CONTAINMENT AND DISPERSAL OF SPOTTED ALFALFA APHID IN THE NORTHERN NORTH ISLAND

B.H. ROHITHA, R.P. POTTINGER and N.R. WRENN

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

SUMMARY

The southward spread of spotted alfalfa aphid (*Thereoaphis trifolii* f. *maculata*) since its discovery in New Zealand in April 1982 is outlined. During May 1982, infestations discovered in the Auckland area on lucerne (*Medicago sativa*) were eliminated by treatment with thiometon (200 g ai/ha) coincident with the onset of cool, moist winter conditions which are adverse to aphid survival. This operation successfully slowed the rate of spread of the aphid. Aphids survived over winter on spotted bur medick (*Medicago arabica*) in the Auckland area.

In summer 1982/83, aphids were seen on traps south of Auckland from January to April. The aphid needed an accumulation of 780 day degrees (D°C) above a temperature threshold of 8.5°C, counted from 1 December 1982 for peak flight.

INTRODUCTION

In April 1982, spotted alfalfa aphid (SAA) was discovered in New Zealand at various points between Helensville and Huntly. The exact source of the aphid is uncertain but it probably arrived from Australia where it established in 1977. Within a year, SAA had spread through all significant lucerne growing areas of Australia and was estimated to have caused \$50 million of damage (Waterhouse 1979). In New Zealand the aphid was observed to colonise spotted bur medick, white clover (*Trifolium repens*) and lucerne with the largest infestations being found on lucerne. Subsequently the aphid has been successfully reared on these legume species (Cameron *et al* 1983). Because of its importance as the major pest of lucerne in the Northern Hemisphere and Australia, the New Zealand Ministry of Agriculture and Fisheries set up a contingency plan in 1978 to cope with this insect if it established in New Zealand. As part of this programme, the Insect Control and Organic Chemistry Group, Ruakura Agricultural Research Centre, was asked to apply insecticide to infested fields within a month of the aphids being discovered in New Zealand. The results of this assignment are included in this paper.

The effects of SAA on lucerne survival and production are well known (Allen 1982). Spotted alfalfa aphid causes leaves to yellow and drop, the lowermost first. The aphid injects a toxin which causes leaf veins to whiten and susceptible plants stunt and die. Seedlings are most susceptible (Gramshaw 1981). Besides direct damage to host plants the aphid is a known vector of viruses, including lucerne mosaic virus (Gaaran and Gibbs 1982).

A study of the aphid's spread through the northern North Island was initiated in December 1982. Preliminary data gathered in this ongoing study is reported here.

METHODS

The location of infested properties and composition of fields sprayed, in order to slow the rate of spread of the aphid, are presented in Table 1. All lucerne stands and lucerne or white clover based pastures were sprayed with 200 g ai thiometon (Ekaton 20 EC)/ha, 12 litres of spray mix being applied as 150 μ droplets through a controlled droplet applicator. This was twice the rate recommended for blue green lucerne aphid (*Acyrtosiphon kondoi*) in order to achieve as high a mortality of SAA as possible. The

Proc. 36th N.Z. Weed and Pest Control Conf.

treatments were applied over a 3 day period during calm, sunny conditions. Each field was sampled a week before and after treatment and then monthly with 300 mm diameter sweep nets. A total of 90 or 180 sweeps being taken per field, the number of sweeps being divided equally between either 3 or 6 parallel transects, depending upon the density of aphids. The sweepings were preserved in 70% ethyl alcohol and samples examined in the laboratory with a binocular microscope. All infested fields sampled by sweep net were also visually examined.

TABLE 1: Results of thiometon application against spotted alfalfa aphid subsequent to establishment in the South Auckland region.

