Abstract:
The present invention relates to the use of succinate dehydrogenase inhibitors for controlling powdery mildew primary infections in crops and to a method for controlling those primary infections.
Use of Succinate Dehydrogenase Inhibitors for Controlling Powdery Mildew Primary Infections

The present invention relates to the use of succinate dehydrogenase inhibitors for controlling powdery mildew primary infections in crops and to a method for controlling those primary infections.

Powdery mildew is a fungal disease that affects a wide range of plants. Powdery mildew diseases are caused by many different species of fungi in the order Erysiphales. It is one of the easier diseases to spot, as its symptoms are quite distinctive. Infected plants display white powder-like spots on the leaves and stems and specific russetting on fruits. The younger leaves are the most affected, but the mildew can appear on any part of the plant that shows above the ground. As the disease progresses, the spots get larger and thicker as massive numbers of spores form, and the mildew spreads up and down the length of the plant.

Powdery mildew species over-winter either as mycelium in dormant buds or as cleistothecia on plant tissues. When over-wintering as mycelium in dormant buds, in spring, the shoots arising from the contaminated buds at the end of the previous season become infected and provide inoculum (mycelium and spores) for the subsequent secondary infections and disease development on plant tissues.

It is known in the art that fluopyram shows a high level of efficacy especially against powdery mildew species on different crops. However, powdery mildew can overwinter in buds to produce early infections the year after (primary infected shoots).

Thus, there is a strong need for active ingredients which can be used to reduce the number of primarily infected shoots.

The problem outlined above has been solved by the use of succinate dehydrogenase inhibitors for controlling powdery mildew primary infections in perennial crops, wherein the succinate dehydrogenase inhibitor was applied to the perennial crop prior to the end of the previous vegetative cycle.
It has surprisingly been found that in the year of the application of the succinate dehydrogenase inhibitor and also in the year after, the number of early infected shoots is significantly reduced and consequently the infection of new growing shoots and leaves is delayed. This finding constitutes a strong advantage for the farmer who can better manage the protection of his orchard.

In conjunction with the present invention all active substances (a.s.) which inhibit succinate dehydrogenase in the mitochondrial respiration chain can be used. In a preferred embodiment of the present invention the succinate dehydrogenase inhibitor is selected from the group consisting of fluopyram, isopyrazam, boscalid, penthiopyrad, N-[2-(1,3-dimethylbutyl)phenyl]-5-fluoro-1,3-dimethyl-lH-pyrazole-4-carboxamide, sedaxan and bixafen or mixtures thereof. In a most preferred embodiment of the present invention the succinate dehydrogenase inhibitor is fluopyram.

Fluopyram having the chemical name N-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]-2,6-dichlorobenzamide is a fungicide belonging to the chemical class of pyridylethylbenzamides. Fluopyram and its manufacturing process starting from known and commercially available compounds is described in EP-A-1 389 614.

Penflufen having the chemical name N-[2-(1,3-dimethylbutyl)phenyl]-5-fluoro-1,3-dimethyl-lH-pyrazole-4-carboxamide and its manufacturing process starting from known and commercially available compounds is described in WO 03/010149.

Bixafen having the chemical name N-(3',4'-dichloro-5-fluoro-1,2-biphenyl-2-yl)-3-(difluoromethyl)-1-methyl-lH-pyrazole-4-carboxamide (Compound 1-2) and its manufacturing process starting from known and commercially available compounds is described in WO 03/070705.

Sedaxane is the mixture of 2 cis-isomers 2'−[[(RS,2RS)-l,2-bicycloprop-2-yl]-3-(difluoromethyl)-l-methylpyrazole-4-carboxamide and 2 trans-isomers 2'−[[(RS,2SR)-l,2-bicycloprop-2-yl]-3-(difluoromethyl)-l-methylpyrazole-4-carboxamide. Sedaxane and its manufacturing process starting from known and commercially available compounds is described in WO 03/074491, WO 2006/015865 and WO 2006/015866.

