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# Field bio-efficacy, phytotoxicity of different insecticides against invasive leafminer, *Liriomyza huidobrensis* in potato and its safety to natural enemies

**Monica Subburaj**
Department of Agricultural Entomology, TNAU, Coimbatore, Tamil Nadu, India.
**Vinothkumar Bojan** ✉
Department of Agricultural Entomology, TNAU, Coimbatore, Tamil Nadu, India.

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## ABSTRACT

**In order to assess the efficiency of different pesticides, their phytotoxicity, and the safety of natural enemies in potato fields of the Nilgiris district against the recently existing invasive pest, *Liriomyza huidobrensis*, two field experiments were conducted at two different locations, namely Kukkal in Kotagiri and Kappachi in Ooty, both located in the district Nilgiris, Tamil Nadu. The outcomes showed that cyantraniliprole 10.26 OD @ 75 g a.i. /ha and chlorantraniliprole 18.5 S @ 30 g a.i. /ha were helpful for managing *L. huidobrensis*. Following spraying, coccinellid and spider populations first declined, but gradually rose. Following it, Profenofos 50 EC @ 500 g a.i. /ha was also demonstrated to yield favourable results, but it was rejected because it significantly reduced the population of natural enemies. Additionally, it was discovered that none of the pesticides had any phototoxic effects on potato during the trial. In light of the fact that profenofos 50 EC has a similar impact on the natural enemy population as cyantraniliprole 10.26 OD and chlorantraniliprole 18.5 S @ 30 g a.i. ha$^{-1}$, they can be used successfully as a management strategy for potato leaf miner.**

## Introduction

The fourth-most significant food crop in the world is the potato (*Solanum tuberosum*), which belongs to the Solanaceae family. China is the world's finest producer of potato, followed by India, Ukraine, Russia, and the United States. In fiscal year 2020, India has over two million hectares of land available for potato cultivation, producing roughly 508.57 lakh tonnes (Anonymous, 2020). Each year, pests destroy potato tubers worth around 60 billion rupees (US$1.2 billion), or 10 to 20 percent of the crop's total production. Pests that affect this crop include aphid, leafhopper, potato cutworms, potato tuber moth, and leafminers (Simpson, 1977). It is thought that *Liriomyza* leafminers (Agromyzidae: Diptera) are the most serious pest in the majority of horticultural crops worldwide (Bader *et al.*, 2006). A thorough investigation was carried out in potato fields at Nilgiris, Tamil Nadu, during 2020–2021, when it was discovered that a new leafminer species, *L. huidobrensis*, causes significant yield losses in potato. Up to 20% of the entire cost of production for potato might be attributed to pesticide use. Chemical control is one of the widely utilized strategies for pest management in the production of potato.

Chemical control remained the most frequently implemented methods for the control of arthropod pests, despite the certainty that the registration of any novel insecticides will be decided based on the environmental and human safety concerns and the identification of successful non-chemical strategies against the majority of pests (Alyokhin, 2011). In order to prevent the pest from spreading and taking on the role of a significant pest, it is crucial that investigations be performed in potato fields given the severity of the damage caused by *Liriomyza huidobrensis*. This study's objective is to assess several synthetic pesticides for the efficient control of *L. huidobrensis*, the potato leafminer.

**Corresponding author E-mail:** *drbvinothkumar@gmail.com*
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## Material and Methods

Two field trials were carried out at farmer's holdings in the Nilgiris region of Tamil Nadu in Kukkal village, Kotagiri (11.46°N 76.88°E and 1,847 MSL), and Kappachi, Ooty (11.43°N 76.76°E and 2,209 MSL). With a plot size of 25 $m^2$, the experiment was carried out using a Randomized Block Design (RBD) on the potato variety Kufri Jyothi. Insecticides were applied initially when the pest passed the ETL (10% leaf damage), and a second application was made 15 days later (TNAU Agritech. portal). The treatment details were:

