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Influence of Seed Size and Seed Rate on Phenology, Yield and Quality of Wheat

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Abstract: A field experiment was conducted to determine the effect of seed size and seed rate on wheat performance. It was concluded that yield components like number of fertile tillers, spike length, 1000-grain weight were significantly affected by seed size and seed rate. Similarly photobiomass producing contributers like plant density and plant height were also found responsive to seed sizes. Seed sizes and seed rates also showed significant results regarding phenology. Protein content, however was increased by large seed size.

Key words: Phenology, quality, seed rate, seed size, wheat

Introduction

Wheat is a primary staple food and grown over larger area than any other crop in Pakistan. It occupied an area of 8.33 m.ha. during 1999, with grain production 18.05 m. tons with average grain yield 2238 kg ha^{-1} (Anonymous, 1999).

Among various factors responsible for low wheat yield, seed rate and seed size play a remarkable role in increasing the wheat production. Maximum genetic potential of high yielding varieties of wheat introduced from time to time cannot be harvested without ensuring proper use of seed rate and seed size. Seeding beyond or below the optimum may lead to overall poor performance of the crop. According to Singh and Uttam (1994) the highest yield was obtained by using 125 kg seed ha^{-1} whereas Ram *et al.* (1988) suggested 160 kg seed ha^{-1} to get maximum yield.

Abadie *et al.* (1982) found that selection of large grains of wheat increased yields by about five percent as compared to smaller grains which caused reduction in both yield and 1000-grain weight.

Keeping this in view, the present study was planned to evaluate the effect of different seed rates and seed sizes on phenology, yield and quality of wheat cultivar under irrigated conditions of Faisalabad.

Materials and Methods

The experiment was conducted at the Agronomic Research Area, Department of Agronomy, University of Agriculture, Faisalabad, during the year 1999-2000. The experiment was laid out in Randomized Complete Block Design (factorial) with four replications. The net plot size was 1.5 X 5 m. The treatments consisted three seed rates i.e. 100, 150 and 200 kg ha^{-1} and three different seed sizes i.e. ungraded (control), small and large.

Seed gradation was done manually. Seed weights of 1000 grains in ungraded, small and large grades on an average were 39.8, 33.6 and 44.7 gm, respectively, Wheat variety Inqulab-91 was used as a test crop. The crop was sown during 3rd week of November, 1999, on a well prepared seed bed in 25 cm apart rows with the help of a single row hand drill.

All other cultural practices like irrigation, weeding were kept uniform and normal for all treatments till harvest of crop. Data about growth, yield and yield parameters were collected by using standard procedure. Soil up to 30 cm layer was sampled before the start of the experiment and subjected to physico-chemical analysis. The data showed 0.040 percent N, 8 ppm P_2O_5 and 169 ppm K_2O. The soil pH was 7.50. At the time of harvesting climatic data of crop growing season showed slight differences, however, the growing season remained normal. For determining protein contents, seed sample (1g) from each plot were taken and ground. After digestion distillation was made with micro Kjeldahl's apparatus (Jackson, 1960) and nitrogen percent in each sample was determined. Thereafter nitrogen percentage of each sample was multiplied by a constant factor 6.25 to calculate the protein contents. Data collected were statistically analyzed by the analysis of variance techniques (Steel and Torrie, 1984). Arcsine square root method was applied for transformation of data, which was applied on those tables in which the values were less than ten or in percentage.

Results and Discussion

Yield: The data pertaining to the seed yield per hectare is given in Table 1. The statistical analysis of transformed data indicated that seed rates and seed sizes had non significant effect on the economic yield. However maximum yield of 10.723 t ha^{-1} was achieved from the seed rate 200 kg ha^{-1} and minimum yield of 10.604 t ha^{-1}. Khan (1973) and Kampawat (1998) found the similar results. As regards seed size, maximum yield of 10.803 t ha^{-1} was obtained from ungraded seeds and minimum seed yield of 10.447 t ha^{-1} was achieved from small seeds. These results are in lime with results of Douglas *et al.* (1994). The interaction of seed rates and seed sizes also showed a non significant trend.

Yield components: The data given in Table 1 indicated that both the seed rates and seed sizes had significant effect on the number of fertile tillers per unit area. Plots seeded with 200 kg ha^{-1} produced significantly greater number of fertile tiller (334.667m^{-2}). Similar results were recorded by Nawaz (1975) and Khan (1996). As regards seed sizes, plots seeded with large seeds produced significantly greater number of fertile tiller (311.67 m^{-2}).

