THE EFFECTIVENESS OF SOME NON-TRADITIONAL MATERIALS AS PESTICIDES TO EGGS AND LARVAE OF COTTON LEAF WORM (BOSID.)

GAMAL ABDEL-LATIF M. ABDU-ALLAH*

Department of Plant Protection, Faculty of Agriculture, Assiut University, 71526 Assiut, Egypt

Abstract

Cotton leaf worm is one of the most important insect pests infesting different varieties of vegetable as well as field crops. Non-conventional insecticides are the promised and used as the alternative agents of traditional pesticides especially in the Integrated Pest Management (IPM) programs. Under laboratory conditions six of these agents plus the carbamate insecticide; methomyl ; were tested against the 48 hours aged eggs as well as the 2nd instar larvae of the cotton leaf worm using both dipping and feeding bioassay techniques, respectively. Based on the LC_{50} values, emamectin benzoate showed the most effective insecticide as ovicidal and larvicidal action, while jojoba oil showed the least efficient one. The toxicity of the tested compounds could be descendingly arranged as ovicidal action as follows: emamectin benzoate > azadirachtin > methomyl > spinetoram > spinosad > abamectin> jojoba oil. Whereas, the trend of these agents as larvicidal action was emamectin benzoate>methomyl > spinetoram > abamectin >spinosad > azadirachtin > jojoba oil. Emamctin benzoate and azadirachtin have more ovicidal potent effect than spinetoram by 12, 2 fold respectively. Also, the toxic effect of emamectin benzoate against 2nd instar larvae of *S. littoralis* was 31 and 258 folds as toxic as the toxicity of methomyl and spinetoram, respectively. Azadirachtin exhibited a moderate lavicidal effect, where the LC_{50} value was 395.67 ppm. Based on the present data, it can be suggested that emamectin benzoate and azadirachtin having good candidate agents as ovicidal pesticides. Moreover, the former was the best candidate as lavicidal pesticides. Also, those agents could be involved in integrated cotton leaf worm program.

Key words ovicidal, larvicidal, non-conventional agents, *Spodoptera littoralis*

*Corresponding author: Tel. +20882412662; Fax,+20882331384,
E-mail address: gamalan@aun.edu.eg *(www.aun.edu.eg)*

INTRODUCTION

In Egypt, the cotton leaf worm (CLW), *Spodoptera littoralis* (Boisd.) is one of the most serious injuries insect pests infesting most vegetables as well as field crops in greenhouses and in open fields. Till now, chemical control using conventional insecticides is still the main dependable method for controlling this pest. Misusing of synthetic insecticides, leads too some problems. In addition, now most people, some exports and some consumers are searching on the safety foods without pesticide residues. Agricultural Organic Production (AOP) is one of the forms of accepted foods.

Insecticide alternatives are essential in controlling for cotton leaf worm not only on in AOP, but also in traditional agriculture. Recently, certain agents like emamectin benzoate, abamectin, spinetoram, spinosad and azadirachtin are become available in the Egyptian local markets. Some of these pesticides were recommended against other pests (Anonymous, 2014). Several studies are insisted that these chemicals have high safety on environment and natural enemies (Ishaaya et al, 2002; Mayes et al. 2003; Besard et al, 2011). Emamectin benzoate is a modified product for abamectin. Two avermectins, abamectin and emamectin benzoate, stimulate the release of γ-amino butyric acid followed by losing in nerve cell functions then confusing nerve cell impulses (Jansson et al, 1997). Spinetoram is an analogous chemical of spinosad. The mode of action of the two spinosyns, spinosad and spinetoram, is making hyperexcitation of nicotinic acetylcholine receptors consequently disturbance in transferring nerve cell impulses. Avermectins and spinosyins are derived natural from actinomycetes bacterium species (Copping and Menn 2000; Putter et al 1981). They have strong insecticidal activity against different insect orders (Jansson and Dybas, 1998).

