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Response of Yield and Yield Attributes of Maize to GA, CCC and B-9, in Relation to Sowing Date

Beeinflussung des Ertrages und Ertragskomponenten bei Mais durch Anwendung von GA, CCC und B-9 in Abhängigkeit von der Saatzeit

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1 Introduction

Great demand on maize in Egypt implies growing of this crop throughout summer season on both early and late planting dates. Grain yield of late planting is much less than that in early one. Abundant data on GA, CCC and B-9 effects on growth of plants including maize (Adler, et al., 1959; Cathey, 1964) indicated promising effects of these compounds on maize production. Possibilities of increasing maize grain yield under Egyptian conditions were mentioned by Nasser (1975), through spraying GA and growth retardants on maize prior to tassel initiation. Yet, application of these compounds at later stages was not effective (Pauli and Strickler, 1961; El-Hindi, et al., 1973).

The present word was conducted to study the effect of GA, CCC and B-9 on growth and yield of maize grown in late or early summer of Egypt.

2 Materials and Methods

Grains of *Zea mays, L.*, the open-pollinated "Early American" cultivar, secured from Ministry of Agriculture A.R.E. were used in a field experiment carried out over 2 suc-

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cessive seasons (1974 and 1975), at the Experimental Station, Faculty of Agriculture, Cairo University. Field practices were those normally applied for maize in Egypt.

Kernels were sown either on May 10th (early sowing) or on July 5th (late sowing) in complete randomized block design with 3 replicates/treatment, and 42 m^2/replicate. Kernels were sown in 35 cm spaced hills on 75 cm apart ridges.

The following growth regulators were applied to plants 40 days after sowing as foliar spray with the following concentrations:

1. Gibberellic acid (GA): At concentrations 25, 50 and 100 ppm, a. i., using "Berelex" 1 g GA_3 tablets, a commercial product of the Imperial Chemical Industries Ltd U.K. (ICI).
2. Chlormequat (CCC): At concentrations 100, 250 and 500 ppm, a. i., using Cycocel 40% CCC solution, a commercial product of Cyanamid International Corporation, Switzerland.
3. Alar (B-9): At concentrations 100, 250 and 500 ppm, a. i., using 85% B-9 powder, commercial product of U. S. Rubber Co., USA. Concentrations of growth regulators were prepared in aqueous solutions.

Spraying was carried out using 600 l solution/feddan. Control treatment was sprayed with water.
Data were recorded at random on 20 plants/replicate. Recording was carried out at anthesis for stem characters and leaf area. Stem and internode lengthes were measured from the basal above-ground node to the uppermost one. Number of internodes was measured as equivalent to number of leaves. The leaf area was determined according to WHALEY, et al., (1950).

Weight of 300 kernels (g), number of well developed ears/plant, apical ear grain yield (g) and total grain yield/plant (g) were determined at maturity. Grain weight at harvest was calculated at 15,5% moisture. Data of the 2 years were subjected to analysis of variance (SNEDECOR, 1961), determining the significance of comparisons by the New Least Significant Difference (New L.S.D.) according to WALLER and DUNCAN (1969).

3 Results

1. Stem length and number of internodes (tab. 1):

   At late sowing, GA and B-9 at all concentrations as well as CCC at 100 ppm increased stem length. No effect on either character could be detected at early sowing in response to GA, CCC and B-9. No effect could be detected on No. of internodes.

2. Length of internodes (tab. 2):

   Internode length responded only in late summer plants. Internode length was increased; in the basal (3rd) one with 25 – 50 ppm GA, in the intermediate (9th) one

Tab. 1: Mean length and internode number of Zea mays L. stem as influenced by GA_3, CCC and B-9.

