IDAECAMENTA EUGENIAE (COLEOPTERA: SCARABAEIDAE: MELOLONTHINAE): A NEW SPECIES OF WHITE GRUB IN UGANDAN SUGARCANE

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Abstract

Towards the end of 2001, at Kinyara Sugar Works Ltd (KSWL) in Uganda, it was noticed that large areas of sugarcane on the estate were dying. After considering and investigating numerous possible causes, it was found that under the stools of dead or dying sugarcane were numerous white grub larvae. Adults of this insect were collected and sent to the Natural History Museum in London, where they were identified as *Idaecamenta eugeniae* Arrow.

This paper documents the first areas attacked by this species on KSWL, the severity of infestation at that time and the spread of *I. eugeniae* on the estate since then. It also documents the occurrence of fungal and bacterial pathogens of the larvae, as well as a dipteran predator. Cultural treatment of the first infected fields by ploughing reduced levels in those fields from more than 20 larvae per pit in 2001, to less than two in late 2002.

Keywords: sugarcane, white grub, *Idaecamenta eugeniae*, Uganda, pest surveys, cultural control, biological control

Introduction

In contrast to the sugar producing areas of Australia, Mauritius and other islands, sugarcane industries on continents, especially Africa, have been free of severe white grub (Coleoptera: Scarabaeidae) infestations. Generally, when infestations have occurred on the African continent, they have been localised, and of short duration. Exceptions to this have been the Swaziland sugar industry, which was heavily infested with *Heteronychus licas* Klug (Coleoptera: Scarabaeidae: Dynastinae) (Carnegie, 1988; Rajabalee, 1994), and an estate in Tanzania, which was severely affected by *Cochliotis melolonthoides* Gerst. (Coleoptera: Scarabaeidae: Melonthinae) (Rajabalee, 1994; Evans *et al*., 1999).

Towards the end of 2001 in Uganda, field staff at the Kinyara Sugar Works Ltd (KSWL) noticed that the cane on fairly extensive areas of the estate appeared to be dying. On investigation, they found white grub larvae under the stools in these areas. Communication by e-mail on the identity and control of these insects ensued. In early March 2002, an opportunity arose for the first author to visit KSWL to assess the situation first-hand. In November 2002, the estate formally requested that another visit be made in December 2002 to assess the extent and possible spread of infestation of this insect.

This paper documents the identity of the white grub species affecting KSWL, and describes preliminary field population structure data obtained since 2001. The occurrence of natural enemies, the successes of some control measures and trials instituted against this pest are also discussed.

Materials and Methods

Surveys for immature and adult stages
For the first survey in December 2001 the method followed by the estate was that 10 pits were dug in 3 x 5 m rows of cane showing symptoms of infestation. These were shallow pits, dug to just below the major root zone of the cane. In January 2002 a more structured survey method was followed, where 10 standard sized pits measuring 300 x 300 x 300 mm were dug at random, but in the cane row, in every field on the estate. This is the method used when conducting surveys in the South African sugar industry.

All adult, pupal and larval specimens were collected from the pits, and a representative sample from these was curated for identification purposes. The adult specimens were sent to the Natural History Museum in London, United Kingdom, and to the Biosystematics Division of the Agricultural Research Council - Plant Protection Research Institute (ARC-PPRI) in Pretoria, South Africa. In addition, photographs were taken of the raster patterns of the larvae, as these are an aid in the identification of this stage of the species.

Extent and severity of infestation on the estate
For the estate-wide surveys, all sections of the estate were visited, and selected fields in each section were inspected using between five and 10 standard sized pits per field. The mean number of life stages per field was determined from these pits.

Seasonal population fluctuations
Following the March 2002 visit, the KSWL agronomy department had instituted monthly surveys in the heavily infested Kiryatete section of the estate, using standard sized pits. Ten pits were dug and inspected per field. The mean proportion of larvae, pupae and adults found in the pits at each sampling date was determined.

Control measures
Surveys for indigenous biological control agents. While searching through the soil from the pits for the various life stages, care was taken to find any immature stages that were dead or infected with bacteria and/or fungi, as species of these are well known entomopathogens of other white grub species (Rajabalee, 1994). Pupae of parasitic hymenopteran wasps were also sought, as were any other organisms that may attack the immature stages.

