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Short communication

Vermicompost+inorganic fertilizers promote yield and nutrient uptake of amaranth *(Amaranthus tricolor* L.)

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Abstract

A field trial on amaranth (*Amaranthus tricolor* L.) with different levels of vermicompost prepared using *ayurvedic* pharmaceutical wastes (from *Oushadhi* Pharmaceuticals, Thrissur), farm yard manure (FYM) and inorganic fertilizers was conducted. Five tonnes of vermicompost together with 50:50:50 N, P_2O_5, K_2O kg ha^{-1} gave the highest vegetative yield as well as nutrient uptake, followed by 2.5 t ha^{-1} of vermicompost+NPK, implying the synergistic effects of combined application of vermicompost and chemical fertilizers in amaranth production.

Keywords: *Ayurvedic* pharmaceutical industry, waste utilization, integrated nutrient management

Among the sources of organic manures, vermicompost has a special place because of the presence of readily available plant nutrients, growth enhancing substances, and number of beneficial microorganisms like N_2 fixing, P solubilising and cellulose decomposing organisms (Sultan, 1997). The vermicomposting technology also enables the utilization/recycling of organic wastes for which no proper disposal mechanisms are available, or that the conventional techniques such as incineration may be hazardous. In particular, the *ayurvedic* pharmaceutical industry, which leaves behind considerable quantities of plant residues, is one source of biowaste production in some parts of Kerala. For instance, the public sector company *Oushadhi* Pharmaceuticals Corporation, Kuttanalloor, Thrissur, produces about one tonne of such wastes daily in the process of manufacturing more than 400 formulations like *asavarishtam, kalkam, himam, lehyam* and the like. Our earlier work showed these wastes could be converted into nutrient-rich compost with in a short period of ~48 days by vermicomposting with *Eisenia foetida* (Preetha et al., 2004). In this study, we evaluated the efficacy of using vermicompost (prepared from *ayurvedic* medicinal plant wastes from *Oushadhi*) in conjunction with inorganic fertilizers on a nutrient-responsive C_4 crop such as amaranth (*Amaranthus tricolor* L.).

The field experiment in randomized block design with nine treatments and three replications was conducted at Vellanikkara from March to May 2003. The soil of the experimental site was of lateritic origin (Oxisol), belonging to Vellanikkara series, having 278, 14.4 and 86.6 kg ha^{-1} of available N, P and K respectively. The mean maximum temperature during the experimental period was 34.6°C and the mean minimum, 25°C. Twenty day-old amaranth seedlings of the variety 'Arun' were transplanted in trenches of 40 cm width, taken 30 cm apart in plots of size 3 x 2 m, with a plant-to-plant spacing of 30 cm. The experimental variables included various combinations of farm yard manure (FYM), vermicompost (VC) and inorganic fertilizers (Table 1). N, P and K concentrations of the vermi-

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compost prepared from *Oushadhi* generated wastes; C. Preetha et al. 2004) and FYM were: 3.62, 0.85 and 0.89% and 0.8%, 0.3% and 0.2% respectively. Inorganic sources included: urea (46% N), rock phosphate (20.04% P_2O_5) and Muriate of potash (60% K_2O). Full dose of FYM, vermicompost and rock phosphate, as per the treatment protocol, were applied basally. For urea and potash, half the dose was applied basally, while the remaining half was applied after the first harvest. Yield per square metre (fresh weight) was recorded 15 and 30 days after planting. N, P, K concentrations of the plant samples were determined as per standard procedures (Jackson, 1958) and all data were analyzed following the analysis of variance technique. Wherever 'F' test was significant, critical differences were computed.

Results show that the treatment receiving vermicompost (5 t ha^{-1}) with 50:50:50 kg N, P_2O_5, K_2O consistently recorded the highest amaranth fresh weight (313.5 and 320.16 g m^{-2} for the first and second harvest respectively; Table 1), followed by the treatment involving 2.5 t ha^{-1} of VC and 50:50:50 kg N,P_2O_5, K_2O ha^{-1}. A comparison of the data on per plant dry matter production also indicates that these treatments recorded the two highest per plant dry matter production, implying a stimulatory effect of vermicompost application in conjunction with chemical fertilizers on vegetative growth and yield of amaranth. Conversely, absolute control recorded the lowest yield, and FYM alone also gave only modest productivity. Overall, vermicompost+NPK combinations registered far better yields than FYM alone or in combination with NPK.

