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SURVEY OF SOME RICE INSECT PESTS AND THEIR PREDATORS IN THREE DISTRICTS OF SRI LANKA

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Abstract : Sampling for planthoppers, leafhoppers and other minor pests was carried out in rice fields, kept free of insecticides, in the districts of Batticaloa, Kilinochi and Jaffna, during Maha 1981–82 and Yala 1982, using the sweep net technique. The brown planthopper *Nilaparvata lugens* (Stal) was recorded in Batticaloa and Jaffna districts and *Sogatella furcifera* Horvath in Kilinochi. The leafhoppers *Nephotettix virescens* (Distant) and *Nephotettix nigropictus* (Stal) were recorded from all three districts. The minor pests collected included *Leptocorisa oratorius* (Fabricius), *Scotinophora lurida* Burmeister, *Nezara viridula* Linnaeus, *Tanymecus* sp., *Aulacophora* sp., Acrididae, Tettigoniidae and Gryllidae. Insect predators recorded were *Cyrtorhinus lividipennis* Reuter, two Coccinellids *Micraspsis discolor* and *Harmonia octomaculata*, a Staphylinid *Paederus fuscipes* Curtis and an Anthocorid. Other general predators observed belong to the Odonata – *Lestes* sp., *Pseudagrion* sp., *Orthetrum* sp. and *Anax* sp.

1. Introduction

The increase in the destructiveness of the planthopper and leafhopper pests of the rice crop during the last decade has followed the introduction of high yielding, nitrogen–responsive rice varieties.[16] The brown planthopper *Nilaparvata lugens* (Stal) is one of the most destructive pests of the rice crop in Southeast Asia, causing damage through feeding as well as by transmitting the virus diseases – "grassy stunt"[8] and "ragged stunt".[6] Among the leafhoppers, *Nephotettix virescens* (Distant), *Nephotettix nigropictus* (Stal) and *Recilia dorsalis* (Motschulsky) also transmit the virus diseases – "rice tungro", "rice dwarf" and "yellow dwarf".

Population sutdies on the planthopper and leafhopper complexes of the rice crop and their natural enemies in Sri Lanka have been carried out in Kandy and surrounding districts by Santa *et al.*[14] and in Amparai district by Otake *et al.*[9] The present paper records the results of a survey of planthopper and leafhopper pests of the rice crop, as well as other minor pests, and their insect predators, in rice fields located in the Batticaloa, Kilinochi and Jaffna districts. The survey was carried out during two rice growing seasons – Maha season of 1981–82 and Yala season of 1982. Of the insect predators, the prospect of using *Cyrtorhinus lividipennis* Reuter for the control of *N. lugens* is discussed in detail.

2. Materials and Methods

Three paddy fields were selected for sampling in Karadianaru, Kilinochi and

Jaffna. Karadianaru is approximately 18 miles west of Batticaloa and Kilinochi 42 miles south of Jaffna. Two plots of ca. 700 sq m each were selected in each location. The fields were thoroughly ploughed and puddled and V_1 fertilizer mixture with NPK at 4:30:12 ratio broadcast at the rate of 126 kg per hectare. The paddy seeds of rice variety BG 90–2 were soaked for 2 days to break the dormancy and then sown on a wet field at the rate of 166 kg per hectare. Fourteen days after sowing, urea was applied at the rate of 162 kg per hectare. The plots were kept free of insecticides during the entire period of growth.

Sampling was carried out using a 25 cm diameter insect net with a 90 cm handle. A single 180^0 angle stroke of the net was considered as one sweep. The sweeps were made just above the level of the rice plants. Eighty sweeps were made at each plot covering two thirds of the area. The insects were collected in separate glass vials after every 10 sweeps. The mean ± SD for 10 sweeps was calculated and presented.

Sampling commenced from the second week of sowing and was continued until the 12th week, i.e just before harvest. (Sampling was continued till the 10th week in Karadianaru in Maha 1981–82). Sampling was repeated at fortnightly intervals at all three locations. The identification of insects was carried out by the senior author and confirmed by reference to specimens maintained at the Entomological Museum of the International Rice Research Institute in Los Banos, Philippines.

3. Results

3.1 Karadianaru

3.1.1 Maha 1981–82

The pest insects collected are recorded in Figure 1A. *N. virescens* and *N. nigropictus* numbered 0.35 ± 0.02 per 10 sweeps in the 6th week, increasing to 0.48 ± 0.03 in the 8th week. They were not present in the 2nd to 4th week after planting. *Leptocorisa oratorius* (Fabricius) was recorded in the 6th and 8th week, numbering 0.5 ± 0.02 and 3.5 ± 0.2 respectively. *Scotinophora lurida* Burmeister was the same 0.13 ± 0.01 in the 6th and 8th week after planting. *Nezara viridula* Linnaeus numbered 0.1 ± 0.01 and 0.65 ± 0.02 in the 8th and 10th week respectively.

