J.Pest Cont. & Environ. Sci. 10(1): 115-126 (2002)

Effect of some biocides on leafminer *Liriomyza* spp. (Diptera: Agromyzidae) and whitefly *Bemisia tabaci* (Homoptera: Aleyrodidae).

By

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Received 30/1/2002, Accepted 7/3/2002

ABSTRACT

Evaluation of biocidal effect of spinosad (bacteria), pyriproxyfen (IGR) and mineral oil (CAPL2) and their binary mixtures on leafminer, *Liriomyza trifolii* and immature stages of whitefly, *Bemisia tabaci* on tomato plant was carried out under field conditions. The results indicated that the combination of spinosad and the oil showed the highest efficacy against *L. trifolii* where the mean number of larvae reached zero at the 15^{th} day after treatment, followed by the treatment of spinosad alone. Pyriproxyfen showed the highest efficacy against immature stages of whitefly where the population reduced to 94.2% followed by pyriproxyfen plus the oil (91.4%), the oil alone (88.62%) and spinosad plus the oil (88.46%) while spinosad alone gave the lowest percentage of reduction (66.51%). From this study it could be concluded that the mixture of spinosad plus the oil was highly effective in controlling *L.trifolli* larvae while pyriproxyfen was effective against *B. tabaci*.

INTRODUCTION

There is a growing demand for the wide use of integrated pest management (IPM) techniques in pest control. IPM is an approach that combines all the various tools and methods such as chemical and biological products, natural enemies and cultural control methods to manage pests at acceptable level.

Leafmining flies of the genus *Liriomyza* Mink are among the most injurious dipterous insects attacking vegetable and floricultural crops (Hammed 1955, Genung and Harris 1961, Musgrave *et al.*, 1975, Jones *et al.*, 1986, Parrella *et al.*, 1987 and Hannou *et al.*, 1995). They are considered secondary pests on tomatoes (Oatman and Kennedy 1976, Johnson *et al.*, 1980) however up to 90% of the foliage may be lost if the population increased (Schuster 1978). Leaflet may be severely injured by high densities of the leafminer larvae which primarily feed in the palisade layer (Oatman and Michelbacher 1958). Despite intense insecticide programs, growers are encountering serious financial losses. On the other hand, several reports of insecticidal resistance in this respect were published documented (Alverson and Gorsuch 1982, Parrella *et al.*, 1984).

The ectoparasite *Diglyphus* spp. (Hymenoptera: Eulophidae) constitutes one of the most important group of parasites that attack *Liriomyza spp.* (Parrella and Robb 1985). However, once insecticide is applied any balance that has existed between parasitoid and host is disrupted and a continual insecticide control program usually becomes necessary (Hannou *et al.*, 2000).

The whitefly, *Bemisia tabaci* (Gennadius), is among the most important economic cosmopolitan pests attacking cotton, vegetables, and ornamentals (Gerling 1990, Byrne and Bellows 1991). It damages crops by extracting large quantities of phloem sap, which may cause yield reduction. The honeydew excreted by the pest serves as a medium for sooty molds that reduce crop quality. In some cases, *B. tabaci* transmits viruses which limit growing of agricultural crops (Cohen, 1990).

Our study was carried out to evaluate the single application of spinosad, pyriproxyfen or their combinations with mineral oil (CAPL2) for controlling the larvae, of *L. trifolii* and encountering their effect on the externally parasitoids *D.isaea* as well as for controlling the whitefly on tomato plants under field conditions.

MATERIALS AND METHODS

Biocides tested: Mineral oil (CAPL2 96.62% EC) supplied from the Central Agriculture Pesticide Laboratory, rate 1l/100 liter water; Spinosad (Tracer 24% EC.) Dow Elanco, USA, rate 30 gm/100 liter water; Pyriproxyfen (Admiral 10% EC) Sumitomo Chemical Co., LTD. Tokyo-Japan, rate 150 ml/100 liter water; Spinosad + CAPL2 at the rate of 20 gm + 1l/100 liter water; Pyriproxyfen + CAPL2 at the rate of 0.1 + 1l/100 liter water.

