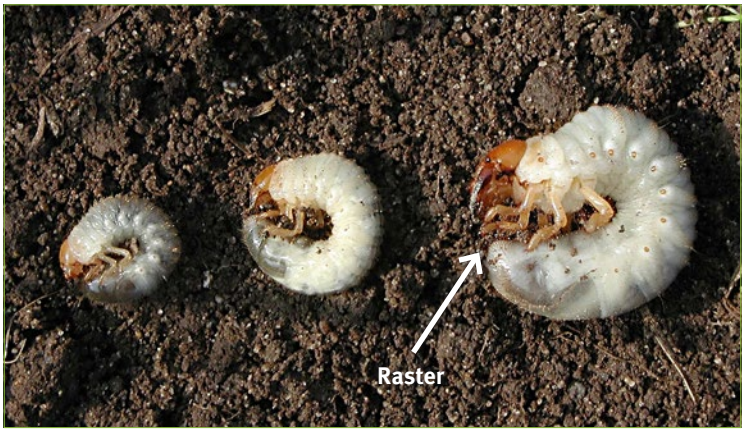
Managing Scarab Beetles in Production Nurseries

Scarab beetles (family Scarabaeidae) are sporadic pests of production nursery stock, particularly in susceptible long-term and in-ground crops. There are about 30,000 species of scarab beetles known worldwide and over 2000 are known from Australia, across 20 sub-families. There are many common names including white grubs, curl grubs, cane grubs, dung beetles, Christmas beetles, elephant beetles, rhinoceros beetles, chafers and flower chafers. Some species may complete their entire lifecycle without feeding on plants. Others may damage plants as adults and/or larvae. Many species are pests of turfgrass, pastures and forestry crops. Some species are also significant pests in production nurseries, most notably African black beetle and others that may become very abundant in a localised area.



Scarab larvae in the typical curled shape. Each individual is a different species. Photo by David Cappaert, Bugwood.org

BIOLOGY

Many scarabs have only one generation per year, or may have one generation every two years. Other species may have one generation in cooler climates but two or three in warmer climates. They are relatively long lived with adults surviving for about 1–9 weeks and larval development occurring over 2–10 months, depending on the species and environmental conditions. Eggs are laid into soil and hatch after a few weeks. The larvae of many species feed solely on decaying organic matter and animal faeces – these species are not pests. However, other species feed on decaying organic matter and living plants; generally roots and/or basal stem tissue. Such species are pests that can cause serious damage. Larvae have three stages (instars). The first and second instars are relatively small compared to third instars, which gain most weight and reach maximum size. If larval development occurs through winter, larvae will often burrow deeper underground to stay relatively warm, particularly in cool climates. Once soil temperatures increase they come closer to the surface and may continue feeding. After completing larval development most species produce an earthen cell in which to pupate and emerge as adults.

FURTHER READING:

Hangay, G. and P. Zborowski (2010) *A Guide to the Beetles of Australia*. CSIRO Publishing. Collingwood, Victoria.

Beehag, G., J. Kaapro and A. Manners (2016) *Pest Management of Turfgrass: For Sport and Recreation*. CSIRO Publishing. Collingwood, Victoria.

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Many species of scarabs swarm as adults. Adults may emerge from the soil in large numbers over a few nights, congregate on nearby shrubs, trees and even posts before flying. Flights may be over short or long distances, depending on the species, and most often occur on calm, warm and humid evenings, particularly at dusk, but may occur at different times of the night depending on the species. The adults of some species do not feed, whereas others may feed on foliage and flowers. Regardless, adults are mainly crepuscular (active at dusk or dawn), although some may be active during specific times of the night.

