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Role of Moth Scales Remain on the Top of Egg Masses of *Spodoptera littoralis* and its Interference with the Performance of the Natural Bio-product Spinosad

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Abstract: During the peak of egg deposition of *Spodoptera littoralis* (Lepidoptera:Noctuidae), the ratio of naked to medium-covered to fully-covered egg masses was 10:2:1, respectively. Also, the ratio between egg masses located on the upper to the lower surface of the cotton leaf was 0.5:99.5, respectively. Based on laboratory test, performance of spinosad on naked egg masses was faster and greater than on fully-covered egg masses. Results of LC50 were 2.43-0.18 ppm for naked and 38.36-2.59 ppm for fully-covered egg masses at 12 and 24 h after hatching, respectively. Fully-covered egg masses may indicate a false resistance to spinosad of the same host insect strain.

Key words: Egg masses, scales, *Spodoptera littoralis*, spinosad

Introduction

The Cotton Leaf Worm *Spodoptera littoralis* (Boisd) (CLW) is a major polyphagous key pest in Egypt. It is active all year round without hibernation period and attacking cotton as well as more than 29 hosts from other crops and vegetables. Egypt use to spend more than 10 million dollars to combat this pest on all crops every year.

Hand picking CLW egg-masses is a reliable practice as well as a safe approach for control, particularly in the first generation of CLW on cotton in Egypt (El-Badawy *et al*., 1980). However, this process is not enough to control CLW due to its overlapping generations. In addition, when cotton grows too big, this process becomes too difficult. Consequently, the Ministry of Agriculture (MOA) has had to spray the cotton crop every year despite hand picking (Temerak, 2002).

Recently, satisfactory hand picking is facing serious problems due to the labour availability as well as the cost. Egypt use to have 10 million children every 3 days to pick up egg masses. Recently, government issued a law to prohibit the children from work in cotton and other work. El-Badway *et al*. (1980) failed to find a product with good ovicidal activity among the 12 tested chemicals from different group of insecticides. However, El-Dahan *et al*. (1990) indicated that chlorpyrifos ethyl alone or with Insect Growth Regulator (IGR) was the best ovicide among certain traditional products. Same author concluded that IGRs alone were weak products to combat egg masses of CLW.

In 1996 and up to now, MOA policy is to use (IGRs) alone without mixing with an organophosphate (OP) to combat the newly hatched larvae in order to conserve natural enemies during egg deposition (Temerak, 2002).

During egg deposition, MOA does not have available a good ovicide after the cancellation of OP+ IGR ready mixtures (Temerak, 2002). The best strategy is to control egg masses before spreading to neighboring plants. No considerable literature was found in regard to the scales and its interference with the chemical performance.

Spinosad was approved as reduced risk product and awarded the green chemical award from EPA and the Whitehouse. This the reason why spinosad was chosen to evaluate its activity on egg masses of CLW.

Materials and Methods

During the peak of egg deposition (mid of July), considerable amount of egg-masses was collected from 10 acres/each of the 6 governorates in this study.

Naked Versus Covered Egg masses

Egg masses/each governorate was sorted into three groups. The first group was the naked egg masses without any covered moth hairs. The second group was the medium-covered and the last group was the fully-covered with hairs or scales. Ratios among these groups were analyzed by F-test. To compare among means, LSD was applied as well.

Egg masses on the Lower Surface Versus the Upper Surface of the Leaf

Also, Egg masses/each governorate were also sorted into two groups. Egg masses that were located on the upper surface versus those located in the lower surface of the cotton leaf. Data were analyzed by t-test.

Susceptibility of Naked Versus Covered to Spinosad

The formulation of spinosad used in this study was spintor 24 SC.

It is trademark of Dow AgroSciences Co. It is a naturally occurring mixture of two active components (spinosyn A&D) produced by fermentation of the soil Actinomycete, *Sacharopolyspora spinosa* Marz & Yao.

Different concentrations of spinosad were prepared and beginning from 0.003, 0.07, 0.15, 0.3 ……up to 160 ppm. A sample of 42 egg masses as naked and also as fully-covered egg masses was selected randomly from all governorates. These egg masses were dipped for few seconds in different concentrations of spinosad and left to dry under laboratory condition of 27-29°C and relative humidity 59%. Each treatment was divided into two groups, each containing 3 naked and 3 fully-covered egg masses. Untreated Egg masses were dipped in water only.

