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FIELD EVALUATION OF FIPRONIL AND LAMBDA CYHALOTHRIN FOR THE CONTROL OF SUGARCANE LEAF HOPPER (*PYRILLA PERPUSILLA*) ON SUGARCANE

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ABSTRACT
Sugarcane is the primary cash crop and the only source of sugar in Pakistan. The growing population has led to an increased demand for sugar, requiring higher yields of sugarcane. However, insect pests, such as *Pyrilla perpusilla*, pose a significant challenge to increasing yields and must be managed to reach production goals. An experiment was carried out in Pattoki, District Kasur to evaluate the effectiveness of chemical control on sugarcane leaf hopper, *P. perpusilla*. Sugarcane US-54 was planted in last week of March, 2022 and two insecticides, Fipronil -5 SC @ 2ml/lit. of water and Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water were tested against an untreated control group using a randomized block design with three replicates. The results showed that both insecticides significantly reduced the infestation of leaf hoppers at 10, 15, and 30 days after treatment, leading to an increase in cane yield as compared to the control group. Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water was found to be the most effective in controlling Pyrilla infestation among all the products tested.

Keywords: Chemical method, Fipronil (5% SC), Lambda cyhalothrin (2.5% EC), Sugarcane, *P. perpusilla*

INTRODUCTION

Sugarcane (*Saccharum officinarum*) holds a prominent position among Pakistan's cash crops, exerting a substantial influence on the economic growth of the farming community. Its significance extends beyond being a source of raw materials for sugar mills, chipboard and paper industries. With its contribution of 2.9 percent to Pakistan's agricultural value added, sugarcane plays a pivotal role in shaping the country's agricultural sector. Moreover, it also contributes 0.5 percent to the nation's GDP, as reported by the GOP in 2019. This highlights the vital role of sugarcane cultivation in Pakistan's overall economic development.

Modern cultivars originated from the hybridization of previously cultivated *S. officinarum, S. barberi*, and wild *S. spontaneum*, followed by the backcrossing of *S. officinarum* almost a century ago (Pompidor *et al.*, 2021). The global sugar production amounts to approximately 160 Mt annually, with a per capita consumption of 23 kg. Consumption is steadily increasing by 1.5 percent each year, especially in densely populated countries like China and India (Biancardi et al., 2010). Beet (*Beta vulgaris*) accounts for about one-fourth of the global sugar production, while the remaining comes from sugarcane (*S. officinarum*) (Taspinar *et al.*, 2019).

The main reason for the low sugarcane output is insect infestations. Precise calculations of the yield losses resulting from insect attacks are not available in Pakistan; however, reports indicate that the top-borer, Gurdaspur borer and Pyrilla reduce yields by 15-20, 10-20 and 30-35 percent, respectively. According to Zubair *et al.* (2006), there have been reports that where insect attacks have resulted in crop output reductions of up to 80–85%. High temperatures exceeding 40 °C, humidity below 50 percent, and westerly winds will significantly decrease the pyrilla population (Gangwar *et al.,* 2008).

The Pyrilla, scientifically known as *P. perpusilla* (Walker) belongs to the order Hemiptera: Lophopidae family, is a notorious pest that feeds on sugarcane leaves. It is commonly referred to as the sugarcane leafhopper and is found extensively across various Asian countries. These countries include India, where it has been studied by Kumar *et al.* (2015) and Mahesh *et al.* (2019), Nepal as documented by Neupane (1976), Pakistan as researched by Rasul *et al.* (2014) and Yaseen *et al.* (2021), Thailand as mentioned by Fennah (1963), Sri Lanka as studied by Ganehiarachchi and Fernando (2006), and China, Cambodia, and Vietnam as reported by Liang (1997) and Emeljanov (2018) respectively. The widespread distribution of this sucking pest highlights its significance and the need for effective management strategies in these regions.

