EFFECTS OF JOJOBA OIL ON *AGROTIS IPSILON* (HÜBN.) (LEPIDOPTERA: NOCTUIDAE) AND ASSOCIATED PREDATORS IN COTTON FIELDS

HODA ABDEL-FATTAH SALEM

Cutworms and Mole Cricket Department, Plant Protection Res. Institute, A.R.C., Dokki

INTRODUCTION

Jojoba oil is a vegetable oil obtained from the jojoba beans. When applied to crops, pesticide products containing the oil can control whiteflies. Jojoba oil products are approved for controlling aphid-borne virus in bean (Sepulveda and Navarrete, 1996). Jojoba oil presents no risks to humans or the environment. The oil has been used for decades in cosmetics, with no reported adverse effects. The physical properties of jojoba oil are similar to those of other vegetable oils, although jojoba oil has a chemical structure that is somewhat different from that of most vegetable oils. Jojoba oil is liquid at room temperature, odorless, and resistant to turning rancid. One of the ways it acts as a pesticide is by forming a physical barrier between an insect pest and the leaf surface. Jojoba oil can also act as toxicant, antifeedant, growth and development inhibitor and oviposition inhibitor (Aboel-Ghar *et al.* (1994), Shemais *et al.* (2002) Osman (2003), Bream *et al.* (2001)).

There is a rich diversity of parasitoid and arthropod predator species that naturally inhabit cotton fields and it is generally recognized that they play an important role in regulating pest populations (Naranjo, 2002).Further studies suggest that natural enemy function, measured as rates of predation and parasitism are affected by the use of additional insecticides for other pests (Rofail *et .al* (2000), Metwally *et. al.* (2004)). Hamdy *et al.* (2005) studied the natural enemies associated with *Bemisia tabaci* (Genn.) and *Aphis gossypii* (Glover) infesting cotton fields in Egypt and their role in suppressing populations of these insects.

The present study represents further investigations to the previous study of 2003 assessing jojoba oil on *Agrotis ipsilon*, which was established in Egypt as a destructive pest for the winter and early summer crops (Nasr and Naguib, 1964, Salem, 1990, Santos and Shields, 1998). Also, preliminary results are presented to evaluate jojoba oil as a pesticide and its effects on abundance of the predatory natural enemies in treated fields.

Bull. ent. Soc. Egypt, Econ. Ser., 32, 2006 (1-8)

MATERIAL AND METHODS

A- Foliage – spray treatment:

A field experiment was carried out during the cotton-growing season 2004 and 2005 at Agaa, Belkas and Sherben (Dakahlia governorate) to evaluate the effect of: jojoba oil 96% EC 1.5 Liter /fed. (Oily extract of jojoba bean *Simmondsia chinensis*, was obtained from Lab. of Pesticides, Agric. Res. Center, Dokki, Giza) compared to hostathion 40% EC, 1.25 Liter/fed to estimate their efficacy against cutworms in open fields.

The infested cotton field was divided into plots according to complete randomized blocks design and each treatment was replicated 4 times. Larvae of cutworms, *A.ipsilon* were counted on 25 cotton plant hills in each plot selected randomly just before and three days after insecticides application, the number of predators found on the same 25 cotton plant was also counted on the same dates.

The formula of Henderson and Tilton (1955) was used to calculate the percentage of reduction in the pest and predators population.

Doses of used insecticides were mixed with 200 liters of water per feddan and sprayed on cotton seedlings by one nozzle dorsal sprayer. For each experiment, one plot was left free of insecticide application as check.

B- Poison-bait treatment:

Insecticides were applied as baits and mixed with 15 Kg of wetted bran per feddan.The poison baits were applied by hand disparate beside cotton hills. Sampling of pest and predators for insecticides evaluation were in accordance with methodologies given herewith.

RESULTS AND DISCUSSION

Data in Tables (1,2) show that the respective values of reduction percentage in black cutworm larval population during 2004, were 73.9% and 83.3% when using jojoba oil 96% EC (nat-1) as foliage sprays applied to cotton seedlings or as poison baits compared to 84.8% and 86.6% for hostathion as chemical insecticide.

During 2005, the average reduction percentage in black cutworm larval population was 78.6% and 84.2% for jojoba oil as sprays and baits respectively compared to 85.01% and 87.1% for hostathion.

