The Relative Efficiency of Some Pesticides and Fertilizers on Cotton Crop. I. Interaction Effects of Fertilizer Type and Some Insecticides on Bollworms Infestation and Cotton Quality

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ABSTRACT

The present field study was carried out on cotton variety Giza 70 during the seasons of 2002 and 2003 to evaluate the interaction effects of applied mineral and / or bio-fertilizers with certain pesticides against the cotton bollworms, besides, the final combined effect of these treatments on the cotton yield and yield losses. The least bollworm infestation reduction values were obtained in case of application of Larvin® with both types of tested mineral and bio-fertilizers in season of 2002 and 2003. Comparatively, the treatment of Karate® and sequential application of Dursban®, Larvin® and Karate® pesticides gave the highest infestation reduction with both of fertilization treatments in the growing seasons of 2002 and 2003. Generally, bio-fertilization treatment gave higher reduction than the mineral one in both seasons. The highest value of cotton yield was obtained in case of pesticides sequential spray under the two tested types of fertilization. Whereas, the values of loss in bolls were found to be greatly lower than that in untreated check.

INTRODUCTION

The cotton crop is the most important crop according to agricultural strategy. The cotton crop suffers from the injury attacking numerous pests especially the bollworms i.e., *Pectinophora gossypiella* (Saund.), *Earias insulana* (Boisd.). Hence, the different chemical groups of pesticides are applied every season to control these pests. The intensive application of pesticides may lead to undesirable effects on the natural enemies, besides the higher expense and hazard to health and environment. The effect of pesticides and fertilizers on cotton crop attracted the attention of many investigators (El-Naggar, 1998; Abd El-Rahman, 1999; Mesbah *et al.*, 2004 and Ahmed, 2002). Therefore, the present study was conducted during two subsequent growing seasons of 2002 and 2003 to evaluate the efficiency of

certain insecticides on bollworms infesting cotton crop under different types of fertilization, besides, their effects on the cotton yield and yield losses.

MATERIALS AND METHODS

Field experiments were carried out during two successive cotton seasons of 2002 and 2003 at the Agriculture Research Farm, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt. The experimental area was divided into plots, each of 1/100 Fadden and each plot was separated from the adjacent one by half-meter belt to minimize undesirable interference. The evaluated treatments as well as an untreated check were distributed, with three replicates, according to the split- split design. On the other hand, soil properties were determined at the Salinity and Alkalinity Soil Laboratory, Alexandria. The soil properties indicated to have pH (7.57), E.C (1.8), $CaCO_3$ % (7.9), organic matter % (2.16) and available Phosphorus, ppm (7.6).

At each season of study, one of two experiments as fertilized by NPK mineral fertilizers at the recommended doses super phosphate as (P_2O_5) was applied at 200 Kg / fed., urea (46.5 N) was applied at 65 N-unites and potassium sulphate as (K2O) was applied at 50 Kg / fed, while in the other treatment seeds were treated with Microbin®® as bio-fertilizer; sown at 25cm between hills with plant spacing of 60 cm between furrows. In each performed experiment, the experimental plots were divided into two subsets. In the 1st set, each plot received one of the evaluated three pesticides with three sprays. The 1st spray was started at the flowering stage of cotton plants and the 2nd spray was applied after two weeks of the former spray (the period of fifty percentage of flowering)while the 3 rd spray was done after 2 weeks of the later one (beginning of fruiting period). Also, in the2nd experimental set, the evaluated pesticides were sprayed according to the same followed program of application. The first application included Dursban® followed by Karate® then Larvin® pesticides. The pesticides were sprayed at the recommended rates according to the Egyptian Ministry of Agriculture using Knapsack sprayer (20 L-capacity) equipped with one nozzle. Dursban® (chlorpyrifos), Karate® (lambda-cyhalothrin) and Larvin® (thidocarb) pesticides were applied at 3 ml, 1.5 ml and 2.5 gm per litre, respectively.

1. Determination of cotton bollworms infestation

The infestation level of the studied insect pests was inspected by picking random samples of the green bolls. Sampling process was carried out for 7 weeks in both seasons of 2002 and 2003. The samples were

externally examined dissection for internal infestation. Infestation level was based on the presence of the larvae on / and inside of the bolls.

