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# Persistance and relative toxicity of different insecticides against Thrips (*Scirtothrips dorsalis*) and whitefly (*Bemisia tabaci*) on cotton ecosystem

**PV Patil and VK Bhamare**

**Abstract**
Residual toxicity of seven different insecticides were tested for their persistence and residual toxicity against thrips and whiteflies on cotton ecosystem. During the investigation all the insecticides except clothianidin @ 0.01 per cent proved toxic to third thrips and whitefly on cotton. Fipronil @ 0.015 per cent and diafenthiuron @ 0.060 per cent exhibited comparatively higher percentage mortality of thrips on cotton (22.35 and 20.22) and (23.21 and 20.98) at 14 days after first and second spraying. The descending order of residual efficacy on the basis of PT values was fipronil 0.015 per cent (878.22) > diafenthiuron 0.060 per cent (824.18) > acetamiprid 0.002 per cent (789.14) > imidacloprid 0.004 per cent (771.26) > thiamethoxam 0.005 per cent (727.02) > dimethoate 0.04 per cent (728) > clothianidin 0.010 per cent (687.12) and fipronil 0.015 per cent (893.06) > diafenthiuron 0.060 per cent (847.98) > acetamiprid 0.002 per cent (802.90) > imidacloprid 0.004 per cent (772.10) > thiamethoxam 0.005 per cent (725.76) > dimethoate 0.04 per cent (685.86) > clothianidin 0.010 per cent (651.56). Highest LT50 value to the extent of 6.39 days and 6.69 days was obtained when the thrips were exposed to cotton leaf sprayed with fipronil after first and second spray respectively. Similarly fipronil @ 0.015 per cent and acetamiprid @ 0.002 per cent gave comparatively higher percentage mortality of whitefly on cotton (20.14) at 14 days after third spraying On the basis of PT values the descending order of persistent toxicity was fipronil 0.015 per cent (889.14) > acetamiprid 0.002 per cent (852.32) > imidacloprid 0.004 per cent (824.32) > diafenthiuron 0.060 per cent (812.98) > thiamethoxam 0.005 per cent (769.86) > dimethoate 0.04 per cent (732.48) > clothianidin 0.010 per cent (700.70). Highest $LT_{50}$ value to the extent of 6.48 days was obtained when the whiteflies were exposed to cotton leaf sprayed with fipronil after third spray.

**Keywords:** persistance, relative toxicity, different, thrips, *Scirtothrips dorsalis, Bemisia tabaci*

## 1. Introduction
Cotton is most important commercial crop known as “king of natural fiber” and world over commonly referred as “white gold” which belongs to family Malvaceae and genus *Gossypium.* Cotton plays an important role in strengthening economy of 82 countries across the world.
Cotton was cultivated in about 35.7 M hectares area across the world and in about 12.2 M hectares area in India (USDA, 2014) [15]. During 2014-15, the total cotton production in India was 400.00 lakh bales of 170 kg/bale with average productivity of 537 kg/ha (CAB, 2015) [3]. In Maharashtra cotton was grown in about 41.92 lakh ha area with the production of 85 lakh bales of 170 kg/bale and average productivity of 345 kg/ha during 2014-15 (CAB, 2015) [3]. At national level Maharashtra ranked first in area, second in production and eleventh in productivity (CAB, 2015) [3].
Introduction of *Bt* cotton technology solved the bollworm problem but continuous cultivation of *Bt* cotton has at some places led to increased incidence of sucking and other pests in the recent years (Nagrare *et al.*, 2009) [11]. The important sucking insect-pests attacking *Bt* cotton are jassid (*Amrasca biguttula biguttula* Ishida), thrips (*Scirtothrips dorsalis* Hood), aphid (*Aphis gossypii* Glover.), whitefly (*Bemisia tabaci* Gennadius) and mealy bug (*Phenacoccus solenopsis* Tinsley). Among that thrips nymph and adults lacerating the leaf and cause damage to seedling and seedling becomes wrinkled and distorted with white shiny patches; infected older crop presents rusty appearance in the field. Nymphs and adults of whiteflies by sucking cell sap causes upward curling of leaves reduce plant vigour, lint contamination with honey dew and associated fungi and also transmit leaf curl virus disease.

