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Use of *Cotesia* for the Control of Sugarcane Drill

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Abstract

Sugarcane plays an important role for Brazil's economy. However, crop infestation such as the common bed borer is still a major challenge for companies and farmers. Previous studies have shown that *Cotesia*, a living product, may be effective in combating sugarcane borer. In order to verify the relevance of the use of *Cotesia* in control of sugarcane borer, the method on infestation prevention, high quality sugarcane preservation and harvesting was optimized in this study. This study confirmed that biological control is effective than that of chemical control but with great viability.

Keywords: *Cotesia*; Sugarcane drill; Combat the sugarcane drill

Introduction

Sugarcane plays an important role in the Brazilian economy and helps to solve many of the challenges faced by government authorities and global leaders [1]. It is notable that such a crop has the potential to reduce the use of oil, reduce carbon dioxide emissions, create jobs in the rural areas and favor energy development committed to a healthier and cleaner planet [1] According to Barros et al. [1], sugarcane presents different benefits for mankind, such as greenhouse gas reductions through ethanol, as it cuts carbon dioxide emissions by 90.0% compared to gasoline, and other sugarcane products offering similar advantages of low carbon, Energy Diversity since only 20 countries produce oil, but more than 100 grow sugarcane. Expansion of production of clean and renewable sugarcane products would help increase energy security and reduce global dependence on fossil fuels, economic growth, as it is known that about 100 sugarcanes producing countries is located in the tropics and often developing countries in need of economic opportunities. The expansion of sugarcane can create rural jobs and increase access to electricity. The use of *Cotesia*, a small wasp that attacks the eggs of the insect responsible for the sugarcane borer, is an excellent alternative to combat the borer through biological control, favoring a better development of plantations [1]. In addition to the presence of the drill that damages the plant, they open spaces for opportunistic pests. To curb the development of the cane drill, chemical or biological controls are usually practiced to ensure planting health. This wasp can be grown in the laboratory by a specific methodology. The drill is an insect that feeds on the cane, consuming it systematically, being able to destroy the whole plantation, since it cannot recover itself. Therefore, in view of this imminent problem, we sought to deepen the studies, regarding the application of *Cotesia* in sugarcane plantations, as a method to prevent infestation, thus preserving the quality of sugarcane, thus guaranteeing a healthy harvest and the viability of operations, which depend on sugarcane as raw material. In Brazil sugarcane has been suffering from a pest known as *Diatraea saccharalis*, popularly known as a sugarcane drill. In its larval period, this enters the stem, forming holes in the shape of a hive, or galleries, thus reducing the mass of the stem, hindering the development of the plant, and may even cause death of the plant and as a consequence, reducing the productivity of the field significantly [2]. Thus, the general objective of this study was to demonstrate the effectiveness of *Cotesia* in the control of sugarcane, demonstrating step by step its operation from the production of the wasp in the laboratory, until its final results.

Materials and Methods

The study was based on data collection at Santo Antonio farm where the applications were made in five plots and each one had 4 hectares, and a control plot was left after the application was made an efficiency survey, and the samples of the drill were taken to the Cofco Plant in Sebastianópolis do Sul. At first, it was tried to produce *Cotesia* in the laboratory, but as it does not offer the specific conditions for the production of the same, it was chosen to acquire *Cotesia* already developed. As previously said, a priori, it was tried to produce *Cotesia* in the laboratory of the university, is therefore used as materials:

1. **For the collection of drills:** Machete, shin guards, gloves, vaqueta, iron nozzle boot, tape measure, pétri plates with artificial diet, pocketknife, Arabic lace, goggles are used.

2. **In laboratory for reproduction of *Cotesia*:** Pétri plates with artificial diet, anatomical tweezers, transparent crepe tape, cane drill, and *Cotesia* are used.

