Islas de Tenerife

BEMISIA TABACI GENNADIUS (HOMOPTERA: ALEYRODIDAE) AND ITS NATURAL, ENEMIES: POSSIBILITIES FOR INTEGRATED PEST MANAGEMENT 1996

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Abstract

Bemisia tabaci is an introduced pest of tropical origin. It is generally wide-spread from the Palearctics to the South American continent. In Canary Islands it was found first on the island of Lanzarote, in 1988. In Hungary it occurred on tobacco, in 1990. It causes damage to protected crops, ornamentals and vegetables as well. The ability to transmit viruses of gemini group causing yellowing and leaf roll, emphasiscs its economical importance. Parasitoids *Eretmocerus mundus*, *Encarsia formosa*, *Encarsia hispida* and *Encarsia pergandiella* play the most important role in control of *Bemisia tabaci* in Canary Islands. Among predators *Cyrtopeltis tenuis* deserves the attention. But beside naturally occurring or artificially introduced beneficial organisms it is also necessary to use agents controlling the transmission of viruses. Toxicity of preparates containing paraffin oil, fatty acid copper salts combined with vaseline oil, fatty acid potassium salts and potassium polysulphide active ingredients was studied in laboratory and greenhouse conditions on *Encarsia hispida* and *Cyrtopeltis tenuis* species. The tested pesticides were moderately toxic to *Encarsia* pupa, while for predatory bugs they were not dangerous.

Introduction

The tobacco whiiefly *Bemisia tabaci* is a pest of tropical origin, described by Gennadius fiom tobacco in 1889. The pest is widely spread in Palearctics, Nearctics, Neotropics, fiom Middle-East to Australia. It occurs fiom the Mediterranean regions further in the territories of the moderate climate belt. In Canary Islands it was first found on batatas in 1988, on the island of Lanzarote (Camero and Perez, 1989). It occurs either in open-air or in greenhouse vegetables and ornamentals, and multiplies on cultivated plants as well as on wild vegetation (Hernandez-Suarezet al., 1995).

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In Europe the pest appeared at the end of 80's. In Hungary it was first found on tobacco (Hatala-Zsellér and Szabó, 1991). Kozár and co-authors (1991) demonstrated its distribution and range of host plants in the frame of a country-wide survey.

Bemisia tabaci has been reported as a polyphagous pest; it was described from 325 plant species of 62 botanical families. The damage caused is economically important. In Canarian Islands the insect infests outdoors ornamentals as *Hibiscus rosa chinensis* and *Euphorbia pulcherrima*, greenhouse crops as tomato, cucumber and paprika, and several pot omamentals like *Fuchsia, Primula, Salvia* species. The range of plants prooved as hosts of *Bemisia tabaci* is shown in Table 1.

Ability to transfer plant viruses places this insect into the focus of attention. *Bemisia* is a general virus vector in Africa and in the Mediterraneum. It contributes to spreading of several important virus diseases: cotton leaf curl virus, cassava African mosaic gemini virus, tobacco leaf curl virus, bean golden mosaic gemini virus, tomato yellow leaf curl gemini virus, cucumber vein mosaic gemini virus. In Hungary tobacco whitefly played substantial role in the establishment of several virus diseases introduced from the south.

In the control of tobacco whitefly populations introduction of its natural enemies provides reasonable solution, serving in the same time the aims of environment protection.

Polaszek et al. (1992) has reported 19 *Encarsia* species paratising *Bemisia*. In France *E. hispida, E. pergandiella, E. fonnosa, E. tricolor* and *Eretmocerus mundus* take part in the control of *Bemisia tabaci* According to Braham (1994), *Eretmocerus mundus* is more likely a potential biological factor oposite to *Encarsia hispida*. In Italy large wild populations of *Eretmocerus mundus* (Benuzzi, 1995) have been found.

B. tabaci often occurs in mixed populations together with greenhouse whitefly (*Trialeurodes vaporariorum*), therefore a lot of efforts were taken for the selection of effective *Encarsia formosa* strains. Polaszek et al. (1992) emphasised that tobacco whitefly is not an ideal host for *E.formosa*. Species which are genetically closed, could have bigger role in the control. This is why study of the occurrence of natural zoophages is important beside examination of the spread of the pest. Complex application of parasitoid species is the right strategy of the control of *B. tabaci*.

Delphastus pusilus (Coleoptera: Coccinellidae) and *Macrolophus caliginosus* (Heteroptera: Miridae) predators as well as entomopathogen fungi (*Verticillium, Aschersonia, Paecilomyces* and *Beauveria* spp.) could be used to strenghten the effect of parasitoids (Lindquist, Albert, Ravensberg, Meeks et al., Oetting, compiled by Enkegard, 1995).

