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# FIELD AND SEMI FIELD APPLICATIONS FOR BIO AND CHEMICAL PESTICIDES ON COTTON LEAF WORM, *Spodoptera littoralis* (BOISD.) (LEPIDOPTERA : NOCTUIDAE)

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## ABSTRACT

Three bio insecticides Biolarve and Triamph derivate from emamectin benzoate and W-Bus which derivate from *Bacillus thuringiensis* (Bt), in addition to one organophosphorus insecticides Linker tested for their effects on 2$^{nd}$ and 4$^{th}$larval instars and egg masses (24, 48 and 72 h old) of the Egyptian cotton Leafworm *Spodoptera littoralis* (Boised) infested tomato crop under field and semi field conditions. The doses used were the recommended dose by Egyptian agricultural ministry. The obtained results showed that all insecticides were potent and effective in controlling *S. littoralis* caused highly mortality and reduced the number of all tested larval instars and egg masses. The bio pesticides caused lower mortalities percentage than the chemical one in case of initial kill calculations, but after one day till ten days caused higher mortalities percentage than the organophosphorus insecticides. The second larval instar recorded sensitive reaction than the fourth larval instar of S. *littoralis*, which shown more resistant to all examined insecticides.

**Keywords:** Bio insecticides, Organopgosphorus insecticides, *Spodoptera littoralis*, Tomato

## INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* (Boisd.) considered as one of the most series pest for many different crops in Asia, Africa and Europe (Smagghe and Degheele,1997).In Egypt, many crops and various vegetables are attacked by numerous insect pests. Among of these, the lepidopterous insects in general and the cotton leafworm *S. littoralis* in particular are the most damaging. In fact, cotton leafworm is a major limiting factor affecting crop and vegetable production not only in Egypt, but also in many other countries. It is one of the most destructive agricultural lepidopterous pests within its subtropical and tropical range (Hosny *et al*.1986). The control of this pest is based mainly on foliage treatments with chemical synthetic insecticides. The widespread of synthetic pesticides since 1945 helped in increasing agriculture production and decreasing the incidence of endemic and epidemic diseases .However, the massive application of pesticides, resulted in building up pest resistance to these poisons, and also resulted in adverse effects on the environment. The present work is an attempt to implement a new promising approach to suppress the population of *S. littoralis* by using new types of pest control agents, biopestisies (Bakr *et al*., 2015).

Due to the appearance of high resistance to many chemical pesticides and resurgence of chemical pesticides (Forgash 1984; Georghiou 1986) there is growing interest in the use of bioinsecticides such as compounds based on bacteria, fungi, insect growth regulators and botanical pesticides (Rao *et al*. 1990; Ahmad *et al*. 2008; Mourad *et al*.2008). These groups have modes of action different from those of conventional products (Ascher1993; Thompson *et al.* 1999); also, their properties may differ considerably from the conventional chemicals with which growers are familiar.

Therefore, the current investigation was conducted to study the effectiveness of some bio and chemical insecticides against *S. littoralis* and determined the best compounds for controlling this economic insect in an integrated pest management program under semi-field and field conditions.

## MATERIALS AND METHODS

**The culture of *S. littoralis***

The culture of *S. littoralis* used in this study obtained from a susceptible strain established in the cotton leafworm research department, Plant Protection Research Institute, Dokki, Giza, Egypt, were reared in the laboratory at 27±2ºC and 65±5% R.H. to supply the number of leafworms required to this study as described by El-Defrawi *et al*., (1964).

**The tested compounds**

Three new bio-pesticide s two from emamectin benzoate isolated from fermentation of *Streptomyces avermitilis*, a naturally occurring soil Actinomycete used as a biological pesticide (Fig. 1), commercially called Biolrve 5% EC used at rate of 30 cm$^3$/100 liter of water and Trimph19.2% used at rate of 150 cm$^3$/Feddan, and another one originated from *Bacillus thuringiensis* (Bt), which is a Gram-positive, soil-dwelling bacterium, commonly used as a biological pesticide, called W-Bus used at rate of 200gm/ Feddan. These Bio-pesticide s were compared with organophosphorous insecticides with common name chlorpyriphos (Fig. 2) and commercially called Linker used at rate of 250cm$^3$/100 L of water.

