EVALUATION OF THE EFFECTS OF COMPOST AS A SUBSTITUTION FOR INORGANIC FERTILIZERS ON YIELD O RICE (BG 94 - I) IN AMPARA DISTRICT

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INTRODUCTION

The integrated nutrient management system is an alternative and is characterized by reduced input of inorganic fertilizers and combined use of chemical fertilizers with organic materials such as animal manures, crop residues, green manure and composts. Several researchers have demonstrated the beneficial effect of combined use of inorganic and organic fertilizers to mitigate the deficiency of many secondary and micronutrients in fields that continuously received only N, P and K fertilizers for a few years, without any micronutrient or organic fertilizer. The effects of organic fertilization and combined use of inorganic and organic fertilizer on crop growth and soil fertility depends on the application rates and the nature of fertilizers used.

In general, the application rates of organic fertilizer are mostly based on crop N need and estimated rates of N supplied via organic fertilizer, but do not consider the amount of P and K provided with organic fertilizer. However, the N/P ratio of organic fertilizer is usually significantly lower than the N/P uptake ratio of the crop nutrients, salt or heavy metal accumulation has also been reported in many papers , especially for the long-term or heavy use of organic fertilizers with higher contents of P, K, salt, or heavy metals. Objectives of this experiment are to determine the effects on growth and yield parameters of rice grown in the Ampara District by using integrated fertilizer application

MATERIALS AND METHODOLOGY

A field experiment was planned at Rice Research Station, Department. of Agriculture, Sammanthurai, in sandy loam soil of the costal area of the Ampara District. The experiment was arranged in a randomized complete block design (RCBD) with 3 replicates during 2015/2016 *Maha* season. Bg 94 – 1 rice variety was used for this experiment. The individual plot size of the experiment was 15 m^2 (5mx3m). Plant in the plot spacing was 30 cm x 15 cm. Land preparation was done by ploughing the field once by a tractor and preparing the bunds and beds were done manually. Beds were cleaned and maintained weeds free. The seeds were soaked in clean water for about 24 hours. Then the seeds were taken out from water and washed and placed in a wet gunny bag. The next day the germinated seeds were established in the 5m x 3m size beds by using the random seed sowing method after reducing the water level of the field.

Treatments of the Experiment

The experiment has five treatments as follows:

T_1- Compost at the rate of 1000 kg $acre^{-1}$

T_2- NPK at the rate of 90 – 22 – 24 kg N, P_2O_5 and K_2O $acre^{-1}$

T_3- 50% of Compost at the rate of 500 kg $acre^{-1}$ and 50% of NPK at the rate of 45 – 11 – 12 kg N, P_2O_5 and K_2O $acre^{-1}$

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T_4 25% of Compost at the rate of 250 kg acre^{-1} and 75% of NPK at the rate of 67.5 – 16.5 – 18 kg N, P_2O_5 and K_2O acre^{-1}

T_5 Control (no inorganic fertilizer and organic manures)

Compost was prepared by incorporating water grass, cow dung, Gliricidia leaves, charcoal and other green manure and animal wastages over a period of 6 months. Compost (1000 kg acre^{-1}) was added three days before sowing to the plots which received integrated compost treatment. Compost used for this research had 6.8 pH, 32% OM and 720 ms cm^{-1} electrical conductivity. Compost was applied to certain plots.

Triple Super Phosphate (T.S.P.) –was applied as a basal fertilizer (22 kg acre $^{-1}$) of certain plots on the same day of sowing. First top dressing was done after 21 days of sowing. Urea (20 kg acre $^{-1}$) was applied to certain plots. Second top dressing (Urea – 35 kg acre $^{-1}$ and MOP – 20 kg acre $^{-1}$) was applied after 42 days of sowing (DOA, 2010).

Measurements taken during the experiment

The following data were collected at 14th week and the 19th week after sowing.

Plant height (cm):- 09 plants were randomly selected from each treatment. The heights of the selected plants were measured manually by using the measuring scale. The height was measured from the base of the main stem to the top of the canopy.

