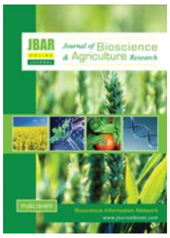
Journal BiNET
Scientific Publication

Published with Open Access at Journal BiNET
Vol. 10, Issue 01: 857-865

Journal of Bioscience and Agriculture Research

Journal Home: www.journalbinet.com/jbar-journal.html



Integrated use of organic and inorganic fertilizers on the growth and yield of Boro rice (cv. BRRI dhan 29)

Mehedi Hashan Sohel[a], Aniruddha Sarker[a], Md. Abdur Razzak[b] and Md. Abul Hashem[c]

[a]Dept. of Soil Science, EXIM Bank Agricultural University Bangladesh, Chapainawabganj-6300, Bangladesh
[b]Agronomy and Farming Systems Division, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna, Bangladesh
[c]Dept. of Soil Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

✉ For any information: ask.author@journalbinet.com, Available online: 14 October 2016

ABSTRACT

A field experiment was conducted to evaluate the integrated effect of cow dung, poultry manure and water hyacinth with chemical fertilizers on the growth and yield of Boro rice (cv. BRRI dhan29). The effect of different levels of organic fertilizers in combination with recommended doses of inorganic fertilizers were tested over growth parameters and yield of rice.Among the yield contributing characters studied plant height, effective tillers hill^{-1}, panicle length and filled grains panicle^{-1} were varied significantly by the different treatments. Most of the yield contributing characters influenced positively in treatment having quarter doses of cow dung, poultry manure and water hyacinth over recommended dose. The highest grain yield (5.58 t/ha)and straw yield (7.28 t/ha) were observed in that same treatmentT_6 (1/3 Cow dung + 1/3 Poultry Manure + 1/3 water hyacinth + Fertilizers) over other treatments. Thus, the application of cow dung, poultry manure and water hyacinth with chemical fertilizers had significant and positive effect on N, P, K and S contents of rice.

Key Words: *Organic fertilizer, Cow dung, Poultry manure and Water hyacinth*

Cite article: Sohel, M. H., Sarker, A., Razzak, M. A. & Hashem, M. A. (2016). Integrated use of organic and inorganic fertilizers on the growth and yield of Boro rice (CV. BRRI dhan 29). *Journal of Bioscience and Agriculture Research,* 10(01), 857-865.

Article distributed under terms of a Creative Common Attribution 4.0 International License.

I. Introduction

Sustainable agricultural productivity might be achieved through wise use of integrated nutrient management (Aulakh and Grant, 2008; Bhuiyan, 1994). Hence, soil fertility maintenance is essential in achieving and maintaining high crop yields over a period of time. Unscrupulous use of inorganic fertilizers to meet up the demands of HYVs rendering the soil organic matter depletion in tropical agriculture. As a result, low organic matter content of the soil, unbalanced use of chemical fertilizers, less use of organic manures and inadequate attention given for its improvement and maintenance have made the situation difficult (Karim et al., 1994; Ali et al., 2009). Before 1980's, deficiency of NPK

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

was a major problem of Bangladesh soil but thereafter along with NPK deficiencies of S and Zn are frequently reported (Haque and Jahiruddin, 1994; Islam and Hossain, 1993). In Bangladesh, most of the cultivated soils have less than 1.5% organic matter, where as good agricultural soil should contain of least 2% organic matter. Miah et al., 2006; Nambiar (1991) reviewed that integrated use of organic manure and chemical NPK fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining higher soil fertility status. Organic matter takes an important role in maintaining soil fertility and productivity (Islam, 2002; Mondal and Chettri, 1998; Rahman and Parkinson, 2007). The problem of nutrient deficiencies as well as nutrient mining caused by intensive cropping with HYV of rice and nutrient imbalance can be minimized by judicious application of nutrients through organic manures. Losses of soil organic matter can only be replenished in the short term by application of organic matter such as manures (Mahajan et al., 2008). Cow dung, poultry manure and water hyacinth are the most popular and promising bulky organic manures produced from solid and liquid excreta of farm animals, which contain considerable amounts of essential nutrient elements required for plant growth. These are one kind of store house of nutrients of plants. Hence an improvement and addition of a good amount of cow dung, poultry manure and water hyacinth to the crop field is essential for fertility and productivityand maintenance of this soil (Singh et al., 1999). Cow dung, poultry manure and water hyacinth have also nutritional value but cow dung use is limited to South East Asian countries including Bangladesh. Besides, cow dung is not utilized properly for crop production. Poultry manure is one of the most promising manure in our country which provides an opportunity to uptake nutrients by plants for a long time, though the poultry farming is now a day's getting popularity (Choudhary and Suri, 2009). Water hyacinth is used to make compostwhich is the important source of essential plant nutrients. Application of cowdung, poultry manure and water hyacinth alone or in combination with recommended fertilizer dose can play important role in rice cultivation (Hossain et al., 1997; Chettri et al., 2002). But the information on the relative contribution of cowdung, poultry manure and water hyacinth alone or in combination with chemical fertilizers in rice production is scarce in Bangladesh. Therefore, this study was designed to study the effect of integrated use of organic and inorganic fertilizers on yield and yield contributing characters of BRRI dhan29 (Saleque et al., 2004; Hossaen, 2011).