The beneficial insects collected are indicated in Figure 1B. The Coccinellids *Micraspsis discolor* and *Harmonia octomaculata* were present in the 8th and 10th week, numbering together 0.98 ± 0.03 and 0.38 ± 0.01 per 10 sweeps respectively. The general predators *Lestes* sp. (Lestidae) and *Pseudagrion* sp. (Ceonagrionidae) were present throughout the sampling period.

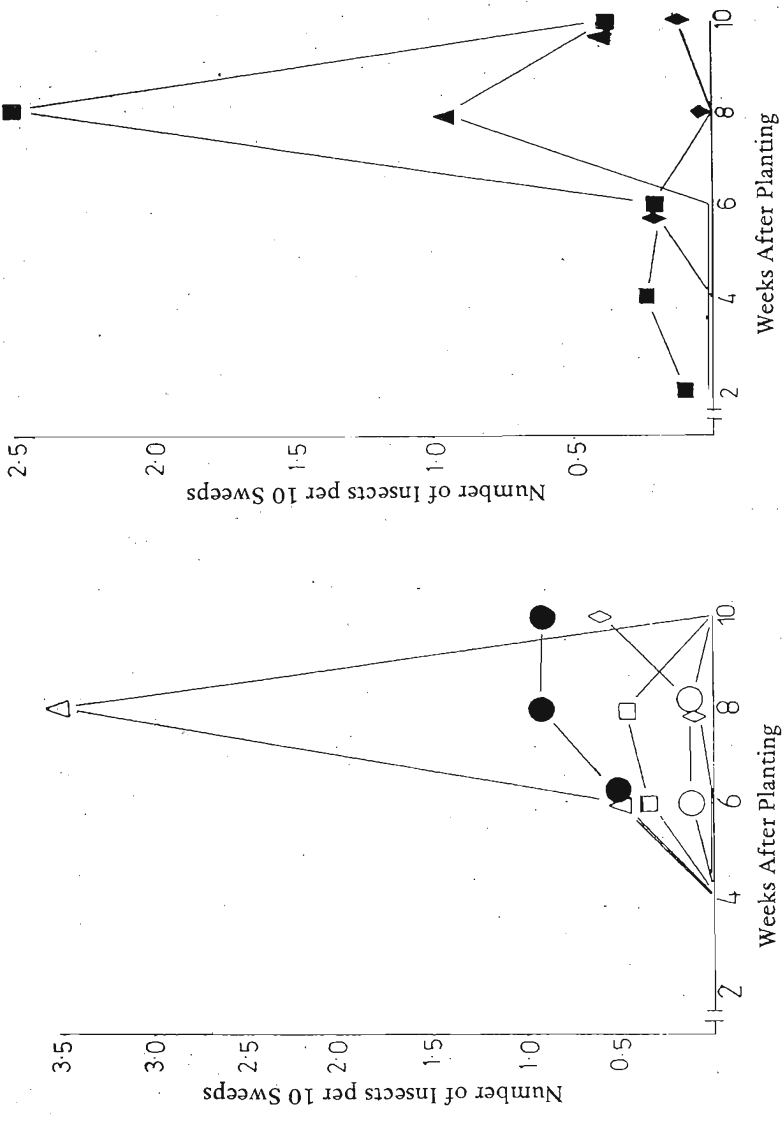

Figure 1 : Pest (A) and beneficial (B) insects collected in Karadianaru during Maha 1981 – 82.

A. □ *N. virescens* & *N nigropictus*
○ *S. lurida*
△ *L. oratorius*
◇ *N. viridula*
● Tettigoniidae & Acrididae

B. ■ *Lestes* sp. & *Pseudagrion* sp.
▲ *M. discolor* & *H. octomaculata*
◆ *Orthetrum* sp.

3.1.2 Yala 1982

Among the pest insects collected (Figure 2A), *N. lugens* was present in the 6th and 8th week after planting, numbering 0.42 ± 0.02 and 0.33 ± 0.02 per 10 sweeps respectively. *N. virescens* and *N. nigropictus* were present in the 8th, 10th and 12th week, numbering 0.1 ± 0.02, 0.4 ± 0.02 and 0.25 ±0.01 respectively. The rice root weevil *Tanymecus* sp. was present at a density of 0.08 ± 0.02 and 0.02 ± 0.01 in the 6th and 8th week respectively. (This is a first record in Sri Lanka.) Tettigoniidae and Gryllidae were also recorded.