- $T_1$ Chlorantraniliprole 18.5 SC @ 30 g ai. / ha
- $T_2$ Cyantraniliprole 10.26 OD @ 75 g ai. / ha
- $T_3$ Flubendiamide 20 WG @ 48 g ai. / ha
- $T_4$ Spinosad 45 SC @ 75 g ai. / ha
- $T_5$ Profenofos 50 EC @ 500 g ai. / ha
- $T_6$ Spinetoram 11.7 SC @ 50 g ai. / ha
- $T_7$ Emamectin benzoate 5 SG @ 10 g ai. / ha
- T8 Control

Pretreatment assessments of the % leaf damage were made on five randomly selected plants from each plot, as well as 3, 5, 7, 10, and 14 days after each spray. In order to evaluate the safety of insecticides at five randomly chosen plants, the populations of natural enemies, such as spiders and coccinellids, were also counted. Phytotoxic symptoms were also examined. Prior to analysis, the experiment's data were converted into an arc sine (angular transformation) for the percentage of leaf damage and a square root (analytical transformation) for the population of natural enemies. The data was then subjected to a variance analysis (ANOVA). Using Duccan's Multiple Range Test, the means of the substantially different treatments (P = 0.05) were separated (DMRT). The significance threshold was set at = 0.05. These processes were performed using the SPSS Statistics 28.0.1 (IBM Corp, 2021).

## Results and Discussion

Table 1 summarises the findings of field trials with eight distinct treatments carried out in the Nilgiris district of Tamil Nadu in Kotagiri and Ooty. Based on the percentage reduction in leaf damage compared to the untreated control at Kotagiri, the following treatments were found to be most effective: cyantraniliprole 10.26 OD @ 75 g a.i. /ha (85.50%) > chlorantraniliprole 18.5 SC @ 30 g a.i. /ha (80.23%) > profenofos 50 EC @ 500 g a.i. /ha (72.92%) > emamectin benzoate 5 SG @ 10 g a.i. /ha (70.05%) > flubendiamide 20 WG @ 48 g a.i. /ha (66.49%) > spinetoram 11.7 SC @ 50 g a.i. $ha^{-1}$(45.74%) > spinosad 45 SC @ 75 g a.i. /ha (42.38%) (Fig.1). At Kappachi, Ooty, plots treated with cyantraniliprole 10.26 OD @ 75 g a.i. /ha showed the greatest percentage reduction compared to controls (92.24 %). According to the percentage reduction in leaf damage compared to the untreated control, the following treatments were found to be the most effective: cyantraniliprole 10.26 OD @ 75 g a.i. /ha (92.24%) > chlorantraniliprole 18.5 SC @ 30 g a.i. /ha (91.96%) > profenofos 50 EC @ 500 g a.i. /ha (88.30%) > emamectin benzoate 5 SG @ 10 g a.i. /ha (79.98%) > flubendiamide 20 WG @ 48 g a.i. /ha (79.00%) > spinetoram 11.7 SC @ 50 g a.i. /ha (73.47%) > spinosad 45 SC @ 75 g a.i. /ha (69.42%). Based on the findings, it was reported that cyantraniliprole 10.26 OD @ 75 g a.i./ ha and chlorantraniliprole 18.5 S @ 30 g a.i./ ha were found to be effective insecticides among various treatments tested for their efficacy in management of leaf miner, *L. huidobrensis* in the potato ecosystem. Similar findings were given by Mohan and Anitha (2017) whom reported that chlorantraniliprole 18.5 SC 0.03 % at 10 days interval reduces the leaf minor damage, number of mines and larvae per plant in tomato. Selvaraj *et al.* (2017) identified that in tomato, chlorantraniliprole 4.3 % as a combination insecticide with Abamectin 1.7% SC was significantly effective while spraying twice fortnightly. The insecticides like profenofos, buprofezin, spinosad, chlorantraniliprole, thiame thoxam, acephate, malathion along with NSKE @ 5% and azadirachtin 1500 ppm were shown to reduce the leaf miner population in ridge gourd to considerable level (Hirekurubar and Tatagar, 2018), which was found to be in accordance with our results. Ramesh *et al.* (2020) also stated that the insecticide cyantraniliprole 10.26 OD registered lower leaf miner infestation in watermelon. Generalist predators in the potato ecosystem, such spiders and coccinellids, were evident during the cropping season. Spiders or coccinellids were significantly impacted by various pesticide treatments. Tables 2 and 3 explain the findings of the impact of various insecticidal treatments on thepopulation of spiders and coccinellids in two distinct locales.

