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GROWTH, YIELD AND ANATOMICAL STRUCTURE OF MAIZE PLANTS AS AFFECTED BY FOLIAR APPLICATION WITH MORPHACTIN CF_{125}

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ABSTRACT

Two field experiments were conducted during two successive growth seasons (1998/1999) at the Experimental Station of the National Research Centre, Giza, Egypt, to study the effect of Morphactin (CF_{125}) at the concentrations of 0.0 , 50 , 100 and 150 mg / l on vegetative growth characteristics, yield and yield components, some bio-chemical constituents of grains as well as the anatomical structure of leaf and stem of maize plants.

Foliar application of morphactin at the concentration of 50 and 100 mg/l, to maize plants at elongation stage of maize growth induced significant increases in plant height, number of leaves / plant, stem diameter, leaf area (LA), leaf area index (LAI), Net assimilation rate (NAR) and total dry weight / plant, as compared with those of the control.

Yield and yield components, i.e. ear length, ear diameter, grain index, grain yield / plant, grain yield / fed., harvest index and shelling percentage were also significantly increased in plants received one and twice foliar application of morphactin. However, increasing morphactin concentrations up to 150 mg / l especially when sprayed at elongation and tassel appearance stages of maize growth caused significant decreases in most growth and yield characteristics. Crude protein, total sugars, oil percentage were significantly increased in plants received one foliar application of morphactin as compared to untreated plants and other treatments.

From the anatomical point of view, morphactin treatments slightly decreased thickness of the upper epidermal layer and showed inconsistent effects among thickness of the lower epidermal and mesophyll tissue layers. In contrast, all morphactin concentrations obviously increased thickness of the mid vien in leaf cross – sections. Also, stem diameter on cross – section increased in response to morphactin treatments, which was accompanied with the increase occurred in the number of large and small vascular bundles / cross – section and dimension measurements of both length and width of stem vascular bundles.

Generally, foliar application with 50 and 100 mg / l of Morphactin to maize plants cv., single cross 10 as once at elongation stage (45 days after sowing) was the most effective treatment to get better results in increasing growth characteristics, yield and its components, chemical contents of maize grains, as well as both leaf and stem anatomical structure.

INTRODUCTION

Morphactins are a group of synthetic plant growth regulators with a high potency, which affect almost every phase of plant growth and development Sundberg *et al.*, (1994).

The action of this class of growth regulators on the extension growth of shoots and internodes was more interest as, they have an opposite effects by varying the concentrations. The inhibition of shoot growth by morphactins usually includes inhibition and /or morphogenetic effects on the new growing organs. Jaiswal and Bhambie (1985) found that, morphactin affected leaf morphology in *Vigna radiata* plants by fusion of leaflets Also, Ali *et al.*, (1994) concluded that, as a result of foliar application with morphactin at 100 ppm, abnormal protrusions were observed on the anatomical structure of leaflets

and main vein of *Vicia faba*. Similar trends of morphactin action were obtained by Bruce (1990) on soybean; Castro *et al.*, (1990) on *Phaseolus vulgaris*, El-Desoki *et al.*, (1994) on *Vicia faba* and Mahanta and Sarma (1996) on *Partenium argentatum*, as relatively, higher doses of morphactin inhibited shoots and internodes elongation and resulted in stunted shoots.

The inhibition of the elongation of shoots and internodes by morphactin could be counteracted either partly or completely by simultaneous application of GA_3. Therefore, other cases in which morphactin did not inhibit but on the contrary, stimulated the elongation of shoots and internodes were reported by several investigators. Aron, (1985) concluded that, morphactin at the concentrations of 250 and 500 ppm did not reduced growth but enhanced it in *Minneola tangelo*. El-Desoki *et al.*, (1994) found that, morphactin at the concentrations of 10 – 40 ppm enhanced plant height and number of leaves/plant on *Vicia faba*. Also, El-Zawily *et al.*, (1985) found that, morphactin at 1-10 mg/l increased the number and length of branches of faba bean plants.

Therefore, the aim of the present investigation is to determine interrelationships of vegetative growth, yield and some bio-chemical constituents of grains as well as anatomical structure of leaf and stem as affected by foliar application of morphactin to maize plants during elongation and tassel appearance stages.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Station of N.R.C. at Shalakan, Kaluebia Governorate during two successive growth seasons of 1998 and 1999, to study the effect of morphactin CF_{125} on the growth parameters yield and its components as well as leaf and stem structure of maize plants.

Morphactin CF_{125} (2 - chloro - 9 - hydroxyfluorene - 9-carboxylic acid) supplied by E-Merck Co., was foliar sprayed to maize plants at the concentrations of 50, 100 and 150 mg/l. The treatments were divided into two groups; the first group of plants were foliarly sprayed once at elongation stage (45 days after sowing) and the second group, was sprayed twice at elongation and tassel appearance stages (45 and 60 days after sowing) with the same concentrations of Morphactin. In addition to the control (distilled water) in both seasons.