II. Materials and Methods

The experiment was carried out at the Field and the Analytical laboratory of Bangladesh Agricultural University, Mymensingh.The experiment was laid out in a Randomized Complete Block Design (RCBD), where the experimental area was divided into 3 blocks representing the replications to reduce soil heterogeneity effects. Each block was divided into 7 unit plots with raised dyke treatments. Thus the total number of unit plot was 21. The unit plot size was 4m×2.5m=10 m^2.The treatment combinations used for the experiment were as follows-T_1: Control (No fertilizer, no manure),T_2: 100% recommended fertilizer dose,T_3: Cowdung (5 t ha^{-1}) + Fertilizers,T_4: Poultry Manure (3 t ha^{-1}) + Fertilizers,T_5: water hyacinth (5 t ha^{-1}) + FertilizersT_6: 1/3 Cowdung + 1/3 Poultry Manure + 1/3 water hyacinth + Fertilizers,T_7: Farmer's Practice (Cowdung 4 t ha^{-1} + Poultry Manure 3 t ha^{-1} + water hyacinth 3 t ha^{-1} + Fertilizers). The chemical composition of the cow dung, poultry manure and water hyacinth are presented in Table 01.

Table 01. Nutrient contents in cow dung and poultry manure and water hyacinth

Name of organic fertilizers	Nutrient contents (%)		
	N	P	K
Cow dung	0.57	0.47	0.69
Poultry Manure	1.18	1.13	0.81
Water Hyacinth (Compost)	2.5	1.5	3.5

Fertilizer Recommendation Guide - 2012.

Data collection for physical properties: Five hills were randomly selected from each plot at maturity to record the yield contributing characters like plant height (cm), numbers of total tillers/hill,

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

numbers of effective tillers/hill, panicle length (cm), numbers of spike/panicle, numbers of grains/panicle and 1000-grain weight (g).

Chemical analysis of grain and straw samples: The estimation of total nitrogen was made by the semi-microKjeldahl method (Page et al., 1982). Phosphorus content of plant extract was determinedcolorimetrically by stannous chloride method (Olsen et al., 1954). Potassiumwas determined from the extract by using flame photometer.Sulphur was determined by turbidimetric method (Hunter, 1984).

Statistical analysis: The data were analyzed statistically by F-test to examine the treatment effects and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) and ranking was indicated by letters.

III. Results and Discussion

Plant growth and yield contributing characters

Plant height

Among the yield contributing characters, plant height was significantly influenced by the different treatments. Plant height increased significantly due to different treatments compared to control treatment. Plant heights ranged from 73.35 to 90.88 cm (Table 02). The highest plant (90.88 cm) was attained in treatment T_6 and second highest plant (88.07 cm) was attained in treatment T_2 (100% RFD). The lowest plant height (73.35 cm) was observed in treatment T_1 (control) which was significantly lower from all other treatments.Cow dung Poultry manure and water hyacinth together with chemical fertilizers showed better performance in increasing the plant height compared to their single application. Channabasavanna and Birandar (2001) noticed that poultry manure induced taller plants as compared to cow dung. The dose of both the organic manures had positive effects on plant height. Babuet et al. (2001) observed that the plant height was significantly influenced by the incorporation of organic manures with fertilizers.

Panicle length

Panicle length of rice was significantly influenced by different treatments (Table 02). All the treatments produced higher panicle length over control treatment (T_1). Panicle length varied from 18.99 to 27.56 cm. The highest panicle length (27.56 cm) was observed in the treatment T_6 which was higher than that of the treatment, T_2, T_3, T_5 and T_7 and was statistically identical to the result of treatment T_2. The lowest panicle length (18.99cm) was observed in the treatment T_1 (control). The result further showed that panicle length increase was directly influenced by the increased dose of organic manure in combination with chemical fertilizers and poultry manure on increased panicle length than cow dung. Ahamed and Rahman (1991) and Kumar and Singh (2006) reported that the combined application of organic matter and chemical fertilizers increased panicle length of rice.

