J. Agric. Sci. Mansoura Univ., 28 (2): 979 - 993, 2003

PHYSIOLOGICAL RESPONSE OF WHEAT PLANT (*Triticum aestivum* L.) TO FOLIAR APPLICATION OF PIX AND ATONIK

Amin, A . A.
Botany department, National Research Centre, Dokki, Cairo, Egypt.

ABSTRACT

Two field experiments were conducted during 1997/1998 and 1998/1999, at the Experimental Station of the National Research Centre at Shalakan, Kalubia Governorate to study the physiological response of wheat plants to different concentration of atonik (0 , 20 , 40 and 60 mg/l) and Pix (0 , 50 , 100 and 200 mg/l) as well as their interaction on vegetative growth, yield and its components as well as the content of crude protein and total carbohydrate in produced grains. The data indicated that spraying atonik with different concentrations at all stages led to significant increases in plant height, number of tiller, number of spikes, blades area, leaf area index, dry weight of plant, spike weight and length, 1000- grains weight, grain and straw yield per plant and per fed. While , spraying pix led to significant decreases plant height, both number of tiller, and spikes/plant, leaf area, leaf area index and carbohydrate percentage in grains.

Spraying wheat plants with atonik at 60 mg/l or pix at 50 mg/l caused the highest values in most of growth characters. Spraying plant with 60 mg/l atonik and pix at 100 and 200 mg/l attained significant increases in economic yield and its components as compared with other treatments. Application of atonik treatments in general had a positive effect in most cases on protein and carbohydrate percentage, atonik at 40 and 60 mg/l was more effective. while, the highest value was obtained at 100 mg/l pix on crude protein content and 50 mg/l pix on total carbohydrate content.

Interaction between atonik at 40 and 60 mg/l and pix at 50 and 100 mg/l gave the highest values of growth characters. Application atonik at 60 mg/l with pix at 200 mg/l increased significantly yield and its components as compared with other treatments. Interaction between atonik 60 mg/l with pix at 100 mg/l and atonik at 20 mg/l with pix at 200 mg/l gave the highest values of crude protein and carbohydrate percentage in produced grains, respectively.

INTRODUCTION

Wheat is considered the most important strategic crop in Egypt. The strategic considerations of this crop are due to the gap between its current and steadily increasing consumption and its relatively unsufficient production at national level. Normal plant growth and development are at least in part controlled by substances produced by the plant itself including the endogenous plant growth regulators. Synthetic growth regulating substances are extremely valuable in controlling crop growth and yield.

Atonik (Sodium 5- nitroguaiacolate + Sodium 1- nitrophenolate + Sodium 4- nitrophenolate) is recently known to stimulate many aspects of plant growth and development. Kopecky (1995) on hops, Steger and Oosterhuis (1997) and Zhao *et al.*, (1998) on cotton found that foliar application with atonik increased growth, yield and its components of both plants.

Pulkrabek *et al.*, (1999) on sugar beet and Vostrel (2000) on hop plant concluded that application of atonik treatments gave higher growth , yield and chemical constituents. Recently, Abd El-Wahed *et al.*, (2002) and Farahat (2002) found that spikes number/m^2, spikes and grain weight (g/m^2) and grain yield kg/fed. of wheat significantly increased as a result of spraying atonik at 2.25 mg/l compared to untreated plants.

Mepiquate chloride (1,1- dimethyl piperidinium chloride) well known as pix is one of systemic plant growth regulator, which is used mainly to control of lodging in cereals due to its antigibberelline activity. Gaber *et al.*, (1993) on soybean and Nowak *et al.*, (1997) on bean found that increasing dose of mepiquate chloride from 500 up to 2000 ppm decrease plant height, leaf area, number of nodes as well as fresh and dry weight of plants compared with the control. While 100-seed weight was increased at low rate of pix application. Also, Carnstoun (1999) concluded that pix suppressed vegetative growth in spring barley by reducing plant height but did not affect on yield barley. However, Jayachandran *et al.*, (1999) reported that the growth regulators with mepiquate chloride generally increased physiological parameters and grain yield of rice. Also, Youssef (1993) on sunflower plant, and Channakeshava *et al.*, (1999) on Zea mays found that application of pix at 100 and 200 ppm concentration at 45 days after sowing gave significantly increased in grain yield compared with the control. While, Bangal *et al.*, (1989) demonstrated that, spraying wheat plants with pix at 100 mg/l had no significant effect on grain yield, grain number/plant and 1000-grain weights. Similar results were obtained by Mekki (1999), Prasad and Prakash (2000) and Lamas *et al.*, (2000) on cotton.

The objectives of the present study was to reveal the effect of foliar application of atonik and pix as well as their interaction on growth and yield and its components and their effect on crude protein and total carbohydrate of produced wheat grains.

MATERIALS AND METHODS

Two field experiments were carried out at the Agricultural Experimental Station, National Research Center at Shalakan, Kalubia Governorate during two successive seasons of 1997/1998 and 1998/1999 to study the physiological response of wheat plants (*Triticum aestivum* L.) cv. Sakha 69 to growth regulators (atonik and Pix). The treatments were divided into two groups, the first group; plants were sprayed with three concentrations of atonik which were 20, 40 and 60 mg/l. Second group, plants were sprayed with three concentrations of mepiquat chloride (pix) which were 50, 100 and 200 mg/l in addition to the control (distilled water)and the interaction between atonik and pix treatments.

