The Effect of Row and Plant Spacings on Yield and Yield Components of Wheat under Kufra Environment

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ABSTRACT

The effect of row and plant spacing on the yield and yield components of wheat cv. 'Sidi Misri 1' was studied under irrigation at the Kufra Oasis in the Libyan desert. Increasing the plant to plant as well as row to row spacing increased the number of tillers per plant. Row spacing between 15 cm and 45 cm had no effect on dry matter production. The narrowest plant spacing (5 cm) had higher dry matter production than the widest spacing (20 cm). There was no effect of row or plant spacing on the grain yield and grain size. While plant spacing did not affect the number of grains per spike, narrow row spacing had a lower number of grains per spike than the wider row spacing. Considering different row and plant spacing to obtain the same plant population, increasing plant density decreased tillering. There was no effect of plant density from 16–66 plants per m^2 on grain yield and other yield components.

INTRODUCTION

Row and plant spacings have an important bearing on the yield of crop plants because they determine the balance of plant to plant competition. Because this competition varies with the environment, it is necessary that these studies be undertaken in widely different climatic conditions.

It has been found that increasing the density of plants decreases the tillers/plant in wheat (5,12,17), 4–8 million seeds per hectare produced less tillers/plant than the lower densities (1); a spacing of 30 cm × 30 cm was necessary to increase the tiller number/plant (9).

The effect of row spacing and plant population has been extensively studied. Increasing the density of plants increased (5,14,17) or decreased the grain yield (12). Three to six million seeds per hectare generally gave the highest grain yield. The row spacing studied varied from 7.5 cm to 40 cm. Narrowest spacings; i.e., 7.5 cm (6) or 11 cm (8) gave the highest grain yields; 12.5 cm and above spacing either decreased the grain yield (15) or had no effect (16). In some cases, however, 30 cm width (9,11) had highest yields. The increase in plant density has been found to decrease both the seed number per spike and the seed size (5,17).

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MATERIALS AND METHODS

Wheat, *Triticum aestivum* L. seed of cv. Sidi Misri 1, (a selection of Mexipak) treated with 'Ceresan', was sown with a planter at the agriculture farm of the Al-Kufra productive project on November 21, 1973. Row spacings of 15 cm, 30 cm and 45 cm were used as main treatments and plant to plant spacings of 5 cm, 10 cm, 15 cm, and 20 cm were used as sub-treatments. There were four replications of each treatment combination. The plots were 6 M × 2 M in size. Fertilizer was applied at the rate of 190 Kg Nitrogen, 190 Kg Phosphorus and 225 Kg Potassium per hectare as a compound fertilizer at the time of seeding. The plants were thinned at seedling stage. This experimental area was under alfalfa crop for the last three years. The field plots were irrigated daily through per-forain for ten minutes during the seedling establishment stage and on alternate days for one hour, therefore, till maturity.

Observations on heading time were taken when spikes in half of the plants in each treatment were seen. The maturity was determined in the same way. Ten plants, taken at random from each plot, were used for the determination of the number of tillers per plant (or per main stem), the number of grains per spike (or main stem) and 1,000 kernel weight (from mixture of ten spikes). At maturity on April 24, 1974, a net plot size of 90 cm × 150 cm was harvested for grain yield and total dry matter determination.

RESULTS AND DISCUSSION

The data on the effect of row and plant spacing on the number of tillers per plant in wheat is presented in Table 1. Row spacing and plant spacing were both significantly different; there was no interaction. The tiller number increased significantly with the increase in both row spacing and plant spacing within a row. Among the row spacings, 45 cm had more tillers than 30 cm and 30 cm more than 15 cm spacing. Among the plant spacing, 5 cm and 10 cm were similar in tiller production. However, they both had lesser tillers than 15 cm and 15 cm had lesser tillers than 20 cm plant to plant spacing.

Plant to plant spacing affected the dry matter production (grain and straw) significantly. Five centimeters of plant spacing gave a higher yield than 20 cm spacing irrespective of row spacing. There was no significant difference due to row spacing (Table 2).

Table 1 Effect of row and plant spacing on number of tillers per plant in wheat.

