POPULATION DYNAMICS OF THE MAIN APHID VECTORS OF SUGARCANE MOSAIC VIRUS IN NATAL

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Abstract

The main aphid vectors of mosaic in sugarcane in Natal have been identified as *Hysteroneura setariae* Thomas and *Rhopalosiphum maidis* Fitch. Their population numbers have been monitored at four different sites over two seasons. The main flights of *H. setariae* took place in January and February, and those of *R. maidis* in January.

Introduction

As early as 1919, Brandes[6] found that sugarcane mosaic virus (SCMV) was transmitted by the aphid *Rhopalosiphum maidis* Fitch (Figure 1). Further work in 1938 on the aphid vectors of SCMV in Lousiana led to the discovery that many other species of aphids, including *Hysteroneura setariae* Thomas (Figure 2) were vectors (Pemberton and Carpentier[10]). Until now little work has been conducted on the population dynamics of the important vectors of SCMV, either in South Africa or elsewhere, and in particular, the identities of the most important vectors of SCMV in cane fields in Natal were not known.

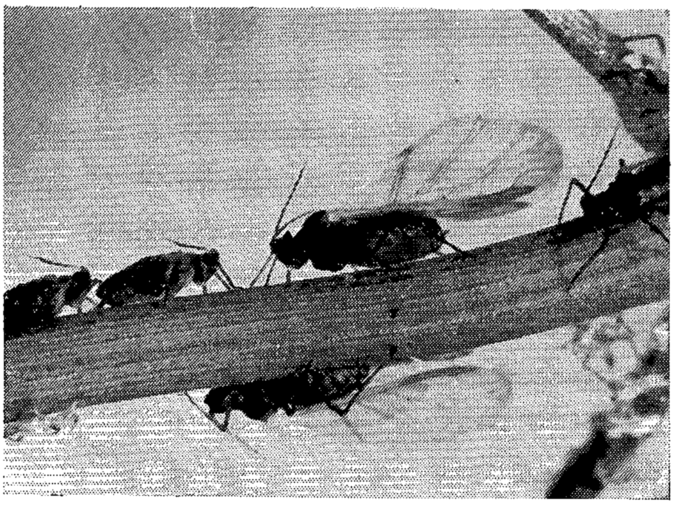

FIGURE 1 *Rhopalosiphum maidis*

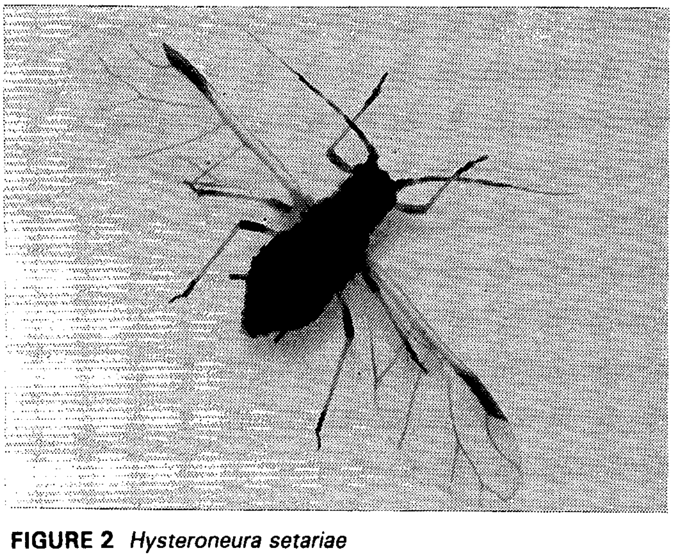

FIGURE 2 *Hysteroneura setariae*

The most common strain of SCMV occurring in Natal, a variant of strain D (Gillaspie[8]), has been estimated to cause a reduction of recoverable sucrose of up to 42% in the commonly grown variety NCo376 (Bailey and Fox[5]).

The spread of SCMV is known to take place in two ways: firstly by infected seedcane and, secondly, by aphid transmission (Anon[2]; Anon[3]). In the areas of Natal most severely affected by mosaic, infection by means of aphid transmission predominates. Aphids cease to transmit the SCMV virus approximately 1 h after acquisition.

The importance of different species of vectors depends not only on their effectiveness in transmitting the virus, but also on their numbers, which are influenced by numerous environmental factors and by aspects of their behaviour (Raccah[11]). To determine the potential for virus transmission by naturally occurring vectors in a field, vectors must be trapped in the field and then tested for infectivity.

Since the aphids that spread mosaic from plant to plant or field to field are airborne, both flying and landing populations must be monitored (Raccah[11]). Experiments that have been carried out to investigate the transmission of SCMV and the members of different species of aphids occurring in cane fields will be presented and discussed.