The following beneficial insects were collected (Figure 2B). The Coccinellids *M. discolor* and *H. octomaculata* were present in the 4th, 8th, 10th and 12th week, numbering together 0.08 ± 0.02, 0.6 ± 0.03, 1.5 ± 0.3 and 0.83 ± 0.02 per 10 sweeps respectively. The Staphylinid *Paederus fuscipes* Curtis was present in the 4th, 8th, 10th and 12th week after planting, numbering 0.08 ± 0.02, 0.1 ± 0.02, 0.1 ± 0.02 and 0.17 ± 0.01 respectively. Anthocoridae were present in the fields from the 4th to 12th week, reaching a peak of 0.75 ± 0.03 in the 6th week. *Lestes* sp. and *Orthetrum* sp. were also recorded.

3.2 Kilinochi

3.2.1 Maha 1981–82

The following pest insects were collected (Figure 3A). *L. oratorius* was observed in the 12th week, at 0.5 ± 0.02 per 10 sweeps. Acrididae were also recorded.

The predators collected were *M. discolor* and *H. octomaculata* in the 12th week and *Lestes* sp., *Pseudagrion* sp. and *Orthetrum* sp. in the 4th and 6th week (Figure 3B).

3.2.2 Yala 1982

The following pest insects were collected (Figure 4A). *S. furcifera* numbered 6.15 ± 0.3 and 1.25 ± 0.2 per 10 sweeps in the 6th and 8th week respectively. *N. virescens* and *N. nigropictus* were present at 0.75 ± 0.03 in the 4th and 8th week. *Aulacophora* sp. numbered 0.25 ± 0.01 in the 6th week. Acrididae and Tettigoniidae were also present.

The following predators were collected (Figure 4B). *M. discolor* and *H. octomaculata* were present at a total density of 1.5 ± 0.3, 0.25 ± 0.01 and 0.5 ± 0.02 per 10 sweeps in the 4th, 6th and 10th week respectively. Anthocoridae were present at 1.2 ± 0.3 per 10 sweeps in the 6th week. *Lestes* sp., *Orthetrum* sp. and *Anax* sp. (Aeschnidae) were also present.

