A HISTORY OF THE OUTBREAKS OF *ELDANA SACCHARINA* WALKER, IN NATAL

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Abstract

An outbreak of *Eldana saccharina* Walker between 1939 and about 1953 was confined to the Umfolozi Flats. It is not known why it did not spread or why it eventually died out. The present outbreak, which started at Hluhluwe in 1970, has spread north and south. Certain areas have been consistently heavily infested. The average level of infestation in these areas has increased as a result of the spread of the insect into previously uninfested fields. This spread appears to be related to the recent drought. However there is no evidence that infestation levels have increased in those fields which were infested before the drought. Some possible reasons for the recent outbreak of the pest in sugarcane are discussed.

Introduction

In the history of the South African sugar industry there have been two outbreaks of the stalk borer, *Eldana saccharina* Walker. The first between 1939 and about 1953, was confined to the Umfolozi Flats. The second, which began in 1970 at Hluhluwe, has spread in succeeding years both north and south to other sugarcane growing areas. This paper reviews the history of these outbreaks, previously published for the first outbreak by Dodds[9] and Dick[7, 8] and for the present one by Carnegie[3, 4] Carnegie *et al*[5], Smaill[15], Smaill and Carnegie[16] and Carnegie and Smaill[6]. The course of the present outbreak is discussed in relation to climatic indices.

History

The 1939 Outbreak

A specimen of *E. saccharina* was recorded from Beira, Mocambique, in 1903 and another from the Nyalazi River, Mtubatuba in 1929 (Dick[7]). In September 1939, a severe infestation of the insect was found at harvesting in a field of two year old cane of variety POJ 2725 on the Umfolozi Flats. Later in the same month heavy infestations were reported from two other locations, and lighter ones from elsewhere on the flats. A more general survey in October suggested that there was only the one focus of infestation at Umfolozi. No infestations were found to the north as far as Hluhluwe, which was then the northern limit of commercially grown cane, nor to the south at Empangeni and Felixton mills (Dodds[9]). At first it was thought that the insect had immigrated, or been brought in chewing-cane from Mocambique, but Dick[7] caught specimens of the moth as far south as Mount Edgecombe. Dick concluded that the insect was widespread, but at a low level, in some other host plant.

The outbreak lasted some 10-13 years at Umfolozi. The most severely infested variety was POJ 2725 but POJ 2878, POJ 2714 and Co 301 were also attacked (Dick[7]). The variety Co 281 was remarkably resistant. It is not clear when the infestation died out, but it was still present at low incidence in 1950 (Dick[8]). It probably disappeared about 1953. It is not known why the infestation died out but the policy of leaving no stand-over cane and a gradual change of variety to Co 281 probably helped (Dick[8]).

During routine surveys in the 1960's for *Numicia viridis* Muir, no borers other than top grub (*Sesamia calamistis* Hampson) were recorded, despite special attention being paid to the cane at Umfolozi (Dick, pers. comm.). These surveys were done from Swaziland southwards. It is conceivable that frequent flooding of the Umfolozi Flats at this time may have discouraged infestation by the pest; there were five major floods in the ten years 1954-1964.

The 1970's Outbreak

The sequence of spread of the present outbreak is summarised in Figure 1. The insect was first noticed in 1970 at Hluhluwe in a field of NCo 376[3]. Adjacent farms were also affected. Further infestations were found at Empangeni and in Swaziland during 1972, at Mtunzini and Amatikulu in 1973, as well as in the eastern Transvaal. In 1974 it again appeared on the Umfolozi Flats after an absence of twenty years. In 1975 the first infestation of cane south of the Tugela River was recorded. Despite this one record on a newly purchased farm at Darnall, the Tugela was for some time regarded as a barrier to the southward spread of the insect in sugarcane. However, in 1977 there were frequent

