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Can parasites and resistant plants control exotic lucerne aphids?

by J. D. Sandow*

The spotted alfalfa aphid (SAA) Therioaphis trifolii and the bluegreen aphid (BGA) Acyrthosiphon kondoi have had profound effects on the lucerne industry in Western Australia. It now seems certain that other pasture species will be affected as the bluegreen aphid reaches its full potential.

Both these pests are recent arrivals in Western Australia; SAA was first detected in January 1978, and BGA appeared in June 1979. An even more recent arrival in Australian pastures is the pea aphid (PA), Acyrthosiphon pisum. This pest is likely to reach Western Australia in due course and is expected to cause additional damage.

Spotted alfalfa aphid

Identification and plant symptoms

The spotted alfalfa aphid is identified by the rows of tiny black spots on its back at all stages of the life cycle. SAA is pale green, sometimes yellowish, and appears in both winged and wingless forms. Smokey coloration around the wing veins can be seen with a good hand lens.

SAA is active in late summer and autumn. Heavy infestations can build up rapidly, with five to ten days, and the effect on lucerne can be devastating. The lower leaves turn yellow and drop off at first but the effects creep up the plant as the damage continues. Finally, only sticky stems are left standing, covered in the black sooty mould which grows on the aphids' excreted honeydew. At this stage very few aphids remain: they disappear as quickly as they appear, owing to the ability of young aphids to produce wing buds when the food supply deteriorates or when overcrowding occurs.

During the first two seasons of SAA activity in Western Australia, severe symptoms were common in irrigated lucerne stands from January to May. Damaging infestations were recorded in dryland lucerne as late as August when local conditions were dry. The effects of SAA have decreased since 1979. This probably is due to a range of environmental pressures including climate, natural enemies, decreasing use of Hunter River Lucerne and the successful establishment of an introduced parasite of the aphid.

Biological control

A number of natural predators can reduce aphid numbers. These include ladybirds, hover-flies and lacewings. However the reproduction rate of these insects is considerably lower than that of SAA. None can keep up with the population explosions of the aphids.

Several species of tiny parasitic wasps with generation times comparable to that of aphids have been introduced into Australia to control SAA. Of these the most successful has been Trioxys complanatus. Entomologists first released this wasp in Western Australia in 1979 and it is now firmly established over a wide area.

The wasps were reared in laboratories at South Perth, using techniques identical to those for rearing parasites of BGA. Lucerne is grown in plastic boxes and infested with aphids when it is four months old; then a collapsible cage is erected on top of each box to introduce the parasite. The female wasps walk up and down the lucerne stems seeking out the young aphids and injecting each one with a single egg.

In a day or so the egg hatches and the tiny wasp larva starts to devour the aphid. After several days the larva occupies most of the space within the aphid, which soon dies. The dead aphid, brown and bloated, is called a mummy. It is firmly attached to the lucerne plant by silken threads spun by the larva. The wasp pupates within the aphid skin and emerges through a neat round hole which it cuts in the back of the mummy. The whole process takes about 14 days.

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When the wasps are ready to emerge, staff take the cages to infested lucerne paddocks and dismantle them, leaving the lucerne plants with their complement of adult wasps, mummies and parasitised aphids. Aphid mummies are now a common sight in irrigated and dryland lucerne stands when SAA is active.

**Bluegreen aphid**

*Identification and plant symptoms*

BGA is 2 to 3 mm long (a little larger than SAA) and is a flat bluish green. The legs and antennae are long and the thorax of winged specimens is pale brown.

The effects on Hunter River lucerne vary from mild stunting of growth and slight yellowing, through to the complete collapse of plants as if under heavy SAA attack.

The Bluegreen aphid also may infest lupins, but at least five other aphid species attack lupins and researchers do not know yet whether BGA will add to the pest problems of existing lupin varieties.

The most serious threat posed by this exotic aphid is its ability to attack annual medics and sub clovers.

The effects of BGA in annual medics and sub clovers are still uncertain. During spring 1980, BGA devastated some medics, and affected sub clover varieties to varying degrees. For example, an ungrazed stand of Tornafiel medic at Cervantes was severely damaged, with some stems carrying more than 500 aphids. There were many circular patches about four metres in diameter containing only dead medic plants and a few weeds. Flowering was reduced severely over most of the remaining area, and the grower subsequently abandoned any hope of harvesting seed.

