MORPHOPHYSIOLOGICAL STUDIES ON EGYPTIAN COTTON PLANTS (*Gossypium barbadense* L.)

1. Effect of some growth regulators and some micronutrients on growth, leaf pigments and chemical constituents of cotton plants

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ABSTRACT

The present investigation was carried out at Faculty of Agriculture Farm, during 1999 and 2000 growing seasons, Department of Agric. Botany, Faculty of Agriculture, Kafr El-Sheikh, Tanta University. The main objective of this investigation is: to study the effect of foliar spraying of the three PGRs *i.e.*, Pix, Kinetin and Morphactin with two concentrations for each one (low and high) and three micronutrients *i.e.*, iron (Fe), zinc (Zn) and manganese (Mn) with one concentration of each one, and their combinations; on: vegetative growth of cotton plants, , leaf pigments and some chemical constituents of cotton plants. The cotton cultivar was devoted in this study is Giza 86 an Egyptian long staple .

The main obtained results may be summarized as follows:

- Pix application 1000 and 2000 ppm significantly decreased plant height, leaf area and dry weight of leaves.
- Kinetin applications (25 and 50 ppm) significantly promote plant growth by increasing plant height, leaf area and dry weight of leaves, compared to the control plants in both seasons.
- Morphactin applications (10 and 20 ppm) slightly increased the vegetative characteristics compared to the control in both seasons.
- Micronutrients applications (Fe, 2000 ppm, Zn, 1500 ppm, and Mn, 1000 ppm) significantly increased plant height, and dry weight of leaves, While zinc (Zn) only, significantly increased leaf area/plant.
- Combined treatments (PGRs + microelement) slightly improved most of growth characteristics.

- All treatments under study significantly increased chl. a, chl. b and carotenoids. The highest values of chl. a were obtained from plants treated with pix.
- Pix applications significantly increased both N % and P% contents in cotton leaves on the other hand decreased K content (ppm) compared to the control in both seasons.Other treatments significantly increased NPK content. Morphactin application had no clear effect on NPK content in cotton leaves.

INTRODUCTION

Cotton is one of the most economically important crops in Egypt, supplies the national and international demand with the highest cotton lint quality. It is consider the main cash crop for most growers, besides it is one of the main sources for the hard currency. Cotton production occupies a very unique position among all other field crops in Egypt.no doubt that cotton production as for other crops could be easily maximized through appropriate nutrition and application of growth regulators.

Plant nutrition is one of the most important factors that affects cotton productivity. Micronutrients in general play an important role in the physiological and metabolic processes in cotton plants during different stages of growth(**Sharma *et al.*, 1988**) and (**Azab *et al.* 1992**).Foliar nutrition of cotton plants by trace elements (Zn, Fe, and Mn) is an attempt to increase cotton growth since Egyptian soil has been affected by its deficiency in trace elements particularly after high Dam (**Wassel *et al.* 2000**).

Plant height of cotton plants and dry weight/plant and chemical constituents were increased by foliar application of Zn, Fe, and Mn (**Azab *et al.*, 1992**) and(**Sawan *et al.*, 1997**).

Foliar application with Zn, Fe and Mn increased chlorophyll content in the green leaves (**Wassel 2001**) and (**Abd El-Shafy *et al.* 2001**) emphasized that application of growth regulators to major field crops is relatively rare and that the beneficial dose not always involve direct increase in yields.

The use of growth retardants such as pix and morphactin can be used to manage the vegetative development of cotton plants. Pix reducing plant height, leaf area, and dry weight of leaves (**Zhang *et***

al. 1990) pix also increased leaf content of chlorophyll a,b and total chlorophyll (**Hodges *et al.* 1991**).Morphactin decreased plant height, number of leaves but increased content of leaf chlorophylls and N, P and K concentration.

(**El-Beheidi *et al.*1991**) stated that applying kinetin to cotton plants increased stem length, and total dry weight.(**Wassel 2001**) indicated that cytokin increased chlorophyll a and b and carotenoids of cotton leaves.Therefore, the main objectives of this investigation are: to study the foliar spraying effect with some plant growth regulators; PGRs (pix, morphactin and kinetin) micronutrients (Fe, Zn, and Mn) and their combinations on morphological characteristics, leaf pigments and chemical composition of cotton leaves for an Egyptian long-staple cotton cultivar, Giza 86 during 1999 and 2000 growing seasons.

MATERIALS AND METHODS

The present investigation was conducted at the Faculty of Agriculture Farm throughout the Department of Agricultural Botany, Faculty of Agriculture, Kafr El-Sheikh, Tanta University during the two successive growing seasons 1999 and 2000. The study includes the effect of three plant growth regulators (PGRs) as well as, three micro-elements and all possible combinations of them with different concentrations and various times of application on growth, leaf pigment and chemical composition of leaves of an Egyptian long-staple cotton cultivar Giza 86. Cotton seeds were sown on April 18th and April 14th in 1999 and 2000 seasons, respectively . Mechanical analysis and chemical composition of the soil of the experiment are presented in Table (1) and (2).