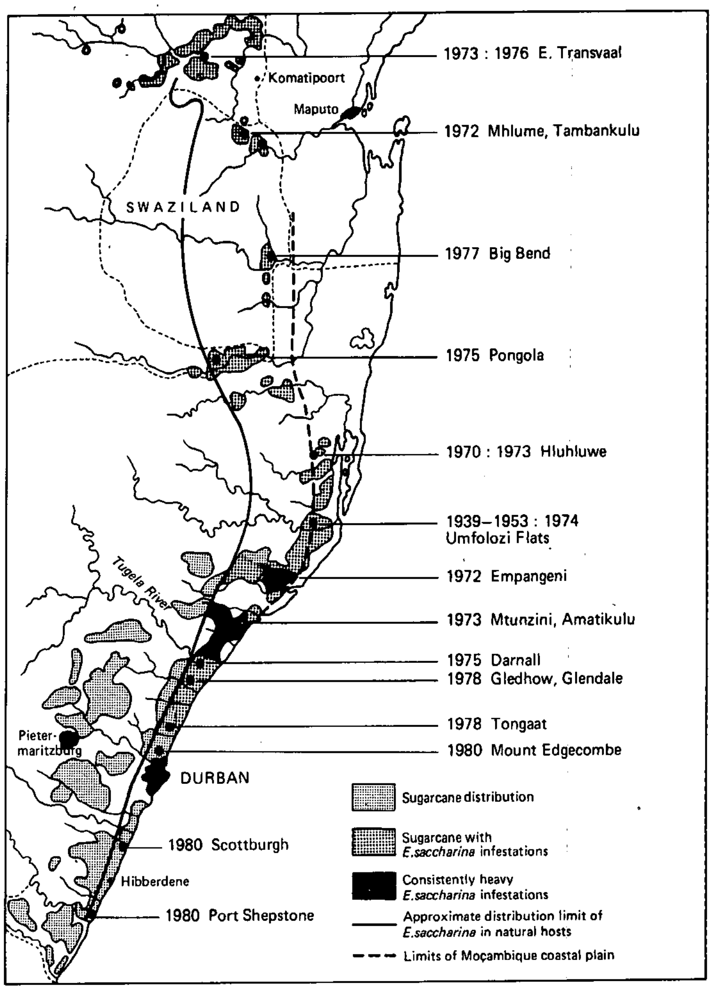

FIGURE 1 Summarised history of the outbreaks of *E. saccharina* in Swaziland and South Africa.

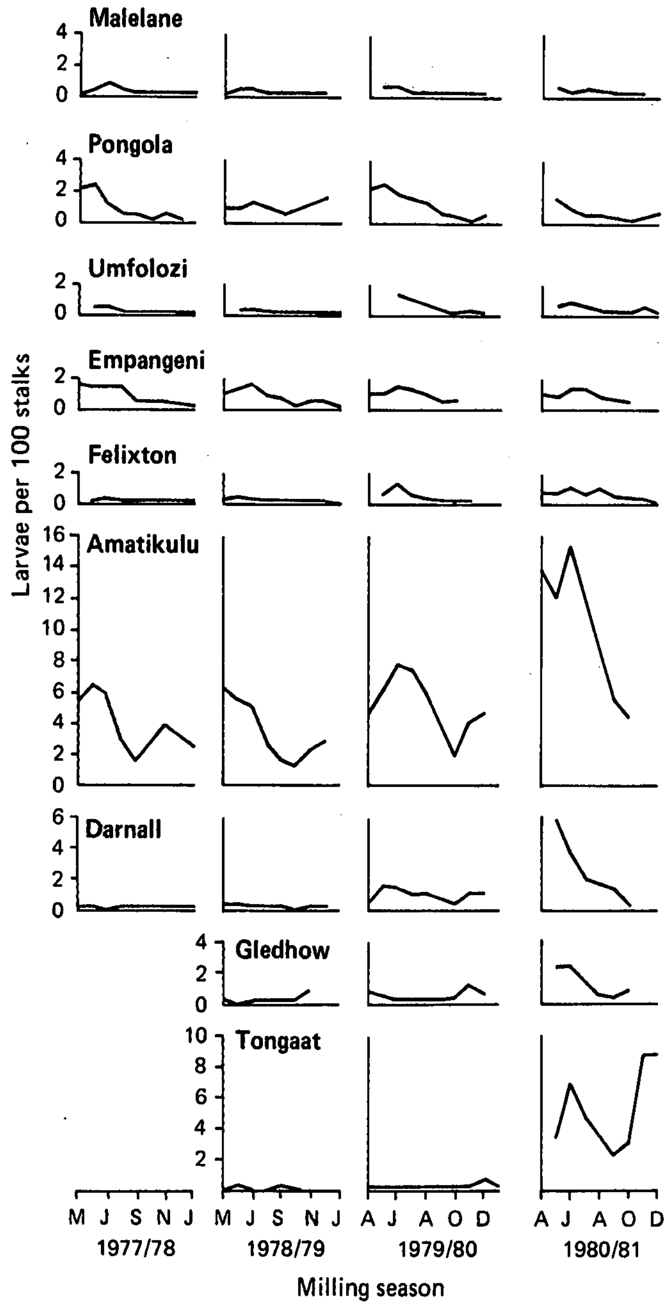

FIGURE 2 Results of millyard surveys in the four milling seasons since 1977/78. The graphs show for each mill, the mean numbers of larvae in samples of stalks drawn from many cane consignments in each month. The mills are listed in order from north to south. The four southerly mills show trends of increasing infestation rates.

