Factsheet 07/11

Cane fruit

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Beetle and weevil pests of cane fruit crops

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This factsheet provides growers with key information about the biology of, and the damage caused by, beetles and weevils to cane fruit crops. It offers guidance on assessing their impact and control. It deals primarily with raspberry beetle (Figure 1), vine weevil, clay coloured weevil (Figure 2), strawberry blossom weevil, cantharid (soldier) beetle, cockchafer and wireworm (click beetle).

Introduction

1 Raspberry beetle adult in raspberry flower

2 Clay coloured weevil adult

The value and demand for raspberries, blackberries and other cane fruits in the UK has increased markedly in recent years. A high proportion of raspberries and blackberries are sold through major multiple retailers, who demand a supply of high quality fruit over an extended season.

The majority of crops destined for sale via the multiples are now grown under protection for at least part or the majority of each growing season. Protected cropping can provide an environment suited to some beetle and weevil pests but can also pose difficulties in their control.

With increasing pressure from customers to reduce the use of conventional pesticides and avoid the presence of detectable residues, growers need to adopt novel control methods where possible. This factsheet aims to improve growers' ability to recognise beetle and weevil pests, monitor for their presence and better understand the integrated and other control methods available.

Beetles

Beetles and weevils belong to one of the largest groups of insects, the *Coleoptera*, with over 4,000 species alone being recorded in Britain. Some are beneficial (e.g. ladybirds) and prey on insect and mite pests (e.g. aphids) and their presence may reduce the need for insecticide use. Fortunately, only a small number cause damage to raspberry and other *Rubus* crops.

Raspberry beetle (*Byturus tomentosus*)

Biology

The adult beetles are small, elongate oval in shape, from 4-5 mm in length and 1.5-2 mm in width (Figure 3). They are uniformly light brown-yellow to nearly black. The adults darken in colour as they mature.

3 Raspberry beetle adult on raspberry flower bud

The eggs are milky white, cylindrical in shape, 1.2 mm long, 0.4 mm wide and tapered at their ends (Figure 4). They darken slightly as a beetle larva develops within them.

4 Raspberry beetle egg laid on developing fruit

Fully grown larvae are 6-8 mm long, pale yellowish-brown in colour with darker head and segmental plates along their body (Figure 5).

5 Raspberry beetle larva burrowing into receptacle of fruit

Adult raspberry beetles emerge from the soil in spring and feed on the young expanding leaves of raspberry primocanes for several days (Figure 6).

6 Raspberry beetle adults on tips of primocane

When the air temperature is above 14-15ºC, they may fly more than 30m to feed on flowers of their intermediate hosts, hawthorn (*Crataegus monogyna*), apple (*Malus domestica*) or pear (*Pyrus* spp). Those that do not migrate feed on developing raspberry or blackberry leaves and buds, causing considerable damage to developing flowers (Figure 7).

7 Raspberry beetle adult on damaged raspberry flower bud

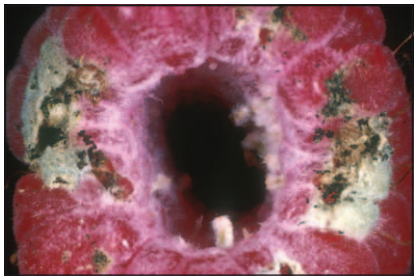
Beetles that migrated to alternate hosts fly back to raspberry or blackberry soon after their first flowers open, attracted by floral volatiles and by the reflected light wavelengths from the flowers. They feed on the newly opened flowers, either on the nectaries at the base of the flower or on the anthers (Figure 8).

8 Raspberry beetle adult damage to stamens & anthers of raspberry flower

Once fed on *Rubus* flowers, mating takes place and egg laying begins. Eggs are attached to the anthers or the styles and in commercial plantations, where the beetle populations are generally low, one egg is laid in each flower. Multiple egg laying can occur, in plantations where control is poor or absent or where nearby wild host plants (e.g. woodland or hedge brambles and wild/abandoned raspberries) provide a reservoir for the build up of high populations of beetles. The complete life cycle of the raspberry beetle is illustrated in Diagram 1.

