). The injudicious use of inorganic fertilizers affects soil health adversely and present day's soil health has been already affected adversely in many states of the country. To protect the fertility of soil and retain it alive, it is important to use N, P and K of biological origin which not only improve the soil microflora but also maintain the soil health.

Keeping the above points under consideration, the present study has been carried out to study the effect of these bioproducts on growth and health of Melia nursery plants.

MATERIALS AND METHODS

The effect of Mycorrhiza, *Trichoderma viride* and Bio N, P, K on melia seedling growth was tested by utilizing the products of Agriland Biotech Ltd. It includes, Mycorrhiza formulation in powder and well as in tablet form {Mycozone tablet (30 spores/ gram and tablet of 500mg), *Trichoderma viride* (Monitor), Bio N, P, K (Biofield combo) and biopesticide (Metasoft). The melia seeds were sown in sand beds, after germination and attaining 3-4 leaf stage seedlings were utilized for conducting the study. The trial was established in RBD (Randomized Block Design) fashion with five replications and 20 melia plants per treatment per replication at Lalgutwa, Ranchi (Jharkhand) (23.35^{o}N, 85.24^{o}E). To identify the best suited dose of bio-products, three different doses of each product were taken for study along with the control for comparison (Table 1).

Table 1: Utilized doses (Treatments) of bio-products

Sl. No.	Treatment	Applied Doses
1.	Mycozone Tablet	1 tablet/plant at the time of sowing
2.	Mycozone Tablet	2 tablet/plant at the time of sowing
3.	Mycozone Tablet	3 tablet/plant at the time of sowing
4.	Mycozone Powder	50 gm/acre
5.	Mycozone Powder	100 gm/acre
6.	Mycozone Powder	150 gm/acre
7.	Monitor	250 gm/acre
8.	Monitor	500 gm/acre
9.	Monitor	1 Kg/acre
10.	Biofield Combo	2 Kg/Acre
11.	Biofield Combo	3 Kg/acre
12.	Biofield Combo	4 Kg/acre
13.	Metasoft	250 gm/acre
14.	Metasoft	500gm/acre
15.	Metasoft	1 Kg/acre
16.	Control	

Table 2: Effect of Mycozone tablets on growth of *Melia dubia* seedlings

Treatment	Height (cm)			Collar Diameter (cm)			Volume index (cm3)		
	Ht (cm)	(Treatment mean-Control Mean)	% increase over control	CD (cm)	Treatment mean-Control Mean	% increase over control	VI (cm^3)	Treatment mean-Control Mean	% increase over control
Treatment 1	228.67	70.10	30.66	1.77	0.79	44.58	1271.78	943.72	74.20
Treatment 2	214.74	56.17	26.16	1.62	0.64	39.29	965.28	637.22	66.01
Treatment 3	240.29	81.72	34.01	1.67	0.68	40.99	1149.88	821.82	71.47
Control	158.57			0.98			328.06		
Mean	210.57			1.51			928.75		
C.V.	13.91			17.99			46.11		
C.D. 5%	40.37			0.37			590.10		

Table 3: Effect of Mycozone powder on growth of *Melia dubia* seedlings

Treatment	Height (cm)			Collar Diameter (cm)			Volume index (cm3)		
	Ht (cm)	(Treatment mean-Control Mean)	% increase over control	CD (cm)	Treatment mean-Control Mean	% increase over control	VI (cm^3)	Treatment mean-Control Mean	% increase over control
Treatment 4	202.93	44.36	21.86	1.64	0.66	40.00	928.82	600.76	64.68
Treatment 5	198.18	39.61	19.99	1.81	0.83	45.70	1253.65	925.59	73.83
Treatment 6	218.65	60.08	27.48	1.70	0.72	42.12	1046.01	717.95	68.64
Control	158.57			0.98			328.06		
Mean	194.58			1.53			889.14		
C.V.	13.83			25.83			70.51		
C.D. 5%	37.07			0.55			-		

Table 4: Effect of Monitor on growth of *Melia dubia* seedlings

Treatment	Height (cm)			Collar Diameter (cm)			Volume index (cm3)		
	Ht (cm)	(Treatment mean-Control Mean)	% increase over control	CD (cm)	Treatment mean-Control Mean	% increase over control	VI (cm^3)	Treatment mean-Control Mean	% increase over control
Treatment 7	244.42	85.85	35.12	2.00	1.02	50.85	1536.31	1208.25	78.65
Treatment 8	237.06	78.49	33.11	1.88	0.90	47.72	1400.37	1072.31	76.57
Treatment 9	191.65	33.08	17.26	1.51	0.52	34.75	776.27	448.21	57.74
Control	158.57			0.98			328.06		
Mean	207.93			1.59			1010.25		
C.V.	13.29			23.69			56.05		
C.D. 5%	38.09			0.52			780.34		

