Factsheet 19/14

Field Vegetables

Disinfection for the control of clubroot during propagation

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HDC projects FV 337 and FV/PE 337a aims were to investigate tray sterilisation options for the control of plant diseases during propagation. Heat treatments and disinfectants were shown to be effective at controlling *Olpidium brassicae* (the vector of Lettuce big-vein disease) and clubroot. The times needed to control clubroot spores at different temperatures are detailed in this factsheet. The disinfectants Aquaform and Jet 5 were used in the studies therefore the times needed to control clubroot spores in different concentrations of these two disinfectants are also given.

Action points

- It is important to clean propagation trays and kill any clubroot resting spores that may be contaminating them in order to ensure clubroot-free transplants.
- Earlier research showed that the concentrations of disinfectants and exposure times necessary to control clubroot resting spores in the absence of soil were lower and shorter than in the presence of soil. This indicates that removing as much soil as possible from propagation trays prior to disinfection will improve the efficacy of disinfectant treatments.
- Microwaves, pulsed light and ozone did not appear to have great potential at controlling clubroot in HDC project FV 337 and they are not commercially viable for controlling clubroot at the present time.

1. Young brassica plants showing severe clubroot symptoms

- Results from HDC project FV/PE 337a showed that treating clubroot spores for a minimum of 105 minutes at 70ºC or for 45 minutes at 80ºC or for 17.5 minutes at 90ºC controlled clubroot in the presence of soil.
- Aquaform at 10% for 100 minutes, 5% for 120 minutes, or 1% for 9 hours also controlled clubroot spores in the presence of soil.
- Jet 5 at 0.5% for 15 hours controlled clubroot spores in the presence of soil. When using workable concentrations of 5% Jet 5, or less, exposure times should be shorter. Jet 5 at 5% or less would need exposure times of greater than 3 hours.

Background

Clubroot is one of the most important diseases affecting brassica crops in the UK and is prevalent in all major areas of vegetable brassica production. It is caused by a pathogenic protist called *Plasmodiophora brassicae* which forms characteristic clubs or galls on the roots of infected plants (Figure 1), resulting in reduced crop yield potential. Mild crop infections result in up to 20% root damage, causing slowed growth and delayed harvesting. Severe infections can result in total crop failure.

Clubroot resting spores (Figure 2) can remain dormant in contaminated soil for up to 18 years, meaning that infected fields often cannot be used for brassica cultivation for considerable periods of time. Measures for ridding land of clubroot spores often involve disease control treatments which are expensive, have associated environmental concerns and are rarely completely successful. It is therefore essential that clubroot is not introduced into clean soils.

It is very important to avoid introduction of spores into fields via infected transplants. Uncontaminated transplants are therefore an essential component of integrated clubroot control strategies. Successful control procedures involving the use of heat and disinfectants have been identified. Using these treatments effectively will minimise the risk of disease transfer to soil via brassica transplants.

It is important for growers to be aware that the sudden appearance of clubroot in a field which had previously produced uninfected crops may not be a direct result of incoming inoculum from contaminated transplants. Crops can appear to be uninfected while, in fact, they may be harbouring plants with low levels of spores that do not affect production until they reach a threshold level.

2. Clubroot resting spores as seen under the microscope

Control

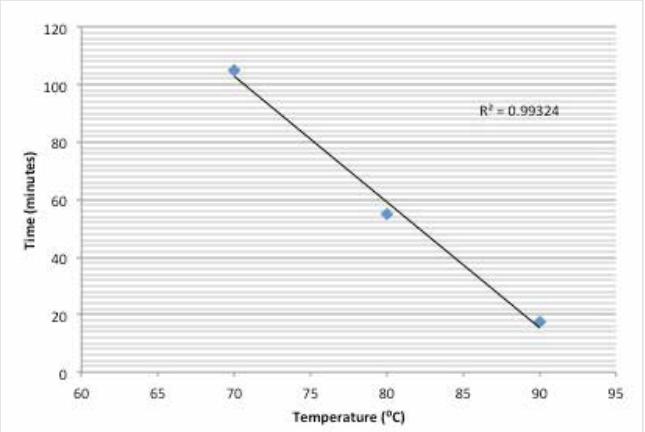
Heat treatment

Treating clubroot resting spores at temperatures ranging from 70ºC to 90ºC identified the minimum exposure times necessary for clubroot control in the presence of soil under experimental conditions. The results are given in Table 1.