Even without success, the following methodologies were sought:

3. **Drill collection:** The person responsible had to enter 50 m (33 grooves), then counted 25 m in (30 steps) and performed a sampling point, which was every 5 hectares being made a drill point. Two rows of 5 m reeds were then cleaned for 10 m and the reeds were removed, which showed infestation of drills, from which the counts of the drill bits were multiplied by 6666 (linear meters), dividing them by 10 (amount of yards from the point), so this calculation was made so that we could have the right amount of release of *Cotesia* per hour. After 15 days of the release of the *Cotesia*, the reeds were collected again at the sampling points to verify the drills that were being parasitized.

4. **Breeding of *Cotesia* (laboratory):** Sterile Petri dishes supplemented with the artificial diet were used, the drills were placed, and then the *Cotesia* were added to ovopozitate in the drills. It should be emphasized that this cycle requires about thirty days for success in reproduction, using the temperature of

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25°C, but as mentioned above, the process cannot be completed because the institution does not provide the appropriate technical conditions for the execution of such an experiment.

Results

The studied area was composed of 20 hectares divided into 5 plots, where 4 underwent the applications of *Cotesia*, and one served as a control so that the obtained results were compared (Figure 1). In the respective plots, there was the incidence of drills in the reeds, as shown in Figure 2. It was observed that the plots had different amounts of infestation, as shown in Figure 1. In each plot, different amounts of *Cotesia* were applied, and they were left in cups at the entrance of the carrier, as shown in Figure 3. Table 1 indicates the amount of *Cotesia* applied per hectare left in each field. The plot identified by number 5 was used as a control. The applications were repeated every 15 days, and later a parasitic survey was carried out to identify whether the number of drills in each field had been reduced or increased. During this survey, drill samples were taken to the laboratory and left at 25°Cto show that they were, in fact, being paralyzed. (As can be seen in Figures 4, 5 and 6). According to the analyses and surveys carried out, it was observed that the number of drills was decreasing with each parasite survey, as observed in Figure 2. As can be seen in Figures 7 and 8, the use of

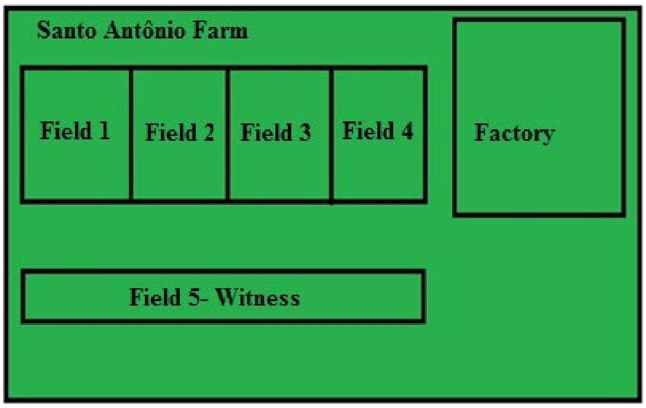

Figure 1: Divisions of the studied area in Santo Antônio farm in the municipality of Sebastianópolis do Sul-SP, Brazil.

Figure 2: Reed drill.

Figure 3: Application of *Cotesia*.

Figure 4: Sample 1.

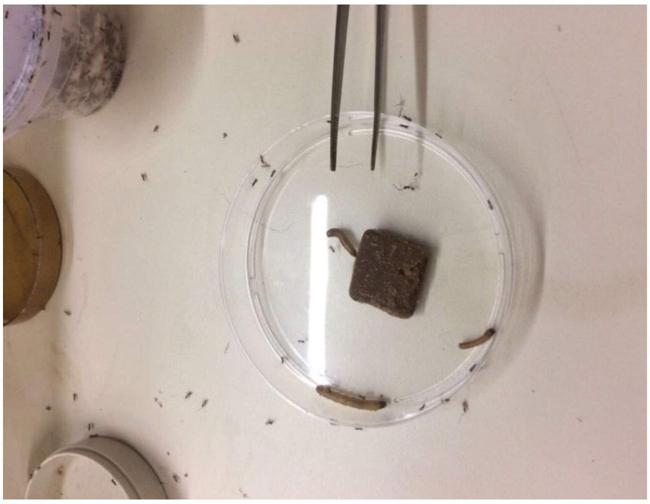

Figure 5: Sample 2.

