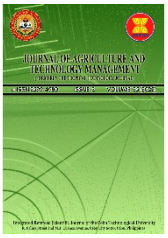
Journal of Agriculture and Technology Management (JATM)
25(2): 314-318 (July-December 2022)



Original article

Productivity of lowland rice (*Oryza sativa* L. Var. NSIC Rc120) using different organic fertilizers with fish amino acid (FAA) supplement

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ABSTRACT

The application of organic fertilizer on lowland rice could be enhanced when supplemented with FAA. This study evaluated the effects of different organic fertilizers on the growth and yield performance of lowland rice and identified what type of organic fertilizer would give better growth and yield on lowland rice. The experiment was conducted in pots and laid out in a Complete Randomized Design with three replications. Each replication was divided into five treatments, with three (3) experimental pots. The treatments were: T_1- Control, T_2- Chicken Manure (10 t ha^{-1}) + FAA, T_3- Carabao Manure (10 t ha^{-1}) + FAA, T_4- Vermicast (10 t ha^{-1}) + FAA, T_5- Inorganic fertilizer 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. The result found that rice plants supplemented with FAA did not influence the heading and maturity of NSIC Rc120. Plants applied with chicken manure + FAA produced longer plant height (cm) and strawweight ($ghill^{-1}$), significantly similar to plants applied with inorganic fertilizer alone at 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. Moreover, the application of chicken manure + FAA produced a greater number of productive tillers and a grain yield comparable to plants applied with inorganic fertilizer at the rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. Hence, chicken manure at 10 t ha^{-1} + FAA can be recommended as a substitute for inorganic fertilizer to rice as it provides comparable grain yield at 19.39 and 22.33 g per hill or equivalent to 4.85tha^{-1} 5.58tha^{-1}, respectively.

KEYWORDS: *Grain yield, fish amino acid (FAA), organic fertilizer, and management.*

1 INTRODUCTION

Rice *(Oryza sativa* L.*)* is one of the most important crops in the world and the most consumed cereal, especially in developing countries. It provides 50–60% of calories to 2.7 billion people (Belder et al., 2004; Metwally et al., 2011) and occupies about 11% of the world's agricultural land (Tumrani et al., 2015). The Philippines, the world's eighth-largest rice producer, has expanded the harvested area from nearly 3.8 million hectares in 2005 to about 4.4 million hectares in 2015 (Ricepedia). Despite this vast area, the country still resorts to rice importation. One cause of low productivity in rice is due to imbalanced nutrient application. To produce higher yields, rice requires a sufficient amount of essential nutrients. Applying inorganic fertilizers readily available in the market has been the solution for most farmers. Unlike organic fertilizer sources, this gives an immediate result once applied to plants. However, the continuous application of inorganic fertilizer in rice over the years has decreased soil productivity. The non-increase manifests this in rice yield despite the increased rate of inorganic fertilizer application. The organic matter content of the soil has already been depleted, affecting the availability of soil nutrients for the rice plant. Correspondingly, it has brought an enormous threat to human health and the environment. Shifting from conventional farming to organic farming has many benefits for the human well-being, protecting the environment (soil, water, and air), rebuilding soil fertility by improving its physical, chemical, and biological characteristics, and improving the quality of produced crops (Ortiz et al., 2017). Although organic manure has low nutrient content and slow decomposition compared to chemical fertilizers, it has multiple benefits due to the balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability. Chand et al. (2016), stated that in agricultural fields, organic manure produced from animal by-products has been utilized to overcome environmental contamination and plant productivity reductions that result from the constant utilization of chemical fertilizers. Recycling waste from the livestock industry prevents environmental contamination and reduces treatment costs, and at the same time, it promotes soil improvements and agricultural productivity.

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p-ISSN: 2599-4875 e-ISSN: 2599-4980

Moreover, with the increasing number of health-conscious people, demand for organically grown rice becomes higher and commands a better price. Therefore, there is a need to know what type of organic fertilizers would compensate for inorganic fertilizers in terms of rice growth and yield performance. Thus, this study was conducted to determine the effects of animal-based fertilizers on the growth and yield performance of lowland rice.