Yellow, sticky impaction traps were selected for these experiments because of their simplicity and durability. Yellow traps depend on the finding that towards the end of a migration flight, aphids are attracted by yellow light (or by wavelengths above 500 nm), while at the same time they avoid ultraviolet light (Harrewijn[9]).

Impaction traps were used to monitor the incidence of flying aphids from May 1985 to May 1987. In 1985, three sites were selected, two in areas where mosaic spreads rapidly: Dumisa in the hinterland of the south coast of Natal; and Eston, inland west of Durban; while the third was located on the Experiment Station farm at Mount Edgecombe where relatively little mosaic occurs. In 1986, six traps were installed at Shongweni where SCMV is common and is known to spread rapidly.

Materials and methods

Impaction Traps

The impaction traps consist of a wooden pole 1,5 m long with a section of plastic drain-pipe bolted onto the top of the pole (Figure 3). The pipe was covered with a sheet of yellow-coloured plastic. The plastic was a weather resistant, commercial 3M product (Scotchcal, colour 'Saturn Yellow') chosen for the trapping studies because this colour remains stable despite exposure. In some previous studies on aphids in cages this colour had proved most attractive. The top and bottom of the pipe was covered with a strip of black insulating tape to provide contrast. A removable sheet of thin, transparent polythene coated with a 100 mm wide band of polybutine adhesive was placed over the pipe and held in place with paper-clips (Figure 3).

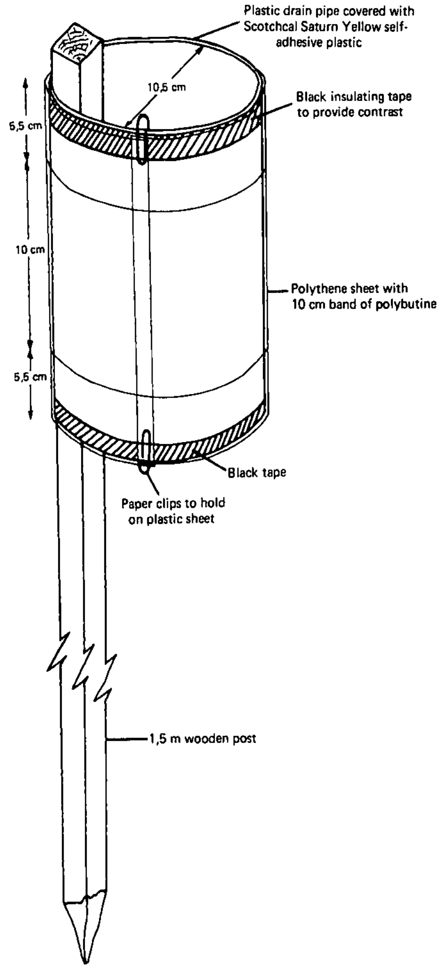

FIGURE 3 Sketch of yellow-coloured cylinder trap

In May 1985, a total of 22 traps were established at 15 m intervals along the edges of fields of young cane plants at Dumisa, Eston and Mount Edgecombe. The traps remained in position for one year. In 1986, a further 6 impaction traps were placed at 15 m intervals through a cane field at Shongweni.

All the traps were changed fortnightly between September and November in 1985 and 1986, and again fortnightly from the beginning of March until May in 1986 and 1987. All the traps were changed weekly between December and February to enhance their effectiveness during periods of peak aphid numbers. This was done in an attempt to pinpoint as accurately as possible the weeks when aphid numbers were highest. An earlier experiment had shown that aphid numbers caught per day were similar, whether the trap had the adhesive film changed weekly or fortnightly.

Aphid identification

It was possible to distinguish aphids readily from other insects caught on the impaction traps by means of simple diagnostic characteristics, ie wing veination and presence of cornicles. Generic and specific identification of the aphids required experience. The initial identification of specimens of trapped aphids was carried out by IM Millar (Plant Protection Department, Pretoria) and this information was then used to build reference collections of photographs and preserved specimens of the more common aphids to aid identification. Trapped aphids were, as far as possible, identified to species level.

Results

The results are presented as numbers of aphids caught per month per trap (Figures 4, 5, 6 & 7).