The treatment involving vermicompost (5 t ha^{-1}) plus 50:50:50 kg N, P_2O_5, K_2O also showed the highest N, P and K uptake (Table 2), which is consistent with previous the reports (Haris, 1989). Complete substitution of inorganic fertilizers by organic fertilizers like vermicompost, however, is not advisable. This is because the nutrient concentrations of organic manures is generally low compared to inorganic fertilizers, signifying the need to apply very large quantities to meet the crop nutrient requirements, which may be impossible—given the scarcity of such materials. Not only that, nutrients in organic manures are released gradually (Kumaraswamy, 2002), which may be advantageous in certain situations. However, to meet the nutrient requirements of an extremely short duration C_4 crop such as amaranth, a judicious mix of organic and inorganic sources may be appropriate. Yet organic farming technology seldom advocates the use inorganic fertilizers and, therefore, for the sustained productivity and profitability of short duration crops such as amaranth under organic farming systems, further research on these aspects may be necessary.

Table 1. Amaranth yield (fresh weight basis) and dry weight per plant as influenced by various combinations of farm yard manure and vermicompost with chemical fertilizer sources

Treatments	First harvest		Second harvest	
	Yield (g m^{-2})	Dry wt (g $plant^{-1}$)	Yield (g m^{-2})	Dry wt (g $plant^{-1}$)
FYM (5 t ha^{-1})	58.5^{h}	1.77^{h}	66.7^{g}	2.01^{h}
FYM (5 t ha^{-1})+NPK (50:50:50)	127.1^{e}	3.86^{e}	133.0^{e}	4.06^{e}
VC (5 t ha^{-1})	87.5^{f}	2.67^{f}	90.4^{f}	2.66^{f}
VC (5 t ha^{-1})+NPK (50:50:50)	313.5^{a}	9.62^{a}	320.2^{a}	9.84^{a}
VC (5 t ha^{-1})+NPK (25:25:25)	225.0^{c}	6.91^{c}	265.0^{c}	8.14^{c}
VC (2.5 t ha^{-1})	75.1^{g}	2.32^{g}	66.8^{g}	2.09^{g}
VC (2.5 t ha^{-1})+NPK (50:50:50)	298.5^{b}	9.16^{b}	299.2^{b}	9.18^{b}
VC (2.5 t ha^{-1})+NPK (25:25:25)	170.0^{d}	5.23^{d}	172.5^{d}	5.29^{d}
Absolute control	31.8^{i}	0.98^{i}	35.0^{h}	1.06^{i}

FYM= farm yard manure; NPK signifies N, P_2O_5, K_2O kg ha^{-1} and 50:50:50 is the recommended dose of fertilizers (KAU, 2002); VC= enriched vermicompost; Means with the same superscript do not differ significantly

Table 2. Nutrient uptake of amaranth as influenced by various combinations of farm yard manure and vermicompost with chemical fertilizer sources

Treatments	Nutrient uptake (mg m^{-2})					
	first harvest			second harvest		
	N	P	K	N	P	K
FYM (5 t ha^{-1})	132.7^{h}	13.6^{h}	149.7^{h}	154.9^{h}	14.5^{h}	176.6^{h}
FYM (5 t ha^{-1})+NPK (50:50:50)	358.6^{e}	39.1^{e}	371.5^{e}	390.8^{e}	38.1^{e}	402.6^{e}
VC (5 t ha^{-1})	292.6^{f}	25.5^{f}	245.8^{f}	280.3^{f}	25.2^{f}	241.6^{f}
VC (5 t ha^{-1})+NPK (50:50:50)	1142.5^{a}	122.3^{a}	1150.3^{a}	1197.2^{a}	116.1^{a}	1156.2^{a}
VC (5 t ha^{-1})+NPK (25:25:25)	783.1^{c}	77.1^{c}	783.0^{c}	949.6^{c}	84.5^{c}	942.8^{b}
VC (2.5 t ha^{-1})	234.6^{g}	19.4^{g}	207.0^{g}	206.3^{g}	16.4^{g}	181.2^{g}
VC (2.5 t ha^{-1})+NPK (50:50:50)	1003.8^{b}	100.4^{b}	870.2^{b}	1036.5^{b}	96.0^{b}	176.6^{c}
VC (2.5 t ha^{-1})+NPK (25:25:25)	562.2^{d}	51.0^{d}	470.6^{d}	544.5^{d}	51.2^{d}	84.8^{d}
Absolute control	57.3^{i}	6.0^{i}	78.7^{i}	64.9^{i}	6.7^{i}	84.8^{i}

FYM= farm yard manure; NPK signifies N, P_2O_5, K_2O kg ha^{-1}; VC= enriched vermicompost; Means with the same superscript do not differ significantly

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