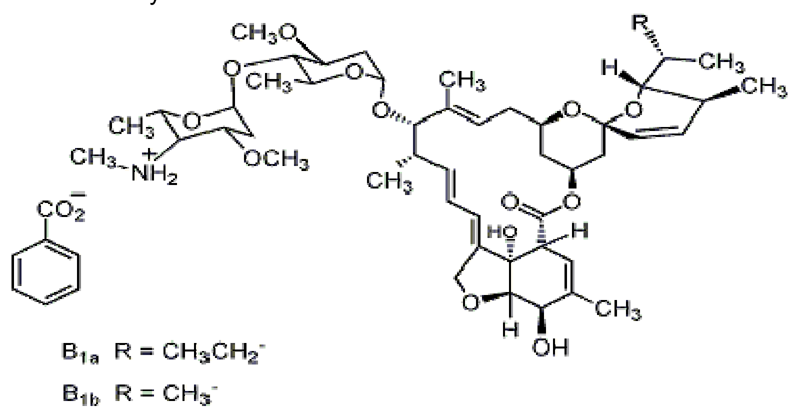


**Fig. 1: Emamectin benzoate**

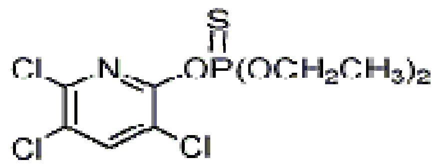

**Fig.2: Chlorpyriphos**

**Treatment of Egg masses**

Different ages of *S. littoralis* egg masses (one, two and three days old) were sprayed with various pesticides used in this study according to the recommended concentrations in the field according to the recommendations of Egyptian agricultural ministry. Three egg masses were used per each treatment with pesticides, then left to dry until hatching, placed in Petri dishes and incubated at 27±2ºC and 70±5% RH. The control treatment was sprayed with water and left to dry until hatching. Hatchability and reduction percentage of hatching eggs were recorded and compared the treated egg masses with untreated one.

**Field experiment**

Three field experiments were conducted at Zaki village, Kaha, Toukh district, Qalyubia governorate, Egypt. Experimental area was approximately1/4 Feddan (one Feddan equal 4200 $m^2$) planted with tomato *Lycorpersicon esculantum* (Mill.) variety Safira after seeded in a greenhouse and then transferred to field during spring cultivation season of 2015, under normal field practices. The experimental plots were designed in random manner for five treatments. Each treatment was replicated three times. Each plot had five rows with twenty five plants. The insecticides Biolarve, Trimph, W-Bus and Linker were applied as foliar spray at the recommended rates using knapsack sprayer for 4 insecticides treatments. The $5^{th}$ left untreated to serve as control. Counts of different egg masses and larvae infested tomato plants were recorded pre and post insecticides applications after 2, 4 and 6 days. To evaluate the efficiency of the tested compounds against *S. littoralis* percentages of reduction in population density of the eggs and larvae were calculated according to Henderson and Tilton formula (1955).

**Semi field experiment**

From the experimental area of treated and untreated tomato plants *S. littoralis* egg masses and larvae were collected after zero time, seven and ten days from application and transfer directly to the laboratory for feeding $2^{nd}$ and $4^{th}$larval instars, three replicates for each treatment were offered. Mortality was calculated at different time intervals, zero time, 7 and 10 days from applications.

## RESULTS AND DISCUSSION

Data presented in Table (1), showed that, the effect of three bio-pesticide s: Biolarve, Trimph, W-Bus and one organophosphorus pesticide: Linker on eggs masses under filed conditions. All the tested insecticides were effective on the eggs of *S. littoralis* with fluctuated manner. Only Trimph from emamectin benzoate bio-pesticide s group indicated that, the highest mortality percent and no hatching 0.0±0.0and gave 100% reduction for *S. littoralis* eggs with one days old. W-Bus *Bt* bio-pesticide shown weak effect on eggs of *S. littoralis* and the lowest mortality percent, hatching number of eggs was71.7±56.9and gave 71.1% reduction for eggs masses one day old, with comparison with Linker organophosphorus pesticide, which gave hatching number of eggs 16.0±5.2 and percentage of mortality 92.0%. The reduction % of eggs one day old of *S. littoralis* can be arranged ascendingly as following: Trimph (100.0), Biolarve (96.4%), Linker (92.0) and W-Bus (71.1%), respectively. In case of egg masses with two days old all tested insecticides were more effective in nearly same manner. Trimph (emamectin benzoate bio-pesticide s), W-Bus (*Bt* bio-pesticide s) and Liker (organophosphorus pesticide) caused no hatching in all tested egg masses and gave reduction percent 100.0%, while Biolarve (emamectin benzoate bio-pesticide s) gave 99.4%, respectively. For egg masses with three days old all tested compounds caused no hatching for eggs of *S. littoralis* and the reduction percentages were 100% under filed conditions.