Effective tillers hill^{-1}

The number of effective tillers hill^{-1} was also significantly influenced by the different treatments. Number of effective tillers hill^{-1} ranged from 8.95 to 15.04 (Table 02). The highest number of effective tillers hill^{-1} (15.04) was obtained in the treatment T_6 (Cow dung + Poultry manure + Water hyacinth + Fertilizer). The number of effective tillers hill^{-1} in the treatments T_2, T_7, T_4, T_3, and T_5 were statistically similar. The lowest number of effective tillers hill^{-1} (8.95) was recorded in treatment T_1 (control). The results clearly indicated that the application of organic manures with fertilizers increased effective tiller's hill^{-1} which was comparable to the 100% chemical fertilized treatment. Rahman et al. (1996) observed that the effect of poultry manure on effective tillers hill^{-1} were more prominent than cow dung, it was more so when chemical fertilizers were used in combination. Azim (1999) and Chaturvedi (2005) also reported beneficial effects of manures in combination with chemical fertilizers on effective tillers hill-^{1}.

Filled grains panicle^{-1}

The number of filled grains panicle^{-1} was significantly affected due to application of cow dung, water hyacinth, poultry manure and chemical fertilizers. The number of filled grains panicle^{-1} ranged from

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

90.17 to 147.02 (Table 02). The highest number of filled grains panicle^{-1} (147.02) was found in treatment T_6 (Cow dung + Poultry manure + Water hyacinth + Fertilizers). On the other hand, the lowest number of filled grains panicle^{-1} (90.17) was recorded in treatment T_1 (control). Umanah et al. (2003) and Usman (2003) reported that poultry manure increased the grains per panicle. A similar finding was also claimed by Satyanarayana et al. (2002).

1000-grain weight

The 1000-grain weight of BRRI dhan29 was significantly influenced by the different treatments. 1000-grain weight ranged from 20.19 to 23.01 g (Table 02). The highest 1000-grain weight (23.01g) was observed in the treatment T_6 which was statistically identical to those observed in the treatments T7, T5 and T2. The lowest 1000-grain weight (20.19g) was observed in treatment T1 (control). Rahman (2001) reported that application of chemical fertilizers with farmyard manure or wheat straw in alternate wetting and drying condition increased N, P, & K uptake by rice plants, increased 1000 grain weight and grain yield of rice.

Table 02. Yield contributing characters of BRRI dhan29 as influenced by different treatments

Treatments	Plant height (cm)	Panicle length (cm)	No. of effective tillers hill^{-1}	No. of filled grains panicle^{-1}	1000-grain weight (g)
T_1	73.35 d ± 0.74	18.99 c ±0.18	8.95 d ±0.27	90.17 e ±1.32	20.19 cd ±0.23
T_2	88.07 ab ± 0.88	27.17 a ±0.26	15.03 ab ±0.33	144.99 ab ±1.52	22.08 ab ±0.24
T_3	84.51 c ± 0.83	25.32 ab ±0.25	12.78 bc ±0.29	133.86 c ±1.41	21.13 bc ±0.22
T_4	85.33 bc ± 0.85	24.11 b ±0.24	13.25 abc ±0.31	137.0 bc ±1.49	19.53 d ±0.19
T_5	76.18 d ± 0.75	22.83 c ±0.22	13.10 c ± 0.30	113.74 d ±1.41	22.11 ab ±0.24
T_6	90.88 a ± 0.89	27.56 a ±0.26	15.04 a ±0.33	147.02 a ±1.55	23.01 a ±0.25
T_7	86.92 abc ± 0.85	25.49 ab ±0.25	14.12 abc ±0.32	141.14 abc ±1.53	22.15 ab ±0.24

The data presented in the table as Mean ± SE and significantly varied with 5% Level of significance followed by DMRT.