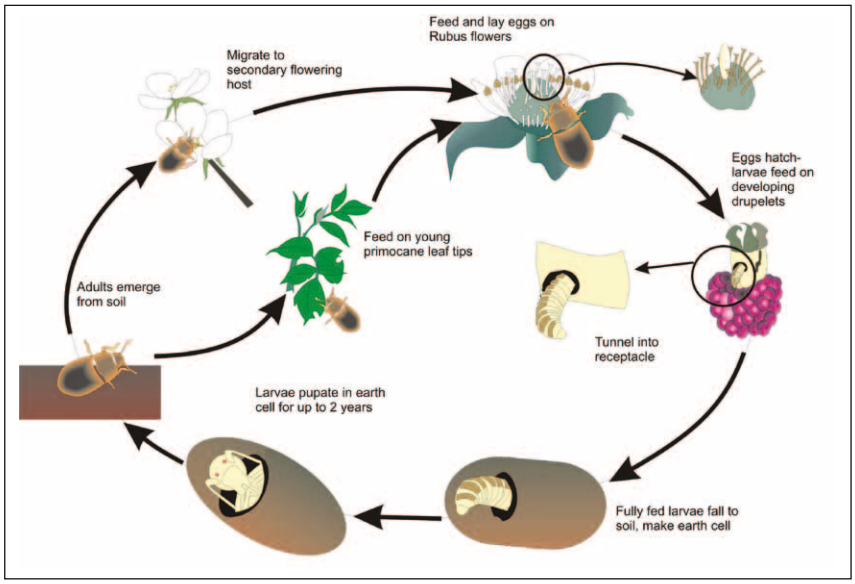
Damage

After hatching, young larvae usually feed around the ‘neck’ of the developing green fruit (Figure 9). When the fruit begins to ripen, the larvae then burrow into the receptacle inside the developing fruit, where extensive tunnelling can be observed at harvest (Figure 10).



9 Raspberry beetle larval damage to the flesh of raspberry

Diagram 1 Life cycle of the raspberry beetle



10 Raspberry beetle larva burrows into fruit receptacle

In raspberry, approximately 90% of the larvae remain on the plants at harvest with 10% removed with the harvested fruit (Figure 11). In contrast, in hybrid berries, where the fruit is harvested with its receptacle, most larvae are removed with the fruit.

Fully fed larvae drop to the soil (Figure 12), burrow to a depth of about 3-15 cm and form earthen cells. They pupate within these cells, most over-wintering as adults, and emerge from the soil the following spring. However, some beetles that have fed on autumn-fruiting raspberries do not pupate in the soil during the first winter, but remain as dormant larvae through the following year, emerging as adults 18-24 months later.

11 Raspberry beetle damaged fruits

12 Raspberry beetle larva in soil

Wingless weevils

Vine weevil (*Otiorhynchus sulcatus*)

Vine weevil is the most common wingless weevil in the UK. It frequently damages strawberry, hardy ornamental nursery stock and house and garden plants. In recent years adult weevils have increasingly caused damage to raspberry and blackberry foliage and posed a risk as a contaminant of fruit especially of protected crops. Their larvae severely damage the roots and thereby weaken cane fruit plantations.

Biology

The largest of the wingless weevils found in the UK, adult vine weevils are 7-11 mm in length (Figure 13). When newly emerged from the soil they are a pale brown colour, darkening to a shiny black to a dull brown colour when mature. There are tufts of yellowish hairs on the upper surface of their elytra (wing cases) which are deeply sculptured (grooved).

Generally there is one generation of this pest per year, with adult weevils emerging from the soil in the spring and early summer. However some weevils do over winter as adults. All vine weevils are parthenogenetic females. Males are not required in reproduction. The adult females are most active at night. During daylight they are quiescent, hiding under weeds, plastic mulches, stones, lumps of soil, leaf litter or under or between other crop debris. The eggs (Figure 14) are white when laid, but turn brown just before they hatch. Larvae are C-shaped and are between 8-10 mm in length when fully grown (Figure 15 overleaf). They pupate in earthen soil cells before emerging in the spring or early summer (Figure 16 overleaf).

13 Vine weevil adult on leaf

14 Vine weevil eggs

15 Vine weevil larvae in soil

16 Vine weevil pupa in soil

Damage

Weevil larvae feed on and destroy fine root hairs and bite sections out of the main feeding roots of raspberries and blackberries. This seriously weakens affected plants (Figure 17). The adults feed mainly on the foliage of primocanes and floricanes, cutting notches out of the margins and gradually destroying the leaf lamina (Figures 18 and 19). They occasionally damage fruiting laterals and flowers and also the rind and bases of newly emerged primocanes. They are potentially serious contaminants of harvested fruit, in both fresh fruit and machine harvested crops.

