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RESEARCH ARTICLE

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Performance evaluation of vermicompost on yield of *Kharif* groundnut and cotton crops

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ABSTRACT : The vermicompost contains plant nutrients including N, P, K, Ca, Mn, Zn and Cu. The uptake of which has a positive effect on plant nutrition, photosynthesis, chlorophyll content in the leaves and improves the nutrient content in different plant component (Root, Shoot etc.). The overall results indicated that organic farming with application of vermicompost @ 3 tons/hectare in groundnut crop during *Kharif* 2011-12 to 2013-14 found higher yield, gross return, per cent increase in yield and BC ratio *i.e.* 2144 kg/ha, Rs. 80888/-, 15.39 per cent and 6.16 BCR, respectively as compared to local check yield of 1858 kg/ha by application of only of recommended dose of fertilizers. Whereas, application of vermicompost @ 5 tons/hectare in cotton crop resulted during *Kharif* 2011-12 to 2012-13 produced higher yield, gross return, per cent increase in yield and BC ratio *i.e.* 3500 kg/ha, Rs. 172375/-, 14.98 per cent and 4.66 BCR as compared to local check yield of 3044 kg/ha. Both the crops (groundnut and cotton) were also observed in organically amended plot did not show any moisture stress during the period of dry spell due to better moisture holding. Further, available soil moisture in organically amended plots found better soil moisture conservation compare to local check in pre seasonal or severe moisture stress or in dry spell period. In the nutshell observed that, the use of vermi compost as fertilizer in groundnut as well as cotton crop performed better as compare to using of chemical fertilizers. Therefore, recommended for large scale adoption in farmer's field of Gir Somnath and Junagadh district of Gujarat.

KEY WORDS : Vermicompost, Plants growth, Pest incidence, Cotton, Groundnut, Organic waste

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INTRODUCTION

The vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes etc. are converted while passing through the worm-gut to nutrient rich vermicompost. The earth worms (*Eisenia Foetida*) are used here for act as biological agents to consume those wastes and to deposit excreta in the process called vermicompost. Vermicompost contains an average of 1.5 per cent - 2.2 per cent N, 1.8 per cent - 2.2 per cent P and 1.0 per cent - 1.5 per cent K and the organic carbon is ranging from 9.15 to 17.98 with contains micronutrients.

The green revolution in India promoted the indiscriminate use of chemical fertilizers and pesticides to obtain higher yield. In course of time, the tropical soil

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after receiving such chemicals turned unproductive due to lack of proper amendments of organic matters (Kale, 1998). The best alternative of the present day's environmental degradation is to make proper use of the available unutilized organic biodegradable wastes in order to convert them into compost within a short period for sustainable production. Vermicompost could be used as an excellent soil amendment for main fields and nursery beds and has been reported to be useful in raising nursery species plants. In nature, some time plants follow altered growth patterns such as negative geotropism of roots, stem elongation and dwarfing, shortening of vegetative phase, enhancement of leaf area, photosynthetic rate, flowering and fruiting by matured plants. Edwards, 1998 reported that vermicompost could promote early and vigorous growth of seedlings/saplings. Vermicompost has found to effectively enhance the root formation, elongation of stem and production of biomass, vegetables, ornamental plants etc.

Vermicompost has been recognized as a low cost and environmentally sound process for treatment of many organic wastes. Furthermore, the rapid decomposition and raised temperatures during composting produce a relatively homogeneous, odor – free, pathogen – free and easy – to – handle product. Bevacqua and Mellano, 1993 reported that vermicompost treated soils and lower pH and increased levels of organic matter, primary nutrients and soluble salts. Edwards and Burrows (1988) reported that vermicompost, especially those from animal waste sources, usually contained more mineral elements than commercial plant growth media. Many of these elements were changed to forms more that could be readily taken up by the plants, such as nitrates, exchangeable phosphorus and soluble potassium, calcium and magnesium. Werner and Cuevas (1996) also reported that most vermicompost contained adequate amounts of macro nutrients and trace elements of various kinds but were dependent on the sources of the worm feed stock.

