Economic Benefits of Aerobic Rice Grown Using Integrated Nitrogen Management

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Abstract - *This study focuses in the effect of integrated nitrogen management to the yield and economic benefits of aerobic rice. This will help farmers to identify which of the two management technique to use to save costs while profit is high. A split plot experiment in Randomized Complete Block design is used with two main treatments and four sub treatments. Main treatments are the use of integrated nitrogen management and an application of synthetic nitrogen fertilizer. Sub treatments are the different rates of nitrogen fertilizer from 0 as control, 90, 120 and 150 kg N ha^{-1}. Data are consolidated and analyzed using the ANOVA of SAS 9.3 statistical tool and comparison means at 5% significance level in Duncan Multiple Range Test. Grain yield, income, costs, profit and return on expenses are the data gathered. There is an increasing yield from control to 120 kg N ha^{-1} and started to decline at 150 kg N ha^{-1} because optimum level reached at 120 kg N ha^{-1}. Significant increased in yield was observed in plants applied with integrated nitrogen management at 120 kg N ha^{-1} compared to plants applied with synthetic nitrogen due to release of nitrogen that contributed to the yield of aerobic rice. However, plants applied of 90 kg N ha^{-1} synthetic nitrogen gives significant yield increased compared to plants with integrated nitrogen management. Yield was subjected to economic analysis using gross income, costs and profit and return on expenses. Plants applied with synthetic nitrogen at 90 kg N ha^{-1} resulted to high income due to lower costs of fertilizer inputs and only treatment that has a positive return on expenses at 3.2% while other treatments have a negative remarks. This will lead to a conclusion that 90 kg N ha^{-1} is the optimum level of nitrogen that can give high yield and positive return on expenses that farmers will benefited.*

Keywords: *aerobic rice, economic analysis, integrated nutrient management, nitrogen*

INTRODUCTION

Aerobic rice is produced and grown in non puddled and non water saturated soils such as uplands, upper slopes, undulating rice terraces, rainfed and water short irrigated rice fields. Aerobic rice production system in the Philippines contributed to 3% rice production from 110, 551 hectares of upland areas in 79 provinces of the Philippines [1]. Production of aerobic rice faced different challenges such as weeds, diseases, insect pests attacked and most especially nutrient stresses[2], [3] .

Nitrogen fertilization affects the growth and development of the rice plants. This practice is required at early to mid tillering stages and reproductive stage to maximize panicle number, spikelets per panicle and percent filled spikelets [4]. Nitrogen affects on the development of amino acids, proteins and yield performance of rice plants. Right amount and proper timing of fertilization will results to high yield and even to high profit of the farmers. However, excessive fertilization will cause lodging, disease and pests attacked as well as high costs of input production like fertilizer. On the other hand, low fertilization will results to stunted growth that will later affect the yield of the crop which gives low income of the farmers.

Farmers used different nutrient management technique to improve yield of their crop. Most of the farmers based on observation and interviews used synthetic fertilizers in fertilization of their rice plants. However, some of the farmers use organic fertilizer that was applied basally coupled with synthetic fertilizer. This practice is refers to as integrated nitrogen management since organic fertilizer has been perceived to increase nitrogen availability in the soil.

Different nitrogen management practices were employed to improve aerobic rice production. Nitrogen fertilization of 180 to 240 kg N ha^{-1} in four splits resulted to significant increased in height, number of tillers and dry matter production compared to other combination of split application with lower amount of nitrogen [3] . In a different study, Awan [5] stated that maximum rice yield was obtained from the application of 156 kg N ha^{-1} following the 22.5 cm spacing. Similar study conducted using the Leaf Color Chart value of four with 150 kg N ha^{-1} in four splits application; 1/6 at 15 days after sowing, 1/3 at tillering, 1/3 at panicle initiation and 1/6 at flowering obtained the highest number of panicle m^{-2}, number of filled grains $panicle^{-1}$ and 1000 grain weight which increased grain yields from 3.4 to 4.4 tons ha^{-1}[6]. Organic fertilizer application could also contribute to nitrogen availability since there is a mineralization of nitrogen at a rate of 5%.

Most of the researches in aerobic production were in nutrient management specifically nitrogen management applied in different fertilization practices. In the first place, aerobic rice production was intended to grow rice plants that can reduce water usage during land preparation to obtain an 88% water productivity [7]. Lafitte [8] even stated that aerobic rice is planted in adverse condition that will expect low yield and study new varieties with management practices are required.