**Table 1: Efficacy of different insecticides against *Liriomyza* leafminer in Potato**

| Treatment | Location I - Kotagiri | | | | | | | | Location II - Ooty | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PTC | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | Mean | PRC (%) | PTC | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | Mean | PRC (%) |
| T1 | 35.31 | 22.29 | 18.04 | 14.91 | 11.36 | 8.45 | 15.01 | 80.23 | 21.12 | 12.18 | 10.26 | 7.18 | 5.30 | 3.84 | 7.75 | 91.96 |
| | (36.46) | (28.17 | (25.14) | (22.72) | (19.69) | (16.89) | (22.79)$^{de}$ | | (27.36) | (20.42) | (18.68) | (15.54) | (13.31) | (11.31) | (16.17)$^{g}$ | |
| T2 | 36.84 | 21.73 | 15.14 | 11.92 | 8.87 | 6.19 | 12.77 | 85.50 | 27.81 | 13.64 | 10.22 | 8.11 | 5.59 | 3.71 | 8.25 | 92.24 |
| | (37.37) | (27.78) | (22.90) | (20.20) | (17.32) | (14.41) | (20.94)$^{e}$ | | (31.82) | (21.67) | (18.64) | (16.55) | (13.67) | (11.11) | (16.69)$^{f}$ | |
| T3 | 38.05 | 28.08 | 22.66 | 19.54 | 17.69 | 16.02 | 20.80 | 62.49 | 24.06 | 15.62 | 13.59 | 12.13 | 11.09 | 10.05 | 12.4 | 79.00 |
| | (38.08) | (32.00) | (28.42) | (26.23) | (24.87) | (23.59) | (27.13)$^{c}$ | | (29.38) | (23.28) | (21.63) | (20.38) | (19.46) | (18.48) | (20.70)$^{d}$ | |
| T4 | 40.15 | 30.68 | 29.82 | 28.30 | 26.08 | 24.61 | 27.90 | 42.38 | 27.22 | 21.14 | 19.05 | 17.04 | 15.53 | 14.63 | 17.48 | 69.42 |
| | (39.32) | (33.63) | (33.10) | (32.14) | (30.71) | (29.74) | (31.88)$^{b}$ | | (31.45) | (27.37) | (25.88) | (24.38) | (23.21) | (22.49) | (24.71)$^{b}$ | |
| T5 | 39.03 | 26.16 | 20.57 | 16.73 | 14.30 | 11.57 | 17.86 | 72.92 | 23.13 | 12.02 | 10.14 | 8.69 | 7.14 | 5.60 | 8.72 | 88.30 |
| | (38.66) | (30.76) | (26.97) | (24.14) | (22.22) | (19.88) | (25.00)$^{cd}$ | | (28.74) | (20.29) | (18.57) | (17.14) | (15.49) | (13.68) | (17.17)$^{e}$ | |
| T6 | 34.91 | 30.65 | 28.57 | 26.63 | 24.62 | 23.18 | 26.73 | 45.74 | 26.53 | 19.03 | 16.65 | 15.21 | 13.64 | 12.69 | 15.44 | 73.47 |
| | (36.22) | (33.62) | (32.31) | (31.07) | (29.75) | (28.78) | (31.13)$^{b}$ | | (31.00) | (25.86) | (24.08) | (22.95) | (21.67) | (20.87) | (23.14)$^{c}$ | |
| T7 | 38.11 | 24.44 | 20.75 | 17.08 | 14.59 | 12.79 | 17.93 | 70.05 | 23.20 | 15.56 | 13.19 | 11.98 | 10.60 | 9.58 | 12.18 | 79.98 |
| | (38.12) | (29.63) | (27.10) | (24.41) | (22.45) | (20.95) | (25.05)$^{cd}$ | | (28.79) | (23.23) | (21.29) | (20.25) | (19.00) | (18.03) | (20.43)$^{d}$ | |
| T8 | 37.66 | 41.90 | 42.50 | 43.01 | 43.50 | 42.71 | 42.72 | - | 22.05 | 33.63 | 37.48 | 40.48 | 43.67 | 47.83 | 40.62 | - |
| | (37.85) | (40.34) | (40.69) | (40.98) | (41.27) | (40.81) | (40.82)$^{a}$ | | (28.01) | (35.44) | (37.75) | (39.51) | (41.36) | (43.76) | (39.59)$^{a}$ | |
| S Em | 0.386 | 1.347 | 1.682 | 1.699 | 1.744 | 1.784 | 1.65 | | 0.257 | 0.159 | 0.188 | 0.24 | 0.21 | 0.232 | 0.155 | |
| CD | 1.183 | 4.126 | 5.15 | 5.203 | 5.434 | 5.463 | 5.054 | | 0.787 | 0.488 | 0.577 | 0.734 | 0.634 | 0.71 | 0.476 | |

