GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

IMPACT OF VERMICOMPOST ON PEAS CULTIVATED SOIL

M. M. Manyuchi[*1], T. Mudamburi[2], A. Phiri1and P. Muredzi[3]

[*1]Department of Chemical and Process Systems Engineering, [2]Department of Technopreneurship , [3]Dean-School of Engineering and Technology, Harare Institute of Technology, 256 Ganges Rd, Belvedere, Harare, Zimbabwe

mmanyuchi@hit.ac.zw

ABSTRACT

Vermicomposting is an environmentally friendly technique that is used for organic solid waste management. Waste corn pulp blended with cow dung and office paper was vermicomposted over 30 days to produce vermicompost which is a solid bio-fertilizer. The vermicompost was applied to clay-loam soil cultivated with peas at the planting phase and after every four weeks. The impact of vermicompost on the soil was quantified. Application of vermicompost resulted in a 33%, 40%, and 67% increase in the soil nitrogen, phosphorous and potassium content respectively. Furthermore, Zinc, copper, manganese and iron indicated a 91%, 67%, 56% and 10% increase in nutrient composition. The peas showed vigor and vitality during the period of growth. Vermicompost can be used for sustainable agriculture practices easing food shortages hence improved food security.

Keywords: bio-fertilizer, peas, soil properties, vermicompost, food demand

I. INTRODUCTION

Vermicomposting of organic waste is widely being used as a solid waste management technology [1-2]. During vermicomposting, epigeic earthworms ingest the organic wastes and are expelled as vermicasts after a bioconversion process in the earthworms gut [3-5]. These vermicasts are termed vermicompost and are rich with the fertilizer macro and micronutrients [2; 5]. Vermicompost also contain living microorganisms and have a high content of humus like material [2; 5]. This vermicompost can be utilized as a bio-fertilizer which is environmentally friendly [6-9]. Vermicompost has been used in sustainable agriculture and was found to stimulate plant growth [1]. Vermicompost has been applied to several plants including strawberries, tomato, rice, lettuce and maize [1; 3; 5; 8; 10-12]. The objective of this study focused on quantifying the impact of vermicompost on peas cultivated's soil physicochemical properties. Peas (*Pisum Sativum*) is a leguminous vegetable crop which can be grown in 2-3 months. Peas thrive best in silt loam, sandy loams or clay loam soils [13]. Ideal temperature conditions of 13-18◦C and pH of 6.0-7.0 is recommended [13].

II. MATERIALS AND METHODS

Materials

Waste corn pulp blended with cow dung manure and office paper was vermicomposted for 30 days using *Eisenia* fetida earthworms. The organic waste and earthworms were covered with grass to create ideal conditions for vermicomposting (Fig 1). The nutrient composition of the vermicompost is indicated in Table 1.

Fig 1: Vermicomposting being done in bins

TABLE I: Vermicompost From Waste Corn Pulp Composition

Nutrient	Vermicompost composition
N (%)	4.19
P (%)	1.15
K (%)	6.18
Na (ppm)	4.85
Mg (ppm)	6.58
Cu (ppm)	0.57
Zn (ppm)	1.35
Fe (ppm)	162.30
Mn (ppm)	1.62

Methods

The clay loam soil pH and electrical conductivity were determined by a Hanna HI 9810 Instrument. 5g of the soil was dissolved in 10ml of water and allowed to settle before taking measurements. The nitrogen and phosphorous content were determined by a Shimadzu *uv-vis* spectrophotometer. The potassium content in the soil was determined by a Cary Model AAS spectrophotometer. The raw soil had a pH of 6.0 and moisture content of 54%..

Green Arrow peas seeds were planted 25mm deep in loam-clay soils and the seeds were 50mm apart from each other and 150mm between rows. The peas beds were regularly watered to maintained adequate moisture content. The peas seeds were 98% germinated at day 4-5. The lettuce was allowed to grow for 2 months and vermicompost was applied upon planting and after every 4 weeks.

III. RESULTS AND DISCUSSION

The peas planted using the vermicompost is indicated in Fig 2. The peas shows vigor and vitality due to the bio-fertilizer addition as well as the action of the microbial inoculants present in the vermicompost to the soil.

Fig 2: Peas grown using vermicompost as bio-fertilizer

Impact on soil nitrogen, phosphorous and potassium content

Nitrogen exists as ammonium nitrate ions, NH_4^+ and NO_3^- in the soil for ready uptake by plants. Addition of vermicompost increased the nitrogen available in the soil by 33% in the peas cultivated soil compared to the virgin soil (see Fig 3). This was because of addition of extra ammonium nitrates from the vermicompost due to mineralization [10-11]. Furthermore, peas as a leguminous crop have a tendency of fixing nitrogen from the soil to the plant [13]. In addition, *Rhizobium leguminosarum* can be inoculated to the pea seeds before planting to promote nitrogen fixation to the soil [13]. Phosphorous exists as phosphates $H_2PO_4^-$ and HPO_4^{2-} in the soil. Addition of vermicompost in the peas cultivated soil resulted in increased phosphorous content by 40% (see Fig 3). This was because of addition of extra slow release phosphates from the vermicompost hence the increase [1; 10; 12]. Potassium exists as K^+ in the soil. Addition of vermicompost in the peas cultivated soil, resulted in 67% increase of the potassium content (see Fig 3). This was possibly because the potassium available from the vermicompost was high thereby increasing the composition in the soil (see Table 1).

