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Effect of Seed Rate on the Yield and Yield Components of Wheat under Irrigated Conditions of Peshawar

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Abstract: Field experiment was conducted during 1998-99 at Malakandher Research Farms, NWFP Agricultural University, Peshawar, Pakistan to study the effect of seed rate on the yield and yield components of wheat cultivars under irrigated conditions of Peshawar. Statistical analysis of the data revealed that the plots treated with 150 kg ha^{-1} seed rate had higher emergence m^{-2} (56.00 plants m^{-2}), number of tillers m^{-2} (264.37), number of productive tillers m^{-2} (252.62 tillers m^{-2}), plant height (98.25 cm) and grain yield (2345.90 kg ha^{-1}). Days to maturity were maximum in those plots, which were seeded with 100 kg ha^{-1}. Number of grains spike^{-1} and thousand grain weight were more in those plots seeded with 50 kg ha^{-1}. Mean value of the data also indicated that in case of cultivars emergence m^{-2} (48.88 plants m^{-2}), plant height (96.75 cm) and thousand grains weight (43.50 g) was maximum in plots seeded with Inqilab-91. Number of tillers m^{-2} (272.25), number of productive tillers m^{-2} (263.75) days to maturity (153.50 days), number of grains spike^{-1} (44.00) and grain yield (2530.37 kg ha^{-1}) was higher in plots sown with Bakhtawar-92.

Key words: Seed rate, yield and yield components, wheat.

Introduction

The Prosperity of Pakistan depends directly and indirectly on proper wheat husbandry and therefore, any improvement in yield and production will improve the food situation of the country and well being of the farmers and all others. The future targets, to meet the food requirements of the growing populations, can be achieved either by increasing area under wheat or maximizing yield unit^{-1} area, and by adopting appropriate production technology with use of high yielding varieties, proper sowing time, optimum seed rate, adequate amount of fertilizers and proper planting geometry. Among the several factors responsible for low yield in Pakistan, low planting use of unbalanced rate of fertilizers and inappropriate seed rats are important and research on these limiting factors will surely lead to high yields. Optimum seed rate is most important for maximum yield of crop. If more seed rate is used, plant population will be more and there will be competition among plants for water, nutrients and sunlight resulting in low quality and low yield. If less seed rate is used yield will be less due to lesser number of plants unit area^{-1} (Attarde and Khuspe, 1989). Rajput *et al.* (1989) concluded that maximum grain yield was obtained with the increase in seed rate, while minimum grain yield was produced by low seed rate.

Ram *et al.* (1988) reported that when wheat was sown wt 140 or 160 kg seed ha^{-1} gave average yields of 4.02 and 4.05 t ha^{-1} compared with 3.83 and 3.69 t ha^{-1} with sowing rates of 120 and 140 kg ha^{-1} respectively. Yoon *et al.* (1991) reported that percentage of effective tillers increased with highest sowing rate due to which grain yield also increased. Bhatnager *et al.* (1991) seeded wheat at the rate of 100, 125, 150, 175 and 200 kg ha^{-1} and observed that grain yield increased with the increase in the seed rate. Qaisar (1991) in an experiment compared different seedling rates and reported the highest grain yield with 100 kg seed ha^{-1}. Singh *et al.* (1993) reported that seeding rates of 100, 125 and 150 kg seed ha^{-1}gave average grain yield. The number of kernels head^{-1} and weight kernal^{-1} showed slight decrease with increase in seed rate (Giotard *et al.*, 1981). Kovac (1978) found that increase in seed rate increased the number of plants m^{-2}, whereas 1000 grain weight were decreased. Urmani *et al.* (1974) reported that wheat seeding rate of 100-125 kg ha^{-1} gave higher grain yield than sown at 75 kg ha^{-1}. The number of tillers plant^{-1} and the highest grain yield was obtained with seeding rate of 100 kg ha^{-1}.

The present experiment was conducted to determine the optimum seed rate for the two wheat cultivars, Bakhtawar-92 and Inqilab-91.

