EFFICACY EVALUATION OF VERMICOMPOST AND INORGANIC FERTILIZER APPLIED IN LOWLAND RICE

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Abstract

The study was conducted to evaluate the effect of vermicompost on the growth and yield of rice as well as on the return on investment on December 2007 to September 2008 at Jose Rizal Memorial State College, Katipunan Campus, Katipunan Zamboanga del Norte. Three treatments were laid in Randomized Complete Block Design (RCBD) with four replications. The vermicompost application alone and the amalgamation of inorganic fertilizer and vermicompost has no significant difference in the height as compared with 60 DAT inorganic fertilizer both in 1st and 2nd trial. It was at harvest that rice applied with inorganic produced a significantly tallest plants among the treatments in 1st trial. Other than that, it generated a dramatic increase in ROI when employing vermicompost supplemented with inorganic fertilizer (103.8%) which is comparably the same with inorganic fertilizer (119.6%) in the 2nd trial. This indicates a favorable effect on the growth, yield and return on capital in rice production when vermicompost was added with inorganic fertilizer and further entails that it can be a substitution to pure inorganic fertilizer application.

Keywords: *Vermicompost, Inorganic fertilizer, lowland rice, evaluation*

Introduction

Jose Rizal Memorial State College-Katipunan Campus Rice Project has long been using inorganic fertilizer in its production. The yield is of great contribution to the income of the institution. However, intensive agriculture or the conventional method has long been criticized because of its negative impacts. Aside from being expensive and of its fluctuating price, it poses hazard to our environment. High amount of fertilizers contributes to pollution of ground and surface waters of lakes and reservoir. Wolf and Snyder (2003) further asserted that intensive agriculture in the United States tolerably met food production needs, however many of the soils mislaid 30 % to 50 % soil organic matter. Soil in Katipunan Campus Rice Project, as per analysis has soil organic matter content (SOM) of 1.23% which is very low and alarming. Soil organic matter plays an

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important role in maintaining crop production. It is a reservoir of plant nutrients. Its maintenance is crucial for maintaining physical, chemical and biological properties of the soil (Sahrawat, 2005). With these facts, the institution had conducted research related to the use of organic materials particularly on the use of vermicompost which is the end product of the breakdown of organic matter by species of earthworm and is considered nutrient rich natural fertilizer and conditioner,

Vermicompost contains a diverse microbial population which help breakdown nutrients already present in the soil into plant available form. It benefit soils by cultivating its physical composition, attracting deep burrowing earthworms already present in the soil, improving root growth and structure and adding plant hormones. It is found to contain 1.6% N, 5.04% P_2O_5 0.8 % K_2O with small quantities of micronutrients (Balasubramanayan, 2004). While other sources found out that it contains 2.3% N, 3.0 % P_2O_5, 0.6 % K_2O and with some micronutrients (www.@gri.Infotech.com)

The use of vermicompost increases crop yield and lessens dependence on chemical fertilizers (Villegas, 2003; Adorado *et al.*, 2003). Grain yield and nutrient uptake of rice increased significantly with the vermicompost application and inorganic fertilizer in a rate of 15 kg N from vermicompost complemented with 45-13-25 kg NPK/ha with a yield of 4.06 and 5.31 tonnes/ha (Banik and Bejbaruah, 1996). Likewise the study of Arancon et al. (2004) on the effects of vermicompost supplemented with inorganic fertilizer on the growth and profitable fruits of field grown tomatoes, peppers and strawberries proved a favorable effects. The marketable tomato yields in all vermicompost treated plots were constantly larger as compared to inorganic fertilizer treated plots. There were significant increases in shoot weights, leaf areas and marketable fruit yields of pepper plants. Leaf area, number of suckers, number of flowers, shoot weights leaf areas and total marketable strawberry yields increased significantly in plot treated with vermicompost. In addition, the study of Tejada and Gonzales (2008) on the vermicompost application on rice crop revealed an assenting effect on biological and rice quality and yield performance.

