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Effect of urea super granules, prilled urea and poultry manure on the yield of *Boro* rice varieties

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Abstract: An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh in *Boro* season 2009 to find out the performance of *Boro* rice varieties and to find out the effect of urea supergranules (USG) on the yield and yield attributes of *Boro* rice varieties, to find out the effect of poultry manure (PM) on the performance of *Boro* rice varieties and to evaluate the combined effect of USG and PM; and prilled urea (PU) and PM on the yield and yield attributing characters of *Boro* rice varieties. Two *Boro* rice varieties, viz. BRRI dhan28 and BRRI dhan29 were included in the study. Data were recorded on different yield parameters from the experiment for analyzing and results discussion. Variety BRRI dhan29 gave higher grain yield than BRRI dhan28. For fertilizer effect, the highest grain yield (6.16 t ha^{-1}) was found from 2.7g USG and other inorganic fertilizers which was similar to 2.7g USG + PM at 5 t ha^{-1}. The lowest grain yield (3.89 t ha^{-1}) was obtained from control treatment. For interaction, the highest grain yield (6.28 t ha^{-1}) was found in BRRI dhan29×2.7g USG and other inorganic fertilizers. The lowest grain yield (3.59 t ha^{-1}) was found in control treatment.

Key words: Urea super granules, prilled urea, poultry manure, yield, *Boro* rice variety.

Introduction

Rice (*Oryza sativa*) is the major food crop of Bangladesh covering about 80 percent of total cropped area. It is grown in more than hundred countries across the world. Agriculture of Bangladesh is characterized by intensive crop production with rice based cropping system. In Bangladesh, the yield of rice is low compared to other rice growing countries of the world. It ranks 4th both in area and production (UNDP and FAO, 1998) and 39th in yield among the rice growing countries (IRRI, 1995). Geographic and agronomic conditions of Bangladesh are favourable for rice cultivation. Rice is grown in over 10 million hectares under diverse ecosystem of irrigated, rainfed and deep water conditions in three distinct seasons, namely *Aus, Aman* and *Boro*.

The average yield of rice is poor in Bangladesh, only 3.2 t/ha (BBS, 2001). On the other hand, rice production area is decreasing day by day due to high population pressure. The possibility of horizontal expansion of rice production area has come to a stand still (Hamid, 1991). As there is very little scope for horizontal expansion of rice production in Bangladesh, farmers and agricultural scientists are diverting their attention towards vertical expansion for increased crop production. Therefore, attempts should be taken to increase the yield per unit area. For vertical expansion, the use of modern production technologies should be included, such as, use of quality seeds, high yielding and hybrid varieties, optimum age of seedlings, adopting proper plant protection measures, seedling raising techniques, fertilizer management and so on.

Variety is the most important factor in rice production. Use of high yielding variety (HYV) has been increased remarkably in recent years and the country has almost reached a level of self sufficiency in food. Selection of potential variety, planting in appropriate method and application of optimum amount of nutrient elements, can play an important role in increasing yield and national income.

According to Crasswell and De Datta (1980), broadcast application of urea on the surface soil causes losses upto 50% but point placement of Urea super granules (USG) at 10 cm depth may result in negligible loss. USG is a fertilizer that can be applied in the rice root zone at 8-10 cm depth of soil (reduced zone of rice soil) which can save 30% nitrogen than prilled urea, increase absorption rate, improve soil health and ultimately increase the rice yield (Savant *et al*., 1991). The recent literatures on nitrogen use efficiency of rice, in general, would indicate the superiority of root zone placement of USG as it would reduce the magnitude of nitrogen losses to a considerable extent and increase its use efficiency for better grain production (Crasswell and De Datta , 1980; Pillai, 1981).

Almost all soils of Bangladesh are deficient in nitrogen mainly due to low level of organic matter caused by rapid decomposition due to warm climate, continuous intensive cropping, cultivation of high yielding varieties and no adding of organic matter. Most of the soils of Bangladesh have less than 1.5% and in some cases less than 1% organic matter. Poultry manure (PM) may play a vital role in soil fertility improvement as well as supplying primary, secondary and micronutrients in addition to N, P and K. It may supply sufficient amount of S, Zn and B for growth of rice plants. Application of PM may play an important role in rice cultivation when used alone or in combination with chemical fertilizers. In addition, organic matter improves the physical, chemical and biological properties of soil and thus helps increase the soil productivity. In addition, global environmental pollution can be controlled considerably by reducing the use of fertilizer and increasing the use of PM.

