PERKINSIELLA SACCHARICIDA KIRKALDY (HOM: DELPHACIDAE) AN INSECT PEST OF SUGARCANE IN SOUTHERN AFRICA

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Abstract

A brief description is given of *Perkinsiella saccharicida* Kirk. as a pest of sugarcane. Population fluctuations, varietal susceptibility, ovipositional habits, natural control, alternate host plants, alary polymorphism, light attraction and the effect on leafhoppers of trash burning are discussed.

Introduction

The sugarcane leafhopper, *Perkinsiella saccharicida* Kirkaldy has attracted considerable attention as a pest of sugarcane since its discovery in 1900 in Hawaii by Perkins (Swezey, 1936). During the years 1903-1905, as a result of the damage done by this insect, the Hawaiian sugar industry was threatened with ruin. One plantation, which had yielded 18,888 tons in 1903, yielded only 1,620 tons in 1905 (Swezey, 1936). However, from observations in fields and insectary cultures heavily infested with this leafhopper in South Africa and Swaziland, such serious damage was not apparent.

The insect has a direct effect on sugarcane by sucking considerable quantities of juice from the plant, but it is also the vector of Fiji disease of sugarcane in Queensland (Mungomery and Bell, 1933) and in Madagascar (Frappa, 1954). This virus disease severely stunts the growth of the plant. Two other species of the same genus *P. vastatrix (Breddin)* and *P. vitiensis* Kirk., are also known to transmit the virus. (Ocfemia, 1934; Pemberton, 1935).

Nineteen species of *Perkinsiella* have been recorded on sugarcane (Box, 1953), of which *P. saccharicida* is widely distributed among sugar producing countries which lie within a belt approximately 30° North and South of the equator (Anon., 1963). More recently it has been recorded on the South American continent (Anon., 1967) and in the Ryukyu Islands (Takara and Azuma, 1968). In relation to Southern Africa the nearest geographic occurrence of Fiji disease is in Madagascar.

P. saccharicida was first recorded in South Africa in about 1900 (Metcalf, 1943) and was listed in 1937 amongst insects attacking sugarcane in Natal (van der Merwe, 1937). It attracted little attention until it was observed, at certain times, in very large numbers throughout the recently established sugar producing areas of Pongola, the Eastern Transvaal and Swaziland.

This paper concerns various aspects of the biology of the insect in relation to sugarcane in South Africa and Swaziland.

Methods and Materials

The data were obtained from three widely separated sugarcane producing areas. The most northerly area was Northern Swaziland, the second was Pongola (approximately 160 kilometres to the south) and the third and most southerly area was Illovo (approximately 500 kilometres south of the Swaziland area).

All population figures were based on numbers of adult *P. saccharicida*. In Swaziland, where populations were higher than in the other two localities, sampling was done by placing a grease-coated or molasses-coated beating sheet (0.4 m^2) between two rows of cane at 10 separate stations within a field and shaking the adjacent cane plants vigorously. This caused adults to alight on the sheets and to become trapped and available for counting. In Fig. 1 Nos. 1-23, the total counts of 10 such samplings, taken at approximately weekly intervals, have been plotted.

At Pongola a portable suction trap (Dietrick, 1961) was used for monthly sampling of adults. All sampling was done along a transect within and parallel to the cane rows. Ten samples were taken, each over a distance of 20 paces, with five paces between samples. The total of 10 such samples was used to plot population curves shown for field Nos. 25 and 26 in Fig 1.

Sampling at Illovo (Field No. 24) was done with the same suction sampler, but the method differed in that samples were taken over a period of two minutes while walking between the cane rows at a constant pace.

Beating sheets were unsuitable for sampling in the Illovo area as too few leafhoppers were present to obtain satisfactory readings. At Pongola, although numbers were considerably higher, the suction sampler was again found to be more efficient.