Assessment

Numbers of hatched as neonate alive and as dead larvae were counted after 12 and 24 h from time of hatching. Concentrations showed mortality more than zero and less than 100% were used in the calculations of LC50 and LC90. The remaining average unhatched eggs in the 3 replicates/each group were also counted.

Results and Discussion

There are various reasons that moth of CLW cover their egg masses with scales (moth hairs from terminal abdomen). These may be attributed to one or more of the following:

- When deposition of egg masses occur during dry condition or low humidity just before the next irrigation
- In order to protect their eggs from the natural enemies e.g., predators or parasitoids. However, Lewis and Tumlinson (1988) indicated that *Tricogramma* spp. attracted to *Helothis* eggs by kiromones emanated from the scales. Also Allen *et al*. (1999) and Turling *et al*. (1990) refer to the possibility of chemical detection of insects as follows: Plant feeding by insects produces unique signatures of chemical compounds that often are exploited by natural enemies
- Other factors

In contrast, moths may leave their egg masses without hair cover due to one or more of the following:

- In case of heavy infestation and most of the scales were being consumed in the previous egg laying.
- Limited numbers of natural enemies around the habitat zone of Egg masses
- There was a short interval period between irrigation (enough suitable humidity)
- Moths may be disturbed by a predator e.g. true spider or ant during the egg deposition
- Moths have high fecundity and fertility
- Other factors

Due to the lack of available literature regarding the role of scales interference and ovicides, it can be inferred that scales may act as barrier between the insecticide chemical and the direct contact with the chorion, consequently, performance may be decreased.

The opposite may happen, when the scales act as sponge and harbor more molecules from the chemical between the hair for relatively long period. The key question of our study, whether these hairs play a positive role to increase the performance or negative role to decrease?

Naked Versus Covered Egg Masses

Table 1 showed the naked, semi-naked or medium-covered and fully-covered egg masses/each governorate. It was clear that naked egg masses was the dominant group followed by medium-covered

Table 1: Ratios of total number of naked and covered egg masses during the peak of egg deposition of *Spodoptera littoralis* cotton, 2004

Governorate	Naked	M-covered	Covered	Total inspected
Bohira	850	170	50	1070
Monofia	720	169	101	990
Sharkia	790	175	80	1045
Qurbia	710	160	100	970
Dakhlia	800	165	90	1055
Assiut	750	170	55	975
Total	4620	1009	476	6105
Average	770a	168b	79c	
Ratio approx.	10	2	1	
Share%	75.7	16.5	7.8	

CV% = 11.07%, LSD 0.01 = 68.82 (1% = 3.169)

Table 2: Total number of Egg masses of *S.littoralis* found in regard of surface of cotton leaves during the peak of Egg masses, cotton 2004

Governorate	Lower surface of leaves	Upper surface of leaves	Total inspected
Bohira	1065	5	1070
Monofia	986	4	990
Sharkia	1040	5	1045
Qurbia	964	6	970
Dakhlia	1047	8	1055
Assiut	990	4	994
Total	6092	32	6124
Average	1015	5	
Ratio approx.	100A	1B	
Share%	99.5	0.5	

CV% = 5.55% LSD 0.01 = 65.97 (1% = 4.032)

Table 3: Probit parameters of spinosad for naked and covered egg masses of *Spodoptera littoralis*

Criteria	Naked	Covered	Fold
	After 12 h from hatching		
b±SE	0.0602±0.0698	0.1178±0.1850	
LC50	2.4299(1.6015-3.4152)	38.3653(31.9899-46.5386)	15.79
LC90	214.4713	318.1006	
	(120.0934-477.4081)	(219.7156-524.7740)	
	After 24 h from hatching		
b±SE	0.1525±0.1097	0.0933±0.0631	
LC50	0.1813(0.1480-0.2167)	2.5880 (2.2149-3.0525)	14.27
LC90	1.1550(0.8654 -1.7209)	17.1707 (13.2473-23.5518)	

and fully-covered during the peak egg deposition. Ratios were 10:2 :1. The reason may attributed to the heavy infestation and the high fecundity of this generation.

Egg Masses on the Lower Surface Versus the Upper Surface of the Leaf

Table 2 showed the egg masses located in the lower surface versus the upper surface of the cotton leaf. Results indicated that the lower surface received significantly greater egg masses than the upper surface. Ratios were 99.5:0.5. When egg masses are being on the lower surface of leaves, the control spray measurements will be more difficult.

