

Relative Resistance of Different Insecticides on Chilli Thrips, *Scirtothrips dorsalis* (Hood) in Andhra Pradesh

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Abstract

The thrips population from Guntur district on chillies has developed high degree of resistance to various insecticides viz., monocrotophos, acephate, dimethoate, phosalone, carbaryl and triazophos followed by the population of Vizianagaram district with low levels of resistance implicating selection pressure and consequent resistance levels. The *S. dorsalis* population of Guntur district acquired resistance to the tune of 4.19 folds to monocrotophos, 5.62 folds to acephate, 5.59 folds to dimethoate, 6.80 folds to phosalone, 4.06 folds to carbaryl and 3.39 folds to triazophos at LC₅₀ in comparison with the Vizianagaram district population.

Keywords: Chilli, insecticides, management, resistance, thrips

1. Introduction

India has emerged today as the foremost producer and exporter of chillies contributing to almost 1/4th of the world's production. In India, chilli is grown in an area of 7.43 lha, with a production of 14.53 lt (Agricultural Statistics, 2015). The important chilli growing states in India are Andhra Pradesh, Orissa, Maharashtra, Karnataka and also in a number of other states as a round the year crop. In Andhra Pradesh, chilli is cultivated in an area of 1.89 lakh ha with a production of 2.08 lakh t. Guntur district in Andhra Pradesh alone contributes to over 35 per cent in area under chilli crop in India.

The important pests are thrips, *Scirtothrips dorsalis* (Hood), white mite, *Polyphagotarsonemus latus* (Banks), aphids, *Aphis gossypii* Glover and *Myzus persicae* Sulzer as sucking complex and tobacco caterpillar, *Spodoptera litura* (Fabricius) and pod borer, *Helicoverpa armigera* (Hubner) as pod borers (Rao and Ahmed, 1985). Chilli thrips, *Scirtothrips dorsalis* (Hood) (Thysanoptera : Thripidae) is a serious pest of *Capsicum annum* L. in India, responsible for leaf curling (Ananthkrishnan, 1971). It multiplies appreciably at a faster rate during dry weather periods and the yield loss caused by the thrips is reported to range from 30–90% (Borah, 1987; Varadharajan, 1994).

Guntur district in Andhra Pradesh is traditionally a chilli

growing district with an area of 63,573 ha with high input usage under monocropping conditions. Further, intensive cultivation of input responsive high yielding varieties and hybrids and sole reliance on insecticides are the common features of chilli cultivation in Guntur district. The excessive dependence on insecticides, their over use and abuse has accelerated insect control problems through development of insecticide resistance (Reddy et al., 1992), pest resurgence, pesticide residues (Joia et al., 2001), reduction in natural enemy population and environmental contamination. Moreover, several of the chilli consignments meant for export were rejected stating higher insecticide residues being the culprit, thus lots of foreign exchange lost by way of rejections.

2. Materials and Methods

2.1. Bioassay studies

Chilly thrips, *S. dorsalis* were collected from chilli fields of Guntur and Vizianagaram. They were exposed to graded concentrations of each test insecticide following leaf dip method recommended by FAO (1979). About 25 ml of an insecticidal emulsion prepared in a beaker. Chilli leaves with petioles were plucked from untreated chilli plants and were dipped in insecticidal emulsion taken in a beaker for about 30 seconds. The treated chilli leaves were taken out of the beaker and dried for 30 minutes. The treated leaves



were kept in specimen tubes of 25 ml capacity at the rate of one or two leaves per tube, allowing the cut end of petiole outside the specimen tube. Second instar nymph of *S. dorsalis* were collected from chilli fields carefully in to the aspirator tubes containing the treated chilli leaf at the rate of 20 per tube. The open end of the tube was closed with a stopper (cotton swab wrapped in a polythene paper) taking care that the petiole is projected outside the tube. The cut end of the petiole was wrapped with moist cotton to maintain turgidity of chilli leaf. Three replications were maintained for each insecticidal concentration with 20 nymphs in each replication. After 24 hours of the treatment, the treated leaf was carefully taken out from the tube and the mortality of thrips was recorded. Control was maintained at each time of experimentation where in the leaves were dipped in water. The treatment mortality data were corrected using Abbott's formula (Abbott, 1925).

Abbott's formula:

$$\text{Corrected per cent mortality} = \frac{T-C}{100-C} \times 100$$

T=per cent mortality in treatment, C = per cent mortality in control

The corrected mortality data of each insecticide was subjected to probit analysis (Finney, 1971) using MLP 3.08 soft ware (Ross, 1987) and LC₅₀, LC₉₀, slope (b), chi-square (χ²), regression equation and fiducial limits were calculated.

The LC₅₀ and LC₉₀ values of each test insecticide against thrips populations of Guntur and Vizianagaram districts were taken into consideration for knowing the relative degree of resistance among the two populations. The relative degree of resistance to insecticides by thrip populations was calculated by the formula given by FAO (1979)

$$\text{Resistance factor} = \frac{\text{LC}_{50} \text{ of resistant population}}{\text{LC}_{50} \text{ of susceptible population}}$$

3. Results and Discussion

The bioassay studies conducted in the laboratory revealed the following results.

