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PERFORMANCE OF PRILLED UREA AND UREA SUPER GRANULES ON THE GROWTH AND YIELD OF WHEAT

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Abstract

An experiment was conducted at the Agronomy Field of Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from November 2011 to March 2012 to evaluate the performance of prilled urea and urea super granules (USG) on the growth and yield of wheat varieties. The experiment comprised of four wheat varieties *viz.,* BARI Gom 21, BARI Gom 24, BARI Gom 25 and BARI Gom 26, and five nitrogen (N) levels *viz.,* control (no Nitrogen), 84 kg ha^{-1} N from USG, and 30, 50 and 70 kg N ha^{-1} from prilled urea i.e., 67, 112 and 155 kg urea ha^{-1}. The experiment was laid out in a split-plot design with three replications where wheat varieties were placed in the main plot and nitrogenous fertilizers in sub-plots. Experimental results indicated that different varieties had the significant effect on plant height, number of tillers and dry weight plant^{-1}, and number of grains spike^{-1}, grain and straw yield, and harvest index. The variety BARI Gom 24 produced the highest grain yield (2.49 t ha^{-1}) that mainly attributed by the maximum number of spikes plant^{-1}, number of grains spike^{-1} and 1000-grain weight. Among the different nitrogenous fertilizers 84 kg N ha^{-1} from USG (1.8 g) gave the highest grain yield (2.69 t ha^{-1}) due to the maximum number of spikes plant^{-1}, maximum number of grains spike^{-1} and 1000-grain weight. The variety BARI Gom 24 produced the highest grain yield (2.80 t ha^{-1}) with 80 kg N ha^{-1} from USG application.

Introduction

Wheat (*Triticum aestivum* L.) is ranked first both in acreage and production among cereal crops in the world but second most important stable food crop in Bangladesh.. Scarcity of food may become a chronic problem in future. To mitigate the food shortages, measures should be taken to increase the total food production. So, the yield of wheat will be needed to increase to boost up its production Wheat cultivation is easier and requires less time and irrigation than other alternative crops like boro rice, legumes and potato; additionally it needs low cultivation cost. The crop is grown under different environmental conditions ranging from humid to arid, sub tropical to temperate zone (Saari, 1998). The area under wheat cultivation during 2007-2008 was about 5.59 lakh hectares producing 9.76 lakh tons of wheat with an average yield of 1.75 ton per hectare (BBS, 2008). However, wheat production has generally stagnated due to high cost of production and low level of technology (Onsongo, 2003). Proper using techniques and doses of fertilizers are mostly important for better growth for any crops. Among the fertilizers, N plays a vital role in producing higher grain yield. . Rate of N application has a great influence on growth, development and yield of wheat. Wheat yield increases with the increase of nitrogenous fertilizer (Singh *et al.*, 1986). Grain yield of wheat increases with increasing N level up to 120 kg ha^{-1} (Malik, 1981 and Sarker *et al.*, 1997). Prilled urea is a fast releasing

nitrogenous fertilizer which is usually broadcast in splits, that causes considerable loss as ammonia volatilization, immobilization, denitrification and surface run off etc. On the other hand, deep placement of slow releasing nitrogenous fertilizer such as USG reduces loss as well as increases its use efficiency in dry land *rabi* crops (Islam *et.al.*, 2011). Proper application of USG can increase yields and fertilizer-N utilization of wheat and simultaneously decrease N losses compared to equivalent use of prill (Khalil *et al.,* 2011). Therefore, the present experiment was conducted tofind out the effect of prilled urea and USG on the growth and yield of wheat as well asfind out the optimum dose of nitrogenous fertilizer for the variety

Materials and Methods

The experiment was carried out at the Agronomy field, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period of 14 November 2011 to 15 March 2012. The soil of the experimental site was clay loam belonging to the AEZ 28 (Madhupur Tract). The selected plot was medium high land. and above flood level Soil samples from 0-15 cm depth were collected from experimental plot. Details of the soil analysis have been shown in Table 1.

Table 1. Chemical properties of soil in the study area

Soil characteristics	Analytical value
pH	5.47-5.63
Organic matter (%)	2.01
Total N (%)	0.20
Available P	22 ppm
Exchangeable K	0.42 meq/100 g soil