Treatment (ppm)		Stem length (cm)		Number of internodes	
		L	E	L	E
Control	0.0	174.4	226.4	14.9	16.5
GA3	25	194.5	232.1	15.0	16.5
	50	196.0	227.1	15.2	16.6
	100	187.5	227.0	14.2	16.2
CCC	100	191.7	233.6	14.5	16.5
	250	182.1	232.7	14.8	16.5
	500	181.2	230.0	14.9	16.3
B-9	100	189.8	234.5	13.9	16.6
	250	190.7	223.3	14.4	16.5
	500	186.1	223.0	14.7	16.2
New L.S.D. : 0.05		9.3	17.0	1.1	0.8

L: Late planting; E: Early planting

Tab. 2:Mean length of different Zea mays L., stem internodes (cm), as influenced by GA_3, CCC and b-9.

Treatment (ppm)		Internodes number					
		3rd		9th		13th	
		L	E	L	E	L	E
Control	0.0	8.0	7.7	14.9	19.7	12.7	15.0
GA3	25	11.7	7.9	15.4	20.7	13.2	15.5
	50	11.3	8.0	16.9	20.3	13.9	15.0
	100	8.8	7.8	16.6	19.8	12.3	15.0
CCC	100	8.3	8.2	18.1	20.7	15.6	16.3
	250	7.8	8.0	16.8	19.9	13.1	16.6
	500	7.1	7.9	16.5	19.5	13.2	15.8
B-9	100	8.6	8.3	16.5	21.0	15.7	15.4
	250	8.1	8.0	17.3	19.6	15.9	14.9
	500	7.7	7.8	16.0	19.5	13.9	14.6
New L.S.D. : 0.05		2.2	1.2	2.3	1.9	2.8	1.7

L: Late planting, E: Early planting

with 100 and 250 ppm CCC and B-9, respectively and in the upper (13th) one with 100 ppm CCC and 100 – 250 ppm B-9.

3. Total leaf area (tab. 3):

Total leaf area was increased with 25 and 50 ppm GA; 500 ppm CCC and B-9 in late-sown plants as well as with 500 ppm CCC and 100 ppm B-9 in early-sown ones. Other treatments had no effect.

Tab. 3: Total leaf area of Zea mays L./Plant as affected by GA_3, CCC and B-9.

Treatment (ppm)		Late planting cm^2	Early planting cm^2
Control	0	4976	9862
GA3	25	5578	9613
	50	5567	9589
	100	4618	9345
CCC	100	5443	10165
	250	5385	10252
	500	5847	10833
B-9	100	5103	10470
	250	5132	9751
	500	5621	9564
New L.S.D. 0.05		588,0	604,0

Tab. 4: Mean yield and yield components of Zea mays L., as affected by GA_3, CCC and B-9.

Treatment (ppm)		Weight of 300 grains (g)		Apical ear grain yield (g)		Number of ears per plant		plant grain yield (g)	
		L	E	L	E	L	E	L	E
Control	0	80.9	93.2	115.7	182.0	1.41	1.47	155.7	232.1
GA3	25	87.2	106.2	138.4	192.3	1.50	1.52	185.9	253.9
	50	87.0	104.4	131.5	191.1	1.46	1.49	171.1	239.3
	100	83.9	96.6	117.3	170.5	1.42	1.46	167.6	227.6
CCC	100	82.4	99.6	123.6	192.4	1.45	1.50	171.2	244.9
	250	81.3	99.1	120.0	192.1	1.45	1.53	172.9	249.5
	500	85.2	99.9	138.6	199.0	1.50	1.55	194.3	257.2
B-9	100	84.5	105.3	112.5	209.4	1.40	1.57	160.9	259.6
	250	87.0	99.5	138.1	192.2	1.46	1.50	177.3	249.1
	500	91.7	96.5	149.0	190.3	1.53	1.52	200.2	253.2
New L.S.D.: 0.05		2.3	1.0	22.5	10.6	0.30	0.36	20.2	21.0

L: Late planting; E: Early planting

4. Yield components and yield of grains (tab. 4):

a) Weight of 300 grains (specific grain weight):

In both late and early planting, specific grain weight was increased with GA and B-9 at all concentrations meanwhile it was increased with all CCC concentrations in late planting and with 500 ppm CCC only in early one.

b) Number of ears/plants:

Showed no response to growth regulators in both sowing dates.

c) Apical ear grain yield:

In both late and early planting dates, grain yield of apical ear was increased with 25 ppm GA, 500 ppm CCC and 250 ppm B-9.
In early planting, it increased with 100 ppm B-9.

d) Plant grain yield:

Showed the same trend of response as apical ear grain yield.

