



TECHNICAL NOTES FOR T34 BIOCONTROL®

These notes are designed to support the main product manual insert on T34 Biocontrol and advise on how to obtain the best possible disease control from the product.

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**USE PLANT PROTECTION PRODUCTS SAFELY.
ALWAYS READ THE LABEL AND PRODUCT INFORMATION BEFORE USE**

WHAT IS T34 BIOCONTROL?

T34 BIOCONTROL is a registered biofungicide approved for control of *Fusarium oxysporum* f.sp. *dianthi* on carnations (*Dianthus* spp.) on MAPP 15603. It has activity on a range of other soil born diseases.

T34 BIOCONTROL is formulated as a wettable powder and contains living spores of a specific fungus strain T34 of the naturally occurring fungus *Trichoderma asperellum* at 1×10^{12} colony forming units (cfu) per kg (10.83 % w/w).

T34 BIOCONTROL does not contain anything that is genetically manipulated.

T34 BIOCONTROL contains pale green conidia (2-5 microns) which germinate producing mycelium which infect and compete with other fungi such as *Fusarium*.

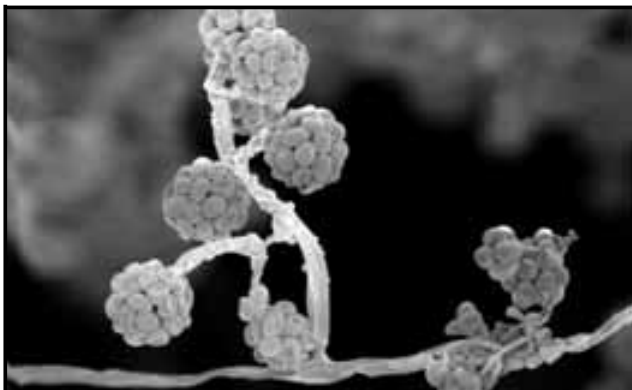


Figure 1: scanning electron micrographs of *Trichoderma asperellum*, strain T34, phialides bearing conidia.

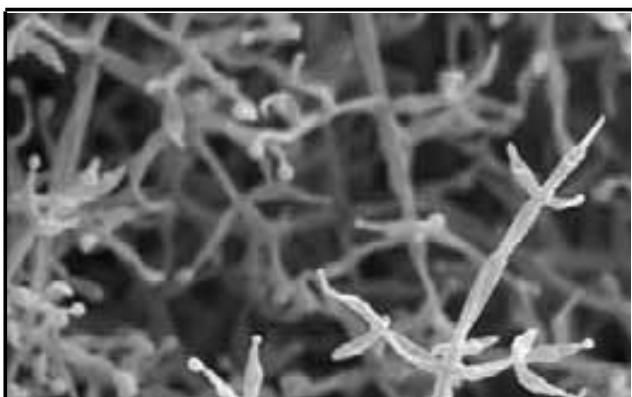


Figure 2: Scanning electron micrographs of mycelia with conidiophores in pyramidal arrangement and phialides in a flask shape and few conidia attached at the tip.

WHY USE T34 BIOCONTROL?

● To Control Disease:

T34 BIOCONTROL has been found to be effective in reducing *Fusarium oxysporum* (Fusarium wilt). This disease has not been well controlled with chemical fungicides.

Activity on *Fusarium*:

