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Effect of tillage, fertilizer level and water regime on yield and yield contributing character of wheat

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Abstract: A field experiment was conducted at the Agronomy field laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2004 to 2005 to study yield and yield components of wheat as influenced by tillage , fertilizer level and water regime. The study included two water regime, viz., rainfed and irrigated, three tillage practices, viz., coarse tilth, medium tilth and fine tilth and four fertilizer levels , viz., low level (150 kg urea+ 120 kg TSP + 30 kg MP + 90 kg gypsum/ ha *ie*.75% of the recommended doses),medium level(200 kg urea + 160 kg TSP + 40 kg MP + 120 kg gypsum/ ha *ie.* 100% of the recommended doses), high level (250 kg urea +200 kg TSP + 50 kg MP + 150 kg gypsum/ ha *ie.* 125% of the recommended doses) and very high level (300 kg urea + 240 kg TSP + 60 kg MP +180 kg gypsum/ha-150% of the recommended doses). A split plot design was used with three replications. Result revealed that water regime significantly influenced various yield and yield components of wheat except the length of spike. In case of water regime, highest grain yield (2.81 t/ha) was obtained in the irrigated treatment and lower (1.88 t/ha) in rainfed crop. Tillage had a significant effect on different plant characters except length of spike, spikelets/spike and 1000-grain weight. The highest grain yield (2.61 t/ha) was obtained from medium tilth condition; while lower grain yield (2.16 t/ha) received from coarse tilth condition, which was identical with fine tilth. Fertilizer level had significantly influenced all the yield components and yield of wheat. The maximum grain yield (2.67 t/ha) considering fertilizer level was obtained from high level of fertilizes and lowest (2.03 t/ha) from low levels of fertilizers. The interaction effect of water regime, tillage and fertilizer level had significantly affected effective tillers/plant, grain yield and straw yield of wheat. The highest grain yield (3.50 t/ha) was obtained from the interaction of irrigated × medium tilth × high level of fertilizer and lowest (1.45 t/ha) from the interaction of rainfed × coarse tilth × very high level of fertilizers. The study shows that irrigated condition , medium tilth and high levels of fertilizer may be used for getting high yield of wheat.

Key words: Wheat, water regime, tillage, fertilizer, yield

Introduction

Wheat (*Triticum aestivum* L.) is one of the major cereal crops of the world ranking first both in acreage and production. Tillage is the first step for crop production. It creates improved physical condition of soil that brings about better nutrient and water relations. Wheat is generally grown in Bangladesh by primitive method of cultivation and the satisfactory yield of wheat is possible with minimum tillage operation. The crop yields from minimum land tillage were generally equal to or sometimes higher than those from the conventional tillage (Bedder and Ragheb,1993). Among all the management practices, fertilizer application is another important one because Bangladesh soils are very much deficient in important nutrient elements. Yield of wheat grains increases with an increase in the amount of nitrogen (Tiwary and Singh, 1969; Karabiniva, 1983; Curic, 1988; Singh *et al.*, 1987; Patra, 1990).There is an ample scope for wheat cultivation in Bangladesh because of the climate suitability during the rabi season. But soil moisture shortage during this season limits the use of fertilizers, especially nitrogen and this consequently limits the yield of the crop. Irrigation also plays a vital role in wheat cultivation but it is a costly input. Irrigation frequency has also a significant influence on growth and yield of wheat (Khajanji and Swivedi, 1988). Improper scheduling of irrigation results not only in the wastage of water but also decreases crop growth and yield. So proper scheduling of irrigation is necessary for wheat production. Higher yields of wheat can be achieved by optimizing tillage, fertilizer application and water management practices. Hence the present work was undertaken to study the yield and yield components of wheat as influenced by the tillage practices, fertilizer level and water regime.

