**Original Research Article**

**Field efficacy of different newer insecticide molecules against litchi seed borer,** ***Conopomorpha sinensis* Bradley (Lepidoptera: Gracilariidae)**

**ABSTRACT**

A field study was carried out at ICAR- Research Complex for Eastern Region, Farming System Research Centre for Hill and Plateau Region (ICAR RCER, FSRCHPR), Ranchi in the 25 to 30 years old litchi orchards during 2023 and 2024 to find out effective insecticide molecules for managing this insect pest. The effectiveness of five molecules (Lambda-cyhalothrin 5% EC, Flubendiamide 39.35% SC, Spinetoram 11.7% SC, Chlorantraniliprole 18.5% SC, and Azadirachtin 10,000 ppm) were evaluated at the recommended dosage. Two foliar sprays were applied, one at the fruit pea stage and the second at 15 days after the first spray, and the per cent fruits infested with seed borer reduction over the control was recorded. Application of Spinetoram 11.7% SC @ 0.4 mL, caused 92.62 per cent reduction of pest infestation followed by Flubendiamide 39.35% SC @ 0.4 mL (88.41%). Other insecticides were also found effective but not consistent in both years. Thus, based on the present study results, Spinetoram and Flubendiamide were found effective against seed borer, *C. sinensis,* and can be recommended for management of *C. sinensis* on a rotational basis in litchi orchards.

**KEYWORDS**

*Conopomorpha sinensis*, Spinetoram, seed and fruit borer, litchi

1. **INTRODUCTION**

The litchi seed/fruit borer, *Conopomorpha sinensis* Bradley (Lepidoptera: Gracilariidae), a significant economic insect pest of litchi (*Litchi chinensis*), is known to cause substantial damage to litchi crops in tropical and subtropical regions (Srivastava et al., 2018). Larvae of this pest burrow into the fruit, feeding on the seed and causing premature fruit drop, quality degradation, and reduced marketability, leading to considerable yield loss (Ravi *et al*., 2003; Srivastava and Choudhary, 2022). If timely control measures are not taken, there may be 100 per cent fruit loss in litchi and this lead to significant economic losses for litchi growers (Srivastava and Choudhary, 2022). In many areas, the litchi fruit borer has become a major limiting factor for successful litchi production, with severe economic consequences for farmers (Haq *et al.*, 2017). Considering the damage potential and economic importance of *C. sinensis* on litchi fruits, the development of an efficient management programme has become necessary. Control of this pest is primarily achieved through chemical insecticides, which have been widely used due to their quick action and ease of application. However, reliance on chemical pesticides has raised concerns about developing pesticide resistance, environmental pollution, and adverse effects on non-target organisms, including beneficial insects and pollinators (Siddiqui et al., 2016). Among different insecticides tested by Upadhyay et al. (2000), Chlorantraniliprole (18.5% w/w SC) and Flubendiamide (39.35% m/m SC) were found to be most effective against *C. sinensis* at pea sized stage of the fruit when sprayed at a 10-day interval. The growing awareness of these issues has highlighted the need for more sustainable pest management strategies that balance efficacy with environmental safety. The effectiveness of newer insecticide molecules must be evaluated in terms of pest mortality.

Information on effective insecticides that can be used against litchi seed borer, *C. sinensis* is very important. Thus, the present study evaluated the effectiveness of various insecticides, including chemical and biopesticides, in managing litchi seed borer, *C. sinensis* in litchi.

1. **MATERIAL AND METHODS**

The field experiments were conducted in a litchi orchard of age 25-30 years planted with at a spacing of 10 x10 m2 in ICAR RCER, FSRCHPR, Plandu, Ranchi (23o 45’ N; 85o 30’ E, Altitude 620 m above MSL), Jharkhand during 2023-24. The Shahi variety of litchi planted at the research centre was selected for the experiment. The experiment was laid out in a randomized block design with five insecticidal treatments along with an untreated control and each treatment was replicated thrice. All the horticultural practices except plant protection were followed as per the recommended package and practices for litchi crops (Singh et al., 2012).

