Trop. Sci. 2000, **40**, 144–153

Population dynamics of the sugarcane planthopper *Pyrilla perpusilla* in the wet zone of Sri Lanka

G.A.S.M. Ganehiarachchi and I.V.S. Fernando
Department of Zoology, University of Kelaniya, Sri Lanka

Abstract *Sugarcane planthopper* Pyrilla perpusilla *causes enormous damage to the crop by sucking cell sap from the leaves. In the wet zone of Sri Lanka, the numbers of eggs, nymphs and adults were high in July, August and October 1993, April and September 1994, and February and March 1995. The population size of* P. perpusilla *showed a negative correlation with rainfall and humidity and positive correlation with minimum temperature. A hymenopteran parasitoid of* P. perpusilla, Parachrysocharis javensis *and nine species of predators were recorded in the plot. The main factors responsible for the fluctuation of population size of* P. perpusilla *are the egg parasitoid, predators and rainfall.*

Keywords: *Pyrilla perpusilla*, sugarcane plant hopper, population dynamics.

Introduction

The sugarcane planthopper *Pyrilla perpusilla* is a very destructive pest and it is widely distributed in Southeast Asia. Both nymphs and adults suck sap from the leaves and most damage is caused by the nymphs. Feeding spots turn yellow and with the loss of sap, the leaves wilt, retarding the growth of the plants. A sooty mould grows on the honeydew produced by these bugs and this further reduces photosynthesis. Both factors result in a significant loss of sugar. Various control measures have been proposed (Butani 1964), but these have not been totally satisfactory. Effective control depends on an understanding of the population dynamics. Climatic factors and natural enemies influence the abundance of *P. perpusilla* (Brar and Bains 1979), and all stages of *P. perpusilla* are parasitized (Butani 1964). Much is known of *P. perpusilla* in other countries, but little is known of its population dynamics in Sri Lanka.

Materials and methods

The experimental plot, 25 × 35 m, was divided into four subplots. Cuttings of variety Co 775 were obtained from the Sugarcane Research Institute (SRI) in Sri Lanka, and planted 20 cm apart with 1 m between rows. After sprouting, the total number of plants in the plot was about 1100. Initially fertilizers were applied according to SRI recommendations, but no insecticides, herbicides or fungicides were applied during the study period (July 1993–May 1995). Watering was as recommended by the SRI. All plants were numbered.

Accepted 22 October 1999

Preliminary sampling showed that 728–955 plants had to be sampled to estimate the planthopper population with 5% error. As this was nearly all of the plants in the plot, the stages of *P. perpusilla* were counted on all the plants on each sampling day. Weekly population data were pooled for each month.

Field counts of egg clusters were made once a week, and each time the number of eggs in each cluster was recorded for about a quarter of the clusters. (The eggs were counted using a hand lens after removing the wax with a fine camel hairbrush.) Parasitized eggs were identified by their blackish colour as opposed to the white colour of the others. On each sampling day two randomly selected parasitized egg clusters were collected by clipping the leaves, and the numbers of parasitized and unparasitized eggs in each cluster were recorded. Each cluster was then placed in a test tube plugged with cotton wool. The eggs were allowed to incubate at room temperature and the number of parasitoids emerging from each cluster was recorded. The number of parasitized eggs from which parasitoids failed to emerge was also recorded. The parasitoids were preserved in 70% alcohol and subsequently identified. Field observations were made of predation and the instars preyed on by different predators. Arthropod predators were collected and preserved in 70% alcohol for identification. Adult *P. perpusilla* and the different nymphal instars on every plant were counted on each sampling day.

Daily records were kept of maximum and minimum temperature, relative humidity and rainfall. The hypothesis that the abundance of the *P. perpusilla* and its egg parasitoids is influenced by climate were tested using Pearson product moment correlation analysis.