Pyrilla, a pest commonly found on sugarcane, has also been observed on a variety of other crops including maize, sponge gourd, sorghum, bitter gourd, pearl millet, barley, okra, wheat, watermelon, pumpkin, rice, oat, peas, bamboo, and wild grasses (Ganehiarachchi and Fernando, 2006). Both nymphs and adult Pyrilla insects feed on the phloem sap of sugarcane leaves, specifically near the midrib, which leads to yellowing of the leaves. When infestations are severe, the sugarcane leaves can turn pale and dry up. Additionally, the insects secrete honeydew, which can promote the growth of sooty mold on the leaves. This mold reduces the plants' ability to carry out photosynthesis, ultimately affecting their overall productivity. Furthermore, the increased glucose content in sugarcane juice due to Pyrilla infestation can negatively impact the quality of gurr production, thereby reducing its economic value (Chaudhary and Sharma, 1988).The impact of *P. perpusilla* has been documented to result in a reduction of up to 28% in potential sugarcane yield and a decrease of 2-3% in sucrose content. Additionally, feeding by *P. perpusilla* leads to stunted growth of sugarcane sets, making milling of affected canes more challenging (Kumarsinghe and Wratten, 1996).

The cane yield is negatively affected by the early infestation of *P. perpusilla* during the growth period. The presence of Pyrilla significantly impacts the sucrose content of sugarcane (Puri and Sidharth, 2001). *P. perpusilla* has been observed in various parts of Asia since 1903, including India where it has sometimes reached epidemic levels (Stebbing, 1903; Rahman and Nath, 1940; Dhaliwal and Bains, 1985). Severe outbreaks of the pest have been reported in the eastern province of Afghanistan reported by Cotterell in (1954) and it has also been found in Bangladesh (Fennah, 1963; Miah *et al.,* 1986; Dean, 1979). In Sri Lanka, the species has been recorded in the Eastern and South-Central provinces (Kumarasinghe and Ranasinghe, 1985, 1988, respectively). In Nepal, the pest has been reported by Neupane (1976) in six districts, while in Pakistan it has been found throughout most of the country (Sheikh, 1968; Rahim, 1989 a, b).

Pyrilla's population shows an inverse relationship with rainfall and humidity, while having a direct correlation with minimum temperature. Research conducted by Ganehiarachchi and Fernando in 2006 identified egg parasitoids, predators, and rainfall as the main factors affecting the fluctuations in the *P. perpusilla* population.

The only way to reduce these losses in sugarcane is to properly protect the crop from insect pests throughout the year using an insect pest management programme that has been scientifically established. When necessary, pesticides are used in conjunction with resistant cultivars, cultural techniques, the introduction and preservation of natural enemies, and others. Pesticides will remain a crucial component of the programme for managing insect pests.

Farmers employ various techniques to manage pests in their fields, with chemical application being the most common method used. The use of chemicals has enabled farmers to achieve a maximum

yield of up to 74 t ha -1 (Kolo *et al*., 2000). Additionally, organophosphorus insecticides such as dimecron 100 WSC, lebaycid, nexion 25 EC, and malathion have been utilized to combat leafhopper (*P. perpusilla*) and whiteflies (*B. Aleyrodidae*) in sugarcane fields, showing significant control against leafhopper (*P. perpusilla*) at both adult and nymph stages (Ahmad *et al*., 1970).
When it comes to managing *P. perpusilla* in sugarcane, chemical control has been proven to be more successful than biological control (Wasim, 2007). The goal of the current study is to determine the most cost-effective and efficient chemicals for Pyrilla management by concentrating on the optimised chemical control of *P. perpusilla.* The objective of the current study is to collect and identify the *P. perpusilla* and to evaluate the efficacy of the chemical insecticides to control the leaf hoppers (*P. perpusilla)* of sugarcane.

METHODOLOGY

The research aimed to explore the chemical control of sugarcane leaf hoppers *(P. perpusilla)* in Pattoki, District Kasur, by studying the cultivation of Sugarcane US-54 planted in last week of March, 2022. The study utilized both quantitative and qualitative methods for data collection. Consistent agronomic practices were maintained during the experiment with irrigation provided as needed and NPK (Nitrogen, Phosphorus and Potassium) fertilizers applied every 2 months as recommended.

