Response of Wheat to Cycocel Application

I. Effects of nitrogen level and CCC concentration on plant height of dwarf and tall wheat.

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INTRODUCTION

In the Libyan Arab Republic (L.A.R.) wheat is the most important cereal crop. The total annual production of wheat in L.A.R. is considerably less than the total annual consumption. Therefore, it appears very important to draw attention towards improvement of total production as well as the yield of the wheat crop. The present investigation was undertaken to study the effect of foliar application of the growth regulant 'CYCOCYL' (2-Cholorethyltrimethyl ammonium chloride), 'CCC' on the growth and yield of two different wheat varieties as well as on their response to different levels of nitrogen fertilizer under the climatic and soil conditions of L.A.R.

Since its discovery by Tolbert in 1960, Cycocel has received the attention of most agriculturists around the world. There are many published reports describing the chemical structure and properties of CCC, its effect on the growth of agronomical and horticultural crops. The compound was originally designated as a growth retardant because of its observed effects in shortening plant internodes; however, many other plant responses to the compound have been reported (5).

Cycocel is a water-soluble crystalline solid. It can be formulated as an aqueous spray. Its low toxicity to mammals, chemical stability, and lack of toxic residues in either plants or animals should stimulate its acceptance in the area of plant production.

The primary effect of Cycocel on wheat and many other cereal grains is to shorten and strengthen the *culms* of the treated plants. The shortening and strengthening of the plants reduces their lodging; therefore the losses in grain yield are reduced consequently.

Most wheat varieties, winter as well as spring wheats, are susceptible to lodging. The degree of lodging depends on the inherent characteristics of the variety and on the soil and climatic factors under which a particular variety is grown. Short and stiff-strawed varieties are less subject to lodging than tall soft-strawed varieties. Environmental factors such as wind, cloud, rainfall, structure, texture and water content of soil may directly or

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indirectly affect the tendency of wheat varieties to lodging (5). Under severe and adverse environmental conditions, most wheat varieties, even though they are short and stiff-strawed, are highly susceptible to lodging. Losses in grain yield due to lodging have been estimated to be up to 30–50% for different varieties grown under various conditions around the world (8). Investigators from many countries reported that lodging in wheat can be reduced or prevented by treatment with CCC. Caldicott and Lindley (4) reported that grain yields increased with CCC treatment when wheat was grown under conditions favourable to lodging in the United Kingdom. During wet seasons, an increase of grain yield of 82% due to treatment with CCC was observed in Australia by Primost (10). Many investigators have reported that CCC increased resistance to lodging and consequently increased grain yields. Adler (2) found that CCC increased yields by up to 60%, depending on the variety. Bockmann (3) reported increases in wheat yield of up to 1,100kg/ha when lodging was reduced due to treatment with CCC. In Italy, Lovato (9) studied the effect of CCC as a seed dressing or as a spray and found that both treatments reduced lodging, and increased yields by 11–23% over the control.

When lodging is of no significance, treatment with CCC may or may not increase the yield. Recently, Humphries et al. (6) found that when lodging was absent, the increase in yield of grain by CCC treatment was only 5%.

Heavy applications of nitrogenous fertilizers, which is recommended in order to produce a high yield of grain, can result in excessive vegetative growth and consequently in lodging. Several workers (8) reported that when nitrogen was applied at relatively high rates and under conditions favourable for lodging, plants treated with CCC lodged less than did the untreated plants. Adler (1) reported that nitrogen with CCC had little effect on the yield of 15 wheat varieties. Other investigators (8) were able to raise the rate of nitrogen in the presence of CCC and they obtained an increase in grain yield and grain quality. Rixhon and Crohain (11) found that treatment with CCC and a high rate of nitrogen increased the yield of winter wheat by 20% and spring wheat by 7.5%.

MATERIALS AND METHODS

The material used in this investigation consists of two wheat varieties, Florence aurora and Sidi Misri '1' (A selection from Mexican wheat).

