

# Effect Evaluation of 50% Chlorantraniliprole FSB against *Spodoptera frugiperda*

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**Abstract [Objective]** The paper was to understand the control effect of 50% chlorantraniliprole FSB on *Spodoptera frugiperda* and its influence on corn growth. **[Method]** Field efficacy test was carried out to comprehensively evaluate the safety of 50% chlorantraniliprole FSB on corn growth. **[Result]** 50% chlorantraniliprole FSB had good control effects on *S. frugiperda*, while corns also had good seedling emergence rate and strong growth at 14 and 20 d post sowing. There were significant difference in yield between treatment area and farmers' governance area, and high benefits had been achieved in treatment area. **[Conclusion]** The technology is eco-friendly, economical and practical, and can be popularized and applied in large-scale field production.

**Keywords** 50% Chlorantraniliprole FSB; *Spodoptera frugiperda*; Effect evaluation

*Spodoptera frugiperda*, belonging to Noctuidae, Lepidoptera, is an invasive omnivorous and migratory major pest originated in tropical America<sup>[1-2]</sup>, and an early warning major migratory pest by the UN Food and Agriculture Organization (FAO)<sup>[3]</sup>. In January 2019, *S. frugiperda* first invaded Pu'er City of Yunnan Province in China<sup>[4-5]</sup>; it spread to Yunnan, Guangxi and Guangdong in April, and harmed in the Yangtze River Basin and northern areas in May. *S. frugiperda* is featured by wide distribution area, strong migration ability, high reproduction ratio, heavy damage and difficulties in prevention and control. In Guangdong, the number of larvae is as high as 222 larvae/100 plants in high incidence area, and the damage rate per plant is 80%<sup>[6]</sup>. *S. frugiperda* occurred in corn fields in cities and counties of Guangxi Province in April of that year. According to the survey, *S. frugiperda* is harmful throughout the whole growth period of corn, and the larvae mainly feed leaves, tender stems, growth points, ears, etc., resulting in a yield reduction of 20%–30%, or even no harvest under severe cases<sup>[7]</sup>. A thin film like orifice is formed in leaves when damaged by low

instar larvae, and cavity is formed when damaged by old instar larvae, resulting in broken heart leaves accompanied by a large amount of sawdust-like frass. Larvae like to hide and feed inside heart leaves, which cause serious impact on developing stamen, and further affect ear fertilization. After tasseling, the larvae move to corn ear and begin to harm the ear.

Since January 2019 when *S. frugiperda* invaded China, it has occurred in 22 provinces<sup>[8]</sup>. Currently, sexual attraction, light attraction and foliar spraying of virions or chemical agents are major measures against *S. frugiperda*, and chlorantraniliprole had good control effect on *S. frugiperda* larvae<sup>[7]</sup>. According to the plant protection policy of "prevention first, comprehensive prevention and control level against *S. frugiperda* has been continuously explored and improved, and the technology has been innovated and integrated, promoted and applied. 50% chlorantraniliprole FSB is a new systematic insecticide for seed treatment developed by Corteva Agriscience (Shanghai) Co., Ltd., and pests will stop feeding within minutes of ingestion because of

stomach toxicity. The insecticide can effectively control soil insects of corn such as blackcutworm, grub and armyworm, which is featured by easy operation and environmental protection, being a good agent against soil insects in corn field.

In order to clear the control effects and application technology of 50% chlorantraniliprole FSB developed by Corteva Agriscience (Shanghai) Co., Ltd. and to evaluate the safety of the insecticide on corn growth, field efficacy test was conducted, which would provide a reference basis for corn cultivation and application of insecticides for the prevention and control of *S. frugiperda*.

