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Fungicidal mixtures

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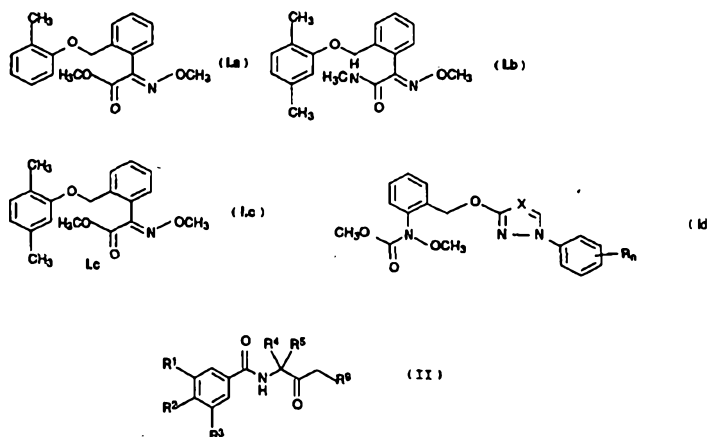


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(54) Title: FUNGICIDAL MIXTURES

(54) Bezeichnung: FUNGIZIDE MISCHUNGEN



(57) Abstract

The invention relates to a fungicidal mixture characterized in that it contains in synergistically effective quantities a) a phenyl-benzylether derivative of the formula (I.a), (I.b) or (I.c), and/or a carbamate of the formula (I.d), in which X is CH and N, n is 0, 1 or 2 and R is a halogen, C₁-C₄-alkyl and C₁-C₄-halogen alkyl, whereby the R radicals can be different if n equals 2, or one of its salts or adducts; and b) an N-acetylbenzamide of the formula (II) in which the substituents have the following meaning: R¹ and R³ independently of each other are a halogen or C₁-C₄-alkyl; R² is a cyano, C₁-C₄-alkyl, C₂-C₄-alkenyl, C₂-C₄-alkynyl or C₁-C₄-alkoxy; R⁴ is a hydrogen or C₁-C₄-alkyl; R⁵ is a C₂-C₄-alkyl; and R⁶ is a thiocyno, isothiocyno or halogen or one of its salts or adducts.

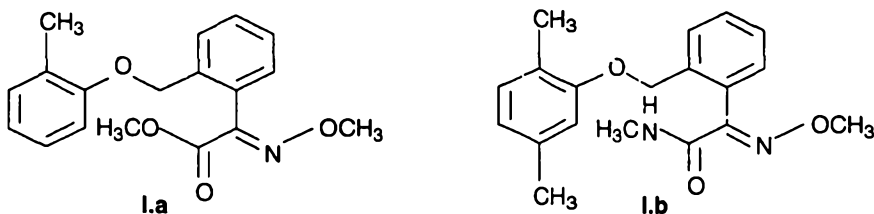
Fungicidal mixtures

Abstract

5 A fungicidal mixture comprises

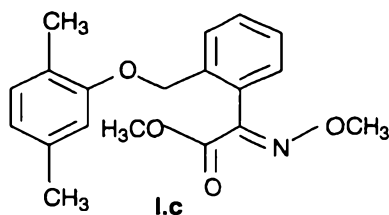
a) a phenyl benzyl ether derivative of the formula I.a, I.b or I.c,

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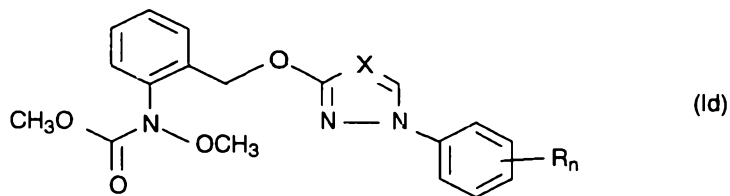
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and/or a carbamate of the formula Id

