

EFFECT OF FERTILIZERS ON GRAIN YIELD AND GRAIN PROTEIN CONTENT OF WHEATM.A. HASAN^{1*} and A.M.A. KAMAL²¹ *Department of Agronomy, Patuakhali Agricultural College, Patuakhali, Bangladesh*² *Institute of Post Graduate Studies in Agriculture, Joydevpur, Gazipur, Bangladesh**(Received: 28 May 1997; accepted: 07 November 1997)*

Abstract: Studies were conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh from November 1994 to March 1995 in a sandy loam soil to investigate the effect of fertilization on grain yield and grain protein content of two varieties of wheat *viz.* Aghrani and Kanchan. Five fertilization treatments were used in this experiment. Kanchan was the superior variety which produced 2.99 t/ha grain yield, 3.79 t/ha straw yield and had 13.8% grain protein content. Aghrani had shorter field duration (107.0 days) than Kanchan (111.1 days). Fertilization treatments exhibited significant influence on all parameters studied. Urea in 4 splits + cowdung 10 t/ha produced the highest grain yield of 3.44 t/ha, straw yield of 4.21 t/ha and 14.1% grain protein content compared to inorganic fertilizers only producing lowest grain yield of 2.31 t/ha, straw yield of 3.14 t/ha and 12.5% grain protein content. Field duration was longest (111.5 days) from the previous treatment and shortest (106.7 days) from inorganic fertilizers only. The results suggest that a higher dose of inorganic fertilizers with increased number of split applications of urea and organic manuring than the recommended dose of inorganic fertilizers may increase grain and straw yields and grain protein content of wheat under conditions of the experiment.

Key words: Cowdung, fertilizers, grain yield, protein, urea, wheat.

INTRODUCTION

Wheat which is the most important cereal in the world, accounts for one-third of the total cereal production. It is the second important cereal crop of Bangladesh. It was grown in 0.64 million hectares of land in 1992-93 which produced 1.18 million metric tons of wheat grain with an average yield of 1.85 t/ha.¹ Bangladesh runs short of food every year. In order to meet the food deficit and to cope with the demand for food for the increasing population, internal wheat production needs to be increased.

It appears that there is much scope for increasing yield to meet the ever rising food demand of the country. Modern wheat varieties need productive soil and optimum supply of growth factors for their proper growth and development. But continuous cropping reduces the nutrient content of most soils of Bangladesh.² The use of chemical fertilizers in wheat without manures is depleting soil organic

*Present address: Department of Agronomy, Hajeé Mohammad Danesh Agricultural College, Dinajpur-5200, Bangladesh.

matter seriously and causing micronutrient deficiencies.³ However, application of organic manures in combination with fertilizers helps both in the proper nutrition of the crop plants and in maintaining the fertility of the soil. Moreover, organic manures will also help to solve the problem of micronutrient deficiency in the soil to some extent. The protein content of wheat is known to be influenced by cultivar,⁴ time of N application,⁵ nitrogen fertilization rate,⁶ method of N application⁷ and residual soil N.⁸ Hence, it appears that there is a need to find out a fertilizer management system using organic manures and inorganic fertilizers. The present investigation is an attempt to study the effect of inorganic fertilizers alone and in combination with organic manure with increased number of split applications of urea on grain yield and grain protein content of wheat.