## 1 Materials and Methods

### 1.1 Experimental time and location

The trial was conducted in corn bases of Lingchuan County and Guanyang County in Guilin City. The experimental site in Lingchuan County was located in Huilin Village, Lingtian Town, covering an area of 600 m<sup>2</sup>; the soil was sandy loam with good drainage and irrigation capacity, soil organic matter content 1.4% and pH 6.0. The experimental site in Guanyang County was Fuxing Village, Guanyang Town, covering an area of 300 m<sup>2</sup>; the soil was sandy loam, with organic matter content 1.8% and pH 5.8.

Received: January 15, 2021 Accepted: March 27, 2021

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**1.2 Materials** Lingchuan experimental site: Liunuo No.8 was sown on May 3, 2020 at the density of 3 200 plants/667m<sup>2</sup>; the variety damaged by *S. frugiperda* scored 8 points in Davis Scale. Guanyang experimental site: Jingtianzihuanuo was sown on May 3, 2020 at the density of 2 778 plants/667m<sup>2</sup>; the variety damaged by *S. frugiperda* scored 6 points in Davis Scale.

**1.3 Experimental methods** Before sowing, 5 mL/kg 50% chlorantraniliprole FSB was prepared and mixed with corn seeds. After drying in the shade for 24 h, corn seeds were sown. The cultivation conditions were consistent during the growth process except for treatment factors. Two treatments were designed in the test, including one insecticide treatment and one control. There was no replicate in large area test, and application of insecticides in each experimental site is shown in Table 1.

**1.4 Survey and statistics** At 14 and 20 d post sowing, the number of seedlings, seedling emergence rate, plant height (from stem base to heart leaf) and stem diameter (stem base) of corn plants in each site were surveyed using five-point sampling method, 20 plants each point, and the damage level was investigated according to Davis Scale (Table 2, Fig.1). The corn yields of each site were measured after harvest. All data and charts were statistically analyzed by Excel 2019.

## 2 Results and Analysis

### 2.1 Corn growth and yield analysis

**2.1.1 Seedling emergence rate.** The number of emerged seedlings in each experimental site at 14 and 20 d post sowing is shown in Fig.2. At 14 d post sowing, the seedling emergence rate in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 84%, and that in treatment 2 (CK) was 72%. The seedling emergence rate in treatment 1 (50% chlorantraniliprole FSB) in Guanyang County was 87%, and that in treatment 2 (CK) was 85%. At 20 d post sowing, the seedling emergence rate in treatment 1 (50% chlorantranilip-

role FSB) in Lingchuan County was 82%, and that in treatment 2 (CK) was 67%. The seedling emergence rate in treatment 1 (50% chlorantraniliprole FSB) in Guanyang County was 85%, and that in treatment 2 (CK) was 83%. The results showed that the emergence rate of corn seeds treated with 50% chlorantraniliprole FSB was better than in blank control.

**2.1.2 Plant height.** The average plant height of corn in each experimental site at 14 and 20 d post sowing is shown in Fig.3.

At 14 d post sowing, the average plant height in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 29.4 cm, and that in treatment 2 (CK) was 24.8 cm. The average plant height in treatment 1 (50% chlorantraniliprole FSB) in Guanyang County was 31.3 cm, and that in treatment 2 (CK) was 27.2 cm. At 20 d post sowing, the average plant height in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 47.7 cm, and that in treatment 2 (CK) was 44.3 cm. The

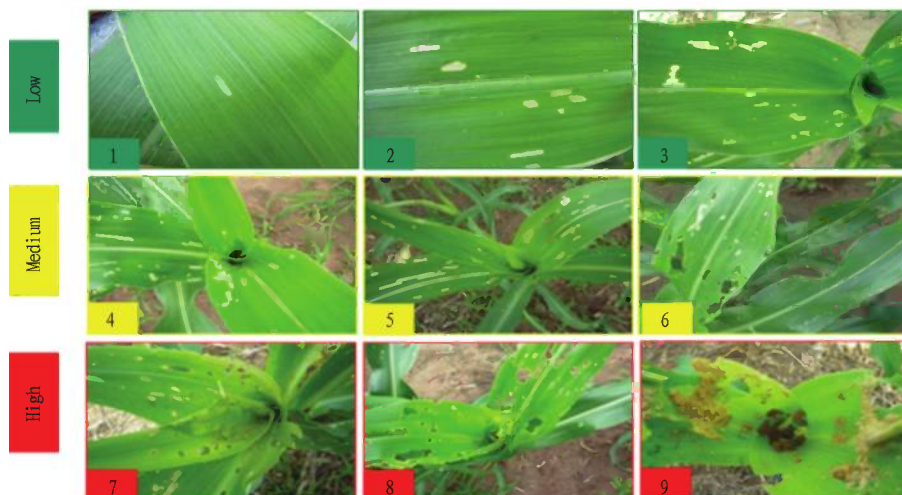
**Table 1 Application of insecticides in each treatment**