Table 5: Effect of Biofield combo on growth of *Melia dubia* seedlings

Treatment	Height (cm)			Collar Diameter (cm)			Volume index (cm3)		
	Ht (cm)	(Treatment mean-Control Mean)	% increase over control	CD (cm)	Treatment mean-Control Mean	% increase over control	VI (cm^3)	Treatment mean-Control Mean	% increase over control
Treatment 10	219.71	61.14	27.83	1.78	0.80	44.78	1190.30	862.24	72.44
Treatment 11	235.25	76.68	32.60	1.75	0.77	43.77	1104.34	776.28	70.29
Treatment 12	214.61	56.04	32.60	1.61	0.62	38.73	1101.57	773.51	70.22
Control	158.57			0.98			328.06		
Mean	207.04			1.53			931.07		
C.V.	11.18			24.51			64.09		
C.D. 5%	31.89			0.52			-		

Figure 1: Percent increase in height, collar diameter and volume index of melia seedlings over control due to treatment

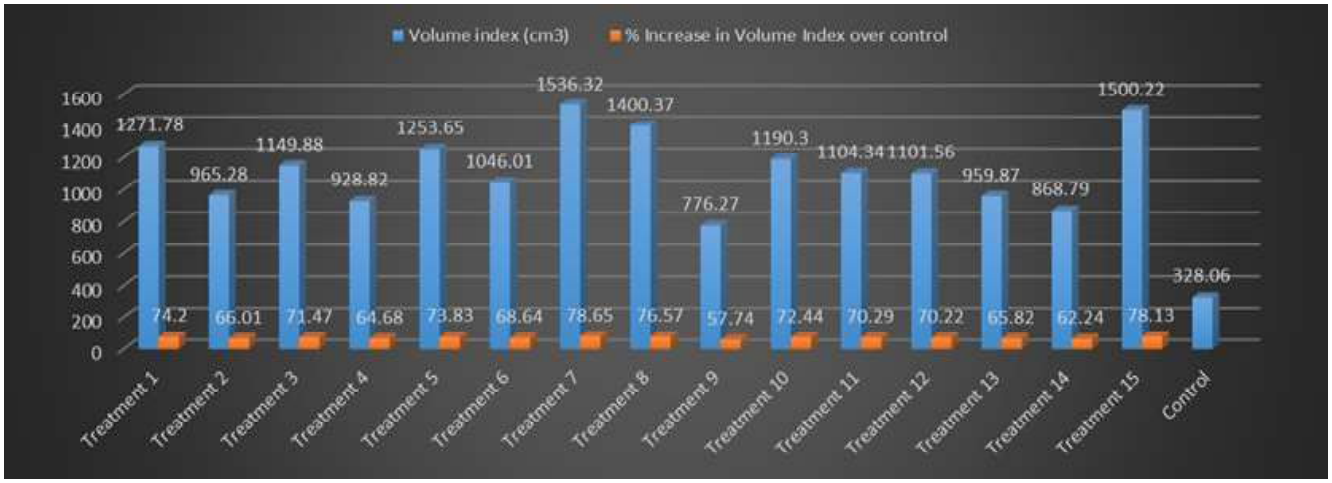

Figure 2: Effect of bio-products on volume index and per cent increase in volume index of melia seedlings over control