The experiment comprised of wheat varieties and N levels, and was laid out in a split-plot design with three replications. Four wheat varieties *viz.*, BARI Gom 21 (V_1), BARI Gom 24 (V_2), BARI Gom 25 (V_3) and BARI Gom 26 (V_4) were assigned to the main plots, while five N levels *viz.,* control (no nitrogenous fertilizer) (N_0), 84 kg N ha^{-1} from USG (N_1), 30 kg N ha^{-1} from prilled urea (N_2), 50 kg N ha^{-1} from prilled urea (N_3) and 70 kg N ha^{-1} from prilled urea (N_4) were assigned to the sub-plots. USG (two pieces 0.9 g each) was placed i.e., 50 and 20 cm distance in rows and plants, respectively. The unit plot size was 3m ×3 m. The land was prepared with power tiller on 12 November 2011. A blanket dose of manures and fertilizers were applied @ 3,000-30-10-24-5 kg ha^{-1} cowdung-Nitrogen-TSP-MoP-Gypsum (FRG, 2005). The whole amount of TSP, MoP, gypsum and two-third of prilled urea (except for control treatment) were incorporated in each plot at the time of final land preparation. Rest one-third of prilled urea was applied at crown root initiation (CRI) stage i.e., 21 days after sowing (DAS). USG was applied only once at a time into the field at CRI stage after irrigation. At a good tilth condition, furrows were made 25 cm apart with hand rakes for sowing. Before sowing, seeds were treated with Provax 200 @ 2.5 g powder for 1 kg seed. Seeds were sown continuously in lines on 14 November 2011 @ 125 kg ha^{-1}. After sowing, the seeds were covered with soil and lightly pressed by hand. Intercultural operations were done to ensure normal growth of the crop. Three irrigations were applied at 21, 45 and 62 DAS i.e., at CRI stage, heading stage and grain filling stage, respectively. Weeding was done twice at 20 and 40 DAS. During the irrigation care was taken so that water could not flow from one plot to another or overflow the boundary of the plot. The varieties BARI Gom 21, 24, 25 and 26 were harvested on 04 March, 28 February, 28 February and 01 March 2012, respectively at physiological maturity.

Prior to harvest, five hills from each plot were selected randomly (excluding border hills) to collect the data on plant characters, yield attributes and yield. Biological yield was calculated from the following formula.

Biological yield (t ha^{-1}) = Grain yield (t ha^{-1}) + Straw yield (t ha^{-1}).

Harvest index was calculated as the ratio of economic yield (grain yield) to biological yield and expressed in terms of percentage. It was calculated by using the following formula (Donald, 1963).

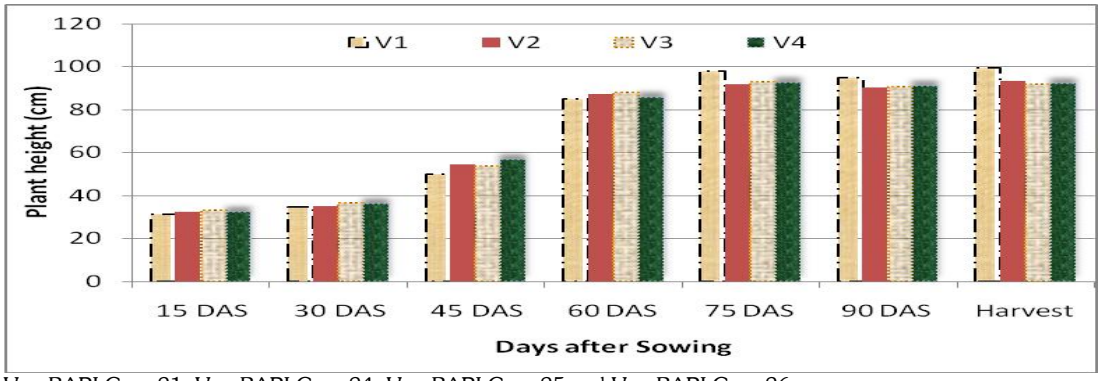
$$\text{Harvest index (\%)} = \frac{\textit{Grain yield}}{\textit{Biological yield}} \times 100$$

The collected data on each plot were statistically analyzed and mean difference among the treatments were tested with the least significant difference (LSD) at 5 % level of significance.

