POPULATION MONITORING STUDIES OF LUCERNE APHIDS AND THEIR PREDATORS IN THE WAIKATO

B.H. ROHITHA, R.P. POTTINGER, A.C. FIRTH

Ruakura Soil and Plant Research Station, MAF, Private Bag, Hamilton

SUMMARY

Population monitoring of spotted alfalfa aphid (SAA) (*Therioaphis trifolii* f. *maculata*), bluegreen lucerne aphid (BGLA) (*Acyrthosiphon kondoi*), and pea aphid (PA) (*A. pisum*) on lucerne (cv. Wairau) in the Waikato is reported. BGLA reached peak populations during early spring while PA and SAA peaked in late summer-autumn. The lacewing (*Micromus tasmaniae*) and the syrphid (*Melanostoma fasciatum*) probably contributed more towards SAA control than did other natural enemies. Spider and nabid activity was not synchronised well enough to contribute effectively towards control of SAA. BGLA and PA probably play a beneficial role in maintenance of natural enemies which transfer to, and effectively control, SAA infestations as they build-up.

INTRODUCTION

Widespread and severe damage in the USA during the early 1950's prompted a number of population ecology studies of SAA (Neilson and Barnes 1957, 1961). With the development of resistant cultivars SAA has become a more manageable pest in USA (Neuenschwander *et al* 1975). In Australia, widespread damage was reported during the establishment phase of SAA (Waterhouse 1979), however it did not reach similar epidemic levels in New Zealand after establishment in 1982 (Rohitha *et al* 1983). Since its arrival in New Zealand, several resistant lucerne cultivars have been introduced (Janson 1983) to replace the more susceptible cultivars. Despite this trend, a substantial area of SAA susceptible lucerne is still grown in New Zealand due to various desirable agronomic characteristics. This study was undertaken because there is a lack of knowledge on the population ecology of the SAA in New Zealand.

MATERIALS AND METHODS

The study was conducted on a 10 ha, 20-year-old Wairau stand, 5 km north of Huntly, during 1983-84. All the lucerne was harvested unwilted for silage, being cut to a stubble height of *ca* 4 cm. The stand was often subdivided and harvested in sections on different dates.

Five blocks, each 10 x 30 m, were established at random in the stand. Aphids were sampled fortnightly with a 210 mm suction sampler driven by a 3 hp two stroke motor. This machine very effectively sampled lucerne for all three aphid species and most of their natural enemies, except syrphid larvae which cling and parasitised aphids which stick to the leaves.

Fauna from ten random sampling positions were bulked to form one sample. Three such samples were taken from each of the five blocks. When the lucerne was wet, and suction sampling was not possible stem samples were taken (up to 30 stems/sample).

All samples were sorted under a microscope in the laboratory. Nymphs and wingless adult aphids were grouped in the results as apterae. Natural enemies such as lacewings, hoverflies, ladybird beetles, spiders and nabids were recorded. Records of SAA flight were kept with the aid of two cylindrical sticky traps (Broadbent *et al* 1948) placed in the lucerne field. Weather records were obtained from the Te Kauwhata meteorological station 5 km north of the study area.

RESULTS AND DISCUSSION

Population levels of lucerne aphids and natural enemies have been summarised in Fig. 1a-g. SAA numbers remained below 100/m^2 until mid-January (Fig. 1a), then