Several new groups of insecticides have been recommended against sucking pest complex of cotton. But according to several reports many recommended label claimed insecticides could not ascertain effective results. Hence these label claimed insecticides at existing recommended doses should have to be reevaluated against sucking pest complex of cotton for effective management.

## 2. Materials and Methods

The field experiment with cotton crop using variety RCH-2 (BG-II) in *Kharif* 2014 was conducted at the Research Farm of Department of Agricultural Entomology, college of Agriculture, Latur (Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani) (Maharashtra) India. The experiment was conducted in a randomized block design with eight treatments including untreated control replicated three times. The cotton crop was sown on 30th June, 2014 in a gross plot of 7.2 x 4.8 sq.m maintaining net plot of 5.4 x 3.6 sq. m. The row to row distance of 90 cm and plant to plant distance of 60 cm were maintained. The dose of fertilizer at the rate of 60 kg N, 30 kg $P_2O_5$, per hectare was given at the time of sowing.

### 2.1 Methods of recording observations

Five observation plants were selected randomly from the net plot of each treatment in each replication. They were labeled properly.

### 2.2 Rearing of test insects

The culture of *S. dorsalis* and *B. tabaci* was maintained on the plants of cotton planted in the field separately throughout the experimentation.

### 2.3 Residual toxicity of different insecticides against sucking pest complex of cotton

The residual toxicity of different insecticides was evaluated during *Kharif* 2014 in the same field which was raised for studying its bio-efficacy against *S. dorsalis* and *B. tabaci*. During the period of these investigations data on temperature, humidity and rainfall were collected from Meteorological Observatory, Oilseed Research Station, Latur (MS).

### 2.4 Bioassay procedure

The studies on residual toxicity of different insecticides were carried out against sucking pest complex of cotton. The residual toxicity of different insecticides was investigated against *S. dorsalis* and *B. tabaci* at 1, 3, 7 and 14 days after application of insecticides.

Due care was taken to cover the entire plant while application of insecticides. The required numbers of leaves receiving application of insecticides were tagged for investigations on residual toxicity of insecticides.

The number of test insects used for the bioassay studies were ten for each treatment in each replication. The tagged leaves were brought into the laboratory at the prescribed day intervals. The treated leaves were kept into petri plate. The petiole of leaf was covered with moistened cotton wool in order to retain their turgidity for 24 hours. The number of dead or moribund test insects was counted after 24 hours of exposure. Similarly control mortality of test insects was also observed by releasing them on untreated substrates of cotton plant.

### 2.5 Statistical analysis of data

Data obtained were subjected to statistical analysis which consisted of following steps.

#### 2.5.1 Correction on percentage mortality

The observations on mortality of test insects were converted into percentage mortality. The average percentage mortality was calculated from the observations in three replications. The observations on percentage mortality thus obtained were corrected with Abbott's (1925) formula as follows

$$P = \frac{T - C}{100 - C} \times 100$$

Where,

P = Corrected percentage mortality
T = Percentage mortality in treatment
C = Percentage mortality in control

#### 2.5.2 $LT_{50}$ values

The values of $LT_{50}$ (time required to give 50 per cent mortality) for different insecticides applied on cotton plants were calculated by using software of probit analysis as suggested by Finney (1971) [5].

#### 2.5.3 PT values

The product (PT) of average residual toxicity (T) and the period (P) for which the toxicity persisted was used as an index of persistent toxicity. The values of corrected percentage mortalities at various specified periods were added. This sum was then divided by number of observations in order to obtain residual toxicity (T). The procedure followed by Saini (1959) [9] and elaborated further by Pradhan (1967) and Sarup *et al*. (1970) was utilized.