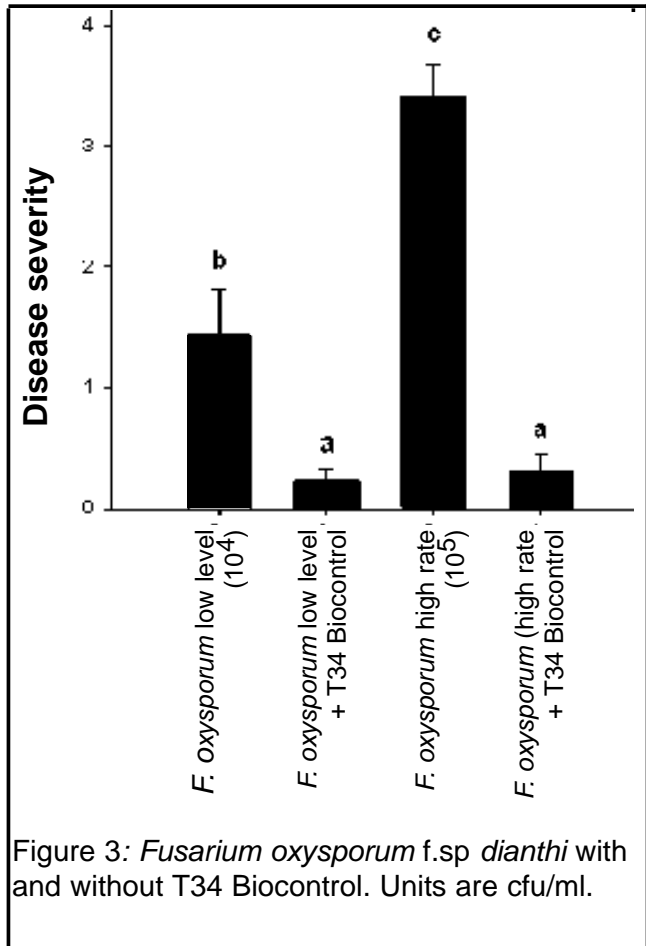
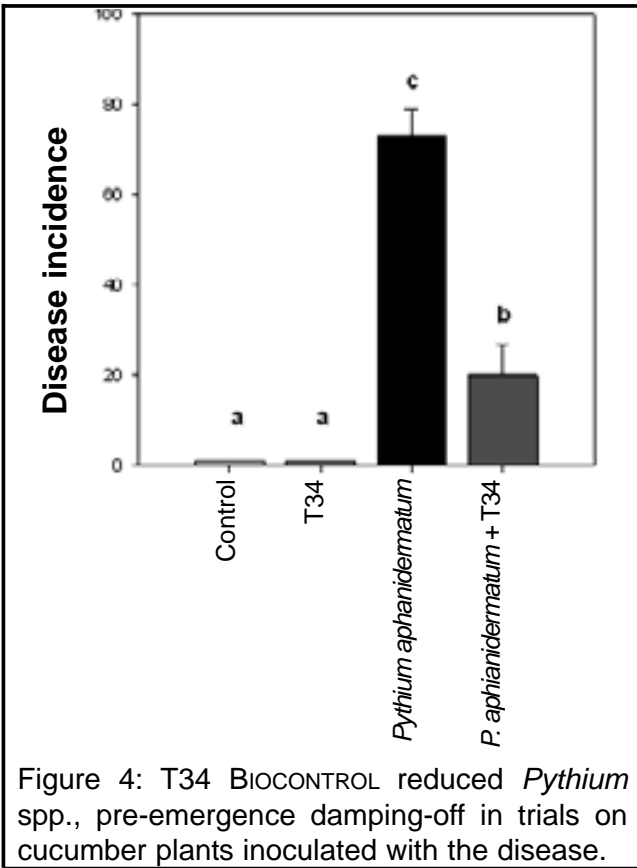