The compost is prepared by biological degradation of plant and animal residues under controlled, aerobic conditions (Eghball *et al*., 1997). However, compost and vermicompost have been widely used in traditional agricultural and have beneficial effects on soil structure or soil biota (Subler *et al*., 1998 and Carpenter-Boggs *et al*., 2000). Cavender *et al*. (2003) has shown that vermicompost stimulated mycorrhizal colonization in sorghum roots.

Grappelli *et al*. (1985); Kale and Bano (1986); Kale *et al*. (1987); Kale (1998); Bano *et al*. (1993); Atiyeh *et al*. (1999) and Ghosh *et al*. (1999) observed that integration of vermicompost with inorganic fertilizers tended to increase the yield of crops *viz.*, potato, rape seed, mulberry and marigold over other traditional composts. Chakraborty *et al*. (2008) also reported that the application of vermicompost rendered better performance in respect of all round growth of mulberry plants in the lateritic soil of South West Bengal. The nutrient level, especially the (macro or micro-nutrients) were found to be always higher than the compost derived from other methods (Kale, 1998). One of the unique features of vermicompost is that during the process of conversion of various organic wastes by earthworms, many of the nutrients are changed to their available forms in order to make them easily utilizable by plants. Therefore, vermicompost have higher level of available nutrients like nitrate or ammonium nitrogen, exchangeable phosphorus and soluble potassium, calcium and magnesium derived from the wastes (Buchanan *et al.*, 1988).

The paper has attempted to evaluate comparative efficacies of vermicompost developed by indigenous method on tomato plants. However, in recent years, researchers have become progressively interested in using another biological process, termed vermicompost *i.e.*, described as "bio-oxidation and stabilization of organic material involving the joint action of earthworms and mesospheric micro-organisms" (Aira *et al.*, 2002). In recent years, there has been considerable progress in the utilization of earthworms to breakdown organic waste including; animal wastes, crop residues, urban and industrial organic refuse and swage bio-solids (Edwards and Neuhauer,1988). The earthworms, fragment the organic waste substrate, greatly stimulate microbial activity and increase the rates of mineralization, rapidly converting the organic wastes into humus substances with a much finer particulate structure than traditional thermo-phillically produced compost. The effects of nutrient transformations produced by earthworms in soil and in vermicompost are well documented and contribute significantly to plant growth and crops yield (Edwards and Bohlen, 1996; Edwards, 1998 and Lavelle and Spain, 2001).

It is clear that rapid breakdown of organic wastes by earthworms, interacting with micro-organisms,

produces vermicompost with a much greater microbial activity and biodiversity, than the parent organic wastes, with increase in microbial activity, sometimes by several orders of magnitude. It seems likely that this greatly enhanced the microbial activity may not only increase the rate of nutrient transformations into forms readily available for plants, but also have effects on plants growth through increased enzymatic activity and disease suppression (Edwards, 1998).

EXPERIMENTAL METHODS

A field experiment as frontline demonstration was conducted to study about the performance of vermicompost on the yield of groundnut (*Arachis hypogaea* L.) for three years during 2011-12 to 2013-14 and cotton for two years during 2011-12 to 2012-13 as conducted in organic deficient Vertisols (Medium black soil) under rainfed farming situations by Krishi Vigyan Kendra-Junagadh (Gujarat). The present work was carried out on 20 farmers fields to effectively recycle the organic waste like grass clippings and cattle dung etc. The locally available earthworm species *Eisenia Foetida* was used for the purpose. KVK provided only 05 kg earthworm to each farmers for preparing vermicompost. Farmers prepared bed himself. The size of vermicompost bed is 5 meters in length and 01 meter of width. The basal layer of the vermi-bed comprised of broken bricks followed by a layer of coarse sand (10 cm thick) in-order to ensure proper drainage. A layer (10 cm) of loamy soil was placed at the top. Earthworms (*Eisenia Foetida*) were introduced into the vermi-bed. Fresh cattle dung was scattered over the soil and then it was covered with a 10 cm layer of dried grasses. Water was added to the unit in-order to keep it moisture, every day two times in summer and one time in winter. The dried grass along with cattle dung was turned once a week. After 60 days, vermicompost units were regularized for the harvesting of vermicompost every 45 days. Harvested vermicompost every 2-3 days interval was collected in gunny bags and puts in a cool place. Vermicompost produced was subjected to physico-chemical characterization. Harvested vermicompost were used by the farmers in their *Kharif* groundnut and cotton crops.

