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Integrated nutrient management affect growth and yield of T. aman rice

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ABSTRACT

A field experiment was carried out at Sher-e-Bangla Agricultural University Farm during the kharif period from July, 2011 to November, 2011 to evaluate the effect of integrated nutrient management on growth and yield of T. Aman rice. The experiment comprised of eleven inorganic and organic manure combination viz., T_0 (Control), T_1 (N_{120} $P_{15}K_{45}S_{20}$, Recommended dose), T_2 (80% NPKS + 2 t ha^{-1} DH), T_3 (80% NPKS + 4 t ha^{-1} CD), T_4 (80% NPKS +1 t ha^{-1} DH + 2 t ha^{-1} CD),T_5 (70% NPKS + 4 t ha^{-1} DH),T_6 (70% NPKS + 8 t ha^{-1} CD), T_7 (70% NPKS + 2 t ha^{-1} DH + 4 t ha^{-1} CD), T_8 (50% NPKS + 6 t ha^{-1} DH), T_9 (50% NPKS + 12 t ha^{-1} CD) and T_{10} (50% NPKS + 3 t ha^{-1} DH + 6 t ha^{-1} CD).. Application of 70% NPKS fertilizers + 4 t ha^{-1} GM produced the highest grain yield (5.9 t ha^{-1}) and the second highest grain yield (5.85 t ha^{-1}) was obtained from T_2 (80% NPKS + 2 t ha^{-1} DH) treatment. Grain yield of T. Aman rice was positively correlated with number of effective tiller, plant height, panicle length, filled grain per panicle and straw yield. In straw yield, the treatment T_3 (80% NPKS + 4 t ha^{-1} CD) produced the highest yield (8.59 t ha^{-1}) and the second highest straw yield (8.08 t ha^{-1}) was obtained from T_1 (N_{120} P_{15} K_{45} S_{20}, Recommended dose). The grain yield increases over control and ranges between 31.18 to 86.31 %. Therefore combined application of 70% NPKS fertilizers with 4 t/ha DH would results in higher number of effective tiller, plant height, panicle length and filled grains $panicle^{-1}$ and 1000 grain weight. BRRI dhan40 at the Tejgoan silty loam soil.

Introduction

Rice (*Oryza sativa*) is one of the most important cereal crops of the world. There are one hundred eleven rice growing countries in the world that occupies about 146.5 million hectares more than 90% is in Asia. It is the staple food for more than two billion people in Asia and many millions in Africa and Latin America. About 95% of the world rice is consumed in Asia. About 40% of the world population consumes rice as a major source of calories (Banik, 1999). Agriculture in Bangladesh is predominately rice based and Bangladesh is the fourth rice producing country in the world (BRRI, 2006). It is grown in 28.06 million hectares of land with a total production of 31.98 million metric tons in the year 2009-2010. Rice is grown in three seasons namely Aus (mid march to mid august), Aman (mid June to November) and Boro (Mid December to mid-June). Out of these aman cover the largest area (about 13.99 million hectares) and the highest production of about 12.21 million metric tons of rice (BBS, 2010).

Integrated nutrient management (INM) or integrated nutrient supply (INS) system aims at achieving efficient use of chemical fertilizers in conjunction with organic manures. Long term fertilizer experiments involving intensive cereal based cropping systems reveal a declining trend in productivity even with the application of recommended levels of N, P and K fertilizers (Mahajan et al., 2002; Mahajan & Sharma, 2005). The crop productivity increases from the combined application of chemical fertilizers and organic manures. Rice *(Oryza sativa* L.) is intensively cultivated in Bangladesh covering about 80% of arable land. Unfortunately, the yield of rice in this country is low (3.4 t/ha) compared to other rice growing countries like South Korea and Japan where the average yield is 6.00 and 5.6 t/ha, respectively (FAO, 2003). On the other hand, the demand for increasing rice production is mounting up to feed the ever-increasing population. A suitable combination of organic and inorganic source of nutrients is necessary for sustainable agriculture that can ensure food production with high quality (Reganold et al., 1990). Nambiar (1997) viewed that integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining better soil fertility. Considering the above facts, the present research was under taken to develop a suitable combination of inorganic fertilizers and organic manures the growth and yield of T. Aman rice and to evaluate the effect of different levels of inorganic fertilizers and organic manures on the growth and grain yield of T. Aman rice.