**Table 1:** Details of insecticides used in the experiment

| Sr. No. | Common name | Trade name and Formulation | Chemical name (IUPAC name) | Group of insecticide |
|---|---|---|---|---|
| 1 | Imidacloprid | Confidor 17.8 % SL | 1-(6-chloro- 3- pyridylmethyl) -N- nitroimidazolidin-2- ylideneamine | Neonicotinoid |
| 2 | Acetamiprid | Dhanpreet 30% EC | (E) - $N_1$- [(6-chloro- 3- pyridyl) methyl ] – $N_2$- cyano- $N_1$- methylacetamidine. | Neonicotinoid |
| 3 | Thiamethoxam | Actara 25 % WG | (EZ) - 3- (2- choloro- 1,3- thiazol- 5- ylmethyl) - 5- methyl- N- nitro- 1,3,5- oxaeliazinan - 4- imine. | Neonicotinoid |
| 4 | Clothianidin | Dentaso% WDG | 1-[(2-Choloro-1, 3-thiazol-5yl) methyl]-2-methyl-3-nitroguanidine. | Neonicotinoid |
| 5 | Fipronil | Reagent 5 % SC | 5- amino- [2, 6- dichloro- 4- (trifluorouethyl phenyl) - 4- (1,R,S) – (trifluorouethylsulfinyl) – 1 H- pyrazole - 3- carbonitrile. | Phenyl pyrazol |
| 6 | Diafenthiuron | Polo % WP | 1- test – butyl - 3- (2,6-di- isopropyl- 4- ohenylphenyl) thiairea. | Neonicotinoid |
| 7 | Dimethoate | Tagfor 30 % EC | O,O-Dimethyl S-methylcarbamoylmethylphosphorodithioate | Organo phosphate |

## 3. Results and Discussion

The data (Table 2) evidenced from that all the insecticides proved toxic against cotton thrips *Scirtothrips dorsalis* for the period of 14 days. At one day after spray, higher percentage mortality of thrips was registered in fipronil 0.015 per cent and diafenthiuron 0.060 per cent (22.35 and 20.22 per cent) at

14 days after first spraying. On the basis of PT values the descending order of persistent toxicity was fipronil 0.015 per cent (878.22) > diafenthiuron 0.060 per cent (824.18) > acetamiprid 0.002 per cent (789.14) > imidacloprid 0.004 per cent (771.26) > thiamethoxam 0.005 per cent (727.02) > dimethoate 0.04 per cent (728) > clothianidin 0.010 per cent (687.12).

The results showed in Table 03 revealed that fipronil 0.015 per cent concentration noted highest $LT_{50}$ value (6.39 days) followed by diafenthiuron 0.060 per cent (5.59 days), acetamiprid 0.002 per cent (4.85 days), imidacloprid 0.004 per cent (4.69 days), thiamethoxam 0.005 per cent (4.28 days), dimethoate 0.04 per cent (4.04 days), clothianidin 0.010 per cent (3.70 days) against *S. dorsalis* when exposed to cotton leaves receiving first spray.

Similar trend of results found in studies on residual toxicity of insecticides against *S. dorsalis* on leaves of cotton indicated that the PT index and $LT_{50}$ values were observed to be highest due to application of fipronil 0.015 per cent and diafenthiuron 0.060 per cent as compared to rest of the insecticides under investigation.

It is evident from Table 04 that fipronil 0.015 per cent and diafenthiuron 0.060 per cent concentration showed highest percentage mortality of *S. dorsalis* (23.21 and 20.98 per cent) at 14 days after spraying. Basis on PT values the persistent toxicity was fipronil 0.015 per cent (893.06), diafenthiuron 0.060 per cent (847.98), acetamiprid 0.002 per cent (802.90), imidacloprid 0.004 per cent (772.10), thiamethoxam 0.005 per cent (725.76), dimethoate 0.04 per cent (685.86) and clothianidin 0.010 per cent (651.56).

It is manifest from Table 05 that fipronil 0.015 per cent showed highest $LT_{50}$ value (6.79 days) against the *S. dorsalis* on cotton leaves receiving second spray application. The descending order of relative efficacy of insecticides in days was found to be fipronil 0.015 per cent (6.79) > diafenthiuron 0.060 per cent (5.60) > acetamiprid 0.002 per cent (5.28) > imidacloprid 0.004 per cent (5.01) > thiamethoxam 0.005 per cent (4.22) > dimethoate 0.04 per cent (3.72) > clothianidin 0.010 per cent (3.69).