To complement the results of the previous studies and to address the problem on limited researches of aerobic rice in economics side, a study focusing on the economic benefits of aerobic rice production coupled with integrated nitrogen management is hereby undertaken to determine its viability and feasibility though the yield is low.

OBJECTIVES OF THE STUDY

This study focuses on the economic benefits of producing aerobic rice using the integrated nitrogen management. It will determine if the integration of organic and synthetic fertilizer application will boost yield compared to application of synthetic fertilizer alone. The treatments will be subjected to economic analysis of which among the two managements will give a higher profit.

MATERIALS AND METHODS

The area was thoroughly prepared, plowed and harrowed twice before lay-outing. There were three blocks equally divided in the area with 5 m by 5 m or 25 m^2 area per plot. The block was divided into two main plots for the integrated nitrogen management and synthetic fertilizer alone. Each main plots were divided into five plots. Distance between plots, subplots and blocks were one meter and a bund of 20 centimeter was made every plots.

Research Design and Treatments

The study was laid out in a split plot experiment following the Randomized Complete Block Design. Main plot A was the application of both synthetic and organic fertilizer while main plot B was the application of synthetic fertilizer alone. Subplots were the application of 0 kg N ha^{-1} as the control , 90, 120 and 150 kg N ha^{-1} were the other treatments.

Treatment Application

Organic fertilizer was applied basally at 1 ton ha^{-1}. The amount of nitrogen fertilizer was based on the treatments. Phosphorus and potassium were applied at a rate of 45 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}, respectively. Nitrogen was applied in three splits; (1/4 at 10 days after seed emergence, 1/2 at 25 DAE and 1/4 at 45 DAE). Phosphorus was applied in full at 10 DAE while potassium was applied in two splits; 1/2 at 10 DAE and 1/2 at 45 DAE.

Cultural Management

NSIC Rc23 was the variety used identified as aerobic rice variety and drilled in shallow furrow at a distance of 25 cm between furrows. The plots were irrigated after seed sowing and flush flooding irrigation was performed when needed. Irrigation during fertilizer application was done. Hand weeding was performed twice, before the application of fertilizer at 25 DAE and 45 DAE. Herbicides were applied twice at 10 DAE and 30 DAE. Fungicides was applied twice in the month of September since these were rainy season. Harvesting was done when 90% of the spikelets turned golden yellow. The harvest area was 6 m^2 located at the center of plot.

Data Gathered

Grain yield was obtained through the weight of fresh harvested grains from the net plot. Moisture of the grains were measured and the yield was adjusted to 14% moisture content. Adjusted yield was equal to 100 subtracted to moisture content divided 86, the result was multiplied to actual yield over net plot and then multiplied to 10,000.

Economic benefit was determined by getting the profit of all treatments comparing the integrated nitrogen management and synthetic fertilizer alone. Net profit was the result from gross income subtracted to total expenses. Percent return on expenses was the result from net profit divided by the total expenses multiplied to 100.

Data Analysis

The data was tabulated, consolidated and analyzed based on the analysis of variance of split plot experiment in RCBD using the SAS 9.1 statistical. Comparison among means was done at 5% level of significance using the Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Grain Yield

Figure 1 shows the grain yield of aerobic rice applied with integrated nitrogen management and synthetic fertilizer alone. It is shown that application of 120 kg N ha^{-1} and organic fertilizer resulted to significant increased in yield compared to plants with no organic fertilizer of 5.74 ton ha^{-1} and 5.27 ton ha^{-1}, respectively. This could be attributed to the amount of available nitrogen released by the applied organic fertilizer as there is a 5% mineralization rate. However, application of synthetic fertilizer at 90 kg N ha^{-1} noted a significant increased of yield 5.71 ton ha^{-1} compared to plants applied with same level with organic fertilizer that resulted to 4.67 ton ha^{-1}. The results could be attributed that nitrogen reached its optimum yield production at that level. This event explains the Law of Diminishing Increment that every increased of the application of 30 kg N ha^{-1}, the increased in production is getting smaller. As shown in figure 1, yield increases at certain level from 0 to 120 kg N ha^{-1} and started to decline at 150 kg N ha^{-1} as it reached maximum level. However, the nutrient management of this study resulted to increase in yield as compared to study conducted by Awan [5] of only 4.4 ton ha^{-1}.