Grains of maize (*Zea mays* L.) cv. single cross 10 were sown on the first and second weeks of June in both seasons respectively, in rows 60 cm apart and the distance between hills along the row was 20 cm apart. The experimental unit consisted of five ridges 3.5 meters in length, occupying an area of 10.5 m^2. The experimental design was split plot with six replications. The plants foliarly sprayed once at elongation stage occupied the main plots while those sprayed twice at elongation and tassel appearance stages were at subplots. Calcium superphosphate (15.5 % P_2O_5) was applied presowing to the soil at the rates of 100 kg/fed. Nitrogen fertilizer as ammonium nitrate (33.5%N) was applied at the rates of 120 kg/fed. in two equal doses, before the first and the second irrigation respectively. In both seasons, growth characters were measured at silky stage (75 days after sowing), milky stage

(90 days after sowing) and dent stage (120 days after sowing) were recorded per plant: Plant height. (cm)- Stem diameter. (cm)-Number of leaves/plant- Leaf area (cm^2/plant): according to Bremner and Taha (1996), Leaf area index (LAI): according to Watson (1952),Dry weight/plant (gm), Specific leaf weight (SLW) (mg/cm^2) was computed as described by Pearce *et al* , (1969), Crop growth rate (CGR) (mg /cm^2 / days): was measured according to AbdEL-Gawed *et al*., (1980) and Net assimilation rate (NAR) (mg /cm^2 / days) was calculated as given by Watson (1958).

At harvest time (dent stage), plants were taken out randomly for yield analysis determining yield and yield characters i.e., ear length, ear diameter, number of rows/ear, number of grain/row, grain index, grain/plant (gm), grain yield ton/fed, harvest index and shelling percentage.

Chemical analysis of grains :

Grain samples from all treatments were dried at 70 °C for constant weight and ground to determine the following constituents:-

Total sugar content, was determined colorimetrically according to the method described by Dubois, *et al.*, (1956).

Crude protein percentage, according to the method of A. O. A. C. (1955). and calculated by multiplying the values of total nitrogen content by 6.25.

Oil percentage in maize grains was extracted by using solvent hexanol in a soxhlet apparatus according to method of A. O. A. C. (1988).

The data were statistically analyzed for each season and then combined analysis of the two seasons was carried out Gomez and Gomez (1984). For comparison between means, L.S.D. at 5 % Level was determined.

Anatomical investigation :

For the anatomical study, samples were taken from middle parts (1-2 cm) in the fourth leaf and internodes in plants received one foliar application of morphactin at elongation stage at the age of 60 days after sowing. Samples were killed and fixed in F.A.A. dehydrated in ascending concentrations according to Clark, (1981), then cleared by soaking in series of xylene and absolute ethanol and imbedded in paraffin wax (M.P. 55-58 °C). Using rotary microtome (Binko-LTD-Japan), serial cross-section (15-20 μ) were obtained and stained with crystal violet-erythrosine combination and mounted in Canada Balsam. The sections were examined and photographed by Nikon light microscope and Nikon camera Fx – 35.

RESULTS AND DISCUSSION

Effect of morphactin CF_{125} on morphological growth parameters of maize plants:

The data in Table (1) show that plant height, number of leaves/plant, stem diameter, leaf area, leaf area index and total plant dry weight were promoted as a result of foliar application with morphactin at the concentrations of 50 and 100 mg/l, when applied once at elongation stage or twice at elongation and tassel appearance stages of maize growth as compared to those of control plants. These results were true during all phonological stages (silky. milky and dent)of maize growth, except few treatments. The enhancement n growth parameters was significantly in

Table (1)a Effect of foliar application with Morphactin on growth characters of maize plants (Combined analysis of 1998 and 1999)

Number and stages of application	Morphactin concentrations (mg/l)	Plant height (cm)			Number of leaves/plant			Stem diameter (cm)			Leaf area (cm2)/plant		
		A	B	C	A	B	C	A	B	C	A	B	C
once at elongation stage	Control	226 45	270 09	281 56	14 28	14 66	15 11	1 97	2 52	2 47	565 16	618 45	606 81
	50 ppm	237 55	272 00	264 80	14 52	15 31	15 49	2 02	2 64	2 59	592 59	690 98	660 33
	100 ppm	253 56	279 82	299 38	15 96	15 92	15 80	2 77	2 84	2 66	627 87	715 70	701 02
	150 ppm	210 08	268 77	280 01	14 70	14 82	15 02	1 99	2 43	2 19	639 38	697 02	648 30
twice at elongation and tassel appearance stages	50 ppm	229 83	269 40	282 69	14 60	15 40	15 21	2 08	2 60	2 31	564 80	628 08	621 11
	100 ppm	240 73	276 91	286 38	15 01	15 73	15 38	2 60	2 74	2 51	572 10	689 32	669 22
	150 ppm	203 54	260 70	271 32	14 20	14 22	15 09	1 93	2 34	2 09	552 89	584 38	570 76
L S D at 5%		7 14	5 44	4 33	0 52	0 47	N S	0 42	0 82	0 99	13 04	29 10	21 30