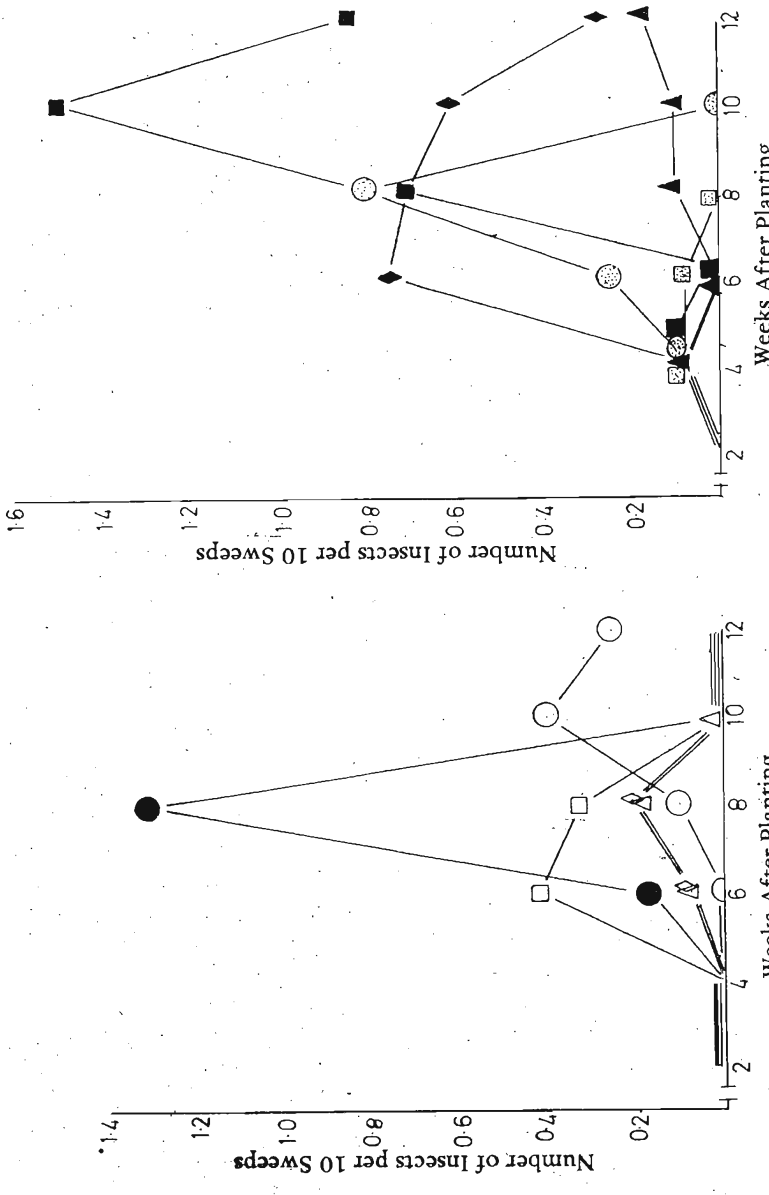

Figure 2 : Pest (A) and beneficial (B) insects collected in Karadianaru during Yala 1982.

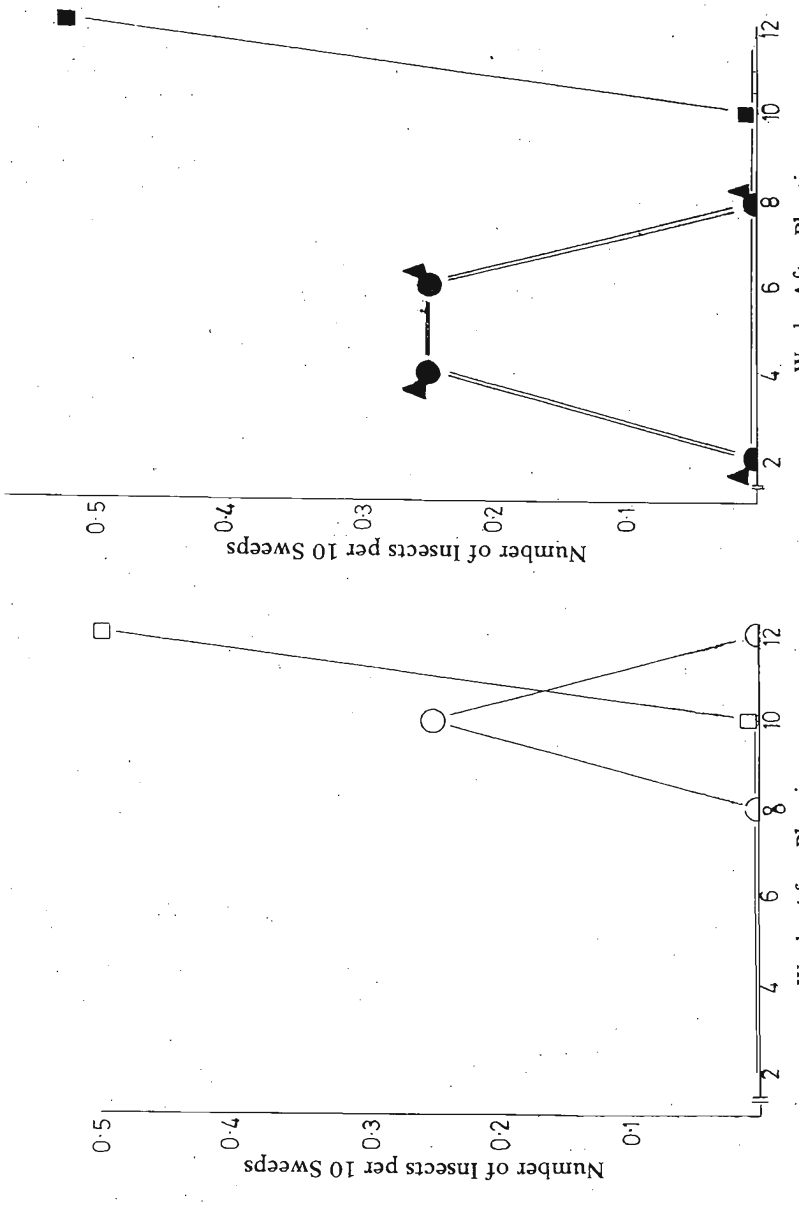

Figure 3 : Pest (A) and beneficial (B) insects collected in Kilinochi during Maha 1981 – 82.