3.1. Monocrotophos

The LC₅₀ and LC₉₀ values of monocrotophos for Guntur population of *S. dorsalis* were 0.1340 and 0.3570 per cent, respectively (Table 1) with a slope (b) of 3.023. The chi-square test revealed that there was no heterogeneity in the population. The LC₅₀ and LC₉₀ values of monocrotophos against *S. dorsalis* of Vizianagaram district were 0.0320 and 0.1680 per cent, respectively (Table 2). The slope (b) of the log concentration probit line was 1.793. The population of *S. dorsalis* used for the study was homogeneous. A comparison of LC₅₀ and LC₉₀ values of monocrotophos against the two populations of thrips revealed that the Guntur population developed 4.19 fold resistance at LC₅₀ and 2.13 fold resistance at LC₉₀ in comparison with Vizianagaram population (Table 3).

3.2. Acephate

The LC₅₀ and LC₉₀ values of acephate (Table 1) against the *S. dorsalis* of Guntur district were 0.1460 and 0.4360 per cent, respectively. Population was homogeneous as indicated by the chi-square test. The log concentration probit line recorded a slope (b) of 2.702. The population of *S. dorsalis* from Vizianagaram district had LC₅₀ and LC₉₀ values of 0.0260 and 0.1530 per cent, respectively for acephate (Table 2) with a slope (b) value of 1.663. The chi-square test indicated that the population was homogeneous. A comparison of LC₅₀ and LC₉₀ values of acephate against the two populations of thrips revealed that the Guntur population developed 5.62 fold resistance at LC₅₀ and 2.85 fold resistance at LC₉₀ in comparison with Vizianagaram population (Table 3).

3.3. Phosalone

The LC₅₀ and LC₉₀ values of phosalone for Guntur population of *S. dorsalis* were 0.1700 and 0.3550%, respectively (Table

Table 1: Toxicity of different conventional insecticides to *S. dorsalis* population of Guntur district

S I . No.	Insecticides	LC ₅₀ (%) (95% FL)	LC ₉₀ (%) (95%FL)	Slope±S.E (b)	Heterogeneity (χ ²)	Regression equation
1.	Monocrotophos	0.1340 (0.0790-0.1770)	0.3570 (0.2480-1.2390)	3.023+0.93	1.141	Y=7.635+3.023 X
2.	Acephate	0.1460 (0.1020-0.1870)	0.4360 (0.3080-0.9940)	2.702+0.64	2.793	Y=7.255+2.702 X
3.	Phosalone	0.1700 (0.1150-0.2080)	0.3550 (0.2760-0.7200)	3.985+1.12	2.115	Y=8.072+3.985 X
4.	Dimethoate	0.1790 (0.1290-0.2150)	0.3520 (0.2790-0.6650)	4.343+1.18	1.412	Y=8.248+4.343 X
5.	Carbaryl	0.1260 (0.0820-0.1650)	0.4640 (0.3090-1.2490)	2.259+0.54	1.294	Y=7.036+2.259 X
6.	Triazophos	0.1120 (0.0690-0.1440)	0.2780 (0.2070-0.5770)	3.233+0.85	1.844	Y=8.080+3.233 X

1) with a slope (b) of 3.985. The chi-square test revealed that there was no heterogeneity in the population. The LC_{50} and LC_{90} values of monocrotophos against *S. dorsalis* of Vizianagaram district were 0.0250 and 0.1670 per cent, respectively (Table 2). The slope (b) of the log concentration probit line was 1.536. The population of *S. dorsalis* used for the study was homogeneous. A comparison of LC_{50} and LC_{90} values of phosalone against the two populations of thrips revealed that the Guntur population developed 6.80 fold resistance at LC_{50} and 2.13 fold resistance at LC_{90} in comparison with Vizianagaram population (Table 3).

3.4. Dimethoate

It is clear from the data (Table 1) that the Guntur population of *S. dorsalis* has LC_{50} and LC_{90} values of 0.1790 and 0.3520%, respectively to dimethoate. The slope (b) of the lcp line was 4.343 with non-significance of chi-square test indicating that

the *S. dorsalis* population tested was homogeneous. The LC_{50} and LC_{90} values of dimethoate for Vizianagaram population of *S. dorsalis* were 0.0320 and 0.1840 per cent, respectively (Table 2) with a slope (b) of 1.690. The chi-square test revealed that there was no heterogeneity in the population. A comparison of LC_{50} and LC_{90} values of dimethoate against the two populations of thrips revealed that the Guntur population developed 5.59 fold resistance at LC_{50} and 1.91 fold resistance at LC_{90} in comparison with Vizianagaram population (Table 3).

