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NEW APPROACH FOR EVALUATING THE USE OF FOLIAR FERTILIZERS, ALTERNATIVE CHEMICAL COMPOUNDS AND RELEASE OF *TRICHOGRAMMA EVANESCENS* IN AN INTEGRATED PEST MANAGEMENT FOR CONTROLLING PINK BOLLWORM, *PECTINOPHORA GOSSYPIELLA* (LEPIDOPTERA: GELECHIIDAE) IN ORGANIC AND CONVENTIONAL COTTON PLANTS

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ABSTRACT : ***The present study was carried out on cotton variety Giza 70 during two consecutive seasons of 2004 and 2005 in the Experimental Farm of the Faculty of Agriculture (Saba Basha), Alexandria, Egypt to evaluate the effect of four IPM organic regimes [Naturalytes, Biocides, Botanicals and releasing a parasitoid of Trichogramma spp.] in organic cotton and six IPM regimes in conventional Cotton [O.P., oxime carbamate, S. pyrethroids, a naturalyte, Spinosad and their mixtures with chemical insecticides at half a rate of each compound] for determining the possible use of them in the programme of Integrated Pest Management (IPM) of the pink bollworm.The obtained results indicated the highest efficiency of the foliar treatment $^{1}/_{2}$ g/liter of each of Ascorbic and Salicylic acid in both seasons during the flowering period of organic cotton plants grown at lower plant density. While in conventional cotton, the highest reduction of pink bollworm was given by the 11th regime (Curacron + Match, Pindelta+ Cotton Seed Oil, Spinosad + KZ oil , Larvin + Dipel) (Deflowering at lower plant density).The applied regime of Trichogramma, Agerin + Achook, Trichogramma + Agerin + Achook, Spinosad + Meenark, Dipel + Meenark was most efficient in reducing population of PBW in green bolls of growing early and late organic cotton plants at lower plant density in both seasons. While, in conventional cotton; the 11th regime also showed the least infestation level.The cotton yield was significantly higher in organic cotton (89.20%) post application of the 4th IPM program ($^{1}/_{2}$ g/ liter .of each Ascorbic , Salicylic at the start of flowering period, Trichogramma, Agerin + Achook, Trichogramma + Agerin + Achook, Spinosad + Meenark, Dipel + Meenark during boll formation). In conventional cotton the 11th IPM (Curacron + Match, Pindelta+ Cotton Seed Oil, Spinosad + KZ oil, Larvin + Dipel with deflowering at the start of flowering stage) gave a higher average of cotton yield in both seasons.***

Key words: ***Foliar Fertilizers, Trichogramma evanescens, Integrated Pest Management, Pink bollworm***

INTRODUCTION

The cotton bollworms are considered to be the utmost destructive late season insect-pests of cotton plant; the highly preferred host for these insects in Egypt. The PBW, *Pectinophora gossypiella* (Saund.) is the key pest of cotton in many areas of the world, because it is the most destructive pest to the yield directly, (lint, oil and seeds). It is capable of causing tremendous financial losses in cotton growing allover the world. The worldwide losses are estimated by an average of 8.2% (Ridgway, 1984) of the total world production. It is difficult to depend only on an automatic schedule of insecticides against bollworms because the destructive larval stage of the PBW spends most of its life cycle hidden. Moreover the laid eggs are well protected between bolls and bracts. This behavior makes it difficult to be controlled with the traditional chemical spray regimes. Therefore, that offers an ideal opportunity to evaluate different IPM regimes for both conventional and organic cotton; which traits of rely upon good agricultural practices.

In this concern, the use of growing of organic cotton cultivation is greatly based upon the use of Biocides, especially the toxins of the *Bacillus thuringiensis*, which are now part of the National integrated pest management (IPM) programme. Also, the use of Spinosad (Tracer) and Abamectin, which are mainly extracted from microorganisms, could be attributed in high yield and clean environment. In addition, the involvement of botanical insecticides i.e. Neem oil, Achock, neem seed kernel extract and the parasite *T. evanescens* which feeds on the PBW and the SBW eggs direct the pest control to the right track of IPM.

MATERIALS AND METHODS

Field experiments were carried out in the agricultural research experimental farm, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt during the successive growing cotton seasons of 2004 and 2005. In both seasons, an area of about half feddan was divided into two subsets; each subset was also divided into plots (each plot was about 0.01 fed.).

The first subset was cultivated and considered as organic cotton, while the second subset was cultivated and treated as conventional cotton. The first subset of organic cotton was fertilized by applying composted goat manure at 20 m^3 per feddan, while the 2^{nd} was fertilized by mineral fertilizers and treated with conventional or synthetic insecticides. Meanwhile, all the normal agricultural practices were applied to both subsets. For the organic and / or conventional cotton in both seasons of 2004 and 2005 cotton seeds were sown during the first week of March (early cotton) or/and during the last week of April (late cotton).

