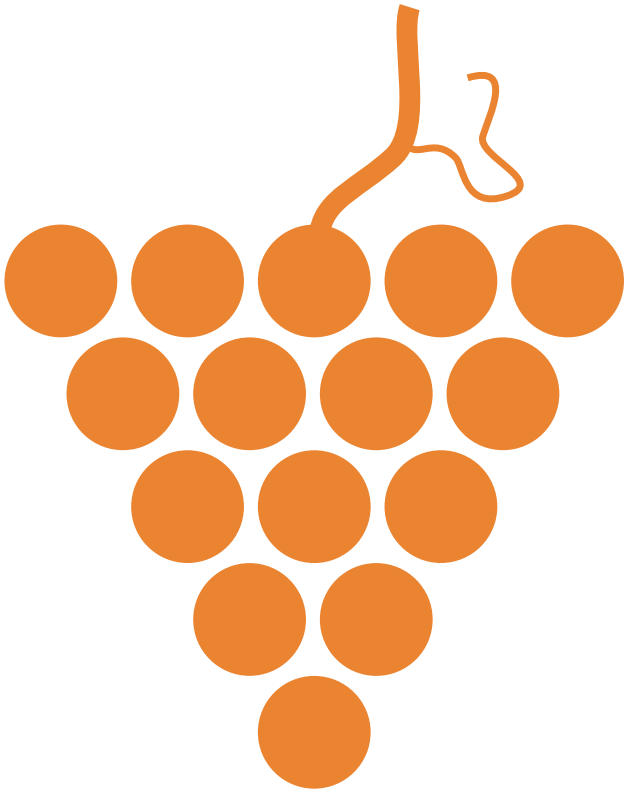
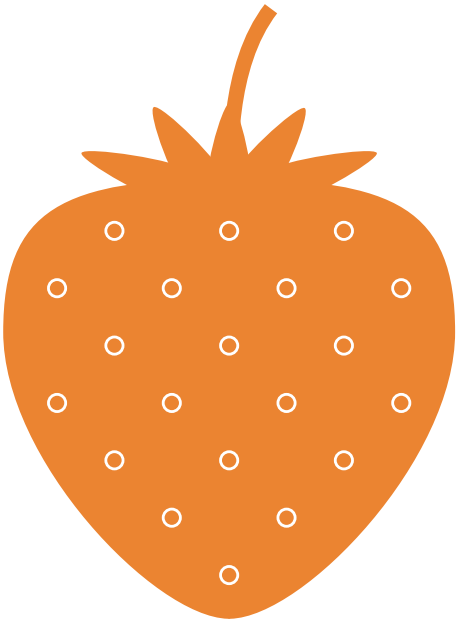


JULI 2017

Botector™ AGAINST GRAY MOLD
Product User Manual

bio-ferm
BIOTECHNOLOGICAL PLANT PROTECTION



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Botector®

Botector® is a biotechnological fungicide for the control of gray mold *(Botrytis cinerea)* in grapes, berries and tomatoes. Botector® is based on two strains of the species *Aureobasidium pullulans*.

Key benefits of Botector®:

- Highly effective
- Safe for humans and animals, harmless to bees and beneficials
- GMO free
- No residues
- No resistance development, FRAC: not classified
- No preharvest interval
- Well adapted to a wide range of temperature
- Fully biodegradable
- No influence on taste and quality of fruits or processing procedure
- Miscible with many chemicals
- Valuable part in a modern IPM strategy and essential for high value organic production

Composition:	*Aureobasidium pullulans* strain DSM 14940 and DSM 14941
Formulation:	Wettable granule (WG)
Package:	PE-HD can 1.2 kg, 1 kg or 0.4 kg

