Pakistan J. Zool., pp 1-4, 2021. DOI: https://dx.doi.org/10.17582/journal.pjz/20180514150558

Short Communication

# Effects of a New Sex Pheromone Trap and Biological Agents on the Control of *Sesamia inferens* Walker and *Argyroploce schistaceana* (Snellen)

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**Article Information**
**Received 14 May 2018**
**Revised 28 May 2019**
**Accepted 25 September 2019**
**Available online 12 November 2020**

**Authors' Contribution**
**YKH conceived and designed the study. WFL wrote the manuscript. RYZ collected and analyzed data. JY, HLS, CXY, ZML, XYW, and JL performed experimental work.**

**Key words**
***Sesamia inferens* walker, *Argyroploce schistaceana* (Snellen), New sex pheromone trap of sugarcane borers, Biological agents, Environmentally friendly control**

## ABSTRACT

The sugarcane borer is a type of pest that severely damages sugarcane. To explore and seek effective and environmentally friendly control technology for sugarcane borers, promote environmentally friendly control for sugarcane pests, new sex pheromone trap of sugarcane borers, Abamectin•*Bacillus thuringiensis* and Tebufenozide were selected and applied for control of *Sesamia inferens* Walker and *Argyroploce schistaceana* (Snellen). The results showed that new sex pheromone trap of sugarcane borers in combination with Abamectin•*Bacillus thuringiensis* or Tebufenozide were the optimum mode for environmentally friendly control techniques of *Sesamia inferens* Walker and *Argyroploce schistaceana* (Snellen). The use of new sex pheromone traps of sugarcane borers (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) or new sex pheromone traps of sugarcane borers (6 a/ha) + 200g/L Tebufenozide SC (1500 mL/ha) were the best. The control effect of dead heart rate and bored stem rate could be more than 69.98% and 49.09%, respectively, and were superior to the control pesticide 3.6% Bisultap GR (90 kg/ha).



The sugarcane borer is a type of pest that severely damages sugarcane and is widely distributed among many sugarcane planting countries. The larvae bore into the sugarcane stem, dramatically reducing yield and sugar content (Sallam *et al*., 2010; Goebel *et al*., 2011; McGuire *et al*., 2012). *Sesamia inferens* Walker and *Argyroploce schistaceana* (Snellen) are widely distributed among the Yunnan sugarcane areas, seriously impacting sugarcane yield and quality (Huang and Li, 2011; Leul *et al*., 2013). In recently years, several species of sugarcane borer have increased in population density, causing a sharp increase in dead heart rate and bored stem rate, and a year-on-year increase in loss of yield and sugar content which causes huge economic loss to the sugarcane planting areas (Yao *et al*., 2006; An and Guan, 2009; Xiong *et al*., 2010; Xie *et al*., 2012; Li *et al*., 2013). To ensure sustainable development of the sugar industry, it is paramount that by enhancing scientific the sugarcane borer is controlled to reduce losses.

The main control measure for sugarcane borers was spraying and spreading chemical pesticides, accustomed using highly toxic reagents, and applying pesticide several times, and the result is killing natural enemy, pesticide residues and environmental pollution which poses a threat to human health and environment safety (Gong *et al*., 2005; Fang *et al*., 2010; Liang *et al*., 2010; Huang and Li, 2011; Ren *et al*., 2012; Jiang *et al*., 2015; Luo *et al*., 2015; Wang *et al*., 2016). Therefore, integrated and environmental pest management view is a new task for current plant protection workers.

To explore and seek effective and environmentally friendly control technology for sugarcane borers, promote environmentally friendly control for sugarcane pests, we evaluated biological agents (e.g. new sex pheromone trap of sugarcane borers, Abamectin. *Bacillus thuringiensis* and Tebufenozide) for the prevention and control of sugarcane borers. This study will provide a foundation for the efficient and effective control of sugarcane pests,

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0030-9923/2021/0001-0001 $ 9.00/0

reducing pesticide application and improving sugarcane quality.