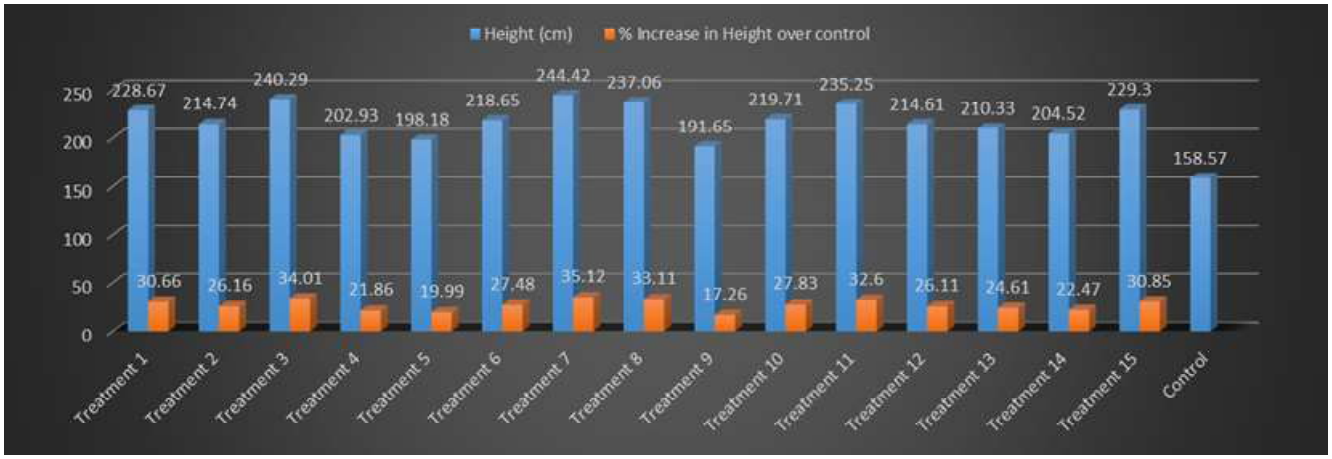

Figure 3: Effect of bio-products on height and percent increase in height of melia seedlings over control

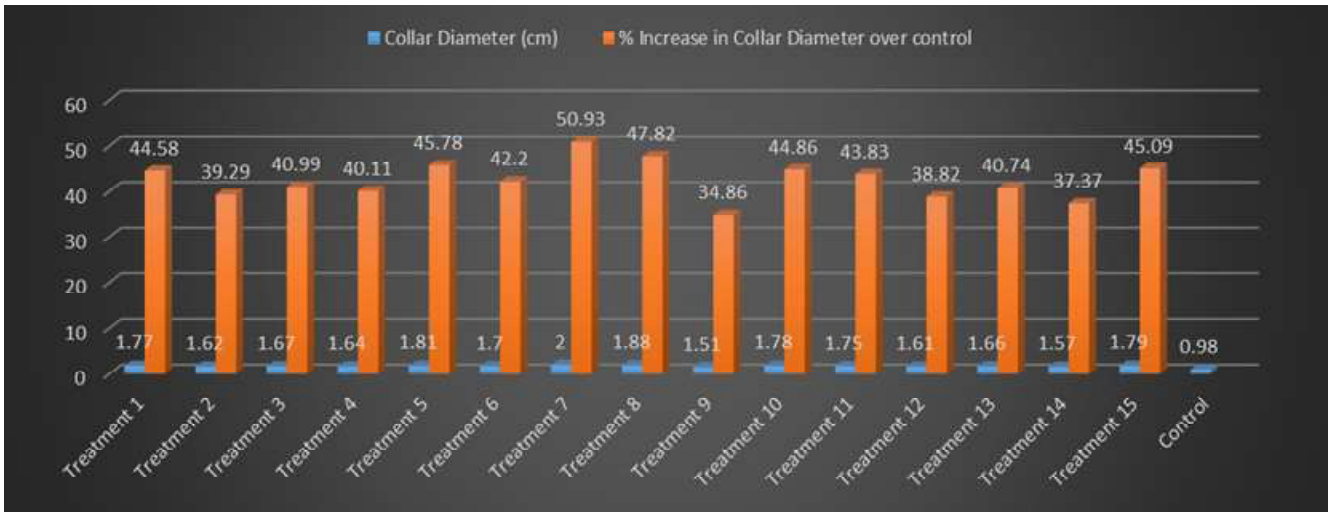

Figure 4: Effect of bio-products on collar diameter and percent increase in collar diameter of melia seedlings over control

Table 6: Effect of Metasoft powder on growth of *Melia dubia* seedlings

Treatment	Height (cm)			Collar Diameter (cm)			Volume index (cm3)		
	Ht (cm)	(Treatment mean-Control Mean)	% increase over control	CD (cm)	Treatment mean-Control Mean	% increase over control	VI (cm^3)	Treatment mean-Control Mean	% increase over control
Treatment 13	210.33	51.76	24.61	1.66	0.67	40.65	959.87	631.81	65.82
Treatment 14	204.52	45.95	22.47	1.57	0.58	37.24	868.79	540.73	62.24
Treatment 15	229.30	70.73	30.85	1.79	0.80	44.97	1500.22	1172.16	78.13
Control	158.57			0.98			328.06		
Mean	200.68			1.50			914.24		
C.V.	19.48			23.33			87.91		
C.D. 5%	-			0.48			-		

Table 7: Comparison of effect of all bio-products provided by Agriland biotech on growth of *Melia dubia*

