

Verdera

Practical experiences of using environmentally friendly fungicides

Prestop[®] and Prestop[®] Mix

In biological and integrated plant protection



Konverents "Kaasaegne taimekasvatuse ja mesinduse"
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Põllumajandusfond:
Euroopa investeeringud
maapiirkondadesse



LALLEMAND PLANT CARE

Lallemand Plant Care

Development and production of biological products for plant protection and growth stimulation for agriculture, forestry and horticulture

- **Products are based on naturally occurring microbes:**

- Fungi
- Bacteria
- Yeast (yeast extract, inactivated yeast)

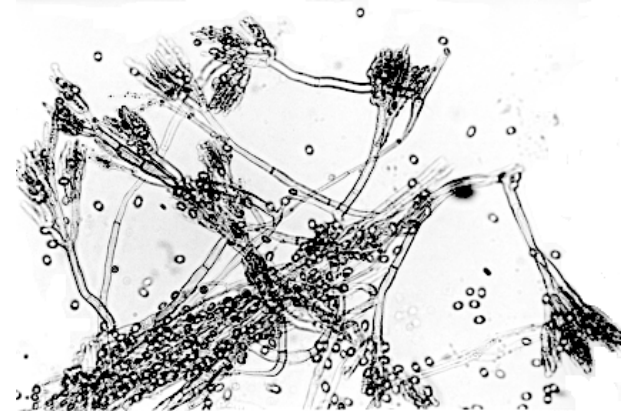
- Products are safe for user and environment
- Do not leave harmful residues in the yield
- Suitable for both organic and integrated plant protection
- Do not cause danger for pollinators or beneficial insects
- Very low risk for development of resistant strains of pathogens
- Efficient plant production with reduced input of chemicals



Biological control with carefully selected microbes

***Gliocladium catenulatum* J1446 (*Clonostachys rosea* J1446)**

- Soil borne fungus isolated from Finnish field soil
- Strain J1446 is carefully selected and tested for its disease prevention abilities
- Is effective in different kind of growth substrates (peat mixtures, rockwool, field soil)
- Survives also in foliage and flowers
- **Main targets in root disease control: *Pythium*, *Rhizoctonia*, *Fusarium*, *Phytophthora***
- **Foliar disease control: *Botrytis* and *Didymella***



Mode of action: Colonization of roots, foliage and flowers, taking the living space from pathogens



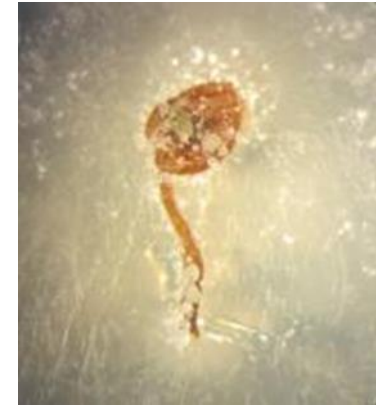
Gliocladium growing on the root surface

> Control of seed and soil borne pathogens



Mycelium and spores of *Gliocladium*-fungus on the leaf surface

> Control of foliar pathogen

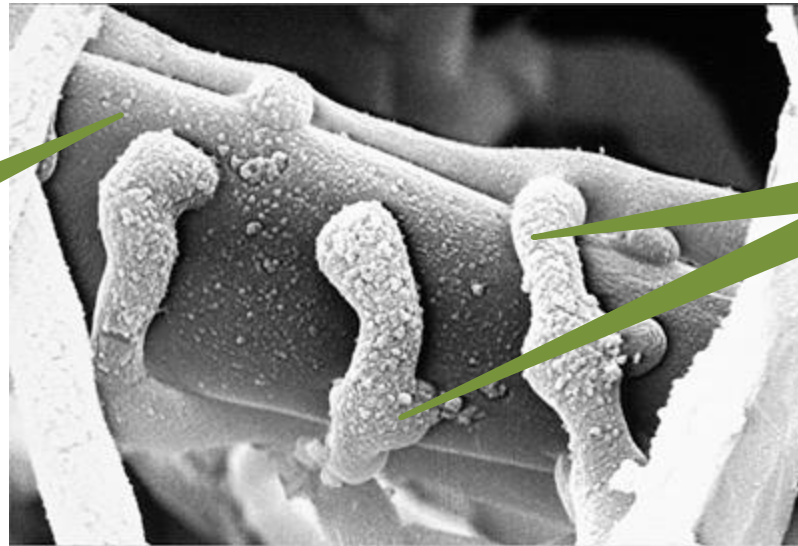


Gliocladium colonizing a stamen of a treated flower

> Control of pathogens infecting through flowers

Mode of action: Hyperparasitism

- Mycelium filaments or hyphae of *Gliocladium catenulatum* J1446 are rolling around pathogenic fungus indicating hyperparasitism

