Grower Summary

SF 121

Sustainable control of crown rot (*Phytophthora cactorum*)

Final 2012

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Further information

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Headline

Ranman, Fenomenal, Paraat, SL567A and a coded product (HDC F105) reduced crown rot incidence in strawberry cv. Malling Pearl when applied as a single drench or spray soon after planting.

Background and expected deliverables

Crown rot caused by the fungus *Phytophthora cactorum* is an important disease of strawberries causing significant losses in both fruit 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 cultivars. Similarly, the presence of crown rot in propagation stocks can result in rejection of the whole stock. The fungus *P. cactorum* has a world-wide distribution and a wide host range and also causes leather rot on strawberry. A recent report (2004) indicates that isolates can be separated genetically into two groups: isolates that cause crown rot are specific to strawberry crown rot, while isolates of *P. cactorum* from other hosts and from leather rot do not cause crown rot. 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 period with prolonged wet conditions 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 by water splash. Cultivars vary in susceptibility to crown rot. ‘Tamella’, ‘Pearl’, ‘Opal’ and ‘’Elsanta’ are very susceptible. ‘Hapil’ and ‘Cambridge Favourite’ are much less susceptible. Most of the problems with the disease are associated with the very susceptible cultivars which are also those most favoured by the market.

Control of crown rot in fruit production is based on soil sterilisation, which only gives partial control, use of disease-free planting material and use of 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 cultivars. The disease 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 alternative 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*) and these may also be suitable for use on strawberry to control crown rot as the fungus responsible – *Phytophthora cactorum* is closely related to the potato blight oomycete. In addition there are alternative chemicals such as Chitoplant (crushed crab shells) or Quillaia (soap bark extract) 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 phosphite are SAR (systemic acquired resistance) compounds and known to be indirectly active against *Phytophthora* diseases. These compounds used alone may not be effective enough for disease control but if used in conjunction with conventional fungicides may improve efficacy.
Some biocontrol agents – *Trichoderma* sp or *Clonostachys* sp have shown activity in trials against *Phytophthora* species, and are available as commercial products and should 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 cultivars, disease-free planting material, adequate soil drainage, growing on raised beds, straw mulching to minimise splash and good hygiene particularly in glasshouse production.

In Project SF 99 the fungicides Amistar (azoxystrobin), Revus (mandipropamid), Ranman (cyazofamid), Fenomenal (fosetyl-Al + fenamidone), Electris (zoxamide + mancozeb), Option (cymoxanil), CERF303 (experimental); alternative chemicals such as Chitoplant (chitosan) and biocontrol agents Serenade (*Bacillus subtilis*) and Prestop (*Gliocladium catenulatum*) were evaluated for control of crown rot on strawberry cv. Malling Pearl. Aliette (fosetyl-Al) and Paraat (dimethomorph) were included as standards and untreated controls. 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. Of the two biocontrol agents evaluated, plants treated with Prestop had less crown rot than those treated with Serenade and just failed to reach significance. All other fungicides and chemicals evaluated were ineffective.

The overall objective of this project (SF121) was to develop an integrated sustainable approach for control of strawberry crown rot based on cultural, fungicides, alternative chemicals and biocontrol agents. The main objective in this project was to further evaluate the products identified in SF99 as effective.

Summary of the project and main conclusions

Two strawberry cultivars were used for the trial - module-raised strawberry plants cv. Malling Pearl and cold-stored runners of cv. Sonata. Both cultivars were known to be susceptible to crown rot. These were planted into peat bags, ten plants per bag and four bags per plot in a polytunnel in late May. The treatments (set out in Table 1) were applied as indicated soon after planting once new leaf growth was visible. A second treatment of the biocontrol agent Pre-stop was applied two weeks later. Two untreated controls were also included. Treatments 2-8 received the initial treatments only. Treatments 9-13 received a foliar spray of a coded product HDC F105 4-6 weeks later. In addition HDC F105 was applied at two spray volumes of 1000 L/ha or 400 L/ha to assess the effect of spray volume on efficacy.
After the initial treatments had been applied potted plants of cv. Malling Pearl or Sonata 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 assessed weekly for any symptoms of crown rot. By 5 July most of the inoculated plants of cv. Malling Pearl had collapsed with typical symptoms of crown rot and some similar symptoms were appearing in the trial plants. In contrast almost none of the inoculated plants of cv, Sonata had developed symptoms by the end of July and these plants

were reinoculated in August. The trial was assessed for crown rot on 23 August, 27 October with a final assessment the following spring on 4 April.

