**Factsheet 08/07**

**Cut flowers**

Project No's. PC 213, PC 213a and PC 249

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# Integrated management of stock fusarium wilt

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**Fusarium wilt is a new and serious threat to the production of column stock. This factsheet describes the symptoms, summarises the results of recent research on the disease and outlines options for integrated disease management.**

## Introduction

In the summer of 2003, a vascular wilt disease seriously affected production of stocks (*Matthiola incana*) on several UK nurseries, causing crop losses in excess of £200,000. The disease was identified as fusarium wilt (caused by *Fusarium oxysporum* f. sp. *mathioli*), a disease that had been confirmed in the UK only once previously. Both seed-raised and bought-in plug plants were affected. Since it was first identified, fusarium wilt has been confirmed on crops of stock in Lincolnshire, Norfolk, West Sussex and Northern Ireland, with several nurseries affected each year. Generally, the disease has been widespread and damaging on at least two nurseries each year and present at a low incidence on others. The nurseries with a severe disease problem have differed from year to year.

Although various soil disinfestation treatments have the potential to eliminate *F. oxysporum* from soil, occasional damaging attacks have been reported in crops following commercial soil treatment with dazomet (Basamid), metam-sodium, methyl bromide and sheet steaming. The disease has occurred from late April to September, with reports of sudden symptom development a few weeks after planting or as crops begin to flower. The disease is generally more obvious in hot weather and second crops, and tends to affect some colours more than others.

## Symptoms

Wilting is often the first obvious symptom of the disease (Figure 1), commencing with softening of leaves and progressing to stem collapse. Other characteristic symptoms are severely stunted growth and bleaching of the leaves from the plant base upwards (Figure 2). White or pale pink growth of the fungus may be visible on the stem base (Figure 3) and on

**1 Wilting of stock plants following infection by *Fusarium oxysporum***

**2 Stunted growth and 'bleached' leaves due to fusarium wilt**

wilted or bleached leaves. On leaves that are still green, veins become a pronounced yellow colour, resulting in a 'leaf netting' effect (Figure 4). Roots may appear healthy but when an infected stem is cut longitudinally, there is often dark brown staining of the vascular tissue particularly at the stem base and leaf nodes, and this is a useful diagnostic feature of the disease (Figure 5). Where fusarium wilt is observed, it often appears to start with just one or two affected plants (Figure 6), with neighbouring plants subsequently developing symptoms.

It is possible to confuse symptoms of fusarium wilt with those of other commonly occurring diseases on stock such as sclerotinia rot *(Sclerotinia sclerotiorum)* or root rots caused by *Pythium* species or *Rhizoctonia solani*. As appropriate management strategies vary with disease, it is important to get a correct diagnosis when symptoms are first observed via a plant clinic or other suitably qualified diagnostician.

Development of sclerotinia rot is favoured by wet, humid conditions and the presence of ageing or damaged foliage. Foliage becomes pale and watersoaked, with dense white fungal growth often present. Hard black survival structures (sclerotia) develop in affected plant tissue (Figure 7).

Root rots caused by *Pythium* species and *R. solani* may develop if soil is poorly drained or temperatures are sub-optimal for growth. Patches of stunted, yellowing plants at an early stage in crop production can be an indicator of root rot problems (Figure 8). Symptoms of root rots caused by these pathogens include discolouration, constriction at the stem base and sloughing away of the outer root cortex.

**3 Development of *Fusarium oxysporum* on a stock stem**

**4 Pronounced yellow leaf veins due to fusarium wilt (leaf netting)**

**5 Dark brown vascular staining is a characteristic symptom of stock fusarium wilt**

**6 Stock fusarium wilt may affect a few plants initially**

**7 Symptoms of sclerotinia rot *(Sclerotinia sclerotiorum)* on stock**

**8 A patch of stock plants dying due to pythium root rot**

## Sources of infection

Management of stock fusarium wilt can be particularly difficult since there are several different sources of infection.

*Seed:*
Similar to many other fusarium diseases, *F. oxysporum* that is pathogenic to stocks can be seed-borne. The frequency of transmission from seed to young plants is not known.

*Soil and crop debris:*
*F. oxysporum* can survive in soil as long-term resting structures. Infested stock's debris remaining in the soil, particularly woody stem bases, can also be an important source of the disease.

