How does Filan work?

The Filan mode of Action is unique in that Group G compounds have not yet been used as foliar application products in Australia. Anilide fungicides currently marketed in Australia are used as seed treatments. Filan works inside the mitochondria and stops fungi from producing the energy that they need to carry out basic functions like obtaining food, growing and reproducing. Unable to conduct these critical functions, the fungus dies.

The way Filan prevents energy production is by binding to an enzyme in the electron transport chain of the fungal mitochondria. This enzyme is called Complex II (succinate ubiquinone reductase) and is depicted in the diagram of a mitochondria in Figure 2. When the boscalid molecule attaches to the Complex II enzyme, it cannot function normally, to drive the other processes of fungal metabolism that it regulates. You could say that the gears become locked.

One Mode of Action - Two mechanisms of Fungal Inhibition

There are actually two critical roles that Complex II plays within the fungal metabolic system and exposure to Filan disrupts both of them. In addition to its role to regulate electron transport and energy production, Complex II also mediates the tricarboxylic acid (TCA) cycle production of building blocks for amino acids and lipids. (See Figure 2) Without these key building blocks from the TCA cycle, fungi cannot make other essential cell components like proteins and membranes that are required for life.
Movement In Plants and Fungal Activity

Uptake and Redistribution in the Plant

Through its ability to move systemically in plants, boscalid is able to protect those plant parts that were not exposed to the original spray application. This results in higher levels of disease control even when spray application coverage is less than optimal.

When boscalid is applied to the leaf surface part of it remains bound to that leaf surface to provide protection but part of the molecules are also taken into the leaf where they are then redistributed. This feature is the result of the combined intermediate leaves the boscalid molecule has for lipophilicity and water solubility.

Lipophilicity is what causes some of the Filan to be retained in the waxy cuticle on the outer surface of the leaf while the moderate solubility allows the product to move in the vascular system and reach untreated part of the plant. Retention in the outer surface leaf wax (lipophilicity) also contributes to the excellent rainfastness exhibited by Filan.

When applied to the leaf, some of the boscalid moves to the surface opposite the point of application. This type of movement is called translaminar systemicity and is demonstrated in (Figure 3).

Additionally, Filan enters the transpiration stream of the plant where it is then carried outward to the margins and tips of the leaves. This type of movement is called acropetal systemicity and is illustrated in Figures 4-6. Of particular interest is Figure 5 that shows that within 24 hours significant quantities of Filan have been moved from the treated area and are now providing protection at the leaf margins.

It is important to note that while boscalid moves toward the margins of treated leaves, it is not transported in the xylem and therefore cannot move from a treated leaf into an untreated leaf nor can it move systemically down the plant.
Highly Rainfast and Low Vaporisation Loss
Filan exhibits extremely favorable rainfastness characteristics once taken up by the plant. Multiple studies show that 24 hours after treatment with Filan, even exposures to extremes such as 1.2 inches of rain in a single 30 minute period did not compromise disease control performance. Due to its relatively modest vapor pressure characteristic, Filan exhibits minimal redistribution or losses from the leaf surface due to volatilisation.

Filan & Cabrio® – Perfect Partners
The activity profile for Filan makes it the perfect complementation partner for use with Cabrio, the most recent strobilurin introduction from BASF, marketed in Australia by Nufarm. The combination of Filan with Cabrio offers growers superior protection against the “big three” major Australian grape diseases with one dose. (The early Michael Dwyer Mittlein and Botrytis.

Crop Safety
Throughout the global development effort, excellent crop safety has been observed from Filan when used at anticipated commercial application rates and timings.

Low mammalian toxicity
Low toxicity of Filan to mammals is a key attribute to its extreme effectiveness in controlling plant diseases caused by fungi is a stark contrast to its tolerable mammalian toxicity profile. The key advantage is driven by differences in bioavailability between fungi and mammals.