Objectives

The study aims to attain the following objectives: to evaluate the effectiveness of vermicompost and inorganic fertilizer on the growth and yield of rice and to compare the cost of production and the return on capital of using vermicompost and inorganic fertilizer

Research Method and Design

Time and Place of Study. The study was conducted for two yielding seasons at JRMSC- Katipunan Campus Rice Project, Katipunan, Zamboanga del Norte. First planting or trial was from December 2007 to March 2008. Second trial was June to September 2008.

Treatments and Descriptions. Treatment 1 - Inorganic fertilizer (60-14-14 N, P_2O_5, K_2O/ha), Treatment 2 - Vermicompost (2 tons/ha or 44.4 bags), Treatment 3 - 1 ton vermicompost and inorganic fertilizer (30-7-7 N, P_2O_5, K_2O/ha)

Experimental Design and Layout. The treatments were laid out in Randomized Complete Block Design (RCBD) with 4 replications as presented in Figure 1. Each plot has an area of 20 square meters. *Post hoc analysis* using Honestly Significant Difference (HSD) was employed to compare the means.

T2 P10		**T1** P7		**T1** P4		**T3** P1
T3 P11		**T3** P8		**T2** P5		**T1** P2
T1 P12		**T2** P9		**T3** P6		**T2** P3

T- Treatment P – Plot number Plot size: 4m x 5 m

Figure 1. Experimental Layout

Cultural Management

The area was plowed with the used of disc plow one month before transplanting. Pre-germination of seedlings was done prior to the leveling of the area. It was done by soaking the seeds for 24 hours and was incubated for 36 hours in a half filled sacks. A puddle plot was prepared to sow the pre-germinated seeds. Seedlings were transplanted 20 days after sowing at a distance 20 x 20 cm at 2 seedlings per hill.

Vermicompost was broadcasted and incorporated one week before transplanting. One-half inorganic fertilizer was applied seven (7) days after transplanting and the other half was applied 30 days after transplanting. Occurrence of pest and diseases were controlled using chemical. Harvesting was done when physiological maturity had reached.

Data Gathered

Sixteen representative plants per plot were gathered for the following data:

1) Height - Using measuring tape, the height was measured from the base of the plant to the tip of the tallest leaf.
2) Number of Tillers- Counting was done at 60 DAT wherein it is considered at maximum tillering stage.
3) Number of filled or productive grains – productive grains were counted in each representative panicle.
4) Weight of 1000 grains – One thousand grains was counted and weighed with the used of triple beam balance.
5) Grain Yield- a representative 2m x 2 m area was harvested in each plot. Grains were sun dried until 4% MC was attained, the grains were then weighed .

Results and Discussion

Influence of Inorganic Fertilizer and Vermicompost on the Growth of Rice

Height. Rice was shorter when applied with 2 tons vermicompost with a height of 75.6 cm in comparison with the used of inorganic fertilizer (84.9 cm) at sixty days after transplanting , first trial. Using 1 ton vermicompost + inorganic (30-7-7 kg/ha) d shorter plants (78.5 cm) comparison with inorganic fertilizer. The same observation was noticed in 2nd trial. Inorganic fertilizer ranked first, followed by the ½ inorganic and vermicompost and the shortest were with the application of vermicompost alone (Fig. 2). Despite the fact that there was a steadily taller plants observed in inorganic treated plots, differences were insignificant as revealed by ANOVA results.

Height at harvest in two seasons is presented in Figure 3. Application of inorganic fertilizer had the tallest plants in the entire treatments in 1st trial with 103 centimeters height. However in 2nd trial, the combination of vermicompost supplemented with inorganic fertilizer was found no marked difference in comparison with inorganic fertilizer with a height of 94 and 99 cm respectively. Height was comparably shorter when rice was applied with 2 tons/ha vermicompost.