In case of lack of natural enemies application of chemical agents still could be necessary. High selectivity is ensured by active ingredients of IGR types: diaphenthyuron, pyriproxiphen, phenoxicarb, buprofezin. Trials are carried out for the introduction of imidacloprid.

In case of large number of whiteflies, insecticides can not prevent spread of viruses because of their selectivity. Introduction of oils and soaps is a possible path for the future (Kajati et al., 1989, Ilovai et al., 1995).

Table 1. Range of hostplants of *Bemisia tabaci* in Canary Islands and Hungary

Host plants	Canary Islands (Hemandez-Suarez et al., 1993)	Hungary (Kozar et al., 1991)
Protected and field crops		
tobacco	+	+
tornato	+	+
swcet pepper	+	+
melon	+	-
batata	+	-
cucumber	+	-
yumpkin	+	-
squash	+	-
lettuce	+	-
courgette	+	-
eggplant	+	+
sunflower	+	-
Ornamentals		
Euphorbia pulcherrima	+	+
Hibiscus rosa-chinensis	+	+
Kosa spp.	+	-
Malva **spp.**	+	-
Chrysanthemum spp.	+	-
Fuchsia **sp.**	-	+
Gerbera **sp.**	-	+
Primula **sp.**	-	+
Salvia **sp.**	-	+
Wild plants and weeds		
Sonchus sp.	+	-
Nicotiana glauca	+	-
Convulvulus canariensis	+	-
Lantana carnara	+	-
Acalypha hispida	+	-
Bauhinia sp.	+	-
Ocimum basilicum	+	-

Materials and methods

In 1994-95 wide survey was carried out in Canary Islands and in Hungary. Distribution of *Bemisia tabaci* and range of its host plants were studied. Natural enemies were identified after laboratory rearing of insects collected from outdoors. In Hungary study of distribution was built on the results received in 1990 (Kozár et al., 1991). Places of earlier occurrence were checked and the state of parasitisation was examined.

Several preparates based on light summer oils, fatty acid potassium salts, fatty acid copper salts and calcium polysulphide active ingredients were tested in laboratory on mixed population of *Bemisia tabaci* reared on *Hibiscus rusa-chinensis* plants (Table 2). Parallelly with this, the side-effect of preparates was checked on nymphs infested by *Encarsia hispida* by submerging the leaves. On the basis of number of died insects in the replicates changing in each test series, mortality %-s were calculated according to development stages. In case of parasitised nymphs modified efficacy was calculated using the Schneider-Orelli formula, in comparison with the water control.

Contact toxicity dried spray-residues on Cyrtopeltis tenuis nymphs and adults was studied on tomato leaves. From the mortality results received on the 3rd and 6th days, a modified efficacy was also calculated. Population growth limiting effect of studied active ingredients was determined every two weeks after foliage spraying of greenhouse tomato crop.

Table 2. Characteristics of pesticides applied in laboratory and open-field trials at I.C.I.A., La Laguna, Tenerife, 1995.

Active ingredient, %	Name of formulated product	Manufacturer	Applied concentration, %
Paraffin oil, 83 %	Vektafid A	Rogator Ltd.,	1,0
Fatty acid copper salts + vaseline oil, 6+79 %	Vektafid R	Rogator Ltd.	1,0
Fatty acid potassium salt, 15 %	Bio-Sect	Florin Co.	2,0
Calcium polysulphide 20 %	Tiosol	Tiosol Ltd.	1,0

Results

In the host-community of *Bemisia tabaci* 9 predators and parasitoids from 4 families were foud. More than half of them occured in open-field crops. Results of faunistical surveys are summarized in Table 3. The order of host plant species of tobacco whitefly was determined as the following: *Euphorbia pulcherrima, Solanum lycopersicum, Nicotiana glauca, Nicotiana tabacina, Hibiscus rosa-chinensis.* Frequency of zoophages species varied in between 3-6 individuals per plant (Tables 4).

Table 3. Natural enemies of *Bemisia tabaci*, their occurence and relation to host plants, I.C.I.A., La Laguna, Tenerife, 1994-95

Natural enemies of *Bemisia tabaci*	Occurence, %	Number of host plant species	
		in fields	in greenhouse
1. Coleoptera: Coccinellidae			
Delphastus catalinia	6,8	1	-
2. Diptera: Drosophillidae			
Acletoxenus formosus	6,8	2	-
3. Hemiptera: Miridae			
Cyrtopeltis tenuis	22,7	4	2
Macrolophus caliginosus	9,0	2	1
4. Hymenoptera: Aphelinidae			
Encarsia formosa	15,9	2	1
Encarsia transvena	4,5	1	1
Encarsia pergandiella	4,5	1	1
Encarsia hispida	4,5	1	1
Eretmocerus mundus	25,0	3	2

Table 4. Host plants of *Bemisia tabaci* and their relationship to natural enemies, I.C.I.A., La Laguna Tenerife, 1994-95.