Results and Discussion

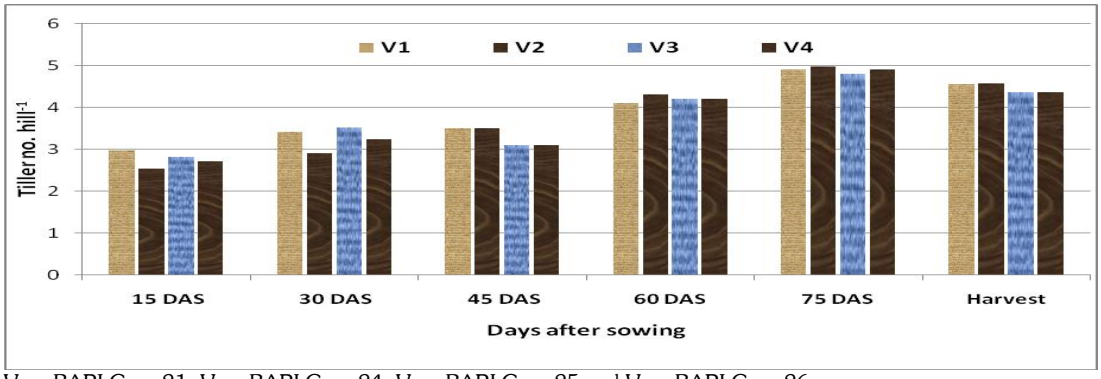
Effect of variety

The effect of variety on plant height was significant at all sampling dates such as 15, 30, 45, 60, 75, 90 DAS and at harvest (Fig. 1). The variety BARI Gom 21 produced the tallest plants (94.9, 97.9 and 99.4 cm at 75, 90 DAS and at harvest, respectively) which was superior to all other varieties. But at 15, 30, 45 and 60 DAS the variety BARI Gom 25 produced the maximum plant height (33.1, 36.5, 56.9 and 88.2 cm, respectively) which was statistically similar to the variety BARI Gom 26 at 30 DAS. On the other hand, the variety BARI Gom 21 was shorter than other varieties from 15 DAS to at 60 but it was observed that at 75, 90 DAS and at harvest the variety BARI Gom 24 produced the shorter plants (90.3, 91.9 and 91.9 cm, respectively). The results obtained from the present study were conformity with the findings of Tariq (2010), Rahman *et al.* (2009). The result revealed that the effect of variety on number of tillers $plant^{-1}$ was significant at all sampling dates (Fig. 2). The variety BARI Gom 24 produced the maximum number of tillers $plant^{-1}$ (2.9, 3.5, 3.5, 4.3, 4.9, 4.9 and 4.6 at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively) which was statistically similar with the variety BARI Gom 21 at 30, 45, 75 DAS and at harvest. Results also showed that the variety BARI Ghom 26 was statistically similar to the variety BARI Gom 24 at 15, 30 and 60 DAS. On the other hand, the variety BARI Gom 21 produced the minimum number of tillers $plant^{-1}$ at 15 DAS (2.53) but at 30, 45, 60, 75, 90 DAS and at harvest the variety BARI Gom 25 produced the minimum (2.91, 3.07, 4.07, 4.78, 4.35 and 4.36, respectively) which was identical to the variety BARI Gom 26 at 45 DAS and at harvest. The results obtained from the present study were similar to the findings of Nadim *et al.* (2012), Hussain *et al.* (2010) and Tariq (2010). Significant variation was observed in dry weight $plant^{-1}$ at all sampling dates (Fig. 3). Results indicated that at 30 DAS, variety had no significant effect but at 60, 90 DAS and at harvest and the variety BARI Gom 24 produced significantly higher dry weight $plant^{-1}$ (6.34, 15.48 and 18.19 g, respectively). Results also showed that the variety BARI Gom 25 produced the lowest dry weight $plant^{-1}$ at 30, 60, 90 DAS and at harvest (5.8, 13.8 and 16.9 g, respectively) which was statistically similar to the variety BARI Gom 21 and BARI Gom 26 at the time of harvest.



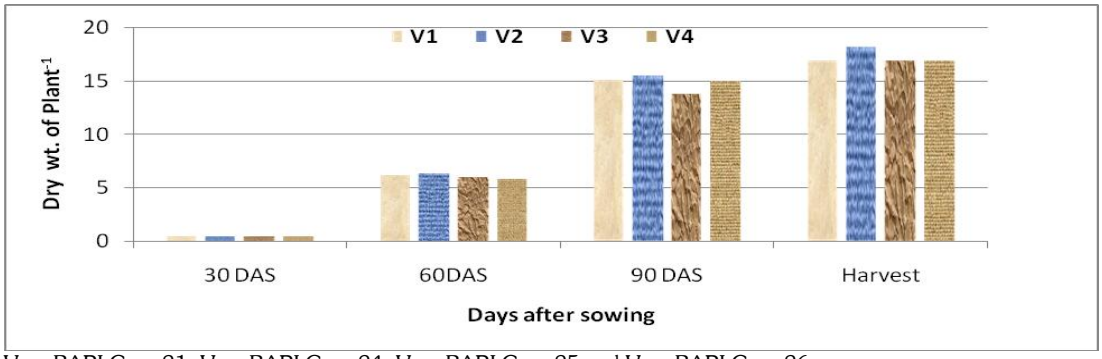
V_1= BARI Gom 21, V_2= BARI Gom 24, V_3= BARI Gom 25 and V_4= BARI Gom 26

Fig. 1. Plant height as influenced by four improved varieties of wheat at different growth stages during November' 2011 to March' 2012. LSD(0.05)= 0.72, 0.58, 0.78, 0.80, 0.68, 0.80 and 0.82 at 15, 30, 45, 60, 75 DAS and at harvest, respectively.



V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26

Fig. 2. Tiller number per hill as influenced by four improved varieties of wheat at different growth stages during November' 2011 to March' 2012. LSD($_{0.05}$)= 0.35, 0.37, 0.31, 0.13, 0.12, 0.08 and 0.11 at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively.



V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26

Fig. 3. Dry weight plant^{-1} as influenced by four improved wheat varieties during to November' 2011 to March' 2012. LSD($_{0.05}$)= NS, 0.24, 0.32 and 0.28 at 30, 60, 90 DAS and at harvest, respectively