Materials and Methods

In order to study the effect of seed rates on the yield and yield components of wheat cultivars under irrigated condition of Peshawar, an experiment was conducted at Malakandher Research Farms, NWFP Agricultural University Peshawar, during 1999. The experiment was laid out in Randomized Complete Block (RCB) design. The wheat cultivars under study were Bakhtawar-92 and Inqilab-91 with 4 seed rates (50,100,120 and 150 kg ha^{-1}). Standard agronomic practices were followed through out the growing season. During the course of the experiment the following observations were recorded on emergence m^{-2}, number of tillers m^{-2}, number of productive tillers m^{-2}, plant height (cm), days to maturity, number of grains spikes^{-1}, 1000-grain weight, grain yield (kg ha^{-1}).

Emergence m^{-2} in subplots was recorded randomly at three different spots with the help of meter rod and then their average was computed.

$$\text{Emergence m}^{-2} = \frac{\text{Number of plants x 1m}}{\text{Area sampled (Row length x Row width)}}$$

Number of tillers m^{-2} and number of productive tillers m^{-2} were recorded by counting the number of tillers in one meter length area of the three central rows in each subplot and their mean was then calculated. Plant height was recorded by measuring height of 5 representative plants at maturity from base to the tip of the spike. Days to maturity were recorded, when 90% plants in each treatment were matured. For calculating number of grains spike^{-1}, five spikes treatment^{-1} were randomly selected in each sub plot and then their grains were counted and divided by 5 to get the average grains spike^{-1}. Data for thousand grains weight data was recorded by weighing one thousand grains from each subplot with an electronic balance and then their mean was calculated. The data recorded for grain yield in each subplot was converted into grains yield ha^{-1}:

$$\text{Grain yield (kg ha}^{-1}) = \frac{\text{Grain yield (kg) subplot}^{-1}}{\text{Area sub plot}} \times 10000$$

The data collected during the experiment was analyzed according to RCB design and upon obtaining significant differences Least Significant Differences (LSD) test was applied (Steel and Torrie, 1980).

Results and Discussion

Statistical analysis of the data revealed that seed rate and varieties had a significant ($P \leq 0.05$) effect on emergence m^{-2}, while non significant effect was observed due interaction between seeding and varieties (Table 1). Mean value of the data indicated that among the seed rate, maximum of 56 plants m^{-2} were obtained in those plots, which were seeded with 150 kg ha^{-1}, while minimum (35.50) plants m^{-2} were recorded in plots seeded with 150 kg ha^{-1}. Similarly, maximum number of 48.88 plants m^{-2} was recorded from Inqilab-91 as compared with Bakhtawar-92 (46.56 plants m^{-2}). In case of interaction, the highest number of 58.50 plants m^{-2} were noted and in plots of Inqilab-91 sown with 120 kg ha^{-1} seed rate with lowest number of 35.25 plants m^{-2} were recorded in case of Bakhtawar-92 when seeding was done at the rate of 150 kg ha^{-1}. These results agree with the findings of Mujahid (1972), who reported that plants density increases plants unit $area^{-1}$ as the seed rate increases.

Data (Table 2) revealed that seed rate and varieties had a significant ($P \leq 0.05$) effect on tillers m^{-2}, while non significant effect was observed due to interaction between seeding density and varieties Maximum number of 264.37 tillers m^{-2} were produced from those plots, which received seed rate at 150 kg ha^{-1}. Similarly minimum (137.37) tillers m^{-2} was recorded for 50 kg ha^{-1}, Inqilab-91 produced the highest number of 226.06 tillers m^{-2}, while the lowest tillers m^{-2} was produced from Bakhtawar-92 (214.87). In case of interaction maximum tillers m^{-2} (272.00) were recorded from Bakhtawar-92 when treated with seed rate of 150 kg ha^{-1},

Table 1: Emergence m^{-2} of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	35.75	35.25	35.50c
100	46.25	44.75	45.50b
120	55.00	52.75	53.88a
150	58.50	53.50	56.00a
Mean	48.88a	46.56b	

