

*The Multi-purpose
Fungicide for
Specialty Crops and More*

• ***Boscalid***

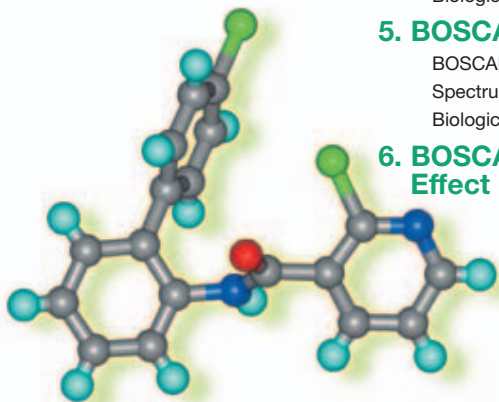
Agricultural Products

 **BASF**

The Chemical Company

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The Active Ingredient and the Product Family

BOSCALID provides for higher yield and quality

New plant protection products are most often developed for large crops rather than for crops with smaller application potential, such as the diverse fruits and vegetables. The result: farmers and official advisors in various countries often find that the registered use of current products does not always meet their needs.

With BOSCALID, BASF has been successful in developing a new fungicide active ingredient with a unique mode of action for use in a wide spectrum of crops: for many fruits and vegetables, grapes, turf and various agronomic crops, for example oilseed rape/canola.

Fungicide trials with BOSCALID in various field and vegetable crops have demonstrated significantly increased yields and that the proportion of the marketable crop was significantly increased.

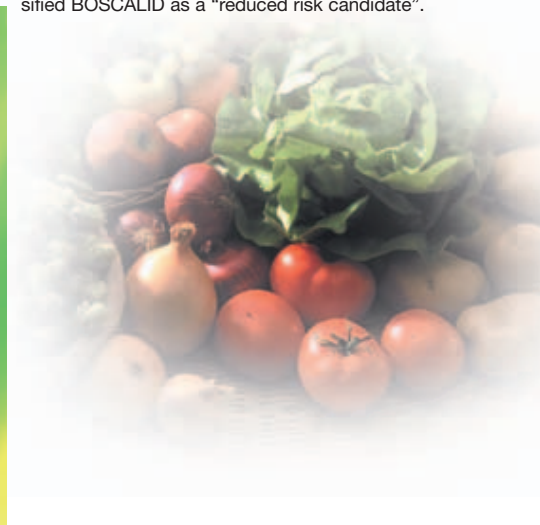
Strong combinations

Through the combination of BOSCALID with other BASF fungicides, it is possible to broaden the activity spectrum and to thus round it off. The result is a family of products that offers an unusually wide spectrum of activity and one which meets the performance level of the most modern fungicides currently available.

On the basis of its positive qualities for both the user and the environment, the US EPA has classified BOSCALID as a “reduced risk candidate”.

Disclaimer

- The data presented in this technical manual represent results from studies conducted in various global environments.
- BOSCALID is currently in the registration process in many countries. This technical manual is provided for informational purposes only and is not intended to promote the sale of the product.
- Any use of BOSCALID after registration is obtained shall be solely on the basis of the approved product label, and any claims regarding product safety and efficacy shall be addressed solely by the label.



Mode of Action

BOSCALID inhibits fungal respiration

BOSCALID inhibits the enzyme succinate ubiquinone reductase, also known as complex II, in the mitochondrial electron transport chain.

Like the other complexes of the respiratory chain (I, III and IV), this enzyme is a component of the inner mitochondrial membrane. However, it does not function as a proton pump and its relatively simple structure consists of only four nucleus-encoded sub-units. Two of these polypeptides anchor the complex in the membrane whilst the others project into the mitochondrial matrix where they catalyse the oxidation of succinate to fumarate as part of the tricarboxylic acid (TCA) cycle. The electrons so released are channeled into the electron transport chain via the co-substrate ubiquinol (QH₂).

A fungicide with double activity

Complex II occupies a key function in fungal metabolism. Not only does it deliver fuel in the form of high energy electrons for energy production, it also forms an essential junction where

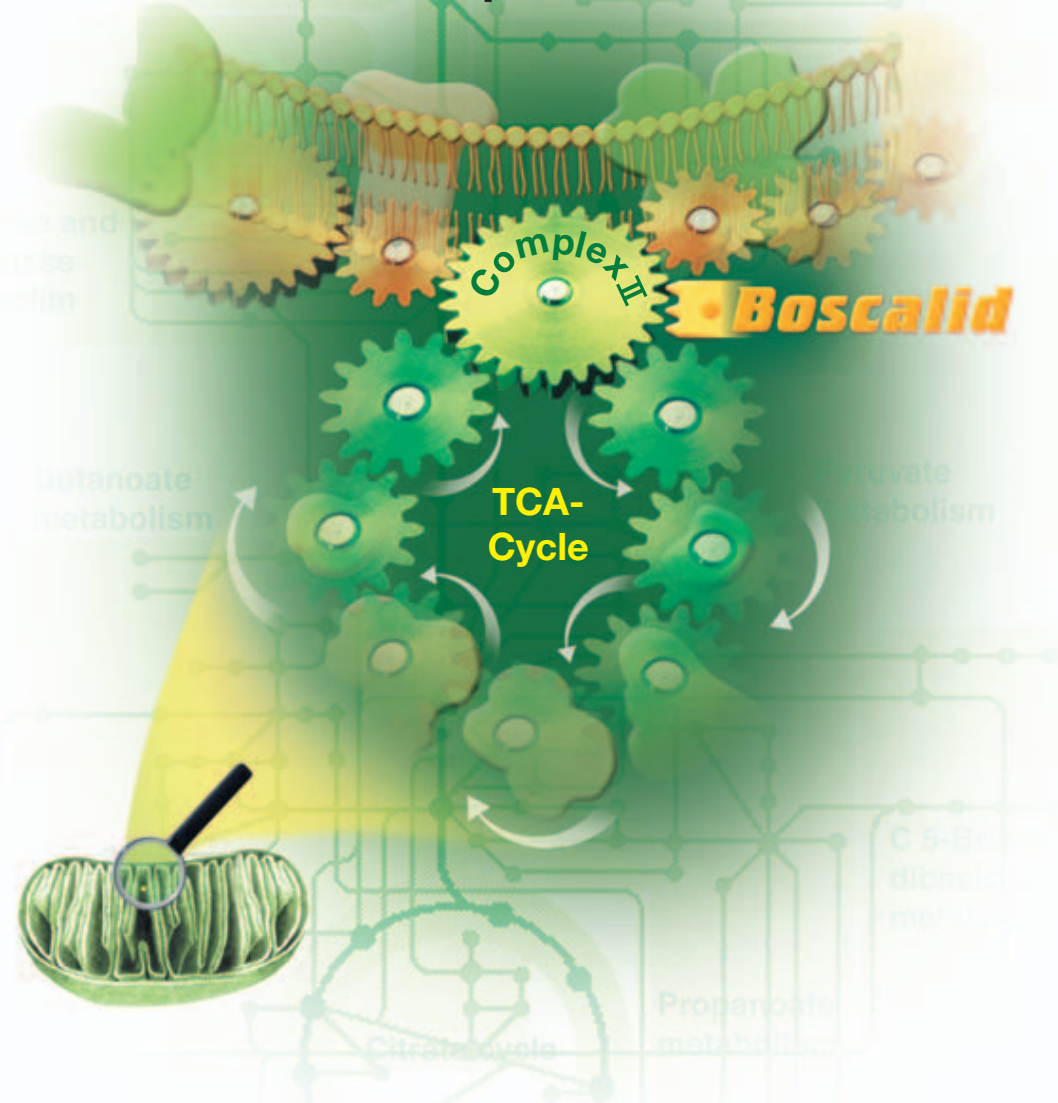
components of the TCA cycle can be diverted to become the building blocks for amino acids and lipids.

Through its inhibition of complex II, BOSCALID disrupts fungal growth by preventing energy production. In this respect, it resembles the strobilurins, but there is no risk of cross-resistance due to its different site of action in the electron transport chain.

It also inhibits fungal growth by eliminating the availability of the chemical building blocks for the synthesis of other essential cellular components.

BOSCALID differs from strobilurins and most other fungicides in both its mode and site of action. It is the first product that utilizes this effective mode of action against a novel range of target diseases in many important crops. Thus, even pathogens which have developed resistance to other chemical classes of fungicides can be controlled by BOSCALID.

Mitochondrial Electron Transport Chain



Uptake and Transport

BOSCALID – Systemically active

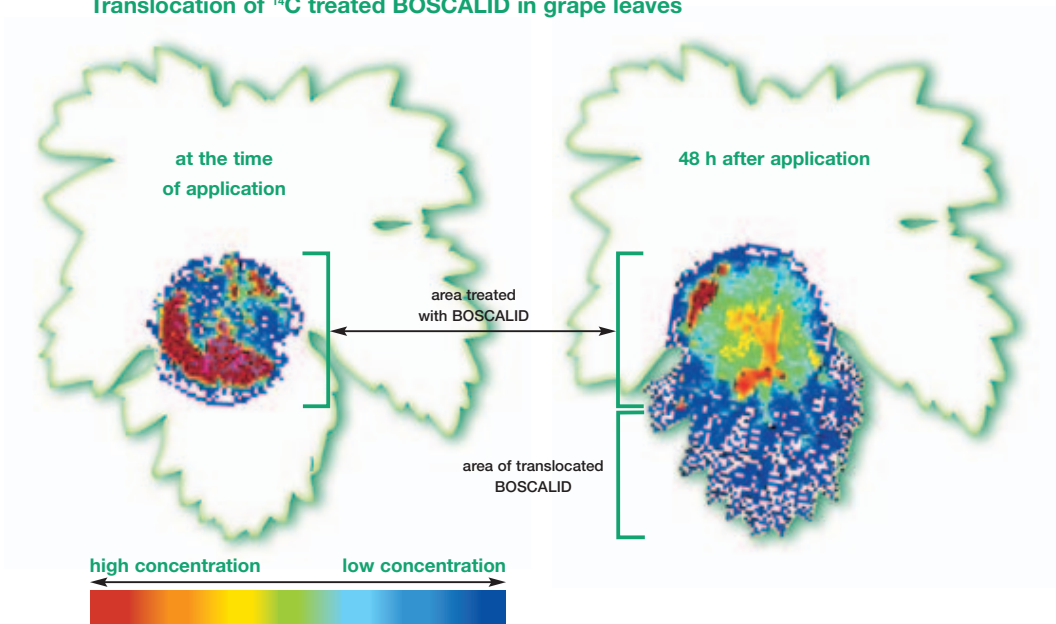
BOSCALID has medium values for lipophilicity and water solubility (log Pow = 2.96 and 4.6 mg/l, respectively). These properties are important characteristics that lead to a systemic activity of BOSCALID. Redistribution via the vapor phase is minimal.