Results

The mean numbers of egg clusters and eggs (Figure 1) were higher in July–September 1993 than in the rest of the study period. There was significant positive linear correlation ($r = 0.965$; $P < 0.001$) between the mean numbers of parasitized and total egg clusters (Figure 2). The rate of egg cluster parasitism over the study period was $57.4 \pm 6\%$; in several months it exceeded 80% and in August 1993 it was around 100%. The number of parasitized eggs in a cluster was 19 to 30 with a mean of 23.55 ± 4.55. The total number of eggs in a cluster and the number of parasitized eggs were not significantly correlated ($r = 0.14$; $P = 0.49$) (Figure 3). The rate of parasitism due to egg parasitoids was between 30 and 68% (Figure 4) with a mean of $46{,}91 \pm 5.2\%$, except that it was only 10% in June 1995 and zero in July 1995. The rate of parasitoid emergence from parasitized eggs was $85.33\% \pm 14.63\%$ and no nymphal or adult parasitism was observed.

Five species of Arthropod predators were recorded: *Camponotus* sp. (Hymenoptera: Formicidae); *Diacamma* sp. (Hymenoptera: Formicidae); *Brinckochrysa* sp. (Neuroptera: Chrysopidae); *Tetragnatha* sp. (Arachnida: Tetragnathidae); and an unidentified salticid. Their abundance is shown in Figure 5. In addition, the common babbler *Turdoides* sp. and the garden lizard *Calotes versicolor* were observed to prey on *P. perpusilla*. Some unidentified Coccinellid larvae fed on *P. perpusilla* nymphs. Among the predators, *Camponotus* sp. was the most abundant: adults built a silken shelter close to the *P. perpusilla* egg cluster, and as the first instar nymphs hatched, the ants emerged from the shelters to feed on them. Another ant, *Diacamma* sp, also fed on first and early second instar nymphs, as did *Brinckochrysa* sp.

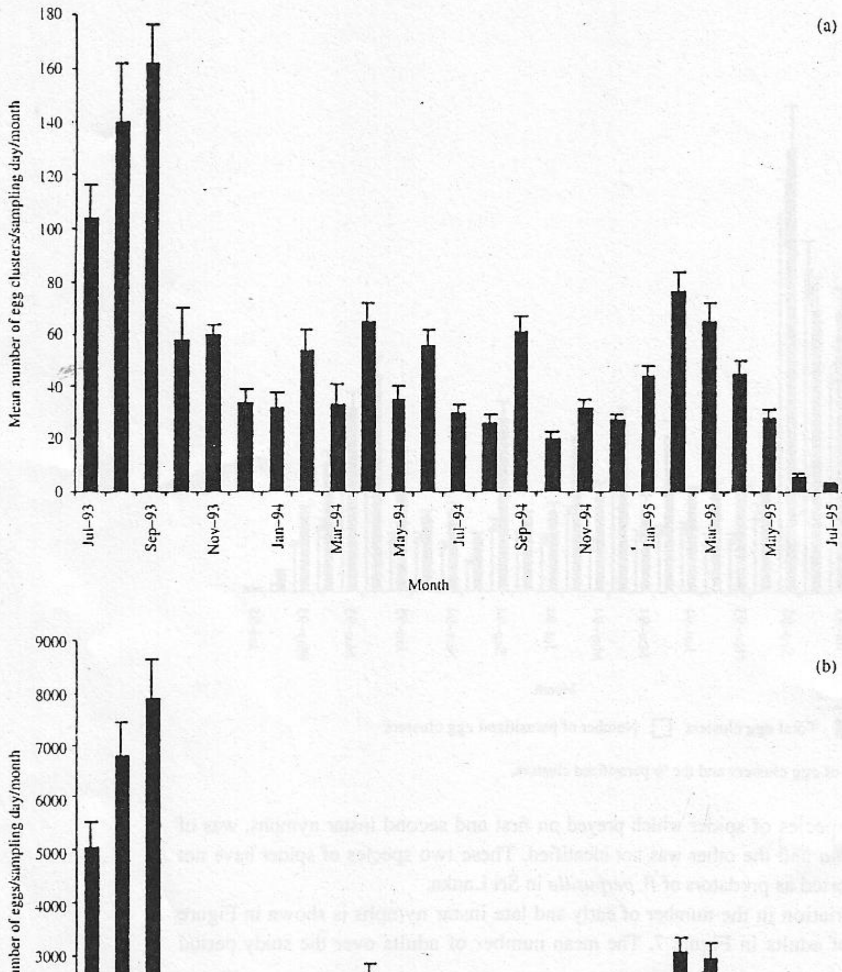

Figure 1. Variation in the mean number of (a) egg clusters and (b) eggs per month.

