Incidence of *Conopomorpha sinensis* Bradley (Lepidoptera: Gracillariidae): A major pest litchi and its management in Bihar

ABSTRACT

Litchi (*Litchi chinensis* Sonn.) is a subtropical fruit; family Sapindaceae. Litchi offers a good potentiality for its cultivation in Bihar both nutritionally and economically. India is the second largest global producer of litchi, next only to China. Litchi fruit borer (*Conopomorpha sinensis* Bradely, 1986 Lepidoptera: Gracillaridae), litchi mite, leaf cutting weevils, litchi looper, and leaf roller are major pests which attack litchi plant, during different seasons. They cause damage to the litchi plant throughout the year but their seasonal abundance not only damage the plant, but also the fruits. Among these pests, *C. sinensis* is the prominent one remaining active throughout the year but it's the peak period was from July to November (as shoot borer) and from March to May (as fruit borer). 30-70% of the dropped. The results revealed that the lowest number of fruits infestation was recorded with Lambda Cyhalothrin 5 EC @ 0.003% followed by the treatment with Spinosad which gave better result 25 % infestation was. Therefore, an attempt has been made to study management options for litchi fruit and shoot borer *C. sinensis* by using new control measures.

Keywords: Litchi, Fruit Borer, Insecticides, New agents, Management

INTRODUCTION

Litchi *(Litchi chinensis* Sonn.) is well known as queen of fruits, it is considered one of the most important subtropical and tropical evergreen fruits. This fruit is well-liked because of its mouth-watering flavor, eye-catching color, and excellent nutritional content (Zhao *et al.,* 2020). Despite having its origins in China, the litchi fruit is now grown in over 20 nations, with China, India, Thailand and Vietnam serving as its top four producers (Zhao *et al.*, 2020; Jana, 2019). It has gained Geographical Indication (GI) for Muzaffarpur, Bihar. Keeping in view its nutritional and economic importance for the area, factors affecting its production are being looked into by farmers as well as scientists. There are as many as 42 insects' species and mite pests that have been reported to attack litchi trees and fruits at different stages of growth and fruiting (Smith and

Wagenknecht, 1956, Siraj *et al.*, 2023). However, litchi fruit borer also known as stem end borer, *Conopomorpha sinensis* Bradley (Lepidoptera: Gracillaridiae) has gained the status of major pest (Fang *et al.*, 2023) and it seen now as a significant concern for Indian litchi growers (Dubey *et al.*, 2023; Srivastava *et al.*, 2019). According to Srivastava *et al.* (2019), this insect causes significant economic losses to young shoots and fruits that range from 24–48% and 7–70%, respectively. During the months of April and May, it infiltrates close to the peduncle of fruits (both developing and mature), after hatching, the larvae immediately enter into the fruit, pierce its peduncle and feed on the soft tissue within and damage the aril causing early fruit drop and such fruits lose their nutritional value. If preventative measures are not taken, this insect can cause up to 100% fruit loss in the field, lead to significant losses for Indian litchi growers. Currently, there is lack of information that comprehensively outlines the research on *C. sinensis*, which is very unfavorable for the development of research efforts on *C. sinensis*. Thus, the infestation remains hidden due to its systemic nature, the fact is that *C. sinensis* prevalence is far and wide both from geographical perspective as well as seasonal availability. But the hidden nature of infestation has led to comparatively poor study progress on the species which is why it is thought to be a research progress limitation. The largest obstacle to developing effective pest control strategies has been our limited understanding of the ecology and behavior of this insect. The seasonality and hidden nature of the infection make it much more challenging to eradicate this insect. The present study was conducted to keep in view these urgencies for control this pest and aim to explore the possibility of *C. sinensis* control by various treatments scheduled on litchi plant.