Since, discovering neem tree, *Azadirachta indica* as one strong resource of botanical insecticides, several commercial neem insecticides were developed and registered in EPA (Ascher, 1993). Moreover, some researchers are trying to discover the biological activity of other botanical trees like Jojoba, *Simmodsia chinensis* (Link) Schneider (Halawa et al.2007; Ismail &Shaker, 2014).Methomyl, oxime carbamte insecticide, inhibits the acetylcholine esterases in central nervous system.

Ministry of Agriculture in Egypt 2014 recommended using Spinosad and methomyl for controlling new neonate of CLW. Moreover spinetoram was recommended as ovicidal insecticides. The objectives of this investigation are comparing the toxicity of some new non-conventional agents in comparable with spinosad and methomyl toward eggs and the 2nd larvae of CLW.

MATERIALS AND METHODS

Insect rearing:

The tested laboratory strain of cotton leaf worm, *Spodoptera littoralis* (CLW) was maintained in Plant Protection Laboratory, Assiut University, Egypt. The strain did not expose for any pesticides more than ten years ago. It is reared on castor bean leaves as described by Eldefrawi et al, 1964.

Chemicals used:

Spientoram (Radient®, 12 % SC, Dow AgroSciences Co); abamectin (Gold®, 1.8 % EC, ELHELB Pesticides & Chemicals Co., Egypt); emamectin benzoate (Radical®, 0.5 % EC, Agromen Chemicals Co., Ltd.) and methomyl (Lannate®, 90 % SP) from DuPont Agricultural Co. provided from Experimental Agricultural Research Faculty of Agriculture, Assiut University. Spinosad (Spintor®, 24 % SC, Dow AgroSciences Co.) and azadirachtin (nimbecidine®, 0.03 % EC, (T. Stanes and Company LTD, India, was got as a gift from an Egyptian friend. Pure jojoba oil was personally supplied by one producer the oil. It is extracted under cold conditions. Iso-octylphenoxy polyethoxy ethanol polyethoxy(Triton $_{X\text{-}100}$®, 100 % purity, BDH Chem, Ltd. Poole England) was bought, it used as surfactant.

Bioassay tests

Leaf-dip bioassay method was used to determine the toxic effect of the rest compounds against 48 hrs aged eggs according to Manna and Attia (1992). Mortality percentages (nonhatched) were calculated after three days of treatment.

For feeding bioassay, the 2nd larvae of CLW at an average weight of 4.8-6.0 mg / larva were used. Five to six serial concentrations of the compounds were

prepared using triton x-100(0.05%) as detergent and distilled water as solvent. Parts of castor bean leaves were dipped in the pesticide solution for 5 seconds. Then, the leaves were transferred to Petri-dishes and left about half an hour until dry. To every replicate, ten selected larvae were fed for 24 hrs on the treated castor bean leaves, where after the larvae were allowed to feed for 24 hrs on untreated castor bean leaves. Then, the mortality percentages were counted.

For both bioassays, the experimental toxicity of each tested compound was duplicated. All treatments were incubated at 25±2 C°, in dark and 55± 5 % R.H. till recording the results. Mortality percentages were corrected by Abbot's formula if needed (Abbott, 1925). The LC_{50s}, slope and X^2 values were determined by a computerized probit analysis program using SPSS 16 software for Windows. Toxicity Index (TI) value was calculated by the following equation:

(TI) = (LC_{50} value of most toxic compound / LC_{50} value of tested compound) ×100.

RESULTS AND DISCUSSION

The data represented in Table (1) were showed that emamectin benzoate was the most ovicidal potent compound, with LC_{50} = 1.05 µg/ml. While Jojoba oil showed the least ovicidal action (LC_{50} = 1053 µg/ml). Emamectin benzoate was more toxic by 35.83 fold than its analogue abamectin.Based on LC_{50} values, the toxicity compounds could be descending arranged as follows; emamectin benzoate > azadirachtin > methomyl > spinetoram > spinosad > abamectin> jojoba oil. The corresponding LC_{50} values were 1.05, 2.28, 5.99, 12.09, 25.14, 37.63 and 1053 µg/ml; respectively.