Survey

Based on the data, interview sessions of the local farmers were scheduled for the collection of the required data.

Treatment

In this experiment namely Fipronil -5 SC @ 2ml/lit. of water and Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water were used for Control of *P. perpusilla*.

Experimental Design

After collecting data related to attack of *P. perpusilla* on sugarcane, the experiment was laid out in randomized complete block design (RCBD) with three plots. Each plot size was 126.46m^2(Talpur *et al.,* 2002)

Collection of Samples

Hand picking method was used for collection of specimens. Random collection was also carried out at certain places within localities. Eggs, nymphs and adult of *P. perpusilla* were collected from leaves of sugarcane. After collection of specimens, these specimens were preserved in killing jars/bottles. Each bottle was labeled with date of collection and locality. The observation on *P. perpusilla* was recorded from June to December 2022.

Identification of Insects

Samples were taken to the Entomology lab at Punjab University, Institute of Zoology for identification purposes using taxonomic keys.

Insecticides and their Applications

Two insecticides namely Fipronil -5 SC @ 2ml/lit. of water and Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water were applied and compared with an untreated plot control. One insecticide was used for one plot. Three dressings were made at one month of intervals.

Observation on Infestation Percentage

The observation of damaged percentage involved examining the population of *P. perpusilla* on three leaves (top, middle, and lower) of 10 randomly selected plants from each plot. Damaged

plants were separated and tabulated for damage percentage according to the given formula.

$$\text{Infestation} = \frac{\text{No.of infested plants}}{\text{No.of total plants}} \text{ x } 100$$

Pre-treatment observation was recorded one day before each application of insecticides, while post-treatment observation was recorded after 10, 15 and 30 days of each dressing of insecticide.

Data Analysis

The population of sugarcane leaf hoppers *P. perpusilla* was assessed across three plots through Analysis of Variance (ANOVA) using Minitab 19 followed by the separation of means using LSD test (Fisher method) at a significance level of 5%.

RESULTS

The infestation percentages of leaf hopper, *P. perpusilla* on Sugarcane after different time intervals of first application are presented in **Table 1**. Looking over the data revealed that after varying times, the initial killing effect of all the insecticides was higher, as the highest infestation percentage was observed 10 days after application. However, the untreated control plot displayed the highest infestation percentage, while plots treated with Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water and Fipronil -5 SC @ 2ml/lit. of water showed the lowest percentages. Each treated plot shows a reduction in the infestation of leaf hoppers after 15 days of exposure. Significant variations were seen between the various treatments Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water continued to exhibit the lowest infestation levels of Pyrilla, followed by Fipronil -5 SC @ 2ml/lit. of water. After 30 days, all tested products showed a significant reduction in pest infestation compared to the control, with Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water demonstrating superior performance in reducing pest infestation compared to the other treatments.

Table 2 summarizes the infestation percentages of the Sugarcane leaf hopper during the second application of insecticides. The results indicate significant differences in pest infestation levels between the various treatments after 10, 15, and 30 days of application. It was noted that after 10 days, pest infestation decreased progressively in all treated plots compared to the control group. Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water demonstrated the most effective control of Pyrilla, with the lowest infestation levels observed in the treated plots, followed by Fipronil -5 SC @ 2ml/lit. of water. Conversely, the untreated plot exhibited the highest pest infestation. Similar trends were observed after 15 days of treatment, with the lowest infestation percentages in plots treated with Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water and Fipronil -5 SC @ 2ml/lit. of water. After 30 days, all products showed a reduction in infestation compared to 15 days, with Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water performing the best in reducing pest infestation overall.

