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Effects of manures and fertilizer on nutrient content and uptake by BRRIdhan 29

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Abstract: An experiment was conducted at Lalmonirhat sadar upazila during aman season of 2008 to evaluate the effect of urea-N, poultry manure (PM) and cowdung (CD) on the nutrient content and uptake by BRRI dhan 29. The experiment was laid out in a Randomized Complete Block Design (RCBD) with eight treatments in three replications. The treatments were T_0: Control (no fertilizer), T_1: CD 5 t/ha, T_2: PM 5 t/ha, T_3: N 120 kg/ha, T_4: N 100 kg/ha + CD 3 t/ha, T_5: N 100 kg/ha + PM 3 t/ha, T_6: N 80 kg/ha + CD 4 t/ha, T_7: N 80 kg/ha + PM 4 t/ha. The P, K and S fertilizers were applied at the rate of 15, 50, and 10 kg/ha, respectively as a basal dose during the final land preparation. Application of poultry manure, cowdung and urea-N significantly influenced the yield components and yield of BRRI dhan 29. The N, P, K and S contents and uptake were profoundly influenced by the application of different doses of urea-N in combination with poultry manure and cowdung. The overall results indicate that application of PM @ 3 t/ha in combination with N 100 kg/ha can reduce the use of N fertilizer at a substantial level which ultimately reduce the cost of production. The findings of the study suggest that integrated use of manure and fertilizer is more important for sustainable production of BRRI dhan 29. However, further investigation is necessary to make conclusive remarks.
Key words: Manures, fertilizers, N-content, BRRIdhan 29

Introduction

Bangladesh is an over populated country having the highest density in the world. On the other hand, the total cultivable land in Bangladesh is decreasing day by day. This brings into focus the need for efficient management of our limited land resources in order to increase and maintain crop production and at the same time preserve the quality of the soils. Bangladesh is predominately a rice growing country where rice is the staple food of her people. Among the crops grown in Bangladesh, rice is covering an area of 11.06 million hectare and producing 38.13 million tons of rice annually (FAO, 2002). Although 78 percent of total crop is devoted to rice production, the country has still a chronic shortage of food grain (BBS, 2004). The annual production in 2004-2005 of aus, aman and boro rice were 1.5, 9.8 and 13.8 million tons, respectively and the individual averages were 1.46, 1.86 and 3.39 t/ha, respectively (BBS, 2006). Rice contributes 91.1% of the total grain production and covers 74% of the total caloric intake of this country's people (MOA, 2001). The soil fertility status is gradually declining. Low organic matter content of the soil, imbalanced 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). In Bangladesh most of the cultivated soil have less than 1.5% organic matter, whereas, a good agricultural soil should contain at least 2% organic matter. Efforts need to be made to build up and maintain a moderate level of soil organic matter.

Use of chemical fertilizers is an essential component of modern farming and about 50% of the world's crop production can be attributed to fertilizer use (Pradhan, 1992). Nevertheless, sustainable crop production cannot be maintained by using only chemical fertilizer and similarly it is not possible to obtain higher crop yield by using organic manure alone (Bair, 1990). A suitable combination of organic and inorganic sources of nutrients is necessary for sustainable agriculture that will provide food with good quality (Reganold *et al.*, 1990). Cowdung, poultry manure and FYM are the common manures of Bangladesh can play a vital role in soil fertility improvement as well as in supplying most of the macro- and micronutrients for crop production. Having considered the above situation, the present research work was undertaken to study the nutrient contents and uptake of rice.

Materials and Methods

The experiment was conducted at Lalmonirhat sadar upazila during the aman season of 2008. The site of the experiment was located at 25.48° N latitude and 88.38° E longitudes at a mean elevation of 21 m above the sea level belonging to Non-Calcareous Dark Grey Floodplain soil under the Active Tista Floodplain Agro Ecological Zone. The soil of the experimental field belongs to Sonatala silt loam having pH 5.02, Organic matter (%) 2.12, CEC (me/100g soil) 11.2, total N (%) 0.12, C:N ratio 10.3, available P (ppm) 8.25, exchangeable K (me/100g soil) 0.16 and available S (ppm) 12.6. The test crop was BRRI dhan 29. Four different types of chemical fertilizers viz. urea, triple super phosphate, muriate of potash and gypsum and two different types of manure viz. cowdung and poultry manure were used in the study. The rates of fertilizers were K 15 kg, P 50 kg and S 10 kg/ha (BARC, 2005). Three individual doses of N, CD and PM including their four combinations were compared with the control. The treatment combinations were- T_0 = Control, T_1 = Cowdung (CD) 5 t/ha, T_2 = Poultry manure (PM) 5 t/ha, T_3 = N 120 kg/ha, T_4 = N 100 kg/ha + Cowdung (CD) 3 t/ha, T_5 = N 100 kg/ha + Poultry manure (PM) 3 t/ha, T_6 = N 80 kg/ha + Cowdung (CD) 4 t/ha and T_7 = N 80 kg/ha + Poultry manure (PM) 4 t/ha. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The size of each unit plot was 4m × 3m. The data were collected after harvest such as- N, P, K and S contents of grain and straw and N, P, K and S uptake by grain and straw of BRRIdhan29.

