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Assessment of Early Growth Performance of Selected Tree Species for Amelioration of Chitradurga Copper Mining Area, Karnataka-India

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Abstract—*A Study was conducted at Forest nursery, GKVK, Bengaluru, Karnataka, to know the early growth performance of eight months old seedlings of six different tree species under copper mined soil under different soil amendments through pot culture. The results showed that, the early growth performance of different tree species in T3 (Copper mined soil + Farm yard manure) and T4 (Copper mined soil + Vermicompost) significantly differed from T1 control (Copper mined soil). Plants grown in Copper mined soil with amendments exhibited higher number of leaves, collar diameter and total biomass. Among the tree species studied, higher relative growth rate of collar diameter was observed in Ficus recemosa and Grewellia robusta. The rest of* the species showed lower values. *Further, results showed that improvement in physico- chemical properties of the copper mined soil, amended with farm yard manure (PH-8.3) and vermicompost (PH-8.1), higher organic matter content in T3 (1.78%) and in T4 (0.93 %). Higher available macro, micro nutrients and reduced copper contents were also noticed in amended soils compared to control T1 (copper mined soil only).*

Keywords: *tree species, copper mined area soil, vermicompost, farm yard manure, organic matter and relative growth rate)*

1. INTRODUCTION

Land is the most important resources on which sustains the biological community on the earth surface. In recent times, the rate of land degradation is increased substantially to meet the diverse requirement of human kind.

The rate of consumption of mineral resources is continuously increasing with advancement of science and technology, economic development, industrial expansion, urbanization and mining activities. Mining not only disrupts the aesthetic of the landscape but also it disrupts the physical, chemical and biological properties of soil, especially bio-geo chemical cycles which are integral part of ecological process. Hence, mining cause the destruction of vegetation and soil profile [3]. The effects of mining could be multiple such as soil erosion, air and water pollution toxicity, geo-chemical disasters, loss of biodiversity and ultimately loss of economic wealth [7].

The mining dumps cause adverse impacts as elevated toxic metal accumulation which in turn enters the food chain, elevated salt content, low water holding capacity, increased compaction and relatively low organic matter content. Thus, reclamation of mined soil is slow and difficult process, which ,made reclamation of degraded and mined land as integral part of whole mining process[1]. With this view in mind, the present study was undertaken to know the performance of different tree species under copper mined soil through pot culture.

2. MATERIAL AND METHODS

An experiment was carried out in forest nursery, GKVK, Bengaluru, Karnataka, during the year 2012

The experiment was lied out in completely randomised block design with four treatments with each treatment consisting of six species replicated

seven times. There were two treatment factor copper mined area soil and copper mined area soilwith amendments and tree species. The copper mined area soil was brought from Ingaldal village of Chitradurga district Karnataka. The composite soil samples from 0-20 cm depth were collected randomly from copper mined area and for local soil aswell. 8kg capacity poly bags were used with drainage hole. The bags were filled with the pre determined proportion with amendments Viz., T_1 – copper mined soil only, T_2- copper mined soil+ local soil(1:1), T_3- copper mined soil + FYM (5:1), T4- copper mined soil + Vermi compost (5:1)).

Uniform 8 months old seedlings of six different tree species were planted in the poly bags and the initial growth measurements of the plants were taken after planting in the poly bags (Table 1). Further, these poly bagged seedlings were assessed for its growth performance for number of leaves,

collar diameter and relative growth rate at monthly intervals for a period of three months and the survival percentage at the end of the third month.

The soil physico-chemical properties were analysed after the sixty days after planting by adopting standard procedure (pH, EC, OC% Available N, P, K and Mn, Ca, Mg). The uniform watering and weeding was done for all the treatments.

3. RESULTS AND DISCUSSION

The results indicated that, early growth performance of plant grown with amendments were significantly differs from the control. Higher number of leaves, collar diameter and total dry matter noticed in T_3 and T4 than the control T_1. (Table 2, 3, 4). It is mainly attributed due to the amendments such as Farm yard manure and Vermi compost. These amendments increased the availability of nutrients, higher organic matter content which influenced the growth of the plants. Similarly improved physico-chemical properties of the soil and increased availability of essential nutrients in FYM amended soil were noticed by [2,4]. Thakur *et. al.,* 1999 also reported improved yield attributing characters such as number of ears, ear length, grains per ear and test weight under FYM amended soil.

Vermi compost not only provides essential nutrients but also improves the soil physico-chemical properties. Sendurkumar *et. al.,* 1998, conducted the study and observed the increased growth and productivity in tomato under soil amended with vermi compost.

Among the six different species, Ficus and Grevillea showed higher relative growth rate than the rest of the species (table 4). It is mainly attributed due to profuse root system of Ficus and fast growing nature of Grevillea. Hence, these species could be used for ameliorating the copper mined soil.

Further investigation indicated that, the soil amendments improved the physico-chemical properties of the copper mined soil. It was noticed higher organic matter content in the T_4 (1.73 %) and T3 (0.93 %) but amendments did not influence much in pH and EC, where as the availability of essential macro and micro nutrients increased significantly compare to the control. (Table 5). Similarly, improvement in physic-chemical properties of amended soil was noticed by Rajashree et. al., 2005.