LSD value for seed rate = 5.145
Mean in the columns followed by different letters is significantly different at $P \leq 0.05$

Table 2: Number of tillers m^{-2} of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	136.00	138.75	137.37c
100	229.25	237.75	233.50b
120	237.75	255.50	246.62ab
150	256.50	272.25	264.37a
Mean	214.87b	226.06a	

LSD value for seed rate = 21.69
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 3: Number of productive tillers m^{-2} of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	124.75	128.00	126.37c
100	220.25	228.75	24.50b
120	228.75	246.25	237.50ab
150	249.50	263.75	252.62a
Mean	205.81b	216.69a	

LSD value for seed rate = 22.71
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 4: Plant height (cm) of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	91.25	89.50	90.37b
100	98.50	96.00	97.25a
120	98.00	96.50	97.25a
150	99.25	97.25	98.25a
Mean	96.75a	94.81b	

LSD value for seed rate = 3.74
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$.

Table 5: Days to maturity of wheat cultivars as affected by seed rate.

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	149.75	151.75	150.75b
100	151.00	153.50	152.25a
120	149.00	150.75	149.87b
150	145.00	147.50	146.50c
Mean	148.81b	15087a	

LSD value for seed rate = 1.433
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 6: Number of grains $spikes^{-1}$ of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	39.25	44.0	41.62a
100	35.00	41.25	38.12b
120	33.50	38.00	35.75bc
150	31.25	35.25	33.25c
Mean	34.75b	39.62a	

LSD value for seed rate = 2.864
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 7: 1000- grain weight of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	45.25	43.25	44.25a
100	44.25	42.00	43.37a
120	43.75	40.50	42.12ab
150	40.75	39.50	40.12b
Mean	43.50a	41.43b	

LSD value for seed rate = 2.445
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

Table 8: Grain yield (kg ha^{-1}) of wheat cultivars as affected by seed rate

Seed rate (kg ha^{-1})	Cultivars		
	Inqilab-91	Bakhtawar-92	Mean
50	1558.00	1792.65	1675.57c
100	1847.95	2028.97	1938.46b
120	2147.20	2354.22	2250.71a
150	2161.42	2530.37	2345.90a
Mean	1928.77b	2176.56a	

LSD value for seed rate = 180.80
Mean in the columns followed by different letters are significantly different at $P \leq 0.05$

while Inqilab-91 recorded the minimum tillers m^{-2} (136.00) when seeding was done at the rate of 50 kg ha^{-1}. Yoon *et al.* (1991) reported that percentage of effective tillers increased with highest sowing rate due to which grain yield also increased. Increasing seed rate from 168 to 202 kg ha^{-1} improved grain yield significantly due to more number of spikes (Lafond, 1994).

Analysis of the data (Table 3) revealed that seed rate and varieties had a significant ($P \leq 0.05$) effect on number of productive tillers m^{-2}, while non significant effect was observed due to interaction between seeding and varieties. Mean value of the data (Table 3) indicated that among seed rate, highest number of 252.62 number of productive tillers m^{-2} were obtained in those plots which were seeded with 150 kg ha^{-1} while lowest (126.37) productive tillers m^{-2} were recorded in case of 50 kg ha^{-1}. Among varieties, highest number of 216.69 numbers of productive tillers m^{-2} was recorded from Bakhtawar-92, while Inqilab-91produced the lowest productive tillers m^{-2} (205.81). Interaction between varieties and seed rate revealed that maximum productive tillers m^{-2} (263.00) were recorded from Bakhtawar-92 in plots sown with 150 kg ha^{-1}, while the lowest productive tillers m^{-2} were produced from Inqilab-91 when seeds were used at the rate of 50 kg ha^{-1}.