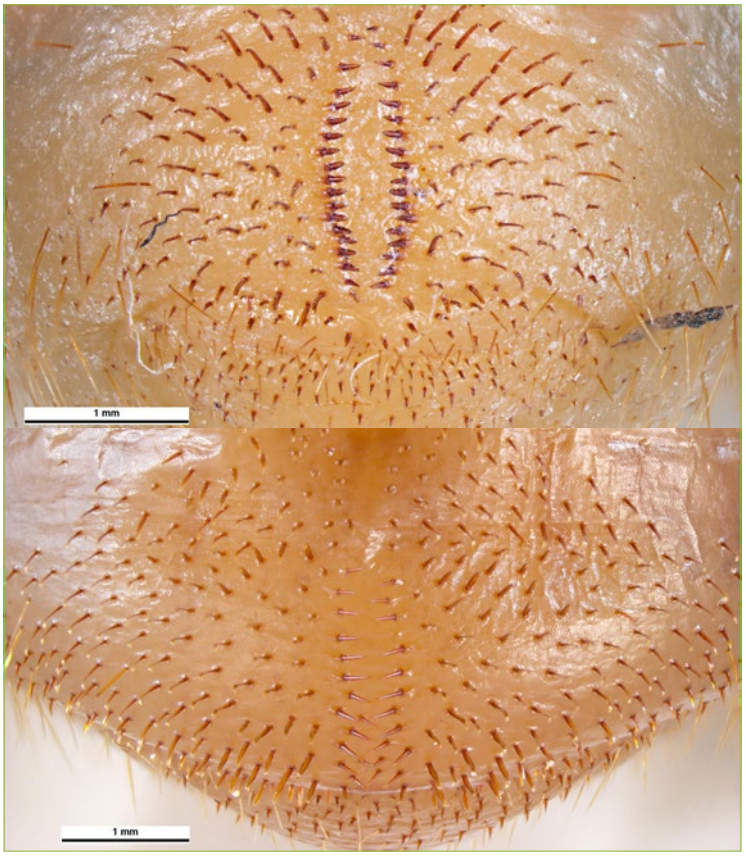
Soil conditions affect survival of scarab eggs, larvae and pupae. In general, very hot and dry conditions that coincide with egg hatching or moulting of young larvae can cause significant mortality. High soil moisture during cold conditions can also cause death of eggs, larvae and pupae.

APPEARANCE

Adults can be quite variable in appearance. They have a hard exoskeleton and often have pits or furrows in rows down their forewings (elytra). Their antennae are almost always relatively short with the last few segments being lamellate (i.e. having finger-like projections that look similar to a stack of plates when viewed on edge). Their bodies are generally robust and roughly oval in shape. The legs of scarab beetles are often spiky and they sometimes have tarsal claws that are like two barb-less fish hooks. They are often brown or black but can be green, yellow or red and sometimes are iridescent. Scarab beetles are medium to large in size, most species being 8–20mm long; some can be as small as 2mm and rhinoceros beetles can be very large, up to about 60mm long.

Insect feet (tarsi and tarsal claw) only have musculature to pull them closer to the tibia. This is why insects with hooks on their feet can get stuck on your skin or clothing when you are trying to pull them off; they do not have muscles that would allow them to unhook themselves! They rely on the muscles relaxing and movement of the entire leg away from the body to get unhooked.

Eggs tend to be oval to spherical in shape and may be slightly flattened. Most species have cream, white or yellowish coloured eggs that are no more than about 1–2mm in diameter.



The raster of two species from *Lepidiota*, grata canegrub, *L. grata* (above) and Bundaberg canegrub, *L. crinita* (below). Photos by Pest and Disease Image Library, Bugwood.org

Adult scarab beetles (*Melolontha* sp.) feeding on an oak (above – photo by Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, Bugwood.org). Adult Japanese beetle (*Popillia japonica*) and its feeding damage (below – photo by Steven Katovich, USDA Forest Service, Bugwood.org). Both species are not known to be present in Australia.

Larvae are almost always cream, white or light brown. When they hatch they are very small (1–3mm long) but generally develop until they are a somewhat longer than the adult. For example, African black beetle larvae become 25–30mm in length, but adults are only about 10–15mm. Scarab larvae of many species appear very similar and almost always curl into a characteristic 'c-shape' when disturbed and at rest. They have three well developed legs and generally have a hard, brown, dark red or black head. Larvae can sometimes be identified by examining the pattern of hairs at the end of the abdomen, called a raster. The size and configuration of the hairs is important and species specific. Some websites and books have the raster configuration published similar to those pictured here. If examining the raster, it is recommended to use as large a larva as possible; the raster is the same, but easier to observe on larger larvae. Place larvae in the freezer for 5–10 minutes or more to either slow them down or kill them before examining the raster.

Pupae are similar in size to adults and similar in colour to larvae. They are immobile and look like a cross between an adult and larva.

DAMAGE

For species that feed on plants, larvae and adults can be damaging. Small larvae are relatively benign and often only feed on dead and decaying organic matter. However, large larvae (3rd instars) consume much more food than previous stages and can destroy root systems when high numbers occur. This can result in a lack of vigour (i.e. poor growth), cause plants to wilt or die, particularly when the tap root and stem below ground is damaged. Adults are more likely to cause cosmetic damage only, similar to leaf beetles. However, when populations become superabundant, adults may congregate on host plants and cause significant defoliation, particularly on *Eucalyptus* spp. Damage is more likely to occur near pastures and other environments that support large populations of scarab beetles.