Spinosad is a mixture of spinosyn A and D. It's naturally derived from new species of Actinomycetes, *Saecharopolyspora spinosa*, which is characterized as bacteria ($2.3x10^7$ conidia/ml) (El-Deeb 1999).

Pyriproxyfen is a chitin inhibiting growth regulator (IGR) which was developed by focusing on the natural occurring hormones that are characteristic of insect pests. Pyriproxyfen acts by disrupting insect growth cycle. It can also be used as a part of complete IPM program along with bioinsecticides and cultural methods (Gabr 1991).

The mineral oil (CAPL2) is a new generation of mineral oils, which is used either alone or in combination with other insecticides for controlling many insects.

Field experiment: The field experiment was conducted on tomato plants in the Nili plantation, September 2001 in a special grower field at Khorshid, Alexandria. The experimental area was divided into plots of about 5X5 m^2 each. Treatments were applied with knapsack sprayer at the rate of 200 liters/feddan. Insecticidal treatments were replicated three times. Five plots were left without spraying and considered as control. Twenty leaflets per plot were randomly sampled before spray and 48hr, 5 days, 7 days 10 days and 15 days post treatments by removing three infested leaflets from the top, middle and bottom strata of each plant to determine the effect of different treatments on leafminer and its parasite. Also, twenty leaflets per plot were randomly sampled as mentioned, above before spray and weekly for three weeks following application to determine the effect of the previous treatments on the immature stags of the whitefly.

Laboratory assay: The collected leaflets were placed in paper bags, transferred to the laboratory and observed through a binocular microscope where the number of mines, live larvae, dead larvae and parasitized larvae of *Liriomyza trifolii* were recorded before and after treatment. Also the number of immature stages of whitefly was counted.

Statistical analysis: Statistical analysis was carried out using Cohort Software, Inc. (1986) and the reduction in whitefly populations was calculated by Henderson Tilton's formula (Henderson and Tilton, 1955).

RESULTS AND DISCUSSION

Tables 1 and 2 represent the mean values and percentage of reduction of *Liriomyza trifolii* due to the application of mineral oil, (CAPL2), bioinsecticide (spinosad), insect growth regulator (pyriproxyfen) and their binary mixtures and the effect on its parasitoide *Diglyphus isaea*. The results showed that spinosad plus the oil was the best treatment for controlling *L. trifolii* larvae where the mean number of live larvae was 0.933 before treatment then markedly reduced through the period of study reaching zero at 15th day after treatment. It is followed by spinosad alone where the reduction in the mean number of live larvae declined to 0.133.

In the case of parasitized larvae, the treatment of spinosad plus the oil gave high reduction. The mean number of parasitized larvae was reduced to 0.666 as well as the mines was, markedly reduced during the period of 15 days following application. However, the mean number of parasitized larvae after the treatment with pyriproxyfen or its mixture with the mineral oil were 2.00 and 2.066, respectively, following the same time intervals. This indicated that those treatments did not cause detrimental effects on parasitoid of *L. trifolii*. This proves that combination of spinosad plus the oil may fit well into IPM programes.

The effect of the mineral oil (CAPL2), bioinsectide (spinosad) and IGR (pyriproxyfen) on the whitefly *B. tabaci* is presented in Table 3. The results showed that the highest reduction percentages of the whitefly were recorded following the treatment with pyriproxyfen (94.21%), followed by pyriproxyfn plus the oil (91.4%), then the oil (88.62%) and spinosad plus the oil (88.46).The lowest percentage of

Table(1):Effect of mineral oil, bioinsecticide, IGR and their binary mixtures on *Liriomyza trifolii* and its parasite *Diglyphus isaea.*