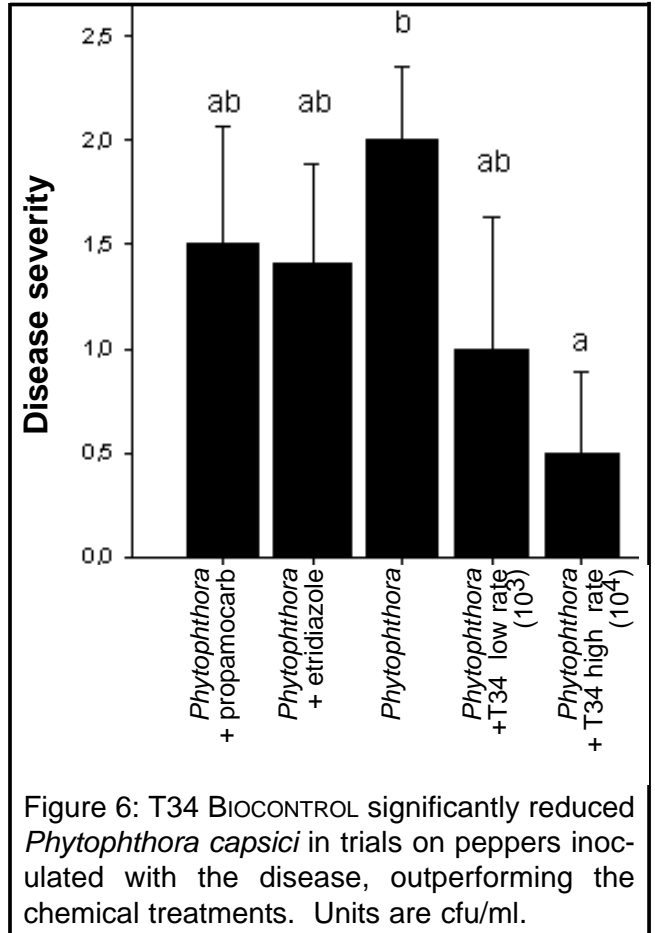
Figure 3: *Fusarium oxysporum* f.sp. *dianthi* with and without T34 Biocontrol. Units are cfu/ml.

T34 BIOCONTROL also has been found to have good preventative control of a range of other root diseases including *Pythium*, *Phytophthora* and *Rhizoctonia*, although there is currently no approval for the control of these diseases.

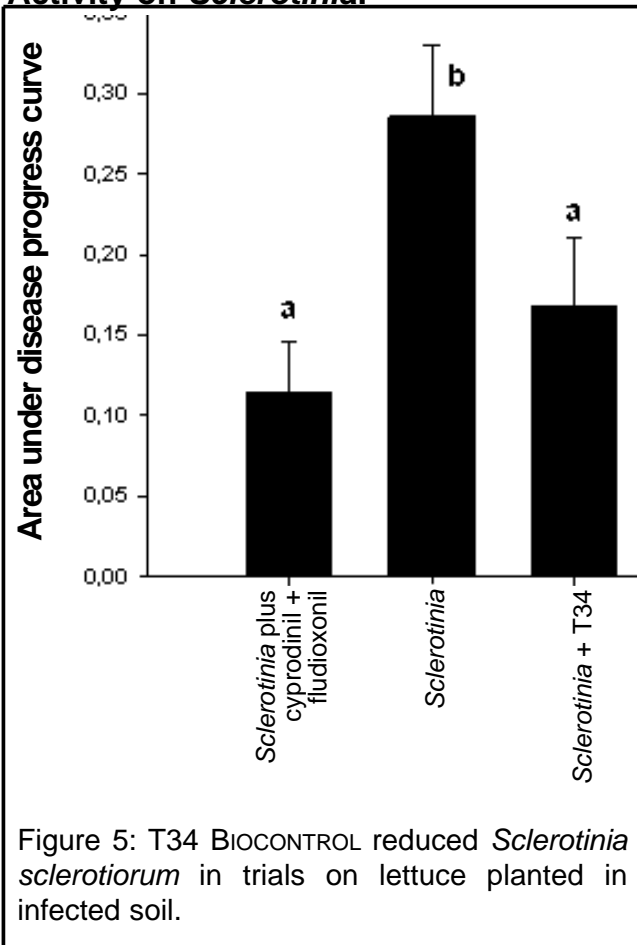
Activity on *Pythium*:



Activity on *Phytophthora*:



Activity on *Sclerotinia*:



Use of T34 Biocontrol will help:

- To reduce chemical fungicide use.
- To eliminate or reduce chemical pesticide residues.
- To reduce the risk of fungicide resistance.
- To minimize environmental problems with chemical pesticides.
- To use in IPM programmes.
- To improve plant growth.

WHAT DISEASES DOES T34 BIOCONTROL CONTROL?