Number of spikelets spike^{-1} was significantly influenced by different varieties (Table 2). The highest number of spikelets spike^{-1} was found in variety BARI Gom 24 and the lowest in BARI Gom 25. Similar results were found by Nadim *et al.* (2012), Hussain *et al.* (2001) and Rahman (2009). Number of grains spike^{-1} was significantly influenced by different varieties where highest number of grains spike^{-1} (37.10) was found in BARI Ghom 24and the lowest number of grains spike^{-1} (33.50) in BARI Gom 25 (Table 2). The results were similar with the findings of Rahman *et al.* (2009), and Sikder *et al.* (2001). Weight of 1000 grains was significantly influenced by different varieties where highest 1000-grain weight (58.66 g) was found in BARI Gom 25 and the lowest weight (52.68 g) in BARI Gom 21. Grain yield was significantly influenced by different varieties and the highest grain yield (2.49 t ha^{-1}) was found in BARI Gom 24) which was statistically similar to BARI Ghom 26. On the other hand the lowest grain yield (2.28 t ha^{-1}) was found in BARI Ghom 25 which was statistically similar to BARI Gom 21. Straw yield was significantly influenced by different varieties and maximum straw yield (3.57 t ha^{-1}) was found in BARI Gom 21 which was statistically similar to BARI Gom 24 and BARI Ghom 25. On the other hand the lowest straw yield (3.53 t ha^{-1}) was found in BARI Ghom 26). Similar result was found by Hussain *et al.* (2010). Results showed that the maximum harvest index (41.08%) was found in BARI Gom 24 which was statistically similar to BARI Ghom 26 and the lowest (39.00%) in BARI Gom 25 but similar to BARI Gom 21.

Table 2. Yield and yield contributing parameters and harvest index of wheat as influenced by variety

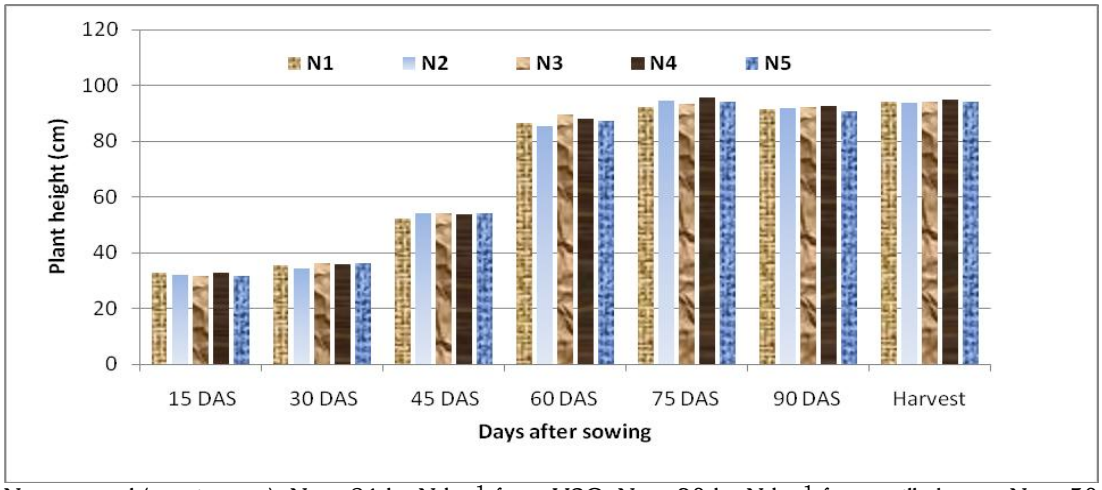
Variety	Number of spikelets spike^{-1}	Number of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1	16.66	36.15	52.68	2.32	3.57	39.29
V_2	17.23	37.10	58.11	2.49	3.55	41.08
V_3	15.72	33.50	58.66	2.28	3.55	39.00
V_4	16.61	36.30	56.31	2.43	3.53	40.69
LSD ($_{0.05}$)	0.29	0.64	0.321	0.096	0.033	1.213
CV (%)	6.34	4.60	6.78	10.4	9.56	9.20

V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26

Effect of N level and source of N

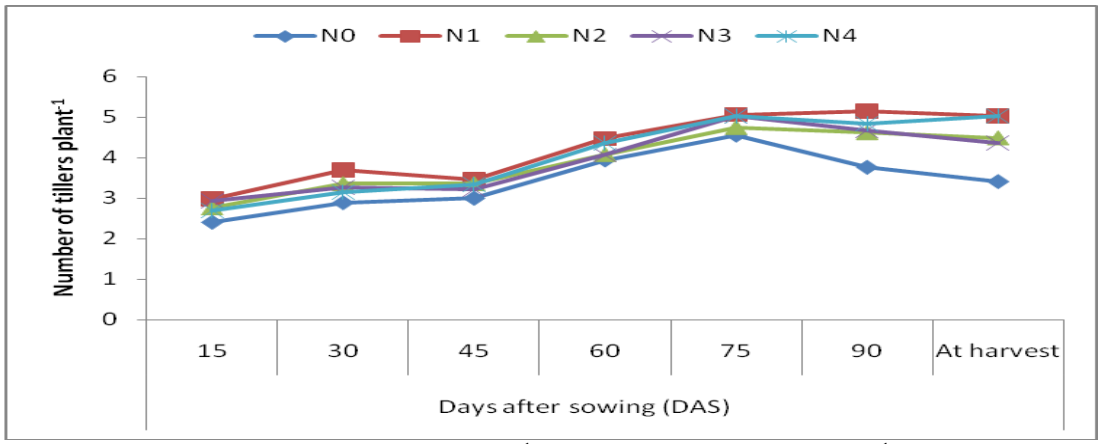
The plant height differed significantly among the different nitrogenous fertilizer at all sampling dates (Fig. 4). The tallest plant was found in 100 kg N ha^{-1} from prilled urea (at all sampling dates (32.9, 36.3, 54.3, 88.0, 92.5, 95.6 and 94.9 cm at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively). On the other hand, the shorter plant was found in control (N_0) treatment throughout the growing season but at 15 DAS, the shortest plant was found in 120 kg N ha^{-1} from prilled urea (N_4). The result obtained from the present study was conformity with the findings of Rahman (2005) and Akter (2005). Significant variation was observed on number of tillers plant^{-1} in case of different forms of N application in the field (Fig. 5). It was found that the maximum number of tillers plant^{-1} was found in 80 kg N ha^{-1} from USG (N_1) at all sampling dates which was statistically similar to N_4 at 60, 75 DAS and at harvest. On the other hand, the lowest number of tillers plant^{-1} (2.41, 2.89, 3.00, 3.94, 4.55, 3.76 and 3.41 at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively) was found in control which was statistically similar to 80 kg N ha^{-1} from prilled urea at 75 DAS and to N_3 at 60 DAS. Significant variation was observed on dry weight plant^{-1} in case of different forms of nitrogenous fertilizer

