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RESEARCH ARTICLE

COMPARISION STUDY ON THE EFFECTS OF VERMICOMPOST PRODUCED FROM PIG MANURE AND CATTLE DUNG.

Timothy Lalrinfela And Lalmuanzovi.
KrishiVigyan Kendra, Lunglei District, Hnahthial -796571, Mizoram, India.

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Abstract

In this study, vermicompost was produced from pig manure and cattle dung using the worm *Eisenia feotida*, assessment of the two compost based on their macronutrient content was done and their effects on soil physico-chemical properties was evaluated in field pea (*Pisum sativum* var. Arkel) at open field condition. The compost was produced by following the standard procedure for production of vermicompost. Partial decomposition of organic composting material was carried out for 7 days before preparation of vermicompost. Assessment indicated that the nutrient content for nitrogen and potassium was found higher in pig manure vermicompost, while phosphorus content was higher on vermicompost produce from cattle dung.Both the compostwere incorporated into the top 15cm of the soil, separate plots were assigned for each compost and same amount of compost (5 t ha^{-1}) was applied. The result showed that field pea yield and other yield attributing factors were found much higher at the plot where pig manure vermicompost was applied. The soil physico-chemical properties like soil pH, bulk density, water holding capacity, electrical conductivity and important macronutrients was affected at higher level by incorporation of pig manure vermicompost as compared to vermicompost produced from cattle dung.

Introduction:-

The ability of some species of earthworm to consume and breakdown a wide range of organic residues such as sewage sludge, animal wastes, crop residues and industrial refuse is well known (Mitchell et al., 1980; Edwards et al., 1985; Chan and Griffiths, 1988).There is accumulating scientific evidence that vermicomposts can influence the growth and productivity of plants significantly (Edward, 1998). During ingestion,the earthworm fragments the waste substrate accelerate the rate of decomposition of the organic matter, alter the physical and chemical properties of the material, leading to an effect similar to composting in which unstable organic matter is oxidize and stabilized aerobically (Albanell et al., 1988; Orozco et al., 1996). Vermicomposting is the non-thermophilic biodegradation of organic material through the interaction between earthworms and microorganisms, whereby organic material residuals are fragmented rapidly into much finer particles by passing them through a grinding gizzard while maintaining nutrient. The soil quality includes soil reaction (pH), mineral nutrient elements, water content, composition of soil atmosphere and biotic factors. Mature compost when added to soil directly affected almost all of these factors (Marinari et al., 2000). Compared to their parent materials, vermicomposts have reduced amounts of soluble salts, greater cation exchange capacity, and increased total humic acid content (Albanell et al., 1988).

Corresponding Author:-Timothy Lalrinfela.
Address:-KrishiVigyan Kendra, Lunglei District, Hnahthial -796571, Mizoram, India.

There is heavy consumption of pork in northeast India (mostly Mizoram, Nagaland, Arunachal Pradesh and Assam) and its rearing on large scale has fed immense income for uplifting rural economy. Meanwhile, there is lack of awareness on management of pig manures and other organic wastes as vermicompost. Most of the research studies on earthworm-processed organic wastes mainly focus on vermicompost produced from cattle dung and its effects on the growth and development of plant. However, none of studies focus on vermicompost produced from pig manure and its effects on plant growth.The main objective of this study was to compare the effects of vermicompost produced from pig manure and cattle dung and to study its effects on soil physico-chemical properties and yield of field pea.

Materials and Methods:-

The experiment was conducted at demonstration farm of Krishi Vigyan Kendra, Lunglei District. Partial decomposition of organic wastes was carried out by treating it with dung slurry and left for 10 days. The duration of partial decomposition was reduced than recommended (20 days) as the location is under sub-tropical region where rate of decomposition was faster than the main lands. The compost pit was constructed in concrete structure with a dimension of 6ft × 3ft × 2.5 ft. Manures of 5 days old should be used for preparation of vermicompost. Pig manure was treated with Calcium sulphate (4%) before composting. Seasonal weeds like *Bidens pilosa, Vicoa indica, Mikania micrantha, Imperata cylindrical, Ageratum histonium, Borreria hispida, Commelina nudiflora* are used and other organic wastes were composted on a pit filled with alternate layers of partially decompose organic waste and dung slurry, included with 2kgs of adult epigamic earthworms (*Eisenia feotida*). The worms were introduced in the material at the beginning of vermicomposting process. The moisture level of beds was maintained at about 60-70% during the vermicomposting period by periodically sprinkling with water. The vermicomposting process lasted for 45 days.