Table (1): Mechanical and chemical analysis of soil sample of the experiment during 1999 and 2000 growing seasons.

Seasons	Soil mechanical analysis			pH	Water table (cm)
	Sand	Silt	Clay		
1999	23.40	35.50	41.10	8.0	85
2000	24.10	35.20	40.70	7.8	87

Soil chemical analysis 1999

Depth (cm)	Anions (meq/L)				Cations (meq/L)				EC dS m^{-1}
	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	
0-30	-	2.40	90.68	76.94	42.08	39.52	88.00	0.42	12.00
30-60	-	2.60	23.25	40.05	12.38	14.02	39.25	0.25	5.20
60-90	-	1.60	34.88	88.39	29.70	27.90	67.00	0.27	8.80
90-120	-	1.80	32.55	47.12	14.75	16.35	50.00	0.27	6.40

Soil chemical analysis 2000

Depth (cm)	Anions (meq/L)				Cations (meq/L)				EC dS m^{-1}
	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	
0-30	-	3.10	25.74	42.17	17.29	10.93	39.25	0.44	7.12
30-60	-	2.40	10.89	56.41	12.74	11.44	45.25	0.27	5.81
60-90	-	2.00	13.86	81.14	20.02	13.18	63.50	0.30	7.56
90-120	-	1.50	15.35	69.29	20.39	8.95	56.00	0.26	7.66

- EC = Electrical conductivity.

Table (2):Chemical analysis of experimental soil sample for microelements during 1999 and 2000 growing seasons.

Season	Depth	Micronutreints of soil profiles (ppm)		
		Fe	Zn	Mn
1999	0-30	12.50	2.35	31.00
	30-60	14.00	2.85	32.30
	60-90	12.50	3.35	35.15
	90-120	14.00	1.10	33.85
2000	0-30	8.46	0.44	7.02
	30-60	7.27	0.29	7.97
	60-90	5.83	0.32	7.71
	90-120	8.58	0.34	9.52

- Field Drainage Res. Dept., Sakha Agric. Res. Sta.

The experiment included 28 treatments as follows in Table(3) The treatments were randomly distributed in 28 experimental plots in each replicate of the randomized complete block. Experiment with three replications. Each plot consisted of five rows 4.5 m in length and 0.6 m in width.

All the agricultural practices were carried out as recommended in the farm. Nitrogen used in urea (46% N) at the rate of 60 kg N/feddan, nitrogen was splitted into two equal doses.

The first dose was added after thinning (before the first irrigation), whereas the second dose was applied before the second irrigation. Phosphorus was added during seed-bed preparation in the form of super phosphate(15.5% P_2O_5)at the rate of 100 kg super phosphate/faddan.

Characters studied:

1.Growth characters :

Were measured at plant age 120 days for spray treatments at 105 days from sowing respectively.

A. Plant height **B.** Leaf area $(dm)^2$/plant.

C. Dry weight of leaves/plant.

Table(3) Studies treatments and time of application

Treatment	Concentrarion	Time of Application
Control (Water)	0	
PGRs:-		
Pix1 (P1)	1000 ppm	PGRs were sprayed twice.
Pix2 (P2)	2000 ppm	The first spray was at 75 days from
Kinetin 1 (k1)	25 ppm	sowing.
Kinetin 2 (k2)	50 ppm	The second at 105 days from sowing.
Morphactin1(Mor.1)	10 ppm	
Morphactin 2(Mor. 2)	20 ppm	
Micronutrients:-		
Fe	2000 ppm	Micronutrients were sprayed three times:-
Zn	1500 ppm	The first spray was at 75 days from
Mn	1000 ppm	sowing.
PGRs+Micro.comb.		The second spray at 90 days from sowing.
P1+ Fe		The third spray at 105 days from sowing.
P1 + Zn		
P1 + Mn		
P2 + Fe		*Sowing date in 1999 season:-April,18.
P2 + Zn		*Sowing date in 2000 season:-April,14.
P2 + Mn		
k1 + Fe		
k1 + Zn		
k1 + Mn		
k2 + Fe		
k2 + Zn		
k2 + Mn		
Mor.1 + Fe		
Mor.1 + Zn		
Mor.1 + Mn		
Mor.2 + Fe		
Mor.2 + Zn		
Mor.2 + Mn		

2.Leaf pigments:

Were measured at plant age 115 days for spray treatments at 105 days from sowing chl. a, chl. b and carotenoids were spectrophotometrically determined as described by **Wettstein (1957).**

3.Chemical composition in cotton plant leaves;

- Total nitrogen 90 in leaves was determined by using micro-Kjeldahl method in A.O.A.C. (1982).
- Phosphorus (40) in cotton plant leaves:

Total phosphorus was determined by ascorbic acid method using the calorimetric method that described by **Murphy and Riely (1962).**

