

EFFECT OF THREE INSECTICIDES AND TWO INSECTICIDE ALTERNATIVES ON THE PINK BOLLWORM, *PECTIONOPHORA GOSSYPIELLA* (Sand.) AND QUALITY OF COTTON YIELD

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ABSTRACT

A field study was carried out in a cotton field at the Research Experimental Farm, Faculty of Agriculture, Saba Basha, Alexandria University, in seasons 2002 and 2003 to determine the effect of five compounds separately namely, Larvin[®], Dursban[®] and Pindelta[®] (synthetic insecticides), Agerin[®] (bioinsecticide), Achook[®] (botanical insecticide) or in sequences on the pink bollworm, *Pectinophora gossypiella* (Saund.). Also, the effect of the tested insecticides on the cotton fiber quality was studied. The tested insecticides reduced the pink bollworm infestation in both seasons. Larvin exhibited the highest reduction (69.55%), followed by Pindelta[®] (69.25%), Dursban[®] (66.9%), Achook[®] (55.42%) and Agerin[®] (44.38%) in 2002 season. While Dursban was gave infestation reduction of (74.00%), followed by Pindelta[®] (73.91%), Achook[®] (70.41%), Larvin[®] (70.08%), and Agerin[®] (37.21%) in season 2003. The reduction of the infestation percentages of the pink bollworm using different sequences of the tested insecticides showed that the first sequence Achook[®], Pindelta[®], Dursban[®] and Larvin[®] and second sequence Pindelta[®], Achook[®], Dursban[®] and Larvin[®] gave a general reduction means of 75.30 % and 76.15%, respectively. The effect of the tested insecticides and their sequences on fiber quality was studied. Obtained results showed that there were no significant effects of these insecticides (separately) on the fiber length and uniformity compared with the control. The treatment with Pindelta[®] gave highest fiber tenacity (37.5- 37.4 g/tex) than the other insecticidal treatments compared with the control (37.0-37.1 g/tex) during the two seasons of study 2002 and 2003, respectively. Also, the use of Pindelta[®] and Achook[®] gave the highest micronaire reading (4.3 and 4.4 in 2002 and 4.9 and 4.4 millitex in 2003). The effect of sequential application of different insecticides on fiber quality showed that the sequences 1 and 2 gave the highest significant on uniformity, elongation and Micronaire reading compared with the control. The study proved that insecticidal sequences were most effective for pink bollworm management.

INTRODUCTION

Cotton is still among the most important commercial crops in Egypt. It is exposed annually to significant yield quantity and quality losses due to attack by different pests (Abdel-Meguid *et al.*, 1999). The Pink bollworm, *Pectinophora gossypiella* (Saund.) (Lepidoptera : Gelechiidae) is one of the major injurious pests in cotton fields in the country. Most of its damage is directed to the green bolls, as well to flower buds and flowers. The pink bollworm larvae also damage the quality of the lint and seeds of fully-mature bolls {Phipps *et al.*, (1997); Herbert (2000); Mann *et al.*, (2001)}. The present investigation aims to study the effect of three synthetic insecticides, a biopesticide and a natural formulation of neem seed kernel (Achook[®]) either individually or comprised in different sequences and applied as periodical spray-program against *P. gossypiella*. Also, the study aimed to spot some lights on the side effects of used insecticides on cotton fiber quality.

MATERIALS AND METHODS

Field experiments were carried out at Agricultural Research Farm, Faculty of Agriculture, Saba Basha, Alexandria University during the growing season 2002 and 2003 using cotton variety "Giza 70". The experimental field was divided into plots each of 0.01 feddan (42 m²). The split split design was utilized in the trial program with three replicates for each treatment as well as untreated

check. Three synthetic insecticides (Dursban[®], Larvin[®] and Pindelta[®]), a biopesticide (Agerin[®]) and natural formulation of neem seed kernel extract (Achook[®]) were individually sprayed in 2002. In season 2003, the insecticides were applied separately and in different sequences as a periodical spray round program, for choosing the best sequence of insecticidal applications against the pink-bollworm. Fifty cotton bolls were picked randomly from each replicate to count the larvae of the pink bollworm before and after each spraying date. The bolls were examined at weekly intervals till the end of the growing season. The equation of Henderson and Tilton (1995) was used to calculate the percentages of infestation reduction. The side effect of the used pesticides on cotton fiber quality was also studied. Statistical analysis of variance was performed by using F and L.S.D. tests according to Steel and Torrie (1980).

