MANAGEMENT OF PERKINSIELLA SACCHARICIDA
IN SUGARCANE IN ECUADOR

By

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Abstract

The sugarcane delphacid, Perkinsiella saccharicida Kirkaldy (Hemiptera: Delphacidae), is an important pest in Ecuadorian sugarcane, where it was first reported in 1966. Several studies by scientists at CINCAE have been carried out to determine the biology of the insect in Ecuador and appropriate pest management strategies. The lifecycle of leafhopper, from egg to adult, is about 39 days (26 ± 5°C). Incubation of eggs requires 11–15 days. The nymphal phase comprises five instars, with a total period of 21–32 days. Adult insects live for 32–36 days. Most of the heavy attacks on sugarcane occur during the dry season, and the main damage produced by this pest on sugarcane growth is related to direct feeding, lesions produced by oviposition in the leaf midrib, and sooty mould production. Research has shown losses of up to 36% of sugarcane production (cane yield). There are no reports of this pest on hosts other than sugarcane. Studies showed that natural enemies provide some control of damaging infestations. The most important of these are Aprostocetus (Ootetrastichus) sp., Zelus pedestris, Ceraeochrysa cincta, C. cubana, Leucochrysa sp., spiders and the pathogens Metarhizium anisopliae, Hirsutella tomponsi and Entomophthora sp. The sugarcane delphacid can be controlled with correct crop management (fertilisation, weed control, and irrigation), preservation of natural enemies, mechanical control, and use of insecticides. The use of the egg predator Tytthus mundulus and M. anisopliae have not been effective under the Ecuadorian conditions.

Introduction

Ecuador has approximately 95 000 ha of sugarcane in production. Most of this is used in sugar production (75 000 ha), and the remaining area is used for small-scale alcohol or household molasses production. Sugarcane for sugar production is grown in the tropical lowland provinces of Guayas, Los Ríos and Cañar.

In Ecuador, 32 insect pest species have been reported; some of them can reduce sugarcane yields and sugar recovery. The most important pest is the sugarcane delphacid, Perkinsiella saccharicida (Hemiptera: Delphacidae) (Mendoza et al., 2000).

Risco (1966) first reported the sugarcane delphacid in Ecuador in 1966; this was also the first report of this insect in the Americas. Gaviria (1996) reported that the insect could cause significant losses in cane production in Ecuador.

However, field populations are often erratic, with heavy insect populations in some periods, whereas in other seasons populations can be moderate or low. The most damaging populations occurred in 1995, with losses of 58 t cane/ha and high levels of non-sugar components in juice (Gaviria, 1996).

The importance of this insect pest in sugarcane production in Ecuador is obvious. CINCAE (Centro de Investigación de la Caña de Azúcar del Ecuador) scientists have carried out many studies to determine its biology, behaviour and ecological relations, and to develop strategic management systems to keep the insect populations at low levels. This paper summarises these Ecuadorian experiences.
Biology and ecology of the P. saccharicida

Flores (2003) studied the biology and behaviour of the sugarcane delphacid. Under laboratory conditions (26 ± 5°C), the life cycle from egg to adult took 36–40 days. The eggs are deposited in the midribs of leaves covered with a waxy white substance in groups up to 10, usually on the upper surface and near to the base of the leaf. Incubation averaged 13 days, ranging from 11–15 days.

The nymphal period is 21–32 days, with five instars each of 4–8 days. Nymphs are gregarious and stay in groups on the lower surface of leaves and on the stems. Adults congregate on upper leaves, mainly in the whorl. Young adults are white-cream and later become light brown.

Adults die after 32–36 days. Adults are polymorphic with macropterous males and females and brachypterous females. The pre-oviposition period is about 4–5 days. Each female can deposit 106–879 eggs, with 87% fertility.

Outbreaks are unpredictable, but it has been observed that leafhoppers prefer young cane and dry conditions. Generally, populations increase during the dry season and continue to grow and spread in the rainy season until they reach their highest levels in February-March (rainy season).

During this period, high relative humidity enhances the development of disease epizootics caused by the entomopathogenic fungi Hirsutella, Metarhizium, and Entomophthora.

Adults migrate primarily from mature cane to young canes. This generally occurs at harvest. Sometimes these migrating populations remain for short periods in the same field, and cause little or no damage to the crop. The most damaging situation occurs when a population establishes in young cane (<6 months) and when several generations then develop.

Damage and crop losses

Gaviria (1995) reported that attacks of leafhoppers on cultivar PR10-59 during 1975–1979 reduced cane yields by 30 t/ha from populations of more than 16 adults per stalk. During 1978–1995, there were yield losses of 10–34% in cane production from populations of 1.4–15.0 adults and nymphs per stalk. In 1996, populations averaging 18 adults and nymphs per shoot caused estimated losses of 20% in cane yields and 10% in sugar yields.