MATERIAL AND METHODS

The infestation of litchi fruits by *C. sinensis* was recorded during 2022 and 2023 in a litchi orchard farm located at Mushahari area, Muzaffarpur district, Indian Council of Agriculture Research-National Research Centre. Twenty four trees of litchi orchard of same cultivar (Var. Shahi) were selected randomly. The experiment was laid out in a randomized complete block design with eight treatments, each treatment was replicated thrice. The efficacies of tested compounds; T_1 Spinetoram 11.7 SC @ 1 mL, T_2, Flubendiamide 39.35 SC @ 1.5 ML, T_3, Lambda cyhalothrin 5 EC @ 0.003%, T_4, Flubendiamide 19.92% + Thiacloprid 19.92% @ 0.48%; T_5, Chlorantraniprole 4.3% SC + Abamectin 1.7 @ 1.5 ml/L SC, T_6 Spirotetramat

11.01% EC + Imidacloprid 11.01@ 0.36% EC, T_7 Spinosad 45 SC @ 1.75 mL/5L against *C. sinensis* borer were evaluated. Untreated control was also designed by spraying with water only and represented as T_8. Each treatment and control was replicated for three times. The recommended doses of each insecticide was prepared by dilution with water and then sprayed separately by using a foot pump sprayer. Spraying was done by the insecticides on outer and inner canopy in all directions of trees through the season. Each season, the first spray was given at cardamom size fruit, while second spray after 15 days of first spray (about 15 days before harvest at color break of fruit).

Data Collection and Analysis

Hundred ripened fruits were chosen from each replicate randomly and the numbers of healthy and infested fruits were recorded. Collected samples were opened, and damages caused by the *C. sinensis* were ascertained (Figure 1), by the presence of a *C. sinensis* larva inside the fruit or remains of its excreta in the interior. The collected data were statistically analyzed for which SPSS software was used.

RESULTS AND DISCUSSION

Litchi fruit borer larva is an internal feeder of fruits. During color break stage the egg laying was done on top of fruits near pedicel. The immature larvae bores in to the fruits and reach towards seed passing through pulp for feeding, the black spot near pedicel with small fruit size is an indicator of infestation by litchi fruit borer. It can be concluded that the larvae of this borer cause direct damage to litchi fruit. They can escape contact with insecticides when they remain inside the fruit but systemic insecticides will be effective. But during their surface existence litchi fruit borer moth can be controlled by contact insecticides. The data in Table 1. pertaining the field efficacy of different pesticides against *C. sinensis* has been plotted. The data showed that treatment of Flubendiamide SC 19.92% and Thiacloprid SC 19.92% @ 0.48% was least effective and recorded highest fruits infestation 55 % followed by 52%, spinetoram11.7 SC @ 1mL/l, spirotetramat SC 11.01% + Imidacloprid SC 11.01% @ 0.36% showed 50 % infestation, while 48% infestation was recorded by Chlorantraniprole SC 4.3% + Abamectin SC 1.7% @ 1.5ml/L ,47% infestation was revealed by Flubendiamide 39.35 SC @ 1.5 ml/5L, 42% fruit infestation was shown by Lambda Cyhalothrin 5 EC @ 0.003%,treatment by Spinosad gave better result 25 % infestation was recorded. The data revealed that the Spinosad 45 SC @ 1.75

ml per liter of water was the most effective in controlling litchi fruit borer. It was more effective against fruit borer even on long rainy days after application than other insecticides and economically beneficial proved in the present study. So, it may be observed on a large scale in litchi orchards of farmers, and effect analysis needed.

Table 1: Depicting treatment and mean number of infested fruits by litchi fruit borer

Treatments	**Mean No. of infested fruits by fruit borer**	**Standard error**
T_1	15.00	6.028
T_2	12.00	4.726
T_3	9.67	2.848
T_4	19.00	5.568
T_5	16.00	1.155
T_6	15.67	8.172
T_7	5.33	1.764
T_8	19.00	3.464
Total	111.67	-
C.D.	N/A	-
SE (m)	4.34	-
SE (d)	6.14	-
C.V.	53.88	-

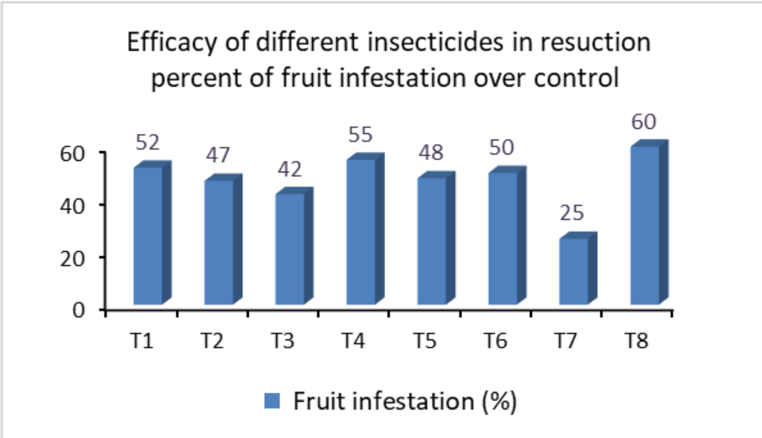

Fig 1: Depicting the infestation of fruits (%)