T34 BIOCONTROL is approved for the control of *Fusarium oxysporum*. However trials have shown control of the following diseases:

Soil disease (growing media application):

- *Fusarium oxysporum*,
- *Rhizoctonia solani*,
- *Sclerotinia sclerotiorum*,
- *Phytophthora capsici*,
- *Pythium aphanidermatum* (damping off),

- *Macrophomina phaesolina* (root rot),
- *Sclerotinia cepivarum*.

Growing media treatment reduces the following diseases by induction of plant defence:

- Bacteria foliar diseases:
 - Pseudomonas syringae*
pv. *lachrymans*,
 - P. syringae* pv. *tomato*.
- Fungal Diseases:
 - Plectosphaerella cucumerina*,
 - Hyaloperonospora parasitica*.

Foliar Disease (foliar application):

Botrytis cinerea,
Didymella brioniae.

Some of these diseases appear on crops for which there may be no approval in the UK. Foliar applications are not currently approved in the UK.

HISTORY AND DEVELOPMENT:

The specific strain of *Trichoderma asperellum*, strain T34 was isolated by the University of Barcelona from composted waste which was found to be naturally suppressive to *Fusarium*. The product is patented. T34 BIOCONTROL is manufactured and approvals held by Biocontrol Technologies, S.L., in association with the University of Barcelona and the University of Seville in Spain.

At the time of writing T34 BIOCONTROL is registered for use in the USA, Canada and the UK. Approvals for other countries were progressing.

HOW DOES T34 BIOCONTROL WORK?

The fungus *Trichoderma asperellum* strain T34 has multiple modes of action:

- Direct competition with the pathogens for space and nutrients.
It has the capacity to colonise growing media and plant roots where it can build up a physical barrier against pathogens.
- Direct effect - synthesis of biostatic com-

pounds.

- Hyperparasitism - T34 grows into and infects the sclerotia and hyphae of fungal pathogens on plants.

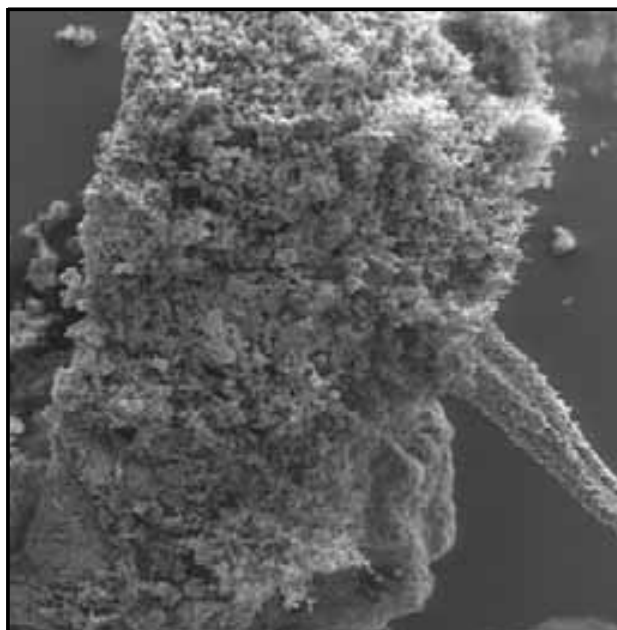


Figure 7: Sclerotia of *Sclerotium sclerotiorum* parasitised by *T. asperellum* strain T34. Sclerotia from a number of plant diseases can be degraded by *T. asperellum* strain T34 providing control of a range of species of *Sclerotinia* and *Rhizoctonia*.

Activity on *Fusarium*: T34 BIOCONTROL infects the hyphae of *Fusarium* and it has been shown that the populations of *T. asperellum* strain T34 are higher in the presence of the pathogen (*Fusarium*) than in their absence.