17 Blackberry weakened by larval feeding on roots (left)

18 Vine weevil damage to blackberry foliage

19 Vine weevil damage to raspberry foliage

Clay-coloured weevil (*Otiorhynchus singularis*)

Clay coloured weevil occurs throughout the UK and can often be found in orchards or on old orchard sites. Although just a sporadic pest of cane fruit, it can cause severe damage to raspberry and blackberry plantations in early spring.

Biology

In contrast to vine weevil, the adult clay coloured weevil is smaller (6-8 mm in length), more compact in appearance and is speckled brown rather than black/brown (Figure 20).

20 Adult vine weevil (left) pictured alongside the clay coloured weevil

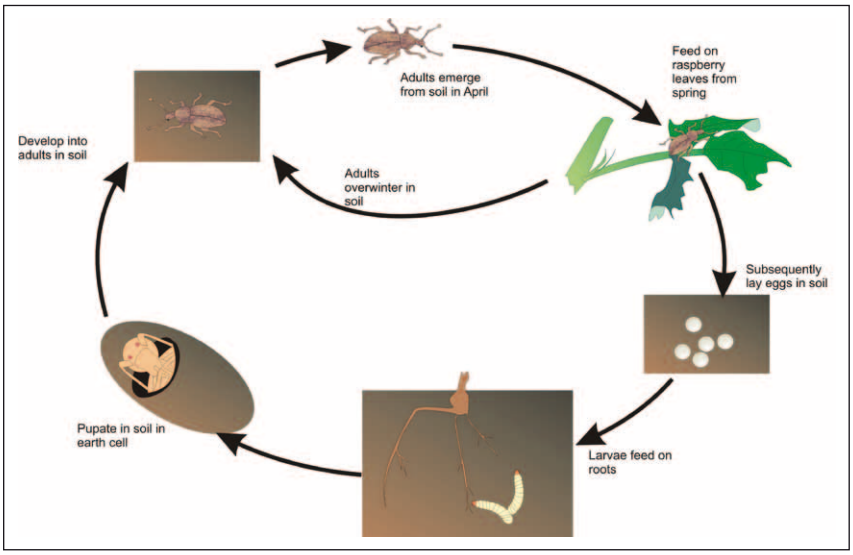
The life expectancy of this weevil is thought to be longer than vine weevil, with adult females living up to three years. Adult females emerge from the soil in spring and after a period of intensive feeding they mate and lay their first batch of eggs. Several cycles of feeding and egg-laying may then occur during the spring.

Initially white, the eggs turn brown in the soil prior to hatching so are very difficult to see. The larvae feed on raspberry roots to a depth of 50 cm, considerably deeper than that of vine weevil. Pupation occurs in the soil within earthen cells. Adult clay-coloured weevils are nocturnal feeders and it is rare to find them on the foliage during daylight hours. The complete life cycle of the clay coloured weevil is illustrated in Diagram 2.

Damage

Most damage is caused by adult weevils feeding on developing lateral buds at night in the early spring (Figure 21). Where weevil infestations are large and especially when their emergence from the soil coincides with the bud elongation phase of the crop, whole laterals can be destroyed

Diagram 2 Life cycle of the clay coloured weevil



(Figure 22). If emergence occurs later the damage to leaf petioles and the stems of developing fruiting laterals can be variable, but usually results in weakened and broken laterals. Unlike vine weevil, clay-coloured weevils rarely feed on mature raspberry leaves, probably because of the anti-feedant chemicals they contain.

In other crops and ornamentals, such as *Rhododendron*, this weevil may also remove the bark from young plants or produce feeding notches in leaves, more in keeping with vine weevil.

21 Clay coloured weevil feeding on developing fruiting lateral

22 Compete removal of lateral caused by clay coloured weevil feeding

Other beetles and weevils

Strawberry blossom weevil (*Anthonomus rubi*)

The strawberry blossom weevil is best known in the UK as a pest of strawberry. However, it is also an increasingly important pest of raspberry in some parts of England, especially of late summer fruiting raspberry varieties such as Malling Leo, Octavia and Tadmor. Early flowering primocane fruiting varieties can also sometimes be affected.

Biology

Adult strawberry blossom weevils hibernate over winter just below the surface of the soil, under crop and other plant debris. They emerge from late April onwards with numbers reaching a peak in mid to late May. They are black with a small body of just 2-4 mm in length (Figure 23). The body is covered with small areas of greyish hairs, predominately in stripes along the wing cases. They have a long snout with a pair of antennae at about one-third the length from the tip. The eggs are very small and laid in flower buds. The larvae are 3-4 mm in length, distinctly C-shaped and cream in colour with a light brown head.