After the production of vermicompost, we tested the effect of different vermicompost produced from cattle dung and pig manure on yield of Field pea in pod at open field condition. Assessment of nutrient content of the compost was carried out for total organic carbon, total nitrogen, phosphorus and potassium. To determine soil physico-chemical properties, the soil samples were collected 4 months after addition of vermicompost from depth of 15 cm.The samples were air dried at room temperature. Soil samples before chemical analysis was screened through a 2 mm sieve. The pH of soil samples were measured in 1:2.5 soil: distilled water suspension by potentiometric method using glass electrode Jackson (1973). The total organic carbon (TOC) content of finely ground sample was determined by Walkely and Black's Wet Oxidation method as describe by Jackson (1973) and expressed in percentage (%). Bulk density was determined by mass volume relationship from the core samples on oven dry weight basis Piper (1966). Water holding capacity of the soil was determined by Keen – Rackzowski box method Piper (1966). Available nitrogen was determined by modified alkaline permanganate method of Subbiah and Asija (1956) and total nitrogen content was determined by Micro-Kjeldahl Method describe by Jackson (1973). Available phosphorus was determined by the method as describe Bray and Kurtz (1945). Available potassium was extracted with neutral normal ammonium acetate and the content of potassium in the solution was estimated by Flame photometer (Jackson, 1973).

Results and Discussion:-

Table 1:-Chemical properties of vermicompost produced from pig manure and cattle dung

Medium	pH	EC (dSm^{-1})	TOC (%)	N (%)	P (%)	K (%)	C:N
Pig Manure	6.3	7.2	30	1.02	0.11	0.50	29.41
Cattle dung	6.4	8.3	26.3	0.92	0.15	0.29	28.58

Initial characteristics of different compost

The chemical properties of different source of vermicompost (Pig manure and cattle dung) used in the experiments is given in Table 1. pH of vermicompost were within a slightly acidic range of 6.3 and 6.4 in case of pig manure vermicompost and cattle dung vermicompost, respectively. High electrical conductivity (EC) of 7.2dSm^{-1} and 8.3dSm^{-1} in pig manure vermicompost and cattle dung vermicompost was observe, respectively. High EC of vermicompost was due to raw materials use for vermicomposting and their ion concentration, Atiyeh et al. (2002b). High amount of total organic carbon was observed in both vermicompost, higher TOC was observed in pig manure vermicompost (30%) as compared to cattle dung vermicompost (26.3%). The nitrogen content was found to be higher in case of pig manure vermicompost (1.02%). This might be due to higher content of nitrogen in pig manure and decomposition of fresh material and digestion of partially decompose matter in the gut of earthworm cause mineralization process. Similar finding was reported by Preush et al. (2002). The phosphorus content was found to be higher in cattle dung (0.15%) as compared to pig manure (0.11%). The conversion of P from organic material to available form was during the digestion in the gut of earthworm due to phospholytic activity in the presence of phosphatase enzymes as reported by Benitez et al. (1999).Total potassium content was higher in pig manure vermicompost (0.50%) as compared to cattle dung vermicompost (0.29%). The increase in K content might be due to action of microbes, decomposers and ingestion of partial decomposed matter by earthworm which change the distribution of K between exchangeable and non-exchangeable K during the gut process Basker et al., (1992). The carbon to nitrogen ratios for both compost were within the most favourable range of 29.41 and 28.58 for pig manure vermicompost and cattle dung vermicompost, respectively. Which indicate that there would be a better mineralization process of nurients for plant uptake. Treatment of pig manure with 4% Calcium sulphate ($CaSO_4$) was due to high ammonia content in the substrate, which led to death of *E. feotida*, by controlling the ammonia content with $CaSO_4$ urine salts were eliminated and the substrate was found to be suitable as feed for the worms, Chan and Griffiths (1988).

Table 2:-Effects of vermicompost on physico – chemical properties of the soil

Medium	pH	TOC (%)	EC (dSm^{-1})	BD (Mg m^{-3})	WHC(%)	Av. N (%)	Av. P(%)	Av. K(%)
Normal soil	4.6	1.22	0.04	1.44	33.48	1.45	0.40	1.21
Pig Manure	6.6	1.88	0.74	0.96	43.2	1.64	1.5	2.43
Cattle dung	7.8	1.74	1.1	0.99	41.2	1.62	0.71	1.4