Translocation provides for broad protection

A portion of the applied active ingredient is taken up by the leaf and moves translaminarily through the leaf tissue to the opposite leaf surface. Another portion of that which enters the leaf moves with the water stream in an acropetal direction to the leaf tip and margins.

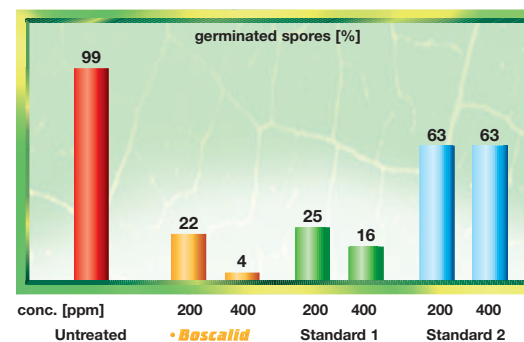
Through this type of translocation, untreated plant parts receive fungicide protection. The extent of this activity may be variable in different plant-pathogen combinations.

Translocation of ¹⁴C treated BOSCALID in grape leaves



Effect on Pathogens

Influence of different compounds on the spore germination of *Botrytis cinerea* at different concentration levels



Lab trials: treatment 4 h protective on collodum membranes, 4 replicates with 50 conidia each, assessment 1 dpi

BOSCALID protects from the beginning

BOSCALID works, above all, prophylactically against pathogens from various fungal classes. When applied at the beginning of the fungal life cycle, spore germination is inhibited; but this new active ingredient can do more, it also inhibits its growth of the germination tube and prevents the formation of appressoria. Thus, the infection is inhibited. In some fungi, BOSCALID also has an additional effect against the mycelial growth and spore development.

The result: BOSCALID protects the plant from disease and secures the yield and quality of the harvest.

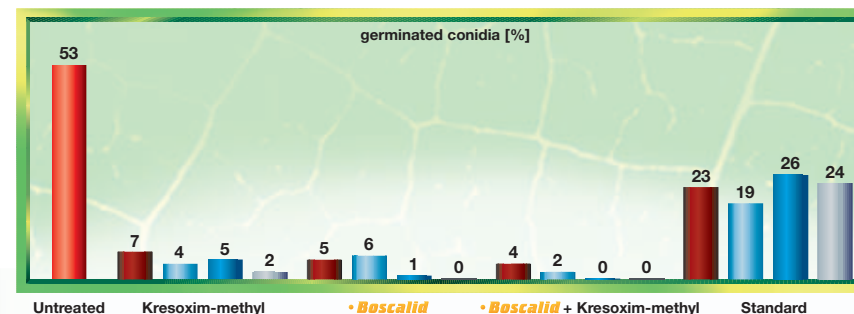


Untreated conidia of *Botrytis cinerea* on the leaf surface



Collapsed conidia of *Botrytis cinerea* after treatment with BOSCALID (250 ppm) on the leaf surface. Next to the conidia BOSCALID particles can be seen.

Effect of different fungicides on the germination of conidia of *Sphaerotheca fuliginea*




3 Glasshouse trials with whole cucumber plants. 1 day protective treatment, 4 replicates with 50 conidia each, assessment 2 dpi

■ 16 ppm ■ 32 ppm ■ 63 ppm ■ 125 ppm

Spectrum of Activity

Efficacy: ●●●● excellent ●●● good ●● moderate ● low

 <p>Beans <i>Botrytis cinerea</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Alternaria alternata</i> ●●● <i>Uromyces appendiculatus</i> ●●</p>	 <p>Cucurbits <i>Botrytis cinerea</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Alternaria cucumerina</i> ●●● <i>Sphaerotheca fuliginea</i> ●● <i>Erysiphe cichoracearum</i> ●● <i>Didymella bryoniae</i> ●●</p>	 <p>Onions <i>Alternaria porri</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Sclerotium cepivorum</i> ●●● <i>Botrytis squamosa</i> ●●●</p>	 <p>Peppers <i>Botrytis cinerea</i> ●●●● <i>Leveillula taurica</i> ●</p>
 <p>Cabbage <i>Alternaria</i> spp. ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Mycosphaerella brassicicola</i> ●●●</p>	 <p>Eggplants <i>Botrytis cinerea</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●●</p>	 <p>Ornamentals Roses <i>Sphaerotheca pannosa</i> ●● <i>Diplocarpon roseum</i> ●●● Carnations <i>Uromyces dianthi</i> ●●● Chrysanthemum <i>Puccinia horiana</i> ●● Tulips <i>Botrytis tulipae</i> ●●● Lilies <i>Botrytis elliptica</i> ●●●● Gladiolus <i>Botrytis gladiolorum</i> ●●●</p>	 <p>Potatoes <i>Alternaria solani</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●●</p>
 <p>Carrots <i>Alternaria dauci</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Cercospora carotae</i> ●●● <i>Erysiphe heraclei</i> ●●</p>	 <p>Grapes <i>Botrytis cinerea</i> ●●●● <i>Uncinula necator</i> ●● <i>Penicillium</i> spp. ●●</p>	 <p>Peanuts <i>Sclerotinia minor</i> ●●●● <i>Mycosphaerella arachidis</i> ●●● <i>Mycosphaerella berkeleyii</i> ●●● <i>Phoma arachidicola</i> ●●●● <i>Puccinia arachidis</i> ●●●</p>	 <p>Stone fruits/Almonds <i>Monilinia</i> spp. ●●●● <i>Blumeriella jaapii</i> ●●●● <i>Sphaerotheca pannosa</i> ●● <i>Wilsonomyces carpophilus</i> ●● <i>Venturia carpophila</i> ●●</p>
 <p>Chick peas <i>Sclerotinia sclerotiorum</i> ●●●● <i>Botrytis cinerea</i> ●●●● <i>Ascochyta rabiei</i> ●●●</p>	 <p>Lettuce <i>Botrytis cinerea</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Sclerotinia minor</i> ●●●● <i>Rhizoctonia solani</i> ●● <i>Erysiphe cichoracearum</i> ●●</p>	 <p>Tomatoes <i>Alternaria solani</i> ●●●● <i>Botrytis cinerea</i> ●●●● <i>Sclerotinia sclerotiorum</i> ●●●● <i>Septoria lycopersici</i> ●●● <i>Leveillula taurica</i> ●</p>	 <p>Strawberries <i>Botrytis cinerea</i> ●●●● <i>Mycosphaerella fragariae</i> ●●●● <i>Sphaerotheca macularis</i> ●●</p>
 <p>Citrus <i>Alternaria alternata</i> ●●● <i>Botrytis cinerea</i> ●●●</p>	 <p>Oilseed rape/Canola <i>Sclerotinia sclerotiorum</i> ●●●● <i>Alternaria</i> spp. ●●●● <i>Leptosphaeria maculans</i> ●●●</p>	 <p>Peas <i>Sclerotinia sclerotiorum</i> ●●●● <i>Botrytis cinerea</i> ●●●●</p>	 <p>Turf <i>Sclerotinia homoeocarpa</i> ●●●●</p>
 <p>Coffee <i>Phoma costarricensis</i> ●●●● <i>Ascochyta tarda</i> ●●●●</p>			

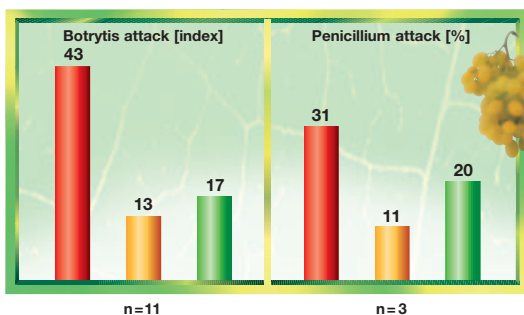
Biological Trial Results



Efficacy of BOSCALID against *Botrytis cinerea* and *Penicillium* spp. in grapes

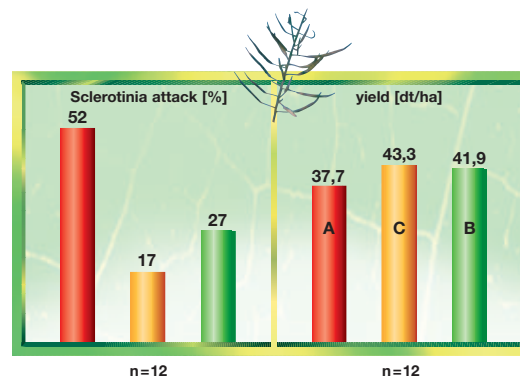
To control *Botrytis cinerea*, grape growers have access to a limited number of effective active ingredients. With its new mode of action, BOSCALID is extraordinarily effective and also controls strains that have developed resistance to other products.

With application of BOSCALID at the customary timings for Botrytis control, an additional powdery mildew treatment becomes unnecessary, because BOSCALID is also active against this fungus. Secondary diseases such as Penicillium rot, dreaded in wine grape culture, are also controlled. BOSCALID provides the basis for a pure, healthy wine.