23 Adult strawberry blossom weevil

Damage

Strawberry blossom weevils damage flower buds and hence cause fruit loss. After laying an egg within an unopened raspberry flower bud, the female weevil bites through the flower stalk attaching the bud to the fruiting lateral. The flower bud fails to develop further and gradually withers whilst providing the developing weevil larvae with shelter and a source of food (Figure 24).

24 Strawberry blossom weevil damage to flower buds of raspberry fruiting lateral

Although the damage can look serious where raspberries have lost flower buds, the consequences have been negligible as the loss is usually restricted to late opening flowers which would normally contribute little to overall yield. Strawberry blossom weevil damage has only caused financial loss where damage has also occurred to earlier flower buds or flowers as a result of frost. In such cases, there have been insufficient viable flower buds left on the affected fruiting laterals to compensate for both losses.

Exotic introduced (alien) wingless weevils (*Otiorhynchus armadillo* and O. *salicicola*)

There has been concern expressed about the introduction of exotic (alien) wingless weevils into the UK from southern Europe in ornamental plants. Two species, *Otiorhynchus armadillo* and *Otiorhynchus salicicola* are a concern in raspberry plantations. Of these two species, *O. armadillo* probably poses the greater risk to the cane fruit industry. Research in the Trentino region of northern Italy has shown that this species was one of the more common weevils in raspberry plantations and it was able to cause significant levels of damage. Although the distribution of this insect in the UK is primarily restricted to urban sites, there is a potential risk to commercial cane fruit plantations close to towns and/or garden centres.

Cantharid or soldier beetle

There are several species of the cantharid or soldier beetle found in the UK, although some of them are very rare. Little is known about their biology, but adults are frequently found feeding on wild flowers. The Black Soldier Beetle (*Cantharis obscura*) is the only species that has been reported as causing direct damage to plants, both in the UK and in the south of France. This species is widespread in eastern Scotland and has been an occasional, but locally severe, pest of raspberry. The damage inflicted by this beetle to raspberry was first identified in

the early 1990s. Large numbers of adult beetles were observed stripping the epidermis from the expanding fruiting laterals of raspberry. This damage was similar to that caused by clay-coloured weevil, but there was less evidence of notching. Close examination of the laterals also showed characteristic 'bruise' marks caused by the insect's mouthparts.

Identification

Cantharid beetles fly from late April until June and are usually found feeding on flowers. The black soldier beetle (*C. obscura*) is recognised by its distinct colour (Figure 25). It is nearly all black except for two longitudinal orange bands running down either side of the thorax and a small amount of orange-brown around the mouthparts. In the field they can be confused with another cantharid beetle (possibly *C. nigricans*) which can also be found in raspberry plantations. *C. nigricans* is of similar size but differs by virtue of being 'dusky' black with more colour. In addition, the red on the base of the antennae, the thorax where the colour forms a U-shape and on the abdomen is slightly darker.

25 Adult cantharid beetle

Damage

The most obvious damage caused by the black soldier beetle is a tearing and stripping of the bark which exposes the pith of the petioles and stem of expanding fruiting laterals in the spring (Figure 26). This results in breakage and loss of fruit.

26 Adult cantharid beetle damage to lateral

Cockchafers

Melolontha melolontha, commonly known as the cockchafer, may bug or white bug is a member of the group of Scarab beetles (Scarabaeidae). Adults of these large beetles (up to 35mm long) are often seen flying in May. They are widely distributed in Europe, being found as far north as central Sweden. In Britain, they are found mainly in southern and central England. Adults have a black thorax (often covered in fine hairs), a pair of reddish-brown wing cases (elytra) and very pronounced fan-shaped antennae and pointed abdomen. Adults begin to fly in May. The larvae are large white grubs that live in the soil for at least two years (Figure 27). They feed on a wide range of plants including grass and cereals, but can cause localised damage to fruit crops. Damage is most common in cane fruit, when crops are established in soils following permanent pasture where high populations of cockchafers are often present. Root feeding by the larvae can give rise to plant stunting, wilting and premature leaf drop.

