Grower Summary

CP 111

A review of vine weevil knowledge in order to design best-practice IPM protocols suitable for implementation in UK horticulture

Final 2014

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

HDC is a division of the Agriculture and Horticulture Development Board.

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Project Leader:	Jude Bennison
Contractor:	ADAS UK Ltd
Industry Representative:	Harriet Duncalfe, H & H Duncalfe Selchuk Kurtev, Darby Nursery Stock
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Headline

This project collated relevant current knowledge on vine weevil biology and control, identified key gaps in knowledge and provides impartial, best practice IPM programmes suitable for commercial adoption. Recommendations for knowledge transfer are given.

Background

Vine weevil is one of the most serious pest problems in UK soft fruit and hardy nursery stock crops. Adult damage to leaves and presence of larvae around roots can make ornamental plants unmarketable. Root damage caused by larvae in both ornamental and soft fruit crops leads to reduced plant vigour and yields and if damage is severe, to plant death. Chemical control of the pest is now difficult on ornamentals due to withdrawal of the most effective persistent products for use in growing media. Chemical control on soft fruit crops is mainly limited to using foliar sprays against adults, which gives unreliable control.

Growers are under pressure to reduce pesticide use and are increasingly adopting biological pest control methods within Integrated Pest Management (IPM) programmes. Biological control methods for vine weevil now available for use on both soft fruit and ornamental crops include insect-pathogenic nematodes and fungi. Growers need more knowledge about the pest biology and the biological methods in order to gain optimum control in their various production systems.

Summary

Objective 1. Collate current knowledge of vine weevil biology and control and identify key gaps in understanding

Task 1.1. Interviews with key industry representatives to identify currently used vine weevil management strategies and their success, and perceived gaps in knowledge

A total of 29 UK industry representatives were interviewed, including seven growers of hardy nursery stock (HNS), one grower of protected ornamentals, seven growers of soft fruit, eight consultants in the ornamentals and/or soft fruit industries and six suppliers of biological and chemical controls for vine weevil. Only growers who experienced vine weevil problems on their farms or nurseries during 2013 were interviewed. Only one of the growers of HNS relied on a pesticide control programme, all other growers of ornamentals and soft fruit used IPM programmes for management of vine weevil and other pests. Two case studies are

summarised below, giving an example grower of HNS and a combined case study of the soft fruit growers who used current 'best practice' IPM programmes.

HNS

Components of the grower's IPM programme for vine weevil management included:

- On both protected and outdoor containerised plants, use of the entomopathogenic nematodes *Steinernema kraussei* (Nemasys L) in cool conditions (5-12°C) and *Heterorhabditis bacteriophora* (e.g. Nemasys H) in milder conditions i.e. 12°C or above was considered to be successful. Nematodes are applied as a drench to all vine weevil-susceptible plants and all plants in propagation. Monitoring of vine weevil larvae around roots is done by knocking out pots to guide autumn application timings but typically applied in weeks 36 and 42/43. Further monitoring of infected or healthy larvae is done following application. Nematode viability is checked using a microscope before application. All supplier application recommendations are followed. Run-off onto the floor from large, densely-spaced plants is a practical application problem and the grower is interested in the development of a specialised applicator to overcome this problem.
- The entomopathogenic fungus, *Metarhizium anisopliae* (Met52) is mixed into the substrate used in plug trays in propagation and is considered as successful in these conditions as no larvae have been detected. Substrate temperature is monitored. Gaps in knowledge identified were more guidance on suitable temperatures and moisture levels for efficacy and potential side effects of fungicides.
- Pymetrozine (Chess WG) is used under protection (daytime application) for adult control when monitoring indicates that adults are feeding. This seems to be effective, judged by monitoring damage on Euonymus 'bait' plants and by night-time crop walks to monitor for adults. Adult sprays are normally applied in April (for overwintered adults) and June or July (for new adults), depending on monitoring.
- Thiacloprid (Exemptor) is used in the growing media used to pot plugs up into all long-term liners potted after 1 July and for potting up highly susceptible saleable plants, bought-in plants with adult feeding damage and re-potted crops with a history of infestation.