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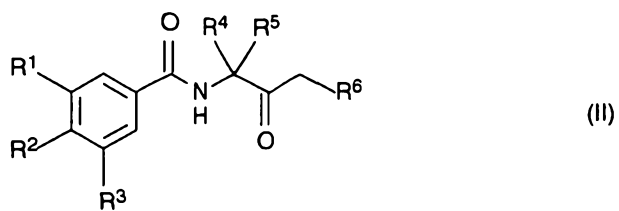
where X is CH or N, n is 0, 1 or 2 and R is halogen, C₁-C₄-alkyl or C₁-C₄-haloalkyl, it being possible for the radicals R to be different if n is 2, or a salt or adduct thereof,

35

and

b) a N-acetylbenzamide of the formula II

40



45

where:

R¹ and R³ independently of one another are each halogen or C₁-C₄-alkyl;

5 R² is cyano, C₁-C₄-alkyl, C₂-C₄-alkenyl, C₂-C₄-alkynyl or C₁-C₄-alkoxy;

R⁴ is hydrogen or C₁-C₄-alkyl;

10 R⁵ is C₂-C₄-alkyl;

R⁶ is thiocyno, isothiocyno or halogen,

15 or a salt or adduct thereof,

in a synergistically effective amount.

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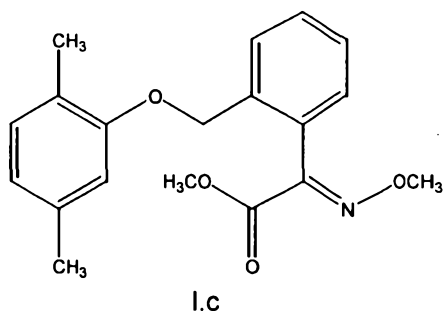
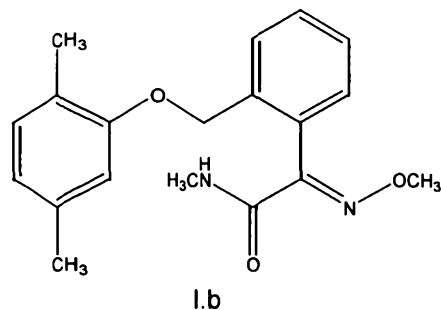
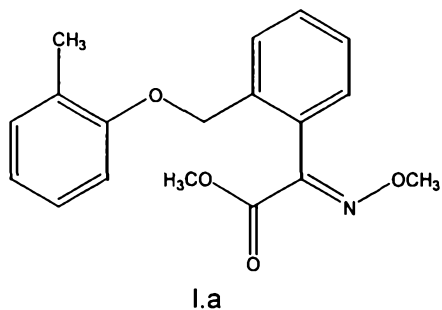
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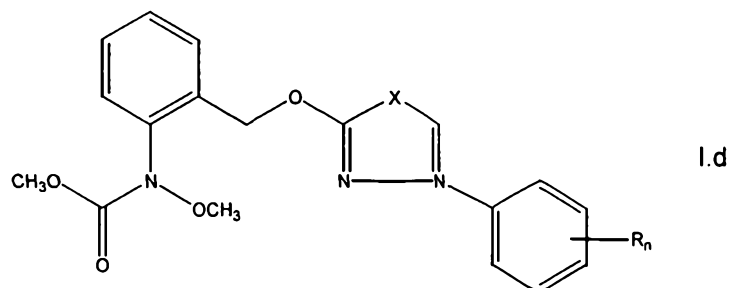
FUNGICIDAL MIXTURES

The present invention relates to a fungicidal mixture which comprises

- a) component I selected from a phenyl benzyl ether derivative of the
5 formula I.a, I.b or I.c,



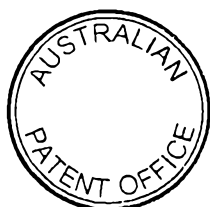
and/or a carbamate of the formula I.d

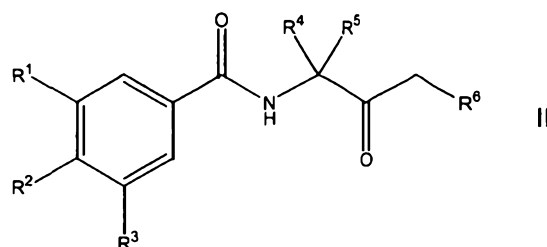


where X is CH or N, n is 0, 1 or 2 and R is halogen, C₁-C₄-alkyl or C₁-C₄-haloalkyl, it being possible for the radicals R to be different if n is 2, or a salt or adduct thereof,