Experimental site	Treatment	Area//m <sup>2</sup>	Insecticide	Concentration//mL/kg
Lingchuan County	1	600	50% Chlorantraniliprole FSB	5
	2	300	CK	–
Guanyang County	1	300	50% Chlorantraniliprole FSB	5
	2	300	CK	–

**Table 2 Classification method of injury by Davis Scale**

Classification standard of injury	Rating
There is no obvious lesion.	0
There are only needle-like lesions on leaves.	1
There are both needle-like and minute annular lesions on leaves.	2
There are needle-like and minute annular lesions, as well as linear lesions ca. 1.3 cm in rolled leaves near bell mouth.	3
There are several medium-sized linear lesions (1.3–2.5 cm) in rolled leaves near bell mouth.	4
There are several linear lesions (>2.5 cm) in rolled leaves near bell mouth or several small- or medium-sized irregular perforations.	5
There are several linear lesions (>2.5 cm) in rolled leaves near bell mouth or several large-sized irregular perforations.	6
There are several large linear lesions in rolled leaves near bell mouth or several large-sized irregular perforations.	7
There are several large linear lesions in rolled leaves near bell mouth or several medium- or large-sized irregular perforations.	8
Rolled leaves near bell mouth are basically damaged.	9

Davis scale



DAS photos, adapted by Andre Aguirre Ramos

**Fig.1 Comparison of field survey classification maps by Davis Scale**

average plant height in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was 52.6 cm, and that in treatment 2 (CK) was 46.4 cm. The results demonstrated that the average plant height of corn treated with 50% chlorantraniliprole FSB was better than that in blank control.

**2.1.3 Stem diameter.** The average stem diameter of corn in each experimental site at 14 and 20 d post sowing is shown in Fig.4. At 14 d post sowing, the average stem diameter in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 1.21 cm, and that in treatment 2 (CK) was 1.04 cm. The average plant height in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was 1.35 cm, and that in treatment 2 (CK) was 1.11 cm. At 20 d post sowing, the average plant height in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 1.77 cm,

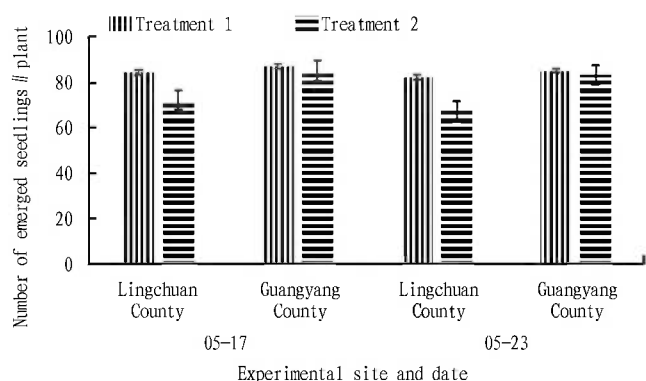
and that in treatment 2 (CK) was 1.42 cm. The average plant height in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was 2.06 cm, and that in treatment 2 (CK) was 1.63 cm. The results demonstrated that the average stem diameter of corn treated with 50% chlorantraniliprole FSB was better than that in blank control.