METHODS AND MATERIALS

Studies were conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh from November 1994 to March 1995 in a sandy loam soil. The land was previously used for wheat and then fallow. The treatments were laid out in a split-plot design with three replications assigning fertilization in the main plot and variety in the subplot at random. The size of each unit plot was 5m x 4m. Two wheat varieties *viz.* Aghrani and Kanchan and five fertilizations: F₁ (control) - inorganic fertilizers only (IF) as recommended by BARI,⁹ with urea in two splits (basal and 27 DAS), F₂ - IF with high yield target (HT), with urea in three splits (basal, 27 and 55 DAS) + cowdung 5 t/ha, F₃ - HT with urea in four splits (basal, 27, 55 and 75 DAS) + cowdung 5 t/ha, F₄ - HT with urea in three splits (basal, 27 and 55 DAS) + cowdung 10 t/ha, F₅ - HT with urea in four splits (basal, 27, 55 and 75 DAS) + cowdung 10 t/ha were used as treatments. Urea (220 kg/ha), triple superphosphate (180 kg/ha), muriate of potash (50 kg/ha) and gypsum (120 kg/ha) were applied as per recommended dose. Topdressing of urea was carried out as per experimental treatments. The crop was irrigated twice during the growth period on 27 December 1994 and 12 February 1995. Weeding was carried out twice prior to first and second irrigations. Crop of each plot was harvested separately. Ten plants were selected at random from four 0.25 m² sample areas in each plot harvested separately. Total nitrogen content of wheat grains was determined by micro-Kjeldahl method.¹⁰ The protein content was determined from per cent total nitrogen multiplied by 5.85. Statistical significance was determined by the LSD Test.

RESULTS AND DISCUSSION

The results showed that Kanchan (103.0 cm) was taller than Aghrani (98.5 cm) (Table 1). That variety may differ for plant height was also reported by Shrestha.¹¹ The shortest plants (96.8 cm) resulted from F₁, whereas the tallest plants (106.0 cm) were obtained from F₅ (Table 2). The interaction effect of variety and fertilization on plant height was statistically significant (Table 3).

Table 1: Effect of variety on yield attributes, grain and straw yields, field duration and grain protein content of wheat.

Variety	Plant height (cm)	Effective tillers/plant (no.)	Grains/spikelet (no.)	Grains/spike (no.)	1000 Grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Field duration (days)	Grain protein content (%)
V1 (Aghrani)	98.5	3.62	1.87	32.6	45.6	2.75	3.49	107.0	13.1
V2 (Kanchan)	103.0	4.08	2.04	36.5	49.3	2.99	3.79	111.1	13.8
LSD at 5% level	-	0.36	-	-	-	0.18	-	-	-
LSD at 1% level	1.2	-	0.05	0.6	1.9	-	0.23	1.3	0.3

Table 2: Effect of fertilization on yield attributes, grain and straw yields, field duration and grain protein content of wheat.

Fertilization	Plant height (cm)	Effective tillers/plant (no.)	Grains/spikelet (no.)	Grains/spike (no.)	1000 Grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Field duration (days)	Grain protein content (%)
F ₁ (control)	96.8c	3.53b	1.95	31.1e	42.7e	2.31d	3.14c	106.7d	12.5d
F ₂	98.2c	3.65b	1.90	32.2d	44.9d	2.61cd	3.42be	108.0c	13.4c
F ₃	100.0b	3.68b	1.94	34.3c	47.6c	2.86bc	3.61bc	109.2b	13.6bc
F ₄	103.0ab	3.95a	1.98	37.0b	50.1b	3.13ab	3.82ab	109.8b	13.9ab
F ₅	106.0a	4.43a	2.01	38.3a	52.3a	3.44a	4.21a	111.5a	14.1a
LSD at 5% level	-	0.48	NS	-	-	-	-	-	-
LSD at 1% level	4.6	-	NS	0.6	1.9	0.39	0.50	0.9	0.3

In each column, values followed by the same letter(s) do not differ significantly at 1% and/or 5% level of probability.

Of the two varieties, Kanchan produced higher number of effective tillers per plant (4.08) (Table 1), the lowest number (3.53) being produced by F_1 treatment and the highest number (4.43) by F_5 treatment (Table 2).