Sl. No.	Treatments	Ht (cm)	Height Difference from Control (cm)	% Increase in Ht over control	CD (cm)	CD difference from control (cm)	% Increase in CD over control	VI (cm3)	Volume index difference from control (cm3)	% Increase in VI over control
1	Treatment 1	228.67	70.10	30.66	1.77	0.79	44.58	1271.78	943.72	74.20
2	Treatment 2	214.74	56.17	26.16	1.62	0.64	39.29	965.28	637.22	66.01
3	Treatment 3	240.29	81.72	34.01	1.67	0.68	40.99	1149.88	821.82	71.47
4	Treatment 4	202.93	44.36	21.86	1.64	0.66	40.11	928.82	600.76	64.68
5	Treatment 5	198.18	39.61	19.99	1.81	0.83	45.78	1253.65	925.59	73.83
6	Treatment 6	218.65	60.08	27.48	1.70	0.72	42.20	1046.01	717.95	68.64
7	Treatment 7	244.42	85.85	35.12	2.00	1.02	50.93	1536.32	1208.26	78.65
8	Treatment 8	237.06	78.49	33.11	1.88	0.90	47.82	1400.37	1072.31	76.57
9	Treatment 9	191.65	33.08	17.26	1.51	0.53	34.86	776.27	448.21	57.74
10	Treatment 10	219.71	61.14	27.83	1.78	0.80	44.86	1190.30	862.24	72.44
11	Treatment 11	235.25	76.68	32.60	1.75	0.77	43.83	1104.34	776.28	70.29
12	Treatment 12	214.61	56.04	26.11	1.61	0.62	38.82	1101.56	773.51	70.22
13	Treatment 13	210.33	51.76	24.61	1.66	0.68	40.74	959.87	631.81	65.82
14	Treatment 14	204.52	45.95	22.47	1.57	0.59	37.37	868.79	540.73	62.24
15	Treatment 15	229.30	70.73	30.85	1.79	0.81	45.09	1500.22	1172.16	78.13
16	Control	158.57			0.98			328.06		
	Mean	215.56			1.67			1086.35		
	C.V.	14.81			22.30			55.37		
	C.D. (5%)	40.39			-			-		

Ht = Height (cm), CD = Collar diameter (cm), VI = Volume index (cm^3)

The growth data (seedling height and collar diameter) were recorded (zero data) after the establishment of experiment. Final data were recorded after one year of application of bio-products. The analysis was carried out on the data which was absolute growth during the study period i.e., data comes after deduction of zero data from the final data. The volume index of the seedlings was calculated by using the formula suggested by Hatchell (1985).

$$\text{Volume Index} = (\text{Collar Diameter})^2 \times \text{Height}$$

Data analysis was carried out by using Windostat 9.2 software and effect of each treatment on seedling growth was compared with the control separately. The analysis was also carried out collectively for all the treatments along with control to compare effect of different products on melia seedling.

RESULT AND DISCUSSION

The performance of melia seedlings (plant height and collar diameter) were recorded after one year of trial establishment. The volume index of plants in trial was estimated from the recorded growth data viz. plant (seedling) height and collar diameter. Three treatments of Mycozone tablets were applied in nursery viz. 1 tablet/plant (contains endomycorrhiza 30 spores/gm, one tablet weight was 500 mg.), 2 tablets/plant and 3 tablets/plant at the time of sowing to identify the best dose. The growth of treated seedlings was compared with the control and found significant increase in plant height, collar diameter and volume index (Table 2) (Ortega *et al.*, 2003, Al-Hmoud and Al-Momany, 2017). One tablet/plant of mycorrhiza (treatment 1) was found sufficient to affect growth significantly. In the present study, 30.66 % increase in height, 44.58 % increase in CD and 74.20 % increase in volume index was observed over control. Though, seedling height was mostly affected by 3 tablets/plant of mycorrhiza (Treatment 3). The result reflects that initial population of mycorrhiza does not affect the collar diameter of the plant but affects the height of the seedling (none significantly). It is also evident from the results that volume index of the seedlings was not affected by the higher dose of the mycorrhiza.

Three different doses (Treatments) of Mycozone powder viz. @ 50 gm/acre, 100 gm/acre and 150 gm/acre (Table 1) were applied to identify its best dose. It affected plant height and collar diameter significantly but no significant increase in volume index was recorded over the control (Table 3). 150 gm per acre mycozone powder affected 27.48 percent increase in plant height over the control while 100 gm/acre mycozone powder (treatment no. 5) affected 19.99 % increase in height, 45.78 % increase in collar diameter and 73.83 % increase in volume index and found most appropriate dose for *Melia dubia* nursery (Hashem *et al.,* 2016, Basiru *et al.,* 2021). Though both the doses were not significantly different as per growth performance of seedlings concerned but 100 gm/acre mycozone powder is more economical so, it can be recommended to continue for *Melia dubia* seedlings.