The data on the average percentage mortality of *Bemisia tabaci* on cotton leaves receiving third spray the results (Table 06) showed that fipronil 0.015 per cent concentration showed highest percentage mortality (20.14 per cent) of *B. tabaci* on cotton leaves at 14 days after third spraying. On the basis of PT values the persistent toxicity was fipronil 0.015 per cent (889.14), acetamiprid 0.002 per cent (852.32), imidacloprid 0.004 per cent (824.32), diafenthiuron 0.060 per cent (812.98), thiamethoxam 0.005 per cent (769.86), dimethoate 0.04 per cent (732.48) and clothianidin 0.010 per cent (700.70).

The $LT_{50}$ values of insecticides against *B. tabaci* on cotton leaves receiving third spray. It is perceptible from (Table 07) that fipronil 0.015 per cent showed highest $LT_{50}$ value (6.48 days) against the *B. tabaci* on cotton leaves receiving third application of insecticides. The descending relative order of efficacy of insecticides in days was found to be fipronil 0.015 per cent (6.48) > acetamiprid 0.002 per cent (6.18) > imidacloprid 0.004 per cent (5.41) > diafenthiuron 0.060 per cent (5.34) > thiamethoxam 0.005 per cent (4.81) > dimethoate 0.04 per cent (4.28) > clothianidin 0.010 per cent (3.75).

Thus it indicates that fipronil 0.015 per cent followed by diafenthiuron 0.060 per cent showed higher residual toxicity to *S. dorsalis* as compared to other insecticides and fipronil 0.015 per cent followed by acetamiprid 0.002 per cent showed higher residual toxicity to *B. tabaci.* This could be due their systemic nature and long lasting effect.

**Table 2:** Persistence of different insecticides on leaves of cotton applied as first spray against thrips

| Insecticides | Concentration | Corrected percentage mortality after different intervals (days) | | | | P | T | PT | R.E. | O.R.E. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 79.26 | 69.87 | 51.87 | 19.38 | 55.09 | 14 | 771.26 | 1.12 | 4 |
| Acetamiprid 20 SP | 0.002 per cent | 82.20 | 72.00 | 53.30 | 18.15 | 56.41 | 14 | 789.74 | 1.14 | 3 |
| Thiamethoxam 25 WG | 0.005 per cent | 76.53 | 62.90 | 51.30 | 17.00 | 51.93 | 14 | 727.02 | 1.06 | 5 |
| Clothianidin 30 WDG | 0.010 per cent | 75.21 | 63.59 | 47.54 | 10.00 | 49.08 | 14 | 687.12 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 89.78 | 79.82 | 59.00 | 22.35 | 62.73 | 14 | 878.22 | 1.28 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 85.16 | 75.12 | 55.00 | 20.22 | 58.87 | 14 | 824.18 | 1.20 | 2 |
| Dimethoate 30 EC | 0.04 per cent | 78.14 | 69.20 | 49.52 | 11.12 | 52.00 | 14 | 728.00 | 1.05 | 6 |

**Table 3:** Relative efficacy of different insecticides against thrips on cotton applied as first spray

| Insecticides | Concentration | Heterogeneity | | Regression Equation (y=……..) | Log $LT_{50}$±S.Em | $LT_{50}$ days | Fiducial Limit (days) | R.E. | O.R.E |
|---|---|---|---|---|---|---|---|---|---|
| | | d.f. | $X^2$ | | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 2 | 1.94 | y=0.1569-1.7014x | 0.6714±0.1358 | 4.69 | 2.24, 11.52 | 1.26 | 4 |
| Acetamiprid 20 SP | 0.002 per cent | 2 | 1.02 | y=0.1109-1.4574x | 0.6860±0.1554 | 4.85 | 1.99, 16.43 | 1.31 | 3 |
| Thiamethoxam 25 WG | 0.005 per cent | 2 | 0.91 | y=0.0514-1.3160x | 0.6323±0.1686 | 4.28 | 1.31, 16.68 | 1.15 | 5 |
| Clothianidin 30 WDG | 0.010 per cent | 2 | 2.38 | y=0.0697-1.5069x | 0.5683±0.1503 | 3.70 | 1.32, 9.27 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 2 | 1.22 | y=0.2264-1.9125x | 0.8057±0.1290 | 6.39 | 3.51, 16.56 | 1.72 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 2 | 1.13 | y=0.1740-1.6548x | 0.7476±0.1441 | 5.59 | 2.75, 16.51 | 1.51 | 2 |
| Dimethoate 30 EC | 0.04 per cent | 2 | 2.34 | y=0.1185-1.6444x | 0.6068±0.1391 | 4.04 | 1.75, 9.51 | 1.09 | 6 |