Fig. 1 Botector® packaging

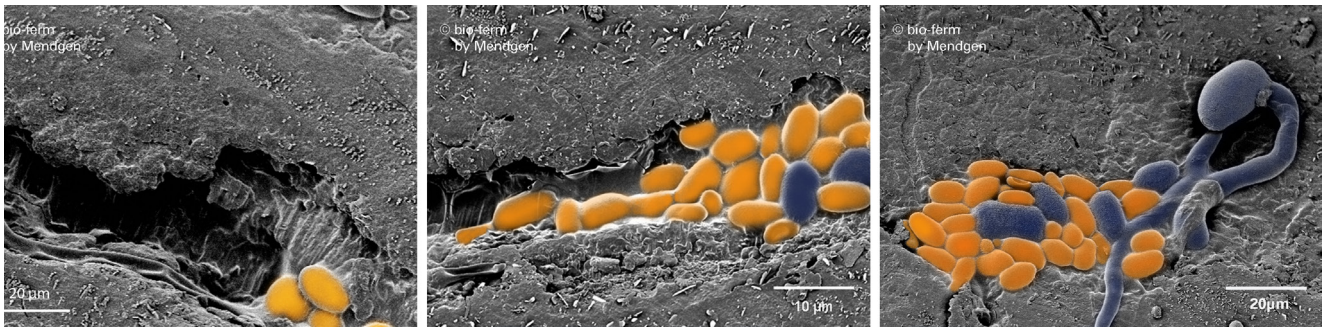
1 *Aureobasidium pullulans*, active substance in Botector®

Aureobasidium pullulans is an eu-ascomycete which can build asexual blastospores showing a yeast-like life form. The fungus is well adapted to outdoor conditions, tolerant against drought, insensitive against solar radiation and frugal even under suboptimal nutrient supply. Of course, both strains of *Aureobasidium pullulans* have not been genetically modified for our products.

Mode of Action, stable efficacy and absence of resistance

The efficacy of *Aureobasidium pullulans* against different pathogens (e.g. *Erwinia amylovora, Botrytis cinerea*, storage pathogens) is based on its antagonistic activity by competing successfully with pathogens for nutrients and space.

Aureobasidium pullulans
Botrytis cinerea



1. Microscratches on the plant's surface provide a natural entry point for gray mold (*Botrytis cinerea*). These scratches are colonized immediately after applying the highly effective microorganisms (*Aureobasidum pullulans*).

2. The rapid proliferation of *Aureobasidium pullulans* consumes available nutrients and inhibits the development of Botrytis

3. The microscrach is sealed by *Aureobasidium pullulans*, which acts as a natural shield and prevents *Botrytis cinerea* from infecting the plant.

Fig. 2 Scanning electron micrograph: Highly efficient microorganism (*Aureobasidium pullulans*) in competition with *Botrytis cinerea* colonizing a microscratch on the plant surface

Due to the antagonistic mode of action, bio-ferm products control also those pathogens which have already developed resistance against chemical substances. As the bio-ferm products are capable of reducing the share of resistance carriers in the population, hence the performance of chemical products subsequently used after bio-ferm products, will be enhanced (Figure 3).