The plants were sprayed twice at 45 and 60 days after sowing. The experiment was arranged as split plot design, keeping pix in main plots and atonik treatments in subplots with four replicates. Wheat grains, variety sakha 69 were sown on 17th and 19th November 1997 and 1998 respectively, plot area was 12 m^2 (4 × 3m) in rows 4 meters long and 25 cm apart.

The recommended agricultural practices of growing wheat were applied. For sowing the grain rate was 60 kg/fed. calcium superphosphate (15.5 P_2O_5 %) was added pre-sowing at 100 kg/fed, ammonium nitrate (33.5 % N) at 100kg/fed added applied at three equal doses ; the first at (seedling stage); the others at third and fifth irrigation (tillering stage), potassium sulfate (48.52 % K_2O) at the rate of 50 kg/fed . was added at two equal doses at the first and third irrigations. At elongation stage (100 days after sowing) and at milky stage (120 days after sowing) were recorded The following data per plant. i. e. plant height, number of tiller, number of spikes and dry weight, blades area (cm^2/plant) was calculated according to Bremner and Taha (1966) and leaf area index (LAI) was calculated according to Watson (1952) . At the harvest stage , the following plant characteristics were measured , i.e; plant height, number of both tiller and spikes/plant , spikes length , weight of spikes/plant (g) , 1000-grain weight/(g) , grain yield per plant , straw yield/plant (g) and grain and straw yield per (tons/feddan). Grains samples from all treatments were dried at 70 °C till constant weight and then ground to determine total Nitrogen and protein percentage (according to the method A.O.A.C.,1970) and protein percentage was calculated by multiplying the value of total nitrogen content by 5.70 . The total carbohydrates percentage was determined according to Dubois *et al.*, (1956).

Combined analysis for data of two seasons and the values of L.S.D. were calculated as described by Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

1-Effect of atonik and pix on growth characteristics :

Date presented in Table (1 , 2) indicate that plant height , tiller number , spikes number , blades area , leaf area index and dry weight per plant significantly responsed due to different treatments of atonik especially at 60 mg/l at elongation and milky stages as compared with other treatments. Foliar spraying with atonik treatments caused significant increases in growth characteristics as its concentration increased from 20 to 60 mg/l. This increase might be due to the stimulation effect of atonik for increasing N uptake and in turn reflected on increasing the metabolic processes and this in turn on their vegetative growth represented in number of tiller and dry weight of wheat. In accordance , Guo and Oosterhuis (1995) , Pulkrabek *et al.*, (1999) and Farahat (2002 b) supported this interpretation for the effect of atonik on sugar beet , cotton and wheat respectively. However , in case of pix treatment the opposite was true as vegetative growth criteria and plant height decreased or slightly affected as pix concentration was increased from 50 to 200 mg/l at both elongation and milky stages (Tables 1 and 2). These results could be in agreement with those obtained by Zhao *et al.*, (1999) and Jones *et al.*, (2000) found that pix treatment reduced vegetative growth of cotton. The inhibitory action of pix might be due to inhibiting GA biosynthesis .

Table (1): Effect of growth regulators (atonik and pix) and their interaction on vegetative growth of wheat plant at elongation stage (100 days after sowing)
(Combined analysis of 1997 and 1998).

Growth regulators treatments (mg/l) Pix / Atonik	00	50	100	200	Mean
	Plant height (cm)				
00	83.7	86.9	78.5	73.9	80.75
20	92.7	99.9	87.6	82.9	90.77
40	99.4	102.5	95.5	91.4	97.20
60	102.3	105.7	98.4	94.1	100.12
Mean	94.53	98.75	90.01	85.57	
	Number of tiller/plant				
00	3.61	3.41	3.96	3.89	3.72
20	4.58	5.23	4.52	4.31	4.66
40	5.35	5.28	5.16	4.73	5.13
60	6.13	5.69	5.36	5.18	5.59
Mean	4.92	4.90	4.75	4.53	
	Number of spikes/plant				
00	3.65	3.53	3.97	3.95	3.78
20	4.68	5.25	4.62	4.44	4.75
40	5.44	5.32	5.24	4.79	5.20
60	6.02	5.71	5.29	5.18	5.55
Mean	4.95	4.95	4.78	4.59	
	Dry weight(g)/plant				
00	10.01	8.95	12.40	11.63	10.75
20	9.63	9.93	10.27	11.79	10.41
40	9.52	11.03	11.06	12.34	10.99
60	10.09	12.36	12.38	11.24	11.52
Mean	9.81	10.57	11.53	11.75	
	Blades area (cm2) /plant (LA)				
00	295.3	340.8	359.6	323.7	329.85
20	407.4	373.7	339.1	381.4	375.40
40	493.8	507.8	453.9	412.2	466.93
60	516.1	456.7	514.6	466.6	488.50
Mean	428.15	419.75	416.80	395.98	
	Leaf area index (LAI)				
00	3.01	3.41	3.59	3.24	3.31
20	4.07	3.73	3.39	3.81	3.75
40	4.94	5.08	4.54	4.12	4.67
60	5.16	4.57	5.14	4.67	4.89
Mean	4.30	4.20	4.17	3.96	

L.S.D. at 5% for :	lant heigh	No. of tiller/plant	No. of spikes/plant	Dry weight/ plant	Blades area /plant	eaf area inde
Atonik (a)	3.12	0.34	0.29	0.67	27.6	0.37
Pix (b)	3.81	0.43	0.39	0.42	28.3	0.34
a x b	4.38	0.92	0.83	2.20	114.5	0.77

Table (2) : Effect of growth regulators (atonik and pix) and their interaction on vegetative growth of wheat plant at milky stage (120 days after sowing) (Combined analysis of 1997 and 1998).