records of infested fields at Darnall. In 1975 there was a record of a single larva in cane at Illovo, south of Durban, but this was unconfirmed and is not shown in Figure 1. However, by 1980 there were several records from fields as far south as Port Shepstone.

Between 1977 and 1978, extensive surveys of the insect's distribution in natural hosts along the Natal coast (Atkinson[1]) revealed that it was common as far south as Port Shepstone (Figure 1). This confirmed Dick's (1945) suggestion that *E. saccharina* was not only indigenous to Natal, but widespread along the coast although at that time it had infested cane only at Umfolozi.

The spread of the recent outbreak appears to have been a result of this widespread distribution of the insect in its natural hosts, rather than to the use of infested seedcane or to the migration of a recently adapted strain of the moth. The evidence of infestations at sites as far apart as Hluhluwe in 1970 and Mhlume in 1972, suggests that there were sporadic incursions into sugarcane at several different points. The insect then took hold and became more abundant. Light-trap catches (1979-80) from regions of natural hosts and of sugarcane have shown that moths are far more abundant in cane. However, the spread of infestations between farms within certain areas, for examble Amatikulu, may have been assisted by the use of infected seedcane.

Girling[10] suggested that a crop-feeding form of the insect has spread across East Africa. It is possible that the moth is capable of migrating some distance although both sexes emerge sexually mature and the female is gravid. This pattern of sexual maturity is not normally associated with migratory insects[11], which emerge immature and in which the female does not become gravid until during or after migrations. Moths of *E. saccharina* do not feed and the apportionment of the female's food reserves, between flight muscle and egg complement, must take place in the pupa, presumably before any stimulus to migrate has occurred. Despite these reservations moths of both sexes, but mainly females, have been caught in traps at 22 m and 30 m above ground, which indicates that individuals may be capable of flying some distance from their sites of emergence. However, it does not seem likely that a sugarcane-feeding strain could have spread up and down the South African coast in the time available. If a particular strain is involved then it must have arisen more than once, not only in Natal but elsewhere in Africa.

Severity of the 1970's outbreak

The distribution of larvae within fields is often highly aggregated, particularly in the early stages of infestation, and field surveys sometimes miss foci of the insect. It is easier to assess the presence of the insect in a field by inspecting bundles of cut stalks. Consequently millyard inspections of cane consignments were instituted early in the outbreak as a means of warning growers if they had infestations on their farms.

In 1975, teams of inspectors were employed at six mills from Pongola south to Darnall. At first only the percentage of damaged stalks was recorded in samples of 20 drawn from each consignment. However, from 1977 onwards, the number of larvae per stalk was also recorded in an attempt to obtain biological information from the inspections. This information is summarised in Figure 2. In 1978 teams were introduced at other coastal mills from Gledhow south to Umzimkulu. Of these southerly mills, data from only Gledhow and Tongaat have been included in Figure 2 because the other mills have either had no larvae recorded, or only a few (eg. Mount Edgecombe, Sezela and Umzimkulu, all in 1980).

From Figure 2 it is evident that average infestation rates have increased each year at Amatikulu, Darnall, Gledhow and Tongaat. At the five northern mills, the average infestation rates have continued much the same; indeed at Pongola they have even decreased. Furthermore the average levels of infestation at these five mills have been consistently lower than those at the four southern ones.