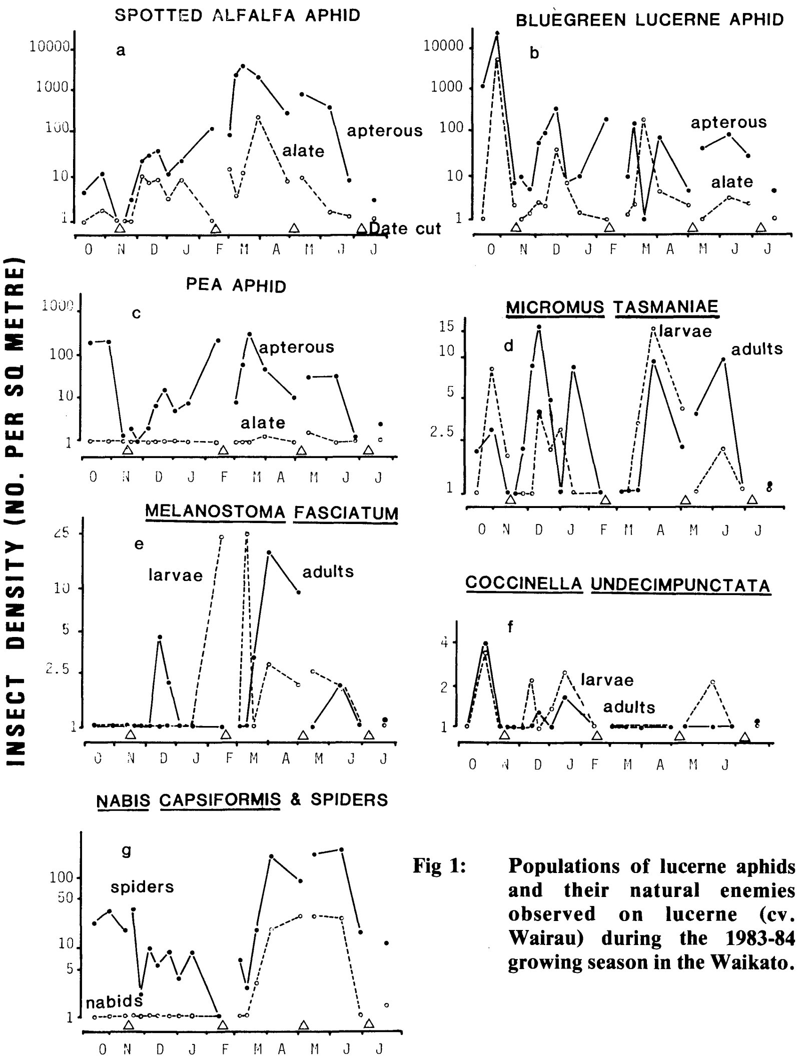

Fig 1: **Populations of lucerne aphids and their natural enemies observed on lucerne (cv. Wairau) during the 1983-84 growing season in the Waikato.**

increased steadily until mid-March, reaching 2960/m². The population declined from early-April to 1.2/m² in mid-July, a trend similar to that reported by Rohitha *et al* (1983). SAA populations have a prolonged peak compared to the other aphids. Winged SAA caught in the sticky traps followed a similar pattern.

The changes in BGLA numbers over the period are shown in Fig. 1b. Populations fluctuated markedly. Peak numbers of both apterous and alate BGLA occurred during early-spring, reaching 20,000/m². In contrast to SAA, BGLA populations crashed to low levels soon after peak numbers had been reached (Fig. 1b). The collapse of BGLA was due to *Entomophthora* spp., which are favoured by warm humid conditions (Nielson and Barnes 1961). In the week preceding the collapse 21.4 mm of rain fell and the mean relative humidity and mean daily temperatures were 88% and 17.5 °C respectively. Dispersal by alates also contributed to losses in BGLA numbers. A second, smaller peak occurred in mid-December associated with a corresponding increase in alate numbers. Coincident with the autumn flushes of growth, a small third peak of BGLA occurred in mid-March.

Pea aphid populations were comparatively low. Their numbers increased gradually until mid-March to a density of $290/m^2$ (Fig. 1c). Winged forms were scarce throughout the sampling period.

Lucerne was allowed to mature before it was cut. Both BGLA and SAA formed alatae, which dispersed from the field before each cut.

No fungal pathogens were observed on SAA in the field, even though the weather remained favourable for fungal activity in March. In the USA, Nielson and Barnes (1961) have reported that high mortality was brought about by heavy rainfall followed by *Entomophthora exitialis* outbreaks. The lack of an *Entomophthora* epizootic in autumn on SAA contrasts with the situation which occurred in BGLA in the spring. If SAA ever becomes a problem in New Zealand considerable potential exists for utilisation of entomophagous fungi during the autumn when suitable environmental conditions prevail. A potential pathogen is *Zoophthora radicans* which is effective under field situations in Australia (R.A. Milner pers comm).

No parasites were found on SAA, while only small levels of parasitism by *Aphidius eadyi* appeared to occur on PA. Levels of parasitism did not exceed 10%.