**PRC is for percent reduction over untreated control; PTC stands for pre-treatment count; DAS stands for days after spraying; and the numbers are pooled from two sprays. Arc sine converted values represent the figures in parenthesis. By DMRT at the 5% level of significance, treatment means having a letter in common are not considered significant. a, b, c, d, e, f and g are letters used to denote the significance by DMRT.**

**Table 2: Efficacy of different insecticides against predatory spiders in potato**

| Treatment | Location I - Kotagiri | | | | | | | | Location II - Ooty | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PTC | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | Mean | PRC (%) | PTC | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | Mean | PRC (%) |
| T1 | 1.72 | 1.52 | 1.64 | 1.76 | 1.83 | 1.93 | 1.73 | 29.69 | 1.28 | 1.24 | 1.34 | 1.45 | 1.54 | 1.63 | 1.44 | 31.34 |
| | (1.49) | (1.42) | (1.46) | (1.50) | (1.53) | (1.56) | (1.49)$^{f}$ | | (1.33) | (1.32) | (1.36) | (1.40) | (1.43) | (1.46) | (1.39)$^{d}$ | |
| T2 | 1.62 | 1.47 | 1.55 | 1.59 | 1.69 | 1.78 | 1.62 | 34.27 | 1.27 | 1.25 | 1.33 | 1.45 | 1.55 | 1.65 | 1.44 | 30.64 |
| | (1.46) | (1.40) | (1.43) | (1.45) | (1.48) | (1.51) | (1.45)$^{g}$ | | (1.33) | (1.32) | (1.35) | (1.39) | (1.43) | (1.46) | (1.39)$^{d}$ | |
| T3 | 1.82 | 1.63 | 1.71 | 1.83 | 1.95 | 2.04 | 1.83 | 25.62 | 1.26 | 1.31 | 1.36 | 1.50 | 1.59 | 1.68 | 1.49 | 29.23 |
| | (1.52) | (1.46) | (1.49) | (1.52) | (1.56) | (1.59) | (1.53)$^{d}$ | | (1.33) | (1.34) | (1.36) | (1.41) | (1.45) | (1.48) | (1.41)$^{c}$ | |
| T4 | 1.81 | 1.87 | 1.99 | 2.13 | 2.21 | 2.31 | 2.10 | 14.57 | 1.32 | 1.41 | 1.52 | 1.62 | 1.73 | 1.80 | 1.61 | 24.10 |