Treatments	Mean no. *L. trifolii* and parasites at intervals					
	Zero	48hr	5 days	7 days	10days	15days
			Live *L. trifolii* larvae			
Untreated	1.066^{b}	6.333^{e}	3.600^{c}	1.933^{d}	0.600^{d}	0.533^{b}
CAPL2	2.600^{e}	8.466^{f}	5.000^{d}	1.733^{c}	0.866^{e}	0.800^{c}
Spinosad	1.600^{d}	4.200^{b}	0.666^{b}	0.333^{b}	0.266^{a}	0.133^{a}
Spinosad + CAPL2	0.933^{b}	0.433^{a}	0.133^{a}	0.133^{a}	0.133^{a}	0.000^{a}
Pyriproxyfen	0.466^{a}	5.933^{d}	5.266^{e}	2.400^{e}	0.400^{c}	0.466^{b}
Pyriproxyfen + CAPL2	1.133^{bc}	5.133^{c}	3.533^{c}	0.333^{b}	0.333^{ab}	0.800^{c}
			Externally parasitized *L. trifolii* larvae			
Untreated	3.066^{c}	3.000^{e}	4.666^{e}	4.666^{f}	3.600^{d}	3.733^{e}
CAPL2	4.400^{e}	1.666^{b}	1.333^{b}	3.133^{c}	4.733^{e}	0.866^{b}
Spinosad	2.600^{a}	0.733^{a}	0.933^{a}	0.933^{b}	1.133^{b}	1.200^{c}
Spinosad + CAPL2	2.533^{a}	3.266^{f}	0.800^{a}	0.400^{a}	0.200^{a}	0.666^{a}
Pyriproxyfen	3.333^{d}	2.266^{c}	1.666^{c}	3.466^{d}	1.733^{c}	2.000^{d}
Pyriproxyfen + CAPL2	2.733^{ab}	2.600^{d}	2.333^{d}	4.200^{e}	4.800^{e}	2.066^{d}
			Dead *L. trifolii* larvae			
Untreated	2.400^{d}	2.733^{b}	2.733^{c}	2.866^{c}	2.133^{a}	1.266^{b}
CAPL2	2.666^{e}	2.066^{a}	1.800^{a}	0.800^{a}	3.133^{c}	0.866^{a}
Spinosad	1.800^{c}	7.066^{d}	6.200^{e}	3.000^{c}	5.333^{e}	2.133^{d}
Spinosad + CAPL2	1.533^{b}	8.000^{e}	4.533^{d}	3.533^{d}	3.333^{d}	1.400^{b}
Pyriproxyfen	1.266^{a}	4.266^{c}	2.333^{b}	2.400^{b}	3.066^{c}	1.600^{c}
Pyriproxyfen + CAPL2	3.066^{f}	2.000^{a}	4.600^{d}	3.800^{e}	2.600^{b}	2.266^{d}
			L. trifolii mines			
Untreated	6.933^{c}	12.40^{c}	12.13^{f}	10.46^{f}	7.666^{c}	6.266^{f}
CAPL2	9.533^{e}	14.33^{f}	9.333^{c}	5.800^{c}	9.733^{e}	3.000^{b}
Spinosad	6.266^{b}	12.86^{d}	8.533^{b}	4.733^{b}	7.733^{c}	4.066^{c}
Spinosad + CAPL2	5.333^{a}	12.20^{b}	5.666^{a}	4.466^{a}	3.333^{a}	2.133^{a}
Pyriproxyfen	5.333^{a}	13.40^{e}	10.73^{d}	9.666^{e}	5.866^{b}	4.400^{d}
Pyriproxyfen + CAPL2	7.000^{d}	10.93^{a}	11.33^{e}	8.866^{d}	8.733^{d}	5.800^{e}

Mean separations in vertical columns by Duncan's multiple range test on transformed data $P \leq 0.05$.

The data which have the same letter (s) haven't significant differences.

reduction in the whitefly population was observed following the application of spinosad (66.51%).

These results indicated that pyriproxyfen was effective in controlling whitefly population. This finding are in agreement with that reported by Gabr 1991, Ishaya 1992., Karkor *et al.*, 1996, Hamid and Karkor, 1998. They found that pyriproxyfen highly suppressed the number of immature stages of *B. tabaci.*

Table (2) : Percentage of reduction of *Liriomyza trifolii* larvae.

