**Original Research Article**

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

**ABSTRACT**

~~Considering the economic importance of litchi and its major insect pest,~~ *~~Conopomorphasinensis~~* ~~Bradley,~~ 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 litchi orchards of age 25 - 30 years 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 centfruits infested with seed borer reduction over the control was recorded. Application of Spinetoram 11.7% SC @ 0.4 ml, followed by Flubendiamide 39.35% SC @ 0.4 mlper litre of water were found to be effective with 92.62 per cent and 88.41 per centprotection of litchi fruits against *C. sinensis*, respectively in litchi. Other insecticides were also found effective but not consistent in both years. Thus, based on the present study results, Spinetoram and Flubendiamide are recommended to control seed borer, *C. sinensis* on a rotational basis in litchi orchards.

**KEYWORDS**

*Conopomorphasinensis*, Spinetoram, seed and fruit borer, litchi

1. **INTRODUCTION**

The litchi seed/fruit borer,*Conopomorphasinensis* Bradley (Lepidoptera: Gracilariidae), a significant 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 against this pest, there may be 100% fruit loss in litchi, leading 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 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 the tested insecticides chlorantraniliprole (18.5% w/w SC) and Flubendiamide (39.35% m/m SC) each were found to be most efficient against *C. sinensis*and the spraying was done at fruit pea stage at 10-day intervals (Upadhyay et al., 2000). Hwang and Hung (1993) noted that bagging litchi effectively protects the fruits from *C. sinensis* without impacting their growth. The growing awareness of these issues has highlighted the need for more sustainable pest management strategies that balance efficacy with environmental safety.In addition to traditional chemical insecticides, newer biopesticides, such as 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). The effectiveness of newer insecticide molecules must be evaluated in terms of pest mortality and their impact on fruit quality and the ecosystem's overall health.

Information on effective and eco-friendly 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 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 years 2023 and 2024. The Shahi variety of litchi available at the research centre was considered for experimentation. The experiment was laid out in a randomized block design with 6 treatments including control. All the ~~agronomic~~ practices except plant protection were followed as per the recommended package and practices for litchi crops.

The experiment consisted of 5 insecticide molecules viz., Lambda-cyhalothrin 5% EC, Flubendiamide 39.35% SC, Spinetoram 11.7% SC, Chlorantraniliprole 18.5% SC, and Azadirachtin 10,000 ppm. Details of each insecticide, such as trade name and its applied dosage are given in Table 1.Treatments were applied twice first at the fruit pea stage and second 15 days after the first spray coincided with the colour break stage of litchi. All sprays were applied at the rate of 25 litre of water per tree. Treatments were arranged in a randomized block design (RBD) and replicated thrice. Ten fruits from each direction and a total of 40 fruits were randomly collected from each treated tree for seed borer observation. For the first observation, fruits were collected on the same day before the application of treatment. Post-treatment observations were made at 1-, 3- and 7- days after the application of sprays.

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 and after that opened for counting the infested free or infested fruits by *C. sinensis*. The infestation was ascertained by the presence of larvae of *C. sinensis* or its excreta or feeding frass inside the fruits.Thepercentof fruit infestedwas calculated using the number of infested fruits from the total collected fruits.The collected data of each treatment was used to assess the percentage 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 = Percent infested fruits after the treatment

 Tb = Percent infested fruits before the treatment

 Ca = Percent infested fruits in untreated control after treatment and

Cb = Percent 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% level of probability in the SPSS version 21 program.

1. **RESULTS & DISCUSSION**

Incidence 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 tested insecticides against litchi seed borer, *C. sinensis* in litchi fruits (year 2023).

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | Trade name and formulation | Dosage (ml or gm/litre) | Mean percent reduction of fruit borer incidence |
| 1- day after 1st spray | 3- day after 1st spray | 7- day after 1st spray | 1- day after 2nd spray | 3- day after 2nd spray | 7- day after 2nd spray |
| Lambda-cyhalothrin | Reeva 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 | Fame 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  | Delegate 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 | Econeem Plus10,000 ppm | 5ml | 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 | Coragen18.5%SC | 0.4ml | 19.20c(26.04) | 39.99c(39.23) | 75.30bc(60.20) | 20.54c(26.95) | 38.52b(38.36) | 83.20b(65.81) |
| Statistical analyses |
| 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).

