

THE EFFICIENCY OF SAMPLING FOR APHID PREDATORS FROM LUCERNE

D.M. LEATHWICK* and D.R. PENMAN

Entomology Department, Lincoln College.

SUMMARY

The sweep-net and D-vac were compared for their ability to sample aphids and aphid predators from lucerne. The relative abundance of the various predator species differed significantly with sampling technique. Both sampling methods failed to detect sizeable populations of some species. A model predicting development of the juvenile stages of the Tasmanian lacewing (*Micromus tasmaniae* Walker) revealed that D-vac sampling underestimated the abundance of first and second instar lacewing larvae but accurately estimated third instars. It is suggested that the abundance of this aphid predator may have been underestimated in the past.

INTRODUCTION

In order to gain insight into the role played by the Tasmanian lacewing (*Micromus tasmaniae* Walker) as a natural enemy of aphids in lucerne it was necessary to establish its seasonality and abundance relative to that of the aphids and other species of aphid predator.

Some data are available on the abundance of lucerne aphid predators in New Zealand (Cameron *et al* 1979; Henderson 1979; Bates and Miln 1982), based mainly on sweep net samples. This is despite considerable literature (see Southwood 1978) which suggests that the results of sweeping are influenced by a wide variety of factors (Hughes 1955; Saugsted *et al* 1967; Cherry *et al* 1977) and that it is not a suitable technique for comparing the abundance of different species (Hodek *et al* 1972).

This paper evaluates the accuracy of the sweep net and D-vac for sampling lacewings from lucerne and establishes bias with respect to different predator species.

METHODS

During the spring and summer of 1983-84 three lucerne fields in the vicinity of Lincoln College, Canterbury, were sampled at approximately weekly intervals whenever the lucerne was actively growing. Five sets of 20 sweeps through the foliage with a 30 cm diameter net and five sets of five subsamples with a D-vac motorized suction sampler were taken on each occasion. D-vac samples were taken in the manner considered most efficient by Southwood (1978); the nozzle was lowered vertically into the foliage and down to the ground surface, held in this position for approximately 30 seconds, and lifted vertically off.

In 1985-86 a time-varying life-table approach (Gilbert *et al* 1976) was used to study lacewing population dynamics. Intensive D-vac sampling at a single site produced a time series of population counts. These were compared with a simulated population to help understand the factors determining population change (Leathwick 1989). The simulated population was based on a temperature-driven developmental rate model which used lacewing egg densities and temperatures, measured in the field as inputs. Lacewing egg density was estimated by searching all the vegetation within 10, 0.625 m² quadrats, and any predator species were recorded at the same time.

Five pitfall traps were placed in the ground along a diagonal transect across the lucerne plot. Traps were half filled with 70% alcohol and were emptied at 7-14 day intervals.

*Present address: Biological Modelling Unit, MAFTech, Levin.

Proc. 42nd N.Z. Weed and Pest Control Conf.

RESULTS

Comparison of sampling methods

The relative efficiency of the D-vac and sweep net at catching different species was assessed by plotting the number of individuals collected by one technique against the number collected by the other (Fig. 1), from the same site on the same day. The areas sampled did not overlap, so all samples were taken from the same population. Hence, when means from the two sampling techniques are plotted against one another a significant deviation from a slope of 1.0 indicates a difference in sampling efficiency between the techniques.