Treatments	% Reduction					Mean
	48hr	5 days	7 days	10days	15days	
	Live *L. trifolii* larvae					
CAPL2	45.19	43.06	63.24	40.82	38.46	46.15[c]
Spinosad	55.81	87.67	88.52	70.46	83.38	77.17[b]
Spinosad + CAPL2	92.19	95.78	92.14	74.67	100.00	90.96[a]
Pyriproxyfen	-114.31	-234.62	-184.02	-52.50	-100.00	-137.09[e]
Pyriproxyfen + CAPL2	23.74	7.66	83.79	47.78	-41.22	24.35[d]

Table (3): Percentage of reduction of the whitefly, *Bemisia tabaci*

Treatments	% Reduction			Mean
	1 week	2 weeks	3 weeks	
CAPL2	69.64	97.75	98.49	88.62[c]
Spinosad	59.17	73.52	66.83	66.51[b]
Spinosad + CAPL2	85.06	80.31	100	88.46[b]
Pyriproxyfen	93.04	93.09	96.67	94.27[a]
Pyriproxyfen + CAPL2	91.31	86.14	95.67	91.04[a]

From this study, it could be concluded that spinosad plus the oil was the highly efficient in controlling *L. trifolii* larvae while pyriproxyfen gave a good control in the case of *B.tabaci.*

REFERENCES

Alverson, D.R. and C.S. Gorsuch. (1982): Evaluation of chrysanthemum cultivars and insecticides for control of damage by a leafminer, *Liriomyza trifolii* (Diptera: Agromyzidae). J. Econ. Entomol., 75: 888-891.

Byrne, D.N. and T.S. Bellows. (1991): Whitefly biology. Ann. Rev. Entomol., 36: 431-457.

Cohen, S. (1990): Epidemiology of whitefly-transmitted viruses, pp. 211-225. In D. Gerling [ed], whiteflies: their Bionomics, pest status and management. Intercept, Andover, Hants, U.K.

Cohort, Software Inc. (1986). Costat Users Manual, Version 3.03 Berkelely, California, USA.

Gabr A.M. (1991): Studied on the integrated pest management to control certain solanaceous pests in order to decrease the pesticide pollution. Ph. D. Thesis. Fac. of Agric., Ain Shams University.

Genung, W.G. and E.D. Harris. Jr. (1961). Notes on the biology and control of serpentine leafminers in the Everglades. Proc. Fla. State Hortic. Soc., 74: 137-143.

Gerling, D. [ed.] (1990): Whiteflies: their bionomics, pest status and management. Intercept, Andover, Hants, U.K.

Hamid, A.M. and A.A. Karkor (1998): New approaches for control of whitefly *Bemisia tabaci* on cotton crop. Alex. Sci. Exch., Vol. 19 (4): 543-558.

Hammad, S.M. (1955): On some dipterous leafminers from Egypt. Bull. Soc. Ent. Egypt, XL, PP. 21-27.

Hannou, M.A., E.M. Hegazi and M.A. Shaaban. (1995): Factors affecting ovipositional and feeding behaviour of *Liriomyza trifolii* (Burgess) adult females (Diptera: Agromyzidae). Egypt.J. Appl. Sci., 10: 677-685.

Hannou, M.A., S.F. Shweil, W.E. Khafagi and E.M. Hegazi. (2000): Effects of a neem-based insecticide on populations of broad bean leafminer (*Liriomyza* spp.) and associated parasitoids in faba bean filed. 1st Int. Conf. Appl. Entomol., Cairo University. Faculty of Science.

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

Ishaaya, L. and A.R. Horwitz (1992): Novel phenoxy Juvenile hormone (pyriproxyfen) suppresses embryogenesis and adult emergence of sweetpotato whitefly (Homoptera: Aleyrodidae). J.Econ. Entomol., 85 (5): 2113-2117.

Johnson, M.W., E.R. Oatman and J.A. Wyman. (1980): Effects of insecticides on populations of the vegetable leafminer and associated parasites on fall pole tomatoes. J. Econ. Entomol., 73: 67-71.

Jones, V.P., M. P. Parrella . and D.R. Hodel, (1986): Biological control of leafminers in greenhouse chrysanthemums. Calf. Agric., 40 (1 and 2): 10-12.