■ Untreated
 ■ • Boscalid 600 g a.i./ha
 ■ Standard 800-1000 g a.i./ha

France, Germany, Italy and Portugal, 1998-2000
 2-4 applications, no initial attack
 disease assessment on clusters at harvest time
 (Botrytis: index=intensity of attack 0-100, Penicillium: % frequency of attack)

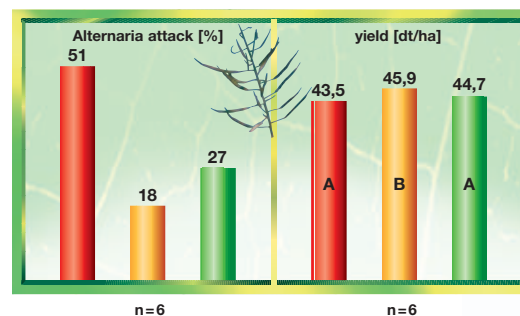


France and Germany, 1998-1999
 1 application during flowering, spray volume 300-350 litres/ha, no initial attack visible
 disease assessment 40-70 days after application (% frequency of attack), yield results analysed using DUNCAN's multiple range test

Efficacy of BOSCALID against *Sclerotinia sclerotiorum* in oilseed rape/canola

Heavy *Sclerotinia* infection in oilseed rape/canola leads to significant yield loss. BOSCALID, when applied at full bloom, possesses an outstanding activity against this pathogen. The result: superior yield thanks to the maintenance of good plant health.

■ Untreated
 ■ • Boscalid 250 g a.i./ha
 ■ Standard 375-750 g a.i./ha



Denmark and France 1998-2000
 1 application at crop growth stage 65-75, spray volume 275-400 litres/ha, initial attack 0-1%
 disease assessment 35-70 days after application (% frequency of attack), yield results analysed using DUNCAN's multiple range test

Efficacy of BOSCALID against *Alternaria* spp. in oilseed rape/canola

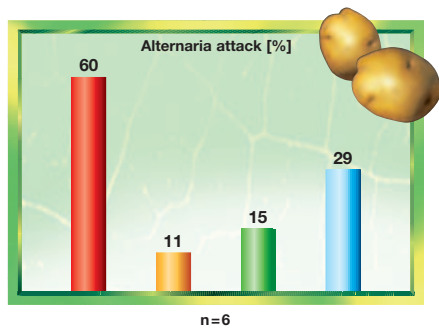
For the control of *Alternaria*, BOSCALID shows a significant advantage with respect to disease reduction and yield performance compared with the current market products.





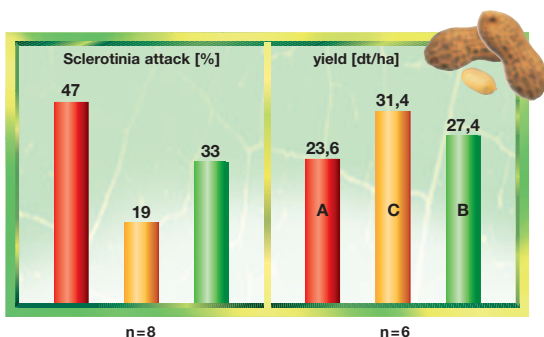
Efficacy of BOSCALID against *Alternaria solani* in potatoes

BOSCALID possesses also an excellent activity against *Alternaria solani* in potatoes.



Brazil 1999-2001
2-4 applications, spray interval 7-14 days, spray volume 500 litres/ha, initial attack 1-3%
disease assessment 7-16 days after last application (% severity of attack)

- Untreated
- • Boscalid 75 g a.i./ha
- Standard 1 50 g a.i./ha
- Standard 2 100 g a.i./ha



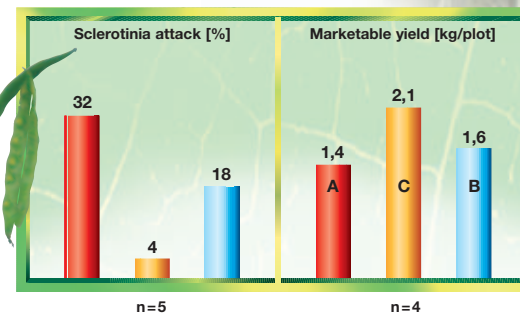
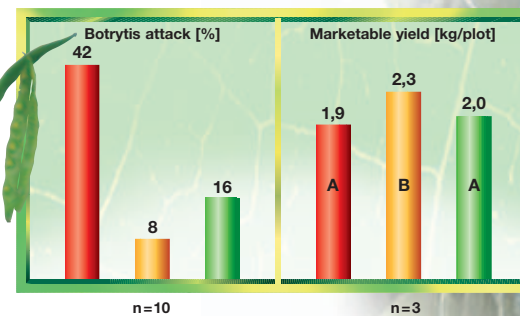
Efficacy of BOSCALID against *Sclerotinia minor* in peanuts

Sclerotinia minor in peanuts is successfully controlled by BOSCALID. The excellent disease control is reflected in significant yield increases.

- Untreated
- • Boscalid 448 g a.i./ha
- Standard 1121 g a.i./ha

USA 1999-2000
3-5 applications, spray interval 14-21 days, spray volume 187-233 litres/ha, initial attack 0-5%
disease assessment 22-58 days after last application (% severity of attack), yield results analysed using DUNCAN's multiple range test

Efficacy of BOSCALID against *Botrytis cinerea* and *Sclerotinia sclerotiorum* in beans



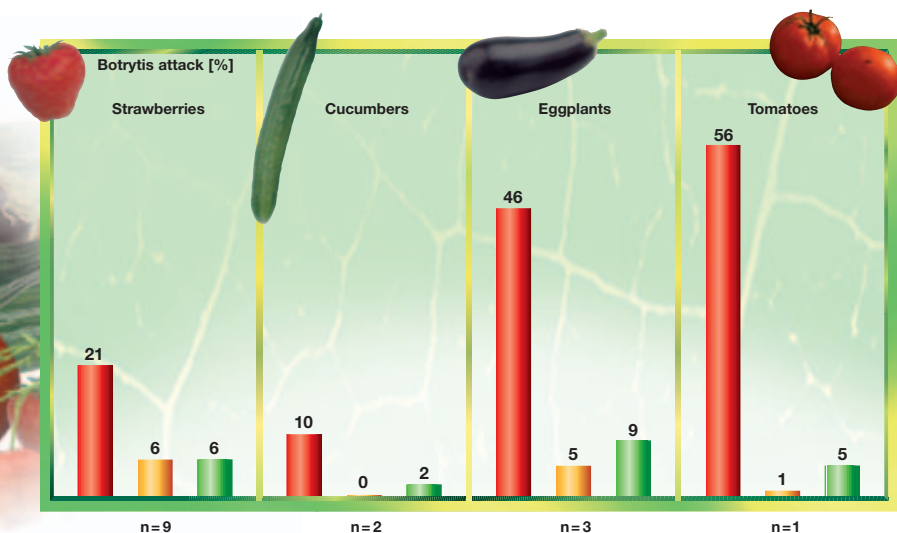
- Untreated
- • Boscalid 500 g a.i./1000 l
- Standard 1 600 g a.i./1000 l
- Standard 2 750 g a.i./1000 l

Germany and Spain 1999-2000
3 applications, spray interval 7-14 days, no initial attack
disease assessment 14-21 days after last application (% severity of attack)
yield results analysed using DUNCAN's multiple range test

Botrytis cinerea and *Sclerotinia sclerotiorum* are the most important diseases in beans. BOSCALID demonstrates excellent activity against both pathogens.



Efficacy of BOSCALID against *Botrytis cinerea* in strawberries and vegetables



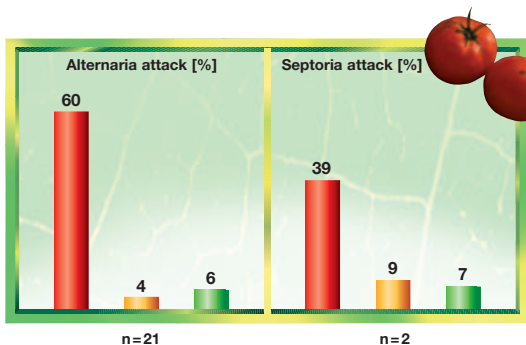
Japan 1998-2001

3-4 applications, spray interval 5-7 days, no initial attack
disease assessment 7-21 days after last application
(% frequency of attacked fruits)

■ Untreated ■ •Boscalid 500 ppm a.i. ■ Standard 200 ppm a.i.

BOSCALID is a highly active botryticide with very good selectivity in many different vegetable crops. In most trials, BOSCALID reached or

exceeded the activity level of the modern fungicide standards.



Brazil and Taiwan 1999-2001

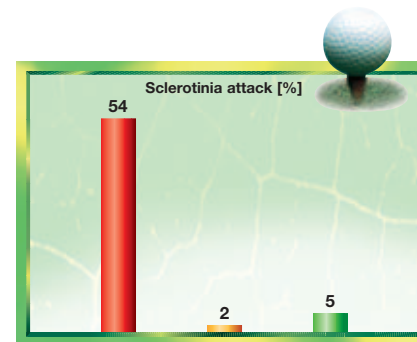
2-4 applications, spray interval 7-10 days, initial attack 0-3%
disease assessment 14-21 days after last application (% severity of attack)

Efficacy of BOSCALID against *Alternaria solani* and *Septoria lycopersici* in tomatoes

World-wide *Alternaria* is the most important pathogen in tomatoes. In a large number of trials, BOSCALID has shown an excellent effect against *Alternaria*.

The best results for the control of *Septoria* were also obtained with BOSCALID.

■ Untreated
■ •Boscalid 75 g a.i./1000 l
■ Standard 50 g a.i./1000 l



n=17

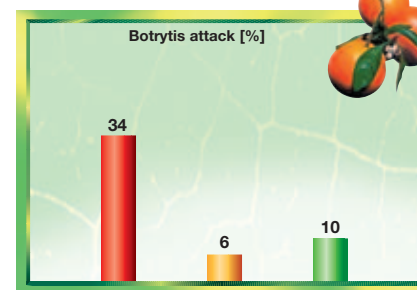
Germany and US 1998-2001

2-4 applications, spray interval 14 days
disease assessment 14 days after last application (% diseased area)

Efficacy of BOSCALID against Dollar spot (*Sclerotinia homoeocarpa*) in turf

Dollar spot is a dreaded disease on golf courses, which results in the regular application of fungicides for its prevention. With comparatively low application rates, BOSCALID gives long residual efficacy.