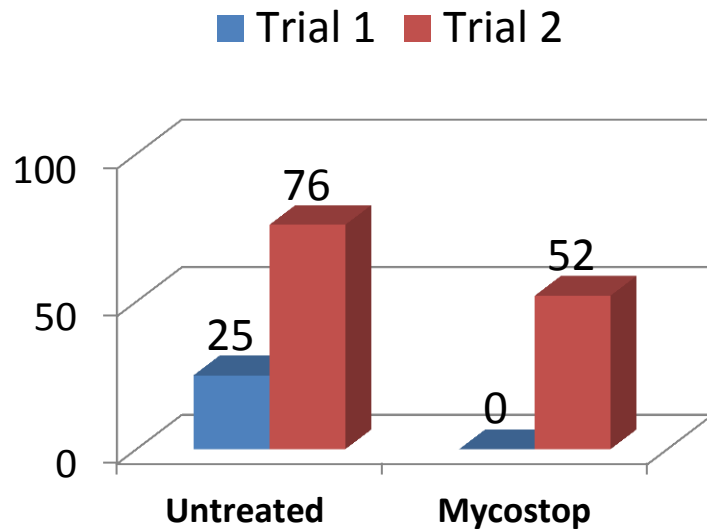


Pathogenic fungus
Rhizoctonia solani

Gliocladium
catenulatum J1446

- *Gliocladium catenulatum* J1446 secretes enzymes that dissolve the cell walls of pathogenic fungus (β 1,3 glucanase, chitinase)

Microbes applied in the root system stimulate plant's own defence mechanism:



***Streptomyces*-ray bacterium given to the root system decreased the foliar symptoms of powdery mildew on Saintpaulia**

Also Prestop-root application has reduced the symptoms of powdery mildew, for example on cucumber

The root application of microbes provide indirect effect against foliar pathogens

Two biopesticide formulations based on mycelium and spores of *Gliocladium catenulatum* J1446



Prestop® Mix

- Wettable powder
- Can be mixed into the growth substrate or applied by drenching
- Non-hygroscopic powder, that can be applied with pollinating honey bees and bumble bees (entomovectoring system)
- 400 g and 1 kg package



Prestop®

- Wettable powder
- Small particle size
- Suitable for spraying and application through drip irrigation systems
- Suitable for dip treatment of cuttings, transplants or onion settings
- 100 g and 1 kg package

Prestop Mix for biological control of root diseases and *Botrytis*

Registered as a biological pesticide in Estonia:

- Control of damping-off and root diseases caused by *Pythium*, *Phytophthora*, *Fusarium* and *Rhizoctonia* on vegetables, ornamentals and herbs
- Control of *Botrytis* on strawberry and raspberry, applied through pollinating honey bees and bumble bees



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Control of *Botrytis* grey mold of berry crops with the help of pollinators

- *Botrytis* grey mold infects the berries through flowers
- *Gliocladium*-fungus is delivered to flowers by pollinating honey bees and bumble bees
- *Gliocladium* colonizes the flowers and takes the living space of *Botrytis* in a preventive way
- *Gliocladium* prevents the infection of *Botrytis* and other fungi that reduce the quality of the berries



Control of *Botrytis* with Prestop Mix delivered by honey bees

- 2 honey bee hives per ha are needed for pollination and Prestop Mix delivery
- Honey bee hives should be equipped with a dispenser for microbial powder
- 5 -10 grams of Prestop Mix is added in the dispenser every day
- Use of Prestop Mix is started in the beginning of flowering and is continued during the whole flowering period
- The rate of Prestop Mix during the flowering period is 300-500 g/ha