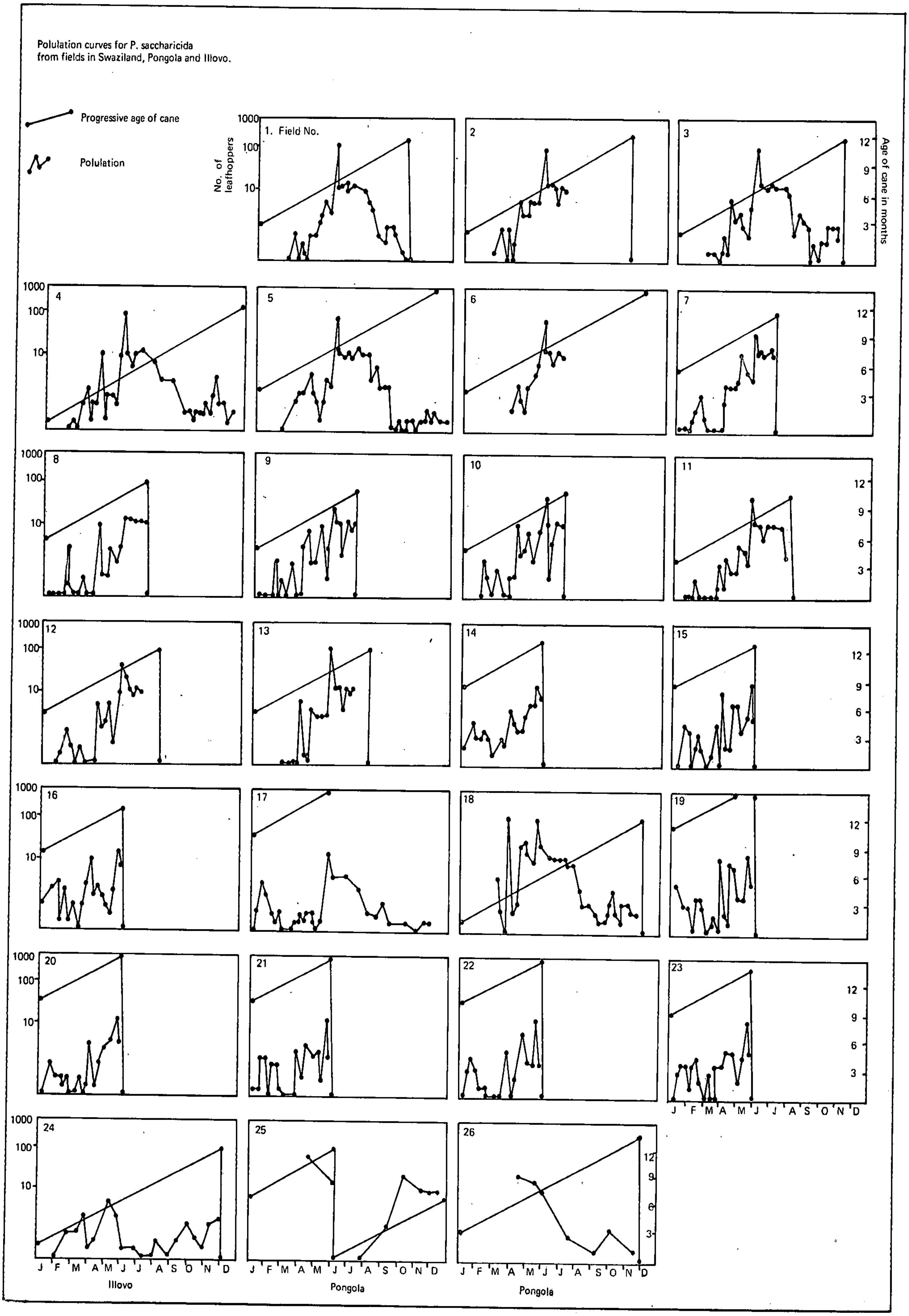
Population Fluctuations

In Swaziland during 1969, twenty-three fields, covering an area of approximately 400 hectares, were sampled as previously described. Fig. 2 shows the layout of this area. The field numbers (1-23) the cane varieties, the crop stage (plant or ratoon) and the date (month and year) of planting or harvesting are also given.

In Fig. 1 the straight diagonal line shown in each graph represents the increasing age of the cane. The perpendicular straight line, where it occurs, shows the month in which it was harvested.

The most evident feature was the simultaneous

FIGURE 1



Polulation curves for P. saccharicida
from fields in Swaziland, Pongola and Illovo.
Progressive age of cane
Polulation
No. of leafhoppers
Age of cane in months
1. Field No.
J F M A M J J A S O N D
Illovo
Pongola
Pongola

build-up in numbers in all fields but one. It commenced during the cooler March-April period, and reached a very high peak at the end of the third week in May. Then, within a week, there followed a sudden drop in numbers to previous high levels, which lasted during winter into July. After this there was a steep decline, apparent in unharvested fields, into the hot summer months. The exception was Field 18, where numbers were highest in early April. At Pongola (Fig. 1, No. 26), where counts were started in April and taken less frequently than in Swaziland, a similar situation occurred with high winter numbers declining as summer approached. At Illovo (Fig. 1, No. 24), where population densities were comparatively low throughout the year, the highest peak was again in May, with others occurring during March, August, October and November, indicating a more even distribution of numbers throughout the year.