Three doses of monitor (Trichoderma) were tested on *Melia dubia* seedlings viz. 250 gm/acre, 500 gm/acre and 1 Kg/acre to study its effect on nursery growth and identify the suitable dose. Trichoderma is one of most important fungi to control the soil borne pathogens habitually and occasionally for foliar pathogens. By controlling the pathogen attack it boost plant/seedling growth indirectly and in present study also the significant increase in plant height, collar diameter and volume index was observed over the control (Table 4) (Zivanov *et al*., 2020, Campos *et al.,* 2020). Through the experiment, it was observed that 250 gm/acre monitor is sufficient to increase the plant height by 35.12 percent, collar diameter by 50.93 percent and volume index by 78.65 percent over control as reported by Khadka and Uphoff (2019) in rice. Biofield combo consists of consortia of nitrogen, phosphorous and potash bacteria with mycorrhiza. To identify its appropriate dose for seedlings of tree species, three doses were applied viz. 2 Kg/Acre, 3 Kg/acre and 4 Kg/acre. Its application increased plant height and collar diameter significantly over control (Table 5) but growth due to different doses does not vary significantly. Biofield combo @ 3 Kg/acre affected height maximum with 76.68 cm increment over control and its dose @ 2 Kg/acre affected collar diameter and volume index maximum i.e., 44.86 percent and 72.44 percent respectively increase over control (Table 10). Though statistically these were not significantly different hence, dose @ 2 Kg/acre is recommended for *Melia dubia*.

To identify the suitable dose of Metasoft (Bio-pesticide) for Melia, its 3 doses were tested in nursery viz. 250 gm/acre, 500gm/acre and 1 Kg/acre. This bio-pesticide is useful to control the soil born insect-pest like termite, white grub, root borer, cut worm etc., hence protect plants in nursery and plantation and promote growth indirectly. Its application leads to significant increase in collar diameter compared to control though not affected plant height and volume index significantly (Table

6). In the trial plot, no soil born insect-pest was observed in any treatment. It was observed that metasoft @ 1 Kg/acre affected plant height, collar diameter and volume index maximum i.e., 30.85 percent, 45.09 percent and 78.13 percent increase respectively over control (Table 6) and it is recommended for *Melia dubia*.

Injudicious use of inorganic fertilizer affects soil health adversely and reduces rhizospheric microbial population which not only affects plant growth adversely but also reduces nutrient availability to the plants. The use of mycorrhiza, trichoderma and bio-N, P, K along with the recommended dose of inorganic fertilizers enhance availability of soil nutrients to the plants and boost growth and resistance power.

CONCLUSION

Bio-products play significant role in maintain soil health and boosting plant growth. In the present study, all the bio-products increased melia plants growth positively in nursery over control (Figure 1). Application of one Mycozone tablet/plant at the time of sowing was found sufficient to obtain vigorous melia seedlings. Similarly, 100gm/acre mycozone powder gave significant increase in growth of melia plants. Trichoderma plays significant role in preventing soil borne pathogens and boosting plant growth. In the present study no incidence of pathogen attack on Melia seedlings were reported in any treatment. Under the trial, 250 gm/acre monitor was found most suitable as it increased plant growth (plant height 35.12 percent, collar diameter 50.93 percent and volume index 78.65 percent) significantly. Biofield combo also increased plant growth significantly and 2 Kg/ acre dose was found most suitable. It increased collar diameter and volume index by 44.86 percent and 72.44 percent respectively over control. In Metasoft treated plots no insect attack was recorded and one kg/acre dose was found most suitable.

The applied bio-products were affected plant height significantly while no significant differences were observed in collar diameter and volume index (Table 7). On application of bio-products, percent increase in plant height was observed from 17.26 % to 34.01 % (Figure 3), percent increase in collar diameter was observed from 34.86 % to 50.93 % (Figure 4) and percent increase in volume index was observed from 57.74% to 78.65% (Figure 2) over the control. Hence, these bio-products can be utilized at recommended doses for raising melia nursery and obtaining healthy and vigorous seedlings.

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CONFLICT OF INTEREST

The authors declare no conflict of interest and there is no financial interest to report. It is an original research work and not submitted to any other journal for consideration.

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