A Silky stage
B Milky stage
C Harvest stage

Table (1)b Effect of foliar application with Morphactin on growth characters of maize plants (Combined analysis of 1998 and 1999)

Number and stages of application	Morphactin concentrations (mg/l)	Leaf area index (LAI)			Net assimilation rate mg/cm²/day		Crop growth rate mg/cm²/day		Total dry weight/plant (g)			Specific leaf weight mg/cm²		
		A	B	C	A-B	B-C	A-B	B-C	A	B	C	A	B	C
once at elongation stage	Control	3 23	4 13	3 83	4 63	4 31	20 44	16 13	123 55	203 63	246 09	7 08	8 59	9 86
	50 ppm	4 06	5 25	4 91	4 68	5 61	21 03	18 08	160 29	213 90	284 55	8 39	9 15	10 21
	100 ppm	4 19	5 69	5 03	4 74	4 95	21 31	18 26	172 51	246 02	301 82	8 68	9 26	10 39
	150 ppm	4 38	5 86	4 92	4 50	3 75	20 96	17 46	158 31	201 26	276 11	7 91	8 96	9 97
twice at elongation and tassel appearance stages	50 ppm	3 84	4 96	4 39	4 61	5 90	20 66	16 73	149 60	211 72	252 70	7 64	9 02	10 36
	100 ppm	3 92	4 80	4 50	4 87	4 42	20 93	16 04	155 36	219 44	267 92	7 69	9 33	10 57
	150 ppm	3 35	4 54	4 11	3 92	4 56	20 36	16 61	134 02	199 06	273 18	7 39	8 80	9 92
L S D at 5%		0 29	0 37	0 46	N S	0 27	N S	N S	10 41	12 35	14 01	0 69	N S	N S

A Silky stage
B Milky stage
C Harvest stage

mostly cases with morphactin at the concentration of 100 mg/l when applied as once at elongation stage, or twice at elongation and tassel appearance stages of growth. However, the highest promotion effect on vegetative growth parameters was obtained from once foliar application of morphactin when compared to the results obtained from twice foliar applications of morphactin. This effect could be attributed to the stimulating effect of morphactin on young growing tissues of intact plants which resulted in enhancement of cell division in cambium and pericycle area (Patel *et al.*, 1977, Patel and Setia, 1979, Murthy and Inamadar, 1980 and Mahmoud, 1987). In otherword, morphactin treatments appeared to have re-greening effects as observed in flax and soybean (Dybing and Lay, 1982a and Dybing and Yarrow 1985). Such, delay in leaves scenceing lead to leaves remained photosynthetically active for long period which increased growth parameters. Another possible mechanism, suggested that, the balance between the growth promoters and growth inhibitors in the source and sink might play a regulatory role in initiation of more growth (El-Bassiouny, 1992).

Effect of morphactin CF_{125} on yield and yield attributed characteristics of maize plants :

The results in Table (2) show that, once foliar application with morphactin at the concentrations of 50 and 100 mg / l to maize plants at elongation stage significantly affected ear characters, i.e, ear length, ear diameter, grain yield / plant, grain index, grain yield ton / fed , harvest index and shelling percentage . Meanwhile, number of grains / row and number of rows / ear were not significantly affected by morphactin treatments.

Once foliar application with morphactin at the concentrations of 50 and 100 mg / l to maize plants at elongation stage were the most effective treatments for increasing yield parameters as compared with those of control and which received twice foliar applications of morphactin at elongation and tassel appearance stages of growth. Such stimulatory effect might be due to the enhancement of growth parameter by morphactin treatments (Table 1). In this regard, Dybing and Lay, (1981) reported that, causes of the yield increases produced in wheat and oats by certain morphactin treatments areunknown. Although, positive relationship between foliar application of morphactin and increments in many growth and yield parameters were observed by many investigators i.e, Dybing and Lay,(1981) on flax, soybean, wheat and oats, Jaiswal and Bhambie (1989) on mung bean, El-Bassiouny (1992) on sunflower and Sharma *et al.*, (1980) on sorgum vulgare. Such improvement of growth and yield parameters might be attributed to the increasing ability of plants in building metabolites, retardation of senescence and promoting root growth by lower rates of morphactin.

From above mentioned results, both stimulating and inhibiting effects of morphactin could be observed on the same characteristics by varying the concentrations.

The significant favourable effects of lower concentrations of morphactin (50 and 100 mg /l) on the growth, yield and yield attributed characteristics of *Zea mays*, might be explained on the basis of the beneficial effects of lower doses of morphactin on the plant growth and increasing

Table (2) : Effect of foliar application of Morphactin on yield and its components of maize plants (Combined analysis of 1998 and 1999)