(1) Chemical used:

1.1 Synthetic pyrethroid compound:

Pindelta[®] 2,7% E.C (Deltamethrin) (S)- α -Cyano-3-phenoxybenzyl (IR)-Cis-3-(2,2 dibromovinyl)-2,2 = dimethylcyclopropanecarboxylate. The applied rate was 2ml/L.

1.2 Organo phosphorus compound:

Dursban[®] 48% Ec. (chloropyrifos); 0.0 diethyl 0-3,5,6 trichloro-2-pyridyl phosphorothioate. The applied rate was 5ml/L.

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1.3 Carbamate compound:

Larvin® 80% DF (Thiodicarb); 3,7,9,13 = tetramethyl-5,11-dioxo-2,8,14-trithia-4,7,9,12-tetra-azapentad 3,12-diene-6,10-dione. The applied rate was 1.25g/L

1.4 Biopesticide:

Agerin® (6.5%w.p) is a commercial product of *Bacillus thuringiensis* (B.t) at 32000 iu/g. It is produced by Bio-Gro-International Egypt Co. Under license from the Agricultural Genetic Engineering Research Institute (AGERI), ARC-Giza. The applied rate was 2.5 g/L.

1.5 Botanical insecticide:

Ashook® is a neem seed kernel extract (triterpenoids) containing Azadirachtin 0.15% (W/W).. The applied rate was 2 ml/L.

(2) Sequence of insecticidal treatments:

The tested insecticides were used in the second season in different sequences as follows:

Sequence (1): Achook® - Pindelta® -Dursban® ,Larvin®

Sequence (2): Pindelta® - Achook® - Dursban® ,Larvin®

Sequence (3): Dursban® -Pindelta® - Achook®, Larvin®

Sequence (4): Larvin® - Dursban® -Pindelta®, Achook®

(3)Effect on fiber quality

At the end of the two the growing seasons, cotton samples (0.5kg) from each replicate and a representative sample from each treatment were ginned in the laboratories of the faculty of Agric.,(Saba Basha), Alex. University, and then transferred to the laboratory of the "Textile Consolidation Fund Development Center" to determine the following properties of fiber quality by using H.V.I. instrument:

- a. Lint length,
- b. Cotton fineness (the micronaire reducing),
- c. Length parameters (25% span length),
- d. Lint tenacity (strength), elongation and uniformity.

RESULTS AND DISCUSSION**1- Effect of the insecticidal treatments on the population of pink bollworm larvae:-**

The obtained results are presented in Tables (1&2). Obviously, all the tested insecticides significantly reduced the rate of occurring infestation with the pink bollworm when they were applied separately. Highest efficiency was detected in both treatments of Dursban® and Pindelta® along the intervals following applied sprays. The mean numbers of larvae/ 50 bolls after one week of each spraying date comprised 0.33& 0.67; 0.33 &0.33; and 0.0&0.0 larvae, respectively, in the first season 2002 (Table1).and 1.67&1.33; 0.33&0.33; 0.0&0.0and 0.0&0.0 larvae /50 bolls, respectively in the second season 2003 (Table 2). This observed superiority was followed by Larvin® and Achook® 1.00&1.00; 0.33&1.00 ; and 0.0 &0.33 in the first season 2002 and 1.67&1.00; 0.33&0.33; 0.00&0.00; 0.00&0.00 larvae/50 bolls, respectively in the second season 2003. Agerin® was the least efficient one where 2.00& 1.67 &1.67 and 0.2 &1.67 &1.33 &1.67 larvae/50 bolls were recorded in both seasons, respectively (Tables 1,2). Highest general mean of reduction was recorded for each of Pindelta® , Dursban® and Larvin® in both seasons. The values of general mean of reduction for Pindelta®,Larvin® and Dursban® amounted 69.25 & 69.65 & 66.9 %in season 2002.While in season 2003, the values were 74.00 and 73.91% for Dursban® &Pindelta® followed by Achook® and Larvin® which ranked second, with a general mean of reduction comprised of 70.41 &70.08%, respectively . The least effective insecticide was Agerin® which gave the lowest values of reduction of 44.38 & 37.21% during 2002 &2003 seasons, in respect. Similar results were obtained by Duhoon and Banerjee(1984), Butter and Kuler (1997) and Mahapatro and Gupta (1999).

