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EFFECT OF IRRIGATION INTERVALS AND GROWTH RETARDANT (PACLOBUTRAZOL) ON LEAF ENDOGENOUS HORMONES CONTENT AND YIELD OF COTTON (CULTIVAR GIZA 92)

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ABSTRACT : *Two field experiments were conducted at the Experimental Farm of Sakha Agricultural Research station, Kafer El-Sheikh governorate to study the effect of irrigation intervals (irrigation every 14, 21 and 28 days) and foliar application of growth retardant "paclobutrazol" levels (0, 60 and 120 ppm) on the leaf endogenous hormones content and productivity of Egyptian cotton (Giza 92 cultivar) during 2010 and 2011 seasons.*

The results obtained could be summarized as follows:

1- *The results indicated that plants which irrigated every 14 days had the highest significant values of leaf gibberellins and cytokinins as compared with those irrigated every 21 and 28 days in a descending order. Irrigation every 14 days significantly increased the values of number of open bolls / plant, boll weight, seed index, lint %, seed cotton yield /plant and seed cotton yield/fed but decreased leaf abscisic acid content compared to other irrigation intervals in the two growing seasons.*
2- *Foliar application of the tested paclobutrazol (60 and 120 ppm) significantly increased cytokinins content, number of open bolls / plant, boll weight and seed index, seed cotton yield /plant and seed cotton yield / fed in favour of 60 ppm compared to untreated plants in the two seasons.*
3- *The interactions between the tested irrigation intervals and paclobutrazole levels were found to be significant for leaf gibberellins content at 85 and 100 DAP in the second season only, leaf cytokinins content at 85 and 100 DAP in both seasons, leaf abscisic acid content at 85 DAP in the first season, number of open bolls / plant and seed index in the first season, in favor of irrigation interval every 14 days combined with paclobutrazol at the rate of 60 ppm produced the highest values of seed cotton yield / plant and seed cotton yield / fed during two growing seasons. On the contrary, untreated plants irrigated every 28 days produced the lowest values of the same characters.*

Key words: *Irrigation, Growth retardant, Endogenous hormones, Yield, cotton.*

INTRODUCTION

Cotton is one of the most important fiber crops of the world which plays a key role in the economic activity (Ali and Abd El-Aal, 2012). It is the oldest among the commercial crops and is regarded as white gold. Cotton enjoys a preeminent status among all the commercial crops in the world, being the principal raw material for flourishing textile industry. Egyptian cotton (*Gossypium barbadense* L.) is one of the most important crops for both local industry and export. Therefore, it is necessary to increase cotton productivity to face the wide gap between the production and consumption of fiber and oils.

From the perspective of water stress, the purpose of irrigation is to keep water status in the root zone at a level that maximizes yield within constraints of irrigation water supply, growing seasons and climate (Tayel *et al.,* 2014).The use of irrigation strategies are fundamental to save more water without putting at risk crop yield (Jalota *et al.,* 2006 and Pereira *et al.*, 2009). Tang and Zhang

(2005) obtained excellent results in cotton yield by managing water deficits during plant development and saving water during irrigation. Also, Buttar *et al*. (2007) reported that saving water is the definition of the suppression of irrigation correctly promoting the physiological seasoning of plants without compromising yield.

Plant growth regulators drew the attention as a practical and efficient way to regulate the flowering and fruiting process and to promote the cotton plants to retain more bolls. An important objective for using plant growth regulators in cotton plants is to balance vegetative and reproductive growth as well as to improve lint yield and fiber quality (Cimen *et al*., 2003). Paclobutrazol “PBZ” affects plant growth through two major ways: (i) it reduces cell elongation by reducing the production of gibberellic acid and (ii) it helps conserve water and slows growth by reducing destruction of abscisic acid. Simply stated, paclobutrazol reduced cambial growth and induced smaller and darker green leaves as well as smaller stomatal pores, thicker leaves and increased tolerance to environmental stress. On this subject, Wang and Yi (1991) reported that paclobutrazol decreased plant height and increased yield, leaf chlorophyll content by 11.8 % and photosynthetic efficiency by 20 % of soybean plants. In addition, Cimen *et al.* (2003) found that application of paclobutrazol increased node number of first fruiting branches, number of vegetative branches, the first flowering date and the first opening date of bolls, mentioned all data showed earliness criterion of cotton. The increase in chlorophyll content may be ascribed to higher cytokinins content that is known to stimulate chlorophyll biosynthesis and/or reduced chlorophyll catabolism (Temiz, 2009).