*Alternative hosts:*
Experiments were done as part of HDC project PC 213 to determine whether *F. oxysporum* from stock could affect other crop hosts (including other cruciferae), and whether *F. oxysporum* from other crops and weeds could affect stocks. Results demonstrated that typical and severe symptoms of fusarium wilt only developed when a stock plant was inoculated with *F. oxysporum* previously isolated from stock (Table 1). Similar results were obtained for lisianthus. However, there was some survival of *F. oxysporum* on roots of non-host crops that could potentially act as a source of infection for subsequent stock or lisianthus crops.

**Table 1 Ability of *Fusarium oxysporum* from stock and lisianthus to cause wilt in various hosts**

| Crop | Family | Source of *F. oxysporum* | |
|---|---|---|---|
| | | Stock | Lisianthus |
| Stock | Cruciferae | ✓✓✓ | ✓ |
| Oilseed rape | Cruciferae | ✓ | ✓ |
| Aubretia | Cruciferae | ✓✓ | ✓ |
| Lisianthus | Gentianaceae | ✓ | ✓✓✓ |

✓ No symptoms but *F. oxysporum* isolated
✓✓ No symptoms, trace of internal stem discolouration and *F. oxysporum* isolated
✓✓✓ Severe external wilt symptoms, internal stem discolouration and *F. oxysporum* isolated

## Conditions for disease development

Experimental work demonstrated that infection of stocks by *F. oxysporum* could occur even when levels of the pathogen in soil are very low. Vascular staining typical of fusarium wilt developed at a low incidence (8% of plants) when stock plants were grown in soil containing less than 3,000 spores per gram of soil. More consistent symptom development occurred when stock plants were grown in soil containing 10,000 spores per gram of soil or higher.

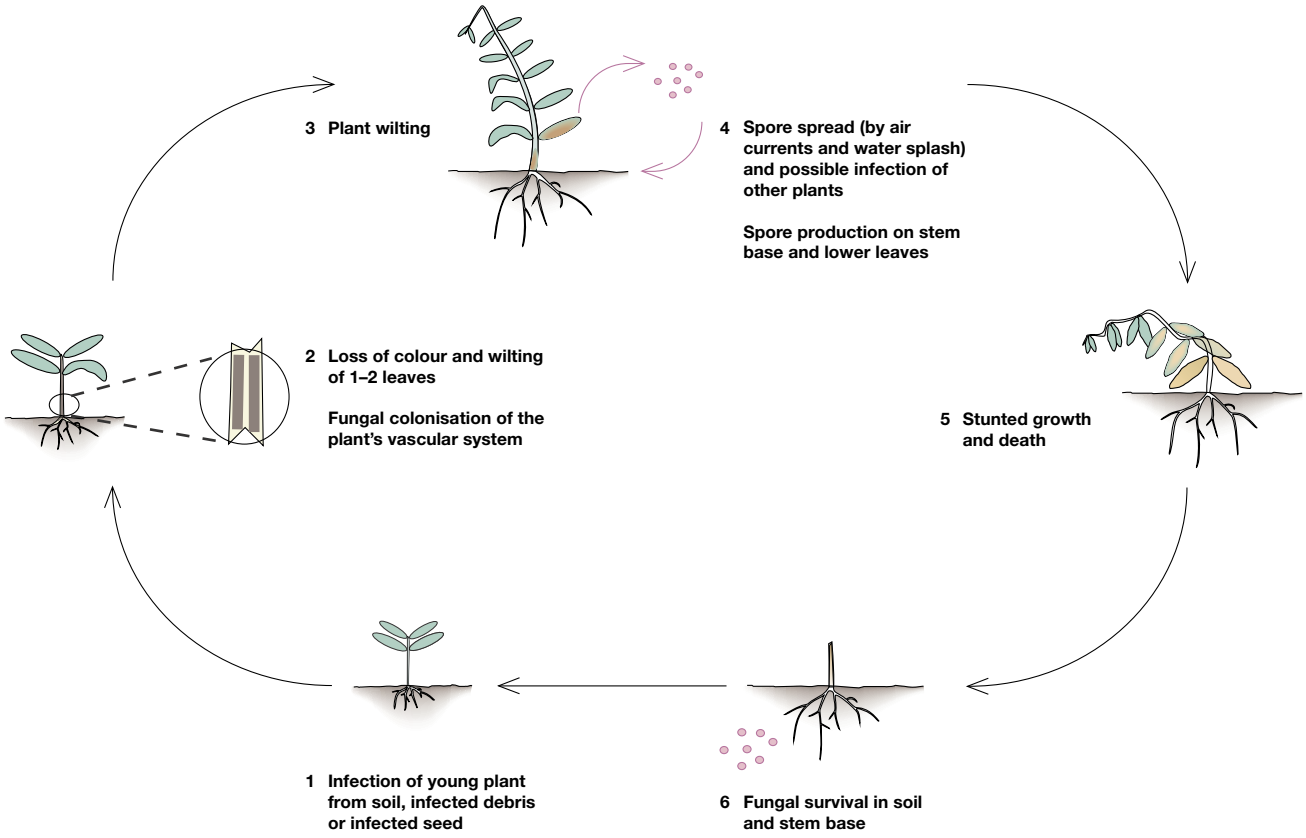
*F. oxysporum* infects the roots of stocks plants, then invades and blocks the vascular system, resulting in wilting. A proposed disease cycle for stock fusarium wilt is shown in Diagram 1.