Four IPM regimes of safe materials were applied to organic cotton, while six IPM regimes of safe compounds chemical insecticides and their mixtures

were applied to conventional cotton. The treatments of 4th program in organic cultivation and 11th program in conventional cultivation were the same as 3rd and 10th programs, but their plants were somewhat with lower density (at 70 cm apart between rows and 25 cm apart between hills). Each IPM regime was represented by 4 replicates. Each plot of (about 0.01 feddan) was separated from the adjacent one by a half meter belt in width to minimize the interference of spray drift from one treatment to another. The IPM programs were arranged in complete and randomized blocks, and organic cotton included five programs 1st, 2nd, 3rd, 4th and an untreated check (1) for both early and late cotton season while in the conventional cotton the included programs were 6 th, 7th, 8 th, 9 th, 10th, 11th and an untreated check (2) for both early and late cotton. Only in the 4th program in organic cotton and 11th program in conventional cotton the seeds were sown at different spacing of 70 cm apart between furrows and 25 cm space between hills, while for all other IPM programs the seeds were planted at 60 cm a part between furrows and 20 cm space between hills.

Table (1) shows the applied treatments in each of the suggested IPM programs of organic and / or conventional cotton plants.

(1) At the beginning of flowering period, all the IPM programs of organic cotton except for untreated check (1) were treated with liquid potassium soap produced from cotton seed oil at the rate of 1 l/fed. to control aphids and red spider mites.

(2) All the IPM programs of conventional cotton except for untreated check (2) were treated with Romectin (1.8 EC) (Abamectin) at a rate of 3 ml/10 L to control PBW as well as the sucking pests.

These IPM regimes were applied to early or late organic and / or conventional cotton plants against the infestation of pink bollworms. Also, the side effect of these IPM regimes was studied and experimented on yield and cotton plants characters.

1. Estimation of pink bollworms infestation

Weekly sampling of 25 green bolls or flowers or squares each from the inspected replicate were randomized taken in cloth case to the lab. along a period lasted 5 weeks post foliar treatments and extended from the beginning of flowering and all the boll formation period. Green bolls were externally examined before dissection for internal inspection. Infestation level was detected. Analysis of variance using "F" and "LSD" tests was performed for comparing the different studied IPM programs. Percent of infest-reduction by PBW was calculated according to Henderson and Tilton, (1955) .

Table 1

2. Determination of cotton yield.

Cotton yield/plant was calculated by weighting the cotton yield of 20 randomizely chosen plants from each replicate, from which the average of cotton yield/plant was calculated in grams, and then in Kentar /fed.

3. Chemicals used in the course of the study

(1) Salicylic acid: $C_7H_8O_3$

Salicylic acid is also called mono-hydroxybenzoic acid.

(2) Ascorbic acid: ($C_6H_8O_6$) white to slightly yellow crystals.

(3) Greenzit SP_{100}: produced by Ciba Geigy limited, Basal (Novartis) and the main components are: EDTA Na_2Mn (40 %) and EDTA Na_2Zn (43 %) supplemented by Ca (0.054), Fe (5.40), Mo (0.027) Mg (0.54) Ni (0.005) Mn (5.54) Cu (0.005) Zn (70.27) gm / Kg.

(4) Meenark: It is fish oil rosin soap prepared as W.P. Formulation (Totally biodegrade- dabbles). It is of long persistence and increase pesticide properties when used in combination.

Rate: 1/2 kg "Meenark" is mixed with 5 liters of warm water and the diluted to 100 liters of water. It was used at a rate of 5 g/l.

(5) Cotton seed oil 1%

Rate of use: 5 ml/l. It was used in combination with Pindelta and Spinosad, at 5 ml/l.

Preparation of this aqueous suspension required the addition of 0.05% triton x-100 to form a stable suspension and to act as an emulsifier and to ensure the uniform distribution on the treated surface (Abo-Shoola, 1990).

(6) Kz oil 95% EC

The rate of application is $1^3/_4$ l/fed. In this study it was used at 875 ml/fed in combinations.

(7) Biological insecticides:

(A) Agerin®: It is biological insecticide, containing *Bacillus thuringiensis* (*B.t*), Subsp. *kusstaki* (32000 IU/mg W.P.). The rate of applied dose was 2 g/l and 1 g/l in combinations.

(B) Dipel.2X® (W.P) 32000 IU/mg a bio-insecticide contains *Bacillus thuringiensis* subsp.-*kurstaki* applied at 200 g/fed.

(8) Botanical insecticide [Achook® 0.15% EC].