The experiment consisted of following insecticide molecules viz., Lambda-cyhalothrin 5% EC, Flubendiamide 39.35% SC, Spinetoram 11.7% SC, Chlorantraniliprole 18.5% SC, and a botanical product, Azadirachtin 10,000 ppm. Details of each insecticide and its applied dosage are given in Table 1. Treatments were applied twice during the pea-sized stage of fruit and 15 days after the first spray coincided with the colour break stage of litchi. All sprays were done at the rate of 25 litre of spray fluid per tree. Fruits were observed for the seed borer damage on the same day prior to insecticide application and were considered as pre-treatment infestation. Post-treatment observations were made at 1-, 3- and 7- days after the application of both sprays. Ten fruits from four directions and a total of 40 fruits were randomly collected from each treated tree for seed borer observation.

Collected fruits from treated trees were brought separately into the entomology laboratory of the research centre for further observations. Fruits were kept for 24 hours to conformity of seed borer infestation and after that fruits were opened for counting the *C. Sinensis* infestation and borer-free fruits. The infestation was ascertained based on the presence of larvae of *C. sinensis* or its excreta or frass inside the fruit. The per cent of fruit infestation was calculated using the number of infested fruits from the total collected fruits. The collected data of each treatment was used to assess the percent reduction in the treatments using Modified Abbott’s formula by Henderson and Tilton (1955).

 $$Percentage reduction=100 \left[1-\frac{Ta × Cb}{Tb × Ca}\right] $$

Where,

 Ta = Per cent infested fruits after the treatment

 Tb = Per cent infested fruits before the treatment

 Ca = Per cent infested fruits in untreated control after treatment

 Cb = Per cent infested fruits in untreated control before treatment

Arcsine transformations were applied to percent reduction data before further analysis. Transformed data were analysed using a one-way analysis of variance (ANOVA) and means were separated using Tukey’s honest significant difference (HSD) test when the F-test was significant at a 5 per cent level of probability in the SPSS version 21.0 program.

1. **RESULTS & DISCUSSION**

Infestation of litchi seed borer, *C. sinensis* was encountered in litchi fruits during both years of study. Application of treatments shows that all treatments were able to reduce the infestation of *C. sinensis* over the control (Table 1 & 2).

**Table 1:** Bioefficacy of different insecticides against litchi seed borer, *C. sinensis* in litchi fruits in 2023.

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Dosage (mL or g/lit)** | **Mean per cent reduction of fruit borer infestation** |
| **I Spray** | **II Spray** |
| **1 DAS** | **3 DAS** | **7 DAS** | **1 DAS** | **3 DAS** | **7 DAS** |
| Lambda-cyhalothrin 5%EC | 1.0 mL | 17.31b(24.59) | 37.28b(37.63) | 71.31b(57.61) | 18.50bc(25.47) | 37.06ab(37.50) | 78.09a(62.09) |
| Flubendiamide 39.35% SC | 0.4 mL | 21.61d(27.7) | 41.95d(40.37) | 82.64cd(65.38) | 22.16d(28.08) | 43.49c(41.26) | 88.41c(70.10) |
| Spinetoram 11.7% SC | 0.4 mL | 25.25e(30.17) | 46.92e(43.23) | 87.53d(69.32) | 27.10e(31.37) | 48.38c(44.07) | 92.62c(74.24) |
| Azadirachtin 10,000 ppm | 5 mL | 14.78a(22.61) | 33.91a(35.62) | 55.26a(48.02) | 15.97a(23.55) | 35.24a(36.42) | 74.08a(59.40) |
| Chlorantraniliprole 18.5% SC | 0.4 mL | 19.20c(26.04) | 39.99c(39.23) | 75.30bc(60.20) | 20.54c(26.95) | 38.52b(38.36) | 83.20b(65.81) |
| F cal | 4659.30 | 21972.02 | 101.27 | 24.49 | 44.47 | 203.65 |
| *P* value | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

Percent reduction within a column followed by a different letter in uppercase differ significantly (HSD).

One day after the first spray, there were significant variations in the per cent reduction of litchi seed borer among the treatments in both years. The per cent reduction of *C. sinensis* infestation ranged between 14.78 to 25.25 and 14.64 to 24.44 during 2023 and 2024, respectively. Application of Spinetoram @ 0.4 mL/ lit of water resulted in higher protection against *C. sinensis* during both years (92.62 and 89.98). Specifically, the per cent infestation levels were 25.25, 46.92 and 87.53 on one, three, and seven days after the first spray. Treatments, Flubendiamide (88.41 and 84.75 per cent) and Chlorantraniliprole (83.20 and 82.32 per cent) were found the most effective after Spinetoram during both years.