Locality	No. of fields	Type of cover	Date sprayed	Pre-treatment mean/90 sweeps	Ratio winged/total	Survivors at 1 week mean/90 sweeps
Waiuku—Site 1	1	Lucerne	3.5.82	910	0.1	1
Waiuku—Site 2	8	Lucerne	4.5.82	361 (range 20-894)	0.1	0.5
Waiuku—Site 3	1	Pasture**	4.5.82	68	0.1	0
	1	Runout lucerne*	4.5.82	31	0.3	0
Aka Aka	2	Runout lucerne*	3.5.82	5 (4-6)	0.3	0
Pukekohe—Site 1	1	Runout lucerne	3.5.82	3	0	0
Pukekohe—Site 2	3	Lucerne	4.5.82	15 (10-22)	0.3	0.3
	2	Pasture**	4.5.82	2.5 (1-4)	0.9	0
Ohinewai	1	Lucerne	5.5.82	21	0.1	0
Rotongaro	2	Lucerne	5.5.82	29 (5-53)	0.1	0
Ruawaro	1	Lucerne/pasture*	5.5.82	2	1.0	0

* Mainly white clover and grasses

** White clover/grass pasture

In order to check the flight activity of SAA, monitoring sites were established at the localities shown in Figure 1.

Monitoring at each site was by means of two sticky traps (Broadbent *et al* 1948) and two water traps each 400 x 280 x 100 mm painted canary yellow. Sticky traps were held 1.2 m and water traps 0.45 m above ground level. All traps were serviced weekly. Traps were sited in lucerne except at Mt Albert and Te Kauwhata where they were in pasture.

Accumulated day degrees (starting from 1 December 1982) for spotted alfalfa development were calculated using the daily maximum and minimum temperature values for Mt Albert, Pukekohe, Te Kauwhata, Rukuhia and Te Puke. The temperature threshold for the aphid was taken as 8.5 °C after Graham (1959).

RESULTS AND DISCUSSION

The results of the insecticide containment programme are summarised in Table 1. As no aphids were recovered from samples taken between June and October 1982, these counts have not been included in the table. The results confirm that the objective of the operation was fulfilled and that insecticide mortality supplemented with natural mortalities, such as cool, moist, winter conditions, eliminated the aphid from all known infested lucerne fields. In contrast to lucerne, pastures and runout lucerne stands with a high proportion of white clover had higher ratios of alate to apterous aphids. This suggests that the aphid was breeding more freely on lucerne during autumn 1982, and that winged adults were dispersing from lucerne and alighting downwind on pastures. Nymphs were recovered from clover based pasture but never in large numbers.

Fig. 1: Locality of spotted alfalfa aphid monitoring sites in the northern North Island.

Subsequent sampling of pastures at regular intervals throughout South Auckland and Waikato, however, has shown the regular southward movement of the aphid from Auckland, from November 1982 until April 1983 (unpublished data). This confirmed earlier observations that white clover dominant pastures support low populations of SAA. Cameron *et al* (1983) also showed in a glasshouse trial that white clover was less favourable for development than lucerne and spotted bur medick. More definitive work is required to determine whether grazing and/or the quality and growth form of white clover are adverse to development of the aphid. The relationship between SAA and damage to both seedling and established white clover, either by direct feeding or by transmission of viruses, must also be determined before its importance to New Zealand's pastoral agriculture can be clearly stated.

Spotted alfalfa aphid was directly observed on host plants in fields at sites 1 and 2 at Waiuku (Table 1). Populations were low, the number found per lucerne stem ranging from 0-7. Visible damage on white clover has not been seen in the field.

Winged SAA were first collected from the monitoring traps at Rukuhia on 13 January 1983, Tauranga on 24 February, Hora Hora on 18 March and Edgumbe on 14 April. The pattern of trap catches supports colonisation of new areas by dispersal flights southward from Auckland city, with its abundant sources of spotted bur medick which could not be treated with insecticide.