It is a neem seed kernel extract (Triterpenoid containing Azadirachtin 15% w.w. The rate of used dose comprised 2 ml/l

(9) Spinosad (Tracer®). It is a new insect control preparation obtained by fermentation of the actionmycete bacterium *Saccharopolyspora spinosa* (Mertz and Yao, 1990) and contains 2 metabolytes, spinosyn A and Spinosyn D which together form the active substance, spinosad

(10) IGR

Lufenuron or Match® EC 5% ; (RS) -1- [2,5-dichloro-4-(1,1,2,3,3,3-Hexafluro Propoxy phenyl] -3- (2,6-difluorobeenzoyl urea).

(11) Synthetic pyrethroids

A - Lambda Cyhalothrin or: Karate® ; A (S) - α - cyano-3 phenoxy benzyl (2)-(IR, 3R) 3-chloro-3,3,3-trifluoro prop-1-only)-2,2 diamethyl cyclopropana carboxylate and (R) - α - cyano-3 phenoxy benzyl (2) – (15, 35) – (2 chloro-3,3,3 trifluaro prop-1-enyl) 2,2 dimethyl cyclo propane carboxylate

B - Deltamethrin or Pindelta® 2.7% EC: (S)- α-Cyano-3 phenoxybenzyl (l*R*, 3*R*)-Cis-3-(2,2 dibromavinyl)-2-2 dimethyl cyclopropane carboxylate

(12) Organophosphorous compounds:

Profenophos or Curacron® 720 E.C; *O*-4bromo-2-Chlorophenyl-*O*-ethyl-*S*-propyl phosphoro- thioate

(13) Carbamates:

Thiodicarb or Larvin® Fl (37.5 %);3,7,9,13-tetramethyl-5, 11-dioxa-2,8,14-trithia-4,7,9,12-tetra-tetra-azapentadeca-3,12 diene-6, 10-dione.

4. The release of the parasitoid *Trichogramma evanescens*.

The parasitoid was released as pupae at a rate of 23100-26400 Parasitoids/fed. The release was applied in the field using a device that protects them from predators and unfavorable weather conditions. The rate of releasing comprised 22 papers cards/fed. release. Also, the distance between the release points was 14 m, and started 7 m apart from the edges of the field (Agamy, 2003). Parasitoid release was conducted after boll formation of organic cotton on the 24th of July for early cotton and the 3rd of August for late cotton in both seasons of 2004 and 2005 and was repeated again after two weeks.

The performed treatments at the start of the growing season and / or flowering period delayed the first application of insecticides till the beginning of August in early sown cotton and the 10th of August in late sown cotton in both seasons of 2004 and 2005.

5. The statistical analysis

The design used in statistical analysis was split-split plot.

RESULTS AND DISCUSSION

1. Effect of performance foliar treatments and / or deflowering at the beginning of flowering stage on the infestation levels of pink bollworm (PBW) in 2004 and 2005 cotton seasons.

Table (2) elucidates the calculated mean numbers and the percentages of detected larvae of pink bollworms in the seasons of 2004 and 2005. The high abundance of PBW was revealed in the last week of July and the first week of August. Earlier grown cotton showed significant lower infestation levels by PBW in both organic and conventional Cotton. All IPM regimes of organic and conventional cotton significantly reduced the infestation by PBW compared to the untreated check in both early and late planted organic and conventional cotton.

The average percentage of reduction of PBW during flowering period in organic cotton was higher (50.40) in 4th program which its plants were grown at lower plant density and treated with ($^1/_2$ g/l of each Ascorbic and Salicylic acid), while this average percentage amounted to 41.90 % in 3rd program, which had the same treatment but its plants were grown at higher plant density. In contrast, the growing plants in 1st program gave the lowest average percentage reduction of PBW in both early and late cotton (33.30 %). Similarly, in conventional cotton, the lowest average percentage reduction of 33.45 % in both early and late cotton was achieved in regime 6th (Greenzit at 0.2 g/l); increased to 39.80 % and 46.90 % when sprays of S.A at 1 g/l and Ascorbic acid at 1 g/l were applied after spraying Greenzit at 0.2 g/l in regimes 7th and 8th, respectively

Herein Ascorbic acid is more efficient than salicylic acid in reducing incidence of PBW. While the treatment of program 9, (Greenzit at 0.2 g/l, followed by $^1/_2$ g/l of each Salicylic and ascorbic acid) was more effective foliar treatment in reducing the infestation level of PBW, which amounted to 53.90 % (Table 2). The highest % reduction (66.45 %) of PBW/25 flowers, square, or young bolls was inspected in plants of the 11th regime, (Deflowering at lower plant density) and comparison to 50.20 % for the inspected plants in the 10th Program. (Deflowering at higher plant density).