The present work was done to study the effect of growth retardant levels on the cotton plants grown under different irrigation intervals as a trying to pass many problems which face the plants through growing season.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of Sakha Agricultural Research Station, Kafer El-Sheikh governorate to study the effect of irrigation intervals and bio-regulator levels on the endogenous hormones and productivity of Egyptian cotton (Giza 92 cultivar) during 2010 and 2011 seasons. This experiment included 9 treatments which were the combination between three irrigation intervals (irrigation every 14, 21 and 28 days) and paclobutrazol "PBZ" levels (0, 60 and 120 ppm). The growth retardant was sprayed twice, firstly at the appearance of squaring and secondly at beginning of flowering. The properties of PBZ are shown in Table (1).

Table (1): The properties of the retardant growth paclobutrazol.

Mode of action and functions	It acts by inhibiting gibberellins biosynthesis, reducing internodial growth to give stouter stems, increasing root growth, causing early fruit set and increasing seed set in plants. Among those are improved resistance to drought stress, darker green leaves, higher resistance against fungi and bacteria, and enhanced development of roots.
Appearance	off – white to beige solid
Formula	$C_{15}H_{20}ClN_3O$
Synonyms	(2S,3S)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl) pentan-3-ol
Molecular weight	293.79
Melting point	165-166 °C
Boiling point	460.9 °C
Solvent solubility	soluble in water

The treatments were arranged in split plot design with three replications, where the irrigation interval treatments were allocated in the main plots, while growth retardant treatments were assigned in the sub plots. The preceding crop was Egyptian clover in the two seasons. Soil samples of experimental site were randomly taken from one layer 0–30 cm before sowing and prepared for analysis according to Jackson (1973) and Chapman and Pratt (1978). The results of mechanical and chemical analysis of the experimental soil are present in Table (2).

Each experimental plot consisted of seven rows, 3.5 m long and 0.6 m width (plot area = 14.70 m^2). The seeds were sown at 15^{th} April during both seasons. Phosphorus fertilizer was applied during soil preparation in the form of calcium super phosphate (15.5 % P_2O_5) at a rate of 15.5 % P_2O_5 /fed. All plots were fertilized with a rate of 60 kg N / fed in the form of urea (46.5 %) in two equal doses, the first dose was added after thinning (before the first irrigation), while the second dose was applied before the second irrigation. Potassium fertilizer was applied after thinning at a rate of 24 Kg K_2O /fed in the form of the potassium sulphate (48% K_2O).

Measurements

Endogenous hormones

At 85 and 100 days after planting (DAP), twenty grams of fresh green leaves (fourth upper leaf) were taken at random from each plot to determine the content of gibberellins, cytokinins and abscisic acid according to the method described by Shindy and Smith (1975) using HPLC.

Yield and yield components:

At harvest, sample of ten guarded plants was taken randomly and labeled from each plot to determine number of open bolls / plant, boll weight (g.), 100 - seed weight (g.), lint percentage, seed cotton yield / plant (g.) and seed cotton yield / fed (Kantar, i .e 157.5 kg). Seed cotton yield/fed was determined from the three central rows from each sub-plot.

All measurements data during the two seasons in this study were analyzed according to the methods described by Snedecor and Cochran (1980). Duncan's multiple range test (Duncan, 1955) was used to compare between the treatments means at probability 5%. Statistical analysis was done using the Costat package program, version 6.311 (cohort software, USA).

RESULTS AND DISCUSSION

1. Endogenous hormones

Leaf gibberellins content (mg / 100 g fresh weight)

The data in Table (3) show that the tested irrigation cotton plants intervals (every 14, 21 and 28 days) had a significant effect on the endogenous amounts of gibberellins at 85 and 100 DAP during the two growing seasons. Moreover, it can be found that the plants irrigated every 14 days gave the highest significant value of leaf gibberellins content during 2010 and 2011 seasons compared with that obtained from the other irrigation intervals (every 21 and 28 days). This means that water supply may be simulated the endogenous hormones in the plants more than the water deficit conditions. Similar results were obtained by Ibrahim and Moftah (1997) who found that GA content was increased by irrigated cotton plants every 14 days.