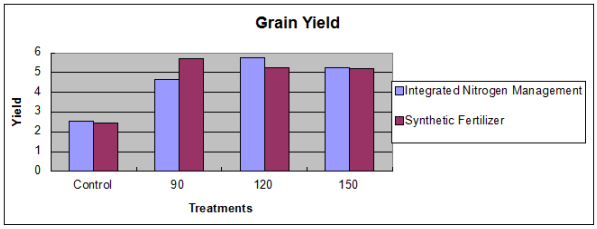

Figure 1. Grain Yield of Aerobic Rice

Gross Income

Figure 2 shows the gross income of the aerobic rice harvested. It was derived from the yield multiplied by Php 17.00 per kilogram, the price set by National Food Authority. As observed in figure 2, integrated nitrogen management at 120 kg N ha^{-1} was higher of Php 97, 610.90 compared to other treatments. On the other hand, gross income of aerobic rice applied with synthetic fertilizer was higher at 90 kg N ha^{-1} of Php 97, 048.91. The gross income was based on the yield of every treatments and this was due to the released nitrogen of organic fertilizer that contributed to the yield increase at 120 kg N ha^{-1} while optimum yield was observed at 90 kg N ha^{-1} where integrated nitrogen management was not applied.

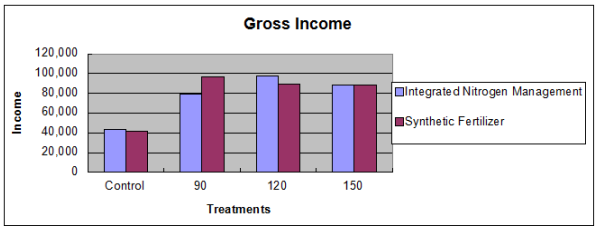

Figure 2. Gross income

Total Costs

Figure 3 shows the total costs of every treatments. Costs from labor, inputs like seeds and fertilizers and miscellaneous costs were recorded. As observed in the figure, treatments applied with integrated nitrogen management had high costs compared to treatments which only uses synthetic fertilizer. This was due to the amount of organic fertilizers that were bought in the production of aerobic rice. Market price of organic fertilizer was valued at Php 270.00 per sack. One ton of organic fertilizer application per hectare was about 20 bags and these were expense of large budget of about Php 5,400.00. Aside from that, labor costs also contributed to high total expenses from land preparation, seed sowing, irrigation and fertilizer application, weeding and harvesting of the rice. Labor costs contributed to approximately Php 53, 000.00.

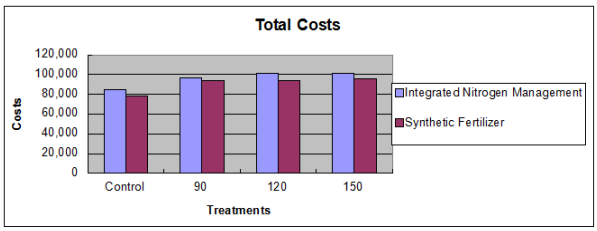

Figure 3. Total costs incurred in aerobic rice production

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Net Income

Figure 4 shows the net income of aerobic rice production. Net income was the result of gross income subtracted to total costs. It was observed that application of integrated nitrogen management was negative due to high total costs that were above from the gross income. However, the net income decreased as the level of nitrogen increased. On the other hand, aerobic rice production applied with synthetic fertilizer had positive net income of Php 3, 052.00 at 90 kg N ha^{-1}. This situation explains the high yield while total costs was low since there were no organic fertilizers bought and applied.

