Effect of Seeding Rate and Nitrogen Fertilization on Growth and Yield of Sidi Misri 1 Wheat Cultivar (*Triticum aestivum* L.)

F. A. SOROUR, M. A. EL-SHARKAWY, AND M. I. SHAALAN[1].

ABSTRACT

The effect of seeding rate under different nitrogen levels on growth and yield of 'Sidi Misri 1' wheat cultivar, *Triticum aestivum* L., was studied under the field conditions of Alfateh University Farm in the 1974–1975 season.

Plant height, spike length and the number of tillers and spikes per plant were increased by increasing the nitrogen level and decreasing the seeding rate.

Total yield (grain plus straw), grain yield, and straw yield were increased by increasing nitrogen level as well as seeding rate. On the other hand, the harvest index (percent grain to total yield) was not significantly affected by either nitrogen level or seeding rate.

On plant basis, the grain yield per plant was increased due to increasing nitrogen level, whereas it was reduced by increasing the seeding rate. The number of grains per plant and per spike were not significantly affected by nitrogen level, but were decreased by increasing the seeding rate.

The number of grains/m^2 was significantly increased by increasing the nitrogen level. On the other hand, no response was noted due to the seeding rate. A high significant interaction was obtained between the nitrogen level and seeding rate with respect to the number of grains/m^2. The maximum number of grains/m^2 resulted from the combination of the highest nitrogen level (200 kg N/ha) and the highest seeding rate (140 kg/ha). This coincided with the highest total yield (grain plus straw).

Grain size (weight of 1,000 grains) was not significantly affected by the nitrogen level, but it was generally increased by increasing the seeding rate.

INTRODUCTION

Growth and yield of wheat is greatly affected by the rate of seeding (1,2,7,10). Sorour and El-Sharkawy (8) reported a decrease in plant height and spike length due to the increase in seeding rate. They also observed a reduction in grain yield per plant, and number of grains and number of tillers per plant by increasing the seeding rate. They concluded that the optimum seeding rate ranged from 75 to 100 kg/ha. Thick planting reduced the number of fertile heads (10). On the other hand, thin planting delayed heading and increased plant height (7). Omar *et al.* (6) noted that thin planting tended to in-

[1] *Plant Production Department, Faculty of Agriculture, University of Alfateh, Tripoli, Libya.*

crease the grain yield and to reduce the straw yield in oats. High plant density increased plant height and decreased tillering (1).

Sawhney (8) reported that Sidi Misri 1 wheat proved to be the highest yielding cultivar under high rates of nitrogen. An economic increase in the grain yield of Mexican semi-dwarf wheat cultivar was obtained by nitrogen application up to 300 kg/ha (3). Black (2) indicated that the number of grains per head and grain size were not significantly affected by nitrogen fertilization.

This paper is concerned with studying the combined effect of seeding rate and nitrogen level on growth, yield and yield components of the Mexican semi-dwarf wheat cultivar 'Sidi Misri 1'.

MATERIALS AND METHODS

A field experiment was conducted in the 1974–1975 season at the Faculty of Agriculture Farm, Tripoli, to study the effect of seeding rate under different nitrogen levels on growth, yield, and yield components of 'Sidi Misri 1' wheat.

A split plot design, with five replicates and 12 treatments, was used as follows:

A. Main treatments: included three nitrogen levels:
   1. 100 kg N/ha top dressed in two splits; 15 and 30 days after planting.
   2. 150 kg N/ha top dressed in three splits; 15, 30 and 45 days after planting.
   3. 200 kg N/ha top dressed in four splits; 15, 30, 45 days after planting and at heading stage.

B. Sub-treatments: included four seeding rates:
   1. 50 kg/ha drilled in rows 30 cm apart.
   2. 80 kg/ha drilled in rows 30 cm apart.
   3. 110 kg/ha drilled in rows 30 cm apart.
   4. 140 kg/ha drilled in rows 30 cm apart.