Nomber and stages of application	Morphactin concentrations (mg/l)	Ear length (cm)	Ear diameter (cm)	Number of grains/row	Number of rows/ear	100-grain weight (g)	Grain yield/plant (g)	Harvest index	Shelling percentage %	Grain yield (ton/fed)
once at elongation stage	Control	21.41	4.81	41.52	14 51	42.91	221.60	0.61	84 08	3.20
	50 ppm	23.74	5.05	44.17	14.59	45.76	243.24	0.69	85.16	4.61
	100 ppm	24.09	5.26	45.06	14 68	46.43	260.46	0 76	85 91	4.68
	150 ppm	22.16	5.11	42.76	14.22	43 82	232 06	0.63	83 06	3 43
twice at elongation and tassel appearance stages	50 ppm	22.65	5.01	43.93	14.32	44 63	237.24	0.66	84.23	3.94
	100 ppm	23.01	5.19	44.02	14.44	44.93	241.44	0 71	85 40	4.19
	150 ppm	21.43	4.84	41.81	13.78	42.66	226.92	0 62	82 02	3.15
L.S.D. at 5%		0 52	0.46	N.S.	N.S	1.56	9 29	0 04	0 07	0.12

photosynthetic activity. Supportive evidence for this view was reported by several investigators. For example, Dybing and Lay,(1981) found that, morphactin when applied to flax and soybean, enhanced shoot and leaf growthand renewed flowering. In addition, morphactin could caused an enlargement and increase in density of root hairs, thus apparently increasing the absorbing surface of the root hairs (Schneider, 1972). In this respect, El-Bassiouny (1992) found that, the lowest concentration of chlorflurenol (0.1 ppm) increased the extractable auxin and decreased the growth inhibitors in terminal buds and roots of *Helianthus annuus* L. Conversely, the highest concentration of Chlorflurenol (10 ppm) induced opposite inhibitory effect. On the same hand, El-Desoki, *et al.*, (1994) found that, morphactin at the concentrations of 10-50 ppm obviously enhanced plant height, number of lateral shoots and number of pods / plant in faba bean plants. Whereas, the higher concentrations (100– 200 ppm) of morphactin sharply suppressed vegetative growth and pod formation.

The data in Tables (1 & 2) indicate that, increasing the level of morphactin concentrations up to 150 mg / l progressively reduced growth, yield and yield attributed characteristics especially in plants received twice foliar application of morphactins. Such inhibitory effect might be due to the antagonism of morphactin and GA_3which inhibited cell elongation and cell division. In general, these results are in agreement with those reported by other investigators Bruce (1990) on Soybean, Castor *et al.*, (1990) on *Phaseolus valgaris*, Dierig and Backhaus (1990) on *Parthenium argentatum* and Mahanta and Sarma (1996) on tea plant, who concluded that, morphactin treatments retarded plants growth in terms of plant height, dry weight and number of leaves / plant.

Effect of morphactin CF_{125} on carbohydrate, protein and oil contents of maize grain :

From Table (3) it is clear that, one foliar application of morphactin at the concentrations of 50 and 100 mg/l gave the highest values for crude protein, total sugar and oil percentage as compared to their control. Furthermore, increasing morphactin concentrations up to 150 mg/l or twice foliar application with all the concentrations of morphactin led to very slight increase or decrease on the above mentioned characters. This means that, once foliar application of morphactin at the concentrations of 50 and 100 mg/l to maize plants at elongation stage was more favourable for enhancement of crude protein, total sugar and oil percentages in maize grain.

The enhancement of growth and yield parameters in response to morphactin treatments at the concentrations of 50 and 100 mg/l when applied as once foliar application at elongation stage was accompanied with similar changes on crude protein, total sugar and oil percentage in maize grain. In this respect Jain and Mukherjee (1981) found that increasing morphactin concentrations from 1.0 to 7.5 ppm was accompanied with similar increase in protein content of tomato plants during three stages of growth and development. Also, Punjabi and Basu, (1987) observed an accumulation of nitrogen compounds in shoots of *Phaseolus vulgaris* treated with 10 ppm

morphactin. Similar results were also obtained by Bruce, (1990) on soybean plants.

Concerning the effect of morphactin especially Chlorflurenol on the oil and protein contents, Dybing and Lay, (1982b) concluded that, treatment with morphactin (Chlorflurenol) significantly increased percent of oil in flax, soybean, wheat and Oats. Whereas, protein percent was declined as oil percent increased in flax and soybean, but not in wheat and oats. They also, suggested that, morphactin treatment could be affected lipid metabolism or affected seed growth and ultimately seed size.

Table (3) : Effect of foliar application with Morphactin CF_{125} on total sugar, protein and oil percentages of maize grains.
(Average of two growing seasons)

Stages of application	Morphactin concentrations mg/l	Crude protein %	Total sugars %	Oil %
Elongation	Control	9.99	62.77	6.78
	50	11.87	70.58	7.80
	100	13.12	72.09	7.99
	150	10.37	67.11	6.96
Elongation and tassel appearance	50	10.02	65.48	6.88
	100	11.55	68.99	7.01
	150	9.84	63.87	6.33

Effect of Morphactin CF_{125} on leaf anatomical structure of maize plants:

The data in Table (4) show that, foliar application with morphactin at the concentrations of 50 and 100 mg / l slightly reduced thickness of the leaf upper epidermal layer and slightly increased thickness of the leaf lower epidermal layer as compared to the control. Furthermore, the higher concentration of morphactin (150 mg/l) reduced both thickness of the upper and lower epidermal cells. Leaf abaxial and adaxial epidermal cells of morphactin treated plants at the concentrations of 100 and 150 mg/l appeared more regular and compacted in shape (Figs. 5 and 7) as compared with the control (Fig.1). In contrast, to the irregular and hypertrophy shape of leaf upper and lower epidermal cells in morphactin treated plants at 50 mg/l (Fig.3).