Wireworms

Wireworms are the larvae of click beetles and are very common in the UK. There are approximately 60 different species, but most of the damage in horticultural crops is done by those belonging to the genus *Agriotes*. They usually colonise grassland, particularly old, well established pasture. Cane fruit crops are susceptible to damage when established into newly cultivated soil following such pasture where larvae may be present. The larvae are characterized by being long and thin insects with hard cylindrical, yellowish-brown bodies that measure up to 30 mm in length (Figure 28). The head has well developed biting mouthparts. Larvae can take up to five years before pupating. The adult beetles are dark brown in colour (Figure 28) and make a distinct 'clicking noise' when they attempt to turn over when they are on their backs. Damage to cane fruit crops occurs as a result of wireworms feeding on cane roots, leading to cane stunting, wilting and die-back.

27 Cockchafer beetle larva

28 Soil inhabiting wireworms and click beetle

Crop monitoring for beetles and weevils

Raspberry beetle

A strategy for monitoring should include use of funnel traps and regular scouting (every 2-3 days) for raspberry beetle adults on nearby Rosaceous plants (e.g. Hawthorn) and in the plantation. Scouting should start several weeks before the crops begin flowering and continue until mid-flowering. Raspberry foliage and especially the expanding leaves at the tips of primocanes need to be checked for signs of beetle feeding and later the flowers should be examined regularly. Hybrid berries and blackberries are particularly attractive to this pest. Traps can be used as a guide to the need for control and timing of chemical control measures. When

traps have been installed in high numbers per hectare to monitor the pest, they have been found to reduce the numbers of adult beeltes and may offer an option for control, especially in the case of organic crops where there are few other control options (see control section).

As part of HDC project SF 74 (Horticulture LINK HL0175), funnel traps (Figure 29) were developed by the James Hutton Institute (formerly SCRI) and Agrisense BSC Ltd. These traps are baited with a lure which mimics the colour and smell of raspberry flowers, and can be used during the period from beetle emergence (generally 3 – 4 weeks before crop flowering) until flowering has finished. For new users, the traps should be used alongside traditional scouting techniques whilst experience is gained. At least 50 traps/ha should be deployed and placed at a height of 1 – 1.6 m above ground level within the crop canopy. The traps should be spaced evenly in a grid iron pattern in the field. Additional traps should be deployed near any remaining wild sources of raspberry beetle.

29 Raspberry beetle funnel trap

The traps should be examined weekly and the numbers of adult raspberry beetles caught should be recorded. If more than 5 beetles have been caught in any trap by the start of flowering, a control measure should be applied locally to the area or tunnels where the threshold has been exceeded. This threshold may vary according to local conditions and damage tolerance, which is generally very low for raspberry beetle.

Pickers should be trained to check fruit during picking, both to exclude any damaged fruit and to report the presence of any beetle larvae found.

Weevils

During the winter, growers should examine any areas of poor cane growth, particularly if it is known that weevils are present in nearby crops. Surface soil should be lightly moved aside and crop roots checked for signs of feeding and/or presence of larvae/pupae. Early covered crops (and those under glass) should be checked in late April/early May for signs of exit holes on the soil surface and immature adult weevils hiding amongst weeds, polythene, mulch etc. Should weevils be present, evidence of leaf notching on the lower leaves may appear. Any primocanes present may have evidence of chewing in the shoot tip. In addition, the rind around the bases of canes may be bitten into sometimes leading either to cane branching or wilting. Regular monitoring thereafter should spot further feeding damage on leaves, stems and fruiting laterals.

An additional approach is to check for weevil feeding by examining crops between dusk and 1am. This is only effective on dry, warm, still nights – but will give an indication of numbers present. Clay-coloured weevils are far more nocturnal in their feeding habits and much easier to spot in this way; however damage tends to be more localised than with the vine weevil.

Strawberry blossom weevil

Start scouting some three weeks before first flowers open. Initial signs of strawberry blossom weevil will be small notches cut out of the margins of the unfolding leaves. Some flowers may also have small bite marks (holes) in their petals. Flower buds hanging down where they have been severed are a classic sign of the pest's presence. Small holes in the petals may also be evident. Autumn or late summer-fruiting raspberry varieties are the most affected.

Cantharid or soldier beetle

The presence of black soldier beetles can only be detected by routine inspection of the plantation during the growing season prior to fruiting. It is essential that correct identification of the insect is made before any chemical treatment is used. There are several similar looking insects that may be on the fruit that are totally harmless.

Cockchafers and wireworms

Populations of cockchafers and wireworms are usually low unless the field concerned has a previous history of grassland or longer-term set-aside. Digging and examination of the old ground may give an indication of a possible infestation and whether a more detailed risk assessment is advisable.

Control of beetles and weevils

Satisfactory control of beetle and weevil pests begins with a proper appreciation of the threat likely to be encountered at each growing site. Having assessed this, an appropriate mix of cultural, biological and chemical measures can be employed to achieve economic control.

