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# BIO-EFFICACY OF SOME INSECTICIDES AGAINST *PYRILLA PEPUSILLA* WALKER AND ITS BIOAGENT *EPIRICANIA MELANOLEUCA* ON SUGARCANE

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## ABSTRACT

Field experiments were carried out during spring season of 2015 to examine the bio-efficacy of selected insecticides on the pest incidence, ectoparasitoids, and yield attributes of sugarcane. The result showed that the mean per cent mortality of pyrilla in 1, 3, 7 and 14 days after spraying, Imidaclopriod 17.8 SL@ 0.5 ml/L proved significantly effectively with 62.31 and 79.83% mortality followed by profenofos 50 EC @ 2 ml/h with 56.32 and 73.44% mortality when these were recorded 1 and 3 DAS, respectively. Same trend was also recorded after 7 and 14 DAS. As far as concerned with bio-efficacy of insecticides against bio-agent. Azadirachtin proved least toxic to cocoons and egg masses of *E. melanoleuca* followed by Thiomethoxam on the basis of per cent reduction of cocoons and egg masses after 10 days treatments. Whereas, Imidacloprid proved highly toxic.The result, status obtained with respect to cane yield revealed that, application of Imidacloprid recorded the highest cane yield of 81.3 t/ha followed by Profenofos yield being 78.2 t/ha, which were 40.5 and 35.0, per cent increased over untreated control, respectively.

## INTRODUCTION

Sugarcane (*Saccharum* sp. hybrid complex) is one of the important cash crops grown in tropical and subtropical countries of the world and world's most efficient living collector of solar energy, storing this energy in a huge quantity of biomass in the form of fiber and fermentable sugars. This crop is of a great importance in the agricultural sector and in general economy of many of the tropical developing countries relies on it. It provides employment not only to agricultural labours in the fields but also to industrial labours in the sugar factories. It is also an important source of foreign exchange. It is cultivated an about 50.12 lakh hectares in more than 90 countries with the worldwide harvest of 1.69 billion tonnes as estimated by FAO during 2014. India occupies an important position among the sugarcane producing countries and has a neck to neck race with Brazil for the first position.

In India, it is cultivated in about 5.08 million hectares of land with an annual production of 351 million tonnes and productivity 70 tonnes per hectare during 2013-14 (Anonymous, 2014). It is grown under varied soil and climatic conditions, but its productivity is generally limited by abiotic and biotic stresses as it has to face vagaries of nature throughout the year around in the field. Productivity of sugarcane in Bihar is 51.7 tonnes per hectare which is very low as compared to national average of 70 tonnes per hectare (Anonymous, 2014). The poor yield of sugarcane is attributed to the attack of pests and diseases, inadequate irrigation facilities, short supply of manures and fertilizers, lack of high yielding varieties, resistant varieties, lack of knowledge of actual time of incidence of pests and multi-ratooning. This is facilitated by the uninterrupted cropping pattern and favorable canopy structure of the crop offering conductive microclimate for pests build up. The sugarcane yield loss is also increasing day by day due to monoculture and negligence towards plant protection measures. The sugarcane leaf hopper, *Pyrilla perpusilla* Walker (Lophopidae: Homoptera) is one of the major insect pests of sugarcane and has been recorded from many parts of India. Both nymph and adults suck the cell sap from the ventral surface of the leaf. In severe condition the leaves becomes pale and wilted, and growth of the plant is arrested. Such crop gives a sticky and blighted appearance (Jena and Nayak, 1994). The sugar recovery and tonnage was reduced as 2.0 and 25.0 per cent, respectively, during the epidemic years (Karla, 1973). Pyrilla perpusilla causes enormous losses to the sugarcane farms and sugar industry. The natural bio agent is abundant in sugarcane agro ecosystem. Keeping this in view, the present study was conducted to evaluate the bio-efficacy of insecticides against pyrilla and safer insecticides against its bio agent.