**Table 4:** Persistence of different insecticides on leaves of cotton applied as second spray against thrips

| Insecticides | Concentration | Corrected percentage mortality after different intervals (days) | | | | P | T | PT | R.E. | O.R.E. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 79.26 | 70.12 | 50.87 | 19.38 | 55.15 | 14 | 772.10 | 1.18 | 4 |
| Acetamiprid 20 SP | 0.002 per cent | 83.10 | 74.00 | 54.30 | 18.00 | 57.35 | 14 | 802.90 | 1.23 | 3 |
| Thiamethoxam 25 WG | 0.005 per cent | 77.56 | 64.50 | 49.30 | 16.00 | 51.84 | 14 | 725.76 | 1.11 | 5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Clothianidin 30 WDG | 0.010 per cent | 75.11 | 61.51 | 39.54 | 10.00 | 46.54 | 14 | 651.56 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 90.14 | 81.82 | 60.00 | 23.21 | 63.79 | 14 | 893.06 | 1.37 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 87.20 | 78.12 | 56.00 | 20.98 | 60.57 | 14 | 847.98 | 1.30 | 2 |
| Dimethoate 30 EC | 0.04 per cent | 76.14 | 63.20 | 42.52 | 14.12 | 48.99 | 14 | 685.86 | 1.05 | 6 |

**Table 5:** Relative efficacy of different insecticides against thrips on cotton applied as second spray

| Insecticides | Concentration | Heterogeneity | | Regression Equation (y=……..) | Log $LT_{50}$±S.Em | $LT_{50}$ days | Fiducial Limit (days) | R.E. | O.R.E |
|---|---|---|---|---|---|---|---|---|---|
| | | d.f. | $X^2$ | | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 2 | 1.72 | y=0.1548-1.5123x | 0.7002±0.1510 | 5.01 | 2.19, 16.05 | 1.35 | 4 |
| Acetamiprid 20 SP | 0.002 per cent | 2 | 1.02 | y=0.2046-1.6197x | 0.7229±0.1433 | 5.28 | 2.52, 15.36 | 1.43 | 3 |
| Thiamethoxam 25 WG | 0.005 per cent | 2 | 0.91 | y=0.1073-1.4486x | 0.6260±0.1548 | 4.22 | 1.57, 12.51 | 1.14 | 5 |
| Clothianidin 30 WDG | 0.010 per cent | 2 | 2.38 | y=0.0115-1.3128x | 0.5681±0.1696 | 3.69 | 0.92, 11.95 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 2 | 1.22 | y=0.2767-1.8467x | 0.8320±0.1349 | 6.79 | 3.70, 19.71 | 1.81 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 2 | 1.13 | y=0.2313-1.7520x | 0.7485±0.1353 | 5.60 | 2.87, 14.93 | 1.51 | 2 |
| Dimethoate 30 EC | 0.04 per cent | 2 | 2.34 | y=0.0761-1.4372x | 0.5714±0.1564 | 3.72 | 1.22, 10.06 | 1.01 | 6 |

**Table 6:** Persistence of different insecticides on leaves of cotton applied as third spray against whitefly

| Insecticides | Concentration | Corrected percentage mortality after different intervals (days) | | | | P | T | PT | R.E. | O.R.E. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 85.00 | 73.65 | 61.22 | 15.68 | 58.88 | 14 | 824.32 | 1.17 | 3 |
| Acetamiprid 20 SP | 0.002 per cent | 86.67 | 77.54 | 62.33 | 17.00 | 60.88 | 14 | 852.32 | 1.22 | 2 |
| Thiamethoxam 25 WG | 0.005 per cent | 79.24 | 69.53 | 59.00 | 12.20 | 54.99 | 14 | 769.86 | 1.09 | 5 |
| Clothianidin 30 WDG | 0.010 per cent | 76.00 | 62.29 | 51.64 | 10.28 | 50.05 | 14 | 700.70 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 90.00 | 79.54 | 64.34 | 20.14 | 63.51 | 14 | 889.14 | 1.27 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 83.49 | 74.55 | 60.00 | 14.27 | 58.07 | 14 | 812.98 | 1.16 | 4 |
| Dimethoate 30 EC | 0.04 per cent | 77.64 | 66.23 | 53.44 | 12.00 | 52.32 | 14 | 732.48 | 1.04 | 6 |

