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Study of the *Sesamia cretica* Population Control Using Fibronil Insecticide in Sugarcane Fields of Khuzestan Province

AMIR KHADEMPOUR[1], AMIR SORAGHI[1], FAKHER KARDONI[1]*, SHABNAM ASHOURI[2]
1- Debal Khazaei Sugarcane Agro-Industry, Khuzestan Province, Iran
2- Nuclear Agriculture Research School, Nuclear Science and Technology Research Institute, Karaj, Iran

*Corresponding author: Email: Kardoni1986@gmail.com

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ABSTRACT

One of the most important pests of sugarcane in Iran is the stem borer, which causes great damage to the amount of sugarcane production every year. Therefore, controlling this pest using insecticides is very important. This experiment was conducted with the aim of investigating the effect of fipronil formulation on sugarcane *Sesamia cretica* control. The experiment was carried out in the research fields of the Debal Khazaei Sugarcane Agro-Industry, Khuzestan Province of Iran, in 2021. The experiment treatments included fipronil 20 kg ha^{-1} (0.2% G), 1 and 1.5 l ha^{-1} (SC 5%) along with controls in two cultivars CP69 and CP48. The experiment results showed that there was a significant difference in the percentage of dead central buds with the use of fipronil in the form of granules and suspension compared to the control. The percentage of dead central bud in CP69 cultivar with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (SC 5%) was reduced by 26, 34 and 32% compared to the control, respectively. Also, in the CP48 cultivar, the percentage of central bud decreased by 20, 23 and 24% compared to the control, respectively, with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (SC 5%). The number of live larvae in both cultivars in 1 and 1.5 l ha^{-1} SC was lower than other treatments. Also, the results of poisons efficiency showed that in both cultivars, the highest efficiency of poison was observed in fipronil SC 5% of 1 and 1.5 l ha^{-1}. In general, due to the lack of difference between 1 and 1.5 l ha^{-1} SC, it is recommended to use fipronil 1 l ha^{-1} to control of sugarcane Sesamia.

Keywords: Dead central buds, Sesamia, live larva, Poisons efficiency

INTRODUCTION

Sugarcane is one of the major crops of tropical and subtropical regions and is cultivated as one of the important agricultural products in the southern regions of Iran. Sugarcane production in the world is 1450 million ton and its cultivated area is about 22 million ha.

Sugarcane is cultivated in more than 100 countries of the world, but 60% of it is produced in two countries, Brazil and India. China, Thailand, Mexico, Pakistan, Australia and Colombia are other major sugarcane producing countries. In 2017, the cultivated area in Iran was 93,654 ha and the yield were 80,740 kg ha^{-1}, ranking 27th in the world (FAO, 2022).

The most important pest of sugarcane fields, which causes a lot of damage every year and has an effect on the quantity and quality of the crop production, is Sesameia stem borer. Sugarcane stem borer in Iran belong to two species of *Sesamia nonagrioides* and *S. cretica* (Agah-Manesh *et al*. 2021). Both species identified in the Iran are present together as sympatric species in some regions such as Khuzestan province. But the prevalence of the species is different in regions. In the world, one of the ways to control this pest is to use insecticides. Insecticides continue to play a major role in sugarcane pest management due to the low efficacy of non-chemical control strategies.

On the other hand, every year a significant amount of chemical insecticides is introduced into the environment to control this stem borer, which has caused many concerns in the field of the health of aquatic animals, birds, livestock and soil microorganisms (Zibaee *et al*. 2009; Su *et al*. 2014). However, factors such as the hiding of larvae inside the stem, the rapid occurrence of resistance to different groups of chemical insecticides, and the destruction of natural enemy populations have often prevented the effectiveness of insecticide compounds from reaching an acceptable level (Cheng *et al*. 2010; Li *et al*. 2007).

In order to reduce the population of the stem borer pest during outbreak, one cannot rely on only one method. In Khuzestan sugarcane fields, besides the use of Telenmus bees, other factors should be considered to control the pest population. For years, chemical poisons have been used to control pests. Because stem borer larvae are present in the stems of agricultural products, they have a more difficult chemical control than other pests. Chemical control of stem borer larvae has been proven in some crops such as rice with toxins such as fipronil (in granular or liquid form) (Mann *et al.* 2009).