Lacewings were common throughout the study period (Fig. 1d), numbers fluctuating throughout the spring and autumn. Hoverflies, *Melanostoma fasciatum* were common at the end of summer (Fig. 1e), whilst ladybird beetles (*Coccinella undecimpunctata*) and larvae were more abundant in spring and summer (Fig. 1f). Neuenschwander *et al* (1975) have observed that several species of ladybird beetles control SAA in the USA. Spiders and nabids (*Nabis capsiformis*) which are less specific predators of aphids were much more populous in autumn than in spring, indicating a high temperature threshold for their development and activity (Fig. 1g). Spiders reached $260/m^2$ during autumn and the numbers remained high until early-June. Nabids followed a similar pattern to spiders and were the most abundant predators present in July.

From the end of July 1983 sufficient heat units (1,259 day degrees) above the temperature threshold of 10.5 °C (Cameron and Walker 1984) for SAA were recorded to allow more than eight generations to occur. If uninterrupted population increases of SAA had occurred the potential for populations in excess of $1.65 \times 10^{17}/m^2$ would result for each aphid/m^2 at the beginning of the season. The potential exists therefore for severely damaging populations to establish.

This study has shown that high populations of natural enemies, particularly lacewings and hoverflies, could potentially play an important role in regulating SAA populations because their periods of peak abundance are well synchronised with those of SAA. Relative to infestations in Australia, SAA populations do not reach high levels in the northern North Island. In Australia SAA populations of over 500/stem or $70,000/m^2$ have been recorded on Hunter River lucerne. Other lucerne aphids are important in the dynamics of SAA in New Zealand as they support natural enemies which transfer to SAA populations as they build up over summer. General predators such as spiders and nabids which occur in the late autumn-early winter complement the more specific aphid predators active over summer, and with cooler temperatures may assist the reduction in SAA numbers at the beginning of winter.

Lucerne aphids and their natural enemies are in a state of balance in the Waikato. Chemicals are rarely utilised to control aphids in this region. If applied, the disruptive effects of insecticides on aphid predators could result in damaging infestations of SAA. Insecticides should therefore be applied with caution. In this study the farmer's practice of leaving parts of the stand uncut at any one time, possibly favoured the survival of predator populations. Conversely, this practice could result in more rapid colonisation of cut areas by the aphids. The effects of predators may not be so pronounced in stands which are completely harvested for silage. Silage harvesting probably removes more natural enemies from the ecosystem than haymaking as the latter practice allows natural enemies to escape.

Harvesting lucerne for silage appeared to have variable effects on natural enemies. The effects of lucerne management on lucerne aphids and their natural enemies and their regulatory role warrants further study.

ACKNOWLEDGEMENTS

The authors thank Mrs Gloria King for laboratory assistance, and Mr F. Jamieson for the use of his farm.

REFERENCES

Broadbent, L., Doncaster, J.P., Hull, R. and Watson, M.A., 1948. Equipment used for trapping and identifying alate aphids. *Proc. Royal. Ent. Soc. London (A) 23:* 57-58

Cameron, P.J. and Walker G.P., 1984. Phenology and host preference of spotted alfalfa aphid on lucerne and white clover. *Proc. 37th N.Z. Weed and Pest Control Conf.:* 77-81.

Janson, C.G., 1983. Lucerne cultivars. *Farm Production and Practice. AgLink 147,* Ministry of Agriculture & Fisheries, Wellington. 3pp.

Neuenschwander, P., Hagen, K.S. and Smith, R.F., 1979. Predation on aphids in California alfalfa fields. *Hilgardia 43(2):* 53-78.

Nielson, M.W. and Barnes, O.L., 1957. Life history and abundance of the spotted alfalfa aphid in Arizona. *J. econ. Entom. 50:* 805-807.

Nielson, M.W. and Barnes, O.L., 1961. Population studies of the spotted alfalfa aphid in Arizona in relation to temperature and rainfall. *Ann. ent. Soc. Am. 54:* 441-448.

Rohitha, B.H., Pottinger, R.P. and Wrenn, N.R., 1983. Containment and dispersal of spotted alfalfa aphid in the northern North Island. *Proc. 36th N.Z. Weed and Pest Control Conf.:* 25-29.

Waterhouse, D.F., 1979. Pasture pests and biological control in Australia. *In* T.K. Crosby and R.P. Pottinger (eds.) *Proc. 2nd Australasian Conf. Grassl. Invert. Ecol.* N.Z. Govt. Printer, Wellington, pp. 12-16.