A sample of 50 green bolls of each treatment was picked up during two successive weeks after each spray. The percentage of infestation reduction was calculated according to Henderson and Tilton (1955) as follow:

$$\% \text{ Reduction of infestation} = 1-[a / b \times C / d] \times 100$$

Where:

a: No. of larvae in untreated check before spray.

b: No. of larvae in untreated check after spray.

c: No. of larvae in treatment after spray.

d : No. of larvae in treatment before spray

2-Estimation of loss cotton yield caused by bollworms:

Throughout the consequent cotton growing seasons of 2002 and 2003, ten cotton plants were randomize in each treatment for detecting and coining the numbers of completely open bolls,⅔ and ⅓ open bolls, which have been symbolic A,B and C respectively. Also, green and dry bolls were transferred to the laboratory for examining and counting the infested dry bolls (D) and green bolls (E). Then, the expected open bolls (F) were calculated as follows:

$$F= A+B+C+D+E$$

The true open bolls (G) were calculated as follows:

$$G= A+ (B\times⅔) + (C \times ⅓)$$

Then the number of unopened boll (H) was calculated as follows:

$$H= F-G$$

The percentage of loss (I) was calculated according to EL-Naggar (1998), ABD EL-Rahman (1999) and Ahmed (2005) as follows:

$$\% \text{ of loss } I= H / F\times 100$$

3- Determination of cotton yield:

In each treatment ripened open bolls from twenty- five cotton plants were collected to determine the rate of cotton yield / plant, from which, the total yield / Fadden was relatively calculated.

RESULTS AND DISCUSSION

1. Influence of some pesticides and fertilizres bollworms.

a. At the 1st season :

As shown in Table 1, the obtained values appeared that the highest infestation reduction was achieved by Karate® (88.4), while the

lowest reduction is given by Larvin® (67.9) in those plots receiving mineral fertilization. The reduction of cotton bollworms had the greatest values with the bio- fertilizer, where these values were corresponding to the following arrangement: plots- received the sequential application of the three tested pesticides (92.27) = Karate® (91.85)> Dursban® (88.03) = Larvin® (85.97). According to the grand means of influence, Larvin® pesticide caused the lowest value of infestation of bollworms (76.94), while the other treatment gave the infestation reduction percent values in a range of 90.0-86.8. Moreover, reduction of cotton bollworms infestation was less in those plots received NPK fertilization compared with those of bio- fertilizer. Generally, the infestation reduction was highest with cotton plants received the second type of fertilization (89.13).

b. At the 2nd season:

As shown in Table 2, treatments which involved Karate® and the sequential application of the three tested pesticides gave the highest reduction of infestation (89.90& 90.90, respectively). However, Larvin® gave the lowest value (84.6). The same trend is related to the bio-fertilizer confirmed the effectiveness of Karate® and the sequential application. Generally, the evaluated treatments are significantly different and highly reduced the infestation by percentages ranged between 85.3 and 90.6. The bio-fertilizer with ½ rate NPK fertilizer is found to be effective to decrease the cotton bollworms infestation (89.05) in comparison with the infestation in those NPK fertilized plots (88.92).

The pooled results generally indicated that bio- fertilizer appeared to increase the efficiency of the tested pesticides against the cotton bollworms than that exhibited by the mineral fertilizers during the two seasons of evaluation. Also, Karate® as a pyrethroids insecticide is the most efficient insecticide followed by Dursban® (chlorpyrifos) as an organ phosphorous one. These results are in conformity with those of Butter *et al.* (1990) and Patill *et al.* (1991) since they found that fenvalerate and cypermethrin (pyrethroids) gave the best control of boll infestation with bollworms. On the contrary, the low toxicity of Larvin® (thidocarb) as a carbamate insecticide in comparison to a synthetic pyrethroids is agreed with that reported by Gupta et *al.* (1991). They found that carbaryl (sevin) ® as a carbamate insecticide did not control *Earias* sp. and *Pectinophora gossypiella*. The plots receiving the three evaluated insecticides as a sequential spray gave good bollworms reduction. This finding is in agreement with that reported by Singh and Lakra (1990) that.

The results mentioned before confirmed that cyano- synthetic pyrethroids (type 2) were more efficient against bollworms than non- cyano

synthetic pyrethroids (type 1). So, Karate® that containing CN group was highly effective to reduce the bollworms infestation as found in this study. Moreover, the obtained results indicated the successful application of the assessed pesticides and agreement with reported by (Jha *et al.*, 1995 and Ibrahim *et al.*, 2000).