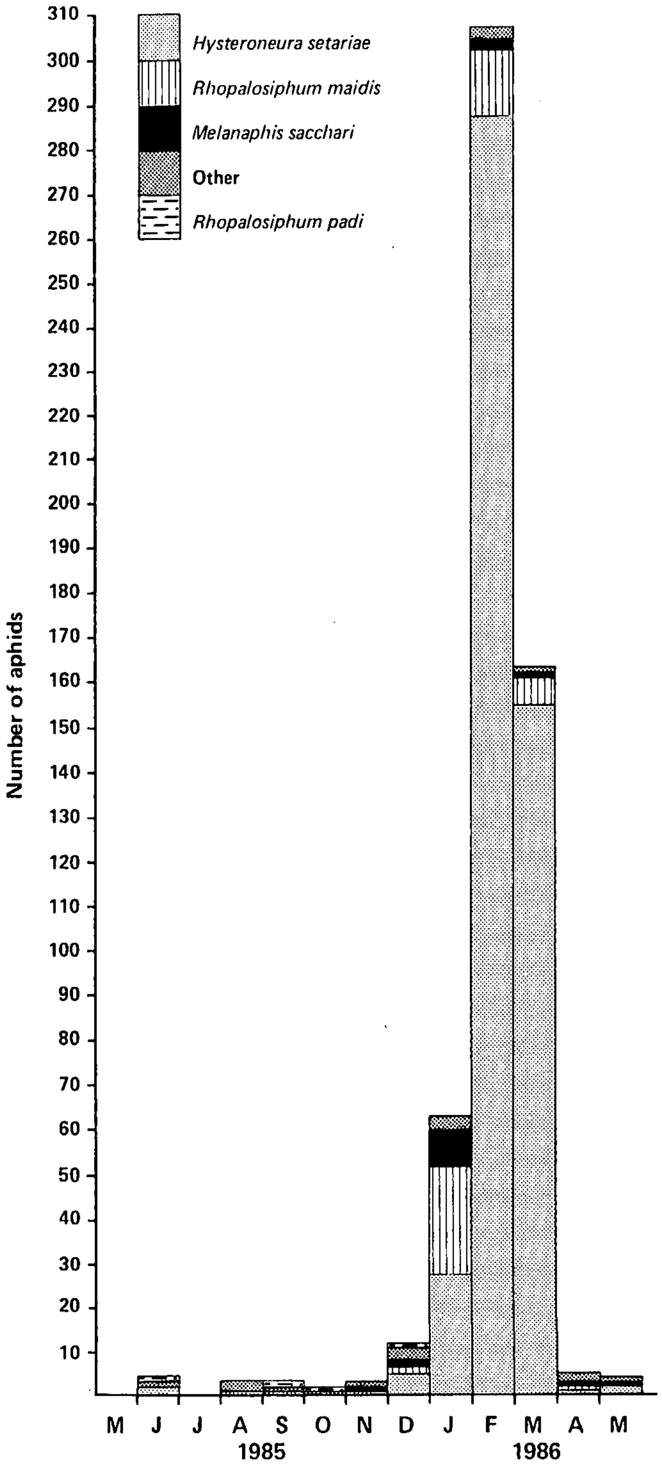

FIGURE 4 Number of aphid species caught per trap per month at Dumisa

At Dumisa and Eston, total number of aphids rose rapidly in January and peaked in February 1986 before falling sharply in March. At Dumisa at the time of peak aphid numbers in February and March, *H. setariae* was noticeably predominant (Figure 4). This species was similarly prevalent at Eston in February (Figure 5), and at Mount Edgecombe from December to February (Figure 6). The next most common species at all sites was *Rhopalosiphum maidis*, while *R. padi* Linn was also present. These three species have all been identified as vectors of SCMV. Relatively low numbers of *Melanaphis sacchari* Zehnt, which is not a vector of SCMV, occurred at all three sites. At Dumisa, vector species constituted 98 to 99% of the total aphid numbers in February and March while at Eston, 88% of the aphids trapped in February were identified as vector species.

