International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 73-76

Received: 16-09-2018
Accepted: 17-10-2018

Sachin US
Department of Entomology, College of Horticulture, UHS main Campus, Bagalkot, Karnataka, India

Suchithra Kumari MH
Department of Entomology, College of Horticulture, Mudigere, Chikkamagaluru Dist, Karnataka, India

Correspondence
Sachin US
Department of Entomology, College of Horticulture, UHS main Campus, Bagalkot, Karnataka, India

Relative residual toxicity of selected insecticides against greenhouse whitefly, *Trialeurodes vaporariorum* Westwood (Hemiptera: Aleurodidae) on tomato

Sachin US and Suchithra Kumari MH

Abstract
The relative residual toxicity of selected insecticides against whitefly was assessed in the Entomology laboratory at College of Horticulture, Mudigere during the year 2014-2015. The treatments *viz.*, imidachloprid (15.70 to 22.97%), triazophos (10.43 to 21.97%), thiamethoxam (20.77 to 37.97%), cyantraniliprole (20.03 to 34.37%), azadirhactin (10.40 to 18.27%), fipronil (6.60 to 29.10%) and buprofezin (7.93 to 17.00%) showed high level of residual toxicity up to sixth day after the treatment. From eighth day after treatment, toxicity started decreasing. However, in treatments acephate and emamectin benzoate, residual toxicity started decreasing from sixth day itself. Although toxicity of spinosad (15.23%) was noticed to be high at two days after treatment, its toxicity started decreasing from fourth day itself. At sixth day after treatment, the order of residual toxicity was thiamethoxam > cyantraniliprole > fipronil > imidachloprid > triazophos > azadirhactin > buprofezin > spinosad > emamectin benzoate > acephate.

Keywords: Whitefly, *Trialeurodes vaporariorum*, insecticides, residual toxicity

1. Introduction

Solanaceous crops are important group of warm season vegetables consumed all over the world and grown in tropical and subtropical regions. The most popular vegetable among these solanaceous crop is tomato (*Solanum lycopersicum* L.). In India, tomato is being grown in an area of 5.60 lakh hectares with a production of 8.08 lakh metric tonnes (Vanitha *et al*., 2013) [16]. This tomato plant is attacked by a plethora of insect and non-insect pests that reduce yield and spoil the quality of tomato fruits, of which whitefly, *Trialeurodes vaporariorum* Westwood is a sap feeder reported to be infesting approximately 859 host plant species, belonging to 469 genera in 121 families and has attained a major pest status globally (Annon, 2015) [1]. This species cause damage in three ways *viz*., the vitality of the plants is lowered through the loss of cell sap; normal photosynthesis is interfered due to the growth of sooty mould on the honey dew and transmits a number of viruses (Johnson *et al*., 1992) [8]. Thus, it not only sucks the plant sap while feeding, but also transmits a limited number of *Crinivirus* and *Torradovirus*. The criniviruses cause Tomato Infectious Chlorosis Virus (TICV) and Tomato Chlorosis Virus (ToCV) in tomato (Wisler *et al*., 1998, Jones, 2003, Castillo *et al*., 2011 and Cavalieri *et al*., 2014) [17, 9, 2, 3].

Although, several management strategies are available to suppress the pests on crops, efficacy, spread and cost of operations are not satisfactory in comparison with chemical control measures. The use of insecticides is the primary strategy employed to control whiteflies, *T. vaporariorum* in tomato. Due to resistance of whitefly against older insecticides, there is a need to identify effective and safer new insecticides for management of whiteflies in tomato. Considering this, it was felt necessary to test the efficacy of new insecticides against adult whitefly under laboratory condition.

2. Material and Methods

Various stages of whiteflies were collected from tomato fields and infested to tomato plants (Hybrid, NS 501) grown in pots inside insect rearing cages in the laboratory. Later these whitefly infested plants (pots) were shifted to the whitefly rearing house (polythene roof) to get constant supply of whiteflies for conducting further experiments (Plate 1).

The adult whiteflies resting over infested leaves were blown off and sufficient number of whitefly nymphs and puparia (pseudo pupae) along with the tomato leaves was shifted to the laboratory and maintained in plastic boxes with mesh lid for emergence of new, uniform aged adults.