Table (2): Mechanical and chemical analysis of the experimental soil during 2010 and 2011 seasons.

Properties / Seasons	Particle size distribution (%)			Texture class	pH	E.C. Mmhos/cm	Available (ppm)		
	Sand	Silt	Clay				N	P	K
2010	23.38	31.36	45.26	Clay	8.0	3.50	25.6	5.9	398.0
2011	25.45	30.74	43.81	Clay	8.0	3.45	26.3	6.4	399.0

Table (3): Effect of irrigation intervals, paclobutrazol concentrations and their interactions on gibberellins content at 85 and 100 DAP during 2010 and 2011seasons.

Treatments	Days after planting (DAP)			
	85		100	
	2010	2011	2010	2011
Irrigation intervals (A)				
Every 14 days	10.66 a	11.34 a	9.23 a	11.35 a
Every 21 days	9.89 a	11.51 a	8.27 b	10.85 a
Every 28 days	8.98 b	9.37 b	7.20 c	8.24 b
F test	**	**	**	**
Paclobutrazol concentrations (B)				
Control	10.58 a	11.24 a	9.39 a	12.63 a
PBZ 60 ppm	9.62 ab	10.82 a	7.82 b	9.12 b
PBZ 120 ppm	9.32 b	10.16 b	7.50 b	8.71 b
F test	**	**	**	**
Interaction (A x B)				
Every 14 days x control	11.29	10.60 c	10.23	15.06 a
Every 14 days x PBZ 60 ppm	10.48	12.53 b	8.92	9.73 b
Every 14 days x PBZ 120 ppm	10.21	10.90 c	8.55	9.26 bc
Every 21 days x control	10.52	13.46 a	9.74	13.76 a
Every 21 days x PBZ 60 ppm	9.76	10.63 c	7.69	9.70 b
Every 21 days x PBZ 120 ppm	9.39	10.43 cd	7.39	9.10 bc
Every 28 days x control	9.94	9.66 de	8.19	9.06 bc
Every 28 days x PBZ 60 ppm	8.62	9.30 e	6.86	7.93 c
Every 28 days x PBZ 120 ppm	8.38	9.16 e	6.56	7.76 c
F test	N.S	**	N.S	**

* = Significant at 0.05 level of probability
** = Significant at 0.01 level of probability
N.S = not significant at 5% level. The mean values within column followed by the same letter (s) are not significantly different at 5 % level, according to DMRT.

It is quite evident from the data in the same table that gibberellins content in leaves were significantly affected by the tested PBZ concentrations at the growth periods in both seasons. It can be observed that unsprayed plants with PBZ gave the highest values of GA compared to with that obtained from application of PBZ at the two concentrations at the two growth stages (85 and 100 DAP) during both seasons. The reduction in GA content obtained from application of PBZ may be attributed to the role of PBZ on inhibition biosynthesis of endogenous gibberellins. In this concern, El-Dayem and El-Deeb (2000) observed that gibberellins content was decreased by the application of PBZ at different concentrations (10 or 25 or 50 ppm).

Regarding the interaction effect between irrigation intervals and PBZ concentration, the data indicate that irrigating cotton plants every 21 days without PBZ spraying produced the highest significant values on GA at growth stages (85 and 100 DAP) in the second season. However, the lowest values were obtained by plants irrigated every 28 days with foliar application of PBZ at (60 or 120 ppm) at the same stages and same season. On the other hand, the interaction effect between the two tested factors was not significant for gibberellins content in the first season.

Leaf cytokinins content (µg / 100 g fresh weight)

The results in Table (4) indicate that plants which irrigated every 14 days had the highest significant values of leaf cytokinins content as compared with those irrigated every 21 and 28 days in a descending order. These results hold fairy true at 85 and 100 days after planting in both seasons.

Significant differences were detected among PBZ concentrations for the cytokinins content in cotton leaves and 100 days after planting in both seasons. The highest values of cytokinins were obtained by untreated plants in the first season and by the application of PBZ at 60 ppm as compared with other concentrations at 85 and 100 DAP in the second season. These increments might be attributed to the effects of PBZ on specific enzyme which responsible for biosynthesis of endogenous cytokinins and the role of PBZ for inhibit the oxidative enzyme which responsible for degradation and / or hydrolysis of cytokinins.