Sidi Misri 1 wheat cultivar was sown on October 27, 1974, in rows 30 cm apart in plots 4 × 4 m. Ammonium sulphate (20.5% N) was applied as a nitrogen source. Sprinkler irrigation was given to supplement the natural rainfall whenever needed.

At maturity, five plants were sampled at random from each plot for the determinations of growth, including plant height, spike length, number of tillers per plant, and number of spikes per plant, and the components of yield which comprised the harvest index, grain yield per plant, grain weight per spike, number of grains per plant, number of grains per spike, number of grains/m^2, and grain size (1,000-grain weight). The whole plots were harvested on 15 May, 1975, and the total yield, grain yield, straw yield, and grain to straw ratio were determined.

RESULTS AND DISCUSSION

I. Growth

Plant height at harvest, as indicated in Table 1, was significantly affected by both nitrogen and seeding rate. The highest nitrogen level (200 kg N/ha) significantly increased plant height as compared with the lower levels. On the other hand, plant height was significantly reduced by increasing the seeding rate above 110 kg/ha. These results agreed with other reports (7,9).

The data of Table 2 show that the increase in spike length due to the increase in nitrogen level was highly significant. On the other hand, a reduction in spike length was

Table 1 Effect of nitrogen level and seeding rate on the average plant height (cm) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				Mean [a]
	50	80	110	140	
100	78.4	78.3	74.6	72.9	76.1
150	82.5	84.6	82.3	81.9	82.8
200	87.4	86.2	86.6	81.1	85.3
Mean [b]	82.8	83.0	81.2	78.6	—

[a] L.S.D. for nitrogen level: (0.05) = 3.0 cm & (0.01) = 4.3 cm.
[b] L.S.D. for seeding rate: (0.05) = 2.5 cm.

Table 2 Effect of nitrogen level and seeding rate on the average spike length (cm) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				Mean [a]
	50	80	110	140	
100	10.1	9.4	8.7	7.2	8.9
150	11.3	11.2	9.6	9.1	10.3
200	11.9	11.3	11.2	10.0	11.1
Mean [b]	11.1	10.7	9.8	8.8	—

[a] L.S.D. for nitrogen level: (0.05) = 0.3 cm & (0.01) = 0.5 cm.
[b] L.S.D. for seeding rate: (0.05) = 0.7 cm & (0.01) = 0.9 cm.

Table 3 Effect of nitrogen level and seeding rate on the number of tillers per plant of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				Mean [a]
	50	80	110	140	
100	3.4	2.7	2.1	2.0	2.6
150	4.3	3.6	2.8	2.4	3.3
200	4.6	3.2	3.3	2.6	3.4
Mean [b]	4.1	3.2	2.8	2.4	—

[a] L.S.D. for nitrogen level: (0.05) = 0.5 & (0.01) = 0.7 tiller/plant.
[b] L.S.D. for seeding rate: (0.5) = 0.5 & (0.01) = 0.7 tiller/plant.

Table 4 Effect of nitrogen level and seeding rate on number of spikes per plant of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate				Mean
	50	80	110	140	
100	3.3	2.6	2.1	2.0	2.5
150	4.0	3.4	2.8	2.3	3.1
200	4.2	2.9	3.0	2.4	3.1
Mean	3.9	3.0	2.6	2.2	—

Table 5 Effect of nitrogen level and seeding rate on the total yield (grain plus straw) in tons/ha of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean[a]
100	5.363[c]	7.613	7.163	6.988	6.782
150	6.813	8.125	8.400	8.450	7.947
200	8.638	7.365	9.313	10.188	8.875
Mean[b]	6.938	7.700	8.292	8.542	—

[a] L.S.D. for nitrogen level: (0.05) = 0.819 & (0.01) = 1.188 tons/ha.
[b] L.S.D. for seeding rate = (0.05) = 0.894 & (0.01) = 1.194 tons/ha.
[c] L.S.D. for interaction: (0.05) = 1.550 tons/ha.

observed with increasing the seeding rate. The difference was highly significant between the two high seeding rates of 110 and 140 kg /ha.