Mammalian Toxicology

<table>
<thead>
<tr>
<th>Toxicity Type</th>
<th>Species</th>
<th>LD₅₀</th>
<th>LD₅₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral</td>
<td>Rat</td>
<td>5000 mg/kg</td>
<td>&gt;5000 mg/kg</td>
</tr>
<tr>
<td>Dermal</td>
<td>Rat</td>
<td>2000 mg/kg</td>
<td>&gt;2000 mg/kg</td>
</tr>
<tr>
<td>Inhalation</td>
<td>Rat</td>
<td>6.7 mg/l</td>
<td>&gt;6.7 mg/l</td>
</tr>
<tr>
<td>Sensitisation</td>
<td>Guinea pig</td>
<td>Non-sensitising</td>
<td>Non-sensitising</td>
</tr>
<tr>
<td>Mutagenicity</td>
<td>5 tests</td>
<td>No mutagenic potential</td>
<td>No mutagenic potential</td>
</tr>
<tr>
<td>Teratogenicity</td>
<td>Rat, rabbit</td>
<td>No teratogenic potential</td>
<td>No teratogenic potential</td>
</tr>
<tr>
<td>Chronic Toxicity</td>
<td>Dog, rat, mouse</td>
<td>No carcinogenic potential</td>
<td>No carcinogenic potential</td>
</tr>
<tr>
<td>Carcinogenicity</td>
<td>Rat</td>
<td>No adverse effects</td>
<td>Rapid absorption and elimination</td>
</tr>
</tbody>
</table>

No impact on flora or fauna
Filan is an ideal tool for Integrated Pest Management systems because it presents low risk to beneficial organisms in the agricultural ecosystem. This is based on laboratory and field studies of organisms such as predatory mites. Also, it is found to be non-toxic to bees.
Soil-Dwelling non target organisms

Laboratory and numerous long-term field studies emphasise that Filan will not cause unacceptable risk to organisms such as earthworms, springtails, micro-organisms or to the function of soil ecosystems.

Non-target plants

Filan will not negatively affect non-target plants.

No impact on natural resources

Filan degrades in natural systems of water and sediment through a process of photoinduced biological reactions and adsorption to the sediment.

In the soil, Filan exhibits moderate binding to the soil particles such that movement downward in the soil profile or contamination of groundwater is not expected. Mineralisation and the moderately rapid biological degradation of the active ingredient in the soil also contributes to the lack of unacceptable impact on the environment by this compound.

Ecological Toxicology

<table>
<thead>
<tr>
<th>Filan</th>
<th>Earthworms</th>
<th>Non-target arthropod (9 species)</th>
<th>Insect</th>
<th>Aquatic organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioassay</td>
<td>LC50</td>
<td>LC50</td>
<td>LC50</td>
<td>LC50</td>
</tr>
<tr>
<td></td>
<td>&gt;2000 mg/kg</td>
<td>&gt;1000 mg/kg</td>
<td>&gt;1000 mg/kg</td>
<td>&gt;1000 mg/kg</td>
</tr>
</tbody>
</table>

Non-target arthropods (6 species) non-toxic

Bees: practicality non-toxic

Aquatic organisms

Rainbow Trout; LD50 2.7 mg/l

Daphnia; LD50 5.3 mg/l

Algae; LD50 3.8 mg/l

Environmental Fate

Hydrolysis in water:
Stable at pH 6, 7, 8 and 9

Photolysis in water:
Stable

Mobility in soil:
Not likely to move down soil profile

Biodegradation:
DF60 between 1 - 280 days

Degradation quickly to < 1 mg/l
Resistance Management Strategy

FILAN should be applied as part of a Botrytis bunch rot control program.

1. If three or fewer bunch rot sprays are applied in a season use only one application of FILAN per season.
2. If four or more bunch rot sprays are applied in a season use no more than two applications of FILAN.
3. Do not apply consecutive sprays of FILAN (including from the end of one season to the next).
4. Application of FILAN at capfall is the best strategy to delay the onset of resistant strains of Botrytis bunch rot as this allows use before high levels of infection can develop and also allows alternative chemistry to be used in following sprays for bunch rot control.

Filan Fungicide is a member of the oxathiin group of fungicides. For fungicide resistance management, Filan fungicide is a Group G fungicide.

**DIRECTIONS FOR USE**

**CROP**
Grapevines

**DISEASE**
Bunch rot

**RATE**
Dilute spray: 120 g/100 L water
Concentrate spray: Refer to the Application section.

**CRITICAL COMMENTS**
Apply as part of a Botrytis bunch rot program:
- In a 3 spray program, apply only 1 spray of FILAN.
- In a 4 spray program, apply only 2 sprays of FILAN.
- Do NOT apply consecutive sprays of FILAN.

The ideal timing for the first spray is 5% capfall.
Applications can also be made at 80% capfall, pre-bunch closure, veraison or 4 weeks prior to harvest.

Apply by dilute or concentrate spraying equipment.
- Apply the same total amount of product to the target crop, whether applying this product by dilute or concentrate spraying methods.
- Do NOT use in equipment that requires rates greater than 600 g/100 L (5X concentration).
- Do not apply in volumes less than 250 L/ha.