| | (1.52) | (1.54) | (1.58) | (1.62) | (1.65) | (1.68 | (1.61)$^{b}$ | | (1.35) | (1.38) | (1.42) | (1.46) | (1.49) | (1.52) | (1.45)$^{b}$ | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **T5** | 1.55 | 1.27 | 1.36 | 1.40 | 1.47 | 1.52 | 1.40 | 42.99 | 1.14 | 0.99 | 1.12 | 1.17 | 1.27 | 1.34 | 1.18 | 43.71 |
| | (1.43) | (1.33 | (1.36) | (1.38) | (1.40) | (1.42) | (1.38)[h] | | (1.28) | (1.22) | (1.27) | (1.29) | (1.33) | (1.35) | (1.29)[e] | |
| **T6** | 1.63 | 1.69 | 1.79 | 1.88) | 2.01 | 2.09 | 1.89 | 23.14 | (1.27 | 1.32 | 1.52 | 1.62 | 1.76 | 1.89 | 1.62 | 20.24 |
| | (1.46) | (1.48) | (1.51) | (1.54 | (1.58) | (1.61) | (1.55)[c] | | (1.33) | (1.35) | (1.42) | (1.45) | (1.50) | (1.55) | (1.46)[b] | |
| **T7** | 1.70 | 1.57 | 1.66 | 1.74) | 1.85 | 2.00 | 1.76 | 28.28 | 1.38 | 1.26 | 1.39 | 1.51 | 1.57 | 1.69 | 1.48 | 28.60 |
| | (1.48) | (1.44) | (1.47) | (1.50 | (1.53) | (1.58) | (1.50)[e] | | (1.37) | (1.33) | (1.38) | (1.42) | (1.44) | (1.48) | (1.41)[c] | |
| **T8** | 1.75 | 2.21 | 2.26 | 2.49) | 2.59 | 2.75 | 2.46 | - | 1.32 | 1.79 | 1.93 | 2.10 | 2.24 | 2.37 | 2.08 | - |
| | (1.50) | (1.65) | (1.66) | (1.73) | (1.76) | (1.80) | (1.72)[a] | | (1.35) | (1.51) | (1.56) | (1.61) | (1.66) | (1.69) | (1.61)[a] | |
| **S Em** | 0.009 | 0.003 | 0.003 | 0.002 | 0.004 | 0.002 | 0.003 | | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 | |
| **CD** | 0.027 | 0.01 | 0.008 | 0.007 | 0.011 | 0.007 | 0.008 | | 0.006 | 0.006 | 0.008 | 0.009 | 0.008 | 0.008 | 0.007 | |

**PRC is for percent reduction over untreated control; PTC stands for pre-treatment count; DAS stands for days after spraying; and the numbers are pooled from two sprays. Arc sine converted values represent the figures in parenthesis. By DMRT at the 5% level of significance, treatment means having a letter in common are not considered significant. a, b, c, d, e, f, g and h are letters used to denote the significance by DMRT.**