Growth regulators treatments (mg/l)					
	Plant height (cm)				
Atonik \ Pix	00	50	100	200	Mean
00	95.10	98.60	92.70	89.90	94.08
20	105.90	109.30	99.60	101.70	104.13
40	106.70	112.70	110.40	102.50	108.08
60	110.30	114.50	113.30	106.50	111.15
Mean	104.5	108.78	104	100.15	
	Number of tiller/plant				
00	4.58	5.23	4.61	4.50	4.73
20	4.84	5.04	4.54	5.34	4.94
40	5.32	5.01	5.53	5.40	5.32
60	5.60	5.67	6.15	5.21	5.66
Mean	5.09	5.24	5.21	5.11	
	Number of spikes/plant				
00	4.61	5.18	4.69	4.51	4.75
20	4.83	5.07	4.56	5.35	4.95
40	5.31	5.06	5.57	5.44	5.35
60	5.55	5.73	6.19	5.26	5.68
Mean	5.08	5.26	5.25	5.14	
	Dry weight(g)/plant				
00	14.82	16.97	19.49	21.34	18.16
20	15.81	17.23	15.65	19.67	17.09
40	17.07	16.45	19.71	17.16	17.60
60	19.03	19.31	22.34	17.73	19.60
Mean	16.68	17.49	19.30	18.98	
	Blades area (cm2) /plant (LA)				
00	467.50	498.30	412.10	387.30	441.30
20	515.60	464.50	501.00	477.90	489.75
40	512.10	547.80	578.60	503.10	535.40
60	617.80	587.00	573.20	531.10	577.28
Mean	528.25	524.40	516.23	474.85	
	Leaf area Index (LAI)				
00	4.67	4.98	4.13	3.87	4.41
20	5.16	4.65	5.01	4.79	4.90
40	5.12	5.48	5.81	5.03	5.36
60	6.18	5.87	5.73	5.31	5.77
Mean	5.28	5.25	5.17	4.75	

L.S.D. at 5% for :	Plant height	No. of tiller/plant	No. of spikes/plant	Dry weight/ plant	Blades area /plant	Leaf area Index
Atonik (a)	3.05	0.42	0.35	1.97	36.7	0.35
Pix (b)	3.22	0.37	0.38	1.45	33.7	0.32
a x b	5.05	0.93	0.87	2.71	118.1	0.94

Concerning the combined effect of atonik and pix treatments , significant increases were obtained in some characteristics of growth . The most promising of the combined effect of these two bioregulators was noticed with atonik at 60 mg/l and pix at 50 mg/l . at the elongation stage . However , at milky stage the combined treatment of atonik at 60 mg/l and pix at 100 mg/l was the most effective ones for increasing some criteria of vegetative growth of wheat plants .

The data in Table (1 and 2) showed that tiller and spikes number per plant were significantly increased as a result of atonik alone or combined with pix especially atonik at 60 mg/l with pix at 100 mg/l . at both elongation and milky stages, While the lowest values were obtained at atonik treatment 20 mg/l and pix 100 mg/l at the same tables. The data clearly indicate that atonik and pix especially at combined treatment 40 mg/l atonik and 200 mg/l pix had significant effects on blades area , leaf area index and dry weight per plant at elongation and milky stages .

These increases in tiller number as well as spike number could be interpreted as a result of the promoting significant effect of the combination of atonik and pix treatments especially at 40 and 60 mg/l atonik and 100 and 200 mg/l pix on growth criteria .

2-Effect of Atonik and pix on yield and its components :-

The date presented in Tables (3 and 4) and Figs (1 , 3) reveal that plant height, No. of tiller ,No. of spikes , weight of spikes / plant (g) , spike length , 1000- grains weight , grain and straw yield / (g / plant) and grain and straw yield (ton/fed.) significantly responsed due to different treatment of atonik. The highest values were obtained with atonik at 40 and 60 mg/l . These results are in agreement with those results obtained by Ceter and Sepetoglu (1995) on faba beans , Pulkrabek et al (1999) on sugar beet and Vostrel (2000) on hop . Recently , Farahat (2002 b) indicated that foliar application with atonik 2.25 mg/l gave higher spikes weight (g/m^2) , spikes number / m^2 , grain weight g/m^2 and grain and straw yield kg / fed of wheat . Also, Guo and Oosterhuis (1995) reported that atonik is a yield and growth which increased cotton crop yield through enhanced assimilation nutrient uptake , nitrate reduction and photosynthesis, improved flow of assimilates(translocation and cytoplsmic streaming) and increased cell integrity.However ,in case of pix treatment (Tables 3 and 4) indicate that plant height , No. of tiller / plant , No. of spikes/plant decreased or slightly affected as pix concentration was increased from 50 to 200 mg/l . Thus , foliar pix at 200 mg/l as compared with other concentrations caused the highest values of spike length , spikes weight (g) , grain and straw yield per plant , and ton / fed . as well as 1000 – grain weight (g) . Similar results had been obtained on other cereals plants e.g. Channakeshava *et al.*, (1999) on zea mays , Oosterhuis *et al.*, (2000 b) on cotton Jayachandran *et al.*, (1999) on rice .