It is interesting to note from the same Table that there are an interaction effect between irrigation intervals and PBZ concentrations at 85 and 100 DAP during the two seasons. The data revealed that plants irrigated every 14 days and sprayed with paclobutrazol at 60 or 120 ppm led to an increase in the amount of cytokinins of the plants compared to the other tested treatments at 85 days after planting in the second season and at 100 days after planting in both seasons. On the contrary, irrigating cotton plants every 28 days with or without PBZ application produced the lowest values of leaf cytokinins content at 85 and 100 days after planting in both seasons.

Leaf abscisic acid content (mg / 100g fresh weight)

It is clear from the data recorded in Table (5) that growing cotton plants under the three irrigation intervals (every 14, 21 and 28 days) had significant effect on leaf abscisic acid content (ABA). The maximum value was obtained from irrigating plants every 28 days compared with the other irrigation intervals at 85 and 100 DAP in both seasons. These result means that irrigation intervals of cotton plants every 28 days (long irrigation interval) play an important role in the formation of ABA which a major role for regulate water balance of cotton plants grown under water stress by controlling in stomatal movement closer and maintaining water uptake by roots.

From the data in the same Table, spraying cotton plants with PBZ at 60 or 120 ppm increased ABA content at 85 and 100 DAP in the second season but decreased it in the first one compared to untreated plants. These results are in harmony with that obtained by El- Dayem and El-Deeb (2000) who observed that ABA content was increased by the application of PBZ at different concentrations (10 , 25 or 50 ppm).

Table (4): Effect of irrigation intervals, paclobutrazol and their interactions on leaf cytokinins content (ug / 100 g fresh weight) at 85 and 100 DAP concentrations during 2010 and 2011seasons.

Treatments	Days after planting (DAP)			
	85		100	
	2010	2011	2010	2011
Irrigation intervals (A)				
Every 14 days	58.12 a	62.84 a	53.91 a	51.75 a
Every 21 days	51.00 b	53.17 b	44.58 b	40.22 b
Every 28 days	39.37 c	41.94 c	32.12 c	31.01 c
F test	**	**	**	**
Paclobutrazol concentrations (B)				
Control	52.13 a	49.34 c	45.67 a	37.97 b
PBZ 60 ppm	48.70 b	56.26 a	42.24 b	42.76 a
PBZ 120 ppm	47.67 b	52.35 b	42.70 b	42.24 a
F test	**	**	**	**
Interaction (A x B)				
Every 14 days x control	60.21 a	59.96 b	52.55 b	48.30 c
Every 14 days x PBZ 60 ppm	57.57 b	68.13 a	53.23 ab	55.40 a
Every 14 days x PBZ 120 ppm	56.59 bc	60.43 b	55.96 a	51.56 b
Every 21 days x control	54.71 c	48.46 cd	48.23 c	37.70 ef
Every 21 days x PBZ 60 ppm	50.89 d	59.86 b	44.39 d	43.06 d
Every 21 days x PBZ 120 ppm	47.42 e	51.20 c	41.12 e	39.90 de
Every 28 days x control	41.48 f	39.60 e	36.24 f	27.93 g
Every 28 days x PBZ 60 ppm	37.63 g	40.80 e	29.10 g	29.83 g
Every 28 days x PBZ 120 ppm	39.00 g	45.43 d	31.01 g	35.26 f
F test	**	**	**	**

* = Significant at 0.05 level of probability
** = Significant at 0.01 level of probability
N.S = not significant at 5% level. The mean values within column followed by the same letter (s) are not significantly different at 5 % level, according to DMRT.

Table (5): Effect of irrigation intervals, paclobutrazol concentrations and their interactions on leaf abscisic acid content at 85 and 100 days after planting during 2010 and 2011 seasons.