As regards spike length, the results from transformed data in Table 1, seed rates showed non significant results. Similar finding was also observed by Bhatti *et al.* (1990). Seed size showed significant result. Maximum spike length (18.334cm) was obtained when large size seed was used. It was statistically at par with that of (17.90 cm) spike length when ungraded seed was used. The data about the number of grains $spike^{-1}$ is presented in Table 1. It is evident from the statistical analysis of the data that seed size showed non-significant results while seed rates showed significant results. As regard seed rates the maximum number of grains $spike^{-1}$ (46.475) were obtained when seed rate of 100 kg ha^{-1} was used. These results are in line with those Sourour and Shackway (1976) and Kafil (1996).

The data regarding the 1000-grain weight is presented in Table 1. Data showed that 1000-grain weight was affected significantly by seed rates as well as seed sizes. Plots seeded

Table 1: Effect of different seed sizes and seed rates on yield and yield components of wheat

Treatment	Grain yield (t ha^{-1})	No. of fertile tillers (m^{-2})	Spike length (cm)	No. of grains spike^{-1}	1000- grain weight (g)
a) Seed size					
Control	N.S.	291.9b	17.90ab	N.S.	30.067b
Small	N.S.	290.0b	17.43b	N.S.	37.450b
Large	N.S.	311.0a	18.33a	N.S.	40.575a
L.S.D.		14.97	0.5570		1.479
b) Seed rate (kg ha^{-1})					
100	N.S.	250.1c	N.S.	46.475a	40.333a
150	N.S.	308.8b	N.S.	38.142b	38.408b
200	N.S.	334.7a	N.S.	41.408b	37.350b
L.S.D.		14.97			1.479

Any two means not sharing the same letter differ significantly at 5% probability. N.S. = Non-significant

Table 2: Effect of different seed sizes and seed rates on photobiomass production, phenology and quality of wheat

Treatment	Plant density (m^{-2})	Plant height (cm)	Biological yield (t ha^{-1})	Harvest index (%)	Straw yield (t ha^{-1})	Germination count (m^{-2})	Protein content (%)
a) Seed size							
Control	302.750b	89.967b	N.S.	N.S.	N.S.	132.625ab	20.274b
Small	300.250b	93.567a	N.S.	N.S.	N.S.	149.417a	19.630b
Large	323.833a	94.867a	N.S.	N.S.	N.S.	118.853b	21.234a
L.S.D.	16.25	2.945				23.90	0.6938
B) Seed rate (kg ha^{-1})							
100	261.667c	N.S.	N.S.	N.S.	N.S.	109.167b	N.S.
150	320.083b	N.S.	N.S.	N.S.	N.S.	134.708a	N.S.
200	345.083a	N.S.	N.S.	N.S.	N.S.	156.750a	N.S.
L.S.D.	16.25					23.90	

Any two means not sharing the same letter differ significantly at 5% probability. N.S. = Non-significant

with 100 kg ha^{-1} produced significantly maximum 1000-grain weight (40.33 g). Kreft and Spiss (1988), Sadiq and Lalah (1986) also found decrease in 1000-grain weight by increasing seed rates. As regards seed sizes, large seeds produced significantly maximum 1000-grain weight (40.575 g).

Photobiomass production: It is clear from the data (Table 2) that plant population was significant among seed sizes as well as seed rates. Their interaction was also found significant and combination of 200 kg ha^{-1} seed rate X large size seed gave the highest plant population. These results are in agreement with Pereira *et al*. (1988) and Randhawa *et al*. (1973). The data pertaining to the plant height given in Table 2 indicated that seed rate had non significant effect while seed sizes showed significant results. As regarding seed sizes the highest plant height 94.867 cm was obtained when large size seeds were used. It was statistically at par with that of 93.567 cm plant height when small size seeds were used. These results were in agreement with those of Randhawa *et al*. (1973) and Love (1970).

It may be seen from Table 2 that the biological yield, harvest index and straw yield were not affected significantly by seed sizes and seed rates.

Phenology: It is evident from the Table 2 that the various seed rates significantly influenced the germination counts m^{-2} and the highest seed rate i.e. 200 kg ha^{-1} produced the highest number of seedlings (156.75), though it is at par with 150 kg ha^{-1} seed rate. These results favor those reported by Nerson and Edelstein (1981). The seed sizes also gave significant results and the small seeds gave the maximum number of seedling i.e. (149.42) though statistically at par with ungraded seeds, which gave 132.63 seedlings per unit area. These results are in accordance with those reported by Muchena and Grogan (1977).

Quality: Transformed data pertaining to the protein content (%) given in Table 2, indicated that seed rates showed non significant results while seed sizes showed significant results. As regarding seed sizes, the highest protein content percentage (21.234) was obtained when large size seeds were used.

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