

RESEARCH ARTICLE

Efficacy of weed vermicompost and chemical fertilizer on yield, morpho-physiological and biochemical investigations of Maize

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ABSTRACT

A field experiment was conducted in the research farm of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad to assess the performance of weed vermicomposts on yield and nutrient uptake of maize. The experimental design was a randomized block design (RBD) with five treatments and four replicates. The treatments were *Parthenium* vermicompost (PV), *Cassia* vermicompost (CV), *Ipomea* vermicompost (IV), Fertilizer (FE) and control (CO). The fodder maize (cv. African Tall) was planted at the rate of 100 kg ha⁻¹. The fertilizers were supplied in the form of N, P₂O₅ and K₂O at the rate of 120:80:40 kg ha⁻¹. The observations were recorded on morpho-physiological traits at 65 DAS. On the basis of results obtained, it is concluded that the combination of *Cassia* vermicompost (CV) and chemical fertilizers is ideal manure enhancing growth, nutrient uptake and productivity of maize crop as compared to *Parthenium hysterophorus*, *Ipomea carnea* Fertilizer and control plots.

KEYWORDS

Parthenium,
Cassia, *Ipomea*,
Vermicompost,
Fertilizers, Maize

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INTRODUCTION

For developing countries the use of organic manure on crop will not only improve the soil properties but will also cut down on the foreign exchange need for the purchase of mineral fertilizers. Weeds are available plenty but they are not wanted. (Cumming, 1977; Thomas, 1956). Corollary defined "weeds as undesirable injurious, unsightly troublesome plants which interfere with cultivated crops and affect human affairs" Thakur (1984). Weeds are not the unwanted plants but valuable resources (Tyagi, 1989) and available free of cost growing without cultivation, irrigation and protecting the soil by giving of a warm soil cover. A farmer can produce his own vermicompost from the biodegradable waste like weeds, generated in his own farm (Verma and Prasad, 2005) and need not spend extra money to purchase the raw material of vermicompost (Shrivastava and Singh, 2013).

Parthenium hysterophorus, *Cassia tora*, *Ipomoea carnea* Jacq. etc. are the major invaded weeds (Puri, 1960). Biomass of the weed is reported to have higher nutrient contents, which adds humus to soil on decomposition and degradation (Saravanane *et al.*, 2008). It not only supplies NPK to soil, but also sustains soil health enhances crop productivity and lead to sustainable

agriculture. Several methods have been developed to convert agricultural wastes into organic manure (Shrivastava and Singh, 2013) to replace inorganic fertilizers. But recently, interest has been shown in the development of ecofriendly novel processes, which are based upon the utilization of biological systems (Hemalatha, 2013a).

Chemical fertilizers have been one of the major components of modern agriculture. Use of chemicals has now raised many questions related to the productivity of land and continuously increasing cost of cultivation. Vermicompost technology has been solved many problems (Parr and Colacicco, 1987). Earthworms have been known as farmer's friends for long (Darwin, 1881). Vermicompost technology is converting all biodegradable waste into plant nutrient rich organic manure (Edwards & Burrows, 1988; Bhawalkar, 1991) with the help of composting (Rajendran *et al.*, 2008). As worms ingest and digest decomposing plant material, their digestive tracts process the organic matter and important nutrients are returned to the soil through castings, or worm waste. Not only do worms play an important role in the nutrient cycle of soil, they also help to increase the percentage of macronutrient (Umamaheswari, 2005) and improve the soil structure such as soil porosity, soil aggregation, water

and nutrient conservation in the soil (Ellerbrock and Hoehn, 1999). Economic utilization of these bio-resources through VC production helps in recycling of organic wastes and reduces the production cost of the field crops for rural development, by minimizing the use of costly chemical fertilizers. During the process of VC, the important plant nutrients viz. nitrogen, potassium, phosphorus and calcium present in feed material are converted into forms that are much more soluble and available to plants than those in the parent compounds (Hemalatha, 2013b; Bhawalkar and Bhawalkar, 1993; Ndegwa and Thompson, 2001). In this investigation attempts were made to evaluate the efficacy of locally available weeds for the growth and nutrient uptake of maize.

