# Relative toxicity of different insecticides to Asian citrus psylla (*Diaphorinacitri*Kuwayama)


**ABSTRACT**

Asian citrus psyllids *Diaphorinacitri* (Kuwayama) act as vector of the devastating citrus disease, Huanglongbing (HLB) or citrus greening which is widely spread in citrus growing regions. The use of insecticide for control of citrus phylla is one of the prominent and effective method to overcome their menace. However, recently very few insecticide have been found under label claim for this pest. The present investigation was conducted in order to know the toxicity of some new chemistry insecticide against *D. citri*. The bioassay experiment was conducted during the year 2022-23 at Toxicology Laboratory, Department of Entomology, Dr. PDKV., Akola (M.S.). The toxicity was assessed through uptake bioassay technique forsystemic insecticide by using fresh citrus twig. The results demonstrated that, amongst the five tested insecticide imidacloprid 17.8% SL was the most the effective insecticide with lowest $LC_{50}$ values. However, except spirotetramat 15.3 % OD, the $LC_{50}$ values of thiamethoxam 25% WG, abamectin 1.9% EC, fenpropathrin 30% EC were lying within the fiducial limit of most toxic insecticide i.e. imidacloprid 17.8% SL. They are considered as at par and equally toxic to *D. citri*. The relative toxicity trend against adult psylla was imidacloprid > abamectin >thiamethoxam>fenpropathrin>spirotetramatand for nymph imidacloprid> thiamethoxam> abamectin>fenpropathrin>spirotetramat against psylla.Abamectin showed least toxic effectagainst nymph than adult psylla.



**Keywords**: Abamectin, Bioassay, Huanglongbing, Imidacloprid,Psylla, Thiamethoxam, relative toxicity.

## Introduction:

The Asian citrus psyllid, (*Diaphorinacitri*Kuwayama) (Homoptera: Psyllidae), is widely distributed in southern Asia. It is an important pest of citrus in several countries as it acts a vector of a most devastating disease called greening disease or Huanglongbing (HLB) caused by "*Candidatus*Liberibacter asiaticus, cause heavy losses to citrus orchards emanates the destruction of several citrus industries in Asia and Africa (Manjunath *et al*., 2008). Fifth instar nymphs act as a vector of greening bacterium which accelerates the decline 83 to 95 per cent losses (Dawane *et al.* 2013). Both nymphs and adults of citrus psylla suck the cell sap with the help of their sharp piercing mouth parts, resulted curling, leaves and flowers defoliation and die back of branches from tip to downward and premature dropping of fruits (Shah and Saleem, 2000).HLB acts to disrupt the phloem of the tree by limiting its ability to uptake nutrients. Initially this leads to yellowing of leaves, infested trees showing stunted growth, sparsely foliated branches, unseasonal bloom, promotion of premature leaf and fruit drop, twig dieback, production of small, misshapen fruit that contain bitter juice with no economic value (Salifu *et al.* 2012). Young leaves are chlorotic with green banding along the major veins. Mature leaves have yellowish-green patches between veins, fruits with small size, generally lopsided, underdeveloped, unevenly colored, hard, and poor in juice (Capoor*et al.*, 1974). The population of citrus psylla has two peaks in a year during spring and summer (Beloti*et al*., 2013), these peaks obtained coincided with the availability of new flush. Insecticides are best strategic measure to control psyllid populations. Imidacloprid and aldicarb are suggested effectively in the period of November and April (Qureshi and Stansly, 2007; 2008; Rogers *et al.*, 2008). Similarly, broad spectrum insecticides are used in winter, spring and summer season as foliar sprays (Rogers *et al*., 2008;Rogers, 2008; Stansly*et al*., 2009), but they give short term protection against immature psyllids (Qureshi and Stansly, 2007 and 2009). Even if, cultural, mechanical and biological control practices are not easily applicable, labour demanding and not greatly effective in heavy attack due to different reasons. The use of chemical for control of citrus psylla is one of the prominent, effective and rapid method to overcome their menace. However, recently a very few insecticide have been found under label claim for this pest. Therefore,it'sa need to test some novel chemical insecticides against *D. citri*, as alternate option tolabel claim insecticide in view to reduce the development of resistances and residual effect. So, keeping these facts in mind, the present investigation was aimed to determine the toxicity of some new chemistry insecticide against *D. citri*.