Table (1) :Effect of insecticide treatments of cotton variety (Giza 70)on infestation level of *P. gossypiella* larvae(mean/50bolls) during 2002 season.

Treatments	Pre Spraying Aug 8	Spraying dates												General Mean Of Red.
		1 st spray 12/8/2002				2 nd spray 26/8/2002				3 rd spray 9/9/2002				
		+19/8		26/8		2/9		9/9		16/9		23/9		
Larvae (No)	Red. %	Larvae (No)	Red. %	Larvae (No)	Red. %	Larvae (No)	Red. %	Larvae (No)	Red. %	Larvae (No)	Red. %	Larvae (No)	Red. %	
Larvin ^(R)	2.00	1.00 ^a	48.8	0.33 ^a	66.7	0.33 ^a	68.9	0.00 ^a	80.4	0.00 ^a	81.1	0.67 ^a	71.4	69.55
Achook ^(R)	1.67	1.00 ^a	40.9	1.33 ^b	32.1	1.00 ^a	44.8	0.67	63.6	0.33 ^a	71.6	0.00 ^a	79.3	55.42
Agerin ^(R)	2.33	2.00 ^a	30.2	1.67 ^b	39.5	1.67 ^a	43.5	2.00 ^b	46.5	1.67 ^a	55.4	2.00 ^a	51.2	44.38
Dursban ^(R)	1.33	0.33 ^a	56.2	0.00 ^a	66.6	0.33 ^a	59.5	0.33 ^a	66.7	0.00 ^a	75.4	0.00 ^a	76.6	66.90
Pindelta ^(R)	1.67	0.67 ^a	52.7	0.00 ^a	70.5	0.33 ^a	64.2	0.33 ^a	70.5	0.00 ^a	78.3	0.00 ^a	79.3	69.25
Untreated check	3.33	4.67 ^b	-	4.67 ^c	-	5.00	-	6.33 ^c	-	6.67 ^b	-	7.00 ^b	-	-
F	-	5.1418*	-	40.57**	-	10.06**	-	78.86**	-	19.18**	-	19.11**	-	-
L.S.D _{0.5}	1.74	2.219		0.878		1.809		0.857		1.898		1.988		

+ Inspection date * Significant ** highly significant Red. = reduction
 • Means that followed with the same letter are not significantly different.

Table (2): Effect of insecticide treatments of cotton variety (Giza 70)on infestational level of *P. gossypiella* larvae (mean/50bolls) during 2003 season.

treatments	Spraying dates																General Mean Of Red.	
	PreSpraying	1 st spray 12/8/2003				2 nd spray 24/8/2003				3 rd spray 7/9/2003				4th spray 21/9/2003				
	Aug 10	+17/8		24/8		31/8		7/9		14/9		21/9		28/9		5/10		
	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %	Larvae (no)	Red. %		
Larvin ^(R)	2.67	1.67 a	42.7	1.00 a	57.9	0.33 a	74.2	0.67 a	68.3	0.00a	80.9	0.33a	77.4	0.00a	83.9	0.67a	75.3	70.08
Achook ^(R)	2.00	1.00 a	47.1	0.67 a	59.6	0.33 a	69.1	0.33 a	69.1	0.00a	77.2	0.00a	79.2	0.00a	80.6	0.00a	81.2	70.41
Agerin ^(R)	3.00	2.00 a	20.6	2.00 a	24.2	1.67 a	38.01	2.00a	28.5	1.33a	47.4	2.00a	37.5	1.67a	49.6	1.67a	51.8	37.21
Dursban ^(R)	3.00	1.67 a	48.4	1.33 a	56.4	0.33 a	76.8	0.67a	71.8	0.00a	82.9	0.00a	84.4	0.00a	85.5	0.00a	86.2	74.00
Pindelta ^(R)	2.67	1.33a	49.3	0.67 a	66.3	0.33 a	74.2	0.33a	47.2	0.00a	80.9	0.00a	82.6	0.00a	83.9	0.33a	79.9	73.91
Untreated check	4.00	5.33 b	-	5.67 a	-	6.00 a	-	6.00b	-	6.33b	-	7.00b	-	7.67b	-	8.00b	-	-
F	0.7166	6.485*	-	9270**	-	22.04*	-	10.73**	-	19.47	-	27.06**	-	43.05*	-	52.24**	-	-
L.S.D _{0.5}	2.5728	1.965	-	2.020	-	1.522	-	2.126	-	1.809	-	1.682	-	1.472	-	1.355	-	-

+ Inspection date

* Significant

** highly significant

Red. = reduction

- Means that followed with the same letter are not significantly different.