A

B

Plate 1: Culturing whitefly population on tomato plants. (A) Tomato plants inside the rearing house. (B) Whitefly culture on tomato leaves.

Another set of tomato plants (Hybrid, NS 501) were raised in pots under 40 mesh net house to obtain treated tomato leaves for testing residual toxicity of insecticides against whitefly. In every pot, only one tomato plant was grown and four such tomato pots were maintained to get sufficient supply of insecticide treated tomato leaves for the said purpose. Such tomato plants were sprayed with selected insecticides (Table 1) at recommended dosage. The top three leaves from these treated tomato plants were brought to the laboratory and maintained in separate plastic boxes.

A batch of 30 newly emerged adult whiteflies collected from the plastic boxes maintained for emergence of new; uniform aged adults with the help of aspirator were released into other plastic boxes containing treated tomato leaves and replicated thrice (Plate 2). At an every alternative days interval (two, four, six, eight and 10 days after treatment), both the treated leaves and adult whiteflies were replaced with new one. Observation was recorded at every 24 hour interval.

Plate 2: Experimental set up to study the residual toxicity of selected insecticides against adult whiteflies.

3. Results and Discussion

Among the selected insecticides, the percent adult mortality in T_1 (Imidachloprid 17.8% SL) ranged from 11.33 to 22.97 percent. There was a drastic increase in adult whitefly mortality up to six DAT (22.97%) from two DAT (15.70%), later from eight DAT there was a decrease in mortality indicating that, imidacloprid gave protection against whiteflies up to six DAT and its low residue level in leaves ended up with low mortality at later days. The mortality rate was 20.77 percent at two DAT in treatment with thiamethoxam (T_3), which increased to 37.97 percent at six DAT. The decrease in mortality rate was observed from eighth day after treatment with a percent mortality of 22.23. At tenth day after treatment percent mortality was 17.17 percent. The variable effect on whitefly by the neonicotinoids might be due to its characteristics influencing the movement in plant tissues such as water solubility which greatly affected their toxicity (Kherb, 2011) [10]. The same trend of increase in percent mortality of whiteflies from 10.43 percent (two DAT) to 21.97 percent (six DAT) was noticed in treatment with triazophos (T_2). Later the percent mortality started decreasing with percent mortality of 19.00 and 17.40 at eighth and tenth day after treatment, respectively (Sreekanth and Reddy, 2011; Ranjeet *et al*., 2015) [15, 12] (Table 1).

The adult mortality ranged from 6.30 to 19.33 percent in the treatment with acephate (T_4). At two days after treatment, the percent mortality was 6.30 which increased to 19.33 percent at four days after treatment. Later, from six days onwards the percent mortality started decreasing with mortality rate of 8.97, 7.70 and 7.10 percent at six, eight and ten days after treatment, respectively. The same trend was noticed in treatments with cyantraniliprole (T_5) where at two days after treatment, the adult mortality which was 20.03 percent increased to 21.83 percent at four days after treatment and 34.37 percent at six days after treatment. At eighth and tenth day after treatment the percent mortality was 7.83 and 8.37 percent, respectively indicating a drastic decrease in percent mortality from eighth day after treatment. The anti-feedant property of cyantraniliprole (an anthranilic diamide insecticide group) might be the reason to record low population of whiteflies in these treated plants.

Table 1: Effect of residual toxicity of selected insecticides on percent mortality of adult whiteflies