The combined effect of atonik and pix treatments led to significant increases in some criteria of yield and its components especially atonik at 60 mg/l with pix at 200 mg/l.

The data in Table (3) show that number of spikes and tillers per plant as well as spike length were significant increased as result of atonik alone or in combination with pix . However , Atonik at 40 and 60 mg/l and pix at 100 and 200 mg/l were more effective in this respect.

The result in the same table indicate that atonik and pix had a significant effect on spike weight , grain and straw yield (g)/plant . This effect of atonik and pix could be due to the increases in spike weight as well as grain and straw yield (g)/plant over their controls , especially atonik at 40 and 60 mg/l and pix at treatments of 100 and 200 mg/l . respectively

Table (3): Effect of atonik and pix and their interaction on yield and its components of wheat plant.(Combined analysis of 1997 and 1998)

Growth regulators treatments (mg/l)	Plant height (cm)				
Pix / Atonik	00	50	100	200	Mean
00	101.60	104.10	99.70	95.10	100.13
20	102.80	107.40	100.60	103.70	103.63
40	110.10	115.90	113.30	106.40	111.43
60	114.70	116.30	112.80	109.40	113.30
Mean	107.30	110.93	106.60	103.65	
	Spike length (cm)				
00	13.10	13.30	16.10	14.80	14.33
20	13.80	12.70	14.60	16.20	14.33
40	14.20	15.30	17.20	14.10	15.20
60	16.50	17.60	16.10	14.80	16.25
Mean	14.40	14.73	16.00	14.98	
	Number of tillers/plant				
00	4.59	4.67	4.33	4.21	4.45
20	4.69	5.02	4.56	5.23	4.88
40	5.41	4.84	5.31	5.42	5.25
60	5.45	4.96	5.94	5.27	5.41
Mean	5.04	4.87	5.04	5.03	
	Number of spikes/plant				
00	4.66	4.72	4.57	4 33	4.57
20	4.87	5.05	4.67	5.34	4.98
40	5.44	4.97	5.33	5.66	5 35
60	5.68	5.15	6.16	5.54	5.63
Mean	5.16	4.97	5.18	5.22	
	Weight of spikes (g)/plant				
00	5.68	6.99	7.18	8.08	6.98
20	6.11	7.92	6.93	8.13	7.27
40	6.69	7.62	7.78	8.29	7 60
60	7.36	7.94	8.62	8.43	8.09
Mean	6.46	7.62	7.63	8.23	
	Grain yield (g)/plant				
00	5.15	6.47	6.72	7.17	6.38
20	6.21	7.04	6.62	7.50	6.84
40	6.03	7.61	7.91	7.81	7.34
60	6.99	7.23	8.11	8.28	7.65
Mean	6.10	7.09	7.34	7.69	
	Straw yield (g)/plant				
00	6.94	7.89	8.41	8.89	8.03
20	7.09	9.12	7.88	9.48	8.39
40	7.31	8.89	9.26	9.82	8.82
60	8 17	9.13	10.16	10.26	9.43
Mean	7.38	8.76	8.93	9.61	

L.S.D. at 5% for :	Plant height	Spike length	No. of Tillers/ plant	No. of spikes / plant	Weight of spikes / plant	Grain yield/ plant	Straw yield/ plant
Atonik (a)	3.03	0.80	0.50	0.40	0.48	0.61	0.38
Pix (b)	2.99	0.61	0.52	0.41	0.42	0.38	0.40
a x b	4.46	1.30	0.83	0.40	0.78	0.74	0.60

Table (4) : Effect of atonik and pix and their interaction on yield and its components and chemical constituents of grains. (Combined analysis of 1997 and 1998)

Growth regulators treatments (mg/l)					
Atonik \ Pix	00	50	100	200	Mean
	1000-grain weight (g)				
00	42.00	43.30	46.40	48.30	45.00
20	45.10	42.90	44.50	46.50	44.75
40	47.60	50.10	48.30	51.30	49.33
60	49.90	47.60	50.40	49.20	49.28
Mean	46.15	45.98	47.40	48.83	
	Grain yield (ton/fed)				
00	1.35	1.56	2.04	2.11	1.77
20	1.47	2.21	1.96	2.36	2.00
40	1.93	2.40	2.71	2.53	2.39
60	2.04	2.57	2.80	2.76	2.54
Mean	1.70	2.19	2.38	2.44	
	Straw yield (ton/fed)				
00	2.06	2.36	2.71	2.88	2.50
20	2.15	2.89	2.70	2.96	2.68
40	2.36	2.98	3.38	3.09	2.95
60	2.76	3.11	3.61	3.39	3.22
Mean	2.33	2.84	3.10	3.08	
	Crude protein %				
00	8.17	9.19	12.30	10.25	9.98
20	9.13	12.28	11.18	9.36	10.49
40	9.23	12.17	13.48	10.34	11.31
60	10.20	12.13	14.35	13.34	12.51
Mean	9.18	11.44	12.83	10.82	
	Total carbohydrate %				
00	79.90	76.90	71.50	74.80	75.78
20	76.80	71.60	75.40	77.80	75.40
40	76.30	72.40	69.10	75.20	73.25
60	76.90	74.20	69.20	72.20	73.13
Mean	77.48	73.78	71.30	75.00	