application in the field (Fig. 6). It was found that the highest dry weight plant^{-1} was found in N_1 treatment at all sampling dates (0.62, 7.40, 17.64 and 20.40 g at 30, 60, 90 DAS and at harvest, respectively). On the other hand, the minimum dry weight plant^{-1} (0.21, 4.11, 9.61 and 10.80 g at 30, 60, 90 DAS and at harvest, respectively) was found in control.



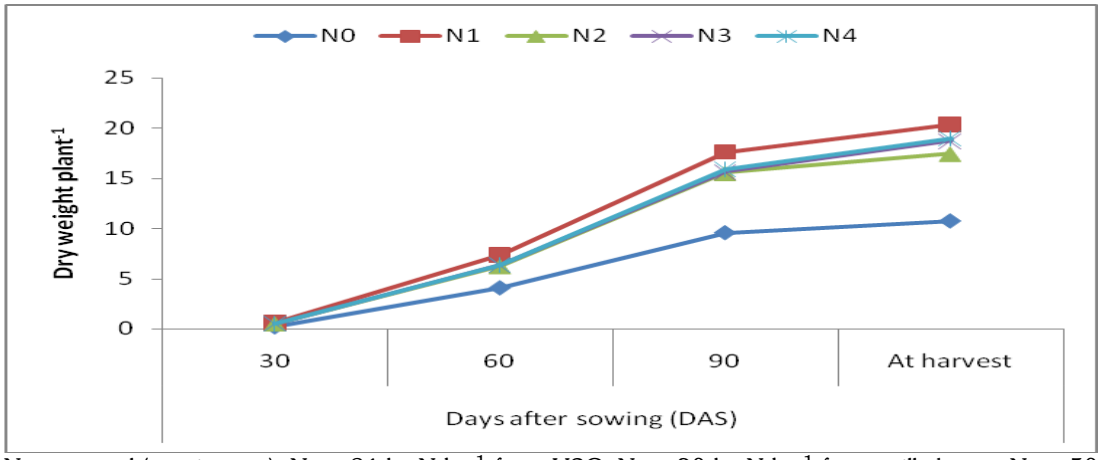
N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 30 kg N ha^{-1} from prilled urea, N_3 = 50 kg N ha^{-1} from prilled urea and N_4= 70 kg N ha^{-1} from prilled urea

Fig. 4. Plant height as influenced by urea super granules (USG) and prilled urea on growth of improved wheat varieties from November' 2011 to March' 2012. LSD$_{(0.05)}$= 0.66, 0.54, 0.73, 0.86, 0.71, 0.83 and 0.88 at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively



N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 30 kg N ha^{-1} from prilled urea, N_3 = 50 kg N ha^{-1} from prilled urea and N_4= 70 kg N ha^{-1} from prilled urea

Fig. 5: Effect on number of tillers plant^{-1} as influenced by urea super granules (USG) and prilled urea on growth of improved wheat varieties from November' 2011 to March' 2012. LSD$_{(0.05)}$= 0.29, 0.32, 0.34, 0.13, 0.23, 0.091 and 0.24 at 15, 30, 45, 60, 75, 90 DAS and at harvest, respectively



N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 30 kg N ha^{-1} from prilled urea, N_3 = 50 kg N ha^{-1} from prilled urea and N_4= 70 kg N ha^{-1} from prilled urea

Fig. 6. Dry weight plant^{-1} as influenced by urea super granules (USG) and prilled urea on growth of improved wheat varieties from November' 2011 to March' 2012. LSD($_{0.05}$)= 0.069, 0.27, 0.35, and 0.31 at 30, 60, 90DAS and at harvest, respectively

