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Short communication

Differential responses of major vegetable aphids to newer insecticide molecules

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Insects are one of the major limiting biotic factors for production of vegetables in India. Among these, the aphids alone have the potential to inflict monetary loss in the tune of Rs. 2000-2600 per hectare at 8-10% infestation (Mistric and Clark., 1979). Besides sucking the sap and there by devitalizing the plants many of them serve as a vector in transmitting the viral diseases. Most of the vegetable crops including cabbage, cauliflower, radish, cowpea, chilies, brinjal and field bean are highly infested with different aphid species through out their growing period. At present there is a great deal of discussion on the resistance and resurgence of insects to commonly used insecticides which is of a grave concern in crop protection. One of the solutions to the resistance problem is the rotation of newer insecticides with the conventional ones. Hence, an attempt has been made to evaluate newer insecticidal molecules to manage different vegetable aphids *viz*. *Myzus persicae*, *Brevicoryne brassicae* and *Aphis gossypii*. Accordingly, toxicity of three newer molecules *viz*., imidacloprid, thiamethoxam and diafenthiuron were compared with most commonly used conventional insecticides like dimethoate and acephate in vegetable ecosystem.

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Different systemic insecticides including three newer molecules *viz*., imidacloprid, diafenthiuron and thiamethoxam were evaluated and compared with two conventional insecticides *i.e.*, acephate and dimethoate under laboratory conditions against three species of aphids infesting major vegetable crops. Six to eight different concentrations of each of these insecticides were prepared by using distilled water for the dilution of the commercial emulsifiable and wettable powder insecticides. Each experiment was conducted in completely randomized block design with three replications.

Lethal concentration (LC_{50}) of insecticides were determined against three species of aphid infesting cabbage (*Myzus persicae*), radish (*Brevicoryne brassicae*) and brinjal (*Aphis gossypii*) by adopting leaf residue method under laboratory conditions. The leaf discs of the size 4x4 cm were cut from the respective host plants and dipped in the required concentrations of different insecticides for 20 seconds and then air-dried. The treated leaf discs were then transferred to petri dishes and thirty aphids were released in each petri dish. The petridishes containing the aphids and treated host were air dried then kept at 27±1 °C.

For the assessment of toxic effect, mortality counts were taken 24 h after the treatment. The moribund insects were also counted as dead. Six to eight concentrations of each insecticide were tested to obtain the concentration-probit mortality curve. The data were subjected to probit analysis (Finney, 1971).

Results indicated marked differences in the toxicity among insecticides towards different species of aphids infesting vegetable crops. Among the three aphids, Brinjal aphid was more susceptible towards the test insecticides followed by cabbage and radish (table 1). Among the five systemic insecticides tested, imidacloprid was found

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to be most toxic systemic insecticides against all the aphids under laboratory conditions and the LC_{50} doses for aphids infested brinjal, cabbage and radish were 0.00003, 0.0004 and 0.0003 per cent, respectively. Another chloronicotinyl insecticide thiamethoxam ranked as second best insecticide in controlling aphids in crucifers' vegetables like cabbage and radish whereas dimethoate was found second in order of toxicity to brinjal aphids. The descending order of toxicity for brinjal were imidacloprid > dimethoate > thiomethoxam > diafenthiuron > acephate. However, diafenthiuron and acephate were reported least toxic among all the test insecticides and order of toxicity for cabbage and radish were imidacloprid > thiomethoxam > dimethoate > diafenthiuron > acephate. Our present study is also in conformity with Schroeder and Dumbleton, (2001) who reported that imidacloprid was found to be more effective than thiamethoxam against cabbage aphid, *Brevicoryne brassicae* (Linn.) feeding on rape seed and mustard applied through seed treatment. In another study, Stufkens and Wallace (2004) documented that strong insecticidal activity of dimethoate against lettuce aphid, *Nasonovia ribisnigri* followed by acephate at recommended doses and they also concluded that acephate failed to give complete kill of lettuce aphids unlike dimethoate. Earlier, Ishaaya *et al*., 1993 reported high insecticidal activity of diafenthiuron against sweet potato whitefly, *Bemisia tabaci* along with mild ovicidal activity. But in our present study diafenthiuron did not show strong aphidicidal activity against aphids infesting different vegetable crops.

