SEASONALITY OF
BLUE GREEN LUCERNE AND PEA APHID
IN THE SOUTHERN NORTH ISLAND OF
NEW ZEALAND

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Summary

The interspecific balance of mixed blue green lucerne aphid (BGLA) (*Acyrtosiphon kondoi*) and pea aphid *A. pisum* populations in lucerne crops (*Medicago sativa*) in the southern North Island changes with season. Generally BGLA predominates in spring-early summer and following cool moist summers is more numerous than pea aphid in autumn. Pea aphid out-numbers BGLA in summers which are favourable for mixed aphid populations and following summer droughts is the more numerous of the two species in autumn. Population collapses of both BGLA and pea aphid appear to be associated with one or more of the following factors, full stem growth, rapid alate production, epizootics of *Entomophora* spp and grazing or harvesting. Moisture stress and dormancy of the host plant are considered to be as important factors as temperature in suppressing BGLA population in summer and winter respectively.

INTRODUCTION

Blue green lucerne aphid and pea aphid were first identified in New Zealand in 1975 and 1976 respectively and now occur in mixed populations in most lucerne crops throughout the country. Both pests are recognised as serious pests of lucerne in North America where they have been effectively controlled through the development of multiple aphid resistant cultivars (Nielson *et al* 1976). 'Wairau', the most commonly grown lucerne cultivar in New Zealand, is highly susceptible to attack from both aphid species. As a consequence, damage caused by these pests has been sidespread and often severe (Kain *unpub*). The present paper reports on the bionomics of these pests in the southern North Island region. The purpose of these studies was to provide information essential to the economic control of both pests and thereby maintain the production of existing lucerne crops until replaced by aphid resistant cultivars. Certain aspects of these studies (Gaynor *et al* 1978) and associated studies on pest assessment (Kain *et al* 1979) have been published.

METHODS

Studies reported here were located at Flock House near Palmerston North, Hawera in Taranaki, Masterton in Wairarapa and at Takapau and Dannevirke in central and southern Hawkes Bay respectively. Study sites were chosen to provide a representative range of climates found within the southern North Island. Takapau and Masterton usually suffer from

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summer droughts and severe winter temperatures. Dannevirke has even cooler winter temperatures but moist cool summers. Hawera and Flock House experience cool winters and usually good summer rainfall. Rises in soil temperature occur earlier in spring in the Himatangi sand at Flock House than in either the soils close by (Manawatu silt loams) or in Taranaki. Because of the poor water holding capacity, of Himatangi sand these soils suffer from severe summer droughts whereas the moisture status of the Manawatu silt loams is maintained above wilting point by rainfall longer into the summer. With the exception of a trial involving different cultivars all studies were carried out on the lucerne cultivar 'Wairau'.

At Flock House, studies were confined to a small plot trial laid down in October 1977 to examine the effect of insecticide (permethrin 0.25 kg/ha) applied at different aphid densities on lucerne production. The trial was sited on Manawatu silt loam and was of a split plot randomised block design with three treatments, sprayed with insecticide as soon as aphid numbers rose to between 5 and 10 /stem and to greater than 30 /stem and an untreated control.

Each treatment was replicated ten times. Plots (3 x 5 m) were split into two equal sub-plots. Each sub-plot was cut initially 14 days apart. There after all sub-plots were cut with a sickle bar mower at the basal bud movement stage and the herbage raked from the sub-plots.

Aphids were sampled weekly by cutting at ground level 10 stems selected at random from each sub-plot. Samples were rinsed in hot water to remove aphids which were then collected over filter paper in preparation for microscopic examination to determine species and developmental stages. Stem lengths of the washed foliage of all samples were measured. At the end of May the complete trial area was sprayed to prevent further aphid damage.

Monitor sites located at Hawera, Takapau and Dannevirke were divided into four plots, each of which were further sub-divided into two sub-plots. Each sub-plot was harvested 14 days apart and sampled weekly for aphids.

At Masterton, studies were extended to two small lucerne paddocks (0.12 ha) one of which was grazed throughout the year with sheep at 6 weekly intervals, the other at basal bud movement. Twenty stem aphid samples were taken weekly from each paddock.

The effect of a number of winter active and winter dormant lucerne cultivars on aphid numbers were studied from late autumn to early spring on a small plot trial (1.5 x 5 m) sited on Himatangi sand at Flock House. The trial was designed to evaluate the performance of a number of different lucerne cultivars and was of a randomised block design with three replicates. Plots were not sampled for aphids until infestations became obvious.

A wind net aphid trap (Ashby 1976) was erected at all sites and aphid catches were collected weekly.

RESULTS AND DISCUSSION

Over the periods that these studies were conducted Takapau, Masterton and Hawera suffered severe summer droughts whereas summer soil moisture levels at Dannevirke and on the alluvial soils at Flock House were maintained by rainfall above wilting point throughout the summer.

Pea aphid occurred at much lower densities than BGLA (Figs. 1 and 2) was not present in plots at Dannevirke in 1976-77. Whereas BGLA frequently rose to 200 /stem pea aphid only reached 60 /stem. Pea aphid increased to low levels early in spring but was then rapidly out-numbered by an upsurge in BGLA (Fig. 1). Relatively high pea aphid populations also occurred at this time. In early to mid-summer aphid populations at most sites collapsed except in the cool areas such as Dannevirke where

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FIG. 1: Blue green lucerne and pea aphid population levels (Nos/stem) and flight (Nos/trap) at three monitoring sites. (Flock House untreated plots; Population levels in 1977-78, ■ = Harvest A, and □ = Harvest B; Flight, □ = 1977-78, and ■ = 1978-79).