Although the chemical control of agricultural pests is of great importance, the use and selection of these substances with less effect on natural enemies and the environment and better control of target insects are of particular importance. On the one hand, introducing more specific insecticides with various mechanisms of action in pest management programs can reduce the rate of emergence of resistance by the target pest, and on the other hand, to some extent, the concerns related to the destructive effects of these factors on reduce non-target organisms (Yao *et al*. 2017).

One of the usual methods of combating Sesamia stem borer pests in Debal Khazaei Sugarcane Agro-Industry is biological control using the bee *Telenomus busseolae*. In the situation of outbreak of this pest, it is recommended to use chemical control methods in order to prevent heavy economic damage. This experimental was carried out with the aim of investigating the effect of using fipronil insecticide to control the population of sugarcane stem borer pest larvae.

MATERIALS AND METHODS

This experiment was carried out in the research fields of Debal Khazaei Sugarcane Agro-Industry company located in Ahvaz city of Khuzestan province of Iran in 2021. The experiment was conducted in the form of a completely randomized block design with four replications in completely natural conditions in the field. Experimental treatments included fipronil 20 kg ha^{-1} (0.2% G), 1 and 1.5 l ha^{-1} (SC 5%) along with the control (without spraying operation) in two cultivars CP69 and CP48. In this experiment, the dimensions of each plot were considered to be 100 m^2.

At first, two farms were selected according to the amount of contamination of the fields with stem borer. At first, two farms were selected according to the amount of contamination of the fields with stem borer. Then, before the spraying operation, the amount of field contamination (the number of infected stems) of each plot was counted and recorded. Poisoning was done seven days after the peak flight of the butterflies caught in the light trap installed in the field. Spraying using fipronil insecticide (provided by Mahan Company, Tehran) was done in the early morning in favorable weather conditions.

Sampling was done one week after spraying and was evaluated based on the percentage of dead central buds and the number of live larvae. The following equation was used to calculate the central bud percentage (Gomez and Gomez 1984):

Percentage of dead central buds= $\frac{Ni}{Nt} \times \frac{N_I}{N_T} \times 100$

Ni= Number of infected plants

Nt = Total number of sampled plants

N_I = Total number of infected stems

N_T = Number of stems in infected plants

The efficiency of the poison was also calculated according to the number of live larvae in the field and based on the following relationship (Henderson and Tilton 1955).

Poison efficiency = $1 - \frac{T_a C_b}{T_b C_a} \times 100$

Ta and Tb = The amount of infected in treated plots before and after spraying

Ca and Cb = The amount of infected in control plots before and after spraying

The extracted information was processed and classified using Excel software and the data were analyzed using SAS (version 9.1) software (SAS Institute, 2001). The means were compared by the method of least significant difference (LSD) at the level of 5%. The figures were drawn using Excel 2013.

RESULTS AND DISCUSSION

Percentage of dead central bud

The effect of fipronil on the percentage of dead central bud in two sugarcane cultivars is shown in Figure 1. The results showed that the use of fipronil decreased the percentage of

dead central buds in two sugarcane cultivars. In the cultivar CP69, the percentage of dead central bud was reduced by 26, 34 and 32% compared to the control, respectively, with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (5% SC). Also, in the CP48 cultivar, the percentage of central bud decreased by 20, 23 and 24% compared to the control, respectively, with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (5% SC) (Figure 1).

In both cultivars, no significant difference was observed between the application rate of fipronil 1 and 1.5 l ha^{-1} (5% SC). Fipronil was highly toxic against the stem borer moth C. *infuscatellus* and termites (*Odontotermes* spp.). Application of fipronil before and after sugarcane germination 75 days after planting (DAP) resulted in 65% and 31% reduction in heart mortality and termite incidence, respectively (Mann *et al*. 2009). The results of a study showed that the use of fipronil has reduced sugarcane stem borer and root borer (Sardana 2001).

