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Yield Performance and Grain Quality of Wheat Varieties Grown under Rainfed and Irrigated Conditions

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Abstract: A study was undertaken to evaluate the growth performance and grain quality of eight modern wheat varieties grown under rainfed and irrigated conditions. Wheat varieties used in the experiment were aghrani, akbar, ananda, balaka, barkat, kanchan, pavon and sonalika. In irrigated condition, one flood irrigation was applied at 28 days of sowing to saturate the soil up to 15 cm depth. The wheat varieties differed significantly ($P<0.05$) with respect to plant height and 1000-grains weight, grain and straw yields, protein, amylose, ash and K contents in grains. The highest grain yield obtained in aghrani (2.16 t ha^{-1}) was statistically identical to those found in kanchan (2.08 t ha^{-1}), akbar (2.06 t ha^{-1}) and barkat (2.02 t ha^{-1}). The highest protein content was found in barkat (13.75%), which was followed by ananda (12.65%), akbar (12.55%), sonalika (12.5%), aghrani (12.35%) and kanchan (12.25%). Balaka had the lowest grain protein content (11.55%). The highest amylose content were found in barkat (24.4%) and was followed by balaka (24.25%), aghrani (23.6%), akbar (23.2%), ananda (23.05%) and kanchan (21.75%). Application of irrigation improved the plant characteristics like grain and straw yields, protein, amylose, P, K and S contents in grains compared to wheat grown under rainfed conditions. Among the eight varieties of wheat barkat, aghrani, akbar and kanchan are the promising varieties than the others with respect to grain and protein yields.

Key words: Wheat, rainfed, irrigation, grain yield, protein, amylose

Introduction

Wheat now occupies an important position as a winter cereal crop in reducing the shortage of food in Bangladesh. It ranks second both in acreage and production (Anonymous, 2001). The ability of wheat to grow both as rainfed and irrigated conditions makes it convenient to fit into the existing cropping system. To meet up the increasing demand for food grains in Bangladesh, efforts are being made to develop modern varieties of wheat with high yield potential. Whenever a crop variety is evolved, field trials are needed to find out the yield performance and quality in different agro-ecological zones. Hassan *et al.* (1998) reported significant variation in grain yield of wheat genotypes grown under different management practices. Dubey and Sharma (1996) found significant increase in grain yield and nutrient uptake of wheat by the application of irrigation. The protein content of wheat is also reported to be influenced by cultivar (Johnson and Mattern, 1975) and environment (Baenziger *et al.*, 1985). In Bangladesh, information on yield performance, aspects of nutritional quality of cultivated and recently released wheat varieties under rainfed and irrigated conditions in different agro-ecological zones are not known. It was, therefore, intended to find out yield performance and grain quality of eight cultivated and recently released modern varieties of wheat under rainfed and irrigated conditions at Agronomy Farm.

Materials and Methods

The experiment was carried out at the Agronomy Farm of Bangladesh Agricultural University, Mymensingh during November 1994 to March 1995. The soil belongs to Sonatala soil series under the agro-ecological zone of Old Brahmaputra Floodplain. Texturally the soil was silt loam, having 6.64 pH, 1.83% organic matter, 14.8 meq 100 g^{-1} CEC, 0.11% total N, 16.3 ppm available P, 0.27 meq 100 g^{-1} exchangeable K and 13.7 ppm available S. Eight varieties of wheat viz. aghrani, akbar, ananda, balaka, barkat, kanchan, pavon and sonalika were used in the experiment. The experiment was laid out in a split plot design with irrigation in the main plot and variety in the sub-plot. A space of 3 m with a deep drain in the middle was kept between irrigated and non-irrigated plots. In irrigated plots, one flood irrigation was applied at 28 days of sowing to saturate the soil up to 15 cm depth. The size of each unit plot was 5x2 m^2. The land was fertilized with 220 kg urea, 180 kg TSP, 50 kg MP, 120 kg gypsum and 10 kg zinc sulphate ha^{-1}. The wheat seeds were sown on 30 November, 1994 @ 120 kg ha^{-1} continuously in lines at 20

cm apart. The crop was harvested at full maturity on 29 March, 1995. Data on yield components were collected from 10 randomly selected plants in each plot. After harvesting, the grain samples were collected plot wise, oven dried and ground. The samples were digested with HNO_3-$HClO_4$ mixture (10:1) for P, K and S determination (Yoshida *et al*., 1976). Estimation of protein was made following procedure of Anonymous (1984). Protein yield was calculated by multiplying protein content and per hectare yield of grain. Amylose content was determined by method of Juliano (1971).