L.S.D. at 5% for:	1000-grain weight (g)	Grain yield (ton/fed)	Straw yield (ton/fed)	Crude protein %	Total carbohydrate %
Atonik (a)	2.0	0.17	0.12	0.49	2.70
Pix (b)	2.4	0.15	0.15	0.44	1.90
a x b	3.4	0.22	0.42	1.06	2.30

It is evident from the data presented in Table (4) that the most significant effect for increasing in 1000 – grain weight (g) , grain yield and straw yield (ton) / fed . were noticed with atonik at 40 and 60 mg/l and pix at 100 and 200 mg/l . However, Radwan and Farahat (2002) found that application of pix at the rates of 50 and 100 ppm increased yied, chlorophyll and total carbohydrates contents as well as nitrogen content of coriander plants. The increase in yield and its components attributed by foliar application of atonik might be due to that, the atonik enhanced photosynthetic apparatus, growth parameters, cell division and enzymatic activity (Guo and Oosterhuis, 1995) .

3-Effect of atonik and pix on chemical constituents of grains :-

Data presented in Table (4) that protein percentage significantly responsed due to different treatments of atonik, especially at treatment 60 mg/l atonik. These results might be attributed to favorable effect of atonik for encouraging nitrogen uptake . Farahat (2002) found that increasing atonik concentration from 0.75 to 2.25 mg/l caused the highest increase in grain nitrogen percentage and nitrogen uptake of wheat plants. Sharma *et al.,* (1990) found that no differences in protein content of soybean by foliar application of atonik. However, pix with atonik treatments the opposite was true as carbohydrate percentage decrease or slightly affected as pix concentration was increased from 50 to 200 mg/l and atonik from 20 to 60 mg/l. It is evident from the data presented in Table (4) that foliar pix at 200 mg/l and atonik at 20 mg/l caused the highest values of total carbohydrate percentage. This might be due that atonik stimulate a variety of physiological responses including changes in enzymatic activities, membrance potential, DNA, RNA, protein synthesis, photosynthetic activity and changes in the balance of the endogenous phytohormones. Sawan *et al.,* (1991) on cotton, Szekeres and Knocz (1998) on Arabidopsis and Vostrel (2000) on hop. The data in Table (4) reveal that atonik at 60 mg/l with pix at 100 mg/l gave the maximum values of protein as compared with other treatments. While, atonik at 20 mg/l with pix at 200 mg/l. caused the highest values of carbohydrate percentage.

From the above mentioned results, it can be concluded that the application of different concentrations of atonik and pix, resulted in pronounced increases in growth characters, yield components and some chemical constituents grains of (protein and carbohydrate percentage). However, most of the previous characteristics, were increased by increasing atonik treatment from 20 to 60 mg/l. and pix treatment from 50 to 200 mg/l.

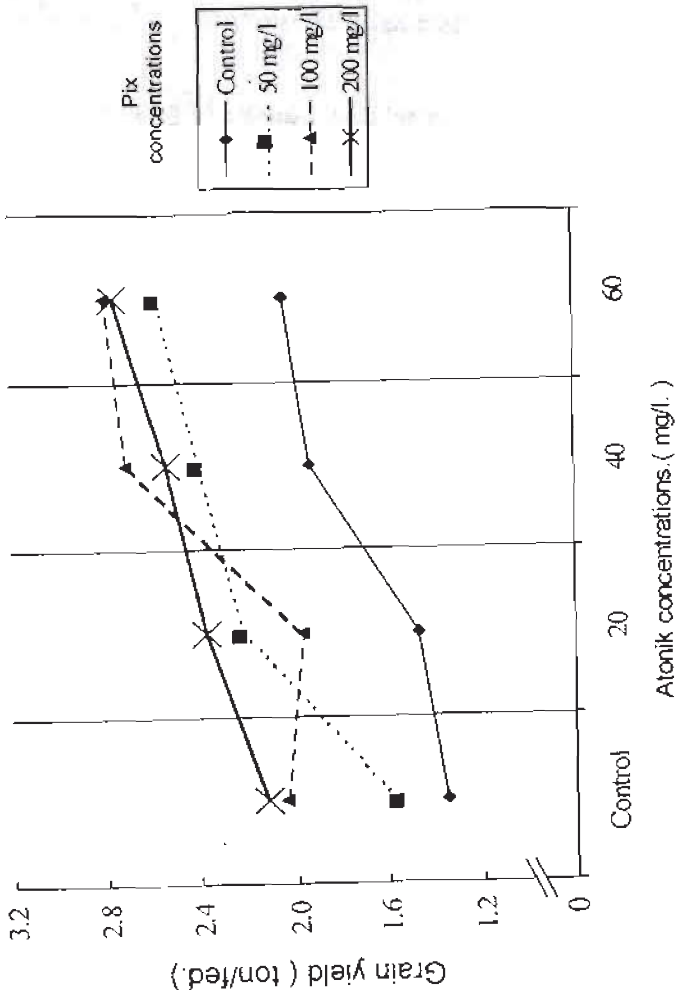

Fig (1) : Effect of bioregulators (Atonik and Pix concentrations) on wheat grain yield (ton/fed.) (seasons 1997 and 1998)