*Materials and methods*

The biological agents used in this study were new sex pheromone trap of *S. inferens* and *A. schistaceana* (Niukang biotechnology company, Ningbo), 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP and 200 g/L Tebufenozide SC (Shanghai Weidi Biochemical company, Nanchang). The control agent was 3.6% Bisultap GR (HaoYang chemical company, Hebei).

The experiment was carried out at the Sugarcane Research Institute, Yunnan Academy of Agricultural Sciences. Each plot contained irrigated, flat, medium fertility, clay loam soil, pH 6.2, organic content of 2.05%. The experimental variety of sugarcane was ROC22. The cane type was a one year ratoon cane. Each plot had a 1 m planting space, water and fertilizer management and consistent sugarcane seedling growth.

Five treatments were included in this experiment: new sex pheromone traps of sugarcane borers (6 a/ha), new sex pheromone traps of sugarcane borers (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha), new sex pheromone traps of sugarcane borers (6 a/ha) + 200 g/L Tebufenozide SC (1500 mL/ha), 3.6% Bisultap GR (90 kg/ha) and blank control. All treatments were replicated 3 times giving a total of 15 randomly arranged plots. Each plot area was 66 $m^2$.To avoid interference of the new sex pheromone, 3.6% Bisultap GR, blank control treatment areas and the new sex pheromone trap of sugarcane borers treatment areas were more than 50 m apart.

The new sex pheromone trap of sugarcane borers was installed on March 5. The lure cores were changed every 15 to 20 days. The 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP and 200 g/L Tebufenozide SC diluted with 900 kg water and uniform pray sugarcane plants were applied on April 13, April 22, May 3, respectively. The 3.6% Bisultap GR was blended with fertilizer at 1:10 per ha and uniformly spread across the base of the sugarcane plant and covered with soil on April 13.

Dead heart rate and bored stem rate were surveyed in June and December, respectively. Total numbers of seedlings (50 plants) and numbers of bored plants were surveyed and recorded in each plot, average dead heart rate calculated (bored stem rate), and the control effect analysed.

Dead heart rate (%) = Number of dead heart/Total number of seedlings × 100

Bored stem rate (%) = Number of bored stem/ Total number of seedlings × 100

Control effect (%) = [Dead heart rate (Bored stem rate) in blank control area) - Dead heart rate (Bored stem rate) in treated area]/Dead heart rate (Bored stem rate) in blank control area × 100

The differences between treated area were analyzed with one-way ANOVA followed by Duncan's multiple range test (SPSS-12 statistical software package). The arcsine transformation was performed on percentages prior to analysis. We set the level of significance to $P < 0.05$ for all statistical tests.

*Results*

As shown in Table I, control effect of dead heart was good all treatments. The new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) sprayed on April 13 was the best treatment with a control effect of 76.62%; significantly higher than the other treatments. The control effect of the new sex pheromone traps (6 a/ha) + 200 g/L Tebufenozide (1500 mL/ha) sprayed on April 13, and the new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) on May 3 were 69.98% and 69.93%, respectively. However, there was no significant difference with 3.6% Bisultap GR (90 kg/ha). The control effect of the new sex pheromone traps (6 a/ha) + 200 g/L Tebufenozide (1500 mL/ha) sprayed on April 22, on May 3, the new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) sprayed on April 22 were 62.64%, 61.64% and 59.07%, respectively. These were significantly difference to the 3.6% Bisultap GR (90 kg/ha). The control effect of the new borer sex pheromone traps (6 a/ha) was 52.00%, significantly lower than the effect of other treatments.

As shown in Table I, control effect of border was different in different treatments. Control effect of new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) sprayed on April 13 was 57.7%, and significantly higher than the effect of other treatments; The control effect of new sex pheromone traps (6 a/ha) + 200 g/L Tebufenozide (1500 mL/ha) sprayed on April 13, and new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) sprayed on May 3 were 49.09% and 48.63%, respectively, yet were not significantly different with the control effect of 3.6% Bisultap GR (90 kg/ha).