Cultural control

Polythene mulches are useful at planting and in the early establishment years for weed control and moisture conservation. However, they provide shelter for weevil populations and where these pests have been found to be a problem they are best removed within one or two years of planting.

Where weevils are present, picking trays, containers and associated equipment should not be placed on the ground where they could provide shelter for adult weevils and lead to the contamination of harvested fruit.

If possible, avoid establishing new cane fruit plantations on land that has been down to permanent grass or set-aside for more than four years. If there is no alternative, a careful examination of the sward roots, especially grasses, should be made before considering planting. Wireworm populations can be a potential threat for up to

five years following cultivations. If numbers are found or suspected, populations can be reduced before establishing cane fruit by repeated cultivations, or by sowing a cereal break crop where the seed has been treated with an insecticide designed to offer wireworm control.

Following planting, establishment of a grass sward between the crop rows will encourage migration of any wireworm into the alleyways and away from the crop. Ryegrass is particularly effective for this purpose.

Predators and natural enemies

Raspberry beetles have a number of natural enemies, particularly parasitoids which feed on beetle larvae and birds which feed on adult beetles. The chalcid wasp, *Tetrastichus halidayi* and the predators *Anthocoris nemorum* (common flower bug) and *Chrysopa perla* (lacewing) have been reported as attacking raspberry beetle larvae and eggs. On their own they are unlikely to provide sufficient control, given the very low damage tolerance for this pest. However, as the industry reduces its use of conventional insecticides by improving trapping and monitoring techniques, their usefulness will increase.

Vine weevils have a number of natural enemies. Work done by East Malling Research and ADAS (Projects SF 15b and 15c) has shown that a range of ground beetles (carabids) and rove beetles (staphylinids) feed on vine weevil. Different species feed on different life stages of the pest. Although they won't prevent vine weevil from becoming a problem, they are worth encouraging wherever possible. Indiscriminate use of slug pellets may adversely affect beetle populations, so their use should be kept to a minimum. A number of bird species are also known to feed on adult vine weevil. Song thrush and skylark will both consume weevils but are not widespread. Pheasant and partridge are more common and can be useful as they tend to scratch and peck around the base of plants where the adults are found. Chickens work in the same way and can also be very beneficial if present in high enough numbers. Observational evidence also points to hedgehogs as useful night time predators of vine weevils.

There is little other information about predators and natural enemies of other beetles and weevils. However, birds including tits, sparrows, chaffinches and goldfinches, have been recorded as predators of apple blossom weevil. In addition, it is probable that general predators such as spiders and ladybirds predate strawberry blossom weevil adults.

Biological control

There are currently very few biological control agents available for controlling any of the beetles and weevils included in this factsheet.

The exception is vine weevil, for which both insect pathogenic nematodes and a bio insecticide are commercially available for control of the larval stage of the pest.

In the case of nematodes, species of both Steinernema and Heterorhabditis are available. They are applied in a drench to the soil or substrate when young larvae are present in the growing medium. The soil or compost must be moist for the nematodes to work effectively. The nematodes swim through the moisture film around the particles of soil/compost to find and enter the vine weevil larvae. Once inside the larvae, they release bacteria which kill the hosts within a few days. The nematodes reproduce inside the larvae, and the next generation of nematodes swim off to find more prey. Nematodes do not prevent vine weevil infestations and will only control existing vine weevil larvae in soils or composts.

The bio insecticide is an entomopathogenic fungus *Metarhizium anisopliae* (sold as Met 52 granular). Its spores germinate and the fungal hyphae penetrate and grow within the insect. Death usually occurs within a few days and a new generation of spores are produced on hyphae emerging from the dead insect. In the absence of a suitable host, the spores can remain in the soil for years without germinating, providing longevity from a single treatment.

Specific details of the products available are listed in Table 1.

Chemical control

Despite being able to influence the numbers and levels of infestations through use of cultural, natural and biological control measures, for many of the beetles and weevils described in this factsheet, some form of chemical insecticides will be required to keep the pests fully under control. A list of all the chemical insecticides approved for use on raspberry, blackberry and hybrid berry are included in Table 2 (see insert in back cover).