It is true that sustainable production of crops can not be maintained by using only chemical fertilizers and similarly it is not possible to obtain higher crop yield by using organic manure alone (Bair, 1990). Use of fertilizer is an essential component of modern farming with about 50% of the world crop production (Pradhan, 1992). In near future, fertilizer N is likely to be even more costly. This situation in turn will pose a serious threat to food security for the vast millions of people of this country. The use of PM and its proper management may reduce the need for chemical fertilizer allowing the small farmer to save part of their cost of crop production.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh in *Boro* season 2008-2009. The experiment consisted of two *Boro* rice varieties viz. BRRI dhan28 and BRRI dhan29; and ten levels of integrated nutrient

management viz. T_1 = Control (No PM and NPKSZn fertilizers), T_2 = PM at 5 t ha^{-1},T_3 = PM at 2.5 t ha^{-1}, T_4= Recommended dose of PU and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P_2O_5, K_2O, S, $ZnSO_4$, respectively ha^{-1}), T_5 = Full dose of USG and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P2O5, K2O, S, ZnSO4, respectively ha^{-1}), T_6 = ½ PU and PKSZn + PM at 2.5 t ha^{-1}, T_7 = 1.8 g USG + PM at 5 t ha^{-1}, T_8 = 1.8 g USG + PM at 2.5 t ha^{-1}, T_9 = 2.7 g USG (full dose for *Boro*) + PM at 5 t ha^{-1} and T_{1o} = 2.7g USG (full dose for *Boro*) + PM at 2.5 t ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The unit plot size of the experiment was 4.0m × 2.5m. Thirty days old seedlings were transplanted at spacing of 20 cm×20 cm with two seedlings hill^{-1}. All the fertilizers except prilled urea were applied as basal at final land preparation. Prilled urea was top dressed in equal splits at 15, 30 and 45 days after transplanting (DAT). Gap filling, weeding, irrigation and other necessary intercultural operations were done in proper time. The crops were harvested at full maturity. The maturity of crops was determined when some 80% of the grains became golden yellow in colour. Five sample plants were randomly selected and uprooted prior to harvesting from each plot excluding border rows to record data on yield contributing characters. Grain and straw yields plot $^{-1}$ were recorded after threshing by a pedal thresher, winnowing and sun drying in the properly. The grain and straw yield was adjusted to 12% moisture content and converted to t ha^{-1}. All the collected data were analyzed following standard statistical procedure and differences among treatment means were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

For varietal effect total tillers hill^{-1}, length of panicle, grains panicle^{-1}, unfilled spikelets panicle^{-1}, grain yield and biological yield were significantly influenced at different levels of significance. BRRI dhan29 produced higher grain yield than BRRI dhan28 because of higher effective tillers hill^{-1} and grains panicle^{-1}(Table 1).

Table 1. Effect of variety on crop characters, yield and yield contributing characters of *Boro* rice

Variety	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Unfilled spikelets panicle^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V1	81.80	13.13	9.75	3.39	22.66	124.71	17.73	23.25	5.34	6.19	11.54	46.28
V2	81.91	12.32	9.23	3.10	22.50	120.53	13.79	23.08	5.18	6.07	11.24	45.93
$S\overline{X}$	0.66	0.22	0.17	0.14	0.25	0.78	0.34	0.11	0.03	0.05	0.06	0.22
Level of sig.	NS	0.01	NS	NS	0.05	0.01	0.01	NS	0.01	NS	0.01	NS
CV (%)	4.43	9.66	9.75	13.20	5.98	3.47	11.80	2.57	3.35	4.16	2.98	2.65

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS = Not significant, V1= BRRI dhan29 and V2= BRRI dhan28

Table 2. Effect of fertilizer on crop characters, yield and yield contributing characters of *Boro* rice