10 and

b) component II, wherein component II is a N-acetyl benzamide of the formula





where:

R^1 and R^3 independently of one another are each halogen or C_1 - C_4 -alkyl;

R^2 is cyano, C_1 - C_4 -alkyl, C_2 - C_4 -alkenyl, C_2 - C_4 -alkynyl or C_1 - C_4 -alkoxy;

R^4 is hydrogen or C_1 - C_4 -alkyl;

5 R^5 is C_2 - C_4 -alkyl;

R^6 is thiocyano, isothiocyano or halogen,

or a salt or adduct thereof,

in a synergistically effective amount.

The invention further relates to methods for controlling harmful fungi using
 10 mixtures of component I (I.a, I.b or I.c and/or I.d) and component II and to the use
 of component I and component II for preparing such mixtures.

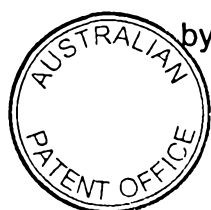
The compounds of the formula I.a-c, their preparation and their activity
 against harmful fungi are known from the literature (EP-A 253 213; EP-A 254 426;
 EP-A 398 692).

15 The compounds of the formula I.d, their preparation and their activity
 against harmful fungi are known from the literature (WO-A 93/15,046; WO-A
 96/01,256 and WO-A 96/01,258).

Also known are synergistic mixtures of component II with
 dithiocarbamates, their preparation and their activity against harmful fungi (EP-A
 20 753 258; US-A 5,304,572).

It is an object of the present invention to provide mixtures which have an
 improved activity against harmful fungi combined with a reduced total amount of
 active ingredients applied (synergistic mixtures), with a view to reducing the
 application rates and to improving the activity spectrum of the known compounds
 25 of formulas I.a, I.b, I.c, I.d and II.

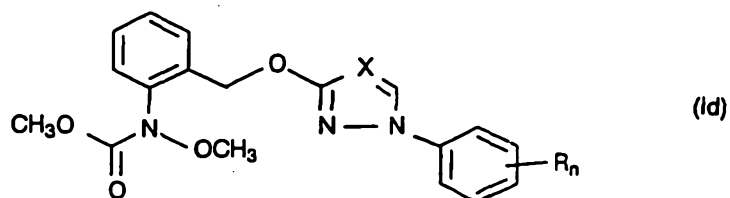
We have found that this object is achieved by the mixture defined at the
 outset. In addition, we have found that better control of harmful fungi is possible
 by applying component I and component II simultaneously, separately as well as



together, or by applying component I and component II in succession, than when the individual compounds are used.

The formula Id in particular represents carbamates in which the combination of the substituents corresponds to a line of the Table below:

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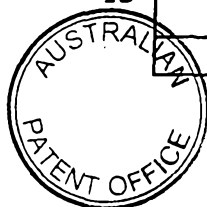
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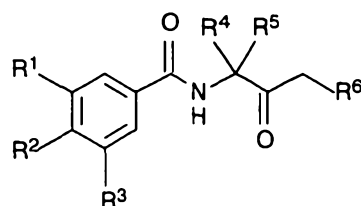
No.	X	R _n
I.1	N	2-F
I.2	N	3-F
I.3	N	4-F
I.4	N	2-Cl
I.5	N	3-Cl
I.6	N	4-Cl
I.7	N	2-Br
I.8	N	3-Br
I.9	N	4-Br
I.10	N	2-CH ₃
I.11	N	3-CH ₃
I.12	N	4-CH ₃
I.13	N	2-CH ₂ CH ₃
I.14	N	3-CH ₂ CH ₃
I.15	N	4-CH ₂ CH ₃
I.16	N	2-CH(CH ₃) ₂
I.17	N	3-CH(CH ₃) ₂
I.18	N	4-CH(CH ₃) ₂
I.19	N	2-CF ₃
I.20	N	3-CF ₃
I.21	N	4-CF ₃
I.22	N	2,4-F ₂
I.23	N	2,4-Cl ₂
I.24	N	3,4-Cl ₂
I.25	N	2-Cl, 4-CH ₃
I.26	N	3-Cl, 4-CH ₃
I.27	CH	2-F
I.28	CH	3-F
I.29	CH	4-F
I.30	CH	2-Cl
I.31	CH	3-Cl
I.32	CH	4-Cl