Materials and Methods

A field experiment was conducted at the Agronomy field laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2004 to 2005 to study yield and yield components of wheat as influenced by tillage, fertilizer level and water regime. The study included two water regime, viz., rainfed (I_0) and irrigated (I_1); three tillage practices, viz., coarse tilth (T_1), medium tilth (T_2) and fine tilth (T_3) and four fertilizer levels viz. low level (F_1) (150 kg urea+ 120 kg TSP + 30 kg MP + 90 kg gypsum/ ha- 75% of the recommended doses),medium level (F_2) (200 kg urea + 160 kg TSP + 40 kg MP + 120 kg gypsum/ ha- 100% of the recommended doses), high level (F_3) (250 kg urea +200 kg TSP + 50 kg MP + 150 kg gypsum/ ha- 125% of the recommended doses) and very high level (F_4) (300 kg urea + 240 kg TSP + 60 kg MP +180 kg gypsum/ha-150% of the recommended doses). Kanchan a high yielding semi-dwarf wheat variety was used for experimentation. The experiment was laid out in a split plot design with three replications. The unit plot size was 3 × 2m. The field was irrigated just after weeding first time on 20 and 40 days. Data on yield and yield contributing characters of Wheat were collected after harvest. Data were statistically analyzed by using MSTAT-C package program and the differences among treatments means were compared with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of water regime on yield and yield components of wheat: Highest plant height(90.90 cm) was obtained from irrigated condition and the lowest (84.44 cm) in rainfed condition (Table 1). The higher number of effective tillers/ plant (4.8) was obtained in irrigated condition and lower (3.7) was found in rainfed condition. Length of spike was not significantly influenced by water regime. The higher number of spikelets/spike (20.5) was found in irrigated condition and lower number of spikelets/ spike (18.2) was obtained in rainfed condition. Number of unfilled spikelets ranged from 2.6 to 2.7. The higher number of unfilled spikelets/spike was obtained from the irrigated condition and lower obtained from rainfed condition. The higher number of grains/spike (30.9) was found in irrigated condition and the lower (28.9) was found in rainfed condition. Effect of water regime was significantly affected by 1000-grain weight. Numerically, the higher value of 1000-grain weight (44.32g) was recorded in irrigated condition and the lower (34.29g) was found in rainfed condition. Grain yield varied significantly with water regime. Under irrigated condition, the higher grain yield was found 2.18 t/ha and the lower grain yield 1.88 t/ha was found under rainfed condition. Significantly higher straw yield (3.63 t/ha) was found in irrigated condition and lower (2.34 t/ha) was observed in rainfed condition.

In case of harvest index, higher harvest index (43.20%) was obtained from irrigated condition and lower (14.26%) was found in rainfed condition.

Effect of tillage on yield and yield components of wheat: There was a significant effect of different tillage system on plant height. The tallest plant height (89.05cm) was found in fine tilth system and the smallest plant (86.35cm) was recorded with coarse tilth system. Significantly highest number of effective tillers/plant (4.3) was found in fine tilth, and lowest (4.0) was obtained at medium tilth condition. Different tillage exerted significant influenced on the number of unfilled spikelets/spike. The highest number of unfilled spikelets/spike (2.7) found in the treatment of medium tilth condition, which was statistically identical with fine tilth condition. The lowest number of unfilled spikelets/spike (2.6) was odtained from coarse tilth condition. The number of grains/spike was significantly affected by different tillage treatments. The highest number of grains/spike (30.4) was obtained from fine tilth condition, which was statistically identical with medium tilth. The lowest number of grains/spike (29.0) was found in coarse tilth. 1000-grain weight was not significantly influenced by tillage (Table 2). Grain yield was significantly influenced by different tillage operations. The highest grain yield (2.61t/ha) was found with the treatment of medium tilth. The lowest grain yield (2.27t/ha) was found in fine tilth, which was statistically similar with the coarse tilth condition. The highest straw yield (3.03t/ha) was obtained from the treatment of medium tilth, which was statistically similar with fine tilth. The lowest straw yield (2.09t/ha) was obtained from the treatment of coarse tilth condition. The highest harvest index (42.60%) was found in fine tilth condition and lowest (42.02%) was obtained from coarse tilth condition, which was statistically similar with medium tilth condition.

Effect of fertilizer on yield and yield components of wheat: The tallest plant height (92.59cm) was found when the crop was fertilized with high level of fertilizer, which was followed by medium level of fertilizer and the smallest plant (84.89cm) was recorded with low level of fertilizer which was identical with the treatment of very high level of fertilizers (Table 3). The highest number of effective tillers/plant (4.9) was obtained from high level level of fertilizer. The lowest number of effective tillers/plant (3.7) was found in low level of fertilizer, which was statistically identical with very high level of fertilizers. Length of spike was significantly influenced by different level of fertilizer application. The highest length of spike (8.97cm) and the lowest length of spike (8.58cm) were found in high level of fertilizer and very high level of fertilizers respectively. The effect of different levels of fertilizer on the number of spikelets/spike was statistically significant. The highest number of spikelets/spike (20.7) was recorded in plots with high level of fertilizer and lowest number of spikelets/spike (17.8) was shown in plot with very high level of fertilizers was applied. The highest number of unfilled spikelets/spike produced in high level of fertilization, which was identical with medium level of fertilizers application. Number of grains/spike varied significantly with levels of fertilizer application. The highest number of grains/spike (33.4) was found in high levels of fertilizer application and lowest (27.3) was found in high levels of fertilizer application, which was identical with very high level of fertilizers application. 1000-grain weight was significantly affected with different levels of fertilizer. The highest value of 1000-grain weight (45.69g) was shown in the treatment of high levels of fertilizer application. The lowest value of 1000-grain weight (27.34g) was shown in the treatment of low levels of fertilizer application, which was statistically identical with very high level of fertilizers application. Grain yield varied significantly with different levels of fertilizer application. The grain yield (2.67 t/ha.) was found in high levels of fertilizers, which was followed by medium level and very high level of fertilizers application, the lowest grain yield (2.03 t/ha.) was obtained in low level of fertilizers application. Straw yield varied significantly with different. levels of fertilizer application statistically significant. The result showed that the straw yield (3.31 t/ha.) was found in high levels of fertilizers, which was followed by medium level and very high level of fertilizers application, the lowest straw yield (2.87 t/ha.) Was obtained in low level of fertilizers application. The present results are agreement with the findings of Honsan *et al*. (1982). Effect of fertilizer level was significantly influenced on harvest index. The maximum harvest index (44.76%) was found in treatment of high level of fertilizers and minimum