According to LC_{50} values and based on the overlap of 95% CL, no significant differences were observed among emamectin benzoate, azadirachtin and methomyl toxicity against eggs. Also the results of the tested agents showed no significant differences between Jojba oil and the other tested compounds (Table1).

Results illustrated in Table (2) showed that emamectin benzoate was the most effective one against the 2nd instar larvae of CLW. Jojoba oil was kept the lowest efficient one. The corresponding LC_{50} values of two compounds were 0.3 and

220000 µg/ml, respectively. The toxicity index (TI) values of emamectin benzoate , azadirachtin, methomyl, spinetoram, spinosad , abamectin, and jojoba oil were 100, 46.05,17.53,8.68,4.18,2.79, and 0.1 , respectively against the eggs. While these values with the same consequence compounds orders were recorded 100, 0.08, 3.19, 0.42, 0.1, 0.39 and 0.0, respectively against2nd instar larvae (Figure1).

The data summarized in Table (2) showed that the 2nd instare larvae of CLW are more susceptible toward emamectin benzoate than the other tested compounds. It has a significant difference between it' s LC_{50} value and the LC_{50S} values of the other tested compounds. Also, based on the overlap 95% CL, there was not any significant differences among spinetoram, methomyl and abamectin. Although, spinosad has a bad toxicity ranking, the LC_{50} values are lesser than jojoba oil.

The slope values of the regression lines so far differed. The highest one was 3.65 with emamectin benzoate, while the least one was 0.45 forjojoba oil (Table1). Also, ıamectin benzoate has the highest slope value with 1.98; however, the lowest one -3.67 in case of azadirachtin treatment (Table2).

For eggs, the presented results indicated that emamectin benzoate had the best ovicidal compound. These results coincided with other studies (Gupta et al. 2005; Ezz El-Din et al, 2009; Abdu-Allah, 2011). Converse results published by Bengochea et al., 2014 who found that emamectin benzoate has no ovicidal activity on *S. exigua* with 0.5 to 10 mg a.i. /L. Ismail and Shaker, 2014 found that neem oil was more ovicidal effect than cyhalothrin insecticides.

For larvicidal potency, our data were insisted that emamectin benzoate have the best larvicidal effect on CLW. These results confirmed by other publications. Abdu-Allah, 2011 who found this compound is better than his analogue abamectin by 4937 fold against the 4th instar larvae of CLW using topical application. Ismail and Shaker, 2014 published jojoba oil has ovicdal and larvicidal activity on the CLW. Also the same author published that the neem oil followed by cyhalothrin in the toxicity against newly hatched larvae of CLW. El-Sheikh, 2014 found that emamectin benzoate is the most potent than spinosad on 3rd and 5th larval instars of *S. littoralis* . Bengochea et al., 2014 found that half mg /L of emamectin benzoate digested in diet

was caused 100 % mortality in L2 and L4 larvae of *S. exigua* after 24, 72 hr, respectively. The high flattening of slope indicates that the insect tested strain was relatively heterogeneous in its susceptibility toward tested insecticides by dipping and feeding methods.

In conclusion, nowadays, the world is directed to increase the Agricultural Organic Production (AOP). Non-conventional agents are essential not only AOP but also on IPM in Agricultural Conventional Production (ACP). In this investigation, emamectin benzoate and azadrachtin showed ovilarvicidal activity on the CLW. The data can be advised using the tested bio-agents as alternative as synthetic methomyl insecticides against *S. littorals.* Further studied should b e applied in the field application of these compounds especially azadrachtin.

Acknowledgements

Deep appreciates were offered by author to all peoples from technical breeding person to the staff supervisor for the rearing CLW insects.