MATERIALS AND METHODS

Weeds collection and vermicomposting -

The fresh green Congress grass (*Parthenium hysterophorus* L.), Tarwat (*Cassia tora* L.) and Beshram (*Ipomoea carnea* Jacq.) were collected from Dr. Babasaheb Ambedkar Marathwada University campus and chopped into small pieces (2 - 3 cm). The same amount (14444.4 kg ha⁻¹) of weed vegetation was used separately for the preparation of vermicomposts. These materials were placed into pits to a height of 7 cm, sprinkled with 15 % cow dung slurry 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 (22 days), first turning was given for uniform decomposition of the organic wastes. Then sufficient amount of water was sprinkled for maintaining 50 - 60 percent moisture and the exotic African night crawler variety *Eudrilus eugeniae* (90 - 100 individuals per pit) were released. Identification of earthworm was done by Julka (1988). The vermicomposting was completed within 15 days and finally, completely decomposed fine, dark brown coloured 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 University campus. The experimental design was a randomized block design (RBD) with five treatments and four replicates. The five treatments were (i) *Parthenium* vermicompost (PV); (ii) *Cassia* vermicompost (CV); (iii) *Ipomea* vermicompost (IV); (iv) Fertilizer (FE) and (v) 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 randomly collected in duplicate before application to the plots for nutrients analyses. The results of vermicomposts are summarized in Table 1. The fodder maize (cv. African Tall) was planted at the seed rate of 100 kg ha⁻¹.

Applications of fertilizers -

The fertilizers were applied in the form of N, P₂O₅ and K₂O at the rate of 120:80:40 kg ha⁻¹. Whole amount of P₂O₅ and K₂O was supplied as a basal dose to all the treatments except absolute CO at the time of sowing and N was applied in two equal doses at 42 and 75 days after sowing (DAS) to FE treatment only.

Growth analyses -

The morph-physiological traits of the crop were noted at 65 days after sowing (DAS) 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 (Shahane and Mungikar, 1984; Mungikar, 1986).

Crop harvesting -

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 (Davys and Pirie, 1969)

Chemical analyses -

Organic matter was estimated by rapid titration method of Walkley and Black (1934). Leaf chlorophyll contents were estimated following Nanjareddy *et al.* (1990). The dry matter (DM) content was analyzed by AOAC (1995) and nitrogen (N) was estimated by micro-Kjeldahl method (Bailey, 1967).

Statistical analysis -

The results were statistically analyzed for analysis of variance (ANOVA) and treatment means were compared using the critical difference at P ≤ 0.05 (Mungikar, 1997).

RESULTS AND DISCUSSION

Growth analyses -

The growth analyses of maize crop were done at 65 DAS (Table 2). During the growth analyses, the tallest plant was observed with the fertilization of CV followed in order by PV, IV and FE treatments over the CO plots. This trend was observed with respect to fresh weight of leaves, width of 4th upper leaf and leaf area. The diameter and 4th upper leaf length was more in CV treated plots then in the PV, IV and less in CO than that of FE alone. The root weight was highest with the CV amendment followed by PV, IV and FE applications and lowest in untreated plots. However, analogous results were obtained in respect of stem and total weight of plant where as fresh weight of 4th upper leaf was maximum for CV treatment then in IV and PV and minimum in FE application (Table 2).

Chlorophyll contents -

The mean values for chlorophyll contents (a, b and total) ranged from 0.30 - 0.61, 0.15 - 0.35 and 0.45 - 0.93 mg g⁻¹ leaf fresh weight (Fig. 1) The chlorophyll contents were highest in all the vermicompost based treatments than that of fertilized and unfertilized plots. Among them, chlorophyll a and total chlorophyll were greater in CV amendment (Fig. 1). Chlorophyll a is called as an essential pigment, because it converts the light energy into chemical energy i.e. ATP, which is necessary for various life processes in plants. These results are similar with the previous findings of Chamle *et al.* (2006).

Percent increase over Control and N efficiency ratio -

The percent increase over Control for fresh weight was maximum in the plots treated with CV 90 Kg/ha followed by PV 88 kg/ha, IV 75 kg/ ha. treatments than the FE 65 kg/ha. alone applied plots and almost similar trend was observed with respect to dry matter (Fig. 2). The highest nitrogen efficiency

ratio for fresh vegetation was observed for PV amendment than in CV, IV and lowest in FE treatment while in case of dry matter, it was more in PV followed in order by CV, IV and then in FE treatment where N was supplied through urea (Fig. 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 exceptions of leaf area in the FE treatment only.

The results of the present study indicate that the applications of weed vermicompost along with chemical fertilizers were found to be significantly higher growth and yield of maize as that of individual application of inorganic fertilizers. Application of weed vermicomposts enhances growth and quality of the crop was also reported by Rajkondha *et al.* (2005).