Materials and methods

Experimental site

The experiment was conducted in the experimental field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from July, 2011 to November, 2011. The soil of the experimental site belongs to the General Soil Type, Deep Red Brown Terrace Soils under Tejgaon Series. Top soils were clay loam in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles having soil pH 6.0 and organic matter 1.19%. The experimental area was

flat having available irrigation and drainage system and above flood level.

Cultivation procedure and experimental treatments

The experiment was laid out in a randomized complete block design with three replications. The experiment comprised of eleven treatment combination viz., T_0 (Control), T_1 ($N_{120}P_{15}K_{45}S_{20}$, Recommended dose), T_2 (80% NPKS + 2 t ha^{-1} DH), T_3 (80% NPKS + 4 t ha^{-1} CD), T_4 (80% NPKS + 1 t ha^{-1} DH + 2 t ha^{-1} CD), T_5 (70% NPKS + 4 t ha^{-1} DH), T_6 (70% NPKS + 8 t ha^{-1} CD), T_7 (70% NPKS + 2 t ha^{-1} DH + 4 t ha^{-1} CD), T_8 (50% NPKS + 6 t ha^{-1} DH), T_9 (50% NPKS + 12 t ha^{-1} CD) and T_{10} (50% NPKS + 3 t ha^{-1} DH + 6 t ha^{-1} CD). The unit plot size was 3.0 m × 2.0 m. According to the experimental specification, no fertilizer was used under control treatment (T_0). The amounts of N, P, K and S fertilizers required per plot were calculated as per treatments. Full amount of TSP, MP and gypsum were applied as basal dose before transplanting of rice seedlings. Urea were applied in 3 equal splits: one third was applied at basal before transplanting, one third in active tillering stage (30 DAT) and the remaining one third was applied at 5 days before panicle initiation stage (55 DAT). Two different types of organic manure viz. green manure (GM) and cowdung (CD) were used. The rate of manure required per plot was calculated as per the treatments, respectively. GM was applied before 2 weeks of transplanting. CD was applied before one week of transplanting. Forty days old seedlings of BRRI dhan40 were carefully uprooted from the seedling nursery and transplanted on 14 August, 2011 in well puddle plots at a spacing of 20 cm × 20 cm using 3 seedlings $hill^{-1}$. All other cultural practices were done uniformly as per recommendation. The crop was harvested at full maturity when 80-90% of the grains were turned into straw colored on 26 November, 2011.

Data collection and statistical analysis

Five hills from each plot were collected for data collection and whole plots were harvested to obtain grain and straw yields. After harvesting plant height (cm), tillering number/hill, effective tiller number/hill, panicle length (cm), grain number/ panicle, number of filled grain/panicle, number of empty grain/panicle, 1000-grain weight (gm) data were recorded from the experiment. The significance of the differences among pairs of treatment means was estimated by the least significant difference (LSD) test at 5% and 1% level of probability (Gomez & Gomez, 1984). The mean comparisons of the treatment were evaluated by DMRT (Duncan's Multiple Range Test).

Results and discussion

Effect of organic manures and chemical fertilizers on growth parameter of T. Aman rice

The plant height of BRRI dhan40 varied significantly in different treatments due to application of organic manure and chemical fertilizers (Table 1). It was revealed that all the treatments produced significantly taller plants compared to the control treatment. The plant height ranged from 132.66 cm to 140.67 cm and highest value (140.67 cm) was noted in the T_5. The lowest plant height (132.66 cm) was obtained in the treatment T_0 where no fertilizers were used. The treatments T_1, T_4, T_6 and T_{10} produced statistically similar plant height. The combined application of fertilizers with manure increased the plant height compared to single application of chemical fertilizer or manure. Several research results revealed that plant height was significantly influenced by the application of organic manure and chemical fertilizers (Rajani Rani et al., 2001; Hossain et al., 1997; Sharma & Mitra, 1991; Babu et al., 2001; Singh et al., 2001).

