N O T E

Incidence of Parasitism of *Bemisia tabaci* (Homoptera: Aleyrodidae) in Three Vegetable Crops After Application of Biorational Insecticides[1]

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Parasitoids, predators, and biorational insecticides are management tools which may offer relief from insect attacks in an environmental friendly manner. Several species of parasitoids have been considered as biological control candidates to help manage whiteflies of the *Bemisia tabaci* (Gennadius) complex in crops (Goolsby et al. 1998, Biol. Control 12: 127-135). This includes *Encarsia sophia* (Girault and Dodd), a species which is considered to have been introduced into the New World, but it is found throughout the Old World (Heraty and Polaszek 2000, J. Hymen. Res. 1: 142-169). *Eretmocerus mundus* Mercet is another Old World species which may be useful for whitefly management. It is widespread in fields in different climatic regions of Egypt (Abd-Rabou 1998a, Boll. Laboratory. Entomol. Ag. Filippo Silvestri 54: 11-16; 1998b, Acta Phytopathol. et Entomol. Hungarica 33: 193-215).

Insecticides may affect the mortality of nontarget organisms (Simmons and Jackson 2000, J. Entomol. Sci. 35: 1-8.), or influence their behavior (Haynes 1988, Annu. Rev. Entomol. 33: 149-168). The objective of this study was to determine the relative compatibility of some biorational insecticides on parasitism of *B. tabaci* in selected vegetable crops.

A field test was initiated in 2003 in Qalyubiya governorate, Egypt, and included foliar spray applications of six biorational insecticides (Table 1). The experiment was conducted in plots of cabbage (*Brassica oleracea* var. *capitata* L.), cucumber (*Cucumis sativus* L.), and eggplant (*Solanum melongena* L.). *En. sophia* adults from a laboratory colony were released at this field site 2 yrs before this experiment began. The colony originated in 1998 after adult *En. sophia* were collected from *B. tabaci*-

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Table 1. Biorational insecticides and their rates used in field plots of cabbage, cucumber, and eggplant parasitism tests in 2003

Insecticide	Rate (ml/liter)	Description of formulation
Biofly®	0.5, 1.0, 1.5	*Beauveria bassiana**
Buprofezin	0.5, 0.75, 1.0	Insect growth regulator
Jojoba oil	5, 10, 15	Oil from *Simmondsia chinensis***
KZ® oil	5, 10, 15	95% paraffin oil
M-Pede®	1.5, 2.0, 2.5	Insecticidal soap
NEEMAZAL®	2.0, 2.5, 3.0	1% Azidrachtrin (neem extract)

* Taxonomic authority: (Balsamo) Vuillemin.
** Taxonomic authority: (Link) C. Schneid.

infested cotton (*Gossypium hirsutum* L.) plants in a field in Ethiopia. The wasps were then shipped to the Plant Protection Research Institute quarantine facility in Dokki, Egypt. There, *En. sophia* was reared in the laboratory on *B. tabaci*-infested *Lantana camara* L. *Er. mundus* observed in the experiment were from feral populations. Feral populations of *B. tabaci*, B-biotype, were allowed to infest the crops. The experiment was conducted in October when a relatively high rate of parasitism on *B. tabaci* was expected.

Three concentrations of each insecticide were applied to each of the three crops. Two adjacent 35-m × 30-m plots were established for each insecticide for a given crop, with one plot for the insecticide treatment and the other for the untreated check comparison. Both the treated and untreated plots were divided into three sections. The insecticides were sprayed on the treated plots at the rates shown in Table 1. All concentrations were in ml per liter of water, except no application was made for the untreated check. The solutions were applied with a knapsack sprayer at a rate of 80 L/ha.

Whiteflies and their parasitoids were counted in all plots just prior to the application and at 1, 2, and 3 wks post application. Samples of 30 whitefly-infested leaves were randomly selected and removed from plants from the middle section of each plot and transported to the laboratory where they were placed individually in 0.5 L cardboard containers with ventilated tops and maintained at 25-29°C and 65 ± 5% RH for 2 wks. All adults of *B. tabaci* and their parasitoids on the bottom of the containers were then collected and identified by comparing them with voucher specimens. Second, third, and fourth instars of *B. tabaci* removed from the leaf samples were dissected to identify and enumerate prepupal and pupal parasitoids. Voucher specimens of *En. sophia* were deposited in the insect collection unit of the Plant Protection Research Institute, Dokki, Egypt.

The number of whiteflies from the leaf samples ranged from 712-2350 for cabbage, 388-1004 for cucumber, and 510-1430 for eggplant. Only two species of whitefly parasitoids, *En. sophia* and *Er. mundus*, were found in the leaf samples. The proportion of parasitism tended to be higher (≈ 60%) by *E. sophia* than by *E. mundus* in each crop. Among crops, percentage of parasitism was in the rank order of eggplant > cabbage > cucumber. In a field study with 16 vegetable and row crops,