Florence aurora is an awnless, tall-straw variety which has been grown in Libya on a large scale for more than thirty years. Sidi Misri '1' is a short straw variety, developed by pure line selection at the Ministry of Agriculture Experimental Station, Sidi Misri, Tripoli, Libya. Seeds of Sidi Misri '1' have recently been increased on a large scale for later distribution to the local farmers. Seeds of both varieties were obtained from pure stocks kept at the Ministry of Agriculture.

The experiment was carried out at the Faculty of Agriculture Experimental Station, Sidi Misri, Tripoli. The experiment consisted of a $2 \times 3 \times 3$ factorial trial with four replications, which included two wheat varieties, 'three' cycocel (CCC) treatment levels, namely 0.0, 6.25, and 15.0 l/ha CCC, and three nitrogen fertilizer treatment levels at the rate of 40, 80 and 120 kg/N/ha. A 40% formulation obtained from Cynamide International was used giving 2.5 and 6.0 kg/ha of CCC, respectively. A complete randomized block design was used in which the individual plots were 1×4.5 m in size.

The soil was treated with a pre-planting fungicide for the control of soil borne diseases. Seeding rate was 122 kg/ha for Florence aurora, and 94 kg/ha for Sidi Misri '1'. The

Table 1 Effect of CCC spray and nitrogen fertilizer on wheat plant height (cm); 34 days after treatment.[1]

Varieties	Sidi Misri '1'			Florence Aurora		
CCC a.i. (Kg/ha)	0	2.5	6.0	0	2.5	6.0
Nitrogen level (kg/N/ha)						
40	24	21	21	40	30	29
80	26	24	27	38	32	30
120	24	30	25	41	28	35

[1] Foliar spray was done when plants were 20 cm high. Least significant difference at 5% = 5 cm.

Table 2 Analysis of variance of stem height

Source of V	DF	SS	MS	F	P
Block	3	1.68401E + 02	5.61336E + 01	4.53674E − 00	7.00073E − 03[2]
Treatments	17	2.43880E + 03	1.43459E + 02	1.55944E + 01	9.60490E − 08[2]
Varieties	1	1.44274E + 03	1.44274E + 03	1.16602E + 02	3.96381E − 08[2]
Cycocel	2	3.37304E + 02	1.68652E + 02	1.36305E − 01	7.98637E − 05[2]
Fertilizer	2	1.07087E + 02	5.35435E + 01	4.79740E − 00	1.79761E − 02[1]
VXC	2	2.89741E + 02	1.44870E + 02	1.17084E + 01	1.80217E − 04[2]
VXF	2	2.60560E + 01	1.30280E + 01	1.05292E − 00	3.57502E − 01
CXF	4	4.32170E + 01	1.08042E + 01	1.14520E − 00	5.11584E − 01
CXEXV	4	1.92661E + 02	4.81651E + 01	3.89273E − 00	7.96650E − 03[2]
Error	51	6.31029E + 02	1.23731E + 01		
Total	71	3.23823E + 03			

[1] Significant
[2] Highly significant V = Variety, F = Fertilizer, C = CCC.

Table 3 Duncan-s multiple range test

TR.	Mean	Statistical Significans	R005	R001	Statistical Significans	Mean
$C_5N_1V_1$	21.06	I	4.99	6.66	I	21.06
$C_2N_1V_1$	21.09	I	5.25	6.94	I	21.09
$C_2N_2V_1$	23.51	I I	5.43	7.14	I I	23.51
$C_1N_3V_1$	24.30	I I I	5.54	7.28	I I	24.30
$C_1N_1V_1$	24.50	I I I	5.64	7.38	I I	24.36
$C_3N_2V_1$	24.50	I I I	5.71	7.49	I I	24.50
$C_1N_1V_1$	26.10	I I I	5.78	7.56	I I I	26.10
$C_3N_2V_1$	27.20	I I I	5.83	7.63	I I I I	27.20
$C_2N_3V_2$	28.36	I I I	5.87	7.68	I I I I	28.36
$C_3N_1V_2$	28.77	I I I	5.90	7.72	I I I	28.77
$C_2N_3V_1$	29.85	I I I	5.94	7.77	I I I	29.85
$C_2N_1V_2$	29.97	I I I	5.97	7.80	I I I	29.97
$C_3N_2V_2$	30.14	I I I	5.99	7.48	I I I	30.14
$C_2N_2V_2$	32.35	I I	6.01	7.87	I I I	32.35
$C_3N_3V_2$	34.51	I I	6.03	7.91	I I I	34.51
$C_1N_2V_2$	37.93	I I	6.05	7.94	I I I	37.93
$C_1N_1V_2$	39.67	I	6.05	7.94	I	39.67
$C_6N_3V_2$	40.85	I			I	40.85