Yield of grain and straw

Grain yield

The grain yield of boro rice (cv. BRRI dhan29) responded significantly to integrated use of cow dung, poultry manure and water hyacinth with chemical fertilizers and results have been presented in the Table 03. The grain yields of rice ranged from 3.28 to 5.58 t ha^{-1} due to different treatments. All the treatments produced significantly higher grain yield over control. The highest grain yield of 5.58 t ha^{-1} showing 71.7 % increase over control was obtained in the treatment T_6 (Cow dung + Poultry manure + Water hyacinth + Fertilizers) followed by that recorded in the treatment T_7 (Farmer's practice) but they were statistically identical. The lowest grain yield of 3.28 t ha^{-1} was observed in control treatment T_1. The treatments can be ranked in the order of $T_6>T_2>T_7>T_4>T_3>T_5>T_1$ in term of grain yields. The results in the Table 03 reveals that BRRI dhan29 responded better to the NPK supplied from organic manures with chemical fertilizers. NPK supplied from cow dung, poultry manure and water hyacinth with fertilizers i.e. treatment T_6 was found more effective in producing grain yield of BRRI dhan29 as compared to rice straw with fertilizers (T_3) and half chemically fertilizer treatment (T_4). The results clearly indicated that organic sources of nutrient gave significantly higher grain yield over chemical fertilizer. The study revealed that integrated use of cow dung and poultry manure with chemical fertilizers reduced fertilizer without any remarkable yield decline. Haque et al. (2001) and Rajni et al. (2001) reported that application of cow dung, poultry manure and water hyacinth in combination with chemical fertilizers increased grain yield of BRRI dhan29. Rahman et al. (2009) and Singh (2006) reported that the application of organic manure and chemical fertilizers increased the grain and straw yields of rice.

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

Straw yield

Like grain yield, the straw yield of boro rice (cv. BRRI dhan29) responded significantly to the application of cow dung, poultry manure and water hyacinth in combination with chemical fertilizers (Table 03). The straw yield varied from 4.17 to 7.28 t ha^{-1} (Table 3). The highest straw yield (7.28 t ha^{-1}) was recorded in treatment T_6 (Cow dung + Poultry manure + Water hyacinth + Fertilizers) which was 70.4% increased over control. The lowest straw yield (4.17 t ha^{-1}) was recorded in the treatment T_1 (control). In producing straw yield, the treatments may be ranked in order of $T_6>T_2>T_7>T_4>T_3>T_5>T_1$.The percent increase in straw yield over control ranged from 28.2 to 70.53 %. However, the highest percent increase in straw yield (70.4%) was recorded in treatment T_6. The results showed that the application of cow dung or water hyacinth or poultry manure with chemical fertilizers induced higher straw yield of BRRI dhan29 and cow dung was superior to poultry manure and increased rate also had positive effect in it.This finding is assembled to the work of Khan (1998) and Reddy et al. (2004) who found significant effects of manures and fertilizers on straw yield. Rajput and Warsi (1992) and Singh (2001) also reported that the application of organic manure and chemical fertilizers increased straw yield.

Table 03. Grain and straw yields of BRRI dhan29 as influenced by different treatments

Treatments	Grain		Straw	
	Yield (t ha^{-1})	% yield increase over control	Yield (t ha^{-1})	% yield increase over control
T_1	3.28 d ± 0.108	-	4.17 e ±0.081	-
T_2	5.38 ab ± 0.116	64.1	7.14 a ±0.085	63.1
T_3	4.93 b ± 0.112	47.2	6.03 cd±0.084	37.7
T_4	4.94 b ± 0.112	50.2	6.23 bc±0.084	46.3
T_5	4.25 c ± 0. 113	29.1	5.77 d ±0.082	28.2
T_6	5.58 a ± 0.116	71.7	7.28 a ±0.085	70.4
T_7	5.28 ab ± 0.116	60.4	6.31 b ±0.084	50.1

The data presented in the table as Mean ± SE and significantly varied with 5% Level of significance followed by DMRT.

Nutrient contents in grain and straw of BRRI dhan29

Nitrogen content

The nitrogen content in grain and straw of BRRI dhan29 was significantly influenced by combined application of cow dung, water hyacinth or poultry manure along with chemical fertilizers than single application of cow dung and poultry manure. The grain N content varied from 0.981 to 1.249% (Table 04). The highest grain N content (1.249%) was observed in the treatment T_6 which was statistically identical to the results of treatments T_7 and T_2. The lowest grain N content (0.981%) was observed in the treatment T_1 (control). On the other hand, N content in straw varied from 0.467 to 0.598% (Table 4). The highest N content (0.598%) in straw was observed in treatment T_6 which was statistically identical to the results of treatments T_7 and T_2. The lowest straw N content (o.467%) was observed in the treatment T_1 (control) which was statistically identical to those in the treatments T_3 and T_5. Farid et al. (2011); Zaman et al. (2000) and Manzoor et al. (2000) reported that chemical properties like organic matter content, CEC, total N, exchangeable K, available P and S were favorably influenced by the application of organic sources of nitrogen and potassium while the inorganic sources mostly did not show positive effect.