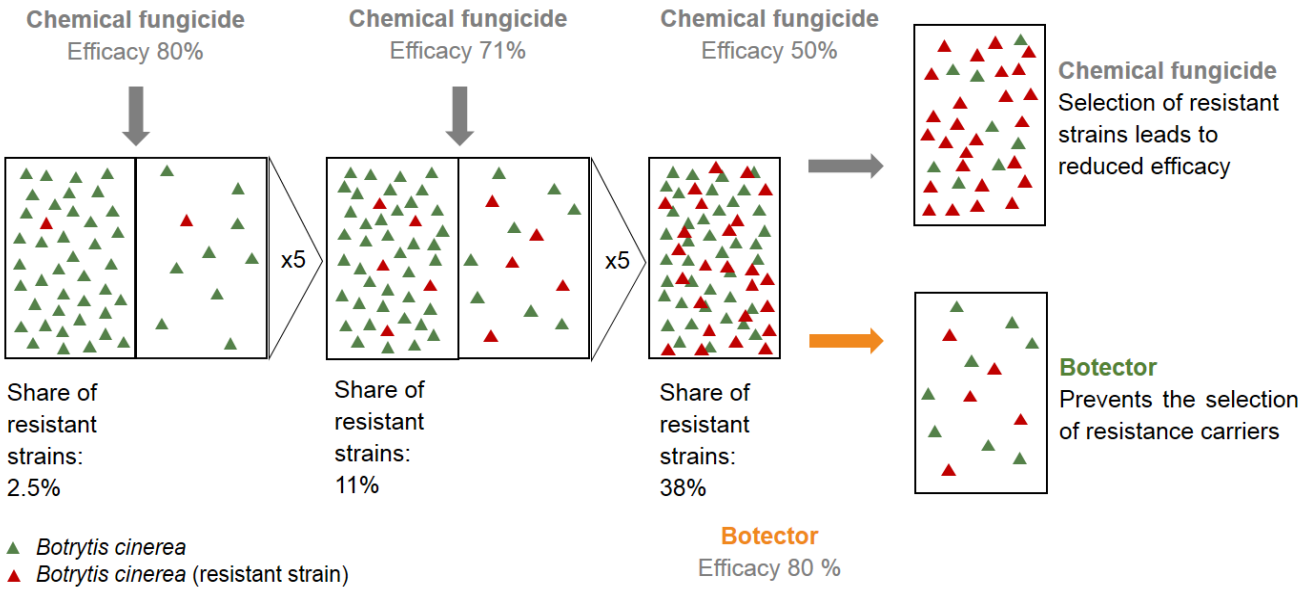


Fig. 3 Botector® reduces the share of resistance carriers in the population

2 Botector® against gray mold *(Botrytis cinerea)*

Wine growers all over the world are facing problems with the fungal pathogen *Botrytis cinerea*, the causal agent of gray mold or botrytis bunch rot of grapes. In vineyards, *Botrytis cinerea* preferably occurs as bunch and stalk rot. Depending on the grape variety and on the season, botrytis can result in a yield loss of more than 50% forcing wine-growers to harvest earlier. Perforations of the berry skin induced by *Botrytis cinerea* and the subsequent leakage of juice increases the risk of undesirable secondary diseases like Penicillium-, Aspergillus-, Trichothecium-, Alternaria- and acetic acid rot.

Infested bunches must be separated and removed from the harvest material in order to avoid strong negative influences on taste, flavor and color of the wine such as bitter and smelly notes, off-flavor, loss of the typical character of the varieties, volatile acid and reduced color gain of red wines.

During vinification, problems can occur due to the increased susceptibility to oxidation, higher pH value and the increased sulphur requirements as well as insufficient filterability and ability to sediment. Off-flavor and wine faults are exceedingly difficult to correct with the common loss of quality by fining.

Fig. 4 Gray mold on Pinot blanc

Fig. 5 Gray mold on strawberries

Gray mold is still a challenge to control in certain highly perishable crops such as small berries. In berries, the pathogen overwinters on dead leaves and starts its pathogenic activity at flowering, and then it can stay latent on stamens below sepals, and infect the fruit close to or soon after harvest. The infected portion is firm and brown while the berry is still green, but it expands and softens as the fruit ripens. For this reason, the origin of most infections in berries is located close to the sepals (Figure 5), which often covers under flower residues.

Gray mold is also a common and often a serious fungal disease of tomato plants in greenhouses and of tomatoes grown in open land. Once established it is di ficult to bring under control. *B. cinerea* can survive in the field under a wide range of conditions, even a germination at 0°C is possible. Furthermore it colonizes as a saprophyte flower residues, fruit juice drops, dead leaves and other non-living plant portions In heated tomato greenhouses as well as in warmer tomato production areas, (e.g. Spain, Italy, Israel) gray mold symptoms develop mainly on stems, following infection of pruning wounds at 75-85% at relative humidity.