The factors responsible for the very high numbers of *P. saccharicida* in Swaziland and Pongola during the winter months, when their life cycle lasts longer, are at present obscure.

For four fields (Fig. 3, Nos. 24, 25, 26 and 17) the percentage of total eggs parasitized have been plotted. All of the eggs from forty of the lowest green leaves, taken throughout the length of the field, were analysed for parasitism, and the results expressed as a percentage. There was an overall tendency for egg parasitism to decrease over the period during which these studies were made. The highest percentages occurred at Illovo. The egg parasites must have had an influence on insect numbers but they were not shown to be a primary cause of the population fluctuations.

Although a young field of sugarcane is soon populated by *P. saccharicida*, it seemed unlikely that mass migratory movements were responsible for the sudden increases during May, as there were no fields among those sampled which showed a corresponding fall in numbers, and the insect does not inhabit grasses (see later). In Swaziland the fields with less mature cane (Fig. 1, Nos. 1, 2, 3, 4, 5, 6, 11 and 18) carried far higher numbers at their peaks (with the possible exception of Field 11) than did the other fields with more mature cane. As the fields lay grouped roughly into two sections, one with older cane and the other with younger cane, these differences could possibly be explained on a positional basis. An argument against this was the position of Field 18, which, although surrounded by some of the most mature cane, gave two of the highest counts.

It is known that high levels of nitrogen in sugarcane result in increased fecundity of *P. vitiensis* (Osborne, 1966), the West Indian canefly, *Saccharosydne saccharivora* Westw. (Metcalfe, 1965) and *Numicia viridis* Muir (Harris, 1968). This factor could explain partly if not entirely, the occurrence of proportionately lower numbers in mature cane. The cane in Field 26 (see Fig. 1) was not cut during the period of observation, and numbers dropped from April to November. In Field 25 numbers started dropping at the same time, but rose again between July and September, probably as a result of the presence of young and more nutritious ratoon cane.

Differential Cane Susceptibility

Figs. 1 and 2 show that there was no obvious difference in the populations occurring on plant cane and on ratoon cane. Certain varieties have been reported as being more susceptible to attack by *P. saccharicida* (Anon., 1967) but no such differences were apparent between the following four varieties sampled in this experiment:

N:Co.310 (Fields 4, 12, 13), N:Co.334 (Field 17), N.55/805 (Fields 5, 6) and N:Co.376 (all others).

Oviposition

The most striking visible feature in a sugarcane field attacked by *P. saccharicida* is the red blotches on the leaf midrib. This discolouration of the tissue surrounding one or more egg batches, which are inserted into the leaf tissue, is caused by a secondary fungal infection (Williams, 1957).

In Mauritius, egg batches of *P. saccharicida* usually contained 3-5 eggs (Williams, 1957). In Madagascar six eggs were more common, with a maximum of 10 (Frappa, 1955). In South Africa and Swaziland batches with as many as 12 eggs were found but these were rare. Batches with a double row of eggs were numerous at times, as shown in Fig. 3, No. 17, where the percentage of double-rowed batches over a seven-month period is plotted. This percentage ranged between 2 and 18%. The maximum amount of double-rowed batches occurred during April. This could be indicative of a higher rate of oviposition before the population peaked in May.

The average number of eggs per batch was plotted for Fields 17, 24 and 26, in which it varied between slightly more than three and slightly more than five, Fig. 3. Overall means of eggs per batch were: Field 17, 4.5; 24, 4.2; and 26, 4.3. These figures increased with population densities from one area to the next, but the differences are too small for conclusions to be drawn.

P. saccharicida eggs were found on all aerial portions of the cane plant, most being laid into the proximal upper surface of the leaf midrib. Where adult numbers were very high, heavy oviposition on the stalk was observed. These observations are similar to those made in other countries (Williams, 1957).

Oviposition into the back of the midrib occurred frequently and the incidence of this is shown in Fig. 3, Nos. 17 and 26, where the percentage of egg batches so laid is plotted. In Field 17 during October as much as 25% of egg batches were laid in the back of the midrib, and there was a tendency for this to happen more frequently during periods of low population density.

Eggs laid into the leafsheath were less heavily parasitized than those inserted into the midrib.