## MATERIALS AND METHODS

Field experiment of different selected insecticides were conducted to examine their effects on the pest incidence, its ecto-parasitoids, quality and yield of the caneduring 2015-16 at the Pusa Farm, S.R.I., Pusa. There were seven treatment including control being$T_1$ = Imidacloprid 17.8 SL @ 0.5 ml/L of water, $T_2$ = Thiomethoxam 25 WG @ 1gm/L of water, $T_3$ =

Profenofos 50 EC @ 2ml/L of water, $T_4$ = Fipronil 5 SC @ 1ml/L of water, $T_5$ = Azadirachtin 0.15% @ 5ml/L of water, $T_6$ = Malathion 50 EC @ 2ml/L of water and $T_7$ = Control.

Selected field was well ploughed and planting of cane was done in the month of February, 2015. A plot size of 10 X 5.4 $m^2$ was maintained with distance between row to row of 90cm and replicate thrice, providing all the agronomical practices recommended by S.R.I., Pusa for cultivation of sugarcane. One meter space was kept between two blocks to facilitate the irrigation, spraying of insecticides, besides lessening the border effects, adopted normal cultural operation like hoeing, weeding, irrigation and earthing up etc. which were timely provided.

The insecticides were sprayed at their respective doses. The control plot will be treated with water. The spraying was done at one time when pyrilla population was at peak level and the crop was about 5 months old having maximum pyrilla population.

**Observation on the incidence of pest and its ecto-parasitoid**

Observations were made on the population of nymphs and adults of pyrilla and its parasitoid (cocoons and egg masses) per 10 leaves randomly selected per reapplication at lower, middle and upper portion of plants. The pre treatments observations were recorded one day before the application and the post treatment observations were recorded on 1, 3, 7 and 14 days after spraying of insecticides for pyrilla and after 10 days in case of bioagents (cocoons and egg masses). The per cent reduction in population of the pest was calculated with the help of Henderson and Tilton formula (1955).

$$\text{Corrected\%} = \left(1 - \frac{\text{n in C before treatment} \times \text{n in T after treatment}}{\text{n in C after treatment} \times \text{n in T before treatment}}\right) \times 100$$

Where,

n = Insect population, T = treated, C = control

**Estimation of quality and yield**

Juice analysis of the cane samples from each of the experimental plot was done in the Department of Soil Science, S.R.I., Pusa. The commercial cane sugar (CCS) per cent and purity per cent were calculated with the help of the following formula given by Gupta (1977) as:

CCS per cent = (S – 0.4 (CB – S) x 0.73

Where

CB = corrected brix

S = sucrose %

$$\text{Purity percent of the juice} = \frac{\text{Pol \%}}{\text{corrected brix of the juice}} \times 100$$

At the time of harvesting yield was recorded from the individual experimental plot during the year and data analyzed statistically.

## RESULTS AND DISCUSSION

**Effect of insecticides on pyrilla population**

The data along with their mean mortality per cent are presented in the Table 1. The per cent mortality of pyrillaon 1, 3, 7, and 14 days after spraying (DAS) of different insecticides revealed that Imidacloprid proved significantly effective with 62.13% mortality, when it was recorded at 1 DAS. Profenofos was the next best treatments with about 56.32% mortality. Malathion (43.02%), Fipronil (41.79%) and Thiomethoxame (38.90%) were moderate in action for mortality. Azadiracht in was less effective with 27.47% mortality.

At 3 DAS, Imidacloprid, Profenofos proved significantly effective with 79.83% and 73.44% mortality, respectively. Malathion was the next best treatments with 61.70% mortality. Thiomethoxam (43.65%) and Fipronil was moderate in action with (43.65%) mortality. Azadiracht in was less effective with 41.6% mortality.

At 7 DAS, Imidacloprid, proved significantly effective with 56.49% mortality followed by Profenofos 51.27%mortality. Malathion and Fipronilwere 38.84% which have some effectiveness Thiomethoxam was moderate in action with 37.14% mortality and Azadirachtin, was less effective 28.5% mortality.