2- Effect of applied of IPM regimes on infestation level by PBW during boll formation period in growing cotton seasons of 2004 and 2005.

The exhibited data in Table (3) show that in organic cotton: the 4th regime (releasing *Trichogramma*, Agerin + Achook, *Trichogramma* + Agerin+ Achook, Spinosad + Meenark, Dipel + Meenark) was utmost efficient in reducing PBW infestation in green bolls (80.55%) in the seasons of 2004 and 2005; in early and late organic cotton grown at lower plant density. The 1st and 2nd program were somewhat lower efficient and gave 74.23% and 79.10 % reduction, respectively. *Trichogramma*, Agerin or Achook each alone did not give good control of PBW, while the combination of each of them or all of them enhanced the performance of higher efficient control against PBW. Also, treatments of cotton seed oil and Meenark increased the efficiency of Spinosad in reducing the infestation of PBW. PBW infestation was more increased in case of higher plant density and in late sown cotton. In conventional cotton, the11th& 10th programs [Curacron+ Match, P+ C.S.O, Spinosad + KZ oil, Larvin + Dipel] at higher and / or lower plant density showed the least infestation level with a reduction of 85.70& 88 % and 85.40 & 85.80 in 2004 and 2005, respectively followed by 9th program[Curacron + Achook, Karate + Spinosad, Spinosad, Spinosad + Achook, Larvin + KZ oil] (82.75, 84 %). Also, that result was confirmed by the deduced reduction mean for each of these above mentioned programs in both seasons and amounted to 86.90, 85.60 and 83.38 %, in respect, while the treatment of single chemical insecticides (6th regime) resulted in the least percent reduction of 75.87 %.

Table 2- 3

These results are in agreement with Dirimanov *et al.* (1980) who mentioned that the use of *B.t* with *Trichogramma* spp. reduced the codling moth up to 4% at harvest, insecticidal treatments reduced it to 1%, but using *B.t* with *Trichogramma* spp. resulted in greater densities of predators. Luo *et al.* (1986) stated that, the mixture of *B.t* with small amount of a pyrethroid insecticide resulted in 70-95% control of 2nd and 3rd generation of PBW. Kharboutly *et al.* (1999) stated that Tracer (Spinosad) was found to be more effective against bollworms than pyrethroids and conventional insecticides. EL-Naggar (1998) and Mesbah *et al.*, (2000) found that the application of Polytrin® / Greenzit N.P.K gave higher efficacy on the level of bollworms infestation. Abdel-Aziz (2002) stated that the tested Salicylic Acid and Ascorbic acid. each at 30 g/fed had a significant effect in reducing the percentages of bollworms infestation (10.9 g for SA. and 11.36 in plots treated with Salicylic Acid and Ascorbic acid., and detected significant differences between the treated and untreated plots. The results, also are in agreement with Hussein *et al.* (2002) who mentioned that the infestation by bollworms after spraying by the foliar fertilizer Mikrosol, was significantly reduced in comparison to the untreated check. Emera *et al.* (2002) explained that Es-fenvalerate at 600 ml followed by Spinosad 24 Sc at 50 ml tank mixed with 1 L mineral oil/feddan gave effective reduction for both the cotton bollworms; and the addition of mineral oil enhanced Spinosad performance and was significantly better either than Spinosad or Larvin at 0.5 kg/fed alone. Mansour (2004) reported that the release of *T. evenescesce* was recommended to control the bollworms, and showed that releasing of *Trichogramma* had a less effect against bollworms, versus the release of *Trichogramma* with Biocid (*B.t*) which gave better control and significantly decreased the level of infestation by PBW than applying *B.t* alone or releasing the parasite alone.

3- Effect of experimented IPM regimes on cotton yield in growing cotton seasons of 2004, 2005

The exhibited data in Table (4) show the calculated averages of cotton yield for both the early and late sown cotton plants and could be concisely explained as follow:

1- In organic cotton, the highest cotton yield amounting to 11.35 Kent/fed was estimated for the treated plants of 4th program [$^1/_2$ g/l Ascorbic, $^1/_2$ g/l Salicylic& *Trichogramma*, Agerin + Achook, *Trichogramma* + Agerin+ Achook, Spinosad + Meenark, Dipel + Meenark] and the lowest yield of 6.18 was estimated for plants in untreated check in the season of 2004. In general, cotton yield was significantly higher in all tested IPM regimes in comparison with the untreated check. The highest % increase in yield (83.70) over the untreated check was detected for the 4th program and ranged from 51.30 to 83.70 % in the other performed IPM regimes. While in the season of 2005, the highest cotton yield in organic cotton comprising

Table 4

7.7 Kent/fed was estimated for the treated plants in the 3rd program [1/2 g/l Ascorbic, 1/2 g/l Salicylic& *Trichogramma*, Agerin + Achook, *Trichogramma* + Agerin+ Achook, Spinosad + Meenark, Dipel + Meenark]. Also all other tested IPM regimes achieved significantly higher yields than the untreated check, the highest % increase in yield (55.6%) was inspected in the 3rd regime and the lowest in the 1st regime 32.30% [1 g/l salicylic acid& *Trichogramma*, Agerin, Agerin + *Trichogramma*, Spinosad, Dipel].