A study conducted at the Banatel Farm in the province of Guayas in 1995 showed losses of 15.5–58.8 t cane/ha in cultivars B-7316 and Ragnar, with average leafhopper populations of 5.5–5.8 insects per stalk (Gaviria, 1995).

In Valdez Sugar Mill (province of Guayas), populations ranging from 5.2 adults per shoot in 1992 to 7.0 adults per shoot in 1994 caused an increase in non-sugar compounds of up to 0.45% in first extracted juice (Gaviria et al., 1997).

Recent studies on infestations have shown that short periods of attack did not affect the production and juice quality when populations were above 30 adults and 80 nymphs per shoot.

However, persistent high populations in the crop (48 adults and 340 nymphs per shoot) reduced cane yield by 35%, but did not affect juice quality (Mendoza et al., 2000).

Pest management

Host plant resistance

Although specific studies on plant resistance have not been conducted, field observations suggest that there are differences among cultivars in resistance. Gaviria et al. (1997) suggested that an increase of leafhopper populations was due to the use of the cultivars Ragnar, B-7316, NC0310, and Azul Casa Grande.

CINCAE began clonal evaluations starting in 2001. Clones from stages three and four of the CINCAE Breeding Program have shown resistance to the leafhopper. These clones show low numbers of adults and few oviposition marks on leaves, suggesting antixenosis.

Natural enemies

Several endemic natural enemies have been found on Perkinsiella in Ecuador (Gaviria et al., 1997).

The most important are: Aprostocetus ( = Ootetrastichus) sp. and Anagrus optabilis, which parasitise the eggs of Perkinsiella; Pseudogonatopus sp. that parasitises nymphs; Tytthus parviceps, an egg predator; Zelus pedestris, Chrysopa sp. and many species of spider that are predators of nymphs and adults.
Entomopathogens, such as *Metarhizium anisopliae*, *Hirsutella thompsoni*, *Entomophthora virulenta* and *Fusarium sp* (?), are also found in the field. Levels of egg parasitism by *Aprostocetus* reach up to 5%. The combined action of the entomopathogens causes mortality of up to 67% of adults and nymphs of *Perkinsiella* in the rainy season. Unknown causes of mortality of eggs (addled eggs) can reach up to 50% mortality.

To improve the biological control of *Perkinsiella*, a program for the multiplication and release of *A. optabilis* and *T. parviceps* was run during 1995–2002. However, because of the difficulty in mass producing these parasites and low success following their release, these programs were discontinued.

In 1978 and again in 1998, the San Carlos mill introduced the egg predator *Tytthus mundulus* from Hawaii. Approximately 615 000 individuals were released in 1978 and 340 000 were released in 1998.

Over several years following both introductions, no evidence of adaptation and establishment was found at San Carlos mill (Mendoza, personal observation).

A biological control program using the fungus *Metarhizium anisopliae* was established with native strains and foreign strains from Costa Rica and Colombia. Laboratory tests have shown 80% mortality of adults and nymphs of *Perkinsiella*, but field trials are still inconsistent. Research on this subject is still going on at CINCAE (Gaviria *et al.*, 1997; CINCAE, 2002).

**Mechanical control**

This type of control is based on the use of a mechanical capturer (‘mad cow’), made of a metal frame 150 cm long and 90 cm wide, and covered with cloth. There are two cylindrical collectors on the top and bottom parts, each comprising a metal frame 55 cm long and 40 cm in diameter covered with fine cloth.

A small bottle collects the insects at the end of each collector. At the bottom there is a horizontal bar that disturbs the adult leafhoppers when the device is passed over the cane shoots. When the insects try to escape, they head into the collecting cylinders.

This capturer is used in canes 2–2.5 months old with high adult populations. The device can reduce adult populations by up to 80%, with an approximate cost of US$ 5.00/ha.

**Chemical control**

Although the erratic behaviour of leafhoppers makes chemical control difficult, high populations of nymphs and adults are sometimes sprayed with insecticides.

Before applying insecticides, a monitoring program must be established to determine the appropriate time to use this type of control. Insecticides with the least environmental impact and risk to people should be used.

The use of malathion (Malathion® 57 CE), at 0.5–1.0 L/ha or fipronil (Regent® 200 SC) at 350 mL/ha is recommended.

**Conclusions**

Any management strategy for *Perkinsiella* should be based on good cultural practices and pest monitoring. Although mass releases of biological-control agents in Ecuador have not been successful, there are some natural enemies that assist in maintaining field populations at low levels.