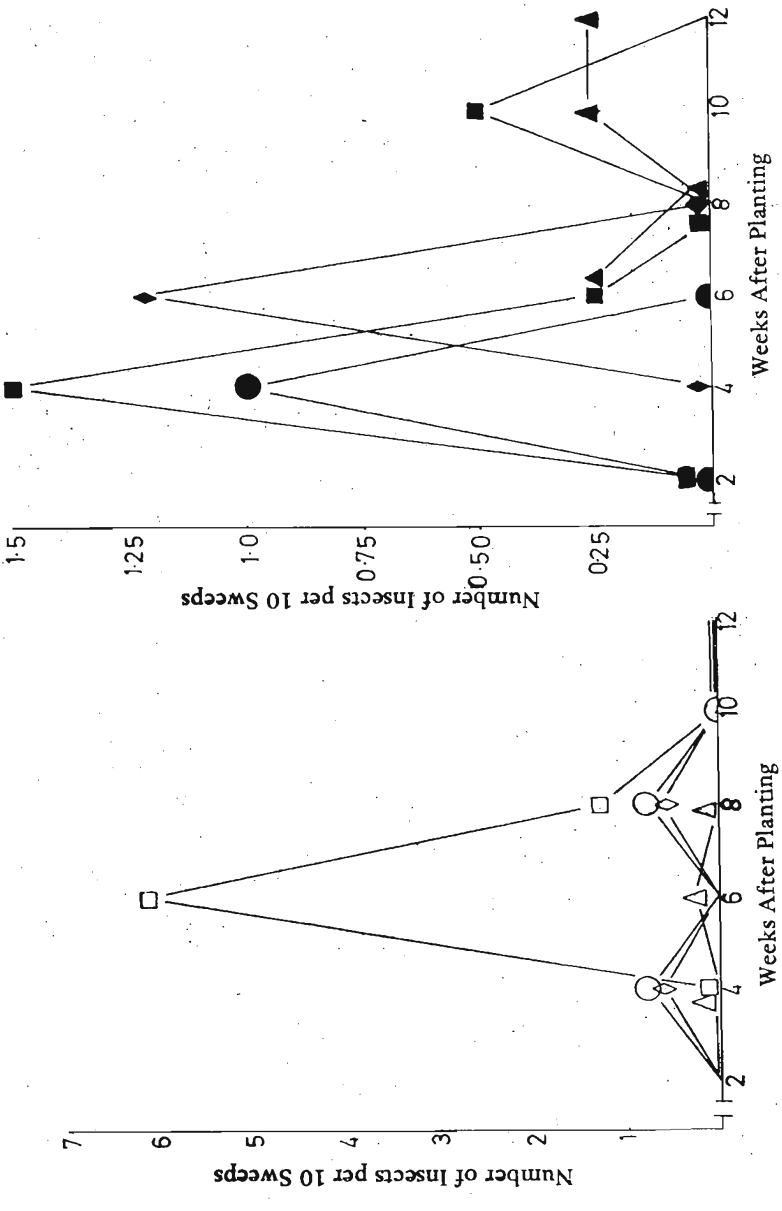

Figure 4 : Pest (A) and beneficial (B) insects collected in Kilinochi during Yala 1982.

A. □ *S. furcifera*
○ *N. virescens* & *N. nigropictus*
△ *Aulacophora* sp.
◇ Tettigoniidae & Acrididae

B. ■ *M. discolor* & *H. octomaculata*
● *Lestes* sp.
▲ *Orthetrum* sp. & *Anax* sp.
◆ Anthocoridae

3.3 Jaffna

3.3.1 Maha 1981–82

The following pest insects were collected (Figure 5A). *N. lugens* was recorded in the 8th week at 0.25 ± 0.01 per 10 sweeps. *N. virescens* and *N. nigropictus* were present only in the 10th week, numbering 1.66 ± 0.3. *L. oratorius* numbered 0.66 ± 0.02, 1.0 ± 0.22, 5.33 ± 0.6 and 1.0 ± 0.03 in the 4th, 6th, 8th and 10th week respectively. The rice root weevil *Tanymecus* sp. was present in the 6th week at a low density of 0.33 ± 0.02. *Aulacophora* sp. numbered 0.66 ± 0.03, 0.33 ± 0.02 and 0.33 ± 0.02 in the 4th, 8th and 10th week respectively. Members of the families Tettigoniidae, Acrididae and Gryllidae were also recorded.

The beneficial insects collected were the following (Figure 5B). *C. lividipennis* was collected in the 6th week numbering 0.33 ± 0.02 per 10 sweeps. *M. discolor* was present in the 6th and 10th week, numbering 2.0 ± 0.03 and 1.0 ± 0.02 respectively. *Lestes* sp. and *Pseudagrion* sp. were also recorded.

3.3.2 Yala 1982

The following pest insects were present (Figure 6A). *L. oratorius* was present in the 10th and 12th week at the same density of 1.33 ± 0.07 per 10 sweeps. The rice root weevil *Tanymecus* sp. was present at the density of 0.33 ± 0.02 and 0.33 ± 0.03 in the 6th and 10th week. Acrididae were also collected.