The results showed that a treatment combination of high inorganic fertilization with 10 t cowdung/ha + 4 split applications of urea produced most favourable influence on number of effective tillers/plant. It was found that Kanchan produced more grains per spikelet (2.04) than Aghrani (1.87) (Table 1). The effect of fertilization on number of grains per spikelet was not statistically significant (Table 2). But the interaction effect of variety and fertilization on number of grains per spikelet was significant and number of grains per spikelet due to the interaction effect ranged from 1.82 to 2.13 (Table 3). The number of grains/spike in Kanchan (36.5) was higher than in Aghrani (32.6) (Table 1). A similar result was also reported by Ceapoiu *et al.*¹² The lowest number of grains/spike (31.1) was obtained from F_1 treatment and the highest number (38.3) from F_5 treatment (Table 2). The interaction effect of variety and fertilization on grains/spike was significant (Table 3). The number of grains/spike due to different interactions ranged from 28.9 to 40.4. The weight of 1000 grains of Kanchan (49.3 g) was higher than that of Aghrani (45.6 g) (Table 1). A similar result was also reported by Shrestha.¹¹ The lowest weight of 1000 grains (42.7 g) was obtained from control (F_1) and the highest weight (52.3 g) from F_5 treatment (Table 2).

Table 3: Effect of interaction of variety and fertilization on plant height, grains/spikelet and grains/spike of wheat.

Treatment	Plant height (cm)		Grains/spikelet (no.)		Grains/spike (no.)	
	V ₁	V ₂	V ₁	V ₂	V ₁	V ₂
Variety						
Fertilization						
F_1 (control)	95.0h	98.7e	1.86e	2.03b	28.9h	33.3ef
F_2	95.7gh	100.7d	1.82e	1.97bc	30.5g	34.0de
F_3	97.0fg	103.3c	1.93cd	1.96c	33.2f	35.4c
F_4	99.3de	105.7b	1.84e	2.12a	34.5d	39.5b
F_5	105.3b	107.3a	1.88de	2.13a	36.1c	40.4a
LSD at 1% level	1.5		0.06		0.7	

In each column, values followed by the same letter(s) do not differ significantly at 1% and/or 5% level of probability.

The results showed that Kanchan produced higher grain yield (2.99 t/ha) than Aghrani (2.75 t/ha) (Table 1). Higher grain yield from Kanchan was the result of superior performance of all yield components from this variety. The lowest grain yield (2.31 t/ha) was produced by F_1 treatment and the highest (3.44 t/ha) by F_5 treatment (Table 2). This higher grain yield from F_5 treatment was attributable to higher number of effective tillers, grains/spike and 1000 grain weight from this treatment, the results being similar to those of Konov *et al.*,¹³ Mehta & Daftardar.¹⁴ Kanchan produced higher straw yield (3.79 t/ha) than Aghrani (3.49 t/ha) (Table 1). Higher plant height and more tillers of Kanchan possibly contributed to higher straw yield of this variety than Aghrani. Similar effect of cultivar on straw yield of wheat was reported by Sharma *et al.*¹⁵ The lowest straw yield (3.14 t/ha) was produced by F_1 treatment and the highest (4.21 t/ha) by F_5 treatment (Table 2). This result was partially similar to the result of Singh *et al.*¹⁶ Field duration of Kanchan (111.1 days) was higher than that of Aghrani (107.0 days) (Table 1). The duration was significantly the shortest (106.7 days) from F_1 treatment and the longest (111.5 days) from F_5 treatment (Table 2). From the results, it can be said that the crop took more time to mature as fertilization with organic manuring increased with increasing split application of urea.

There was a significant difference between the varieties for grain protein (Table 1). It was found that grain protein content of Kanchan (13.8%) was higher than that of Aghrani (13.1%) (Table 1). That varieties may differ for grain protein content was also reported by Nedelciue *et al.*¹⁷ The effect of fertilization on grain protein content was significant (Table 2). Grain protein content from different treatments ranged from 12.5% to 14.1% (Table 2). Significantly lowest grain protein content resulted from F_1 treatment and the highest from F_5 treatment. The grain protein contents from F_4 and F_5 , from F_3 and F_4 , and from F_2 and F_3 did not differ significantly (statistically). These results suggest that application of cowdung as organic manure up to 10 t/ha together with high level of inorganic fertilization can increase grain and straw yields and grain protein content of wheat over recommended dose of inorganic fertilizers alone under conditions of the experiment.

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