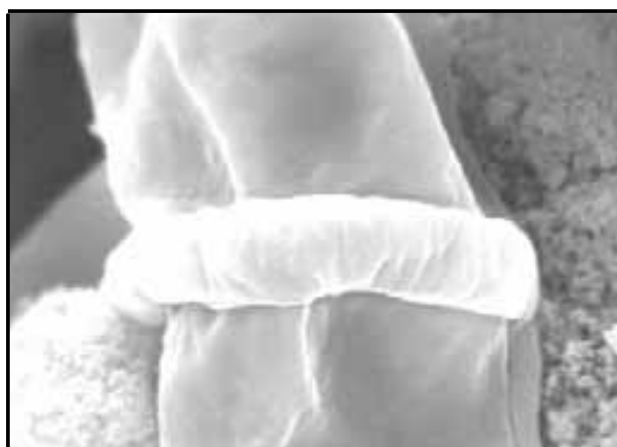


Figure 8: *T. asperellum* strain T34 coiling around the hyphae of *Didymella brioniae*, parasitising the pathogen.

- By inducing plant disease resistance mechanisms.

T34 BIOCONTROL stimulates the expression of a group of defence orientated proteins directly involved in protection and can switch the plant's metabolism to a defensive non-assimilatory role.

Research work has demonstrated that germinating pathogen spores can be blocked by the synthesis of callose. (Callose is a plant polysaccharide produced in response to wounding or invasion by plant pathogens).

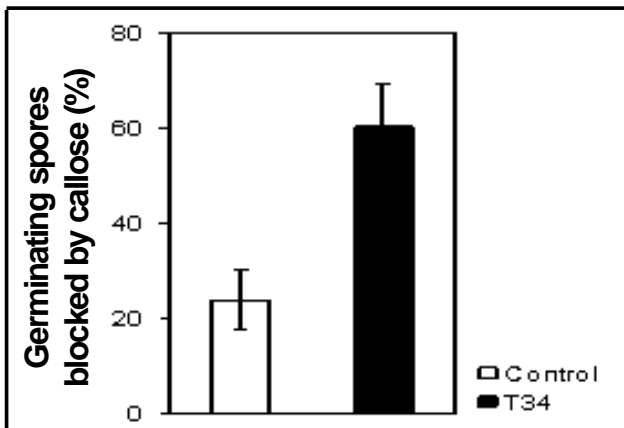


Figure 9: *T. asperellum* strain T34 applied to the roots is able to induce the synthesis of callose in *Arabidopsis* leaves and this blocks the germination and diminishes disease caused by *Hyaloperonospora parasitica*.

- Root colonisation - enhanced plant growth.

T34 BIOCONTROL colonises plant roots and there is evidence that even in the absence of pathogens plants can often show a positive growth response.

WHEN SHOULD T34 BIOCONTROL BE APPLIED?

T34 BIOCONTROL is a preventative treatment. T34 BIOCONTROL should be used prior to potting or shortly afterwards. *T. asperellum* strain T34 associates closely with the plant root. It can follow the root by colonising the surface as the root grows.

For optimum effect T34 BIOCONTROL should be applied repeatedly during the life of the

crop beginning during plant propagation (seedlings and cuttings). T34 BIOCONTROL must be reapplied at appropriate intervals to maintain the fungal population in the compost especially at re-potting.

ON WHAT CROPS AND IN WHAT SITUATIONS CAN T34 BIOCONTROL BE USED?

T34 BIOCONTROL is approved for use on protected containerised carnations *Dianthus* spp.. An extension of authorisation (EAMU) allows use on other crops, see below. T34 BIOCONTROL may be applied by growing media incorporation, by root dipping and by drench or irrigation treatments.

EXTENSION OF AUTHORISATION (SOLA):

CRD have granted an extension of authorisation EAMU, previously known as a specific off label approval or SOLA.

1118 of 2012:

Protected ornamental plant production, ornamental plant production - container grown crops.

Protected forest nursery, forest nursery - container grown crops.

"This extension of authorised use provides for the use of T34 BIOCONTROL in respect of crops and situations, other than those included on the product label. No efficacy or phytotoxicity data have been assessed and as such the 'extension of use' is at all times done at the user's choosing, and the commercial risk is entirely theirs".

Before use of any pesticide under an extension of authorisation users must have a copy of the document which is available at www.pesticides.gov.uk. These documents are frequently revised and therefore it is important to check that the documentation is current and correct before any use.

HOW BEST TO APPLY T34 BIOCONTROL?