Table 3 shows the infestation percentages of leaf hoppers at various time intervals following the application of different insecticides. The results indicated that all plots treated with insecticides significantly reduced pest infestation after 10, 15, and 30 days (**Fig 1**). Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water was the most effective in reducing infestation after 10 days, followed by Fipronil (5% SC). The lowest infestation was observed in plots treated with Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water and Fipronil -5 SC @ 2ml/lit. of water, while the untreated control plot had the highest infestation. The differences in infestation percentages between the insecticides were highly significant. Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water treated plots had lower infestation compared to Fipronil -5 SC @ 2ml/lit. of water and the control. Overall, Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water showed the best results in reducing Pyrilla infestation compared to the other insecticides tested.

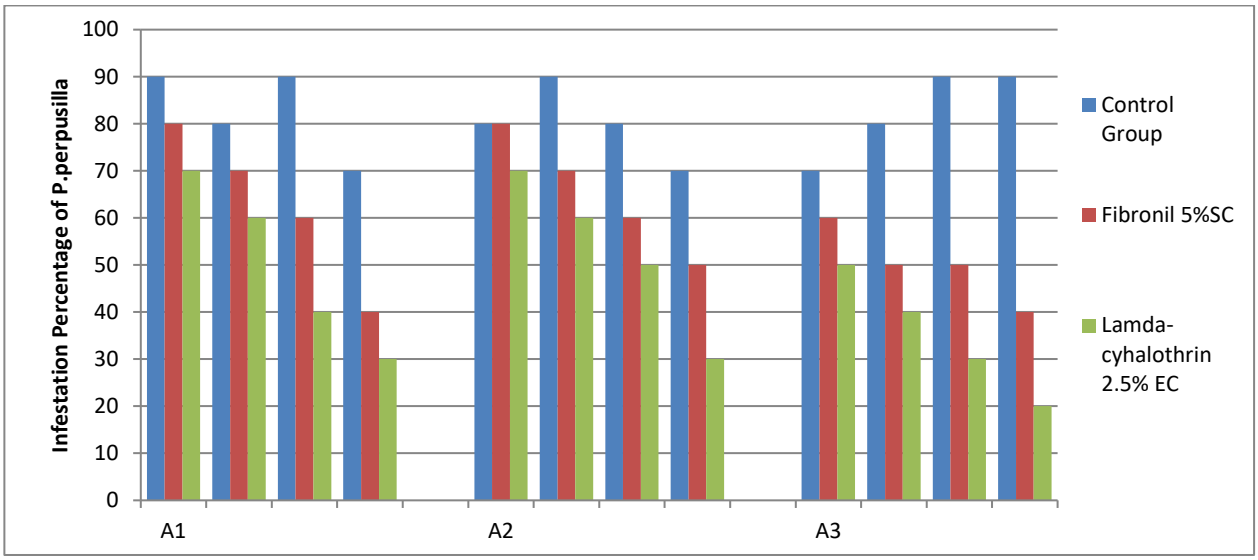

Fig: 1 Infestation percentage of *P. perpusilla* on Sugarcane recorded at various intervals during applications of insecticides.

Table 1: Infestation percentage of *P. perpusilla* on sugarcane recorded at various intervals during first application of insecticides

Insecticides	Pretreatment	Time Interval			Mean
		Infestation percentage after 10 days	Infestation percentage after 15 days	Infestation percentage after 30 days	
Check (Plot)	7.5	7.00^{ab}	7.75^{a}	6.00^{bc}	6.91
Fipronil-5 SC @ 2ml/lit. of water	6.5	6.25^{bc}	5.25^{c}	3.25^{d}	4.91
Lambda Cyhalothrin- 2.5 EC @ 5ml/lit. of water	5.5	5.50^{c}	3.50^{d}	2.50^{d}	3.83
SEM	-	0.433	1.23	1.06	-

Mean values followed by similar letter do not differ significantly different at 5% level.

Table 2: Infestation percentage of *P. perpusilla* on sugarcane recorded at various intervals during second application of insecticides

Insecticides	Pretreatment	Time Interval			Mean
		Infestation percentage after 10 days	Infestation percentage after 15 days	Infestation percentage after 30 days	
Check (Plot)	6.5	7.00^{ab}	7.25^{a}	6.25^{abc}	6.83
Fipronil-5 SC @ 2ml/lit. of water	6.5	5.50^{bcd}	5.25^{cd}	3.25^{ef}	4.67
Lambda Cyhalothrin- 2.5 EC @ 5ml/lit. of water	5.5	5.00^{cd}	4.25^{de}	2.25^{f}	3.91
SEM	-	0.601	0.882	1.20	-

Mean values followed by similar letter do not differ significantly different at 5% level.