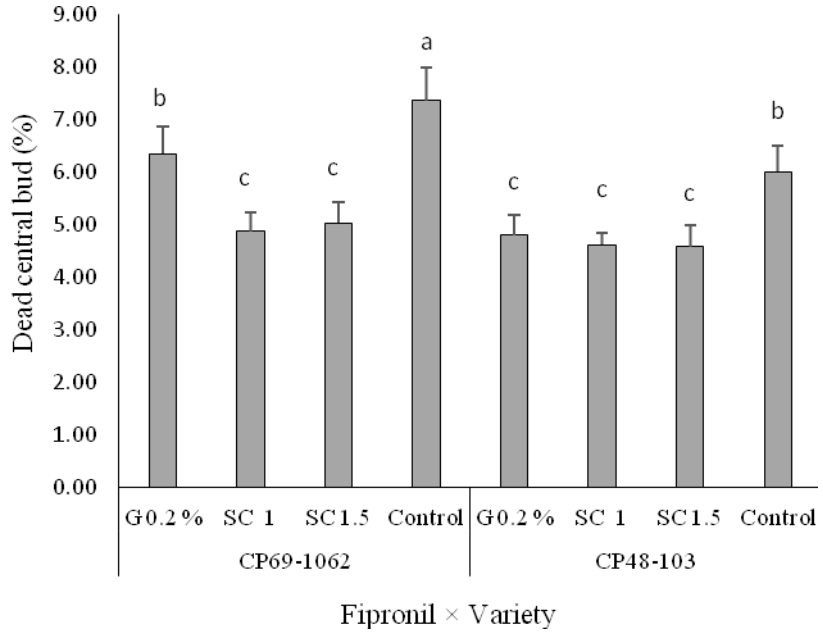

Figure 1. Percentage of dead central bud with fipronil application in two sugarcane cultivars

Number of live larvae

The use of fipronil has reduced the number of live larvae in sugarcane cultivars. In the cultivar CP69, the number of live larvae was reduced by 21, 32 and 34% compared to the control with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (5% SC). Also, in the CP48 variety, the percentage of central bud decreased by 12, 24 and 21% compared to the control, respectively, with the application of fipronil 20 kg ha^{-1} (0.2% G) and 1 and 1.5 l ha^{-1} (5% SC) (Figure 2).

In the number of live larvae in both cultivars, no significant difference was observed between the amount of fipronil SC of 1 and 1.5 l ha^{-1}. Fipronil-treated sugarcane shoots fed to C. *infuscatellus* larvae resulted in 64.6-73.6% and 39-54.1% mortality at 15 and 30 days after

insecticide spraying, respectively (Mann *et al*. 2009). In another study, it was shown that fipronil granule treatments of 18 kg ha^{-1}, 22.5 kg $ha^{-1}$and suspension of 1 l $ha^{-1}$are significantly effective in controlling C. saccharphagus (Kumarasinghe 2008). It seems that the use of fipronil can be one of the effective ways to control the population of this insect in sugarcane fields infected with Sesamia stem borer.