FIGURE 2

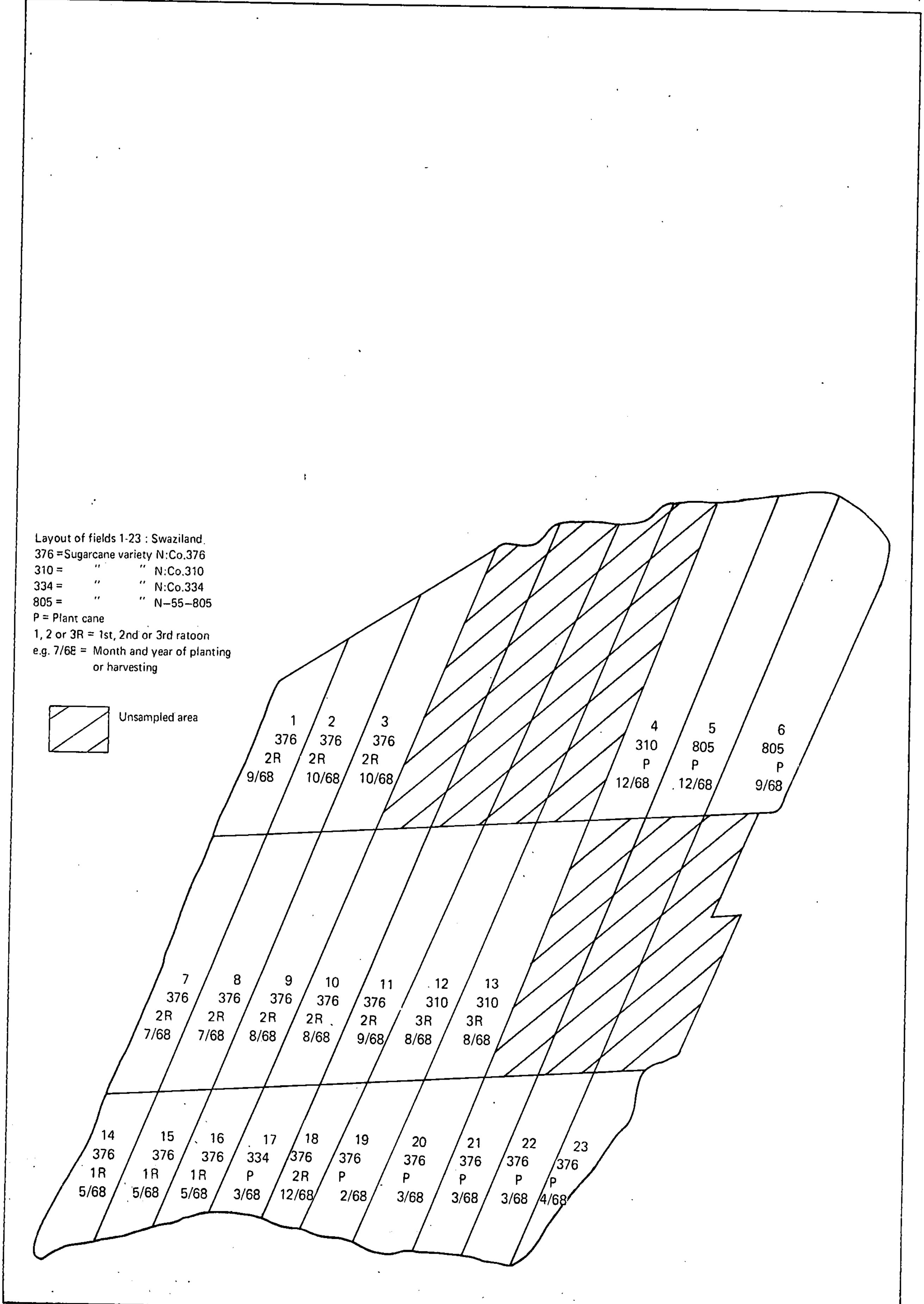
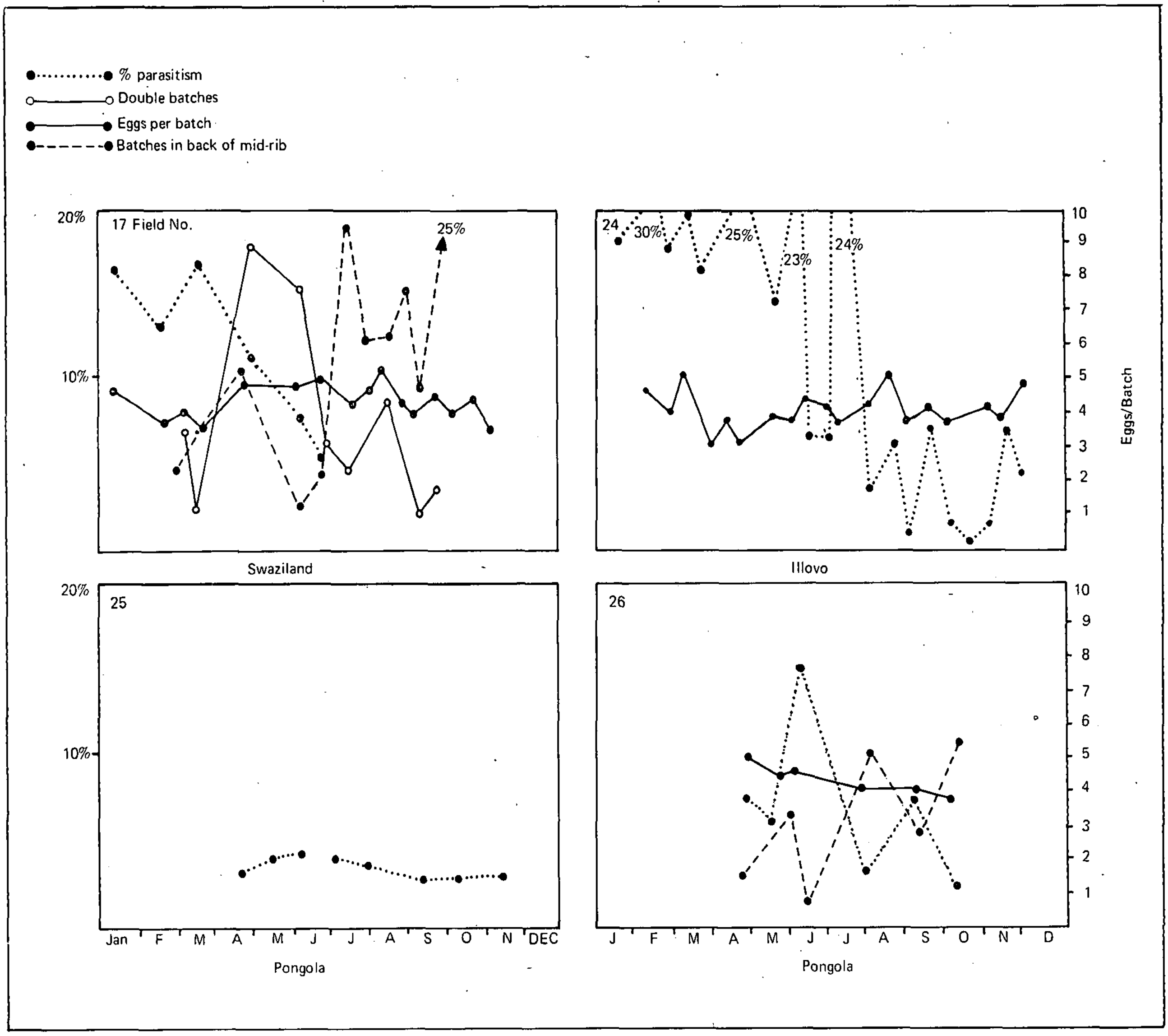