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FIG 2. Bluegreen lucerne ■ and pea □ aphid levels of lucerne at six weekly and base bud movement and flight at Masterton and aphid levels (1976-77) and flight (1977-78) at Dannevirke.

FIG. 3: Population levels of blue green lucerne aphid and pea aphid ■ on lucerne and number of alate present □ at Takapau and Flock House in 1977-78.

BGLA persisted at low levels throughout the summer and at Flock House where pea aphid increased to high levels. Where aphids were present in summer, large autumn increases in BGLA occurred (Figs. 1 and 2) whereas in areas which experienced summer droughts (e.g. Fig. 2 Masterton or Fig. 3 Takapau) or in years with dry summers (e.g., Fig. 1 Hawera) small autumn rises occurred in pea aphid but not in BGLA numbers (Fig. 1).

Flight of BGLA and pea aphid began in mid-September to early October and peak flights coincided with or were slightly ahead of peak BGLA occurrence on lucerne (Figs. 1, 2 and 3). As with population levels autumn flights of BGLA did not occur following dry summers and were only recorded in areas or years with moist summers where soil moisture levels did not fall below wilting point. In comparison small pea aphid flights occurred in autumn at all sites irrespective of summer droughts (Figs. 1, 2 and 3). Under cool summer conditions flights of both aphids occurred from spring through to early winter (Figs. 1 and 2).

Pea aphid and BGLA overwintered as apterae in low numbers in lucerne crops and were found in higher numbers in ungrazed than winter grazed crops. As a result of the higher aphid numbers which over-wintered in ungrazed or laxly grazed lucerne, population increases in spring were much more rapid than in winter grazed crops (c.f. basal bud movement and six weekly grazed crops – Fig. 3) where numbers were low until the occurrence of spring flights.

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From these studies, the seasonality of BGLA in the southern North Island appears to be controlled by at least three factors, day length, temperature and soil moisture. It is clear from observations on BGLA levels on a range of lucerne cultivars (Table 1) that the seasonality of this pest is markedly affected by the winter active cultivars of lucerne. Any change from 'Wairau' to more winter active cultivars will immediately alter the seasonal activity on lucerne of both pests and possibly flight, although this will be determined by the temperature thresholds for flight as well as a late development. Winter dormancy of lucerne is associated with day length and therefore in the warmer areas of the southern North Island day length is probably as important as winter temperature in suppressing winter populations of aphids.

It is interesting to note in this regard that in spite of the widely differing climates the study sites represent, aphid populations began to build up at very similar times in spring on all sites (mid September to early October) (Figs. 1, 2 and 3) a time when Wairau begins to make rapid spring growth. An exception to this trend was found in the lucerne cultivar trial (Table 1), where spring increases in BGLA occurred earlier than at all other sites. This may have resulted from cross infestation of apterae from winter active to winter dormant cultivars and/or the high spring soil temperatures found in Himatangi sands which favour early spring growth and thus rapid development of aphid populations.

TABLE 1: Effect of different winter dormancy class of lucerne cultivars on blue green lucerne aphid levels/stem at Flock House.

	9 May	6 July	20 Sept
Semi winter active	18.9	9.6	27.4
Winter dormant	4.5	2.6	35.5
LSD (P = .05)	4.5	4.7	9.7

Winter dormant cultivars = 'Washoe', 'Saranac', 'Wairau'. Winter active cultivars = 'C.R.D. winter grower', 'Hunter River', 'Florida 66'.

Observations made in these studies place in question the extent to which collapses in BGLA aphid populations in summer are caused by high summer temperatures and support the view of Gaynor *et al* (1978) that in N.Z., summer moisture stress on plants may cause population collapse rather than high summer temperatures. For example, levels of both aphids collapsed at Hawera when the district suffered a drought in January whereas at Flock House aphid populations persisted throughout the summer although summer temperatures at the two sites were not appreciably different. In comparison soil moistures differed markedly between the two sites and at Hawera loss in cell turgor of lucerne was evident just after midday during January and February. This condition is usual for this time of the year at Takapau and Masterton and may trigger population collapses of BGLA through the rapid production of alate and dispersal (Fig. 3). However the reasons for the disappearance of pea aphid during summer droughts are not clear.

Spring increases in BGLA are exponential (Figs. 1, 2 and 3) and as the asymptote of the growth curve is approached, aphid levels begin to decline with a corresponding increase in alates (Fig. 3 Takapau). Reasons for this decline in BGLA populations is unknown. Collapses of pea aphid and BGLA populations also occurred at harvest or grazing (Kain unpub.) and on occasions epizootics of *Entomophora* spp caused sudden reductions in

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numbers of both pests. Substantial numbers of predators were not observed at any of the sites during these studies. The extent to which interspecific competition occurs between the two species is not known but frequently in these studies pea aphid populations appeared to be competitively displaced by BGLA, particularly in autumn.

CONCLUSIONS

From information on the seasonal nature of flight and occurrence of BGLA and pea aphid on lucerne an obvious strategy in controlling both pests in winter dormant lucerne cultivars in the summer dry areas of the southern North Island rests on reducing aphids to extremely low levels in winter by grazing or through the use of insecticide in order to prevent rapid upsurges in aphid levels until reinfestation occurs with spring flight in mid to late October. Aphid control may then be required until summer population collapses occur in December-January. Dependent on the adverse effects of summer on aphid population crops may or may not require protection from aphids in autumn until flight has ceased in May. In areas with conditions which favour the summer persistence of aphid populations control methods will have to be imposed frequently and it is in these areas that aphid control creates problems. However, it is also in these areas that the drought resistant properties of lucerne are less important than in summer dry districts and hence in such localities the crop has few advantages over traditional pasture species.

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