COMPARISON BETWEEN SOME NATURAL CONTROL AGENTS AND BUPROFEZIN IN MANAGEMENT OF *BEMISIA TABACI* (HOMOPTERA: ALEYRODIDAE) ON COTTON PLANTS

By **ASHRAF A. H. MANGOUD[1], HANY A. S. ABD EL-GAWAD[2] AND MOHAMED G. M. RAGAB[3]**

[1]Scale Insects and Mealybug Research Dept., [2]Biological Control Research Dept., [3]Bollworm Research Dept., Plant Protection Institute, A.R.C., Dokki, Giza, Egypt

(Received 23-12-2003)

INTRODUCTION

The silver leaf whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) has an extremely wide host range. It attacks more than 500 species of plants (Greathead, 1986) from 63 plant families (Mound and Halsey, 1978). Whitefly is a serious pest of vegetable, ornamental plants, weeds and agronomic crops throughout tropical and increasingly temperate regions of the world (Cock, 1986). *B. tabaci* attacks many high value plant hosts of several different families in Egypt (Abd-Rabou, 1997). *B. tabaci* whitefly was described as *Aleyrodes tabaci* from tobacco in Greece in 1889. The pest can cause economic damage to plant in several ways. Heavy infestations of adults and their progeny can cause seedling death, or reduction in vigour and yield of older plants, due simply to sap removal. When adult and immature whiteflies feed, they extract honeydew, a sticky excrete waste that is composed largely of plant sugars. The honeydew can stick cotton lint together, making it more difficult to gin and therefore reducing its value. Sooty mold grows on honeydew which falls on leaves obscuring the leaf and reducing photosynthesis, and reducing fruit quality grade (Brown *et al.*, 1995). Abd-Rabou *et al.* (2002) recorded eight parasitoid species (*Cales* sp., *Encarsia formosa* Gahan, *E. inaron* (Walker), *E. lutea* (Masi), *E. mineoi* Viggiani, *E. sophia* (Timberlake), *Eretmocerus eremicus* Rose and Zolnerowich and *Er. mundus* Mercet.) associated with *Bemisia tabaci*.

The present work was designed to study the effect of different natural control agents (Biofly, Misrona oil and NeemAzal) compared with buprofezin to manage *Bemisia tabaci* on cotton plants.

MATERIAL AND METHODS

Four formulated compounds were used in all trails:

a. **Biofly,** an entomopathogenic fungi (3X 10^7 c.f.u./1ml), containing the fungus *Beauveria bassiana.* It was applied at a rate of 1.5 ml/liter of water.

b. **Buprofezin (Applaud 25% SC) (insect growth regulator IGR's):** A soluble concentration, formulated by I.C.I. Co., containing 25% a.i.: 2-tetra-butylimino-3-isopropyl-5-phenyl-1, 3, 5-thiadiazinan-4-one. It was applied at a rate of 1.5 ml/liter of water.

c. **NeemAzal,** a botanical extract containing 1% Azadirachtin A (10 g/liter) from the neem tree, *Azadirachta indica* (Meliaceae). It was applied at a rate of 1.5 ml/liter of water.

d. **Super Misrona 95% EC,** a local mineral oil, containing 95% paraffinic oil w/w and 5% inert ingredients, unsulfonated residue content reached 92%. It was applied at a rate of 20 ml/liter of water.

This study was conducted on cotton plants grown in Gharbia Governorate. Two experiments were conducted during August of the two successive years 2002 and 2003 when pest population density and parasitism rate were high. An area of 1/4 feddan was divided into 20 plots, each of approximately 50 m^2. The plots were arranged in randomized block with four replicates for each treatment, and another four replicates as control. The plots were sprayed with different tested agents. Control plots were sprayed with water using a knapsack sprayer.

Spraying in the two successive years (2002 and 2003) was carried out on August 15th. One spray was conducted during each year. To evaluate the efficacy of insecticides tested against whitefly stages, the number of adults and immature stages (nymphs and eggs) were counted at pre-treatment and 1, 2 and 3-week after post-treatment. Each sample consists of 30 cotton leaves taken randomly for each plot. The sampled leaves were collected in paper bags and transferred to the laboratory for careful examination. Eggs and nymphs of whitefly were counted under a stereomicroscope. Both surfaces of the leaf were inspected.

For counting the adult of *B. tabaci*, counting was done in the field by a hand lens for counting the adult stage of whitefly. Both surfaces of the leaf were inspected. To avoid escape adults on leaves were counted early in the morning.

Each leaf was stored in well-ventilated emergence glass tubes and monitored daily for parasitoid emergence and rate of parasitism was determined.