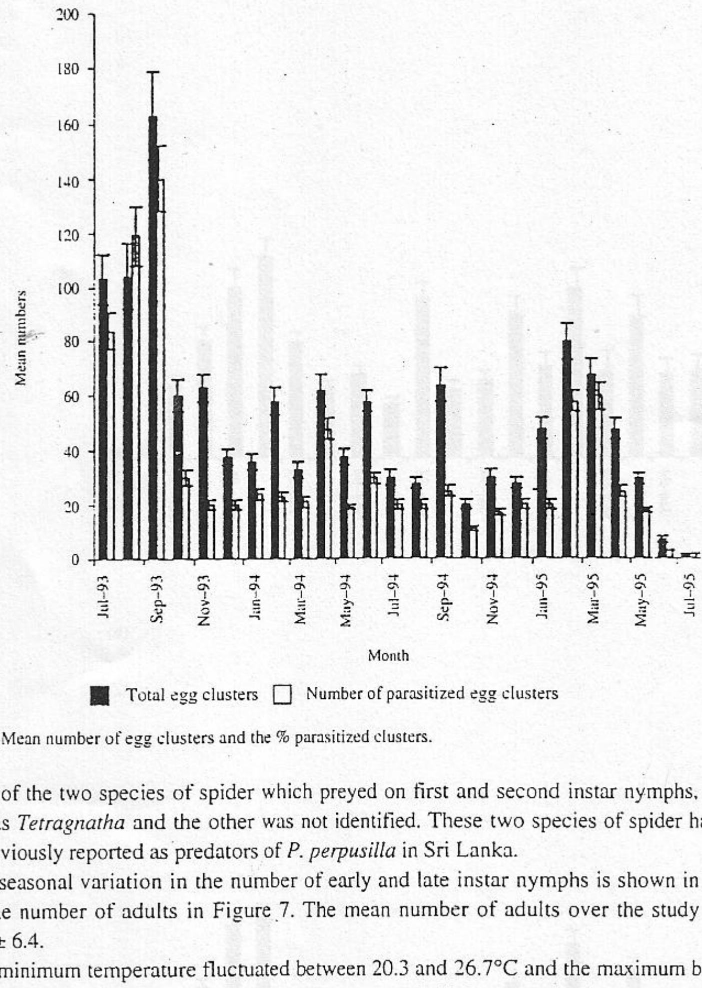

Figure 2. Mean number of egg clusters and the % parasitized clusters.

One of the two species of spider which preyed on first and second instar nymphs, was of the genus *Tetragnatha* and the other was not identified. These two species of spider have not been previously reported as predators of *P. perpusilla* in Sri Lanka.

The seasonal variation in the number of early and late instar nymphs is shown in Figure 6 and the number of adults in Figure 7. The mean number of adults over the study period was 70 ± 6.4.

The minimum temperature fluctuated between 20.3 and 26.7°C and the maximum between 30 and 32.4°C. The differences ranged from 4 to 10.2°C. The variation was highest in December and January in both 1994 and 1995, and low in July–October 1993 and May–June 1994. The mean daily rainfall ranged from zero to 19 mm, with a mean of 6.8 ± 5.8 mm. Rainfall was high in October–December 1993, May–June and September–November 1994, and April–July 1995. There was no rain in July–August 1993 and February–March 1995. The monthly relative humidity ranged from 70.1 to 87.4% with a mean of 80.6 ± 4.1%.

The correlations of the parameters measured with climatic factors are in Table 1. The monthly means of egg clusters, early and late instar nymphs, adults and total population were negatively correlated with the rainfall and relative humidity, but they were positively correlated with the minimum temperature and negatively with the temperature difference.

