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# COMPARATIVE EFFICACY AND ECOLOGICAL IMPACT OF CONVENTIONAL AND BIOLOGICAL INSECTICIDES ON TORTOISE BEETLE, *CASSIDA VITTATA* VILL (COLEOPTERA: CHRYSOMELIDAE) AND BENEFICIAL PREDATORS IN SUGAR BEET FIELDS

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**ABSTRACT:** The tortoise beetle, Cassida *vittata* Vill (Coleoptera: Chrysomelidae), is a major pest threatening sugar beet (*Beta vulgaris* L.) cultivation in Egypt, often resulting in severe foliage and root damage, as well as substantial yield losses. This field study, conducted over the 2023 /2024 and 2024/2025 growing seasons at Kafr El-Sheikh Governorate, evaluated the comparative efficacy and ecological impact of two conventional insecticides, lambda-cyhalothrin and a Pyriproxyfen + Bifenthrin mixture, and two alternative insecticides, emamectin benzoate and indoxacarb. All insecticides significantly reduced *C. vittata* populations, achieving average reductions exceeding 85% in 2023/2024 and over 93% in 2024/2025 with no statistically significant differences among treatments ($P > 0.05$). However, marked differences emerged in their effects on beneficial predators. Conventional insecticides caused severe and prolonged reductions in populations of green lacewings (*Chrysoperla* spp.) and lady beetles (*Coccinella* spp.), with average reductions exceeding 82% across both seasons. In contrast, the biological insecticides demonstrated significantly lower impact, maintaining predator reductions to 55-67% ($P < 0.05$). These findings underscore the suitability of emamectin benzoate and indoxacarb as selective insecticides that strike a balance between high pest suppression and improved ecological safety. Overall, the results support the integration of biological insecticides into sustainable integrated pest management (IPM) programs for sugar beet cultivation in Egypt, reducing ecological disruption while maintaining effective control of *C. vittata*.

**Keywords:** *Cassida vittata*, Sugarbeet, Conventional insecticides, Alternative insecticides, Associated predator, Pest management.

## INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is a significant global crop, accounting for approximately 20% of the world's sugar production, second only to sugarcane (El-Fergani, 2019; FAOSTAT, 2022). In Egypt, sugar beet plays a key role in the country's sugar self-sufficiency plans, with over 600,000 feddans cultivated annually, making Egypt the leading sugar beet producer in the Mediterranean region (Egyptian Ministry of Agriculture, 2023).

However, productivity is heavily restricted by tortoise leaf beetle, *Cassida vittata* (Coleoptera: Chrysomelidae), a major pest whose adults and larvae skeletonise foliage, resulting in reduced photosynthesis and potential yield losses of up to 50% under favourable conditions (El-Hawary *et al*., 2020; Ali *et al*., 2021; Refaei *et al*., 2023). Conventional pest control methods in Egyptian beet fields often depend greatly on broad-spectrum insecticides, notably pyrethroids (e.g., lambda-cyhalothrin), organophosphates, and neonicotinoids. While these substances provide a quick knockdown, they pose significant

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ecological problems, especially due to their adverse effects on non-target organisms, such as *Chrysoperla* spp. (green lacewings) and *Coccinella* spp. (ladybird beetles), which are vital natural enemies of aphids and other soft-bodied pests (Desneux *et al.*, 2007; Biondi *et al*., 2012; El-Dessouki *et al.*, 2014; Dinter & Wiles, 2000). The continuous application of these chemicals disrupts predator-prey relationships, hastens the development of pest resistance, and leads to increased frequency and amounts of chemical use —a cycle known as the pesticide treadmill (Geiger *et al.*, 2010; Pappas *et al.*, 2011; Sparks & Nauen, 2015).

The search for ecologically sustainable alternatives has drawn attention towards reduced-risk insecticides, particularly those derived from microbial or biochemical sources. Compounds such as emamectin benzoate (a fermentation product of *Streptomyces avermitilis*) and indoxacarb (a pro-insecticide activated in the insect midgut) offer enhanced target specificity, lower environmental persistence, and compatibility with integrated pest management (IPM) frameworks (IRAC, 2022; El-Fergani, 2019). Emamectin primarily acts on glutamate-gated chloride channels, while indoxacarb blocks voltage-dependent sodium channels, both of which result in insect paralysis and death (Tomizawa & Casida, 2005; Sparks *et al*., 2012). Despite their promising mode of action, field-level evaluations of these compounds in sugar beet ecosystems remain scarce, particularly under Egyptian climatic and agronomic conditions.