The parasitized larva becomes swollen, and the puparium becomes brownish and smaller than the non-parasitized one. Parasite female may oviposit on any of the three instar nymphs and on the pupa of the whitefly. However, the second instar nymph is preferred for oviposition. No successful parasitism occurs if eggs are deposited on 1st instar nymph or on pupae (Tawfik *et al.*, 1978-1979).

The percent reduction of infestation and the rate of parasitism were calculated according to the equation of (Henderson and Tilton 1955). The data was subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test at 0.05 level, using SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

The average pre-spraying counts of adults, nymphs and eggs of *B. tabaci* were 26.4-28.6, 90.3-96.4 and 98.2-140.6/leaf, respectively and the average numbers of the mature and immature parasitoides were 4.1-5.8 and 11.2-14.3/leaf,respectively (Table 1).

Results in Table (1) indicated that in first year (2002) Biofly gave moderate effect against adults, nymphs and eggs of *B. tabaci*, they gave 67.9%, 68.6% and 62.9% reduction, respectively after 3 weeks. Also, it gave medium toxicity (36.5% and 51.1% toxicity against mature and immature stages, respectively after 3-week) on the parasitoids (*Cales* sp., *Encarsia formosa* Gahan, *E. inaron* (Walker), *E. lutea* (Masi), *E. mineoi* Viggiani, *E. sophia* (Timberlake), *Eretmocerus eremicus* Rose and Zolnerowich and *Er. mundus* Mercet.).

Also, results in Table (2) showed that in second year (2003) Biofly also gave medium effect against adults, nymphs and eggs of *B. tabaci*, they gave 70.7%, 70.9% and 63.9% reduction, respectively after 3 weeks. Also, it gave medium toxicity against mature and immature stages of the parasitoids (41.4% and 53.0%, respectively after 3-week). Data in the two seasons show that the percent reduction of *B. tabaci* decreased from 1-week, 2-week and 3-week after application with Biofly and also toxicity percent on parasitoids changed significantly.

Beauveria bassinana fungal pathogens infect insects with contact and do not need to be consumed by their host to cause infection. Once the fungus has killed its host, it grows back out through the softer portions of the cuticle, covering the insect with a layer of white mold which produces millions of new infective spores that are released to the environment (Groden, 1999).

TABLE (I)

Effect of tested agents on *Bemisia tabaci* /leaf of cotton plants during 2002 season.

Treatment	Rate of applic./L.	Pre-spraying count					Post-spraying count after indicated period														
							1-week					2-week					3-week				
		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite	
		A	N	E	M	I	A	N	E	M	I	A	N	E	M	I	A	N	E	M	I
Biofly	1.5 ml	26.4	81.5	122.1	4.5	11.2	12.1	25.3	37.1	3.2	5.1	22.1	41.4	55.9	4.6	5.5	28.5	60.1	115.1	5.8	6.5
Buprofezin	1.5 ml	27.1	90.3	110.8	4.1	14.3	43.2	28.2	148.1	4.6	9.2	66.3	23.5	180.1	4.5	9.1	80.9	10.2	245.1	5.8	11.2
NeemAzal	1.5 ml	26.9	95.7	98.2	5.8	11.8	30.2	58.6	49.0	6.7	6.2	48.2	65.9	51.2	7.9	7.8	59.2	62.3	60.1	10.1	9.8
Super Misrona	20 ml	28.6	96.4	124.6	5.8	14.2	28.3	31.0	10.2	5.6	5.6	50.2	45.2	20.2	7.1	6.1	65.4	55.9	23.5	8.9	7.4
Control	-	27.4	97.2	126.3	6.5	13.9	46.1	163.2	213.7	9.4	16.2	68.6	198.1	251.5	11.2	15.3	82.1	228.3	321.5	13.2	16.5

Treatment	Rate of applic./L.	% reduction after indicated period														
		1-week					2-week					3-week				
		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite	
		A	N	E	M	I	A	N	E	M	I	A	N	E	M	I
Biofly	1.5 ml	75.7	81.5	82.0	50.8	60.9	70.2	75.1	77.0	40.6	55.4	67.9	68.6	62.9	36.5	51.1
Buprofezin	1.5 ml	15.6	81.4	21.0	22.4	44.8	13.0	87.2	18.4	36.3	42.2	11.3	95.2	13.1	30.3	34.0
NeemAzal	1.5 ml	40.6	63.5	70.5	20.1	54.9	36.3	66.5	73.8	20.9	39.9	35.6	72.3	75.9	14.3	30.0
Super Misrona	20 ml	47.6	80.8	95.1	33.2	67.3	37.6	77.0	91.8	28.9	61.0	32.0	75.3	92.6	24.4	56.1
F value P<0.05												21.21	4.11	11.63	2.27	21.88
LSD =												17.97	12.95	32.71	17.44	8.17

A = Adult N = Nymphs E= Eggs M= Matures I= Immatures

TABLE (II)

Effect of tested agents on *Bemisia tabaci* /leaf of cotton plants during 2003 season.