	Plant spacing, cm				
Row spacing, cm	5	10	15	20	mean
15	4.4	4.3	6.2	8.1	5.9
30	5.2	6.2	10.5	11.0	8.2
45	7.2	9.2	12.1	14.4	10.7
Mean	5.6	6.6	9.6	11.2	—

LSD (.05) for row spacing = 1.7, for plant spacing = 1.4.

Table 2 Effect of row and plant spacing on total dry matter of wheat (grain & straw in tons/ha).

	Plant spacing, cm				
Row spacing, cm	5	10	15	20	Mean
15	12.34	11.80	11.62	11.26	11.76
30	12.34	10.53	11.62	10.53	11.26
45	10.16	10.16	8.35	7.62	9.06
Mean	11.61	10.83	10.53	9.80	—

LSD (.05) for plant spacing = 1.39

Table 3 Effect of row and plant spacing on grain yield of wheat in tons/ha.

	Plant spacing, cm				
Row spacing, cm	5	10	15	20	Mean
15	4.25	4.43	4.56	4.41	4.41
30	4.93	4.12	4.15	4.18	4.35
45	4.07	3.82	3.34	3.11	3.59
Mean	4.42	4.12	4.02	3.90	—

The data on the effect of row spacing and plant spacing on grain yield is given in Table 3. There was no significant change in grain yield due to row or plant spacings.

There was a significant effect of row spacing on the number of grains per spike. Fifteen cm spacing between rows had a lower number of grains/spike than 30 cm and 45 cm; there was no difference between 30 cm and 45 cm spacing. There was no effect of plant spacing on the number of grains per spike (Table 4).

The data on the effect of row and plant spacings, given in Table 5, show no significant effect of 1,000 kernel weight of wheat.

Table 4 Effect of row and plant spacing on number of grains/spike of wheat.

	Plant spacing, cm				
Row spacing, cm	5	10	15	20	Mean
15	70.8	68.3	79.6	76.9	73.9
30	74.8	76.0	81.1	82.6	78.6
45	80.3	79.8	82.8	81.4	81.1
Mean	75.3	74.7	81.1	80.3	—

L.S.D. (.05) for row spacing = 4.1.

Table 5 Effect of row and plant spacing on 1000 kernel wt (g) of wheat.

Row spacing, cm	Plant spacing, cm				
	5	10	15	20	Mean
15	35.0	37.3	39.8	38.1	37.6
30	42.1	38.1	38.3	38.8	39.3
45	35.6	39.6	39.5	37.3	38.0
Mean	37.6	38.3	39.2	38.1	—

A summary of results, given in Tables 1 to 5, arranged to get the same number of plants/m^2 with different combination of row spacing and plant spacing, is presented in Table 6. The data indicate that the number of tillers per plant and dry matter/ha. were significantly different in treatments. Tiller number decreased with increase in plant number between 16 to 66 plants/m^2, 66 plants/m^2 had less tillers than 33 plants/m^2 and 33 plants/m^2 less than 16 plants/m^2. A similar effect was seen with doubling the number of plants from 22 to 44. When the row width was increased (Table 6–II) the effect was significant only with 22 and 16 plants/m^2. There was no effect of the number of plants on dry matter production in narrow spacings. In the wider spacings, the dry matter production was decreased only in 16 plants/m^2. The other plant populations were not different.

Table 6 The effect of constant plant numbers on some crop characteristics of wheat.

Plant no. per m^2	Tillers per plant		Dry tillers Tons/ha		Grain yield Tons/ha		No. grain per spike		Grain wt. (g) per 100 kernels	
	I[a]	II	I	II	I	II	I	II	I	II
66	4.8	5.2	11.80	12.34	4.43	4.80	68.3	74.8	37.3	42.1
44	6.2	7.2	11.62	10.16	4.56	4.07	79.7	80.3	39.8	35.6
33	8.1	5.7	11.26	10.53	4.41	4.12	76.9	76.0	38.1	38.1
22	10.5	9.2	11.62	10.16	4.15	3.82	81.1	79.8	38.3	39.6
16	11.0	12.1	10.53	7.60	4.18	3.34	82.6	82.6	38.8	39.5
L.S.D.[b]	2.5		2.39			NS		NS		NS

[a] I and II are row spacings different in each case to give the requisite number of plants/m^2 (I = narrow, II = wide).
[b] L.S.D. for interaction, NS = Not significant.

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