From the data obtained, it was possible to calculate what is known as a 'z' value and extrapolate to produce a graph providing combinations of temperatures and exposure times that should give complete clubroot spore control (Figure 3). Table 2 shows the corresponding temperature and time combinations required for complete clubroot spore control.

Table 1. Minimum exposure times necessary for control of clubroot resting spores in the presence of soil at temperatures of 70-90ºC

Treatment temperature (°C)	Minimum exposure time for control (minutes)
70	105
80	45
90	15



3. Graph showing the possible combinations of exposure time (minutes) and temperature (°C) that gave complete clubroot spore control

Table 2. The combinations of minimum exposure times and temperatures in the range 70-90°C required to control clubroot resting spores extrapolated from the 'z' value.

Temperature (°C)	Minimum exposure time for control (minutes)
70	105.0
71	96.0
72	87.8
73	80.3
74	73.4
75	67.1
76	61.3
77	56.1
78	51.3
79	46.9
80	42.9
81	39.2
82	35.8
83	32.8
84	30.0
85	27.4
86	25.0
87	22.9
88	20.9
89	19.1
90	17.5

Disinfectant treatments

In further experiments carried out in the presence of soil, treating clubroot resting spores with Aquaform and Jet 5 at different concentrations identified the minimum treatment times necessary for clubroot control.

Aquaform is a mixture of performic acid 1%, peroxide 16% and formic acid 6% in water that provides a powerful oxidizing action which quickly breaks down into water and oxygen. It is a two component product. The components are mixed in equal proportions (1:1) in an open container away from heat sources and sunlight the day before it is to be used. There may be other brands and formulations of the active ingredients in Aquaform.

Clubroot spores needed to be treated for 9 hours in 1% Aquaform, for 2 hours in 5%, 100 minutes in 10%, or 21 minutes in 80% Aquaform in experiments in order to achieve control (Table 3).

Table 3. Minimum exposure times required to control clubroot resting spores in different concentrations of Aquaform

Concentration	1%	5%	10%	80%
Minimum exposure	9 hours	2 hours	100 mins	21 mins

Jet 5 contains peroxyacetic acid and is formulated with a surfactant to help penetration. There are several other brands and generic formulations of peroxyacetic acid.

Clubroot spores needed to be treated for 15 hours in 0.5% Jet 5 in order to achieve control or for 25 minutes in 40%. Treatment for 4 hours in 2.5% Jet 5 or 3 hours in 5% did not give complete control (Table 4).

Table 4. Minimum exposure times required to control clubroot resting spores in different concentrations of Jet 5

Concentration	0.5%	2.5%	5%	40%
Minimum exposure	15 hours	Not killed after 4 hours	Not killed after 3 hours	25 mins

Disinfectants should be used with extreme care in well ventilated areas, they should never be heated up and the guidelines provided in the relevant hazard information should be followed.

Clubroot resting spores are very resistant to control treatments, hence, any treatments that control them are likely to give control of most plant pathogens including, *Pythium* species. However, it should be noted that the data given in this factsheet is based on laboratory experimental work and is not from commercial trials.

No information is currently available on the effect of the heat treatments and disinfectants on the life of propagation trays.

Further information

HDC Project FV 337 *Brassica* and lettuce propagation: Identifying means of killing clubroot and *Olpidium* resting spores in trays to avoid infection of transplants.

HDC Project FV/PE 337a *Brassica* and lettuce propagation: Scaling-up means of controlling clubroot resting spores in trays to avoid infection of transplants.

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