Field data of the tested different sequences of insecticides against the cotton bollworm in season 2003 were summarized in Table 3. The data suggested that first and second sequences were able to reduce the infestations by reduction rate of 87.1 and 86.2% ,respectively after the 4th spray. On the other hand, the general means of reduction means were 76.15%

and 75.31% for sequence No.2 and 1, respectively. The sequences included Achook[®] in the first or second spray achieved highest efficacy, which may be due to the delayed effect of its components as antimoulting effect or the multiple active ingredients with different mode of actions. This conclusion is in agreement with that of Gupta et al,(1996).

Table (3) : Reduction percentages of *P. gossypiella* on cotton variety Giza 70 sprayed by different sequences of insecticides during season 2003.

Spraying Dates	12/8/2003 1 st		24/8/2003 2 nd		7/9/2003 3 rd		21/9/2003 4 th		General Mean
	17/8	24/8	31/8	7/9	14/9	21/9	28/9	5/10	
Sequences	Reduction percentage								
1) Ach→P→D→L	52.1	64.8	73.4	73.4	84.1	81.1	86.5	87.1	75.31
2) P→Ach→D→L	54.4	62.1	76.8	82.1	77.7	84.4	85.5	86.2	76.15
3) D→P→Ach→L	44.6	59.5	73.4	66.7	79.3	81.1	86.5	79.3	71.30
4) L→D→P→Ach	49.3	66.3	74.2	68.3	75.3	82.6	83.9	79.9	72.48

L= Larvin[®] Ach = Achook[®] D = Dursban[®]
 P = Pindelata[®] → = followed by

2- Effect of the tested insecticides and their sequences on fiber quality:-

Data presented in Table 4 shows the effect of insecticides applications on certain parameters of fiber quality during the growing season of 2002. It seems that the treatment with pindelata[®], Dursban[®] and Achook[®] elongated the resulted cotton fiber length up to 36.8, 36.6 and 36.5 mm, respectively, while Larvin[®] and Agerin[®] gave a shorter fiber length (36.0 and 35.8 mm, respectively) compared with the control (36.1 mm). Cotton fiber uniformity was insignificantly increased due to the effect of all tested insecticides

compared with untreated check, but the best insecticides were Achook[®] and pindelata[®] (51.3 and 50.6%). While fiber tenacity was significantly affected by all performed applications. The highest value of fiber tenacity (37.5 g/tex) was detected using the insecticide pindelata[®]. The treatment of Agerin[®] showed the lowest values of fiber tenacity (34.1 g/tex). It was also obvious that the elongation percentage of fibers was increased by Agerin[®] (5.6%) followed by pindelata[®] and Dursban[®] (5.4, and 5.4, respectively). The highest micronaire reading gave a significant effect of the tested insecticides.

Table (4). Effect of t insecticides on fiber quality of the cotton variety “Giza 70 “during the growing season of 2002.

Treatments	Fiber quality characters				
	Length mm	Uniformity (%)	Tenacity g/tex	Elongation (%)	Micronaire reading millitex
Larvin [®]	36.0	50.3	35.9 bc	5.4	3.9 c
Achook [®]	36.5	51.3	36.7 b	5.4	4.4a
Agerin [®]	35.8	50.1	34.1 c	5.6	4.2 abc
Dursban [®]	36.6	49.9	35.8 bc	5.4	4.2 abc
Pindelata [®]	36.8	50.6	37.5 a	5.4	4.3ab
Untreated cheak	36.1	49.6	37.1 b	5.2	4.0bc
F	1.18205046	1.09328745	13.281129**	1.42739725	5.932885**
L.S.D. _{0.05}	N.S	N.S	1.070468	N.S	0.2340822

N.S = Not significantly * = Significantly ** = Highly significant

The highest effect was recorded for cotton plants treated with Achook® and Pindelata® (4.4 and 4.3 millitex) and the lowest value was found for the treatment with Larvin® (3.9 millitex) when compared with the untreated check (4.0 millitex). Data of growing season 2003 (Table 5) indicate that the application of pindelata® and Achook® increased fiber length (36.7 and 36.3 m.m, respectively). The shortest length was recorded for Agerin® (35.0 m.m) compared with the untreated check (36.1 m.m). Also,

the highest insignificant values of fiber uniformity were recorded for Larvin®, Pindelata® and Achook® treatments (51.5, 51.2 and 50%, respectively). Cotton fiber tenacity was significantly increased due to the effect of applied Pindelata® (37.4 g/tex). The best effects on fiber elongation were recorded when Larvin® and Agerin® were used (6.4 and 6.2%). The highest micronaire reading was recorded for treatment of cotton plants with Pindelata® and Achook® (4.5 and 4.4 millitex, respectively).