Treatments	Days after planting (DAP)			
	85		100	
	2010	2011	2010	2011
Irrigation intervals (A)				
Every 14 days	77.85 c	78.86 c	81.24 c	80.78 c
Every 21 days	82.11 b	85.64 b	85.49 b	87.61 b
Every 28 days	85.64 a	88.13 a	88.47 a	89.56 a
F test	**	**	**	**
Paclobutrazol Concentrations (B)				
Control	84.28 a	81.87 b	86.28 a	84.20 b
PBZ 60 ppm	78.39 c	85.11 a	84.25 b	86.77 a
PBZ 120 ppm	82.93 b	85.65 a	84.67 b	86.97 a
F test	**	**	**	**
Interaction (A x B)				
Every 14 days x control	81.13 c	75.83	83.05	79.27
Every 14 days x PBZ 60 ppm	71.83 e	79.50	79.42	80.93
Every 14 days x PBZ 120 ppm	80.59 c	81.26	81.25	82.13
Every 21 days x control	84.62 b	83.53	86.49	86.00
Every 21 days x PBZ 60 ppm	77.74 d	86.40	84.64	88.07
Every 21 days x PBZ 120 ppm	83.96 b	87.00	85.35	88.77
Every 28 days x control	87.08 a	86.26	89.32	87.33
Every 28 days x PBZ 60 ppm	85.59 ab	89.43	88.69	91.33
Every 28 days x PBZ 120 ppm	84.24 b	88.70	87.42	90.03
F test	**	N.S	N.S	N.S

* = Significant at 0.05 level of probability
** = Significant at 0.01 level of probability
N.S = not significant at 5% level. The mean values within column followed by the same letter (s) are not significantly different at 5 % level, according to DMRT.

Regarding the combined action, the data reveal that there are significant interactions at 85 DAP in the first season. The highest values were obtained from irrigated cotton plants every 28 days with untreated plants. On the other hand, irrigated plants every 14 days with spraying of PBZ at 60 ppm produced the lowest values of ABA. It should be mentioned that the other combined treatments mostly induced no significant effect in this criterion.

2. Yield and yield components

The mean values of yield and yield components characters (number of open bolls / plant , boll weight, seed index, lint percentage, seed cotton yield per plant and per fed) as influenced by irrigation intervals, PBZ concentrations and their interactions in the two seasons are shown in Tables (6 and 7).

Number of open bolls/ plant, boll weight and seed index

The data presented in Table (6) indicate that growing cotton plants under the influence of three irrigation intervals (every 14, 21 and 28 days) had significant effect on number of open bolls per plant, boll weight and seed index during the two studied seasons. The highest values of such characters were resulted from irrigated the plants every 14 days compared with the other two intervals. These results are in accordance with other investigators such as Darwish and Hegab (2000), Ali (2002) and Ahmad and Kassem (2008) who found that such characters were increased by irrigated cotton plants every 14 days.

The results in the same Table indicate that spraying PBZ at 60 or 120 ppm on cotton plants lead to significant increase in all the above mentioned characters in both seasons compared with untreated plants. The positive effects of PBZ on seed index and boll weight might be attributed to its effects on the activity of photosynthetic process which led to increases in the biosynthesis of carbohydrates and other essential metabolites. In this concern, El-Dayem and El-Deeb (2000) observed that application of PBZ at 50 ppm increased number of open bolls and seed index.

Consider to the interaction between irrigation intervals and PBZ concentrations, the data indicate that the application of PBZ at two concentrations 60 or 120 ppm combined with irrigation every 14 days produced the highest values of number of open bolls and seed index during the first season. On the contrary, irrigated plants every 28 days without spraying of PBZ produced the lowest values on such characters in the first season. Other combined treatments had in significant effect on boll weight in both seasons.

Lint % and seed cotton yield

Data presented in Table (7) show that irrigation intervals (every 14 days) had significant increase in lint % and seed cotton yield per plant and per fed compared with the other two irrigation intervals (every 21 and 28 days). The increase of seed cotton yield / fed might be attributed to the increases in the leaf gibberellins and cytokinins contents and/or seed cotton yield / plant, boll weight and number of open bolls/ plant. Similar results were obtained by Soomaro *at al.* (2001) and Abdelatif *et al.* (2002) who found that irrigation cotton plants every 14 days produced the highest values of seed cotton yield per plant and per fed. However, Gomaa *et al.* (1981) mentioned that lint % was decreased when the cotton plants irrigated every 28 days.

Data in the same Table show that spraying cotton plants with PBZ concentrations (60 or 120 ppm) lead to increase the seed cotton yield per plant and per fed compared to the control plants. The high values of seed cotton yield per plant which resulted from the application of PBZ were mainly attributed to their beneficial effects on boll retention and boll weight, leading to yield enhancement. In this concern, Abdel-Aal *et al.* (2011) mentioned that application of growth retardant “Pix” reduced 44.24 % of bolls abscission and 16.06 % of total abscission compared to untreated cotton plants. Thus, it could be concluded that there is a positive relationship between abscission percentage and growth regulators which are useful for increasing the number of setting and total bolls/plantSimilar results were obtained by El-Dayem and El-Deeb (2000) who mentioned that seed cotton yield was increased by the application of PBZ at 50 ppm.