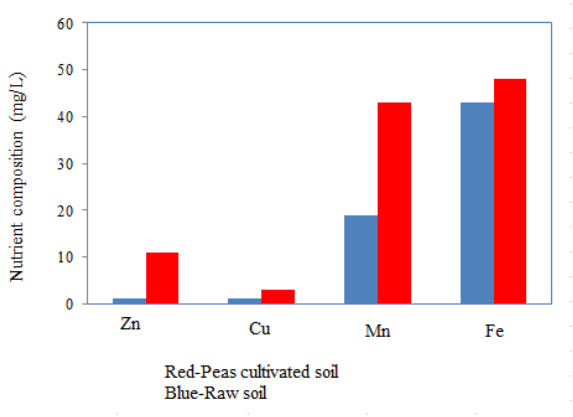

Fig 3: Comparison of soil NPK in raw soil and peas cultivated soil

Impact on soil Zn, Cu, Mn and Fe content

Zinc, copper, manganese and iron exist in the soil as Zn^{2+}, Cu^{2+}, Mn_2O_3 and Fe^{2+} and Fe^{3+} respectively. Addition of vermicompost on peas cultivated soil significantly altered the bio-fertilizer micronutrients content (see Fig 4). The Zn, Cu, Mn and Fe content increased significantly by 91%, 67%, 56% and 10% respectively upon addition of the vermicompost. Vermicompost has a tendency of increasing the micronutrients composition in the soil since it contains trace elements from the bio-conversion process [6, 8-9].

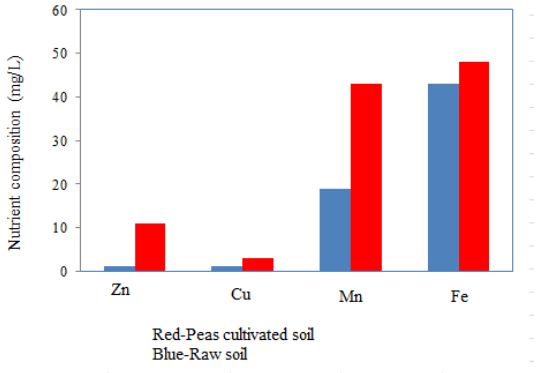

Fig 4: Comparison of soil micronutrients in raw soil and peas cultivated soil

IV. CONCLUSION

Vermicompost can be successfully used as a bio-fertilizer for the growth of peas. The vermicompost impacts positively on the nutrient available for uptake by the peas due to the presence of living organisms in the vermicompost thereby stimulating growth. Vermicomposting technology can be used for sustainable agriculture practices.

V. ACKNOWLEDGEMENT

The Harare Institute of Technology is thanked for funding this work.

VI. REFERENCES

[1] *C. Lazcano, and J. Dominguez. The use of vermicompost in sustainable agriculture: Impact on plant growth and soil fertility. Soil Nutrients. 2011, 1-23.*

[2] *M. M. Manyuchi, A. Phiri, N. Chirinda, P. Muredzi, J. Govha and T. Sengudzwa. Vermicomposting of Waste Corn Pulp Blended with Cow Dung Manure using Eisenia Fetida. World Academy of Science, Engineering and Technology. 2012, **68**, 1306-1309.*

[3] *G. K. Chanda, G. Bhunia and S. K. Chakraborty. The effect of vermicompost and other fertilizers on cultivation of tomato plants. Journal of Horticulture and Forestry, 2011, **3** (2), 42-45.*

[4] *M. M. Manyuchi, T. Chitambwe, P, Muredzi and Kanhukamwe, Q. Continuous flow-through vermireactor for medium scale vermicomposting. Asian Journal of Engineering and Technology. 2013, **1** (1), 44-48.*

[5] *P. K. Ramasamy, K. Baskar and S. Ignacimuthu. Influence of vermicompost on kernel yield of maize (Zea Mays L.). Elixir Agriculture, 2011, **36**, 3119-3121.*

[6] *Manyuchi, M. M., A. Phiri, P. Muredzi and T. Chitambwe. Comparison of vermicompost and vermiwash bio-fertilizers from vermicomposting waste corn pulp. World Academy of Science, Engineering and Technology. **78**, 365-368. 2013.*

[7] *M. M. Manyuchi, T. Chitambwe, A. Phiri, P, Muredzi and Q, Kanhukamwe. Effect of vermicompost, vermiwash and application time on soil physicochemical properties. International Journal of Chemical and Environmental Engineering, 2013, article in press.*

[8] *M. M. Manyuchi, L. Kadzungura, A. Phiri, P, Muredzi and Q, Kanhukamwe. Effect of vermicompost, vermiwash and application time on soil micronutrients. International Journal of Engineering and Advanced Technology, 2013, **2** (5), 215-218.*

[9] *M. M. Manyuchi, T. Chitambwe, A. Phiri, P, Muredzi and Q, Kanhukamwe. Effect of vermicompost, vermiwash and application time on Zea Mays growth. International Journal of Scientific Engineering and Technology. 2013, **2** (7), 638-641.*

[10] *N. Q. Arancon, C. A. Edwards, and P. Bierman. Influences of vermicomposts on field strawberries: Part 2. Effect on soil microbiological and chemical properties. Bioresource Technology. 2006, **97**, 831-840.*

[11] *R. Azarmi, M. T. Giglou and R. D. Taleshmikail. Influence of vermicompost on soil chemical and physical properties in tomato (Lycopersicum esculentum) field. African Journal of Biotechnology. 2008, **7** (14), 2397-2401.*

[12] *K. Tharmaraj, P. Ganesh, K. Kolanjinathan, K. R. Suresh and A. Anandan. Influence of vermicompost and vermiwash on physicochemical properties of rice cultivated soil. Current Botany. 2011, **2** (3), 18-21.*

[13] *C. A. Miles and M. Sonde, Peas shoots, Farming West of the Cascades, PNW 567.*