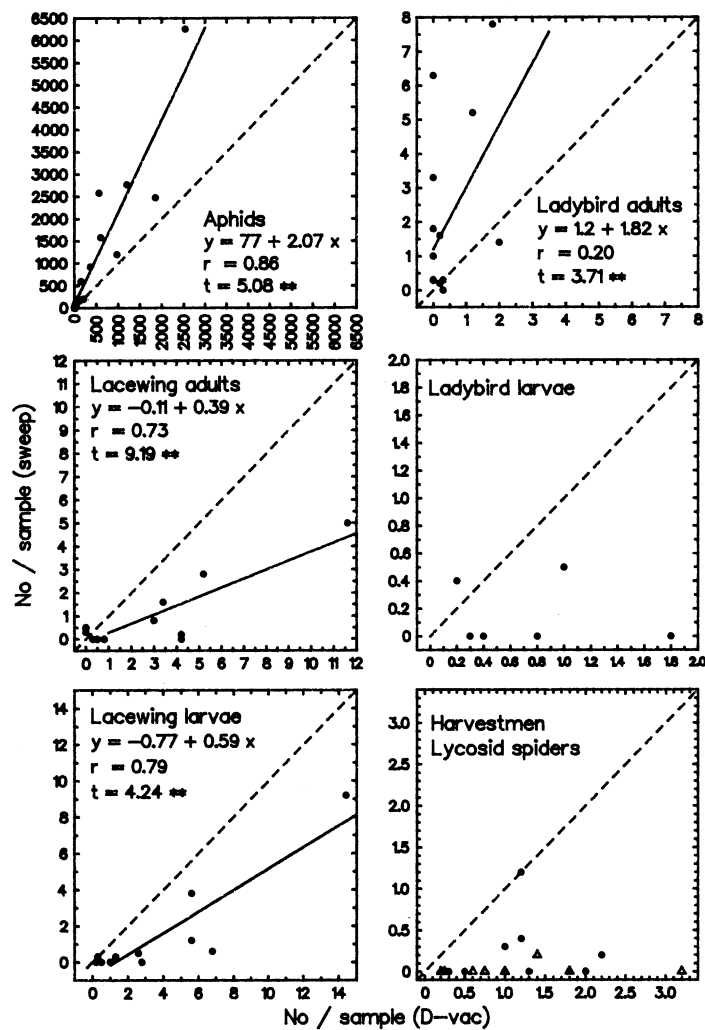


Fig. 1: Regression of the number of individuals caught by D-vac against the number caught by sweep net. **indicates that the slope of the regression line (solid) deviates significantly from 1.0 (dashed) $P < 0.01$.

All the regression lines presented in Fig. 1 have slopes which deviate significantly from 1.0. The sweep net showed a bias toward catching aphids and adult ladybirds (*Coccinella* spp.) while the D-vac caught more lacewing adults and larvae. Regressions were not possible for ladybird larvae, harvestmen (*Phalangium opilo*) and lycosid spiders (*Lycosa* spp.) because the sweep net often failed to catch any of these species.

The sampling technique can therefore have considerable influence on the observer's impression of what is occurring within the crop. For example, data from sweep sampling on 4/1/84 indicated that adult ladybirds outnumbered adult lacewings by 6.5:1 and that the aphid:predator ratio was 11:1. However, D-vac samples from the same site on the same day indicated that adult lacewings outnumbered adult ladybirds by 7:1 and that the aphid:predator ratio was less than 2:1.