Treatment	Rate of applic. /L.	Pre-spraying count					Post-spraying count after indicated period													
							1-week					2-week					3-week				
		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite	
		A	N	E	M	I	A	N	E	M	I	A	N	E	M	I	A	N	E	M	I
Biofly	1.5 ml	28.9	102.7	145.1	6.4	13.7	9.9	27.5	28.1	4.8	5.6	17.8	48.1	68.2	6.5	8.2	25.4	89.2	140.6	8.8	10.3
Buprofezin	1.5 ml	31.7	99.6	155.3	5.9	12.2	38.1	26.1	180.2	7.1	8.1	57.2	22.5	240.1	6.9	9.4	80.8	11.2	300.6	9.2	12.3
NeemAzal	1.5 ml	29.6	101.1	136.4	7.1	12.8	24.1	54.2	58.2	8.6	6.8	38.2	72.3	69.1	10.3	10.6	54.1	74.1	88.5	13.3	13.6
Super Misrona	20 ml	30.4	110.2	141.2	6.8	13.1	22.1	48.3	15.1	7.2	5.1	39.2	49.3	20.6	9.1	6.7	60.1	75.2	20.2	11.8	8.5
Control	-	31.1	100.7	141.7	6.9	13.5	45.1	156.1	213.1	10.7	16.1	66.7	221.2	298.1	13.1	19.2	93.2	298.1	381.1	16.2	21.6

Treatment	Rate of applic. /L.	% reduction after indicated period														
		1-week					2-week					3-week				
		Whitefly			Parasite		Whitefly			Parasite		Whitefly			Parasite	
		A	N	E	M	I	A	N	E	M	I	A	N	E	M	I
Biofly	1.5 ml	76.3	82.7	87.1	51.6	65.7	71.3	78.7	77.7	46.5	57.9	70.7	70.9	63.9	41.4	53.0
Buprofezin	1.5 ml	17.1	83.1	22.8	22.4	44.3	15.9	89.8	26.5	38.4	45.8	14.9	96.2	28.0	33.6	36.9
NeemAzal	1.5 ml	43.9	65.4	71.6	21.9	55.5	39.8	67.4	75.9	23.6	41.8	39.0	75.2	75.9	20.2	33.6
Super Misrona	20 ml	49.9	71.7	92.9	31.7	67.4	39.9	79.6	93.1	29.5	64.0	34.0	76.9	94.7	26.1	59.4
F value P<0.05												188.59	6.25	52.75	11.12	22.60
LSD =												5.86	11.74	13.97	10.72	7.80

A = Adult N = Nymphs E= Eggs M= Matures I= Immatures

The present results were in harmony with that of Issa *et. al.* (1995) who found that, the use of Naturalis (a *Beauveria bassiana* formulation) affected significantly the population of all stages of the whitefly on tomato plants. Also El-Bessomy *et al.* (1997) found that Biofly fungal compound can be used successfully to reduce the three whitefly stages (eggs, immature stages and adults) without environmental pollution.

Results in Table (1) for year 2002 indicated that buprofezin gave low toxicity against adults of *B. tabaci*, it gave only 11.3% reduction, while, it was highly effective against nymphs average reduction (95.2%). Buprofezin also gave low reduction against eggs but it was very toxic to crawlers. The direct effect on eggs was only 13.1%. Buprofezin gave low toxicity against mature and immature stages of parasitoids (30.3% and 34.0% reduction, respectively).

Results in Table (2) in year 2003 indicated that buprofezin had also low toxicity against adults of *B. tabaci*, it gave only 14.9% reduction, while it gave high mortality in nymphs (96.2% reduction). The direct effect on eggs was only 28.0% reduction. Buprofezin gave low toxicity against mature and immature stages of parasitoids (33.6% and 36.9% reduction, respectively). Data of the two seasons show that the percent reduction of *B. tabaci* decreased from 1-week, 2-week and 3-week and also toxicity percent on parasitoids changed significantly between 1-week, 2-week and 3-week after application with buprofezin.