HOST RANGE

Each species has a range of plants on which they may feed, some more than others. African black beetle feeds on a large number of vegetable and ornamental crops including cabbage, cauliflower, dahlia, grape, marigold, pasture grasses, petunia, potato, roses, many seedling lines, sweet corn and turfgrass. Adult pruinose scarab (*Sericesthis* spp.) and some species of Christmas beetles (*Anoplognathus* spp.) feed on *Eucalyptus*. Rhopaea canegrub (*Rhopaea magnicornis*) is a known pest of pineapple, hoop pine seedlings and various grasses. No doubt many native scarab species feed on a range of native plants that occur in production nurseries, particularly when populations in an area are very high.

MANAGEMENT

LARVAE

Short term crops are unlikely to be damaged by scarab larvae unless growing media is infested at the time they are potted up. This is only likely to occur if media has been stored outside for long periods of time. Observing media at the time of potting up should be sufficient to observe moderate to large populations of medium to large larvae present. Monitor the root health of all nursery stock at key points in the growing system (e.g. when potting up) and when plants are showing any signs of lack of vigour. Even a few large scarab larvae could cause significant damage to plants with a relatively small root system.

Severe damage caused by scarab larvae feeding on the roots and taproot of seedling tree (on left) compared to the healthy tree (right). Photo by James Solomon, USDA Forest Service, Bugwood.org

Establish patterns of damage from scarab larvae, particularly on long term crops. If particular plant lines are consistently damaged, it is recommended to submit infested plants to a diagnostic laboratory to have the species identified. This may assist in determining the number of generations per year, the egg laying period and when small larvae are present. Management of scarabs should focus on when larvae are small (first or second instar) as they are less tolerant to pesticides and entomopathogenic nematodes (ENs – insect eating nematodes).

Monitoring of plants could therefore be directed to high risk plant lines during critical periods. It is recommended to remove plants from pots and loosen media and root ball to observe larvae. It is recommended to do this on a bench, drain board or tarp so that media does not remain in the growing area and increase risk of weeds. If necessary, wash the roots to remove media and search for larvae. First instar larvae are difficult to detect because they are very small. Focus on monitoring for second instar larvae; they are large enough to detect reliably but not so large as to cause economic damage. Remedial action can then be taken before significant damage occurs.

ADULTS

Small numbers of adults are unlikely to cause significant damage unless feeding occurs on main stems. However, large numbers of adults feeding could cause foliage to become tattered and unthrifty. Very large infestations may cause significant defoliation. Such damage is most likely to occur during the short window when swarming occurs. If damage occurs consistently have adults identified, which may involve monitoring stock and collecting insects at night. Identifying the species involved can provide information on when the species swarms. Systemic insecticides may then be applied strategically to prevent and or limit damage from occurring.

PESTICIDES AND BIOPESTICIDES

Insecticide products are registered for use against larvae only or against both adults and larvae. Active ingredients against larvae only include those on the minor use permit PER81707: imidacloprid (4A) and fipronil (2B). These products must be drenched into the media. Active ingredients registered against both larvae and adults include carbaryl (1A), chlorpyrifos (1B) and dimethoate (1B). Apply insecticides against adults late in the day or at night when they are active to maximise efficacy. All of these products are very broad spectrum and highly residual. Imidacloprid and dimethoate are systemic products, fipronil and chlorpyrifos are not. Also be aware that 1B products are currently being reviewed by the APVMA and their labels may change.

Heterorhabditis zealandica is an EN that may be applied against a number of scarab beetle larvae and is commercially available through Ecogrow Environment. It is recommended to apply this product to populations of small larvae. Contact Ecogrow directly before using this product for the first time to maximise the efficacy of the application.

When drenching ENs and pesticides ensure that media is moist (but not saturated). This allows the product to better penetrate the media and contact the pest. Post irrigation is also required to flush the product in. It is important to apply enough to help permeation, but not so much as to cause the product to drain out of the pot. The exact amount will depend on the size of the pot, type of media and soil moisture at the time.

BIOSECURITY

There are numerous scarab beetles that are exotic to Australia and are serious pests of particular plant species. Japanese beetle, Oriental beetle, Asiatic garden beetle and European chafer feed on various tree, fruit, flower and vegetable crops causing defoliation and root damage. Many other species do not occur in Australia. If you observe a beetle that you suspect is an exotic species, call the **Exotic Plant Pest Hotline on 1800 084 881** and or submit a sample to a diagnostic laboratory for identification.

This document was prepared by Andrew Manners (Agri-science Queensland, Department of Agriculture and Fisheries, Ecosciences Precinct, GPO Box 267, Brisbane QLD 4001) as part of the nursery levy and Hort. Innovation funded project Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry (NY15002) in 2017. Thanks also go to John Duff and Lindy Coates for assistance in preparing this fact sheet.