Existing studies have primarily focused on cotton, tomato, or maize pests (e.g., *Spodoptera littoralis*, *Tuta absoluta*, *Helicoverpa armigera*), rather than on *C. vittata*, highlighting a critical knowledge gap in sugar beet-specific IPM (Abd-Rabou *et al*., 2019; El-Wakeil & Gaafar, 2014). Similarly, the impact of these insecticides on beneficial arthropods under field conditions in Egyptian beet agroecosystems is insufficiently documented, which limits our ability to design ecologically sound pest control programs.

This study aimed to compare the efficacy of conventional (lambda-cyhalothrin and Pyriproxyfen + Bifenthrin) and alternative (Emamectin benzoate and Indoxacarb) insecticides against C. vittata, while concurrently evaluating their side effects on beneficial predator populations (*Chrysoperla* spp. and *Coccinella* spp.). By integrating pest suppression efficacy with assessments of non-target safety, the findings will contribute to refining sustainable integrated pest management (IPM) protocols in sugar beet production systems in Egypt.

## MATERIALS AND METHODS

### Tested Insecticides

1. **Emamectin benzoate (Alternative insecticides) 4% ME**: applied at a rate of 35ml per 100 liters of water.
2. **Indoxacarb (Alternative insecticides) 25% WG**: Applied at a rate of 60 g per Feddan.
3. **Pyriproxyfen 10% + Bifenthrin 10% (conventional insecticides) 20% EC:** Applied at a rate of 120 ml per 100 liters of water.
4. **Lambda-cyhalothrin (conventional insecticides)**: Applied at a rate of 500 g per 200 liters of water.

### Field Studies

This experiment was conducted over two successive sugar beet seasons (2023/2024 and 2024/2025). At the Agricultural Research Station - Production Sector Farm, Sakha, Kafr El-Sheikh Governorate, Egypt. A standard completely randomized block design was used. The local sugar beet variety "Gloria" was planted on October 25, 2023, and October 26, 2024. For each treatment and the untreated control, the experimental area was 168 square meters, which was divided into four equal plots of 42 square meters each, roughly equivalent to 1/100th of a Feddan per treatment. To prevent accidental mixing of treatments, we ensured that two unsprayed rows of plants were left between the plots.

Insecticide applications occurred once per growing season. This was on April 1, 2024, and again on April 3, 2025. A 20-litre motorized backpack sprayer was used to apply the insecticide formulations, always at the field rates officially recommended by the Agricultural Pesticide Committee (available guidelines can be found at http://www.apc.gov.eg/ar/APCReleases.aspx). Meanwhile, the control plots were sprayed with just water. All standard farming practices were uniformly applied to every treatment area.

To assess *C. vittata* populations, forty individuals were used for each treatment (10 plants per plot). Plants were randomly selected from each plot for sampling. To evaluate the effect of the tested insecticides on the associated predators, two rows of plants were left unsprayed between plots. Observations were recorded at four time points: immediately before insecticide application, and at three, seven, and ten days post-application. Initially, a fungicide was applied, followed by washing the backpack sprayer with clean water before proceeding with other pesticide applications, ensuring the sprayer was cleaned between each use.

The reduction percentage of *C. vittata* and associated predators, green lacewings (*Chrysoperla* spp.) and lady beetles (*Coccinella* spp.), population density was calculated using Henderson and Tilton's formula (1955):

Reduction %=

$$\left\{1-\frac{n\ in\ Co\ before\ treatment\ x\ n\ in\ T\ after\ treatment}{n\ in\ Co\ after\ treatment\ x\ n\ in\ T\ before\ treatment}\right\}\times 100.$$

n: Insect number, C: control, T: treated.

Alongside our main observations, we monitored populations of vital predators, such as green lacewings (Chrysoperla spp.) (eggs and larvae) and Coccinella spp. (eggs and larvae). We conducted counts at several intervals: before treatment, and then three, seven, and ten days after application. These measurements are crucial for gaining insights into two key aspects: the direct toxicity and safety of these treatments for beneficial insects that are not the target pests. Both factors must be thoroughly assessed before integrating them into a pest control strategy.

Both the insect population and associated predators' data were statistically evaluated using one-way ANOVA to detect significant variations among treatments. The analysis was performed with SPSS software (version 2004).