- Potassium (%) in cotton plant leaves:
  Potassium content in cotton leaves samples were estimated using flame photometer by **Pearson (1976).**

Statistical analysis:

The analysis of variance for randomized competed block design was carried out for, each character in each season as outlined by **Snedecor and Cochran (1980).** The differences between the different treatment combination were tested using the Duncan's Multiple Range Method outlined by **leclerg *et al.* (1962).**

RESULTS AND DISCUSSION

1. Growth analysis:

1.1. Effect of plant growth regulators:

1.1.1. Effect of pix (Mc):

Data recorded in Table (4) showed that plant height, leaf area and dry weight of leaves were significantly reduced by pix application in both seasons compared to untreated plants.the shortest cotton plants were resulted from the highest application of pix (2000 ppm) at 120 days of plant age. This reduction in plant height could be explained on the basis that pix partially inhibitors one of the enzymes that involved in (GA_3) biosynthesis and blocking (GA_3) production. These results are parallel with those obtained by **Azab *et al.* (1993) Ramachandra *et al.* (1996)**

Reduction in leaf area, plant due to pix modulated suppression of cell enlargement. The reduction in dry weight of leaves/plant due to that pix treated plants resulted in lesser number of leaves, plant, smaller leaves and reduction in leaf area consequently, the net photosynthetic rates were lower in pix treated plants and this could be related to reduction in dry weight of leaves/plant similar results were obtained by **Ghourab *et al.* (2000).**

1.1.2. Effect of kinetin:

Data in Table (4) indicated that kinetin applications (25 and 50 ppm) significantly promote plant growth by increasing plant height, leaf area and dry weight of leaves compared to the control plants in both seasons.

The increasing in plant height tended to increase growth rate and plant development, from cell division and cell enlargement to formation more number of nodes per main stem. These results were in harmony with obtained by **Hedin and McCarty (1994), Cothren (1994) and Sawan *et al.* (2000).** The highest leaf area of cotton plants were resulted form the highest concentration of kinetin at 120 days of plant age in both seasons.similar results were obtained by **Wassel (2001)** who reported that the cytokin enhanced the vegetative growth.

Dry weight are increased in kinetin applications may be due to the increase in number of leaves and leaf area. These results are in line with **El-Beheidi *et al.* (1991)** on broad bean.

1.1.3. Effect of morphactin:

Data in Table(4)showed that morphactin resulted in significantly taller plants compared to control plants at 120 days of plant age the similar results was obtained by **El-Desoki *et al.* (1994)** studied that lower concentration (10-50 ppm) of morphactin increased stem length. Also morphactin increased the leaf area per plant and dry weight of leaves at 120 days of plant age. These results are in line with those obtained by **El-Desoki *et al.* (1994).**

1.1.4. Effect of micronutrients:

Data in Table (4) recorded that micronutrients applications Fe, 2000 ppm, Zn, 1500 ppm and Mn, 1000 ppm) significantly increased plant height, , leaf area/plant, dry weight of leaves at 120 days of plant age in both growing seasons.

The enhancing effect of these micronutrients may be due to their promoting effect on vegetative growth. However these elements increased photosynthesis activity and produced metabolites processes. Required for building both the vegetative and productive growing parts. these results were in agreement with those obtained by **Abdel-Shafy *et al.* (2001) and El-Sabbagh *et al.* (2002).**

1.1.5. Effect of PGRs + micronutrients combinations:

Data recorded in Table (4) that PGRS + microelement) Improved most of growth characteristics effect of these treatments due to the effect of microelements are very important for physiological and metabolic processes in cotton plants during different stages of plant

growth and give a beneficial effect when applied to retardants PGRs treatments, such as pix or morphactin. The similar results were obtained by **Bauer and Cothern (1990).**

Table (4): Effect of foliar spraying treatments with PGRs. Micronutrients and their combinations on growth (vegetative characteristics) of cotton plants measured at 15 days form 2nd applications during 1999.