After 1-day of the first spraying of treatments, 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* incidence ranged between 14.78 - 25.25% (F (4, 14) =4659.30) and 14.64 – 24.44% (F (4, 14) =48.42) for 2023 and 2024, respectively.Application of Spinetoram @ 0.4 ml per litre of water resulted in higher protection against *C. sinensis* during both seasons (92.62 and 89.98 percent borer-free fruits in 2023 and 2024, respectively). Specifically, the infestation levels were 25.25% after one day, 46.92% after three days, and 87.53% after seven days after first spray. Treatments with Flubendiamide and Chlorantraniliprole were the most effective after Spinetoram during both years.

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

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment  | Trade name and formulation  | Dosage (ml or gm/litre) | Mean percent reduction of fruit borer incidence  |
| 1- day after 1st spray  | 3- day after 1st spray  | 7- day after 1st spray  | 1- day after 2nd spray  | 3- day after 2nd spray  | 7- day after 2nd spray  |
| Lambda-cyhalothrin | Reeva 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 | Fame 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  | Delegate 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 | Econeem Plus10,000 ppm | 5ml | 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  | Coragen18.5%SC | 0.4ml | 18.06b(25.15) | 40.03b(39.25) | 80.23c(63.6) | 20.24a(26.74) | 36.32a(37.06) | 82.32b(65.14) |
| Statistical analyses  |
| 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).

The second most effective treatment was Flubendiamide, which resulted in infestation levels of 21.61% after one day, 41.95% after three days, and 82.64% after seven days in the first spray.After 7- days of the second application, all insecticides were found best effective and significantly differ from each other ((F (4, 14) =203.65) and (F (4, 14) =59.92) during 2023 and 2024, respectively. 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 lowest effective insecticide, Azadirachtin 1000 ppm, protected nearly 75% of litchi fruits from seed borer infestation.Present research findings showed that Flubendiamide and Chlorantraniliprole were the next best of Spinetoram.

Hung (2008) revealed C. sinensis larvae bored into the fruit, causing internal damage and leading to premature fruit drop. Effective insecticide, Spinetoram is a novel spinosyn insecticide with translaminar action which 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 foliar application of Spinosad, Flubendiamide and Chlorantraniliprole significantly reduced the litchi fruit borer in litchi fruits. Upadhyay et al. (2020) reported that the insecticide chlorantraniliprole (18.5% w/w SC) and Flubendiamide (39.35% m/m SC) each were found to be most efficient against *C. sinensis* and could be applied at the rate of 1 ml per 3 litre of water when fruit size was about pea and applied 3 times with 10 days interval. Suman et al. (2024) revealed the lowest number of fruit infestations was recorded with Lambda-cyhalothrin followed by Spinosad application where 30 to 70 % fruit drop was reduced. 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, *Marucavitrata* (Lepidoptera: Pyralidae) and fruit borer species in guava (Yule and Srinivasan, 2013; Kaul and Yogesh, 2003). Conventional chemical insecticides belonging to organochlorine, organophosphate, and carbamate groups have residual toxicity, resistance, and resurgence problems in many crops (Rao et al., 2019). 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 newer generation insecticides available for the management of litchi seed borer, *C. sinensis* in litchi orchards.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 is also suggested to delay the development of resistance in *C. sinensis* against any specific insecticides.

**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.

**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) *Scirpophagaincertulas* 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, *Helicoverpaarmigera* (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, J. Econ. Entomol. 48:157-161.

Hung, S. C., Ho, K. Y. and Chen, C. C. (2008). Investigation of Fruit Damages of Litchi Caused by *Conopomorphasinensis* Bradley and *Bactrocera dorsalis* (Hendel) in Chiayi. *J. Taiwan Agril. Res.* 57: 143-152.

Hwang, J. S. and C. C. Hung. 1993. Control of the Litchi Fruit Borer, *Conopomorphasinensis* Bradley, with Bagging Method and Insecticides. Plant Protec. Bull. (Taichung) 35(3): 225-238.

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.

Rao, C. N., George, A. and Rahangadale, S. (2019). Monitoring of resistance in field populations of *Scirtothrips dorsalis* (Thysanoptera: Thripidae) and *Diaphorinacitri* (Hemiptera: Liviidae) to commonly used insecticides in citrus in Central India. Journal of Economic Entomology 112(1): 324–28.

Ravi, K., Gupta, S., & 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., & Rahman, M. (2016). Consequences of chemical pesticide use on beneficial insects and pollinators. *International Journal of Pest Management*, *62*(3), 215-220.

 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, *Phycitaerythrolophia* 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. Semi-synthesis and insecticidal activity of spinetoram J and its D-forosamine replacement analogues. *Beilstein J Org Chem*. 2018 Sep 4;14:2321-2330. doi: 10.3762/bjoc.14.207. PMID: 30254696; PMCID: PMC6142758.