Table (5). Effect of the tested insecticides on fiber quality of the cotton variety "Giza 70" during the growing season of 2003.

Treatments	Fiber quality characters				
	Length mm	Uniformity (%)	Tenacity g/tex	Elongation (%)	Micronaire reading millitex
Larvin®	35.9	51.5	35.2 c	6.4 a	4.0 b
Achook®	36.3	50.1	37.0 b	5.6 c	4.4 a
Agerin®	35.0	49.5	34.7 c	6.2 ab	4.2 ab
Dursban®	35.9	48.8	36.1 bc	5.6 c	4.1 ab
Pindelata®	36.7	51.2	37.4 a	5.9 bc	4.5 a
Untreated check	36.1	49.3	37.0 b	5.4 c	3.6 c
F	2.72123023	1.6746116	8.303529**	8.59688197**	12.6877829**
L.S.D. _{0.05}	N.S	N.S	1.186017	0.406348384	0.28509311

N.S = Not significant

** = Highly significant

The effects of sequential applications of different insecticides on fiber quality are shown in Table 6. Sequence No 2 and 3 insignificantly increased the length of cotton fiber (36.4 and 36.3 m.m, respectively). while sequence 4 decreased it (35.5 m.m). The uniformity of cotton fiber was significantly increased due to the effect of sequence 1 giving a value of 51.19%, while those sprayed with sequence 3 decreased the value of fiber uniformity (49.1%). The highest measured values of fiber tenacity (38.2 and 37.9 g/tex) were achieved after using both

the sequences 2 and 1 respectively. The elongation of the fiber was increased by the sequences 1 and 2 (5.8% for both sequences), while the lowest value was achieved after the use of sequence 3 (5.2%) although this value is not significantly differ from the untreated check. The highest micronaire reading was recorded for sequence 1 (4.2 millitex). In general, sequences 1 or/and 2 gave better fiber quality. These results are in agreement with El-Sabbagh *et al.* (1989), Sharma and Agarwal (1992), Siddiqui *et al.* (1994) and Mann *et al.* (1997).

Table (6). Effect of different sequences of insecticides on fiber quality of the cotton variety "Giza 70" during the growing season of 2003.

Sequences	Fiber quality characters				
	Length mm	Uniformity (%)	Tenacity g/tex	Elongation (%)	Micronaire reading millitex
1) Ach→P→D → L	35.7	51.9a	37.9	5.8 a	4.2 a
2)P→ Ach→D → L	36.4	50.6 ab	38.2	5.8 a	4.1 a
3) D→P→ Ach → L	36.3	49.1 b	37.5	5.2 b	4.0 a
4) L→D→P → Ach	35.5	50.6 ab	36.2	5.6 ab	4.1 a
Untreated check	36.1	49.3b	37.0	5.4 b	3.6 b
F	1.6690889	5.35066156*	0.92971767	8.150685**	4.62376238*
L.S.D. _{0.05}	N.S	1.5956111	N.S	0.29370764	0.345473318

Ach = Achook[®] P = Pendelta[®] D = Dursban[®] L = Larvin[®] → ⇒ Followed by
 N.S = Not significantly * = Significantly ** = Highly significant

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الملخص العربي

دراسة تأثير استخدام ثلاث مبيدات و اثنين من بدائل المبيدات علي دودة اللوز القرنفلية ، وعلی جودة محصول القطن

