EVALUATION OF NOVEL LOW TOXIC INSECTICIDES AND ORGANIC INSECTICIDES ON ADULT WHITEFLY, *Bemisia tabaci*

D.I.N. Wanigasooriya*[1], J.P. Marasinghe[2] and W.M.A.U.K.M. Wijesekara[1]
[1]Department of Export Agriculture, Sabaragamuwa University of Sri Lanka, Belihuloya
[2]Division of Entomology, Horticultural Crop Research & Development Institute, Gannoruwa
**Corresponding author (email: inwanigasooriya@gmail.com)*

Introduction

Cucurbitaceae is one of the families with highest species diversity of vegetables which include many crops that are principally grown in the tropics. Cucurbits such as gourds, pumpkin, water melon, cucumber etc. have immense commercial, dietary and medicinal values. Occurrence of virus diseases is a very serious problem of cucurbit cultivation which causes very high yield losses. Cucurbit virus diseases are transmitted by a number of vectors such as aphids, whiteflies, thrips, leaf hoppers and mites. Thus, it has become essential to apply virus vector control strategies in order to acquire a quality and higher yield. Use of insecticides is one such strategy. Whenever insecticides are tested for this purpose, low toxic and less environmental hazardous insecticides are essentially considered.

The Department of Agriculture (DOA), Sri Lanka has introduced an Integrated Pest Management package for the management of virus diseases in cucurbits which is composed of several practices including virus vector control through periodical application thiamethoxam, buprofezin, acetamiprid and abomactin in seven days' intervals. However, DOA continuously receives complaints from farmers stating that the recommended insecticides do not provide effective control of the pests. Since cucurbit virus vectors such as whiteflies, aphids etc. have possibility to develop resistance, it is important to conduct resistance monitoring programs to modify the prevailing recommendations on chemical control. In order to address this problem, it is necessary to check the efficacy of recommended chemicals. Also it is important to study the effectiveness of less toxic novel insecticides as well plant derived chemicals to replace the ineffective ones. The present study was conducted with the objectives of to assess the efficacy of currently recommended and new insecticides on whitefly (*Bemisia tabaci*).

Methodology

The laboratory bioassay was carried out at Division of Entomology, Horticultural Crop Research and Development Institute with whitefly (*B.tabaci*) using a leaf dip method described in Insecticide Resistance Action Committee.

***Treatment Schedule:* Several insecticides were selected based on product availability, product specific pests targeted by manufacturers, results of previous studies, their modes of action and low mammalian toxicity to use in the experiment. The treatments are given inTable 1. Adult *Bemisia tabaci* was used as the test insect.**

Preparation of Treatments: **The treatments and dosages were selected based on the recommendations given by Department of Agriculture and literature based information for the novel insecticides and local preparations. Neem seed water extract and the mixture of vegetable oil and detergent were prepared prior to application of treatments. Since other insecticides used in the study were already formulated, they were diluted to required volumes depending on the stage of the crop.**

Table 1. Formulation, trade name and dilution rate of the test compounds for the bioassay

Treatment Number	Test compound /treatment	Trade name	Dilution rate
1	Vegetable oil + liquid detergent	Flora® Teepol®	60 mL/L 5 mL/L
2	Sulfoxaflor 240g/L SC	-	0.5 mL/L
3	Thiamethoxam 25% WG	Actara®	0.5 g/L
4	Acetamiprid 20% SP	Mospilan®	1 g/L
5	Buprofezin 10% WP	Applaud®	0.6 g/L
6	Neem seed water extract + liquid detergent	- Teepol®	50 g/L 5 mL/L
7	Pymetrozine 50% WG	-	0.05 g/L
8	Liquid detergent	Teepol®	5 mL/L
9	Untreated control	-	-

Neem Seed Water Extract: **Fifty grams of neem seeds were ground well with a motor and a pestle and soaked overnight (24 hours) in 50 mL water. The mixture was strained using a cheese cloth, diluted with water to make a solution of 50 g/L of water. Five millilitres of teepol® was added to every litre of solution just before application.**

Vegetable Oil and Detergent Mixture: **60 mL of vegetable oil was added with 10 mL of liquid detergent (teepol®) and was mixed thoroughly. The solution was topped up with water to make a 1 L of solution and mixed well. The required volume depends on the stage of the crop.**

Number of live whiteflies 24 and 48 hours after treatment application were assessed.