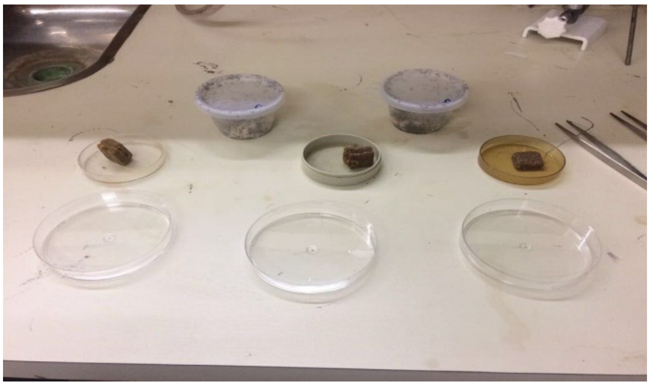

Figure 6: Three paralyzed collections/samples.

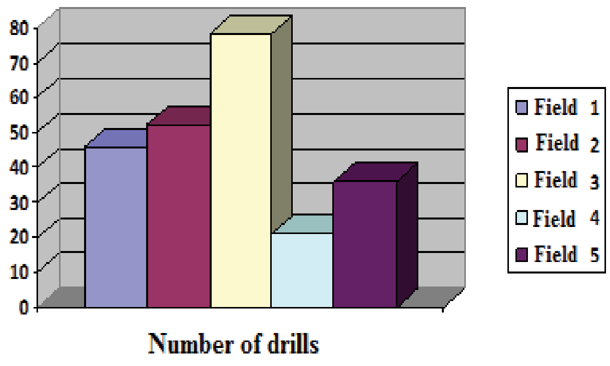

Figure 7: Number of drills found in each field.

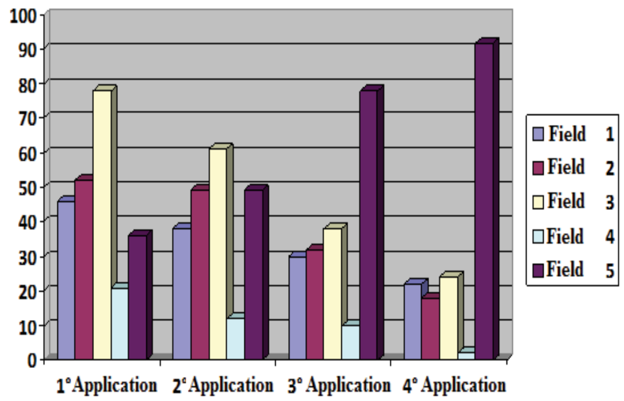

Figure 8: Drills with each application.

Field 1	4 cups
Field 2	6 cups
Field 3	8 cups
Field 4	10 cups
Field 5	Witness

Table 1: Amount of *Cotesia* applied per hectare.

Cotesia is efficient in relation to the combat of the sugarcane borer, still being healthier for the environment, since the type of control is made through biological intervention, and not through the use of agrochemicals, which represents not only benefits to the environment, but also to those directly linked to its handling.