Phosphorus content

Phosphorus content in rice grain and straw (Table 04) of BRRI dhan29 were increased significantly due to the combined application of cow dung, poultry manure and water hyacinth with chemical fertilizer. Data in Table 04 indicated that phosphorus content in grain was significantly and in straw insignificantly affected by various treatments under study. The phosphorus in rice grain ranged from 0.208 to 0.289% (Table 4) due to application of chemical fertilizers along with the cow dung or poultry manure. It was evident from the results that poultry manure accumulated more P in rice grain than

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

that of cow dung. The highest P content (0.289%) in grain was found in treatment T_6. The second highest P content (0.288%) was statistically similar with the results of treatment T_3, T_4, T_5 and T_7. The lowest P content (0.208%) in grain was found in treatment T_1 (control). The P content in straw ranged from 0.124 to 0.188%. The highest P content (0.188%) in straw was observed in treatment T_6 which was statistically different from all other treatments. The lowest P content (0.124%) in straw was recorded in treatment T_1 (control). All the treatments produced higher P content in grain than that in straw. Laximinarayana (2000) and Vennila et al. (2007) reported that the application of organic manure and chemical fertilizers increased the phosphorus content in rice.

Potassium content

Results in Table 04 indicated that potassium contents in rice grain and straw were significantly influenced by the different treatments over control. The K contents in grain and straw varied from 0.194 to 0.299% and 1.259 to 1.631%, respectively (Table 04) due to application of chemical fertilizers along with the cow dung, water hyacinth and poultry manure. It was evident from the results that poultry manure was more K accumulating in rice grain than that of cow dung. The highest K content in grain (0.299 %) was found in treatment T_6. The lowest K content in grain (0.194%) was obtained in treatment T_1 (control). In straw, the highest K content (1.631%) was found in treatment T_6 which was statistically different from all other treatments. The lowest K content in straw (1.259%) was observed in treatment T_1 which was different from all other treatments. Whalen et al. (2000) reported that mineral N, available P,K, Ca and Mg increased immediately after cattle manure application.

Sulphur content

Data in Table 04 indicated that sulphur contents in grain and straw was insignificantly affected by various treatments under study. Sulphur content in rice grain ranged from 0.097 to 0.144%. The highest value (0.144%) was found in T_6. which was statistically identical to the result of treatment T_2. The lowest S content was in treatments T_1 which was statistically similar to the results of treatments T_3, T_4, and T_5. On the other hand, the S content in straw varied from 0.071 to 0.125%. The highest S content in straw (0.125%) was observed in treatment T_6 (Cow dung + Poultry manure + Water hyacinth + Fertilizers) which was statistically similar to those in treatments T_2, T_4, and T_7. The lowest S content in straw (0.071%) was found in treatment T_1 (control). Hossain (1996) and Muhammad et al. (2003) reported that the levels of S concentrations in rice grain and straw improved due to combined use of organic manures and chemical fertilizers.

Table 04. N, P, K and S contents in grain and straw of BRRI dhan29 as influenced by different treatments

Treatment	% N		% P		% K		% S	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1	0.981 d ± 0.0074	0.467 d ±0.0079	0.208 b ±0.0088	0.124	0.194 d ±0.0092	1.259 c ±0.0075	0.097	0.071
T_2	1.233 ab ±0.0084	0.569 ab ±0.0088	0.266 ab ±0.0092	0.165	0.287 ab ±0.0099	1.525 ab ±0.0084	0.128	0.112
T_3	1.148 c ±0.0075	0.512 bcd ±0.0083	0.239 ab ±0.0091	0.139	0.228 bcd ±0.0095	1.325 c ±0.0079	0.107	0.097
T_4	1.171 bc ±0.0079	0.538 abc ±0.0089	0.249 ab ±0.0090	0.149	0.233 bcd ±0.0096	1.338 c ±0.0081	0.113	0.107
T_5	1.132 c ±0.0080	0.502 cd ±0.0082	0.234 ab ±0.0091	0.133	0.211 cd ±0.0093	1.289 c ±0.0078	0.107	0.088
T_6	1.249 a ±0.0081	0.598 a ±0.0086	0.289 a ±0.0093	0.188	0.299 a ±0.0098	1.631 a ±0.0085	0.144	0.125
T_7	1.223 ab ±0.0084	0.545 abc ±0.0089	0.288 a ±0.0093	0.168	0.263 abc ±0.0095	1.392 bc ±0.0079	0.133	0.088

Data presented in the table as Mean ± SE and significantly varied with 5% Level of significance followed by DMRT.