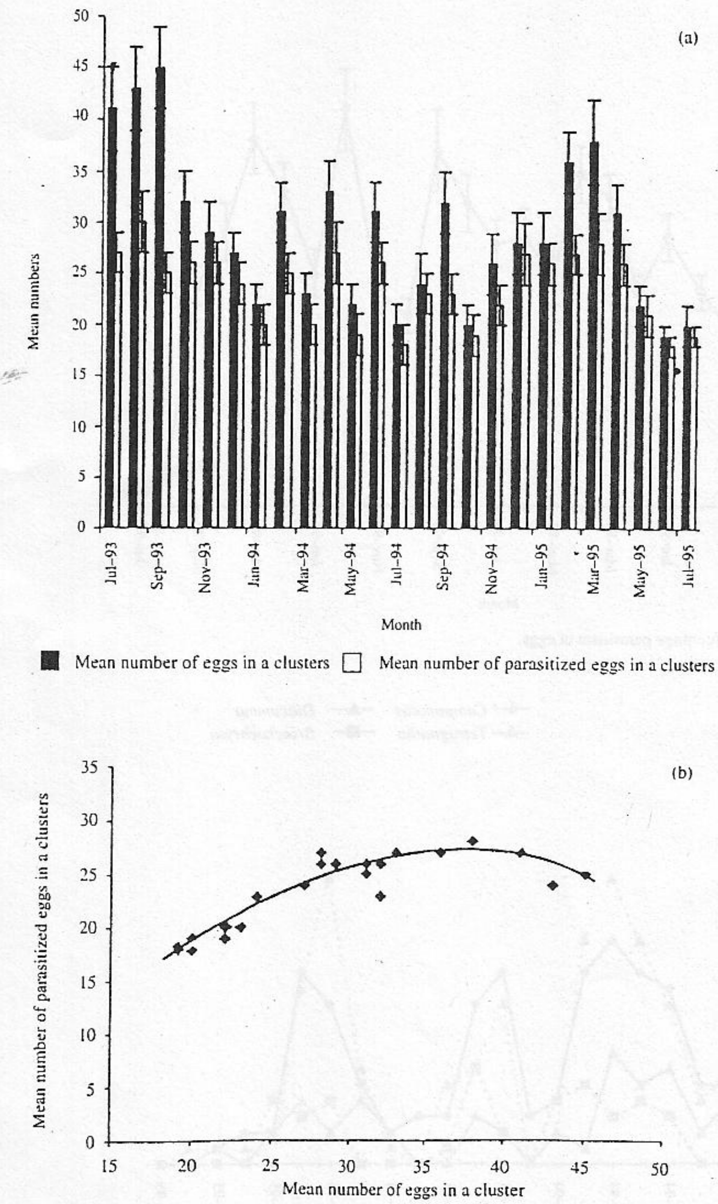

Figure 3. (a) Mean number of eggs in a cluster and the number of parasitized and (b) their correlation.

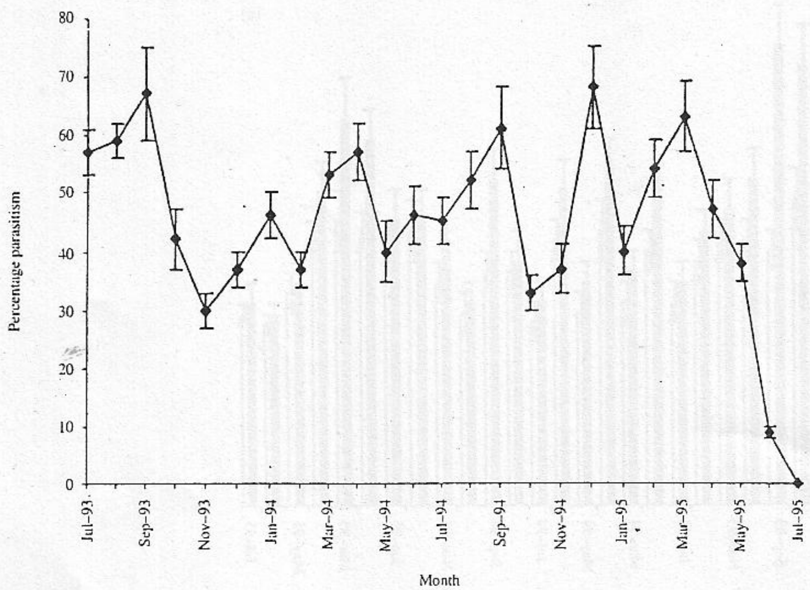

Figure 4. Monthly variation of percentage parasitism of eggs.