Soft fruit

A combined case study of the growers interviewed is presented, as although most growers used similar programmes, some individual growers used one or more adapted or additional IPM components which justify presenting:

- All the growers used entomopathogenic nematodes and considered them to give satisfactory control when used in substrate-grown crops (strawberry, raspberry and blackberry) but to give poor control when used in field-grown crops, thus nematodes are seldom applied to soil-grown crops. Application is mainly through drip irrigation systems as it is much less labour-intensive than drenching, however drenching is sometimes used e.g. to infested strawberry tray plants or to large pots used for growing blueberries. Dripper efficiency is monitored using dye and some growers also check numbers of nematodes at the start and end of the irrigation system. Nematodes species used, as in HNS, are *S. kraussei* (Nemasys L or Exhibitline sk) or *H. bacteriophora* (Nemasys H, Larvanem, Nematop or Exhibitline h) depending on the time of year and temperatures. Efficacy is monitored by checking for live and infected larvae 2-4 weeks after application.
- Most growers use recommended nematode rates, in one or two applications in August or August and September) and again in April if live larvae are seen and temperatures are suitable. Several growers in Scotland have successfully used a 'little and often' method with lower rates (one fifth or half-rates) applied monthly, often between April and October. This strategy has been advised by Syngenta Bioline, following unreliable control given by recommended rates applied in autumn and spring, possibly due to overlapping vine weevil generations. Research to validate this approach compared with conventional nematode timings is justified.
- The current formulation and recommended incorporation method for Met52 is not suitable for use in soft fruit. Most strawberry crops are grown in coir, delivered in solid blocks in bags for wetting up, so incorporation is not possible. Most beds used for soil-grown strawberry crops are made up in autumn for spring planting, thus the product would run out of persistence by the following autumn when vine weevil larvae would be present, and in the second year's cropping when most vine weevil problems occur. Raspberry plants are cropped for 3-4 years and thus Met52 incorporation into the mixed coir substrate and chopped roots of previous crops would not give sufficient persistence. Growers would be interested in a liquid formulation that could be applied through drip irrigation. One grower had successfully used Met52 in a sawdust mulch (using EAMU 1997/2011) in spring on potted blueberry and considered this to have given successful control of any young larvae hatching from eggs laid into the mulch.
- Most growers used insecticide sprays at or just after dusk on warm, still nights for adult weevil control, including chlorpyrifos (Dursban WG or Equity), thiacloprid (Calypso) or pyrethroids such as lamda-cyhalothrin (Hallmark). Most growers

reported poor control, with only one grower reporting dead adults after spraying chlorpyrifos to the base of raspberry canes.

- Five of the seven growers interviewed applied a chlorpyrifos drench to strawberry crops after harvest in October to November, particularly on older, soil-grown crops where vine weevil numbers have built up due to the impracticality of using nematodes. Drenches were reported to give variable control of larvae.
- Cultural control methods used included using barrier glue on table top legs to prevent weevil adults crawling up to strawberry crops, removing polythene mulches on raised beds which was reported to significantly reduce weevil populations and choosing isolated sites away from infested areas to plant new crops.

Task 1.1, 1.2 and 1.3. Systematically retrieve relevant peer reviewed scientific literature, retrieve 'grey' literature and collate and summarise key relevant information.

A search of international scientific publications and 'grey' literature (such as HDC, Defra and HortLINK funded project reports, USDA funded research reports and conference proceedings) identified over 560 papers or reports with relevant information on vine weevil biology and management. These publications were grouped together in a database and each one was read by the project team and summaries of key knowledge were written up as a comprehensive report (given in the Science Section of this report) which collated current understanding of vine weevil biology and management. Key knowledge or technology gaps were highlighted. The report is split into the following five sections:

- Vine weevil biology and behaviour, monitoring and forecasting
- Biological control with entomopathogenic nematodes
- Biological control with entomopathogenic fungi
- Other non-chemical methods including predators and other natural enemies, plant extracts and botanical biopesticides, cultural control methods
- Chemical control, relevant to currently approved products in the UK or those with potential for future approval

Objective 2. Identify opportunities for the delivery of existing knowledge to support implementation

