INTEGRATED EFFECT OF ORGANIC MANURES AND NITROGEN ON SOIL AGGREGATE STABILITY, CARBON SEQUESTRATION AND YIELD OF RICE

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Extended Summary

The rice-rice system is the most important cropping system in Bangladesh. Continuous cultivation of this highly exhaustive cropping sequence in most of the irrigated fertile lands has resulted in the decline of soil physical condition in general and soil organic carbon (SOC) content in particular. This has led to a reduction in the total factor productivity and raised questions on the sustainability of this cropping system. A key challenge will be to maximize grain production with minimum or zero degradation of soil resource and environmental quality. It will, therefore, be necessary to place greater emphasis on strategic research to increase the efficiency of applied nutrients through integration with organic manures, which will help in accomplishing twin objectives of sustaining soil health and ensuring food security and environmental protection.

Research Objectives

i) To study the potentiality of vermicompost, poultry litter, cow dung and press mud to supplement nitrogen for rice production.

ii) To evaluate the efficacy of the vermicompost, poultry litter, cow dung and press mud (sugar mill wastes) on soil aggregate formation and stability.

iii) To evaluate the effect of integrated use of organic and inorganic fertilizers on carbon sequestration in soil.

The experiment was conducted at Shere-e-Bangla Agricultural University Farm. Seeds of BRRI dhan29 was collected from Bangladesh Rice Research Institute Joydebpur, Gazipur. Plot size was 36 m x 24 m for experimental plot. 2.5 m x 6 m area was selected for individual treatment plot. There were 12 treatments with 3 replications, so total numbers of plots were 36. Transplanting of seedlings was done on 29 January, 2010, seedlings were transplanted maintaining the space of 25 cm x 15 cm. The experiment was carried out with the following treatments-

i. T_1- No chemical fertilizer, no organic manure (control)

ii. T_2- 100% recommended N(120 kg nitrogen / ha) + recommended P,K,S, Zn

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iii. T_3- 80 kg N from urea + 40 kg N substituted by vermicompost + P,K,S, Zn

iv. T_4- 80 kg N from urea + 40 kg N substituted by poultry litter + P,K,S, Zn

v. T_5- 80 kg N from urea + 40 kg N substituted by cow dung) + P,K,S, Zn

vi. T_6- 80 kg N from urea + 40 kg N substituted by press mud + P,K,S, Zn

vii. T_7- 60 kg N from urea + 60 kg N substituted by vermicompost + P,K,S, Zn

viii. T_8- 60 kg N from urea + 60 kg N substituted by poultry litter + P,K,S, Zn

ix. T_9- 60 kg N from urea + 60 kg N substituted by cow dung + P,K,S, Zn

x. T_{10}- 60 kg N from urea + 60 kg N substituted by press mud + P,K,S, Zn

xi. T_{11}- 80 kg N from urea + 40 kg N substituted by equal portion of vermicompost, poultry litter, cow dung and press mud + recommended P,K,S, Zn

xii. T_{12}- 60 kg N from urea + 60 kg N substituted by equal portion of vermicompost, poultry litter, cow dung and press mud + recommended P,K,S, Zn

Harvesting was done on 23-05-2010. Five hills per plot was randomly selected for collecting plant height data and other yield contributing data (number of tillers, number of effective tillers per hill, length of panicle, number of filled and unfilled grain per panicle, thousand grain weight, straw weight etc)

Sufficient amount of soil was collected during harvesting of rice for study of carbon sequestration of soil after harvest of rice.

From this experiment it is revealed that supplement of chemical fertilizers by organic manures performed better in respect of rice yield and also for soil health. It is found that to maintain sustainability integrated nutrient management is the key factor to improve the yield as well as to improve soil productivity and carbon sequestration in to soil. Among the treatment combinations treatment T_3 performed best in respect of rice yield. Treatment T_3 comprises 80 kg nitrogen from urea fertilizers and rest 4o kg nitrogen from vermicompost. Treatment T_2, comprises all the recommended chemical fertilizers without any organic manures failed to provide maximum yield of rice.