2- In Conventional cotton: In the season of 2004, the cotton yield of all carried out IPM regimes was significantly higher than that in the untreated check (5.76 Ken/fed.). Whereas, the highest yield of 10.90 Kent/fed. was estimated for the 9th program [0.2 g/l Greenzit + 1/2 g/l of each Ascorbic and salicylic acid& Curacron + Achook, Karate + Spinosad, Spinosad, Spinosad + Achook, Larvin + KZ oil] achieving 89.20 % increase over the untreated check; followed by 10.34 Kent/fed. for the treated plants in the 8th program[0.2 g/l Greenzit$_{Sp100}$ + Ascorbic acid 1 g/l& Curacron + KZ oil, Karate + Agerin, Spinosad + Meenark, Larvin + Match] achieving 79.50 % increase over check and the lowest 8.2 Kent/fed. was detected in the 10th program, resulting in 42.40 % increase over check. Also, in 2005, all IPM regimes achieved significantly higher cotton yield than the untreated check (4.93 Kent/fed.). The highest yield of 9.86 Kent/fed was revealed in the 11th program[Deflowering at the start of flowering stage& Curacron+ Match, P+ C.S.O, Spinosad + KZ oil, Larvin + Dipel]; resulting in 100% increase over check, while the lowest 7.16 Kent/fed. was estimated for the 6th regime [0.2 gm/l Greenzit$_{Sp100}$& single chemical insecticides] was achieving 45.20% increase in yield over check treatment.

Shalaby *et al.* (2002) mentioned that releasing *T. bactrae* reduced % losses in cotton yield by 12.3 and 58.9% in 2000 and 2001 cotton seasons as, reducing the infestation percent of both bollworms by 15.2 and 35.82% and 10.88, 31.63% in both season. Mann *et al.* (1997) mentioned that deflowering at the start of the season did not affect yield of cotton; no significant difference detected in cotton maturity and yield after 100% removed of flower buds (which extended into mid July) and no significant interactions with removal occurred. El-Naggar (2003) and Mesbah *et al*. (2004) mentioned that the tri-sequent sprays of Baythroid with Greenzit N.P.K and neem oil or with Greenzit$_{SP100}$ and Ascorbic acid on the bio-fertilized cotton plants with Microbin gave the highest cotton. Johnson *et al.* (1997) stated that the highest yield was obtained by mixing Spinosad with Karate and provided excellent control of bollworm complex. Boguslawski and Basedow (2001) in Fayoum, found that the cotton yield showed no difference between organically (without insecticides or mixed fertilizers) and conventionally managed farms (with insecticides and mineral fertilizers) in 1998. However, in 1999, the yield from the organically grown cotton (with mating disruption) was significantly 52% more than that from conventionally managed cotton

(with mineral fertilizers and insecticides. Abdel-Rhman (2004) started that the treatments of Tracer® (Spinosad), Chlorpyrifos, and Methoxyfenozide ® increased the cotton yield. Similar results were also explained by Sun and Xu (1986), EL-Naggar (1998) and Mesbah *et al*. (2000).

REFERENCES

Abdel-Aziz Mahasen A. (2002). The ffect of Potassium fertilizers, Ascorbic acid and Salicylic acid on inducing resistance in cotton plants Gossypium barabadense L. against the spiny bollworm Earias insulana (Boisd.). 2nd International Conference, Plant Protection Research Institute, Cairo, Egypt, 21-24 December, 871-876.

Abdel-Rhman Kh.A. (2004). Effect of certain bio and chemical insecticides on the incidence of bollworms, physiological and yield parameters of cotton plants. Adv. Agric. Res., 9(1): 125-136.

Abo-Shoola, M.K.A. (1990). Naturally occurring chemicals for pest control in comparing with synthetic pesticides. Ph.D. Thesis agric. Fac. Tanta Univ.

Agamy, E. (2003). International Company for bio-Agriculture, Personal communication.

Boguslawski, C.V. and T. Basedow (2001). Studies in cotton fields in Egypt. Effects of pheromone mating disruption on PBW and on Occurrence of other insects and on yields J. Applied, Entomol., 125 (6) : 327-331.