HDC intends to fund activities to communicate key information reported in the review to growers and other industry members. The report summarises knowledge transfer methods previously and currently used for communicating knowledge on vine weevil biology and

control. These include HDC reports, website, factsheets, HDC News articles, Crop Walkers Guides, grower IPM workshops funded by HDC, Defra and others, consultancy provided by ADAS, other consultants and biological control suppliers, product labels and leaflets and supplier websites. When growers, consultants and suppliers were interviewed about their current management strategies in Objective 1, they were also asked to comment on the effectiveness of these knowledge transfer methods and which they would find most helpful in supporting the implementation of vine weevil control strategies. Full details of previously and currently used methods and industry feedback are given in the Science Section. Taking into account feedback from the industry, the following methods are suggested for communicating relevant knowledge and IPM protocols to growers in each relevant sector:

- HDC News article(s)
- Presentations at relevant grower meetings
- Vine weevil seminars or workshops in England, Scotland and Wales.
- Factsheets to be updated for both soft fruit and HNS/protected ornamentals
- Vine weevil section on the HDC website, designed to allow easy navigation and access to key information, seasonal action points and practical tips.
- Emails / texts to growers with vine weevil alerts and action points
- Practical demonstration of current best-practice application methods for vine weevil control on a soft fruit farm and HNS nursery.

Communication plans and research priorities to fill gaps in knowledge will be confirmed after discussions with key HDC staff and the industry representatives.

Objective 3. Design 'best-practice' IPM protocols suitable for implementation on susceptible crops in each relevant horticultural sector

Using the information on vine weevil biology and control collated in Objective 1, two flow charts were produced, one for containerised ornamentals and one for soft fruit, summarising key decisions and options for vine weevil management within an IPM programme. Each chart is presented in two parts, one for early season and the other for mid-late season (see Figures 1a and 1b (ornamentals) and 2a and 2b (soft fruit). Options for the various components of the IPM programmes are summarised in Table 1.

Table 1. Summary of components of IPM programmes for containerised ornamentals and soft fruit

IPM component	Containerised ornamentals	Soft fruit
Monitoring	Check around roots for larvae March-November, check again 2-4 weeks after nematode application to guide repeat applications Check for adult activity and damage April-October	
Cultural control	Dispose of badly infested plants and growing media, keep weeds controlled and maintain nursery hygiene	As for ornamentals, also consider removing polythene mulch, and using barrier glue on table-top legs
Entomopathogenic nematodes - timing	Apply as drench in April if live overwintered larvae found, repeat in August-November to control larvae hatching from summer and autumn-laid eggs if temperatures suitable (2 applications may be needed)	In substrate crops, apply by drip-irrigation in April if live larvae found and temperatures suitable, repeat in August-September (2 applications may be needed). Or consider the 'little and often' approach (low rates applied monthly April-October). Research is justified to validate this approach.
Entomopathogenic nematodes - temperatures	*Steinernema kraussei* (Nemasys L, Exhibitline sk) 5-30°C *Heterorhabditis bacteriophora* (Nemasys H, Exhibitline h) 12-30°C *H. bacteriophora* (Larvanem) 14-33°C *H. bacteriophora* (Nematop) minimum 12°C Mix of *Steinernema carpocapsae, S. feltiae* and either *H. bacteriophora* or *H. megidis* (SuperNemos) minimum 10°C	
Met52	Consider incorporation in growing media for spring/summer pottings. Minimum temperature for activity against larvae 15°C. Unlikely to be effective against larvae hatching September-November from late-laid eggs	Consider EAMU 1997/2011 for use in a mulch, e.g. to plants in large pots
Chemical control - adults	Consider foliar spray(s) against adults in April-May (overwintered adults) or June/July (new adults). Chess WG (EAMU 2834/2008 for protected ornamentals) or Steward (EAMU 2905/2008 for outdoor ornamentals) are more IPM-compatible than other pesticides and showed promise in HDC semi-field trial. (Lower, on-label or other EAMU application rates than those in the above EAUMUs have not been tested). Efficacy in commercial conditions needs validation.	Timing as for ornamentals. Chess WG (EAMU 2834/2008 for protected crops) or Steward (EAMU 2905/2008) on outdoor, uncropped soft fruit where a 1-year harvest interval is possible i.e. plants in propagation) are more IPM-compatible than other pesticides. Comments on efficacy at rates in other EAMUs as for ornamentals.
Chemical control - larvae	Consider thiacloprid (Exemptor) incorporation into peat-based growing media. Imidacloprid (Imidasect 5GR or Intercept 5GR only in peat-based growing media in glasshouses, do not move outside until after flowering).	Consider chlorpyrifos drench to strawberry after cropping if sufficient soil moisture and temperatures above 5°C