**Table (1):Effect of bio and chemical pesticides on cotton leaf worm *S. littoralis* egg masses under field conditions.**

| Treatments | Ages of egg masses and reduction % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1-days old | | | 2-days old | | | 3-days old | | |
| | Mean no. eggs± SD | Mean no. hatching ± SD | Red. % | Mean no. eggs± SD | Mean no. hatching ± SD | Red. % | Mean no. eggs± SD | Mean no. hatching ± SD | Red. % |
| Biolarvee | 287.3±23.0 | 10.3±8.9 | 96.4 | 297.7±67.1 | 1.7±0.9 | 99.4 | 583.0±294.9 | 0.0±0.0 | 100.0 |
| Trimph | 327.3±120.9 | 0.0±0.0 | 100.0 | 425.7±35.5 | 0.0±0.0 | 100.0 | 548.7±67.9 | 0.0±0.0 | 100.0 |
| W-Bus | 247.7±86.3 | 71.7±56.9 | 71.1 | 316.7±65.7 | 0.0±0.0 | 100.0 | 202.0±51.1 | 0.0±0.0 | 100.0 |
| Linker | 200.3±59.0 | 16.0±5.2 | 92.0 | 415.7±49.5 | 0.0±0.0 | 100.0 | 220.3±21.0 | 0.0±0.0 | 100.0 |
| Control | 337.3±99.2 | 291.3±94.2 | 13.6 | 304.0±53.7 | 247.7±78.5 | 5.7 | 348.7±64.0 | 343.3±63.0 | 1.5 |

Field evaluations of bio and chemical pesticides on cotton leaf worm *S.littoralis* larvae were carried and offered in (Table 2). The obtained results showed that all tested compounds were effective against the larvae of *S. littoralis*. Linker (organophosphorus pesticide) indicated the highest mortality percentage for *S. littoralis* larvae 90.8% among all tested pesticides, while W-Bus (*Bt* bio-pesticide ) indicated the lowest reduction percentage 48.7% among all tested pesticides. Both of emamectin benzoate bio-pesticide s (Biolarvee and Triamph) shown reduction percentages were 86.8% and 80.4%, respectively among all tested pesticides after two days. After four days, Linker (organophosphorus pesticide) still the most effective one caused mortality percentage was 88.6%. The other bio-pesticide s shown reduction percentage in *S. littoralis* larvae lower than that offered by organophosphorus pesticide i.e. Linker as following: Biolarvee (80.3%), Triamph (78.6%) and W-Bus (67.3), respectively. From the bio-pesticide s groups Biolarvee was the most potent one in comparison with the chemical pesticide Linker. After six days of application, all examined bio-pesticides shown nearly same mortality percentages and higher than the chemical pesticide were Biolarvee (76.8%), Triamph (75.4%) ,W-Bus (75.2%) and Linker (58.5%), respectively. This data indicated that all tested bio-pesticide s caused highly effects on controlling *S. littoralis* larvae in comparison with the chemical pesticide and this may help to spread the utilization of bio-pesticide s instead of the chemical pesticides (Table 2).

**Table (2): Field evaluations of bio and chemical pesticides on cotton leaf worm *Spodoptera littoralis* larvae.**

| Compounds and rate of applications | Reduction % | | | General reduction mean % |
|---|---|---|---|---|
| | after 2 days | after 4 days | after 6 days | |
| Biolarve (30 $cm^3$/100 l of water) | 86.8 | 80.3 | 76.8 | 81.3 |
| Trimph (150 $cm^3$/Feddan*) | 80.4 | 78.6 | 75.4 | 78.1 |
| W-Bus (200gm/ Feddan) | 48.7 | 67.3 | 75.2 | 63.7 |
| Linker (250$cm^3$/100 l of water) | 90.8 | 88.6 | 58.5 | 88.3 |

Semi field evaluations of bio and chemical pesticides on cotton leaf worm *S. littoralis* also in the same trend like field applications. Initial kill for both of 2nd and 4th larval instars had high mortality percentage in case of applied the chemical pesticide Linker under semi field applications was 91.6% and 86.6%, respectively. Trimph gave mortality percentage was 83.3%, followed by Biolarve68.3% and 65.0% for 2nd instars and 66.6% for Trimph , 63.3% for Biolarve and 56.6% for W-Bus for 4th larval instars, respectively. After seven days of applications still the chemical pesticide Linker was the most potent one with mortality percentages were 65.0% and 60.0% for 2nd and 4th larval instars, respectively. For 2nd larval instars still Trimph the most bio-pesticide one with mortality percentage 60.0% , followed by Biolarve 58.3% and W-Bus 55.0, while for 4th larval instars all bio-pesticides caused same action with mortality percentage 51.6%. After 10th days the chemical pesticide Linker shown lowest 46.6% and 38.3% for 2nd and 4th larval instars, respectively, and still Triamph bio-pesticide the most potent one with mortality percentages were 61.0% and 53.3%, followed by Biolarve 55.0% and 50.0%, followed by W-Bus 48.3% and 46.6% for 2nd and 4th larval instars, respectively. Generally, 2ndlarval instars were more sensitive than 4th larval instars to all tested insecticides.