Two beneficial insects were collected (Figure 6B). *C. lividipennis* was present in the 6th and 10th week after planting, at the same density of 0.33 ± 0.02 per 10 sweeps. *H. octomaculata* was present in the 6th, 8th, 10th and 12th week at densities of 0.33 ± 0.02, 0.33 ± 0.01, 0.66 ± 0.03 and 0.33 ± 0.01 respectively.

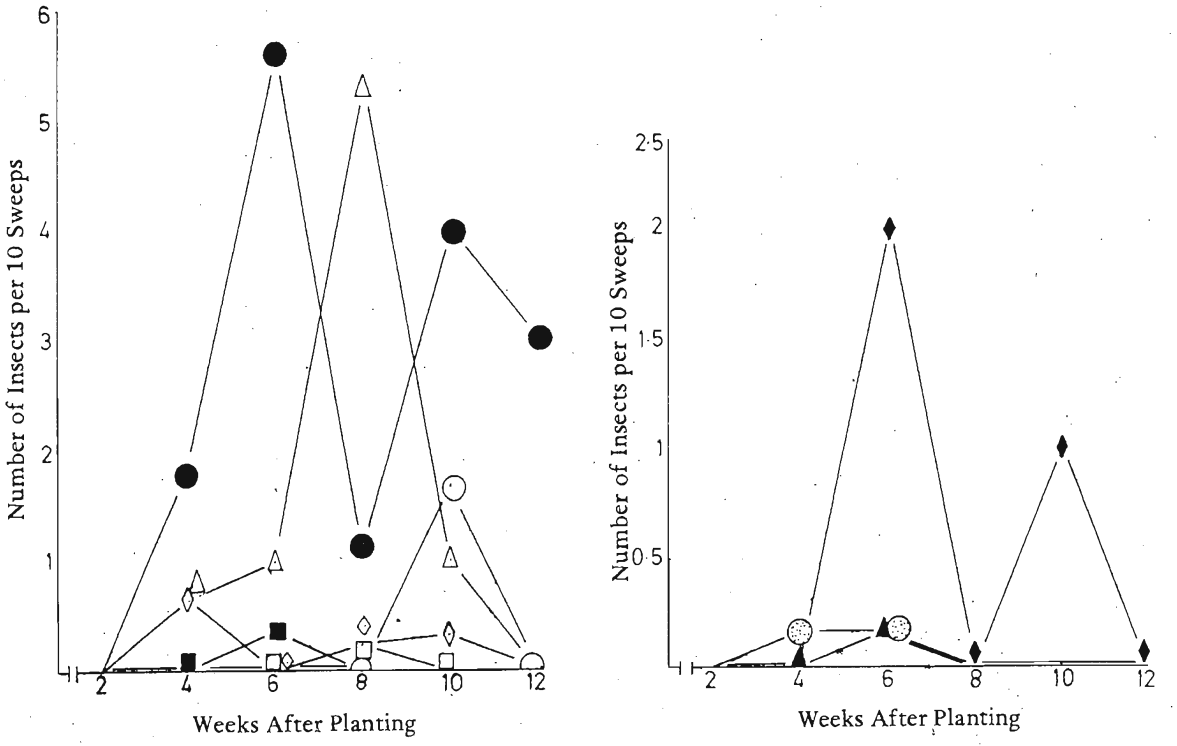

Figure 5 : Pest (A) and beneficial (B) insects collected in Jaffna during Maha 1981–82.

A. □ *N. lugens*
○ *N. virescens* & *N. nigropictus*
△ *L. oratorius*
◇ *Aulacophora* sp.
■ *Tanymecus* sp.
● Gryllidae & Acrididae