Insecticide trials. A trial was set down in Field 8 of Kingo section, using the insecticides Confidor (active ingredient imidacloprid, 200g/l SC), Dursban (active ingredient chlorpyriphos 480g/l EC) and Pyrinex (active ingredient chlorpyriphos). The insecticides were applied just after harvest, in three metre long furrows, dug 50 cm apart, and to a depth of 12.5 cm, on either side of the cane row. All three insecticides were applied at a rate of 2.6 l/Ha in 150 l water. A control section three metres long was also demarcated. In December 2002, two pits were dug in each treated row, and the numbers of immature stages found per pit were counted.

Cultural control. The fields in Kiryatete section that were the first to be heavily infested by this insect species were ploughed out, and then ploughed and harrowed twice more to ensure that no volunteers were allowed to grow. The fields were replanted in February 2002. In December 2002, 10 pits per field were again dug, and immature stages found were counted and recorded.

Results and Discussion

Species identification
The species was identified by the Natural History Museum in London as *Idaecamenta eugeniae* Arrow (Coleoptera: Scarabaeidae: Melolonthinae). According to their records, the insect was described from Zanzibar, and was also collected from Tanzania. There are no host plant records from these collections. Voucher specimens are housed at the Natural History Museum in London, the South African Sugar Association Experiment Station (SASEX) in Mount Edgecombe, and at the ARC-PPRI Biosystematics Division in Pretoria. This is the first time *I. eugeniae* has been recorded from sugarcane. A related species, *C. melolonthoides,* has been recorded from sugarcane in Tanzania (Evans *et al.,* 1999).

Extent of infestation
An estate-wide survey at KSWL to determine the extent and the severity of infestation by *I. eugeniae* was completed in December 2002. Figure 1 shows the mean number of grubs collected from the pits in each section sampled.

In general, infestations were widespread but very low, and in many of the pits no grubs were present. Only on Kingo (King) and Kyabagenyi (Kyab) sections were populations of any significance found (higher than five grubs per pit; Figure 1).

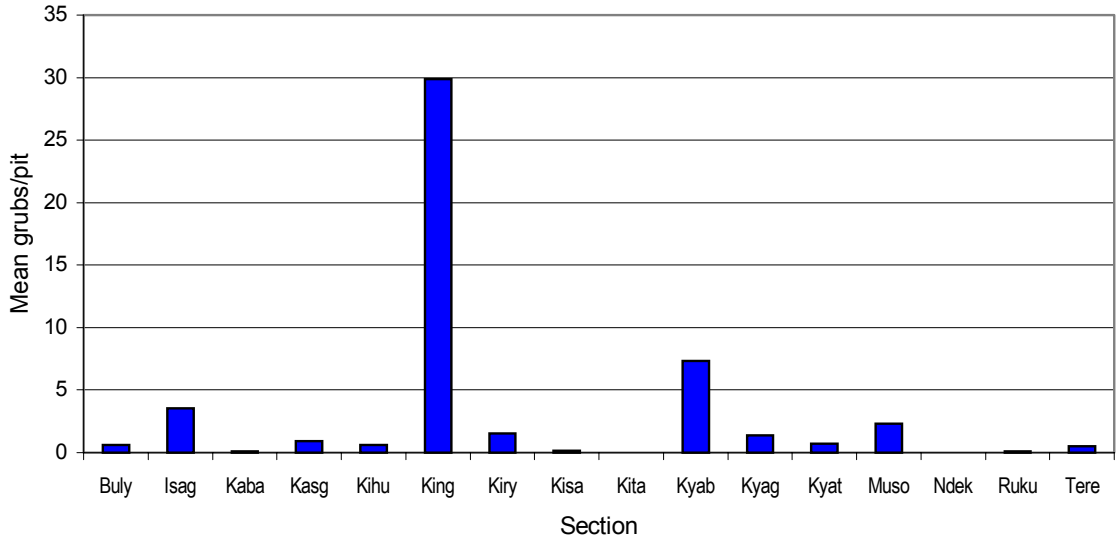

Figure 1. Mean number of grubs found per pit in fields surveyed for *I. eugeniae* in the different sections of Kinyara Sugar Works Ltd, Uganda.

Population structure in Kiryatete section
Figure 2 shows the proportion of each life stage present in pits sampled in the Kiryatete section, on a monthly basis, from February 2002 to March 2003.