C_1 = 0 kg/ha N_1 = 40 kg/ha V_1 = Sidi Misri 1
C_2 = 2.5 kg/ha N_2 = 80 kg/ha V_2 = Florence aurora
C_3 = 6.0 kg/ha N_3 = 120 kg/ha TR. = Treatment

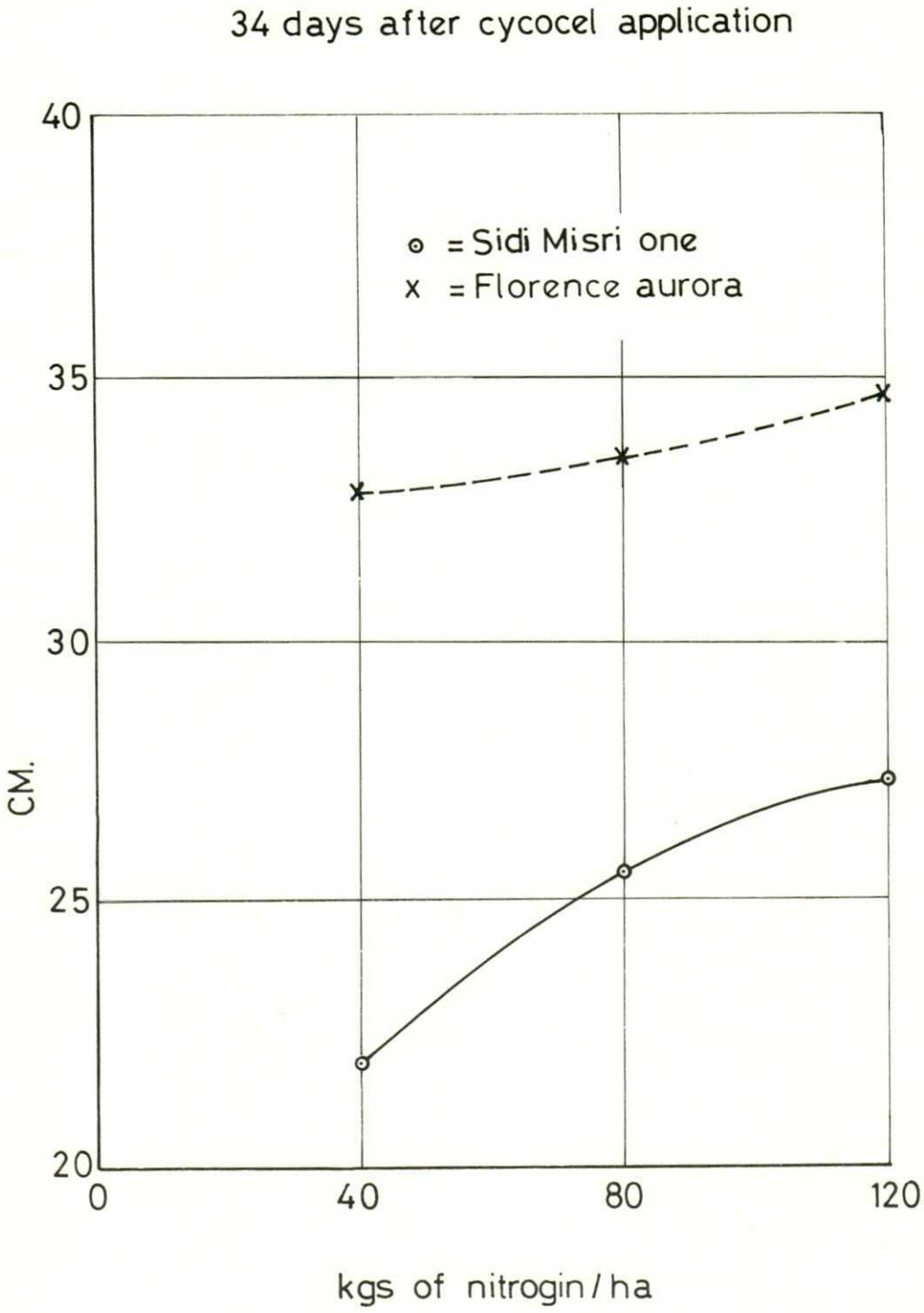

Fig. 1. Effect of nitrogen level on stem height of two wheat varieties sprayed with CCC.

