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Response of Wheat Cultivars to Varying Seeding Rates under Rainfed Conditions

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Abstract: An experiment was conducted at Agronomy Farm, NWFP Agricultural University, Peshawar during 1998-99 to study the response of wheat cultivars to varying seeding rates under rainfed conditions. The cultivars sown were Khattakwal, Suleman-96 and Tatar-96. Seed rates were 40, 80, 120 and 160 kg ha⁻¹. The results revealed that the wheat planted at the rate of 160 kg ha⁻¹ significantly produced highest grain yield 2733 kg ha⁻¹ as compared to lower seeding rate. Similarly highest biological yield of 8466 kg ha⁻¹ was recorded for highest seed rate (160 kg ha⁻¹), and the lowest biomass yield of 5807 kg ha⁻¹ for the lowest seed rate of 40 kg ha⁻¹. Highest number of 215 spikes m⁻² was for the highest seed rates and lowest of 113 spikes m⁻² were for the lowest seed rate. Among the cultivars, Suleman-96 gave the highest grain yield (2708 kg ha⁻¹) whereas Tatar-96 and Khattakwal produced 2500 and 1233 kg ha⁻¹, respectively. Suleman-96 produced more number of grains/spike than Tatar-96 and Khattakwal. In addition, the 1000 grain weight of Suleman-96 was slightly more than Tatar-96 and Khattakwal i.e., 43, 42 and 31g respectively. Number of spikes m⁻² were equal in case of Khattakwal and Tatar-96, whereas slightly less in Suleman-96 i.e., 163, 160 and 164 respectively. Khattakwal was highly susceptible to lodging as compared to Suleman-96 and Tatar-96. However, Suleman-96 had a higher number of loose smut attacks and the seeds should be treated with fungicides before sowing.

Key words: Seed rate, wheat, cultivars, rainfed area

Introduction

Wheat (*Triticum aestivum* L.) belongs to family Gramineae. It is a major source of food for a large section of the population of the world and is applying about 73 % of the calories and proteins of the average diet (Heyne, 1987). Wheat is the most important crop produced in Pakistan. It is a staple and indispensable food article of the people of Pakistan and occupies more land than any other crop. Although Pakistan is one of the top ten producers of wheat throughout the world yet, the wheat yield per unit area is still far below its potential yield. Apart from other factors causing low yield, optimum seed rate and suitable cultivars play an important role in achieving its potential yield. Planting wheat at optimum rate and selection of suitable variety are very important for economic yield. Greater plant population can be obtained from higher seed rate, but would give poor growth and development of the crop, which will ultimately have adverse effect on the number of productive tillers, number of grains per ear, length of ear, 1000 grain weight and finally the grain yield.

Similarly, varietal performance of different cultivars is not similar at all locations. Several reports address the importance of seed rates and cultivars in obtaining greater yield. Abo-Shataia *et al.* (2001) concluded that as sowing rates increased the yield of wheat crop increased. The results of Barriga and Pihan (1980) showed that 80, 120, 160 and 200 kg ha⁻¹ seed rate gave significant increased number of spikes m⁻² but significant decrease in number of grains/spike. High seed rate resulting in lodging and hence low yield are the similar results reported by Ciha (1983). Shaheena *et al.* (1987) reported that plant density did not significantly effect 1000 grain weight. The results of Schoonwinkel *et al.* (1991), showed that seed rate of 75 and 100 kg ha⁻¹ consistently produced greater grain yield than 50 kg ha⁻¹. The experiment was designed with the aim to select the optimum seed rate and high yielding varieties for rainfed conditions.

Materials and Methods

Field studies on response of wheat cultivars to varying seeding rates under rainfed conditions was conducted during 1998-99 at the Agriculture Research farm of NWFP Agricultural University, Peshawar, Pakistan. The experiment was laid out in Randomized Complete Block Design. Four seeding rates (40, 80, 120 and 160 kg ha⁻¹) and three cultivars (Khattakwal, Suleman-96 and Tatar-96) were sown on 30th October.

Data were recorded on plant height (cm), lodging index (lodging data was recorded at the scale of 0.2 = no lodging and 9.0 = complete lodging) (Freez and Bacon, 1990). Grains spike⁻¹, number

of spikes m⁻², 1000 grain weight (g), biomass yield (kg ha⁻¹) and grain yield (kg ha⁻¹).