At 14 DAS, Imidacloprid, proved significantly effective with 48.62% mortality. Profenofos was the next best treatments with 40.27% mortality. Malathion, Fipronil and Thiomethoxam were moderate in action with 27.49, 25.38 and 21.33% mortality, respectivley. Azadirachtin was less effective with about 19.76% mortality.

It is evident from the Table 1 that maximum pest reduction was found due to application of Imidacloprid after 1DAS, 3 DAS, 7 DAS and 14 DAS as 62.13, 79.83, 56.49 and 48.62 per cent, respectively followed by Profenofos as 56.32, 73.44, 51.27 and 40.27 per cent, respectively,Similarly Yadav *et.al.*2016 reported that Imidacloprid spray resulted into 97.88% reduction in aphid population over control followed

**Table 1: Bio-efficacy of some insecticides against *Pyrilla perpusilla* Walker on sugarcane under field conditions**

| T. No. | Treatments | Dosage | Mean corrected per cent mortality (days) | | | |
|---|---|---|---|---|---|---|
| | | | 1 DAS | 3 DAS | 7 DAS | 14 DAS |
| $T_1$ | Imidacloprid 17.8 SL | 0.5 ml/L | 62.13 | 79.83 | 56.49 | 48.62 |
| $T_2$ | Thiomethoxam 25 WG | 1gm/L | 38.90 | 43.65 | 37.14 | 21.33 |
| $T_3$ | Profenofos 50 EC | 2ml/L | 56.32 | 73.44 | 51.27 | 40.27 |
| $T_4$ | Fipronil 5 SC | 1ml/L | 41.79 | 43.65 | 38.84 | 25.38 |
| $T_5$ | Azadirachtin 0.15% | 5ml/L | 27.47 | 41.76 | 28.56 | 19.76 |
| $T_6$ | Malathion 50 EC | 2ml/L | 43.02 | 61.90 | 38.84 | 27.49 |
| $T_7$ | Control. | - | 11.86 | 24.45 | 17.60 | 9.78 |
| | SEm ± | | 1.694 | 2.635 | 1.983 | 1.536 |
| | CD at 5% | | 5.220 | 8.121 | 6.113 | 4.733 |
| | CV (%) | | 7.296 | 8.376 | 9.864 | 9.667 |

Tabulated data represents mean of three replications;* Significant at 5% probability level;** Significant at 1% probability level.

**Table 2: Effect of different insecticides on cocoons and egg masses of *Epiricania melanoleuca* on sugarcane**

| T. No. | Treatments | Per cent reduction of cocoons and egg masses after 10 days of treatments | |
|---|---|---|---|
| | | Cocoons | Egg masses |
| $T_1$ | Imidacloprid 17.8 SL | 36.14 | 39.39 |
| $T_2$ | Thiomethoxam 25 WG | 22.10 | 24.12 |
| $T_3$ | Profenofos 50 EC | 33.80 | 36.68 |
| $T_4$ | Fipronil 5 SC | 28.68 | 29.94 |
| $T_5$ | Azaradichtin 0.15% | 11.57 | 13.45 |
| $T_6$ | Malthion 50 EC | 31.25 | 34.76 |
| $T_7$ | Control. | 5.07 | 7.69 |
| | SEm ± | 1.232 | 1.474 |
| | CD at 5% | 3.797 | 4.340 |
| | CV (%) | 8.863 | 9.642 |

Tabulated data represents mean of three replications;* Significant at 5% probability level ; ** Significant at 1% probability level.