Seed rate and varieties had a significant ($P \leq 0.05$) effect on plant height while a non significant effect was observed due to interaction between seeding and varieties (Table 4). It can be inferred that among the seed rate, taller plants (98.25 cm) were noted in those plots, which were sown with 150 kg ha^{-1} while shorter plants (90.37 cm) was recorded for 50 kg ha^{-1}. Among varieties, taller plants (96.75 cm) were noted in case of Inqilab-91, while shorter plants were noted for Bakhtawar-92 (94.81 cm). In case of interaction maximum plant height of 99.25 cm was noted in plots sown with Inqilab-91 sown plots seeded at the rate of 150 kg ha^{-1}, while shorter plants (89.50 cm) was recorded in case of Bakhtawar-92 when seeding was done at the rate of 50 kg ha^{-1}. Similar results were also obtained by Cholick (1982), who stated that maximum height was obtained due to increase in seed rate.

Analysis of the data (Table 5) revealed that seed rate and varieties had a significant ($P \leq 0.05$) effect on days to maturity, while non significant effect was observed due interaction between seeding and varieties. Mean value of the data indicated that among the seed rate, maximum days to maturity were taken by those plots which were sown at the rate of 150 kg ha^{-1} while minimum days to maturity were recorded in plots sown at the rate of 50 kg ha^{-1}. Among the varieties, highest number of 150.87 days to maturity were noted in case of Bakhtawar-92. In case of interaction maximum days to maturity (153.50) was noted for Bakhtawar-92 when treated with seed rate of 100 kg ha^{-1}, while the minimum days to maturity were recorded for Inqilab-91 when seeding was done at the rate of 120 kg ha^{-1}.

Analysis of the data (Table 6) indicated that seed rate and varieties had a significant ($P \leq 0.05$) effect on grain $spike^{-1}$, while non significant effect was observed due to interaction between seeding density and varieties. Maximum number of 41.62 grains $spike^{-1}$ were produced by those plots, which were sown at the rate at 50 kg ha^{-1} (Table 6). Similarly minimum (33.25) grains $spike^{-1}$ was recorded for 150 kg ha^{-1}. Similarly Bakhtawar-92 produced the highest number of 39.62 grains $spike^{-1}$, while the lowest grains $spike^{-1}$ (34.75) These results agree with those reported by Barriga and Pihan (1980).

Seed rate and varieties had a significant ($P \leq 0.05$) effect on days to maturity, while non significant effect was observed due interaction between seeding and varieties (Table 7). Mean value of the data indicated that among seed rate, heavier seeds (44.25 g 1000^{-1} grains) was recorded in those plots which were sown at the rate of 50 kg ha^{-1} while lighter seeds (40.12 g 1000^{-1} grains) noted in plots sown at the rate of 150 kg ha^{-1}. Among varieties, maximum 1000 grain weight (43.50 g 1000^{-1} grains) were noted for Bakhtawar-92, while minimum 1000 grain weight was noted by Inqilab-91. In case of interaction maximum 1000 grain weight (45.25 g 1000^{-1} grains) were obtained for Inqilab-91 when seeded at seed rate of 50 kg ha^{-1}, while minimum 1000-grain weight of 39.50 g 1000^{-1} grains were recorded for Bakhtawar-92 when sowing was done at the rate of 150 kg ha^{-1}. These results agree with the findings of Kovac (1978), who found that increase in seed rate increased 1000 grain weight. Seed rate and varieties had a significant ($P \leq 0.05$) effect on grain yield. Among the seed rate, maximum grain yield (2345.90 kg ha^{-1}) was noted in those plots which were sown with 150 kg ha^{-1}, while minimum grain yield (1675.57 kg ha^{-1}) was recorded for 50 kg ha^{-1} seeded plots (Table 8). Among varieties, highest grain yield of 2176.56 kg ha^{-1} was observed for Bakhtawar-92, while minimum grain yield was recorded by Inqilab-91 (1928.77 kg ha^{-1}). In case of interaction highest grain yield of 15580.00 kg ha^{-1} was produced by Bakhtawar-92 when seeded at the seed rate of 150 kg ha^{-1}, while minimum grain yield of 2530.37 kg ha^{-1} was recorded for Inqilab-91 when sowing was done at the rate of 50 kg ha^{-1}. These results agree with those reported by Singh and Singh (1984), who concluded that increase in seed rate increased the grain yield.

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