Data analysis

Abbott's formula was used to calculate corrected mortality values and data were analyzed using probit analysis in SAS system version 9.0. ***The Abbott's formula:***

$$\text{Corrected \% mortality} = \frac{(\text{Percentage alive control} - \text{Percentage alive treated}) \times 100}{(\text{Percentage alive control})}$$

Results and Discussion

There were significant differences in percentage mortality among treatments (*Pr*>ChiSq<.0001) after 24 hours of treatment application. The mortality of untreated control was 5.65% and the corrected mortalities of all other treatments excluding buprofezin exceeded 50%. The highest % mortality (96.82%) was observed with vegetable oil and liquid detergent mixture followed by neem seed water extract (93.33%), thiamethoxam (91.45%), acetamiprid (89.35%), sulfoxaflor (89.19%) and liquid detergent (73.84%), pymetrozine (64.67%) and buprofezin (32.43%).

After 48 hours of treatment application, untreated control recorded mortality of over 50% and that data was not used for further calculations. The possible reasons for the death of insects in the control could be high stress to the insects at transition to test vials.

Table 2. Mortality of adult whiteflies 24 hours after treatments

Treatment	Dilution Rate	No. alive	No. dead	% Mortality	Corrected % Mortality
Untreated control		167	10	5.65%	
Vegetable oil and detergent mixture	60 mL/L	5	160	97.0%	96.82%
Sulfoxaflor	0.5 mL/L	15	146	89.8%	89.19%
Thiamethoxam	0.5 g/L	13	148	91.93%	91.45%
Acetamiprid	1 g/L	17	152	89.95%	89.35%
Buprofezin	0.6 g/L	102	58	36.25%	32.43%
NSWE	50 g/L	10	149	93.71%	93.33%
Pymetrozine	0.05 g/L	50	100	66.67%	64.67%
Liquid detergent	5 mL/L	39	119	75.32%	73.84%

Twenty-four hours after treatments, buprofezin has recorded comparatively lower level of mortality (36.25%). Buprofezin is a chitin biosynthesis inhibitor which affects the moulting of nymphal stages of whiteflies. In the experiment it was tested against adult whiteflies which resulted in lower mortality rate. Previous studies have found that buprofezin mostly affects the nymphal stages of whiteflies and it suppresses embryogenesis and progeny formation of *B.tabaci.* Buprofesin was tested in bioassay because it was a component of recommended chemical control component. Pymetrozine, a novel insecticide also gave comparatively low mortality rate (66.67%). Since this product has not previously been tested in Sri Lanka and a lower rate was tested against the whiteflies it could be possible that the dosage is not sufficient for an effective control of the insect. The detergents are formulated for other purposes than using as insecticides. Detergents can be effective when used on insects as contact poisons. In this study, the leaves were dipped in detergent solution and dried in air before whiteflies were introduced, hence the efficacy of the treatment may be reduced.

Tested insecticide formulations showed a high efficacy against adult whitefly (*B. tabaci)* except for Buprofezin. Further trials needed to forecast the most effective doses.

Conclusions and Recommendations

The existing DOA recommendation of insecticides is effective in controlling cucurbit virus vectors in laboratory bioassay.

Novel insecticides (pymetrozine and sulfoxaflor) and organic insecticides are also effective in whitefly control in laboratory bioassay

References

Antignus, Y. (2000). Manipulation of wavelength-dependent behaviour of insects: an IPM tool to impede insects and restrict epidemics of insect borne viruses. *Virus Research*, 71(1-2), pp.213-220.

Castle, S. J., Merten, P. and Prabhaker, N., (2013). Comparative susceptibility of *Bemisia tabaci* to imidacloprid in field- and laboratory-based bioassays. *Pest Management Science,* 10, pp. 17-37.

Insecticide Resistance Action Committee, (2009). *IRAC Susceptibility Test Methods Series.* Available at: www.irac-online.org [Accessed 02 03 2014].

Ishaaya, I., Mendelson, Z. and Melamed-Madjar, V. (1988). Effect of Buprofezin on Embryo genesis and Progeny Formation of Sweet Potato Whitefly (Homoptera: Aleyrodidae). *Journal of Economic Entomology*, 81(3), pp.781-784.

Miller, A., Tindall, K. and Leonard, B. (2010). Bioassays for Monitoring Insecticide Resistance. *Journal of Visualized Experiments*, (46).