Grower Summary

SF 99

Sustainable control of crown rot (*Phytophthora cactorum*)

Final 2011

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Before using all pesticides check the approval status and conditions of use.

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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.

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Headline

- Revus, Ranman, Fenomenal and a coded product HDC F10 were as effective as Aliette and Paraat in reducing crown rot in the strawberry variety Malling Pearl

Background and expected deliverables

Crown rot caused by the fungus *Phytophthora cactorum* is an important disease of strawberries causing significant losses in both fruiting production and plant production and propagation, especially in crops grown under protection. Complete crop loss in fruit production can occur under favourable warm, wet conditions in susceptible varieties. Similarly, the presence of crown rot in propagation stocks can result in rejection of the whole stock.

The fungus produces several spore types – asexual spores (sporangia) that are mainly involved in infecting plants and initiating new epidemics, asexual resting spores (chlamydospores) that are thick walled and can survive adverse conditions and sexual spores (oospores) that are also thick walled and capable of surviving adverse conditions. The resting spores can remain in soil and plant debris for many years. The fungus is favoured by warm wet conditions (optimum temperature 25^{o}C for infection and development). A warm and prolonged wet period is essential for infection. High temperatures and water stress appear to enhance disease development and / or symptom expression.

The disease is introduced into new crops by planting into infected soil or into areas contaminated by infected debris or water or by planting infected planting material. Inoculum dispersal and disease spread within plantations is brought about by water splash. Varieties vary in susceptibility to crown rot. Elsanta, Sonata, Rosie, Sophie, Malling Pearl and Malling Opal are known to be very susceptible, whilst Symphony, Alice, Judibell and Pegasus have some resistance. Most of the problems with the disease are associated with the very susceptible varieties which are also those most favoured by the market.

To control crown rot in fruit production, growers rely on soil fumigation (which only gives partial control), use of disease-free planting material and protective fungicide treatments. Many of the current problems with crown rot in fruit production are associated with planting symptomless-infected plants especially of very susceptible

varieties. The disease then manifests itself at a later stage of fruit production, generally as fruit production commences.

The production of healthy planting material is crucial to the control of the disease in fruiting beds. The epidemiology of the disease in plant propagation is not clear and requires basic research to understand the nature of the symptomless infection of propagation material by *P. cactorum*. The production of crown rot-free planting material must be a long term objective of any control strategy for crown rot.

In the short term there is a need to identify new chemicals for control of crown rot in fruit production. Currently only Aliette (fosetyl-Al) and Paraat (dimethomorph) can be used in fruit production and the industry is very dependent on the availability of these fungicides for strawberry. It is important to identify additional fungicides effective against crown rot, as repeated use of a limited number of effective products can result in reduced efficacy because of the development of fungicide resistance. Previously *P. cactorum* has developed resistance to certain fungicide groups including metalaxyl (Ridomil) that has resulted in reduced efficacy.

Many new fungicides are developed for control of potato blight (*Phytophthora infestans*), which is closely related to *P. cactorum* and these may also be suitable for use on strawberry to control crown rot. In addition there are alternative chemicals such as Chitoplant (crushed crab shells) that have shown efficacy against Phytophthora diseases of other crops or downy mildew on grapevines (a fungus closely related to Phytophthora) that may also be worth evaluating. Phosphonic acid and potassium phosphate are also known to be active against *Phytophthora* diseases. These compounds used alone may not be sufficiently effective for disease control, but if used in conjunction with conventional fungicides, may improve efficacy. Some biocontrol agents such as *Trichoderma* sp or *Clonostachys* sp, have shown activity in trials against *Phytophthora* species, and are available as commercial products so should also be included.

Cultural methods of disease control are an important part of any integrated control programme. Important cultural methods of control include avoiding very susceptible varieties, disease-free planting material, adequate soil drainage, growing on raised beds, straw mulching to minimise splash and good hygiene, particularly in glasshouse production.

The overall objective of this project is to develop an integrated sustainable approach for control of strawberry crown rot based on cultural techniques, fungicides, alternative chemicals and biocontrol agents. The main objective in the first year of the project was to evaluate fungicides, additional chemicals and biocontrol agents for control of crown rot. Both experiments were conducted on the variety Rosie, which had previously been shown to be very susceptible to crown rot. However, the disease failed to develop sufficiently for differences between treatments to be identified. Therefore the second year of the project was largely a repeat of the first year but used the very susceptible variety Malling Pearl to ensure the development of the disease in the trial.