Application of poultry and carabao manures enhanced days to panicle initiation produced the tallest plants with more tillers and broader leaf area per hill (Amanullah et al. 2016). In a study conducted by Odivilas, (2016) on organic fertilizers Vis-à-vis growth performance of euphorbia fulgens, she found out that in terms of growth parameters, Euphorbia orchid with carabao manure obtained more leaves, shoots, and became taller. In addition, it has produced bigger stem girths, and broader and longer leaf sizes of Siam Ruby hybrid. Carabao manure also significantly influenced the growth of flowers' number of flower clusters in Euphorbia orchids. Meanwhile Beltran, (2018) pointed out that using vermicompost and vermitea is a biological method of fertilization and pest control that can increase rice productivity by up to 28%. At the same time, these organic products can reduce the cost of production by more than 50% through continuous application.

Fish Amino Acid (FAA) or fish emulsions made from spoiled fish and fish trash such as bones, head, internal organs, and skin with crude sugar; juice of the fish is extracted and gets fermented after storing for seven days. FAA contains nitrogen (90%) and phosphorus (2.5%). It has a great value to both plants and microorganisms in their growth because it contains various types of amino acids and an abundant amount of nutrients. Boras et al. (2011) stated that amino acids could directly or indirectly influence the physiological activities in plant growth and development. An exogenous application of amino acids has been reported to modulate the growth, production, and quality of tomatoes in plastic greenhouse. Furthermore, fish emulsions have been documented to promote seedling growth (Murray and Anderson, 2004), fruit-ing (Aung and Flick, 1980), and microbe action in the soil El-Tarabily et al. (2003).

The farmers need to find other cheap and effective fertilizer sources, as FAA is supplemented with an organic fertilizer in the hope that it will enhance the growth and yield of the rice plants. However, there are limited studies conducted on the effect of the different sources and levels of the organic fertilizer supplemented with FAA. Hence, this study.

2 MATERIALS AND METHODS

Ten (10) kg of wet soil from rice paddy were used and placed in the pail (25cm length x 35 cm width). Forty-five pails were used in the study arranged in RCBD replicated three (3) times. The treatments are designated as follows: T_1- Control (no application), T_2- Chicken Manure (10 t ha^{-1}) + FAA, T_3- Carabao manure (10 tha^{-1}) + FAA, T_4- Vermicast (10 tha^{-1}) + FAA, T_5- Inorganic fertilizer 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. Rice seeds NSIC Rc120 (Matatag 6) were used. Seeds were soaked in water for 24 hours and incubated for 48 hours. After incubation, the pre-germinated seedlings were spread in the seedbed. Necessary care and management were provided to the seedlings until they were ready for transplanting to the experimental pots.

The different organic fertilizers were procured from different sources. The Chicken carabao manures were taken from the poultry farm and at the Philippine Carabao Center (PPC). The vermicompost was taken from the Ecological Farm and Resource Management Institute (EcoFARMI) in VSU, Visca, Baybay City, Leyte. All the organic fertilizers were applied two (2) weeks before planting. All amounts of P and K were applied ten days after transplanting for the inorganic treatment. The nitrogen fertilizer was applied in 2 splits: 60 kg ha^{-1} ten days after transplanting and 30 kg ha^{-1} at mid-tillering. Insect pest was controlled by handpicking after transplanting. Handpicking and Panyawan-based extracts were applied as a foliar spray to control diseases. Rice plants were harvested when approximately 85% of the grains in each panicle were ripened as indicated by yellow color, firm matured, and hard grains. The samples were threshed, and the grains were sun-dried and cleaned separately per treatment before gathering the necessary data.

Data Gathered

The following parameters were evaluated: For the agronomic characteristics: number of days from sowing to 50% flowering, number of days from sowing to maturity, plant height (cm), and number of tillers $hill^{-1}$. For yield and yield components: number of productive tillers $hill^{-1}$, number of grains $panicle^{-1}$, percent filled grains $panicle^{-1}$; the weight of 1,000 grains (g), and total grain yield (g $hill^{-1}$). However, only parameters with significant differences were presented in the discussion.