**Table 7:** Relative efficacy of different insecticides against whitefly on cotton applied as third spray

| Insecticides | Concentration | Heterogeneity | | Regression Equation (y=……..) | Log $LT_{50}$±S.Em | $LT_{50}$ days | Fiducial Limit (days) | R.E. | O.R.E |
|---|---|---|---|---|---|---|---|---|---|
| | | d.f. | $X^2$ | | | | | | |
| Imidacloprid 17.8 SL | 0.004 per cent | 2 | 2.64 | y=0.2419-1.7577x | 0.7333±0.1341 | 5.41 | 2.76, 13.94 | 1.44 | 3 |
| Acetamiprid 20 SP | 0.002 per cent | 2 | 2.21 | y=0.2678-1.7724x | 0.7912±0.1367 | 6.18 | 3.26, 17.56 | 1.64 | 2 |
| Thiamethoxam 25 WG | 0.005 per cent | 2 | 3.00 | y=0.1951-1.5643x | 0.6826±0.1459 | 4.81 | 2.15, 13.75 | 1.28 | 5 |
| Clothianidin 30 WDG | 0.010 per cent | 2 | 2.38 | y=0.0738-1.5256x | 0.5742±0.1490 | 3.75 | 1.37, 9.35 | 1.00 | 7 |
| Fipronil 5 SC | 0.015 per cent | 2 | 2.33 | y=0.2974-1.9630x | 0.8120±0.1265 | 6.48 | 3.62, 16.31 | 1.72 | 1 |
| Diafenthiuron 50 WP | 0.060 per cent | 2 | 3.00 | y=0.2549-1.7491x | 0.7282±0.1344 | 5.34 | 2.72, 13.74 | 1.42 | 4 |
| Dimethoate 30 EC | 0.04 per cent | 2 | 2.09 | y=0.1126-1.5145x | 0.6316±0.1491 | 4.28 | 1.72, 11.79 | 1.14 | 6 |

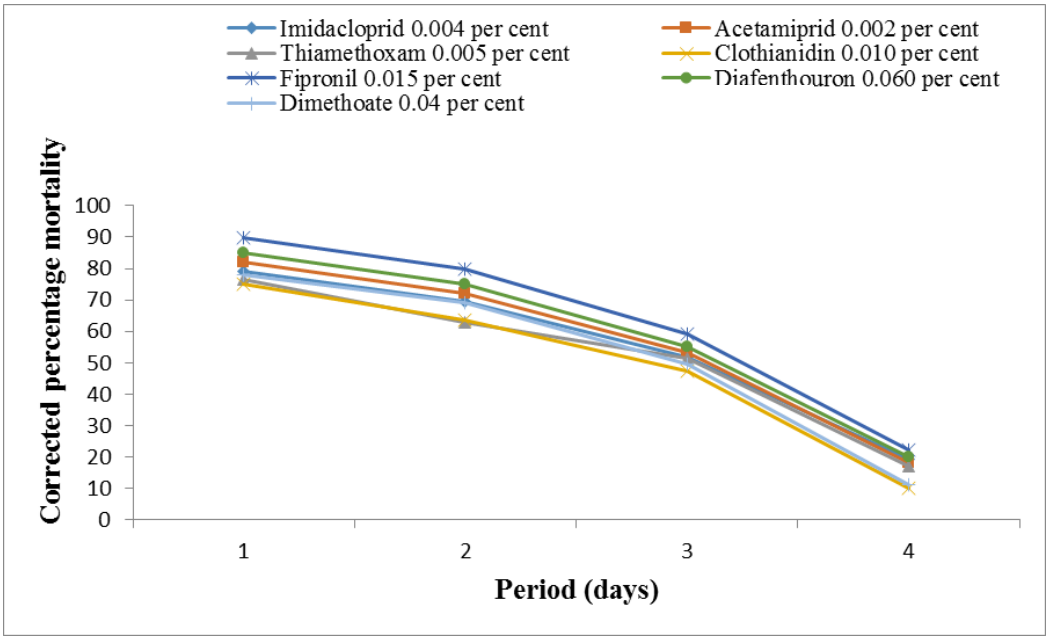


**Fig 1:** Effect of different insecticides on mortality of *Scirtothrips dorsalis* (Hood) on cotton leaves at different intervals (first spray)