What is the application rate:

1. Incorporation into growing media

Mix 10 g T34 BIOCONTROL with 1 litre water and apply by spraying to a cubic metre (1,000 litres) of growing media prior to potting or seed sowing. Mix thoroughly.

OR

2. Drench treatment

Apply 0.5 g T34 BIOCONTROL in at least 50 ml water per square metre of growing media, immediately after sowing seeds or sticking cuttings

AND OR

3. Dip treatment

Rooted cuttings may be dipped in a solution of 0.01 g T34 BIOCONTROL per litre of water for several hours or overnight.

The dipping solution can remain active for 1 or 2 days at room temperature or if refrigerated up to a week. Note that this technique can increase the risk of disease cross contamination if some cuttings are infected.

AND OR

4. Irrigation treatment

Apply 5 g T34 BIOCONTROL to 1000 litres growing media, (1000 x 1 litre pots).

What is the recommended water volume for dilution?

The water volume should be appropriate for the method of application and can be up to 10 % of the container volume. In any event the maximum concentration should not exceed 10 g per litre.

Can the material be leached out of the growing media?

Trichoderma asperellum strain T34 can be leached until it associates with the growing media.

How long does it take for T34 BIOCONTROL to establish in the growing media or on plant roots?

It takes 2 to 3 days for the *Trichoderma* to associate with the plant roots or growing media. When associated with plants roots it will then follow the root as it grows.

This process will be temperature dependant and at 25°C association would proba-

bly take only a few hours. So after 2-3 days it should be OK. The optimal for the plant is the optimal for T34.

If the product is pre-soaked for a few hours prior to application establishment will be faster.

Application by means of dosing pumps (Dosatron)

T34 BIOCONTROL can be applied using dosing pumps. Agitation of the stock solution is suggested to prevent precipitation.

The maximum concentration for a stock solution has not been assessed but probably around 100 g per litre.

Does the product require pre-creaming prior to mixing?

There is no requirement for pre-creaming, as T34 BIOCONTROL disperses very easily in water.

WHAT IS THE EFFECTIVE TEMPERATURE RANGE?

Trichoderma asperellum strain T34 is actively growing between 15°C and 35°C. At temperatures above 36°C, the mycelium is not able to grow and may be killed.

IS THERE A LIMIT ON THE ACIDITY OR ALKALINITY OF THE GROWING MEDIA OR SPRAY SOLUTION?

T34 Biocontrol is effective over a wide range of growing media pH levels.

WILL T34 BIOCONTROL WORK IN ANY GROWING MEDIA OR SUBSTRATE?

T34 will colonise organic growing media (from peat with low microbial activity to high microbial activity composted waste) and inorganic (rockwool, perlite) growing media.

IS THERE ANY SPECIAL WATER MANAGEMENT REGIME REQUIRED TO KEEP THE FUNGUS ALIVE?

T34 BIOCONTROL will survive at normal

growing media water levels suitable for plant growth.

WHAT HAPPENS IF THE GROWING MEDIA DRIES OUT OR BECOMES WATERLOGGED? DOES THE FUNGUS DIE AND NEED REPLACING?

In the event of waterlogging or drying out the population of T34 will decrease and may necessitate another application. The populations of T34 will recover after a while of normal plant growing conditions. Even if populations decline the conidia (spores) will survive.

IS THERE ANY BENEFIT FROM PREMIXING TO ACTIVATE SPORES OR MYCELIUM BEFORE USE?

There is no need to pre-soak the spores but if soaked for a few hours prior to application establishment will be faster.

WHAT TREATMENT INTERVAL IS RECOMMENDED?

T34 BIOCONTROL must be reapplied at appropriate intervals to maintain the fungal population in the growing media especially at re-potting.

For carnations (*Dianthus* spp.) T34 BIOCONTROL may be applied:

- Into the growing media before use OR immediately after sowing seeds or rooting cuttings,
- And/or by dipping young plants in a solution.
- And/or by irrigation. Repeat an initial irrigation treatment after one week if the plants were not treated in propagation. Repeat the treatments at intervals of 2 to 3 months and also prior to a high risk situation or if the plants are stressed.