The number of tillers and number of spikes per plant were similarly affected by both nitrogen level and seeding rate (Tables 3 & 4). They were significantly increased by increasing the nitrogen level, but decreased by increasing the seeding rate. The differences were significant only between the 100 kg N/ha and the other two rates. The lowest seeding rate (50 kg/ha) gave the highest significant average values for both number of tillers and spikes (4.1 tillers per plant and 3.9 spikes per plant).

II. Yield and yield components

Total yield of grains plus straw was significantly increased by increasing the nitrogen level (Table 5). The increase in seeding rate also caused this yield to increase. Highly significant differences were found between the lowest seeding rate (50 kg/ha) and the two highest rates (110 and 140 kg/ha). A significant interaction was observed between the nitrogen level and seeding rate for the total yield. In case of the lowest seeding rate, the increase in nitrogen level over 100 kg N/ha resulted in a highly significant increase in the total yield. On the other hand, at the seeding rate of 80 kg/ha the differences between the nitrogen levels were not significant. At the higher seeding rates of 110 and 140 kg/ha, the increase in nitrogen resulted in a highly significant increase in the total yield.

The data of Table 6 show that the increase in nitrogen level or seeding rate increased

Table 6 Effect of nitrogen level and seeding rate on grain yield (tons/ha) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean[a]
100	2.513	3.138	3.338	3.113	3.025
150	3.000	3.913	3.863	3.738	3.628
200	3.638	3.163	4.144	4.569	3.878
Mean[b]	3.050	3.404	3.781	3.806	—

[a] L.S.D. for nitrogen level: (0.05) = 0.169 & (0.01) = 0.244 tons/ha.
[b] L.S.D. for seeding rate: (0.05) = 0.444 & (0.01) = 0.594 tons/ha.

Table 7 Effect of nitrogen level and seeding rate on straw yield (tons/ha) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean[a]
100	2.850	4.475	3.825	3.875	3.756
150	3.813	4.213	4.538	4.713	4.319
200	4.000	4.200	5.169	5.619	4.997
Mean[b]	3.888	4.296	4.511	4.736	—

[a] L.S.D. for nitrogen level: (0.05) = 0.806 tons/ha.
[b] L.S.D. for seeding rate: (0.05) = 0.694 tons/ha.

the grain yield. The differences were highly significant between the nitrogen levels. The seeding rates above 50 kg/ha significantly increased the grain yield as an average of all nitrogen levels.

Straw yield responded positively to both the nitrogen level and seeding rate (Table 7). Differences were significant between the lowest and the highest nitrogen levels and seeding rates.

Table 8 Effect of nitrogen level and seeding rate on harvest index (percent grain to total yield) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate				
	50	80	110	140	Mean
100	47.60	41.1	47.2	44.7	45.2
150	45.50	48.5	46.5	44.1	46.0
200	42.60	43.8	44.7	45.2	44.1
Mean	45.2	44.4	46.1	44.7	—

Harvest index (percent of grains to total yield) was not affected by variation in both nitrogen and seeding rates (Table 8).

The grain yield per plant was significantly increased by increasing the nitrogen level above 110 kg/ha. On the other hand, it was significantly reduced with the seeding rates above 50 kg/ha (Table 9).

Table 9 Effect of nitrogen level and seeding rate on grain yield per plant (g) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean[a]
100	8.5	6.9	5.6	4.4	6.4
150	10.8	8.6	6.7	5.8	8.0
200	10.5	7.9	8.2	6.7	8.3
Mean[b]	9.9	7.8	6.9	5.7	—

[a] L.S.D. for nitrogen level: (0.05) = 1.3 g/plant.
[b] L.S.D. for seeding rate: (0.05) = 1.3 g/plant.

Table 10 Effect of nitrogen level and seeding rate on grain weight per spike (g) of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean
100	2.6	2.7	2.7	2.3	2.6
150	2.8	2.6	2.4	2.6	2.6
200	2.5	2.8	2.8	2.8	2.7
Mean	2.6	2.7	2.7	2.6	—

The grain weight per spike was not significantly affected by both the nitrogen level and seeding rate (Table 10).