Discussion

According to Silva et al., [2] the biological control used in the combat of the sugarcane borer is the introduction of the parasite classified as *Cotesia* so that the cultivation of sugarcane happens in a healthy way. In line with this concept Furtado et al. [3] understands that this procedure consists of the introduction and release of wasps in areas where a certain population index has been demonstrated. The wasps lay eggs released in the field, which in turn releases larvae, which feed on the parasite, that is, the sugarcane caterpillar. Usually, the chemical control is carried out by pesticides, where its application is aerial, requiring little work. According to Jordao et al. [4], there is a peculiarity in the application of chemical control, so that the application is efficient, being necessary that the larva of the drill is at the beginning of its life cycle, with about 2 centimeters. Therefore, Marucci et al. [5] states that after this stage, the larvae migrate to the cane and are not affected by the insecticide, unlike what occurs in biological control, once it is understood that it moves to capture the animal once which feeds on it, thus following its natural cyclic. According to the theorists and the results obtained in the case study, it was observed that the use of *Cotesia* in the combat and the decrease in the incidence of the sugarcane borer is relevant and has great effectiveness, and also causes less damage to the environment, and in return it still preserves the cane crop, thus preserving the quality of the product. The world sugar economy is characterized by a combination of complex problems affecting developed and developing countries, exporting sugarcane or beet. It faces recurrent supply/demand imbalances, reflected in extremely volatile prices in free markets. In recent years, world free market prices have been severely depressed and by 1985 have probably reached historic lows [6]. This has had the most adverse effects on agricultural incomes and on commodity exports from many countries, particularly sugar-dependent developing countries, for a large proportion of their export earnings. For Jordão et al. [4] sugar exports represent the economic base of many developing countries, especially Latin America and the Caribbean, as well as some countries in South Africa, Asia, and the Pacific. Even with low prices prevailing in export markets in recent years, sugar was still accounted for in 1984 for $8 billion in export earnings or almost 10.0% of the total value of agricultural exports in all developing countries. Again, despite the low prices, sugar was surpassed only by coffee as an individual source of export revenue for developing countries and a bigger winner than all cereals, livestock products, forest products, and fisheries. This highlights the dependence of developing countries on sugarcane exports and the pressures on which they should be subject, owing to the drastic decline in sugar revenues. According to Pinto and Ivan [7] to further emphasize the relative weights and importance of sugar to developing countries, it can be added that 70.0% of world sugar production is produced in developing countries and 85.0% of sugarcane. Likewise, developing countries account for 65.0% of total world sugar exports in volume, including 80.0% of sugarcane exports. Globally, cane sugar accounts for about two-thirds of total world sugar exports and beet sugar, one-third. An analysis of world sugar markets over the past 20 to 25 years indicates that production more than doubled from 50 to 100 million tons and consumption, but that in most years since 1960, world production actually exceeded consumption. In the twenty-five years from 1960 to 1985, there were only eight years with a production shortfall caused in each case by a crop failure in one or more of the major producing countries [8]. In each of the periods in which the deficits occurred - 1962/63, 1971/74 and 1979/80 - prices rose sharply and rapidly but subsequently declined equally rapidly [3]. Therefore, production may be considered sufficient to meet demand, except in those years that have accumulated in the past at intervals of six to seven years, when the adverse weather in the major producing countries causes falls in supply significantly above normal. It seems that producers, exporters operate under the assumption that they will do well enough in the good years around the top of the cycle to carry them in lean years around the bottom. A number of other elements need to be taken into account when considering production trends in particular. This has been a trend, particularly evident since the mid-1970s, in a number of important developed importing countries, for protectionism, that is to say, aid producers to achieve or maintain a level of production that would not be economically viable if they were exposed to international prices, another has been the tendency of many developing countries to adopt programs to increase their level of self-sufficiency in sugar or even to achieve self-sufficiency. Many of these programs were designed during periods of high prices and with the aim of saving foreign exchange, but in many cases, the cost was not the main consideration in its implementation, since it would normally have been much cheaper to import sugar over time [9]. A third element has been the misinterpretation by countries of cyclical periods of high prices. All too often, there has been false optimism that these periods of expansion would last, which led to accelerated increases in output, which in turn accentuated the inevitable price collapses. According to Marucci et al. [5], such considerations undoubtedly influenced the EEC sugar regime when planning its production quotas for the second quota period (1975-1981) coincided with the 1973/1974 sugar price boom. Technological advances have also played an important role in increasing production in both developed and developing countries. Improved cane varieties, new pest and disease control measures, and improved cropping practices have yielded appreciable yields and improved milling technology has also raised sugar extraction rates in sugar mills. Finally, the trend of national policy considerations to obscure the overall picture - the separation of supply, which seems to have a life of its own, demand can be summarized in one Figure 3 it is estimated that in 1983/1984 sugar production capacity in the level was about 120 million tonnes (compared to 1984 consumption of 94 million tonnes) [5]. Agricultural capacity was obviously lower, but it should be emphasized that both sugarcane and beet sugar have a potential for rapid expansion and there is a large stock of sugarcane that could be used for sugar production, if the price warrants, for example, through increased fertilizer application, irrigation or diversion of sugarcane from other users (e.g. of non-centrifugal sugars in India or ethanol in Brazil). As evidence of the expansion capacity of sugar production Nardin et al. [10] may note that world production increased by 8 million tonnes or 10% between 1980 and 1981, in response to high prices at the time and the following year by another 9 million tonnes, increasing from 17 million tonnes or 20.0% every two years to the present day.