Drimanov, M., R. Angelova and T. Sabrikova (1980). State of harmful entomotomo and Carofauna and Predicious protect. Technologies. Nauchni Tudova, Ent. Microbial. Fitophathol. 25: 15-30.

El-Naggar, A.Z. (1998). Evaluation of certain foliar fertilizers and microelements in IPM program its control cotton bollworms. M.Sc. Thesis. Agric. Fac. Alex. Univ. Egypt.

EL-Naggar, A.Z. (2003). Evaluation of certain new approaches of control measures in an Integrated Pest Management Program of cotton bollworms. Ph.D. Thesis, Fac. Agric., (Saba-Bacha), Alex.Univ. Egypt.

Emara, S.A., H.I. Omar and I.S. Abdel-Wahab (2002). Different spray programs of insecticides to combat cotton bollworms with reference to the natural product spinosad . 2nd Inter. Conf. Plant protect. Res. Instit., Cairo, Egypt., 443-448.

Henderson, C.F and F.W. Tilton (1955). Tests with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161

Hussein, N.M., F.F. Shalaby, E.F. ELkhayat and S. Salem (2002). Relative population density of cotton bollworms In cotton fields. Inter. Conf. Plant Protec. Res., Cairo, Egypt.: 474.478

Johnson T.D., L.J. Debbs and J. Yancy (1997). Efficacy of Condor XL, for Control of Tobacco budworm and cotton bollworm in Texas. Proc. Beltwide Cotton Conf. New Orleans, USA., (2): 1157-1161.

Kharboutly, M.S., C.T. Allen and C. Capps (1999). Bollworm and Tobacco bud worm control studies. Proc. Beltwide Cotton Conf. Orlando, Florida, USA, (2): 1136-1189.

Luo, S.B., J.P. Yan, C.J. Chai, S.P. Liang and G.K. Lee (1986). Control of PBW with *B.t* in cotton fields. Chinese Journal of Biolog. Cont., 2: (4), 167-169.

Mann, G.S., S.G. Turnisspeed, M.J. Sullivan and O.L. May (1997). Effect of early season loss of flower buds on yield, quality and maturity of cotton in south California J. Econ. Entomol., 90 (5) : 1324-1331.

Mansour, E.S. (2004). Effectiveness of *T. evanesces* Westwood, bacterial insecticide and their combination on the cotton bollworms in comparison with chemical insecticides. J. Biological Pest Cont., 14 (2): 239-243.

Mertz, F.P. and R.C. Yoo (1990). *Saccharopolyspora* sp. Nov. isolated from soil collected in sugar rum still. Inter. J. Sust. Bacteriol. (40): 34-39.

Mesbah, H.A., M.A. Ibrahim., E.H. Tayeb, A.Z. El-Naggar and Hanyiat M. El-Nimr (2000). Plant health, a new approach for the attainment of tolerant plants to pests infestation and foliar application of nutritive elements on the infestation of cotton with bollworms. Adv. Agric. Res., 5 (2): 1437-1454

Mesbah, H.A., Mahasen M. Ibrahim, H.A. Awad and A.z. EL-Naggar (2004). Performance of plant nutrients and alternative chemicals against the cotton bollworms: *Pectinophora gossypiella* (Lep.: Gelechiidae) and *Earias insulana* (Lep.: Noctuidae), at EL-Beheira Governorate. Adv. Agric. Res., 9(3): 689-706.

Ridgway, R.L. (1984). Cotton protection practices in the USA and world. Chapter " cotton" Edkohel. B.L and C.P Lewis No. 24 in the Series Agronomy. Madison; Wisconsin, USA.

Shalaby, F.F., A.A. Abdel-Hafez, E.F. ELkhayat and M.A.A. Sharkawy (2002). Applied control of PBW and SBW in cotton Fields releasing *Trichogrammatoidae bactrae* Nagaraja. 2nd Inter. Conf. Plant Protec. Res. Instit., Cairo, Egypt, 611-615.

Sun, Z.y. and C.J. Xu (1986). Soil available B in the south of Hebi province and application of boron to cotton. J. Soil Sci. Chaina, 17: 130-137.