■ Untreated
■ •Boscalid 280 g a.i./ha
■ Standard 1500-3000 g a.i./ha



n=3

Japan 1998

2 applications, spray interval 6 days, no initial attack
disease assessment 3-7 days after last application
(% frequency of diseased blossoms)

Efficacy of BOSCALID against *Botrytis cinerea* in citrus

Botrytis cinerea, a problem of citrus culture in Japan and South America, can be solved with BOSCALID.

■ Untreated
■ •Boscalid 333 ppm a.i.
■ Standard 333 ppm a.i.

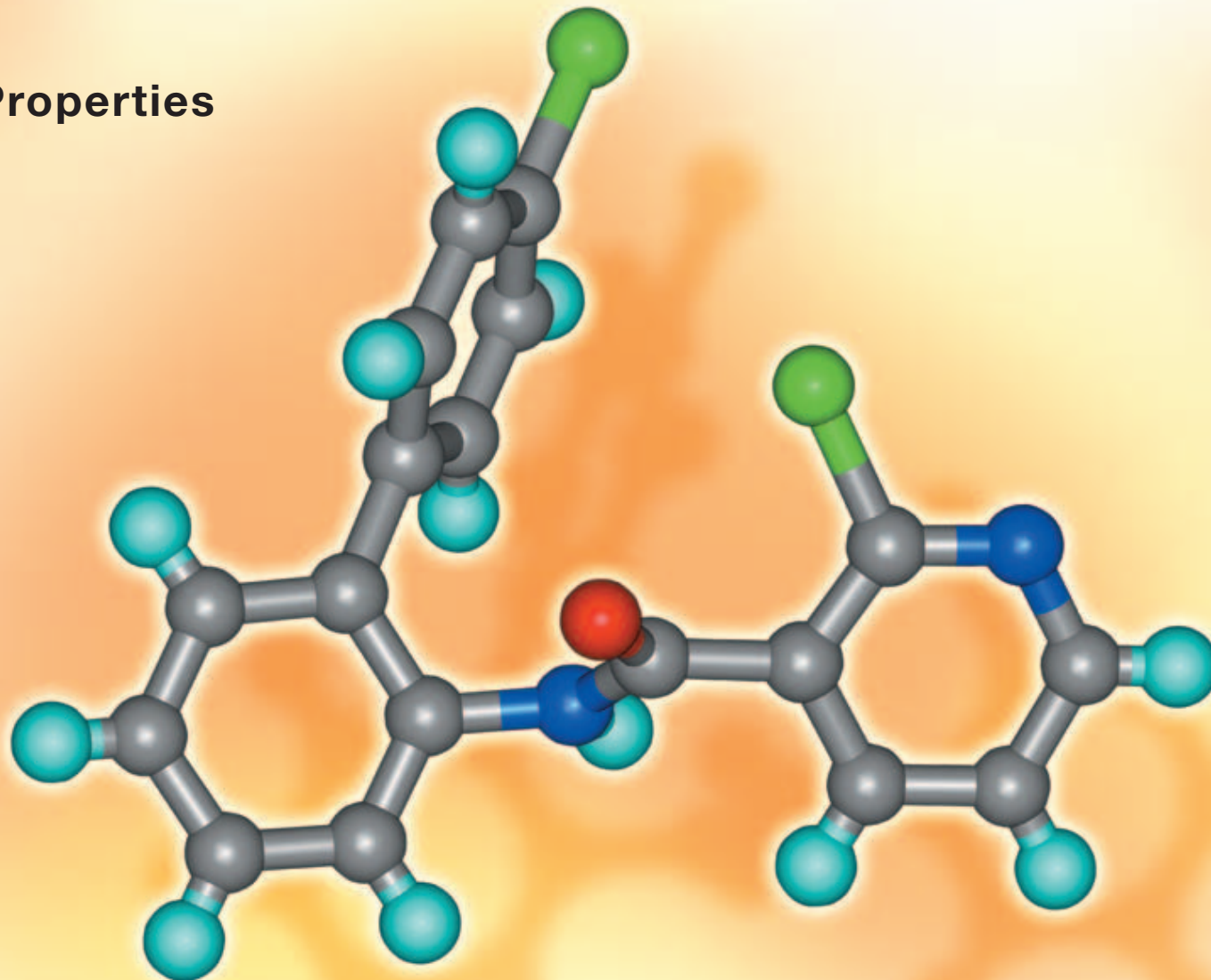
Chemical and Physical Properties

Identity

Common name:	BOSCALID
BASF Code No.:	BAS 510 F
Chemical class:	Anilides
Chemical name (IUPAC):	2-Chloro-N-(4,-chloro-biphenyl-2-yl)nicotinamide
Empirical formula:	$C_{16}H_{12}Cl_2N_2O$
Molecular weight:	343.2

Physical and chemical properties:

Appearance at 20 °C:	white crystals
Odour:	odourless
Melting point:	142.8 – 143.8 °C
Vapour pressure at 20 °C:	7×10^{-7} Pa
Solubility at 20 °C:	
(g substance per 100 ml) in	
water	0.00046
n-heptane	< 1.0
toluene	2.0 – 2.5
dichlormethane	20 – 25
methanol	4 – 5
acetone	16 – 20
ethylacetate	6.7 – 8.0



Toxicity and Environmental Performance

Toxicity data for BOSCALID:

Acute oral	LD ₅₀ rat > 5000 mg/kg
Acute dermal	LD ₅₀ rat > 2000 mg/kg
Acute inhalation	LC ₅₀ > 6.7 mg/l
Irritation to skin	non-irritating
Irritation to eyes	non-irritating
Sensitisation	non-sensitizing
Mutagenicity	non-mutagenic

Low toxicity

Due to the differences in bioavailability, BOSCALID acts highly selective. Whereas fungi are highly sensitive, the toxicity for mammals is low.

Natural resources not affected

Soil

BOSCALID has a moderate degradation behaviour in soil. It is mineralised substantially and bound to the soil. No major metabolites are formed. No unacceptable impact on the environment has to be expected by BOSCALID.

The mobility of BOSCALID is considered to be low.

Ecotoxicity data for BOSCALID:

Birds	practically non-toxic, LD ₅₀ > 2000 mg/kg
Earthworms	practically non-toxic, LC ₅₀ (14 d) > 1000 mg/kg
Non-target arthropods (6 types)	practically non-toxic
Bees	practically non-toxic
Aquatic organisms	moderately toxic LC ₅₀ fish = 2.7 mg/l EC ₅₀ daphnia = 5.3 mg/l EC ₅₀ algae = 3.8 mg/l

Water

BOSCALID degrades in natural water/sediment systems by photoinduced biological reactions and by adsorption to the sediment.

Air

With a value of 7×10^{-7} Pa, the vapour pressure of BOSCALID is low. The danger of escaping into the atmosphere is equally low.

No impact on fauna and flora

BOSCALID presents low risk to beneficials and is, therefore, an ideal product for use in Integrated Pest Management (IPM) programmes.

Birds and terrestrial vertebrates

The active substance is practically non-toxic to birds and terrestrial vertebrates.

Fish, fish prey, and algae

Numerous ecological studies demonstrate the low risk of the active ingredient BOSCALID to aquatic organisms like fish, daphnia and algae.

Bees

BOSCALID is non-toxic to bees.

Non-target arthropods

Based on laboratory and field studies, low risk will be anticipated for e.g. predatory mites or other beneficial organisms.

Soil-dwelling non-target organisms

Laboratory and numerous long-term field studies emphasize that BOSCALID will not cause unacceptable risk to e.g. earthworms, springtails, micro-organisms or to soil ecosystem functions.

Non-target plants

Non-target plants will not be affected by BOSCALID.

Resistance Management

Reliable resistance management with BOSCALID

The risk of resistance development with the use of fungicides is generally known. Optimized and highly efficacious active ingredients such as BOSCALID have to be used responsibly to sustain long-term efficiency.

BASF's product stewardship includes clear strategies from the start of commercialization, to minimize the risk of resistance development. BASF is continuously exploring possibilities of resistance management and monitors the efficacy of the products and recommended spray programs under commercial conditions, to control the efficiency of these strategies and to update the use recommendations.

Keys to the resistance management

- Limitation of the number of applications
- Alternation with other classes of active ingredients
- Protectant use
- Compliance with label recommendations
- Use of mixtures with fungicides of different modes of action

BOSCALID + F 500®

BOSCALID + F 500: Reliable solution with a broad use pattern

The combination of BOSCALID and F 500 offers an impressive use pattern in view of both the range of diseases and crops and the high level of efficacy. This is especially evident in specialty crops.

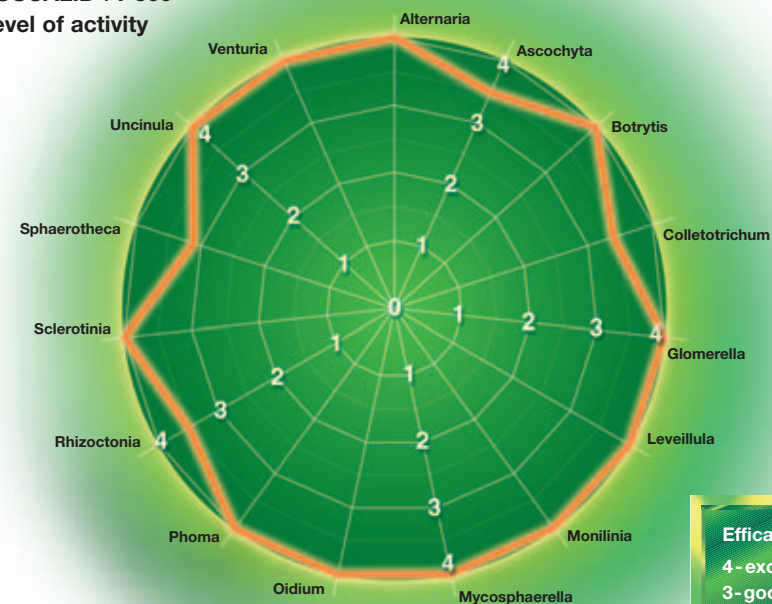
The single components, BOSCALID and F 500, with their different modes of action, are both effective against many important pathogens (for example, powdery mildew, Monilinia, Alternaria).