Fig. 6 Gray mold on tomato stem (close to a pruning wound)

Botector® application instructions for use against *Botrytis cinerea*

- For the application of Botector®, use standard spraying equipment
- Clean the tank before using
- Put the product into the mesh and jet it into the tank with water
- Keep the water temperature below 25°C
- Use the tank suspension within 8 hours
- Apply preferably in the evening or when temperatures are low
- The suspension should be agitated during spraying
- Do not leave leftovers in the tank. The microorganisms in the product might multiply and block the jets

2.1 Botector® application instructions for use against gray mold in grapes

Application rate: 1 kg/ha, to be adapted to development stage, crop density and cultivation system. Up to 4 preventive treatments between end of flowering (BBCH 68) and ripening (BBCH 85-89):

BBCH 68: 80% of flower hoods fallen
Against latent infection and colonization of flower residues, depending on weather conditions.

BBCH 77: Beginning of bunch closure
Against stalk and berry infection.

BBCH 85: Start of berry softening
Against berry-infection (susceptible grapes).

BBCH 85-89: During ripening
Against berry infection (depending on weather conditions).

Between 2007 and 2016, trials on the processing procedure were performed in Austria, Italy and France. The vinification of Botector® treated bunches showed that there was no influence on the criteria bunch maturation, ingredients of must, nutrients, must sedimentation, fermentation (spontaneous and with additive pure culture yeast), chemical analysis of wine, sensory wine evaluation and wine aging, even if Botector® was applied one day before harvest.

Efficacy results against B*otrytis cinerea* in grapes

In efficacy trials between 2007 and 2016, Botector® reduced the mean gray mold incidence of 38% in the untreated control by 49%. The efficacy in reducing severity of disease symptoms averaging 18% in the untreated control was around 40% and comparable to chemical botryticides (Figure 7). Detailed information on single trial results can be delivered upon request.

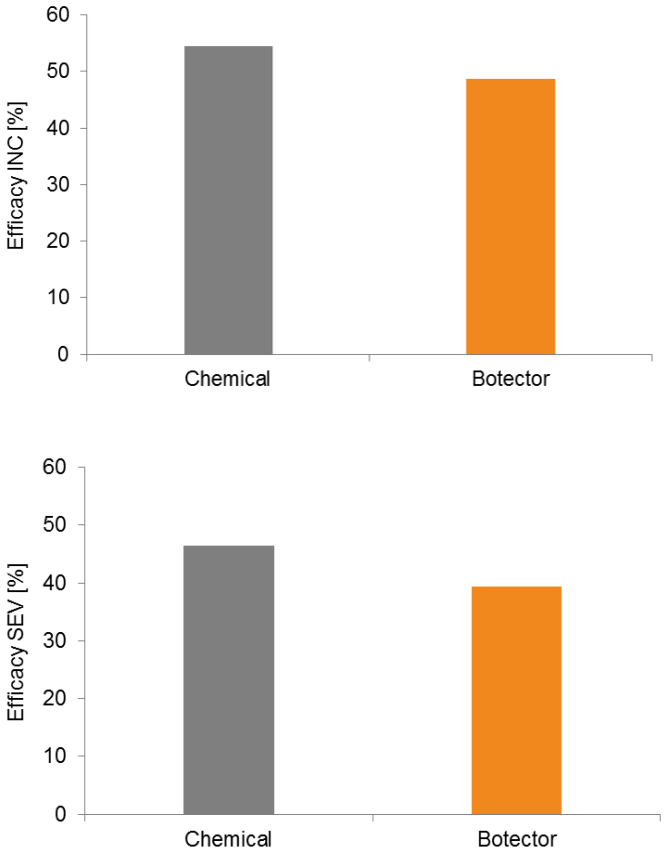


Fig. 7 Mean Efficacy of Botector® 2007-2016, top: Disease incidence, bottom: Disease severity

With increasing infection pressure, the efficacy of the treatments, chemical as well as Botector®, against *Bortytis cinerea* decreases. However, the efficacy of Botector® is comparable to standard botryticides within the whole range of infection pressure (Figure 8).