harvest index (40.55) was found in very high level of fertilizers application, which was significantly identical with low level of fertilizers.

Effect of interaction of water regime x tillage x fertilizer level

The result of interaction of water regime, tillage and fertilizer level on yield and yield components of wheat have been presented in Table 4. Interaction of water regime, tillage and fertilizer level did not show any significant effect on plant height. But had a significant effect on effective tllers/plant (Table 4). The highest effective tillers/plant (6.2) was found in the treatment combination of irrigated x medium tilth x medium level of fertilizers.

Grain yield was significantly influenced by interaction of water regime, tillage and fertilizer level. The highest grain yield (3.50t/ha) was found in the treatment combination of irrigated x medium tilth x high level of fertilizers application, which was statistically identical in the treatment combination of irrigated x fine tilth x high level of fertilizers used. The lowest grain yield (1.45t/ha) was obtained in the treatment combination, rainfed x coarse tilth x very high level of fertilizers application. Interaction of water regime, tillage and fertilizer level had significantly influenced on straw yield. The highest straw yield (4.27t/ha) was shown in treatment combination, irrigated x medium tilth x high level of fertilizers application. The lowest straw yield (2.12t/ha) was obtained in the treatment combination, rainfed x coarse tilth x very high level of fertilizer, which was similar with the treatment, rainfed x medium tilth x very high level of fertilizers application.

Table 1. Effect of Water regime on yield component of wheat

Treatment (I)	**Plant height (cm)**	**Effective Tillers/ plant(no.)**	**Length of spike (cm)**	**No. of spikelets /Spike**	**No. of unfilled spikelets /Spike**	**No. of Grains /Spike**	**1000-grain weight(g)**	**Harvest Index(%)**
Rainfed (Io)	84.44b	3.7b	8.6	18.2b	2.6b	28.9b	43.29b	41.26b
Irrigated (I1)	90.90a	4.8a	8.87	20.5a	2.7a	30.9a	44.32a	43.20a
Lsd Values	0.74	0.10		0.24	0.13	0.37	0.57	1.03
Level of significance	**	**	NS	**	*	**	*	*

* = Significant at 5% level of probability **= Significant at 1% level of probability NS= Non Significant

Table 2. Effect of Tillage on yield component of wheat

Treatment(T)	**Plant height (cm)**	**Effective Tillers /plant**	**Length of spike (cm)**	**No. of spikelets /Spike**	**No. of unfilled spikelets /Spike**	**No. of Grains /Spike**	**1000-grain weight(g)**	**Harvest Index(%)**
Coarse Tilth(T1)	86.35c	4.0b	8.70	19.4	2.6b	29.0b	43.55	42.02b
MediumTilth(T2)	87.61b	4.4b	8.81	19.3	2.7a	30.3a	43.79	42.67b
Fine Tilth(T3)	89.05a	4.3a	8.81	19.4	2.7a	30.4a	44.07	42.60a
Sx	0.30	0.05			0.03	0.28		0.14
Level of significance	**	**	NS	NS	*	**	NS	*

* = Significant at 5% level of probability **= Significant at 1% level of probability NS= Non Significant