These results are in harmony with those obtained by Mangound (2002) who mentioned that buprofezin had low toxicity against adults of the pomegranate whitefly, *Siphoninus phillyreae*, while, it gave good reduction against nymphs. Buprofezin also did not kill eggs immediately but severely affected the crawlers. Buprofezin gave low toxicity against mature stages of the parasitoids *Encarsia inaron*.

Results in Table (1) show that NeemAzal (Azadirachtin) had low effect against adults (35.6% reduction), while it had medium effect against, nymphs and eggs of *B. tabaci* (72.3% and 75.9% reduction, respectively) after 3-weeks. Also, it gave low toxicity (14.3% and 30.0% reduction) against mature and immature stages of parasitoids after 3-week.

Results in Table (2) show that NeemAzal gave low effect against adults of *B. tabaci* in the second season, (39.0% reduction), while, it gave medium reduction against nymphs and eggs of *B. tabaci* in the second season after 3 weeks (75.2 and 75.9% reduction, respectively). Also, it was of low toxicity against mature and

immature stages of parasitoids after 3-week (20.2% and 33.6% reduction, respectively). Data of the two seasons show that the percent reduction of *B. tabaci* decreased from 1-week, 2-week and 3-week and also its toxicity percent on parasitoids changed significantly between 1-week, 2-week and 3-week after application with NeemAzal.

Results in Table (1) for year 2002 also show that Misrona oil was toxic to whitefly adults only when wet. It gave 32.0% reduction against adults, while it had moderate effect against nymphs (75.3%) and high effect against eggs (92.6%) after 3-weeks. On the other hand, oil had low toxicity against mature and immature stages after 3-week against mature and immature stages of parasitoids after the same period (24.4% and 56.1% reduction, respectively).

Results of 2003 in Table (2) also show that oil was significantly superior than Biofly and NeemAzal. It gave 34.0% reduction against adults, while it had moderate and high effect against nymphs and eggs (76.9% and 94.7% reduction, respectively) after 3-weeks. While, it was of low toxicity against mature stages after 3-week (26.1% reduction) and of medium toxicity against immature stages of parasitoids after 3-week (59.4% reduction).

Data of both seasons show that the percent reduction of *B. tabaci* decreased from 1-week, 2-week and 3-week and also toxicity percent on parasitoids changed significantly between 1-week, 2-week and 3-week after oil application.

Mineral oil was the most effective on eggs. When crawlers were treated, they were prevented from developing. Nymphs were not able to moult and grow normally. Mineral oil interferes with both respiration and membrane function and disrupts feeding activities. For oil to be effective, it must coat the pest and its eggs, thus complete coverage is essential for optimum results (Sieburth *et al.*, 1998).

Statistical analysis in (Tables 1) for year 2002 show significant differences between the four tested agents on adults of whitefly (F = 21.21, L.S.D. 0.05= 17.97); and non-significant differences on nymphs of whitefly (F= 4.11, L.S.D.0.05 = 12.95). While significant differences occurred between them on eggs (F= 11.63, L.S.D.0.05 = 32.71); and proved to be non-significant on mature stages of parasitoids (F= 2.27, L.S.D.0.05 = 17.44), and significant on immature stages of parasitoids (F= 21.88, L.S.D.0.05 = 8.17).

Statistical analysis in (Table 2) obtained for year 2003 indicate highly significant differences between the tested materials on adults of whitefly (F = 188.59, L.S.D. 0.05= 5.86), and significant differences between nymphs (F= 6.25,

L.S.D.0.05 = 11.74). While highly significant differences between were among them on eggs of whitefly (F= 52.75, L.S.D.0.05 = 13.97); and significant differences on mature stages of parasitoids (F= 11.12, L.S.D.0.05 = 10.72) and on immature stages of parasitoids (F= 22.600, L.S.D.0.05 = 7.80).

It could be concluded that the natural control agents (Biofly and NeemAzal) gave medium reduction against *B. tabaci* and also, they were less toxic against the parasitoids. These natural control agents can be used against this whitefly. Also, we can use these compounds in IPM programs by spray these compounds to reduce the pest population and then release the mass reared parasitoids to complete reduction of insect population.

Misrona oil is very effective against eggs and nymphs of *B. tabaci*, and had medium or low toxicity against parasitoids. This oil can be also useful in IPM programs.

Buprofezin is very effect against nymphs but gave low effect against adults and eggs. On the other hand, it was almost safe to parasitoids and we can recommend its use in IPM programmers.