Despite the second introduction of crown rot inoculum, the incidence of plants with crown rot symptoms in the Sonata plants remained very low throughout the trial and was not related to treatment. After the final assessment in April 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 cv. Malling Pearl plants infected with crown rot in August, October and April are shown in Figure 1a. The main conclusions were:

- Ranman, Fenomenal and Paraat applied as a single drench reduced the incidence of crown rot compared to the untreated control although differences were not significant.
- SL567A applied as a single drench significantly reduced the incidence of crown rot compared to the untreated control and was still effective 9 months after treatment.
- HDC F105 at 10L/ha applied as one spray at 1000 L/ha soon after planting was also effective in reducing the incidence of crown rot. However, application at 400 l/ha appeared to be much less effective.
- Single drenches of Fenomenal, Paraat, SL567A or a single spray of HDC F105 applied soon after planting with a spray of HDC F105 one month later significantly reduced crown rot compared to the untreated control.
- The biocontrol agent Prestop applied as two drenches soon after planting did not reduce crown rot but the addition of a spray of HDC F105 one month later resulted in a significant reduction of crown rot.
- Another coded product HDC F12 (0.5 ml/L) applied as two sprays at one month intervals significantly reduced the incidence of crown rot and was more effective than the same chemical applied at the higher dose of 1.0 ml/L.
- No phytotoxicity was observed on any of the treatments.

Table 1. Fungicides, chemicals and biocontrol treatments evaluated for control of crown rot in 2011

Treatment number	Treatment	Active ingredient	Product rate/ litre	First treatment	Second treatment
1	Untreated	-	-	-	-
2	Ranman	cyazofamid	0.1 ml	Drench soon after planting	Nil
3	Fenomenal	fosetyl-Al + fenamidone	0.75 g	Drench soon after planting	Nil
4	SL567A	metalaxyl-M	1.3 ml	Drench soon after planting	Nil
5	Paraat	dimethomorph	1 g	Drench soon after planting	Nil
6	Prestop	*Gliocladium catenulatum*	5 g	Drench soon after planting and repeated 2 weeks later	Nil
7	HDC F105	Experimental (44% ai)	10 ml	Foliar spray to new growth at 1000 L/ha	Nil
8	HDC F105	Experimental (44% ai)	10 ml	Foliar spray to new growth at 400 L/ha	Nil
9	Ranman	cyazofamid	0.1 ml	Drench soon after planting	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
10	Fenomenal	fosetyl-Al + fenamidone	0.75 g	Drench soon after planting	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
11	SL567A	metalaxyl-M	1.3 ml	Drench soon after planting	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
12	Paraat	dimethomorph	1 g	Drench soon after planting	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
13	Prestop	*Gliocladium catenulatum*	5 g	Drench soon after planting and repeated 2 weeks later	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
14	HDC F105	Experimental (44% ai)	10 ml	Foliar spray to new growth at 1000 L/ha	Foliar spray HDC F105 4-6 weeks later at 1000 L/ha
15	HDC F12	Experimental (10% ai)	0.5 ml	Foliar spray to new growth at 1000 L/ha	Second foliar spray 4-6 weeks later
16	HDC F12	Experimental (10% ai)	1.0 ml	Foliar spray to new growth at 1000 L/ha	Second foliar spray 4-6 weeks later