The combined treatments of irrigation interval every 14 days combined with PBZ at the rate of 60 ppm produced the highest values of seed cotton yield / plant and seed cotton yield / fed in both seasons. On the contrary, untreated plants irrigated every 28 days produced the lowest values of the same characters. In addition, all the combined treatments induced no significant effect on lint % in both seasons.

Table (6): Effect of irrigation intervals, paclobutrazol concentrations and their interactions on number of open bolls / plant, boll weight and seed index during 2010 and 2011 seasons.

Characters / Treatments	No. of open bolls / plant		Boll weight (g.)		Seed index (g.)	
	2010	2011	2010	2011	2010	2011
Irrigation intervals (A)						
Every 14 days	21.77 a	22.10 a	1.70 a	1.55 a	10.16 a	10.27 a
Every 21 days	17.75 b	19.07 b	1.49 b	1.42 b	9.80 b	10.12 a
Every 28 days	11.70 c	12.57 c	1.64 ab	1.61 a	9.64 c	9.97 b
F test	**	**	**	**	**	**
Paclobutrazol Concentrations (B)						
Control	15.93 b	16.56 b	1.65 a	1.48 b	9.77 b	10.04 b
PBZ 60 ppm	17.65 a	18.83 a	1.61 b	1.55 a	9.94 a	10.17 a
PBZ 120 ppm	17.64 a	18.33 a	1.57 c	1.56 a	9.88 ab	10.16 a
F test	**	**	*	*	**	**
Interaction (A x B)						
Every 14 days x control	20.03 b	20.53	1.94	1.50	9.95 b	10.21
Every 14 days x PBZ 60 ppm	23.06 a	23.50	1.67	1.60	10.33 a	10.32
Every 14 days x PBZ 120 ppm	22.23 a	22.26	1.50	1.55	10.20 a	10.29
Every 21 days x control	16.93 c	17.73	1.45	1.39	9.78 bc	10.08
Every 21 days x PBZ 60 ppm	18.50 c	20.40	1.51	1.44	9.84 b	10.18
Every 21 days x PBZ 120 ppm	17.83 c	19.06	1..52	1.44	9.78 bc	10.12
Every 28days x control	10.83 e	11.43	1.58	1.54	9.59 d	9.83
Every 28days x PBZ 60 ppm	11.40 de	12.60	1.66	1.61	9.66 c	10.01
Every 28days x PBZ 120 ppm	12.86 d	13.66	1.70	1.68	9.66 c	10.07
F test	**	N.S	N.S	N.S	*	N.S

* = Significant at 0.05 level of probability
** = Significant at 0.01 level of probability
N.S = not significant at 5% level. The mean values within column followed by the same letter (s) are not significantly different at 5 % level, according to DMRT.

Table (7): Effect of irrigation intervals, paclobutrazol concentrations and their interactions on lint %, seed cotton yield during 2010 and 2011 seasons.

Characters / Treatments	Lint (%)		Seed cotton yield / plant (g.)		Seed cotton yield / fed (kantar)	
	2010	2011	2010	2011	2010	2011
Irrigation intervals (A)						
Every 14 days	36.58 a	36.01 a	33.32 a	34.28 a	9.20 a	9.99 a
Every 21 days	35.81 a	34.88 ab	28.87 b	27.16 b	7.89 b	8.44 b
Every 28 days	32.77 b	34.00 b	20.23 c	20.13 c	5.53 c	6.24 c
F test	**	**	**	**	**	**
Paclobutrazole Concentrations (B)						
Control	35.15	34.47	25.32 b	25.91 b	7.23 c	8.06 b
PBZ 60 ppm	34.76	35.36	27.19 a	28.01 a	7.79 a	8.33 a
PBZ 120 ppm	35.25	35.06	26.92 a	27.64 a	7.61 b	8.28 a
F test	N.S	N.S	**	**	**	**
Interaction (A x B)						
Every 14 days x control	36.16	35.46	32.22 c	32.90 c	8.93 b	9.85 b
Every 14 days x PBZ 60 ppm	36.96	36.73	34.35 a	35.39 a	9.56 a	10.11 a
Every 14days x PBZ 120 ppm	36.63	35.86	33.40 b	34.54 b	9.13 b	10.01 ab
Every 21 days x control	35.70	34.30	25.67 f	25.66 f	7.55 e	8.25 d
Every 21 days x PBZ 60 ppm	35.96	35.33	27.85 d	28.35d	8.28 c	8.65 c
Every 21 days x PBZ 120 ppm	35.76	35.03	27.10 e	27.49 e	7.84 d	8.43 d
Every 28days x control	33.60	33.66	18.08 i	19.18 h	5.21 h	6.07 f
Every 28days x PBZ 60 ppm	31.36	34.03	19.36 h	20.30 g	5.55 g	6.24 ef
Every 28days x PBZ 120 ppm	33.35	34.30	20.26 g	20.91 g	5.85 f	6.41 e
F test	N.S	N.S	*	**	**	**