Results and Discussion

Varietal effect: There was a significant ($P<0.05$) variation among the varieties of wheat with respect to plant height and 1000-grains weight but statistically no variation was observed in tillering and filled grains plant^{-1} (Table 1). The tallest plant was recorded from Sonalika (86.3 cm), which was identical to those of aghrani (85.5 cm), kanchan (84.9 cm), barkat (83.1 cm), ananda (82.6 cm) and balaka (81.1 cm). The shortest plant was observed from akbar (78.6 cm). Hassan *et al.* (1998) also reported variation in plant height of wheat genotypes. The number of total tillers plant^{-1} in wheat varieties ranged from 2.97 in akbar to 3.28 in ananda. There was no difference among the varieties in producing fertile tillers plant^{-1}. The highest number of fertile tillers plant^{-1} was produced in aghrani (2.78) followed by balaka (2.77), ananda and pavon (2.73), kanchan (2.68), barkat (2.63) and akbar (2.61). The different varieties were very close with respect to the production of filled grains panicle^{-1}, the highest in akbar (31.6) and lowest in balaka (30.1).

The weight of 1000-grains ranged from 33.1 to 46.0 g (Table 1). The heaviest grains were produced by kanchan (46.0 g), which was followed by sonalika (45.9 g), aghrani (44.1 g), barkat (43.0 g), akbar and balaka (42.4 g), ananda (39.7 g) and pavon (33.1 g). Among the varieties, kanchan, sonalika and aghrani were statistically identical for 1000-grains weight. Grain and straw yields of wheat varieties varied significantly (Table 1). The grain yield varied from 1.70 t ha^{-1} in sonalika to 2.16 t ha^{-1} in aghrani. The grain yield of aghrani (2.16 t ha^{-1}) was statistically identical to those found in kanchan (2.08 t ha^{-1}) and akbar (2.06 t ha^{-1}). The grain yield of akbar (2.06 t ha^{-1}) was statistically identical to those found in barkat (2.02 t ha^{-1}), ananda (1.99 t ha^{-1}) and balaka (1.97 t ha^{-1}). The grain yields of pavon (1.75 t ha^{-1}) and sonalika (1.7 t ha^{-1}) were significantly lower compared to rest of the varieties. The highest straw yield observed in sonalika (3.12 t ha^{-1}) was identical to that of pavon (3.02 t ha^{-1}). The straw yield of pavon (3.02 t ha^{-1}) was identical to those found in kanchan (2.79 t ha^{-1}) and barkat (2.76 t ha^{-1}). The rest of the varieties showed identical straw yields. Hassan *et al.* (1998) reported significant variation in grain yield of wheat genotypes grown under different management practices. Similar result was also reported by Sarkar *et al.* (1996).

The varieties differed significantly ($P<0.05$) with respect to protein content and protein yield, amylose, ash and K content in grains while P and S contents did not differ significantly (Table 2). The highest grain protein content was in barkat (13.75%) which was identically followed by ananda (12.65%), akbar (12.55%), aghrani (12.35%), sonalika (12.50%) and kanchan (12.25%). The lowest grain protein content was found in Balaka (11.55%). The highest protein yield was from Barkat (277.8 kg ha^{-1}), which was identically followed by aghrani (266.8 kg ha^{-1}), akbar (258.4 kg ha^{-1}), kanchan (254.8 kg ha^{-1}) and ananda (251.7 kg ha^{-1}). The lowest protein yield was from pavon (210.8 kg ha^{-1}). Barkat had the highest amylose content (24.40%) which was identically followed by balaka (24.3%), aghrani (23.6%), akbar (23.2%), ananda (23.1%) and kanchan (21.8%). Pavon had the highest ash content

Table 1: Effect of variety and irrigation on growth and yield parameters of wheat