Table1. Ovicidal activity of certain non-conventional agents against 48- hours eggs.of *S. littoralis.*

Non-conventional agent	µg/ml LC_{50} (CL 95%)	Slope ±SE	X^2	P
Abamectin	37.63 (23.85-47.76)	2.35±0.46	0.93	0.335
Azadirachtin	2.28 (1.72-2.87)	1.61±0.19	2.09	0.351
Emamectin benzoate	1.05 (0.93-1.37)	3.65±0.82	0.023	0.870
Spinetoram	12.09 (2.39-26.91)	1.82±0.56	22.34	< 0.0001
Spinosad	25.14 (15.93-35.51)	0.88±0.12	1.78	0.409
Jojoba oil	1053.00 (460.56- 3590.63	0.45±0.07	0.001	0.982
Methomyl	5.99 (0.002-18.98)	0.87±0.10	30.45	< 0.0001

* Chi-Square value for goodness of fit of data to probit model was significant (P< 0.05)

Table 2. Larvicidal activity of certain non-conventional agents against the 2nd instars' larvae of *S. littoralis.*

Non-conventional agent	µg/ml LC_{50} (CL 95%)	Slope ±SE	X^2	*P*
Abamectin	77.53 (67.73-88.91)	-2.88±0.80	1.38	0.24
Azadirachtin	395.67 (207.34-1623.01)	-3.67±0.55	0.08	0.77
Emamectin benzoate	0.30 (0.0001-0.588)	1.98±0.10	7.06	0.07
Spinetoram	70.92 (65.73-76.72)	1.38±0.12	2.56	0.28
Spinosad	286.42 (92.55-1492.53)	-1.80±0.42	0.31	0.58
Jojoba oil	2.2 E+5 (19723.3- 2.2 +10)	-2.47±0.47	0.19	0.66
Methomyl	9.39 (3.20-78.63)	-1.35±0.11	23.11	< 0.0001

* Chi-Square value for goodness of fit of data to probit model was significant (P< 0.05)