TANK MIXING:

T34 BIOCONTROL should not be applied in mixture with other pesticides or liquid fer-

tilisers.

However in limited overseas trials T34 BIOCONTROL was not damaged by mixing with products containing the following active ingredients. (Note that these active ingredients may not be approved for use on the label crops or for the method of application approved in the UK at time of writing.)

Tank mixing acceptable in limited trials:

Fungicides:

fosetyl-aluminium, propamocarb (Proplant), metalaxyl-m (Subdue), toclofomethyl,

Insecticides

None were found to be damaging.

Fertilisers

None were found to be damaging*

*Mixing dry T34 BIOCONTROL concentrate with a fertiliser concentrate as an admixture technique for incorporating in to potting media is not recommended as trials have shown that T34 BIOCONTROL can be damaged by the fertiliser. Admixing with dry sand prior to incorporation in to the growing media has been shown to be safe to T34 BIOCONTROL.

Wetting agents:

Not known to be damaging.

Do not tank mix with:

Fungicides:

thiophanate-methyl, prochloraz, copper fungicides.

COMPATIBILITY WITH OTHER COMPONENTS OF A CROP PRODUCTION PROGRAMME?

T34 BIOCONTROL is a biological fungicide. It may be affected by residues of or subsequent applications of other pesticide product.

Soil Sterilants:

Leave an interval of 7 to 10 days after the process is complete before treating with T34 BIOCONTROL.

Fungicides

Leave an interval of 10 days before or after

application of fungicides active on Ascomycetes or Basidiomycetes, e.g. prochloraz and thiophanate methyl. See below for biofungicides.

Insecticides

Data suggest no issues with compatibility, e.g. imidacloprid (e.g. Imidasect 5GR), thiacloprid. See below for bio-insecticides.

IS T34 BIOCONTROL COMPATIBLE WITH OTHER BENEFICIAL FUNGI OR ORGANISMS?

Biofungicides

T34 Biocontrol is compatible with *Bacillus* spp. (eg Serenade).

Work is underway to assess compatibility with *Coniothyrium* (Contans) and *Gliocladium* (Prestop).

Bioinsecticides:

Work is underway to assess compatibility with *Metarhizium*.

Nematodes:

Steinernema feltiae, *S. krausai* and *S. carpocapsae* are compatible.

Biocontrol agents:

Hypoaspis, *Atheta*, *Aphidoletes*, *Amblyseius cucumeris* and *A. andersoni* are all compatible

Microbial inoculants:

It has been suggested that mycorrhizae are applied first and then the T34 BIOCONTROL after 2 to 4 weeks.

ARE THERE ANY ISSUES WITH REGARD TO FILTERS IN SPRAYERS OR IN IRRIGATION SYSTEMS?

T34 conidia will pass through filters normally included in irrigation or spray equipment.

IS T34 BIOCONTROL USABLE IN ORGANIC SYSTEMS?

The product contains a naturally occurring soil fungus. Consult your organic assurance scheme before using on organic crops.

WHAT IS THE SHELF LIFE?

At the optimum storage conditions of 4°C the product will keep for two and a half years. One opened the product can be stored for up to 6 months if the pack is resealed and kept at 4°C provided it is handled in a clean area.

WHAT ARE THE RECOMMENDED STORAGE CONDITIONS?

T34 BIOCONTROL should be stored at 4°C. Do not freeze.

ARE THERE ANY ISSUES OF PLANT PHYTOTOXICITY?

T34 BIOCONTROL has been trialled on a wide variety of plants under a wide range of conditions and no phytotoxicity has been observed.

IS THERE ANY ACTIVITY IN THE ABSENCE OF DISEASE?

T34 BIOCONTROL *Trichoderma* will establish in the absence of pathogens and in some trials growth benefits have been recorded, due to strengthening of the root system. However it is not known how consistent these benefits are and no recommendations are made for them.

Pack Sizes: 100g, 250g, 500g.

Approval holder:

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Safety data sheet available on request.

Spanish Patent ES 2 188 385 B, European Patent EP 1 400 586 B1, USA Patent US 7 553 657 B2.

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