Results and Discussion

Plant height (cm): Statistical analysis of the data (Table 1) revealed that plant height of the varieties was significantly affected by seed rates. Variety Khattakwal had significantly highest plant height of 125.31 cm while Tatar-96 had the lowest plant height (99.16 cm). The significant difference in plant height at the similar seed rate and same environmental condition might be due to the inherited characteristics of the varieties. Seeding rate had significant effect on plant height; increasing seed rate from 40 to 160 kg ha⁻¹ a trend of increase in plant height was noticed. The increase in plant height with increase in seed rate may be due to greater competition for light. The results are in agreement with the findings of Marwat *et al.* (1989) and Nazir *et al.* (1987).

Lodging index: Cultivars, seed rate and their interaction had significant effect on lodging index (Table 2). Among cultivars highest lodging (7.0) was noticed for Khattakwal. As seeding rate increased lodging index was also increased. Highest lodging was recorded for 160 kg ha⁻¹ seed rate while a seed rate of 40 kg ha⁻¹ had lowest lodging %age. The effect of seed rate on lodging in case of variety Khattakwal is very clear. Increasing the seed rate, lodging in Khattakwal significantly increased. The results are in greater analogy with the findings of Freez and Bacon (1990).

Number of grains spike⁻¹: Cultivars and seed rates had significant effect on the number of grains/spike as well as their interaction (Table 3). Among the cultivars, Khattakwal had lowest grains spike⁻¹ (26.51). Seed rate 40 kg ha⁻¹ produced more (41.99) grains spike⁻¹, while lowest of 35.04 grains spike⁻¹ was found at 160 kg ha⁻¹. Number of grains spike⁻¹ decreased as seeding rate increased. These results are supported by Wright *et al.* (1991) and Barriga and Pihan (1980).

Number of spikes m⁻²: Statistical analysis of the data showed that seed rates and its interaction with cultivars had significant effect on the number of spikes m⁻², while cultivars have no significant effect (Table 4). The higher number of spikes m⁻² was 215.3 for seed rate of 160 kg ha⁻¹. The number of spikes m⁻² decreased as seeding rate decreased. The highest of spikes m⁻² at highest seed rate are in line with those reported by Vellosos *et al.* (1988) and Wright *et al.* (1991).

Khan *et al.*: Seeding rates at rainfed condition

Table 1: Plant height (cm) of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	119.03cd	123.05bc	126.28b	132.90a	125.31a
Suleman-96	107.40fg	109.63ef	110.15ef	115.38de	110.64b
Tatara-96	095.55i	101.30hi	101.73gh	098.08hi	99.16c
Means	107.33c	111.33b	112.72ab	115.45a	

LSD value at 5 % level of significance for cultivars = 2.968 LSD value at 5 % level of significance for seed rates = 3.428
LSD value at 5 % level of significance for interaction = 5.937

Table 2: Lodging index of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	5.00d	6.50c	7.75b	8.75a	7.00a
Suleman-96	0.20e	0.20e	0.25e	0.33e	0.24b
Tatara-96	0.23e	0.33e	0.55e	0.73e	0.46b
Means	1.81d	2.34c	2.85b	3.27a	

LSD value at 5 % level of significance for cultivars = 0.2868
LSD value at 5 % level of significance for seed rates = 0.33123.428 LSD value at 5 % level of significance for interaction = 0.5736

Table 3: Number of grains spike⁻¹ of three wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	28.48e	29.08e	28.8e	19.63f	26.51b
Suleman-96	49.25a	47.75ab	46.05bc	42.10d	49.29a
Tatara-96	48.25ab	45.78bc	43.83cd	43.40cd	45.31a
Means	41.99a	40.87ab	39.58b	35.04c	

LSD value at 5 % level of significance for cultivars = 1.476 LSD value at 5 % level of significance for seed rates = 1.705
LSD value at 5 % level of significance for interaction = 2.953

Table 4: Number of spikes m⁻² of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	109.8e	137.3d	188.8b	217.3a	163.3
Suleman-96	113.0e	148.0d	162.3c	215.0a	159.6
Tatara-96	115.8e	142.0d	184.3b	213.8a	163.9
Means	112.8d	142.4c	178.4b	215.3a	

LSD value at 5 % level of significance for cultivars = 6.903 LSD value at 5 % level of significance for interaction = 11.96

Table 5: 1000 grains weight (gm) of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	31.40f	31.80f	31.50f	28.38g	30.77c
Suleman-96	45.20a	42.00c	41.35cd	41.80c	42.61a
Tatara-96	43.55b	42.40bc	39.40e	40.38de	41.63b
Means	40.05a	38.73b	37.42c	36.88c	

LSD value at 5 % level of significance for cultivars = 0.7275 LSD value at 5 % level of significance for seed rates = 0.8401
LSD value at 5 % level of significance for interaction = 1.455