Dispenser for microbial powder

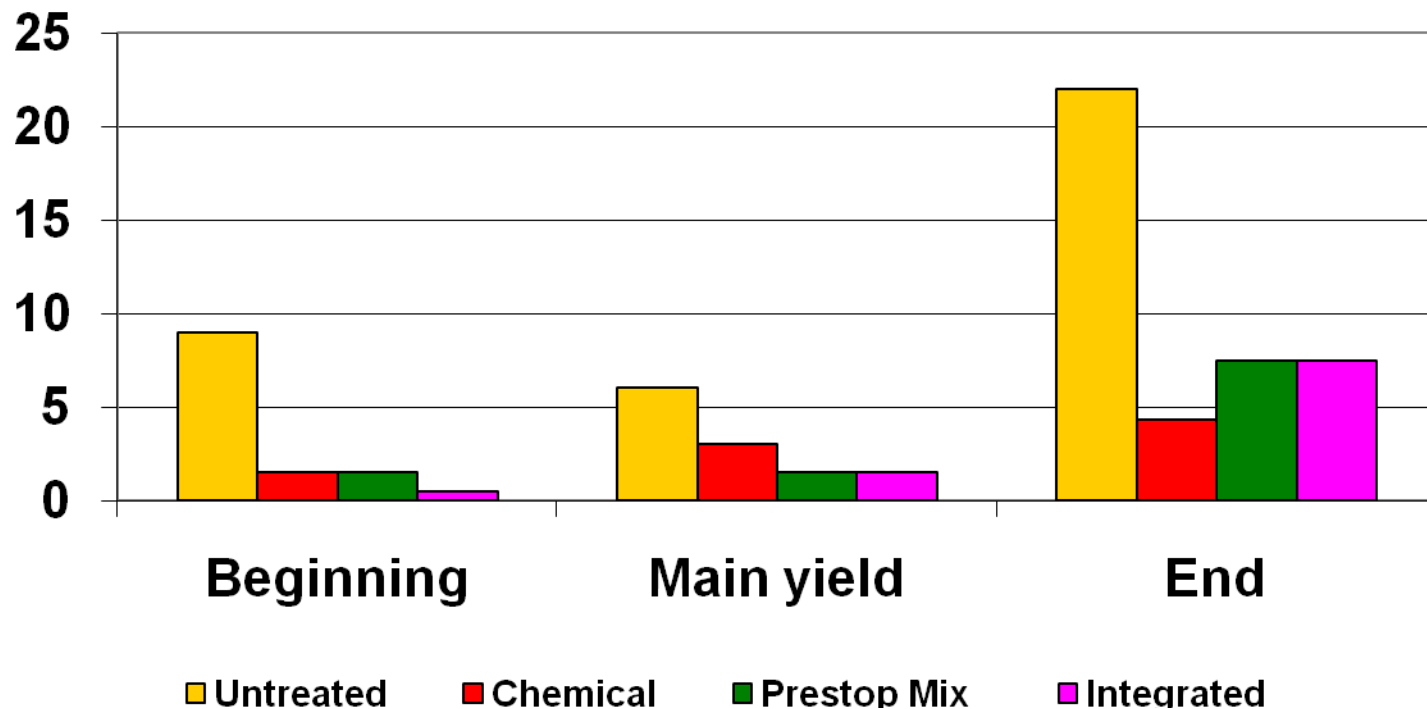
- Honey bee hives are equipped with a dispenser
- Prestop[®] Mix powder is spread on the inoculum field of the dispenser
> only a thin layer of powder is needed
- The product adheres to the hairy bodies of bees as they walk through the powdered surface
- The dispenser forces the bees to enter and exit the hive through different entrance



BeeTreat[®] inoculum dispenser
by Aasatek Oy, Finland

Mean results from three grey mould trials (honey bee-vectoring) on strawberry, commercial conventional farms

Percentage of berries infected by grey mould in the beginning of the harvesting, under the main harvesting period and at the end of the harvesting



Prestop Mix on apple

- *Fusarium avenaceum* and other pathogenic fungi such as *Botrytis*, infects the apple flowers
 - > cause storage diseases such as core rot
- Prestop Mix was successfully tested in the honey bee assisted control of apple storage diseases in Åland (2013-2015)
- Minor Use approval in Finland and Sweden (2015) for the control of core rot and other storage rots on fruit trees