Results and Discussion

Nutrient content in rice grain and straw of BRRI dhan 29: The nitrogen content in rice grain and straw varied significantly due to application of urea-N, poultry manure and cowdung in different treatments (Table 1). The grain N content varied from 0.95 to 1.34%. The highest N content of 1.34% was observed in T_5 and the lowest N content of 0.95% was

recorded in T_0 (control). Combined application of urea-N and poultry manure increased the N content in rice grain markedly in T_5 which was identical with T_3 treatment. The N content in straw varied from 0.48 to 0.72% in which the highest value was observed in T_5 which was statistically similar with T_3 and the lowest value was recorded in T_0 treatment. The results revealed that N content in rice grain was higher than that of straw. A significant increase in N content in rice grain and straw due to the application of manures and fertilizers has been reported by Azim *et al*. (1999).

Table 1. Effects of urea-N, cowdung and poultry manure on N, P, K and S content of BRRIdhan 29

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)		Sulphur (%)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_0 : (control)	0.95 e	0.48 f	0.21 e	0.06 b	0.25 e	1.07 d	0.06 c	0.05 c
T_1: CD 5 t/ha	1.06 d	0.59 e	0.29 d	0.07 ab	0.34 d	1.45 c	0.07 bc	0.06 bc
T_2: PM 5 t/ha	1.13 c	0.62 d	0.31 c	0.07 ab	0.35 d	1.50 c	0.07 bc	0.06 bc
T_3: N 120 kg/ha	1.34 a	0.71 a	0.33 b	0.07ab	0.41 ab	1.68 a	0.08 ab	0.07 ab
T_4: N 100 kg/ha + CD 3 t/ha	1.17 bc	0.65 c	0.31 c	0.07 ab	0.38 c	1.59 b	0.08 ab	0.07 ab
T_5: N 100 kg/ha + PM 3 t/ha	1.34 a	0.72 a	0.35 a	0.08 a	0.42 a	1.71 a	0.09 a	0.08 a
T_6: N 80 kg/ha + CD 4 t/ha	1.20 b	0.67 b	0.31 c	0.07 ab	0.38 c	1.60 b	0.08 ab	0.07 ab
T_7: N 80 kg/ha + PM 4 t/ha	1.22 ab	0.69 b	0.31 bc	0.07 ab	0.40 bc	1.62 ab	0.08 ab	0.07ab
CV (%)	2.16	3.89	2.37	2.47	4.27	2.25	3.10	5.63
SE (±)	0.01	0.17	0.04	0.01	0.04	0.19	0.01	0.03

Figures in a column having common letters do not differ significantly at 5% level of significance, CV (%) = Coefficient of variation, SE (±) = Standard error of mean

The phosphorus contents in grain and straw were significantly influenced by different treatments under the study. Phosphorus content in grain varied from 0.21 to 0.35%. The highest P content of 0.35% in grain was found in T_5 and the lowest P content 0.21% was found in T_0 (control). The highest P content in straw (0.08%) was observed in T_5 and the lowest value of 0.06% was obtained in T_0. Application of poultry manure in combination with urea-N showed more pronounced effect in increasing the P contents in rice grain and straw compared to cowdung. The P content in rice grain was much higher than that of straw in all the treatments. An increase, both in rice grain and straw due to the application of poultry manure and chemical fertilizers was reported by Azim *et al*. (1999) and Hoque (1999).

Potassium content in both grain and straw was significantly influenced due to application of manures and fertilizers (Table 1). The highest K content in grain was 0.42% in T_5 and the lowest K content was 0.25% in T_0 (control). Poultry manure showed the best performance in increasing the K content in both grain and straw compared to cowdung. The K content in rice straw ranged from to. The highest K content in rice straw was 1.71% in T_5 which was statistically similar with T_3 and the lowest P content 1.07% in T_0 (control). These results are in agreement with the results of Singh *et al.* (2001).

Sulphur content both in rice grain and straw was significantly influenced by different treatments. The highest S content (0.09%) in grain was obtained in T_5 and the lowest value (0.06%) was noted in T_0. All the treatments caused an increase effect on S content of rice grain and the effect of poultry manure was better compared to cowdung in combination with different urea-N doses. The highest S content in straw (0.08%) was recorded in T_5 and the lowest S content (0.05%) was observed in T_0 (control) (Table 1). The effect of poultry manure was more pronounced in increasing the S content in rice straw as compared to cowdung. Azim *et al.* (1999) reported that application of sulphur from manures and fertilizers increased the S contents both in grain and straw of rice.