Larvae were always found in these pits. However, from February to May 2002 pupae and adults were also found. It is evident that pupae are present from as early as December. Pupal numbers were highest in February (15% of the population in 2002 and 10% in 2003), while the number of adults found in the pits was greatest in April 2002 (55% of the population). In March 2003, adults comprised about 35% of the population found in the pits. During the March 2002 visit, many adults were flying at dusk, being attracted in particular to the lights around the factory and in the houses on the estate. However, from the 2003 surveys, it is evident that adults are found from January onwards. From June to November, only larvae were found in the pits (Figure 2).

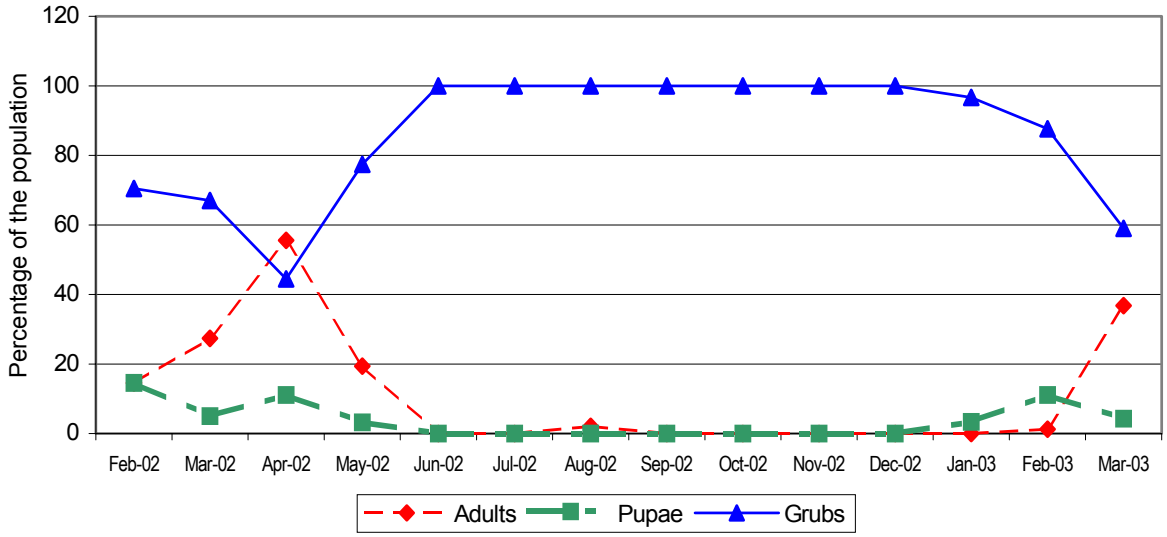

Figure 2. Structure of the population of *Idaecamenta eugeniae* in the Kiryatete section of Kinyara Sugar Works Ltd, Uganda, on a monthly basis from February 2002 to March 2003.

Control measures

- Insecticide trial
  Table 1 shows the effects of three insecticides used in field 8 of Kingo section, in a small trial planted in March 2002, and sampled in December 2003. Where the insecticides Confidor, Dursban, and Pyrinex were applied, grub populations were higher in the treatment plots than in the control plot (Table 1). The insecticides thus had no effect on populations in this trial.

Table 1. Effects of the insecticides Confidor, Dursban and Pyrinex on soil populations of *Idaecamenta eugeniae* in a trial planted in field 8 on the Kingo section of Kinyara Sugar Works Ltd, Uganda.

Treatment	No. of pits	No. pits with no grubs	Grubs/pit			Total life stages found			
			Min	Max	Mean	Larvae	Pupae	Adults	Total
Confidor	1	0	27	27	27.0	27	0	0	27
Dursban	2	0	52	65	58.5	117	0	0	117
Pyrinex	1	0	43	43	43.0	43	0	0	43
Control	2	0	24	27	25.5	51	0	0	51

- Biological control agents
  It was pleasing to find *I. eugeniae* larvae killed by the entomogenous fungus *Metarrhizium anisopliae*, and an unidentified bacterium in the pits examined. Pupae of an as yet unidentified hymenopteran parasitoid (most likely belonging to the family Scoliidae) and a predaceous dipteran larva were also collected. When identified, populations of these natural enemies could be augmented to provide more effective control.

- Mechanical control
  The fields badly infested by *I. eugeniae* in December 2001 (Kiryatete 20 and 22), were ploughed out in January 2003. These fields were ploughed and harrowed twice more to remove all cane and roots of the old crop before being replanted. In December 2002, the fields were again surveyed. Figure 3 compares the populations of grubs found in pits in December 2001 and 2002.
  It is clear that the extensive ploughing of these heavily infested fields reduced grub numbers from a mean of 9 to less than 1 per pit in field 20, and from 11.5 to less than 1 per pit in field 22.