Treatments	1999			2000		
	Plant height/cm	Leaf area/dm^2	Dry weight/leaves gm	Plant height/cm	Leaf area/dm^2	Dry weight/leaves gm
PGRs						
Pix_1	96.67 ig	20.51 m	26.17 e-f	96.33 jk	19.88 l	24.35 kl
Pix_2	92.67 j	21.49 kl	26.57 ef	91.33 l	21.19 ij	25.00 kl
Kinetin1	168.67 a	34.19 c	36.20 ab	158.33 b	34.23 b	36.00 cd
Kinetin2	168.67 a	35.04 b	38.30 a	162.00 a	34.99 a	37.77 bc
Morphactin1	140.00 f	21.13 lm	27.70 e	129.00 h	20.16 kl	26.93 jk
Morphactin2	154.67 e	21.12 lm	25.33 ef	135.67 fg	20.14 kl	26.87 jk
Micro-nutrients:						
Fe	134.33 fg	29.05 f	34.17 abc	134.67 g	28.40 d	31.90 e-h
Zn	157.00 cde	30.10 e	35.70 ab	138.00 efg	28.73 d	34.40 c-f
Mn	159.67 be	29.93 e	35.33 ab	139.33 ef	28.56 d	33.07 d-g
PGRs+Micro. comb.						
P_1 + Fe	104.67 h	21.99 ijk	27.57 e	99.67 ij	21.34 hij	26.30 jk
P_1 + Zn	106.00 h	22.49 hi	28.87 de	102.00 i	21.78 ghi	29.00 hij
P_1 + Mn	102.33 hi	22.23 ij	28.03 de	99.33 ij	21.69 ghi	27.70 ijk
P_2 + Fe	93.67 j	21.62 jkl	27.13 e	95.33 k	21.29 hij	26.20 jk
P_2 + Zn	94.00 j	22.34 i	28.60 de	94.00 kl	21.70 ghi	28.80 hij
P_2 + Mn	97.00 ij	22.68 ghi	30.07 cde	96.33 jk	22.59 ef	30.67 ghi
K_1 + Fe	164.67 ab	35.04 b	37.17 ab	155.33 bc	34.33 ab	36.37 cd
K_1 + Zn	163.67 abc	34.13 c	36.07 ab	155.00 bc	33.21 c	35.30 cde
K_1 + Mn	162.67 abc	33.28 d	35.83 ab	150.33 d	32.80 c	34.97 cde
K_2 + Fe	165.00 ab	35.08 b	38.83 a	157.67 b	35.07 a	40.00 ab
K_2 + Zn	163.33 abc	34.91 b	36.57 ab	153.00 cd	34.32 ab	36.27 cd
K_2 + Mn	162.67 abc	35.74 a	39.17 a	150.33 d	35.10 a	41.00 a
Mor_1 + Fe	155.00 de	21.35 kl	28.93 de	136.33 efg	21.50 hij	29.20 hij
Mor_1 + Zn	154.67 e	21.15 lm	28.33 de	135.67 fg	20.77 jk	27.80 ijk
Mor_1 + Mn	162.00 ad	22.66 ghi	32.77 bcd	140.33 e	22.37 efg	31.45 fgh
Mor_2 + Fe	160.00 be	22.01 ijk	28.57 de	140.33 e	22.02 fgh	28.80 hij
Mor_2 + Zn	153.00 e	23.14 gh	35.17 ab	135.67 fg	22.40 efg	32.23 e-h
Mor_2 + Mn	157.67 be	23.30 g	35.47 ab	138.33 efg	22.98 e	34.33 c-f
Water (Control)	131.33 g	28.56 f	22.27 f	126.0 h	28.38 d	22.07 l
Mean	140.20	26.65	31.82	130.20	26.14	31.24

Means designed by the same letter at each cell are not significantly different at the 5% level according to duncan's multiple rang test

2.Chemical composition in cotton plant leaves:

2.1.Macro microelements content in cotton plant:

2.1.1.Effect of pix:

Data in Table (5) indicated that pix significantly increased both N% and P% contents in cotton leaves and decreased K content (ppm) compared to the control in both seasons. similar results were recorded by **Stein *et al.* (1983) and Zhang *et al.* (1990).**

2.1.2.Effect of kinetin:

Data in Table (5) showed that kinetin applications significantly increased N and P content (%) and K content (ppm) in cotton leaves compared to the control. This may be due to that treatment with kinetin significantly enhanced growth and NPK uptake. Similar findings were obtained by **Oosterhuis and Janes (1994).**

2.1.3. Effect of morphactin:

Data in Table (5) showed that morphactin had no clear effect on NPK content in cotton leaves in both seasons compared to control. These results were in agreement with those obtained by **Sakr and Leilah (1996).**

2.1.4.Effect of micronutrients:

Data in Table (5) indicated that micronutrients applications significantly increased NPK content in the leaves compared to the control in both seasons.

This may be due to that micronutrients applications increased NPK uptake by cotton plants. Similar results in this respect were obtained by **El-Aggory *et al.* (1986).**

2.1.5. Effect of PGRS + micronutrients combinations:

Data in Table (5) recorded that combined treatments applications significantly increased NPK content in cotton leaves compared to the control in both seasons. Similar results were obtained by **Sakr and Leilah (1996).**

3.Leaf pigments:

3.1.Effect of pix:

Data recorded in Table (5) that pix applications significantly increased chl. a, chl. b and carotenoids content in cotton leaves as mg/dm^2 compared to control. The highest values of chl. a were obtained from plants treated with pix.

Table (5): NPK and Leaf pigments as influenced by foliar spraying treatments with PGRs, micronutrients and their combinations. Leaf pigments measured at 115 days of plant age during 1999 and 2000 growing seasons.