Once root infection has occurred, there is a 'latent phase' during which symptoms are not apparent. The duration from infection to development of visible symptoms can vary depending on pathogen level and environmental conditions but is typically around 20 days.

Once infection has occurred, symptom development tends to be most rapid when water demand is high.

Laboratory studies showed that for *F. oxysporum* obtained from stocks, fungal growth occurred in the temperature range 10–30°C, with the highest growth rate between 23 and 25°C. There was very little growth at 5 or 35°C. These results support grower observations that the development of fusarium wilt can occur over a wide range of conditions but that it is favoured by high temperatures.

**Diagram 1 Proposed disease cycle for stock fusarium wilt**




## Survival and spread

*F. oxysporum* from stocks can remain viable on infested crop debris buried in soil at sufficient quantities to cause disease, for at least 16 months and probably for several years. This means that stock plants cropped on untreated soil where stock fusarium wilt occurred the previous season will be at high risk of disease development. The exact length of time for which *F. oxysporum* from stocks can survive in soil is unknown.

Where stock fusarium wilt develops, it often appears to affect one or two plants initially before spread to neighbouring plants, resulting in a circle or oval of affected plants. Secondary disease spread is most likely due to dispersal of spores that develop on the stem bases and lower leaves of affected plants, by air currents or water splash. Growers observe that disease spread within the crop is more rapid when overhead irrigation is used, due possibly to splash dispersal of *F. oxysporum* spores from infected leaves to neighbouring plants.

# Integrated management

There is no simple, single measure that will provide reliable control of fusarium wilt. However, by thorough application of a soil disinfestation treatment which is suitable for your soil, use of a suitable fungicide treatment at planting, frequent crop monitoring, prompt removal of affected plants (if only a few are affected), minimising crop debris incorporated into the soil, and general good hygiene, it should be possible to keep the disease at a very low level. Combinations of treatments warrant further study. For example, disinfestation using a soil surface treatment (such as Formalin or flaming) could improve the efficacy of a subsequent chemical or steam soil treatment. Another option is to encourage breakdown of woody debris prior to soil disinfestation. Pay particular attention to control of fusarium in houses where the disease occurred the previous year, or where the ground was double-cropped.

## Seed health

Growers are advised to check with their seed supplier that, where possible, stock seed has been tested and found free from *F. oxysporum*, or has been treated to reduce the risk of seed contamination.

## Varietal resistance

Varieties that are resistant to stock fusarium wilt are not commercially available. Observation of disease outbreaks in the last three years indicates that some varieties appear more susceptible to the disease than others. For example, there was 90% loss of cultivars 'Debora Blue' and 'Centum Dark Blue' at one nursery in 2006, with red colours less affected. However, there is evidence that the varieties seriously affected vary between nurseries and years, possibly indicating differences in infection levels in young plants or infestation levels in the soil.

## Cultural controls

**There is a high risk that fusarium wilt will re-occur if stocks are planted in an area where the disease was severe in the previous crop of stocks.** Cultural practices can help to reduce the risk of disease spread and persistence between crops and seasons:

- Monitor crops frequently.
- If only a few plants are affected by wilt, carefully remove them from the crop (bag them *in situ*) as soon as possible, before spores of *F. oxysporum* are produced on the lower leaves and stem.
- At the end of a crop, take care to remove as much crop debris as possible, and as soon as possible, before preparing the land for the next crop. Woody stem bases in particular pose a high risk as *F. oxysporum* may survive in these despite soil disinfestation treatment. Initially, remove large pieces of debris by hand, then consider using a propane burner to flame the surface and remove small pieces of debris.

Shading of glasshouses as normally applied for stocks will help reduce the air temperature, which may delay development of fusarium wilt but will not control it.