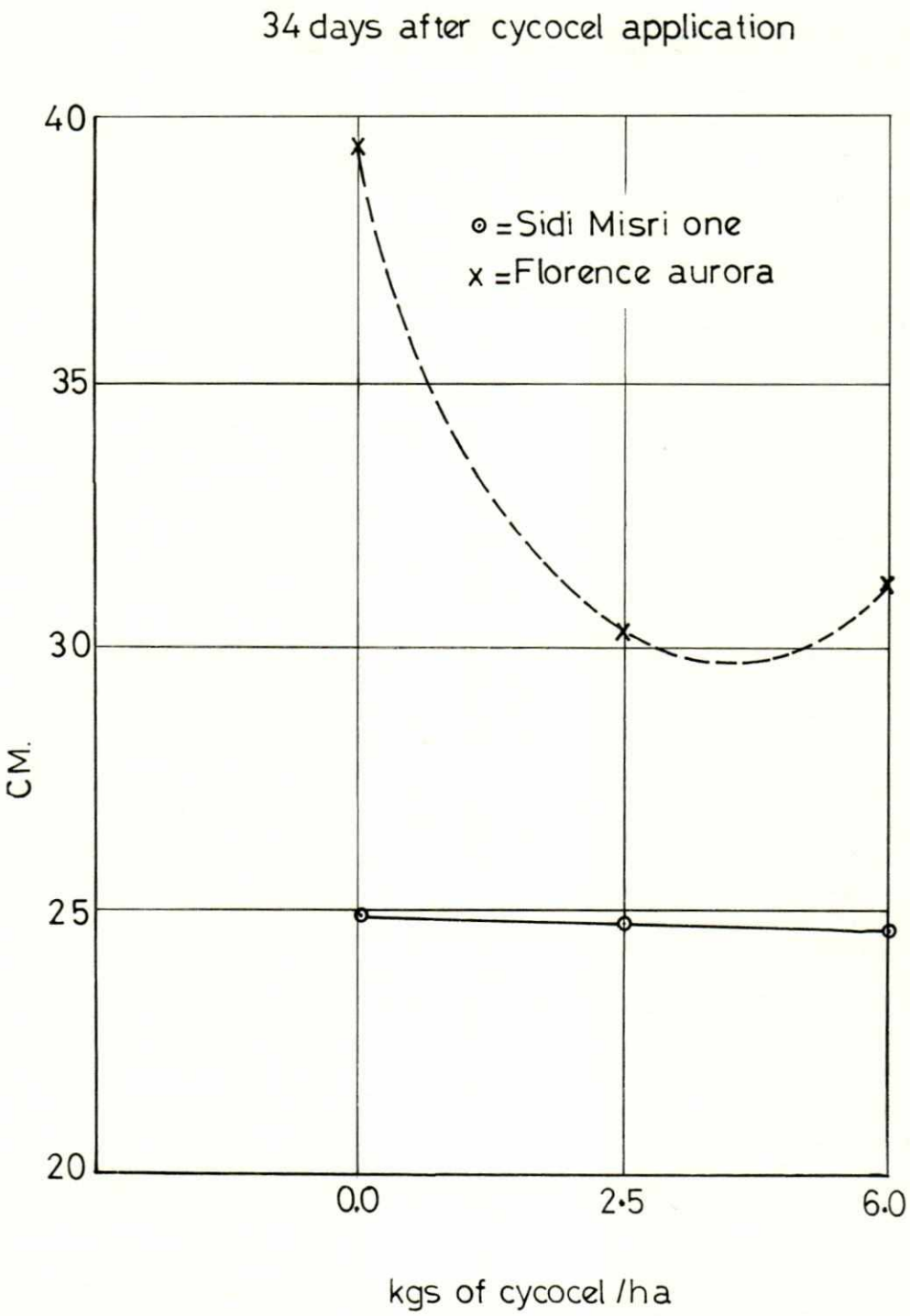

Fig. 2. Effect of cycocel on stem height of two varieties of wheat

seeds were hand drilled in lines 20 cm apart with a total of five lines/plot. The four replicates were planted on the 12th and 13th of November 1970. Later, after the establishment of seedlings, a few plots required transplanting due to loss of seeds by birds.

All plots received 40 kg/of N/ha 47 days after planting and the second and third levels of N at the rate of 80–120 kg of N/ha were applied 69 days after planting. Plants were sprayed with benlate and difolitan for the control of downey mildew.

Cycocel application as a foliar spray was done on 19th January, 1971, when the plants were about 20 cm high. An automatic sprayer with a constant pressure valve was used for the CCC spraying. Water requirements were applied by natural rainfall supplemented with infrequent irrigation.

RESULTS AND DISCUSSION

The effects of CCC and nitrogen fertilizer on plant height are outlined in Table 1. Analysis of variance and Duncan's multiple range test for the result are shown in Tables 2 and 3 respectively. Statistically, there were significant differences in the plant height due to varieties, cycocel and nitrogen fertilizer.

The level of nitrogen fertilizer slightly affected plant height of both varieties. As an average of all cycocel concentrations, Sidi Misri '1' variety showed a significant increase of 5 cm in plant height by increasing the nitrogen level from 40 to 120 kg/ha (Fig.1).

On the other hand there was no significant effect on plant height after nitrogen application with the variety 'Florence aurora'.

Figure 2 shows the effect of cycocel concentration on stem height as an average of all nitrogen levels. As indicated in Table 1 and Fig. 2 foliar application of cycocel up to 6.0 kg/ha a.i. did not affect the height of the variety Sidi Misri '1'. Such a response could be due to the genetic make-up of this variety since it is a local selection from the original dwarf mexican wheat.