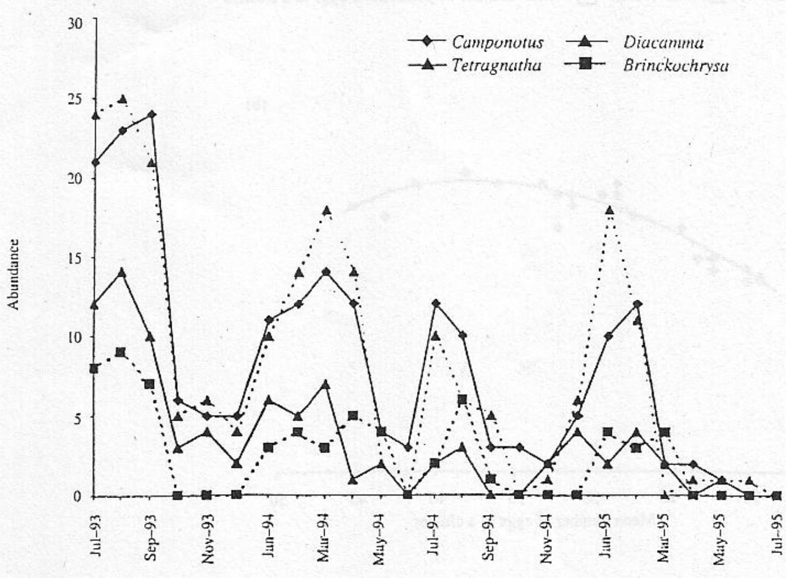

Figure 5. Abundance of predator species.

