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RESEARCH ARTICLE

EFFECT OF ORGANIC MANURE AND VERMICOMPOST ON THE NUTRIENT LEVELS (NITROGEN, PHOSPHORUS AND POTASSIUM) IN AMENDED SOIL

Eswaran, N. and *Mariselvi, S.

Department of Zoology, Nallamuthu Gounder Mahalingam College, Pollachi, India

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ABSTRACT

Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases. Vermicompost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital NKP to plants in shorter time, the vermicompost does. Vermicompost is the product or process of composting using various worms, usually red wigglers, white worms, and other earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Significantly, vermicompost works as a 'soil conditioner' and its continued application over the years lead to total improvement in the quality of soil and farmland, even the degraded and sodic soils. Vermicompost is free of toxic chemicals, Induce biological resistance in plants, Suppress plant disease, Rich in humic acids and Biochemical promoting root growth & nutrient uptake. Similarly, the vermicompost prepared from cow dung had the highest total nitrogen (N) content (275%) phosphorus (12.70 mg/g) and total potassium (11.44 mg/g). Reduced use of 'water for irrigation' as application of vermicompost over successive years improved the 'moisture holding capacity' of the soil.

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INTRODUCTION

In today's era, heavy doses of chemical fertilizers and pesticides are being used by the farmers to get a better yield of various field crops. These chemical fertilizers and pesticides decreased soil fertility and cause health problems to the consumers. Due to adverse effects of chemical fertilizers, interest has been stimulated for the use of organic manures (Follet *et al*., 1981). The green revolution in India promoted the indiscriminate use of chemical fertilizer and pesticides to obtain a better crop yield. In course of time, the tropical soil after receiving such chemicals turned unproductive due to lack of proper amendments of organic matters (Kale, 1995). The best alternative of the present day's environmental desperation is to make proper use of the available unutilized organic biodegradable wastes in order to convert them in to compost within a short period (Edwards, 1998). Use of organic manures to meet the nutrient requirements of crop would be an inevitable practice in the years to come for sustainable agriculture since organic manures not only improve the soil physical, chemical and biological properties (Heitkamp *et al*., 2011) but also improves the moisture holding capacity of soil, thus resulting in enhanced crop productivity along with better quality of crop produce (Premsekhar and Rajashree, 2009). Although organic manures contain plant nutrients in small quantities as compared to the chemical fertilizers, the presence of growth promoting substances like enzymes and hormones, along with plant nutrients make them essential for improvement of soil fertility and productivity (Szczeck, 1999). Sustainability in agriculture refers to the capacity to remain productive while maintaining the soil fertility but without effecting soil biodiversity. Manure and biologically active preparations of animal and plant origin are most commonly used for sustainable production (Premsekhar and Rajashree, 2009) due to their beneficial effects on nutrient uptake and retention, pest control and productivity (Barrios - Masias *et al.,* 2011). Using the biological fertilizers such as vermicomposts increases the quality and sustainability, in addition un preserving of the environment (Kader *et al*., 2002) Vermicomposts are micro-organisms in the breakdown of organic wastes (Edwards *et al*., 2010). In is now well established fact that organic fertilizers provide enough requirements for proper growth of the crop plant and

Corresponding author: Mariselvi, S.
Department of Zoology, Nallamuthu Gounder Mahalingam College, Pollachi, India.

may enhance the uptake of nutrients, increase the assimilation capacity and will stimulate the hormonal activity as well (Tomati *et al*., 1990;Grapelli *et al*.,1985). Vermicompost is also useful as it increases soil porosity, aeration and water holding capacity.