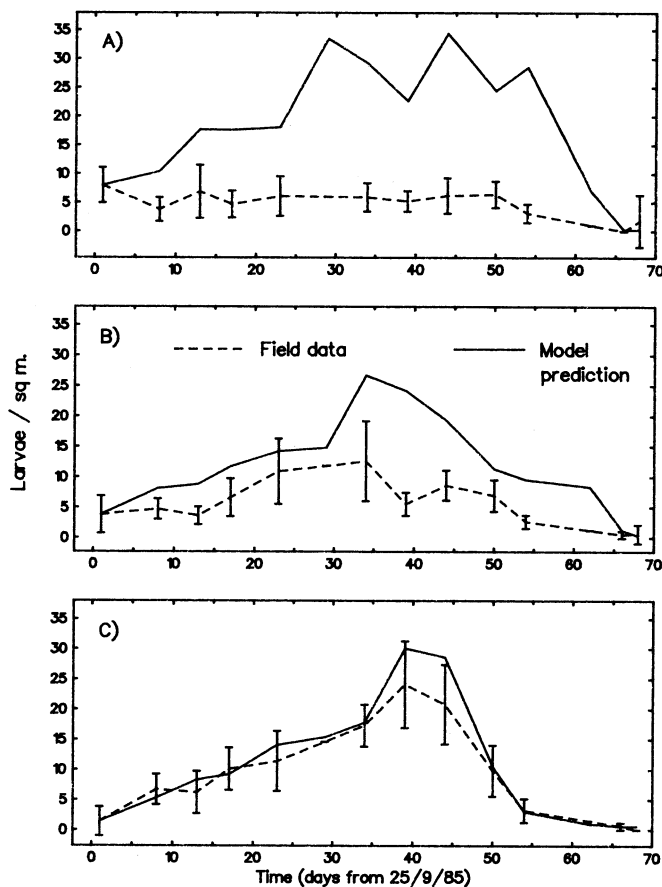


Fig. 2: Comparison of predicted densities of *Micromus tasmaniae* larvae and those recorded in the field in D-vac samples during the spring 1985. Error bars are 95% confidence intervals for the means.

- A) First instar larvae
- B) Second instar larvae
- C) Third instar larvae

The predator most often caught in the pitfall traps was the lycosid spider (identified as *Lycosa* spp., J.A. Wightman, pers. comm.). The number of these spiders in the pitfall traps indicated that they were far more abundant in the lucerne than predicted from the D-vac samples. For example, in November 1985, 130 lycosids were caught in five pitfall traps over a 10 day period, while none appeared in the D-vac samples. Similarly the stem samples indicated the presence of syrphid (*Melanostoma fasciatum* and *Syrphus novaezealandica*) larvae in considerably greater numbers than indicated by the D-vac.

Assessment of D-vac sampling

When the model's predictions for larval lacewing density were compared with the results of D-vac sampling, the level of agreement was found to increase with larval size (compare the different instars in Fig. 2). Given the common starting point for the model and field populations and a long period of high survival, it follows that if the model accurately predicts third instar larval densities it should also accurately predict the number of first and second instars. In general the model predictions for third instar larval density do approximate those observed in the field (Fig. 2). The lower values recorded in the field for first and second instars, therefore, suggest that the sampling method underestimates abundance of small lacewing larvae.

DISCUSSION

In the present study, where sampling was by D-vac, lacewings were consistently more abundant than any other predator species, with densities twice exceeding 100/m² (Leathwick 1989). Other workers (Cameron *et al* 1979; Bates and Miln 1982; Leathwick and Winterbourn 1984) recorded the 11-spotted ladybird (*Coccinella undecimpunctata* L.) as the most abundant predator in their day-time sweep net samples. This difference may simply reflect the sampling technique used since sweeping samples only the upper portion of the foliage (Heathcote 1972), where coccinellids predominantly hunt for aphids (Frazer and Gilbert 1976). Rohitha *et al* (1985) used a D-vac to sample lucerne aphid predators and also recorded lacewings as being more abundant than coccinellids. It is likely, therefore, that sweeping during the day is a poor indicator of lacewing number and is likely to overestimate the importance of coccinellids as aphid predators.

Day-time sweeping may also underestimate the overall importance of natural enemies by producing low ratios of total predators to prey (see above). Leathwick and Winterbourn (1984) found that sweeping at night caught more than four times as many predators as sweeping during the day.

The model provides a check on the efficiency of the D-vac at sampling lacewings by providing an estimate of the maximum densities possible given the measured egg densities. If field sampling produces estimates close to this maximum then the sampling method must be catching a high proportion of the individuals present. In this case the level of agreement between the model and field data suggests that the D-vac closely estimates the true density of third instar and adult lacewings (Leathwick 1989). However, total lacewing densities will be higher than indicated because of the D-vac's inefficiency at catching small larvae.