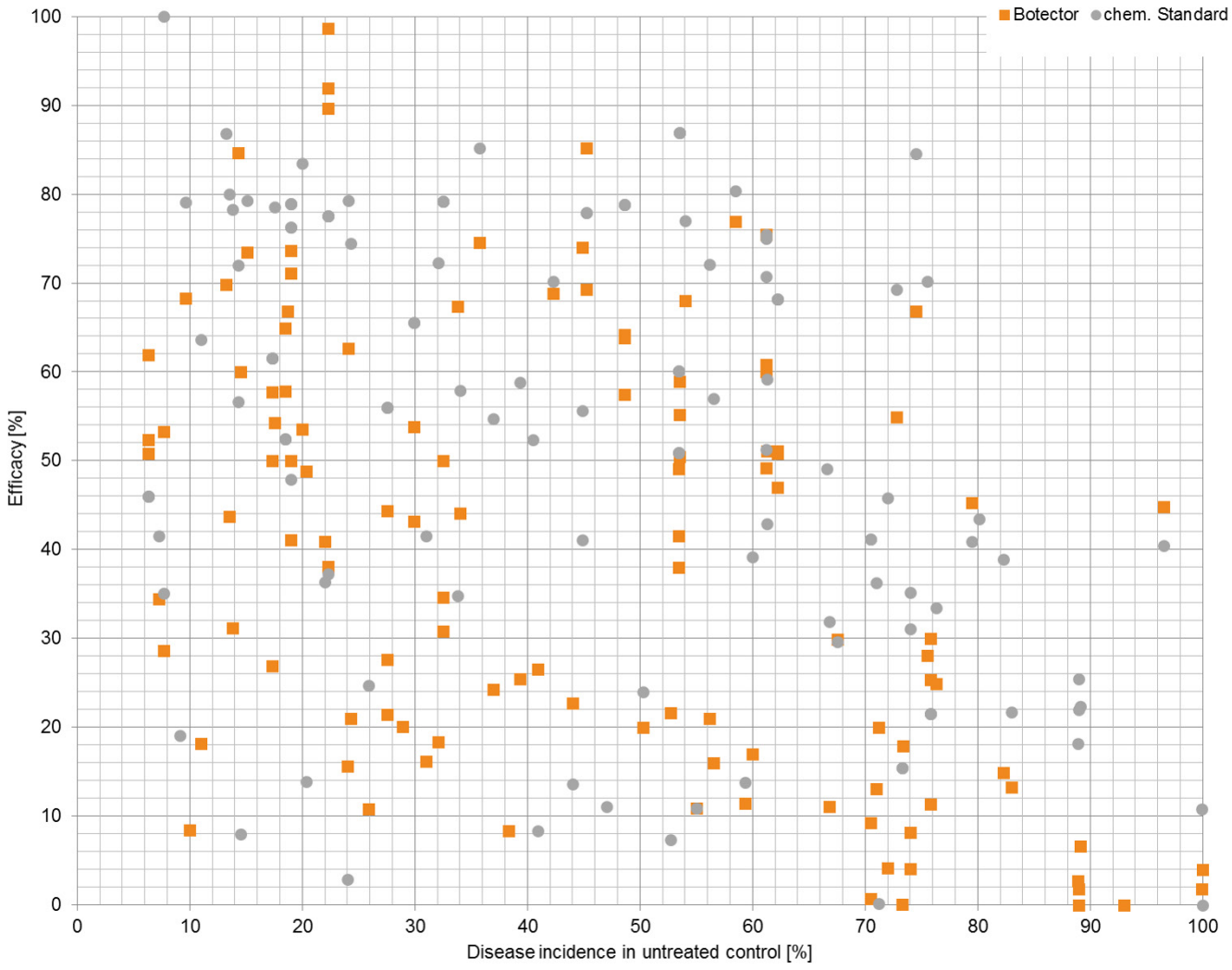


Fig. 8 Efficacy of Botector® and chemical standard botryticides at increasing infection incidence