Table (4) : Effect of Morphactin CF_{125} on leaf anatomical structure of maize plants .

Thickness and measurements (µm)	control	Morphactin concentrations (mg/l)					
		50		100		150	
		Absolute value	± as % of control	Absolute value	± as % of control	Absolute value	± as % of control
Upper epidermal layer	30	26	-13.33	28	-6.67	26	-13 33
Lower epidermal layer	26	30	+15.38	26	00.00	24	-7 69
Mesophyll tissue layer	176	176	00 00	184	+4.55	160	-9.09
Main vein	760	1040	+36 84	1120	+47.37	840	+10 53
Dimension measurements of leaf vascular bundle							
Length	88	96	+9.09	72	-18 18	72	-18 18
Width	96	96	00 00	80	-16.67	72	-25.00
Whole leaf thickness	232 00	232.00	00 00	238.00	+2.59	210.00	-9 48

Each value is the mean of 4 sections, 10 reading per each.

The most evident alterations on the photometric measurements of maize leaf tissues was due to the effect of morphactin on the mesophyll tissue layer. Morphactin treatment at the concentrations of 50 mg/l resulted in thickness of mesophyll tissue layer similar to that recorded on the control plants. Whereas, morphactin treatment at 100 mg/l slightly increased the

thickness of mesophyll tissue layer by + 4.45 more than the control. However, the only reduction on the mesophyll tissue layer (- 9.09 % less than the control) was recorded with the higher rate of morphactin (150 mg/l), such effect could be due to fewer intercellular spaces between parenchyma cells of mesophyll tissue layer as reported by Dybing and Yarrow (1984), on leaf mesophyll tissue of treated morphactin soybean plants.

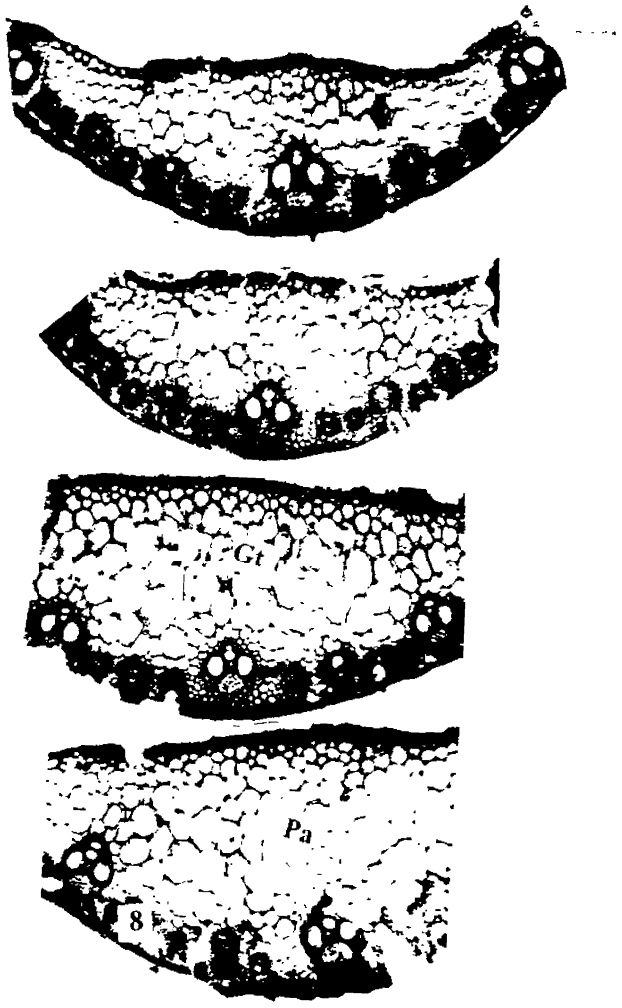
The vascular tissues in leaf blade assumed normal in shape and structure with all the applied concentrations of morphactin (Figs. 2, 3 and 4) as compared to the control (Fig. 1). However, dimension measurements of leaf vascular bundles showed tendency to reduction on both length and width (Table 4). This effect appeared to be greater as the concentrations of morphactin increased up to 150 mg/l (Table 5). Such response could be due to the effect of morphactin on the differentiation and development of leaf vascular tissues especially xylem vessels which become narrow and smaller in size in morphactin treated plants, Patel and Setia, (1979). These results seem to be differ from data obtained by Dybing and Yarrow (1984) who observed, an increase in xylem cell diameter and activity of vascular cambium in leaf of soybean plants treated with morphactin. Owing to the increase or decrease occurred on the thickness of the epidermal layer, mesophyll tissue layer, width and length of leaf vascular bundles it could be expected similar change on whole leaf thickness as presented in Table (5).