## Results

### Efficacy of conventional and alternative insecticides against *C. vittata* and non-target predators:

The study evaluated the efficacy of conventional (Pyriproxyfen 10% + Bifenthrin 10%, and Lambda-cyhalothrin) and alternative (Emamectin benzoate, Indoxacarb) insecticides against *C. vittata* and their impact on beneficial predators (*Chrysoperla* spp. and *Coccinella* spp.) in Egyptian sugar beet fields during the 2022 and 2023 seasons (Tables 1 and 2). Additionally, the study evaluated the impact of these treatments on non-target predators, specifically green lacewings (Tables 3 and 4) and *Coccinella* spp. (Tables 5 and 6), by tracking their population fluctuations before and after insecticide application. The percentage reduction in both *C. vittata* and predator populations was calculated to gauge treatment efficacy and ecological safety.

### 1- Efficacy against *C. vittata*

**In the 2023/2024 season**:

In the 2023 season, all tested insecticides demonstrated high efficacy against *C. vittata*, with average population reductions exceeding 85% (Table 1). Emamectin benzoate and Indoxacarb (alternative insecticides) showed gradual yet consistent pest suppression, achieving a reduction of 86-94% by day 7. In contrast, conventional insecticides (lambda-cyhalothrin and Pyriproxyfen + Bifenthrin) caused rapid knockdown, with reductions of 85-86% observed as early as the first day. There are no statistically significant differences among treatments (P > 0.05).

## In the 2024 /2025 season

Results in 2024 reflected those of 2023, with all insecticides achieving over 93% reduction in pests (Table 2). Emamectin benzoate and Indoxacarb again showed delayed but sustained efficacy (87-94% reduction by the 3rd day), while conventional insecticides maintained their rapid action (88% reduction by the 1st day). There are no statistically significant differences among treatments (P > 0.05).

**Table 1: Reduction percentage of *Cassida vittata* (Larvae + Adults) in sugar beet field after treatment with tested insecticides (2023/2024 season).**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | 10th Days | Average Reduction |
|---|---|---|---|---|---|---|
| **Emamectin benzoate (AI)** | 103.25± 0.48 | | 15.25± 0.25 (86.28%) | 6.5± 0.5 (94.84%) | 2.5± 0.29 (81.22%) | 85.93% |
| **Indoxacarb (AI)** | 103± 0.82 | | 15.5± 0.65 (86.04%) | 7.5± 0.29 (94.03%) | 3.25± 0.25 (85.2%) | 85.2% |
| **Pyriproxyfen 10% + Bifenthrin 10% (CI)** | 102.75± 0.63 | 14.75± 0.48 (85.95%) | | 6.25± 0.48 (95.01%) | 1.75± 0.25 (86.80%) | 88.7% |
| **Lambda-cyhalothrin (CI)** | 103± 1.2 | 13.75± 0.48 (86.94%) | | 6± 0.41 (95.22%) | 1.5± 0.29 (88.70%) | 90.3% |
| **Untreated Area** | 102.75± 0.85 | 105± 0.82 | 110.75± 0.75 | 125.25± 0.48 | 13.25± 0.48 | |

-In a column, means followed by the same letters are non-significantly different, P≥0.0548

**Table 2: Reduction percentage of *Cassida vittata* (Larvae + Adults) in sugar beet field after treatment with tested insecticides (2024 /2025 season)**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | Average Reduction | Average Reduction |
|---|---|---|---|---|---|---|
| **Emamectin benzoate (AI)** | 105.25±0.25 | | 14.5±0.65 (87.29%) | 7.5±0.5 (94.16%) | 3±0.41 (97.76%) | 93.1% |
| **Indoxacarb (AI)** | 104.75±0.48 | | 14.25±0.25 (85.93%4%) | 7±0.58 (94.52%) | 2.75±0.48 (97.94%) | 93.3% |
| **Pyriproxyfen 10% + Bifenthrin 10% (CI)** | 105±0.91 | 12±0.41 (88.86%) | | 5.25±0.25 (95.90%) | 1.5±0.29 (98.88%) | 93.8% |
| **Lambda-cyhalothrin (CI)** | 104.75±0.85 | 12.5±0.29 (88.37%) | | 5±0.58 (96.09%) | 1.25±0.25 (99.06%) | 94.5% |
| **Untreated Area** | 104.5±0.5 | 107.25±0.25 | 113.25±0.25 | 127.5±0.5 | 133±0.91 | |