When the five northern mills referred to in Figure 2 are considered, it is worthy of note that the crop at Malelane is wholely irrigated; a high proportion of the crop at Pongola is irrigated and the irrigated proportion has increased each year; Empangeni and Felixton receive some irrigated cane from the Nkwaleni Valley; at Umfolozi the water table is generally high and at Felixton the rainfall is usually high. On the other hand, the four southern mills receive cane which

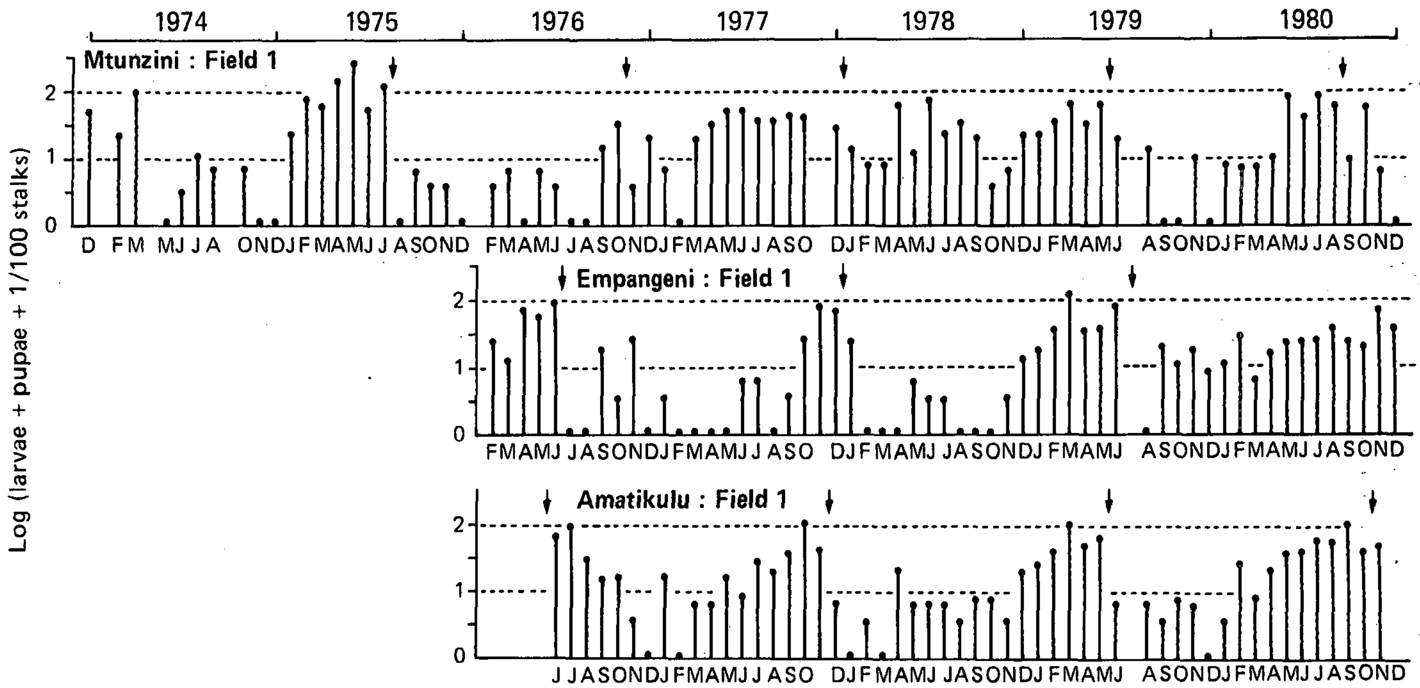

FIGURE 3 Intensities of larvae in monthly counts in three fields at Mtunzini, Empangeni and Amatikulu. Vertical arrows denote cutting dates.

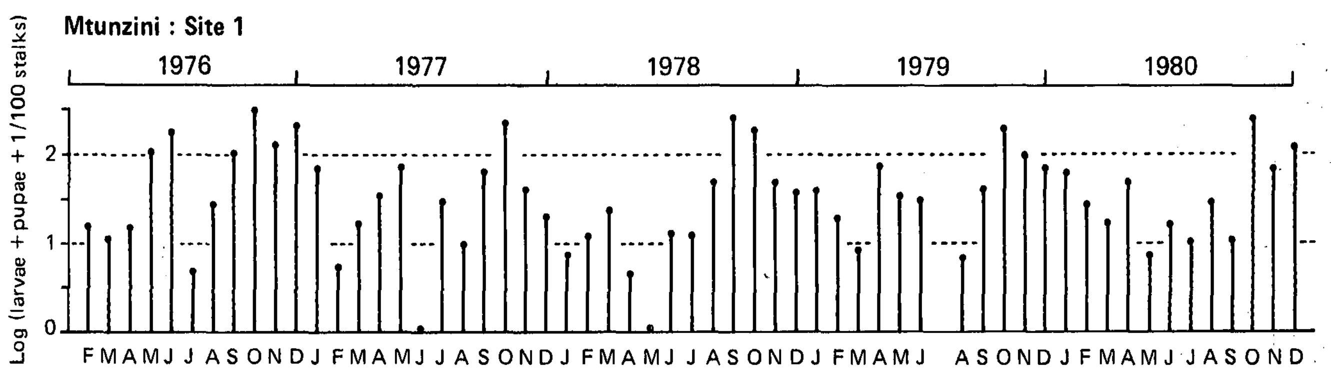

FIGURE 4 Intensities of larvae in monthly counts in the natural host, *Cyperus immensus*, at a sampling site at Mtunzini.