Host plants	Occurence of natural enemies, %	Number of natural enemy species
Tobacco	9,0	4
Tomato	22,7	3
Pumpkin	2,2	1
Melon	2,2	1
Batata	4,5	1
Paniana	2,2	1
Euphorbia pulcherrima	22,7	3
Hibiscus rosa-chinensis	9,0	4
Nicotiana glauca	20,6	6
Sonchus spp.	2,2	1
Ageratina adenoflora	2,2	1

Hungarian surveys showed that *Bemisia tabaci* after a period of comparatively wide appearance became permanent on some places (Figure 1). There were places, where after the eradication the infestation stopped, then reappeared again. The number of host plants was 10. Parasitisation was found on *Hibiscus rosa-chinensis, Nicotiana* sp., *Gerbera* sp. and *Euphorbia pulcherrima*; in all checked places *Encarsia formosa* was found. Occasional occurence of *Eretmocerus mundus* was also reported (Reider-Saly, pers. comm).

The natural based pesticides were prooved to be effective in killing of all developmentai stages of *Bemisia tabaci* (Figure 2). In the same time they show very low toxicity on *Encarsia hispida* and *Cyrtopeltis tenuis* (Table 5, 6).

Table 5. Effect of natural pesticides on *Encarsia hispida* pupae in laboratory test, I.C.I.A., La Laguna, Tenerife, *1995.*

Treatments	Mortality, %			Risk category
	Series 1.	Series 2.	Series 3.	I.O.B.C.
Vektafid A (1 %)	66,6	-5,0	-5,8	1-2
Vektafid R (1 %)	-12,8	10,0	9,5	1
Biosect (2 %)	20,7	40,0	43,6	1-2
Tiosol (1 %)	-13,8	-5,0	34,2	1

Table 6. Effect of natural pesticides on *Cyrtopeltis tenuis* in laboratory test (average of 4 replicates) I.C.I. A., La Laguna, Tenerife *1995*

Treatments	Mortality, %*				Categories of toxicity by IOBC**		
	Nymphs		Adults				
	1	2	1	2	a	b	c
Vektafid A	0.0	0.0	7.5	15.9	1	1	1
Vektafid R	2.5	2.7	10.0	9.6	1	1	1
Biosect	0.0	2.7	15.0	16.0	1	1	1
Tiosol	5.1	0.0	2.5	24.9	1	1	1

*Mortality of nymphs/adults: 1- three days after treatment, 2 - six days after treatment

*+a-mortality of nymphs < 30%; b - mortality of adults < 30%; c - persistence, 100%mort. > 5 days

In the case of effect on growth of predatory bug population changes in number of individuals were observed after sprayings but the presence of predators could be considered permanent (Table 7).

Table 7.Changes in population of mirid predators on tomato plants treated by different preparates, Arico ,Tenerife, 1995

Treatments	Number of mirid bug individuals per leaf		
	before spraying	1 week after spraying	2 weeks after spraying
Tiosol (1 %)	0	6	1
Vektafid A (1 %)	3	0	1
Vektafid R (1 %)	1	5	3
Biosect (2 %)	1	0	1
Untreated	1,25	3	8

Conclusions

Biotop studies showed that in spite of the poor plant coverage *Bemisia tabaci* has much more host plants on Canary Islands than in Hungary. It is because of subtropical climate, which provides more favourable conditions for development and possibility for overwintering outdoors.

Most of natural enemies of the pest were reported from *Nicotiana* and *Hibiscus* plants. This means that these plants couid be considered as good conserving or collecting species.

Cyrtopeltis tenuis predatory bug,and *Eretmocerus mundus* and *Encarsia formosa* parasitoids were dominating among natural enemies of *B. tabaci.* In case of *Eretmocerus mundus* it was proved that it has closer relationship to *B. tabaci*, than *E. formosa.*

Faunistical studies in Hungary have proved that natural spreading of *B. tabaci* is not possible, it can be spread by the heip of sales of pot plants. The fact, that at all new places where it occurred, it was found on pot plants, also proves that. According to control surveys, at some places tobacco whitefly became a permanent pest on protected crops. In greenhouse circumstancesit is able to get from one crop to another and to continue muitiplying.