The mean number of SAAs taken in the sticky and water traps plotted against time are given in Figure 2. Spotted alfalfa aphids were not trapped at the other sites. The highest numbers of flying aphids were trapped at Pukekohe whilst the last recorded infestation was at Edgumbe, approximately 250 km south-eastward from Auckland. Obviously the aphid has the propensity to quickly disperse, even though its preferred host, lucerne, is not abundant in the initial area of its establishment. Dispersal may be enhanced when SAA reaches more extensive lucerne growing areas, such as the Volcanic Plateau, and builds its population base. Besides natural dispersal it seems likely that winged aphids could be accidentally spread by internal airplane flights from Mangere and Rukuhia airports to other parts of New Zealand, as disinfection procedures have not been practiced.

The values of accumulated day degrees obtained from 1 December until the peak flight were:

Mt Albert	799 D°
Pukekohe	788 D°
Te Kauwhata	775 D°
Rukuhia	764 D°
Te Puke	986 D°

The accumulated heat value required by the insect for peak flight is around 780 D°. At Te Puke, the aphids arrived much later in the season and possibly the flight peak was delayed until population development took place. Because of its warmer conditions Te Puke appears to have been much more favourable for increase of aphid populations compared to other localities infested between December and February. This response to heat by SAA is also reflected in the larger field populations on lucerne at Pukekohe. Figure 2 shows that SAA populations peaked in late summer/autumn in all localities, seasonally the driest and hottest period of the year in the northern North Island and declined in late autumn. In colder regions of New Zealand, the aphid may not reach peak populations until autumn. The ability of the aphid to survive and disperse in the northern North Island suggests that the aphid could reach damaging levels in central and eastern districts which have hotter, drier summer conditions and extensive lucerne plantings, particularly if an accumulation of 800 D° in excess of a threshold temperature of 8.5°C occurs between December and April.

Fig. 2: Trap catches of winged spotted alfalfa aphid in the northern North Island 1982/83.

CONCLUSIONS

Thiometon applied at 200 g ai/ha controlled SAA south of Auckland in 1982 and when coupled with adverse winter conditions appears to have eliminated the aphid from lucerne which was treated. The success of the containment programme was also assisted by the decline of winged SAA populations in autumn. Because of the reduced source of aphids the rate of SAA migration to other parts of New Zealand may have been slowed. This supports the policy to contain newly introduced pests as long as possible, in order to allow time for research and development of control procedures.

The aphid could establish in lucerne growing districts with hotter, drier summer conditions than Waikato. Lucerne is much more favourable than white clover for field development of the aphid. The results indicate that sticky traps are much more efficient than water traps for monitoring SAA flight.

ACKNOWLEDGEMENTS

The assistance of MAF and DSIR staff and farmers in servicing traps in their districts is gratefully acknowledged. Also, P.J. Addison and A.C. Firth for technical assistance.

REFERENCES

- Allen, P.G., 1982. The impact of spotted alfalfa aphid on dryland lucerne in South Australia. In: K.E. Lee (Editor), *Proc. 3rd Australasian Conf. Grassl. Invert. Ecol.*, S.A. Govt. Printer, Adelaide: pp. 17-23
- Broadbent, L., Doncaster, J.P., Hull, R. and Watson, M.A., 1948. Equipment used for trapping and identifying alate aphids. *Proc. Royal Ent. Soc. Lond. (A)* 23: 57-58
- Cameron, P.J., Sunde, R.G. and Walker, G.P., 1983. Spotted alfalfa aphid in New Zealand (Hemiptera:Aphididae). *N.Z. J. Agric. Res.* (in press).
- Gaaran, J. and Gibbs, A., 1982. Studies on alfalfa mosaic virus and alfalfa aphids. *Aust. J. Agric. Res.* 33: 657-664
- Graham, H.M., 1959. Effects of temperature and humidity on the biology of *Therioaphis maculata* (Buckton). *Univ. Calif. Publ. Ent.* 16: 47-80
- Gramshaw, D., 1981. Factors limiting lucerne production. *Queensland Agricultural Journal* 107: 15-18
- Waterhouse, D.F., 1979. Pasture pests and biological control in Australia. In: T.K. Crosby and R.P. Pottinger (Editors), *Proc. 2nd Australasian Conf. Grassl. Invert. Ecol.* N.Z. Govt. Printer, Wellington. pp. 12-16