Susceptibility of Naked Versus Covered Egg Masses to Spinosad

Results indicated that LC50 12 h after hatching was 2.43 and 38.36 ppm for naked and fully-covered, respectively (Table 3). The same trend was recorded after 24 h. The LC50 was 0.18 versus 2.59 ppm for the naked and fully-covered after 24 h from hatching, respectively. The fold of susceptibility between both groups was 15.79 and 14.27 for the 12 and 24 h after hatching, respectively. Fully-covered egg masses may indicate a false resistance to spinosad of the same host insect strain. LC50 for naked was decreased from 2.43 to 0.18 ppm, when time increased from 12 to 24 h. The same trend for the fully-covered, it decreased from 38.36 to 2.59 ppm.

Results showed that naked egg masses were more susceptible than the fully-covered egg masses. So, scales act as barrier or shield protection from the chemical direct contact and decrease performance.

Data revealed that spinosad proved to have ovicidal activity only on naked egg masses (Table 4). Most of these eggs having neonate larvae inside the chorion and can not successfully emerge. The same product indicated good effect on neonate larvae hatched from both. However, the product have a faster effect on the newly hatched larvae coming from naked than those coming from the fully-covered egg masses.

Table 4: Remaining unhatched eggs% of *S. littoralis* after dipping in different dilutions of spinosad

Concentration	Naked (%)	Covered (%)
0.003	0.00	0
0.07	0.00	0
0.15	0.00	0
0.3	0.00	0
0.6	0.00	0
1.25	19.50	0
2.5	30.50	0
5	40.55	0
10	41.08	0
20	43.22	0
40	43.25	0
80	46.52	0
160	48.82	0
Untreated	0.00	0

Nolting *et al*. (1997) found that spinosad has good ovilarvicidal effect on *Heliothis* eggs and most of mortality in treated eggs was from larvae ingesting spinosad as they fed on the chorion of the eggs.

Spraying spinosad, can save considerable numbers of natural enemies according to Peterson *et al*. (1997) who stated that similar beneficial arthropod populations were measured in the untreated and spinosad treated cotton plots in Florida USA. He added that after application of spinosad will not be a significant flare up of secondary pests such as whiteflies. Furthermore, he indicated that application of spinosad in conjunction with naturally occurring beneficial arthropods are an excellent example of a functional cotton integrated pest management IPM program.

In 1996, MOA stopped using conventional insecticides+ IGRs as ready mixtures and to be tank mixed when it is necessary and there a need for it. They depend on IGRs alone to control newly hatched larvae early in the season in order to protect the natural enemies (Temerak, 2002). Spinosad can represent a viable solution for the control of CLW egg masses segment based on the majority were naked egg masses. Hence, it could be an alternative to hand picking of egg masses by children.

References

Allen, J.C., D.D. Kopp, C.C. Brewster and S.J. Fleischer, 1999. 2011: An agricultural Odyssey. Am. Entomol., 45: 96-104.

El-Badawy, F.A., A.R. Frag, L.A. Halawa, A.A. Korkor and A.A. Hariry, 1980. The ovicidal activity of certain insecticides against egg-masses of *Spodoptera littoralis* (Boisd) in Gmmeiza Experimental Farm. Proc. Ist Conf. Plant Prot. Res. Ins. Cairo, 1: 89-99.

El-Dahan, A.A., M.A. Serig and M. Kady, 1990. Ovicidal action of organophosphate insecticides, insect growth regulators and their binary mixtures on eggs of the cotton leafworm *Spodoptera littoralis* Boisd. Agric. Res. Rev., 68: 113-120.

Lewis, W.J. and J.H. Tumlinson, 1988. Host detection by chemically mediated associative learning in a parasitic wasp. Nature, 331: 257-259.

Nolting, S.P., R.M. Huckaba, B.A. Nead, L.G. Peterson and D.J. Porteous, 1997. Insect control in cotton with tracer. Down to Earth, 52: 21-27.

Peterson, L.G., J.R. Ruberson, R.K. Sprenkel, J.R. Weeks, M.C. Donahoe, R.H. Smith, J.S. Swart, D.J. Reid and G.D. Thompson, 1997. Tracer naturalyte insect control and IPM. Down to Earth, 52: 28-34.

Temerak, S.A., 2002. Historical records of cotton leafworm (*Spodoptera littoralis*) resistance to conventional insecticides as influenced by the resistance programs in Egypt from 1950-2002. Resistant Pest Manage., 12: 33-36.

Turling, T.C.J., J.H. Tumlinson and W.J. Lewis, 1990. Exploitation of herbivore-induced plant odors by host-seeking parasitic wasps. Science, 250: 1251-1253.