In the present study, Karate® (lambda cyhalothrin) followed by Dursban® (chlorpyrifos) and Larvin® (thidocarb), which gave a fruitful influence against cotton bollworms. The present study exhibited the importance of NPK fertilization which was confirmed by Ilango and Uthamasamy (1992) who showed that the damage caused by *Earias viettal* was lowest at 40: 40: 80 NPK kg/ ha. On the other hand, the minerally fertilized plants showed a low population of the spiny bollworm larvae in comparison to that bio-fertilized ones. The role of bio-fertilization to improve the cotton plant health may be attributed to the explanation that this fertilization may induce the plant health to be more tolerant towards the infestation by pests than the naturally by fertilized plants. This explanation is in agreement with reported by Mesbah *et al.* (2004).

2. Influence of pesticides and two types of fertilization on cotton yield and yield losses:

It is obvious from Table 3 that the pesticides increased the cotton yield (expressed as % increase than the untreated check according to the of Hussein *e t. al.*, 2002) either in the presence of mineral or bio-fertilization during the two seasons of evaluation. The yield increased by 86,82,58 and 52 % in those plots treated by sequential spray of the 3 pesticides, Karate®,Dursban®,Larvin® treatments, respectively in the mineral fertilization. In respect to the effect of bio-fertilization, the values of yield increase by 102.2, 97.8, 80 and 42 % with the previous treatment, at the end season of 2002. The obtained results, also gave same pattern at the harvest season of 2003. The highest increase in cotton yield is related to the plants sprayed sequential by the three tested pesticides.

In contrast, the least increase was due to by Larvin® in a range of 19.7 and 52 %. According to the common means of increase, values of cotton yield revealed that the highest value (80.60) is achieved by bio-fertilized plants at the end season of 2002 followed by that value produced by mineral fertilized plants (69.5). The increase values of cotton yield at season of 2003 were less than obtained at the 1st season.

The results in Table 4 show that the pesticides seemed to decrease the loss in cotton bolls due to infestation by bollworms where the

values of loss percentage are in a range of 2.1 and 5.4 % compared with the untreated check 15.4 and 21.9 % during the two seasons of study.

However, the pesticides in the presence of the two types of fertilization gave little loss percentage of the cotton bolls where the values are between 2.1 and 5.4 after the two seasons of evaluation.

The pooled results indicated that the importance of both pesticides and fertilization on cotton yield. This finding is in accordance with previous reports where certain fertilizers alone or mixed with certain pesticides, i.e. chlorpyrifos and cypermethrin, increased the rates of bolls ripening and simultaneous opening (El- Nawawy *et al.*, 1983).

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Table (1). Influence of three pesticides and their sequential applications under two types of fertilization on cotton bollworms Infestation during season of 2002.

Pesticides	Infestation reduction %														Grand mean
	NPK mineral fertilizers							Microbin ® Bio-fertilizer							
	1	2	3	4	5	6wk	Av.*	1	2	3	4	5	6wk	Av.*	
Dursban®	72..5	72..5	84.7	90. 8	94. 7	95. 2	85.07 ab	63. 3	90. 6 .	88. 8	94. 7	95. 1	95. 7	88. 03 b	86. 6 b
Karate®	91. 7	75. 2	91. 3	92. 5	94. 7	85. 0	88. 4 a	88. 9	87. 7	88. 8	94. 7	93. 7	95. 7	91. 58 a	90. 0 a
Larvin®	55. 8	24. 8	58. 0	79. 2	94. 7	95. 0	67. 9 c	60. 0	90. 6	83. 9	93. 2	95. 1	93. 0	85. 97 b	76. 94 c
Sequential application	64. 2	75. 2	89. 3	90. 8	94. 7	97. 5	85 2 8 b	88. 9	87. 7	93. 0	93. 2	95. 1	95. 7	92. 27 a	88. 78 ab
Grand mean				**81.729 b**								**89.133 a**			

* LSD at 0.05 fertilizer (A) = 4.56 * LSD at 0.05 pesticides = (B) 2.69 * LSD at 0.05 (AB) = 3. 046
*Av. = Average

Table (2) Influence of three pesticides and their sequential applications under two types of fertilization on cotton bollworms infestation during season of 2003.