No.	X	R _n
I.33	CH	2-Br
I.34	CH	3-Br
I.35	CH	4-Br
I.36	CH	2-CH ₃
I.37	CH	3-CH ₃
I.38	CH	4-CH ₃
I.39	CH	2-CH ₂ CH ₃
I.40	CH	3-CH ₂ CH ₃
I.41	CH	4-CH ₂ CH ₃
I.42	CH	2-CH(CH ₃) ₂
I.43	CH	3-CH(CH ₃) ₂
I.44	CH	4-CH(CH ₃) ₂
I.45	CH	2-CF ₃
I.46	CH	3-CF ₃
I.47	CH	4-CF ₃
I.48	CH	2,4-F ₂
I.49	CH	2,4-Cl ₂
I.50	CH	3,4-Cl ₂
I.51	CH	2-Cl, 4-CH ₃
I.52	CH	3-Cl, 4-CH ₃

Particular preference is given to the compounds I.12, I.23, I.32 and I.38.

The formula II in particular represents N-acetylbenzamides in which the combination of the substituents corresponds to a line of the Table below:



(II)

No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶
II.1	Cl	CH ₃	Cl	CH ₂ CH ₃	CH ₃	Cl
II.2	Cl	CH ₂ CH ₃	Cl	CH ₂ CH ₃	CH ₃	Cl
II.3	Cl	OCH ₃	Cl	CH ₂ CH ₃	CH ₃	Cl
II.4	Cl	OCH ₂ CH ₃	Cl	CH ₂ CH ₃	CH ₃	Cl
II.5	Cl	CN	Cl	CH ₂ CH ₃	CH ₃	Cl
II.6	Br	CH ₃	Br	CH ₂ CH ₃	CH ₃	Cl
II.7	Br	CN	Br	CH ₂ CH ₃	CH ₃	Cl

Particular preference is given to those N-acetylbenzamides which are generally and particularly preferred in EP-A 753 258.

Owing to the basic character of their nitrogen atoms, the compounds Id and II are capable of forming adducts or salts with inorganic or organic acids or with metal ions.

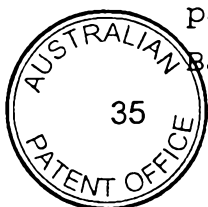
5 Examples of inorganic acids are hydrohalic acids such as hydrofluoric acid, hydrochloric acid, hydrobromic acid and hydriodic acid, sulfuric acid, phosphoric acid and nitric acid.

10 Suitable organic acids are, for example, formic acid, carbonic acid and alkanolic acids, such as acetic acid, trifluoroacetic acid, trichloroacetic acid and propionic acid, and also glycolic acid, thiocyanic acid, lactic acid, succinic acid, citric acid, benzoic acid, cinnamic acid, oxalic acid, alkylsulfonic acids (sulfonic acids having straight-chain or branched alkyl radicals of 1 to 20 carbon atoms), arylsulfonic acids or aryldisulfonic acids (aromatic radicals, such as phenyl and naphthyl, which carry one or two sulfo groups), alkylphosphonic acids (phosphonic acids having straight-chain or branched alkyl radicals of 1 to 20 carbon atoms), arylphosphonic acids or aryldiphosphonic acids (aromatic radicals, such as phenyl and naphthyl, which carry one or two phosphoric acid radicals), it being possible for the alkyl or aryl radicals to carry further substituents, eg. p-toluenesulfonic acid, dodecylbenzenesulfonic acid, salicylic acid, p-aminosalicylic acid, 2-phenoxybenzoic acid and 2-acetoxybenzoic acid, etc.

20 Suitable metal ions are, in particular, the ions of the elements of the first to eighth sub-group, in particular chromium, manganese, iron, cobalt, nickel, copper, zinc and of the second main group, in particular calcium and magnesium, and of the third and fourth main group, in particular aluminum, tin and lead. The metals can exist in the various valencies which they can assume.