Fertilizer	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Unfilled spikelets panicle^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
T1	72.57c	9.63g	6.54e	3.10b	22.52	90.48f	27.10a	22.92	3.89e	5.07g	8.96g	43.33c
T2	84.08ab	12.64cde	8.42cd	4.23a	22.92	116.43e	19.87b	23.22	4.98d	5.65f	10.63f	46.81ab
T3	83.98ab	11.96def	8.24d	3.72ab	22.78	115.68e	17.94b	23.34	4.97d	5.88ef	10.84ef	45.80ab
T4	82.08ab	11.23ef	7.69d	3.55ab	22.80	117.57de	17.97b	23.14	5.14cd	5.89ef	11.03d	46.67ab
T5	84.43ab	15.39a	13.47a	1.93c	21.58	143.92a	9.82f	22.95	6.16a	7.08a	13.24a	46.50ab
T6	79.71b	11.07f	7.63d	3.45ab	22.50	119.14de	13.26cd	23.23	5.21c	6.04de	11.25d	46.33ab
T7	83.53ab	13.33bcd	9.47c	3.87ab	23.37	126.03c	14.98c	23.47	5.44b	6.35cd	11.79c	46.11ab
T8	80.79ab	13.20bcd	9.50c	3.70ab	22.43	122.78cd	13.47cd	23.36	5.17cd	6.21cd	11.38d	45.46b
T9	84.95a	14.64ab	12.73a	1.92c	22.02	140.02a	11.01ef	22.88	6.04a	6.74b	12.77b	47.28a
T10	82.41ab	14.15abc	11.18b	2.98b	22.90	134.16b	12.16de	23.16	5.61b	6.40c	12.01c	46.72ab
$S\overline{X}$	1.48	0.50	0.38	0.31	0.55	1.74	0.76	0.24	0.07	0.10	0.14	0.50
Level of Sig.	0.01	0.01	0.01	0.01	NS	0.01	0.01	NS	0.01	0.01	0.01	0.01
CV (%)	4.43	9.66	9.75	13.20	5.98	3.47	11.80	2.57	3.35	4.16	2.98	2.65

In a column, figures with same letter(s) or without letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT; NS =Not significant, T_1 = Control (No PM and NPKSZn fertilizers), T_2 = PM at 5 t ha^{-1}, T_3 = PM at 2.5 t ha^{-1}, T_4 = Recommended dose of PU and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P_2O_5, K_2O, S, $ZnSO_4$, respectively ha^{-1}); T_5 = Full dose of USG and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P2O5, K2O, S, ZnSO4, respectively ha^{-1})., T_6 = ½ PU and PKSZn + PM at 2.5 t ha^{-1}, T_7 = 1.8 g USG + PM at 5 t ha^{-1}, T_8 = 1.8 g USG + PM at 2.5 t ha^{-1}, T_9 = 2.7 g USG + PM at 5 t ha^{-1}, T_{1o} = 2.7 g USG + PM at 2.5 t ha^{-1}

Table 3. Interaction effect of variety and fertilizer on crop characters, yield and yield contributing characters of *Boro* rice

Interaction (V×T)	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Unfilled spikelets panicle^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harv-est index (%)
V1×T1	73.09	10.07	6.63fg	3.43	22.97	92.63	27.31a	22.83	4.18h	5.26hi	9.44i	44.28
V1×T2	85.40	12.22	8.44de	3.80	23.60	117.60	25.03ab	23.53	5.20e	5.80efg	11.00efg	47.26
V1×T3	81.20	11.67	7.87efg	3.80	22.27	117.27	23.04b	23.36	5.10ef	6.08c-f	11.18def	45.58
V1×T4	81.40	11.47	8.00efg	3.47	22.77	122.30	22.90b	23.51	5.15ef	6.00def	11.15def	46.30
V1×T5	83.64	15.94	13.83a	2.13	21.87	145.67	10.27efg	23.14	6.28a	7.06a	13.33a	47.08
V1×T6	78.87	11.33	7.73efg	3.60	21.57	118.15	13.95cd	23.02	5.08ef	5.75efg	10.83fgh	46.93
V1×T7	80.80	13.60	9.87cd	3.73	23.23	128.57	14.90c	23.38	5.33de	6.23cd	11.57cde	46.11
V1×T8	82.28	14.87	11.13bc	3.73	23.63	125.20	14.13cd	23.67	5.21e	6.21cd	11.41c-f	45.61
V1×T9	86.57	15.15	12.98a	2.20	22.83	143.13	12.10c-g	23.31	6.08ab	6.97ab	13.05a	46.60
V1×T10	84.74	15.00	10.98bc	4.03	21.87	136.58	13.63cde	22.80	5.82bc	6.57bc	12.39b	46.99
V2×T1	72.05	9.18	6.45g	2.77	22.07	88.33	26.90a	23.00	3.59i	4.88i	8.47j	42.37
V2×T2	82.77	13.07	8.40def	4.67	22.23	115.27	14.70c	22.90	4.75g	5.50gh	10.25h	46.36
V2×T3	86.77	12.25	8.62de	3.63	23.30	114.10	12.83c-g	23.32	4.83fg	5.67fg	10.50gh	46.01
V2×T4	82.77	11.00	7.38efg	3.63	22.83	112.83	13.03c-f	22.77	5.13ef	5.78efg	10.92fg	47.04
V2×T5	85.22	14.83	13.10a	1.73	21.30	142.17	9.38g	22.76	6.04ab	7.11a	13.15a	45.92
V2×T6	80.55	10.80	7.52efg	3.30	23.43	120.13	12.57c-g	23.43	5.33de	6.33cd	11.67cd	45.73
V2×T7	86.27	13.07	9.07de	4.00	23.50	123.50	15.05c	23.56	5.54cd	6.47cd	12.01bc	46.12
V2×T8	79.30	11.53	7.87efg	3.67	21.23	120.37	12.80c-g	23.05	5.14ef	6.21cd	11.35def	45.31
V2×T9	83.34	14.12	12.49ab	1.63	21.20	136.90	9.92fg	22.46	5.99ab	6.50c	12.49b	47.97
V2×T10	80.08	13.31	11.37bc	1.93	23.93	131.73	10.70d-g	23.52	5.40de	6.23cd	11.63cde	46.45
$S\overline{X}$	2.10	0.71	0.53	0.43	0.78	2.45	1.07	0.34	0.10	0.15	0.20	0.70
Level of Sign.	NS	NS	0.05	NS	NS	NS	0.01	NS	0.01	0.01	0.05	NS
CV (%)	4.43	9.66	9.75	13.20	5.98	3.47	11.80	2.57	3.35	4.16	2.98	2.65

