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Determination & Evaluation of the Effect of Different Seed Rates on the Growth and Yield of Wheat (*Triticum aestivum* L.)

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Abstract: *Due to high annual variability in rainfall, it is very difficult to maintain agronomic practices for wheat crop. However, planting density has particular importance in production of wheat because it can be controlled at farmer level. A three yield trial was conducted at adaptive Research Farm Sheikhupura, to investigate the impact of different seeding rates on growth, yield and yield parameters of wheat(Triticum aestivumL.). Plant density, number of fertile tillers, biomass and all other yield factors significantly increased with increase in seeding rate by 12%. Four seed rates were compared: 112, 125, 136 and 150 kg ha^{-1}. The maximum germination, productive tillers, plant height and number of grains per spike were observed under seed rate of 136 kg ha^{-1}. However, number of grain per spike is not significantly correlated with seeding rate. Maximum grain yield was observed under seeding rate of 136 kg ha^{-1}. From this study, it is concluded that wheat cultivar Faisalabad- 2008 at the seed rate of 136 kg ha^{-1} performed best followed by seeding rate at 150 kg ha^{-1}.*

Keywords*:Growth, Seed Rate, Seed-cum-fertilizerdrill, Wheat, Yield*

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I. Introduction

Among all the cereals used as a food grain in the world, wheat (*Triticumaestivum* L.) is the most important one. It is a staple food of about one third of the world's population. In Pakistan wheat is the most important cereal crop which contributes about 30-35% of total grain production in Pakistan. Government of Pakistan has given vital status to wheat in most of the agricultural improvement policies and programs because it is staple food for majority of population. During 2013-2014, area under wheat production in Pakistan was 9.039 million hectare and annual production 25.29 million tons with average yield of 2.80 t ha-1 (Govt. of Pakistan, 2014). The average yield of the country is very low as compare to its potential of 6 to 8 t ha-1. There are so many factors responsible for this yield gap. Among various factors responsible for this yield gap, cultivation of long duration paddy and delayed sowing of wheat after paddy. Similarly late sowing of wheat with inadequate technical know-how of package and practices including choice of varieties. Among the agronomic factors seed rate has vital importance as production factor. Seed rate determines the crop vigor and ultimately crop yield (Kores and Williams, 2002). It is of particular importance in most cropping systems because it is under the control of farmer. For different varieties, appropriate seeding rate is required for better quality and higher yield of wheat crop (Hamid et al., 2002). Various yield factors like number of plants, length of the spike, grains per spike and 1000 grain weight are significantly correlated with different cultivars and seed rates. Seed rates of 101 and 134 kg ha^{-1} are sufficient for higher grain yield (Joseph *et al*., 2012). For achieving yield potential optimum, seed rate and proper selection of variety have vital importance. Sikandar et al (2009) conducted a study and concluded that higher seed rate is recommended to obtain higher yield.Another study was conducted by Staggenborg et al (2003) for the assessment of impact of seeding rate on grain yield of wheat. They reported that high seed rates compensate low tillering and also produce more main stem spikes. This higher number of main stem spikes is very favourable for those varieties which have low tillering capacity. Hanson (2001) reported that just like other cereal crops wheat show an optimum sowing density. However, grain yield cannot be increased if more than optimum seed is used because all yield components will reach to a balance. So, there is no significant increase in yield to higher planting densities.

II. Materials And Methods

1.1. Details of experiment

A three year field study was conducted at Adaptive Research Farm Sheikhupura, Pakistan during the Rabi season 2013-2014, 2014-2015 and 2015-2016. The experiment was laid out in randomized complete block design (RCBD) with three replicates and four treatments. A net plot size of 28.75×94feet was maintained for each treatment. The field was smoothed with the help of land leveler. The wheat cultivar Faisalabad-2008 was sown by mean of fertilizer cum seedtractor driven drill in 2nd week of November each year. The distance of 25cm among the rows was maintained. NPK fertilizer dose of 120-60-60 kg ha^{-1} was used in the form of urea and DAP and sulphate of potash respectively. All the phosphorus, potash and ½ of nitrogen was applied at the time of land preparation. While remaining ½ nitrogen was splitted in to two equal doses and one is used as top dressing with 1st irrigation and other is used with second irrigation.First irrigation was applied after 25 days of sowing. Subsequent irrigations were applied as per soil and crop requirement. All other cultural operations were kept uniform for all the treatments. The treatments included; T_1 = seed @112 kg ha^{-1}, T_2 = seed @ 125 kg ha^{-1} (Weedy Check), T_3 = seed @ 136 kg ha^{-1} andT_4 = seed @ 150 kg ha^{-1}. Harvesting and threshing of wheat was done separately from each plot in 2nd week of April.

1.2. Determination of yield parameters

1.2.1. Plant germination (m^{-2})

Number of plants were counted after 7 days of sowing from an area of one sq. meter (m^{-2}).

1.2.2. Plant height (cm)

Plant height of ten randomly selected plants was measured in centimeters from ground to tip of flag leaf and then average was taken.

1.2.3. Number of productive tillers (m^{-2})

Number of productive tillers were counted at the time of harvesting per meter.

1.2.4. Grains per spike

Number of grains per spike were counted from ten randomly selected plants from eachplot.

1.2.5. 1000 grain weight (g)

1000 grain weight was measured with the help of sensitive electronic balance in grams.

1.2.6. Grain yield (t ha^{-1})

Wheat bundles from each plot threshed separately and weighed in kg per plot. Then weight was converted in t ha^{-1}.

1.2.7. Biological yield (t ha^{-1})

Wheat bundles from each plot threshed separately and average biological yield was taken in kg per plot and then converted in tons per hectare.