## Disinfection of equipment and structures

Stocks badly affected by fusarium wilt usually develop abundant sporulation on lower leaves and the stem base. It is likely that these spores will contaminate pathways, the glasshouse structure, soil, cultivation machinery or other equipment. If contaminated equipment is then used after soil disinfestation, without thorough cleaning, the fungus may be re-introduced into the soil, with the potential for rapid recolonisation because of the lack of antagonistic and/or competing micro-organisms.

Laboratory tests were done to determine the efficacy of some common disinfectants in killing *F. oxysporum* from stocks. Six products (Jet 5, sodium hypochlorite, Mossicide, Unifect-G, Vitafect and Iodel FD) representing different disinfectant types (Table 2), were each tested at their recommended rate and exposure times of 5 and 30 minutes. All of the disinfectants were effective against

**Table 2 Disinfectant products shown to be fully effective against spores of *F. oxysporum* from stocks (using recommended product rate and 30 minute exposure)**

| Product | Notes | Recommended product rate |
|---|---|---|
| Jet 5 | Peroxyacetic acid | 1:125 |
| Sodium hypochlorite | 10–14% available chlorine | 10% (= 10,000 ppm hypochlorite) |
| Mossicide | 30% dichlorophen | 17 ml/L |
| Unifect-G | QAC + glutaraldehyde | 4% |
| Vitafect | QAC + biguanidine salts | 1% |
| Iodel FD | 2% iodine | 8 ml/L |

spores of *F. oxysporum* even when there was peat contamination. Products were generally less effective against fungal strands (mycelium) of *F. oxysporum* due possibly to the presence of resting spores within the mycelium. Unifect-G was the best treatment in these tests, giving complete kill of mycelium even when peat contamination was present. The experiments demonstrated that several disinfectant products offer good potential for use after an outbreak of fusarium wilt. For further information on chemical disinfectants, see HDC Factsheet 15/05: Use of chemical disinfectants in protected ornamental production.

# Soil disinfestation

For many years, methyl bromide has been the pre-plant soil treatment of choice for stock growers. Its proven efficacy and rapid turn-around time were definite advantages over other treatments. An experiment in 2004 showed that methyl bromide applied commercially at 50 g/m² was highly effective in reducing the viability of *F. oxysporum* in naturally infested woody stem pieces of stock buried at depths of up to 45 cm. As methyl bromide is no longer permitted as a pre-plant soil treatment for cut flower production, experiments were done to evaluate the efficacy of alternative soil disinfestation methods in eradicating *F. oxysporum* from naturally-infected woody stem pieces of stock, buried at different depths.

## Chemical disinfestation

Four methods of chemical soil disinfestation were examined – Basamid (dazomet), K&S Chlorofume (chloropicrin), Formalin (formaldehyde) and Discovery (metam-sodium (MeNa)). All are permitted as pre-plant treatments for protected cut flower crops (Table 3). Basamid gave very good results at one site and moderately good results at a second site (Table 4). K&S Chlorofume was applied by injection into drip tape irrigation lines laid on the soil surface and covered with virtually impermeable film (VIF). This treatment gave promising results against *F. oxysporum* and also gave very effective control of another soil-borne pathogen (*Sclerotinia sclerotiorum*) and weeds. Formalin, applied as a drench at 0.5 L/m² gave excellent control at the soil surface but results at depth were variable. Similarly, Discovery applied as a soil drench gave moderate control at the soil surface but was less effective at depth.

**Table 3 Details of chemical soil disinfestation methods tested against stock fusarium wilt**

| Product | Chemical | Rate | Approval details |
|---|---|---|---|
| Basamid | Dazomet | 760 kg/ha | Full Approval |
| K&S Chlorofume | Chloropicrin | 400 L/ha | SOLA 1948/2005 |
| Formalin* | Formaldehyde | 0.5 L/m² at a minimum dilution of 1:4 in water | Commodity Substance Approval |
| Discovery | Metam-sodium | 900 L/ha | Full Approval |

* **Product is expected to be withdrawn from use**

**Table 4 Efficacy of chemical soil disinfestation treatments for the control of *Fusarium oxysporum* in stock stem pieces (% kill of *F. oxysporum*)**

| Depth (cm) in soil | Basamid | | Chloropicrin | | Formalin | | Metam-sodium |
|---|---|---|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 1 | Trial 2 | Trial 1 | Trial 2 | Trial 1 |
| 0 | 78 | 100 | 81 | 51 | 100 | 96 | 86 |
| 5 | – | 90 | – | – | 100 | 0 | 84 |
| 15 | 12 | 96 | 72 | 57 | 67 | 2 | 42 |
| 30 | 5 | 80 | 69 | 6 | – | 8 | 54 |
| 45 | – | – | – | – | – | – | – |