25 When preparing the mixtures, it is preferred to employ the pure active ingredients I and II, to which further active ingredients against harmful fungi or other pests, such as insects, arachnids or nematodes, or else herbicidal or growth-regulating active ingredients or fertilizers can be admixed.

30 The mixtures of components I and II, or the simultaneous joint or separate use of components I and II, have outstanding action against a wide range of phytopathogenic fungi, in particular from the classes of the Ascomycetes, Basidiomycetes, Phycomycetes and Deuteromycetes. Some of them



act systemically and can therefore also be employed as foliar and soil-acting fungicides.

They are specially important for controlling a large number of fungi in a variety of crop plants, such as cotton, vegetable species (e.g. cucumbers, beans, tomatoes, potatoes and cucurbits), barley, grass, oats, bananas, coffee, maize, fruit species, rice, rye, soya, grapevine, wheat, ornamentals, sugar cane, and a variety of seeds.

They are particularly suitable for controlling the following phytopathogenic fungi: *Erysiphe graminis* (powdery mildew) in cereals, *Erysiphe cichoracearum* and *Sphaerotheca fuliginea* in cucurbits, *Podosphaera leucotricha* in apples, *Uncinula necator* in grapevines, *Puccinia* species in cereals, *Rhizoctonia* species in cotton, rice and lawns, *Ustilago* species in cereals and sugar cane, *Venturia inaequalis* (scab) in apples, *Helminthosporium* species in cereals, *Septoria nodorum* in wheat, *Botrytis cinerea* (gray mold) in strawberries, vegetables, ornamentals and grapevines, *Cercospora arachidicola* in groundnuts, *Pseudocercospora herpotrichoides* in wheat and barley, *Pyricularia oryzae* in rice, *Phytophthora infestans* in potatoes and tomatoes, *Plasmopara viticola* in grapevines, *Pseudoperonospora* species in hops and cucumbers, *Alternaria* species in vegetables and fruit, *Mycosphaerella* species in bananas and *Fusarium* and *Verticillium* species.

Furthermore, they can be used in the protection of materials (e.g. in the protection of wood), for example against *Paecilomyces variotii*.

The components I and II can be applied simultaneously, that is either together or separately, or in succession, the sequence, in the case of separate application, generally not having any effect on the result of the control measures.

The components I and II are preferably applied in a weight ratio of 10:1 to 0.01:1, more preferably 5:1 to 0.05:1, in particular 1:1 to 0.05:1.

Depending on the nature of the desired effect, the application rates of the mixtures according to the invention are, in particular in agricultural crops, from 0.01 to 8 kg/ha, preferably 0.1 to 5 kg/ha, in particular 0.5 to 3.0 kg/ha.



The application rates of component I are from 0.01 to 2.5 kg/ha, preferably 0.05 to 2.5 kg/ha, in particular 0.05 to 1.0 kg/ha.

Correspondingly, the case of component II, the application rates are from 0.01 to 10 kg/ha, preferably 0.05 to 5 kg/ha, in particular 0.1 to 2.0 kg/ha.

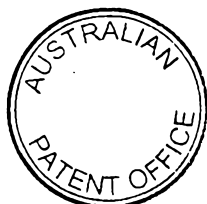
5 For seed treatment, the application rates of the mixture are generally from 0.001 to 250 g/kg of seed, preferably 0.01 to 100 g/kg, in particular 0.01 to 50 g/kg.

10 If phytopathogenic harmful fungi are to be controlled, the separate or joint application of components I and II or of the mixtures of components I and II is effected by spraying or dusting the seeds, the plants or the soils before or after sowing of the plants, or before or after plant emergence.

15 The fungicidal synergistic mixtures according to the invention, or components I and II, can be formulated for example in the form of ready-to-spray solutions, powders and suspensions or in the form of highly concentrated aqueous, oily or other suspensions, dispersions, emulsions, oil dispersions, pastes, dusts, materials for broadcasting or granules, and applied by spraying, atomizing, dusting, broadcasting or watering. The use form depends on the intended purpose; in any case, it should guarantee as fine and uniform as possible a distribution of the mixture according to the invention.

