

OBSERVATIONS ON THE BORER *ELDANA SACCHARINA* WALKER (LEP., PYRALIDAE) IN MAIZE AND SUGARCANE IN IVORY COAST

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Abstract

Maize and sugarcane in Ivory Coast are severely damaged by the borer *Eldana saccharina* Walker. Young tillers of sugarcane and young maize plants are attacked by a *Sesamia* complex, notably *S. calamistis* and *S. botanephaga*. It was found that maize can carry up to fifteen times more eldana larvae than an adjacent sugarcane field of the same size, and maize was more attractive to ovipositing moths. The extent of infestation by eldana in sugarcane was affected by factors such as variety of the sugarcane, time of planting, time of harvest and extent of irrigation in the dry season.

High numbers of eldana eggs on maize support large populations of parasitoids. It is suggested that small maize plots grown amongst sugarcane could provide a "reservoir" of parasitoids, a proportion of which would move into the sugarcane. The consequent constant presence of higher numbers of parasitoids in the cane fields has the potential to reduce eldana numbers.

Introduction

The first sugar estate in Ivory Coast became operative in 1974, and there are now six mills fed by six estates, each with an area of five to six thousand hectares. Overhead irrigation systems are used on all estates prior to harvesting during the dry season, which is from late November to April.

The estates are situated in the savannah regions in the centre and north of the country. In the bush surrounding the estates, the natural host plants of *Eldana saccharina* Walker include the large grasses *Hyparrhenia rufa*, *Rottboellia exaltata*, *Panicum maximum* and *Pennisetum atropurpureum*.

Government agricultural development agencies have recently established a few large-scale maize schemes but, by and large, maize is grown in small lots around rural villages, and is used mainly as a subsistence crop. Local varieties are low yielding, but are very hardy and well adapted to local conditions. Maize is grown during the rainy season from April to November. In the north where the season is short (June to September), only one crop is grown per annum. In the central and southern regions the season is longer and two crops are grown, one straight after the other.

Five varieties of sugarcane are planted extensively on an industrial basis: NCo 376, Co 449, M 31/45, B 37/172 and RAGNAR. The varieties NCo 310 and Co 740 are used to a lesser extent. The mean growing cycle is 12 months. Harvesting (by machine and by hand) is done in the dry season. The varieties NCo 376, NCo 310 and Co 449 are harvested first and B 31/45 and B 37/172 are cut in February-March. All cane is burnt before harvest and this kills many eldana larvae in the stem. However, roughly 5% of larvae survive in the underground portions of the plants.

The growth rates of some varieties from June to harvest are as follows. With good irrigation in the dry season,

NCo 376 can, on average, grow 2,2 internodes per month, while RAGNAR reaches 2,8 internodes per month. At harvest, NCo 376 and Co 449 have a mean of 17 to 18 internodes per stalk, while B 37/172, RAGNAR and M 31/45 develop 20 to 21 internodes per stalk. Without irrigation growth stops at the end of the rainy season, and then only 16 to 17 internodes per stalk are obtained. These variations in the number of internodes are accounted for in estimations of eldana damage and crop loss.

Damage and Crop Loss

In Ivory Coast, maize and sugarcane are attacked by the eldana borer and by a complex of *Sesamia* species, notably *S. calamistis* and *S. botanephaga*. *Mussidia nigriovenella* attacks the cobs of maize. It is not easy to assess the true extent of the damage wrought by these borers. In maize the damaging effect of eldana is masked by the fact that it normally attacks and debilitates the mature plant, and so presumably causes a reduction in the weight of the cobs. The extent of this reduction has not yet been established because of the difficulty in obtaining meaningful samples. Eldana females seem to select the biggest plants on which to oviposit: bigger plants usually produce bigger cobs and thus the assessment of losses by comparing infested and uninfested plants in the field is very difficult.

Sesamia borers cause much more damage to maize than they do to sugarcane. *Sesamia* attacks mainly young plants and, in maize, destroys or debilitates whole plants. However, in sugarcane, new tillers can replace damaged ones, and thus losses of young tillers may be compensated.

Eldana does not normally damage young sugarcane tillers, except when infested setts are planted, or when, in newly cut cane, a larva bores up from the roots to complete its development in the tiller.

Eldana is normally found on cane in which internode formation has already begun. In mature cane, losses due to eldana may be calculated on the basis of a 0,5% loss in weight of sugar produced by the mill for each 1% of internodes bored in the field. The overall losses for the 1980-1981 season on four estates in Ivory Coast are shown in Table 1.

