Start dry, stay healthy

John Clarkson and Steve Roberts have found that keeping watering to the minimum is still the best way to manage pythium in brassica transplants though several non-chemical seed treatments can help against phoma and alternaria

Diseases caused by soil- and seed-borne fungi can be a major problem for plant propagators, especially for high volume, high value plants such as brassicas and particularly in organic production where there are fewer options for control. So HDC's Field Vegetables Panel commissioned FV 352 to test a range of organically acceptable treatments for damping-off diseases caused by pythium and rhizoctonia and seed-borne phoma and alternaria diseases.

The treatments included a number of natural or microbial products now available in the EU, plus some experimental ones (see table).

We started by looking separately at growing media treatments for their effects on seedling emergence and damping-off caused by pythium or rhizoctonia; and seed treatments for their effects on seed-borne alternaria and phoma. The growing media treatments were tested in mini module trays with seed sown in a standard peat-based organic module medium artificially inoculated with either pythium or rhizoctonia.

Two of them had a significant effect on pythium: the experimental trichoderma S17A; and green waste incorporated at 20% with the growing medium either alone or combined with the trichoderma. For rhizoctonia, the only significant impact was from green waste. The thiram seed treatment used for comparison consistently controlled pythium but was less effective against rhizoctonia.

The seed treatments were applied at suppliers' recommended rates to brassica seed lots naturally infested (either contaminated or infected) with alternaria or phoma. We used two methods to assess them: a standard blotter seed test, which is a cheap and easy way to show the direct effects of treatments but may underestimate any indirect effects of microbial treatments such as enhancing disease resistance; and a transmission/emergence test, which is more difficult as treated seed is sown in trays of a standard growing medium so that emergence and seedling symptoms can be recorded, but shows both direct and indirect effects.

In the standard blotter test, hot water, thyme oil, and the experimental product HDC B0002 gave significant reductions in phoma infection levels, and were all better than thiram. Hot water, in particular, reduced infection to undetectable levels, below 1.5%. All treatments significantly reduced the level of alternaria infection but the best were hot water, thyme oil, clove oil, the microbials Serenade ASO and HDC B0002, and the fungicide thiram. Again hot water reduced infestation to undetectable levels.

In the transmission test, the proportion of seedlings affected by phoma was significantly reduced by treatment with hot water, thiram, thyme oil and Serenade with hot water having the greatest effect. No transmission of alternaria was observed.

We took the most promising treatments and tested them in combination in larger scale experiments representing a more realistic plant-raising set-up using 345 module trays filled with pythium-inoculated growing medium and sown with phoma-infested seed. Watering was by overhead sprinklers controlled by a timer to provide two watering regimes in which the 'low' was watered for four minutes daily and the 'high' eight minutes daily.

The seed treatments we chose were thyme oil, Serenade ASO and HDC B0002; and the growing medium treatments were 20% green waste and Trianum G in a total of 12 combinations including untreated seed and growing media. We included Trianum G because although it did not on its own reduce pythium infection in the initial experiments, it was already being used by commercial plant raisers and we thought that it might be effective if allowed to colonise the growing medium before pythium was introduced, so we incorporated two weeks before sowing.

The biggest impact on pythium infection was from the watering regime, with four or five times the level of emergence in the 'low' compared to the 'high'. Both of the

WHAT THE FUNGI DO TO SEEDLINGS

Species of both pythium and rhizoctonia can kill seedlings before emergence or cause post-emergence damping-off; rhizoctonia also causes wirestem in older seedlings. *Phoma lingam* is responsible for blackleg, stem canker and leaf spots in the field and can also cause a damping-off and reduced vigour in seedlings. *Alternaria brassicicola*, which causes dark leaf spot in the field, can also reduce emergence in seedlings.