**– Not tested**

Detailed information on each of the soil disinfestation methods relevant for fusarium wilt control is provided in Factsheet 09/07. None of the chemical treatments penetrate soil as well as methyl bromide, so appropriate soil preparation and thorough application of the chemical, as advised by the manufacturer or contractor, are critical to get the best results. Key points to note when using the different soil disinfestation methods are as follows:

**Basamid**

- Soil should be cultivated to a fine crumb structure, neither too cloddy nor too fine.
- A high soil moisture is required for 7–10 days prior to treatment to activate weed seeds.
- Soil moisture should be at 60–70% field capacity at application.
- The soil temperature must be above 7ºC.
- The Basamid granules need to be incorporated thoroughly and evenly to the depth to which disinfestation is required.
- The treated area should be covered with polythene film, or sealed by rolling and irrigation with water, as soon as the granules have been incorporated.
- The soil should be thoroughly cultivated before planting to ensure all residual gas is dissipated; residual gas may remain in wet areas even after several months over winter.
- Crops should not be planted until a cress test has been carried out and germination found to be satisfactory; ensure that any wetter areas around walls and posts are tested, as well as centres of beds.

**K&S Chlorofume (also Chloropicrin Fumigant)**

- The use of chloropicrin is strictly restricted to certificated contractor application only.
- The only approved method of application in the confined environment of a glasshouse or ridged polytunnel is through the drip tape irrigation system, with the soil surface sealed prior to application with virtually impermeable film (VIF).
- A period of at least 20 days must be allowed before planting; in practice, a period of 4 – 6 weeks is usually allowed.
- Crops should not be planted until a cress test has been carried out and germination found to be satisfactory.

**Formalin**

- Despite variable efficacy at depth, Formalin provides an inexpensive option to reduce viable inoculum in surface debris prior to soil disinfestation using either another chemical or steam.
- Follow the conditions of the Commodity Substance Approval.
- The maximum permitted concentration of Formalin for soil treatment is 1:4 parts water, at a maximum application rate of 0.5 L/m².
- Note that the cress seed germination test does not work for Formalin. The rate of Formalin breakdown depends on soil temperature. Persistence is reported to be 5 to 6 weeks at 0 to 5ºC soil temperature, and 7 to 8 days at 25ºC soil temperature.
- This product is unlikely to be available for soil treatment after late 2008.

**Discovery (also Fumethan, Metam 510, Metham Sodium 400, Sistan, Sistan 38 and Vapam)**

- This is a relatively easy treatment for growers to apply themselves.
- The soil should be well worked and friable, without clods.
- Soil temperature must be above 10°C.
- Soil moisture should be within 50 – 80% of field capacity for maximum efficiency.
- Product can be directly injected into the soil, or applied as a drench to the soil surface and rotovated in.
- Some growers apply product through the overhead spray lines, seal it in with water, and maintain the seal by occasional further waterings.
- The soil should be thoroughly cultivated prior to planting.
- Crops should not be planted until a cress test has been carried out and germination found to be satisfactory.

