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Growth Response of Maize to Weed Vermicomposts

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Abstract: The aim of the present investigation was to assess the influence of different weed vermicomposts on growth and yield of maize. Afield experiment was conducted at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The experimental design was a randomized block design (RBD) with six treatments and four replications. The treatments were *Achyranthes* vermicompost (AV), *Cassia* vermicompost (CV), *Tephrosia* vermicompost (TV), mixed vermicompost (MV), fertilizer (FE) and control (CO). The fodder maize (cv. African Tall) was sown at the rate of 100 kg ha^{-1}. The fertilizers were supplied in the form of N, P and K at the rate of 120:80:40 kg ha^{-1}. The observations were recorded on morphphysiological traits at 106 days after sowing (DAS). On the basis of results, it is concluded that the application of *Cassia* vermicompost (CV) is more efficient in enhancing the growth and productivity of maize.

Keywords: *Achyranthes*, *Cassia*, *Tephrosia*, Vermicompost, Fertilizers, Maize

INTRODUCTION

The excess use of chemical fertilizers worsens soil physical properties and declines the fertility status. To curb the trend of declining soil fertility and productivity, there is a need to develop ecofriendly and innovative technologies for preparing natural fertilizers. The methodology of organic waste management has shifted from conventional disposal strategies such as incineration, landfill etc. to conversion of sludge into value added products[1]. Vermiculture technology ensures effective bioconservation of organic residues into biosoil with more plant nutrients which promote plant growth[2].Vermicompost has also been reported to contain biologically active substances such as plant growth regulators[3], bacteria, actinomycetes, fungi[4] and cellulose-degrading bacteria[5]. It seems that, the nutrient status of vermicomposts depends mainly upon the nutrient content of organic wastes provided to the earthworms. *Achyranthes aspera*, *Cassia tora* and *Tephrosia hamiltoni* are the major invaded weeds. Biomass of these weeds is reported to have higher nutrient content, which adds humus to soil on decomposition and degradation. It not only supplies NPK to soil, but also sustains soil health, enhances crop productivity and lead to sustainable agriculture. One of the beneficial methods for the management of weeds is preparation of vermicompost. In order to investigate the efficiency of wasteland weeds as vermicompost, a study was conducted to analyze its influence on growth and yield of maize crop.

MATERIALS AND METHODS

Weeds collection and vermicomposting: The fresh green foliages of same weeds viz. Aghada (*Achyranthes aspera* L.), Tarwat (*Cassia tora* L.) and Unhali (*Tephrosia hamiltoni* Drumm.) were collected from University campus and chopped into small pieces (2 - 3 cm). Equal amount (13333 kg ha^{-1}) of weed pieces was used either individually or in combination (1:1:1) for the preparation of vermicomposts. These materials were placed into pits to a height of 5 cm and then sprinkled with 10 percent cow dung slurry (1 kg dung in 10 liter water) and soil alternately. This procedure was repeated until the composting materials were used. Finally, the trenches were sealed with dung-mud mixture to prevent loss of heat or moisture. After partial decomposition (25 days), first turning was given for homogeneous decomposition of the organic wastes. Sufficient water was sprinkled for maintaining 50 - 60 percent moisture and then the exotic African night crawler variety *Eudrilus eugeniae* (70 - 75 individuals per pit) was released. Identification of earthworm was done[6]. The vermicomposting was completed within 15 days and completely decomposed fine, dark brown colored granular materials were obtained which were used for field trials.

Experimental site, design and treatments: The field experiment was conducted in the research farm of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The experimental design was a randomized block design (RBD) with six treatments and four replicates. The six treatments were (i) *Achyranthes* vermicompost (AV); (ii) *Cassia* vermicompost (CV); (iii) *Tephrosia* vermicompost (TV); (iv) Mixed vermicompost (MV); (v) Fertilizer (FE) and (vi) Control (CO). These treatments were applied to the appropriate plots along with mineral fertilizers and control plots. The samples (100 gm) of each amendment were arbitrarily collected in duplicate before materials were applied to the plots for nutrients analyses. The results of vermicomposts are summarized in Table 1. The fodder maize (*Zea mays* L. cv. African Tall) was planted at the seed rate of 100 kg ha^{-1}. A plot with the size 9 m^2 consisted of nine rows spaced 30 cm apart.

Applications of fertilizers: The fertilizers were supplied in the form of N, P_2O_5 and K_2O at the rate of 120:80:40 kg ha^{-1}. Whole amount of P_2O_5 and K_2O was applied as a basal dose to all the treatments except absolute CO at the time of cultivation and N was applied in two equal splits at 42 and 75 days after sowing (DAS) to sole application of FE treatment.

Growth analyses and Harvesting: The morph-physiological traits of the crop were noted at 106 DAS (Days after sowing) as plant height, diameter, number of leaves per plant, fresh weight of root, stem, leaves and total weight, 4th upper leaf length, its width and weight and leaf area per plant was determined by gravimetric method[7-8].The crop was harvested during the early hours of the day at 10 - 20 % flowering stage. At the time of harvest, total yield of maize crop per plot was recorded[9].

Chemical analyses: Organic matter was determined by rapid titration method[10]. Ash values were obtained by heating the samples in a muffle furnace at 600°C for 2 hours and calcium (Ca) content was analyzed by titrating the sample against 0.01 N $KMnO_4$ solution[11]. Nitrogen (N) was estimated by micro-Kjeldahl method after digesting the sample with Conc. H_2SO_4[12]and crude protein (CP) was then calculated by multiplying N value with 6.25[11]. Reducing sugar (RS) was determined by reacting the sample with phosphomolybdic acid at 420 nm and phosphorus (P) was analyzed by reacting the sample with ammonium molybdate solutionat 660 nm[13] and potassium (K) content was determined on a flame photometer[14].