These attributes contribute to the reliable performance of this combination in resistance management.

The combination BOSCALID + F 500 presents a low risk to beneficials and is ideal for use in Integrated Pest Management programs.

The illustrations on the following pages demonstrate the extraordinary broad activity spectrum and high efficacy of this combination in grapes, fruit and vegetable crops.

BOSCALID + F 500 Level of activity



Efficacy:
4 - excellent
3 - good
2 - moderate
1 - low

Spectrum of Activity

Efficacy: ●●●● excellent ●●● good ●● moderate ● low



Apples

- Venturia inaequalis* ●●●●
- Podospaera leucotricha* ●●●●
- Alternaria mali* ●●●●
- Gloeodes pomigena* ●●●●
- Schizothyrium pomi* ●●●●
- Glomerella cingulata* ●●●●
- Botryosphaeria* spp. ●●●●
- Diplocarpon mali* ●●●●
- Monilinia mali* ●●●●
- Mycosphaerella pomi* ●●●●



Blueberry

- Botrytis cinerea* ●●●●
- Colletotrichum acutatum* ●●●●
- Monilinia vaccinii-corymbosi* ●●●●
- Phomopsis vaccini* ●●●



Cabbage

- Alternaria* spp. ●●●●
- Mycosphaerella* spp. ●●●
- Peronospora parasitica* ●●●
- Albugo candida* ●●●



Carrots

- Alternaria dauci* ●●●●
- Sclerotinia sclerotiorum* ●●●●
- Erysiphe heraclei* ●●●●
- Cercospora carotae* ●●●●



Chick peas

- Ascochyta rabiei* ●●●●
- Sclerotinia sclerotiorum* ●●●●
- Botrytis cinerea* ●●●●



Garlic

- Penicillium* spp. ●●●●
- Sclerotium cepivorum* ●●●



Grapes

- Uncinula necator* ●●●●
- Botrytis cinerea* ●●●●
- Plasmopara viticola* ●●●●
- Guignardia bidwellii* ●●●●
- Pseudopezicula tracheiphila* ●●●●
- Phomopsis viticola* ●●●●
- Elsinoe ampelina* ●●●●
- Glomerella cingulata* ●●●●
- Isariopsis clavispora* ●●●●



Hops

- Pseudoperonospora humuli* ●●●●
- Sphaerotheca humuli* ●●●●
- Botrytis cinerea* ●●●●



Leek

- Alternaria porri* ●●●●
- Cladosporium allii-porri* ●●●●
- Phytophthora porri* ●●●●
- Pleospora herbarum* ●●●
- Puccinia allii* ●●



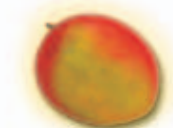
Lentils

- Sclerotinia sclerotiorum* ●●●●
- Ascochyta fabae* ●●●
- Colletotrichum truncatum* ●●●
- Botrytis cinerea* ●●●



Lettuce

- Botrytis cinerea* ●●●●
- Sclerotinia sclerotiorum* ●●●●
- Sclerotinia minor* ●●●●
- Rhizoctonia solani* ●●●●
- Erysiphe cichoracearum* ●●●



Mango

- Glomerella cingulata* ●●●●
- Oidium mangifera* ●●●●



Onions

- Alternaria porri* ●●●●
- Sclerotium cepivorum* ●●●●
- Sclerotinia sclerotiorum* ●●●
- Botrytis squamosa* ●●●
- Peronospora destructor* ●●



Papaya

- Oidium caricae* ●●●●
- Asperisporium caricae* ●●●●



Pears

- Alternaria kikuchiana* ●●●●
- Stemphylium vesicarium* ●●●●
- Venturia pirina* ●●●●
- Venturia nashiicola* ●●●●
- Botryosphaeria berengeriana* ●●●●
- Phyllactinia pyri* ●●●●
- Gymnosporangium* spp. ●●●



Peppers

- Leveillula taurica* ●●●●
- Botrytis cinerea* ●●●●



Potatoes

- Alternaria solani* ●●●●
- Rhizoctonia solani* ●●●
- Phytophthora infestans* ●●



Stone fruits/Almonds

- Monilinia* spp. ●●●●
- Blumeriella jaapii* ●●●●
- Wilsonomyces carpophilus* ●●●●
- Venturia carpophila* ●●●●
- Tranzschelia* spp. ●●●●
- Sphaerotheca pannosa* ●●●
- Rhizopus* spp. ●●●
- Taphrina deformans* ●●●
- Phomopsis amygdali* ●●●



Strawberries

- Botrytis cinerea* ●●●●
- Colletotrichum* spp. ●●●●
- Gnomonia fragariae* ●●●●
- Phytophthora cactorum* ●●●
- Rhizopus stolonifer* ●●●
- Sphaerotheca macularis* ●●●
- Mycosphaerella fragariae* ●●●●



Tomatoes

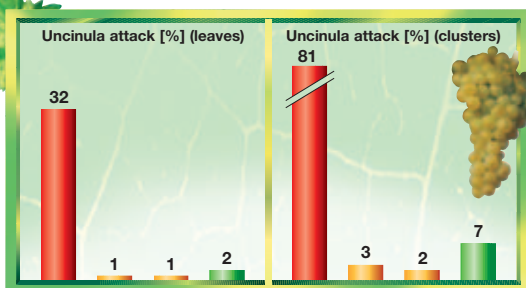
- Alternaria solani* ●●●●
- Leveillula taurica* ●●●●
- Botrytis cinerea* ●●●●
- Septoria lycopersici* ●●●●
- Phytophthora infestans* ●●



Waxapple

- Glomerella cingulata* ●●●●

Biological Trial Results



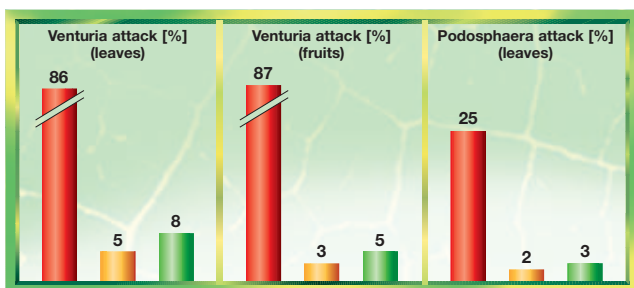
Spain and USA 2000-2001
6 applications, spray interval 14 days, no initial attack
disease assessment 28 days after last application (% severity of attack)

■ Untreated
■ • Boscalid + F 500 100+50 g a.i./1000 l
■ • Boscalid + F 500 150+75 g a.i./1000 l
■ Standard 50 g a.i./1000 l

Efficacy of BOSCALID + F 500® against *Ucinula necator* in grapes

Under extremely strong infection pressure, the combination BOSCALID + F 500 has demonstrated an excellent activity against powdery mildew (*Ucinula necator*). The strong residual activity allows an application interval from 14 to 21 days. A further advantage of this combination is the broadness of its spectrum of activity. In addition to *Ucinula*, *Plasmopara viticola*, *Guignardia bidwellii*, *Phomopsis viticola* and *Pseudopezicula tracheiphila* are controlled. With the combination BOSCALID + F 500, a product is available that secures protection against all important grape diseases for the entire growing season.

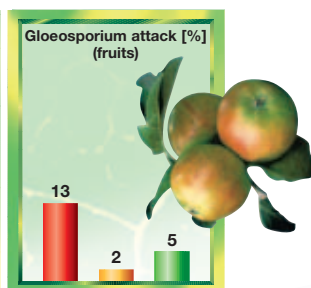
Efficacy of BOSCALID + F 500 in apples: against *Venturia inaequalis* and *Podosphaera leucotricha*



Belgium, France, Germany, Italy and UK 1999-2001
5-11 applications, spray interval 7-14 days
disease assessment 14-35 days after last application (% frequency of attack)

■ Untreated ■ • Boscalid + F 500 200+100 g a.i./ha ■ Standard 100 g a.i./ha

against storage diseases (*Gloeosporium* spp.)

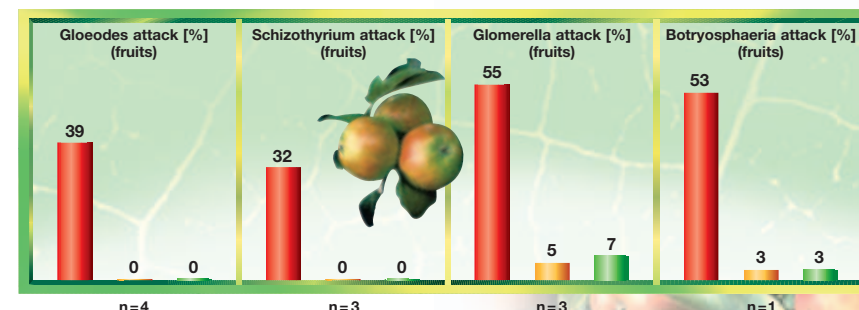


Belgium 2000
5 applications, spray interval 7-14 days
disease assessment 8 months after harvest (% frequency of attack)

The most important diseases in the production of pome fruits, *Venturia inaequalis* and *Podosphaera leucotricha*, are reliably controlled with the combination BOSCALID + F 500®. This combination is also effective against the difficult to control primary mildew infection and storage rot (*Gloeosporium* spp.) as well as the summer

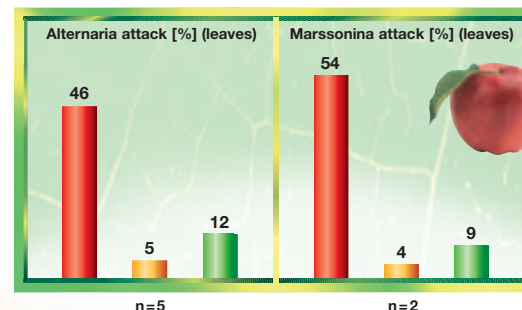
diseases (*Gloeodes*, *Schizothyrium*, *Glomerella*, *Botryosphaeria*, *Alternaria*, *Marssonina*). The combination BOSCALID + F 500 possesses both preventative and curative activity. It also exhibits a strong rainfastness, is temperature independent and therefore offers a flexible solution for managing diseases of pome fruits.