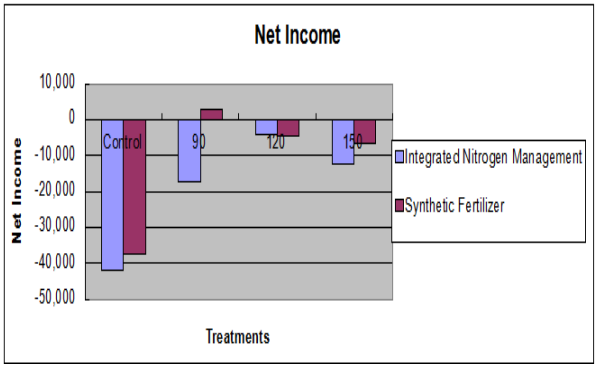

Figure 4. Net income of aerobic rice production

Return on Expenses

Figure 5 shows the return on expenses of the aerobic rice production applied with integrated nitrogen management and synthetic fertilizer. Return on expenses was the result from net income divided by the total expenses. It is shown that application of synthetic fertilizer at 90 kg N ha^{-1} gives a positive return on expenses of 3.2% compared to aerobic rice applied with integrated nitrogen management at same level.

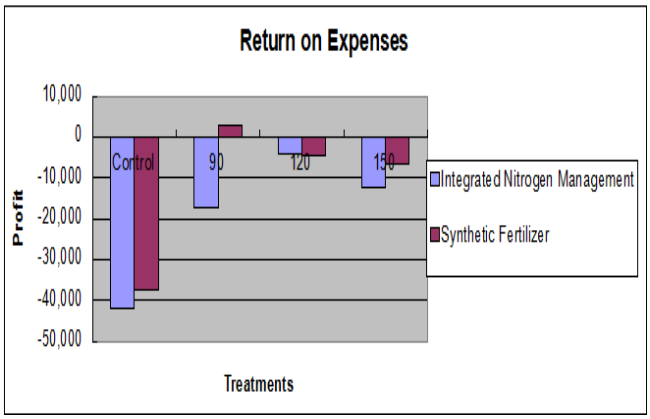

Figure 5. Return on expenses

This situation happened due to high yield of plants applied with 90 kg N ha^{-1} that compensated its total costs. Aside from that, there was no additional costs incurred of buying organic fertilizers. The negative remarks on return on expenses of treatments like control, 120 kg N ha^{-1} and 150 kg N ha^{-1} were also attributed to low yield harvested of aerobic rice.

CONCLUSION AND RECOMMENDATION

This study wanted to determine the efficacy of integrated nutrient management to the yield of aerobic rice and if the yield could provide higher economic benefits.

Based on the findings of this study, it is still better to use synthetic fertilizer at a rate of 90 kg N ha^{-1} as it gives higher yield and expenses on fertilizers specifically organic fertilizer will be avoided. Aside from high yield, a positive return on expenses was also realized.

In addition, further research on the use of organic fertilizer is recommended. Management and practices will be explored to increase the release of nutrient from organic fertilizer to help augment the available nitrogen from synthetic fertilizer. This will might boosts the yield of rice.

REFERENCES

[1] PHILRICE. 2014. Upland Rice Development Program 2011 - 2016. A report. Science City of Munoz, Nueva Ecija.

[2] Fageria, N. K., N. A. Slaton and V.C. Baligar. 2003. Nutrient management for improving rice producivity and sustainability. Advances in Agronomy 80: 63-152.

[3] Anil, K., M. Yakadiri, And G. Jayasree. 2014. Influence of nitrogen levels and times of application on growth parameters of aerobic rice. International Journal of Plant, Animal and Environmental Sciences , 4(3): 231-234.

[4] Lampayan, R. M., B. M. Bouman, J. L. De Dios, A. J. Espiritu, J. B. Soriano, A. T. Lactaoen. 2010. Yield of aerobic rice in rainfed lowlands of the Philippines as affected by nitrogen management and row spacing. Field Crops Research116: 165-174.

[5] Awan, T. H., R. I. Ali, Z. Manzoor, M. Ahmad, And M. Akhtar. 2011. Effect of different nitrogen levels and row spacing on the performance of newly evolved Medium Grain Rice Variety, KSK-133. The Journal of Animal and Plant Sciences , 231-234.

[6] Sathiya, K., And T. Ramesh. 2009. Effect of split application of nitrogen on growth and yield of aerobic rice. Asian J. Exp. Sci , 23(1): 303-306.

[7] Nie, L., S. Peng, M. Chen, F. Shah, J. Huang and K. Cui. 2012. Aerobic rice for water saving agriculture. A review. Agron. Sustain. Dev. 32: 411-418.

[8] Lafitte R.H., B. Courtois & Arraudeau, M. 2002. Genetic improvement of rice in aerobic systems: progress from yield to genes. Field Crop Res. 75: 171-190.

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