Response of Growth and Yield of Semi-dwarf Wheat to Phosphorus and Nitrogen Fertilizers

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ABSTRACT

The response of the semi-dwarf wheat cultivar 'Sidi Misri 1' to both phosphorus and nitrogen fertilizers was studied in a field experiment on the sandy soil of Tripoli, Libya.

The vegetative growth, as indicated by the studied parameters, and the grain yield and its components were significantly enhanced by the addition of phosphorus before planting.

Postemergence nitrogen application up to 120 kg N/ha significantly increased the production of grains as well as straw. Excess nitrogen, beyond 120 kg N/ha, did not significantly increase the grain or straw production. Most of the grain yield components behaved similarly.

INTRODUCTION

The growth and yield of wheat grown in loamy soils was reported to be significantly affected by nitrogen and phosphorus fertilization (1,8). Black (1) found that addition of phosphorus to a loamy soil, in Montana, U.S.A., increased the adventitious roots, tillers and the total number of heads. Both nitrogen and phosphorus fertilization significantly increased the total grain yield.

Under semi-arid conditions and in calcarious soils, the response of wheat plants to phosphorus and the availability of added phosphorus were affected by some edaphic factors, such as soil moisture, temperature, and organic matter content (5,6,7). El-Sharkawy (2) and El-Sharkawy and Sgaier (3,4) found that the growth and yield of semi-dwarf Mexican wheat, grown in the sandy soil of Al-Kufra Oasis, Libya, were greatly enhanced by the application of high levels of nitrogen and phosphorus. Moreover, they observed that normal growth was attained when a reasonable amount of both nitrogen and phosphorus fertilizers were added before planting.

The objective of this study was to investigate the response of growth and yield of the semi-dwarf wheat cultivar, Sidi Misri 1, to nitrogen and phosphorus fertilization.

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MATERIALS AND METHODS

A field experiment, in a randomized complete block design, was conducted at the Faculty of Agriculture Farm, Tripoli, to study the response of the semi-dwarf wheat cultivar, Sidi Misri 1 (*Triticum aestivum* L.) to certain levels of applied phosphorus and nitrogen. The experimental plots were 4 × 4 m^2 in four replications. Wheat kernels were hand-drilled on 30 October, 1974, at the rate of 100 kg/ha in rows 30 cm apart. The phosphorus fertilizer was applied preplanting at the rates of 0, 36 and 72 kg P_2O_5/ha in the form of single superphosphate (18% P_2O_5). The nitrogen treatments were 60, 120 and 180 kg N/ha in the form of ammonium sulfate applied postemergence in one (2 weeks after planting), two (2 and 5 weeks after planting) and three (2, 5 and 11 weeks after planting) splits, respectively. In addition to the rainfall received during the growing season, supplementary irrigation was carried out whenever needed.

Plant samples (10 plants each) were collected at random at three different intervals (32, 48, and 128 days after planting) during growing period for the measurements of growth parameters. Such parameters included plant height in centimeters, number of tillers/plant and fresh and dry weights/plant in grams. At harvest, random samples of mature plants were taken for the determination of yield components (spike length in centimeters, number of spikes/plant, grain weight/plant and spike in grams, number of grains/plant and spike, and 1,000-grain weight in grams). The five middle rows were harvested for estimation of total (grain and straw), grain and straw yields.

RESULTS AND DISCUSSION

I. Plant Growth

Table 1 summarizes the effects of preplanting and postemergence applications of phosphorus and nitrogen levels, respectively, on plant growth as measured by plant height, fresh and dry weights, and number of tillers per plant at 32, 48 and 128 days after planting. All these vegetative parameters were significantly affected by the phosphorus treatments. As means of nitrogen levels, the application of both 32 and 72 kg P_2O_5/ha significantly increased the plant height, fresh and dry weights of plants and tiller production over the control treatment (zero phosphorus). This positive plant response to added phosphorus supports the view of low content of available phosphorus in the soil of the coastal region around Tripoli.

Postemergence application of nitrogen at 120 and 180 kg N/ha in two and three splits (60 kg/ha each) significantly increased plant height and both fresh and dry weights of 48- and 128-days old plants as compared with 60 kg N/ha applied two weeks after planting. On the other hand, these higher rates of postemergence nitrogen application did not significantly affect the production of tillers. This might be anticipated since the nitrogen excess, above 60 kg N/ha, was applied at five and eleven weeks after planting. It appears, therefore, that the tiller production responds only to the early applied nitrogen (during the first four weeks).

II. Yield and Yield Components

Tables 2 and 3 show the effect of phosphorus and nitrogen fertilizers on the production of grain and straw as well as the various components of wheat yield. There were positive responses in total and grain yields with the addition of phosphorus. However, the increase in grain production due to phosphorus was more pronounced than in

Table 1 Effect of phosphorus and nitrogen levels on growth parameters of wheat at different ages after planting.