These results shed light on the possibility of using this oil as insecticide to control black cutworm population especially as poison baits, which was as effective as the tested chemical insecticide.

TABLE (I)

Efficacy of insecticides as foliage sprays applied to cotton seedlings, in the field, on larvae of black cutworm *Agrotis ipsilon* during 2004 & 2005

Treatments	Rate of appl /fed.	No. of alive larvae during 2004									% average redaction
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	
Jojoba oil	1.5L	36	13	76.0	37	12	73.8	35	15	72.1	73.9
hostathion	1.25	37	6	88.6	35	7	85.5	34	11	80.1	84.8
Control	0.0	39	50	0.0	36	47	0.0	33	57	0.0	0.0
		No. of alive larvae 2005									
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	
Jojoba oil	1.5L	34	7	83.9	33	8	79.4	31	9	72.5	78.6
hostathion	1.25	35	6	85.8	30	5	88.3	32	6	81.1	85.01
Control	0.0	36	41	0.0	32	40	0.0	29	35	0.0	0.0

TABLE (II)

Efficacy of insecticides as poison baits on larvae of black cutworm *Agrotis ipsilon* during 2004 & 2005

Treatments	Rate of appl/fed.	No. of alive larvae 2004									% average redaction
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	
Jojoba oil	1.5L	34	6	84.6	29	6	82.7	30	7	81.8	83.3
hostathion	1.25L	32	5	86.3	23	4	85.5	26	4	87.9	86.6
Control	0.0	35	40	0.0	30	36	0.0	25	32	0.0	0.0
		No. of alive larvae 2005									
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	Pre T.	Post T.	% red.	
Jojoba oil	1.5L	37	7	77.3	29	7	87.1	35	6	88.1	84.2
hostathion	1.25L	35	6	81.6	30	5	90.5	32	6	89.3	87.1
Control	0.0	30	83	0.0	35	45	0.0	39	46	0.0	0.0

The present results are in agreement with those of Rofail *et.al* (2000), who investigated the insecticidal activity of some mineral and plant oils (Solar oil E.C., CAPL-2 and jojoba oil E.C.) on newly hatched larvae of susceptible and Cyanox-resistant strains of cotton bollworm, *Pectinophora gossypiella*, in laboratory and

TABLE (III)

Effect of insecticides as foliage sprays applied to cotton seedlings, in the field, on the number of predators during 2004

Treatments	Predators	Number of predators									% average reduction
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		pre T	post T	% R	pre T	post T	% R	pre T	post T	% R	
Jojoba oil	*Orius* sp.	18	8	59.6	12	8	44.4	20	17	42.0	48.7
	Scymnus sp.	15	7	55.4	17	8	58.6	10	6	55.7	56.6
	Paederus alfierii	18	8	71.4	20	15	42.9	13	11	23.8	46.0
	Chrysoperla carnea	18	13	32.6	18	18	21.4	15	12	26.2	26.7
	Coccinella undecimpunctata	19	12	43.6	25	15	41.7	22	24	8.4	31.2
Hostathion	*Orius* sp.	18	4	79.8	15	5	72.2	24	3	91.5	81.2
	Scymnus sp.	18	3	84.1	20	2	91.2	18	2	91.8	89.0
	Paederus alfierii	23	5	86.0	28	5	86.4	19	2	90.5	87.6
	Chrysoperla carnea	22	4	83.0	19	2	91.7	19	4	80.6	85.1
	Coccinella undecimpunctata	23	1	96.1	23	2	91.6	21	3	88	91.9
control	*Orius* sp.	20	22	0.0	35	42	0.0	15	22	0.0	0.0
	Scymnus sp.	22	23	0.0	29	33	0.0	31	42	0.0	0.0
	Paederus alfierii	18	28	0.0	32	42	0.0	18	20	0.0	0.0
	Chrysoperla carnea	28	30	0.0	33	42	0.0	48	52	0.0	0.0
	Coccinella undecimpunctata	25	28	0.0	34	35	0.0	21	25	0.0	0.0

TABLE (IV)

Effect of insecticides as foliage sprays applied to cotton seedlings, in the field, on the number of predators during 2005