**Table 3: Effect of insecticides application on the quality parameters of sugarcane**

| T. No. | Treatments | Brix (%) | Pol (%) | Purity (%) | CCS% |
|---|---|---|---|---|---|
| $T_1$ | Imidacloprid 17.8 SL | 19.60 | 17.69 | 89.87 | 12.33 |
| $T_2$ | Thiomethoxame 25 WG | 18.93 | 16.55 | 87.73 | 11.44 |
| $T_3$ | Profenofos 50 EC | 19.20 | 16.98 | 88.46 | 11.75 |
| $T_4$ | Fipronil 5 SC | 19.06 | 16.74 | 87.86 | 11.54 |
| $T_5$ | Azadirachtin 0.15% | 18.33 | 15.90 | 86.76 | 10.90 |
| $T_6$ | Malathion 50 EC | 19.13 | 16.84 | 88.03 | 11.62 |
| $T_7$ | Control. | 17.80 | 15.20 | 85.40 | 10.34 |
| | SEm ± | 0.403 | 0.478 | 0.651 | 0.84 |
| | CD at 5% | 1.244 | 1.473 | 2.416 | 1.02 |
| | CV (%) | 3.708 | 4.621 | 1.549 | 3.21 |

Tabulated data represents mean of three replications;* Significant at 5% probability level;** Significant at 1% probability level.

**Table 4: Effect of insecticides application on the yield parameters of sugarcane**

| T. No. | Treatments | Dosage | Yield (t/ha) | % increase over control |
|---|---|---|---|---|
| $T_1$ | Imidacloprid 17.8 SL | 0.5ml/L | 81.30 | 40.50 |
| $T_2$ | Thiomethoxam 25 WG | 1gm/L | 73.80 | 27.400 |
| $T_3$ | Profenofos 50 EC | 2ml/L | 78.20 | 35.00 |
| $T_4$ | Fipronil 5 SC | 1ml/L | 75.60 | 32.50 |
| $T_5$ | Azadirachtin 0.15% | 5ml/L | 70.10 | 21.00 |
| $T_6$ | Malathion 50 EC | 2ml/L | 76.70 | 30.60 |
| $T_7$ | Control. | - | 57.90 | - |
| | SEm ± | | 3.277 | - |
| | CD at 5% | | 10.103 | - |
| | CV (%) | | 7.743 | - |

Tabulated data represents mean of three replications;* Significant at 5% probability level;** Significant at 1% probability level.

by thiamethoxam, dimethoate and fipronil with 97.27, 96.67 and 95.45 per cent reduction in aphid population over control respectively.Malathion, Fipronil and Thiomethoxam also possessed better insecticidal action and these were statistically significant at 5% probability in the field conditions in comparison to control. The insecticides arranged on the basis of relative toxicity in the following descending order of performance are, Imid aclo prid > Profenofos > Malathion > Fipronil > Thiomethoxam > Azadirachtin.The effectiveness of Imidacloprid in reducing *P. perpusilla* population was reported by several researchers (Rajak 2006, Deepak and Chaudhary, 1999; Tewari *et al*., 1990). Similarly, Kalyan *et al*. (2012) also reported that imidacloprid, acephate and fipronil effectively managed the population of whiteflies.Tripathi (2004) reported that the sequence of effectiveness in descending order of various treatments were Imidacloprid > Deltamethrin > Acephate > Malathion > Endosulfan > NSKE > Nimbicidin > Achook > M. anisopliae > B. bassiana. Mathur and Upadhyay (2005) recommended Endosulfan, Phosalone, Dimethoate and Malathion for the control of Pyrilla.

Rahim (1989) reported that the efficacy of Malathion was the most effective, followed by Phorate, Azinphos-methyl, Dimethoate, Chlorpyrifos, HCH and Acephate. Tewari *et al*. (1990) also reported that the efficacy of synthetic PyrethroidsPermethrin; Quinalphos and Cypermethrin were highly toxic to *Pyrilla perpusilla*, the relative toxicities being 19.500, 2.198 and 1.773 times greater than that of Malathion.

**Effect of different insecticides on cocoons and egg masses of *Epiricania melanoleuca***

Effect of different insecticides on cocoons and egg masses of *Epiricania melanoleuca* on sugarcane in field conditions (Table 2). The results indicated that all the insecticides were significantly toxic to the cocoons and egg masses of *E. melanoleuca*. Among the treatments, Azadiractin proved least toxic to cocoons and egg masses of *E. melanoleuca* followed by Thiomethoxam and Fipronil on the basis of per cent reduction of cocoons and egg masses after 10 days treatments. Profenofos and Malathion were found moderately toxic whereas, Imidacloprid proved highly toxic.