Core rot symptoms on variety Gala Schnitzel

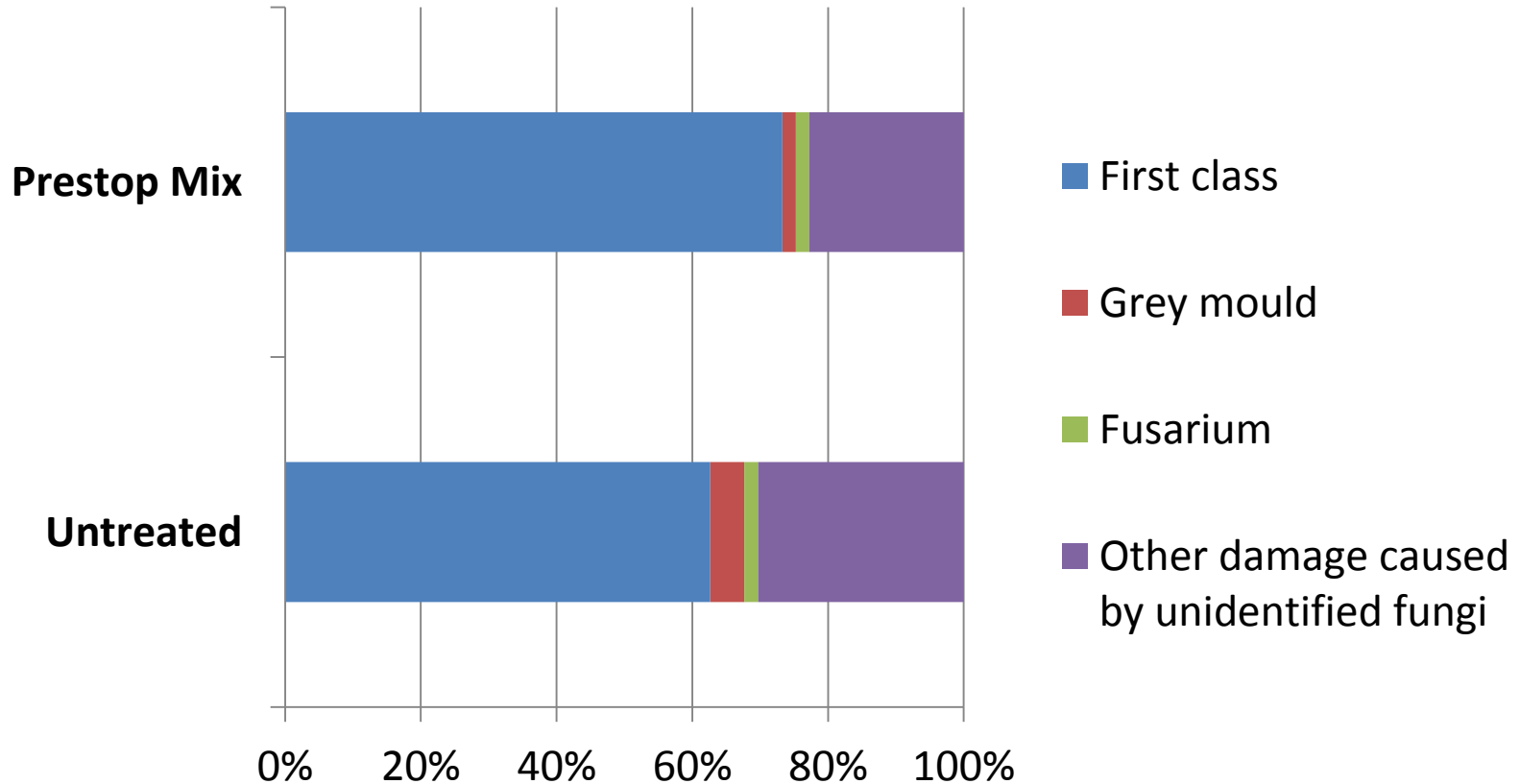
Prestop Mix trials on apple

- Peter Sundin's apple orchard in Åland 2013-2015
- Winter varieties Rubinola and Santana that are sensitive to core rot
- Prestop Mix delivered during flowering with honey bees
- Untreated and Prestop Mix areas so far from each other that bees are not flying to the untreated area
- Apple samples were stored in cold storage and assessed for storage diseases in January and February (3-4 months after harvesting)



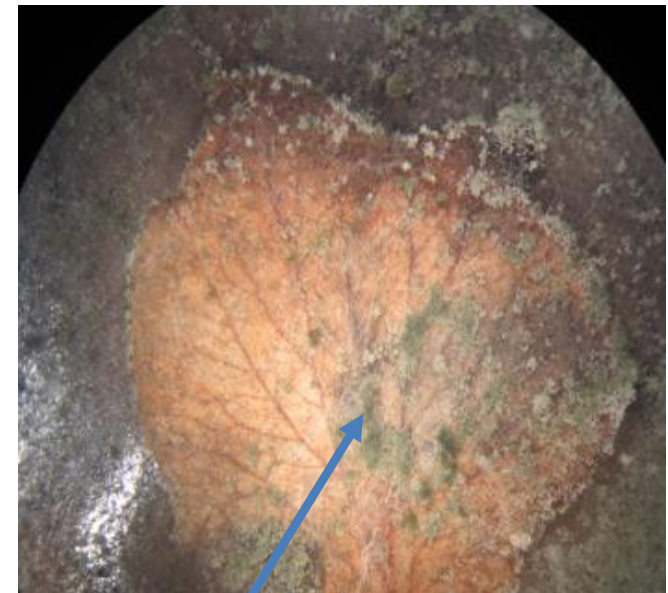
Prestop Mix vectored by honey bees

Quality of apples "Rubinola" in February 2014



Gliocladium catenulatum in apple flowers

Treatment/ Distance from the hive	<i>Gliocladium</i> % in apple flowers		
	Stamens	Petals and pistils	Flowers
Untreated	0	0	0
Prestop Mix near (10 m)	18.3	22.0	75
Prestop Mix in the middle (50 m)	5.3	13.5	60
Prestop Mix farthest away (100 m)	5.7	9.5	50