	Plant characters					Yield	
Factors	Plant height (cm)	Total tillers plant^{-1} (No.)	Fertile tillers plant^{-1} (No.)	Filled grains spike^{-1} (No.)	1000-grains weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Varieties							
Aghrani	85.5ab	3.07	2.78	30.4	44.1a	2.16a	2.61c
Akbar	78.6c	2.97	2.61	31.6	42.4b	2.06a-c	2.57c
Ananda	82.6a-c	3.28	2.73	30.4	39.7c	1.99bc	2.56c
Balaka	81.1bc	3.25	2.77	30.1	42.4b	1.97c	2.62c
Barkat	83.1a-c	3.10	2.63	30.8	43.0b	2.02bc	2.76bc
Kanchan	84.9ab	3.13	2.68	30.6	46.0a	2.08ab	2.79b
Pavon	79.7c	3.08	2.73	31.0	33.1d	1.75d	3.02ab
Sonalika	86.3a	3.17	2.75	30.7	45.9a	1.70d	3.12a
LSD (0.05) value	4.9	NS	NS	NS	2.2	0.10	0.28
Irrigation							
Rainfed	78.2b	2.95b	2.63b	29.3b	42.3a	1.77b	2.55b
Irrigated	87.2a	3.32a	2.80a	32.1a	41.9b	2.18a	2.96a
LSD (0.05) value	13.1	0.17	0.16	1.8	0.9	0.06	0.21

Values in a column having same letters do not differ significantly at 5% level of probability

Table 2: Grain quality of wheat varieties under rainfed and irrigated conditions

Factors	Protein (%)	Protein yield (kg ha^{-1})	Amylose (%)	Ash (%)	P (%)	K (%)	S (%)
Varieties							
Aghrani	12.35ab	266.8a	23.60ab	1.30c	0.42	0.31b	0.19
Akbar	12.55ab	258.5ab	23.20ab	1.60b	0.43	0.36ab	0.21
Ananda	12.65ab	251.7ab	23.05ab	1.61b	0.40	0.36ab	0.19
Balaka	11.55b	227.4bc	24.25a	1.65b	0.40	0.36ab	0.19
Barkat	13.75a	277.8a	24.40a	1.53bc	0.44	0.41a	0.22
Kanchan	12.25ab	254.8ab	21.75ab	1. 66b	0.41	0.34b	0.22
Pavon	12.05b	210.8c	21.15b	1.95a	0.40	0.36ab	0.21
Sonalika	12.5ab	212.5c	21.40b	1.63b	0.40	0.33b	0.20
LSD (0.05) value	1.63	33.8	2.71	0.23	NS	0.05	NS
Irrigation							
Rainfed	12.26	217.0b	22.68	1.42b	0.41	0.35	0.19
Irrigated	12.65	275.8a	23.03	1.83a	0.42	0.36	0.22
LSD (0.05) value	NS	29.7	NS	0.38	NS	NS	NS

Values in a column having same letter do not differ significantly at 5% level of probability
NS = Non Significant

(1.95%), which was superior to all other varieties. The lowest ash content (1.30%) was in aghrani. Barkat had the highest grain K content (0.41%), which was followed by akbar, ananda, balaka and pavon (0.36%). The lowest K content of 0.31% was found in aghrani.

Irrigation effect: Wheat grown with irrigation had significantly taller plants, tillering, filled grains, 1000-grains weight, grain and straw yields compared to those of wheat grown under rainfed condition (Table 2). The grain and straw yields of wheat increased by 23 and 16%, respectively than the wheat grown under rainfed condition. The grains of wheat grown with irrigation had higher protein, amylose, P, K and S contents compared to the grains of wheat grown under rainfed condition but such increase was not statistically significant. Naser *et al.* (1999) reported that application of irrigation irrespective of frequencies and time significantly increased grain and straw yields and all yield attributes over control. Dubey and Sharma (1996) found significant increase in grain yield and nutrient uptake of wheat by the application of irrigation in India.

From the results of the experiment, it can be concluded that barkat, aghrani, akbar and kanchan are the promising varieties than the others with respect to grain and protein yields. Application of supplemental irrigation is desirable to augment yield and quality of wheat.

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