The treatment T_1 gave the highest number of effective tiller $hill^{-1}$ where chemical fertilizers were applied at the recommended doses. The treatment T_2 and T_3 was statistically similar and T_4 was statistically identical to T_7. The lowest number of effective tillers $hill^{-1}$ was observed in the treatment T_0 (control). The superior effect of Dhaincha in increasing the number of effective tiller $hill^{-1}$ of BRRI dhan40 over cowdung was noted. Chandar and Pandey (1996) reported a significant increase in effective tillers $hill^{-1}$ due to application of higher doses of nitrogen.

The highest straw yields (8.59 t/ha) was obtained in the treatment T_3 and the lowest value (4.63 t/ha) was noted in the treatment T_0 (control). The treatment may be ranked in order of T_3> T_1> T_2> T_4> T_5> T_7> T_6> T_8> T_{10}> T_9> T_0 in terms of straw yield. The percent increase in straw yield range from 23.22 to 87.2% in different treatments over the control. The highest value (87.2%) was obtained in the treatment T_3 and the lowest value (30.22%) was noted in the treatment T_8. Cowdung exerted comparatively better effect in producing higher straw yield as compared to dhaincha. These findings are well corroborated with the work of Khan (1998) and Islam (1997). It is clear that organic manure in combination with inorganic fertilizers encouraged vegetative growth of plants and thereby increasing straw yield.

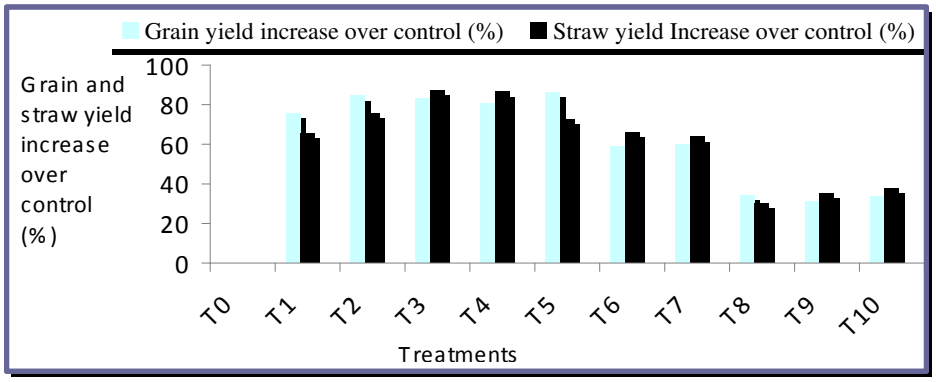

Fig. 1. Grain and straw yields of T. Aman rice cv. BRRI dhan40 increase over control by different treatment

Effect of organic manure and chemical fertilizer on yield attributes of T. Aman rice

The panicle length ranged from 23.23 to 27.73 cm. The highest panicle length of 27.73 cm was observed in the treatment T_5. The lowest panicle length (23.23 cm) was recorded in the treatment T_0 (control). The fertilizer combinations were T_6, T_8 and T_9 produced statistically similar panicle length. BRRI dhan 40 responded significantly better in combined application of 50% chemical fertilizers with organic manure. Babu et al. (2001) and Haque (1999) noted a significant increase in panicle length due to combined application of organic manure and chemical fertilizers. The highest value (122.7) was observed in the T_5. The treatment T_3 and T_4 was statistically similar and T_9 was statistically identical to T_{10}. The lowest value (93.0) was obtained in the treatment T_0 (control).