Summary of the project and main conclusions

Module-raised Malling Pearl plants were used for the trial. These were planted into peat bags, ten plants per bag and two bags per plot in a polytunnel in late May. The treatments listed in Table 1 were applied as drenches immediately after planting, two weeks after planting or as foliar sprays applied two weeks after planting, once new leaf growth was visible. All treatments were applied once, apart from the biocontrol agents Serenade and Pre-stop which were applied at planting with a second treatment two weeks later. Aliette (fosetyl-Al) and Paraat (dimethomorph) were included as standards. Two untreated controls were also included.

After the treatments had been applied, potted plants of Malling Pearl inoculated with *Phytophthora cactorum* were introduced into each peat bag and overhead irrigation applied at set intervals to provide conditions conducive to disease development and spread.

The trial was checked weekly for any symptoms of crown rot. By 4 June most of the inoculated plants had collapsed with typical symptoms of crown rot and some similar symptoms were appearing in the trial plants. The inoculated and trial plants were assessed for crown rot on 13 July with second assessments made on 15 September. After the final assessment in September, the crowns of some plants were checked for crown rot by slicing the crown longitudinally. The crowns of all wilted plants examined showed internal necrosis typical of that caused by *Phytophthora cactorum.*

The percentage of plants infected with crown rot in July and September are shown in Figure 1A. At both assessment dates, the percentage of infected plants was significantly reduced by treatments 3 (Revus), 4 (Ranman), 5 (Fenomenal), 10 (Aliette), 11 (Paraat) and 13 (Farmfos 10 L). Treatment 14 (HDC F10 5 L) was significant at the assessment in July but not in September. HDC F10 (10 L) had the lowest crown rot score in July but was not significantly different from the other treatments reducing crown rot. Of the two biocontrol agents evaluated, plants treated with Prestop had less crown rot than those treated with Serenade and just failed to be significant at the assessment in July. The main conclusions were:

- Revus, Ranman and Fenomenal, applied as one spray or drench, significantly reduced the incidence of crown rot compared to the untreated control and were as effective as the standards Aliette and Paraat.

- HDC F10 at 10L/ha applied as one spray soon after planting was also effective in reducing the incidence of crown rot.

- HDC F10 at 5 L/ha also reduced crown rot incidence at the first assessment in July but was not as effective as the higher rate.

- The biocontrol agents evaluated – Serenade and Prestop both reduced crown rot compared to the untreated control but differences were not significant.

- All other fungicides and chemicals evaluated were ineffective.

Table 1. Fungicide, chemicals and biocontrol treatments tested on strawberry plants in 2010 for control of crown rot (*Phytophthora cactorum*)

Product	**Active ingredient**	**Product type**	**Product rate per litre**	**Application method**
Untreated	-	-	-	-
Amistar	azoxystrobin	Fungicide	0.5 ml	Drench soon after planting
Revus	mandipropamid	Fungicide	0.3 ml	Drench soon after planting
Ranman A	cyazofamid	Fungicide	0.1 ml	Drench soon after planting
Fenomenal	fosetyl-Al + fenamidone	Fungicide	0.75 g/L	100 ml of diluent per plant 2 weeks after planting
Experimental 1	HDC F6	Fungicide	1.6 g/l	Foliar spray to new growth at 1000L/ha
Untreated	-	-	-	-
Electris	zoxamide + mancozeb	Fungicide	0.9 g	Drench soon after planting
Option	cymoxanil	Fungicide	0.075g	Drench soon after planting
Aliette	fosetyl-Al	Fungicide	3.75g	Foliar spray to new growth at 1000L/ha
Paraat	dimethomorph	Fungicide	1g	Drench soon after planting
Chitoplant	chitosan	Plant resistance stimulator	1g	Foliar spray to new growth at 1000L/ha
Experimental 2	HDC F10	Plant resistance stimulator	10 ml	Foliar spray to new growth at 1000L/ha
Experimental 3	HDC F10	Plant resistance stimulator	5 ml	Foliar spray to new growth at 1000L/ha
Prestop	*Gliocladium catenulatum*	Biocontrol agent	5 g/L 50 ml / plant	Drench 100ml/plant at planting and repeated 4 weeks later
Serenade	*Bacillus subtilis*	Biocontrol agent	4 ml/L 50ml / plant	Drench 100ml/plant at planting and repeated 4 weeks later