**Table 3: Efficacy of different insecticides against predatory coccinellids in potato**

| **Treatment** | **Location I - Kotagiri** | | | | | | | | **Location II - Ooty** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PTC** | **3 DAS** | **5 DAS** | **7 DAS** | **10 DAS** | **14 DAS** | **Mean** | **PRC (%)** | **PTC** | **3 DAS** | **5 DAS** | **7 DAS** | **10 DAS** | **14 DAS** | **Mean** | **PRC (%)** |
| **T1** | 1.92 | 1.77 | 1.81 | 1.88 | 1.94 | 2.06 | 1.89 | 34.17 | 1.95 | 1.88 | 1.99 | 2.13 | 2.18 | 2.31 | 2.10 | 33.12 |
| | (1.55) | (1.50) | (1.52) | (1.54) | (1.56) | (1.60) | (1.55)[e] | | (1.56) | (1.54) | (1.58) | (1.62) | (1.64) | (1.68) | (1.61)[d] | |
| **T2** | 1.66 | 1.53 | 1.63 | 1.71 | 1.80 | 1.92 | 1.72 | 38.65 | 1.95 | 1.89 | 2.00 | 2.12 | 2.21 | 2.32 | 2.11 | 32.79 |
| | (1.47) | (1.42) | (1.46) | (1.49) | (1.52) | (1.55) | (1.49)[f] | | (1.56) | (1.55) | (1.58) | (1.62) | (1.65) | (1.68) | (1.62)[d] | |
| **T3** | 2.02 | 1.81 | 1.90 | 1.95 | 2.09 | 2.20 | 1.99 | 29.47 | 2.06 | 2.02 | 2.10 | 2.17 | 2.28 | 2.38 | 2.19 | 31.10 |
| | (1.59) | (1.52) | (1.55) | (1.57) | (1.61) | (1.64) | (1.58)[c] | | (1.60) | (1.590 | (1.61) | (1.63) | (1.67) | (1.70) | (1.64)[cd] | |
| **T4** | 1.98 | 1.83 | 1.93 | 2.01 | 2.15 | 2.27 | 2.04 | 27.28 | 2.34 | 2.32 | 2.43 | 2.51 | 2.58 | 2.71 | 2.51 | 21.54 |
| | (1.57) | (1.53) | (1.56) | (1.58) | (1.63) | (1.66) | (1.59)[b] | | (1.69) | (1.68) | (1.71) | (1.73) | (1.76) | (1.79) | (1.73)[b] | |
| **T5** | 1.51 | 1.27 | 1.37 | 1.43 | 1.47 | 1.56 | 1.42 | 50.13 | 1.82 | 1.49 | 1.61 | 1.67 | 1.72 | 1.95 | 1.69 | 43.60 |
| | (1.42) | (1.33) | (1.37) | (1.39) | (1.40) | (1.43) | (1.38)[g] | | (1.52) | (1.41) | (1.45) | (1.47) | (1.49) | (1.56) | (1.48)[e] | |
| **T6** | 1.87 | 1.81 | 1.92 | 1.99 | 2.09 | 2.21 | 2.00 | 29.20 | 2.25 | 2.20 | 2.27 | 2.37 | 2.50 | 2.59 | 2.39 | 24.92 |
| | (1.54) | (1.52) | (1.56) | (1.58) | (1.61) | (1.65) | (1.58)[c] | | (1.66) | (1.64) | (1.66) | (1.69) | (1.73) | (1.76) | (1.70)[bc] | |
| **T7** | 1.82 | 1.66 | 1.91 | 1.98 | 2.03 | 2.13 | 1.94 | 31.93 | 2.19 | 2.12 | 2.21 | 2.30 | 2.90 | 2.50 | 2.41 | 27.67 |
| | (1.52) | (1.47) | (1.55) | (1.57) | (1.59) | (1.62) | (1.56)[d] | | (1.64) | (1.62) | (1.65 | (1.67) | (1.84) | (1.73) | (1.70)[bc] | |
| **T8** | 1.92 | 2.48 | 2.56 | 2.68 | 2.97 | 3.12 | 2.76 | - | 2.51 | 3.03 | 2.60 | 3.20 | 3.33 | 3.45 | 3.12 | - |
| | (1.56) | (1.72) | (1.75) | (1.78) | (1.86) | (1.90) | (1.81)[a] | | (1.74) | (1.88) | (1.76) | (1.92) | (1.96) | (1.99) | (1.90)[a] | |
| **S Em** | 0.003 | 0.002 | 0.002 | 0.005 | 0.005 | 0.003 | 0.002 | | 0.004 | 0.003 | 0.003 | 0.002 | 0.003 | 0.003 | 0.025 | |
| **CD** | 0.008 | 0.007 | 0.007 | 0.014 | 0.014 | 0.008 | 0.005 | | 0.013 | 0.008 | 0.008 | 0.008 | 0.008 | 0.01 | 0.076 | |