B. ▲ *C. lividipennis*
◆ *M. discolor*
⊗ *Lestes* sp. & *Pseudagrion* sp.

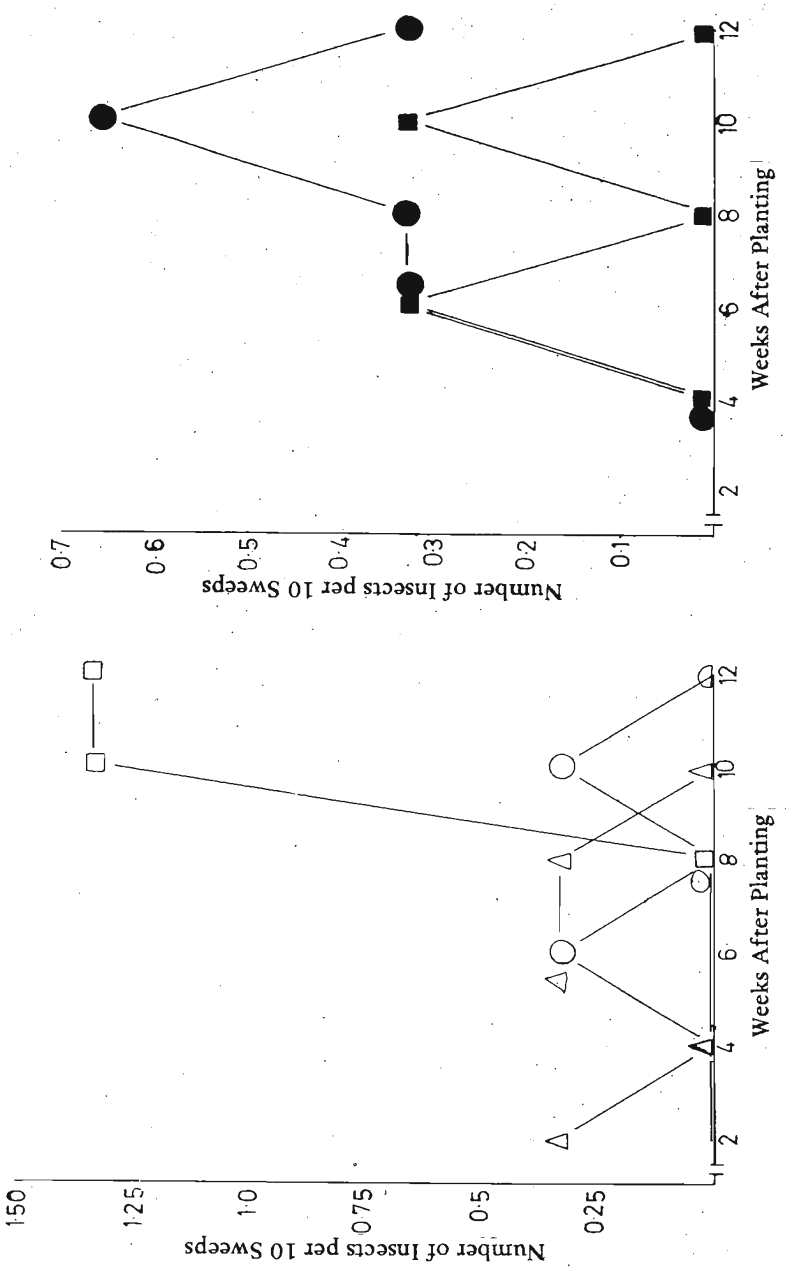

Figure 6 : Pest (A) and beneficial (B) insects collected in Jaffna during Yala 1982.

A. □ *L. oratorius*
○ *Tanymecus* sp.
△ Acrididae

B. ■ *C. lividipennis*
● *H. octomaculata*

4. Discussion

In Karadianaru, *N. lugens* was recorded only during Yala 1982; it was not recorded during Maha 1981–82. But *C. lividipennis* was not present during the entire period of sampling. Neither *N. lugens* nor *C. lividipennis* was present during either season at Kilinochi. In Jaffna, both *N. lugens* and *C. lividipennis* were present during Maha 1981–82 while only *C. lividipennis* was present in Yala 1982. Hence we can conclude that the distribution patterns of both *N. lugens* and *C. lividipennis* tend to be localized. This was confirmed by personal observation of other paddy fields in the districts. During Maha 1981–82, though *N. lugens* was not present at Karadianaru, a severe infestation was observed in Kalmunai, only a distance of 20 miles (as the planthopper flies) from Karadianaru. And although *C. lividipennis* was not observed at Kilinochi during both seasons, it was present at Paranthan, only 2 miles distant from the Kilinochi rice fields under study. It was noted however that paddy was planted in rows at Paranthan. Previous research in the distribution of *C. lividipennis* in India seems to indicate that planting in rows, with space between tillers, encourages the presence of *C. lividipennis* in rice fields (S. Nagarkatti : personal communication).

In Jaffna, during Maha 1981–82, *N. lugens, N. virescens, N. nigropictus* and *C. lividipennis* were present. In the following season, Yala 1982, only *C. lividipennis* was present. It could not be determined if the absence of the planthopper–leafhopper complex during Yala 1982 was directly due to the predatory activity of *C. lividipennis* during Maha 1981–82. *N. virescens* and *N. nigropictus* were present during both seasons at Karadianaru and during Yala 1982 at Kilinochi. It was also not possible to determine the precise role, if any, of *C. lividipennis* and *M. discolor* in the subsequent reduction of the high density of *L. oratorius*, Gryllidae and Acrididae noted during the 4th to 8th week, during Maha 1981, in Jaffna.