EXPERIMENTAL RESULTS AND ANALYSIS

We trailed for three years on 21 farmer's field under organic farming with application of vermicompost @ 3 tons/hectare in groundnut crop during *Kharif* 2011-12, resulted very significantly in per hectare unit is con concern as yield, gross return, cost of cultivation, net return, per cent increase in yield and BCR comparing to local check (14.58; 11.06 quintal, Rs. 68609/-; 52258/-, Rs. 13645/-; 11570/-, Rs. 54964/-; 40688/-, 31.83 per cent and 5.03, respectively). Whereas, in the year 2012-13 crop was found also significant results with per cent increase in yield as 16.36 per cent and BCR as 7.14. But in the last year of experiment (2013-14), the yield was reported non-significant with 6.15 per cent increase in yield but found better response as far as B:C ratio is

Table 1: Performance of vermicompost in *Kharif* groundnut crop

Year	No. of demo	Yield (qtl./ha)		Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		% increase in yield	B:C ratio
		Demo	Local check	Demo	Local check	Demo	Local check	Demo	Local check		
2011-12	21	14.58	11.06	13645.00	11570	68609	52258	54964.00	40688	31.83	5.03
2012-13		26.25	22.56	12875.00	12320	91875	78960	79000.00	66640	16.36	7.14
2013-14		23.48	22.12	12875.00	12320	82180	77420	69305.00	65100	06.15	6.38
Overall		21.44	18.58	13131.67	12070	80888	69546	67756.33	57476	15.39	6.16

Table 2 : Performance of vermicompost in cotton crop

Year	No. of demo	Yield (qtl./ha)		Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		% increase in yield	B:C ratio
		Demo	Local check	Demo	Local check	Demo	Local check	Demo	Local check		
2011-12	09	26.25	20.63	35509.00	33434	112875	88687	77366.00	55253	27.24	3.18
2012-13		43.75	40.25	38450.00	33434	231875	213325	193425.00	179891	08.70	6.03
Overall		35.00	30.44	36979.50	33434	172375	151006	135395.50	117572	14.98	4.66

concern (Table 1).

Hence, conducted two years trial on nine farmer field under FLD for farming of cotton crop by using vermicompost @ 5 tons/hectare resulted during 2011-12 significantly in per hectare unit area as yield, gross return, cost of cultivation, net return, per cent increase in yield and BCR comparing to local check as ((26.25; 20.63 quintal, Rs. 112875/-; 88687/-, Rs. 35509/-; 33434/-, Rs. 77366/-; 55253/-, 27.24% and 3.18, respectively). In the year 2012-13, the results were also found satisfactory with 08.70 per cent increase in yield and 6.03 B:C ratio (Table 2).

The overall results for three years experiment were observed in groundnut crop during *Kharif* 2011-12 to 2013-14 as higher yield, gross return, per cent increase in yield and B:C ratio (21.44 q/ha, Rs. 80888/-, 15.39 % and 6.16 BCR, respectively as compared to local check yield of 18.58 q/ha by application of only of recommended dose of fertilizers. Whereas, in case of cotton crop by application of vermicompost @ 5 tons/hectare resulted during *Kharif* 2011-12 to 2012-13 produced higher yield, gross return, per cent increase in yield and B:C ratio (BCR) *i.e.* 35.00 q/ha, Rs.172375/, 14.98 % and 4.66 BCR) as compared to local check yield of 30.44 q/ha. Both the crops (groundnut and cotton) were also observed in organically amended plot did not show any moisture stress during the period of dry spell due to better moisture holding. Further, available soil moisture in organically amended plots found better soil moisture conservation compare to local check in pre-seasonal or severe moisture stress or in dry spell period (Table 1 and 2).

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