* = Significant at 0.05 level of probability
** = Significant at 0.01 level of probability
N.S = not significant at 5% level. The mean values within column followed by the same letter (s) are not significantly different at 5 % level, according to DMRT.

REFERENCES

Abdel-Aal, S.M., M.E. Ibrahim, A.A. Ali, G.A. Wahdan, O.A.M. Ali and Y.F.A. Ata Allah (2011). Effect of foliar application of growth regulators, macro and micronutrients on abscission, yield and technological characters of Egyptian cotton (*Gossypium barbadense,* L.). Minufiya J. Agric. Res., 36 (5): 1277-1304.

Abdelatif, A. H., A. A. Hashim, A. S. Fadlalla, M.M. Omer and H.S. Adam (2002). Effect of irrigation interval and picking time on fiber quality and the degree of stickiness in two cotton cultivars. Sudan Journal of Agricultural Research Vol. 14,1-10.

Ahmad, A.M. and M.A. Kassem (2008). Cotton response to irrigation intervals under different levels of potassium and nitrogen. Assiut J. of Agric. Sci., 39 (5): 171-185.

Ali, O.A.M. and A.A.A. Abd El-Aal (2012). Response of Egyptian cotton (*Gossypium barbadense*, L.) to honeybee pollination and biofertilizers inoculation. Minufiya J. Agric. Res., 37 (1): 93-105.

Ali, S.A. (2002). Response of cotton cultivar Giza 85 to irrigation intervals and nitrogen levels. J. Agric. Mansoura Unvi., 27 (1):117-127.

Buttar, G.S., M.S. Aujla, H.S. Thind, C.J. Singh and K.S. Saini (2007). Effect of timing of first and last irrigation on the yield and water use efficiency in cotton. Agric. Water Manage. 89:236-242.

Chapman, H.D. and P.F. Pratt (1978). Methods of Analysis for Soils, Plants and Water. Davis: Division of Agriculture Sciences, University of California.

Cimen, S. Basbag, M. Temiz and A. Sagir (2003). Effect of paclobutrazol on earliness of cotton (*Gossypium hirsutum*). Indian Journal of Agricultural Sciences 73 (5): 298-300.

Darwish, A.A. and S.A.M. Hegab (2000). Effect of irrigation intervals and soil conditions on water use efficiency, growth, yield and fiber quality of cotton cultivar Giza "89". Minufiya J. Agric. Res. 25 (5): 1199-1214.

Duncan, D.B (1955). Multiple ranges and multiple F. Tests. Biometrics, 11:1-42.

El-Dayem, H.M.M.A. and A.E.A. El-Deeb (2000). Effect of some plant growth regulators on growth, yield components and some chemical constitutes of cotton plant. Annals of Agric. Sci., Moshtohor, 38(2): 907-925.

Gomaa, M.E., K.M. El-Sayed and M.S. Rady (1981). Response of Egyptian cotton to nitrogen fertilizer and irrigation frequency . II - fiber properties and seed quality characters. Minufiya J . Agric. Res., 4 (12):189 -201.

Ibrahim, M.E. and A. E. Moftah (1997). The response of cotton plants to frequent irrigation and Mepiquat Chloride (pix), Minufiya J. Agric. Res.22 (3): 723 -737.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India, Ltd., New Delhi, India.

