MAJOR NATURAL ENEMIES

1 INTRODUCTION

Some biocontrol agents of economic importance are mentioned in sections dealing with specific pests. It is important to remember that those mentioned are only a small proportion of the complex of species associated with each pest. Although the population levels of one or a few biocontrol agents are routinely assessed in association with a particular pest in deciding on the need for chemical intervention, it must be remembered that the entire complex of species contributes to the control of the pest. Different components of the complex, such as the predators, may become more abundant at higher pest population levels.

A particularly large and problematic complex of pests is associated with citrus in southern Africa. However, there is likewise a large complex of biocontrol agents associated with these pests. These agents consist of indigenous species either associated with indigenous pests on citrus or having switched from their indigenous host or prey to an exotic pest on citrus. There is also a large component of the biocontrol complex which consists of species originating from other parts of the world. Some of these species entered the region together with the pest organism. In other cases the distribution of the natural enemy increased subsequent to the initial invasion of the pest, either passively or with the aid of human activity, both intentional and accidental.

The resultant complex often maintains the population level of the pest species below economically damaging thresholds. This balance is seldom maintained at a level where the pest is not readily observable in the orchard. This point is important for growers to realise and to avoid being excessively intolerant of some pest presence in their orchards.

The need to maintain this balance is the reason for basing intervention decisions on effective monitoring of pest and natural enemy population levels. However, in the case of some phytosanitary pests the level of pest control required is unsustainable for natural enemies to exist without augmentation.

2 PARASITOIDS

This group of biocontrol agents consists primarily of small hymenopteran wasps. Parasitoids generally lay their eggs in or on their hosts. The larvae then feed on the host, killing it in the process. One or more larvae may develop inside a single host. Each parasitoid larva therefore kills no more than one host, unlike predatory larvae that eat many prey individuals. After pupating, the adult parasitoid emerges. The lifespan of adult parasitoids is generally short, ranging from only a few days to several weeks. Some newly emerged parasitoids must first mate before they commence parasitising their hosts, whereas others do not require mating and may commence laying eggs in hosts as soon as they emerge from the pupal case.

In addition to killing host individuals with her offspring, the adult female parasitoid of some species is responsible for the death of many other host individuals through feeding. In this process the host's body is punctured with the parasitoid's ovipositor (egg laying appendage) and the escaping body fluids consumed.

Parasitoids have particularly acute senses for mate- and host-location. This makes them especially efficient at locating individual hosts even when the pest population level is very low. This behavioural attribute often results in parasitoids being capable of maintaining stable pest populations at low levels.

Some parasitoids are less effective at controlling higher population levels associated with pest outbreaks (e.g. *Aphytis*) and in such instances predators become more important (e.g. *Chilocorus nigritus*). There are, however, instances where parasitoids are capable of rapidly bringing very high pest population levels under control (e.g. mealybugs).

Parasitoid population levels and their efficacies may be reduced by several factors, some not under the grower's control. Temperature extremes, particularly hot conditions together with low relative humidity, can be very detrimental to some biocontrol agents, whereas the pest may be less sensitive. Parasitoid populations are often negatively affected by the activity of hyper-parasitoids which parasitise the

immature stages of the primary parasitoids. Dust can also be very detrimental to parasitoid populations. Fine dust is believed to abrade the insect's integument leading to desiccation and death. Red scale population outbreaks adjacent to dusty roads can often be attributed to dust and every effort should be made to reduce this factor (see "Cultural Practices" in this section).

The identification of most parasitoids is beyond the scope of the average grower. However, it is very important for pest control advisors to be able to identify at least the key components of the biocontrol complexes. It is also important for them to develop an understanding of the potential control that may be expected from various abundance levels of these natural enemies, something which can only be acquired through experience.

The following publications should be consulted to assist in the identification of biocontrol agents:

- Prinsloo, G.L. 1984. An illustrated guide to the parasitic wasps associated with citrus pests in the Republic of South Africa. Government Printer, Division of Agricultural Information, Private Bag X144, Pretoria 0001.
- Grout, T.G., Moore, S.D. & Stephen, P.R. 2015. Identification manual for citrus pests and their natural enemies. Citrus Research International.

3 PREDATORY INSECTS AND MITES

Ladybird beetles are important biocontrol agents of numerous citrus pests, consuming many prey individuals in both adult and larval forms. Adult beetles are good fliers and like parasitoids have the ability to locate small isolated patches of prey over long distances. Larvae are mobile and generally voracious feeders. The excellent dispersal ability of the beetles means that reservoir populations from outside orchards can play an important role in providing control of pest outbreaks within the orchard.