Table 1: Initial observations on different growth parameters of selected trees species

Species	Parameter				
	Number of leaves	Shoot length(cm)	Collar Diameter (mm)	Dry Weight (g/plant)	Root length (cm)
Swietenia mahagoni	8.67	29.67	6.00	13.70	14.9
Azadirachta indica	6.67	39.17	5.67	8.24	18.6
Artocarpus integrifolia	6.33	43.50	6.40	10.83	22.00
Pongamia pinnata	4.33	34.67	5.00	13.38	33.30
Ficus racemosa	12.67	26.33	7.03	20.10	25.80
Grevillea robusta	20.67	27.33	5.00	15.62	19.70
Mean	9.89	33.44	5.85	13.65	22.38
F. value				-	-
SEM±	0.49	1.2	0.23	-	-
CD @ 5%	1.5	3.90	0.74	-	-

* Significant at 5%

Table 2: Relative growth rate (per month) for number of leaves under different treatments.

Species	Treatment				
	T1	T2	T3	T4	Mean
Swietenia mahagoni	0.0674	0.1079	0.1331	0.1256	0.1085
Azadirachta indica	0.1991	0.1837	0.2106	0.2770	0.2176
Artocarpus integrifolia	0.1343	0.1606	0.1869	0.1981	0.1700
Pongamia pinnata	0.1676	0.1716	0.2033	0.1924	0.1837
Ficus racemosa	0.1246	0.1354	0.1561	0.2101	0.1566
Grevillea robusta	0.0840	0.1574	0.1797	0.2059	0.1568
Mean	0.1313	0.1510	0.1783	0.2015	-
	SP	T	SP × T	-	-
F. value	*	*	*	-	-
SEM±	0.0096	0.0079	0.0193	-	-
CD @ 5%	0.0191	0.0156	0.0381	-	-

* : Significant at 5%
S : Species
T : Treatment
SP × T : Species and treatment combination
T_1: Copper mining soil only
T_2: Copper mining soil + local soil
T_3: Copper mining soil + farmyard manure
T_4: Copper mining soil + vermicompost

Table 3: Relative growth rate (mm/mm/ month) for collar diameter under different treatments.

Species	Treatment				
	T1	T2	T3	T4	Mean
Swietenia mahagoni	0.0384	0.0709	0.0746	0.0773	0.0653
Azadirachta indica	0.0414	0.0423	0.0786	0.0710	0.0583
Artocarpus integrifolia	0.0386	0.0491	0.0623	0.0740	0.0560
Pongamia pinnata	0.0597	0.0774	0.0921	0.0800	0.0773
Ficus racemosa	0.0629	0.0887	0.0987	0.1113	0.0904
Grevillea robusta	0.0670	0.0979	0.1116	0.0984	0.0937
Mean	0.0513	0.0710	0.0863	0.0853	-
	SP	T	SP × T	-	-
F. value	*	*	NS	-	-
SEM±	0.0045	0.0037	-	-	-
CD @ 5%	0.0090	0.0073	-	-	-

NS: Not significant
* : Significant at 5%
T_1: Copper mining soil only

S : Species
T : Treatment
SP × T : Species and treatment combination
T_2: Copper mining soil + local soil
T_3: Copper mining soil + farmyard manure
T_4: Copper mining soil + vermicompost

Table 4: Relative growth rate (g/g/ month) for total dry matter under different treatments

Species	Treatment				
	T1	T2	T3	T4	Mean
Swietenia mahagoni	0.0583	0.1413	0.1480	0.1559	0.1259
Azadirachta indica	0.0891	0.1279	0.1989	0.1813	0.1493
Artocarpus integrifolia	0.0397	0.1021	0.1194	0.1610	0.1056
Pongamia pinnata	0.1144	0.1160	0.1550	0.1300	0.1289
Ficus racemosa	0.0914	0.1200	0.1601	0.1781	0.1374
Grevillea robusta	0.1031	0.1461	0.1866	0.1841	0.1550
Mean	0.0827	0.1256	0.1613	0.1651	-
	SP	T	SP × T	-	-
F. value	*	*	*	-	-
SEM±	0.0036	0.0029	0.0072	-	-
CD @ 5%	0.0071	0.0058	0.0141	-	-

* : Significant at 5%
T_1: Copper mining soil only
S : Species
T_2: Copper mining soil + local soil
T : Treatment
T_3: Copper mining soil + farmyard manure
SP × T : Species and treatment combination
T_4: Copper mining soil + vermicompost

Table 5: Physico-chemical properties of copper mining soil after amendments

Sl. No.	Treatment	pH	E.C.	O.C %	Av. N Kg/ac	Av. P2O5 Kg/ac	Av. k2o Kg/ac	Available micronutrients (ppm)			
								Zinc	Iron	Copper	Mn
1	T1	7.5	0.09	0.32 L	234.00 L	4 L	192 H	7.32 S	13.4 S	29.2 S	46.4 S
2	T2	8.3	0.09	0.45 L	301.5 M	16 L	160 H	4.12 S	15.0 S	8.8 S	41.0 S
3	T3	8.3	0.12	1.78 H	520.20 M	172 H	200 H	9.98 S	27.1 S	24.1 S	47.7 S
4	T4	8.1	0.1	0.93 H	430.3 M	60 H	192 H	8.41 S	23.1 S	24.7 S	47.1 S

T1=Copper Mining Area Soil (CMAS)
T2= Copper Mining Area Soil + Local Soil (CMAS 1: 1LS).100%.
T3= Copper Mining Area Soil + Farmyard Manure (CMAS 5: 1 FYM).
T4= Copper Mining Area Soil + Vermicompost (CMAS 5:1 VC).
L=Low, M= Medium, H=High, S=Sufficient

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