Dhaincha manure applied in combination with NPKS fertilizer increased the number of grains panicle^{-1} of BRRI dhan 40 considerably compared to cowdung in combination with NPK fertilizers. This might be due to more availability of nutrient from the green manure (Dhaincha). Grain panicle^{-1} significantly increased due to the application of organic manures and chemical fertilizers (Razzaque, 1996). These results are also in agreement with Hoque (1999) and Azim (1996). The 1000-grain weight ranged from 23.08 gm to 23.44 gm. The highest thousand grain weight of 23.44 gm was obtained in T_7 treatment which was statistically identical to all other treatments except T_0. The lowest thousand-grain weight was recorded in T_0 (Control) treatment. Abedin et al. (1999) reported that the combined application of organic manure and chemical fertilizers increased the 1000-grain weight of rice.

The grain yield of BRRI dhan40 varied significantly due to combined application of organic manure and chemical fertilizers (Table 2). All the treatments gave significantly higher grain yield over the control. The grain yield ranged from 3.63 ton to 5.90 t/ha. The highest grain yield (5.90 t/ha) was observed in the treatment T_5 and the lowest value (3.63 t/ha) was recorded in the treatment T_0 (control). The treatment may be ranked in order of T_5> T_2> T_3> T_4> T_1> T_7> T_6> T_8> T_{10}> T_9> T_0 in term of grain yields. The percent increase in grain yield over control ranged from 86.31-31.18%. The highest value (86.31%) was obtained in the treatment T_5 and the lowest value (31.18%) was noted in the treatment T_9. Dhaincha manure when applied in combination with NPKS fertilizer exerted marked effect in increasing the grain yield of BRRI dhan40 as compared to cowdung. Haque (1999) also reported the grain yield was significantly increased due to application of organic manure and chemical fertilizers. This is also in agreement with the findings of other researchers (Laxminarayan, 2000; Dwivedi & Thakur, 2000; Rajni et al. 2001).

Correlation of yield components with grain yield

Grain yield of a crop is a complex character, which results from interactions of many characters. Grain yield was positively correlated with plant height (r = 0.816), number of effective tiller (r = 0.739), panicle length (r = 0.354) and number of filled grains panicle^{-1} (r = 0.739).