Tr. No.	Treatment details	Dose / l.	Adults released	Percent mortality				
				2DAT	4DAT	6DAT	8DAT	10DAT
T_1	Imidachloprid 17.8%SL	0.3 ml	30	15.70 (23.34)	18.73 (25.64)	22.97 (28.64)	13.13 (21.25)	11.33 (19.67)
T_2	Triazophos 40% EC	2.0 ml	30	10.43 (18.81)	12.83 (21.13)	21.97 (27.95)	19.00 (25.84)	17.40 (24.65)
T_3	Thiamethoxam 25%WG	0.3 g	30	20.77 (27.11)	30.77 (33.71)	37.97 (38.04)	22.23 (28.13)	17.17 (24.48)
T_4	Acephate 75% SP	1.0 g	30	6.30 (14.18)	19.33 (26.06)	8.97 (17.43)	7.70 (16.11)	7.10 (15.45)
T_5	Cyantraniliprole 10% OD	1.8 ml	30	20.03 (26.87)	21.83 (27.83)	34.37 (35.89)	7.83 (16.22)	8.37 (16.82)
T_6	Azadirhactin 10000 ppm	2.0 ml	30	10.40 (18.81)	13.13 (21.22)	18.27 (25.31)	7.77 (16.19)	3.50 (10.78)
T_7	Fipronil 80% WG	0.5 g	30	6.60 (14.89)	9.60 (18.05)	29.10 (32.65)	8.43 (16.88)	7.63 (16.04)
T_8	Emamectin benzoate 5% SG	0.2 g	30	6.37 (14.65)	10.43 (18.81)	10.33 (18.75)	7.33 (15.71)	6.53 (14.81)
T_9	Spinosad 480% SC	0.2 ml	30	15.23 (22.97)	13.10 (21.22)	13.00 (21.13)	11.2 (19.55)	10.63 (19.03)
T_{10}	Buprofezin 25%SC	1.0 ml	30	7.93 (16.32)	13.10 (21.22)	17.00 (24.35)	15.13 (22.89)	12.87 (20.96)
T_{11}	Control		30	0.00 (0.87)	0.00 (0.87)	0.00 (0.87)	0.00 (0.87)	0.00 (0.87)
SEm±				0.21	0.18	0.14	0.20	0.19
CD @ 1%				0.83	1.73	0.58	0.82	0.76

Note: The values in the parenthesis are angular transformed
DAT- Days After Treatment

Whereas, in azadirachtin treated plants (T_6), mortality rate of whiteflies abruptly decreased to in 7.77 percent and 3.50 percent mortality at eight and ten days after treatment, respectively from 18.27 percent at six DAT which had increased drastically from 10.40 percent at two days (Table 1) which is in agreement with the results of Elling *et al*. 2002 [5] who reported that neemazal had no effect on the mortality of whitefly, *T. vaporariorum* when female which was exposed to fresh, 24-h-old and 72-h-old residues of neemazal.

The percent mortality recorded at two days after treatment, in the treatment fipronil (T_7) was 6.60 percent which increased to 9.60 percent at four days after treatment and 29.10 percent at six days after treatment. The mortality started decreasing drastically to 8.43 percent at six days after treatment and 7.63 percent at ten days after treatment. The same trend was noticed in treatment with buprofezin (T_{10}). However, in T_8 (emamectin benzoate 5% SG) and T_9 (spinosad 480% SC), the adult mortality increased initially at two and four DAT and started to decrease from sixth DAT up to tenth DAT indicating that acephate, emamectin benzoate and spinosad gave protection against whiteflies only up to fourth DAT, the low level of residues of these insecticides in the leaves resulted in low mortality at later days. The lower mortality on application of spinosad (a natural pesticide from soil microbe) could be due to slow penetration rates and slow metabolism once inside the body of the insect (Kumar and Poehling, 2007; Sparks *et al*., 1998; Sparks *et al*., 2001) [11, 13, 14] (Table 1). The present findings can be supported by work of Horowitz and Ishaaya (2004) [6] who reported that emamectin benzoate has translaminar activity, providing a relatively prolonged residual activity. Similarly, Cock and Degheele, 1998 reported that buprofezin has long residual activity. However, in the untreated control (T_{11}), zero percent mortality was recorded.

4. Conclusion
The tomato plants treated with insecticides *viz*., imidachloprid, triazophos, thiamethoxam, cyantraniliprole, azadirhactin, fipronil and buprofezin showed high level of residual toxicity up to sixth day after treatment. But it started decreasing slightly from eighth day after treatment. In treatments with acephate and emamectin benzoate, residual toxicity started decreasing from sixth day itself. But spinosad resulted high residual toxicity, two day after treatment and it started decreasing from fourth day onwards itself. The residual toxicity of selected insecticides at sixth day after treatment resulted in the following order: thiamethoxam > cyantraniliprole > fipronil > imidachloprid > triazophos > azadirhactin > buprofezin > spinosad > emamectin benzoate > acephate.