Effects on soil physico-chemical properties

The pH of the soil after application of pig manure vermicompost and cattle dung vermicompost were in normal (6.6) and slightly alkaline (7.8) range, respectively (Table 2). On incorporation of both source of vermicompost, there is an increase in pH of the soil, with a little higher pH in case of cattle dung vermicompost. This might be due to high levels of ammonium in cattle dung, which is in accordance with the finding of Atiyeh et al (2000), who reported that there is an increases in the substrate pH with increasing concentrations of compostedcattle added to the growth medium.Electrical conductivity (EC) of cow dung vermicompost was higher in comparison with pig manure vermicompost, which may be attributed to the presence of more salts in the feed of cattle. It was 0.04dSm^{-1} in soil (control), 0.74 dSm^{-1}in pig manure vermicompost and 1.1 dSm^{-1} in cattle dung vermicompost, respectively. Similar finding was reported by Sangwan et al (2010). Bulk density of the soil decreases from 1.44Mg m^{-3} in normal soil (control) to 0.96Mg m^{-3} and 0.99 Mg m^{-3} (Table 2) in case of pig manure vermicompost and cattle dung vermicompost, respectively. This might be due to increase in soil organic carbon due to application of different source of compost. This is substantiated by the finding of Askin and Ozdemir (2003), who reported that soil bulk density showed a negative rrelation with soil organic carbon content. Water holding capacity (WHC) of the soil increases from 33.48 % in normal soil to 43.2 % in case of soil treated with pig manure vermicompost, which was found to be higher than soils treated with cattle dung vermicompost (41.20%). This might be due to increase in soil organic carbon on application of pig manure vermicompost. Similar finding was reported by Singh (2005). Total organic carbon (TOC) of the soil increases from 1.22% in normal soil (control) to 1.88% and 1.74% (Table 2) in case of soil incorporated with pig manure vermicompost and cattle dung vermicompost, respectively.The results showed that the available N concentration in soil was affected by vermicompost treatments (Table 2). The soils treated with pig manure vermicompost at the rate of 5 t ha^{-1} had more available N compared to soils without vermicompost application. The marked decrease in available N in soils without vermicompost application in comparison with vermicompost treated soils may have been due to larger amounts of total C and N in pig manure vermicompost (29.41:1)that could have provided a larger source of N for mineralization. Similar finding was reported by Nethra et al., (1990). Soils treated withvermicompost at the rate of 5 t ha^{-1} had more available P (1.5% & 0.71%) as compared to control plots (0.40 %).This implied that the continuous inputs of P to the soil were probably from slow release from vermicompost and release of P was due largely to the activity of soil microorganisms (Arancon et al., 2006). Higher available P was found in soils treated with pig manure vermicompost. This might be due to neutral pH (6.6) condition of the soil. Havlin et al. (2007) were also of the opinion that P availability in most soils were at a maximum near pH 6.5. Application of vermicompost at rate of 5 t ha^{-1} increased available K comparison to control plots (Table 2). The selective feeding of earthworm on organically rich substances which breakdown during passage through biological grinding, together with enzymatic influence on finer soil particles, were likely responsible for increasing the different forms of K (Rao et al., 1996). The increase of soil organic matter resulted in decrease K fixation and subsequent increase K availability (Olk and Cassman, 1993).

Table 3:-Effects of vermicompost on yields and its attributes in field pea

Treatments	Plant height (cm)	Number of pods/plant	No. of seed/pod	Seed yield (q/ha)
Control	21	5	3.2	18.5
Pig manure	33	10	5.6	23
Cattle dung	29	9	4.7	22.5

Effect of different source of vermicompost on crop growth

The effect of vermicompost on field pea was dependent on soil physico-chemical characteristics and treatments applied.Maximum plant height (33cm) was observed in treatments with pig manure vermicompost.The increase in plant height with 5 t $ha^{-1}$of pig manure vermicomposts might be due to enhanced amount of growth promoting substances in the compost. Similar results have been reported by Atiyeh et al. (2000) with pig manure vermicompostapplied to tomato plants.The lower growth rates at same dose of cattle dung vermicompost could be attributed to the higher electrical conductivity (1.1dSm^{-1}) or excessive nutrient levels in the more concentrated mixtures. Similar finding was reported by Arancon et al. 2008. Application of vermicompost at a rate of 5 t ha^{-1}effect productivity (Number of pods, number of seeds per pod and seed yield) of field pea (Table 3) as compared to controlled condition. Furthermore, application of pig manure vermicompost was found to enhance the growth and productivity of field pea as compared to application of cattle dung vermicompost. Similar finding was reported by Atiyeh et al. (2002), where 40% concentration of pig manure vermicompost was found to be effective as compared to commercial potting medium Metro mix 360.

Conclusion:-

The pig manure vermicompost used in this experiment offered potential advantage over vermicompost produced from cattle dung. The pig manure vermicompost has a potential for increasing yield of field pea over controlled condition. This study indicated that production of vermicompost from pig manure is feasible and this would provide immense scope for producing vermicompost and promote organic agriculture by pig rearing farmers of northeast India.

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