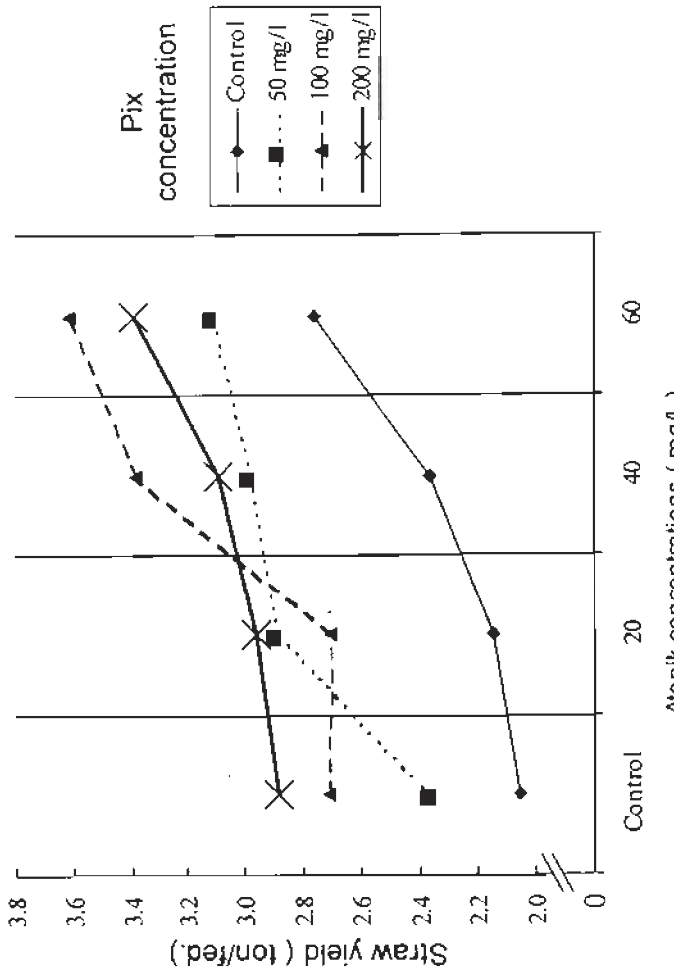

Fig (2) : Effect of bioregulators (Atonik and Pix concentrations) on wheat straw yield (ton/fed.) (seasons 1997 and 1998)

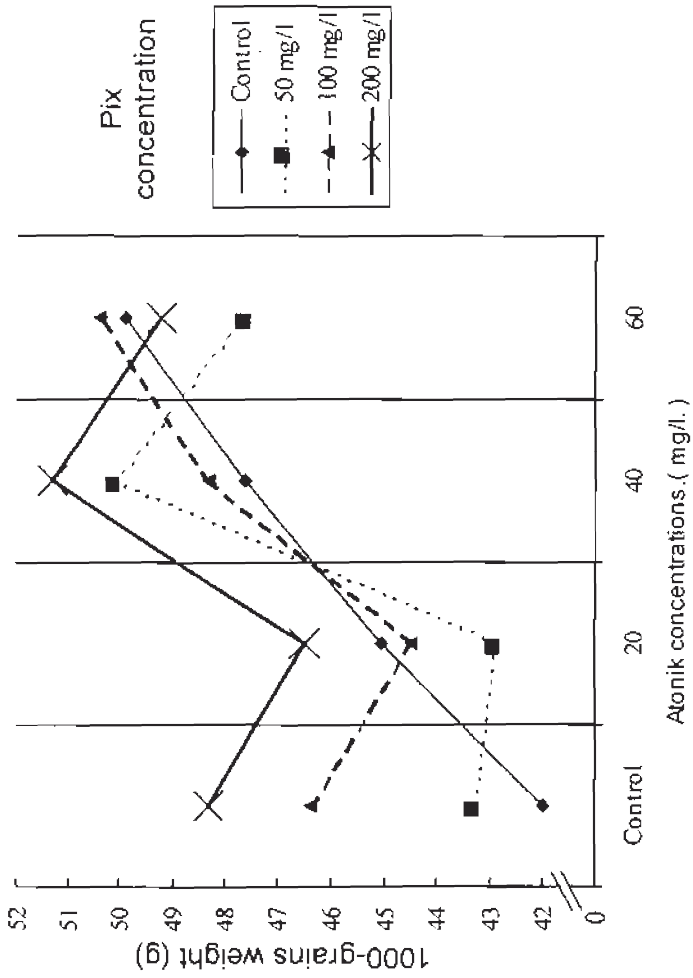

Fig (3) : Effect of bioregulators (Atonik and Pix concentrations) on wheat 1000-grains weight (g) (seasons 1997 and 1998)

REFERENCES

Abd El-Wahed , M. S. A. ; M. M. Farahat and E. EL. Habba (2002) Response of wheat (*Triticum aestivum*) to seed rates and stigmasterol . J. Agric . Sci. Mansoura Univ ., 25 (1) : 7649 – 7658 .