SUMMARY

Four materials (Biofly, Buprofezin, NeemAzal and Super Misrona oil) were tested against the silver leaf whitefly, *Bemisia tabaci* on cotton plants during 2002 and 2003 seasons. Biofly (*Beauveria bassinana*) gave moderate effect against adults, nymphs and eggs of *B. tabaci* and medium toxicity against mature and immature stages after 3-week on the parasitoids *Cales* sp., *Encarsia formosa*, *E. inaron*, *E. lutea*, *E. mineoi*, *E. sophia*, *Eretmocerus eremicus* and *Er. mundus*. Buprofezin was of low toxicity against pest adults, and was highly effective against nymphs. Its effect on eggs was only 13.1%. Buprofezin showed low toxicity against mature and immature stages of parasitoids. NeemAzal had low effect against pest adults and medium effect against nymphs and eggs. Also, it was of low toxicity against mature and immature stages after 3-week on parasitoids. Misrona oil was toxic to adults of *B. tabaci* only when wet, and reduced third the population, while it had moderate effect against nymphs and reduced little more 70%. It was highly effective on eggs and killed 92.6% and 94.7% in both years, respectively. Oil was of low toxicity against mature stages of parasitoids, while, it showed medium toxicity against immature stages.

REFERNCES

ABD-RABOU, S. (1997): Hosts, distribution and vernacular names of whiteflies (Homoptera: Aleyrodidae) in Egypt. *(Annals of Agric. Sci., Moshtohor, 35: 1029-1048).*

ABD-RABOU, S.; N. HUSSEIN and A. A. H. MANGOUD (2002): Parasitoids attacking *Bemisia tabaci* Biotype "B" (Homoptera:Aleyrodidae) in Egypt. *(2nd international Conference, Plant Protection Research Institute, Cairo, Egypt, 21-24 December, 2002, 301-304).*

BROWN, J.K., D. R. FROHLICH and R. C. ROSELL (1995): The sweetpotato or silverleaf whiteflies: biotype *Bemisia tabaci* or a species complex. *(Annu. Rev. Entomol. 40: 511-534).*

COCK, M. J. W. (1986): *Bemisia tabaci,* A Literature Survey on the Cotton Whitefly with an Annotated Bibliography. *(Food and Agriculture Organization of the U.N., C.A.B. Int. Inst. Biol. Cont. 121 pages).*

EL-BESSOMY, M.A.E., H.I. H., EL-KHAWALKA, H.I.H. OMAR and H.M. EL-MAGRABY (1997): Effect of the fungal insecticide (Biofly) compared with chemical insecticides in controlling different stages of whitefly *Bemisia tabaci* (Genn.) and its relates virus. *(Egypt J. Agric. Res., 75 (4): 915-919).*

GREATHEAD, A. H. (1986): Host Plants. Chapter 3, pp. 17-25. *(In: Bemisia tabaci – a literature survey on the cotton whitefly with an annotated bibliography (Ed. M. J. W. Cock). CAB International Institute of Biological Control, Ascot, UK. 121 pp).*

GRODEN, E. (1999): Using *Beauveria bassiana* for insect management. *(http:// www.hort.uconn.edu/ipm/general/htms/bassiana.htm).*

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

ISSA, Y. H., I. H. OMAR, M.H. M. EL-KHAWALKA, H.M. EL-MAGRABY and M. A. E. EL-BESSOMY (1995): Reduction in the population of different stages of whitefly *Bemisia tabaci* (Genn.) on tomato plants using two formulation of fungal compound (Naturalis). *(Egypt J. Appl. Sci., 10 (8): 599-603).*

MANGOUD, A. A. H. (2002): Evaluation of present pest management practices for the pomegranate whitefly, *Siphoninus phillyreae* in Upper Egypt. *(Egypt, J. Agric. Res., 80 (3): 1143-1155).*

MOUND, L.A. and S. H. HALSEY (1978): *Bemisia tabaci* (Gennadius). Pp. 118-124. In Whitefly of the World, A Systematic Catalog of the Aleyrodidae): a preliminary guide to identification. *(Bulll. Entomol. Res. 82:375-392).*

SAS INSTITUTE (1988): SAS/STAT User's Guide, Ver. 6.03. *(SAS Institute Inc., Cary, North Carolina).*

SIEBURTH, P. L.; W. J. SCHOEDER and R. T. MAYER (1998): Effect of oil and oil-surfactant combinations on silver leaf whitefly nymphs (Homoptera: Aleyrodidae) on collard. *(Flora. Entomol., 81: 446-452).*

TAWFIK, M.F. S.; K.T. AWADALLAH, M.HAFEZ and A. SARHAN (1978-1979): Biology of the Aphelinid parasite *Eretmocerus mundus* Mercet. *(Bull. Soc. ent., 62, 33-48).*