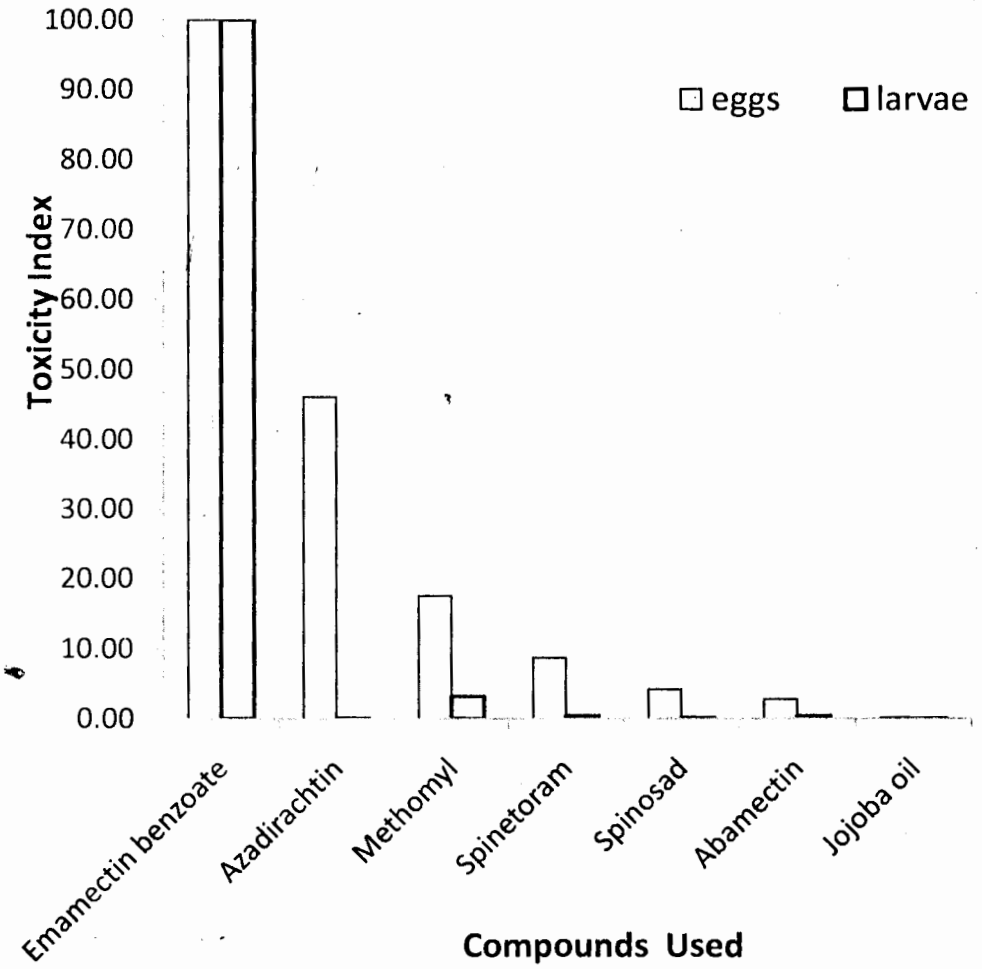

Figure1. Toxicity Index (TI) of seven non-conventional agents against eggs and 2nd instars' larvae of cotton leaf worm, *Spodoptera littoralis.*

REFERENCES

1. Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. Journal Economic Entomology, 18: 265–267.
2. Abdu-Allah, G. 2011. Potency and Residual Activity of Emamectin Benzoate and Spinetoram on *Spodoptera littoralis* (Boisduval).African Entomology,19:733-737.
3. Anonymous, Ed. 2014. Ministry of Agriculture, Egypt. Program of the Pest Control. Egypt.pp 296.
4. Ascher,K.R.S. 1993. Non conventional insecticidal effects of pesticides available from neem tree, Azadirachta indica. Archives of insect Biochemistry and Physiology, 22:433-449.
5. Bengochea, P.; I. Sănchez-Ramos; R. Saelices,; F. Amor,; P.del Estal,; E.Vinuela ;A. Adan; A.Lopez; F. Budia and P. Medina. 2014. Is emamectin benzoate effective against different stages of Spodptera exigua (hubner)(Lepidoptera: Noctuidae)?. Irish Journal of Agricultural and Food Research , 53:37
6. Besard, L., V.Mommaerts; G. Abdu-Alla; and G. Smagghe. 2011. Lethal and sublethal side-effect assessment supports a more benign profile of spinetoram compared with spinosad in the bumblebee Bombus terrestris. Pest Management Science, 67: 541–547.
7. Copping, L.G. and J.J. Menn. 2000. Biopesticides: A review of their action, application and efficacy. Pest Management Science, 56: 651-676.
8. Eldefrawi, M. E., A.Tappozada; N. Mansouer; and M. Zied 1964. Toxicological studies on the Egyptian cotton leaf worm, Prodenia litura: susceptibility of different larval instar of P. litura to insecticides. Journal Economic Entomology, 57, 591-593.
9. El-Sheikh, E.A. 2014. Comparative toxicity and sublethal effects of emamectin benzoate, lufenuron and spinosad on Spodoptera littoralis Boisd. (Lepidoptera: Noctuidae). (doi:10.1016/j.cropro.(accessed 22.10.14).
10. Ezz El-Din, H.A.; A. M.El-Gahreeb; A.M.K. El-Sayed; and G.A.M Abdu-Allah. (2009).Toxicity of spinosad and abamectin compared with some conventional insecticides against parent field strain of cotton leaf worm, Spodoptra littoralis (Boisd). Journal Agricultural Science Mansoura University, 34 (5): 5221-5229.
11. Gupta, G. P.; A.Birah; S, Rani; M, Raghurman. 2005. Relative toxicity of novel

insecticides to American bollworm. Indian Journal Agricultural Science 75: 235-237.