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

IV. Conclusion

Plant height, effective tillers hill^{-1}, panicle length, number of filled grains panicle^{-1} and 1000-grain weight were significantly influenced due to different treatments. It may be mentioned here that the combined application of organic and inorganic fertilizers showed the better performance in the yield components of rice.It was observed that cow dung, poultry manure and water hyacinth with chemical fertilizers gave better grain and straw yields than only chemical fertilizers. It also appeared that yields due to organic manure (cow dung, poultry manure and water hyacinth) were statistically superior to the yield obtained with the control treatment.

Acknowledgement

Authors wish to thank Dr. Md. Abul Hashem, Dr. M. Mazibur Rahman and all of the teachers, technicians and staffs of the department of soil science, Bangladesh Agricultural University, Mymensingh for their assistance in conducting the study.

V. References

[1]. Ahemd, M. & Rahman, S. (1991). Influence of organic matter on the yield and mineral nutrition of modern rice and soil properties. *Bangladesh Rice J.* 2(1-2), 107-112.

[2]. Ali, M. E., Islam, M. R. & Jahiruddin, M. (2009). Effect of integrated use of organic manures with chemical fertilizers in the rice-rice cropping system and its impact on soil health. *Bangladesh J. Agril. Res.* 34(1), 81-90.

[3]. Aulakh, M. S. & Grant, C. A. (2008). Integrated nutrient management for sustainable crop production. The Haworth Press, Taylor and Francis Group, New York.

[4]. Azim, S. M. A., Rahman, M. M., Islam, M. R. & Hoque, M. A. (1999). Effect of sulphur, zinc and boron supplied from manures and fertilizers on BRRI Dhan 29. MS Thesis, Dept. of Soil Sci., BAU, Mymensingh.

[5]. Babu, S., Marimuthu, R., Manivanna, V. & Ramesh-Kumer, S. (2001). Effect of organic and inorganic manures on growth and yield of rice*. Agriculture Science Digest.* 21(4), 232-234.

[6]. BARC (2012). Fertilizer Recommendation Guide. Pub. No. 41. Bangladesh Agricultural Research Council, Farmgate, Dhaka.

[7]. Bhuiyan, N. I. (1994). Crop production trends and need of sustainability in Agriculture. Paper presented at the workshop on Integrated Nutrient Management of Sustainable Agriculture, held at SRDI, Dhaka. Bangladesh, during June 26-28.

[8]. Channabasavanna, A. S. & Birandar, D. P. (2001). Response of irrigated rice to the application of poultry manure and inorganic fertilizer N, P, and K in Karnata, India. *Int. Rice Res. Newslett.* 26(2), 64-65.

[9]. Chaturvedi, I. (2005). Effect of nitrogenous fertilizers on growth, yield and quality of hybrid rice. *J. Cent. Europ. Agri.* 6(4), 611–618.

[10]. Chettri, M., Mondal, S. S. & Roy, B. (2002). Suties on the effect of sources of potassium and sulphur with or without farm yard manure on the yield components, grain yield and percent disease index in rice under intensive cropping system. *J. Interacademicia,* 6(1), 45-50.

[11]. Choudhary, A. K. & Suri, V. K. (2009). Effect of organic manures and inorganic fertilization on productivity, nutrient uptake and soil fertility in rice (Oryza sativa)-wheat (Triticum aestivum) crop sequence in Western Himalayas. *Current Advances in Agricultural Sciences,* 1, 65-69.

[12]. Farid, M. S., Mamun, M. A. A., Matin, M. A. & Jahiruddin, M. (2011). Combined effect of cowdung, poultry manure, dhaincha and fertilizers on the growth and yield of rice. *J. Agrofor. Environ.* 5(1), 51-54.

[13]. Gomez, K. A. & Gomez, A. A. (1984). Duncan's Multiple Range Test in Statistical Procedures for Agricultural Research. Awiley Interscience publication. John Wiley and Sons. New York, Brisbane. Singapore. pp. 139-240.