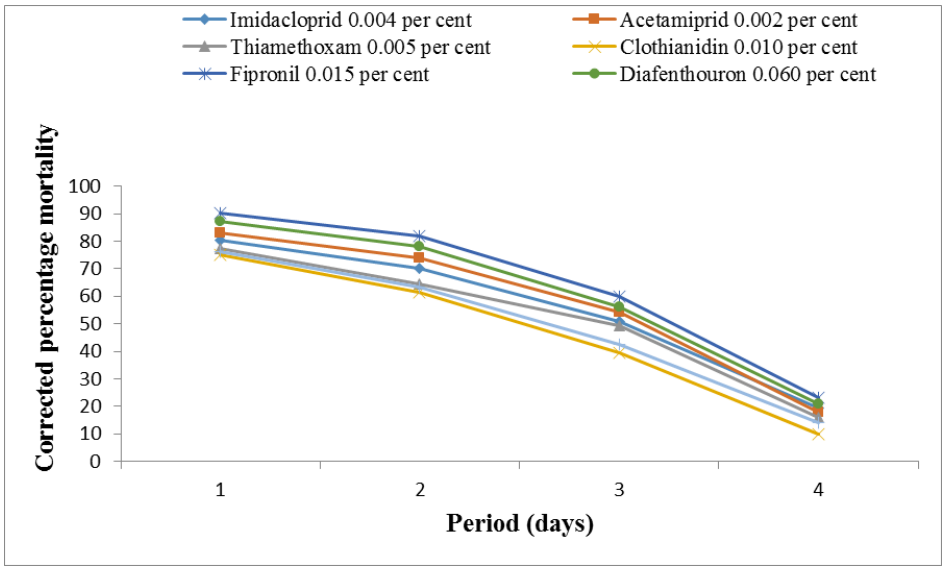


**Fig 2:** Effect of different insecticides on mortality of *Scirtothrips dorsalis* (Hood) on cotton leaves at different intervals (second spray)

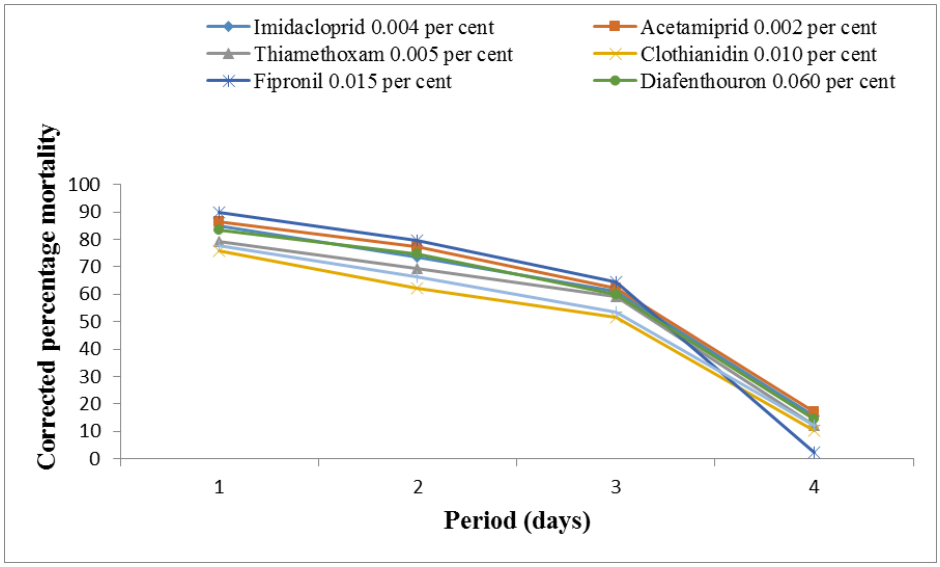


**Fig 3:** Effect of different insecticides on mortality of *Bemisia tabaci* (Gennadius) on cotton leaves at different intervals (third spray)

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