The complete biological control of Australian bug by *Rodolia cardinalis* and other *Rodolia* spp. demonstrates the potential of ladybird predators, not only to provide rapid control of outbreak population levels, but also to maintain stable, low population levels of a pest. *R. cardinalis* is a readily recognisable beetle with adults being approximately 3 to 4 mm in length, mostly red, with irregular black markings.

Another well known predator of economic importance is *Chilocorus nigritus* which, if not disrupted through the use of pesticides such as certain IGRs, is capable of rapidly controlling population levels of red scale which have become too high for *Aphytis* to effectively control. *C. nigritus* also plays an important, and often neglected, role in providing stable control of low levels of red scale. Maintenance of stands of giant bamboo in close proximity to citrus orchards will ensure that a reservoir of *C. nigritus* is supported on the scale which thrives on the bamboo. This scale *Asterolecanium miliaris* does not infest citrus and the beetles will continually colonise the orchard. *C. nigritus* is also an easily recognisable predator, being black, approximately 4 to 5 mm in length and almost completely circular when viewed from above. There are a number of other *Chilocorus* species which also play a role in the control of various armoured and soft scale insects.

Nephus reunioni is another ladybird beetle of economic importance as a biocontrol agent of mealybugs. They are approximately 2 mm in length, oval in shape (if viewed from above) and are mainly dark brown with 4 small orange spots on the elytra. Their larvae resemble mealybug and burrow into the mealybug egg sacs.

Stethorus sp. ladybird beetles are often associated with citrus red mite infestations. They are small (1.5 to 2 mm long), black with a fine, silvery pubescence (hairiness) and are slightly oval in shape when viewed from above.

There are numerous other coccinellids with varying levels of economic importance as biocontrol agents of many pest insects. Some common examples are *Rhyzobius lophantae* and *Lotis* spp. associated with red scale, *Exochomus* spp. feeding on a wide range of pests, *Cryptolaemus montrouzieri* and *Hyperaspis* sp. attack mealybugs, and *Cheilomenes lunata*, *C. propingua, Hippodamia variegata* and *Harmonia axyridis* which feed on aphids. Staphylinidae are small dark brown to black, elongated beetles (approximately 0.5 mm long) which feed on citrus red mite.

Green lacewings (Chrysopidae) are often associated with mealybug infestations. The

fragile adults (15 to 20 mm long) are not predatory but the larvae are voracious predators of a wide range of soft bodied pests including thrips. They characteristically lay small white eggs on the end of 10 mm long stalks attached to the plant surface. Brown lacewings (Hemerobiidae) have a similar prey range to green lacewings although the adults are slightly smaller than green lacewings. As the name suggests, they have a brownish colour with hairy wings. Dusty wings (Coniopterigidae) have a similar adult form to lacewings but are much smaller (approximately 4 mm long) and are white in colour. They are effective mite and whitefly predators and their presence is readily recognised by the flat, circular, white, silk cocoons in which they pupate on leaves.

Various fly maggots are predatory. Syrphidae (hover flies) feed on aphids and mealybugs, and Cecidomyiidae are often associated with mealybugs. Predatory thrips such as *Scolothrips hartwigi* are known to attack mite pests. Another predatory thrips *Haplothrips bedfordi* attacks citrus thrips, is often found below the calyces and because of its black colour is easily recognised. *Orius thripoborus* is a small predatory bug often found in association with mealybug infestations and known to be a predator of thrips. Immature stages are orange in colour but adults are black and winged.

Phytoseiid predatory mites can be distinguished from mite pests by their dashing movement over the surface of a leaf or fruit, their similar size to citrus red mite and their pear-shaped, straw-coloured bodies. They play an important role in suppressing populations of certain mite pests and thrips. *Euseius addoensis* is particularly important in suppressing thrips populations in the Cape Provinces where it survives the winter in high numbers, although mancozeb sprays reduce fecundity. *Euseius* spp. in other parts of southern Africa appear to be less effective in controlling early thrips populations because their numbers are low after the dry season. But they contribute to the suppression of late thrips, citrus red mite and lowveld citrus mite during summer. *Euseius* spp. can survive on various pollens when prey is scarce so some flowering plants in the ground cover can be beneficial. Other phytoseiid genera such as *Typhlodromus, Typhlodromalus* and *Transeius* are more specific predators of thrips and mites and sometimes may occur together with *Euseius* spp. However, they are usually less abundant where pesticides are used.

Tydeid mites are small, whitish mites which move fairly rapidly at a constant speed. Very little is known about their biology but some are predators of mites such as rust mite and probably grey mite. They sometimes occur in large numbers on leaves, particularly if numbers of phytoseiids are low.