Layout of fields 1-23 : Swaziland
376 = Sugarcane variety N:Co.376
310 = " " N:Co.310
334 = " " N:Co.334
805 = " " N-55-805
P = Plant cane
1, 2 or 3R = 1st, 2nd or 3rd ratoon
e.g. 7/68 = Month and year of planting or harvesting
Unsampled area
1 376 2R 9/68
2 376 2R 10/68
3 376 2R 10/68
4 310 P 12/68
5 805 P 12/68
6 805 P 9/68
7 376 2R 7/68
8 376 2R 7/68
9 376 2R 8/68
10 376 2R 8/68
11 376 2R 9/68
12 310 3R 8/68
13 310 3R 8/68
14 376 1R 5/68
15 376 1R 5/68
16 376 1R 5/68
17 334 P 3/68
18 376 2R 12/68
19 376 P 2/68
20 376 P 3/68
21 376 P 3/68
22 376 P 3/68
23 376 P 4/68

FIGURE 3



Natural Control

At present *P. saccharicida* is effectively controlled by biological means in Hawaii, the most successful controlling agent being the Mirid egg predator *Tytthus mundulus* (Bredd) (Swezey, 1936). Attempts to establish this insect in South Africa have so far been unsuccessful, but it seems that more success may be achieved with another species of the same genus, *T. parviceps* (Reuter). This insect readily preys upon and survives on the eggs of *P. saccharicida*, which was formerly thought to be *P. insignis* (Carnegie and Harris, 1969).