Insecticide applications and cultural practices should be designed to keep native natural enemies at high levels. If insecticides have to be applied, it is necessary to determine the pest developmental stage, extent of natural enemy activity, and crop age.

Fields should be surveyed every 7–15 days during the first 6 months of growth. A sample of 50 stalks should be taken at random and the number of adults and large nymphs (fourth and fifth instar) and natural enemies determined.

In making pest-management decisions, it is important to consider if the present population is composed only of adult insects (a feature of migrating populations), or if the populations are of different stages of development (nymphs and adults).

The most appropriate time (control level or economic level) for pesticide application is when high nymphal populations and the initial presence of sooty mould are observed.

Pesticide applications against adult populations generally result in unsatisfactory control; they could even cause new migrations or the spread of the infestation to other fields.
REFERENCES


GESTION DU PERKINSIELLA SACCHARICIDA DANS LA CANNE À SUCRE EN EQUATEUR

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Résumé
Le delphacid Perkinsielia saccharicida Kirkaldy (Hemiptera: Delphacidae) est un ravageur important de la canne à sucre en Equateur où il a été rapporté pour la première fois en 1966. Plusieurs études ont été entreprises par les chercheurs au CINCAE afin de déterminer la biologie de cet insecte en Equateur et de définir les stratégies de gestion appropriées. Le cycle de vie de l'insecte, de l'œuf à l'adulte, est d'environ 39 jours (26 ± 5°C). L'élosion a lieu après 11 à 15 jours. La phase nymphale comprend cinq étapes qui durent au total 21 à 32 jours et les adultes vivent pendant 32 à 36 jours. Les infestations les plus importantes ont lieu pendant la saison sèche et les dégâts causés par ce ravageur sont associés à l'alimentation directe, aux lésions provoquées pendant l'oviposition sur la nervure médiane et à la production de fumagine. Les travaux de recherches ont démontré jusqu'à 36% de pertes en rendement de canne. Ce ravageur n'a pas été répertorié sur les cultures autres que la canne à sucre. Les études ont établi que les ennemis naturels exercent un certain contrôle sur les populations devastatrices. Les ennemis les plus importants sont Aprostocetus (Ootetrastichus) sp., Zelus pedestris, Ceraeochrysa cincta, C. cubana, Leucochrysa sp., les araignées, et les pathogènes tels Metarhizium anisopliae, Hirsutella tomsoni et Entomophthora sp. Le delphacid de la canne à sucre peut être contrôlé par une gestion adéquate de la culture (fertilisation, lutte contre les mauvaises herbes et irrigation), la préservation des ennemis naturels, le contrôle mécanique et l'utilisation des insecticides. Les prédateurs des oeufs Tytthus mundulus et le champignon M. anisopliae n'ont pas été efficaces sous les conditions équatoriennes.

MANEJO EN ECUADOR DE PERKINSIELLA SACCHARICIDA EN CANA DE AZÚCAR

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Resumen
El delphacid de la caña de azúcar, Perkinsielia saccharicida Kirkaldy (Hemiptera: Delphacidae) es una plaga importante en la caña de azúcar ecuatoriana, registrado por primera vez en 1966. Se han adelantado varios estudios por científicos en el CINCAE para determinar la biología del insecto en Ecuador, al igual que estrategias adecuadas de manejo. El ciclo de vida del saltahojas, de huevo a adulto es de 39 días (26 ± 5°C). La incubación de los huevos requiere de 11 a 15 días. La fase ninfa comprende cinco instares para un tiempo total de 21 a 32 días. Los adultos viven de 32 a 36 días. La mayoría de ataques fuertes en caña de azúcar se presentan en el periodo seco y el daño principal causado por la plaga está relacionado con la alimentación directa, con las lesiones producidas por su oviposición en la nervadura central, y con la producción de fumagina. Se han demostrado pérdidas hasta del 36% de la producción de caña (tonelaje). No hay ningún registro de esta plaga sobre otros hospederos. Las investigaciones han mostrado que los enemigos naturales realizan algún control sobre las infestaciones de importancia económica. Los más importantes son Aprostocetus (Ootetrastichus) sp., Zelus pedestris, Ceraeochrysa cincta, C. cubana, Leucochrysa sp., arañas y los patógenos Metarhizium anisopliae, Hirsutella tomsoni y Entomophthora sp. El delphacid de la caña de azúcar puede ser controlado con un manejo adecuado del cultivo (fertilización, manejo de malezas y riego), preservación de los enemigos naturales, control mecánico y uso de insecticidas. El empleo del depredador Tytthus mundulus y M. anisopliae no han sido efectivos bajo las condiciones ecuatorianas.