1.2.8. Harvest index (%)

Harvest index was determined for each plot by using following formula.

Harvest index = Grain yield ÷ Biological yield ×100

1.3. Statistical analysis

The data collected was analyzed using Fisher's analysis of variance and the treatment's means were separated by using Tukey's HSD procedure at 5% probability level (Steel and Torrie., 1997).

III. Results And Discussions

The results of the study showed that seeding rates have significant impact on germination, productive tillers per unit area and plant height. Seeding rate of 136 kg ha-1 produced higher number of seedlings i.e. 176 m-2, 124.33

during 2013-14 and 2014-15 respectively. However, in 3rd year trial seeding rate of 150 kg ha-1 produce maximum number of seedlings. The lowest germination was observed under seeding rate of 112 kg ha-1. Results obtained from study showed that germination under 125 kg ha-1 (control) is lower as compared to 136 and 150 kg ha-1 seeding rates. Similarly maximum number of productive tillers m-2 i.e. 373, 378 and 318 were recorded under 136 kg ha-1 seed rate during 2013-14, 2014-15 and 2015-16 respectively. Seeding rate of 150 kg ha-1 produce 264.3, 241 and 216 productive tillers during 2013-14, 2014-15 and 2015-16 respectively. These results are at par with seeding rate of 125 kg ha-1 (control). While lowest grain yield was recorded in seed rate 112kg ha-1. In case of plant height it was found that maximum plant height was recorded under the seed rate of 136 kg ha-1 i.e. 98.6cm during. While the lowest plant height was recorded under seeding rate of 112 kg ha-1 i.e. 85 centimeters. These observations have the similarity with the results of Laghari et al. (2011) who concluded that lower seed rates produce better yield (Table No. 1). There was also significant variations among seeding rates for number of grains per spike, 1000-grain weight and grain yield. Results of the experiments showed that seed rate of 136 kg ha^{-1} produced the number of grains per spike which was statistically insignificant to the rest of the seed rates. Results revealed that seeding rates had significantimpact on 1000-grain weight in 2013-14, 2014-15 and 2015-16. Among the seeding rates, the maximum 1000-grain weight was recorded under the seed rate of 136 kg ha^{-1} in three years of study. The data collected also depicted that seed rate had maximum substantial impact on grain yield (Table no. 2). Maximum grain yield was recorded under the seeding rate of 136 kg ha^{-1}. Minimum yields was recorded at 112 136 kg ha^{-1}. The results are in agreement with the findings of Kumar et al. (2006) and Otteson et al. (2007). They reported that sowing at optimum seeding rate produce maximum number of filled grains and ultimately grain yield.

IV. Conclusion And Recommendations

In the light of aforementioned results, it can be concluded that optimum seeding rate of 136 kg ha^{-1} showed superior yield performance over the rest of the seeding rates. Also seeding rate of 150 kg ha^{-1} indicated wider yield stability in yield performance over the 112 kg h^{-1} and 125 kg h^{-1} (control).

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Table no. 1. Effect of different seed rates on plant germination, number of productive tillers $m^{-2}$and plant height.

Treatments	**Germination (m^{-2})**			**Productive Tillers m^{-2}**			**Plant Height(cm)**		
Seed rate kg ha^{-1}	***2013-2014***	***2014-2015***	***2015-2016***	***2013-2014***	***2014-2015***	***2015-2016***	***2013-2014***	***2014-2015***	***2015-2016***
112	70.3d	90.67d	184.67	234.3bcd	280.2bc	189.3cd	96.6bc	100a	85c
125 (control)	90.7c	106.67c	216.3	242.6bc	284.6b	205bc	93d	94.9bc	84cd
136	176a	124.33a	223	373.0a	378.3a	318.7a	98.6a	97.7b	92a
150	148b	115.67b	239.33	264.3b	241bcd	216.7b	96.2b	99.3ab	89b

LSD (0.05)	3.75 **	3.8 **	4.3 **	89.3 NS	79.3 NS	60.3 NS	2.2 *	2.06 NS	2.01 *

Means in a column with the same letter are not significantly different at the 5% level, NS- non significant, *: significant at the 0.05 level of probability for the seed rate, **: Significant at 0.01 level of probability for seed rate.

Table no. 2. Effect of different seed rates on number grains per spike, 1000-grain weight and grain yield.

Treatments	**No. of Grains/Spike**			**1000-Grain Weight (g)**			**Grain Yield kg ha^{-1}**					
Seed rate kg ha^{-1}	*2013-2014*	*2014-2015*	*2015-2016*	*2013-2014*	*2014-2015*	*2015-2016*	*2013-2014*	*% inc/dec*	*2014-2015*	*% inc/dec*	*2015-2016*	*% inc/dec*
112	42.00	45	39	36bc	41c	41.7d	2500d	-9.09	2650c	1	3050c	3
125 (control)	42.33	44.3	37.7	34d	44b	39.7bc	2750bc	0	2623cd	0	2950cd	0
136	41.34	43.3	41	44a	46a	44.6a	2973a	8.1	3155a	15.4	3850a	16
150	41.67	44.6	39.3	37b	44b	40.9b	2883b	4.8	2900b	11.6	3450b	13.9
LSD (0.05	**3.90 NS**	**4.62 NS**	**NS NS**	**1.25 ***	**1.2 ***	**1.02 ***	**192 ****		**212 ****		**185 ****	

Means in a column with the same letter are not significantly different at the 5% level, NS- non significant, *: significant at the 0.05 level of probability for the seed rate, **: Significant at 0.01 level of probability for seed rate.

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