Pesticide Research Journal Vol. 19(1): 76-78, June, 2007

Relative Toxicity of Some Synthetic Insecticides with Special Reference to Change in Susceptibility Level of *Myzus Persicae* Sulz Over A Decade

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The toxicity of various synthetic pyrethroids and organophosphorus insecticides to green peach aphid, *Myzus persicae* Sulz has been worked out by direct spray and leaf dip method in the laboratory. Amongst the synthetic pyrethroids evaluated alphamethrin was found to be most toxic insecticide, the relative toxicity values being 10.08 and 6.96 times higher than that of cypermethrin by direct spray and leaf dip method, respectively. Profenophos was the most toxic organophosphorus insecticide followed by chlorpyriphos, methyl demeton, triazophos and quinalphos. Out of the two methods of bioassay, leaf dip method was found to be the most effective. A comparison of LC_{50} values for commonly used and recommended insecticides determined over a decade revealed that there has been a shift in susceptibility to various insecticides used where aphid showed 64.3, 52.7, 51.9 and 6.0 fold resistance to λ-cyhalothrin, deltamethrin, fenvalerate and cypermethrin, respectively. However, there was only 2.5 and 1.4 fold increase in the LC_{50} values of methyl demeton and alphamethrin during the same period.

Keywords: *Myzus persicae*, synthetic insecticides, relative toxicity, resistance

Myzus persicae Sulz is an important pest of crucifers like mustard, cabbage, cauliflower and many solanaceous *crops like tobacco*, tomato, chilies and potato[1]. It affects yield and quality of various crops by transmitting over two hundred viral diseases of plants, belonging to widely different plant families[2]. In India this aphid is found to infest 250 plant species belonging to 166 genera of plants[3] and causes significant losses to tobacco directly by desapping and indirectly by honeydew deposition[4]. Recently it has been reported that aphids have the potential to inflict monetary loss in the tune of Rs. 2000-2600 per hectare at 8-10% infestation[5]. Chlorinated hydrocarbons and organophosphorus insecticides have been in use against *M. persicae*. However these insecticides have become progressively less effective[6]. These considerations led to determine the relative toxicity of various insecticides belonging to different groups as also to detect the level of resistance in adults of *M. persicae* to these insecticides after a lapse of thirteen years (1993-2006).

MATERIALS AND METHODS

Proprietary insecticidal formulations of profenophos (Curacron, 50 EC, M/s. Syngenta Ltd.), alphamethrin (25 EC, M/s Gharda Chemicals Ltd.), chlorpyriphos (Dhanvan, 20 EC, M/s. Dhanuca Pesticide Limited), methyl demeton (5 EC, M/s Bayer India Ltd.), triazophos (Hostathion, 40 EC, M/s. Aventis Crop Science India Ltd.), quinalphos (Kinlux, 25 EC, M/s United phosphorus Ltd.), λ-cyhalothrin (Karate, 4 EC, M/s Syngenta Ltd), deltamethrin (Decis, 2.8 EC, M/s Bayer Crop Science Ltd, India.), cypermethrin (Lacer, 10 EC, M/s Searle Agrochemicals), fenvalerate (Fenval, 20 EC, M/s Searle Agrochemicals) were obtained from different firms. Different concentrations of these insecticides emulsions representing the various treatments were prepared by using distilled water for the dilution of the commercial emulsifiable concentrate.

Direct spray method — The aphid infested leaves of cabbage were brought from the farm of the Division of Entomology and only apterous viviparous adults were used for bioassay tests. About ten insects were placed in each petridish which were directly sprayed with 1 ml of each concentration of different insecticides under Potter's tower at 340 g/cm^2 pressure. The sprayed petridishes containing the aphids were dried for five minutes under fan. The treated insects were then transferred to separate glass specimen tubes (10x 4 cm.) containing fresh uninfested and untreated cabbage leaves as food. These tubes covered with pieces of muslin cloth held in position by rubber band, then kept at 27±1ºC.

Leaf-dip method — The apterous viviparous adults of *M. persicae* were exposed to insecticidal residues on mustard leaves. After washing the leaves thoroughly, the leaf-discs of ~6 cm diameter were cut from well-grown mustard leaves. They were later dipped in the required concentrations of each insecticide for 20 seconds and then dried. The treated leaf-discs were then transferred to clean jars (10 x 4 cm). In each jar ten aphids were placed and each treatment was replicated thrice.

For the assessment of toxic effect, mortality counts were taken 24 h after the treatment. The moribund insects were also counted as dead. Each experiment was replicated thrice. Five to seven concentrations of each insecticide were tested to obtain the concentration- probit mortality curve. The data were subjected to probit analysis[7]. The values of relative toxicity of different insecticides have been calculated by taking LC_{50} value of cypermethrin as unity.

RESULTS AND DISCUSSION

On the basis of LC_{50}, the descending order of toxicity of different insecticides was profenophos, alphamethrin, chlorpyriphos, methyldemeton, triazophos, quinalphos, lamdacyhalothrin, deltamethrin, cypermethrin and fenvalerate. Out of ten insecticides tested only eight insecticides *viz*., profenophos, alphamethrin, chlorpyriphos, methyldemeton, triazophos, quinalphos, lamdacyhalothrin and deltamethrin were found to be 21.74, 10.08, 6.64, 3.02, 2.50, 1.96, 1.50 and 1.17 times as toxic as cypermethrin, respectively (Table 1) by direct spray method and 18.0, 6.96, 6.20, 3.17, 1.97, 1.70, 1.43, and 1.13 times more toxic by leaf residue methods (Table 2). Only fenvalerate manifested less toxicity than cypermethrin and was found to be 0.76 and 0.82 times as toxic as cypermethrin in direct spray and leaf residue methods, respectively.