-In a column, means followed by are non-significantly different, P≥0.05

**Table 3: Reduction percentage of *Chrysoperla* spp. (eggs+larvae) in the sugar beet field after treatment with tested insecticides (2023/2024 season)**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | 10th Days | Average Reduction |
|---|---|---|---|---|---|---|
| Emamectin benzoate (AI) | 17.5±0.65 | | 13.25±0.25 (40.49%) | 10.25±0.48 (56.84%) | 8.5±0.29 (66.32%) | 54.55% |
| Indoxacarb (AI) | 17±0.41 | | 12.75±0.48 (41.01%) | 9.75±0.63 (57.72%) | 8.25±0.25 (66.35%) | 55.02 % |
| Pyriproxyfen 10% + Bifenthrin 10%(CI) | 17.25±0.25 | 4.75±0.48 (74.64%) | | 3±0.41 (87.19%) | 1 (95.98%) | 85.93% |
| Lambda-cyhalothrin (CI) | 17.75±0.25 | 5.5±0.29 (71.46%) | | 3.25±0.25 (86.51%) | 1.25±0.25 (95.12%) | 84.63% |
| Untreated Area | 17.5±0.29 | 19±0.41 | 22.25±0.25 | 23.75±0.25 | 25.25±0.25 | |

-In a column, means followed by are non-significantly different, P≥0.05

**Table 4: Reduction percentage of *Chrysoperla* spp. (eggs+larvae) in the sugar beet field after treatment with tested insecticides (2024 /2025 season)**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | 10th Days | Average Reduction |
|---|---|---|---|---|---|---|
| Emamectin benzoate (AI) | 20.5±0.29 | | 14±0.41 (52.01%) | 11.25±0.25 (63.65%) | 9±0.41 (73.33%) | 62.99% |
| Indoxacarb (AI) | 20.75±0.25 | | 13±0.41 (55.97%) | 11±0.58 (64.89%) | 9.75±0.48 (71.45%) | 64.1% |
| Pyriproxyfen 10% + Bifenthrin 10%(CI) | 20.25±0.75 | 7.75±0.25 (65.65%) | | 4.5±0.29 (85.28%) | 1.25±0.25 (96.25%) | 83.39% |
| Lambda-cyhalothrin (CI) | 19.75±0.75 | 7.5±5 (65.90%) | | 4.5±0.29 (84.91%) | 1.5±0.29 (95.39%) | 82.06% |
| Untreated Area | 20.20±20 | 22.5±0.29 | 28.75±0.25 | 30.5±0.29 | 33.25±0.48 | |

-In a column, means followed by the are non-significantly different, P≥0.05

**Table 5: Reduction percentage of *Coccinella* spp. (Larvae + Adults) in the sugar beet field after treatment with tested insecticides (2023/2024 season)**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | 10th Days | Average Reduction |
|---|---|---|---|---|---|---|
| Emamectin benzoate (AI) | 22±0.41 | | 15.75±0.25 (47.02%) | 8±0.41 (74.91%) | 6.5±0.29 (81.07%) | 67.66% |
| Indoxacarb (AI) | 22.5±0.5 | | 15.25±0.63 (49.86%) | 8.5±0.29 (73.96%) | 7±0.41 (80.06%) | 67.96% |
| Pyriproxyfen 10% + Bifenthrin 10%(CI) | 23±0.87 | 10.25±0..25 (95.39%) | | 5±0.41 (76.03%) | 1.5±0.29 (95.82%) | 89.08% |
| Lambda-cyhalothrin (CI) | 23.25±0.75 | 9.75±0.48 (74.53%) | | 4.75±0.25 (85.92%) | 1.25±0.25 (96.55%) | 85.66% |
| Untreated Area | 22.75±0.25 | 27.5±0.29 | 30.75±0.48 | 33±0.41 | 35.5±0.5 | |