**Table (3): Semi field evaluations of bio and chemical pesticides on cotton leaf worm *Spodoptera littoralis* larvae.**

| Pesticide and rate of application | Corrected larval mortality% | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Initial kill | | | | Residual effects | | | |
| | After 24 h for 2nd instar | After48 h for 2nd instar | After 24 h for 4th instar | After 48 h for 4th instar | After 7days | | After 10 days | |
| | | | | | 2nd instar | 4th instar | 2nd instar | 4th instar |
| Biolarve | - | 68.3 | - | 63.3 | 58.3 | 51.6 | 55.0 | 50.0 |
| Trimph | - | 83.3 | - | 66.6 | 60.0 | 51.6 | 61.0 | 53.3 |
| W-Bus | - | 65.0 | - | 56.6 | 55.0 | 51.6 | 48.3 | 46.6 |
| Linker* | 91.6 | - | 86.6 | - | 65.0 | 60.0 | 46.6 | 38.3 |

*** Only initial kill of Linker checked after 24 h while other pesticides checked after 48 h.**

The obtained results from this study cleared that all tested bio-pesticide s (two derivative Emamectin benzoate and one *Bt*) from were potent and effective in controlling cotton leaf worm, *S.littoralis* when compared with chemical pesticide these findings agree with Abou- Taleb, *et al*., (2009) who reported that the toxicity of Emamectin benzoate against the different larval instars of laboratory and field strains of *S.littoralis* was increased with increasing the concentration and exposure time and decreased by increasing the insect instar. Prasad *et al.,* (2007) demonestreated that emamectin benzoate was the most toxic insecticide against *S.litura.* Emamectin benzoate showed that Latent effect against 2nd and 4th instar larvae of *S .littoralis*, these are shown in previous studies with El-Dewy (2013), and El-Zahi (2013), they mentioned that the latent effects of emamectin benzoate against 4$^{th}$ larval instar of *S .littoralis* were significantly decreased in pupal duration, pupal weight, pupation and adult emergence percentages. Generally, the bio-pesticide s derivative from have been shown to be effective against broad spectrum of arthropod pests (Putter *et al.*,1981). Furthermore, our results were in the same trend with the results obtained in this experiment are similar to those obtained by Abo-El-Ghar *et al.* (1995), who worked with *Bacillus thuringiensis* and Abamectin against cotton leafworm *S. littoralis*, with a pronounced decrease of pupation (36%) after Abamectin treatment, and a high reduction of moth fecundity(87.4%).

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**تطبيقات حقلية ونصف حقلية لمبيدات حيوية وآخر كيميائي على دودة ورق القطن**

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تم إختبار تأثير ثلاثة مبيدات حيوية بيولارف وتريمف مشتق من بنزوات إيمامكتين و دبليو بس مشتق من باسيلس ثيورجينسز بالأضافة إلى مبيد فوسفوري (لينكر) على العمر الثانى والرابع وكتل البيض لدودة ورق القطن لحقل طماطم مصاب فى الظروف الحقلية والنصف حقلية . وكانت الجرعات المستخدمة موصى بها من قبل وزارة الزراعة المصرية . حيث أظهرت النتائج المتحصل عليها أن كل المبيدات أعطت نتائج عالية وفعالة فى مكافحة دودة ورق القطن حيث كانت نسبة الموت عاليه ، كما أظهرت خفض فى التعداد لكل الأعمار اليرقية المختبرة و كتل البيض . ومن ناحية أخرى أعطت المبيدات الحيوية نسب موت منخفضة عن المبيد الكيميائي فى التأثير بمجرد الرش ولكن اظهرت النتائج من بعد يوم إلى عشرة أيام نسب إبادة عالية عن المبيد الفوسفوري . وقد أظهرت يرقات العمر الثاني حساسية عالية عن يرقات العمر الرابع التى أظهرت مقاومة أعلى لكل المبيدات المختبرة .