Efficacy of BOSCALID + F 500 against *Gloeodes pomigena*, *Schizothyrium pomi*, *Glomerella cingulata* and *Botryosphaeria* spp. in apples



Japan 1999: 3-8 applications, spray interval 10-14 days; disease assessment at harvest time (% frequency of attack)

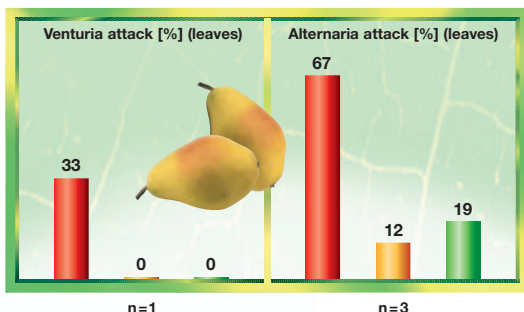
Efficacy of BOSCALID + F 500 against *Alternaria mali* and *Marssonina mali* in apples



Japan 1999: 2-7 applications, spray interval 7-14 days
disease assessment 4-15 days after last application (% severity of attack)

■ Untreated
■ • Boscalid + F 500 80+40 ppm a.i.
■ Standard 1000 ppm a.i.

With its enormously broad activity spectrum and reliable performance, coupled with excellent crop tolerance, BOSCALID + F 500 sets a new standard for the control of fungal diseases in Japanese apple culture.

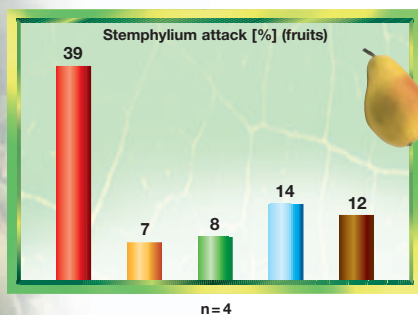


Efficacy of BOSCALID + F 500® against *Venturia nashicola* and *Alternaria kikuchiana* in Japanese pears

BOSCALID + F 500 controls the most important diseases of the Japanese pear: *Venturia nashicola*, *Alternaria kikuchiana* and *Gymnosporangium asiaticum*. The efficacy level of the existing market standards is reached or surpassed.

■ Untreated
■ •Boscalid + F 500 80+40 ppm a.i.
■ Standard 1000 ppm a.i.

Japan 1999-2001
3-8 applications, spray interval 7-14 days
disease assessment 7-35 days after last application (% frequency of attack)



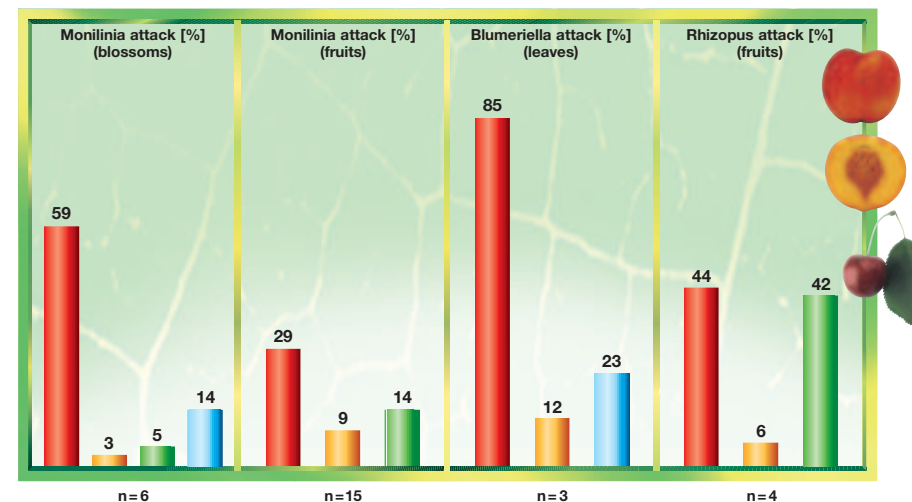
Efficacy of BOSCALID + F 500 against *Stemphylium vesicarium* in pears

In addition to its extraordinary activity against scab (*Venturia pirina*) in pears, BOSCALID + F 500 has demonstrated an excellent activity against *Stemphylium vesicarium*, an important disease in Italy. Due to its long-lasting protection, the number of applications needed may be significantly reduced.

■ Untreated
■ •Boscalid + F 500 200+100 g a.i./ha
■ Standard 1 100 g a.i./ha
■ Standard 2 75 g a.i./ha
■ Standard 3 1125 g a.i./ha

Italy 2000
10-11 applications, spray interval 9-14 days
disease assessment 7-21 days after last application (% frequency of attack)

Efficacy of BOSCALID + F 500® against blossom blight (*Monilinia laxa*) in peaches, nectarines, cherries; brown rot (*Monilinia* spp.) in peaches and nectarines; *Blumeriella jaapii* in cherries and *Rhizopus* spp. in peaches



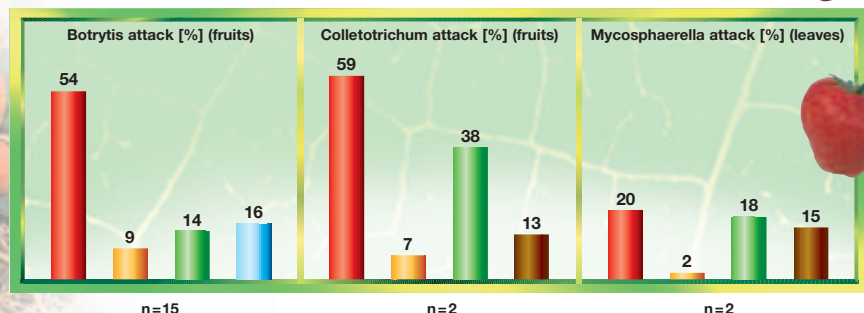
Brazil, Denmark, France, Germany, Italy, South Africa, USA 1999-2001
2-4 applications, spray interval 4-14 days
disease assessment: % frequency of attacked blossoms/fruits and % severity of leaf attack, respectively

■ Untreated
■ •Boscalid + F 500 200+50 g a.i./ha
■ Standard 1 750 g a.i./ha
■ Standard 2 135 g a.i./ha

BOSCALID + F 500 is a highly active product against *Monilinia* diseases (blossom and fruit) in stonefruits. On the account of the added activity of both components, the combination product offers a top performing solution for all the

important leaf and fruit pathogens (*Monilinia*, *Blumeriella*, *Rhizopus*, *Sphaerotheca*, *Wilsonomyces*, *Venturia* and *Tranzschelia*). At the same time, it offers effective resistance management.

Efficacy of BOSCALID + F500® against *Botrytis cinerea*, *Colletotrichum* spp. and *Mycosphaerella fragariae* in strawberries

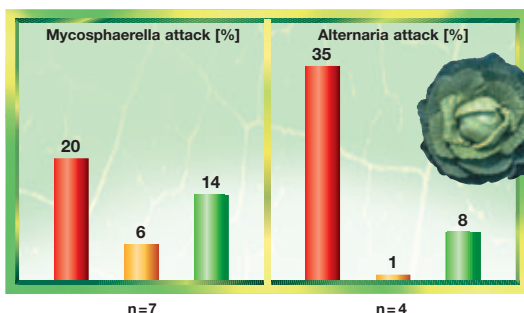


Belgium, Brazil, Germany, Japan, Spain, Taiwan and USA, 1997-2001
4-6 applications, spray interval 5-10 days
disease assessment 7-28 days after last application
(% frequency of attacked fruits and % severity of leaf attack, respectively)

- Untreated
- • Boscalid + F500 480+120 g a.i./ha
- Standard 1 1000 g a.i./ha
- Standard 2 1000 g a.i./ha
- Standard 3 625 g a.i./ha

Also in strawberries, BOSCALID + F500 rises on account of its broad-spectrum activity above the competition. Not only grey mould (*Botrytis*

cinerea) but also all other important fruit and leaf diseases are reliably controlled.

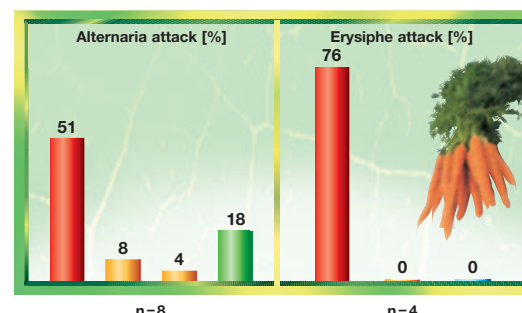


Denmark, Germany, UK and The Netherlands 1999-2001
3-4 applications, spray interval 21-35 days (Mycosphaerella) and 7-13 days (Alternaria), initial attack 0-3%
disease assessment 14-30 days after last application (% severity of attack)

Efficacy of BOSCALID + F500 against *Mycosphaerella* spp. and *Alternaria* spp. in cabbage

On the basis of its broad spectrum, BOSCALID + F500 offers comprehensive protection against the most common fungal diseases in cabbage: *Mycosphaerella* spp., *Alternaria* spp. and *Albugo candida*.