إتجاهات جديدة لتقييم إستخدام الأسمدة الورقية وبدائل المركبات الكيماوية وإطلاق طفيل الترايكوجراما ضمن برنامج المكافحة المتكاملة لدودة اللوز القرنفلية فى نباتات القطن العضوي والقطن التقليدي

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الملخص العربى

تم إجراء الدراسة لهذا البحث على صنف قطن جيزة ٧٠ فى موسمين متتالين (٢٠٠٤، ٢٠٠٥) فى مزرعة كلية الزراعة (سابا باشا) وذلك بهدف دراسة تأثير برامج تطبيقية ناجحة فى برنامج المكافحة المتكاملة لدودة اللوز القرنفلية وهى ٤ برامج وتشمل (زيوت طبيعية ، ومبيدات حيوية، ومواد نباتية ، بالإضافة إلى إطلاق طفيل الترايكوجراما) وذلك فى نباتات القطن العضوى (أسمدة بلدية بدون إستخدام مبيدات كيماوية) & و ٦ برامج فى نباتات القطن التقليدى (إستخدام الأسمدة الكيماوية والمبيدات الكيماوية) وتشمل إستخدام (مبيدات فوسفورية ، كربامتية ، وبيرثرويدية ، زيوت طبيعية ، سبينوساد ومخاليط تلك المواد مع نصف الجرعة من المبيدات الكيماوية).

أوضحت النتائج أن أعلى تأثير على دودة اللوز القرنفلية تم الحصول عليه عند إستخدام المعاملة التالية ½ جم من كل من حامض الأسكوربيك والسليسليك فى كلا الموسمين وذلك فى خلال فترة التزهير فى نباتات القطن العضوى مع كثافة نباتية منخفضة. بينما فى القطن التقليدى كان أعلى معدل خفض فى دودة اللوز القرنفلية تم الحصول عليه عند إسستخدام البرنامج رقم ١١ (كوراكرون + ماتش ، بندلتا + زيت بذرة القطن ، سبينوساد + كزد أويل ، لارفن + دايبل مع إزالة الأزهار مع كثافة نباتية منخفضة).

وجد أن تطبيق البرنامج الذى يشتمل على الترايكوجراما ، أجرين + أشوك ، الترايكوجراما + أجرين + أشوك ، سبينوساد + مينراك ، دايبل + مينراك أعطى تأثير عالى فى خفض الإصابة بدودة اللوز القرنفلية فى اللوز الأخضر فى نباتات القطن المنزرع مبكرا ومتأخرا مع كثافة نباتية منخفضة فى كلا الموسمين. بينما فى القطن التقليدى حقق البرنامج رقم ١١ أقل مستوى إصابة.

أوضحت النتائج أن أعلى محصول قطن تم الحصول عليه فى القطن العضوى بعد إستخدام البرنامج رقم ٤ (½ جم من كل من حامض الأسكوربيك والسليسليك فى بداية فترة التزهير & الترايكوجراما ، أجرين + أشوك ، الترايكوجراما + أجرين + أشوك ، سبينوساد + مينراك ، دايبل + مينراك فى فترة تكون اللوز). بينما فى القطن التقليدى أعطى البرنامج رقم ١١ أعلى محصول قطن (كوراكرون + ماتش ، بندلتا + زيت بذرة القطن ، سبينوساد + كزد أويل ، لارفن + دايبل مع إزالة الأزهار أثناء فترة التزهير).

Table (1): Treatments and rates of IPM regimes in both growing cotton seasons of 2004 and 2005 in both organic and conventional cotton

Prog. No.	Treatments at the start of both season	Treatments at the start of flowering period	Treatments during boll formation of recommended rates
		1. Organic Cotton	
Prog. 1	All IPM regimes of organic cotton were treated by liquid potassium soap at 1 l/fedd.	1 g/l salicylic acid	T, Ag, Ag + T, SP, Di
Prog. 2		1 g/l Ascorbic acid	T, Ash, Ach + T, Sp + C.S.O, Di + M
Prog. 3		$^1/_2$ g/l Ascorbic, $^1/_2$ g/l Salicylic	T, Ag+Ach, T+Ag+Ach, Sp+M, Di+M
Prog. 4		$^1/_2$ g/l Ascorbic, $^1/_2$ g/l Salicylic	T, Ag+Ach, T+Ag+Ach, Sp+M, Di+M
Untreated check			
		2. Conventional cotton	
6	All IPM regimes of conventional cotton were treated with Romectin® (Abamectin) At g ml/10 l	0.2 gm/l Greenzit$_{Sp100}$	Cu, Ka, Sp, Lar. At the recommended dose each
7		Greenzit$_{Sp100}$ (0.2 g/l), SA. 2 g/l	Cu+Ag, Ka+KZ oil, Sp+O, Lar.+Ach
8		0.2 g/l Greenzit$_{Sp100}$ + Ascorbic acid 1 g/l	Cu+ KZ oil, Ka+Ag, Sp+M, Lar.+Mat
9		0.2 g/l Greenzit + $^1/_2$ g/l of each Ascorbic and salicylic acid	Cu+Ach, Kar+Sp, Sp, Sp+Ach, Lar.+KZ
10		Deflowering at the start of flowering stage	Cu+Mat, P+C.S.O, Sp+ KZ , Lar+Di
11		Deflowering at the start of flowering stage	Cu+Mat, P+C.S.O, Sp+ KZ , Lar+Di
Untreated check			