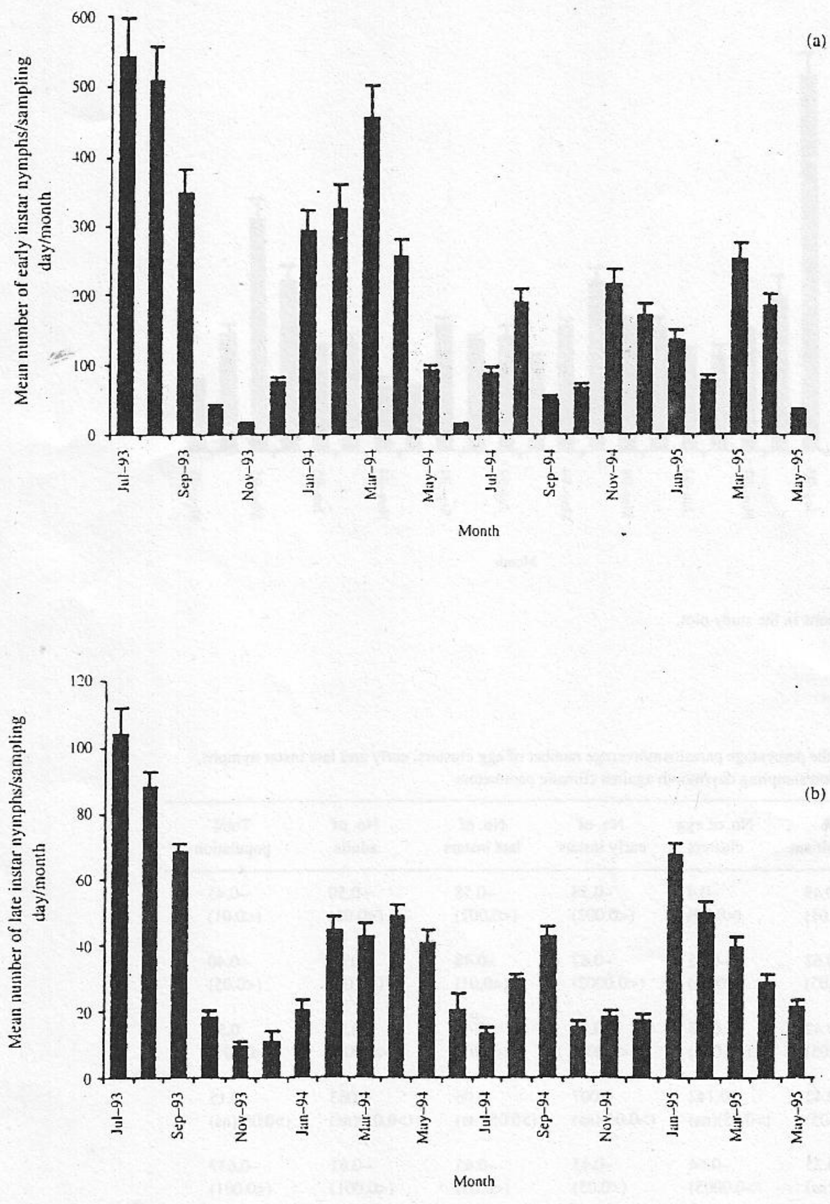

Figure 6. Number of (a) early and (b) late instar nymphs in the study plot.

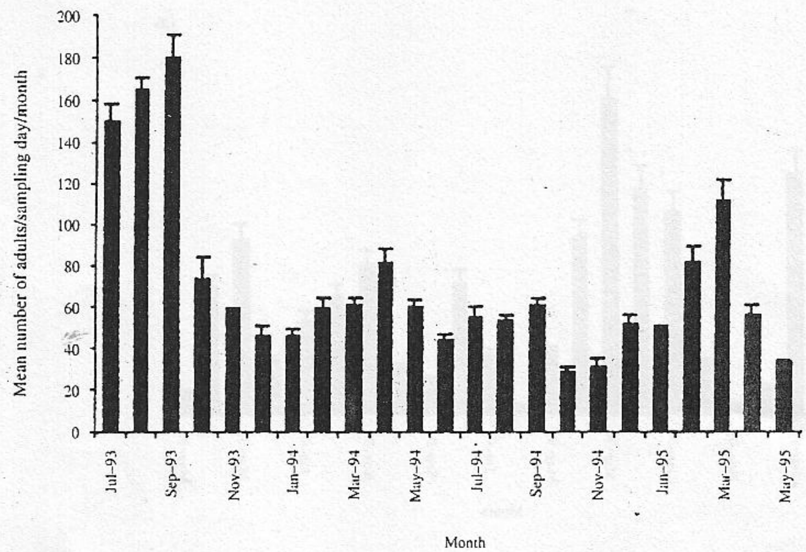

Figure 7. Number of adults in the study plot.

Table 1. Regression of the percentage parasitism/average number of egg clusters, early and late instar nymphs, adults and total population/sampling day/month against climatic parameters

	% Parasitism	No. of egg clusters	No. of early instars	No. of late instars	No. of adults	Total population
Rainfall	–0.49 (<0.01)	–0.4 (<0.05)	–0.58 (<0.002)	–0.58 (<0.002)	–0.50 (<0.05)	–0.45 (<0.01)
Humidity	–0.62 (<0.05)	–0.45 (<0.05)	–0.67 (<0.0002)	–0.48 (<0.01)	–0.40 (<0.05)	–0.40 (<0.05)
Minimum temperature	0.42 (<0.05)	0.58 (<0.002)	0.59 (<0.001)	0.47 (<0.01)	0.59 (<0.001)	0.57 (<0.001)
Maximum temperature	0.42 (<0.05)	0.142 (>0.05)(ns)	0.007 (>0.05)(ns)	0.06 (>0.05)(ns)	0.063 (>0.05)(ns)	0.15 (>0.05)(ns)
Temperature difference	0.25 (>0.05)(ns)	–0.64 (>0.0005)	–0.45 (<0.05)	–0.45 (<0.05)	–0.61 (<0.001)	–0.637 (<0.001)

ns = not significant at 5% level.

Discussion

Climatic conditions that favour *P. perpusilla* in India appear to be high humidity and summer temperatures not exceeding 40°C (Singh and Kalra 1951). In our study, all stages of the planthopper had a negative correlation with humidity even though temperature remained below 40°C. This apparent discrepancy may be because in Kelaniya, high humidity occurred concurrently with high rainfall, when egg clusters get washed off the leaves and delicate nymphal stages are injured. The adults, too, may perish in a monsoonal downpour.