Nutrient uptake by grain and straw of BRRI dhan 29:

Integrated application of urea-N, poultry manure and cowdung significantly influenced the N uptake of grain and straw (Table 2). The N uptake by grain ranged from 24.00 to 73.20 kg/ha and that by straw 16.80 to 49.10 kg/ha. The highest N uptake by grain (73.20 kg/ha) and straw (49.10 kg/ha) was recorded from T_5 and the lowest N uptake by grain (24.00 kg/ha) and by straw (16.80 kg/ha) was found in T_0 (control). The total N uptake by both grain and straw was influenced significantly by different treatments (Table 2). The highest total N uptake (122.30 kg/ha) was observed in T_5 and the lowest value of 40.80 kg/ha was found in T_0. Similar results were reported by Duhan and Singh (2002).

Phosphorus uptake by both grain and straw was influenced significantly by different treatments. The maximum P uptake by grain (18.60 kg/ha) and straw (5.46 kg/ha) was found in T_5 and the minimum P uptake by grain (5.20 kg/ha) and straw (2.07 kg/ha) was obtained in T_0 (control). The application of urea-N fertilizer and manures showed significant influence on the total P uptake by BRRI dhan 29. The highest total P uptake (24.06 kg/ha) was recorded from T_5 and the lowest total P uptake (7.27 kg/ha) was observed in T_0 (control). Performance of poultry manure was better than that of cowdung in increasing the P uptake by rice grain and straw compared to cowdung.

Potassium uptake by grain and straw were significantly influenced by different treatments (Table 2). The K uptake by grain varied from 6.28 to 22.60 kg/ha and in straw range from 31.50 to 116.60 kg/ha. The highest K uptake by grain found in T_5 treatment, which was statistically identical to T_3 treatment and the lowest K uptake by grain was obtained in T_0 (control). The highest K uptake 116.60 kg/ha by straw observed in T_5 and the lowest value of 31.50 kg/ha was found in T_0. The highest total K uptake was 139.20 kg/ha in T_5 and the lowest total K uptake was 37.78 kg/ha in T_0 (control) (Table 2).

Table 2. Effects of urea-N, cowdung and poultry manure on N, P, K and S uptake by rice (cv. BRRIdhan 29)

Treatments	Nitrogen (kg/ha)			Phosphorus (kg/ha)			Potassium (kg/ha)			Sulphur (kg/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_0 : (control)	24.00f	16.80c	40.80 e	5.20g	2.07c	7.27 g	6.28 d	31.50 c	37.78d	1.42f	1.96 c	3.38e
T_1: CD 5 t/ha	34.90e	27.60b	62.50d	9.41f	3.28b	12.69 f	11.40cd	67.80 b	79.20 c	2.28e	3.25bc	5.53d
T_2: PM 5 t/ha	42.30d	28.90b	71.20 c	11.40e	3.40b	14.80 e	13.30 c	70.00 b	83.30bc	2.82d	3.49bc	6.31c
T_3: N 120 kg/ha	69.90a	43.90a	113.80a	16.90b	4.90a	21.80ab	21.30 a	104.70ab	126.00ab	4.53a	5.42 a	9.95a
T_4: N 100 kg/ha + CD 3 t/ha	59.70b	43.40a	103.10b	15.60bc	5.01a	20.61bc	19.70b	106.50ab	126.20ab	3.95b	5.19 a	9.14a
T_5: N 100 kg/ha + PM 3 t/ha	73.20a	49.10a	122.30a	18.60a	5.46a	24.06 a	22.60 a	116.60 a	139.20 a	4.81a	5.73 a	10.54a
T_6: N 80 kg/ha + CD 4 t/ha	52.00c	44.70a	96.70b	13.10d	4.97a	18.07d	16.80bc	106.50a	123.30ab	3.42c	5.27 a	8.69b
T_7: N 80 kg/ha + PM 4 t/ha	56.30bc	41.40a	97.70b	14.30cd	4.59a	18.89cd	18.50b	97.90ab	116.40 b	3.76bc	4.92ab	8.68b
CV (%)	7.43	6.38	5.27	7.30	6.48	5.57	6.60	6.65	5.46	6.64	7.31	4.98
SE (±)	2.21	1.33	2.67	0.55	0.15	0.55	0.61	3.31	3.23	0.12	0.18	0.221

Figures in a column having common letters do not differ significantly at 5% level of significance, CV (%) = Coefficient of variation, SE (±) = Standard error of mean

Sulphur uptake by grain and straw were influenced significantly by different treatments (Table 2). The highest S uptake by grain (4.81 kg/ha) and straw (5.73 kg/ha) were found in T_5 and the lowest S uptake by grain (1.42 kg/ha) and straw (1.96 kg/ha) was found in T_0 (control). The highest total S uptake (10.54 kg/ha) was found in T_5 and the lowest value of 3.38 kg/ha was observed in T_0 (Table 2). Poongothai *et a1.* (1999) observed that application of fertilizers and manures (poultry manure and cowdung) enhanced sulphur uptake significantly by rice.

The overall results indicate that application of N fertilizer in T_5 as N @ 100 kg/ha in combination with 3t PM/ha can reduce the amount of recommended N fertilizer dose. Also this treatment combination was the best in terms of nutrients content and uptake. Therefore, the findings of this study suggest an integrated use of fertilizer and manures in an optimum ratio for sustainable crop production. However, further investigation is necessary to make a concrete recommendation.

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