**2.1.4 Yield.** The corn yields in Lingchuan County and Guangyang County were measured respectively (Fig.5). The yield in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was 713.25 kg/667m<sup>2</sup>, and that in treatment 2 (CK) was 601.57 kg/667m<sup>2</sup>. The yield in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was 691.72 kg/667m<sup>2</sup>, and that in treatment 2 (CK) was 644.5 kg/667m<sup>2</sup>. The results suggested that the corn yield treated with 50% chlorantraniliprole FSB was

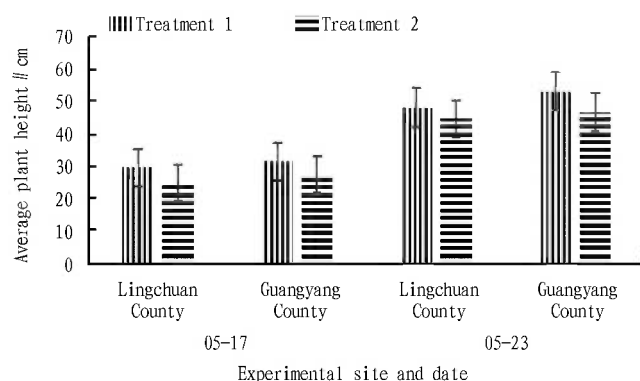
better than that in blank control.

**2.2 Control effects on *S. frugiperda***

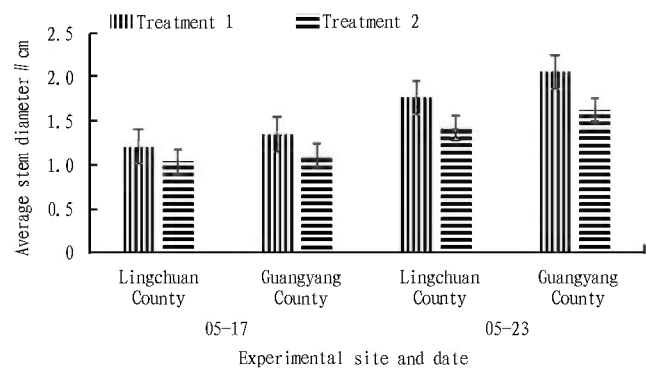
According to Davis Scale five-point sampling method, the damage of leaves in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County at 14 d post sowing was level 3, and that in treatment 2 (CK) was level 5; the damage of leaves in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was level 0, and that in treatment 2 (CK) was level 0. At 20 d post sowing, the damage of leaves in treatment 1 (50% chlorantraniliprole FSB) in Lingchuan County was level 4, and that in treatment 2 (CK) was level 8; the damage of leaves in treatment 1 (50% chlorantraniliprole FSB) in Guangyang County was level 0, and that in treatment 2 (CK) was level 6. Thus, 50% Chlorantraniliprole FSB had good prevention and control effects against *S. frugiperda*.



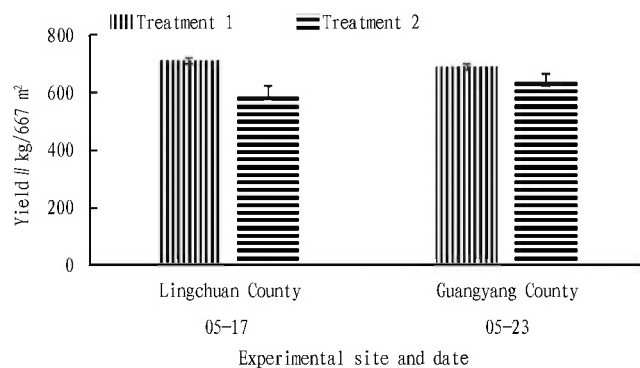
**Fig.2** Number of emerged seedlings in each experimental site at 14 and 20 d post sowing