is almost entirely rainfed. Successive averages for rainfall in the Mtunzini, Empangeni and Amatikulu areas since 1974 were 920, 1 150, 1 780, 1 310, 920 and 790 mm respectively; which shows how the rainfall has decreased each year since 1976 as the incidence of eldana has increased. White[17, 18, 19] has proposed that outbreaks of a wide variety of plant-feeding insects were caused by moisture stress. It is possible that decreasing rainfall has caused the infestation rates to increase at the four southerly mills as shown in Figure 2.

Results of monthly surveys in three canefields at Mtunzini, Empangeni and Amatikulu are plotted in Figure 3. The field at Mtunzini was among the first in which the borer was found during the present outbreak. Similar results were obtained in four other fields at Mtunzini, two at Empangeni and two at Amatikulu. None of the results suggests that infestation levels have increased since as early as 1974. In Figure 4 there is no evidence of increased infestation rates in the natural host plant, *Cyperus immensus* C.B. Cl. sampled at a site at Mtunzini since 1976. The results obtained at three other sites at Mtunzini, Empangeni and Amatikulu, gave the same impression. The conclusion is that, provided a field was infested before the recent drought, its level of infestation has not increased. The increasing trend of the average infestation rates in the mill areas noted in Figure 2 can be accounted for by the spread of infestations in successive years to previously uninfested fields. This spread would have increased the monthly average infestation for consignments at the mills.

The progress of infestation in the Amatikulu area from 1977/78 to 1980/81 is illustrated in Figure 5, as is the southwards progress of infestation along the coast in Figure 1. This southwards movement could have occurred regardless of the drought. However, it is known that the insect tends to oviposit in dry leaf matter rather than living tissue (Atkinson[1]) and so is presumably attracted to dry leaf matter. Unusually large amounts of dry matter were certainly in evidence during 1980, the second year of the drought, and this may have accounted, at least in part, for the accelerated spread which has taken place during the last two years.

Discussion

Several theories can be advanced for the outbreaks of the pest from its natural hosts into sugarcane. None of them alone is entirely satisfactory and it is possible that a combination of circumstances is responsible.

In Figure 6 it can be seen that the outbreaks may have been associated with periods of high rainfall. The natural hosts of *E. saccharina* appear to be hydrophytic, so their distribution and abundance might have increased during periods of high rainfall, especially along cane breaks and in drainage channels, but on this basis it is difficult to explain the absence of the insect from sugarcane during the late 1950's.

Disturbance of the natural habitat of the insect could have precipitated the outbreaks. It may be significant that out-