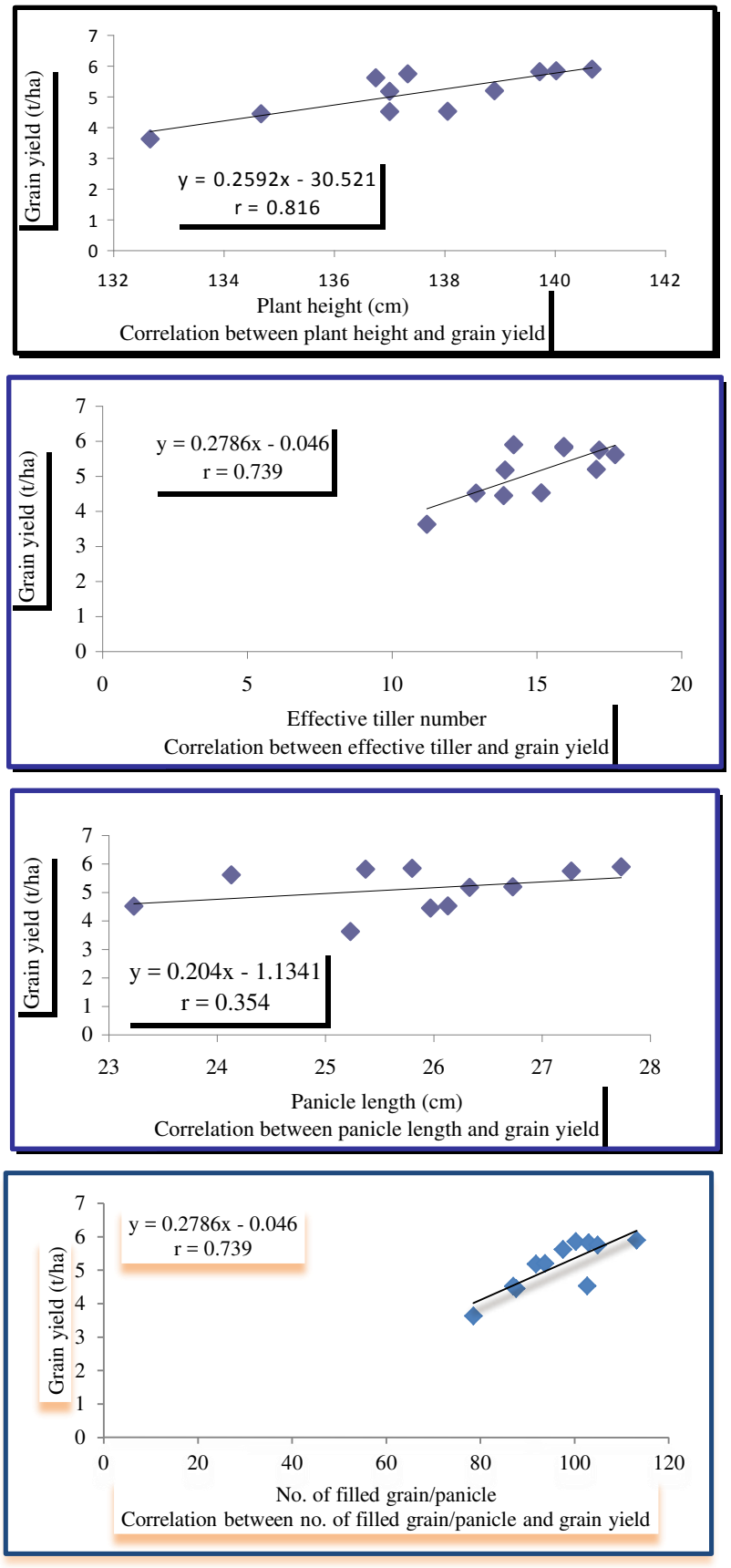

Fig. 2. Correlation between grains yield and yield components of T. Aman rice cv. BRRI dhan40

Table 1. Effect of organic manures and chemical fertilizers on different growth parameter of T. Aman rice cv. BRRI dhan40

Fertilizer combinations	Plant height (cm)	Tiller number/ hill	Effective Tiller number	Straw yield (t ha^{-1})	Straw yield increase over control (%)
T_0	132.66g	13.00g	11.20h	4.66e	-
T_1	136.75e	18.70a	17.70a	8.08ab	65.5
T_2	140.02b	17.00c	15.93c	8.00abc	75.6
T_3	139.72c	16.50d	15.93c	8.59a	87.2
T_4	137.33e	18.50a	17.15b	7.82bc	86.5
T_5	140.67a	15.00e	14.2e	7.47bc	72.51
T_6	137.00e	13.9f	13.9f	7.34c	65.9
T_7	138.90c	17.60b	17.05b	7.37bc	63.69
T_8	138.05d	16.20d	15.15d	6.24d	30.22
T_9	134.67f	15.00e	13.85f	6.06d	35.18
T_{10}	137.00e	14.00f	12.90g	6.16d	37.84
Significance Level	0.01	0.01	0.01	0.01	
CV (%)	4.24	7.42	6.79	5.34	--

T_0= Control, T_1 = N_{120} P_{15} K_{45} S_{20} (Recommended dose), T_2 = 80% NPKS + 2 t ha^{-1} DH, T_3 = 80% NPKS + 4 t ha^{-1} CD, T_4 = 80% NPKS + 1 t ha^{-1} DH + 2 t ha^{-1} CD, T_5 = 70% NPKS + 4 t ha^{-1} DH, T_6 = 70% NPKS + 8 t ha^{-1} CD, T_7 = 70% NPKS + 2 t ha^{-1} DH + 4 t ha^{-1} CD, T_8 = 50% NPKS + 6 t ha^{-1} DH, T_9 = 50% NPKS + 12 t ha^{-1} CD and T_{10} = 50% NPKS + 3 t ha^{-1} DH + 6 t ha^{-1} CD.