Damping-off caused by pythium

Wirestem symptom of rhizoctonia

Phoma lesions spread from infected cotyledons

Alternaria sporulating on seed surface

PRODUCTS TESTED AND THEIR APPROVAL STATUS

TREATMENT	ACTIVE COMPONENT	UK APPROVAL STATUS
Compost treatments		
Exp S17A	*Trichoderma viride* bran formulation	Experimental product. Not approved
Trianum G	*Trichoderma harzianum*	Listed on Annex 1 of 91/414. Currently undergoing registration
Prestop	*Gliocladium catenulatum*	Full approval for all edible and non-edible protected crops
Mycostop	*Streptomyces griseoviridis*	Not approved in the UK. Approved in several EU countries
Subtilex	*Bacillus subtilis*	Not approved
Revive P	*Bacillus subtilis*	Not approved for crop protection but marketed as a microbial soil treatment
Green waste	4mm seived, Organic Recycling Ltd	Approval as growing media ingredient not required
Seed treatments		
Hot water		Approval not required
Agrichem Flowable Thiram	Thiram	Approved brassica seed treatment, included for experimental comparison
Thyme oil	Mixture, mainly thymol	Not approved, Annex 1 listing in progress
Clove oil	Mixture, mainly eugenol	Not approved, listed on Annex 1 of 91/414
Serenade ASO	*Bacillus subtilis*	Not approved for application to seeds. Approved for foliar application to all crops (SOLA)
Mycostop	*Streptomyces griseoviridis*	Not approved in the UK. Approved in several EU countries
HDC B0001	*Pseudomonas* sp.	Experimental product. Not approved
HDC B0002	Beneficial micro-organism	Experimental product. Not approved
HDC B0003	Beneficial micro-organism	Experimental product. Not approved

PROJECT PROFILE

FV 352 Disease management in organic brassica seed and transplants

Term: June 2009 to May 2011

Project leaders: John Clarkson and Steve Roberts

Industry representative: Roger White

Location: University of Warwick and Garden Organic, Coventry

growing medium treatments increased emergence and the number of healthy brassica seedlings.

Unfortunately the high level of pythium infection masked any transmission of seed-borne phoma, so it wasn't possible to evaluate the effects of the seed treatments on that disease. However, none of the seed treatments significantly improved emergence or the number of healthy seedlings – and in contrast to the earlier experiments Serenade ASO and thyme oil appeared to have an adverse effect.

The level of pythium resulting from our inoculated medium was probably higher than generally seen in commercial propagation which highlights how difficult it can be to obtain realistic and consistent levels of this disease in experiments, a major factor influencing the results from treatments involving microbial products.

Companion plants such as bird's foot trefoil are often sown with organic brassica transplants to help manage cabbage root fly in the field. Some believe that because these are fodder crops of variable seed quality they may also carry pathogens and contribute to losses in the crop. No specific pathogens were detected on the bird's foot trefoil seed lot we examined and although emergence of untreated bird's foot trefoil seed was relatively poor, this was not improved by any of the seed treatments.

On the other hand, treatment with hot water led to a small but significant increase in damping-off. We didn't research the optimum hot water treatment timings or temperatures for the bird's foot trefoil so the ones used were probably too stringent for the relatively small seed. Bird's foot trefoil also appeared to be less susceptible to pythium than the brassicas.

So, keeping water applications to the minimum necessary is still likely to have the biggest impact on pythium infection in brassica transplants. Incorporating 20% green waste into the growing medium just before sowing is likely to reduce pythium infection but vegetable-plant raisers also need to consider other perceived risks associated with green waste both for themselves and down the production chain.

Pre-incorporation of Trianum G into the growing medium two weeks in advance of sowing also resulted in lower levels of pythium infection. Pre-incorporation probably allows more opportunity for trichoderma to colonise. Green waste can enhance trichoderma proliferation and it could be worth testing both pre-incorporation and use of green waste as strategies for using some of the other microbial products tested in the first part of this project.

Hot water (50°C for 30 minutes) gave the greatest control of phoma, and reduced alternaria seed infestation to undetectable levels. This is not without problems and precise temperature-time conditions should be determined for individual seed lots.

Thyme oil (1%) reduced both phoma and alternaria in brassica seed, although its use is not currently approved.

Two microbial treatments (Serenade ASO and an experimental product B0002) gave promising results against both phoma and alternaria. Their use as seed treatments is not currently approved, but we would encourage their manufacturers to seek such approval.

The project highlights the key problem with testing microbial or biopesticide products to demonstrate consistent effects in a cost-effective manner. The precise details of the treatment, such as the timing of incorporation of growing media treatments, can have a big influence on the outcome, showing the care needed when evaluating reports of both successful and unsuccessful trials with biological control agents.

ABOUT THE AUTHORS

John Clarkson (above left) is a plant pathologist at the Warwick Crop Centre; Steve Roberts is a plant pathologist and runs the consultancy Plant Health Solutions