Vermicompost increases the surface area, provides strong absorbability and retention of nutrients as well and retain more nutrients for a longer period of time. It has been observed that the soil which is amended with vermicompost had significantly greater soil cult density and the soil does not become compacted (Lunt and Jacobson, 1994; Martin, 1976). Vermicompost enhances the uptake of nutrients by the plants by increasing the permeability of root bell membrane, stimulating growth of roots and increasing proliferation of root hairs (Pramanik *et al*., 2007). It is also believed to be very good organic fertilizer and soil conditioner (Gajalakshmi and Abassi, 2003). The integration of vermicompost with inorganic fertilizers tended to increase the yield of crops viz- potato, rape seed, mulberry and marigold over other traditional composts. The application of vermicompost rendered better performance in respect of all round growth of mulberry plants in the lateritic soil of South West Bengal (Chakraborty *et al.,* 2008). 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, vermicomposts have higher level ofavailable nutrients like nitrate or ammonium nitrogen, exchangeable phosphorous and soluble potassium, calciumand magnesium derived from the wastes (Buchanan *et al.,* 1988). The objective of this work is to evaluate the impact of vermicompost and organic manures on the nutrient levels (Nitrogen, Phosphorus and Potassium) in amended soil. Reduced 'termite attack' in farm soil especially where worms were in good population, Reduced 'weed growth', Faster rate of 'seed germination' and rapid seedlings growth and development, Greater numbers of fruits per plant (in vegetable crops) and greater numbers of seeds per ear (in cereal crops), heavier in weight-better in both, quantity and quality as compared to those grown on chemicals, Fruits and vegetables had 'better taste' and texture and could be safely stored up to 6-7 days, while those grown on chemicals could be kept at the most for 2-3 days, Wheat production increased from 35 to 40%, Fodder growth was increased by nearly 50% @ 30 to 40 quintal/hectare, Flower production (commercial floriculture) was increased by 30-50% @ 15-20 quintal/hectare. Flower blooms were more colorful and bigger in size.

MATERIALS AND METHODS

Preparation of vermicompost

Leaf litter was collected periodically from the camps of Kongunadu Arts and Science College, Coimbatore and kept in large plastic container. The collected leaf litter was sun dried, cut into small pieces of 4 to 5 cm length and kept ready for composting. Compost mixture was prepared in the ratio of 1:1 (w/w) of lead and cow dung (13kg) in round plastic container, sprinkled with water to maintain moisture content and was allowed for predigestion. Predigestion of consort mixture was done for 21 days with regular mixing and turning of the mixture for pre-decomposition by the microbes. On 21 day of predigestion, the weight of the predigested compost mixture was noted. After 21 days of predigestion, 10 kg of predigested mixture was transferred to the plastic container and 100 clitellate adult (45 days old). Sample of the epigenic earthworms, *Eudrilus eugeniae* (kinberg) were obtained from Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu and maintained under laboratory conditions. The acclimatized earthworms were used for periodical vermicomposting of leaf litter collected from the college campus. *Eudrilus eugeniae* (total biomass of 520 Gms) were introduced into each container containing the predigested mixture. Vermicomposting was allowed for 90 days with regular sprinkling of water to maintain the moisture content (65-70% RH) in the mixture. At the end of 90 days of vermicomposting, the vermicompost from the container were spread separately on a polythene sheet. From the vermicompost adult worms and young ones were handpicked and isolated. The vermicompost thus obtained by composting leaf litter was dried and for cultivation of plants.

Experimental set up

The polythene bag culture was conducted to analyze the effect of organic manure and vermicompost on the nutrient levels (NPK)

Estimation of Nitrogen (Humphries, 1956)

One gram of the sample was taken in 100 ml conical flask and 10-15 ml of diacid mixture was added. The mouth of the flask was covered with funnel. The content of the flask was digested by heating over a same bath till a clear solution was obtained. The content of the flask was transferred into a 250 ml volumetric flask by using minimum quantity of water and made up to the volume of 250 ml. 10 ml of the diacid extract was pipetted out and transferred into the distillation flask. 25 ml of 2% boric acid was taken in an iced-beaker and 2 drops of double indicator (bromo cresol/green methyl red) were added. This beaker with the mixer was kept at the delivery end of the distillation set. 10 ml of 40% sodium hydroxide was added to the distillation flask. The content of the distillation flask was heated and distillate was collected in the 2% boric acid solution containing indicator. The completion of distillation was tested using a moistened red litmus paper. Absence of blue colour indicated that all ammonia has been distilled. The contents of iced-beaker (containing the distillate in boric acid solution) were titrated against N/10 sulphuric acid. The titre value was used to calculate the percentage of total nitrogen as per the formula given by Humphries (1956). The estimated nitrogen content of the sample was represented in percentage.

Estimation of Phosphorus (Jackson, 1973)

5 ml of triple acid extract was pipetted out and poured into a 25 ml of volumetric flask. 5ml of Barton's reagent was added and shaken well and made up to 25 ml with distilled water.

The homogenate solution was allowed to stand for about 2 minutes to develop yellow colour. O.D. was obtained using a colorimeter at 470 nm. From the already prepared standard curve, the phosphorus content of the sample was calculated and expressed in percentage.

Estimation of Potassium (Piper, 1966)

5 ml of triple acid extract was pipetted out into a 25 ml of volumetric flask and 5 ml ammonium hydroxide was added. The content was made up to 25 ml with distilled water. The content was transferred to an injection vial and fed to a flame photometer. The of galvanometer reading for the sample was obtained. The potassium content of the sample was obtained by referring to an already prepared standard curve for potassium. The potassium content of the sample was expressed in percentage.