Treatments	Total N% in leaves		Total P% in leaves		K content in leaves ppm		Chl. a mg/dm²		Chl. b mg/dm²		Car. mg/dm²	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
PGRs:												
Pix 1	2.38 fgh	2.25 ijk	0.23 ghi	0.22 hi	58.77 hi	60.67 ij	6.47 a	6.45 a	1.60 n	1.64 i	2.09 g	1.64 gh
Pix 2	2.50 cd	2.37 f	0.26 a-d	0.27 abc	61.02 ghi	61.33 ij	6.47 a	6.34 a	1.65 lm	1.70 h	2.13 g	1.60 h
Kinetin 1	2.54 c	2.39 ef	0.22 hi	0.22 hi	75.85 b	81.10 bcd	5.42 def	5.51 de	1.74 k	1.72 gh	2.70 ab	1.96 ab
Kinetin 2	2.72 ab	2.52 ab	0.27 abc	0.27 ab	82.62 a	83.08 abc	5.96 b	6.00 b	1.85 a-d	1.87 a-d	2.29 f	1.69 fgh
Morphactin 1	2.20 j	2.16 m	0.25 d-g	0.25 def	69.41 cde	69.42 fgh	5.57 cde	5.52 de	1.82 d-i	1.85 c-f	1.15 m	0.74 o
Morphactin 2	2.28 i	2.20 lm	0.23 ghi	0.23 ghi	66.47 d-g	67.26 g-j	5.79 bc	5.80 bc	1.89 a	1.90 ab	1.45 j	0.94 jkl
Micro-nutrients:												
Fe	2.37 fgh	2.25 ijk	0.26 a-e	0.27 abc	67.10 def	68.38 f-i	5.72 bcd	5.54 de	1.81 e-i	1.84 c-f	1.11 m	0.63 p
Zn	2.38 fgh	2.27 h-k	0.24 e-h	0.4 efg	72.55 bc	76.70 cde	5.41 def	5.47 def	1.82 d-g	1.84 c-f	1.17 m	0.77 mno
Mn	2.39 e-h	2.30 hi	0.26 a-e	0.25 b-e	70.35 cd	73.00 efg	4.79 h	4.77 g	1.78 hig	1.81 ef	1.17 m	0.76 no
PGRs + Micro. comb.												
P_1 + Fe	2.40 e-h	2.31 gh	0.25 b-f	0.24 d-g	58.15 i	59.69 j	5.39 def	5.29 ef	1.75 jk	1.76 g	2.68 ab	1.91 a-d
P_1 + Zn	2.38 fgh	2.27 h-k	0.27 abc	0.26 a-d	59.67 hi	61.17 ij	4.75 hi	4.48 h	1.80 ghi	1.84 c-f	2.52 e	1.72 fgh
P_1 + Mn	2.40 efg	2.35 fg	0.28 a	0.27 a	61.24 ghi	62.83 hij	5.14 fg	5.22 f	1.78 ij	1.80 f	2.29 f	1.65 gh
P_2 + Fe	2.45 de	2.37 f	0.26 a-e	0.27 ab	61.54 ghi	62.94 hij	5.27 efg	5.24 f	1.68 l	1.72 gh	2.65 e	1.89 a-d
P_2 + Zn	2.39 e-h	2.30 hi	0.27 abc	0.27 a	64.fgh	66.76 g-j	5.13 fg	4.96 g	1.62 mn	1.69 h	2.52 e	1.75 ef
P_2 + Mn	2.33 hi	2.23 kl	0.27 abc	0.27 a	63.18 f-i	64.33 hij	4.34 j	4.24 h	1.60 n	1.68 h	2.70 ab	1.92 abc
K_1 + Fe	2.65 b	2.43 de	0.22 i	0.21 ij	84.79 a	85.27 ab	5.75 bc	5.63 cd	1.84 c-f	1.87 a-d	2.56 de	1.80 c-f
K_1 + Zn	2.70 ab	2.50 bc	0.24 e-h	0.25 cde	85.55 a	87.0 ab	4.38 j	4.35 h	1.79 ghi	1.83 def	2.56 cde	1.84 b-e
K_1 + Mn	2.66 b	2.46 cd	0.26 a-e	0.26 a-d	86.05 a	88.83 a	4.36 j	4.25 h	1.82 d-h	1.85 c-f	2.62 bcd	1.85 a-e
K_2 + Fe	2.73 a	2.53 ab	0.26 a-d	0.26 a-d	83.43 a	85.20 ab	5.38 ef	5.25 f	1.87 abc	1.88 abc	2.54 de	1.79 def
K_2 + Zn	2.75 a	2.56 a	0.27 ab	0.27 ab	85.29 a	85.93 ab	4.74 hi	4.37 h	1.87 abc	1.88 abc	2.56 cde	1.84 cde
K_2 + Mn	2.69 ab	2.49 bc	0.27 ab	0.27 a	85.11 a	85.50 ab	5.88 bc	5.86 bc	1.88 ab	1.90 ab	2.76 a	1.97 a
Mor_1 + Fe	2.36 gh	2.25 jk	0.22 i	0.22 hi	66.08 d-g	67.08 g-j	5.22 fg	5.23 f	1.85 bcd	1.87 a-d	1.27 l	0.83 l-o
Mor_1 + Zn	2.38 e-h	2.28 hij	0.22 hi	0.23 fgh	65.80 efg	66.87 g-j	4.43 ij	4.35 h	1.89 a	1.91 a	1.31 l	0.86 k-n
Mor_1 + Mn	2.39 e-h	2.30 hi	0.24 f-i	0.23 ghi	61.04 ghi	61.52 hij	4.45 ij	4.36 h	1.84 b-e	1.85 b-e	1.34 kl	0.86 k-n
Mor_2 + Fe	2.39 e-h	2.30 hi	0.25 d-g	0.24 d-g	62.43 f-i	63.3. hij	5.96 b	5.92 b	1.85 bcd	1.87 a-d	1.41 jk	0.88 klm
Mor_2 + Zn	2.43 ef	2.37 f	0.25 c-g	0.25 b-e	71.29 bcd	75.10 def	4.95 gh	4.86 b	1.80 f-i	1.85 b-e	1.46 j	0.97 jk
Mor_2 + Mn	2.39 e-h	2.30 hi	0.23 f-i	0.23 fgh	63.09 f-i	63.67 hij	4.94 gh	4.85 g	1.84 b-f	1.85 c-f	1.55 i	1.02 j
Water (control)	2.20 j	2.17 m	0.20 j	0.20 j	63.72 fgh	66.46 g-j	4.3 j	3.75 i	1.50 o	1.55 j	1.75 h	1.42 i
Mean	2.46	2.34	0.25	0.25	69.84	71.44	5.23	5.14	1.78	1.81	2.01	1.41