Table 6: Grain yield (kg ha⁻¹) of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	1100e	1267e	1300e	1267e	1233c
Suleman-96	1733d	2800b	2933b	3367a	2708a
Tatara-96	1700b	2100c	2833d	3567a	2500b
Means	1511d	2056c	2355b	2733a	

LSD value at 5 % level of significance for cultivars = 1.235 LSD value at 5 % level of significance for seed rates = 142.6
LSD value at 5 % level of significance for interaction = 246.5

Khan *et al.*: Seeding rates at rainfed condition

Table 7: Biomass yield (kg ha⁻¹) of wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	6767d	7050cd	8120ab	8533a	7617a
Suleman-96	6277e	6930cd	8037b	8397ab	7410b
Tatara-96	4377f	6150e	7200c	8467a	6548c
Means	5807d	6710c	7786b	8466a	

LSD value at 5 % level of significance for cultivars = 207.5

LSD value at 5 % level of significance for seed rates = 239.6

LSD value at 5 % level of significance for interaction = 415.0

Table 8: Loose smut attack subplot⁻¹ of three wheat cultivars at four seed rates

Cultivars	Seed rate (kg ha ⁻¹)				Means
	40	80	120	160	
Khattakwal	5.75	07.50	09.25	15.50	09.50b
Suleman-96	34.75	33.75	35.50	46.25	37.56a
Tatara-96	0.00	00.00	00.00	00.00	00.00c
Means	13.50b	13.75b	14.92b	20.58a	

LSD value at 5 % level of significance for cultivars = 4.776

LSD value at 5 % level of significance for seed rates = 5.515

1000 grains weight (g): Cultivars, seed rates and their interaction had significant effect on 1000 grains weight. Suleman-96 produced heaviest grain weight of 1000 grains (42.61), while Khattakwal had lowest 1000 grain weight of 30.77 g (Table 5). The lowest of 36.88 g was produced at the seed rate of 160 kg ha⁻¹ although it was at par with 120 kg ha⁻¹ while highest at lowest seed rate (40 kg ha⁻¹). Highest 1000 grain weight at lowest seed rate is the similar result reported by Aziz (1997). He concluded that seed rate and different wheat varieties significantly affected 1000 grain weight.

Grain yield (kg ha⁻¹): Statistical analysis of the data (Table 6) showed that cultivars, seed rates and interaction had significant effect on the grain yield of the three cultivars. Suleman-96 yielded 2708 kg ha⁻¹ followed by Tatara-96 (2500 kg ha⁻¹), while Khattakwal produced the lowest yield of 1233 kg ha⁻¹. As for as the seed rate are concerned, increasing seed rate there was a significant increase in grain yield. Interaction of seed rates and cultivars showed that Tatara-96 and Suleman-96 produced 3567 and 3367 kg ha⁻¹, respectively at seed rate of 160 kg ha⁻¹. Similar results were reported by Nazir *et al.* (1987).

Biomass yield (kg ha⁻¹): Khattakwal gave heaviest biomass yield of 7617 kg ha⁻¹ followed by Suleman-96 which produced 7410 kg ha⁻¹ biomass, while the lightest biomass (6548 kg ha⁻¹) was produced by Tatara-96 (Table 7). In case of seed rates the heaviest biomass yield (8466 kg ha⁻¹) was obtained at 160 kg ha⁻¹ seed rate followed by 120 kg ha⁻¹ seed rate, which produced 7786 kg ha⁻¹ biomass yield, while the lightest biomass yield (5807 kg ha⁻¹) was obtained at 40 kg ha⁻¹ seed rate. While the interaction of Khattakwal at seed rate of 160 kg ha⁻¹ and Tatara-96 at seed rate of 160 produced the highest biomass yield of 8533 kg ha⁻¹ and 8467 kg ha⁻¹, respectively. While the lightest biomass (4377 kg ha⁻¹) was obtained in Tatara-96 sown at 40 kg ha⁻¹ seed rate. The results obtained are in agreement with Hassan (1999).

Number of loose smut effected spikes plot⁻¹: Highest numbers of spikes were affected by loose smut in Suleman-96 with (37 spikes/plot) followed by Khattakwal. Whereas no spike was effected in case of Tatara-96. Among the means of seed rates 160 kg ha⁻¹ produced more effected spikes (20.58) spikes and minimum were affected in case of lowest seed rate of 40 kg ha⁻¹ (Table 8). It is suggested that Suleman-96 and Khattakwal should be treated with fungicides necessarily to minimize loose smut losses in wheat production.

The present study showed that a seed rate of 160 kg ha⁻¹ is probably the optimum seed rate in the prevailing conditions. Variety Suleman96 out yielded despite of the loose smut attack. Application of fungicides to seed can further increase yield per unit area.

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