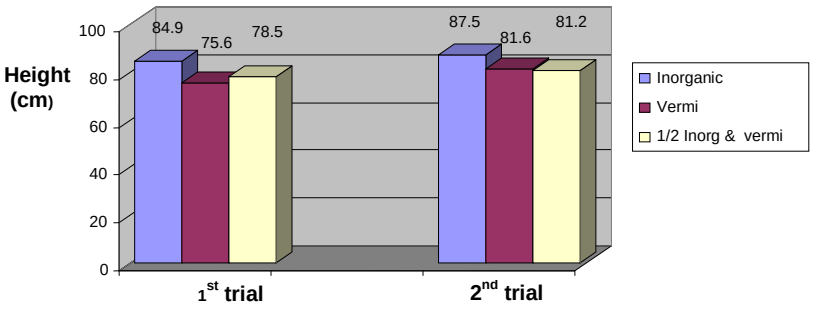

Figure 2. Height of rice at 60 DAT as affected by the application of inorganic fertilizer and vermicompost.

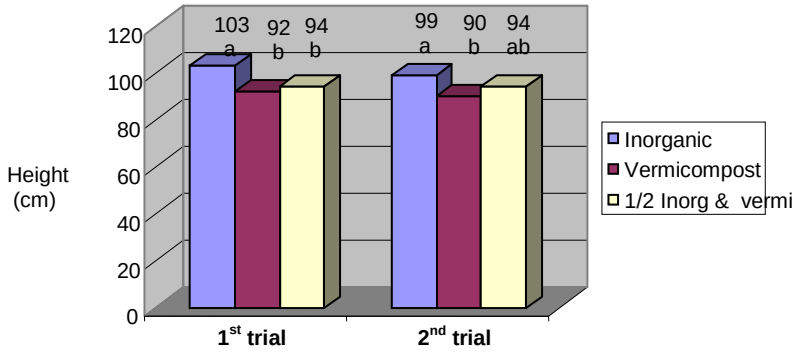

Figure 3. Height of rice at harvest as affected by the application of inorganic fertilizer and vermicompost

Number of Tillers. Figure 4 shows that more number of tillers emerged when rice was applied with inorganic fertilizer. Nineteen (19) tillers in the inorganic while the used of vermicompost had only 16 tillers.

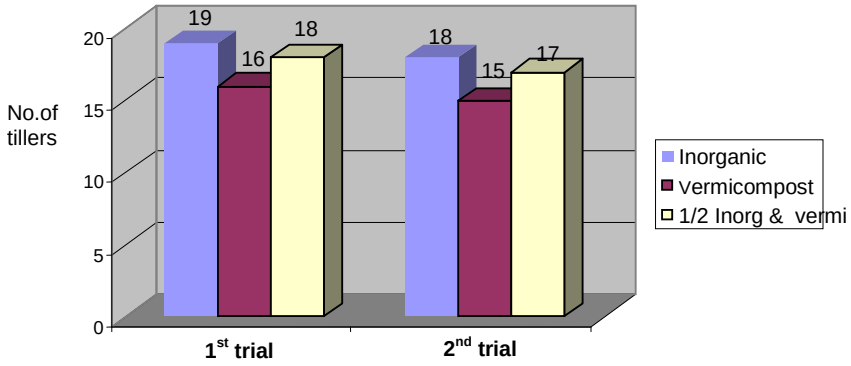

Figure 4. Effect of inorganic fertilizer and vermicompost on the number of tillers of rice at 60DAT

In 2nd trial (June-Sept, 2008), the application of vermicompost got the lowest number of tillers (15) followed by the combination of inorganic and vermicompost (17) and the highest was using inorganic fertilizer. Statistical analysis revealed that the differences were insignificant in all the treatments.

Influence of Inorganic Fertilizer and Vermicomposton Some Yield Parameters of Rice

Weight of 1000 Grains or Paddy. A slightly heavier grains or paddy was found in the application of the ½ inorganic and 1 ton vermicompost in all cropping seasons with 29.9 and 30.3 grams respectively. Inorganic fertilizer application in two cropping seasons

was second in rank among the three treatments. Differences among the treatments were not significant .