How ever, Gore *et al*., 2010 reported from Gujarat that among the newer insecticidal molecules tested against safflower aphid, *Uroleucon carthami* thiomethoxam was most effective followed by imidacloprid, dimethoate, acephate and diafenthurion.

From the table 1 it is also clear that among the three aphids infested on different vegetables, brinjal aphids required least doses to kill fifty per cent of the aphids. Considering this lowest LC_{50} doses of brinjal aphids the toxicity of different insecticides taking the LC_{50} doses for brinjal aphid as base (1), imidacloprid showed consistency for all the three aphids and the dose required to kill fifty per cent of the test population was 28.46 and 8.46 times higher for radish and cabbage aphid respectively than the brinjal aphid. However, highest variations in toxicity were recorded from acephate and diafenthiuron. The LC_{50} doses for diafenthurion for cabbage and radish aphids were 807.25 and 52.75 times higher than the brinjal aphid and similarly for acephate it was 60.98 and 279.07. Our earlier study also showed

Table 1: Toxicity of systemic insecticides against three species of aphids by leaf dip method

Insecticides	Heterogenity		Regression Equation (Y=)	LC_{50} (%)	Fiducial Limit
	df	χ^2			
Myzus persicae					
Dimethoate	4	3.269	1.682X+10.012	0.0011	0.0014 - 0.0008
Imidacloprid	4	1.6117	1.728X+10.859	0.0004	0.0006 - 0.00 03
Thiomethoxam	5	4.995	1.314X+9.205	0.0006	0.0009 - 0.0004
Acephate	5	9.978	1.084X+5.120	0.7745	1.473 - 0.4072
Diafenthurion	5	1.780	0.548X+5.269	0.3229	3.398 - 0.0307
Brevicoryne brassicae					
Dimethoate	4	4.673	1.223X + 7.978	0.0037	0.0024 - 0.0055
Imidacloprid	4	1.729	0.8731X+8.112	0.0003	0.0005- 0.00016
Thiomethoxam	4	1.688	0.9735X+8.137	0.0006	0.0009 - 0.0004
Acephate	4	1.524	0.4271X+4.765	3.5442	5.3497 - 0.2348
Diafenthurion	4	3.178	1.257X+7.106	0.0211	0.0432 - 0.0104
Aphis gossypii					
Dimethoate	3	5.708	1.795X+11.971	0.00013	0.0002-0.00007
Imidacloprid	3	3.794	0.554X+7.481	0.00003	0.0003-0.00003
Thiomethoxam	3	5.814	2.048X+12.489	0.0002	0.00034-0.0001
Acephate	3	2.296	0.948X+6.799	0.0127	0.0276 - 0.0058
Diafenthurion	5	1.031	0.791X+7.691	0.0004	0.001-0.00015

Table 2: Relative toxicity of five systemic insecticides as compared to brinjal aphids

Insecticides	Brinjal aphid	Cabbage aphid	Radish aphid
Dimethoate	0.00013 (1)	0.0011 (8.46)	0.0037 (28.46)
Imidacloprid	0.00003 (1)	0.0004 (13.33)	0.0003 (10)
Thiomethoxam	0.0002 (1)	0.0006 (3)	0.0006 (3)
Acephate	0.0127 (1)	0.7745 (60.98)	3.5442 (279.07)
Diafenthurion	0.0004 (1)	0.3229 (807.25)	0.0211 (52.75)

Relative toxicity = LC_{50} worked out in cabbage or radish / LC_{50} worked out in brinjal

the same trend when these insecticides were tested against these major vegetable aphids by direct spray method (Halder *et al*., 2011). Toxicity of an insecticide depends on crop architecture, environmental factors, chemical nature and its structure action relationship, target specificity, persistency, etc. Variation in toxicity of acephate and diafenthiuron might be due to mode of action of the insecticides and its target specificity or innate capacity of test insect (s) to metabolize them in their system.

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