Two Hymenopterous egg parasites, *Anagrus sp*, (Mymaridae) and *Ootetrastichus pallidipes* Perk. (Eulophidae), have been seen attacking the eggs of *P. saccharicida*. The combined effects of their parasitism is shown in Fig. 3, Field Nos. 17, 24, 25 and 26. The highest degree of parasitism (30% of eggs parasitized) was recorded at Illovo.

Although *Ootetrastichus beatus* Perk. is recorded as an egg parasite of *P. saccharicida* in Hawaii and Australia (Swezey, 1936) and of *Numicia viridis* Muir in South Africa (Carnegie, 1966), it has not been reared from eggs of *P. saccharicida* in South Africa.

A Dryinid parasitic wasp, *Gonatopus* sp. has been observed to parasitize nymphs of *P. saccharicida*, but usually in very low numbers. An exception occurred at Pongola, where, at the end of May, 1969, between 25 and 30% of the nymphs had been attacked by it. A likely reason for its generally low numbers is the presence of a hyperparasite, *Cheiloneurus sp.* (Encyrtidae), which was responsible for parasitizing 96% of the Dryinid larvae at Pongola.

Alternate Host Plants

During a twelve-month period, regular intensive suction sampling was done among grasses adjacent to and also distant from sugarcane fields in Swaziland and Pongola. No *P. saccharicida* were found. This is indicative of the insect being restricted to breeding on sugarcane. It is of interest to note that no alternate host plants have been confirmed for this pest in Australia (Osborn, 1969, personal communication), but Pemberton in 1919 mentioned certain grasses and sedges in Hawaii as being suitable host plants to the leafhopper (Williams, 1957).

Alary Polymorphism

Williams (1957) and Osborn (1969) recorded, in Mauritius and northern New South Wales respectively, brachypterous forms of *P. saccharicida* of both sexes. All brachypterous individuals examined during these investigations were females.

Light Attraction

At Pongola on May 20th, 1969, an ultraviolet light-trap was installed. Although numbers of leafhoppers were very high at the time, it was not until October 19th, 1969, that any were trapped (see Table 1).

TABLE 1
Numbers of *P. saccharicida* taken at light at Pongola

Date Taken	♂	♀
10.10.1969	28	30
8.11.1969	1	0
6.12.1969	4	0
11.12.1969	1	5
14.12.1969	1	5
15.12.1969	1	2
25.12.1969	17	35
26.12.1969	1	3
7.1.1970	3	3
14.1.1970	2	0
18.1.1970	0	3
19.1.1970	31	8
26.1.1970	0	1
5.2.1970	0	1
12.2.1970	0	1
16.2.1970	4	1

From October, 1969, until March, 1970, the light-trap operated continuously, and both males and females have been taken sporadically, with occasional high numbers on the days shown in Table 1. The reasons for the variation in numbers trapped are not yet clear.

Trash Burning

It was thought that burning a field before harvesting the cane might have the effect of flushing leafhoppers into other fields.

Before burning a field which was heavily infested with leafhoppers, three sticky sheets, each about one metre square, were secured on adjacent cane in a field 7 metres away and downwind from the cane to be burnt. This was done in an attempt to trap individuals which might fly out of the burning cane or be carried out on thermal currents. Another sticky sheet was held horizontally in such a position that it was continuously receiving the draught caused by the fire. No *P. saccharicida* or any other leafhoppers were found on these sheets.

Eggs in leaves from portions of the field which were not well burnt were taken for observation. All failed to hatch, due presumably to the excessive heat generated by the fire. The field was intensively suction-sampled immediately after burning and no live insects were taken. The indications are that, during the burning of a canefield, its leafhopper population is virtually destroyed.

Acknowledgements

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Discussion

Dr. Dick: This insect is the vector of a very serious virus disease which has already reached Madagascar. It is almost certain that it will reach South Africa eventually so the more we know about it the better.

Mr. Andries: I was associated with the Experiment Stations' entomologists when they investigated *Numicia* in Swaziland, a pest we did not take seriously at first and I am glad they are now investigating *Perkinsiella*.

Mr. Bartlett (in the chair): I think it is most important that we should have some prior knowledge of pests that are likely to arrive in this country.