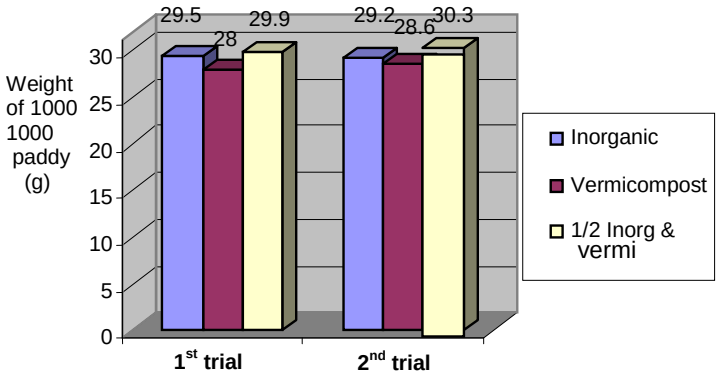

Figure 5. Weight of paddy or grains as affected by the application of inorganic fertilizer and vermicompost

Number of Filled or Productive Grains. It was noticed that the number of filled grains applied with 1 ton vermicompost and 1/2 inorganic fertilizer had no significant difference comparing with inorganic fertilizer alone which has 41 and 43 grains respectively.

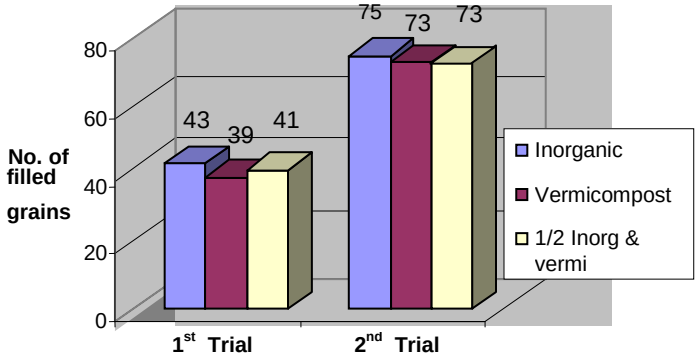

Figure 6. Number of filled/productive grains as influenced by the application of inorganic fertilizer and vermicompost

Productive grains in 2nd trial also manifested the same trend wherein no marked differences among treatments were observed. Observation shows that in 2nd trial, productive grains were almost doubled than in 1st trial that contributed to the higher yield.

Grain Yield of Rice. Figure 7 shows the data on the grain yield in 1st trial. The addition of ½ inorganic and 1 ton vermicompost has no significant difference than the application of inorganic fertilizer alone with a yield of 3,262.5 and 3,894.9 kilograms respectively. Application of vermicompost at the rate of 2 tons/ha produced a significantly lower yield which is 2883.4 kg in comparison with inorganic fertilizer application having a yield of 3,894.9 kilograms.

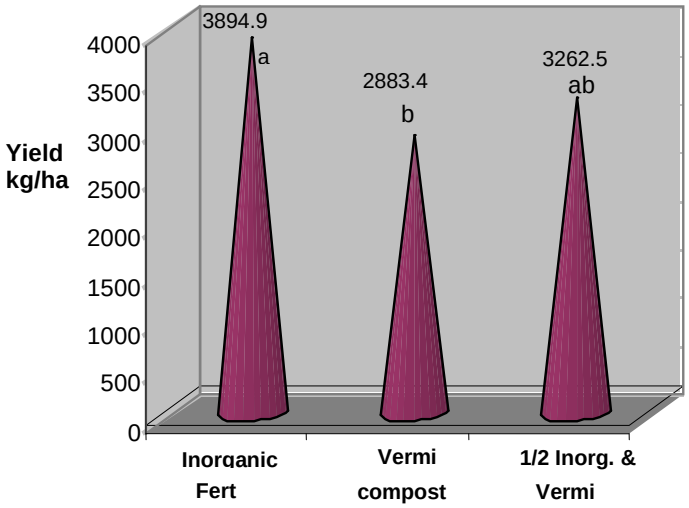

Figure 7. Grain yield of rice as affected by the application of inorganic fertilizer and vermicompost (1st trial, Dec. 2007-March 2008)