In Hungary no natural enemies were found. Those few cases of parasitisation by *Encarsia formosa* also shows that the purpose of limitation of spreading could be realised only by the help of artificial introduction. Potentially introduction of both predatory bugs and parasitoid wasps could provide a solution for the control but it would be necessary to widen the biocenological studies, including greenhouses, too.

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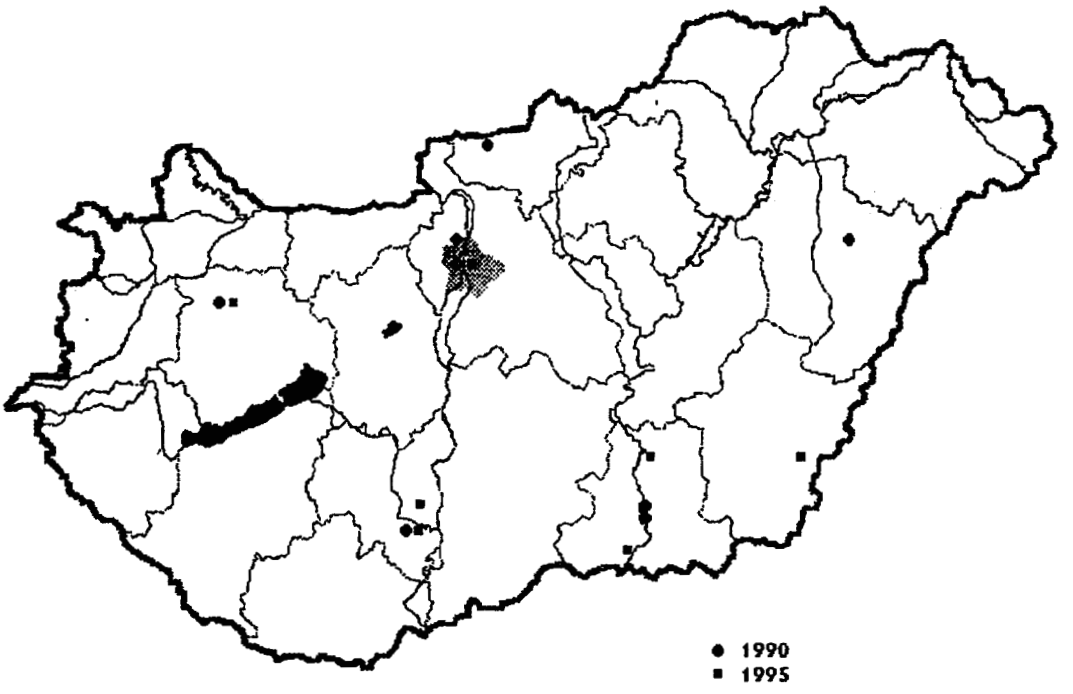
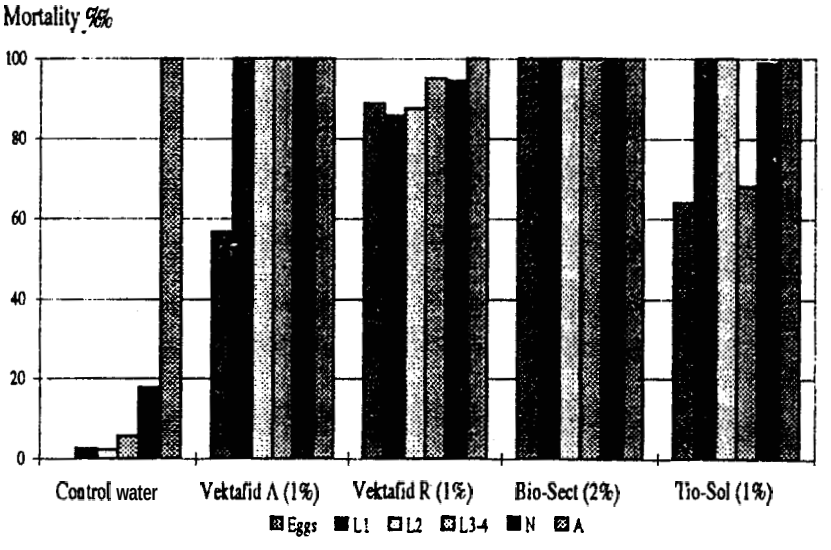


Figur 1. Distribution of **Bemisia tabaci in Hungary 1990 (Kozar et al 1991) and spread in 1995 in greenhouses.**



Figur 2. Effect of pesticides on Bemisia tabaci reared on Hibiscus, Tenerife, 1995.