Table 1 Biological control agents currently approved for use in cane fruit crops for the control of vine weevil larvae

Biological agent	Pack size	Rate of use	Other information
Steinernema kraussei (Various products)	50 or 250 million	1 million treats 1m^2	Drench application; water temp 5ºC -15ºC, works down to soil temp. of 5ºC
Steinernema carpocapsae (Various products)	5, 50 or 250 million	1 million treats 1m^2	Compost or soil should be moist and its temp. between 14ºC – 30ºC
Heterorhabditis spp. (Various products)	50 million	1 million treats 1m^2	Compost or soil should be moist and its temp. not below 12ºC for 2 weeks after treatment
Metarhizium anisopliae (Met 52 granular)	1 kg and 10 kg	Compost – incorporate granules at 0.5 kg/m^3 Soils – broadcast at a rate of 122 kg/ha immediately prior to planting and incorporate into top 5cm of soil	Compost or soil temp. should be between 15ºC – 30ºC and not excessively wet. Full approval – raspberry and blackberry. SOLA – loganberry and hybrid berry

It should be noted that all of the insecticides listed have a broad spectrum of activity and will have varying harmful effects on non-target insect species, including beneficial insects. Further details on the effect of the active ingredients listed on predators commonly used in cane fruit production are included in Table 3 (see insert in back cover).

Formulating a control programme

In planning control measures, knowledge of the threat likely to be encountered from the key pests will help. The choice of product should be dictated by the seriousness of pest infestation, the time of year, harvest intervals and requirement for minimising potential pesticide residues.

The decision to use a chemical pesticide for raspberry beetle control should be based on knowledge of numbers present through funnel trapping and/or regular scouting, as described earlier. Knowledge of the site history should also be taken into account along with market tolerance to the pest.

With summer-fruiting raspberries, where few or no raspberry beetles have been detected, then no preventative insecticide applications may be necessary. Should raspberry beetles have been found or trap thresholds reached, then in most situations a single spray at late green bud will suffice.

For primocane raspberry crops grown purely for autumn cropping, a combination of scouting and trapping is recommended for detection of raspberry beetle, with summer-fruiting control programmes followed. For double-cropped primocane varieties, a similar programme to that for summer-fruiting types is suitable for the first harvest. Further monitoring should be undertaken up to the start of the second fruiting period, to determine whether additional treatments are required.

Where prior knowledge indicates a greater threat, a two-spray programme should be considered, one at green bud stage and the second at late green fruit. Only under exceptional circumstances is it likely that three spays for raspberry beetle would be needed.

For blackberries, similar programmes would be suitable, but on some sites where high raspberry beetle populations have been recognised and damage has been experienced, a programme of three sprays should be considered at early green bud, late green bud and late green fruit stages. Rubus hybrids should be treated as for blackberries.

Action points for growers

- Protected cropping of cane fruits provides a favourable environment for beetle and weevil development and more challenging conditions for applying successful control measures.
- Growers should make sure that their field staff and pickers have suitable training to identify key pests and the damage they can cause (see HDC Cane Fruit Crop Walkers' Guide).
- Use monitoring and scouting techniques to build up knowledge of the potential threat from each pest and the timing of their appearance. Use this information to plan and adjust control programmes.
- Where feasible, employ biological and integrated measures to control pests and to minimise residues and impact on the environment.
- Implement control measures early to reduce the need to use pesticides close to harvest.

Further information

Suppliers of biological control agents

Agralan Ltd (Biobest products)
The Old Brickyard
Ashton Keynes
Swindon
Wiltshire SN6 6QR
Tel . (01285) 860015
www.agralan.co.uk

Becker Underwood UK
Unit 1 Harwood Industrial Estate
Harwood Road
Littlehampton
West Sussex BN17 7AU
Tel. (01903) 732323
www.beckerunderwood.co.uk

BCP Certis
Newbury House
Court Lodge Farm
Hinxhill
Ashford
Kent TN25 5NR
Tel. (01233) 667080
www.bcpcertis.com

Biowise
Hoyle Depot
Graffham
Petworth
West Sussex GU28 0LR
Tel. (01798) 867574
www.biowise-biocontrol.co.uk

Fargro Ltd
Toddington Lane
Littlehampton
West Sussex BN17 7PP
Tel. (01903) 721591
www.fargro.co.uk

Koppert UK Ltd
Unit 8
53 Hollands Road
Haverhill
Suffolk CB9 8PJ
Tel. (01440) 704488
www.koppert.co.uk

Syngenta Bioline
Telstar Nursery
Holland Road
Little Clacton
Clacton
Essex CO16 9QG
Tel. (01255) 863200
www.syngenta-bioline.co.uk

Biocontrol agents can also be obtained through most horticultural merchants.