Isopyrazam is the mixture of 2 syn-isomers 3-(difluoromethyl)-1-methyl-N-[(RS,4SR,9RS)-1,2,3,4-tetrahydro-9-isopropyl-1,4-methanophenalen-5-yl]pyrazole-4-carboxamide and 2 anti-isomers 3-(difluoromethyl)-1-methyl-N-[(RS,4SR,9SR)-1,2,3,4-tetrahydro-9-isopropyl-1,4-
methanonaphthalen-5-yl]pyrazole-4-carboxamide. Isopyrazam and its manufacturing process starting from known and commercially available compounds is described in WO 2004/035589.

Penthiopyrad having the chemical name (RS)-N-[2-(1,3-dimethylbutyl)-3-thienyl]-l-methyl-3-(trifluoromethyl)pyrazole-4-carboxamide and its manufacturing process starting from known and commercially available compounds is described in EP-A-737 682.

Boscalid having the chemical name 2-chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide and its manufacturing process starting from known and commercially available compounds is described in DE-A-195 31 813.

Fluxapyraxad having the chemical name 3-(Difluoromethyl)-l-methyl-N-(3',4',5'-trifluorobiphenyl-2-yl)-lH-pyrazole-4-carboxamide and its manufacturing process starting from known and commercially available compounds is described in WO 2006/087343.

In conjunction with the present invention “primary infection” denotes an infection which occurs when water-borne sporangia or zoospores, produced by germinating oospores, are splashed onto wet foliage.

In conjunction with the present invention "controlling" denotes a significant reduction of the powdery mildew infestation in comparison to the untreated crop, more preferably the infestation is essentially diminished (50-79%), most preferably the infestation is totally suppressed (80-100%).

In conjunction with the present invention the time specification "prior to the end of the previous vegetative cycle" means that the succinate dehydrogenase inhibitor, preferably fluopyram was applied to the crop at the previous year at least prior to the abscission of the leaves, preferably prior to the maturation of the fruits for harvesting, most preferably prior to the closing process of the end buds of the extension shoots.

The use/method according to the present invention can be applied to any kind of crops as long as these crops are perennial crops, i.e. plants that live for more than two years. In a preferred embodiment of the invention the crops to be treated are selected from the group consisting of apples, grapes, European gooseberry, chestnut, pecan nuts, cashew, papaya, mango, rambutan, citrus, hazel, pear, cherry, quince, apple, apricot, plum, peach and nectarine. Most preferred are
apples and grapes. In a more preferred embodiment of the invention fluopyram is used for controlling powdery mildew infestations in apples or pears.

The succinate dehydrogenase inhibitors, preferably fluopyram can be employed for controlling powdery mildew primary infections within a certain period of time after the treatment. The period of time within which protection is effected generally extends from 1 day to 1 year, preferably from 1 day to 0.5 years after the treatment of the plants with the active compounds. Generally, fluopyram is applied to the trees prior to the end of the previous vegetative cycle.

When employing the succinate dehydrogenase inhibitors, preferably fluopyram, according to the present invention as a fungicide, the application rates can be varied within a broad range, depending on the type of application. For foliar applications the application rates of active compound are generally ranging from 1 to 200 g/ha, more preferably from 10 to 150 g/ha, most preferably from 20 to 50 g/ha based upon the pure a.s. (active substance).

According to the present invention the succinate dehydrogenase inhibitors, preferably fluopyram can be applied to all parts of the plants such as shoot, leaf, flower and root, leaves, needles, stalks, stems, flowers, vegetative buds and flower buds fruiting bodies and fruits.

Plants are understood as meaning, in the present context, all plants and plant populations, such as desired and undesired wild plants or crop plants (including naturally occurring crop plants). Crop plants or crops may be plants which can be obtained by conventional breeding and optimization methods or else by biotechnological and genetic engineering methods or by combinations of these methods, including the transgenic plants and including the plant varieties capable or not capable of being protected by plant breeders’ rights.

According to the invention the treatment of the plants with the succinate dehydrogenase inhibitors, preferably fluopyram is carried out directly by the customary treatment methods, for example by immersion, spraying, vaporizing, fogging, injecting, dripping, drenching, broadcasting or painting.

In a preferred embodiment of the invention fluopyram is applied by injecting, dripping, drenching or spraying.