The positive correlation between minimum temperature and population is presumably because the pest produces more eggs in a given time as the daily minimum increases. The variations in daily maximum temperature were slight throughout the study period, and changes in the daily temperature differences were mainly due to variations in the minimum. As the minimum increased, the difference decreased, leading to the negative correlation between temperature difference and population size. In July–September 1993, April, June and September 1994, and February–March 1995, the total population of this pest was high due to favourable conditions of low rainfall and relatively high minimum temperatures.

Two virulent fungi, *Metarhizium anisopliae* and *Paeciliomyces lilacinus*, which cause heavy seasonal mortality in *P. perpusilla* at Udawalawe in Sri Lanka were not observed at Kelaniya. A lepidopteran parasitoid of *Epiricania melanoleuca*, was brought to Sri Lanka from Pakistan, and it has successfully controlled *P. perpusilla* infestations in other places in Sri Lanka (Kumarasinghe and Wratten 1996), but it was not present at Kelaniya. The egg parasitoid observed in this study was *Parachrysocharis javensis* Girualt (Hymenoptera: Eulophidae), which is well known as a parasitoid of *P. perpusilla* (e.g. Appanna *et al.* 1954; Cheema 1942). In our work, this was the most important biological control agent of *P. perpusilla*. The overall parasitism rate of individual eggs was 46.91 ± 5.2%; whereas Kumarasinghe and Ranasinghe (1988) have found that *P. javensis* parasitism stayed below 20% in the Sevanagala area of Sri Lanka. This low level is probably due to the practice of burning the trash after harvest, which should reduce the parasitoid population.

The rate of egg cluster parasitism was positively correlated with the number of egg clusters present in the field, presumably because the presence of more egg clusters increases the chances of the parasitoids finding eggs. Frequently, all the eggs in a cluster were parasitized when the number of eggs in the cluster was low, but there was no correlation between number of eggs in a cluster and the number parasitized.

From our data, the most vulnerable stage of *P. perpusilla* is the first instar nymphs followed by eggs and second instar nymphs. Third and fourth instar nymphs were less vulnerable, but fifth instar nymphs are vulnerable to predation by birds and lizards as, being large, they are more noticeable. The abundance of predators such as *Camponotus*, *Diacamma*, *Brinckochrysa* and *Tetragnatha* was also affected by heavy rainfall, but this reduced predator pressure does not lead to an increase in the *P. perpusilla* population because heavy rainfall also has a big impact on the early instar nymphs. This is the likely reason why the *P. perpusilla* did not have a high population density in the study plot at any stage.

Acknowledgements

We thank Drs U.S. Amarasinghe and W.U. Chandrasekara for their help in statistical analysis. This work was funded by the Research and Publications Division of the University of Kelaniya.

References

Appanna M, Usman S and Sastry KSS (1954) A note on the change in the status of the sugarcane leafhopper, *Dictyophora pallida* (Don) (*Pyrilla perpusilla* Walker) in Mysore. Mysore Agricultural Journal 30, 19–26.

Brar RS and Bains SS (1979) Population dynamics of *Pyrilla perpusilla* Walker during different seasons. Indian Journal of Ecology 6, 110–21.

Butani DK (1964) Sugarcane leafhopper *Pyrilla perpusilla* Walker – a review. Indian Sugarcane Journal 9, 60–75.

Cheema PS (1942) Effect of food on the longevity of *Tetrastichus pyrillae* Craw. Indian Journal of Entomology 4, 94–5.

Kumarasinghe NC and Ranasinghe MASK (1988) Effect of environmental factors on populations of the sugarcane leafhopper *Pyrilla perpusilla singhalensis*. Proceedings 44th Annual Sessions of the Sri Lanka Association of Advancement of Science, Colombo, Sri Lanka.

Kumarasinghe NC and Wratten SD (1996) Sugarcane lophopid planthopper *Pyrilla perpusilla* (Homoptera: Lophopidae). A review of its biology, pest status and control. Bulletin of Entomological Research 86, 485–98.

Singh H and Kalra AN (1951) Sugarcane pyrilla (*Pyrilla perpusilla* Wlk) a serious pest of sugarcane. Proceedings of the 1st Biennial Conference of Sugarcane Research & Development Workers, Coimbatore, Pt II, 100–7.