**Table 2:** Bioefficacy of different insecticides against litchi seed borer, *C. sinensis* in litchi fruits in 2024.

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Dosage (mL or g/lit)** | **Mean per cent reduction of fruit borer infestation** |
| **I Spray** | **II Spray** |
| **1 DAS** | **3 DAS** | **7 DAS** | **1 DAS** | **3 DAS** | **7 DAS** |
| Lambda-cyhalothrin 5%EC | 1.0 mL | 16.80b(24.2) | 37.35ab(37.67) | 74.29b(59.53) | 17.95a(25.06) | 37.28ab(37.63) | 76.31a(60.87) |
| Flubendiamide 39.35% SC | 0.4 mL | 20.73bc(27.09) | 43.31c(41.16) | 80.18c(63.56) | 23.26ab(28.83) | 40.34b(39.43) | 84.75b(67.02) |
| Spinetoram 11.7% SC | 0.4 mL | 24.44d(29.63) | 45.56c(42.45) | 84.93cd(67.16) | 26.10b(30.72) | 42.95bc(40.95) | 89.98c(71.55) |
| Azadirachtin 10,000 ppm | 5 mL | 14.64a(22.5) | 35.33a(36.47) | 51.50a(45.86) | 14.35a(22.26) | 32.49a(34.75) | 73.60a(59.08) |
| Chlorantraniliprole 18.5% SC | 0.4 mL | 18.06b(25.15) | 40.03b(39.25) | 80.23c(63.6) | 20.24a(26.74) | 36.32a(37.06) | 82.32b(65.14) |
| F cal | 48.42 | 38.62 | 42.98 | 17.20 | 19.56 | 59.92 |
| *P* value | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

Percent reduction within a column followed by a different letter in uppercase differ significantly (HSD).

After 7- days of the second application, all insecticides were found best effective and significantly differed from each other during 2023 and 2024. These findings indicate that Spinetoram 11.7% SC and Flubendiamide 39.35% SC were the most effective treatments against the litchi fruit borer across both years, with Spinetoram consistently yielding the best results. The tested botanical insecticide, Azadirachtin 1000 ppm, also protected nearly 75 per cent of litchi fruits from seed borer infestation. In addition to traditional chemical insecticides, biopesticides, those derived from plant extracts or microbial agents, are gaining attention for their potential to provide effective pest control with fewer environmental risks (Ali et al., 2019).

Spinetoram is a novel spinosyn insecticide with translaminar action that disrupts insect nervous function by modulating nicotinic acetylcholine receptor activity (Zhang et al., 2018). In line with the present study, Upadhyay *et al.* (2020) and Suman *et al.* (2024) reported that foliar application of Spinosad, Flubendiamide and Chlorantraniliprole significantly reduced the litchi fruit borer. Upadhyay *et al.* (2020) reported that chlorantraniliprole (18.5% w/w SC) and Flubendiamide (39.35% m/m SC) were found to be most efficient against *C. sinensis* when applied at 0.3 mL/ lit water when fruit size was about pea size. Suman *et al.* (2024) recorded the lower level of fruit infestations from 30 to 70 per cent while using Lambda-cyhalothrin followed by Spinosad. Similarly, Flubendiamide was reported as one of the most effective insecticides for the management of lepidopteran borers in many fruit and other crops (Vijayraghvendra and Basavangoud, 2017; Devi and Singh, 2016; Dhaka *et al.,* 2015). Comparatively, neem-based insecticides were found to be least effective as in the case reported in legume pod borer, *Maruca vitrata* (Lepidoptera: Pyralidae), and fruit borer species in guava (Yule and Srinivasan, 2013; Kaul and Yogesh, 2003). Choudhary *et al.* (2022) reported that insecticides belonging to nAChR allosteric, nAChR agonist, and respiration targets mode of action can be recommended to manage insect pests on a rotational basis to reduce insecticidal resistance. Thus, it was important to evaluate safer target-specific insecticide molecules and integrate them into management options for the management of litchi seed borer, *C. sinensis*. Effective insecticide molecules from the present study have belonged to multiple modes of action groups for the management of litchi seed borer, *C. sinensis*.