Jalota, S.K., A.G.B.S. Sood and B.U. Chahal (2006). Crop water productivity of cotton (*Gossypium hirsutum* L.) – wheat (*Triticum aestivum* L.) system as influenced by deficit irrigation, soil texture and precipitation. Agric. Water Manage. 84:137-146.

Pereira, L.S., P. Paredes, E.D. Eholpankulov, Inchenkova O.P.; Teodoro P.R. and Horst M.G. (2009): Irrigation scheduling strategies for cotton to cope with water scarcity in the Fergana Valley, Central Asia. Agric. Water Manage. 96:723-735.

Shindy, W.W. and O. Smith (1975). Identification of plant hormones from cotton ovules. Plant Physiol., 55:550-554.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods, 7^{th} Ed. The Iowa State Univ. Press, Ames. Iowa, USA.

Soomaro, A., M.S. Mirjat, F.C. Oad, H. Soomro, M.A. Samo and N.L. Oad (2001). Effect of irrigation intervals on soil salinity and cotton yield. Journal of Biological Science, 1 (6): 472-474.

Tang, L. and J. Zhang (2005). Physiological and yield responses of cotton under partial root zone irrigation. Field Crops Res. 94:214-223.

Tayel, M.Y., Sabreen, Kh. Pibars, and H. A. Mansour (2014): Response of cotton crop to irrigation intervals and tillage treatment: 2- Yield and water use efficiency. International Journal of Advanced Research, 2 (1): 725-732.

Temiz, M. (2009). Effect of paclobutrazol on fiber quality of cotton (*Gossypium hirsutum* L.). Asian journal of Chemistry, 21 (3): 1990-1994.

Wang, Z.B. and S.Q. Yi (1991). Soybean and growth regulators Sci. Book, 10- 69.

تأثير فترات الرى ومؤخر النمو (باكلوبيوترازول) على محتوى الورقة من الهرمونات الداخلية ومحصول القطن (صنف جيزة ٩٢)

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الملخص العربى

أجريت تجربتان حقليتان بالمزرعة البحثية لمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ – مصر لدراسة تأثير الرى على فترات (١٤ ، ٢١ ، ٢٨ يوم) مع الرش بمؤخر النمو (باكلوبوترازول) بمعدلات (بدون ، ٦٠ ، ١٢٠ جزء فى المليون) على محتوى الورقة من الهرمونات الداخلية و محصول القطن ومكوناته (صنف جيزة ٩٢) خلال موسمى الزراعة ٢٠١٠ ، ٢٠١١.

ويمكن إيجاز أهم النتائج المتحصل عليها على النحو التالي :-

١- أوضحت النتائج أن الرى كل ١٤ يوما أدى إلى زيادة معنوية فى محتوى الورقة من الجبريللينات والسيتوكينينات والمحصول ومكوناته (عدد اللوز المتفتح على النبات ، وزن اللوزة، معامل البذرة ، نسبة الشعر ، محصول القطن الزهر للنبات وللفدان) مقارنة بالرى على فترات ٢١ ، ٢٨ يوما فى حين أدى الى تقليل محتوى الأوراق من حمض الابسيسيك وذلك خلال موسمى الزراعة.

٢- أدى رش مؤخر النمو بمستويات (٦٠ ، ١٢٠ جزء فى المليون) إلى تحسين محتوى الورقة من السيتوكينينات وعدد اللوز المتفتح على النبات ، وزن اللوزة ، معامل البذرة ، محصول القطن الزهر للنبات وللفدان خاصة عند معدل ٦٠ جزء فى المليون وذلك مقارنة بمعاملة الكنترول خلال موسمى الزراعة.

٣- أدى التفاعل بين فترات الرى المختبرة ومستويات الباكلوبيوترازول الى حدوث تأثير معنوى على محتوى الورقة من الجبريلينات عند ٨٥ و ١٠٠ يوم من الزراعة فى الموسم الثانى فقط ومحتوى الورقة من السيتوكينينات عند ٨٥ و ١٠٠ يوم من الزراعة فى كلا الموسمين ومحتوى الورقة من حمض الابسيسيك عند ٨٥ يوم من الزراعة فى الموسم الاول وعدد اللوز المتفتح على النبات ومعامل البذرة فى الموسم الاول فى صالح الرى كل ١٤ يوم مع الباكلوبيوترازول عند معدل ٦٠ جزء فى المليون.