Gliocladium growing
on the flower petal

Petals and pistils of apple in laboratory analysis

Untreated

> *Fusarium* growing on petals and pistils

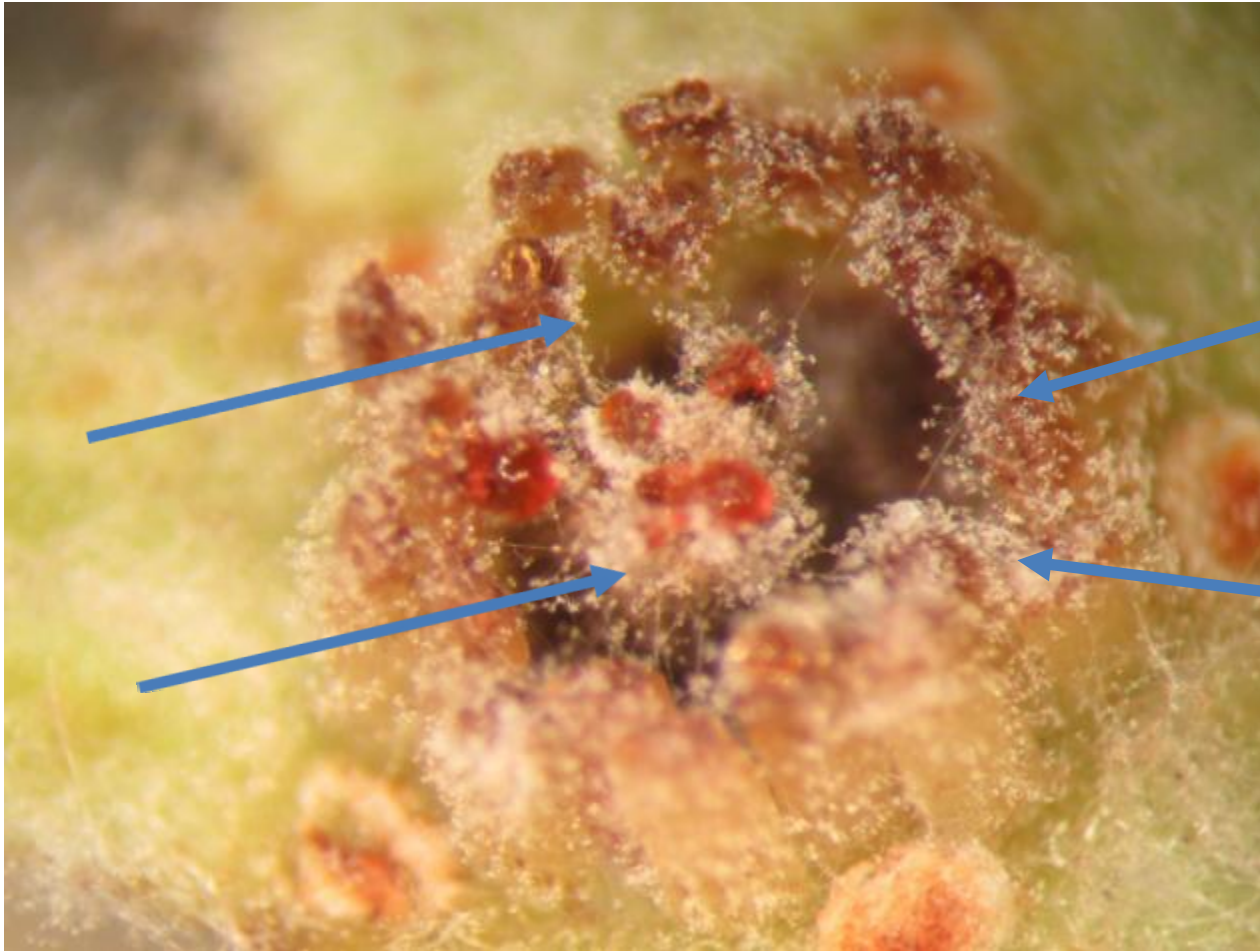


Entomovectoring

> *Gliocladium* has taken the place of *Fusarium* in petals and pistils



...calyx colonization by *G. catenulatum*



Gliocladium
mycelium
growing all
over the
calyx >
takes the
living space
of
pathogens