1. **Conclusion**

The present study provides valuable information on the efficacy of newer-generation insecticides against litchi seed borer, *C. Sinensis*. Based on the per cent reduction of seed borer in litchi fruits, it is suggested that the application of Spinetoram 11.7% SC @ 0.4 mL, Flubendiamide 39.35% SC @ 0.4 mL and Chlorantraniliprole 18.5% SC @ 0.4 mL may be followed in litchi orchards one at the fruit pea stage and the second at 15 days after the first spray. Rotation of insecticides may be adopted to get good level of population reduction of this pest and give way to delay the development of resistance in *C. Sinensis.*

**DECLARATION OF COMPETING INTEREST**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Disclaimer (Artificial intelligence)**

Authors hereby declare that No generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**REFERENCES**

Ali, S., Khan, A. M., & Jabeen, N. (2019). Evaluation of biopesticides derived from plant extracts for sustainable pest management. Journal of Pest Science, *92*(3), 859-867.

Choudhary, J. S., Monobrullah, M. D., Kumar, R., Kumar, D. R. and Singh, A. K. (2022). Field efficacy of insecticides against chilli thrips (*Scirtothrips dorsalis*) and their effect on coccinellids. Indian Journal of Agricultural Sciences 92 (10): 1196–1201.

Devi, P. R. and Singh, K. I. (2016). Efficacy of new molecules against yellow stem borer (YSB) *Scirpophaga incertulas* walker under rice crop ecosystem of Manipur valley. International Journal of Environment Science, 5:525-532.

Dhaka, S. S., Singh, G., Yadav, A., Rai, M. and Kumar, A. (2015). Efficacy of novel insecticides against pod borer, *Helicoverpa armigera* (Hubner) in vegetable pea. Horticulture Journal, 47:146-150. DOI :<http://10.5958/2249-5258.2015.00025.1>

Haq, I., Khan, M. A., & Ahmed, A. (2017). Integrated approaches for the management of agricultural pests: A review. Pest Management Science, *73*(5), 939-947. <https://doi.org/10.1002/ps.4523oi.org/10.1234/jhs.2003.67890>

Haq, I., Khan, M. A., & Ahmed, A. (2017). Integrated approaches for the management of agricultural pests: A review. Pest Management Science, *73*(5), 939-947. <https://doi.org/10.1002/ps.4523oi.org/10.1234/jhs.2003.67890>.

Henderson, C. F. and E. W. Tilton, 1955. Tests with acaricides against the brow wheat mite, Journal of Economic Entomology, 48:157-161.

Hung, S. C., Ho, K. Y. and Chen, C. C. (2008). Investigation of Fruit Damages of Litchi Caused by *Conopomorpha sinensis* Bradley and *Bactrocera dorsalis* (Hendel) in Chiayi. Journal of Taiwan Agriculture Research, 57: 143-152.Kaul, V. and Yogesh, K. K. (2003). Incidence and Management of Lepidopteran Fruit Borers of Guava (*Psidium guajava* L.) in Jammu, India. Journal Asia-Pacific Entomology. 6:201-205. DOI: https://10.1016/S1226- 8615(08)60187-9.

Ravi, K., Gupta, S. and Verma, T. (2003). Impact of pest infestations on fruit quality and yield in litchi cultivation. Journal of Horticultural Science, *78*(4), 345-352.

 Siddiqui, Z. A., Khan, S. A. and Rahman, M. (2016). Consequences of chemical pesticide use on beneficial insects and pollinators. International Journal of Pest Management, *62*(3), 215-220.

Singh, H.S., Nath, V., Singh, A. and Pandey, S.D. (2012): Litchi: Preventive practices and Curative measures. – Satish Serial Publishing House, New Delhi.

 Upadhyay, S. K., Aryal, S., Bhusal, B., and Chaudhary, B. (2020). Evaluation of Insecticides for the Management of Litchi Fruit and Shoot Borer. Journal of Nepal Agricultural Research Council*,* 6: 85-91.

Vijayaraghavendra, R. and Basavanagoud, K. (2017). Evaluation of insecticides against sapota fruit Borer, *Phycita erythrolophia* Hampson. Journal of Entomology and Zoology Studies, 5: 1358-1361.

Yule, S. and Srinivasan, R. (2013). Evaluation of bio-pesticides against legume pod borer, *Marucavitrata* Fabricius (Lepidoptera: Pyralidae), in laboratory and field conditions in Thailand. Journal of Asia Pacific Entomology, 16:357-360. DOI: <https://doi.org/10.1016/j.aspen.2013.05.001>.

Zhang, K., Li J., Liu H., Wang H. A. L. (2018). Semi-synthesis and insecticidal activity of spinetoram J and its D-forosamine replacement analogues. Beilstein Journal of Organic Chemistry. 4; 14:2321-2330. DOI: 10.3762/bjoc.14.207.