In case of soil health it is found from that the amount of macroaggregates accumulation in soil is better where chemical fertilizers are supplemented with organic manures. Increasing amount of organic manures increases the amount of macroaggregates in soil. It is also revealed from the experiment that vermicompost and cowdung performed better than poultry litter and pressmud in the formation of macroaggregates as well as carbon sequestration in soil.

INTEGRATED NUTRIENT MANAGEMENT FOR HYBRID BORO RICE

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Extended Summary

Research objectives: A crop production system with high yield targets cannot be sustainable unless balanced nutrient inputs are supplied to soil against nutrient removal by crops. Neither organic manure nor chemical fertilizer alone can increase satisfactory yield under intensive farming.Therefore, a judicious integration of chemical fertilizer along with organic manure may help to maintained soil fertility as well as increase crop productivity.

The present study was carried out to evaluate an imported hybrid rice cultivar Hira-2

i) To study and compare the potentiality of vermicompost and cow dung to supplement nitrogen for hybrid boro rice production.

ii) To find out the appropriate combination of inorganic N with different organic sources for high yield of hybrid boro rice.

iii) To evaluate the effect of integrated use of organic and inorganic fertilizers on organic carbon content in soil.

The whole of the research works was completed within a period of 1 year (2009-2010). The experiment was conducted in the field of SAU farm during boro season. The laboratory analytical works were conducted at Sher-e-Bangla Agricultural University Soil Science laboratory. The textural class, pH, total N, organic matter, available P, available S and exchangeable K of the initial experimental soil were silty clay loam, 5.8, 0.06%, 0.85%, 19.7 ppm, 20.5 ppm and 0.112 meq/100 g soil, respectively. The used vermicompost and cowdung were analysed in the laboratory for total N. The vermicompost contained 1.4% and cowdung contained 0.6% total N. The field experiment consisted of 12 treatments.

Treatment combinations:

xiii. No chemical fertilizer, no organic manure (Control)

xiv. 100% recommended N(120 kg nitrogen / ha) + recommended P,K,S

xv. 80 kg N from urea + 40 kg N substituted by vermicompost + recommended P,K,S

xvi. 80 kg N from urea + 40 kg N substituted by cow dung + recommended P,K,S

xvii. 60 kg N from urea + 60 kg N substituted by vermicompost + recommended P,K,S

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xviii. 60 kg N from urea + 60 kg N substituted by cow dung + recommended P,K,S
xix. 40 kg N from urea + 80 kg N substituted by vermicompost + recommended P,K,S
xx. 40 kg N from urea + 80 kg N substituted by cow dung + recommended P,K,S
xxi. 80 kg N from urea + 40 kg N substituted by equal portion of vermicompost and cow dung + recommended P,K,S
xxii. 60 kg N from urea + 60 kg N substituted by equal portion of vermicompost and cow dung + recommended P,K,S
xxiii. 40 kg N from urea + 80 kg N substituted by equal portion of vermicompost and cow dung + recommended P,K,S
xxiv. 100% N substituted by equal portion of vermicompost and cow dung + recommended P,K,S

Hybrid boro Rice (Hira-2) was used as test crop. Seeds were collected from the market. To raise seedlings seeds were sown on 15th December, 2009. One month old seedlings were transplanted in the main field on 16th January, 2010. There were 36 plots in total and size of individual plot was 5 m × 2 m. The crop was grown in the field with the above mentioned treatments having 3 replications in RCBD. Rice was harvested on 4th May, 2010. Post harvest soil samples were taken after harvest of the crop, analysed for organic carbon, total N, available P, K and S following standard methods.

