

Response of Wheat to Cycocel (CCC) Application

II. Effects of nitrogen level and CCC concentration on yield components of dwarf and tall wheat (*triticum aestivum*).

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INTRODUCTION

Grain yield of wheat was found to be affected by treatment with the growth regulant 2-chloroethyl trimethyl ammonium chloride, known as cycocel (CCC). Under conditions favourable to lodging, treatment with CCC increased grain yield of several wheat varieties (2, 3).

When lodging is of no significance, treatment with CCC may or may not increase the grain yield. Humphries et al. (7) found that when lodging was absent, the increase in yield of grain by CCC treatment was only 5%.

The application of high nitrogen level to wheat with CCC did not result in high lodging rate as compared to untreated plants (6). Adler (1) reported that application of nitrogen with CCC had little effect on grain yield of several wheat varieties. On the other hand Rixhon and Crohain (8) found that treatment with CCC at high rate of nitrogen increased the yield of spring wheat by 7.5%. El-Sharkawy et al. (5) found that the tall-straw 'florencia aurora' variety and the short-straw 'sidi misri 1' responded differently to application of CCC and nitrogen in respect to stem height. It is the objective of this work to investigate the effect of CCC and nitrogen level on the grain yield and its components in the short-straw 'sidi misri 1' and the tall-straw 'florencia aurora' varieties of spring wheat.

MATERIALS AND METHODS

The experiment was carried out at the Faculty of Agriculture farm, sidi misri, Tripoli. It consisted of a $2 \times 3 \times 3$ factorial trial, which included two wheat varieties, three CCC levels namely, O.O, 2.5, and 6.0 kg a.i./ha and three nitrogen levels at the rate of 40, 80 and 120 kg N/ha. The individual plots were arranged in a randomized block design with 4 replicates. The seeding rate was 122 and 94 kg/ha for 'florencia aurora' and 'sidi misri 1', respectively. The nitrogen was applied in form of ammonium sulfate 35 and 65 days after planting. Cycocel in a 40% formulation was sprayed when the plants were 20 cm high. The grain yield was taken from a 2.4 square meter of the middle rows of each plot.

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Number of tillers, number of grains per spike and the weight of grains per spike were estimated from 10 plants randomly selected from outer rows of each plot. Grain size was estimated as the weight of 1,000 grains taken from the bulked grains of the whole plot.

RESULTS AND DISCUSSION

Total grain yield, number of tillers, number of grains per spike, weight of grains per spike and the weight of 1,000 grains of 'sidi misri 1' and 'florencia aurora' varieties at different levels of CCC and nitrogen are given in Tables 1, 2, 3, 4, and 5, respectively. Averages of each treatment within varieties are given, since the differences due to interactions were not significant. Table 6 shows the percentage change in grain yield and its various components due to application of CCC and nitrogen.

In both varieties, there was an apparent increase in total grain yield due to application of nitrogen (Table 1). Compared with 40 kg N/ha, the addition of 80 and 120 kg N/ha significantly increased the grain yield of 'sidi misri 1' by 44% and 23%, respectively (Table 6). With 'florencia aurora', the only significant increase in grain yield due to nitrogen was 24% at 80 kg N/ha. The grain yield of 'sidi misri 1' was increased by 14% and 21% due to application of CCC at the rate of 2.5 and 6.0 kg a.i./ha. The increase in yield with the higher CCC level (6.0 kg a.i./ha) was significant. Whereas, there was a little or no response in yield of 'florencia aurora' to CCC treatments. No lodging was observed in the untreated and treated plants of 'florencia aurora'. Previously it was reported that the short-straw 'sidi misri 1' did not respond, in respect to plant height, to CCC treatments; while the tall-straw 'florencia aurora' was significantly shortened by CCC application (5).

Although there was some increase in number of tillers of both varieties with nitrogen and CCC treatments, the differences were not significant (Tables 2 and 6). However, it is obvious that the data on number of tillers is highly variable with increases ranging from 4 to 13.6%.

There was a highly significant increase in the number of grains/spike of 'sidi misri 1' of 14.3% and 8% at the rate of 80 kg and 120 kg N/ha, respectively (Tables 3 and 6). On the other hand, the only significant increase in the number of grains/spike of 'florencia aurora' was 8% with 120 kg N/ha. Cycocel application at the rate of 2.5 and 6.0 kg a.i./ha significantly increased the number of grains/spike of 'sidi misri 1' by 10% and 6% respectively. No effect of CCC treatments was found on number of grains/spike of 'florencia aurora'.