Statistical analysis

Data were subjected to one way analysis of variance (ANOVA) Duncan's multiple ranged test using sigmostat software to identify the homogeneous type of the data sets among different treatments for different plant parameters in different treatments.

RESULTS

A study have been carried out to analyse the effect of organic manure and vermicompost on the level of nutrients like Nitrogen, Phosphorus and Potassium were estimate in control soil and amended soil.

Analysis of the level of NPK in soil

The level of NPK in control soil before and after the cultivation of tomato (*Lycopersicum esculentum*) plants. Organic manure and vermicompost amended soil compared to control soil showed significant variable changes in the levels of major nutrients such as Nitrogen (N), Phosphorus (P) and Potassium (K) before and after cultivation of tomato (*Lycopersicum esculentum*). The dates are presented in Table 1-3 and the same shown in 1-3The estimated levels of Nitrogen before and after cultivation in control soil were 0.017% and 0.024% respectively with an increase of 0.007%. The level of Nitrogen estimated were 0.084% (25%), 0.134% (50%), 0.195% (75%), 0.278% (100%) and 0.103% (25%), 0.162% (50%), 0.241% (75%), 0.342% (100%) before and after cultivation in organic manure amended soil, which recorded an increase of 0.019% (25%), 0.028% (50%), 0.046% (75%), 0.064% (100%).

Table 1. The level of Nitrogen in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

Treatment	Organic manure			Vermicompost		
	Initial	Final	Increase	Initial	Final	Increase
Control soil	0.017±.001	0.024±0.001	0.007	0.017±0.001	0.024±0.001	0.007
25%	0.084±0.001	0.103±0.001	0.019	0.225±0.001	0.298±0.001	0.073
50%	0.134±0.001	0.162±0.002	0.028	0.473±0.001	0.570±0.001	0.097
75%	0.195±0.002	0.241±0.001	0.046	0.580±0.001	0.699±0.001	0.119
100%	0.278±0.001	0.342±0.001	0.064	0.618±0.001	0.743±0.001	0.125
LSD 5%	0.004	0.003		0.002	0.003	

Values are mean ± SD of three replicates
Means followed by a common superscript are not significant at 5% level by using DMRT

Table 2. The level of Phosphorus in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

Treatment	Organic manure			Vermicompost		
	Initial	Final	Increase	Initial	Final	Increase
Control soil	0.017±0.001	0.024±0.001	0.007	0.017±0.001	0.024±0.001	0.007
25%	0.023±0.002	0.032±0.001	0.009	0.225±0.001	0.298±0.002	0.073
50%	0.029±0.001	0.041±0.002	0.012	0.473±0.002	0.570±0.001	0.097
75%	0.043±0.001	0.057±0.001	0.014	0.580±0.001	0.699±0.001	0.119
100%	0.048±0.001	0.064±0.001	0.016	0.618±0.002	0.743±0.001	0.125
LSD 5%	0.003	0.002		0.002	0.003	

Values are mean ± SD of three replicates
Means followed by a common superscript are not significant at 5% level by using DMRT

Table 3. The level of Potassium in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

Treatment	Organic manure			Vermicompost		
	Initial	Final	Increase	Initial	Final	Increase
Control soil	0.013±0.001	0.019±0.001	0.006	0.013±0.001	0.019±0.001	0.006
25%	0.015±0.001	0.028±0.001	0.013	0.023±0.001	0.054±0.001	0.031
50%	0.020±0.002	0.038±0.001	0.017	0.073±0.001	0.136±0.001	0.063
75%	0.025±0.001	0.048±0.001	0.023	0.108±0.002	0.206±0.002	0.098
100%	0.032±0.001	0.060±0.002	0.028	0.136±0.001	0.242±0.001	0.106
LSD 5%	0.003	0.002		0.003	0.005	

Values are mean ± SD of three replicates
Means followed by a common superscript are not significant at 5% level by using DMRT