- Untreated
- • Boscalid + F500 267+67 g a.i./1000 l
- Standard 750 g a.i./1000 l

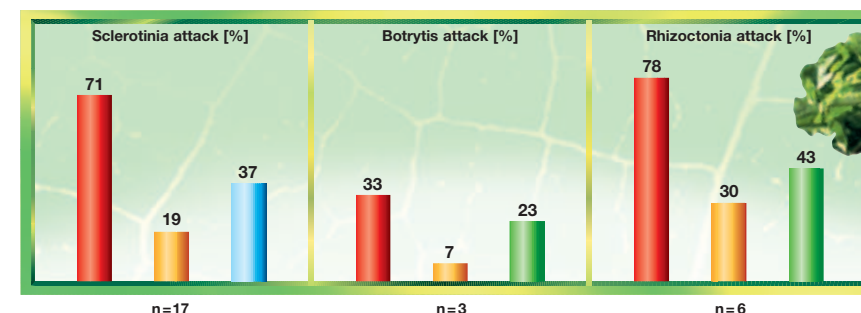


Denmark, Germany, Austria, The Netherlands and France 1999-2000
3-4 applications, spray interval 7-14 days, initial attack 0-1%
disease assessment 14 days after last application (% severity of attack)

Efficacy of BOSCALID + F500® against *Alternaria dauci* and *Erysiphe heraclei* in carrots
BOSCALID + F500 sets a new, reliable standard for the control of *Alternaria* in carrots. In addition, powdery mildew (*Erysiphe heraclei*) and *Sclerotinia sclerotiorum* are controlled.

- Untreated
- • Boscalid + F500 106+27 g a.i./1000 l
- • Boscalid + F500 200+50 g a.i./1000 l
- Standard 1 750 g a.i./1000 l
- Standard 2 125 g a.i./1000 l

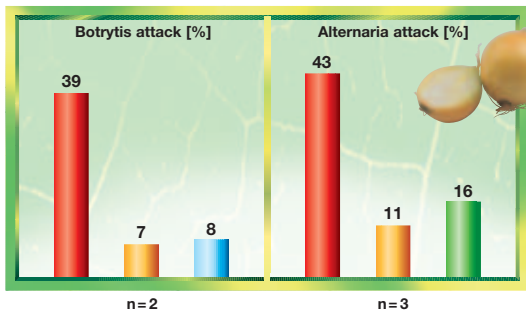
Efficacy of BOSCALID + F500 against *Sclerotinia sclerotiorum*, *Botrytis cinerea* and *Rhizoctonia solani* in lettuce



Germany, Spain, France, The Netherlands, Japan, USA and South Africa 1999-2001
2-5 applications, spray interval 7-14 days (Sclerotinia/Botrytis) and 7-30 days (Rhizoctonia), initial attack 0-1%
disease assessment at harvest time (Sclerotinia/Botrytis: % severity of attack, Rhizoctonia: % frequency of attack)

- Untreated
- • Boscalid + F500 400+100 g a.i./1000 l
- Standard 1 750 g a.i./1000 l
- Standard 2 625 g a.i./1000 l

BOSCALID + F500 is disease problem solution "Number 1" in lettuce. The product combination has demonstrated a superior activity against all important lettuce diseases – *Sclerotinia sclerotiorum*, *Botrytis cinerea* and *Rhizoctonia solani*.



Efficacy of BOSCALID + F 500® against *Botrytis squamosa* and *Alternaria porri* in onions

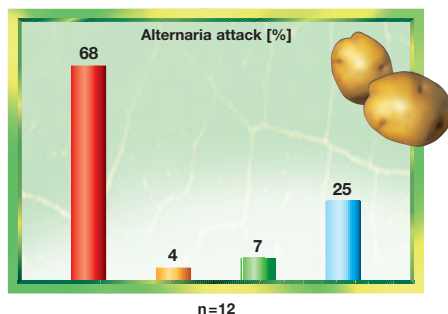
The most common diseases in onions, *Botrytis squamosa* and *Alternaria porri* are reliably controlled with BOSCALID + F 500.

■ Untreated	
■ •Boscalid + F 500	333+167 g a.i./1000 l
■ Standard 1	150 g a.i./1000 l
■ Standard 2	625 g a.i./1000 l

USA 1999-2000
2-7 applications, spray interval 7-11 days
disease assessment 14 days after last application (% severity of attack)

Efficacy of BOSCALID + F 500 against *Alternaria solani* in potatoes

Alternaria in potatoes, distributed widely in many regions and increasing in Europe, is reliably controlled by the application of BOSCALID + F 500.

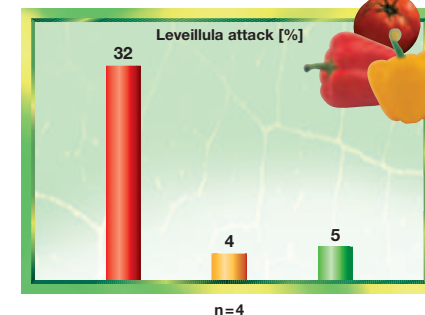


Brazil 2000
2-5 applications, spray interval 7-14 days, spray volume 500 litres/ha, initial attack 0-4%
disease assessment 7-20 days after last application (% severity of attack)

■ Untreated	
■ •Boscalid + F 500	50+25 g a.i./ha
■ Standard 1	50-75 g a.i./ha
■ Standard 2	100 g a.i./ha

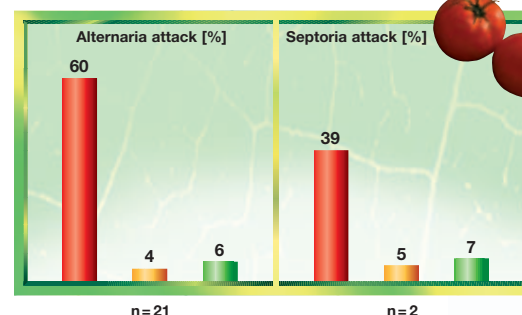
Efficacy of BOSCALID + F 500® against *Leveillula taurica* in tomatoes and peppers

The application of BOSCALID + F 500 has demonstrated an excellent effect against mildew (*Leveillula taurica*) in tomatoes and peppers. Moreover, the wide activity spectrum is a decided advantage. In addition to *Leveillula*, *Alternaria solani* and *Septoria lycopersici* are controlled. With the rate registered for use against *Leveillula*, a good effect against *Botrytis* has also been observed.



Brazil and Spain 2000-2001
3-6 applications, spray interval 7-10 days, initial attack 2-3%
disease assessment 14-21 days after last application (% severity of attack)

■ Untreated	
■ •Boscalid + F 500	267+67 g a.i./1000 l
■ Standard	30 g a.i./1000 l



Brazil and Taiwan 1999-2001
2-4 applications, spray interval 7-10 days, initial attack 0-3%
disease assessment 14-21 days after last application (% severity of attack)

Efficacy of BOSCALID + F 500 against *Alternaria solani* in tomatoes

A large number of trials have confirmed the broad activity spectrum of BOSCALID + F 500 against tomato diseases. The most important fungal pathogen of tomatoes world-wide, *Alternaria solani*, was controlled by BOSCALID + F 500.

■ Untreated	
■ •Boscalid + F 500	50+25 g a.i./1000 l
■ Standard	50 g a.i./1000 l



BOSCALID + Dimoxystrobin

BOSCALID + Dimoxystrobin: double action against Sclerotinia

The combination of two different modes of action leads to outstanding, reliable activity against Sclerotinia in oilseed rape, known as one of the most yield-challenging diseases for this and other oilseed crops. A wide application window and the control of other important diseases

make this combination the preferred choice for spring and flower application in winter oilseed rape.

The combination of BOSCALID + Dimoxystrobin also shows an excellent fit for the crop management of sunflowers, controlling Sclerotinia and Botrytis as well as many secondary pathogens.

Spectrum of Activity



Oilseed rape

<i>Sclerotinia sclerotiorum</i>	●●●●
<i>Alternaria</i> spp.	●●●●
<i>Leptosphaeria maculans</i>	●●●●
<i>Botrytis</i> spp.	●●●●

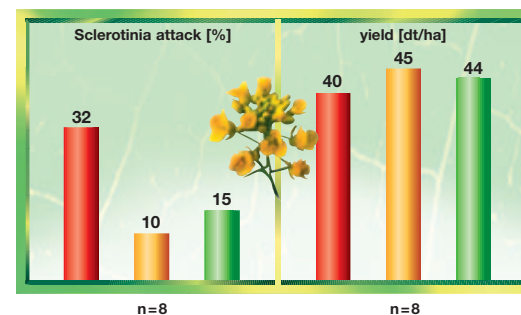


Sunflowers

<i>Sclerotinia sclerotiorum</i>	●●●●
<i>Diaporthe helianthi</i>	●●●●
<i>Alternaria</i> spp.	●●●●
<i>Botrytis</i> spp.	●●●●
<i>Phoma macdonaldii</i>	●●●●

Efficacy: ●●●● excellent ●●● good ●● moderate ● low

Biological Trial Results



France and Germany, 2001–2004
1 application during flowering, spray volume 200–350 litres/ha, no initial attack visible
disease assessment 60–80 days after application (% frequency of attack)

- Untreated
- Boscalid + Dimoxystrobin 100 + 100 g a.i./ha
- Standard 375-750 g a.i./ha

Efficacy of BOSCALID + Dimoxystrobin against Sclerotinia sclerotiorum in winter oilseed rape

The control of White Mold (*Sclerotinia sclerotiorum*) is gaining increasing importance at all oilseed rape growing areas around the world. BOSCALID + Dimoxystrobin provides outstanding and reliable control particularly for this disease, helping farmers to optimize output. The control of other diseases like Phoma or Alternaria further increases the convenience level for farmers and makes this combination the product of choice.



BOSCALID + Epoxiconazole

BOSCALID + Epoxiconazole: an exciting new fungicide for control of foliar diseases and eyespot in cereals

It is well documented that cereal diseases limit the development and productivity of cereal crops, leading ultimately to a reduction in yield and quality. The combination of two different actives controls a broad spectrum of cereal

diseases, including foliar and stem base diseases. Thus yield losses are effectively prevented. The combination of complementary modes of action also provides resistance management.