Karkor, A.A., M.Z. Awad, A.M.Hamid and A.R. Farag (1996): meet the menace of whitefly on cotton by using some natural materials. J. Agric. Sci. Mansoura Univ., 21 (2): 779-786.

Musgrave, C.A., S.L. Poe and H.V. Weems, Jr. (1975): The vegetable leafminer, *Liriomyza sativae* on tomato, J. Econ. Entomol., 69: 667-668.

Oatman, E.R. and A.E. Michelbacker. (1958): The melon leafminer, *Liriomyza pictella* (Thomson) (Diptera: Agromyzidae). Ann. Entomol. Soc. Am., 51: 557-566.

Oatman, E.R. and G.G. Kennedy. (1976): Methomyl induced outbreak of *Liriomyza sativae* on tomato. J. Econ. Entomol., 69: 667-668.

Parrella, M.P., C.B. Keil and J.G. Morse. (1984): Insecticidal resistance in *Liriomyza trifolii*. Calif. Agric., 38: 22-23.

Parrella, M.P. and K.L. Robb. (1985): Economically important members of the genus *Liriomyza* Mik: a selected bibliography. Entomol. Soc. Am. Misc. Pub., 59.

Parrella, M.P., K.L. Robb, G.D. Christie and J. A. Bethke (1982): Control of *Liriomyza trifolii* with biological agents and insect growth regulators. Calif. Agric., 36, 17-19.

Parrella, M.P., V. Jones and G.D. Christie. (1987): Feasibility of parasites for biological control of *Liriomyza trifolii* (Diptera: Agrmyzidae) on Commercially grown chrysanthemum. Environ. Entomol., 16: 832-837.

Schuster, D.J. (1978): Vegetable leafminers control on tomato, 1977. Insectic Acaric., Tests 3: 108.

Shweil, S.F., M.A. Hannou, W.E. Khafagi and E.M. Hegazi(2000): Efficacy of alternative control methods against the broad bean leafminers (*Liriomyza* spp.) (Diptera: Agromyzidae). Annals Agric. Sci., (4) 1561-1571.

الملخص العربى

تأثير بعض المبيدات الحيوية على نافقات الاوراق والذبابة البيضاء

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تقييم كفاءه بعض المبيدات الحيوية ومنظمات النمو والزيوت المعدنية وخليط مخفض الجرعة من تلك المبيدات مع الزيت على تعداد نافقات الاوراق والذبابة البيضاء على نبات الطماطم. ولقد وجد ان الخليط من الجرعه المخفضة من المبيد الحيوى سبينوساد مع الزيت المعدنى كابل ٢ قد اظهر اعلى كفاءه فى مكافحة نافقات الاوراق حيث وصل متوسط اعداد اليرقات الحيه لذبابة الفول *L.trifolii* الى صفر فى اليوم الخامس عشر من المعاملة يلية فى الكفاءه المبيد الحيوى سبينوساد منفردا. وقد اظهرت النتائج ان منظم النمو بيروبركسفين . قد اظهر اعلى كفاءه فى مكافحة الاطوار الغير كاملة للذبابة البيضاء *Bemisia tabaci* حيث كانت النسبة المئوية للخفض فى تعداد الاطوار الغير كاملة حوالى ٩٤,٢% يلية فى الكفاءه الجرعه المخفضة من بيروبروكسفين مضافا اليه الزيت المعدنى حيث كانت نسبة الخفض حوالى ٩١,٤% يليه الزيت المعدنى منفردا(٨٨,٦٠%) يلية الجرعه المخفضة من المبيد الحيوى سبينوساد مضافا اليه الزيت المعدنى حيث كانت نسبه الخفض ٨٨,٤٦ % واظهرت النتائج ايضا ان المبيد الحيوى سبينوساد منفردا اعطى اقل نسبه خفض ٦٦,٥١% من هذا البحث نستنتج من ذلك ان الجرعه المخفضه من المبيد الحيوى سبينوساد مضافا اليها الزيت المعدنى كان اكثر كفاءه فى مكافحة نافقات الاوراق بينما منظم النمو بيروبروكسفين كان اكثر كفاءه فى مكافحة الاطوار الغير كاملة للذبابة البيضاء.