On the other hand, there was a pronounced stem shortening due to cycocel application with variety Florence aurora. An average reduction in stem height of 10 and 9 cm was observed at 2.5 and 6.0 kg/ha a.i. respectively. This reduction in stem height corresponds to about 25% of the non-treated plants. Since Florence aurora is a tall variety and is subject to lodging the application of cycocel at a rate of 2.5 kg/ha a.i. may effectively shorten the stem and reduce its tendency to lodging.

The significant variety × cycocel interaction (Table 2) could be attributed to the differential response of the two varieties to cycocel treatment. Sidi Misri '1' as a dwarf variety selection from the short mexican wheat didn't respond to cycocel treatments. This difference in response to cycocel between the two varieties could be due to genetic factors.

The significant variety × cycocel × nitrogen interaction (Table 2) indicates that the differential response of the two wheat varieties to a given concentration of cycocel is not constant at different levels of nitrogen fertilizer. In general the reduction in plant height was more pronounced at a lower nitrogen level in the case of the Florence aurora variety.

SUMMARY

The effect of nitrogen fertilizer at the rate of 40, 80 and 120 kg/ha and the foliar spray of the growth retardant, cycocel, at a rate of 0, 2.5, 6.0 kg/ha a.i. on the plant height was studied using the dwarf variety Sidi Misri '1' and the tall variety Florence aurora; CCC strongly reduced plant height of the Florence aurora variety with an average reduction of 10 and 9 cm at 2.5 and 6.0 kg/ha a.i. respectively, whereas Sidi Misri '1' did not respond to CCC application even at the highest concentration used.

Nitrogen application significantly increased stem height of Sidi Misri '1' while Florence aurora was not affected. Also there were significant variety × cycocel and variety × cycocel × nitrogen interactions.

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