Vol. XII (3—4), 1975

THE ROLE OF CYCOCEL IN INDUCING DROUGHT AND SALT TOLERANCE IN WHEAT.

Inam-ul-Haq, M. Latif Khan Niazi and Shah Muhammad*

Cycocel seed treatment and spray of the plant were almost similar in their effects. Some beneficial effects of these treatments were observed in inducing drought resistance and salt tolerance in wheat Mexipak-65. The ultimate measuring rod was the grain yield which increased only nominally. Cycocel seemed to be of little practical importance in inducing drought and salt tolerance in wheat Mexipak-65.

INTRODUCTION

The agriculture in West Pakistan is faced with shortage of good quality irrigation water and the twin menace of water logging and salinity. As a consequence of these problems, crop yields have been adversely affected. Any treatment which may induce drought resistances and/or salt tolerance in crop is highly desirable. It has been claimed by many foreign research workers that cycocel "a plant growth regulant" which is chemically known as 2–chloroethyl-trimethyl-ammonium chloride and addreviated as "CCC" induces drought and salt tolerance in a wide range of plant species.

Miyamoto (1962) reported that cycocel treated wheat seeds built up the salt tolerance to some extent. Ota (1963) in presowing experiments found that cycocel and some other growth retardants had increased drought resistance and salt tolerance in wheat plant. El - Damaty *et al* (1964) reported that cycocel treated wheat plants showed less damage after exposure to saline solutions regardless of concentrations. Halevy and Kessler (1963), Plaut & Halevy (1966) and Humphries *etal* (1967) reported some beneficial effects of cycocel in inducing drought resistance in plants.

The purpose of present study was also to learn whether cycocel treated wheat plants could withstand more moisture stress and higher concentration of salts in the soil than untreated ones.

MATERIALS AND METHODS

A pot culture experiment was conducted with soil collected from square No. 16, Block No. 20 of Agronomy Research Area of the University Farm. Twenty Five lbs. of air dried, sieved and thoroughly mixed soil were taken in each glazed pot with dimensions of 10½" X 10½" (height x diamenter), each. The textural class of the soil was sandy loam, (clay = 9.2%), EC_e = 4.75 mmhos/cm and the pH was 7.70.

*Department of Soil Science, University of Agriculture, Lyallpur

The original salt contents were taken as S_1 (5 mmhos/cm) and two more salinity levels of 10 and 15 mmhos cm (S_2 & S_3) were produced by adding a mixture of NaCl, Na_2SO_4, $CaCl_2$, $NaHCO_3$ and $MgSO_4$ $7H_2O$ in the ratio of 8:7:2:2:1. The salts were mixed into the soil and irrigated and when the soil attained about "Wattar" condition, 20 wheat seeds (Mexi-Pak-65) were sown in each pot. After one month of seeding, only 5 plants were kept in each pot.

Four irrigation levels of 15 (I_4), 20 (I_3), 25 (I_2) and 30 (I_1) days intervals and four cycocel treatments comprising control, (C_1), water spray (C_2), seed soaking in 0.5% cycocel solution for 14 hours at 25°C, (C_3) and 0.25% cycocel spray (C_4), were included in the investigation. Water and cycocel solution were sprayed twice with an interval of one month from sowing till earing. Plants were wetted using 10 and 20 ml/pot of each spraying material in first and second spray respectively. Various observations were recorded during the growth, and after the crop harvest. Grain and straw were analysed for moisture, ash, N, P and K. A basal dose of 120 lbs. of nitrogen and 75 lbs. of P_2O_5 per 2 millions lbs of soil were applied. TSP was mixed with the soil before sowing and urea was applied with first irrigation.

Moisture was determined by oven drying at 130°C for one hour to a constant weight (A.O. A.C., 1950). Ash was made by dry ashing method (Piper, 1950). Nitrogen was estimated by sulphuric acid digestion and Micro-Kjeldahl's distillation method (Jackson, 1958). Extract for phosphorus and potassium was made according to method 54a of U.S.D.A. Handbook No. 60. Phosphorus was estimated by EEL Colorimeter (Olson *et al* 1954) and Potassium by EEL Flame Photometer (Method 11a, U.S.D.A. Handbook No. 60).

RESULTS AND DISCUSSION

A. Effect of Cycocel on Plant Growth Characteristics

Cycocel seed treatment and cycocel spray of the plant affected the following characteristics (Table 1).