The succinate dehydrogenase inhibitors, preferably fluopyram can be converted to the customary formulations, such as solutions, emulsions, suspensions, powders, foams, pastes, granules, aerosols,
very fine capsules in polymeric substances and in coating compositions for seed, and also ULV cold-
and warm-fogging formulations.

These formulations are produced in a known manner, for example by mixing the active compounds
with extenders, that is liquid solvents, pressurized liquefied gases and/or solid carriers, optionally with
the use of surface-active agents, that is emulsifiers and/or dispersants and/or foam formers. If the
extender used is water, it is also possible to employ for example organic solvents as cosolvents.
Suitable liquid solvents are essentially: aromatics, such as xylene, toluene or alkynaphthalenes,
chlorinated aromatics or chlorinated aliphatic hydrocarbons, such as chlorobenzenes, chloroethylenes
or methylene chloride, aliphatic hydrocarbons, such as cyclohexane or paraffins, for example mineral
oil fractions, alcohols, such as butanol or glycol as well as their ethers and esters, ketones, such as
acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents, such as
dimethylformamide and dimethyl sulphoxide, and also water. Liquefied gaseous extenders or carriers
are those liquids which are gaseous at ambient temperature and at atmospheric pressure, for example
aerosol propellants such as halogenated hydrocarbons and also butane, propane, nitrogen and carbon
dioxide. As solid carriers there are suitable: for example ground natural minerals, such as kaolins, clays,
talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic minerals,
such as finely divided silica, alumina and silicates. As solid carriers for granules there are suitable: for
example crushed and fractionated natural rocks such as calcite, pumice, marble, sepiolite and dolomite,
and also synthetic granules of inorganic and organic meals, and granules of organic material such as
sawdust, coconut shells, maize cobs and tobacco stalks. As emulsifiers and/or foam formers there are
suitable: for example non-ionic and anionic emulsifiers, such as polyoxyethylene fatty acid esters,
polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulphonates, alkyl
sulphates, arylsulphonates and protein hydrolysates. As dispersants, for example, lignosulphite waste
liquors and methylcellulose are suitable.

Tackifiers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders,
granules or latices, such as gum arabic, polyvinyl alcohol and polyvinyl acetate, as well as natural
phospholipids, such as cephalins and lecithins, and synthetic phospholipids, can be used in the
formulations. Other possible additives are mineral and vegetable oils.

It is possible to use colorants such as inorganic pigments, for example iron oxide, titanium oxide and
Prussian Blue, and organic dyestuffs, such as alizarin dyestuffs, azo dyestuffs and metal phthalocyanine
dyestuffs, and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

The formulations in general contain between 0.1 and 95 per cent by weight of active compounds, preferably between 0.5 and 90 per cent by weight, based upon the total formulation.

According to the present invention, the succinate dehydrogenase inhibitors, preferably fluopyram as such or their formulations, can also be used as a mixture with known fungicides, bactericides, acaricides, nematodes, or insecticides, for example, to broaden the activity spectrum or prevent the development of resistance. In many instances, synergistic effects are obtained, i.e. the activity of the mixture exceeds the activity of the individual components.

A further embodiment of the invention relates to the use of a composition comprising a succinate dehydrogenase inhibitor, preferably fluopyram and a second fungicide for controlling powdery mildew primary infections in perennial crops.

Suitable fungicides which can be used in combination with the succinate dehydrogenase inhibitor, preferably with fluopyram are selected from the group consisting of