However, treated maize plants with all the concentrations of morphactin (50, 100 and 150 mg/l) progressively increased thickness of the midvein in leaf blade (Table 5). The most pronounced effect of morphactin on the thickness of the main vein was obtained at treatments of 50 and 100 mg/l which resulted in increasing the thickness of the main vein by + 39.64 % and +53.68 % respectively more than that of their control. Such enhancement in thickness of the main vein was mainly due to the increasing number and size of parenchyma cells in the leaf ground tissue (Figs. 6 , 7 and 8) as compared to the control (Fig. 5). These results agree with those reported by Dybing and Yarrow, (1984) on leaves of soybean treated by morphactin at the concentrations of 2.5 or 25 µg , and found tissues puckered between veins of treated leaves which apparently a result of continuous division and growth in rnesophyll tissue.

Effect of morphactin CF_{125} on the stem anatomical structure of maize plants:

Cross-sectional area of the Fourth-internode maize stem was greater in plants foliarly sprayed with morphactin at the concentrations of 50 , 100 mg/l (Figs 5-8). The magnitude of increase on stem diameter was run parallel with increasing morphactin concentrations up to 100 mg/l which increased stem diameter by + 15 % more than the control plants. Such stimulatory effect could be attributed to the positive effect of morphactin not only on the number of vascular bundles/cross-sections but also on improving their width and length (Figs 9-12). These results are consistent with other anatomical studies which showed an increase in stem diameter due to morphactin treatments on increasing stem diameter (Dierig and Backhaus, 1990; Clifford *et al.*, 1992 and Ali *et al.*, 1994).

Figs. 1-4 : Cross – sections of the fourth leaf of maize (*Zea mays* L. cv. Cross line 10). Showing effect of foliar application with morphactin (CF_{125}). Figs. 1, 2, 3 and 4, cross – sections through leaf blade. Fig. 1, control; Fig. 2, treatment with 50 mg/l of morphactin, Fig. 3, treatment with 100 mg/l of morphactin. and Fig.4, treatment with 150 mg/l morphactin (x = 50)



Figs 5-8 Cross – sections through midvien of leaf blade Fig 5 control Fig 6, treatment with 50 mg/l of morphactin Fig 7, treatment with 100 mg/l of morphactin Fig 8 treatment with 150 mg/l of morphactin (Up) upper epidermal layer, (Le) Lower epidermal layer, (Me) mesophyll tissue, (Vb) Vascular bundle, (Gr) Ground tissue and (Pa) parenchyma cells ($x = 50$)

The epidermis composed of 3 – 4 layers of highly compressed sclerenchymatous cells (Figs. 9 – 12) which formed a continuous ring Morphactin treatments showed no effect on the thickness of the stem sclerenchymatous layer except at treatment with 100 mg/l which decreased sclerenchymatous layer by – 28.57 % less than the control The present results differ from those obtained by Mahmoud. (1987) who reported that, morphactin at 100 ppm gave an increase in vascular tissue and defined much lignified elements in stem of tomato plants. The vascular tissue in maize stem trans section comprised two types of vascular bundles, small and large vascular bundles scattered in the ground tissue (Figs. 9-12). The small vascular bundles occurred often near the peripheral zone of stem-cross-section whereas, the large vascular bundles scattered towards the inner and outer layers of stem transver cross-section (Figs. 9-12).

The ground tissue on the stem cross –section composed of multi – layers of parenchyma cells which had thin cell walls, large intercellular spaces and varied in size (Figs. 9-12). These observations were identifiable in the morphactin treated and untreated plants . Number of vascular bundles on the stem cross-section and dimension measurements (length and width) of both large and small vascular bundles were increased in response to foliar application of Morphactin (Table 5).