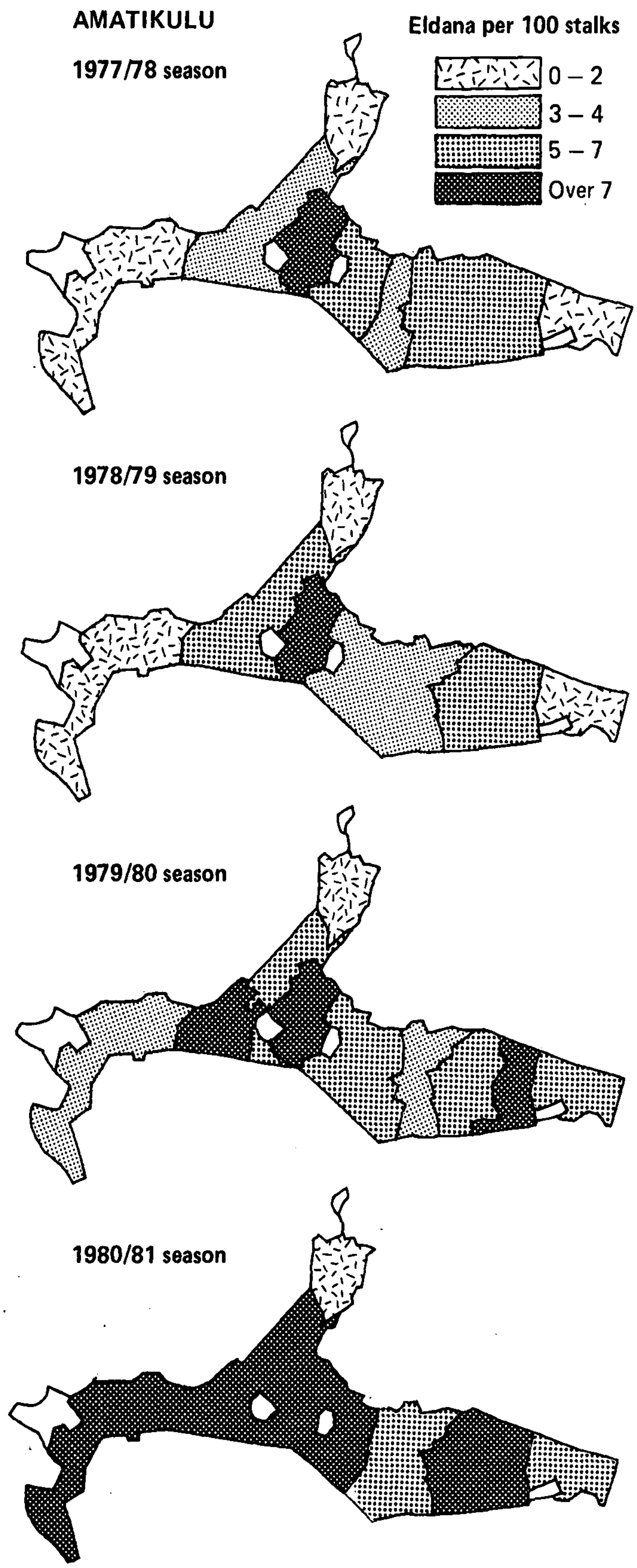

FIGURE 5 The incidence of *E. saccharina* on farms in the Amatikulu area in successive years from 1977 to 1980.

breaks began in the vicinity of Lake St. Lucia and the Umfolozi estuary, which together constitute a very large area of natural host plants. The Mkuze swamp is the biggest stand of papyrus (a good natural host) in Natal. Since the 1930's on the Umfolozi flats there have been a number of drainage schemes which have changed the courses of the Umfolozi and Msunduzi rivers and altered their estuary (Begg[2]). Lake St. Lucia itself is subject to great changes in salinity. Its salt content increased during the drought of the late 1980's. The situation was aggravated because afforestation in the catchment reduced runoff and agriculture made increased demands on its largest tributory, the Mkuze River (Begg[2]). During this period the plants growing in the swamps at its edges died back almost to stubble. Salinity reached a maximum level in 1972, when the drought broke, but this was after the first outbreak of *E. saccharina* at Hluhluwe in 1970.

From Hluhluwe southwards the proportion of land used for both agriculture and industry increases. Sugarcane is the most abundant crop. Figure 1 shows the limits of the Mocambique (Zululand) coastal plain, a region with lakes and marshes which constitute a large area of the natural habitat of the insect. This plain ends between Richards Bay and Mtunzini, and it is at this point that consistently high infestations have occurred in sugarcane. During the 1970's there has been extensive development at Richards Bay, involving reclamation of marshland for the harbour, industry and townships. These disturbances may also have contributed to the spread of eldana in sugarcane.

Crop damage by the insect increases with cane age, partly because the damage is cumulative and partly because the insect population builds up. This suggests a simple explanation for the consistently high levels of infestation in the central region of the cane belt. To the north, where irrigation is practiced and the temperatures are higher, the average crop cycle of 12-14 months may be too short for eldana to thrive. In the extreme south (and in the midlands), although the average crop cycle is nearer to 24 months, temperatures are probably too low for the insect to increase rapidly. It may be that only in the central region are the duration of the crop cycle and temperatures such that maximum damage results.