Table 3: Infestation percentage of *P. perpusilla* on sugarcane recorded at various intervals during third application of insecticides.

Insecticides	Pretreatment	Time Interval			Mean
		Infestation percentage after 10 days	Infestation percentage after 15 days	Infestation percentage after 30 days	
Check (Plot)	5.5	6.25^{a}	7.50^{a}	7.25^{a}	7
Fipronil-5 SC @ 2ml/lit. of water	5.25	3.25^{bc}	3.50^{b}	2.50^{bc}	3.08
Lambda Cyhalothrin- 2.5 EC @ 5ml/lit. of water	4.25	2.50^{bc}	1.75^{bc}	1.50^{c}	1.91
SEM	-	1.15	1.70	1.77	-

Mean values followed by similar letter do not differ significantly different at 5% level.

DISCUSSION

The research aimed to explore the chemical control of sugarcane leaf hoppers *(P. perpusilla)* in Pattoki, District Kasur, by studying the cultivation of Sugarcane US-54 planted in last week of March, 2022. The population of *P. perpusilla* experienced a notable decrease across all treatments compared to the control group. Each treatment effectively managed to control the population of *P. perpusilla* when compared to the control treatment, consistently across all observation dates. The differences in infestation percentages between the insecticides were highly significant. Lambda cyhalothrin 2.5 EC @2ml/lit. of water treated plots had lower infestation compared to Fipronil -5 SC @2ml/lit. of water and the control. Overall, Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water showed the best results in reducing Pyrilla infestation compared to the other insecticides tested.

The present findings are comparable with the study of Shah et al., (1979) who evaluate the efficacy of seven different insecticidal sprays against P. perpusilla infestation on sugarcane crops during spanning from 1976-1977. These insecticidal sprays were administered during periods of severe infestation, and concluded that these sprays containing 0.075% endosulfane, 0.03% monocrotophos and 0.25% carbaryl, were effective against pest population. Additionally, phenthoate, dimethoate, demeton-O-methyl and phosalone were also identified as effective. Our results are also consistent with the findings of Madan et al, (1980), who controlled the population of *P. perpusilla* with the introduction of the 10 insecticides that were evaluated in field trials, it was found that BHC [HcH] 10% dust at a rate of 2.5 kg/ha or parathion-methyl at a rate of 0.25 kg/ha provided the most effective control (ranging from 95.5% to 18.8%) of *P. perpusilla* on sugarcane. These particular treatments not only demonstrated high efficacy in managing the pest population but also proved to be economically viable options for farmers.

The current results are in line with the studies conducted by Sheikh (1968), Singh and Mavi (1972), Marwat and Khan (1987), Rahim (1989), Patel *et al.* (1993), Singh *et al*. (1995), Singla *et al*. (1997), Tripathi and Katiyar (1998), and Tripathi (2004), where different chemical pesticides were utilized for managing *P. perpusilla*. The current results are not directly comparable to the study conducted by Madan (2001), where the primary focus was on the successful biological control of pyrilla in Haryana.

Utagi Shreedhar *et al.* (2020) observed a reduction in the infestation rate of *P. Perpusilla* following the application of insecticides. The decrease in the percentage of infestation indicates the effectiveness of the insecticides in controlling the population of *P. Perpusilla*. This finding suggests that the insecticides used were successful in reducing the infestation level, which is important for managing the impact of *P. Perpusilla* on the affected area.

CONCLUSION

From our findings it is concluded that Lambda Cyhalothrin- 2.5 EC @ 2ml/lit. of water was found to be the most effective in controlling *P. perpusilla* infestation among all the products tested.

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