20 The formulations are prepared in a manner known per se, e.g. by adding solvents and/or carriers. It is usual to admix inert additives, such as emulsifiers or dispersants, to the formulations.

25 Suitable surfactants are the alkali metal salts, alkaline earth metal salts and ammonium salts of aromatic sulfonic acids, e.g. ligno-, phenol-, naphthalene- and dibutyl-naphthalenesulfonic acid, and of fatty acids, alkyl- and alkylarylsulfonates, alkyl, lauryl ether and fatty alcohol sulfates, and salts of sulfated hexa-, hepta- and octadecanols, or of fatty alcohol glycol ethers, condensates of sulfonated naphthalene and its derivatives with formaldehyde, condensates of naphthalene or of the naphthalenesulfonic acids with phenol and
30 formaldehyde, polyoxyethylene octylphenol ether, ethoxylated isooctyl-, octyl- or nonylphenol, alkylphenol polyglycol ethers, tributylphenyl polyglycol ethers, alkylaryl polyether alcohols, isotridecyl alcohol, fatty alcohol/ethylene oxide condensates, ethoxylated castor oil, polyoxyethylene alkyl ethers or



polyoxypropylene alkyl ethers, lauryl alcohol polyglycol ether acetate, sorbitol esters, liginosulfite waste liquors or methylcellulose.

Powders, materials for broadcasting and dusts can be prepared by mixing or jointly grinding components I or II or the mixture of components I and II with a
5 solid carrier.

Granules (e.g. coated granules, impregnated granules or homogeneous granules) are usually prepared by binding the active ingredient, or active ingredients, to a solid carrier.

Fillers or solid carriers are, for example, mineral earths, such as silica gel,
10 silicas, silica gels, silicates, talc, kaolin, limestone, lime, chalk, bole, loess, clay, dolomite, diatomaceous earth, calcium sulfate, magnesium sulfate, magnesium oxide, ground synthetic materials, and fertilizers, such as ammonium sulfate, ammonium phosphate, ammonium nitrate, ureas, and products of vegetable origin, such as cereal meal, tree bark meal, wood meal and nutshell meal,
15 cellulose powders or other solid carriers.

The formulations generally comprise 0.1 to 95% by weight, preferably 0.5 to 90% by weight, of one of components I or II or of the mixture of components I and II. The active ingredients are preferably employed in a purity of from 90% to 100%, preferably 95% to 100% (according to NMR spectra or HPLC).

20 The components I or II, or the mixtures, or the corresponding formulations, are applied by treating the harmful fungi or the plants, seeds, soils, areas, materials or spaces to be kept free from them with a fungicidally effective amount of the mixture, or of components I and II in the case of separate application.

Application can be effected before or after infection by the harmful fungi.

25 The synergistic action of the mixtures according to the invention was demonstrated by the following experiments:

Use Example 1 – Activity against *Phytophthora infestans* on tomatoes



Leaves of plants of the cultivar "Große Fleischtomate" in pots were sprayed to run-off with an aqueous suspension made with a stock solution of 10% of active ingredient, 63% of cyclohexanone and 27% of emulsifier. The next day, the leaves were infected with an aqueous zoospore suspension of *Phytophthora infestans*. The plants were subsequently placed in a water-vapor-saturated chamber at from 16 to 18°C. After 6 days, the tomato blight had developed on the untreated, but infected, control plants to such an extent that it was possible to evaluate the disease level visually in %.

Evaluation was carried out by determining the infected leaf areas in percent. These percentages were converted into degrees of action. The efficacy (E) was calculated as follows using Abbot's formula:

$$E = (1 - \alpha) \cdot 100 / \beta$$

α corresponds to the fungal infection of the treated plants in % and

β corresponds to the fungal infection of the untreated (control) plants in %

A degree of action of 0 means that the infection level of the treated plants corresponds to that of the untreated control plants; a degree of action of 100 means that the treated plants were not infected.