Amongst the synthetic pyrethroids, alphamethrin was found to be most toxic insecticides followed by λ-cyhalothrin and deltamethrin. Alphamethrin was about six and half times and five times as toxic as λ-cyhalothrin in both direct spray and leaf residue methods, respectively.

Out of the various organophosphorus insecticides evaluated profenophos was observed to be most toxic insecticide followed by chlorpyriphos, methyldemeton,

Table 1. Relative toxicity of some important insecticides to the adults of *Myzus persicae* Sulz

Insecticides	Heterogenity		Regression Equation (Y=)	LC_{50}	Fiducial Limit	Relative
	df	x^2		(%)		toxicity
			Direct Spray method			
Profenophos	3	2.0327	1.2778X+7.9389	0.0050	0.0063 – 0.0039	21.74
Alphamethrin	5	0.7095	1.2714X+7.5000	0.0108	0.0870 – 0.0134	10.08
Chlorpyriphos	4	5.1816	1.0851X+6.9369	0.0164	0.0212 – 0.0127	6.64
Methyl Demeton	5	2.9600	1.0629X+6.5338	0.0361	0.0450 – 0.0288	3.02
Triazophos	4	4.9526	0.9160X+6.2461	0.0436	0.0569 – 0.0338	2.50
Quinalphos	4	3.2815	0.0909X+0.1409	0.0555	0.0722 – 0.0426	1.96
Lamdacyhalothrin	3	3.4008	1.0073X+6.1466	0.0727	0.1073 – 0.0493	1.50
Deltamethrin	3	2.5588	1.1405X+6.1770	0.0928	0.1195 – 0. 0722	1.17
Cypermethrin	3	1.9582	1.3579X+6.3073	0.1089	0.1342 – 0.0884	1.00
Fenvalerate	3	2.8243	1.0424X+5.8820	0.1426	0.1831 – 0.1111	0.76
			Leaf residue method			
Profenophos	3	1.5510	1.3903X+8.3112	0.0041	0.0053 – 0.0033	18.00
Alphamethrin	5	1.7292	0.7340X+6.3159	0.0106	0.0249 – 0.0104	6.96
Chlorpyriphos	4	5.3289	1.1298X+7.1738	0.0119	0.0158 – 0.0089	6.20
Methyl Demeton	5	7.0939	1.2056X+7.0399	0.0233	0.0246 – 0.0167	3.17
Triazophos	4	6.6090	0.9582X+6.3670	0.0374	0.0488 – 0.0287	1.97
Quinalphos	4	4.3598	0.9876X+6.3412	0.0434	0.0562 – 0.0342	1.70
Lamdacyhalothrin	3	5.8668	1.5177X+6.9524	0.0517	0.0658 – 0.0412	1.43
Deltamethrin	3	1.7199	1.0078X+6.193	0.0655	0.0915 – 0.0469	1.13
Cypermethrin	3	5.7512	1.7822X+7.0136	0.0738	0.0860 – 0.0633	1.00
Fenvalerate	3	4.7191	1.3188X+6.3768	0.0903	0.1124 – 0.0726	0.82

Table 2. Relative resistance of some insecticides to *Myzys persicae* by direct spray method

Insecticides	LC_{50}		Relative
	1993*	2006	Resistance
Alphamethrin	0.008010	0.01080	1.4
Methyl Demeton	0.014290	0.03606	2.5
Lamdacyhalothrin	0.001130	0.07270	64.3
Deltamethrin	0.001760	0.09280	52.7
Cypermethrin	0.018200	0.10890	6.0
Fenvalerate	0.002745	0.14260	52.0

*Dhingra[8]; Relative resistance = LC_{50} worked out in the present investigation / LC_{50} worked out during 1993

triazophos and quinalphos. Profenophos was found to be about three times more toxic than chlorpyriphos in both the methods.

A comparison of LC_{50} values by direct spray method for alphamethrin, methyl demeton, λ-cyhalothrin, deltamethrin, cypermethrin and fenvalerate determined during the last thirteen years (1993[8]-2006) revealed a change in the level of susceptibility of *Myzus persicae*. There was about 1.35, 2.52, 64.3, 52.7, 5.98 and 51.95 times increase in the LC_{50} values of these insecticides, respectively (Table 2). Field derived strains of *M. persicae* showed strong resistance against carbamate and organophosphate insecticides[9]. Although there was a slight change in the LC_{50} values of alphamethrin, methyldemeton and cypermethrin, the shift in the level of susceptibility of *M. persicae* to λ-cyhalothrin, deltamethrin and fenvalerate was much pronounced with in this period (Table 3). Two-spray programmes starting with λ-cyhalothrin gave poor control in comparison with programmes starting with pirimicarb or pirimicarb-containing mixtures[10]. The kdr mechanism was associated with resistance to λ-cyhalothrin, cypermethrin and deltamethrin[11,12]. On the other hand, toxicity of of alphamethrin and methyl demeton to *M. persicae* remained more or less the same and the LC_{50} values being 0.00801 and 0.01429 in 1993 where as 0.01080 and 0.03606 values were worked out during 2006. Obviously, response of *M. persicae* to alphamethrin and methyl demeton did not change significantly as compared to other insecticides. Many fold resistance obtained in λ-cyhalothrin, deltamethrin, fenvalerate and cypermethrin that probably reflect the counteracting forces of selection imposed by insecticides for aphids possessing more copies of esterase resistance genes.

Manuscript No. 07/06-01
Received 22 July 2006; Accepted 30 June 2007

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