**9 Application of Basamid prior to incorporation and soil sealing**

## Soil steaming

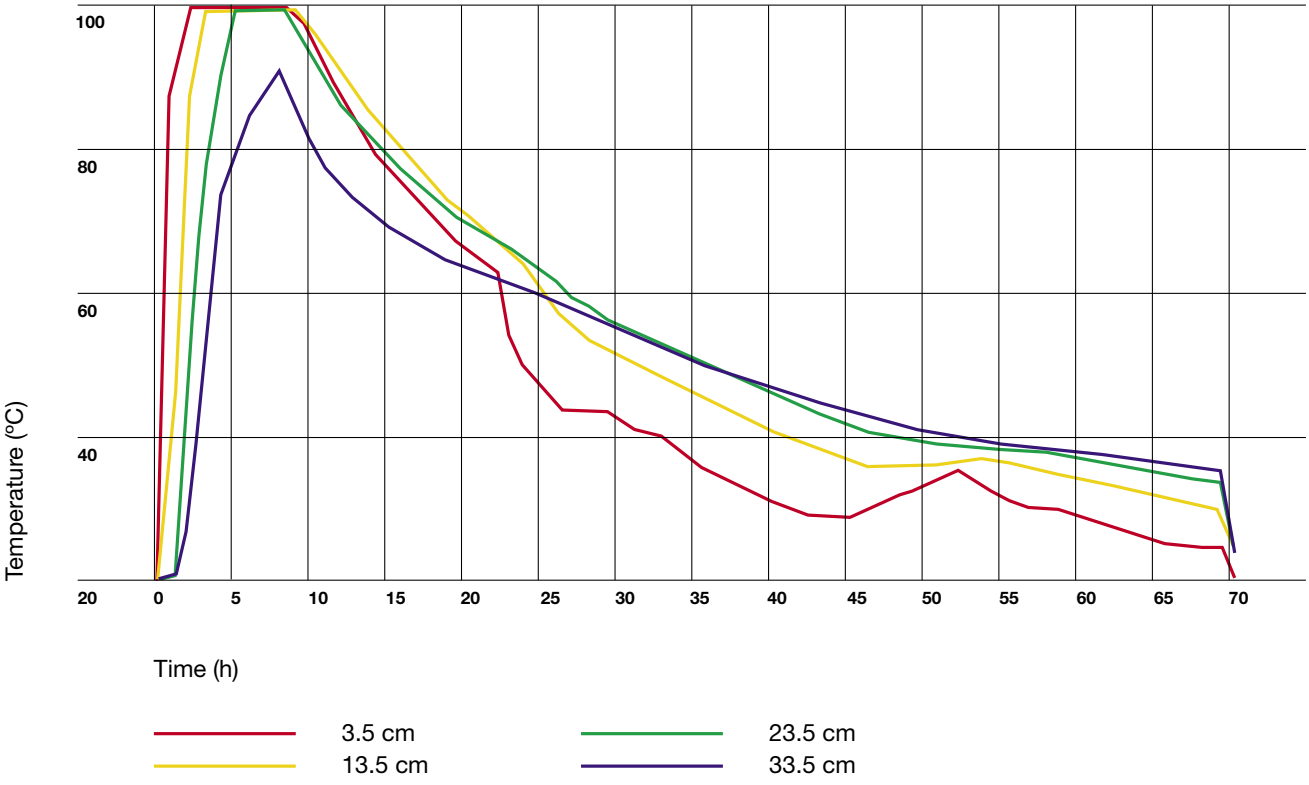
Two methods of soil steaming were evaluated for control of *F. oxysporum* – sheet steaming and injection of steam by steam plough (Table 5). Excellent control of both *F. oxysporum* and *S. sclerotiorum* was obtained using either sheet steaming or a steam plough in June 2006, but in other sheet steaming experiments, treatment efficacy was reduced, due possibly to soil type, insufficient preparatory cultivation, sub-optimal soil moisture (too wet or too dry) or other factors. Temperatures achieved following sheet steam and steam plough treatments that effectively controlled *F. oxysporum* and *S. sclerotiorum* are illustrated in Graphs 1 and 2. Pathogen kill is a function of temperature achieved in the soil and duration of exposure to high temperatures. From HDC Project PC 213, best results were obtained when temperatures exceeded 90ºC for at least 30 minutes. In another experiment, soil temperatures were monitored during sheet steaming with a vacuum applied to suck the steam down into the soil, using perforated plastic pipes buried at 60 cm depth and 1.6 m apart (vacuum steaming). On a site where conventional sheet steaming for 12 hours gave poor results, vacuum steaming for just 4 hours raised the soil temperature to above 90ºC at 23.5 cm depth and to above 80ºC at 33.5 cm depth.

**Table 5 Efficacy of soil steaming treatments for the control of *Fusarium oxysporum* in stock stem pieces (% kill of *F. oxysporum*)**