Statistical analysis: All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant differences (CD) at $P \leq 0.05$[15].

Table 1: Analyses of weed vermicompost applications

Treatments	%						C : N
	DM	Ash	N	P	K	OC	
AV	68.50	86.75	0.33	0.14	0.14	3.36	10.18
CV	62.60	84.12	0.45	0.16	0.15	4.56	10.13
TV	59.00	85.10	0.41	0.14	0.13	4.20	10.24
MV	59.40	85.55	0.41	0.18	0.13	4.20	10.24

RESULTS AND DISCUSSION

Growth analyses: The growth analyses of maize crop were done at 106 DAS **(Table 2).**The highest plant was recorded in the plots amended with TV followed in order by MV, AV, CV applications and lowest in un-amended plots than those of FE treatment. The diameter of plant was greater for CV in comparison with other vermicompost and FE applications. A similar pattern was observed in respect of fresh weight of stem and total whereas root weight was high in AV amendment then in MV and CV based plots and less in FE and CO than that of TV treatment. Almost similar results were observed for leaf area also. Fresh weight of leaves was superior for plots receiving CV than in AV, MV, FE and TV applications over the CO. The length of 4th upper leaf was more in the MV followed by AV, TV and CV treatments and less in total control than that of fertilized plots while the width and weight of 4th upper leaf was highest with AV treatment as compared to all the other amendments **(Table 2).**

Yield of maize crop: The average yield of fresh vegetation of maize was maximum with the fertilization of CV followed by AV, MV, TV and FE treatments over the CO plots (Table 3). Almost similar pattern was observed in respect of dry matter and total RS whereas N and CP contents were more in AV followed in order by MV, TV, FE and CV amendments than the absolute CO. The P, K and Ca uptakes were high in all the vermicompost applications as compared with fertilized and unfertilized plots (Table 3).All the results are calculated on dry matter basis and the values are the means of four replicates. These results are statistically significant over the control with the exception of plant height during growth analysis.Based on the results, it is obvious that the growth and yield of maize increased significantly due to the application of weed vermicomposts in combination with inorganic fertilizers because of the better uptake of nutrients from the soil. Organic manuring along with application of fertilizers helps to release nutrient elements slowly and steadily during the period of crop growth. Application of weed vermicomposts enhances growth and quality of the crop was also reported[16].

Table 2: Growth analyses of maize plants

Treatments	Plant height (cm)	Diameter (cm)	No. of leaves (plant^{-1})	Fresh weight (g plant^{-1})				4th upper leaf			Leaf area (cm^2 plant^{-1})
				Root	Stem	Leaves	Total	Length (cm)	Width (cm)	Weight (g)	
AV	242.97	1.59	10.50	12.06	215.58	62.41	290.06	99.22	6.80	9.23	491.68
CV	231.77	1.61	11.50	11.50	226.02	62.94	300.46	88.80	6.62	7.25	445.47
TV	264.15	1.55	10.75	9.38	174.60	44.87	228.86	89.85	5.67	5.91	410.94
MV	251.02	1.57	10.50	11.62	203.89	57.95	273.47	102.30	6.42	8.01	519.11
FE	197.80^{ns}	1.40	10.25	6.26	156.39	47.05	209.70	83.60	5.67	6.56	392.83
CO	175.62	1.25	9.50	5.06	99.88	28.68	133.62	73.40	4.62	4.20	253.12
S.E.	12.61	0.05					23.35				35.06
C.D.	28.49	0.11					52.77				79.23

AV= Achyranthes vermicompost, CV= Cassia vermicompost, TV= Tephrosia vermicompost, MV= Mixed vermicompost, FE= Chemical fertilizers, CO= Control

Table 3: Analyses of total aerial biomass of maize plants

Treatments	Fresh weight		Dry matter		N		Total CP	Total RS		%		
	kg $plot^{-1}$	kg ha^{-1}	%	kg ha^{-1}	%	kg ha^{-1}	(kg ha^{-1})	%	kg ha^{-1}	P	K	Ca
AV	41.950	46611	17.59	8195	0.70	57.93	362.10	15.42	1264	0.09	1.21	0.44
CV	42.625	47360	18.84	8922	0.57	50.95	318.44	15.64	1400	0.07	0.99	0.43
TV	38.450	42722	18.63	7938	0.66	52.27	326.72	14.11	1121	0.09	1.08	0.50
MV	40.925	45472	17.18	7807	0.68	53.35	333.48	14.33	1118	0.10	1.11	0.47
FE	36.375	40416	18.07	7308	0.70	51.41	321.32	12.81	934	0.05	0.68	0.39
CO	23.600	26222	16.20	4274	0.53	23.35	145.95	11.94	521	0.04	0.51	0.36
S.E.	2.65	2945		605		4.63	28.96		114.3			
C.D.	6.00	6655		1367		10.46	65.45		258.3			

CONCLUSION

Based on the above results, it can be concluded that the combination of *Cassia* vermicompost (CV) and chemical fertilizers is an ideal organic manure enhancing growth and productivity of maize crop as compared to all other amendments. There are no earlier reports on increased crop growth amended with these weed vermicomposts. However, the growth of plants amended with other vermicompost plus fertilizers are reported[17-19]. Its regular use in agriculture may result in the long-term enhancement of soil fertility and productivity. The utilization of vermicompost results in several benefits to farmer, environment and overall national economy.

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