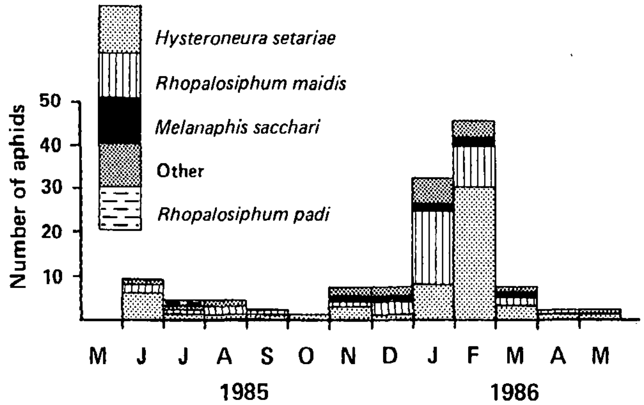

FIGURE 5 Number of aphid species caught per trap per month at Eston

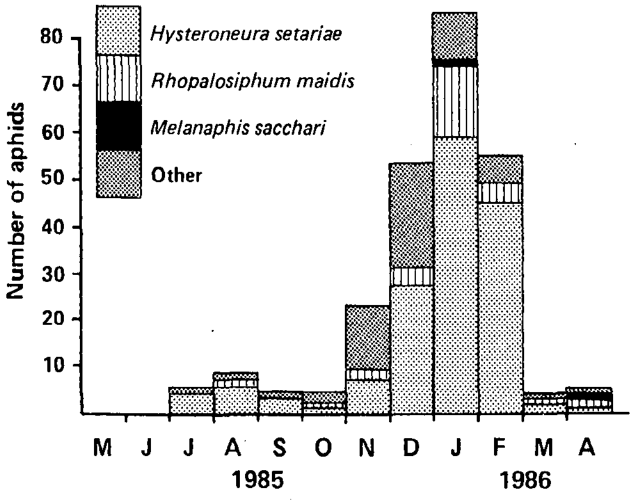

FIGURE 6 Number of aphid species caught per trap per month at the Experiment Station.

At Shongweni (Figure 7), the total number of winged aphids was low during September 1986 and then increased each month, reaching a peak in January and February 1987 before declining abruptly in March. The two species *R. maidis* and *H. setariae* constituted more than 80% of the total number of aphids trapped in January and February. *H. setariae* was the predominant aphid from October to April while *R. maidis* constituted approximately 20% of the total number of aphids trapped in January and February.

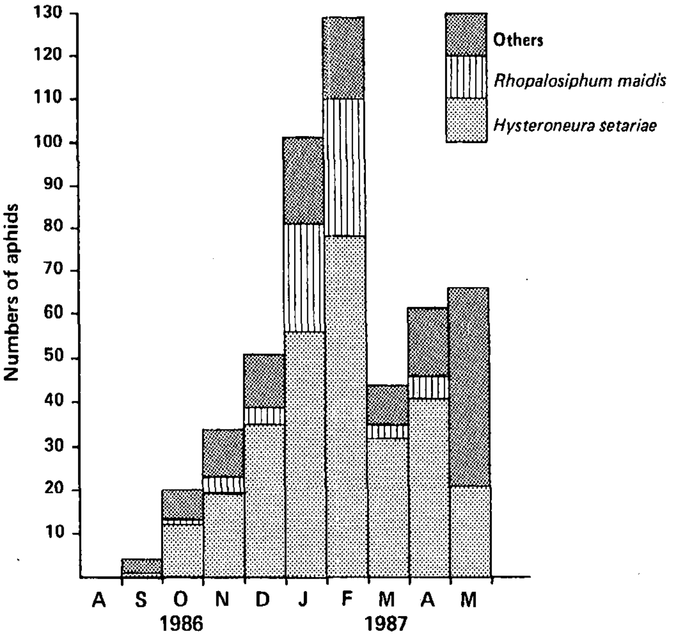

FIGURE 7 Number of aphid species caught per trap per month at Shongweni

Discussion and Conclusions

The main aphid species that were predominantly trapped at all four experimental sites and in both seasons were *H. setariae* and *R. maidis*. *H. setariae* was always the more common of the two species, usually comprising 50 to 90% of the total aphids trapped. The two species together usually constituted from 60 to more than 95% of the total number of aphids trapped on each occasion. Both species are known to be vectors of SCMV and this was confirmed as part of this investigation (unpublished data). Pemberton and Carpentier[10] found that *R. maidis* was the more efficient vector of the two and it therefore seems likely that these two species are the most important vectors of SCMV in cane fields in Natal. Further evidence of the importance of *H. setariae* and *R. maidis* as vectors is the coincidence between the main flights of the species with the period of the year when mosaic is seen to spread most rapidly in the field, ie January to March, particularly in young cane (Bailey and Fox[4]).

The very high numbers of *H. setariae* at Dumisa were possibly associated with the large numbers of flowering grasses, which provided favourable breeding sites. Large colonies of *H. setariae* were found on inflorescences of *Cynodon dactylon*, *Eleusine indica* and *Sporobolus africanus*.

The somewhat higher proportion of *R. maidis* at the Eston site compared with the other sites may have been associated with the large areas of maize being grown in proximity to the trapping site on the farm. A higher incidence of mosaic in cane grown in the vicinity of maize, possibly because the maize enabled *R. maidis* to build up in numbers, has been reported previously (Anon,[1] David et al[7]).

Experiments to investigate the interrelationship between aphid movements, time of planting and spread of mosaic were started as a consequence of the aphid trapping data reported here. These have confirmed that the fastest rate of spread occurs when young, rapidly growing cane coincides with these main flights of vectors.

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