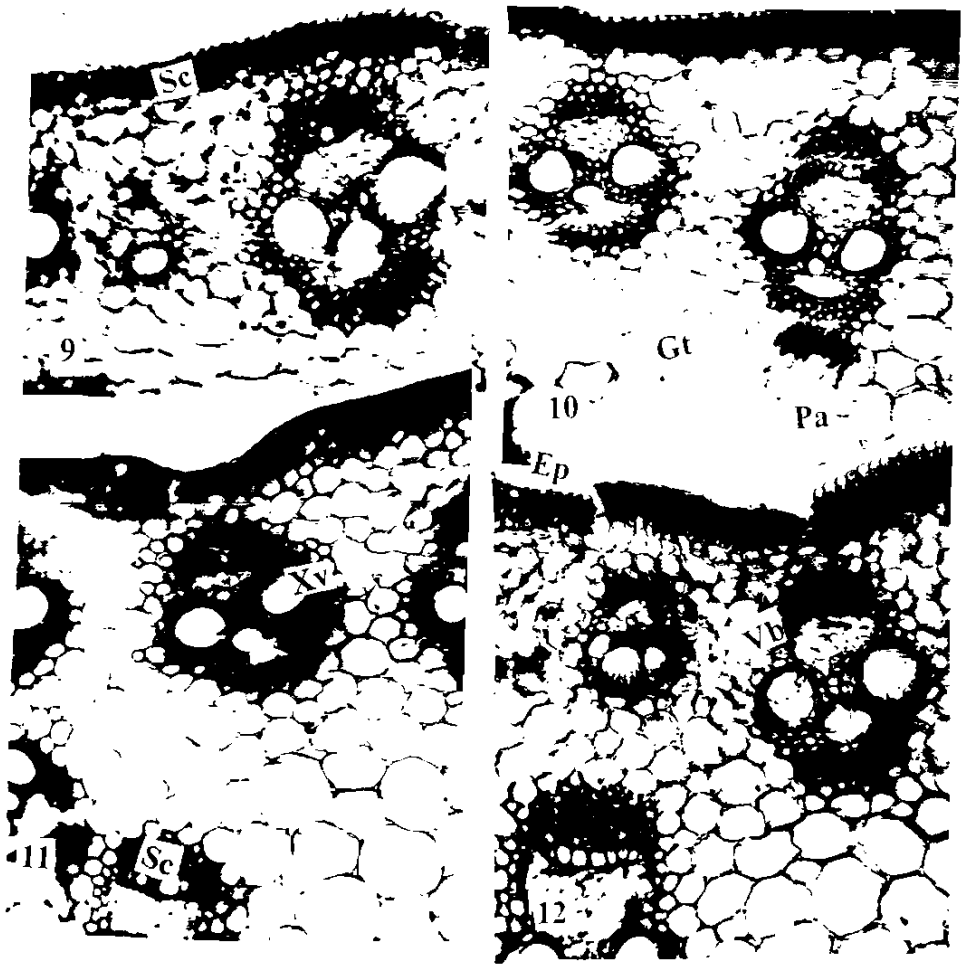
Table (5) : Effect of Morphactin CF_{125} on the stem anatomical structure maize plants.

Thickness and measurements (µm)	control	Morphactin concentrations (mg/l)					
		50		100		150	
		Absolute value	± % of control	Absolute value	± % of control	Absolute value	± % of control
Stem diameter/cross-sections	6650 00	7140 00	+7 37	7700 00	+15.79	7200 00	+8 27
Ebidermal sclerenchymatous layer	56 00	56 00	0 00	40 00	-28 57	56 00	+0 00
No of the small vascular bundles/cross-section	24 00	25 00	+4 17	27 00	+12 50	26 00	+8 33
Dimension measurements of the small vascular bundle							
Length	240 00	296 00	+23 33	240 00	0 00	280 00	+16 66
Width	184 00	160 00	-13.04	232 00	+26 09	208 00	+13 04
No of the large vascular bundles/cross-section	24 00	25 00	+4 17	37 00	+54 17	27 00	+12 50
Dimension measurements of the large vascular bundle							
Length	320 00	400 00	+25 00	440 00	+37.50	400 00	+25 00
Width	240 00	240 00	0 00	280 00	+16 66	280 00	+16 66

Each value is the mean of 4 sections, 10 reading per each.

The greatest number and size of both types of vascular bundles were obtained at morphactin treatment at 100 mg / l. Such enhancement in the number and size of stem vascular bundles as a result of morphactin treatments might be have a role of absorption and translocation of nutrients, assimilates and metabolites through stem tissues to different organs of maize plants.

From above mentioned results, one foliar application of morphactin at the concentrations of 100 mg/l to maize plants at elongation stage (45 days after sowing) improved growth, yield characteristics, grain-protein and carbohydrate content of maize plants. Such favourable effects were accompanied with the increase occurred in the thickness and number of ground tissue cells and layers in the leaf midvin, and with the increase in number and size of both large and small vascular bundles on the stem cross-sections



Figs 9 – 12 Stem cross – sections of the fourth internode of maize (*Zea mays* L. cv. Cross line 10). Showing effect of foliar application with morphactin CF_{125} Fig. 9. control; Fig 10 treatment with 50 mg/l of morphactin. Fig.11, treatment with 100 mg/l of morphactin and Fig 12, treatment with 150 mg/l of morphactin. (EP) Epidermal layer; (Sc) sclerenchymatous layer (Vb) Vascular bundles (Gt) ground tissue. (Xv) Xylem vessels; (Ph) *Phloem elements and* (Pa) *parenchyma cells* (x = 50)

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تأثير استخدام المورفاكتين على النمو،المحصول،التركيب التشريحى فى نباتات الذرة الشامية.