Table 3. Effect of Fertilizer level on yield component of wheat

Treatment (T)	Plant height (cm)	Effective Tillers /plant	Length of spike (cm)	No. of spikelets /Spike	No. of unfilled spikelets /Spike	No. of Grains /Spike	1000-grain weight(g)	Harvest Index (%)
Low level(F1)	84.49c	3.7c	8.43bc	19.3c	2.5b	27.3c	42.60c	40.93c
Medium level(F2)	87.67b	4.7b	9.91ab	19.7b	2.8a	30.9b	44.73b	42.67b
High level(F3)	92.59a	4.9a	8.97a	20.7a	2.8a	33.4a	45.69a	44.76a
Very high level(F4)	85.54c	3.7c	8.58c	17.8d	2.4b	28.0c	42.20c	40.55c
Sx	0.34	0.06	0.10	0.12	0.05	0.32	0.28	0.17
Level of significance	**	**	*	**	**	**	**	**

* = Significant at 5% level of probability **= Significant at 1% level of probability NS= Non Significant

Table 4. Effect of Interaction of Water regime x Tillage x Fertilizer level (IxT x F) on yield and yield components of wheat

Treatment (TxF)	Plant height (cm)	Effective Tillers/ plant	Length of spike (cm)	No. of spikelets / Spike	No. of unfilled spikelets / Spike	No. of Grains /Spike	1000-grain weight (g)	Grain yield (t/ha.)	Straw yield (t/ha.)	Harvest Index (%)
I0xT1 xF1	80.40	3.0l	8.47	18.2	2.2	24.5	42.00	1.45i	2.22hi	39.15
I0xT1 xF2	43.20	3.7igk	8.29	20.1	2.7	28.0	43.70	1.65hi	2.37ghi	41.02
I0xT1xF3	88.98	4.0hi	8.82	17.1	2.7	31.8	44.50	2.00fgh	2.58fgh	43.68
I0xT1xF4	81.80	3.4kl	8.63	18.3	2.4	28.9	42.45	1.45i	2.12i	40.54
I0xT2 xF1	80.27	3.3kl	8.48	18.3	2.4	27.0	42.35	1.50i	2.33ghi	39.11
I0xT2xF2	85.15	4.0hi	9.10	19.2	2.8	30.7	43.85	1.70hi	2.38ghi	41.62
I0xT2xF3	89.93	4.5efg	8.91	17.0	2.9	33.3	44.75	1.92ghi	2.44fghi	44.01
I0xT2xF4	80.75	3.4kl	8.50	18.4	2.4	26.0	42.00	2.40ef	2.17i	39.23
I0xT3xF1	84.50	3.5jkl	8.52	19.2	2.4	27.9	42.90	1.55hi	2.23hi	40.96
I0xT3xF2	85.40	3.9hij	9.24	19.8	2.9	31.9	42.00	1.67hi	2.25hi	42.52
I0xT3xF3	92.93	4.7def	8.95	19.9	2.8	33.6	45.00	1.88hi	2.70fg	45.15
I0xT3xF4	80.00	3.1l	8.26	15.5	2.4	24.0	42.00	1.49i	2.31hi	39.15
I1xT1 xF1	85.47	3.6ijk	8.75	19.9	2.5	25.3	42.13	2.50de	3.47de	41.64
I1xT1 xF2	88.19	5.6bc	8.91	20.5	2.8	30.5	44.83	2.90cd	3.68bcde	42.99
I1xT1xF3	93.02	5.2cd	9.00	22.3	2.8	32.9	46.33	2.30b	4.03ab	45.03
I1xT1xF4	89.79	4.2gh	8.72	19.5	2.5	30.4	42.53	2.03fgh	2.79f	42.15
I1xT2 xF1	87.72	4.0ghi	8.79	20.8	2.7	39.8	42.77	2.67de	3.65cde	42.30
I1xT2xF2	91.63	6.2a	8.97	20.7	2.8	32.2	45.73	2.90cd	3.73bcd	43.77
I1xT2xF3	94.60	5.5bc	9.15	21.1	3.0	34.1	46.77	3.50a	4.27a	45.23
I1xT2xF4	90.87	4.3fgh	8.63	18.9	2.6	29.1	42.13	2.33efg	3.30e	41.32
I1xT3xF1	91.00	4.8def	8.76	20.3	2.8	29.4	43.50	2.55de	3.36de	42.47
I1xT3xF2	92.44	4.9de	8.97	21.4	2.8	32.3	46.27	3.20dc	4.05ab	44.14
I1xT3xF3	96.09	5.8b	9.02	21.6	2.9	34.6	46.83	3.47b	3.87bc	46.49
I1xT3xF4	90.05	4.0hi	8.77	19.2	2.5	30.0	42.13	2.40ef	3.47de	40.95
Sx		0.15						0.15	0.12	
Level of significance	NS	**	NS	NS	NS	NS	NS	**	*	NS

I0=Rainfed I1=Irrigated; T1= Coarse tilth T2= Medium tilth T3= Fine tilth; F1=Low level, F2=medium level, F3=High level, F4=Very high level

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