Biological control of sugarcane plantation

The search for effective sustainability initiatives and new perspectives adopted in relation to the environment brought agriculture to adapt to sustainable development. These actions were supported by the Ministry of the Environment through policies and projects of financial incentives, technical assistance, and standardization of sustainable rural practices, in order to maintain Brazil as a global supplier of raw materials and sustainable food. According to the Ministry of Agriculture, Brazil is the fourth largest producer in the ranking in organic agriculture, with production growth of 20.0% per year. These products are organic agriculture, which includes the sustainable use of agricultural technologies for low chemical inputs. One of the technologies employed in agriculture is biological pest control, according to the Organic Agriculture Association includes the use of living organisms to maintain the population of specific pest organisms in agro-ecosystem equilibrium [11]. Biological Pest Control in Agriculture to elucidate the underlying reasons for using biological control, in short, the advantages and disadvantages of biological control compared to chemical control in agriculture. In the specific case of the sugarcane crop is another advantage in the use of biological control. In plantations where no sugarcane was burned, the possibility of *Cotesia*s being reproduced in culture increases, reducing the need to reapply it to the new crop [2]. With the natural reproduction of the biological agent of culture reduces costs. It is worth mentioning that in several Brazilian states sugarcane burning is already prohibited by law and there are project laws that aim to prohibit burning throughout the country. This legal measure favors the use and efficiency of control. In addition, studies show that sugar and alcohol plants that adopted biological control in 1980 reduced the rate of pest infestation in sugarcane by applying 9.0% in the subsequent three years to 3.71% [1]. Cynosia is considered biological control agent pests in sugarcane [12], such as the drill (*Diatraea saccharalis*). The insect is released into the cane fields and naturally attack the sugarcane parasite, combating pests without using chemical inputs. Sugarcane suffers great damage in relation to its productivity and quality when it is affected by this pest. Hence the concern with the fight, being common in the cultivation of sugarcane and for this purpose there are several biological products and chemical origin.

Conclusion

This study began with the questioning of what benefits the use of biological control would bring in the cultivation of sugarcane, and how this control could reduce damages in the production of the same. In order to answer the proposed question, the objective of this study was to verify the relevance of the use of *Cotesia* in the control and control of the sugarcane borer. The analysis observed that the biological control and is more effective than chemical control so that it can be noted that the *Cotesia* had excellent results in combating the drill. Based on the results presented, great viability was found regarding the use of biological control in the cultivation of sugarcane. Because of the *Cotesia* and its live entry, it was observed a great quality in the use of the same, causing that the development of the drill stopped or even reduced significantly. It should be noted that in contrast, the chemical is purchased in large batches and stored for use, which can cause harm to humans and the environment, increasing the costs of the product and may not be fully effective.

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