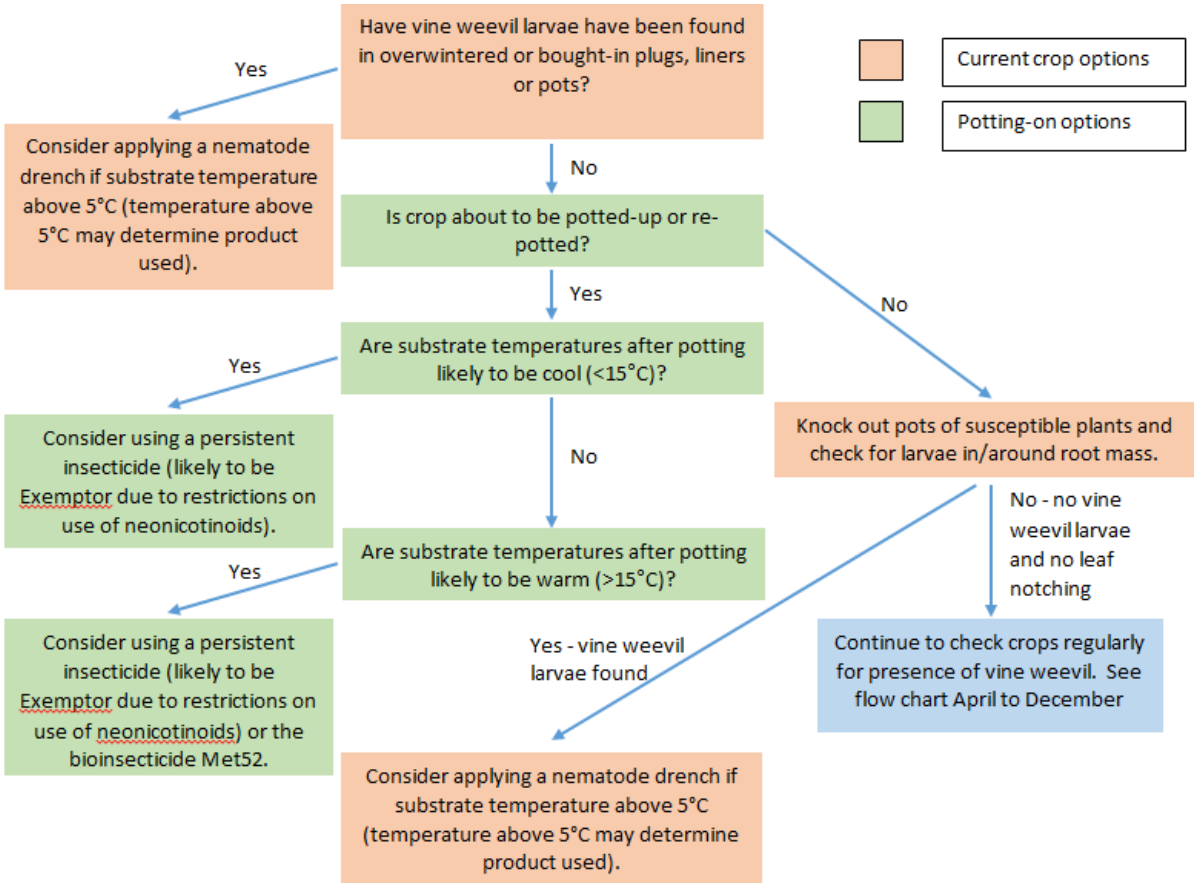


Figure 1a. Early season (January to April) decisions in vine weevil management on susceptible containerised ornamentals.