It was moderately effective in reducing the percentage of fruit infestation and increased yield among systemic insecticides. However, its higher application costs reduced the profit margin and showed a lower benefit-cost ratio. These results were in accordance with Purbey (2016) reported that spraying systemic insecticides like thiacloprid and imidacloprid is the most effective against LFB. In the current study, Chlorantraniliprole was found effective against *C. sinensis* borer which was also confirmed by various researchers (Wang *et al.*, 2008). Upadhyay *et al.* (2020) showed chlorantraniliprole effectiveness against brinjal shoot and fruit borer and Larrain *et al*. (2014) proved its effectiveness for tomato pinworm *Tuta absoluta* (Meyrick) in tomato. Moreover, Kiss *et al.* (2023) indicated that at the injection of chlorantraniliprole in the apple trunk it caused moderate to high mortality of banded leaf roller *Choristoneura rosaceana* (Harrish). Similar result was achieved against the rice stem borer, *Chilo suppressalis* (Walker) (Wang *et al*., 2008). Chlorantraniliprole is a novel anthranilic diamide insecticide, effective for control of lepidopteran insect pests, as well as some species in the orders coleoptera, Diptera, and Hemiptera. The sub-lethal concentration of Chlorantraniliprole significantly affected on the development of beet armyworm, *Spodoptera exigua* (Hubner) and diamond backmoth, *Plutella xylostella* (Linnaeus). Based on feeding cessation and reduction in feeding damage, chlorantraniliprole and flubendiamide is among the fastest-acting insecticides available for control of Lepidopteran pests.

Our results showed that flubendiamide was also effective against *C. sinensis* with low damage rate in both year. Related to this aspect, Taher *et al.* (2022) demonstrated that flubendiamide was efficient against yellow stem borer *Scirophaga incertulas* Walker. Similarly, Shahid *et al.* (2015) confirmed that less damage was caused by pod borer, *Helicoverpa armigera* (Hubner) in vegetable pea, legume pod borer, *Maruca vitrata* (Geyer) in pigeon pea, spotted stem borer, *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae) in maize at the treatment with flubendiamide. Treated sapota with the flubendiamide found that the yield was significantly higher than control against sapota fruit borer, *Phycita erythrolophia* Hampson. Both chlorantraniliprole and flubendiamide was found effective in managing shoot and fruit borer and suggested that these insecticide could be used in integrated pest management system. The per cent infestation in our result varied from 12 to 85.5% in 2015 whereas it ranged from 15.25 to 88.75%. Srivastava *et al.* (2016) study was in line with our study where he found the infestation of the insect up to 59.35% on dropped fruit.

However, neem based insecticide was not found effective against *C. sinensis.* Similar result was found in legume pod borer, *Maruca vitrata* Fabricius (Lepidoptera: Pyralidae) and fruit borers of guava, *Psidium guajava* Linn. (Yule and Srinivasan, 2014) reported that it was found effective against poplar borer, *Saperda calcarate* .It may be effective against stem borer than fruit borer. Our result suggests either of chlorantraniliprole or flubendiamide could be used to minimize damage and loss caused by *C. sinensis*. Selectivity of the chlorantraniliprole and flubendiamide have more towards the insect ryanodine receptor (Lahm *et al.*, 2009) thus have low mammalian toxicity (Tohnishi 2005; EFSA, 2013).

CONCLUSION

It appears that treatment by best, but various permutation and combination of different pesticide further should be tried so as to ascertain the least destructive combination which is most effective in controlling the pest and at the same time least destructive to the plant. The pest management against litchi fruit borer was cost effective as the one or two year time is not enough for the treatment to have a better results. It must be treated on larger scale in wide managed area (orchard) to increase the quality and quantity of the fruit.

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