Table 1 Effect of cycocel and nitrogen levels on grain yield (tons/ha.)¹

Variety	sidi misri '1'				florencia aurora			
	0.0	2.5	6.0	Average	0.0	2.5	6.0	Average
CCC a.i. kg/ha								
kg N/ha.								
40	2.281	2.268	2.744	2.431	2.268	2.660	2.143	2.357
80	3.286	3.665	3.586	3.512 ³	3.036	2.873	2.887	2.932 ²
120	2.932	2.790	3.248	2.990 ²	2.360	2.527	2.627	2.505
Average	2.633	2.907	3.193 ²		2.555	2.687	2.552	

¹ Foliar spray was done when plants were 20 cm high.

² Significant.

³ Highly significant (LSD at 5% = 0.423 tons/ha)
(LSD at 1% = 0.564 tons/ha)

Table 2 Effect of cycocel and nitrogen levels on number of tillers¹ (average of 10 plants).

Variety		sidi misri '1'				florencia aurora		
CCC a.i. kg/ha	0.0	2.5	6.0	Average	0.0	2.5	6.0	Average
kg N/ha								
40	2.0	2.4	2.1	2.2	2.3	2.5	2.7	2.5
80	2.1	2.7	2.6	2.5	2.3	3.1	2.4	2.6
120	2.4	2.1	2.4	2.3	2.5	2.5	2.9	2.6
Average	2.2	2.4	2.4		2.4	2.7	2.7	

¹ Foliar spray was done when plants were 20 cm high. LSD at 5% for averages of treatments within varieties = 0.5 tiller.

Table 3 Effect of cycocel and nitrogen levels on number of grains/spike¹ (average of 10 spikes).

Variety		sidi misri '1'			florencia aurora			
CCC a.i. kg/ha	0.0	2.5	6.0	Average	0.0	2.5	6.0	Average
kg N/ha								
40	45	52	51	49	35	39	37	37
80	54	56	57	56 ²	38	40	36	38
120	51	57	51	53 ²	40	39	42	40 ²
Average	50	55 ²	53 ²		38	39	38	

¹ Foliar spray was done when plants were 20 cm high.

² Highly significant (LSD 1% = 3 grains/spike)

Table 4 Effect of cycocel and nitrogen levels on weight of grains spike, (g)¹ (average of 10 spikes)

Variety		sidi misri '1'				florencia aurora			
CCC a.i. kg/ha	0.0	2.5	6.0	Average	0.0	2.5	6.0	Average	
kg N/ha									
40	2.08	2.11	2.15	2.11	1.87	1.86	1.92	1.88	
80	2.27	2.27	2.28	2.27	1.98	2.03	1.91	1.97	
120	2.14	2.34	2.12	2.20	2.11	2.01	2.15	2.09	
Average	2.16	2.24	2.20		1.99	1.97	1.99		

¹ Foliar spray was done when plants were 20 cm high. LSD at 5% for averages of treatments within varieties = 0.26 g/spike.

Table 5 Effect of cycocel and nitrogen levels on weight of 1,000 grains (g)¹

Variety		sidi misri '1'			florencia aurora			
CCC a.i. kg/ha	0.0	2.5	6.0	Average	0.0	2.5	6.0	Average
kg N/ha								
40	47.26	40.47	42.16	43.30	53.22	49.08	52.57	51.62
80	41.75	40.88	39.85	40.83 ²	52.72	50.78	52.64	52.50
120	43.72	40.98	42.91	42.54	52.52	52.27	51.87	52.22
Average	44.24	40.77 ²	41.64 ²		52.82	50.71 ²	52.36	

¹ Foliar spray was done when plants were 20 cm high.

² Highly significant (LSD at 1% = 1.232 g).

Table 6 % Changes in grain yield, number of tillers, number of grains/spike, wt. of grains/spike and wt. of 1,000 grains, due to application of nitrogen and cycocel levels.

Treatments Compared	sidi misri '1'					florence aurora				
	Grain Yield	Number of tillers	Number of grains per spike	wt. of grains per spike	wt. of 1,000 g.	Grain yield	Number of tillers	Number of grains per spike	wt. of grains per spike	wt. of 1,000 grains
$\frac{(80-40)\text{kg N/ha}}{40 \text{ kg N/ha}} \times 100$	+44%	+13.6%	+14.3%	+7.6%	-5.7%	+24%	+4%	+2.7%	+4.8	+1.7%
	HS	NS	HS	NS	HS	S	NS	NS	NS	NS
$\frac{(120-40) \text{ kg N/ha}}{40 \text{ kg N/ha}} \times 100$	+23%	+4.5%	+8%	+4.2%	-1.7%	+6%	+4%	+8%	+11.1%	+1%
	S	NS	HS	NS	NS	NS	NS	S	NS	NS
$\frac{2.5 \text{ kg CCC-Untreated}}{\text{untreated}} \times 100$	+14%	+9%	+10%	+3.7%	-7.8%	+5%	+12.5%	+2.6%	-1%	-4%
	NS	NS	HS	NS	HS	NS	NS	NS	NS	HS
$\frac{6.0 \text{ kg CCC-Untreated}}{\text{untreated}} \times 100$	+21%	+9%	+6%	+1.9%	-5.8%	0.0%	+12.5%	0.0%	0.0%	-0.8%
	S	NS	HS	NS	HS		NS			NS