1. Inhibitors of the nucleic acid synthesis, for example benalaxyl, benalaxyl-M, bupiπmate, clozylacon, dimethiπmol, ethiπmol, furalaxyl, hymexazol, metalaxyl, metalaxyl-M, ofurace, oxadixyl and oxohnc acid.
2. Inhibitors of the mitosis and cell division, for example benomyl, carbendazim, chlorfenazole, diethofencarb, ethaboxam, Albendazole, pencycuron, thiabendazole, thiophanate, thiophanate-methyl and zoxamide.
3. Inhibitors of the respiration, for example diflumetoπm as CI-respiration inhibitor; bixafen, boscahd, carboxin, fenfuram, flutolanil, fluopyram, furametpyr, furmecyclox, isopyrazam (9R-component), isopyrazam (9S-component), meproml, oxycarboxin, penthio.pyrad, thifluзамide as CII-respiration inhibitor; amisulbrom, azoxystrobin, cyazofamid, dimoxystrobin, enestrobuπn, famoxadone, fenamidone, fluoxastrobin, kresoxim-methyl, metominostrobin, orysastrobin, picoxystrobin, pyraclostrobin, pyribencarb, trifloxystrobin as CHI-respiration inhibitor.
Compounds capable to act as an uncoupler, like for example binapacryl, dinocap, fluazinam and meptyldinocap.

Inhibitors of the ATP production, for example fentin acetate, fentin chloride, fentin hydroxide, and silthiofam.

Inhibitors of the amino acid and/or protein biosynthesis, for example andoprim, blasticidin-S, cyprodinil, kasugamycin, kasugamycin hydrochloride hydrate, mepanipyrim and pyrimethanil.

Inhibitors of the signal transduction, for example fenpiclonil, fludioxonil and quinoxyfen.

Inhibitors of the lipid and membrane synthesis, for example biphenyl, chlozolinate, edifenphos, etridiazole, iodocarb, iprobenfos, iprodione, isoprothiolane, procymidine, propamocarb, propamocarb hydrochloride, pyrazophos, tolclofos-methyl and vinclozolin.

Inhibitors of the ergosterol biosynthesis, for example aldimorph, azaconazole, bitertanol, bromuconazole, cyproconazole, diclobutrazole, difenoconazole, diniconazole, diniconazole-M, dodemorph, dodemorph acetate, epoxiconazole, etaconazole, fenarimol, fenbuconazole, fenhexamid, fenpropidin, fenpropimorph, fluquinconazole, fluφrimidol, flusilazole, flutriafol, furconazole, furconazole-cis, hexaconazole, imazalil, imazalil sulfate, imibenconazole, ipconazole, metconazole, myclobutanil, naftifme, nuarimol, o xoconazole, paclobutrazol, pefurazoate, penconazole, piperalin, prochloraz, propiconazole, prothioconazole, pyrubicaric, pyrifenox, quinconazole, simeconazole, spiroxamine, tebuconazole, terbinafine, tetraconazole, triadimefon, triadimenol, tridemorph, triflumizole, triforine, triticonazole, uniconazole, viniconazole and voriconazole.

Inhibitors of the cell wall synthesis, for example benthiavalicarb, dimethomorph, flumorph, iprovalicarb, mandipropamid, polyoxins, polyoxorim, prothiocarb, validamycin A, and valiphenal.

Inhibitors of the melanine biosynthesis, for example carpropanid, diclocymet, fenoxanil, phthalide, pyroquilon and tricyclazole.

Compounds capable to induce a host defence, like for example acibenzolar-S-methyl, probenazole, and tiadinil.
Compounds capable to have a multisite action, like for example bordeaux mixture, captafol, captan, chlorothalonil, copper naphthenate, copper oxide, copper oxychloride, copper preparations such as copper hydroxide, copper sulphate, dichlofluanid, dithianon, dodine, dodine free base, ferbam, fluorofolpet, folpet, guazatine, guazatine acetate, iminocadine, iminocadine albesilate, iminocadine triacetate, mancopper, mancozeb, maneb, metiram, metiram zinc, oxine-copper, propamidine, propineb, sulphur and sulphur preparations including calcium polysulphide, thiram, tolyfluuranid, zineb and ziram.