2.2 Botector® application instructions for use against gray mold in soft fruits

Application rate: 1 kg/ha, to be adapted to development stage, crop density and cultivation system. Up to 6 preventive treatments between the beginning of flower setting (BBCH 55) and until the end of harvesting (BBCH 89) are possible per growing season. Current research has consistently shown that an excellent gray mold control can be obtained in none remontant varieties with two fungicide sprayings, applied at early bloom (around 10% of flowers open) and 10 days later (around 50% of flowers open). However, additional application of Botector® till harvest can improve shelf life of the harvested berries (Figure 10).

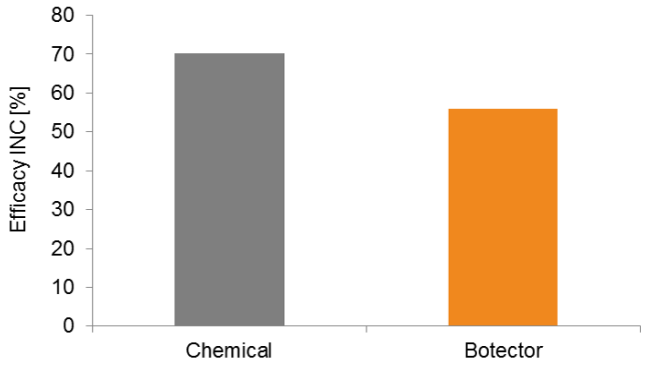


Fig. 9 Efficacy results Botector® against *Botrytis cinerea* in soft fruits

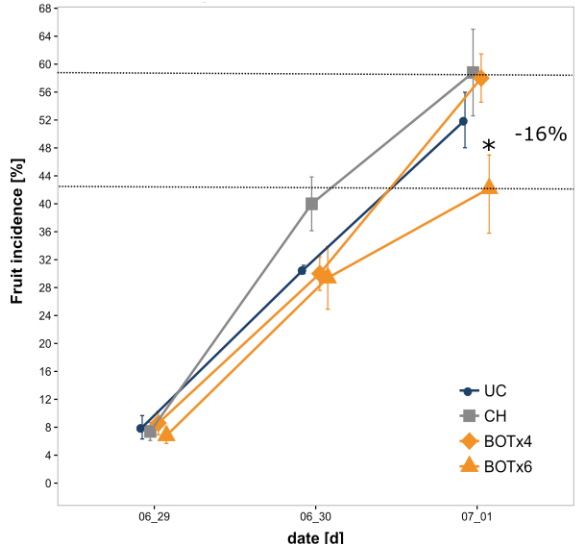


Fig. 10 Shelf life evaluation of Botector® in 2016 under room temperature conditions. Botector® applied 6 times versus 4 times were compared to a standard chemical treatment and an untreated control

Efficacy results against *Botrytis cinerea* in soft fruits

Between 2007 and 2016, numerous efficacy trials were performed worldwide. Trials were conducted at different research institutes, 16 at GEP certificated research centers, 9 at none GEP research centers and 3 at agricultural chambers. Presented traits are fruit and flower incidence at field level and fruit incidence at storage. No differentiation was done, if trial was conducted open land or under protected conditions. Figure 9 shows an overview generated out of 29 single trials, in the mean Botector® showed an efficacy of 56% compared to the standard chemical treatment with a mean of 70%.

It can be stated that Botector® applied on the ripening fruit short before harvest does have a significant positive effect on the shelf-life of strawberries under room temperature conditions. 16 % less fruits were rotten after 3 days of storage (Figure 10). Under cold storage conditions, the rotting process was prolonged. After 8 days of storage 32% less fruits were rotten in the Botector® treated batch.

2.3 Botector® application instructions for use against gray mold in tomatoes

Application rate: 1 kg/ha, to be adapted to development stage, crop density and cultivation system. Up to 5 preventive treatments between the first inflorescence visible (first bud erect / BBCH 51) until the end of harvesting (BBCH 89) are possible per growing season. The most important dates to consider a Botector® application are when pruning, wiring and harvesting take place. Botector® is able to form a protective shield against Botrytis infestation on wounded plant material.