Significant variation was observed in number of spikelets spike^{-1} in case of different forms of N application (Table 3). The highest number of total spikelets spike^{-1} (20.63, 1.05 and 21.76, respectively) were achieved from USG application and the lowest number of total spikelets spike^{-1} (9.43, 4.70 and 13.89, respectively) was found in N_0 (control). Similar results were found by Hossain *et al.* (2005) and Mozumder (2001). Significant variation was observed on number of grains spike^{-1} and the highest number of grains spike^{-1} (44.05) was achieved from USG application. On the other hand, the lowest number of grains spike^{-1} (24.86) was found in N_0 (control). Significant variation was observed on 1000-grain weight in case of different forms of N application where the highest 1000-grain weight (64.66 g) was achieved from USG application and the lowest 1000-grain weight (45.26 g) was found in N_0 (control). Significant variation was observed on grain yield in case of different forms of N application where highest grain yield (2.69 t ha^{-1}) was achieved from USG application with 80/84 kg ha^{-1}. On the other hand, the lowest grain yield (1.97 t ha^{-1}) was found in N_0 (control). The results obtained from the present study was conformity with the findings of Rahman (2005), Akter (2005) and Yadav *et al.* (2005). The maximum straw yield (3.59 t ha^{-1}) was achieved from USG which was statistically similar to 80-120 kg N ha^{-1} from prilled urea while the lowest straw yield (3.43 t ha^{-1}) was found in N_0 (control). The highest harvest index (43.96%) was achieved from USG application and the lowest harvest index (35.69%) was found in N_0 (control).

Interaction effect of variety and nitrogen

The plant height differed significantly due to the interaction effect of variety and different nitrogenous fertilizer at all sampling dates (Table 4). Results showed that the maximum plant height was obtained from V_3N_3 at 15, 30, 45 and 60 DAS (34.5, 40.7, 59.3 and 90.1, respectively) which was statistically similar to V_2N_3 and V_3N_0 at 15 and 60 DAS and V_3N_4 at 60 DAS. But at 75, 90 DAS and at harvest the tallest plant was obtained from V_1N_3 (98.2, 100.4 and 100.7 cm, respectively). On the other hand the shortest plant (30.0 cm) was obtained from V_2N_4 combination at 15 DAS, but at 30, 45 and 60 DAS, the shortest plant

inV_1N_0 combination and at 75, 90 DAS and at harvest, the shortest plant was obtained fromV_2N_0 combination.

Table 3. Yield and yield contributing parameters and harvest index of wheat varieties as influenced by prilled urea and USG

Treatments	Number of spikelets spike^{-1}	Number of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
N level and source of N						
N_0	9.43	24.9	45.3	1.9	3.43	35.7
N_1	20.6	44.0	64.7	2.7	3.60	43.9
N_2	17.8	36.5	56.8	2.4	3.60	40.2
N_3	17.5	36.5	57.9	2.3	3.60	39.2
N_4	17.4	36.7	57.6	2.5	3.60	41.0
LSD ($_{0.05}$)	0.31	1.23	0.32	0.11	0.03	1.06
CV (%)	8.87	10.2	5.90	11.0	8.51	7.10

N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 30 kg N ha^{-1} from prilled urea, N_3 = 50 kg N ha^{-1} from prilled urea and N_4= 70 kg N ha^{-1} from prilled urea

Table 4. Plant height of wheat varieties as influenced by interaction of variety and prilled urea or urea super granules (USG) at different dates from November 2011 to March 2012

Interaction (Variety x Nitrogen)	Plant height (cm) at different days after sowing						
	15	30	45	60	75	90	At harvest
V_1N_0	32.3	32.6	47.2	82.2	95.2	95.9	93.6
V_1N_1	31.1	34.1	49.3	84.6	94.1	97.4	96.9
V_1N_2	31.0	36.7	52.3	86.2	95.0	97.2	96.6
V_1N_3	30.3	34.6	47.8	87.5	98.2	100.4	100.0
V_1N_4	32.5	35.3	52.5	85.4	92.3	98.83	97.8
V_2N_0	32.4	35.8	57.7	86.1	86.8	86.5	85.8
V_2N_1	33.9	36.2	51.8	88.2	93.3	95.6	92.3
V_2N_2	30.9	35.4	53.8	85.8	89.7	91.3	91.1
V_2N_3	34.5	34.7	54.4	89.8	89.8	92.2	91.4
V_2N_4	30.0	32.9	54.4	86.0	91.9	94.3	92.3
V_3N_0	34.4	36.8	48.1	89.6	91.5	91.9	96.2
V_3N_1	30.6	33.4	56.9	86.0	89.4	92.7	93.7
V_3N_2	34.3	37.0	52.5	85.1	90.4	93.2	92.2
V_3N_3	34.5	40.7	59.3	90.1	91.8	95.7	92.9
V_3N_4	31.5	36.2	54.6	89.9	91.2	92.2	91.1
V_4N_0	32.2	35.7	55.4	85.6	89.5	90.3	91.2
V_4N_1	32.0	34.5	57.1	85.6	90.6	91.9	92.5
V_4N_2	31.1	35.2	58.7	84.8	93.8	96.7	92.3
V_4N_3	32.8	35.5	56.4	84.7	93.3	94.1	99.2
V_4N_4	33.2	39.1	54.9	87.2	88.3	90.8	92.8
LSD ($_{0.05}$)	0.35	0.57	1.64	1.00	1.31	1.38	1.40
CV (%)	8.17	10.4	10.5	7.12	8.33	9.00	9.44

V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26; N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 30 kg N ha^{-1}from prilled urea, N_3 = 50 kg N^{-1} from prilled and N_4= 70 kg N ha^{-1} from prilled urea