4 Discussion

Climatic conditions, especially night air temperature of early summer planting (May) were more favourable than those of late planting (July) for growth and grain yield of "Early American" maize. This was in agreement with results of SHALABY and KHALIL (1962) and PETERS, et al., (1971).

Relatively less growth of stem and leaf in late summer grown plants was partially compensated by spraying all growth regulators. Meanwhile more growth vigour of early sown plants was less affected by the concentrations used of the 3 growth regulators. Promotion of maize stem elongation and leaf enlargement with GA, CCC or B-9 without affecting number of internodes was previously inicated by NASSAR, (1975). Such results would point out that GA and "growth retardants", effects might not necessarily be adverse to each others. It might be a matter of the timing at which the morphological expression of growth promotion occurs, in response to the applied concentration. Thus, elongation of basal internodes by GA and of upper ones by "growth retardants" would indicate that such a promotive effect was exerted by GA earlier than by "growth retardants". Under conditions of the present work, probably GA acted as an "early" promotor and CCC or B-9 "late" ones.

Increase of grain yield could be mainly attributed to more grain filling, as indicated by increments of specific grain weight with spraying GA, CCC and B-9. It might be thus deduced that growth regulators-induced yield increase was not only a consequence of attaining more source capacity, but also of strengthening the sink of the plant. This could be shown by the results that grain yield was also increased with spraying growth regulators at concentrations which had no effect on leaf area, indicating more mobilization of photosynthates towards kernels. However, maximum yield increases in both early and late summer plantings occurred with concentrations which increased leaf area. It might be concluded that spraying 25 ppm GA, 500 ppm CCC and 100 – 500 ppm B-9, 40 days after sowing have beneficial effect on grain yield of maize planted in early or late summer.

5 Summary

A field experiment was conducted in 2 successive seasons on "Early American" corn. Seeds were sown in either 10th May (early) or 5th July (late). In comparison with control plants grown on each of early or late dates, plants were sprayed with 25, 50 or 100 ppm GA, 100, 250 or 500 ppm CCC or 100, 250, 500 and 2.500 ppm Alar. Results indicated stimulation of the stem and its internodes elongation with all growth regulators in case of late sowing. Total leaf area was increased in both seasons due to all growth regulators. Specific grain weight was increased by all growth regulators. Grain yield was increased with GA (25 ppm), CCC (500 ppm) in both seasons as well as with B-9 (100 ppm) in early sowing and 500 ppm in late sowing.

Zusammenfassung

Ein Feldversuch mit Mais, Sorte: Early American, wurde in zwei aufeinanderfolgenden Jahren durchgeführt. Die Aussaat wurde zu zwei verschiedenen Zeiten, früh (10. Mai) und spät (5. Juli) vorgenommen.

Die Behandlungen in beiden Versuchen waren wie folgt: 25, 50, 100 ppm GA, 100, 250, 500 ppm CCC und 100, 250, 500, 2.500 ppm B-9. Bei der späten Aussaat führten alle angewandten Wachstumsregulatoren in allen Konzentrationen zu Wachstumstimulierung und Internodienverlagerung. Der Kornertrag wurde erhöht durch GA (25 ppm), CCC (500 ppm) in beiden Versuchen sowie durch B-9 (100 ppm) beim frühen Saattermin und durch 500 ppm beim späten Saattermin.

Die Gesamtblattfläche pro Pflanze wurde durch die Behandlungen in beiden Versuchsreihen erhöht.

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