[14]. Haque, M. Q., Rahman, M. H., Islam, Rijpma, F. J. & Kadir, M. M. (2001). Integrated nutrient management in relation to soil fertility and yield sustainability under Wheat-Mung-T. Aman cropping pattern. *Online J. Biol. Sci.* 1(8), 73 1-734.

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

[15]. Haque, M. R. & Jahiruddin, M. (1994). Effects of single and multiple applications of sulphur and zinc on a continuous rice cropping pattern. *Indian J. Agril. Res.* 28, 9-14.
[16]. Hossaen, M. A., Shamsuddoha, A. T. M., Paul, A. K., Bhuiyan, M. S. I. & Zobaer, A. S. M. (2011). Efficacy of different organic manures and inorganic fertilizer on the yield and yield attributes of Boro Rice. *The Agriculturists*, 9, 117-25.
[17]. Hossain, M. B. (1996). Integrated nutrient management for BR 11 rice. MS Thesis, Dept. of Soil Sci. (July-Dec/1996), BAU, Mymensingh.
[18]. Hossain, M. B., Islam, M. R., Rhaman, M. M. & Jahiruddin, M. (1997). Effect of integrated nutrient management on rice yield and components of BR 11 rice. *Progressive Agriculture*, 8(1 &2), 83-86.
[19]. Hunter, A. H. (1984). Soil fertility analytical service in Bangladesh. Consultancy Report, BARC, Dhaka.
[20]. Islam, M. R. & Hossain, A. (1993). Influence of additive nutrients on the yield of BR 11 rice. *Thai. J. Agril. Sci.* 26, 195-199.
[21]. Islam, M. S. (2002). Soil fertility history, present status and future scenario in Bangladesh. Paper presented at the Training Course on Soil Fertility and Fertilizer Management held at CERDI, Gazipur, 9 Sept. 2002.
[22]. Karim, Z., Miah, M. M. V & Razia S. (1994). Fertilizer in the national economy and sustainable environment. *Asia Pacific Environ. Develop.* 2, 48-67.
[23]. Khan, M. M. R. (1998). Effect of cowdun, poultry manure and urea-N on the growth and yield of BRRI dhan 29. MS Thesis, Dept. of Soil Sci. (July-December/1998), BAU, Mymensingh.
[24]. Kumar, V. & Singh, O. P. (2006). Effect of organic manures Nitrogen and Zinc fertilization on growth, yield, yield attributes and quality of rice (Oryza sativa L). *J. Plant Sci.* 1(2), 311-314.
[25]. Laximinarayana, K. (2000). Effect of integrated use of organic manures on yield of low land paddy. *J. Hill. Res.* 13(2), 125-127.
[26]. Mahajan, A., Bhagat, R. M. & Gupta, R. D. (2008). Integrated nutrient management in sustainable rice-wheat cropping system for food security in India. *SAARC J. Agric*, 6, 29-32.
[27]. Manzoor, Z., Awan, T. H., Safdar, M. E., Ali, R. I., Ashraf, M. M. & Ahmad, M. (2006). Effect of nitrogen levels on yield and yield components of basmati 2000. *J Agric Res.* 44, 115–22.
[28]. Miah, M. A. M., Ishaque, M. & Saha, P. K. (2006). Integrated nutrient management for improving soil health and rice production. Proc. of twenty first BRRI-DAE joint workshops on bridging the rice yield gap for food security. BRRI, Gazipur, Bangladesh, 19-21 September, paper 11. pp. 1-15.
[29]. Mondal, S. S., Chettri, M. (1998). Integrated nutrient management for sustaining productivity and fertility under rice (*Oryza sativa*) based cropping system. *Indian J. Agr. Sci.* 68 (7), 337–340.
[30]. Muhammad, U., Ullah, E., Warriach, E. A., Farooq, M. & Liaqat, A. (2003). Effect of organic and inorganic manures on gowth and yield and of rice variety Basmati- 2000. *Intl. J. Agric. & Bio.* 5(4), 481-483.
[31]. Nambiar, K. K. M. (1991). Long-term fertility effects on wheat productivity. Wheat for the nontraditional warm areas: A proceedings of the International Conference. Mexico DF (Mexico), CYMMYT. pp. 516-521.
[32]. Olsen, S. R., Cole, C. V., Watanabe, F. S. & Dean, L. A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *U. S. Dept. Agric. Circ.* 929 .
[33]. Page, A. I., Millar, R. H. & Keeney, D. R. (1982). Methods of soil analysis. Part-2. Madison, Wisc.
[34]. Rahman, M. A. (2001). Integrated use of fertilizer and manure for crop production in wheat-rice and rice-rice cropping patterns. Ph.D. Thesis, Dept. of Soil Sci., Bangladesh AgriI. Univ., Mymensingh.
[35]. Rahman, M. S., Islam, M. R., Rahman, M. M. & Hossain, M. I. (2009). Effect of cowdung, poultry manure and urea-N on the yield and nutrient uptake of BRRI dhan 29. *Bangladesh Research Publications Journal*, 2, 552-558..
[36]. Rahman, S. & Parkinson, R. J. (2007). Productivity and soil fertility relationships in rice production systems. *Bangladesh Agricultural Systems*, 92, 318-33. http://dx.doi.org/10.1016/j.agsy.2006.04.001
[37]. Rajni, R., Srivastava, O. P. & Rani, R. (2001). Effect of integration of organics with fertilizer N on rice and N uptake. *Fert. News.* 46(9), 63-65.