5. Acknowledgement
We gratefully acknowledge the support given by the College of Horticulture, Mudigere. Chikkamagaluru district, Karnataka.

6. References
1. Annonymus. Data sheet on White fly, *Trialeurodes vaporariorum*, Invasive species compendium, 2015.
2. Castillo NJ, Olive EF, Campos SS. Emerging virus disease transmitted by whiteflies. Annual Review of Phytopathology. 2011; 49:219-248.
3. Cavalieri V, Manglli A, Tiberini A, Tomassoli L, Rapisarda C. Rapid identification of *Trialeurodes vaporariorum*, *Bemisia tabaci* (MEAM and MED) and tomato-infecting *criniviruses* in whiteflies and in tomato leaves by real-time reverse transcription-PCR assay. Bulletin of Insectology. 2014; 67(2):219-225.
4. Cock AD, Degheele D. Buprofezin: a novel chitin synthesis inhibitor affecting specifically planthoppers, whiteflies and scale insects. In: Ishaaya I, Degheele D. (Eds.), Insecticides with Novel Modes of Action. Springer, New York, NY, 1998, 74-91.
5. Elling EV, Borgemeister C, Setamou M, Poehling HM. The effect of neemazal-T/S®, a commercial neem product, on different developmental stages of the common greenhouse whitefly *Trialeurodes vaporariorum* Westwood (Hom., Aleyrodidae). Journal of Applied Entomology. 2002; 126:40-45.
6. Horowitz AR, Ishaaya I. Susceptibility of the sweetpotato whitefly (Homoptera: Aleyrodidae) to buprofezin during the cotton season. Journal of Economic Entomology. 2004; 85(2):318-324.
7. Ishaaya I, Mendelsonn Z, Madjar VM. Effect of buprofezin on embryogenesis and progeny formation of sweetpotato whitefly (Homoptera: Aleyrodidae). Journal of Economic Entomology. 1998; 81(3):781-784.
8. Johnson MW, Caprio LC, Coughlin JA, Tabashnik BE, Rosenheim JA, Welter SC. Effect of *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae) on yield of fresh market tomatoes. Journal of Economic Entomology. 1992; 85(6):2370-2376.
9. Jones DR. Plant viruses transmitted by whiteflies. European Journal of Plant Pathology. 2003; 109:195-219.

10. Kherb WAA. Field Efficacy of some neonicotinoid insecticides on whitefly *Bemisia tabaci* (Homoptera: Aleyrodidae) and its natural enemies in cucumber and tomato plants in Al-qassim region, KSA. European Journal of Entomology. 2011; 8(5):429-439.
11. Kumar P, Poehling HM. Effects of azadirachtin, abamectin, and spinosad on sweetpotato whitefly (Homoptera: Aleyrodidae) on tomato plants under laboratory and greenhouse conditions in the humid tropics. Journal of Economic Entomology. 2007; 100(2):411-420.
12. Ranjeet K, Rita S, Leena S. Bio-efficacy of synthetic insecticides against whitefly (*Bemisia tabaci*) infesting *Bt* cotton. Research Journal of Recent Sciences. 2015; 4:1-2.
13. Sparks TC, Thompson GD, Krist HA, Hertlein MB, Larson LL, Worden TV *et al.* Biological activity of the spinosyns, new fermentation derived insect control agents, on tobacco budworm (Lepidoptera: Noctuidae) larvae. Journal of Economic Entomology. 1998; 91:1277-1283.
14. Sparks TC, Crouse GD, Durst G. Natural products as insecticides: the biology, biochemistry and quantitative structure-activity relationships of spinosyns and spinosoids. Pest Management Science. 2001; 57:896-905.
15. Sreekanth PN, Reddy KMS. Efficacy of different insecticides against sucking pests of Cotton. Environmental Ecology. 2011; 29(4A):2035-2039.
16. Vanitha SM, Chaurasia SNS, Singh PM, Naik PS. Vegetable statistics. Technical Bulletins. No. 51, IIVR, Varanasi, 2013, 250.
17. Wisler GC, Duffus JE, Liu HY, Li RH. Ecology and epidemiology of whitefly transmitted clostero viruses. Plant Diseases. 1998; 82(3):270-280.