Panicle length (cm): 09 panicles were randomly selected from each treatment. The panicle lengths of the selected plants were measured manually by using the measuring scale. The panicle length was measured from the bottom of the panicle to the top of the panicle.

Number of filled grain per panicle: - 09 panicles were randomly selected from each treatment. The number of filled grain was counted and recorded.

Number of unfilled grain per panicle: - 09 panicles were randomly selected from each treatment. The number of unfilled grain was counted and recorded.

1000 grain weight (g): - The weight of thousand seeds from the selected plants was measured by an electronic balance.

Seed Yield (g):- Collected seeds after the harvesting left for drying under sunlight. Weight of the seeds was measured.

All the data were collected for the experimental purpose were analyzed statistically using ANOVA with SAS package.

RESULTS AND DISCUSSION

Growth Parameters

Canopy height at 100% flowering

Use of compost with chemical fertilizer was found beneficial for canopy height of paddy (Table 1). The highest canopy height at 100% flowering was recorded in the treatment of half dose of compost applied along with half dose of chemical fertilizer (85.92) followed by full dose of chemical fertilizers (85.80), and control plots (82.70). Differences among these treatments were found to be non significant statistically. However these results agree with Masarirambi *et al.* (2012) as they also found that the half a dose of chemical and organic fertilizers gave significant canopy height. This study showed that there was no relationship between canopy height and the application of different type and combination of fertilizer.

Yield Parameters

1000 – grain weight

Maximum number of 1000 grain weight of 28.88g was recorded in the T_3 treatment. i.e., half dose of compost + half dose of chemical fertilizer followed by full dose of chemical fertilizer (26.34g) and ¼ dose of compost + ¾ dose of chemical fertilizer (26.12g). There was no significant difference between treatments T_2 and T_4.Treatments T_1, T_3, T_5 were significantly different. But the minimum 1000 grain weight (23.08g) was counted in control plots. The results were in line with the findings of Parmer and Sharma (2002), Kuepper (2003) and Sarwar *et al.* (2007, 2008) as their findings too showed that the organic fertilizer improved the 1000-grain weight. There was positive relationship between 1000 – grain weight and application of substitution of inorganic fertilizers with organic manures.

Table 1. Growth and Yield Parameters

Treatment	Canopy height (cm)	Panicle length (cm)	No. of filled grains per panicle	No. of unfilled grains per panicle	1000 grain weight (g)	Yield (kg/ha)
T_1	80.15 a	20.40 a	33.00 c	21.00 a	24.17 c	3.60 cd
T_2	85.80 a	21.90 a	37.00 c	20.00 a	26.34 b	4.75 ab
T_3	85.92 a	25.03 a	72.00 a	11.00 a	28.88 a	5.47 a
T_{4-}	80.63 a	22.20 a	49.33 b	27.66 b	26.12 b	4.31 bc
T_{5-}	82.70 a	19.98 a	23.00 d	28.00 b	21.91 d	3.08 d

Seed yield

Seed yield increased significantly ($P \leq 0.05$) in combination of half dose of compost with half dose of chemical fertilizer (T3) compared to the compost alone (T1), and chemical fertilizer alone were applied (T2) as well as (table 1). The application of half dose of compost along with half dose of chemical fertilizer yielded maximum (5.47 kg ha^{-1}) followed by full dose of chemical fertilizer (4.75 kg ha^{-1}) and ¼ dose of compost along with ¾ dose of chemical fertilizer (4.31 kg ha^{-1}) and the differences among these treatments were found to be statistically significant. The minimum yield (3.08 kg ha^{-1}) was measured in control plots. When compost was applied even alone, it shows increasing trend in paddy yield in this study.(Jagadeeswari and Kumaraswami, 2000; Rekhi *et al.*, 2000; Dixit and Gupta (2000), Ahamed *et al.*,(2002), Sarwar *et al.* (2008) and Ali *et al.* (2012), have also observed increased yields of rice with the use of organic manures in combination with chemical fertilizer.