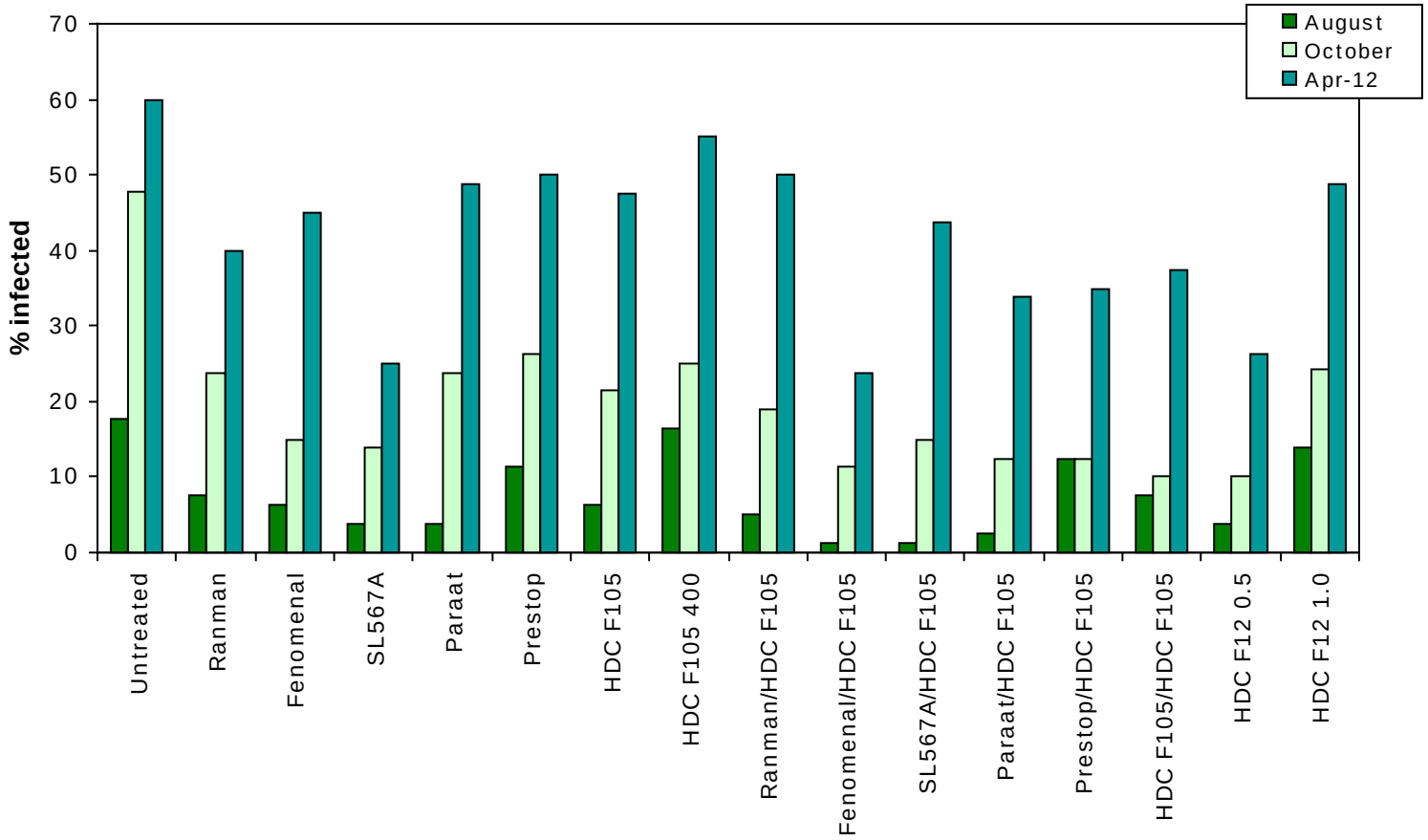

Figure 1a. Mean per cent strawberry plants cv. Malling Pearl infected with crown rot following treatment with various fungicides, alternative chemicals and biocontrol agents assessed in August, October 2011 and April 201

Financial benefits

This project has demonstrated the efficacy of Paraat, Fenomenal and HDC F105 for control of crown rot. In addition the biocontrol agent Prestop has also shown some efficacy for crown rot control. The information generated will form the basis of an integrated approach to crown rot control, which will reduce financial losses caused by the disease.

Action points for growers

- Paraat is now approved for use on strawberries for control of crown rot in outdoor and protected crops. One treatment per year is permitted.
- Fenomenal is now approved for use on strawberries to control crown rot but only on outdoor crops.
- Prestop is approved for use on strawberry in both outdoor and protected crops for control of various diseases including *Phytophthora* and *Botrytis.*