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WOOLLY APPLE APHID IN APPLE TREES

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The woolly apple aphid, ***Eriosoma lanigerum*** (Hausmann), is a serious pest of apple trees. It attacks both the aerial parts (Fig. 1) and the roots (Fig. 2). Aphid feeding causes the formation of galls which destroys developing buds (Fig. 3) and damages the wood. Under ground feeding also causes galls (Fig. 4) which adversely affects the translocation of water and nutrients (Brown *et al.* 1991). This can impair the development of the tree. In severe cases trees can be pushed out of the ground by these root galls (Fig. 5).

Aphelinus mali (Hald), the most effective natural enemy of woolly apple aphid (Fig. 6), is found in most apple growing areas. However, biological control is not always successful. In areas where *A. mali* has not performed satisfactorily, it appeared as if there was a lag between parasitoid activity and that of the aphid. This is probably due to differential temperature thresholds for development and reproduction between the host and its parasitoid (Heunis 2001).

BIOLOGY

In South Africa woolly apple aphid propagates entirely parthenogenetically. Therefore females do not need males and only one aphid is needed to start a new colony. During the winter woolly apple aphids live and feed on the roots. In spring and summer an endless migration of woolly apple aphid crawlers from colonies on the roots takes place up into the tree. These crawlers start new colonies in the aerial parts. Crawler movement from the roots into the trees occurs from October to June with peak movement from October to December (Fig.7). Under the local, mild conditions woolly apple aphids are also able to overwinter in suitable protected sites on the tree above ground. Peak movement up from the roots also coincides with a peak in aerial movement of crawlers (recorded on the yellow sticky traps). A second and longer peak in aerial movement of crawlers occurs from January to mid-May. This coincides with peak occurrence of colonies in the trees.

Although *A. mali* is also active throughout the winter, some enter diapause and emerge at the end of winter and early spring. Peak numbers of unparasitised colonies (Fig. 1) are

Fig. 1. Woolly apple aphid colonies on an apple tree.

Fig. 2. Woolly apple aphid feeding on the roots of an apple tree.

Fig. 3. Galls on apple tree branch caused by woolly apple aphid feeding.

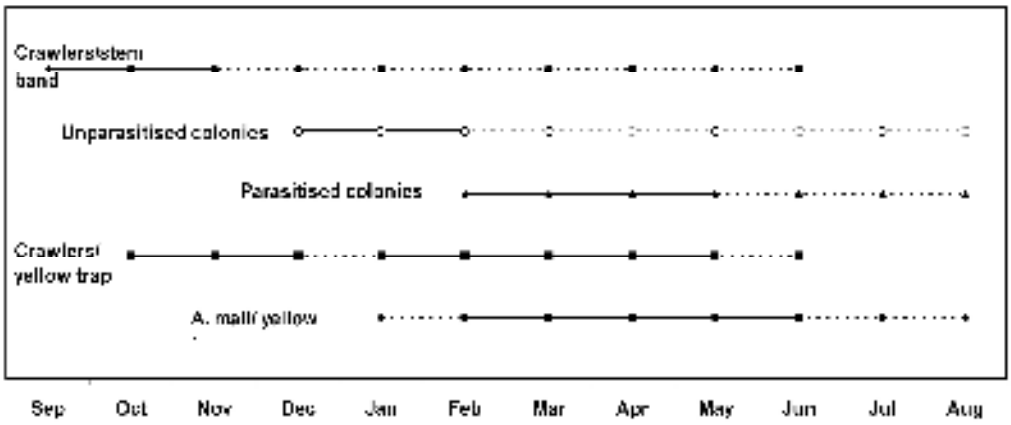

Fig. 7. Periods during which woolly apple aphid crawlers moved up from the roots to the aerial parts of the trees (crawlers/stem band); there was aerial movement of crawlers (crawlers/yellow trap); unparasitised and parasitised colonies were recorded; *Aphelinus mali* was active (*A. mali*/yellow trap). Broken line = present; solid line = peak numbers.

usually present from December to February, the peak of parasitism by *A. mali* occurs from February until mid-May when the trees start entering dormancy (Fig. 7).