Table 2. Effect of organic manure and chemical fertilizer on the yield and yield attributes of T. Aman rice cv. BRRI dhan40

Fertilizer combinations	Grain yield (t ha^{-1})	Grain yield increase over control (%)	Panicle length (cm)	Grain number / panicle	Number of filled grain/ panicle	1000 grain wt.(g)
T_0	3.63h	-	23.23i	93.00i	78.5i	23.08b
T_1	5.62d	75.66	24.13h	106.57e	97.57e	23.35ab
T_2	5.85ab	84.41	25.80f	108.8d	100.3d	23.35ab
T_3	5.82b	83.27	25.37g	111.47c	103.00c	23.29ab
T_4	5.75c	80.61	27.27b	110.9c	104.9b	23.41a
T_5	5.90a	86.31	27.73a	122.7a	113.2a	23.34ab
T_6	5.18e	58.93	26.33d	102.8g	91.80g	23.26ab
T_7	5.20e	59.69	26.73c	103.7f	93.70f	23.44a
T_8	4.53f	34.22	26.13de	114.2b	102.7c	23.41a
T_9	4.45g	31.18	25.97ef	98.6h	87.6h	23.30ab
T_{10}	4.52f	33.84	25.23g	99.00h	87.0h	23.40a
Significance Level	0.01		0.01	0.01	0.01	0.01
CV (%)	6.87	--	5.73	8.37	7.32	5.68

T_0= Control, T_1 = N_{120} P_{15} K_{45} S_{20} (Recommended dose), T_2 = 80% NPKS + 2 t ha^{-1} DH, T_3 = 80% NPKS + 4 t ha^{-1} CD, T_4 = 80% NPKS + 1 t ha^{-1} DH + 2 t ha^{-1} CD, T_5 = 70% NPKS + 4 t ha^{-1} DH, T_6 = 70% NPKS + 8 t ha^{-1} CD, T_7 = 70% NPKS + 2 t ha^{-1} DH + 4 t ha^{-1} CD, T_8 = 50% NPKS + 6 t ha^{-1} DH, T_9 = 50% NPKS + 12 t ha^{-1} CD and T_{10} = 50% NPKS + 3 t ha^{-1} DH + 6 t ha^{-1} CD.

Conclusion

The highest plant height, panicle length, number of grain panicle^{-1}, number of effective tiller per hill and 1000-grain weight were recorded in the treatment T_3,T_5, T_5, T_1 and T_7 respectively and the lowest were found in the control treatment T_0. The highest grain (4.9 t ha^{-1}) and straw (8.59 t ha^{-1}) yields were obtained in the treatment T_5 and T_3, respectively and the lowest grain yield (2.63 t ha^{-1}) and straw yields (4.66 t ha^{-1}) were observed in the treatment T_0. The grain yield was positively correlated with the number of effective tiller, plant height, panicle length and filled grains panicle^{-1} and 1000 grain weight. BRRI dhan40 can be cultivated profitably in the Tejgoan silt loam soil by using combined application of 70% NPKS fertilizers with 4 t ha^{-1} DH. The overall findings of this study indicate that the combined use of fertilizer and manure in T. Aman rice should be encouraged for maintaining rice yield, quality and soil fertility.

References

Abedin, M.J., Rashid, M.H. & Eaqub, M. (1999). Residual effects of TSP and Farmyard manure under renewed application of urea on the yield of crop and some chemical properties of soil. *Bangladesh J. Agril. Sci.* 10, 100-109.

Azim, S.M.A. (1996). Effect of sulphur, zinc and boron supplied from manure and fertilizers on BRRI 29. MS Thesis, Dept. Soil Sci. BAU, Mymensingh.

Babu, S., Marimuthu, R., Manivanna, V. & Ramesh-Kumer, S. (2001). Effect of organic and inorganic manures on growth and yield of rice. *Agric. Sci. Digest.* 21, 232-234.