The control effect of new sex pheromone traps (6 a/ha) + 200 g/L Tebufenozide (1500 mL/ha) sprayed on April 22 and May 3, the new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) sprayed on April 22,

**Table I. Effect of sugarcane borer control treatments on dead heart rate and bored stem rat[1).]**

| Treatments/a,kg,ml,g·ha$^{-2}$ | | Processing time/ month | Control effect of dead heart rate | | Control effect of bored stem rate | |
|---|---|---|---|---|---|---|
| | | | Dead heart rate/% | Control efficacy/% | Bored stem rate/% | Control efficacy/% |
| New sex pheromone trap of sugarcane borers | 6 | 3.5 | 9.55 | 52.00 d | 51.67 | 29.54 d |
| New sex pheromone trap of sugarcane borers + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP | 6+1800 | 3.5+4.13 | 4.65 | 76.62 a | 31.02 | 57.70 a |
| | | 3.5+4.22 | 8.14 | 59.07 c | 44.33 | 39.55 c |
| | | 3.5+5.3 | 5.98 | 69.93 b | 37.67 | 48.63 b |
| New sex pheromone trap of sugarcane borers + 200g/L Tebufenozide SC | 6+1500 | 3.5+4.13 | 5.97 | 69.98 b | 37.33 | 49.09 b |
| | | 3.5+4.22 | 7.43 | 62.64 c | 43.17 | 41.13 c |
| | | 3.5+5.3 | 7.63 | 61.64 c | 43.33 | 40.91 c |
| 3.6% Bisultap GR | 90 | 4.13 | 6.48 | 67.42 b | 36.67 | 50.00 b |
| Blank control | | | 19.89 | - | 73.33 | - |

1) Different letters in the same column indicate significant difference at 0.05 level.



were 41.13%, 40.91% and 39.55%, respectively, and significantly difference from the control effect of 3.6% Bisultap GR (90 kg/ha). The control effect of new sex pheromone traps (6 a/ha) was 29.54%, significantly lower than the effect of other treatments.

*Discussion*

The results of the study showed that the control effect of the new sex pheromone trap of sugarcane borers alone for dead heart rate and damage stem rate were poor, significantly lower than the effect of 3.6% Bisultap GR. The control effect of the new sex pheromone trap of sugarcane borers in addition with Abamectin•*Bacillus thuringiensis*, or Tebufenozide were good, and significantly better than the effect of new sex pheromone trap of sugarcane borers alone and 3.6% Bisultap GR. These results were consistent with previous studies described by Chen *et al*. (2016) and Xu *et al*. (2016). The new sex pheromone trap of sugarcane borers in combination with Abamectin•*Bacillus thuringiensis* or Tebufenozide were the optimum control regimen for *S. inferens* and *A. schistaceana*. Control effect of new sex pheromone traps (6 a/ha) + 0.05% Abamectin•10 billion active gemma/g *Bacillus thuringiensis* WP (1800 g/ha) or new sex pheromone traps (6 a/ha) + 200 g/L Tebufenozide (1500 mL/ha) were best. The following is suggested as an effective control method. New sex pheromone trap of sugarcane borers should be installed on early March, diluted agents were diluted with water (900 kg/ ha) and sprayed sugarcane evenly on early April.

The control of the sugarcane borers has relied on chemical pesticides for decades. This has resulted in serious environmental pollution which poses a threat to human, animal and environment security. The current aim is to seek efficient and safe prevention technology and reduce the reliance on chemical pesticides; especially those with highly toxicity. Previous researches have shown that environmentally friendly control techniques, such as light trap, sex trap, *Trichogramma*, biological missiles and biological agents for sugarcane borer control are beneficial (Ashok *et al*., 1996; Huang and Li, 2011; Luo *et al*., 2015; Chen *et al*., 2016; Xu *et al*., 2016). While promoting the development of sugarcane industry, our targets should include chemical pesticide reduction, and focus on integrating and coordinating application of environmentally friendly control technology.

*Acknowledgments*

This work was supported by the Earmarked Fund for Sugar Crop Research System (CARS-170303), Leading Talents Program of Yunnan Industrial Technology-Sugarcane Pest Control (2018LJRC56) and the Earmarked Fund for Yunnan Province Agriculture Research System.

*Statement of conflicts of interest*

The authors declare no conflicts of interest.

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