Yield in 2nd trial followed the same trend to that of 1st trial (Fig. 8). Vermicompost supplemented with inorganic fertilizer produced 4663.9 kilograms which had no significant difference to inorganic fertilizer application with a yield of 5044.4 kilograms. Yield of rice in 2nd trial showed a dramatic increase in comparison with the 1st trial in all of the treatments. Inorganic fertilizer application in 1st trial had a yield of 3894.9 kg and rose up to 5044.4 kg in 2nd trial. The increase yield was 23 % in inorganic fertilizer while the used of ½ inorganic and vermicompost rose up by 30 % and vermicompost alone by 35%. The study result contested with the study of Banik and Bejbaruah (1996) on the effect of vermicompost supplemented with inorganic fertilizer on rice. The 15 kg N from vermicompost + 45 kg 13 and 25 kg/ha NPK produced a maximum grain yield of rice.

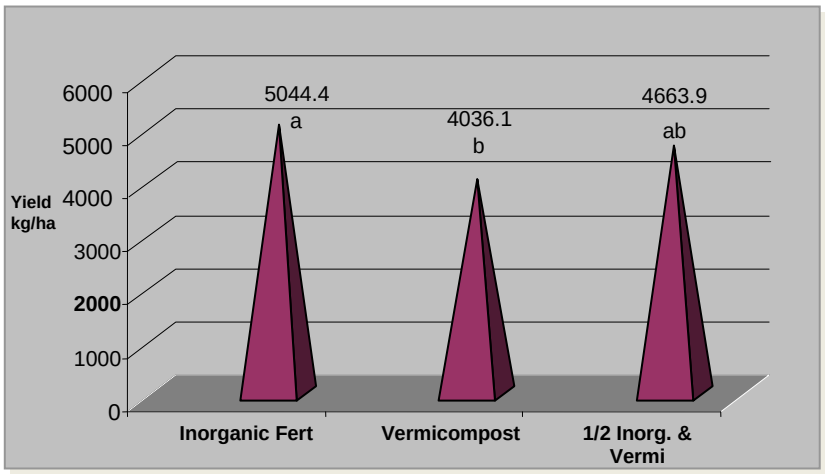

Figure 8. Grain yield of rice as affected by the application of inorganic and vermicompost (2nd trial, June-Sept. 2008)

Cost and Return Analysis

First Trial. Expenses on production when using vermicompost was higher with a cost of 32,295.62 than with inorganic which is only 28,256.72. A difference of almost 4,000 was noticed. The used of inorganic fertilizer generated a highest net income of PhP 20,064.80 with a correspondingly highest net return of investment (ROI) of 71 %. This is followed by the used of ½ inorganic and 1 ton vermicompost with 31.8 percent. The lowest Return on Investment was with the application of vermicompost alone (Table 1).

Table 1. Cost and return analysis of using vermicompost and inorganic fertilizer at first trial

Parameters	Inorganic Fertilizer	Vermicompost 2 tons/ha	½ Inorganic + Vermicompost
Yield/ha (kg)	3,896.9	2,883.4	3,262.5
Price/kg (PhP)	12.40	12.40	12.40
Gross sales(PhP)	48,321.56	35,754.16	40,455.00
Total expenses(PhP)	28,256.72	32,295.62	30,691.17
Net Income(PhP)	20,064.84	3,458.54	9,763.83
ROI	71.0 %	10.7%	31.8 %

Urea- 1,060.00/bag Complete - 950.00/bag Vermicompost- 200.00/bag

Second Trial. Using inorganic fertilizer had a highest gross sale of PhP 75,666.00 with a net income of 41,214.51 and return on Investment of 119.6% (Table 2). Application of ½ inorganic and 1 ton vermicompost ranked second with a net income of 35,638.32 with 103.8% ROI while the used of vermicompost alone got the return on investment of 71.4%. Comparing with the 1st trial the application of ½ inorganic fertilizer + 1 ton vermicompost and vermicompost alone increased markedly by 60.7 % and 72 % respectively. The increase in the price of inorganic fertilizer contributed to slight difference in the ROI in comparison with the use of vermicompost which remain the same.