CONTROL

Monitoring

A presence-absence sampling system is used:
1. Divide orchards into ±2 ha blocks.
2. Select 25 evenly spaced trees (using the variety that is harvested last) throughout the block.
3. Examine half of each tree every second week for the presence or absence of colonies in the leaf axils.
4. Note the number of trees infested without (Fig. 1) and with parasitised aphids (Fig. 8). A tree is classified as having parasitised aphids when at least one black mummified aphid is visible (Fig. 9).
5. If no trees with parasitised aphids are found chemical intervention is advised when 7 trees are infested.
6. If parasitised colonies are present spraying can be POSTPONED until 13 of the 25 trees are infested.

Chemical control

Chemicals should be selected with the assistance of a pest management adviser. Withholding periods and residue levels applicable to the markets for which the fruit is destined should be taken into account.

Biological control

Two major factors influence the efficacy of biological control by *A. mali*, namely temperature and the chemical sprays applied for different pests in the apple orchard.

Relatively safe chemicals for biological control

Use chemicals that assure some survival of the natural enemy of woolly apple aphid, *A. mali.* From the chemicals tested we advise the use of insect growth regulators for codling moth control, endosulfan for the control of woolly apple aphid and the fungicides, penconazole, mancozeb, myclobutanol and iprodione (Heunis & Pringle, 2003).

Storing of diapausing *A. mali*

Twigs with the black mummified aphids containing diapausing *A. mali* larvae can be collected during June or July. They can be kept in cold storage until after the upward migration of woolly apple aphid crawlers during spring when they can be released to augment the number of parasitoids occurring naturally. These parasitoids will also escape the negative effect of chemicals sprayed at the end of winter, as they will be placed in the orchards after the sprays have been applied.

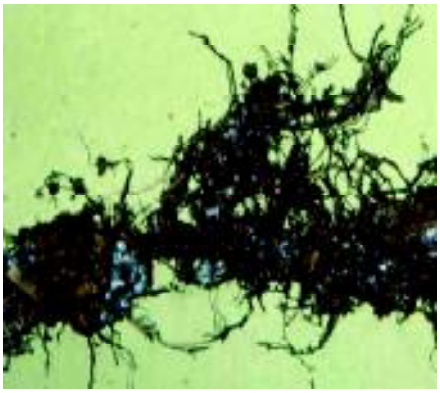

Fig. 4. Galls on apple roots caused by the feeding of woolly apple aphid.

Fig. 5. Woolly apple aphid galls on the roots of an apple tree pushing the tree out of the ground.

Fig. 6. *Aphelinus mali* on a woolly apple aphid colony with the small first instar aphids wandering around on waxy excretions.

Other treatments

Subterranean colonies: The control of subterranean colonies is very important. In one case during spring we found that 15 000 crawlers were caught on a sticky band (Fig. 10) left on the stem of an apple tree for a two week period. Therefore the control of these subterranean colonies can be the most important step to minimise aerial infestation and delay the spread of woolly apple aphid through the orchard.

1. These aphids can survive on root galls for long periods after the trees have been removed, infecting new trees that are planted in the same area. Replanting of orchards must only take place when it is certain that no more woolly apple aphids survive in the ground.
2. Ensure that clean nursery material is used.
3. Imidacloprid (Confidor) soil application after blossom is registered (Pringle 1998).
4. Straw mulch under the trees has provided good control (Damavandian 2000).

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Fig. 8. Woolly apple aphid colonies parasitised by *Aphelinus mali*.

Fig. 9. The black mummified aphids cause by parasitisation by *Aphelinus mali*.

Fig. 10. Sticky bands applied to monitor movement of woolly apple aphid crawlers.