Treatments	Predators	Number of predators									% average reduction
		Dakahlia governorate									
		Agaa			Sherben			Belkas			
		pre T	post T	% R	pre T	Post T	% R	pre T	post T	% R	
Jojoba oil	*Orius* sp.	7	4	66.9	9	6	59.0	9	6	47.6	57.8
	Scymnus sp.	11	8	45.5	7	5	56.0	5	4	45.0	48.8
	Paederus alfierii	18	12	64.7	12	8	55.6	10	9	36.5	52.2
	Chrysoperla carnea	12	6	80.0	9	7	50.5	6	5	21.9	50.8
	Coccinella undecimpunctata	12	6	69.2	7	5	35.1	7	5	54.5	52.9
Hostathion	*Orius* sp.	24	7	83.1	20	8	75.4	20	5	80.4	79.6
	Scymnus sp.	10	2	85.0	14	2	91.2	15	2	90.83	89.0
	Paederus alfierii	15	2	92.9	16	4	83.3	15	5	76.5	84.2
	Chrysoperla carnea	18	3	93.3	15	3	87.3	15	2	87.5	89.4
	Coccinella undecimpunctata	28	3	93.4	24	2	92.4	25	3	92.4	92.7
control	*Orius* sp.	11	19	0.0	8	13	0.0	11	14	0.0	0.0
	Scymnus sp.	9	12	0.0	8	13	0.0	11	16	0.0	0.0
	Paederus alfierii	9	17	0.0	8	12	0.0	12	17	0.0	0.0
	Chrysoperla carnea	8	20	0.0	7	11	0.0	15	16	0.0	0.0
	Coccinella undecimpunctata	8	13	0.0	10	11	0.0	7	11	0.0	0.0

field trials. In a field in Egypt, oils were sprayed on cotton plants 2 and 3 times during the 1997 and 1998 growing seasons. Results showed that the second spray in 1997 and the third spray in 1998 resulted the best control of bollworm. Solar oil recorded the greatest control of bollworm population, followed by CAPL-2 and jojoba oil E.C.

The predators species found during this experiment were (*Coccinella undecimpunctata, Scymnus* sp., *Chrysoperla carnea, Orius* sp., *and Peaderuis alfierii).* The effects of jojoba oil on the natural enemies are shown in (Tables 3&4).Using jojoba oil as foliage sprays has the same effects on predators as the tested insecticide. During 2005, the average reduction percentages in the predators' numbers were higher than those in 2004, but it was lower than those of hostathion in both seasons. No reduction was found when jojoba oil was used as poison baits.

Metwally *et.al.* (2004), in field studies conducted in Kafr El-Sheikh, Egypt, during the 2000 and 2001 cropping seasons, determined the parasitism percentages by the aphelinid parasitoids *Eretmocerus mundus* and *Encarsia lutea* on tomatoes infested with *Bemisia tabaci.* They found that jojoba oil exhibited the lowest reduction in parasitism (26.55 and 31.75%) for *E. mundus* and *E. lutea* (25.65 and 21.71%) during 2000 and 2001, respectively. Population fluctuations of these aphelinids were markedly decreased by the different treatments during both seasons. A mixture of jojoba oil and the insecticide silicron greatly decreased the numbers of ova, nymphs and adults of *B. tabaci*, followed by jojoba oil, silicron application and mulching treatment during both seasons. Salem *et al.* (2003) in laboratory studies concluded that jojoba oil gave similar effect on *A. ipsilon* as capl –2 and have the same mortality effect as the chemical pesticide.

SUMMARY

Efficacy of jojoba oil as insecticide against the black cutworm, *Agrotis ipsilon* was used as bran bait or foliage spray in comparison with the most used insecticide hostathion 40% EC. Three experiments were conducted during the cotton-growing seasons 2004 & 2005 at Agaa, Belkas and Sherben (Dakahlia governorate). The average reduction percentages in black cutworm larval population during 2004 were 73.9% and 83.3% when using jojoba oil 96% EC (nat-1) as foliage sprays applied to cotton seedlings or as poison baits compared to 84.8% and 86.6% for hostathion.

During 2005, the average reduction percentage in black cutworm larval population was 78.6% and 84.2% for jojoba oil as foliage sprays applied to cotton seedlings and as poison baits compared to 85.01% and 87.1% for hostathion.

Numbers of predators were decreased by both control measures against *A. ipsilon* on cotton plants during seasons 2004 and 2005. Jojoba oil exhibited the lowest reduction of predators during both seasons. Using poison baits had no effect on predator numbers.