-In a column, means followed by the are non-significantly different, P≥0.05

**Table 6: Reduction percentage of *Coccinella* spp. (Larvae + Adults) in the sugar beet field after treatment with tested insecticides (2024/2025 season)**

| Treatment | Before Treatment (Mean ± SE) | 1st Day | 3rd Day | 7th Day | 10th Days | Average Reduction |
|---|---|---|---|---|---|---|
| **Emamectin benzoate (AI)** | 25.75±0.48 | | 18.75±0.25 (44.64%) | 11.5±0.29 (69.09%) | 9.5±0.29 (84.39%) | 66.04% |
| **Indoxacarb(AI)** | 25±0.41 | | 19±0.58 (42.29%) | 12±0.91 (66.79%) | 9.25±0.25 (76.50%) | 61.86% |
| **Pyriproxyfen 10% + Bifenthrin 10%(CI)** | 25±0.58 | 12.75±0.25 (54.42%) | | 6.5±0.29 (82.01%) | 2.25±0.25 (94.28%) | 75.57 % |
| **Lambda-cyhalothrin (CI)** | 25.5±0.65 | 12.25±0.86 (57.09%) | | 5.75±0.25 (84.39%) | 2±0.41 (95.02%) | 78.83% |
| **Untreated Area** | 25.25±0.25 | 28.25±0.25 | 33.25±0.25 | 36.5±0.29 | 39.75±0.63 | |

-In a column, means followed by the are non-significantly different, P≥0.05

## 2- Impact on Green Lacewings (*Chrysoperla* spp.):

### In the 2023/2024 season:

Alternative insecticides caused moderate reductions (40-41% by the third day), with populations rebounding to 50% of their pre-treatment levels by day 10 (Table 3). In contrast, conventional insecticides led to severe declines (a 71-75% reduction by the first day) (p = 0.00054) and maintained long-term suppression (>80% reduction by day 10). Emamectin and Indoxacarb (alternative insecticides) are statistically less toxic to predators. Pyriproxyfen, bifenthrin, and Lambda-cyhalothrin (conventional insecticides) caused significantly greater reductions in predator populations (p = 0.00054).

### In the 2024 /2025 season:

Alternative insecticides showed slightly better safety for predators in 202٤, with reductions of 52-56% by the 3rd day and recovery to 71-73% by the 10th day (Table 4), indicating a statistically significant difference (p = 0.0005). In contrast, conventional insecticides caused significant declines (65-66% by the 1st day), resulting in long-term effects (>99% reduction by the 10th day). There is an approximately 20% gap between the alternative and conventional groups. This difference is likely to be statistically significant at p = 0.0005, particularly given the consistent pattern observed in Table 3.

## Impact on Lady Beetles (*Coccinella* spp.):

### In the 2023 /2024 Season

Similar trends were observed for *Coccinella* spp., where alternative insecticides caused population declines of 47-49% by the third day, followed by partial recovery (60% by the tenth day).

### In the 2024/2025 Season

Alternative insecticides reduced *Coccinella* populations by 42–45% by the third day, with recovery reaching 65-85% by the tenth day (Table 6). In comparison, conventional treatments remained highly damaging, showing an 80% reduction.

## Discussion

Sugar beet (*B. vulgaris* L.) is a key global crop, contributing approximately 20% of the world's sugar production, second only to sugarcane (FAOSTAT, 2022). In Egypt, sugar beet occupies a strategic role in sugar self-sufficiency plans, with more than 600,000 feddans cultivated annually, making Egypt the top sugar beet producer in the Mediterranean region (Egyptian Ministry of Agriculture, 2023). However, productivity is severely constrained by the leaf beetle, *C. vittata* (Coleoptera: Chrysomelidae), a significant pest whose larvae damage foliage, stems, and taproots, causing yield losses of up to 50% under favourable conditions (El-Wakeil *et al*., 2013; Refaei *et al*., 2023).

Conventional pest control strategies in Egyptian beet fields often rely heavily on broad-spectrum insecticides, notably Pyrethroids (e.g., Lambda-Cyhalothrin), organophosphates, and neonicotinoids. While these agents offer rapid knockdown, they pose serious ecological drawbacks, notably their negative impact on non-target organisms, particularly natural enemies such as *Chrysoperla* spp. (green lacewings) and *Coccinella* spp. (ladybird beetles), which are key biological control agents against aphids and small soft-bodied pests (Desneux *et al*., 2007; Biondi *et al*., 2012; Dinter & Wiles, 2000). Continuous exposure to these chemicals disrupts predator-prey dynamics, accelerates the development of pest resistance, and increases the frequency and dosage of chemical applications phenomenon termed the pesticide treadmill (Geiger *et al*., 2010; Sparks & Nauen, 2015).