Pesticides	Infestation reduction %														Grand mean
	NPK mineral fertilizers							Microbin ® Bio-fertilizer							
	1	2	3	4	5	6wk	Av.*	1	2	3	4	5	6wk	Av.*	
Dursban®	74.6	83.9	91.2	87.4	94.9	95.2	87.9 ab	78.3	88.7	91.0	94.8	92.1	94.8	90.0 a	88.7 a
Karate®	74.6	90.9	91.2	92.8	94.9	95.2	89.9 a	75.4	88.7	93.1	94.8	92.1	96.1	90.2 a	90.04 a
Larvin®	66.9	83.9	82.5	87.4	93.4	93.7	84.6 c	68.8	91.3	82.1	89.7	88.8	94.8	85.9 b	85.3 b
Sequential application	82.3	88.8	91.2	91.2	98.4	93.7	90.9 a	84.9	86.2	93.3	93.3	90.6	94 8	90 5 a	90 60 a
Grand mean	88. 292 b							89. 050 a							

Table (3). Evaluation of efficacy of certain pesticides and their sequential application under two types of fertilization on the cotton yield during the growing seasons of 2002 and 2003.

Pesticides	Season 2002				Season 2003			
	Min*		Bio*		Min*		Bio*	
	Weight / Fe. (Ken. / Fed.)	% Increase	Weight / Fe. (Ken. / Fed.)	% Increase	Weight / Fe. (Ken. / Fed.)	% Increase	Weight / Fe. (Ken. / Fed.)	% Increase
Dursban®	7.9	58.0	8.1	80.0	8.6	41.0	8.1	44.6
Karate®	9.1	82.0	8.9	97.8	9.8	60.7	9.3	66.1
Larvin®	7.9	52.0	6.4	42.2	7.3	19.7	6.9	23.2
Sequential application	9.3	86.0	9.1	102.2	10.7	75.4	9.7	73.2
Untreated check	5		4.5		6.1		5.6	
Increase mean		69.5		80.6		49.2		51.18

Min* : Mineral fertilizer (NPK) Bio*: Microbin® as bio- fertilizer

Table(4). Evaluation of efficacy of certain pesticides and their sequential application under two types of fertilization on the yield losses during the growing seasons of 2002 and 2003.

Pesticides	Season 2002 %-Loss		Season 2003 % Loss	
	Min *	Bio *	Min *	Bio *
Dursban®	2.7	3.3	2.5	2.9
Karate®	2.4	2.3	2.1	2.3
Larvin®	3.1	5.4	2.9	3.1
Sequential application	2.3	3.2	2.4	2.1
Untreated check	15.4	17.4	19.7	21.9
General mean	3.18	6.32	5.92	6.46

Min * : Mineral (NPK)
Bio * : Microbin ® as bio-fertilizer

الملخص العربى

تأثير بعض من نوعية الأسمدة والمبيدات على محصول القطن ١- العلاقة مابين نوعية التسميد وبعض المبيدات فى التأثير على الإصابة بديدان اللوز وإنتاجية القطن .

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إجريت الدراسة على صنف قطن جيزة ٧٠ , وذلك خلال موسمى ٢٠٠٢ ,٢٠٠٣ وذلك بهدف دراسة تأثير بعض المبيدات على ديدان اللوز تحت ظروف التسميد الحيوى والمعدنى بجانب دراسة التأثيرات الجانبية على إنتاجية القطن ونسبة الخسارة فى المحصول .

ويمكن تلخيص النتائج المتحصل عليها كالأتى :

* أدى إستخدام اللارفن إلى الحصول على أقل معدل خفض بالاصابة بديدان اللوز وذلك تحت نوعى التسميد المعدنى والحيوى فى موسمى ٢٠٠٢ ,٢٠٠٣ , بينما أدى إستخدام الكاراتى والتتابع الثلاثى المكون من ثلاث مبيدات (دورسبان , ولارفن , كاراتى) أعطى أعلى نسبة خفض فى نسبة الاصابة بديدان اللوز وذلك فى موسمى ٢٠٠٢ , ٢٠٠٣ .

* بصفة عامة أعطى التسميد الحيوى أعلى معدل خفض عن التسميد المعدنى .

* أوضحت الدراسة أيضا أنه تم الحصول على أعلى إنتاجية عند إستخدام التتابع الثلاثى من المبيدات فى كل من نوعى التسميد ومن ناحية أخرى كانت نسبة الخسارة أقل بدرجة كبيرة عن الكنترول .