The data of Tables 11 and 12 summarize the effect of nitrogen level and seeding rate on the number of grains per plant and spike, respectively. Both the number of grains per plant and spike did not significantly respond to the variation in nitrogen level. However, the variation in seeding rate exerted a highly significant effect on the number of grains per plant. The effect was significant on the number of grains per spike. This

Table 11 Effect of nitrogen level and seeding rate on number of grains per plant of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean
100	182.2	143.5	100.8	89.2	128.9
150	225.1	169.9	123.7	103.9	155.7
200	229.2	158.6	157.5	123.9	167.3
Mean[a]	212.2	157.4	127.3	105.7	—

[a] L.S.D. for seeding rate: (0.05) = 19.7 & (0.01) = 26.3 grains/plant.

might be attributed to the effect of seeding rate on tillering and plant growth. The number of grains per plant was significantly reduced by increasing the seeding rate above 50 kg/ha. On the other hand, the number of grains per spike was significantly reduced by increasing the seeding rate from 50 to 110 or 140 kg/ha. It was not significantly affected by the seeding rates above 80 kg/ha.

The number of grains/m^2 was reported to have a positive relationship with total grain yield (4). Grafius (5) considered the yield as the product of grains/m^2 and grain weight. He stated that the commonly observed inverse relationship between the two under com-

Table 12 Effect of nitrogen level and seeding rate on number of grains per spike of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean
100	55.2	54.5	46.7	46.7	50.8
150	56.5	55.0	43.6	45.3	49.1
200	53.6	56.0	52.9	51.2	53.4
Mean[a]	55.1	53.8	47.7	47.7	—

[a] L.S.D. for seeding rate: (0.05) = 6.6 grains/spike.

Table 13 Effect of nitrogen level and seeding rate on number of grains/m² of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean[a]
100	5387.2[b]	6251.2	5713.2	5773.0	5780.7
150	6189.0	7593.0	6945.7	6788.1	6879.1
200	7455.0	6234.7	7822.2	8140.1	7413.0
Mean	6343.7	6692.9	6826.4	6900.6	—

[a] L.S.D. for nitrogen level: (0.05) = 529.5 & (0.01) = 770.2 grains/m².
[b] L.S.D. for interaction: (0.05) = 625.8 & (0.01) = 838.5 grains/m².

petition implied an optimum number of grains/m² for maximum yield. The results obtained in Table 13 indicate that the number of grains/m² was significantly increased by increasing the nitrogen level, whereas it was not significantly affected by the seeding rate. The results also indicated a highly significant interaction between the nitrogen level and seeding rate. At the seeding rate of 80 kg/ha, there was a significant increase in the number of grains/m² due to the increase in nitrogen level to 100 kg N/ha. This was followed by a significant reduction with further increase in the nitrogen level from 150 kg N/ha to 200 kg N/ha. At seeding rates higher than 80 kg/ha, there was a significant increase in the number of grains/m² with increasing nitrogen. The maximum number of grains/m² was obtained from the highest nitrogen level (200 kg/ha) and the seeding rates of 110 and 140 kg/ha. This coincided with the highest total yield (Table 5) and grain yield (Table 6).

Grain size (1,000-grain weight) was not significantly affected by the nitrogen level, although it was generally increased by increasing the seeding rate (Table 14). The two seeding rates of 110 and 140 kg/ha produced significantly large grains than the lower rates.

Table 14 Effect of nitrogen level and seeding rate on grain size (1000-grain weight) in grams of Sidi Misri 1 wheat.

Nitrogen level (kg/ha)	Seeding rate (kg/ha)				
	50	80	110	140	Mean
100	47.1	50.2	58.3	54.5	52.5
150	48.6	51.6	55.9	56.0	53.0
200	48.7	50.9	53.0	56.4	52.3
Mean[a]	48.2	50.9	55.7	55.5	—

[a] L.S.D. for seeding rate: (0.05) = 3.5 & (0.01) = 4.6 g.

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