A . O . A . C . (1970). Associatation of Official Agricultural Chemists . Official Methods of Analysis . PP . 832 – 849 Washington D.C. U.S.A.

Bangal, D. B; Gabakh , S. R; Birari , B. M. and Patil, K. G. (1989) Effects of growth regulators and micronutrients on yield of wheat . J. Maharashtra , Agric . Univ ., 14 (1) : 110 – 113 .

Bremner , P. M. and Taha , M. A. (1966) . Studies in potato agronomy . I. The effect of variety , seed size and spacing on growth , development and yield . J. Agric. Sci . 66 : 241 – 252 .

Cranstoun . D, (1999) Effect of sowing and harvest dates , nitrogen , PGR and fungicide on yield and malting quality of spring barley . HGCA-project . Report No- 179 , 114 , PP. 26.

Ceter, M. and Sepetoglu, H. (1995) . Effect of different nitrogen fertilizer rates and different rates of two plant growth regulators on the growth , yield , yield components and abscission of faba beans . Ege. Universitesi Ziraat Fakultesi Dergisi. 32 (2) : 249-255.

Channakeshava , B. C. , Prasanna, K. P. R. and Ramachandtappa, B. K. (1999) . Effect of plant growth regulators and micronutrients on seed yield and yield components in African tall fodder maize (*Zea mays* L .) Mysore J. Agric , Sci 33 (3) 111 – 114 .

Dubois, M., Gilles, K. A., Hamilton, J., Rebers, R. and Smith, F. (1956). Colorimetric methods for determination of sugar and related substances. Ann. Chem. 28, 350 – 356 .

Farahat, M. M. (2002). Effect of Amcotone and Atonik with some additives on nitrogen accumulation and productivity of wheat (*Triticum aestivum* L.) plants. J. Agric. Sci., Ain Shams Univ., Cairo. 10 (1) : 193-203.

Gaber , A. M. ; Mansour, F. A., EL. Shahaby, O. A., Mostafa, H. A. M. and Ramadan, A. A. (1993) effect of pix on growth , Pigments and productivity of soybean plants . Egypt . J. Physiol. Sci , 17 (2) : 225 – 270 .

Guo, C. and Oosterhuis, D. M. (1995). Atonik : a new plant growth regulator to enhance yield in cotton. Proceeding Beltwide Cotton Conferences, San Antonio T.x. USA .January 4-7 ,1995: vol (2) : 1086-1088 .

Jayachandran, M., Ramaswami, C., and Thangara J.M. (1999) Effect of chemical and botanics spray in low – irradiance susceptible rice cultivar, C 0.45. Oryza, 36 (2): 182 – 184.

Jones M.A.; Snipes, C.E.; Tupper, G.R.; Dugger, P., and Richter, D. (2000). Management systems for transgenic cotton in ultranarrow rows. Proceedings beltwide cotton conferences, San Antonio USA, Vol., 1, 714 – 716.

Kopecky , J. (1995). The effect of Atonik on the growth , development , yield and quality of hops Chmelarstvi . 68 (4) : 48 – 49

Lamas, F.M.; Athayde, M.L.F., and Banzatto, A. (2000). Reactions of cotton CNPA – ITA 90 to mepiquat chloride. Resquisa Agropecuaria Brasileira., 35 : 3, 507 – 516. CAB Abstracts. 2000/08 – 2001 / 07.

Mekki (1999) Effect of mepiquat chloride on growth, yield and fiber properties of some Egyptian cotton cultivars. J. Agric. Sci 7 (2) 455 – 466.

Nowak, G.A., Wierzbowska, J., Klasa, A. and Gotkiewicz, M. (1997) yield and macronutrient content of field bean plants growing under conditions of growth retardant and phytohormone application.part 2. Macronutrient content . Biuletyn– Instytutu – Hodowli – I – Aklimatyzacji – Roslin No. 201, 297 – 303 .

Oosterhuis, D. M. and Zhao, D. L. (2000 b) Field evaluation of plant growth regulators. Special Report, Arkansas Agric. Experiment Station., No. 198, 89 – 93.

Prasad, M. and Prakash, R. (2000). Influence of mepiquat chloride on growth, yield and quality of cotton. Pesticides Res. J., 12, 261 – 262.

Pulkrabek, J.; Sroller, J. and Zahradnicek, J. (1999). The effects of the growth regulators on the yield and quality of sugar beet roots. Rostlinna Vyroba, 45 : (8) : 379 – 386.

Radwan, S.M. and Farahat, M.M. (2002). Growth and yield of coriander plants as affected by bio-organic fertilization and pix application. Egypt. J. Appl. Sci; 17 (7) : 268-286.

Sawan, Z. M.; Sakri, R.A., Ahmed, F.A. and Abd-Al Samed, A.M. (1991). Effect of 1,1 – dimethyl piperidinium chloride (pix) on the seed, protein, oil and fatty acids of Egyptian cotton. J. Agron. and Crop Sci, 166 (3) 157 – 161.