S = Significant at 5%:

NS = Non significant

+ = increase

- = decrease

HS = Significant at 1%

In both varieties, there was a small and not significant response in the weight of grains/spike due to nitrogen and CCC application (Tables 4 and 6).

Grain size as estimated by the weight of 1,000 grains was found to be significantly decreased in 'sidi misri 1' by 5.7% at the rate of 80 kg N/ha. At a higher rate of nitrogen, a noticeable, but not significant, decrease in grain size was observed (Tables 5 and 6). Conversely, grain size of 'florencia aurora' was slightly increased (differences were not significant) by nitrogen application. Cycocel treatments with 2.5 and 6.0 kg a.i./ha significantly decreased the grain size of 'sidi misri 1' by 7.8% and 5.8%, respectively. Grain size of 'florencia aurora' was significantly decreased by 4% only at 2.5 kg a.i. CCC/ha. No effect was observed at the higher rate of CCC.

From this experiment, it appears that the short-straw 'sidi misri 1' showed a greater response to both nitrogen and CCC application in respect to grain yield, number of grains/spike and the size of grain than the tall-straw 'florencia aurora'. Apparently, the increase in grain yield of 'sidi misri 1' was associated with increase in the number of grains/spike, and a decrease in grain size. It seems that the number of grains/spike and the size of grains of 'sidi misri 1' are the most responsive yield components to both nitrogen and CCC application. Most of the increase in grain yield, could be attributed to the increase in number of grains/spikes. At the same time, the increase in the number of grains/spike resulted in a significant decrease in grain size which negatively affected the total grain yield. Taking this into consideration, one might suggest that the slight increase in the number of tillers, although not significant, could account in part for increases in grain yield due to nitrogen and CCC treatments.

Since lodging was absent in both untreated and treated plants, the unchanged grain yield of the tall-straw 'florencia aurora' may indicate that CCC application has no direct effect on the yield of this variety. Conversely, the grain yield of the short-straw 'sidi misri 1' is directly affected by CCC in absence of lodging. From this study and previous work (5) it appears that the effect of CCC on tall-straw wheat such as 'florencia aurora' is only morphological through shortening the stem; whereas in the case of short-straw wheat such as 'sidi misri 1' CCC might improve the photosynthetic capability of the foliage (4).

SUMMARY

The effect of nitrogen level at the rate of 40, 80, and 120 kg N/ha and the foliar spray of the growth retardant CCC at the rate of 0.0, 2.5 and 6.0 kg a.i./ha on grain yield and its components were studied using the short-straw variety 'sidi misri 1' and the tall-straw variety 'florencia aurora'. Nitrogen application at 80 and 120 kg N/ha significantly increased grain yield (44 and 23%) and number of grains per spike (14.3 and 8%) of 'sidi misri 1'. Grain size was significantly decreased (5.7%) only with 80 kg N/ha. Slight, but not significant, increase of number of tillers and weight of grains/spike was found due to nitrogen application. Cycocel application at the rate of 2.5 and 6.0 kg a.i./ha increased grain yield of 'sidi misri 1' by 14% and 21%, respectively. Number of grains/spike was significantly increased (10% and 6%) by CCC treatments; whereas grain size was significantly decreased (7.8% and 5.8%). Number of tillers and weight of grains/spike were slightly increased by CCC treatments.

With the tall-straw variety 'florencia aurora', no significant increase in grain yield due to nitrogen and CCC treatments was observed except at 80 kg N/ha (there was 24% increase). The number of tillers, the number of grains/spike, weight of grains/spike and the grain size were not significantly affected by nitrogen application with the only excep-

tion of 8% significant increase in number of grains/spike at 120 kg N/ha. No significant response to CCC treatments was observed in regard to grain yield, number of tillers, number of grains/spike, weight of grains/spike and size of grain. Only at 2.5 a.i. CCC/ha the grain size of 'florencia aurora' was significantly reduced by 4%.

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