TABLE 1

Estate	Ferké I	Ferké II	Katiola	Borotou
Mean number of internodes per stalk	20,1	16,9	19,9	20,5
Number of damaged internodes per 100 stalks at harvest	153	273	166	224
Percentages of damaged internodes	7,6%	16,2%	8,3%	10,9%
% sugar lost = % damaged internodes × 0,5	3,8%	8,1%	4,15%	5,45%

In estimating losses the extent of damaged internodes is expressed as a percentage rather than as an absolute number or mean. In this way any growth which may have taken place after borer damage is accounted for. In the field the estimation of the number of damaged internodes is more time consuming and thus more expensive than the straightforward counting of damaged stalks. It has been found that the percentage of damaged internodes (y) can be obtained from the percentage of damaged stalks (x) using the simple straight line equation $y = 0,165 x$, where stalks have been between 0% and 60% damage. When 60% to 90% of stalks are damaged the relationship is $y = 0,265 x - 6$.

Populations in Sugarcane and Maize

Eldana populations and their damaging effects were usually studied in sugarcane with small experimental maize strips planted close by. Also, maize fields remote from cane plantations were observed, and the levels of eldana in these were compared with eldana levels in the maize grown amongst sugarcane.

Two aspects of eldana populations were studied:

- (a) dynamics of eldana populations in relation to crop varieties, time of planting and time of harvest;
- (b) interactions of eldana populations in stands of maize and cane grown side by side, with particular reference to oviposition preferences and the activities of egg parasitoids.

Sampling methods

The sampling criterion chosen was the number of live borers per 1 000 sugarcane stalks, or 100 maize stalks. On each of four sugarcane estates, 30 to 50 fields were selected so as to obtain representative samples with regard to variety, cane age and the situation of the field. The fields were sampled once a month, using a "stratified" system: each field was divided into ten equal sized quadrats, and ten stalks were taken at random from each quadrat. More detailed sampling was undertaken on 15 fields at the *Ferké II* estate. An average of 3,2 stalks per hectare were sampled monthly.

In the maize fields, stalks were selected from the rows by means of random numbers.

Once the samples had been taken, the actual densities of the borer populations per hectare in sugarcane could easily be inferred by using the numbers of cane stalks per hectare (between 70 000 and 110 000, depending on the variety). The density of maize (80 cm rows) is normally about 50 000 plants per hectare, but may often be less.

Eldana populations in sugarcane

In general, results of constant sampling of larvae in cane fields show that eldana populations begin to make an impact in July, when 50 to 100 larvae per 1 000 stalks are found. If the crop is irrigated from the onset of the dry season, the density of eldana rises continuously until harvest. If there is no irrigation, the eldana population reaches a maximum in November-December and then decreases slowly until harvest.

The level of infestation varies from one estate to another, as shown in Table 1. Some varieties are more susceptible to attack than others. For example, on the *Ferké II* estate during the 1979-1980 season, the varieties B 37/172 and M 31/45 had about 300 eldana larvae per 1 000 stalks at harvest in March, while NCo 376 and Co 449 had 480 larvae per 1 000 stalks when harvested much earlier, in

January. NCo 376 is the variety most susceptible to eldana. On new estates the first crop on newly cleared land is usually heavily attacked, and the intensity of infestation decreases in subsequent ratoons. Plant cane is generally more susceptible to eldana than ratoon cane.

After burning and harvesting the cane, a population of predominantly old larvae survives in the roots and stubble, and remains there during the rest of the dry season. On the *Ferké II* estate in 1980 there were 3 600 larvae per hectare in the stubble. The effect of this residual population on the next ratoon is negligible.

An interesting result was that very few pupae were found, relative to the number of larvae. This raises the possibility that the larvae may move away from the stalk to pupate, perhaps underground? During the rainy season, larvae were observed moving about on the outside of the stalks, in leaf axils and beneath leaf sheaths. These larvae were more highly parasitized than larvae from inside the stalks.

Eldana populations in maize

In maize fields remote from sugarcane, eldana populations occur at very low levels during the first crop: from May to July the percentage of damaged internodes attains about 3%. The second crop is attacked to a much greater extent — as many as 15% internodes damaged. In an experiment in which maize was planted at staggered intervals between July and September, three times more larvae were observed in the September plantings than in the July plantings. The percentages of internodes attacked in this maize increased in similar fashion. It seems likely that the infestation rates in maize planted in the bush may reflect the populations present in the surrounding natural host plants.