Further compounds like for example 2,3-dibutyl-6-chlorothieno[2,3-d]pyrimidin-4(3H)-one, ethyl (2Z)-3-amino-2-cyano-3-phenylprop-2-enoate, N-[2-((1,3-dimethylbutyl)phenyl]-5-fluoro-1,3-dimethyl-1H-pyrazole-4-carboxamide, N-2-[2,1,1'-bi(cyclopropyl)-2-yl]-phenyl]-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-(3',4',5'-trifluorobiphenyl-2-yl)-1H-pyrazole-4-carboxamide, 3-(difluoromethyl)-N-[4-fluoro-2-(1,1,2,3,3,3-hexafluoroisoproxy)phenyl]-1-methyl-1H-pyrazole-4-carboxamide, (2E)-2-(2-[[6-(3-chloro-2-methylphenoxy)-5-fluoropyrimidin-4-yl]oxy]phenyl)-2-(methoxyimino)-N-methylethanamide, (2E)-2-[2-[[[[2(E),3(E)]4-(2,6-dichlorophenyl)but-3-en-2-ylidene]amino]oxy]methyl]-1-methyl-1H-pyrazole-4-carboxamide, 2-chloro-N-(1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl)pyridine-3-carboxamide, N-(3-ethyl-3,5,5-trimethylcyclohexyl)-3-(formylamino)-2-hydroxybenzamide, 5-methoxy-2-methyl-4-(2-[[([1(E)]4-3-(trifluoromethyl)phenyl]ethylidene]amino)oxy)methyl]phenyl)ethanamide, 2-(2-hydro-3H-1,2,4-triazol-3-one, (2E)-2-(methoxyimino)-N-methyl-2-[[1-[[[2(E)]1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl)ethanamide, (2E)-2-(methoxyimino)-N-methyl-2-[[2-[2-[[2(E)]1-[1-[3-(trifluoromethyl)phenyl]ethoxy]imino]methyl]-phenyl]ethanamide, (2E)-2-[2-[[1-[1-[2-[2-[[2(E)]1-[1-[[[2(E)]1-[1-fluoro-2-phenylethenyl]oxy]phenyl]ethylidene]amino]oxy]methyl]phenyl]ethanamide, (2E)-2-[[[[1(E)]1-[1-[2-[2-[[2(E)]1-[[[2(E)]1-fluoro-2-phenylethenyl]oxy]phenyl]ethylidene]amino]oxy]methyl]phenyl]ethanamide, 1-(4-chlorophenyl)-1^/^OH-l^/^triazol-l-y^/cycloheptanol, methyl 1-(2,2-dimethyl-2,3-dihydro-1H-inden-1-yl)-1H-imidazole-5-carboxylate, N-ethyl-N-[2-[[2(E)]1-[2-methyl-5-(trifluoromethyl)-4-[3-(trimethylsilyl)propoxy]phenyl]imidoformamide, N'-[[2(E)]1-[2-methyl-4-[3-(trimethylsilyl)propoxy]phenyl]N-ethyl-N-(methyl)imidazo[1,2,4]-triazolyl]-2,2-dimethylpropyl]-lH-imidazole-1-carbothioate, N-[[2(E)]1-[2-[[2(E)]1-[[2(E)]1-methylsulfonyl]valinamine, 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)]1,2,4-triazolo[1,5-a]pyrimidine, 5-amino-1,3,4-thiadiazole-2-thiol, propamocarb-fosetyl, 1-[[4-
methoxyphenoxy)methyl]-2,2-dimethylpropyl lH-imidazole-1-carboxylate, 1-methyl-N-[2-(1,1,2,2-tetrafluoroethoxy)phenyl]-3-(trifluoromethyl)-lH-pyrazole-4-carboxamide,