Application of bran baits of jojoba oil (nat-1,96% EC) at rate of 1.50 Liter/feddan showed the highest reduction levels among cutworm population with the lowest influence on the natural enemies (*Coccinella undecimpunctata, Scymnus* sp., *Chrysoperla carnea, Orius* sp., *and Paederuis alfierii*).

REFERENCES

ABOEL–GHAR, G.E.S.; M.S. KHALIL and T.M. EID (1994): Effect of plant extracts on development and fecundity of *Agrotis ipsilon* (Lep.: Noctuidae).*(Bull. ent. Sco. Egypt,Econ.Ser., 21:171-190)*

BREAM, A.S.; K.S. GHONEIM, M.A. TANANI, and, M.I NASSAR.(2001): The disruptive effects of Azadirachtin and Jojoba on development and morphogenesis of the red palm weevil, *Rhynchophorus ferrugineus* (Curculionidae : Coleoptera)*.(Mededlingen–faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen,Universiteit Gent. , Belgium: 66:2a, 491-502).*

EL-SAYED, N.A. and M. NAGUIB (1964): Contribution to the biology of the Greasy cutworm, *Agrotis ipsilon* Rott. *(Bull.Soc.Ent. Egypte, 47,197- 200).*

HAMDY M.I.; I.S. ABDEL–WAHAB and H.F. DAHI (2005): Seasonal Fluctuations of Natural Enemies Associated with *Bemisia tabaci* (Genn.) and *Aphis gossypii* Glover in Cotton Fields at Minia Governorate *(3rd International Conf. on IPM Role in Integrated Crop management and Impacts on Environment and Agricultural Products. 26-29 November 2005, Giza, Egypt).*

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

METWALLY, S.M.I.; I.A KHODEIR; I.S EL-HAWARY; I.F. KHAFAGY (2004): I.Effects of four control measures on *Bemisia tabaci* (Genn.) and its

parasitoids on tomato at Kafr El-Sheikh. *(Egypt. J. Biol. Pest Control, 14(2): 349-353).*

NARANJO S. E. (2002): Arthropod communities and transgenic cotton in the western USA. pp. 33-38. In M. Hoddle, (ed.), *(Proceedings 3rd California Conf. on Biological Control, 15-16 August 2002, Davis, CA).*

OSMAN, S.M. (2003): Effect of different plant oils on the black cutworm *Agrotis ipsilon* (Hüfn.) (Lep. Noctuidae). *(Egyptian J.Appl. Sci., 18 (11):316-322).*

ROFAIL, M. F.; M.A. NADA; A.G. EL-SISI; A.M. RASHAD (2000): Time of spraying some natural oils as a limiting factor for controlling cotton bollworm, *Pectinophora gossypiella* (Saunders). *(Egypt. J.Agric. Res. 78: 4, 1499-1507).*

SALEM, A.A. (1990): The effect of host plants on certain biological aspects of The Greasy Cutworm, *Agrotis ipsilon* (Hüfn.).*(Annals Agric. Sci. Cairo.35: (1):485-490).*

SALEM H.A.; M.M.A. EL-SHERSHABY and F.A. KWAIZ (2003): Evaluation of some natural and chemical pesticides against the black cutworm *Agrotis ipsilon* (Hüfn.) *(J.Agric. Sci. Mansoura Univ. 28 (4): 3053 – 3059).*

SANTOS L. and E.J. SHIELDS (1998): Temperature and diet effect on Black Cutworm (Lep.: Noctuidae) larval development. *(J. Econ. Entomol, 91:1,267-273).*

SEPULVEDA, R.P. and G.J.F. NAVARRETE (1996): Use of oils in the reduction of aphid-borne virus in bean (*Phaseolus vulgaris* L.).(Spanish). *(Agric.Tecnica (Santiago).56:2, 99-106).*

SHEMAIS, S.A.; S.R. KASSIS and S.M.S. AHMED (2002): Effectiveness of jojoba oil for the protection of wheat grains against the rice weevil, *Sitophilus oryzae* L. and the granary weevil, *Sitophilus granarius* L. adults (Curclionidae: Coleoptera*).(2nd. Inter. Conf., Plant Protect.Res. Inst., 21-24 Dec., 2:781-784).*