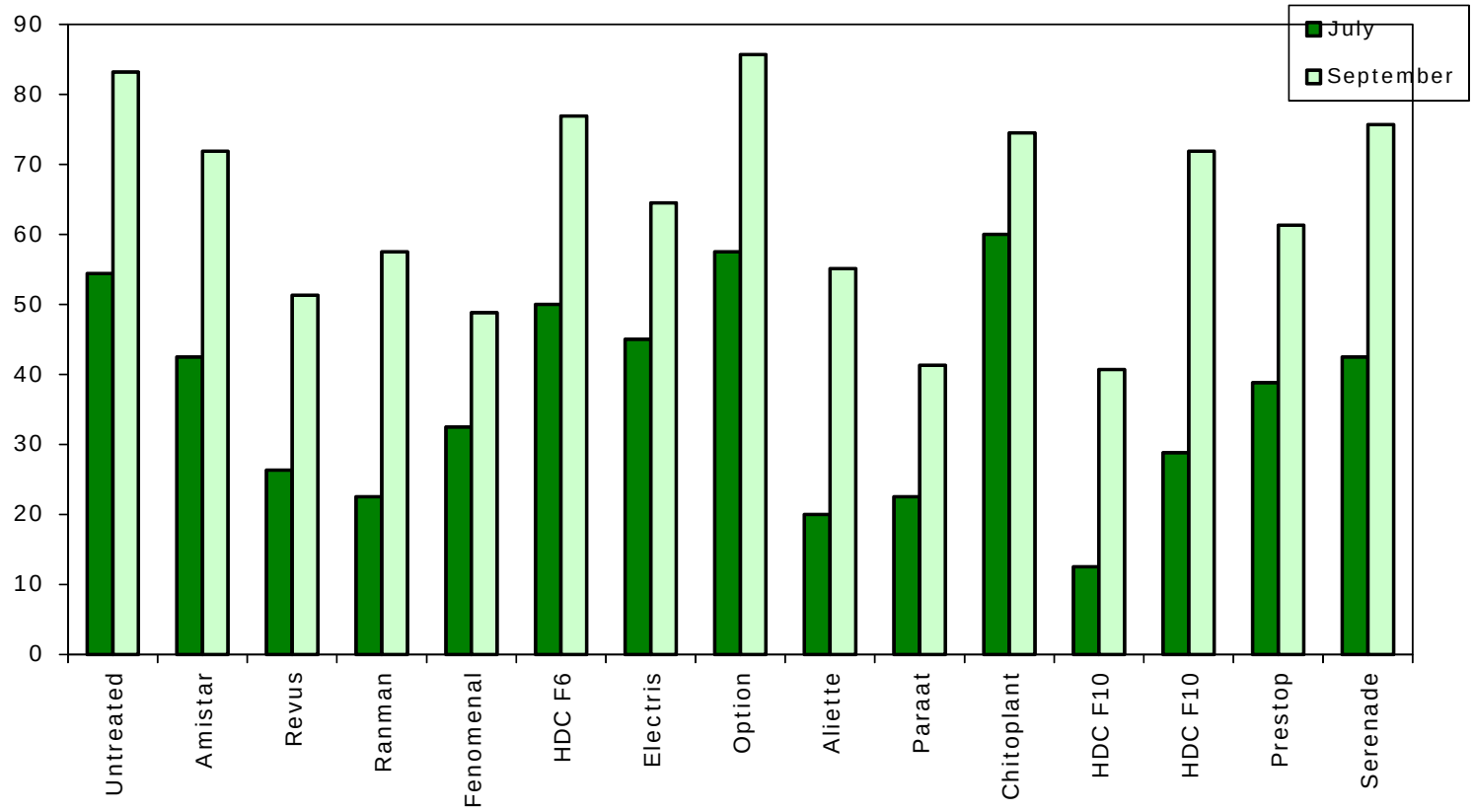

Figure.1A Mean per cent strawberry plants cv. Malling Pearl infected with crown rot following treatment with various fungicides, alternative chemicals and biocontrol agents assessed in July and September 2010.

Financial benefits

Crown rot caused by the fungus *Phytophthora cactorum* is an important disease of strawberry both in the propagation phase and in fruit production. Failure to control the disease in fruit production with a susceptible cultivar can result in severe losses or even complete crop loss. Clean planting material is vital in the integrated approach to disease control but effective fungicides are also important to prevent infection in the fruiting plantation. Currently only Aliette (fosetyl-Al) and Paraat (dimethomorph) can be used in fruit production and the industry is very dependent on the availability of these fungicides for strawberry. It is important to identify additional fungicides effective against crown rot as repeated use of a limited number of effective products can result in reduced efficacy because of the development of fungicide resistance. Previously *P. cactorum* has developed resistance to certain fungicide groups including metalaxyl (Ridomil) that has resulted in reduced efficacy. It is also important for control of this disease to explore the use of alternative chemicals and biocontrol agents because of the possible limitations on use of conventional fungicides by the EU in the near future. This project has identified effective additional fungicides to Aliette and Paraat, including Fenomenal or biocontrol agents for crown rot control. The information generated will form the basis of an integrated approach to crown rot control which will be evaluated in a future project.

Action points for growers

- Currently Revus and Ranman are not approved for use on strawberry.
- Fenomenal is approved for use on outdoor strawberry.