Number of tillers plant^{-1} was significantly influenced by the interaction of variety and nitrogenous fertilizer at different DAS (Table 5). Results showed that the maximum number of tillers plant^{-1} was obtained from V_2N_1 at 15, 30, 45, 60, 75, 90 DAS and at harvest (3.5, 4.0, 4.4, 4.8, 5.4, 5.8 and 5.8, respectively) which was statistically similar with V_4N_2 and V_4N_3 at 30 DAS and 75 DAS, respectively. On the other hand the minimum number of tillers plant^{-1} at 15, 30, 45, 60, 75, 90 DAS and at harvest was observed as 2.3, 2.6, 2.7, 3.4, 4.3, 3.5 and 3.3, respectively, with V_3N_0 which was statistically similar to V_1N_0 at 15 and 60 DAS.

Table 5. Number of tillers plant^{-1} as influenced by interaction of variety and prilled urea or urea super granules (USG) during the period from November' 2011 to March' 2012

Interaction (Variety x Nitrogen)	Number of tillers plant^{-1} at different days after sowing						
	15	30	45	60	75	90	At harvest
V_1N_0	2.3	2.9	3.2	3.6	4.8	4.1	3.6
V_1N_1	3.1	3.7	3.4	3.9	4.7	4.9	4.9
V_1N_2	2.9	3.4	3.0	4.3	4.8	4.1	3.8
V_1N_3	2.5	3.4	3.3	3.9	4.7	4.5	4.6
V_1N_4	3.0	3.7	3.9	4.6	4.6	4.8	4.8
V_2N_0	2.4	2.9	3.1	4.1	4.9	3.9	3.4
V_2N_1	3.5	4.0	4.4	4.8	5.4	5.8	5.8
V_2N_2	2.6	3.3	3.7	4.4	5.2	4.9	4.8
V_2N_3	2.8	2.8	3.1	3.8	5.1	4.8	4.7
V_2N_4	2.3	2.7	3.6	4.4	5.1	5.2	5.1
V_3N_0	2.3	2.6	2.7	3.4	4.3	3.4	3.3
V_3N_1	2.7	3.7	3.2	4.1	4.7	4.7	5.0
V_3N_2	3.1	2.9	4.0	4.4	4.9	4.5	4.5
V_3N_3	3.1	3.5	3.2	4.2	4.9	4.3	4.2
V_3N_4	2.9	3.1	3.1	3.9	4.8	4.6	4.6
V_4N_0	2.6	3.2	2.9	4.2	4.7	3.5	3.4
V_4N_1	2.8	3.2	2.8	4.2	4.7	5.1	5.3
V_4N_2	3.3	4.0	3.8	4.3	5.2	4.8	4.7
V_4N_3	2.3	3.3	3.2	4.3	5.4	4.9	4.0
V_4N_4	2.5	3.1	2.8	4.5	4.9	4.67	4.5
$LSD_{0.05}$	0.20	0.22	0.21	0.18	0.23	0.14	0.23
CV (%)	10.1	15.2	16.1	13.2	11.1	10.4	10.2

V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26; N_0 = control (no nitrogen), N_1 = 80 kg N ha^{-1} from USG, N_2 = 80 kg N ha^{-1} from prilled urea, N_3 = 100 kg N ha^{-1} from prilled urea and N_4= 120 kg N ha^{-1} from prilled urea

Dry weight plant^{-1} was significantly influenced by interaction of variety and N at different DAS (Table 6). Results showed that the highest dry weight plant^{-1} was obtained from V_2N_1 at 30, 60, 90 DAS and at harvest (0.64, 7.73, 18.8 and 21.2 g respectively) which was statistically similar with V_1N_1, V_3N_1 and V_4N_1 at 30 DAS, but at 60, 90 DAS and at harvest. On the other hand the lowest dry weight plant^{-1} at 30, 60, 90 DAS and at harvest was observed as 0.20, 3.88, 8.83 and 10.36 g respectively with V_3N_0.

The highest number of spikelets spike^{-1} was found the treatment combination of V_2N_1 and the lowest number of spikelets spike^{-1} 9.27 in V_1N_0. Number of grains spike^{-1} was significantly influenced by interaction of variety and N, where the highest number of grains spike^{-1} (46.3) was found the treatment combination of V_2N_1. On the other hand, the lowest number of grains spike^{-1} (22.90) was observed in V_1N_0 .

Table 6. Dry weight plant^{-1} as influenced by interaction of variety and prilled urea or urea super granules (USG) from November' 2011 to March' 2012