Table 2. Growth analyses of maize plants

Treatments	Plant height (cm)	Diameter (cm)	No. of leaves (plant ⁻¹)	Fresh weight (g plant ⁻¹)				4 th upper leaf			Leaf area (cm ² plant ⁻¹)
				Root	Stem	Leaves	Total	Length (cm)	Width (cm)	Weight (g)	
PV	84.35	1.37	8.50	2.97	47.62	21.34	71.93	61.25	3.40	1.86	149.81
CV	86.55	1.67	8.50	3.68	58.16	29.81	91.66	65.45	3.77	2.74	174.07
IV	78.45	1.37	8.00	2.16	37.07	20.96	60.20	61.25	3.35	1.87	148.88
FE	71.20	1.21	7.50	1.43	26.53	17.67	45.64	53.95	2.85	1.12	109.27 ^{ns}
CO	47.32	0.97	6.25	0.83	12.80	8.64	22.27	44.70	2.52	0.85	84.08
S.E.	5.27	0.08					8.76				12.00
C.D.	11.91	0.18					19.79				27.12

Fig. 1: Analysis of weed vermicompost

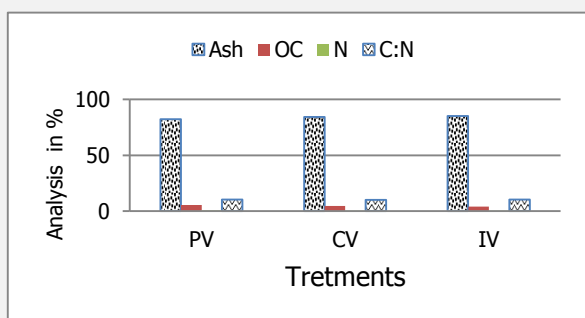


Fig. 2: Effect of vermicompost on Percent increase over control of Maize.

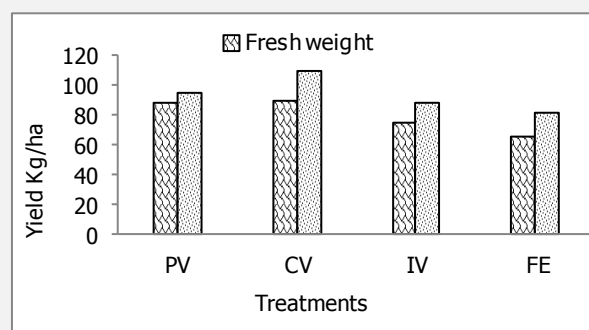


Fig. 3. Nitrogen efficiency ratio Maize plant.

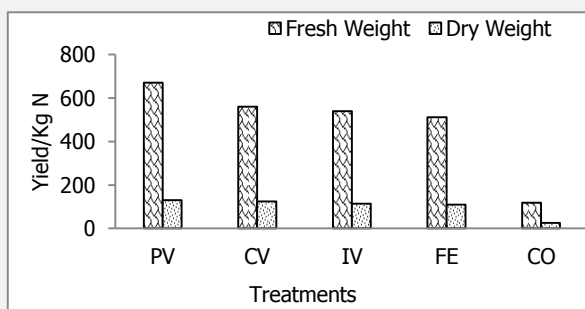
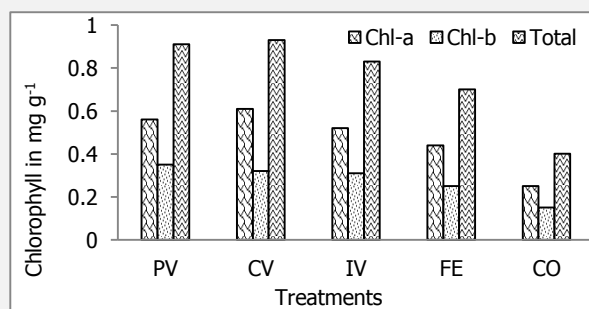


Fig. 4: Effect of Vermicompost on Chlorophyll content of Maize



CONCLUSION

Based on the above results, it can be concluded that the combination of *Cassia* vermicompost (CV) and inorganic fertilizers is best organic manure enhancing growth and

productivity of maize in comparison with *Partenium hysterothorus* and all other treatments. 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 by Preetha *et al.* (2005) and Sundararasu and Neelananayanan (2012).

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