2,3,5,6-tetrachloro-4-(methylsulfonyl)pyridine, 2-butoxy-6-iodo-3-propyl-4H-chromen-4-one, 2-phenylphenol and salts, 3-(difluoromethyl)-1-methyl-N-[2-(1,1,2,2-tetrafluoroethoxy)phenyl]-lH-pyrazole-4-carboxamide, 3,4,5-trichloropyridine-2,6-dicarbonitrile, 3-[5-(4-chlorophenyl)-2,3-dimethylisoxazolidin-3-yl]pyridine, 3-chloro-5-(4-chlorophenyl)-4-(2,6-difluorophenyl)-6-methylpyridazine, 4-(4-chlorophenyl)-5-(2,6-difluorophenyl)-3,6-dimethylpyridazine, quinolin-8-ol, quinolin-8-ol sulfate (2:1) (salt), 5-methyl-6-octyl-3,7-dihydro[1,2,4]triazolo[1,5-a]pyrimidin-7-amine, 5-ethyl-6-octyl-3,7-dihydro[1,2,4]triazolo[1,5-a]pyrimidin-7-amine, benthiace, bethazin, capsicin, carvone, chinomethionat, chloroneb, cufraneb, cyflufenamid, cymoxanil, cyprosulfamide, dazomet, debacarb, dichloromen, dicloremine, dicloran, difenzoquat, difenzoquat methylsulphate, diphenylamine, ecofumide, fluoroimide, flusulfamide, flutinil, fosetyl-aluminium, fosetyl-calcium, fosetyl-sodium, hexachlorobenzene, irumycin, isotianil, methasulfocarb, methyl (2E)-2-[2-[(cyclopropyl[(4-methoxyphenyl)imino]methyl]thio)methyl]phenyl]-3-methoxyacrylate, methyl isothiocyanate, metrafenone, (5-bromo-2-methoxy-4-methylpyridin-3-yl)(2,3,4-trimethoxy-6-methylphenyl)methanone, mildiomicyn, tolfinanide, N-(4-chlorobenzyl)-3-[3-methoxy-4-[(prop-2-yn-1 -yloxy)phenyl]propanamide, N-[4-chlorophenyl](cyano)methyl]-3-[3-methoxy-4-[(prop-2-yn-1 -yloxy)phenyl]propanamide, N-[5-bromo-3-chloropyridin-2-yl]methyl]-2,4-dichloropyridine-3-carboxamide, N-[l-(5-bromo-3-chloropyridin-2-yl)ethyl]-2,4-dichloropyridine-3-carboxamide, N-[l-(5-bromo-3-chloropyridin-2-yl)ethyl]-2-fluoro-4-iodopyridine-3-carboxamide, N-[(Z)-[(cyclopropylmethoxy)imino][6-(difluoromethoxy)-2,3-difluorophenyl]methyl]-2-phenylacetamide, N-[(E)-[(cyclopropylmethoxy)imino][6-(difluoromethoxy)-2,3-difluorophenyl]methyl]-2-phenylacetamide, natamycin, nickel dimethylthiocarbamate, nitrothal-isopropyl, octolinone, oxamocarb, oxyfenthin, pentachlorophenol and salts, phenazine-1-carboxylic acid, phenothrin, phosphorous acid and its salts, propamocarb fosetylate, propanosine-sodium, proquinazid, pyrrolnitrine, quintozene, S-prop-2-en-l-yl 5-amino-2-(l-methylethyl)-4-(2-methylphenyl)-3-oxo-2,3-dihydro-IH-pyrazole-1-carbothioate, tecloftalam, tecazene, triazoxyde, trichlame, 5-chloro-N'-phenyl-N'-prop-2-yn-l-yli thiophene-2-sulfonohydrazide and zarilamid. In a preferred embodiment the second fungicide is tebuconazole. In a more preferred embodiment of the invention a composition
comprising fluopyram and tebuconazole is used for controlling powdery mildew infestations in apples or pears.