TABLE 1. *Effect of cycocel treatments on various plant characterics (Average of 4 repeats).*

Treatment	Height (cm)	Total tillers per pot	Mature tillers per pot	Days for		Grains per pot	Yield g/pot		Grain to straw ratio
				Earing	Maturing		Straw	Grain	
C_1	36.37a	16.7b	7.0	85.4b	115.8c	186b	16.2b	5.6	0.33a
C_2	37.29a	16.7b	7.2	86.0b	116.5c	189b	16.5b	5.7	0.33a
C_3	33.18b	19.8a	7.2	88.1a	118.7b	201a	17.5a	5.9	0.32b
C_4	31.88c	20.7a	7.1	88.8a	120.5a	201a	17.8a	5.9	0.31b

Average values followed by the same letter (s) did not differ statistically (P=0.05) among themselves.

a) Significantly reduced the plant height. On an average, the height was reduced from 36.37 cm at control to 33.18 and 31.88 cm with seed and spray treatment, the reductions being 9 and 12% respectively. An increase of 24.27% over control was observed in total tillers' count and 7 to 10% in straw yield. Number of grains/pot was considerably increased with both treatments. The values recorded were 186 for control, 201 for both seed treatment and spray of the plant

b) Mature tillers and grain yield were not appreciably affected, however an increase of 5% in grain yield was noted over control. An appreciable increase in grain yield was to be expected on account of significant increase in total tillers and grain population, but due to lack of effects on ear bearing tillers and lesser grain weight under these treatments, cycocel failed to induce marked effects on grain yield.

c) Delay in earing by 3 days and in maturity by 3 to 5 days was noticed.

d) Grain/straw ratio was lowered significantly, on account of considerable increase in straw yield without appreciable effect on grain yield.

Water spray did not affect the foregoing characteristics significantly, however, it had some beneficial effects at low irrigation levels.

B. Cycocel and Chemical Composition :

Cycocel treatment did not show any marked effect on moisture and ash contents of the plant material (Table 2). Nitrogen, phosphorus and potassium concentrations in grain remained un-affected, whereas in straw, as a result of "growth dilution effect" the concentrations of these nutrients were lowered significantly (Tables 2 and 3). Total uptake of N, P_2O_5 and K_20 was markedly increased on account of significant increase in straw yield and slight increase in grain yield.

TABLE 2. *Cycocel treatment means with respect to various chemical determinations*

Treatment	Moisture % age		Ash % age		Nitrogen% age		Nitrogen Uptake
	Straw	Grain	Straw	Grain	Straw	Grain	(mg/pot)
C_1	5.78	6.42	9.05	1.46	0.53 a	1.96	189.2 b
C_2	5.79	6.41	9.07	1.46	0.53 a	1.95	190.5 b
C_3	5.77	6.41	9.03	1.45	0.50 b	1.96	199.4 a
C_4	5.78	6.40	9.05	1.44	0.49 b	1.95	197.7 a

Average values followed by the same letter(s) did not differ statistically (P = 0.05) among themselves

TABLE 3. *Cycocel treatment means with respect to various chemical determinations*

Treatment	Phosphorus % age		P_2O_5 uptake	Potassium % age		K_20 Uptake
	Straw	Grain	mg/pot	Straw	Grain	mg/pot
C_1	0.0405 a	0.245	20.4 b	0.926 a	0.314	169 b
C_2	0.0401 a	0 244	20.6 b	0.925 a	0.313	17. b
C_3	0.0386 b	0.243	21.4 a	0 921 b	0.313	181 a
C_4	0.0383 b	0.244	21.4 a	0.920 b	0.313	182 a

Average values followed by the same letter(s) did not differ statistically (P = 0.05) among themselves

C. Cycocel - Irrigation Interaction

From the results obtained during this investigation, it was concluded that cycocel seed treatment and spray of the plant were similar in their effects (Table 4). Both of these treatments reduced the adverse effects of moisture stress to some extent. Similar views were expressed by Halevy and Kessler (1963), Plaut and Halevy (1966) and Humpries *et al* (1967). Total tillers were increased at all levels of irrigation. Number of grains were favourably affected only at low levels. Straw yield was increased under low irrigation treatments, whereas at high levels, no appreciable effect was observed, and the agrain yield seemed to be un-affected.

TABLE 4. *Cycocel treatment means with respect to various plant characteristics under different Irrigation levels.*

Treatment	Total tillers/pot	Grains per pot	Yield g/pot	
			Straw	Grain
C_1I_1	10.1 h	123.00 g	8.3 f	2.5 d
C_2I_1	10.8 gh	128.00 fg	8.8 f	2.6 d
C_3I_1	14.6 de	141.70 e	10.2 e	2.7 d
C_4I_1	15.7 de	141.30 ef	10.6 e	2.8 d
C_1I_2	12.7 fg	150.20 e	10.4 e	3.7 c
C_2I_2	13.0 efg	155.00 e	11.0 de	3.9 c
C_3I_2	16.9 e	172.80 d	12.7 cd	4.1 c
C_4I_2	16.9 d	173.30 d	13.2 c	4.2 c
C_1I_3	20.8 c	226.70 c	21.9 b	7.6 b
C_2I_3	21.0 c	228.0 bc	22.1 b	7.6 b
C_3I_3	22.1 bc	241.7 ab	22.5 b	7.8 b
C_4I_3	24.8 ab	240.0 abc	22.7 b	7.7 b
C_1I_4	22.8 bc	241.6 ab	24.2 a	8.7 a
C_1I_4	22.7 bc	243.8 ab	24.3 a	8.8 a
C_3I_4	25.7 a	247.0 a	24.7 a	8.9 a
C_4I_4	26.2 a	248.2 a	24.6 a	8.9 a
S E.	0.924	4.6	0.444	0.18

Average values followed by the same letter(s) did not differ statistically (P = 0.05) among themselves.