Prestop Mix delivered by bumble bees

- In Finland bumble bee hives used mainly in tunnel and greenhouse production of strawberry and raspberry
- The use of bumble bee pollination is becoming more popular also in open field
- In open field 2-3 bumble bee hives are required per ha (6-9 bumble bee colonies/ha)
- In tunnels and greenhouses 1-2 bumble bee hives are used/1000 m²
- Biobest has developed a bumble bee hive with an integrated dispenser for microbial powder: "Flying Doctor" system



Prestop Mix in Finland

- Prestop Mix has been used in Finland in berry crops since 2008
- Prestop Mix is used in both conventional and organic production
- Positive grower feedback in 2017 even though the *Botrytis* pressure was high due to rainy weather conditions
- Approximately 25 % of strawberry and raspberry production area is treated annually with Prestop Mix
- It is estimated that the use of Prestop Mix will increase due to problems with *Botrytis* strains that have become resistant to many chemical active ingredients



Positive experiences in Finland

- Jouko Mönkkönen was chosen by the Finnish Beekeepers Association to be the Beekeeper of the Year
- Has been used Prestop Mix in his farm since 2010
- Production of strawberry and organic honey as well as pollination service for other growers
- Strawberry yield has doubled since implementing new technologies in the Mönkkönen farm: new strawberry varieties, use of honey bee pollination and biological control with Prestop Mix
 - > The number and size of the berries has increased



Farmit News 31. Jan 2018

<https://www.farmit.net/kasvinviljely-kotielain/2018/01/31/vuoden-mehilaistarhaajaksi-jouko-monkkonen-puheessaan-monkkonen>

The *Gliocladium* biocontrol microbe & honey

- The active substance *Gliocladium catenulatum* J1446 of Prestop Mix is classified as fully harmless by the EU registration authorities
- There are no restrictions set for the honey production even if the production hives are also used for biological control of mould
- Dispensers make the bees exit and enter the hive through different entrances > Prestop Mix powder is not carried back into the hive
- Studies show that the honey produced in hives, which are used for biological control of grey mould, do not contain higher-than-usual concentration of fungal spores



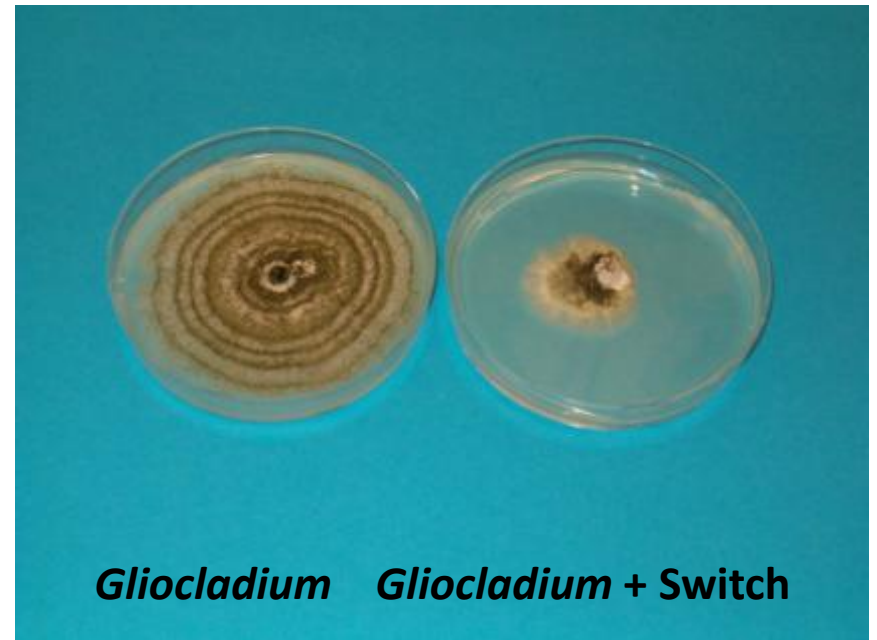
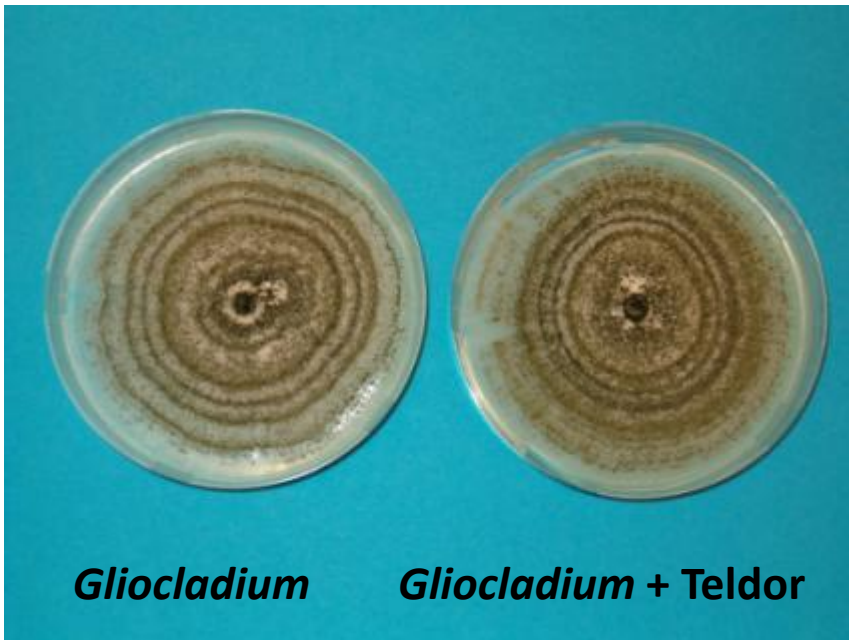
Prestop Mix and chemical pesticides