A further embodiment of the present invention is a method for controlling powdery mildew primary infections of crops, preferably *Podospora leucotricha* of apple trees, characterized in that, fluopyram was applied to the perennial crop prior to the end of the previous vegetative cycle.

The present invention is exemplified by the following examples.
Examples

Fluopyram was tested in apples orchard in comparison with already known fungicides active against Powdery mildew such as triadimenol (Bayleton) and boscalid.

Fluopyram was applied at range of rates: 18.5g - 25g - 37.5 - 50g a.s./ha/meter canopy height (g ha/m c.h.). Bayleton was applied at 25g a.s./ha/m c.h. Boscalid (Cantus WG50) was applied at 125 g a.s./m c.h.

Trial conditions

During the spray season, the compounds were applied at apple susceptible stages from BBCH09 (green leaf tips 5mm above bud scales to BBCH73 Fruit size between 20 and 40mm (as described in BBCH Monograph, 2. Edition, 2001, edited by Uwe Meier, Federal Biological Research Centre for Agriculture and Forestry) in order to protect leaves, buds and shoots against Powdery mildew. The compounds have been applied eight times with an interval of 7 days during spray season.

Assessment

The type of assessments of infections was:

- % infested area on leaves (severity) and % infested leaves (incidence) were assessed 10 days after application 8 (10DAT8).
- Count and % infested shoots (primary infection) were assessed 345 days after application 8 (345 DAT8).
Results

<table>
<thead>
<tr>
<th>Compounds / g a.s./ha/m c.h.</th>
<th>10DAT8 [% infested leaves]</th>
<th>10DAT8 [% efficacy] (Abbott)(^{i1})</th>
<th>345DAT8 [% infested shoots]</th>
<th>345DAT8 [% efficacy] (Abbott) (^{i1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triadimenol @ 25g</td>
<td>32</td>
<td>66.7</td>
<td>27.5</td>
<td>39.1</td>
</tr>
<tr>
<td>Fluopyram @ 18.5g</td>
<td>8.7</td>
<td>91</td>
<td>17.7</td>
<td>60.9</td>
</tr>
<tr>
<td>Fluopyram @ 25g</td>
<td>10</td>
<td>89.6</td>
<td>14</td>
<td>69</td>
</tr>
<tr>
<td>Fluopyram @ 37.5g</td>
<td>2.7</td>
<td>97.2</td>
<td>13</td>
<td>71.2</td>
</tr>
<tr>
<td>Fluopyram @ 50g</td>
<td>0.7</td>
<td>99.3</td>
<td>9</td>
<td>80.1</td>
</tr>
<tr>
<td>Boscald @ 125g</td>
<td>46</td>
<td>52.1</td>
<td>30.8</td>
<td>31.7</td>
</tr>
</tbody>
</table>


As it becomes evident from the above table 1, fluopyram clearly demonstrate an excellent efficacy against powdery mildew on apples against secondary infections controlled during the spray program (assessment 10DAT8), with a visible dose rate effect between 18.5g to 50g a.s./m c.h. This efficacy, from the lowest rate is superior to triadimenol (25g a.s./m c.h) and boscald (125g a.s./m c.h.).

In the proximate year (assessment 365DAT8), without any other application, the level of infection measured by the % of primary infested shoots shows clearly a high decrease of infestation in fluopyram treated plots with a dose rate relation. Significant protection, superior to triazoles and other SDH inhibitors, is achieved with 50g a.s./m c.h but already superior at 18.5g g a.s./m.c.h.
Claims:

1. Use of succinate dehydrogenase inhibitors for controlling powdery mildew primary infections in perennial crops, wherein the succinate dehydrogenase inhibitor was applied to the perennial crop prior to the end of the previous vegetative cycle.

2. Use according to claim 1, wherein the succinate dehydrogenase inhibitor is selected from the group consisting of fluopyram, isopyrazam, boscalid, penthiopyrad, penflufen, sedaxane, fluxapyraxad and bixafen.

3. Use according to any one of claims 1 or 2, wherein the succinate dehydrogenase inhibitor is fluopyram.

4. Use according to any one of claims 1 to 3, wherein the perennial crops are selected from the group consisting of apples, grapes, European gooseberry, chestnut, pecan nuts, cashew, papaya, mango, rambutan, citrus, hazel, pear, cherry, quince, apricot, plum, peach, nectarine.

5. Use according to any one of claims 1 to 4, wherein the crops are apples.

6. Use according to any one of claims 1 to 5, characterized in that succinate dehydrogenase inhibitor is applied at a rate ranging from 1 to 200 g/ha - based upon the pure a.s.

7. Use according to any one of claims 1 to 6, wherein a composition comprising fluopyram and a further fungicide was applied to the crop.

8. Use according to claim 7, wherein the further fungicide is tebuconazol.

9. Method for controlling powdery mildew primary infections in crops, characterized in that, a succinate dehydrogenase inhibitor was applied to the perennial crops prior to the end of the previous vegetative cycle.

10. Method for controlling powdery mildew primary infections in crops according to claim 9, characterized in that, the succinate dehydrogenase inhibitor is selected from the group consisting of fluopyram, isopyrazam, boscalid, penthiopyrad, penflufen, sedaxane, fluxapyraxad and bixafen.