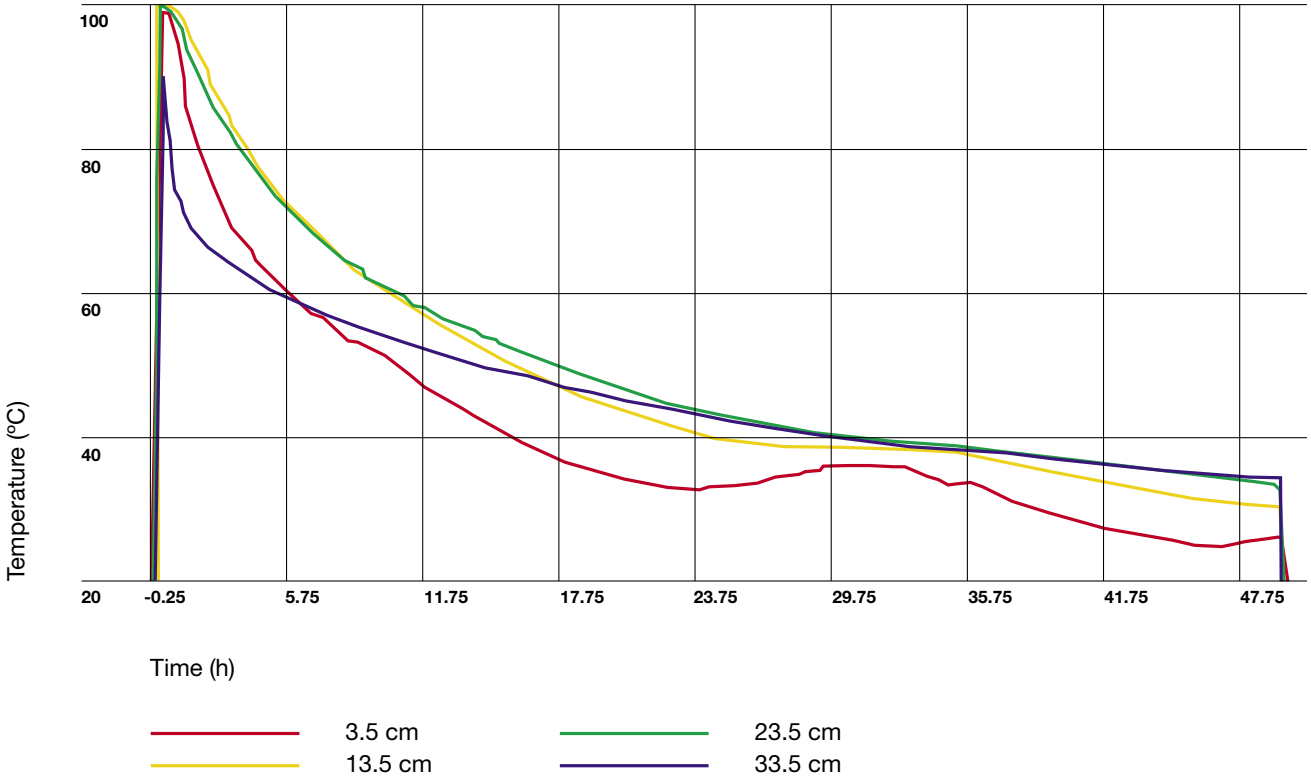
| Depth (cm) in soil | Sheet steaming | | | | Steam plough |
|---|---|---|---|---|---|
| | July 04 | Sept 04 | June 06 | Sept 06* | June 06 |
| 0 | 70 | 72 | 94 | 30 | 94 |
| 5 | 76 | 66 | 92 | 67 | 90 |
| 15 | – | – | 94 | 23 | 98 |
| 30 | 32 | 44 | 92 | 2 | 98 |
| 45 | 12 | 0 | – | – | – |

* Lisianthus stem pieces

**Graph 1 Mean soil temperatures achieved at different depths during soil treatment by sheet steaming**



**Graph 2 Mean soil temperatures achieved at different depths during soil treatment by a steam plough**




**Sheet steaming**

- Where sheet steaming is used, the soil should be fairly dry and cultivated to a coarse tilth (no lumps more than 5 cm diameter).
- Take care not to cultivate deeply after steaming, or to recontaminate the soil from dirty boots, equipment or unsteamed soil.
- The effectiveness of sheet steaming is profoundly influenced by soil type and requires attention to detail for good results. Check that soil temperature has exceeded 90°C to the required depth. Consider vacuum steaming if steam penetration is poor.
- The treated area can be re-cropped as soon as the soil has cooled.

**10 Sheet steaming in progress**

**Steam plough**

- Steaming soil with a steam plough is more time-consuming than sheet-steaming and requires constant attendance, but it is also more fuel efficient; it is best on sandy loam soils.
- Check that soil temperature has exceeded 90ºC to the required depth.
- The treated area can be re-cropped as soon as the soil has cooled.

**Vacuum steaming**

The cost for burying perforated plastic pipes to enable vacuum steaming is around £3.00 per square metre, at a pipe spacing of 1.6 m. Fuel consumption for vacuum steaming is estimated to be around 75% of that required for conventional sheet steaming.

## Pre-planting soil amendments

Soil disinfestation methods can leave a 'biological vacuum' such that soil can be rapidly re-colonised by micro-organisms, including plant pathogens such as *F. oxysporum*. There is the potential for use of soil amendments (eg beneficial or antagonistic micro-organisms) after soil treatment and prior to planting, to reduce the incidence of fusarium wilt. This area of work warrants further research.