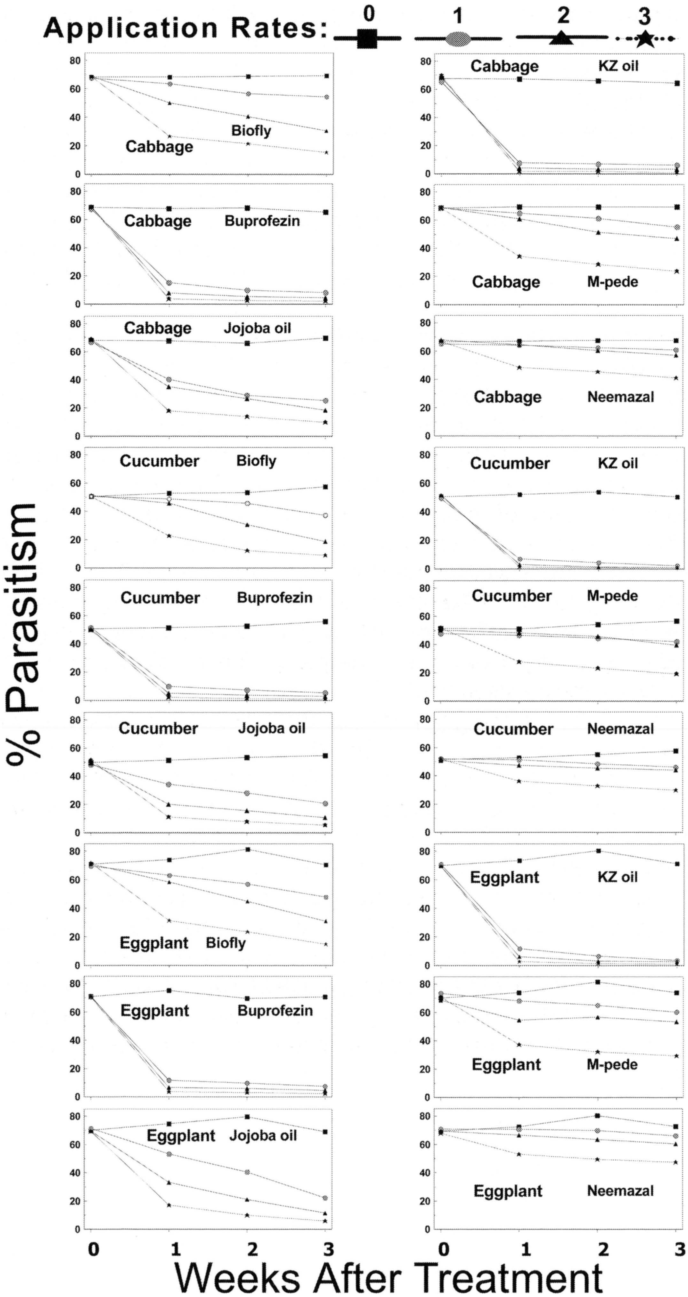

Fig. 1. Parasitism on *B. tabaci* after treatments with 3 rates of foliar applications of each of 6 biorational insecticides in 3 crops in field plots during 2003. Rate 0 = untreated check. Rates 1, 2, and 3 = 0.5, 1.0, and 1.5 ml for Biofly; 0.5, 0.75, and 1.0 ml for buprofezin; 5, 10, and 15 ml for jojoba oil and KZ oil each; 1.5, 2.0, and 2.5 ml for M-Pede; and 2.0, 2.5, and 3.0 ml for Neemazal, respectively.

incidence of parasitism on *B. tabaci* was high in two *Brassica* crops and eggplant, but was low in cucumber (Simmons et al. 2002, Environ. Entomol. 31: 1030-1036). In the current study, there was high fidelity among the three crops for the response of parasitoids to the different treatments (Fig. 1). The data suggest that the insecticides may generally have had a negative impact on the incidence of parasitism because parasitism in the untreated checks remained relatively high over time (Fig. 1). For several of the biorationals, increased dosages appeared to have depressed the rate of parasitism. However, regardless of the application rate of KZ oil, parasitism plummeted to less than 15% after the treatment and remained low throughout the experiment (Fig. 1). A similar observation was seen in the plots treated with buprofezin (Fig. 1).

Among the insecticides, parasitism tended to be high for plants treated with either Neemazal or M-Pede (Fig. 1). In laboratory and greenhouse experiments, M-Pede caused relatively high (about 65%) mortality on adult *Encarsia formosa* Gahan after the residue was 1 h old, but the impact was less after 3 h (Bentz and Neal 1995, J. Econ. Entomol. 88: 1611-1615). Stansly and Liu (1997, Bull. Entomol. Res. 87: 525-531) demonstrated that M-Pede and some other biorational and synthetic insecticides cause variable mortality of immature parasitoids with a concomitant reduction in parasitism because of the repellency of the insecticides to the wasps. However, they concluded that M-Pede has little adverse toxic effect on adult *En. pergandiella* Howard. In a field study with some vegetable crops, foliar applications of chlorpyrifos and imidacloprid reduced populations of whitefly parasitoids (predominately *En. pergandiella* and *En. nigricephal* Dozier), but the parasitoids persisted during the growing season (Simmons and Jackson 2000). Neem used in this test appeared to have been one of the two biorational insecticides tested that were most compatible to parasitism of *B. tabaci* by *En. sophia* and *Er. mundus*. Although the data were consistent across crops tested, because the experimental design limited the power of the test, more data are needed for a better understanding on the impact of these insecticides on parasitism of *B. tabaci*.

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