P & N levels (kg/ha)	Growth parameters											
	Plant height (cm)			No. of tillers/plant			Fresh weight/plant (g)			Dry weight/plant (g)		
	32 days	48 days	128 days	32 days	48 days	128 days	32 days	48 days	128 days	32 days	48 days	128 days
Phosphorus:												
0	18.97[a]	38.28	63.47	1.70	2.18	2.04	1.14	3.23	7.07	0.39	1.01	2.77
32	21.24	46.29	68.52	2.41	2.73	2.85	1.74	6.03	6.36	0.76	1.91	2.57
72	23.33	46.29	71.56	2.68	3.03	3.16	2.09	6.62	7.76	0.79	2.22	3.02
L.S.D. (0.05)	1.94	4.55	4.23	0.37	0.30	0.40	0.29	1.27	1.12	0.16	0.48	0.34
(0.01)	2.64	6.18	5.75	0.50	0.41	0.55	0.40	1.72	N.S.	0.22	0.66	N.S.
Nitrogen:												
60	20.10[b]	35.43	59.80	2.21	2.58	2.60	1.59	3.59	6.35	0.65	1.39	2.51
120	21.79	47.57	70.36	2.28	2.74	2.70	1.63	6.49	7.04	0.64	1.94	2.82
180	21.65	47.86	73.38	2.29	2.63	2.75	1.75	5.79	7.81	0.65	1.81	3.02
L.S.D. (0.05)	N.S.[c]	4.55	4.23	N.S.	N.S.	N.S.	N.S.	1.27	1.12	N.S.	0.48	0.34
(0.01)	N.S.	6.18	5.75	N.S.	N.S.	N.S.	N.S.	1.72	N.S.	N.S.	N.S.	0.47

[a] Means of N levels.
[b] Means of P levels.
[c] N.S. = Not significant.

Table 2 Effect of phosphorus and nitrogen levels on wheat yield (tons/ha).

P & N levels (kg/ha)	Total yield (grain + straw)	Grain yield	Straw yield
Phosphorus:			
0	4.926[a]	1.750	3.175
32	5.500	1.951	3.550
72	6.350	2.431	3.919
L.S.D. (0.05)	1.231	0.494	N.S.
(0.01)	N.S.[b]	0.669	N.S.
Nitrogen:			
60	3.813[c]	1.325	2.488
120	6.213	2.307	3.906
180	6.750	2.513	4.238
L.S.D. (0.05)	1.231	0.494	0.858
(0.01)	1.675	0.669	1.167

[a] Means of N levels.
[b] N.S. = Not significant.
[c] Means of P levels.

straw. This was indicated by the nonsignificant increase in straw production as compared with the highly significant increase in grain yield (Table 2).

There was a highly significant increase in total, straw and grain yields due to the addition of 120, and 180 kg N/ha as compared with 60 kg N/ha. However, the differences between the 120 and 180 kg N/ha levels were not significant (Table 2).

Application of phosphorus significantly increased the length of spike, grain weight

Table 3 Effect of phosphorus and nitrogen levels on components of wheat yield.

P & N levels (kg/ha)	Spike length (cm)	No. of spikes/ plant	Grain wt./plant (g)	Grain wt./spike (g)	No. of grains/ plant	No. of grains/ spike	1000-grain weight (g)
Phosphorus:							
0	7.92[a]	2.25	2.48	1.26	61.67	30.09	42.10
32	8.67	2.42	3.06	1.36	73.33	32.53	42.23
72	8.75	2.75	4.22	1.60	103.25	39.56	40.91
L.S.D. (0.05)	0.82	N.S.[b]	0.56	0.32	11.44	8.03	N.S.
(0.01)	N.S.	N.S.	0.77	N.S.	15.55	N.S.	N.S.
Nitrogen:							
60	7.83[c]	2.00	2.76	1.49	68.50	35.84	42.36
120	8.75	2.58	3.42	1.37	82.92	33.30	41.31
180	8.75	2.83	3.57	1.36	86.83	33.03	41.57
L.S.D. (0.05)	0.82	0.61	0.56	N.S.	11.44	N.S.	N.S.
(0.01)	N.S.	0.83	0.77	N.S.	15.55	N.S.	N.S.

[a] Means of N levels.
[b] N.S. = Not significant.
[c] Means of P levels.

and number of grains per spike, and the grain weight and number of grains per plant as shown in Table 3. This positive response in yield components was reflected on the grain yield, as indicated in Table 2. Both the number of spikes per plant and the 1,000-grain weight were slightly affected by phosphorus.

As with grain yield, the 120 and 180 kg N/ha levels significantly increased the spike length, number of spikes per plant, grain weight and number of grains per plant (Table 3). The differences between these two levels were not significant. The 1,000-grain weight, number of grains and their weight per spike were not significantly affected by excess nitrogen above 60 kg N/ha. However, there was a slight decrease in 1,000-grain weight due to such excess.

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