- The compatibility of chemical substances and *Gliocladium* has been tested in lab conditions
- Practice has shown that even substances which demonstrate poor compatibility in laboratory conditions can be used for berries together with Prestop Mix
- However, the best option is to use a chemical product that has shown good compatibility with Prestop Mix also in laboratory conditions
- Chemical product spraying should be done late in the evening or early in the morning when pollinators are not flying

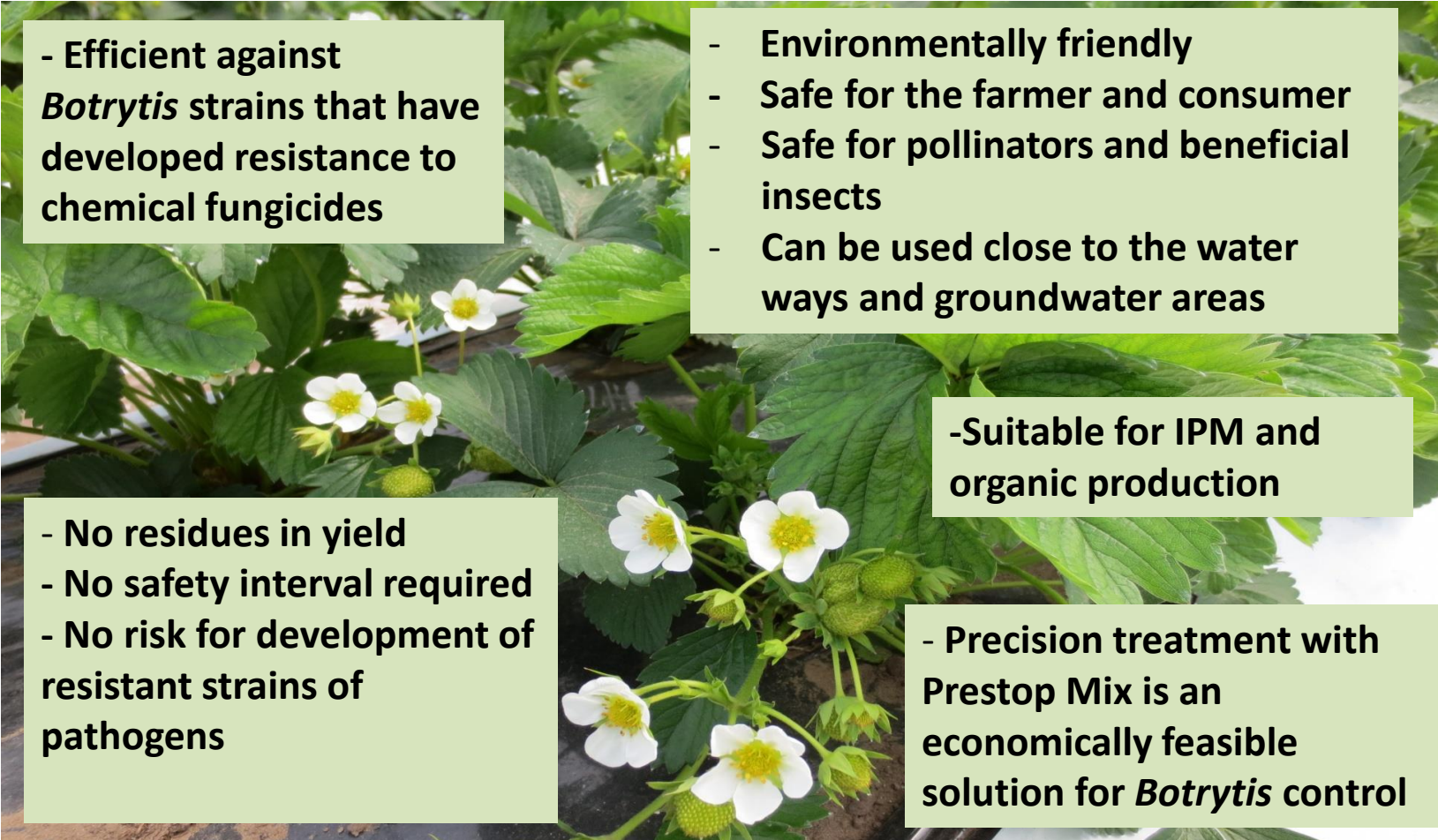
Inhibition effect (0-3) of chemical fungicides on *Gliocladium*