3.5. Carbaryl

The LC_{50} and LC_{90} values of carbaryl for Guntur population of *S. dorsalis* were 0.1260 and 0.4640%, respectively (Table 1) with a slope (b) of 2.259. The chi-square test revealed that there was no heterogeneity in the population. The LC_{50} and LC_{90} values of carbaryl against *S. dorsalis* of Vizianagaram district were 0.0310 and 0.2030%, respectively (Table 2). The

Table 2: Toxicity of different conventional insecticides to *S. dorsalis* population of Vizianagaram district

S I . No.	Insecticides	LC_{50} (%) (95% FL)	LC_{90} (%) (95%FL)	Slope±S.E (b)	Heterogeneity (χ^2)	Regression equation
1.	Monocrotophos	0.0320 (0.0190-0.0470)	0.1680 (0.1010-0.5580)	1.793 + 0.41	1.185	Y = 7.669+ 1.793 X
2.	Acephate	0.0260 (0.0130-0.0380)	0.1530 (0.0900-0.5270)	1.663 + 0.39	0.617	Y = 7.640 + 1.663 X
3.	Phosalone	0.0250 (0.0120-0.0370)	0.1670 (0.0940-0.7350)	1.536 + 0.39	1.209	Y = 7.474 + 1.536 X
4.	Dimethoate	0.0320 (0.0180-0.0470)	0.1840 (0.1060-0.7190)	1.690 + 0.41	0.990	Y = 7.525 + 1.690 X
5.	Carbaryl	0.0310 (0.0160-0.0470)	0.2030 (0.1110-0.9970)	1.576 + 0.40	0.550	Y = 7.373 + 1.576 X
6.	Triazophos	0.0330 (0.0180-0.0500)	0.2190 (0.1170-1.1680)	1.564 + 0.40	0.854	Y = 7.314 + 1.564 X

slope (b) of the log concentration probit line was 1.576. The population of *S. dorsalis* used for the study was homogeneous. A comparison of LC_{50} and LC_{90} values of carbaryl against the two populations of thrips revealed that the Guntur population developed 4.06 fold resistance at LC_{50} and 2.29 fold resistance at LC_{90} in comparison with Vizianagaram population (Table 3).

3.6. Triazophos

The LC_{50} and LC_{90} values of triazophos (Table 1) against the *S. dorsalis* of Guntur district were 0.1120 and 0.2780 per cent, respectively. Population was homogeneous as indicated by the chi-square test. The log concentration probit line recorded a slope (b) of 3.233. The population of *S. dorsalis* from Vizianagaram district had LC_{50} and LC_{90} values of 0.0330 and 0.2190%, respectively for triazophos (Table 2) with a slope (b) value of 1.564. The chi-square test indicated that the population was homogeneous. A comparison of LC_{50} and LC_{90} values of triazophos against the two populations of thrips revealed that the Guntur population developed 3.39 fold

resistance at LC_{50} and 1.27 fold resistance at LC_{90} in comparison with Vizianagaram population (Table 3).

Guntur population of *S. dorsalis* showed higher resistance to all the chemicals tested compared to Vizianagaram population, which may be due to the consumption of higher quantity of insecticides in Guntur district. This might have led to development of more resistance in Guntur population. More intensive cultivation of chilli which started much earlier in Guntur district, must have contributed to the higher degree of resistance acquired by Guntur population to all the conventional insecticides. In general there was resistance development even though at varying levels in both Guntur and Vizianagaram populations for commonly used conventional insecticides implicating selection pressure over years. Such selection pressure induced resistance was well documented in several polyphagous pests like *Spodoptera litura* (Fab.), *Spodoptera exigua* Hubner, *Helicoverpa armigera* (Hubner) etc.



Table 3: Relative degree of resistance among the two populations of *S. dorsalis* to conventional Insecticides

Insecticide	Thrips population	LC ₅₀ (%)	LC ₉₀ (%)	RFCWVP	
				LC ₅₀ (%)	LC ₉₀ (%)
Monocrotophos	Guntur	0.1340	0.3570	4.19	2.13
	Vizianagaram	0.0320	0.1680	-	-
Acephate	Guntur	0.1460	0.4360	5.62	2.85
	Vizianagaram	0.0260	0.1530	-	-
Phosalone	Guntur	0.1700	0.3550	6.80	2.13
	Vizianagaram	0.0250	0.1670	-	-
Dimethoate	Guntur	0.1790	0.3520	5.59	1.91
	Vizianagaram	0.0320	0.1840	-	-
Carbaryl	Guntur	0.1260	0.4640	4.06	2.29
	Vizianagaram	0.0310	0.2030	-	-
Triazophos	Guntur	0.1120	0.2780	3.39	1.27
	Vizianagaram	0.0330	0.2190	-	-

RFCWVP: Resistance factor in comparison with Vizianagaram population

4. Conclusion

The consumption of higher quantity of insecticides in Guntur district lead to higher resistance of *S. dorsalis* to all the chemicals tested compared to Vizianagaram population. Hence it is the right time to withdraw selection pressure with insecticides in chilli ecosystem such that normally may be regained over a period of time.

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