The plant height ranged from 92.60 to 101.20 cm and the highest value (101.20 cm) was noted in the treatment T_5 (60 kg N as Urea + 60 kg N as vermicompost), which was statistically similar to those found in treatments T_4 and T_6. The shortest plant height (92.60 cm) was obtained in the treatment T_1 where no fertilizers and manures were used. The combined application of fertilizers with manure increased the plant height compared to single application of recommended dose of fertilizers. The treatment T_3 (80 kg N as Urea + 40 kg N sub. by vermicompost + recom. P,K,S) gave the highest number of total tillers per hill and this value was 17.80 which was statistically similar to T_5 (60 kg N as Urea + 60 kg N as vermicompost + recom.P,K,S). The minimum number of total tillers per hill (12.50) was observed in the treatment T_1 i.e. under control condition. The treatment T_3 (80 kg N as Urea + 40 kg N as vermicompost + recom. P,K,S) gave the highest number of total tillers per hill and this value was 15.90. The lowest number of effective tillers per hill (10.00) was observed in the treatment T_1 i.e. under control condition. The highest panicle length of 27.80 cm was found in the treatment T_3 (80 kg N as Urea + 40 kg N as vermicompost + recom. P,K,S) which was followed by the treatment T_5 (26.95). The lowest panicle length 23.65 cm was recorded in the treatment T_1 i.e. under control condition. The highest number of filled grains per panicle (112.80) was observed in the treatment T_3 (80 kg

N as Urea + 40 kg N as vermicompost + recom. P,K,S) which were identical to the treatment T_4.The lowest value (101.20) was obtained in the treatment T_1 where no chemicals and organic manures were used. The highest number of unfilled grains per panicle (19.00) was observed in the treatment T_1 (control). Minimum number of unfilled grains per panicle (12.25) was found in the treatment T_3 (80 kg N as Urea + 40 kg N as vermicompost + recom.P,K,S,) which were statistically identical with the treatments T_4 and T_{12}.

The grain yield ranged from 3.75 to 7.54 ton ha^{-1}. The highest grain yield (7.54 ton ha^{-1}) was observed in the treatment T_3 (80 kg N as Urea + 40 kg N as vermicompost + recom.P,K,S) and the lowest value (3.75 ton ha^{-1}) was recorded in the treatment T_1 i.e. under control condition. The next higher grain yield (7.04 ton ha^{-1}) was observed in the treatment T_4 (80 kg N as Urea + 40 kg N as cow dung + P,K,S). Vermicompost manure when applied in combination with urea exerted marked effect in increasing the grain yield of hybrid boro rice Hira-2 compared to cow dung manure and urea. . The highest straw yield (8.35 ton ha^{-1}) was obtained in the treatment T_3 which was statistically similar to T_4 and the lowest value (6.30 ton ha^{-1}) was noted in the treatment T_1. Vermicompost exerted comparatively better effect in producing higher straw yields as compared to cow dung. Maximum organic carbon (0.70%) in post harvested soil under T_{12} treatments (120 kg N sub. by equal portion of vermicompost and cow dung + P,K,S) were recorded and the lowest organic carbon (0.63%) was recorded in post harvest soil under the T_1 treatment i.e. under control condition. Maximum total nitrogen (0.091%) in post harvested soil under T_{11} treatment were recorded and the lowest total nitrogen (0.064%) was recorded in post harvest soil under the T_1 treatment i.e. control condition. The total nitrogen of the soils under T_2, T_3, T_4, T_7 and T_{10} treatments were statistically similar. The highest available P (18.60 ppm) in post harvested soil was recorded in T_3 treatment (Table 3) which was statistically identical (18.40 ppm) with T_8 treatment and the lowest available P (14.85 ppm) was recorded in post harvest soil from the T_1 treatment. Highest available S (27.38 ppm) in post harvested soil was recorded in T_3 treatment (Table 2) which was closely followed (26.48 ppm) by T_4 treatment and the lowest available S (21.45 ppm) in post harvest soil from the T_1 treatment i.e. under control condition. The highest exchangeable K (0.148 meq/100 g soil) in post harvested soil was recorded in T_3 treatment (Table 2) which was closely followed by (0.142 meq/100 g soil) with T_5 and T_6 treatment and the lowest exchangeable K (0.110 meq/100 g soil) in post harvest soil from the T_1 treatment. From the above discussion it can be concluded that the treatment T_3 (80 kg N from urea +40 kg N from vermicompost) performed better than all other treatments. It is also revealed that vermicompost as organic manure was better than cowdung in relation to crop growth and yield of rice.