**Fig. 3** Average plant height in each experimental site at 14 and 20 d post sowing



**Fig.4** Average stem diameter in each experimental site at 14 and 20 d post sowing



**Fig.5** Corn yield in each experimental site

**3 Conclusions and Discussion**

When corn seeds were mixed with 50% chlorantraniliprole FSB before sowing, corns had good seedling emergence rate and strong

growth. 50% Chlorantraniliprole FSB increased crop yield and further created greater benefit, and could effectively control *S. frugiperda*. Meantime, 50% chlorantraniliprole FSB had certain control effect against *Pyrausta nubilalis* and *Gryllotalpa* spp.

liprole FSB had certain control effect against *Pyrausta nubilalis* and *Gryllotalpa* spp.

The control effect of 50% Chlorantraniliprole FSB against *S. frugiperda*

was up to 20 d when corn seeds were mixed with the insecticide before sowing, and it also had control effects on underground pests. The technology is eco-friendly, economical and practical, and can be popularized and applied in large-scale field production.

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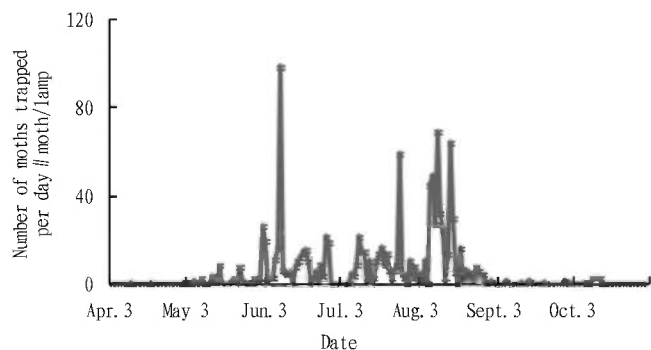
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first peak was in early June, which was



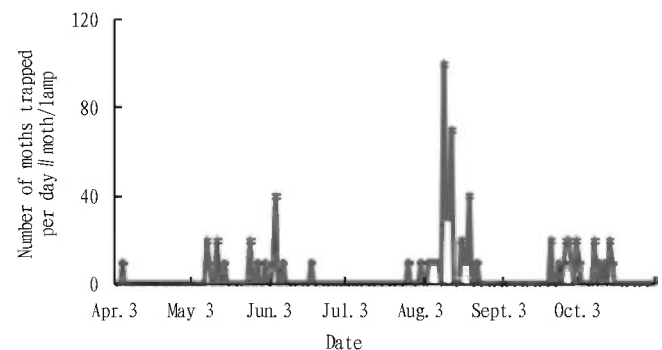
**Fig.1** Occurrence dynamics of *Agrotis ypsilon* caught by high-altitude trap lamp in Changyi area of Weifang

est in the whole year. The peak day was on August 10, and the number of moths trapped per day was 10.

## 3 Discussion

*A. ypsilon* is an omnivorous obligate migratory insect that occurs widely in the world. In the east Asian migratory field, *A. ypsilon* find suitable habitats and host plants by long-distance migration across wintering areas and different agro-ecological zones, so as to complete annual life cycle and population reproduction. Due to long-distance migration of adults and the concealment of larval damage, *A. ypsilon* often breaks out suddenly, resulting in great loss of crop production. The peak periods of *A. ypsilon* caught by high-altitude trap lamp were basically consistent

the second highest of the year. The peak date was June 5, and the number of moths



**Fig.2** Occurrence dynamics of *Agrotis ypsilon* caught by ground trap lamp in Changyi area of Weifang

with those caught by ground trap lamp, indicating that *A. ypsilon* was more likely to immigrate from local area of Weifang. Therefore, a series of measures can be taken in advance to prevent and control *A. ypsilon*. Physical measures, such as placing poplar branches in the field, hanging sex attractants, setting black lamp, can be adopted. Due to incomplete records of early meteorological data and other reasons, some of the results have not been reasonably explained. Relevant monitoring records will be continued in the future, in order to provide scientific reference for production practice.

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