NS =Not significant; In a column, figures with same letter(s) or without letter(s) do not differ significantly whereas figures with dissimilar letter(s) differ significantly as per DMRT, V = Variety, T = Fertilizer level, V1= BRRI dhan29 and V2= BRRI dhan28, T_1 = Control (No PM and NPKSZn fertilizers), T_2 = PM at 5 t ha^{-1}, T_3 = PM at 2.5 t ha^{-1}, T_4 = Recommended dose of PU and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P_2O_5, K_2O, S, $ZnSO_4$, respectively ha^{-1}), T_5 = Full dose of USG and other inorganic fertilizers (i.e. 120,60,40,10,5 kg of N, P2O5, K2O, S, ZnSO4, respectively ha^{-1}), T_6 = ½ PU and PKSZn + PM at 2.5 t ha^{-1}, T_7 = 1.8 g USG + PM at 5 t ha^{-1}, T_8 = 1.8 g USG + PM at 2.5 t ha^{-1}, T_9 = 2.7 g USG + PM at 5 t ha^{-1}, T_{10} = 2.7 g USG + PM at 2.5 t ha^{-1}

For fertilizer effect all the parameters were significantly influenced at different levels of significance except length of panicle and 1000-gran weight. The highest plant height (84.95 cm) was found from 2.7g USG and PM at 5 t ha^{-1} and the lowest one (72.57 cm) was found from control treatment. The highest grain yield was obtained in T_5 (full dose of 2.7g USG and other inorganic fertilizers) which was as good as T_9 (2.7g USG + PM at 5 t ha^{-1}). Production of highest effective tillers hill^{-1} and number of grains panicle^{-1} were mainly responsible for this highest grain yield. The lowest grain yield was obtained from control treatment (Table 2).

Effective tillers hill^{-1}, unfilled spikelets panicle^{-1}, grain yield, straw yield and biological yield were significantly influenced by the interaction between variety and nutrient management. The highest effective tillers hill^{-1} (13.83) was found in BRRI dhan29×2.7g USG with other inorganic fertilizers and the lowest one (6.45) was found in control treatment. The highest grain yield (6.28 t ha^{-1}) was obtained from V_1×T_5 (BRRI dhan29×2.7g USG with other inorganic fertilizers) and the lowest one (3.59 t ha^{-1}) was obtained from the control treatment V_2×T_1 (Table 3). Variety BRRI dhan28×2.7g USG with other inorganic fertilizers (V_2×T_5), variety BRRI dhan29×2.7g USG with PM at 5 t ha^{-1}and variety BRRI dhan28×2.7g USG with PM at 5 t ha^{-1} were as good as BRRI dhan29×2.7g USG with other inorganic fertilizers. The highest effective tillers hill^{-1} was mainly responsible for this highest grain yield.

In *Boro* season, BRRI dhan29 can be successfully cultivated with full dose of USG (2.7g) and other inorganic fertilizers (PKSZn) to obtain the highest grain yield. BRRI dhan28 can also be successfully cultivated with full dose of USG (2.7g) and other inorganic fertilizers (PKSZn) to obtain similar grain yield. In *Boro* season using full dose of USG with other inorganic fertilizers (PKSZn) showed the best yield performance

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