Table 2. Cost and return analysis of using vermicompost and inorganic fertilizer at 2nd trial

Parameters	Treatment 1	Treatment 2	Treatment 3
Yield/ha (kg)	5,044.4	4,036.1	4.663.9
Price/kg (PhP)	15.00	15.00	15.00
Gross sales	75,666.00	60,541.50	69,958.50
Total expenses	34,451.28	35,320.18	35,638.32
Net Income	41,214.51	25,221.32	35,638.32
ROI	119.6%	71.4%	103.8%

Note: Urea – 1950.00/bag Complete – 2,060.00/bag Vermicompost- 200.00/bag

Conclusions and Recommendations

The problem on conventional method of agriculture leads to this research which was conducted at Jose Rizal Memorial State College - Katipunan Campus, Katipunan, Zamboanga del Norte. The study aimed to evaluate the effect of vermicompost on the growth and yield of rice and the cost and return of production. It was conducted for two cropping seasons from December 2007 to September 2008. The three treatments were laid out in Randomized Complete Block Design (RCBD) in four replications. Treatment 1, using inorganic fertilizer or the school's practice (60-14-14, N-P_2O_5-K_2O kg/ha). Treatment 2 was the used of vermicompost (2 tons or 44.4 bags of vermicompost). Treatment 3 was the application of 1 ton vermicompost and ½ inorganic (30-7-7 N-P_2O_5-K_2O kg/ha).

Study revealed that the height of rice in all cropping seasons at 60 DAT were not significantly different. It was at harvest when the height of was found the tallest plants when applied with inorganic fertilizer. Number of tillers was not significantly different among treatments also. The number of productive grains per panicle and the weight of grains per 1000 grains were statistically the same when vermicompost and inorganic fertilizer were used in two cropping seasons. The addition of 1 ton vermicompost supplemented with inorganic fertilizer (30-7-7 kg/ha) resulted to no significant difference in yield in comparison with the inorganic fertilizer. Cost of production was higher when 1 ton of vermicompost and ½ inorganic fertilizer and 2 ton vermicompost were used in all cropping seasons. Return on Investment in vermicompost supplemented with inorganic fertilizer generated an income which ranked second to inorganic fertilizer which was slightly lower by almost 16 percent.

This implies that 1 ton of vermicompost if added with inorganic fertilizer (30-7-7 kg/ha) can be a replacement in the application of pure inorganic fertilizer (60-14-14 kg/ha). This further entails that the 16% difference in the ROI can be justified by its favorable effect to the environment because of the reduction in the use of inorganic fertilizer.

References

Adorado, J. L., E. M. Buctuanon, L. G. Villegas and C.M Bondad. 2003. Vermiculture and Vermicomposting Technology. Available: http:// www pcarrd.dost.gov.ph

Arancon, N. Q., C. A. Edwards, P. T. Bierman, J. D. Metzger, S. Lee and C. Welch. Effects of vermicomposts on growth and marketable fruits of field grown tomatoes peppers and strawberries. Available: http;//www.sciencedirect.com/science.

Balasubramanayan, P. and S. P. Palaniappan. 2004. Principles and Practices of Agronomy. 2nd ed. Agrobios India.

Banik, P. and R. Bejbaruah. 1996. Effect of vermicompost on rice (*Oryza sativa)* yield and soil fertility status of rainfed humid sub-tropics. Indian Journal of Agricultural Sciences. Available:http://www.cababstractsplus.org.

Sahrawat, K. L. 2005. Fertility and organic matter in submerged rice soils. Current Science. Vol. 88 (5):

Tejada, M. and J. L. Gonzales. 2008. Application of vermicomposts on rice crop: Effects of biological properties and rice quality and yield. http://www. agron.scijournal. org/cgi/contents/abs

Villegas, L. N. 2003. Vermiculture and Vermicomposting Technology. BPI Los Banos National Crop Research and Development Center (LBNCRDC) Los Banos, Laguna. Available: htpp://www.pcarrd.dost.gov.ph.

Wolf, B. and G. Snyder 2006. Sustainable Soils: The Place of Organic Matter in Sustaining Soils and Their Productivity. Food Products Press.