## Methodology:

The bioassay experiment was conducted during the year 2022-23 in the Toxicology Laboratory, Department of Entomology, Dr. PDKV., Akola (M.S.).The toxicity was assessed through uptake bioassay techniquefor systemic insecticides(Molina *et al.*, 2022) using fiveinsecticides viz. Thiamethoxam 25 % WG, Abamectin 1.9 % EC, Imidacloprid 17.8 % SL, Spirotetramat 15.3% OD, Fenpropathrin30% EC etc.Bioassays were conducted against nymph and adult in laboratory withfour replicates per insecticide.The nymphal population of psylla was collected in the zipped plastic bags and brought to the laboratory. The adult population were carefully captured in glass vial or polythene bag and tied it with rubber band to avoid the escape. Provided them fresh, moisten leaves in the laboratory till the start of assay.Citrus shoots infested with psyllid nymphs of 15 cm (at least two-three terminal leaves) was placed in a glass tube (50 ml) with one insecticide solution for 24 h. Distilled water was used as a control treatment. Each stem was protected with a paper cone with glycerin in the corners to prevent nymphs from escaping. After that, shoots was transferred to a glass tube with water, where nymph mortality was checked after 24, 48, 72 and 96 hours.

For the adult experiment, citrus shoots were placed in each insecticide solution for 24 h. After that, shoots were transferred to a clean 50 ml tube with water. Each tube was placed inside a plastic container (1 L) with a filter paper disc on the bottom, a 2 ml water vial as a humidity source, ten adults were released in container and covered with muslin cloth. The numbers of dead and live psyllids adults were counted observations were recorded at 6, 12, 24 and 48 hr after treatment. The corrected per cent mortalities were determined as per Abbott's formula (Abbott, 1925) and the $LC_{50}$ values were determined by running probit analysis (Finney, 1952).

## Results and Discussion:

The nymph and adult mortality of *D. citri* were exposed to different concentrations of insecticides. $LC_{50}$ and $LC_{90}$ value calculated to compare the toxicity of various insecticides

(Pandi *et al.*, 2013). The bioassay results demonstrated that, amongst the five tested insecticide imidacloprid was the most effective insecticide with lowest $LC_{50}$ values. In case of nymphal bioassay,at the $LC_{50}$ levels the imidacloprid was 3.61 time more toxic than spirotetramat(Unity). Abamectin, thiamethoxam and fenpropathrin 30% EC recorded 2.97, 3.48and 2.73 fold higher toxic thanspirotetramat(Table 1). In adult, the relative toxicity of imidacloprid was found 3.13 fold more toxic than the unity i.espirotetramat, The next better insecticide were abamectin, thiamethoxam and fenpropathrin recording relative toxicity values, respectively of 2.94, 2.70 and 2.44 fold more toxic than spirotetramat(Unity), which was found least toxic to *D. citri*(Table 2).

A similar trend of toxicity at $LC_{90}$ level was observed against nymph and adult for the all the tested insecticides.However, except spirotetramat, the$LC_{50}$ values of thiamethoxam, abamectin, fenpropathrin were lying within the fiducial limit of most toxic insecticide i.e. imidacloprid. They are considered as at par and equally toxic to *D. citri*.

The above results, regarding the relative toxicity of different insecticides are in agreement with the findings of previous workers;Chauhanand Srivastava(2018)who tested the field efficacy of different insecticide against *D. citri* and revealed that, imidacloprid in most effective in reduction of nymph and adult population of psylla, followed by thiamethoxam and novaluron.The present study is also supported by Powell *et al.* (2007) who reported that, the biannual or more frequent applications of Admire (imidacloprid) significantly reduced psyllid population, percentage of trees infestations and percentage of flushes infestations.

Similar results were reported by Childers and Rogers (2005) reported that, foliar applications with thiamethoxam and imidacloprid was found to reduce psylla population of 86.9-96.4 % and 91.5-98.0 % over control up to 12 DAT (Sharma 2008). Foliar application with abamectin @ 0.3ml/l resulted 90.2-92.5% reduction in psylla population (Rao and Shivankar 2011). Sarada *et al.* (2014) also reported that, foliar application of abamectin @ 0.0007 % reduced psylla population more than 80 % after 3 and 7 DAT. The present findings are in line with the findings of Boina *et al.* (2009) who reported that feeding by psylla adults on daily treated plants with a sublethal concentration (0.1μ/L) of imidacloprid significantly reduced the population of citrus psylla. Khan *et al.* (2012) reported that, bioassay with methomyl and imidacloprid inflicted 97-100% mortality to *D. citri*.They also observed gradually decline in mortality in case of methomyl but it was very quick in imidachloprid and lambda cyhalothrin.