Suppliers of funnel traps for raspberry beetle monitoring

AgriSense
Treforest Industrial Estate
Pontypridd
South Wales CF37 5SU
Tel. (01443) 841155
www.agrisense.co.uk

Other useful publications

HDC Factsheet 08/08
Strawberry blossom weevil

HDC Factsheet 01/03
Vine weevil control in soft fruit crops

SAC Technical Note
Recognising pest damage on raspberries

HDC Crop Walkers' Guide
Cane Fruit

Project reports

SF 74
Integrated pest and disease management for high quality protected raspberry production (Horticulture LINK HL 0175).

Images

All of the images included in this factsheet are provided by the authors unless stated otherwise alongside.

Non-capacity pocket to go here

June 2011

Table 2 Insecticides currently approved for use with cane fruit crops offering control of beetles and weevils

Active ingredient	Typical products	Beetles and weevils controlled incidentally by use	Raspberry		Blackberry		Hybrid Berry		Harvest interval	Target pests on label or SOLA	Max no. of applications and other information
			Outdoor	Protected	Outdoor	Protected	Outdoor	Protected			
chlorpyrifos	Dursban WG Equity	All	✓	✓	✓(S)	×	×	×	7 days	Aphids Raspberry beetle Raspberry cane midge	**Dursban** WG 3 applications or max 1.8 kg/ha **Equity** 3 applications or max 3 l/ha May cause crop scorch under protection. Organophosphate pesticide
deltamethrin	Decis	Most except wireworm	✓	✓	✓(S)	×	×	×	Nil	Raspberry beetle	Rate varies according to product. Unlimited Systemic pyrethroid pesticide
lambda cyhalothrin	Hallmark with Zeon technology	All except wireworm	✓(S)	×	✓(S)	×	✓(S)	×	28 days	Clay-coloured weevil Capsids	Maximum individual dose 75ml/ha, 2 applications or max 150 ml/ha per annum Systemic pyrethroid pesticide
pyrethrins	Spruzit	Blossom weevil	✓	✓	✓	✓	✓	✓	Not stated	Aphids Capsids	**Outdoor crops** 4 applications/year, individual dose 6-12 l/ha (according to method of application), maximum concentration must not exceed 2 l of product/100 l of water **Protected crops** 4 applications/year, individual dose 9-24 l/ha (according to method of application), maximum concentration must not exceed 12 l of product/600 l of water
thiacloprid	Calypso	Most except wireworm	✓(S)	✓(S)	✓(S)	✓(S)	✓(S)	×	3 days	Common green capsid Raspberry beetle	Maximum individual dose of 250ml/ha, 3 applications / annum Max total dose 750ml/ha Neo-nicotinoid pesticide

(S) Specific off label approval

Table 3 Harmful effects posed by approved insecticides to predators commonly used in cane fruit crops

Active ingredient	Product	Amblyseius californicus	Amblyseius cucumeris	Feltiella acarisuga	Phytoseiulus persimilis	Bees
chlorpyrifos	e.g. Equity	Moderately harmful to adults & nymphs (2 weeks)	Harmful to adults & nymphs (6-8 weeks)	Harmful	Moderately harmful to adults & nymphs (up to 3 days)	Do not apply to crops in flower or when bees foraging
deltamethrin	Decis	Moderately harmful to adults & nymphs	Harmful to adults & nymphs (> 8 weeks)	Harmful to adults & nymphs (> 8 weeks)	Harmful to adults & nymphs (> 8 weeks)	Do not apply during flowering
lambda-cyhalothrin	Hallmark with Zeon technology	Moderately harmful to adults & nymphs	Harmful to adults & nymphs (> 8 weeks)	Harmful (> 8 weeks)	Harmful to adults & nymphs (> 8 weeks)	Do not apply during flowering
pyrethrins	Spruzit	Harmful	Harmful (1 week)	Harmful	Harmful (1 week)	Do not apply during flowering
thiacloprid	Calypso	?	Moderately harmful (2 weeks)	Harmful to larvae moderately harmful to adults	Moderately harmful	No SOLA restriction on applying during flowering

Safe: kills<25%
Slightly harmful: kills 25-50%
Moderately harmful: kills 50-75%
Harmful: kills >75%

(Persistence against bio controls given in brackets)

? Side effects on bio controls or persistence not known.

This data has been compiled from the following websites, and from the practical experience of ADAS, BCP Certis and Syngenta Bioline:

http://www.biobest.be
http://www.koppert.com

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