Among the parameters to be considered in the explanation of the varying densities of *N. lugens* and *C. lividipennis*, the rice variety is not a factor, since the same variety BG 90–2 was used in all three fields. This variety is susceptible to attack and population build up of the planthopper and leafhopper complex.

The role of the abiotic factors could not account for the difference in population densities of *N. lugens* and *C. lividipennis* in the fields sampled. The rainfall during the months of sampling during Maha 1981–82, October to December, in Karadianaru, Kilinochi and Jaffna are 21.96 in, 24.0 in and 20.33 in respectively. The corresponding figures for Yala 1982, April to June, are 5.06 in, 4.88 in and 2.09 in. The temperature range in the locations are respectively 24.3–30.6°C, 25.0–30.5°C and 25.2–30.1°C in Karadianaru, Kilinochi and Jaffna respectively. The differences do not appear to be significant enough to explain the differences in the composition of the populations of *N. lugens* and *C. lividipennis* in the locations sampled.

Fernando[2] and Otake *et al.*[9] recorded *N. lugens* as the predominant planthopper species in Amparai district. Fernando[2] also recorded this as the predominant planthopper species in Batticaloa district. Otake *et al.*[9] also observed the leafhopper species of *N. virescens* and *N. nigropictus*. They also reported a *Cyrtorhinus* sp., 2 coccinellids, the assasin bug (Reduviid) and *Casnoidea interstialis*, a carabid. *S. furcifera*, noted in Kilinochi in the present study, was indicated as the predominant planthopper species in Kandy and surrounding districts by Santa *et al.*[14] These workers also reported that *N. lugens* was present only in small numbers and *C. lividipennis* made up 25% of the insect population while *N. virescens* and *N. nigropictus* together accounted for 37% of the insect population.

The present survey was undertaken to consider the prospects of biological control of *N. lugens* by *C. lividipennis*. In the light of the present findings, the following may be mentioned. Studies have already been carried out in Sri Lanka on the biology of *N. lugens*[11] and of *C. lividipennis.*[12] Laboratory studies are also available on the predatory effectiveness of *C. lividipennis* on *N. lugens.*[13] Though field studies on the predatory effectiveness of *C. lividipennis* on *N. lugens* are not available from Sri Lanka, such studies are available from other countries. Hinckley[3] mentions that *C. lividipennis* was an important source of *N. lugens* mortality in Fiji. Stapley[18] credited *Cyrtrohinus* sp. with a cultural practical role in controlling *N. lugens* in Solomon Islands. These workers stress the importance of the role of grass as a reservoir for populations of *C. lividipennis*. Stapley[17] suggests that *Eleusine indica* and *Eleusine coracanna* may be the favoured grass that maintain *Cyrtorhinus* sp. in Solomon Islands. Stapley[18] also claims that *Cyrtorhinus* sp. invades rice where there is an abundance of grass, especially *Digitaria* in the vicinity. Since these grass species – *E. indica, E. coracanna* and *Digitaria adscendens* are widespread in both dry and wet lowlands of Sri Lanka according to Senaratne,[15] these grasses may be hidden reservoirs of *C. lividipennis* in lowland paddy fields. Planting of such grasses on the borders of paddy fields may augment the reservoir populations of *C. lividipennis* and thus help in the biological control of *N. lugens*. Confirmation however could be obtained only by direct sampling of these grasses.

Though these grasses are not found in the hills, the transplanting of paddy in rows with space between tillers may explain the frequent occurence of *C. lividipennis* in paddy fields in Kandy as reported by Santa *et al.*[14]

The present study shows that the absence of synchrony among the generation patterns of *N. lugens* and *C. lividipennis* could severely limit the effectiveness of this predator in suppressing outbreaks of *N. lugens* populations. The presence of the predators recorded in this survey may compensate for such lack of synchrony. *M. discolor* and *H. octomaculata* were observed in all three locations during both seasons. *P. fuscipes* was present in Karadianaru during Yala 1982 and in Jaffna during Maha 1981–82 and Yala 1982. Anthocorids were noted in Karadianaru and Kilinochi during Yala 1982.

Hence the biological control of *N. lugens* by *C. lividipennis* in Sri Lanka appears to be feasible. Further studies are under way to determine the actual role of these grasses as reservoirs of *C. lividipennis* in Sri Lanka.

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