According to Wankhade *et al.*(2015) the treatment with abamectin 1.9 EC @ 0.4 ml/l (0.0007%) was found most effective inrecording the least nymphal population under field conditionsfollowed by imidacloprid 17.8 SLwhich proved effective against citrus psylla.The present studies are in line with Molina *et al.*(2022) who reported that thiamethoxamand imidacloprid were the equally effective on African citrus psylla (*Triozaerytreae)*nymphs and were persistentover time. Spirotetramat and abamectin were the least effective on*T. erytreae* nymph control, which collaborates with the resultsin the present studies. Khan *et al.* (2013), reported a cumulative mortality of adult *D. citri* with Confidor® (imidacloprid), Movento® (spirotetramat) and Radiant® (spinetoram) were more than 95% at commercially recommended doses.Qasim and Hussian (2015) reported that, imidacloprid was better than Bifenthrin against*D. citri*.The results are in congruent with Dalvaniya*et al.* (2015) who reported that foliar applications of imidacloprid and thiamethoxam significantly reduced *D. citri.*population in lime plants. In accordance with the present findingof Rao*et al.*(2011) revealed that, module with foliar application of thiamethoxam, abamectin and imidacloprid at 20 days interval before, during and after flushing periods was found to be superior in protecting new flush against *D. citri*.

## Conclusion:

Based on the relative toxicity values obtained in the present studies the various insecticide tested can arranged in sequence of better toxicity as imidacloprid > abamectin > thiamethoxam >fenpropathrin>spirotetramatagainst adult psylla and imidacloprid > thiamethoxam> abamectin >fenpropathrin>spirotetramatagainst nymph.

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*Fig. 1 Adult psylla bioassay*


*Fig. 2 Nymph psylla bioassay*

**Table 1. Median lethal concentration (LC 50) of different insecticides on citrus psylla (nymph) under laboratory conditions.**

| Sr. no. | Insecticide | Slope | Regression equation (y) | Chi-Square | LC50 % | Fiducial Limit | | LC90 % | Fiducial Limit | | Relative Toxicity atLC50 | Relative Toxicity Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper | | Lower | Upper | | |
| 1 | Thiamethoxam 25 % WG | 2.72 | Y=4.19+2.72x | 0.566 | 0.029 | 0.018 | 0.045 | 0.086 | 0.055 | 0.134 | 3.48 | 2 |
| 2 | Abamectin 1.9 % EC | 17.28 | Y=25.35+17.28x | 0.622 | 0.034 | 0.032 | 0.037 | 0.040 | 0.038 | 0.044 | 2.97 | 3 |
| 3 | Imidacloprid 17.8 % SL | 4.33 | Y=6.70+4.33x | 0.754 | 0.028 | 0.021 | 0.038 | 0.056 | 0.041 | 0.076 | 3.61 | 1 |
| 4 | Spirotetramat 15.3 % OD | 4.46 | Y=4.44+4.46x | 0.737 | 0.101 | 0.077 | 0.133 | 0.196 | 0.149 | 0.257 | 1.00 | 5 |
| 5 | Fenpropenthrin 30 % EC | 20.04 | Y=28.73+20.04x | 0.755 | 0.037 | 0.035 | 0.039 | 0.043 | 0.040 | 0.045 | 2.73 | 4 |

**Table 2. Median lethal concentration (LC 50) of different insecticides on citrus psylla (Adult) under laboratory conditions.**

| Sr. no. | Insecticide | Slope | Regression equation (y) | Chi-Square | $LC_{50}$ (%) | Fiducial Limit | | $LC_{90}$ (%) | Fiducial Limit | | Relative Toxicity at $LC_{50}$ | Relative Toxicity Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper | | Lower | Upper | | |
| 1 | Thiamethoxam 25 % WG | 2.56 | Y=3.67+2.56x | 0.020 | 0.037 | 0.023 | 0.060 | 0.117 | 0.072 | 0.191 | 2.70 | 3 |
| 2 | Abamectin 1.9 % EC | 16.94 | Y=24.97+16.94x | 0.952 | 0.034 | 0.031 | 0.036 | 0.040 | 0.037 | 0.043 | 2.94 | 2 |
| 3 | Imidacloprid 17.8 % SL | 3.30 | Y=4.92+3.30x | 0.283 | 0.032 | 0.022 | 0.047 | 0.079 | 0.054 | 0.114 | 3.13 | 1 |
| 4 | Spirotetramat 15.3 % OD | 4.54 | Y=4.54+4.54x | 0.811 | 0.100 | 0.076 | 0.131 | 0.192 | 0.146 | 0.251 | 1.00 | 5 |
| 5 | Fenpropenthrin 30 % EC | 16.35 | Y=22.73+16.35x | 0.837 | 0.041 | 0.037 | 0.044 | 0.049 | 0.045 | 0.053 | 2.44 | 4 |