Figure 2 shows that pupae and adults were present in the pits from January. Similar ploughing of the other infested fields in January would have had a major impact, especially on pupae, which were at their highest numbers in the pits in February. January would therefore be the recommended time for treatment by thorough ploughing of all infested fields, as this would impact greatly on adult numbers. Reducing the number of adults would reduce the number of new fields infested. In addition, by damaging the grubs and pupae present in the soil, indigenous pathogenic biocontrol agents would more readily infest the weakened life stages, thereby increasing mortality in *I. eugeniae*. Populations of entomopathogens in the soil of these areas would also increase. The regular surveys now instituted will provide more detailed information on the life cycle of *I. eugeniae*, and will show what proportion of the population will be in the pupal stage in January. This will provide more detailed evidence for timing of the plough-out operation.

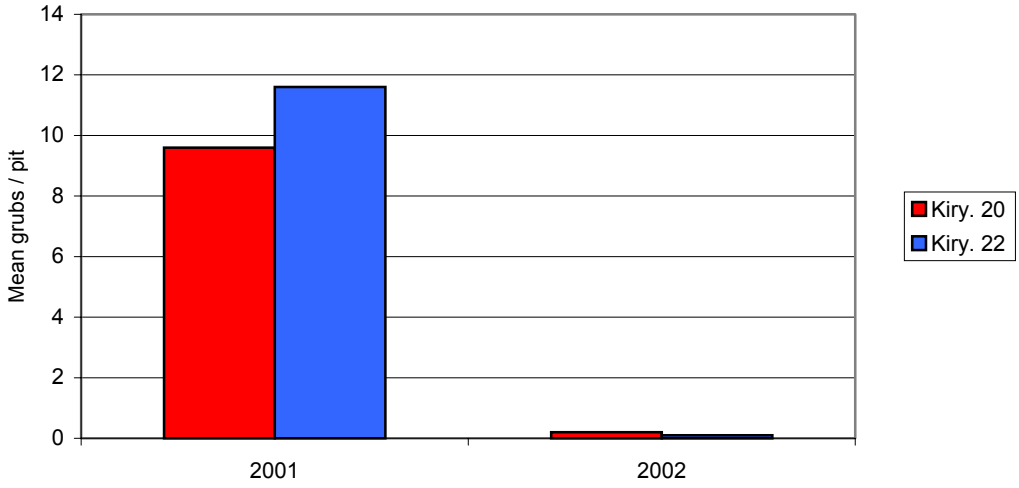

Figure 3. Populations of *Idaecamenta eugeniae* in pits before and after ploughing fields 20 and 22 of the Kiryatete section of Kinyara Sugar Works Ltd, Uganda.

Conclusions

- Infestations of *I. eugeniae* are generally very low over the whole of KSWL, with only two sections having fields with a mean of more than 5 per pit.
- The pupal period of *I. eugeniae* starts in December, peaks in February and ends in May. Adults are found from February through to May. These observations have control implications.
- The insecticide trials completed so far are not encouraging. It is premature to consider large scale applications because of the generally very low populations of *I. eugeniae* present on the estate. In addition, it cannot be predicted where high infestations of this white grub will occur, for the application of insecticide trials.
- The presence of entomopathogens, parasitoids and predators in the soil is very encouraging. This also has control implications.
- Thorough ploughing (at least three ploughings followed by harrowing), especially in December/January, of heavily infested fields is recommended. Ploughing at this time will have a major impact on the pupae present in the soil, thereby reducing the number of flying adults and thus the spread of infestation and infestation intensity. Also, ploughing will damage the grub stages still in the soil, thereby making them more susceptible to infestation by the entomopathogens present. Populations of entomopathogens will thus also build up in these soils.
- This is still a relatively new pest in sugarcane, and very little is known about its biology. Routine soil sampling should be continued in selected fields to confirm life stage presence. In addition, light traps should be installed to accurately monitor adult flight times and patterns. There is also a need to determine life table parameters such as female fecundity, the length of the different life stages, and the presence of *I. eugeniae* in different habitats. Because the latter will probably be out of the range of the agronomy staff at KSWL to complete, consideration should be given to having a university student complete this work.

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