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أجري هذا البحث لدراسة تأثير استخدام بعض المبيدات المخلقة صناعيا والحديثة منها (حيوية أو من أصل نباتي) للوصول إلى أعلى كفاءة أبادية علي بديان اللوز القرنفلية علاوة علي محاولة إيجاد أنسب تتابع دوري من المبيدات تم إجراء التجارب الحقلية في مزرعة كلية الزراعة-سابقا باشا جامعة الإسكندرية خلال موسمي ٢٠٠٢،٢٠٠٣ لتقييم كفاءة خمسة مركبات منها ثلاثة مبيدات مخلقة صناعياً (اللافين-الدورسبان-البندلتا) ومركب حيوي (الاجرين) ومركب من أصل نباتي (الاشوك) كل علي حده وكذلك أجريت التجارب لتقييم كفاءة أربع تتابعات مختلفة وتأثيرهم علي معدل إصابة القطن (جيزة ٧٠) بدوده اللوز القرنفليه وكذلك التأثير الجانبي علي الصفات التكنولوجية لشعر القطن.

ويمكن تلخيص النتائج التي تم الحصول عليها كالآتي:-

- أدت جميع المبيدات المستخدمة إلى انخفاض ملحوظ في معدلات الإصابة ببديان اللوز القرنفلية مقارنة بالكنترول خلال موسمي ٢٠٠٢، ٢٠٠٣.
- في عام ٢٠٠٢ أدت جميع المبيدات المستخدمة إلى زيادة النسبة المئوية للخفض في مستوي الإصابة حيث وصلت إلى ٧٩,٣% وذلك في المعاملة بمبيد الاشوك والبندلتا ويتبعهم الدورسبان (٧٦,٦%) ثم اللافين (٧١,٤%) ثم الاجرين (٥١,٢%) وأما نتائج عام ٢٠٠٣ أعطي أيضا مبيد الدورسبان نسبة خفض عالية في مستوي الإصابة بدودة اللوز القرنفلية وصلت إلى ٨٦,٢% يليه مبيد الاشوك (٨١,٤%) ثم البندلتا (٧٩,٩%) ثم اللافين (٧٥,٣%) وأقلهم في التأثير كان مبيد الاجرين (٥١,٨).
- تم أيضا دراسة تأثير استخدام التتابعات المختلفة علي النسبة المئوية لخفض مستوي الإصابة بدودة اللوز القرنفلية وجد أن استخدام التسابعين رقم ٢,١ أظهروا أعلى نسبة خفض للإصابة (٨٧,١ - ٨٦,٢%) في نهاية الرش الرابعة علي الترتيب اعطى التتابع رقم ٢ (٧٦,١٥%) والتتابع رقم ١ (٧٥,٣١%). ومن ذلك يتضح أن التتابع المشتمل علي الاشوك في الرش الأولى أو الثانية يعطي كفاءة عالية ضد دودة اللوز القرنفلية
- تم أيضا دراسة التأثير الجانبي لاستخدام المبيدات المختبرة علي الصفات التكنولوجية لشعر القطن ولقد وجد أن المعاملة بالبندلتا أعطى قيم أعلى في صفة المتانة عن باقي المعاملات حيث بلغت القيم (٣٧,٥، ٣٧,٤، ٣٧,١ جم/تكس) بالمقارنة بالكنترول (٣٧,١، ٣٧,١ جم/تكس) خلال الموسمين (٢٠٠٢، ٢٠٠٣) علي التوالي.
- كذلك المعاملة بالبندلتا والاشوك أعطى تأثيرات معنوية ووجد أن أعلى قيم لقراءة الميكرونيير (٤,٣، ٤,٥، ٤,٤، ٤,٤، ٤,٤ مليتكس علي الترتيب) وذلك مقارنة بالكنترول (٤، ٣,٦، ٣,٦ مليتكس) خلال الموسمين علي الترتيب. أما باقي المعاملات فكانت لها تأثيرات طفيفة علي الصفات التكنولوجية ولكنها ليست معنوية.
- درس أيضاً التأثير الجانبي لاستخدام تتابعات مختلفة من المبيدات علي تلك الصفات خلال الموسم ٢٠٠٣ وقد وجد أن هذه التتابعات لها تأثير علي معظم هذه الصفات التكنولوجية. حيث وجد أن استخدام التسابعين ٢,١ حقق زيادة في صفة الانتظامية (٥١,٩%، ٥٠,٦% مقارنة بالكنترول (٤٩,٣%) وأيضاً صفة الاستطالة وكذلك وجد أن له تأثير معنوي في قراءة قيم الميكرونيير (٤,٢، ٤,١، ٤,١ ملي تكس) مقارنة بالكنترول (٣,٦ ملي تكس).