Statistical Analysis

The data were statistically analyzed using the computer software Statistical Analysis System (SAS version 6.20). The mean comparison was made using the Honestly Significant Difference (HSD) test at a 5% level of significance

3 RESULTS AND DISCUSSION

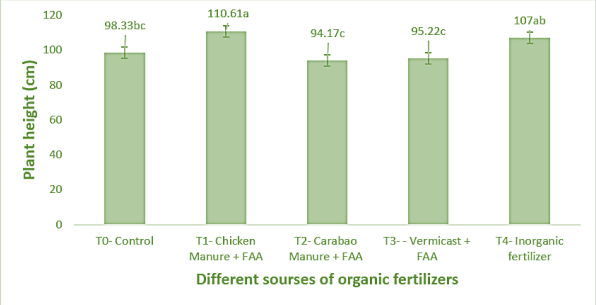
General Observation

p-ISSN: 2599-4875 e-ISSN: 2599-4980

Three days after transplanting, the seedlings raised under T_1 (Chicken Manure + Fish Amino Acid) showed wilting of leaves, which turned pale yellow due to the heat decomposition of chicken manure because it is not fully decomposed. One week later, the seedlings had recovered, and leaf buds started to develop. Typically, the greenhouse temperature is higher than the outside environment. Watering was done every day, especially on sunny days, so seedlings would not show temporary wilting due to water stress. Noticeable differences in the growth were observed one month after transplanting. Plants applied with inorganic fertilizer showed vigorous growth and produced greener leaves and numerous leaves and tillers compared to the other treatments. Weeds were observed in some pots, but it was uprooted immediately to avoid nutrient and sunlight competition.

Agronomic Characteristics

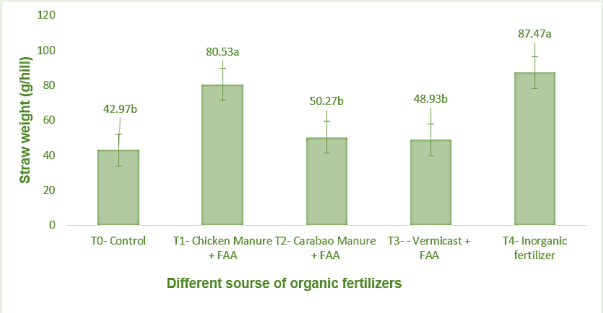
Among the agronomic characteristics, only plant height (cm) and strawweight (g/hill) significantly responded to the treatments (Figures 1 and 2). Applying chicken manure + fish amino acid produced the highest plant height among all treatments. Still, it is statistically comparable to those applied with inorganic fertilizer at 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. The increase in plant height in rice could be due to the longer time for organic materials to decompose and release nutrients for plant growth (Chastain *et al.,* 1999). This follows the findings of Hussein *et al.,* (1997), who recorded that better performance was associated with poultry manure over other organic manures, as evidenced in many agronomic plants. Moreover, the application of carabao manure and vermicast + fish amino acid had the lowest plant height.



Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

Figure 1. Plant height (cm) of lowland rice under different organic fertilizer materials supplemented with FAA

In terms of strawweight, the application of chicken manure + fish amino acid produced straw weight statistically similar to those applied with inorganic fertilizer at the rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. Rahman et al. (2009) reported that the application of organic manures increased the grain and straw weights of rice. Therefore, it is clear that organic manure fertilizers increased plants' vegetative growth and thereby increased rice's straw weights. However, the application of carabao manure, vermicast + FAA, and the control had a lower strawweight.

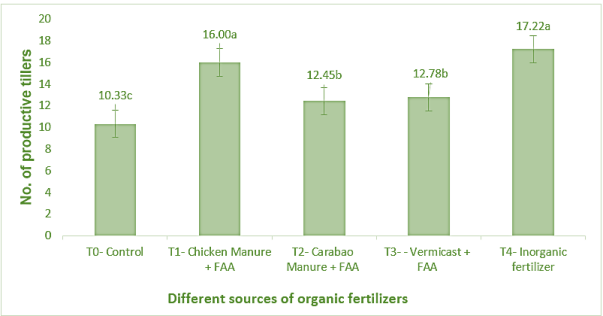


Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

Figure 2. Strawweight (g/hill) of lowland rice under different organic fertilizer materials supplemented with FAA

Yield and Yield Characteristics

The yield and yield characteristics of lowland rice (NSIC Rc120) as affected by different organic fertilizers supplemented with fish amino acids are shown in Table 3. Among the yield components, the number of productive tillers, filled grains, and grain yield was significantly affected by the treatment used. Application of chicken manure + fish amino acid had produced many productive tillers comparable to the application of inorganic fertilizer at the rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. However, plants with carabao manure and vermicast + fish amino acid gave a lower number of productive tillers than those with inorganic fertilizer. The application of carabao manure and vermicast + fish amino acid did not favor the production of higher productive tillers of lowland rice (NSIC Rc120).



Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

Figure 3. Number of productive tillers of lowland rice under different organic fertilizer materials supplemented with FAA

In terms of the number of filled grains, application of inorganic fertilizer at the rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O produced a higher number of filled grains, followed by chicken manure and vermicast + fish amino acid.

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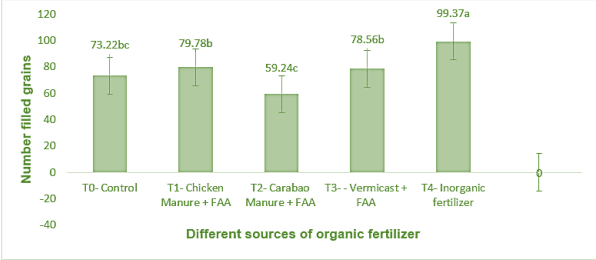
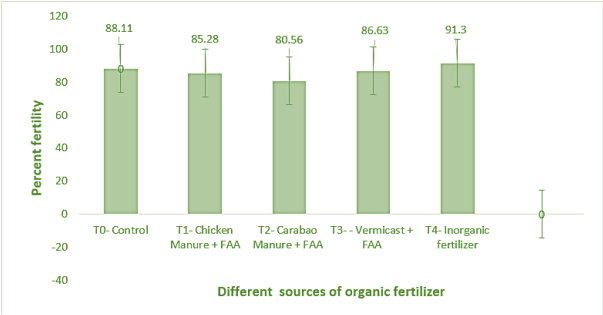
However, the application of carabao manure + fish amino acid and without fertilizer application resulted in a lower number of filled grains. Application of inorganic fertilizer at the rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O produced higher grain yield compared to those applied with organic fertilizers supplemented with fish amino acid that produced lower grain yield. Moreover, applying organic fertilizers supplemented with fish amino acids cannot produce a higher yield of lowland rice (NSIC Rc120).



Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

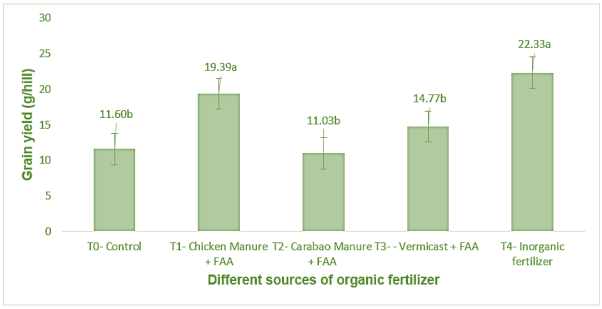
Figure 4. Number of filled grains of lowland rice under different organic fertilizer materials supplemented with FAA

Generally, plants applied with an organic fertilizer at 90-60-60 kg ha^{-1} N, P_2O_5, K_2O produced the highest number of productive tillers, number of filled grains, and grain yield due to the readily available nutrients from the fertilizer material. However, rice plants applied with chicken manure supplemented with FAA had a significantly similar grain yield to the rice plants applied with the recommended inorganic fertilizer. Therefore, according to Muhammad (2006), the increase in yield attributes in rice was due to better plant development through efficient utilization of inorganic fertilizers, where primary growth elements were available in a sufficient amount.



Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

Figure 5. Percent fertility of lowland rice under different organic fertilizer materials supplemented with FAA



Means with the same letter(s) and without letter designation in the bar graph are not significantly different at the 5% level, HSD.

Figure 6. Grain yield (g/hill) of lowland rice under different organic fertilizer materials supplemented with FAA

4 CONCLUSION AND RECOMMENDATION

Based on the results obtained from the study, conclusions can be drawn that the application of different organic fertilizers supplemented with FAA influenced the plant height and straw weight, number of productive tillers, number of filled grains, and grain yield but not in heading, maturity, total leaf area and percent fertility of NSIC Rc120. Supplementation of FAA to chicken manure enhanced the plant height and straw weight compared to the application of inorganic fertilizer at a rate of 90-60-60 kg ha^{-1} N, P_2O_5, K_2O. However, the application of chicken manure supplemented with FAA increased the yield comparable to the plants applied with the recommended inorganic fertilizer.

It is recommended that a similar study be conducted in the open field with the economic profitability to be presented to verify further the effects of different sources of organic fertilizers supplemented with FAA on lowland rice.

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p-ISSN: 2599-4875 e-ISSN: 2599-4980

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p-ISSN: 2599-4875 e-ISSN: 2599-4980