In sub clovers, damage is seen first when plants wilt and dry off in patches. From the fenceline the paddock may have a patchwork appearance but as damage continues the whole pasture may dry off. The dried plants have a characteristic ‘cardboard brown’ appearance. It is still too early to say whether such damage will be a common occurrence in sub clovers. But if BGA continues to attack these legumes to any significant extent, some 7 million hectares of pasture may come under threat.

*Biological control*

Naturally occurring predators are effective in reducing aphid numbers, but the most important natural control of BGA under moist winter conditions is by several fungal diseases. Affected aphids turn white or brown and may become covered in furry, fungal growths before shrivelling.

Departmental entomologists started a parasite rearing and release programme similar to that for SAA shortly after BGA was first detected in Western Australia. The parasitic wasp *Aphidius ervi* was released extensively during 1980 in lucerne and sub clover. For many months there were no signs of establishment despite the vast numbers of wasps released. Then a method of liberating parasites under tent-like enclosures was developed to improve their survival in the field. Finally, in October 1980, good recoveries of parasites were made from Hunter River Lucerne in the Myalup district. Since then, *A. ervi* has proved itself to be a very effective aphid parasite indeed. It spread rapidly to neighbouring properties in Myalup, where parasitism levels of 30 per cent were not uncommon in moderate BGA infestations. In April of this year, BGA was very active in the south west of Western Australia, affecting irrigated lucerne and early-germination sub clover pastures around Harvey. Simultaneously, parasite activity also increased dramatically.

A heavy aphid infestation on lucerne at Myalup was controlled entirely by parasites just as serious damage appeared imminent. At the height of the parasite’s population explosion, over 70 per cent of the aphids sampled from the paddock contained developing wasps. The lucerne leaves were dotted with mummies. In fact 69 of these bloated aphid skins were counted on a single lucerne stem.

Within a week of this remarkable spectacle, living aphids were very difficult to find in this crop.

The parasite’s success was not restricted to lucerne. Even as the first BGA infestations in sub clovers at Harvey were noticed, parasitism was already rife. The task of establishing BGA parasites in sub clovers and annual medics is complicated by the annual growth pattern of these species. Since annual pasture legumes
damaging to all of the commercially available sub clover varieties in Western Australia. If heavy aphid infestations are maintained for four weeks, damage varies between cultivars from yellowing of a few leaves to complete death of plants. These results are useful for determining those varieties which have a genetic basis for resistance, however their value in the field is limited by the variable conditions which exist in sub clover pastures. For example, flowering time may be of critical importance in the field. The early flowering sub clover variety, Nungarin, ranks as second most resistant sub clover in the laboratory, but several Nungarin pastures appeared to suffer heavy seed losses as a result of BGA infestations during 1980. Such anomalies will take several years to clarify, not only because of the research work involved but also because the pest can be expected to go through a 'settling in' period in which damage will not necessarily be typical.

In the interim there is no doubt that chemical control will be required to deal with population increases which cannot be contained by the aphid’s natural and introduced enemies.

Resistant plant varieties

Several Australian plant breeding programmes are aimed at developing suitable aphid-resistant lucerne and medic varieties.

One aphid tolerant lucerne variety (CUF 101) is commercially available in Western Australia but many more from Australian and overseas breeding programmes are now under test.

Entomologists and agronomists are monitoring these varieties for aphid resistance, growth habit and susceptibility to a range of diseases.

BGA infestations on irrigated trial plots have already shown up a wide range of resistance to aphids among the experimental varieties. However these results must be interpreted carefully. Loss of yield does not always correlate well with absolute aphid numbers. Some varieties may tolerate heavy aphid infestations and perform better than those which appear to attract fewer aphids.

It seems likely that some of the commercially available sub clover cultivars will need to be replaced by more resistant lines.

Western Australia holds the National Subterranean Clover Collection comprising some 6,000 genotypes. As many as 20 per cent of these could require testing for resistance to BGA.

Researchers started a screening programme in the summer of 1980. They expect to continue this until 1986. Information from this programme will be used in conjunction with existing sub clover screening experiments to identify improved sub clover varieties which are resistant to BGA and suitable for Western Australian conditions.

Plant screening trials started in January 1980 as a joint project combining the expertise of researchers in the Plant Research Division and the Entomology Branch of the Department of Agriculture.

These trials are conducted under controlled conditions at South Perth. To date, BGA has proved to be

• Aphid mummies on clover... evidence of the parasite's success.

• A mummified aphid. The wasp larva is inside.

• The wasp's exit hole through the mummified body.