Teldor (inhibition=0)

Switch 62.5 WG (inhibition=2.5)



Benefits of biological *Botrytis* control



- Efficient against *Botrytis* strains that have developed resistance to chemical fungicides

- Environmentally friendly
- Safe for the farmer and consumer
- Safe for pollinators and beneficial insects
- Can be used close to the water ways and groundwater areas

- No residues in yield
- No safety interval required
- No risk for development of resistant strains of pathogens

- Suitable for IPM and organic production

- Precision treatment with Prestop Mix is an economically feasible solution for *Botrytis* control

Prestop for biological control of root and foliar diseases

Registered as a biological pesticide in Estonia:

- Control of damping-off and root diseases caused by *Pythium*, *Phytophthora*, *Fusarium* and *Rhizoctonia* on vegetables, ornamentals and herbs in greenhouses
- Control of *Botrytis* and *Didymella* in greenhouse crops
- Extension of approval in Estonia 2017 (Minor Use) to open field crops :
 - Root diseases in strawberry and raspberry in open field and tunnels
 - *Fusarium* and *Botrytis* in onion
 - *Plasmodiaphora brassicae* on cabbage crops
 - *Didymella* on field cucumber and cucurbits



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Prestop in seedling production of vegetables, herbs and ornamentals

- Control of damping-off and improvement of the root system

Growth substrate infected by *Pythium* and *Rhizoctonia*



Untreated

Prestop
drench 10 g/m²

Gliocladium on leek seedlings



Gliocladium

Untreated

Prestop for root disease control in cabbage crops

Cabbage crops can be infected during seedling production and later in the field:

- *Alternaria*-damping off
- *Rhizoctonia*-damping off
- *Plasmodiaphora*-club root

- Drench of the seedlings with Prestop (5-10 grams/m²)
- Prestop drench just before planting in the field controls *Plasmodiaphora* infection in the field soil

- If necessary, second application can be made in the field by row spraying



Untreated reference



Prestop drench

Effect of Prestop against club root on broccoli

- Prestop drench of seedlings before planting in the field



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Prestop for the control of club root in cabbage crops



Untreated reference



Prestop drench

Prestop drench of broccoli seedlings just before transplanting in the field soil, that was naturally infected with *Plasmodiaphora*

Prestop for the control of *Didymella* on field cucumber and cucurbits

- Symptoms occur in fruits, stems and in the foliage
- *Didymella* infects the plants especially in moist and warm conditions, survives in the plant residues

Control with Prestop:

- Spraying of the transplants before planting in the field with 0,5% Prestop solution (600 g/25 000 plants)
- Second spray application 1 month after planting in the field (2-3 kg/ha)



Prestop in field onion crops

- *Fusarium sp.* and *Botrytis* have caused major yield loss of field and tunnel onion
- *Fusarium* infection in onion settings and/or through contaminated field soil

Control methods with Prestop:

- Dip of onion settings in 0,5% Prestop solution (not soaking) before planting
- Drench of seedling onion before planting in the field (5-10g/m²)
- Alternatively row spraying after planting (1-2 kg/ha in tunnel and 2-3 kg/ha in field)



Prestop has improved the marketable yield of red onion in tunnel (rate 1,2 kg/ha)



Prestop for the control of root diseases on strawberry

Strawberry suffers from many root diseases:

- *Phytophthora* (crown rot and red core)
- *Fusarium*, *Pythium*
- *Verticillium-wilt*
- *Colletotrichum*

Field soil and/or planting material can be infected with root pathogens

Treatment of strawberry plants with Prestop:

- Dip of strawberry plants in 0,5 % Prestop suspension just before planting in the field
- Prestop drench application of tray/plug plants



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Prestop for the control of root diseases on strawberry



**Effect of Prestop dip treatment
on Manille variety at planting.
Photo 3,5 months after planting.**



**Effect of Prestop dip treatment
on Sonata variety at planting.
Photo 3,5 months after planting.**

Thank you for your interest!