In recent years the use of agrochemicals in the sugar industry has increased rapidly. Since 1950 the use of nitrogen and potassium has grown from about 7 to 70 kg per hectare (Wood[20]), and since the early 1960's the value of herbicides used has increased from about R100 000 to over R5 million (Moberly[13]). These changes might account for the present outbreak of the pest and its rapid spread. It is known that the use of fertilizers can increase the incidence of crop-feeding insects. It has been observed that cane which received little or no fertilizer rarely has high levels of infestation by eldana. The use of herbicides may also be involved. Leslie[12] investigated the toxicity of herbicides to ants on the assumption that these chemicals might reduce the numbers of ants which were potential predators of eldana, but although a level of toxicity was registered it was always low. Oka and Pimental[14] reviewed references to the increased incidences of pests after crops had been treated with herbicides, and they argued that the herbicides might improve the nutritional quality of the plants for insects. They showed that the pupal weight and the fecundity of the European corn borer (*Ostrinia nubilalis* Hübner) increased with increasing dosages of 2,4-D applied to hybrid corn plants. Wort[21] reported that an effect of 2,4-D on plants was to increase protein and amino acids in the stem at the expense of the leaves. However, herbicides are usually applied when the sugarcane crop is young but *E. saccharina* populations usually build up in old cane. It therefore seems unlikely that herbicides would have a significant effect upon infestation levels of the insect.

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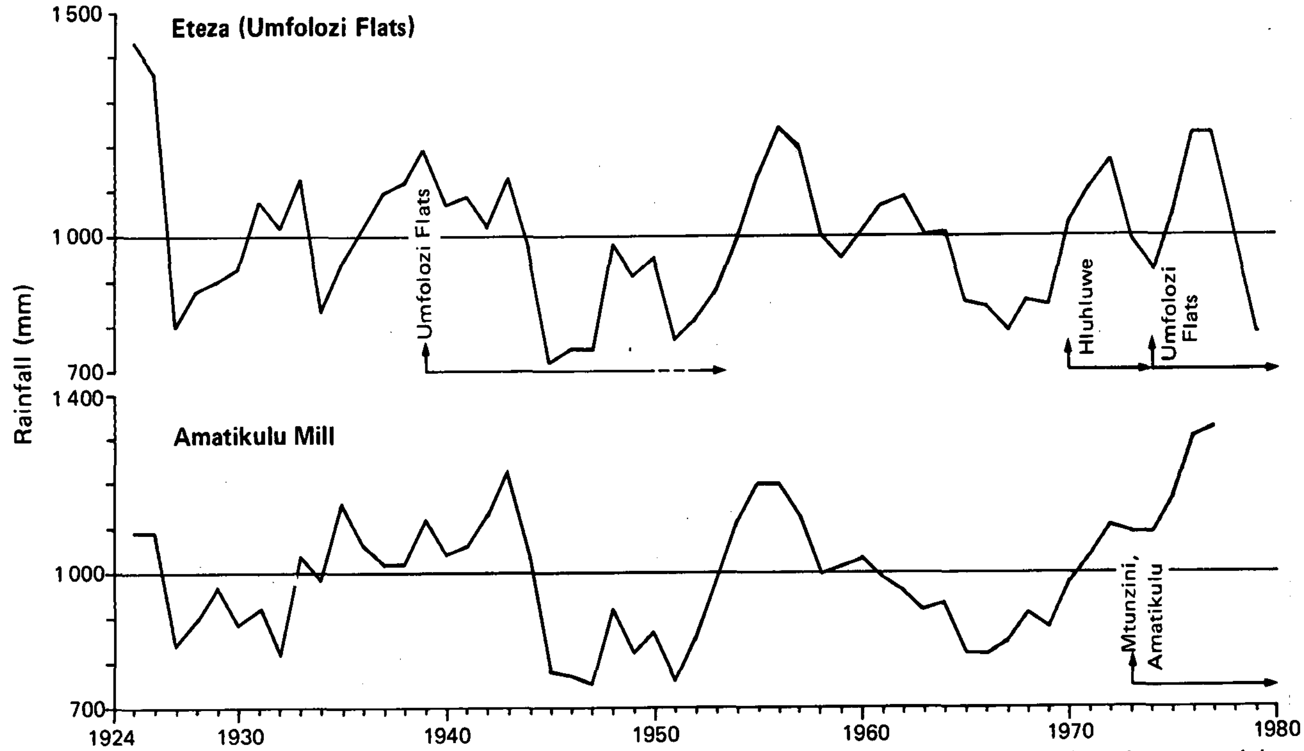

FIGURE 6 Rainfall cycles (3-year running means) for two meteorological stations, Eteza and Amatikulu. Arrows show the years and durations of local outbreaks of E. saccharina.

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