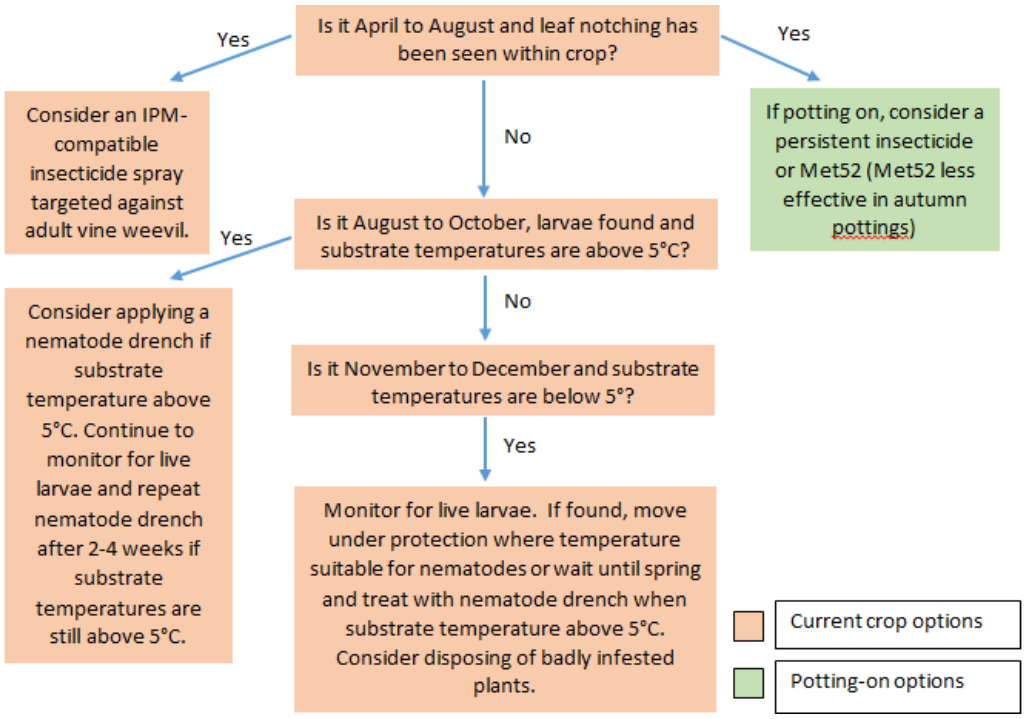
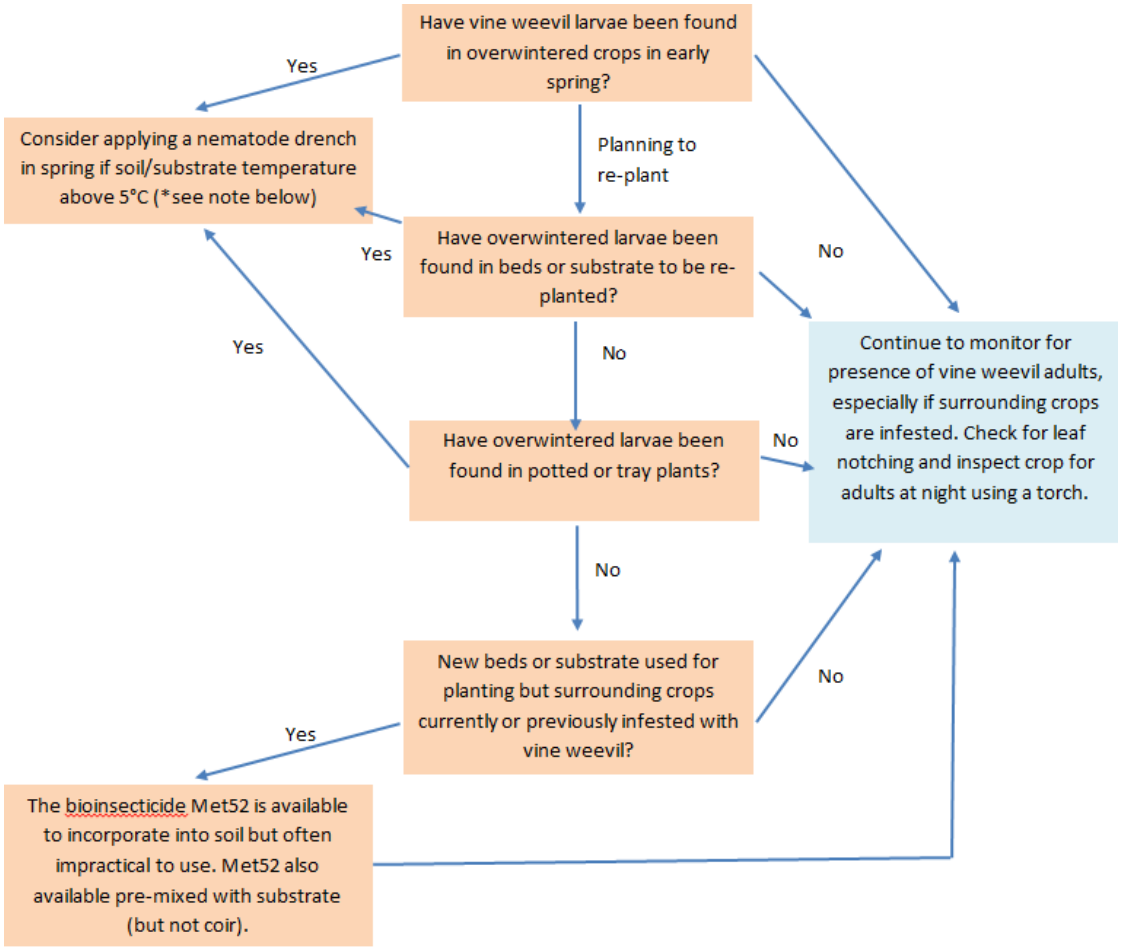
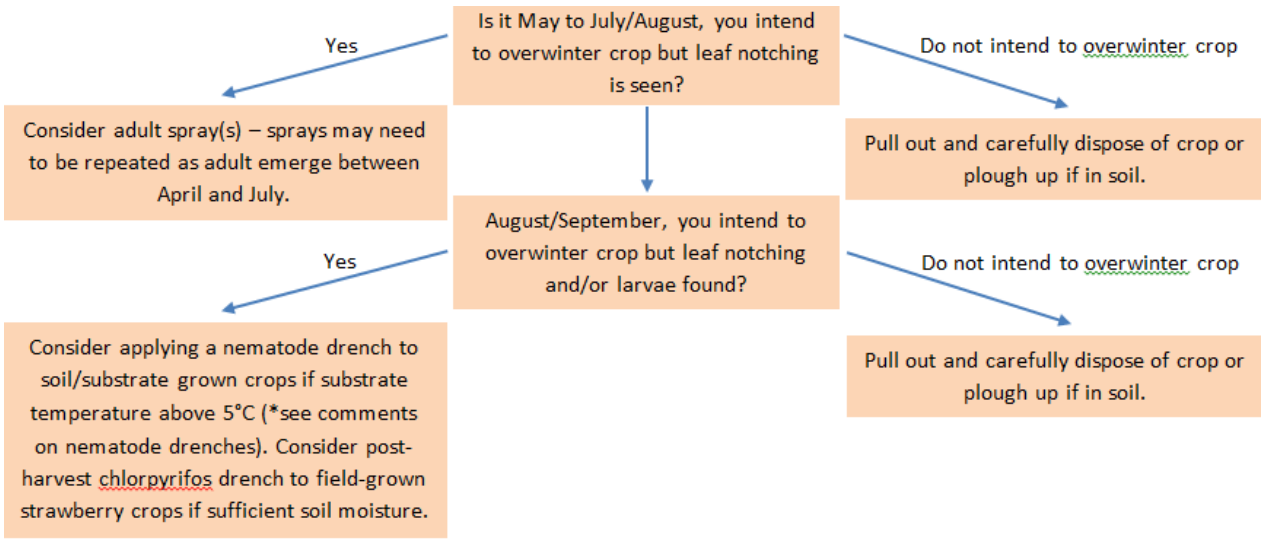


Figure 1b. Mid to late season (April to December) decisions in vine weevil management on susceptible containerised ornamentals.



*Nematode drenches are most likely to be applied through drip irrigation. The temperature above 5°C may determine the species/product used. Nematode drenches are likely to be more effective in substrate than in soil-grown crops.

Figure 2a. Early season (February to April) decisions in vine weevil management on soft fruit crops.



*Nematode drenches are most likely to be applied through drip irrigation. The temperature above 5°C may determine the species/product used. Nematode drenches are likely to be more effective in substrate than in soil grown crops.

Figure 2b. Mid to late season decisions (May to September/October) in vine weevil management on soft fruit crops.