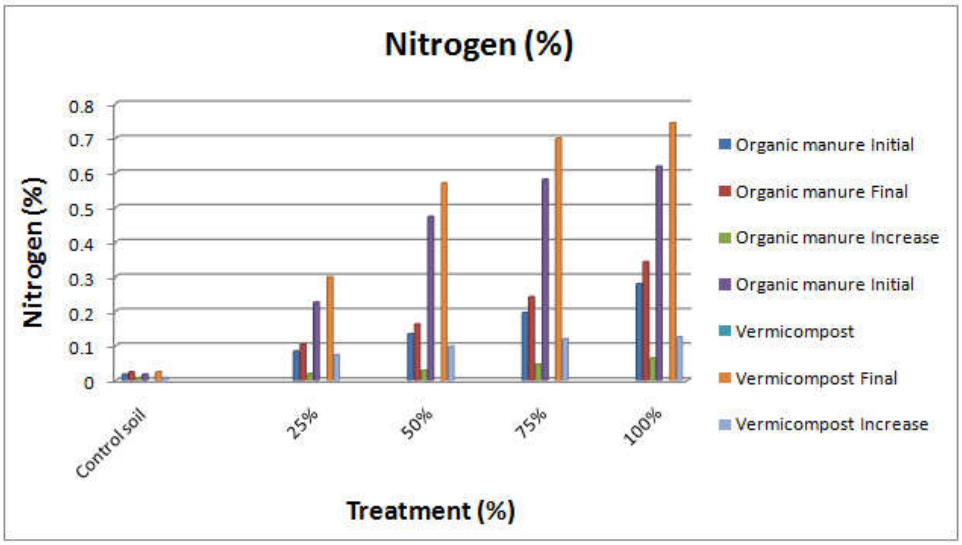

Figure 1. The level of Nitrogen in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

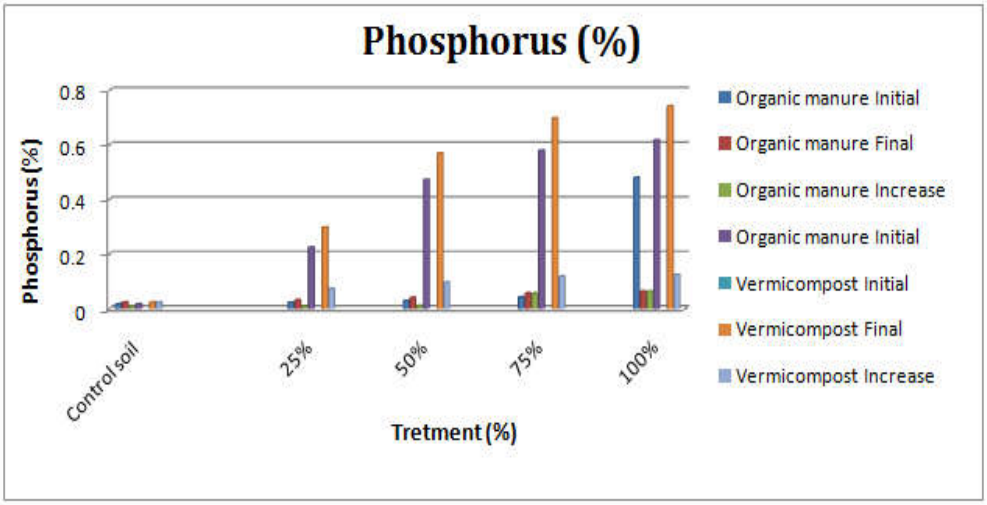

Figure 2.The level of Phosphorus in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

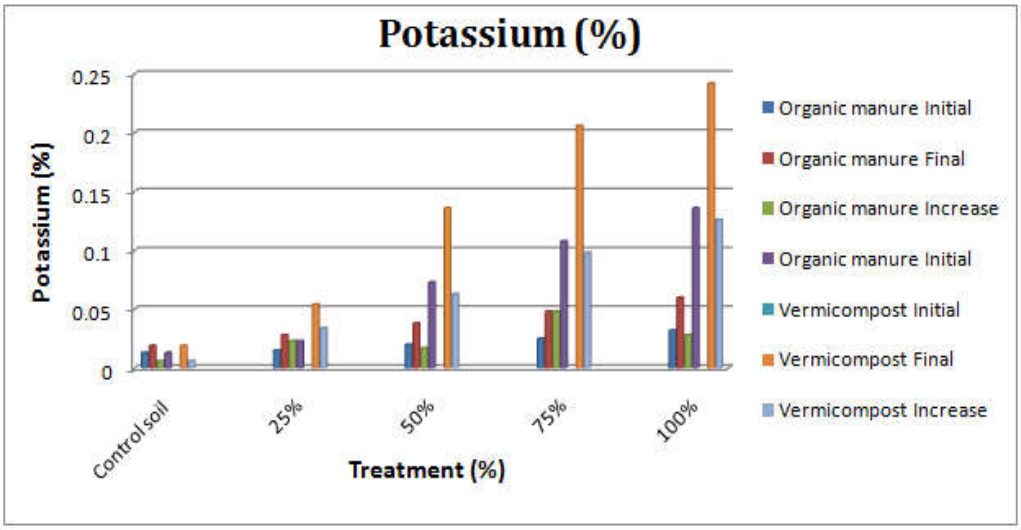

Figure 3.The level of Potassium in control garden soil and amended with organic manure and vermicompost before and after cultivation of tomato (Lycopersicum esculentum) plants