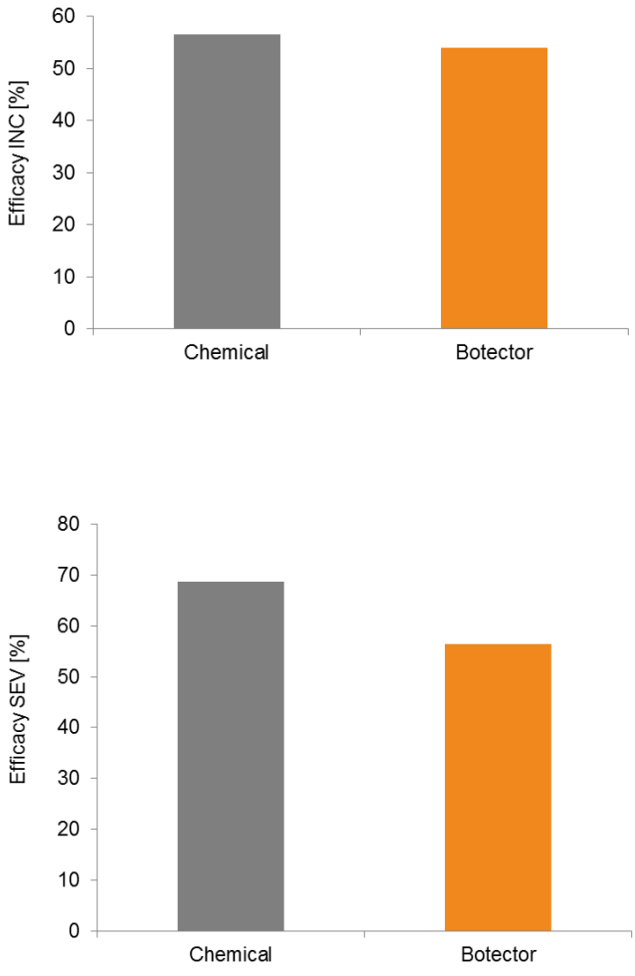


Fig.11 Efficacy results Botector® against *Botrytis cinerea* in tomatoes

Efficacy results against *Botrytis cinerea* in tomatoes

Between 2009 and 2016, numerous efficacy trials were performed worldwide. Trials were conducted at different research institutes, 13 at GEP certificated research centers, 1 at none GEP research center and 1 at the University of Almeria. Presented traits are fruit, stem, leaf, apical cut and flower incidence at field level and fruit incidence at storage. No differentiation was done, if trial was conducted open land or under protected conditions.

Results from Figure 11 are the summary of 17 trials performed between 2009 and 2016, estimated over fruit, stem, leaf, apical cut and flower incidence at field, as well as fruit incidence at storage level.

The efficacy of Botector® on Botrytis incidence was 54% compared to the standard chemical treatment with 56%. Also regarding the severity the results of the standard chemical treatment and Botector® were comparable (69% chemical compared to 56% Botector®).

3 Compatibility of Botector® with other products

Botector® can be combined with numerous pesticides and fertilizers. For detailed information on compatibility, please refer to www.bio-ferm.com to obtain the latest updates. For plant protection products not compatible with Botector®, keep an interval of minimum 3 days before and after the application of Botector®.

Note: For the latest version of our compatibility list, please refer to www.bio-ferm.com

4 Storage stability of Botector®

The bio-ferm products contain living microorganisms, do not store above 25°C!

Storage stability from date of manufacture:

- at room temperature (≤20°C, 77°F) 18 months,
- at cold temperature (≤8°C, 46°F) minimum 30 months.

Please note that storage stability is subject to national product registration. Depending on national authority and procedure, different information on shelf life may appear on the label. Please refer to the national product label.

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