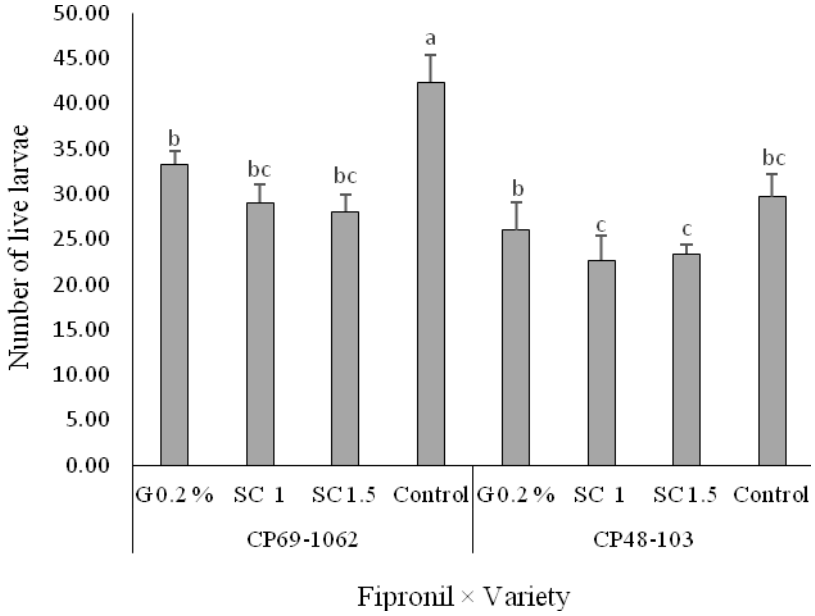

Figure 2. The number of live larvae with fipronil application in two sugarcane cultivars

Poison efficiency

The results of the effect of fipronil application on the efficiency of the poison in two sugarcane cultivars showed that the highest efficiency of the poison was observed in the fipronil suspension of 1 and 1.5 l ha^{-1} in the CP69, and the lowest efficiency of the poison was obtained in the fipronil granule in the CP48 (Figure 3). Also, the results showed that the efficiency of the poison was higher in the CP69 cultivar than in the CP48 cultivar. One of the reasons for the higher efficiency in the CP69 cultivar is probably due to the greater sensitivity of this variety to Sesamia pest, which chemical control of this pest is considered to be one of the effective ways to reduce its population in this variety.

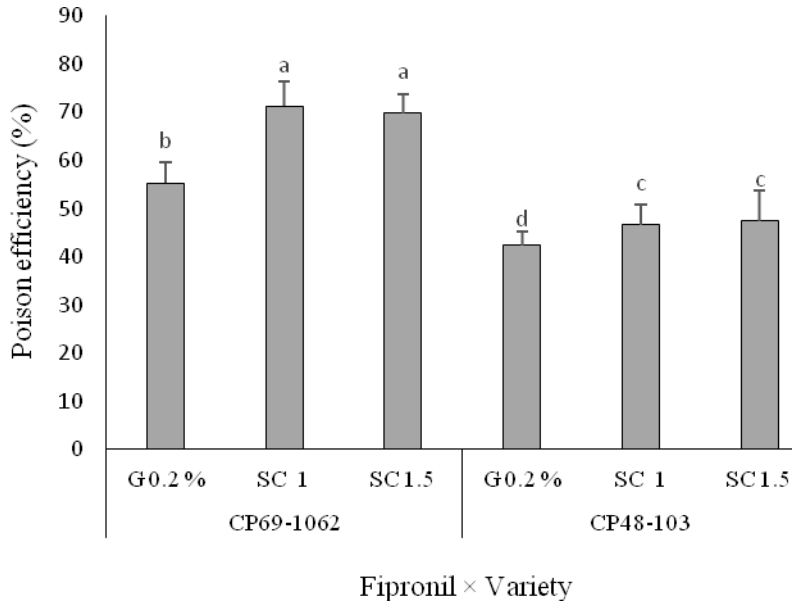

Figure 3. The efficiency of the poison with the application of fipronil in two sugarcane cultivars

CONCLUSION

The results of this study showed that the application of fipronil in the form of 0.2% G and 5% SC has reduced the percentage of dead central buds and the number of live larvae in sugarcane. In the cultivar CP69 compared to the CP48, the percentage of the dead central bud has decreased more and this decrease was higher in the 5% SC than of the 0.2% G. No significant difference was observed in the number of live larvae between the 5% SC of 1 and 1.5 l ha^{-1} of fipronil.

The efficiency of the poison varied between different fipronil formulations. The highest poison efficiency was observed in the suspension of 1 and 1.5 l ha^{-1} in CP69 cultivar. The efficiency of the poison in the CP69 cultivar was higher than that of the CP48 cultivar due to the greater sensitivity of the CP69 cultivar to Sesameia stem borer. In general, the results showed that the use of fipronil was effective in controlling the sugarcane stem borer, and between fipronil fertilization and considering the lack of difference between the effect of 1 and 1.5 l ha^{-1} SC 5%, the use of 1 l ha^{-1} in sugarcane fields It is recommended.

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