The search for ecologically sustainable alternatives has driven attention toward reduced-risk insecticides, particularly those derived from microbial or biochemical sources. Compounds such as emamectin benzoate (a fermentation product of *S. avermectin*) and Indoxacarb (a pro-insecticide activated in the insect midgut) offer enhanced target specificity, lower environmental persistence, and compatibility with integrated pest management (IPM) frameworks (IRAC, 2022; El-Fergani, 2019). Emamectin acts primarily on glutamate-gated chloride channels, while indoxacarb blocks voltage-dependent sodium channels, both of which result in insect paralysis and death (Tomizawa & Casida, 2005; Sparks *et al*., 2012). Despite their promising mode of action, field-level evaluations of these compounds in sugar beet ecosystems remain scarce, particularly under Egyptian climatic and agronomic conditions.

Moreover, most studies have primarily focused on cotton, tomato, or maize pests (e.g., *S. littoralis*, *T. absoluta*, *H. armigera*), rather than on *C. vittata*, highlighting a critical knowledge gap in sugar beet-specific IPM (Abd-Rabou *et al*., 2019; El-Wakeil & Gaafar, 2014; Refaei *et al*., 2023). Similarly, the impact of these insecticides on beneficial arthropods under field conditions in Egyptian beet agroecosystems is insufficiently documented, limiting our ability to design ecologically sound pest control programs.

## Conclusion

The results across both seasons confirmed that conventional and alternative insecticides are equally effective against *C. vittata*, but their speeds of action differ. Conventional chemicals provide immediate control, whereas alternatives offer slower yet equally thorough suppression. Alternative insecticides (Emamectin benzoate, Indoxacarb) consistently showed lower toxicity to predators in both seasons, while conventional insecticides, despite their effectiveness in pest control, pose significant risks to beneficial arthropods.

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# الفعالية المقارنة والتأثير البيئي للمبيدات الحشرية التقليدية والبديلة على خنفساء البنجر (Coleoptera: Chrysomelidae) والمفترسات النافعة في زراعة بنجر السكر بمصر

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**الملخص العربي**

تعتبر خنفساء البنجر (كاسيدا فيتاتا) (Coleoptera: Chrysomelidae) آفة رئيسية تهدد زراعة بنجر السكر في مصر، وغالبًا ما تتسبب في أضرار شديدة للأوراق والجذور، بالإضافة إلى خسائر كبيرة في المحصول. وقد أجريت هذه الدراسة الميدانية خلال موسمي ٢٠٢٣ و٢٠٢٤ في محافظة كفر الشيخ، وقد قيمت الفعالية المقارنة والتأثير البيئي لمبيدين حشريين تقليديين، هما لامبادا-سايهالوثرين وخليط بيريبروكسيفين + بيفنثرين، ومبيدين حشريين بديلين، هما إيمامكتين بنزوات وإندوكساكارب. وقد أظهرت النتائج أن جميع المبيدات الحشرية قللت بشكل كبير من أعداد خنفساء البنجر، حيث حققت متوسط انخفاض تجاوز ٨٥% في ٢٠٢٣ وأكثر من ٩٣% في ٢٠٢٤، دون وجود فروق إحصائية معنوية بين المعاملات ($P > 0.05$). ومع ذلك، ظهرت اختلافات واضحة في تأثيرها على المفترسات النافعة. فقد تسببت المبيدات التقليدية في انخفاض حاد وممتد في أعداد أسد المن (*Chrysoperla spp.*) وابو العيد ١١ نقطة (*Coccinella spp.*) ، حيث بلغ متوسط الانخفاض أكثر من ٨٢% خلال الموسمين، في المقابل، كان للمبيدات البديلة تأثير أقل بكثير، حيث حافظت على انخفاض أعداد المفترسات عند حوالي ٥٥-٦٧% ($P < 0.05$). وقد أثبتت الدراسة أن هذه النتائج تؤكد ملاءمة إيمامكتين بنزوات وإندوكساكارب كمبيدات حشرية انتقائية توازن بين كفاءة القضاء على الآفة وتحسين السلامة البيئية. وبشكل عام، تدعم النتائج دمج المبيدات البديلة في برامج المكافحة المتكاملة للآفات (IPM) المستدامة لزراعة بنجر السكر في مصر، مما يقلل من الاضطراب البيئي مع الحفاظ على التحكم الفعال في خنفساء البنجر.