**PRC is for percent reduction over untreated control; PTC stands for pre-treatment count; DAS stands for days after spraying; and the numbers are pooled from two sprays. Arc sine converted values represent the figures in parenthesis. By DMRT at the 5% level of significance, treatment means having a letter in common are not considered significant. a, b, c, d, e, f and g are letters used to denote the significance by DMRT.**

The proportion of spiders that were reduced by over 1% for profenofos 50 EC @ 500 g a.i /ha was the highest (27.28 percent). The spider population decreased in treatment plots over control plots in the following order: profenofos 50 EC @ 500 g a.i. /ha > cyantraniliprole 10.26 OD @ 75 g a.i. $ha^{-1}$> chlorantraniliprole 18.5 SC @ 30 g a.i. /ha > emamectin benzoate 5 SG @ 10 g a.i. /ha > flubendiamide 20 WG @ 48 g a.i. /ha > spinetoram 11.7 SC @ 50 g a.i. /ha > spinosad 45 SC @ 75 g a.i. /ha at both the locations. Similarly, the order of reduction in population of coccinellids in treated plots over control were profenofos 50 EC @ 500 g a.i. /ha > chlorantraniliprole 18.5 SC @ 30 g a.i. /ha > cyantraniliprole 10.26 OD @ 75 g a.i. /ha > flubendiamide 20 WG @ 48 g a.i. $ha^{-1}$> emamectin benzoate 5 SG @ 10 g a.i. /ha > spinetoram 11.7 SC @ 50 g a.i. $ha^{1}$ > spinosad 45 SC @ 75 g a.i. /ha in both the locations. Profenofos 50 EC was found to cause higher reduction in natural enemy population at both the locations. Whereas, cyantraniliprole 10.26 OD and chlorantraniliprole 18.5 S @ 30 g a.i./ ha doesn't cause much harm to the natural enemy population comparable to the effect of profenofos 50 EC. Cyazypyr 10% OD @ 45–105 g a.i./ha has not significantly reduced the population of natural enemies even @ 360 g a.i./ha and was found to be safer to the natural enemies (Mandal, 2012). During the post-application period, the predatory coccinellid population did not significantly differ from the control population, demonstrating the safety of cyantraniliprole 10% OD @ 90 and 105 g a.i./ha and spinosad at the tested levels to the predators, with the exception of other treatment (Misra, 2013).The results of the field trial in each of the tested locations showed that potato plants sprayed with concentrations of chlorantraniliprole 18.5 SC @ 30 g a.i. $ha^{-1}$, cyantraniliprole 10.26 OD @ 75 g a.i. $ha^{-1}$, flubendiamide 20 WG @ 48 g a.i. $ha^{-1}$, spinosad 45 SC @ 75 g a.i. $ha^{-1}$, profenofos 50 EC @ 500 g a.i. $ha^{-1}$, spinetoram 11.7 SC @ 50 g a.i. /ha and emamectin benzoate 5 SG @ 10 g a.i. /ha concentrations had not caused any phytotoxic effects. None of the insecticides were found to cause any phytotoxic symptoms. In his assessment of the bio-efficacy of cyantraniliprole 10 % OD against major sucking pests and potato armyworms in the potato environment, Bojan (2021) concluded that the compound exhibited no phytotoxic effects at any dose. According to Mandal (2012), cyazypyr 10 percent% OD did not cause phytotoxicity in the treated tomato crop, even at a dosage of 360 g a.i./ ha.

## Conclusion

The results indicated that the insecticides cyantraniliprole 10.26 OD @ 75 g a.i. /ha and chlorantraniliprole 18.5 S @ 30 g a.i. /ha were successful in controlling leafminers in the potato environment. Additionally, it was discovered that none of the pesticides had any phototoxic effects on the ecosystem of potato during the trial. The method validation addressed the specificity, linearity, recovery, repeatability, and ruggedness. Therefore, both pesticides may be used at the required dosage to manage the Liriomyza huidobrensis leafminer effectively in the potato habitat.

## Conflict of interest

The authors declare that they have no conflict of interest.

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