12. Halawa, S.M.; A.M.Kamel; and S.R. Abd El hamid. 2007. Chemical constituents of Jojoba oil and insecticidal activity against Schistocera gregaria and biochemical effect on Albino rats. 36: 77-87.
13. Ishaaya, I., S.Kontsedalov; A.R. Horowitz. 2002. Emamectin, a novel insecticide for controlling field crop pests. Pest Management Science, 58:1091–1095.
14. Ismail, S.M. and Shaker, N. 2014. Efficacy of some essential oil against the immature stages of Spodoptera littoralis. 2014. Alexandra Journal Agricultural Research 59:97-103.
15. Jansson, R.K. and R.A.Dybas. 1998. Avermectins: Biochemical mode of action, biological activity and agricultural importance.pp.152- 170. In Ishaaya, I.(ed.,) Insecticides with novel modes of action. Springer-Verlag, Heidelberg, Berlin. pp.289.
16. Jansson, R.k.; R.F. Peterson; P.K.Mookerjee; W.R. Halliday; J.A. Argentin; and R.A. Dybas. 1997. Development of a novel soluble granule formulation of emamectin benzoate for control of lepidopterist pests. Florida Entomologist, 80:425-442.
17. Manna, S.H. and A.A.Attia. 1992. Insecticidal properties of some lignan compounds, extracted from the root bark of Artemisia argentea L Her on the cotton leaf worm, *Spodoptera littoralis* (Boisd.). Assiut Journal Agricultural Science, 23:119-129.
18. Mayes, M. A.; G.D.Thompson; B. Husband;and M. M. Miles. 2003. Spinosad toxicity to pollinators and associated risk. Reviews of Environmental Contamination and Toxicology. 179: 37-71.
19. Putter, O.; Macconnel, J.G.; F.A Preiser; A.A.Haidri; S.S. Ristich;and R.A. Dybas, 1981. Avermectins: novel insecticides, acaricides and nematicides from a soil microrganism. Experientia. 37: 963-964.

فعاليه بعض المواد غير التقليديه كمبيدات بيض ويرقات لدودة ورق القطن

جمال عبداللطيف محمد عبدالله

- قسم وقاية النبات كلية الزراعة جامعه اسيوط ٧١٥٢٦ (www.aun.edu.eg)

تصنف دودة ورق القطن على أنها افه من أهم الافات فى العديد من محاصيل الخضر والحقل. تعتبر المواد غير التقليدية من المواد الواعدة والبديله للمبيدات الشائعة خاصه فى برامج المكافحه المتكامله للافات. أجريت الدراسه فى المعمل، وذلك بأختبار ست مواد غير التقليدية بالاضافة لمبيد الكاربمات الميثوميل ضد بيض عمره ٤٨ ساعة ويرقات عمر ثانى لدودة ورق القطن وذلك بأستعمال طريقه الغمر للبيض وتغذية يرقات العمر الثانى على اوراق خروع معامله ضد كل من البيض ويرقات العمر الثانى، بينما زيت الجوجوبا اظهر انه اقل سمية ، وذلك بناءا على قيم التركيز النصف السام أمكن ترتيب سمية المركبات المختبرة تنازليا على البيض كالتالى: ايمامكتين بنزوات > ازدراكتين > ميثوميل > سبينوترام > سبينوساد > ابامكتين > زيت جوجوبا. كان هذا الترتيب للسميه على اليرقات كالتالى: ايمامكتين بنزوات > ميثوميل > سبينوترام > ابامكتين > سبينوساد > ازدراكتين > زيت جوجوبا. أظهر مبيدى ايمامكتين بنزوات والازدراكتين سمية ضد البيض أكثر من سبينوترام بمقدار ١٢ ، ٢ ضعف على التوالى. كذلك توضح النتائج زيادة سمية ايمامكتين بنزوات على اليرقات اكثر من ميثوميل و سبينوترام بمقدار ٣١ ، ٢٥٨ ضعف. يمكن استخدام ايمامكتين بنزوات و ازدراكتين كمبيدات بيض لدودة ورق القطن. ويمكن استخدام هذه المركبات فى المكافحة المتكاملة لدودة ورق القطن.

كلمات افتتاحية مبيد بيض- مبيد يرقات- مبيدات ذات اصل طبيعى- دودة ورق القطن.