Banik, M. 1999. Cold injury problem in Boro rice. In Proc. of the workshop on Modern Rice Cultivation in Bangladesh. Bangladesh Rice Res. Inst. Joydevpur, Gazipur, Bangladesh. 14-16 February, p.37.

BBS (Bangladesh Bureau of Statistics). 2010. Statistical Year book of Bangladesh. Stat. Div. Min. Planning, Dhaka, Bangladesh

BRRI (Bangladesh Rice Research Institute). 2006. Annual Report for 2006. Bangladeh Rice Res. Inst. Joydebpur, Gazipur.

Chander, S. & Pandey, J. (1996). Effect of herbicide and nitrogen on yield of scented rice (*Oryza sativa*) under different rice cultures. *Indian J. Agron.* 41, 209-214.

Devivedi, D.K. & Thakur, S.S. (2000). Effect of organic and inorganic fertilizers levels on productivity of rice (*Oryza sativa*) crop. *Indian Agron.* 45, 568-574.

FAO (Food and Agricultural Organization) 2003.Yearbook of Production, FAO Statistics Division.605-607.

Gomez, K.A. & Gomez, A.A. (1984). Statistical procedures for Agricultural Research. Jhon Wiley and Sons, New York.

Haque, M.A. (1999). Response of BRRI dhan 29 to sulphur, zinc and boron supplied from manure and fertilizers, MS Thesis, Dept. Soil Sci. BAU, Mymensingh.

Hossain, M.B., Islam, M.R., Rahman, M.N. & Jahiruddin, M. (1997). Effect of integrated nutrient management on rice yield and components of BR 11 rice. *Progress. Agric.* 8, 83-86.

Islam, M.M. (1997). Response of BRRI dhan 30 rice to cowdung and urea-N in the Boro season. MS Thesis, Dept. Soil Sci. BAU, Mymensingh.

Khan, M.M.R. (1998). Effect of cowdung, poultry manure and urea-N on the growth and yield o f BRRI dhan. MS Thesis, Dept. Soil Sci. BAU, Mymensingh.

Laxminarayana, K. (2000). Effect of integrated use of organic and inorganic manures on yield of low land paddy. *J. Hill Res.* 13, 125-127.

Mahajan, A. and R. Sharma. 2005. Integrated nutrient management (INM) system- Concept, need and future strategy. Agrobios Newsletter. 4 (3): 29-32.

Mahajan, A., A.K. Choudhary and R.M. Bhagat. 2002. Integrated plant nutrient management (IPNM) system for sustainability in cereal based cropping system. Indian Farmer's Digest., 35 (7): 29-32.

Nambiar, K.K.M. (1997). Nutrient management for soil fertility restoration and sustaining cropping system productivity. In: Nutrient Management Practices in Crops and Cropping System. Ghonsikar, C.P. & Shinde V.S. (eds)., Pub., India. pp. 213-250.

Rajni, R., Srivastava, O.P. & Rani, R. (2001). Effect of integration of organics with fertilizer N on rice and N uptake. *Fert. News.* 46, 63-65.

Razzaque, M.M.A. (1996). Comparative study on the effect of rice straw, FYM and nitrogen fertilizer on the growth and yields of BR 11 rice. MS Thesis, Dept. Soil Sci. BAU, Mymensingh.

Reganold, J.P., Robert, I.P., and Parr, J.F., 1990. Sustainability of agriculture in the United States-An overview. Proc. Sustainable Agriculture, Issues, Prospectives and Prospects in Semi Arid Tropics.

Sharma, A.R. & Mitra, B.N. (1991). Direct and residual effect of organic materials and P fertilizers in rice (*Oryza sativa*) based cropping system. *Indian J. Agon.* 36, 299-303.

Singh, R., Singh, S. & Prasad, K. (2001). Effect of fertilizer, FYM and row spacing on transplanted rice. *Crop Res.* (Hisar). 22, 295-296.