Means designed by the same letter at each cell are not significantly different at the 5% level according to duncan's multiple rang test

In general these results mean that the application of pix to cotton plants was active in chloroplast pigments biosynthesis especially chl. a.**Gousman *et al.* (1981)** reported that Mc (Pix) delayed leaf chlorophyll degradation and increased chlorophyll content in cotton leaves. These results supported the findings of many investigators **Wahdan(1990) and Azab *et al.* (1993).**

3.2.Effect of kinetin:

As shown from the results(Table 5)kinetin applications significantly increased chl. a, chl. b and carotenoids content in cotton leaves compared to the control in both seasons.In this respect it could be presumed that favourable effect of kinetin on chlorophyll content

may be attributed to increase in the carotenoids which may led to protect chlorophyll against degradation by photo-oxidation processes **El-Beheidi *et al.* (1991).**

3.3.Effect of morphactin:

Data in Table (5) showed that morphactin applications significantly increased leaf pigments (chl. a, chl. b and carotenoides) in cotton leaves compared to the control. The promotive effect of morphactin in this respect may be interpreted with that it delays senescence of cotton leaves as mentioned by **(Schneider 1972).**

3.4.Effect of micronutrients:

As shown from Table (5) micronutrients applications significantly increased leaf pigments in cotton leaves compared to the control. In general, such results mean that these micronutrients treatments enhanced and stimulate the biosynthesis of leaf pigments. Also, it is well known that Fe is initial for chlorophyll synthesis, Zn and Mn are involved in several enzymes which attributed to carbohydrate and protein metabolism **(Abd El-Shafy, 1998).**

3.5.Effect of PGRs + micronutrients combinations:

Data in Table (5) showed that combined treatments applications significantly increased leaf pigments in cotton leaves in both seasons compared to the control. The combined treatments involve one of PGR with Fe resulted in the highest values of chl. a compared to the control. These results were in agreement with those obtained by **Ibrahim and El-Labban (1986).**

REFERENCES

Abdel-Shafy, N.A. (1998). Egyptian cotton varieties response to foliar nutrition with microelements. J. Agric. Sci. Mansoura Univ., 23(12): 5275-5285.

Abdel-Shafy, N.A.; M.E. El-Menshawi and E.A. Girgis (2001). Effect of some macro and micronutrients fertilization on cotton yield. Minufiya J. Agric. Res. Vol. 26 No. 3: 673-687.

A.O.A.C. Official Methods of Analysis, 14th ed.; Association of Official Analytical Chemists: Arlington, VA, 1982.

Azab, A.S.M.; M.A. Eweida and A.W. Shalaby (1992). Response of two long staple cultivars of Egyptian cotton to foliar application with some micronutrients. Zagazig. J. Agric. Res. Vol. 19(1); 49-60.

Azab, A.S.M.; Sh.H.M. El-Halawany and F.M.M. Ahmed

(1993). Effect of mepiquat chloride under high nitrogen rate on reproductivity of cotton plant. Assiut. J. Agric. Sci., 24(1): 283-295.