Interaction (Variety x Nitrogen)	Dry weight plant^{-1} (g) at different days after sowing			
	30	60	90	At harvest
V_1N_0	0.20	4.1	9.8	11.2
V_1N_1	0.63	7.3	17.0	20.2
V_1N_2	0.55	6.5	15.6	16.7
V_1N_3	0.45	6.4	16.7	19.4
V_1N_4	0.53	6.2	17.3	18.2
V_2N_0	0.23	4.4	9.9	10.7
V_2N_1	0.64	7.7	18.8	21.2
V_2N_2	0.42	6.4	16.6	18.4
V_2N_3	0.46	6.9	17.3	19.9
V_2N_4	0.47	6.8	15.9	20.7
V_3N_0	0.20	3.8	8.8	10.4
V_3N_1	0.61	7.3	17.0	19.3
V_3N_2	0.46	6.2	13.8	16.6
V_3N_3	0.48	6.2	14.2	17.6
V_3N_4	0.52	6.1	14.3	19.7
V_4N_0	0.22	4.1	9.9	10.9
V_4N_1	0.61	7.2	17.7	20.7
V_4N_2	0.47	5.6	16.1	18.0
V_4N_3	0.46	5.7	14.2	17.9
V_4N_4	0.53	6.4	15.9	17.3
$LSD_{0.05}$	0.07	0.3	0.5	0.35
CV (%)	10.3	12.8	9.7	10.3

V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26; N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 80 kg N ha^{-1} from prilled urea, N_3 = 100 kg N ha^{-1} from prilled urea and N_4= 120 kg N ha^{-1} from prilled urea

Weight of 1000 -grains was significantly influenced by interaction of variety and N (Table 7). The highest 1000-grain weight (64.85 g) was found in the treatment combination of V_3N_1 which was statistically similar to V_1N_1, V_2N_1 and V_4N_1. On the other hand, the lowest 1000-grain weight (38.13 g) was observed in V_1N_0. Grain yield was significantly influenced by interaction of variety and N (Table 7). Results showed that the maximum grain yield (2.80 t ha^{-1}) was found in the treatment combination V_2N_1 which was statistically similar to V_4N_1 and V_2N_4 while lower grain yield (1.97 t ha^{-1}) was observed with V_3N_0 and V_4N_0 which was statistically similar to V_1N_0 and V_2N_0. The maximum straw yield (3.67 t ha^{-1}) was found in V_2N_3 which was statistically similar to V_3N_4 and V_4N_1. On the other hand the lowest straw yield (3.36 t ha^{-1}) was observed in V_2N_0 which was statistically similar to V_2N_0 and V_4N_0The maximum harvest index (45.39%) was found with the treatment combination V_2N_1 which was statistically similar to V_4N_1 while lowest harvest index (34.98%) was observed in V_3N_0 which was statistically similar to V_4N_0.

Table 7. Yield and yield contributing parameters and harvest index of wheat as influenced by variety and prilled urea or urea super granules (USG)

Interaction (Variety x Nitrogen)	Number of spikelets spike^{-1}	Number of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1N_0	9.2	22.90	38.13	2.03	3.52	36.32
V_1N_1	20.1	43.68	64.75	2.53	3.55	41.88
V_1N_2	18.2	38.33	53.83	2.47	3.60	40.64
V_1N_3	17.7	37.68	54.62	2.12	3.57	37.22
V_1N_4	18.0	38.18	52.07	2.45	3.61	40.42
V_2N_0	9.4	23.87	48.95	2.02	3.36	36.16
V_2N_1	22.3	46.34	64.38	2.80	3.56	45.39
V_2N_2	17.9	36.51	56.11	2.30	3.61	38.94
V_2N_3	18.0	37.94	59.59	2.37	3.67	39.18
V_2N_4	18.4	40.66	61.51	2.70	3.42	44.13
V_3N_0	9.3	24.44	50.87	1.97	3.42	34.98
V_3N_1	19.0	41.14	64.85	2.63	3.61	43.51
V_3N_2	16.7	33.42	59.04	2.23	3.54	38.68
V_3N_3	16.9	34.32	57.64	2.17	3.53	38.05
V_3N_4	16.7	34.01	60.89	2.38	3.66	39.45
V_4N_0	9.8	28.24	43.08	1.97	3.39	35.32
V_4N_1	21.1	45.04	64.66	2.78	3.65	45.07
V_4N_2	18.2	37.86	58.15	2.63	3.56	42.53
V_4N_3	17.4	36.18	59.61	2.62	3.53	42.35
V_4N_4	16.5	34.14	56.06	2.42	3.61	40.13
$LSD_{0.05}$	0.49	1.040	1.80	0.104	0.05	0.72
CV (%)	8.8	10.16	5.90	11.09	8.51	7.10

V_1 = BARI Gom 21, V_2 = BARI Gom 24, V_3 = BARI Gom 25 and V_4 = BARI Gom 26; N_0 = control (no nitrogen), N_1 = 84 kg N ha^{-1} from USG, N_2 = 80 kg N ha^{-1} from prilled urea, N_3 = 100 kg N ha^{-1} from prilled urea and N_4= 120 kg N ha^{-1} from prilled urea

Conclusion

The results of the experiment revealed that the variety BARI Gom 24 gave the maximum grain yield that was similar to the variety BARI Gom 26. So, both the varieties may be recommended for wheat cultivation for obtaining the maximum yield. Among the different nitrogenous fertilizer, the highest grain yield was obtained from 84 kg N ha^{-1} from urea super granules (USG). Among the interaction effect the combination of 84 kg N ha^{-1} from USG along with the variety BARI Gom 24 performed best in case of grain yield that was statistically similar to the variety BARI Gom 26. Therefore, wheat variety BARI Gom 24 and BARI Gom 26 could perform better with 84 kg N ha^{-1} from USG.

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