The combination of BOSCALID + Epoxiconazole shows an excellent fit for the crop management in wheat, barley and oat.

Spectrum of Activity

Wheat

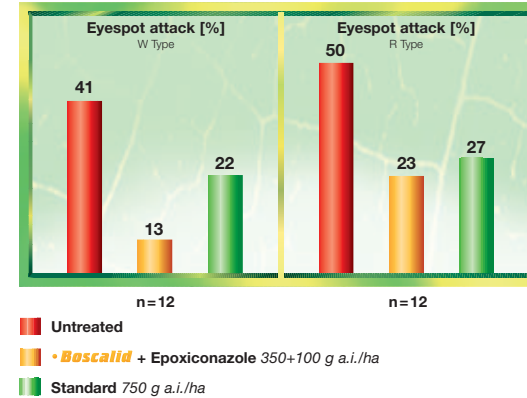
- Septoria tritici* ●●●●
- Rusts ●●●●
- Mildew ●●
- Eyespot ●●●●
- Sharp Eyespot ●●

Barley

- Rust ●●●●
- Rhynchosporium* ●●●●
- Net Blotch ●●●●
- Mildew ●●
- Necrotic Spotting ●●

Efficacy: ●●●● excellent ●●● good ●● moderate ● low

Biological Trial Results

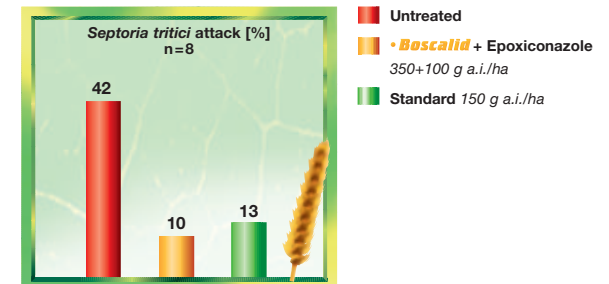


Efficacy of BOSCALID + Epoxiconazole against eyespot in winter wheat

BASF research has shown a consistency of performance across eyespot sites over a three-year period, and in many cases the eyespot type has been determined. Results clearly indicate outstanding control, irrespective of the eyespot type involved.

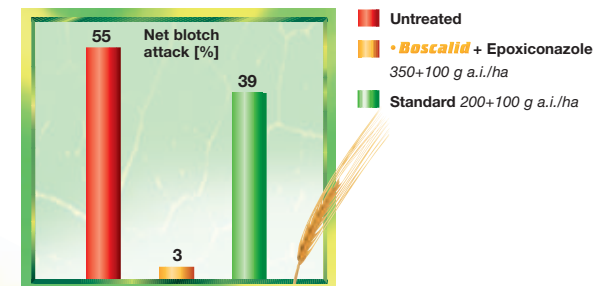
Efficacy of BOSCALID + Epoxiconazole against *Septoria tritici* in winter wheat

BASF have collected independent trials from the 2004 growing year to compare BOSCALID + Epoxiconazole with the newly introduced and most relevant standard. Results show equal to slightly superior control of *Septoria tritici*, being one of the most important diseases in winter wheat in Europe.



Efficacy of BOSCALID + Epoxiconazole against net blotch in barley

Net blotch (*Pyrenophora teres*) has been associated with yield losses of between 10 % and 40 % under epidemic conditions. It commonly occurs on young autumn sown barley following over-wintering of inoculum on stubble and debris. BASF development trials show that BOSCALID + Epoxiconazole clearly outperforms existing standard solutions.



BOSCALID + Kresoxim-methyl

BOSCALID + Kresoxim-methyl: doubly strong against powdery mildew

In the combination BOSCALID + Kresoxim-methyl, two different modes of action for the control of powdery mildew are united. The result is, that in addition to the extraordinary mildew activity in grapes, vegetables and ornamentals, an especially good residual activity has been observed. More-

over, a range of diseases in ornamentals are controlled.

The combination BOSCALID + Kresoxim-methyl is an important instrument for resistance management and is ideal for Integrated Pest Management programs.

Spectrum of Activity



Grapes

Uncinula necator ●●●●
Botrytis cinerea ●●

Cucurbits

Sphaerotheca fuliginea ●●●●
Erysiphe cichoracearum ●●●●
Alternaria cucumerina ●●●●



Ornamentals

Roses

Sphaerotheca pannosa ●●●●
Diplocarpon roseum ●●●

Carnations

Uromyces dianthi ●●●●

Chrysanthemum

Puccinia horiana ●●●

Tulips

Botrytis tulipae ●●●●

Lilies

Botrytis elliptica ●●●●

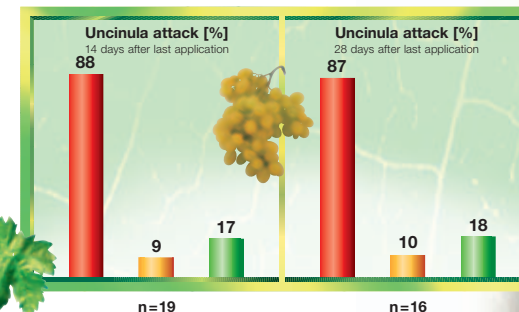
Gladiolus

Botrytis gladiolorum ●●●●

Efficacy: ●●●● excellent ●●● good ●● moderate ● low

Biological Trial Results

Efficacy of BOSCALID + Kresoxim-methyl against *Uncinula necator* in grapes



France, Germany, Italy and Portugal, 1998-2000
6-7 applications, spray interval 14 days
disease assessment on clusters (% frequency of attack)

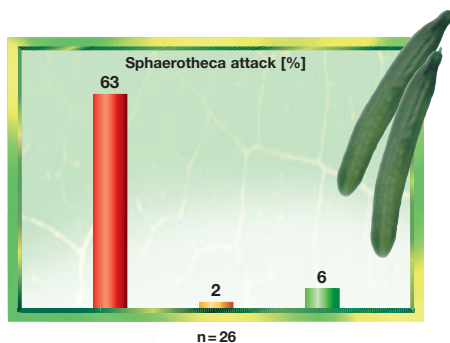
■ Untreated
■ **Boscalid** + Kresoxim-methyl 80+40 g a.i./1000 l
■ Standard 65 g a.i./1000 l

Against powdery mildew (*Uncinula necator*) in grapes, BOSCALID + Kresoxim-methyl is an exceptional product. With application intervals from 12-14 days, BOSCALID + Kresoxim-methyl has demonstrated an excellent activity in all important European grape growing regions. BOSCALID + Kresoxim-methyl distinguishes itself through an extraordinary plant safety and provides outstanding healthy, functional leaves.



Efficacy of BOSCALID + Kresoxim-methyl against *Sphaerotheca fuliginea* in cucurbits

BOSCALID + Kresoxim-methyl has been tested against powdery mildew in cucurbits in extensive research trials around the world. Its outstanding activity distinguishes itself in field and glasshouse use by excellent plant safety. Powdery mildew is controlled significantly better than with commercially available products.



Brazil, Denmark, Germany, Italy, Japan, Portugal, South Africa, Spain, Taiwan and USA, 1998-2001
3-4 applications, spray interval 7-10 days, initial attack 0-2%
disease assessment 14 days after last application (% severity of attack)

■ Untreated
■ • Boscalid + Kresoxim-methyl 100+50 g a.i./1000 l
■ Standard 150 g a.i./1000 l



BOSCALID: Effect on Yield and Quality

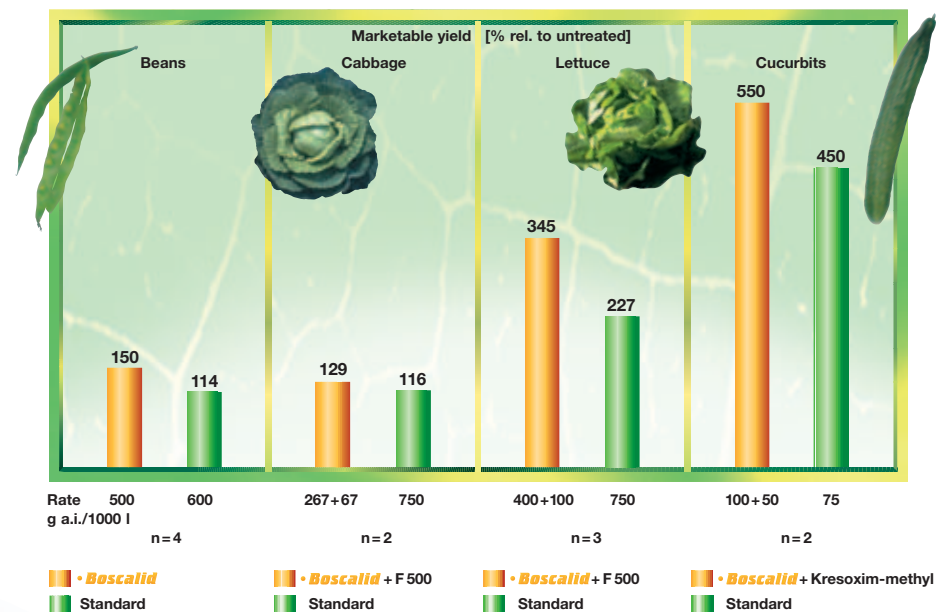
BOSCALID brings more of the harvest to market

Strong efficacy, broad activity spectrum and outstanding plant safety make BOSCALID and its combination products most profitable for the grower.

exceptional quality effects. Yield results from fungicide trials in various vegetables document the high profitability of disease control and the exceptional economic benefit from application of BOSCALID.

(See also the positive yield effects in agronomic crops, pages 11 - 13)

Significantly higher yield and an increased portion of marketable yield are the result of these



■ • Boscalid
■ Standard
■ • Boscalid + F 500
■ Standard
■ • Boscalid + F 500
■ Standard
■ • Boscalid + Kresoxim-methyl
■ Standard



BOSCALID:

- **Broad spectrum of crops and diseases**
- **Unique mode of action**
- **Outstanding crop tolerance**
- **Superior yield and quality**
- **IPM-fit**

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