D. Cycocel - Salinity Interaction.

At all levels of salinity, cycocel treatments considerably increased the the total number of tillers, number of grains and straw yield (Table 5). An appreciable increase in grain yield was to be expected on account of marked effects on two important yield components i.e. total tillers and grain population, but on account of lack of effects on ear bearing tillers and lesser grain weight, grain yield was not affected. However, increased tillering, number of grains per pot and straw yield indicated that cycocel treatments had some effects for the better plant growth at all salinity levels, regardless of concentrations. Results arrived at are in agreement with those of Miyamoto (1962), Ota (1963) and El-Damaty *et al* (1964). They also reported some beneficial effect of cycocel treatments in building up salt tolerance in crop plants.

TABLE 5. *Cycocel treatment means with respect to various plant characteristics under different salinity leaves.*

Treatment	Total tillers/ pot	Mature tillers/ pot	Grains per pot	Yield g/pot	
				Straw	Grain
C_1S_1	20.4 b	8.3 a	228.8 b	20.4 c	7.60 a
C_2S_1	20.9 b	8.5 a	233.1 b	20.8 c	7.69 a
C_3S_1	24.1 a	8.5 a	247.6 c	21.6 b	7.90 a
C_4S_1	24.5 a	8.2 a	243.0 a	22.0 a	7.90 a
C_1S_2	16.2 de	6.9 b	177.5 d	15.8 e	5.25 b
C_2S_2	15.8 e	7 1 b	179.0 d	16.1 c	5.41 b
C_3S_2	18.3 cd	7.3 b	182.1 c	17.4 d	5.60 b
C_4S_2	19.8 c	7.2 b	194.4 c	17.5 d	5.60 b
C_1S_3	13.1 f	5.6 c	151.0 f	12.3 g	3.88 c
C_2S_3	13.9 ef	5.9 c	155.2 f	12.7 g	3.95 c
C_3S_3	17.1 d	5.9 c	165.6 c	13.5 f	4.11 c
C_4S_3	17.60 cd	5.9 c	164.8 e	13.7 f	4.12 c
S.E.	0.80	0.22	4.0	0.156	0.39

Average values followed by the same letter(s) did not differ statistically (P=0.05) among themselves.

LITERATURE CITED

A.O.A.C. 1950. Official and tentative methods of analysis of the Association of Official Agricultural Chemists. Ed. 8.,Wash. D.C.

El-Damaty, H. Kuhn and H. Linser. 1964. A preliminary investigation of increasing salt tolerance of plants by application of 2-chloroethyl-trimethyl-ammonium-chloride. Agrochimica 8: 129–138. (Cycocel "Plant Growth Regulant" Pub. by Cyanamid Co. p 26).

Halevy, A.H. and B. Kessler. 1963. Increased tolerance of bean plants to soil drought by means of growth retarding substances. Nature 197:310-311.

Humphries, E.C., P.J. Welbank and E.D. Williams. 1967. Intraction of cycocel and water deficit on wheat yield. Nature 215: 782.

Jackson, M.L. 1958. "Soil Chemical Analysis" Prentic-Hall, Inc. Englewood Cliffs, N.J., U.S.A.

Miyamoto, T. 1962. Antagonistic effect of urea & cycocel on the resistance to high salt concentration in wheat seedlings. Nature 196: 491-92.

Olsen, S. R., C. V. Cole, F. S, Watanabe and L. A. Dean. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U.S.D.A. Circ. No. 939, Washington D.C.

Ota, T. 1963. The effect of growth retardants on salt tolerance and drought resistance in beans. Abst. Japanese Proc. Crop Sci. Jaapan 32: 197 (F.C. Abst. 2121, 17: 11, 1964).

Piper, C.S. 1950 "Soil and plant analysis" Interscience Publishers, Inc. New Yourk.

Plaut, Z. and A.H. Halevy. 1966. Increasing the regeneration of wheat plants following wilting by treatment with two growth retarding chemicals. Naturewissenchaften 53: 509. (F.C. Abst. Rev. Article, 21: 91-96, 1968).

United States Dopartment of Agriculture 1954. "Diagnosis and Improvement of Saline and Alkali Soils. U.S.D.A. Agri. Handbook 60.