In maize grown near large stands of sugarcane the rate of infestation by eldana is always very much higher than that found in the maize in the bush. (This is because sugarcane maintains higher populations of eldana than the natural bush). In maize grown with sugarcane the percentage of damaged internodes usually attains about 40% although it can exceed 75%. Maize younger than 60 days does not normally support larvae of eldana. From the 60th day onwards, the level of infestation increases steadily until harvest. At the *Ferké II* estate in 1979, more than 600 larvae and pupae per 100 stalks were counted at harvest in some of the experimental maize amongst sugarcane. After harvest, while the stalks are drying, populations decrease rapidly and disappear within two months.

A stand of maize may have up to 15 times as many borers as the surrounding sugarcane, and the actual numbers may involve up to 400 000 eldana larvae per hectare of maize; and between 16 000 to 18 000 larvae per hectare of sugarcane. The ratio of percentage damaged internodes between maize and cane is about 3 to 1.

Use of maize plots in sugarcane plantations to study eldana oviposition habits and egg parasitoids

In stands of sugarcane and maize growing side by side it is likely that there is a constant to and fro movement of eldana moths and other insects including various parasitoids of eldana. In general it is much easier to study eldana in maize than in cane. One reason for this is that populations of eldana are much higher in maize. Also, the eggs of eldana are easy to find in maize: difficult to find in cane. Maize is thus used as an aid to studying eldana in sugarcane: it can also be used in the control of the pest.

Two aspects of the uses of maize in cane are being studied. First, it seems possible that eldana will oviposit

on maize in preference to cane. Thus maize could be used as a "trap crop" by attracting eldana away from neighbouring cane.

Secondly, the high numbers of eggs laid by eldana on maize serves as a "reservoir" in which populations of egg parasitoids can build up. At harvest, the attractiveness of maize to ovipositing eldana females decreases, and thus the populations of parasitoids from the eldana eggs on the maize are forced to search in the neighbouring cane for their host eggs.

When maize plots are used in sugarcane, the eldana in the maize must not be allowed to reach the adult stage. Adults emerging from the maize could, of course, drift into neighbouring cane and so increase the infestation there. The aim is thus to use the maize to attract ovipositing eldana moths; then to build up parasitoid numbers in the eggs on the maize; and then to destroy the maize just before the first moths begin to emerge from it. To achieve this, the maize must be destroyed after it is harvested, whilst the stalks are still green. The maize stalks must be pulverized when they are destroyed: they cannot simply be cut and stacked to dry before burning, because the larvae will continue to develop in the cut stalks.

Any variety of maize may be used, but, if the cobs are to be harvested and utilized as food, then a variety with a short growing period should be used, so that the cobs have time to develop before the crop has to be destroyed.

Observations on populations of the egg parasitoids of eldana in sugarcane and maize

Eldana lays its eggs in the rows of hairs on the outer margins of the leaf and cob sheaths of maize. Eggs are found much more easily on maize than on cane, where they are hidden amongst dry trash.

In Ivory Coast the eggs of eldana are parasitized by *Telenomus* sp. near *dignus* (Scelionidae), and by *Trichogrammatoidea eldanae* Viggiani, both of which multiply very quickly on the numerous eggs found on maize.

From June to November (1981), egg masses of eldana were sampled regularly from seven maize fields planted alongside cane fields. A total of 6 530 plants were surveyed, and 2 308 eldana egg masses were found. Of these, 1 053 egg masses were collected and examined in the laboratory for parasites; 201 were empty. Of the remaining 852 live egg masses, only 30 were unparasitized. (The 852 egg masses contained 12 826 individual eggs, ie an average of 15 eggs per egg mass).

Extensive sampling of estate-grown maize showed that an average of 96,5% (91% to 99%) of egg masses were parasitized, mainly by *Telenomus*. Parasitization of the eggs themselves was 88% (82% - 93%).

T. eldanae has a much lower rate of parasitization than *Telenomus*. The proportion of eggs parasitized by the trichogrammatid varied between 0,2% and 10,7% in different areas; populations showed a gradual increase during the year until the start of the dry season. Counts of numbers of adults emerging from eggs collected in the field gave an average of 2,6 parasitoids per host egg.

Possible applications of maize plots on sugarcane estates

The establishment of many small plots ($\pm 0,5$ ha) throughout a sugarcane estate would doubtless benefit the multiplication and spread of parasitoids of eldana. It would be very difficult to assess the extent to which maize plots act as "traps" in luring moths away from cane. Of much greater importance is the maintenance of a constant high population of parasitoids throughout the cane plantation. To achieve this in Ivory Coast, maize must be sown once a month in each plot, starting on the first of May. The first planting is timed to ensure a supply of suitable maize plants just as the eldana populations begin to build up at the beginning of July. Maize plots managed in this way can only be beneficial in cane plantations. It remains to note that in Ivory Coast fungal and viral diseases that affect both maize and cane are absent.