Sharma, R.; Singh, G., Gane-Shan , K.P., Kaur, G. and Raheja, R.K. (1990). Yield improvement in Soybean by foliar application of some commercial growth regulators. Indian Agriculturist, 34 (2): 79-82.

Snedecor, G. W. and Cochran W. G. (1990). Statistical Methods, 8th Ed. Iowa State Univ., Press. Ames Iowa, USA.

Steger, A. and D. Oosterhuis (1997). Seed treatment with plant growth regulators to enhance emergence and seedling growth. Proceedings Beltwide Cotton Conference. New Orleans, LA, USA, January, 7-10, (2) : 1396.

Szekeres, M. and Koncz, C. (1998). Biochemical and genetic analysis of brassinosteroids metabolism and function in *Arabidopsis*. Plant Physiol. Biochem. 36: 171-182.

Watson. D.J. (1952). The physiological basis of variation in yield. Adv. Agron. 4 : 101 – 145.

Vostrel, J. (2000). Assessment of Atonik growth stimulator on hop yield. Chmelarstvi. 73 (1):6-8.

Youssef – M.M.A. (1993) Effect of growth regulators, and population density of meloidogyne incognita on seed yield of sunflower. Egypt. J. Agron. 18 (1 – 2): 247 – 255.

Zhao, D.U.L.; Oosterhuis, D. Zhao, D.L. Dugger P. and Richter D. (1998). Evaluation of plant growth regulators for effect on the growth and yield of cotton. Listy Cukrovarnicke a Reparske, 114 (5-6): 147-150.

Zhao, D. Oosterhuis, D. Zhao, D.L. Dugger P. and Richter D. (1999) Physiological, growth and yield responses of cotton to mepplus and mepiquate chloride. Proceedings Beltwide cotton Conferences Orlando, Florida 7 (1) : 599 – 602.

الاستجابة الفسيولوجية لنبات القمح للرش بالأتونك والبكس

أبو بكر أحمد السيد أمين
قسم النبات- المركز القومى للبحوث -الدقى- القاهرة -مصر

أجريت تجربتان حقليتان بمحطة التجارب الزراعية للمركز القومى للبحوث – بشافان -محافظة القليوبية موسمي ١٩٩٧ / ١٩٩٨ – ١٩٩٨ / ١٩٩٩ – لدراسة تأثير الاتونك بتركيز (٢٠ ، ٤٠ ، ٦٠ مليجرام/لتر) والبكس بتركيز (٥٠ ، ١٠٠ ، ٢٠٠ مليجرام/لتر) وكذلك التفاعل بينهما على صفات النمو والمحصول ومحتوى حبوب القمح من البروتين والكربوهيدرات ولقد اظهرت النتائج مايلى :-

١- أن معاملة نباتات القمح بالأتونك إلى وجود اختلافات معنوية فى صفات النمو والمحصول المتمثلة فى ارتفاع النبات وعدد الخلفات/نبات ، وعدد ووزن السنابل / نبات ومساحة الورقة ودليل مساحة الأوراق والوزن الجاف/نبات (وذلك عند عمر ١٠٠ – ١٢٠ يوم من الزراعة) وطول السنبلة ، وزن ١٠٠٠ حبة – ومحصول الحبوب والقش / نبات ومحصول الحبوب والقش/فدان وقد أعطى الرش بالاتونك عند تركيز ٦٠ مليجرام / لتر أفضل النتائج لكل من صفات النمو والمحصول

٢- أدت معاملة نباتات القمح بالبكس إلى وجود اختلافات معنوية فى صفات النمو والمحصول والوزن الجاف/نبات ، ومساحة الورقة ، دليل مساحة الأوراق بينما أدى زيادة تركيز الرش بالبكس إلى انخفاض معنوى فى ارتفاع النبات ، وعدد الخلفات وعدد السنابل/نبات وذلك عند مرحلة الاستطالة ومرحلة الطور اللبنى – كما أعطى الرش ٥٠ مليجرام/لتر بالبكس إلى استجابة معنوية فى صفات النمو وكانت أحسن النتائج للمحصول عند تركيز ١٠٠ ، ٢٠٠ مليجرام/لتر عند الرش بالبكس.

٣- أوضحت نتائج التحليل الكيميائي إلى وجود اختلافات معنوية لمحتوى الحبوب من البروتين عند المعاملة بالاتونك وكانت أفضل النتائج عند رش الأتونك بتركيز ٦٠ ملليجرام/لتر وبالبكس بتركيز ١٠٠ مليجرام/لتر وقد أدى الرش بالبكس والأتونك معا إلى حدوث زيادة غير معنوية للكربوهيدرات الكلية وكانت أعلى القيم عند رش الاتونك ٢٠ مليجرام/لتر والبكس ٢٠٠ مليجرام/لتر

٤- معاملة نباتات القمح بالتركيزات المختلفة للاتونك والبكس معا تؤدى إلى حدوث تأثير معنوى على ارتفاع النبات – عدد الخلفات/نبات ، عدد ووزن السنابل/نبات مساحة الورقة ، دليل مساحة الأوراق ، الوزن الجاف/نبات ، وزن ١٠٠٠ حبة ، طول السنبلة الرئيسية ، محصول الحبوب والقش للنبات وللفدان.