## Fungicides

Control of fusarium wilt using fungicides alone is unlikely to be effective since it is a soil-borne disease that colonises the vascular tissue within roots and stems, making it a difficult target. Fungicides should be used as part of an integrated disease management strategy.

Since 2003, use of a carbendazim fungicide (Bavistin DF, Cleancrop Curve or Delsene 50 Flo) to drench young plants either before or soon after planting has been standard practice by stock growers. In a short-term experiment in 2004, it was demonstrated that Amistar (azoxystrobin) and Bavistin DF (carbendazim) both significantly reduced fusarium wilt in artificially inoculated plug plants. However, please note, use of carbendazim is not permitted after 30 June 2008.

In two fungicide evaluation experiments run under conditions of high disease pressure, none of the programmes tested provided complete control of fusarium wilt on stock. The work confirmed results from the USA and Italy that the most effective products available at present for control of fusarium wilt of cut flower crops include Amistar (azoxystrobin), Octave (prochloraz) and carbendazim fungicides.

# Action points

## Identification of fusarium wilt

- Monitor crops frequently so that the disease is identified at an early stage.
- Ensure that the cause of any wilting or plant death in a stock crop is correctly identified.
- Dark brown staining of vascular tissue at the stem base is an indicator of fusarium wilt.

## Reducing the risk of persistence between crops and disease spread

- Fusarium wilt is highly likely to re-occur if stocks are planted in an area where the disease was severe in the previous stock crop.
- Ensure that seed and young plants are obtained from a reliable supplier and that where possible, seed has been tested and found free from *F. oxysporum*, or has been treated to reduce the risk of seed contamination.
- If only a few plants are affected by fusarium wilt, remove them from the crop (bag them *in situ*) before spore production occurs on the lower leaves and stem.
- Avoid overhead watering late in crop production to minimise disease spread by water-splash.
- After harvest, remove as much crop debris (including woody stem bases) as possible, before preparing the land for the next crop; consider pulling flowers at harvest and removing stem bases in the packhouse.
- Disinfectants can be used to eliminate *F. oxysporum* from glasshouse structures and equipment. Unifect G used at the recommended rate for a 30 minute treatment is effective against both spores and mycelium of *F. oxysporum* from stock.
- Clean and disinfect surfaces where trays of plug trays are stood before planting out (eg concrete pathways).

## Control of fusarium wilt: soil treatment

- Basamid, Chlorofume (applied in drip-line irrigation), Formalin drench, Discovery, and soil steaming all give some control of *F. oxysporum* in woody stock stem pieces. See Table 3 for approval details of chemical treatments.
- Treatment efficacy is likely to be improved by prior removal of large pieces of crop debris and by encouraging rapid breakdown of any crop debris incorporated.

- Where Basamid, Discovery or Chlorofume are used, conduct a cress seed germination test to ensure all fumes have dissipated before re-planting.

- Where steam treatments are used, ensure that soil temperature has exceeded 90ºC to at least 25 cm depth.

- Take care not to re-contaminate newly disinfested soil, through the use of dirty equipment or shoes for example.

- After steaming, analyse the soil nutrient levels and adjust feeding accordingly.

## Control of fusarium wilt: fungicides

- As a precaution against fusarium wilt, consider applying a carbendazim drench treatment to plug plants before planting. Cleancrop Curve (SOLA 1213/04) and Delsene 50 Flo (SOLA 1004/04) can be applied as a drench treatment to stock at growers' own risk. Use of carbendazim is not permitted after 30 June 2008.

- Fungicide applications to the crop may reduce the severity of fusarium wilt. Delsene 50 Flo (SOLA 1004/04), Amistar (SOLA 1684/01) and Octave (LTAEU) can be used at growers' own risk.

## Relevant literature

Further information can be found in the following factsheets:

- HDC Factsheet 15/05. Use of chemical disinfectants in protected ornamental production.

- HDC Factsheet 09/07. Soil disinfestation options for disease control in cut flower crops

## Note

Always read and follow the Label or Specific Off-Label Approval Notice.

Regular changes occur in the approval status of pesticides, arising from changes in pesticide legislation or for other reasons. For the most up to date information, please check with your professional supplier, BASIS registered adviser or with the Information Section at the

**Pesticides Safety Directorate (PSD)**
Tel. (01904) 455775
information@psd.gsi.gov.uk
**www.pesticides.gov.uk**

**Additional information:**



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