It is evident from the Table: 2 that minimum (11.57%) reduction of cocoons and egg masses (13.45%) of *E. melanoleuca* was found due to application of Azadirachtin after 10 days, followed by Thiomethoxam (22.10%) during crop season which were highly safe insecticides against *E. melanoleuca*. Fipronil, Malathion and Profenofos also possessed better safe in action and it is statistically significant at 5% probability in the field conditions in comparison to control. The insecticide arranged on the basis of relative safety in the following descending order of performance are, Azadiracht in > Thio methoxam > Fipronil > Malathion > Profenofos > Imidacloprid. Thus, the safer insecticides like Azadiracht in, Thiomethoxam and Fipronil can be included in the management of pyrilla, since these insecticides showed greater capability with population of *E. melanoleuca* than the test of the insecticides. The effectiveness of Azadiractin in reducing *E. melanoleuca* population was reported by Tripathi (2004).Achook, Endosulfan and Chlorpyriphos as less toxic to *E. melanoleuca*.Tripathi (1998) also revealed that Endosulfan was most effective in respect to the pest control as well as safety to the ecto-parasitoid.Bindra *et al*.(1970) reported Malathion to be safer to the ecto-parasitiod, whereas, in the present finding *Achook* and Endosulfan proved safer to ecto-parasitoid. Bindra *et al*.(1970) also reported the increase of cocoons of *E. melanoleuca* up to 25 per cent due to the application of Malathion UTV. Tewari *et al*.(1986) also reported an increase in numbers of cocoons in different insecticidal treatments.

**Effect of insecticides application on the quality parameters**

The data of quality parameter is presented in table 3.Effect of different insecticides application on brix per cent reveals that 19.60% was highest with Treatment ($T_1$) followed by 19.20%, 19.13% and 19.06% of $T_3$, $T_6$ and $T_4$, respectively. Pol%, Purity% and CCS% were also high with $T_1$ which were highly significant over control. Remaining treatments also remained at par. The pol, purity and CCS per cent ranged from 15.27 to 17.79, 85.4 to 89.83 and 10.34 to 12.33 per cent, respectively. However treatment-1 (Imidacloprid), showed highly significant results among all the treatments. Thus, it may be concluded that among the different insecticides application treatment-1 may be utilized as indicated by brix (19.60%), pol (17.79%), purity (89.83%) and CCS (12.33%). The overall performance of Imidacloprid was found to be the best in improving the cane quality followed by Profenofos, Thiomethoxam and Fipronil. Tewari (1984) observed that the application of Fenavalerate, Quanalfos and Malathion @ 0.15, 0.3 and 0.5 kga.i./ha were effective in improving the quality of cane juice significantly.

**Effect of insecticides application on the yield parameters**

The data recorded on cane yield and increasedpercentage in yield over untreated control (UTC) are presented in the Table 4 the result, status obtained with respected to cane yield revealed that, application of Imidacloprid @ 0.5 ml/L recorded the highest cane yield of 81.3 t/ha and 40.5% increased over UTC. This was followed by Profenofos 50 EC @ 2ml/L which was recorded 78.2 t/ha and 35.0% increased over UTC, Malathion 50 EC @ 2ml/L recorded 76.7 t/ha and 30.6% increased over UTC, Fipronil 5 SC @ 1ml/L recorded 75.6 t/ha and 32.5% increased over UTC. The next best treatment was Thiomethoxam 25 WG @ 1gm/L which recorded 73.8 t/ha with 27.4% increased over UTC. Azadirachtin 0.15% @ 5ml/L also recorded significant increase in cane yield and increased over UTC. All these insecticides were statistically at par with each other in terms of bio-efficacy and cane yield.

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