Cothren, J.T. (1994). Use of growth regulators in cotton production in: Constable, G.A., Forrester, N.W. (Eds.), Challenging the future. Proceeding of the World Cotton Research Conference. I. February 14-17. Brisbane, Australia, pp. 6-24.

El-Aggory, E.M.A.; E.T. Eid and M.E. El-Akkad (1986). Relationship between yield and nutrient concentration in plant portions of 14 Egyptian cotton varieties. (*Gossypium barbadense* L.). Agric. Res. Rev. 64(4): 701-714.

El-Beheidi, M.A.; M.H. El-Sawah; E.A. El-Ghamriny and F.H. Afia (1991). Effect of foliar spray with kinetin, CCC and GA_3 on growth and yield of broad bean plants. Zagazig J. Agric. Res. Vol. 18(6): 1935-1945.

El-Desoki, E.R.; S.I. Omara; Z.A. Ali and R.R. El-Masry (1994). Effect of chlorflurenol (Morphactin CF 125) on the growth and development of *Vicia faba* L. and *Orobanche crenata* Forsk. J. Agric. Sci. Mansoura Univ., 19(5): 1691-1699.

El-Sabbagh, A.A.; S.A. Abd El-Hafez; A.Z. El-Bably and E.I. Abou-Ahmed (2002). Cotton response to frequent irrigation and foliar application of some micronutrients J. Agric. Res., Tanta Univ., 28(1): 193-205.

Gausman, H.W.; D.E. Escobar and R.R. Rodriguez (1981). Reflectance measurements of cotton leaf senescence altered by mepiquat chloride plant growth regulator Bulletin, 9(4): 6-8 (C.F. Field Crop Abst., 39(3): 2574, 1983).

Ghourab, M.H.H.; O.M.M. Wassel and M.S. Abou El-Nour (2000). The effect of mepiquate chloride application on the productivity of cotton plants Egypt. J. Agric. Res., 78(3): 1207-1218.

Hedin, P.A.; J.C.Jr. McCarty (1994). Multi year study of effect of kinetin and other plant growth hormones and yield, agronomic. Traits and Allelochemicals of Cotton. J. Agric. Food Chem. 42, 2305-2307.

Hodges, H.F.; V.R. Reddy and K.R. Reddy (1991). Mepiquate chloride and temperature effects on photosynthesis and respiration of fruiting cotton. Crop Sci. 31(5): 1302-1308.

Ibrahim, A.A. and T.T. El-Labban (1986). Effect of kinetin, cycocell and some micro nutrients on the accumulation of some micronutrients in *Vicia faba.* Annals of Agric., Sci., Moshtohor, Vol. 24(2).

LeClerg, E.L.; W.H. Leonard and A.G. Clark (1962). Field plot technique. Burges Publishing Company.

Murphy, J. and J.P. Riely (1962). A modified single solution method for the determination of phosphate in natural water. Anal. Chemi. Acta, 27: 31-36.

Oosterhuis, D.M. and L.D. Janes (1994). Research on new plant growth regulators for cotton. In proceeding of FAO and 2nd consultative meeting of the working group 3 on growth regulators on cotton. 28-29 January, 1994. Anthens, Greece.

Pearson, D. (1976). The chemical analysis of foods 7th Ed. Churchill, London, U.K.

Ramachandra, R.A.; K.R. Reddy and H.F. Hodges (1996). Mepiquate chloride (Pix) induced changes in photosynthesis and growth of cotton. Plant Growth Regulation, 20(3): 179-183.

Sakr, M.T. and A.A. Leilah (1996). Influence of uniconazole, ethrel and some micronutrients on growth, yield and some physiological traits of soybean plants. J . Agric. Sci. Mansoura Univ. 21(2): 593-602.

Sawan, Z.M.; M.H. Mahmoud and O.A. Momtaz (1997). Effect of phosphorus fertilization and foliar application of chelated zinc and calcium on quantitative and qualitative properties of Egyptian cotton (*Gossypium barbadense* L. var. Giza 75). J. Agric. Food Chem. 1997, 45, 3326-3330

Sawan, Z.M.; A.A. Mohamed; R.A. Sakr and A.M. Tarrad (2000). Effect of kientin concentration and methods of application on seed germination, yield components, yield components, yield and fiber properties of the Egyptian cotton (*Gossypium barbadense* L.) Environmental and Experimental Botany 44: 59-68.

Schneider, G. (1972). Morphactin and plant growth regulation. Kaladewey, H.Y. (Ed.). Hormonal regulation in plant growth and development proceedings of the Advanced Stady Institute. Izmir (1971). 371-Verlag Chemie, Weinhein.

Sharma, J.C.; N.K. Tomar and V.K. Gupta (1988). Effect of

levels and methods of zinc application and growth, yield attributes and yield of cotton (*Gossypium hirsutum* L.). Agricultural-Science-Digest-Karnal, 1988, 8: 3, 165-169.