زكريا أمين على ، أبو بكر أحمد السيد أمين ، محمد سلامة أحمد عبد الواحد ، الشربينى محمد رشاد
قسم النبات – المركز القومى للبحوث – الدقى

أجريت هذه الدراسة بمحطة التجارب الزراعية للمركز القومى للبحوث بشلقان – قليوبية خلال موسمى ١٩٩٨ / ١٩٩٩ بهدف دراسة تأثير التركيزات المختلفة لمادة المورفاكتين (صفر ، ٥٠ ، ١٠٠ ، ١٥٠ جزء فى المليون) على النمو والمحصول والتركيب الكيماوى والتشريحى لنباتات الذرة الشامية (صنف هجين فردى ١٠) وكانت أهم النتائج المتحصل عليها كالآتى :

١- أدت معاملة نباتات الذرة الشامية بمادة المورفاكتين بالتركيزات ٥٠ ، ١٠٠ ملجم / لتر خلال مرحلة الاستطالة (٤٥ يوم من الزراعة) إلى حدوث زيادة معنوية فى صفات النمو الخضرى المتمثلة فى طول النبات ، عدد الأوراق ، قطر الساق ،مساحة الورقة ، دليل مساحة الأوراق ، والوزن الجاف الكلى للنبات بينما لم تعطى سرعة نمو المحصول ، الكثافة النوعية للأوراق أى استجابة معنوية نتيجة للمعاملات.

٢- أدت معاملة نباتات الذرة الشامية بماة المورفاكتين بالتركيزات المنخفضة ٥٠ ، ١٠٠ جزء فى المليون (أى بعد عمر ٤٥ يوم من الزراعة) إلى حدوث زيادة معنوية فى المحصول ومكوناته حيث زاد طول الكوز وقطر الكوز ، وزن ١٠٠ حبة ، نسبة التصافى ، دليل الحصاد ، محصول الحبوب / نبات ، محصول الحبوب / فدان بينما لم تعطى صفة عدد الحبوب بالكوز وعدد الحبوب بالصف اى استجابة معنوية. بينما كان لتأثير الجرعات العالية من المورفاكتين (١٥٠ ملجم/لتر) أثر ملحوظ على انخفاض فى معظم صفات النمو ، المحصول ومكوناته خاصة فى النباتات التى تم رشها مرتين خلال مرحلتى الاستطالة وظهور الحريرة.

٣-أشارت نتائج التحليل الكيماوى إلى زيادة محتوى الحبوب من البروتين والكربوهيدرات والزيت عند المعاملة بالتركيزات المنخفضة نسبيا من مادة المورفاكتين (٥٠ ، ١٠٠ ملجم / لتر) وذلك عند اضافتها مرة واحدة خلال مرحلة الاستطالة أو مرتين خلال مرحلتى الاستطالة وظهور الحريرة ولكن أفضل النتائج فى هذه المركبات البيوكيميائية تم تسجيلها عند استخدامها مرة واحدة فقط خلال مرحلة الاستطالة.

٤- أهم النتائج التى تم ملاحظتها فى التركيب التشريحى فى القطاعات العرضية لكل من أوراق وسيقان النباتات المعاملة بالتركيزات المختلفة من المورفاكتين هى كالآتى :

١- فى الأوراق :

أدت معاملة نباتات الذرة الشامية بالتركيزات المختلفة من المورفاكتين إلى تناقص فى سمك طبقة البشرة العليا فى الأوراق . بينما أدى استخدام التركيزات العالية من المورفاكتين (١٠٠-١٥٠ ملجرام/لتر) إلى حدوث تناقص فى أبعاد الحزم الوعائية للأوراق. وقد أدت المعاملة بالتركيزات المنخفضة من المورفاكتين (٥٠ ملجم/لتر) إلى حدوث تأثير منشط خفيف على أبعاد الحزم الوعائية للأوراق بينما لم يتأثر سمك النسيج المتوسط للأوراق . كذلك أدت المعاملة بالتركيزات المختلفة من المورفاكتين (٥٠-١٠٠ ملجرام / لتر) إلى زيادة ملحوظة فى سمك العرق الوسطى الرئيسى بالأوراق . وقد ازداد سمك طبقة النسيج المتوسط للأوراق زيادة طفيفة مع التركيز ١٠٠ ملجرام/لتر من المورفاكتين بينما تناقص سمك طبقة البشرة العليا للأوراق عند المعاملة بالتركيز ١٥٠ ملجرام / لتر من المورفاكتين.

ب- فى السيقان :

أدى زيادة التركيز المستخدم من المورفاكتين إلى زيادة فى قطر السيقان فى القطاعات العرضية بينما أدى التركيز ١٠٠ ملجرام/لتر من المورفاكتين إلى تناقص فى سمك طبقة الخلايا الاسكلرانشيمية الموجودة فى منطقة البشرة للساق . وقد أدت المعاملة بالتركيزات المختلفة من المورفاكتين إلى حدوث تأثيرات إيجابية على إعداد وأبعاد (قطر × طول) كلا من الحزم الوعائية الصغيرة والكبيرة المنتشرة خلال النسيج الأساسى فى السيقان .

مما سبق يتضح أن استخدام مادة المورفاكتين بالتركيز ١٠٠ ملجم/لتر مرة واحدة خلال مرحلة الاستطالة فى نباتات الذرة أدى إلى تحسين النمو الخضرى والمحصول ، كما كان لهذه التركيزات (٥٠ ، ١٠٠ ملجم / لتر) أثرا ايجابيا على بعض التراكيب التشريحية لكلا من أوراق وسيقان النباتات .