Vermicompost amended soil showed significant variable changes in the level of Nitrogen before and after cultivation as 0.225% (25%), 0.473% (50%), 0.580% (75%), 0.618% (100%), and 0.298% (25%), 0.570% (50%), 0.699% (75%), 0.743% (100%) respectively. There was an increase of 0.073% (25%), 0.097% (50%), 0.119% (75%), 0.125% (100%) of Nitrogen level in vermicompost amended soil. The values are significant at 5% level. The level of phosphorus in the control soil was recorded to be 0.017% and 0.024% before and after cultivation and an increase of 0.007% was noted. The estimated level of Phosphorus in organic manure amended soil before and after cultivation it was found to be 0.023% (25%), 0.029% (50%), 0.043% (75%), 0.048% (100%) and 0.032% (25%), 0.041% (50%), 0.057% (75%), 0.064% (100%) . There was an increase of 0.009 (25%), 0.012% (50%), 0.014% (75%) 0.016% (100%) in Phosphorus level. The Phosphorus level was estimated to be higher particularly in vermicompost amended soil as 0.225% (25%), 0.473% (50%), 0.580% (75%), 0.618% (100%) and 0.298% (25%), 0.570% (50%), 0.699% (75%), 0.743% (100%) before and after cultivation 0.073% (25%), 0.097% (50%), 0.119% (75%), 0.125% (100%) of increase was recorded. The values are significant at 5% level.

The estimate level of Potassium in control soil before and after cultivation was 0.013% and 0.019% with an increase of 0.006%.The Potassium level estimated in organic manure amended soil was 0.015% (25%), 0.020% (50%), 0.025% (75%), 0.032% (100%) and 0.028% (25%), 0.038% (50%), 0.048% (75%), 0.060% (100%), respectively with an increase of 0.013% (25%), 0.017 (50%), 0.023% (75%), 0.028% (100%) of potassium. The vermicompost amended soil recorded the estimated level of potassium as 0.023% (25%), 0.073% (50%), 0.108% (75%), 0.136% (100%) and 0.054% (25%), 0.136% (50%), 0.206% (75%), 0.242% (100%) respectively before and after cultivation. There was an increase of 0.031% (25%), 0.063% (50%), 0.098% (75%), 0.106% (100%) in the level of Potassium estimated. The values are significant at 5% level.

DISCUSSION

In the present study the effect of organic manure and vermicompost on the nutrient levels (Nitrogen, Phosphorus and Potassium) in amended soil was studied. Ramaligam and Thilagar, (2000) reported that the reduction in pH towards neutrality, reductions in organic matter, organic carbon, sulphur, calcium, manganese, zinc and significant elevations particularly in nitrogen, phosphorus and potassium levels in the vermicompost of sugarcane trash compared to control levels. Suthar, (2009) demonstrated that during the vermicompost of some crop residue mixed with cattle dung resulted in an increase in total N (91-144%), available P (63-105%) and exchangeable K (45-90%) content of it. An important feature of vermicompost is that, during the processing of the various organic wastes by earthworms, many of the nutrients that it contains age changed to forms that are more readily taken by plants such as nitrate or ammonium nitrate, exchangeable phosphorous and soluble potassium, calcium and magnesium (Suthar and Singh 2008).

Increased levels of NPK were reported by Deepa kurian *et al.,* (2008) during prolonged period of 90 days of vermicomposting of leaf litter using *Eudrilus eugenia.* Present result is supported by the findings of Ramalingam and Thilagar, (2000); Suthar, (2006); Deepa kurian *et al.,* (2008); Suthar and Singh (2008 ab). Vermicompost of paddy straw appears to be favourable for seed germination whereas, the higher nitrogen content of vermicompost of lead litter night favour growth and yield of plants (Sathish kumar, 2004). Owa *et al*., (2008) reported that earthworm products are probably involved in nutrient utilization of the catabolic products of endosperm such that the bell proliferation and elongation in the embryo are facilitated. Vermitechnology in organic waste management would lead to zero waste technology farms without the organic waste being wasted and burned rather than would result in recycling and reutilization of precious organic waste brining about bio conservation and bio vitalization of natural resources.

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