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper

[38]. Rajput, A. L. (1992). Effect of fertilizer and organic manure on rice (*Oryza sativa* L.) and their residual effect on wheat (*Triticum aestivum*). *Indian J. Agron.* 40(2), 292- 294.
[39]. Rahman, M. S., Islam, M. R., Rahman, M. M. and Hossain, M. I. 2009. Effect of cowdung, poultry manure and urea-N on the yield and nutrient uptake of BRRI dhan 29. Bangladesh Research Publications Journal, 2, 552-558.
[40]. Reddy, V. C., Ananda, M. G. & Murthy, K. N. K. (2004). Effect of different nutrients sources on growth and yield of paddy. *Environ. Ecol.* 22(4), 622-626.
[41]. Saleque, M. A., Abedin, M. S., Bhuiyan, N. I., Zaman, S. K. & Panaullah, G. M. (2004). Longterm effect of inorganic and organic fertilizer sources on yield and nutrient accumulation of lowland rice. *Field Crops Res.* 86, 53-65. http://dx.doi.org/10.1016/S0378-4290(03)00119-9
[42]. Satyanarayana, V., Prasad, P. V., Murthy, V. R. K. & Boote, K. J. (2002). Influence of integrated use of farmyard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. *J. Pl. Nut.* 25, 2081-90. http://dx.doi.org/10.1081/PLN-120014062
[43]. Singh, N. P., Sachan, R. S., Pandey, P. C., Bisht, R. S. (1999). Effects of decade long fertilizer and manure application on soil fertility and productivity of rice-wheat system in a Mollisol. *J. Indian Soc. Soil Sci.* 47(1), 72–80.
[44]. Singh, R. P., Yadav, P. K., Singh, R. K., Singh, M. K. & Singh, J. (2006). Effect of chemical fertilizer, FYM and biofertilizer on performance of rice and soil properties. *Crop Res.* 32, 283-285.
[45]. Singh, R., Singh, S. & Prasad, K. (2001). Effect of fertilizer, FYM and row spacing on transplanted rice. *Crop Research*, 22 (2), 296-299.
[46]. Umanah, E. E., Ekpe, E. O., Ndon, B. A., Etim, M. E. & Agbogu, M. S. (2003). Effects of poultry manure on growth characteristics, yield and yield components of upland rice in South Eastern Nigeria. *J. Sustainable Agric and the Environment,* 5(1), 105-110.
[47]. Usman, M., Ullah, E., Warrich, E. A., Earooq, M. A. & Liaqat, A. (2003). Effect of organic manures on growth and yield of rice variety “Basmati 2000”. *Int. J. Agric. Biol.* 5, 481-483.
[48]. Vennila, C. (2007). Integrated nitrogen management for wet seeded rice + daincha dual cropping system. *Journal of Soils and Crops,*17(1), 14-17.
[49]. Whalen, J. K., Chang, C., Clayton, G. W. & Caretool, J. P. (2000). Cattle manure amendments can increase the PH of acid soills. *Soil Sci. Soc. Am. J.* 64(3), 962-966. http://dx.doi.org/10.2136/sssaj2000.643962x
[50]. Zaman, S., Hashem, M. A., Mian, M. H., Mallik, S. A. & Shamjuddoha. A. T. M. (2000). Effect of organic and inorganic sources of nitrogen and potassium on physical and chemical properties of soil under rice cropping. *Bangladesh J. Agril. Sci.* 27(1), 71-76.

Published with open access at journalbinet.com
EISSN: 2312-7945, © Sohel et al. (2016), Research paper