- All combinations were done according to difference of the two mixed compounds in mode of action and were mixed at half a recommended dose of each compound in a mixture
- T = releasing the parasitoid *Trichogramma evanecsemce*, Ach = Ashook (2 ml/l), Ag = Agerin at 2 g/l, Di = Dipel at 2 g/l, Sp = Spinosad at 50 ml/fed., KZ = KZ oil at $1^3/_4$ l/fed., C.S.O = Cotton Seed Oil at5 ml/l Lar. = Larvin at 1 l/fed., Mat. = Match at 160 ml/fed., Ka = Karate at 750 ml/fedd, Cu = Curacron at 750 ml/fedd., M = Meenark (Fish oil rosin soap) at 5g/l., P = Pindelta® at 1ml/l

  Prog. 4 treatments were the same as Prog. 3 but the plants were sown with lower plant density. Also, Prog. 11 treatments as Prog. 10 but the plants were sown with lower plant density.

Table (2): Mean numbers and % reduction of infestation by PBW throughout the growing cotton seasons of 2004 and 2005 during flowering period.

Prog.	2004		2005		Average % reduction
	Mean	% R	Mean	% R	
			A: Org. Cotton		
1	2.13 b	35.0	1.83 b	29.60	33.30
2	2.08 b	36.6	1.53 a	41.15	38.87
3	1.50 a	54.2	1.83 b	29.60	41.90
4	1.45 a	55.8	1.43 a	45.00	50.40
Untreated Check	3.28 c	--	2.60 c	--	--
L.S.D.$_{0.05}$	0.29		0.24		
			B: Conv. Cotton		
6	2.35 c	29.9	2.08 d	37.00	33.45
7	2.28 c	31.9	1.73 bc	47.60	39.80
8	1.73 b	48.3	1.80 c	45.50	46.90
9	1.58 b	52.8	1.48 b	55.10	53.90
10	1.68 b	49.9	1.63 bc	50.60	50.20
11	1.23 a	63.2	1.00 a	59.00	66.45
Untreated Check	3.35 d	--	3.30 e	--	--
L.S.D.$_{0.05}$	0.24		0.24		

Table (3): Mean numbers and % reduction of infestation by PBW throughout the growing cotton seasons of 2004 and 2005 during boll formation period.

Prog.	2004		2005		Average % reduction
	Mean	% R	Mean	% R	
			A: Org. Cotton		
1	2.78 b	71.46	2.14 a	77.00	74.23
2	2.14 a	78.00	1.84 a	80.20	79.10
3	2.04 a	79.00	1.97 a	78.84	78.92
4	1.96 a	79.90	1.75 a	81.20	80.55
Untreated Check	9.74 c	--	9.31 b	--	
L.S.D.$_{0.05}$	0.17		055		
			B. Conv. C		
6	2.42 d	74.60	2.19 e	77.14	75.87
7	2.04 c	78.50	1.82 d	81.00	79.75
8	1.74 b	81.70	1.61 c	83.19	82.45
9	1.64 b	82.75	1.53 bc	84.00	83.38
10	1.39 a	85.40	1.36 b	85.80	85.60
11	1.36 a	85.70	1.15 a	88.00	86.90
Untreated Check	9.51 e	--	9.58 f	--	--
L.S.D.$_{0.05}$	0.20		0.15		

Table (4): The average mean of cotton yield (kentar/fed.) of both early and late sown cotton plants seasonsof 2004 and 2005

IPM regimes	Average mean of both early and late cotton yield on kent/fed of cotton season of 2004	% Average increase in 2004 cotton yield	Average mean of cotton yield in kentar/fed in season 2005	% average increases in cotton yield 2005	% average increase in cotton yield of 2004 and 2005
			A. Organic c.		
1	9.35 b	51.30	6.56 c	32.30	41.80
2	10.00 c	61.80	6.42 b	29.70	45.80
3	10.50 d	69.90	7.70 d	55.60	62.80
4	11.35 e	83.70	7.60 d	53.30	68.50
Untreated Check	6.18 a		4.95 a		
			B. Conv. C		
6	8.48 b	47.20	7.16 a	45.20	46.20
7	9.30 c	61.50	7.20 b	46.00	53.80
8	10.34 d	79.50	7.63 c	54.80	67.20
9	10.90 e	89.20	8.03 d	62.90	76.10
10	8.20 b	42.40	8.30 e	67.80	55.10
11	9.10 c	58.00	9.86 f	100.00	79.00
Untreated Check	5.76 a		4.93 a		