CONCLUSIONS

There was no effect on canopy height and panicle length due to the application of substitution of inorganic fertilizers with organic manures. There was a positive relationship on numbers of filled grain per panicle, numbers of unfilled grain per panicle, 1000 – grains weight and seed yield due to the application of substitution of inorganic fertilizers with organic manures. Overall results indicate that the combination of half dose of compost along with half dose of inorganic fertilizer is the best integrated fertilizer application for the sandy loam soil of the costal area of the Ampara District even though it is not significantly different from the inorganic fertilizer only treatment. However when consider the cost of inorganic fertilizer and the subsequent soil and groundwater, this study proves that the half dose of inorganic with half dose of organic will be a better option in the view of health hazards due to water pollution. The compost could be produced at a very low cost compared to the inorganic fertilizers and such prepared compost would not only be a supplement to chemical fertilizers but also reduce the environmental pollution. Hence, the cost of production will be analyzed for the integrated use of compost and chemical fertilizer alone and it can be predicted that the yield would increase and the low cost for organic fertilizer may improve the income of farm families on sustainable basis.

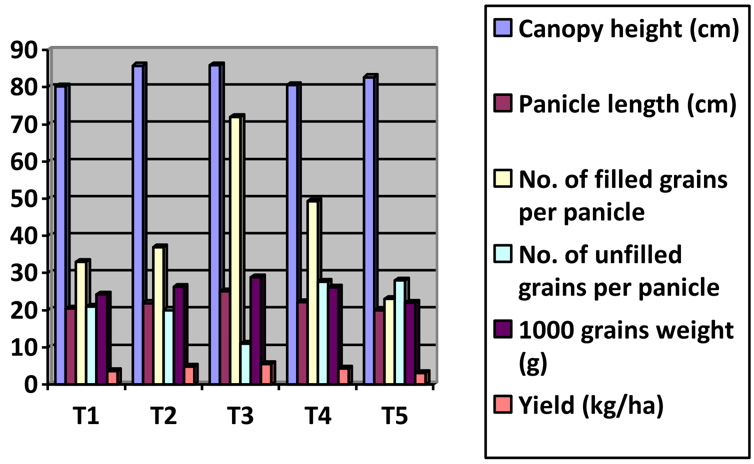

Figure 1. Overall results of the parameters

REFERENCES

Jagadeeswari, P.V. and K. Kumaraswami, 2000. Long term effects of manure fertilizers schedules on the yield and nutrient uptake by rice crop in a permanent manorial experiment. J. Ind.Soc. Soil Sci., 48: 833-836.

Korsaeth, A., T.M. Henriksen and L.R. Bakken, 2002. Temporal changes in mineralization and immobilization of Nduring degradation of plant material. Implications for the plant N supply and nitrogen losses. Soil Biol. Biochem., 34: 789-799.

Kuepper, G., 2003. Manures for organic rice production. Fundamentals of sustainable agriculture. Appropriate technology transfer for rural areas (ATTRA) USA.

Masarirambi, M.T., A.M. Manyatsi and N. Mhazo, 2010. Distribution and utilisation of Wetlands in Swaziland. Res. J. Environ. Earth Sci., 2:147-153

Muhammad, S., T. Muller and R.G. Joegensen, 2007. Compost and P amendments for Stimulating microorganisms and maize growth in a saline soil from Pakistan in comparison with a non-saline soil from Germany. J.Plant Nutr. Soil Sci., 170: 745-751.

Nelson, D.W. and L.E. Sommers, 1996. Total Carbon, Organic Carbon, and Organic Matter. In Methods of Soil Analysis, Part 3. Chemical Methods, 961-1009.

Rekhi, R.S., D.K. Benbi and B. Singh, 2000. Effect of fertilizers and manures on crop yields and soil properties in rice-wheat cropping system.

Long term soil fertility experiments. Rice-wheat Consortium for the Indo-Gangetic Plains. New delhi, India.