Snedecor, G.W. and W.G. Cochran (1982). Statistical methods. The Iowa State University Press. 7th Edit. 2nd Printing. 507 pp.

Stein, E.R.; F.R. Rittig and G.W. Gausman (1983). Influence of Pix on modified cotton (*G. hirusum*) leaf senescence. Plant growth Bulletin, 11(3): 5-7 (CF. Field Crop Abst. 37(6): 4777, 1984).

Wahdan, G.A. (1990). Physiological effect of nitrogen as foliar application and some growth regulators on cotton plants. Ph.D. Thesis, Fac. of Agric., Monoufia Univ., Egypt.

Wassel, O.M.M. (2001). Effect of some natural plant growth regulators on growth and productivity of Giza 77 cotton cultivar. Minufiya J. Agric. Res. Vol. 26(4): 965-975.

Wassel, O.M.M.; M.H.H. Ghourab and Gamalat A. Wahdan (2000). Response of cotton plant to nitrogen fertilizer and some micronutrients. Minufiya J. Agric. Res. Vol. 25(6): 1413-1424.

Wettestien, D. (1957). Chlorophyll, letal und dersubimicros-Kopische formech Sellder Plastiden. Exptl. Cell. Res., 12: 427-433.

Zhang, S.; J.T. Cothren and E.J. Lorenz (1990). Mepiquate chloride seed treatment and germination temperature effects on cotton growth, nutrient partitioning and water use efficiency J. of Plant. Growth. Regulation. 9:(4), 195-199.

دراسات مورفوفسيولوجية على نبات القطن المصري

اولا:تأثير بعض منظمات النمو والعناصر الصغرى على نمو نبات القطن وكذلك على صبغات الورقة وعلى المحتوى الكيميائي للأوراق

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الملخص العربى

تم تنفيذ هذا البحث فى مزرعة كلية الزراعة خلال موسمي الزراعة ١٩٩٩/٢٠٠٠م قسم النبات الزراعى ــ كلية الزراعة ــ كفر الشيخ ــ جامعة طنطا. وكان الهدف الرئيسي من هذا البحث هو دراسة تأثير الرش الورقي لثلاثة منظمات نمو هي: البكس والكينيتين والمورفاكتين بتركيزين لكل منظم نمو ، تركيز منخفض وتركز عالي

وكذلك ثلاثة عناصر صغرى هى الحديد والمنجنيز والزنك بتركيز واحد لكل منهما بالإضافة إلى كل التوافيق الممكنة بين منظمات النمو والعناصر الصغرى على صفات النمو وصبغات الورقة وعلى المحتوى الكيميائي للأوراق من NPK وكان الصنف المستخدم هو جيزه ٨٦ وهو من طبقة الأصناف الطويلة التيله.

وكان أهم النتائج المتحصل عليها هى:

١- أدت المعاملة بمنظم النمو بيكس بالتركيزات ١٠٠٠ ، ٢٠٠٠ جزء فى المليون إلى تثبيط النمو المستطرد لنباتات القطن وأدت أيضا إلى نقص معنوى لكل من ارتفاع النبات والمساحة الورقية/نبات والوزن الجاف للأوراق/نبات مقارنة بالنباتات الغير معاملة (الكنترول).

٢- أدت المعاملة بالكينتين بالتركيزات ٢٥ ، ٥٠ جزء فى المليون إلى زيادة معنوية فى كل من طول النبات ، والمساحة الورقية/نبات ، والوزن الجاف للأوراق/نبات مقارنة بالنباتات الغير معاملة (الكنترول).

٣- أدت المعاملة بالمورفاكتين بالتركيز المنخفض (١٠ جزء فى المليون) إلى زيادة معنوية فى الوزن الجاف للأوراق بعد ١٥ يوما من الرشة الثانية (عمر النبات ١٢٠ يوم) مقارنة بالنباتات غير المعاملة (الكنترول).

٤- أدت المعاملة بالعناصر الصغرى إلى زيادة معنوية فى ارتفاع نبات القطن والوزن الجاف للأوراق والمساحة الورقية/نبات مقارنة بالنباتات الغير معاملة (الكنترول).

٥- أدت المعاملات المشتركة من منظمات النمو والعناصر الصغرى إلى زيادة طفيفة فى طول النبات .

٦- أدت جميع المعاملات تحت الدراسة إلى زيادة معنوية فى محتوى الأوراق من كلوروفيل أ ، ب والكاروتينوانات ملليجم/ديسمتر^{٢}.

٧- أدت المعاملات بالبيكس إلى زيادة معنوية الورقة من النيتروجين ، الفوسفور بينما أدت إلى نقص محتوى الورقة من البوتاسيوم ولم يكن هناك تأثير واضح للمعاملة بالمورفاكتين على محتوى الورقة من هذه العناصر. باقي المعاملات أدت إلى حدوث زيادة معنوية فى محتوى الأوراق من NPK.