Neither the sweep net nor the D-vac is capable of sampling all species accurately. The D-vac caught more lycosids than the sweep net, but the pitfall trap catches indicated that both were significantly underestimating the actual numbers present. A similar situation is indicated for syrphid larvae (see also Rohitha *et al* 1985).

These results suggest that sweep net sampling is likely to overestimate the importance of coccinellids as predators in lucerne and underestimate the role of most other species. The D-vac is capable of accurately measuring adult and late instar lacewing density and is likely to be superior to the sweep net for most other species. For greatest accuracy D-vac sampling should be combined with other methods such as stem samples and pitfall traps.

ACKNOWLEDGEMENTS

The authors wish to thank Megan Brown for technical assistance, Nigel Barlow (MAFTech) for comments on the script and Entomology Division D.S.I.R. who funded the project.

REFERENCES

- Bates, L.H. and Miln, A.J., 1982. Parasites and predators of lucerne aphids at Flock House, Bulls. *Proc. 35th N.Z. Weed and Pest Control Conf.*: 123-126.
- Cameron, P.M., Thomas, W.P. and Hill, R.P., 1979. Introduction of lucerne aphid parasites and a preliminary evaluation of the natural enemies of *Acyrtosiphon* spp. (Hemiptera : Aphididae) in New Zealand. *Proc. 2nd Australasian Conf. Grassland Invert. Ecol.*: 219-233.
- Cherry, R.H., Wood, K.A. and Ruesink, W.G., 1977. Emergence trap and sweep net sampling for adults of the potato leafhopper from alfalfa. *J. Econ. Ent.* 70: 279-283.
- Frazer, B.D. and Gilbert, N., 1976. Coccinellids and aphids: a quantitative study of the impact of adult ladybirds (Col. Coccinellidae) preying on a field population of pea aphids (Homoptera : Aphididae). *J. Ento. Soc. of British Columbia* 37: 33-56.
- Gilbert, N., Gutierrez, A.P., Frazer, B.D. and Jones, R.E., 1976. Ecological Relationships. Freeman, N.Y.
- Heathcote, G.D., 1972. Evaluating aphid populations on plants. Chapter 3. *In* van Emden, H.F. (ed.) *Aphid Technology*. Academic Press, London.
- Henderson, N.C., 1979. Studies on the predators, a parasite, and an entomophthorous fungus affecting *Acyrtosiphon kondoi* (Hemiptera : Aphididae) in the Manawatu, New Zealand. *Proc. 2nd Australasian Conf. Grassland Invert. Ecol.*: 278-282.
- Hodek, I., Hagen, K.S. and van Emden, H.F., 1972. Methods for studying effectiveness of natural enemies. Chapter 4. *In* Van Emden (ed.) *Aphid Technology*. Academic Press, London.
- Hughes, R.D., 1955. The influence of the prevailing weather on the numbers of *Meromyza variegata* Meigen (Diptera : Chloropidae) caught with a sweep net. *J. Animal Ecol.* 24: 324-335.
- Leathwick, D.M., 1989. Applied Ecology of the Tasmanian Lacewing *Micromus tasmaniae* Walker (Neuroptera : Hemerobiidae). Unpublished Ph.D. thesis, Lincoln College, University of Canterbury, New Zealand.
- Leathwick, D.M. and Winterbourn, M.J., 1984. Arthropod predation on aphids in a lucerne crop. *N.Z. Entomologist* 8: 75-80.
- Rohitha, B.H., Pottinger, R.P. and Firth, A.C., 1985. Population monitoring studies of lucerne aphids and their predators in the Waikato. *Proc. 38th N.Z. Weed and Pest Control Conf.*: 31-34.
- Saugstad, E.S., Bram, R.A. and Nyquist, W.E., 1967. Factors influencing sweep-net sampling of alfalfa. *J. Econ. Ent.* 60: 521-526.
- Southwood, T.R.E., 1978. *Ecological Methods* Methuen, London.