The expected degrees of action of the mixtures of the active ingredients were determined using Colby's formula [R.S. Colby, Weeds 15, (1967) 20-22] and compared with the observed degrees of action.

$$\text{Colby's formula: } E = x + y - x \cdot y / 100$$

E expected degree of action, expressed in % of the untreated control, when using the mixture of the active ingredients A and B at the concentrations of a and b

x degree of action, expressed in % of the untreated control, when using active ingredient A at a concentration of a

y degree of action, expressed in % of the untreated control, when using active ingredient B at a concentration of b

The results are shown in Tables 2 and 3 below.

Table 2

Active ingredient	Concentration of active ingredient in the spray liquor in ppm	Efficacy in % of the untreated control
Control (untreated)	(100 % infection)	0
Ia	1	0
	0.5	0
	0.25	0
Ib	0.25	0
Compound I.32	0.25	70
Compound II.1	0.5	20
	0.25	0

5 Table 3

Mixtures according to the invention	Observed efficacy	Expected efficacy *)
1 ppm Ia + 0.25 ppm II.1	30	0
0.5 ppm Ia + 0.5 ppm II.1	50	20
0.25 ppm Ia + 0.5 ppm II.1	40	20
0.25 Ib + 0.5 ppm II.1	60	20
0.25 ppm I.32 + 0.5 ppm II.1	97	76

*) calculated using Colby's formula

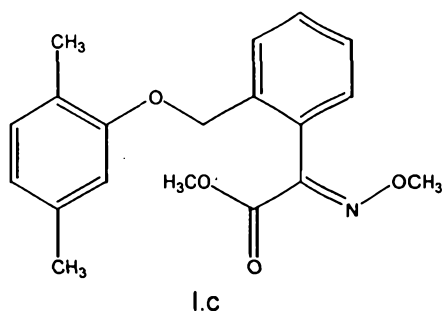
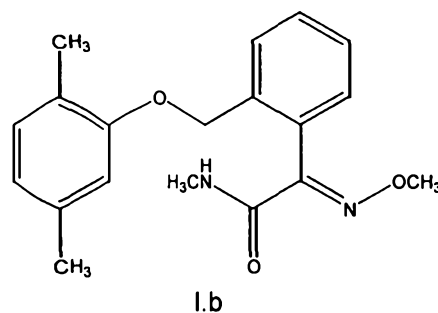
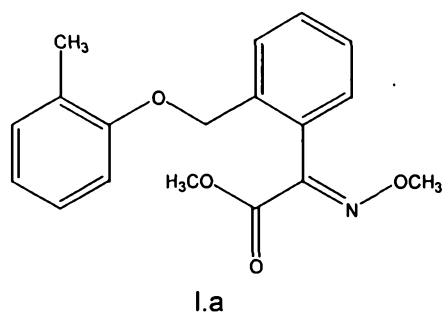
The experimental results reveal that the observed efficacy in all mixing ratios is higher than the efficacy calculated beforehand using Colby's formula.

10 "Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

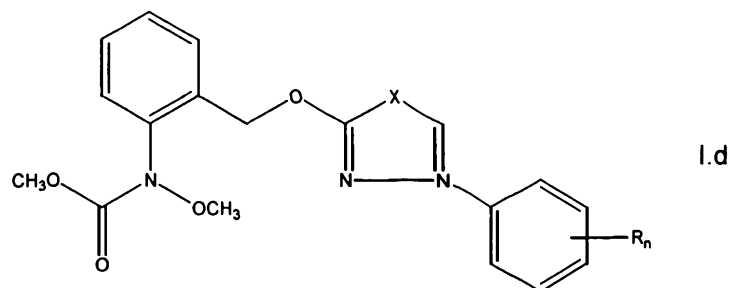


THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A fungicidal mixture comprising
 a) component I selected from a phenyl benzyl ether derivative of the formula I.a, I.b or I.c,



and/or a carbamate of the formula I.d

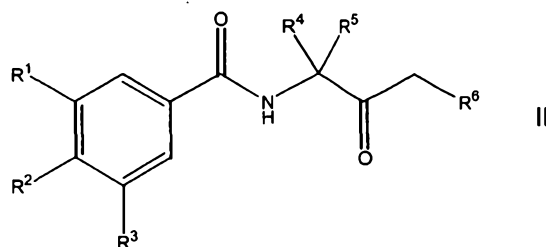


where X is CH or N, n is 0, 1 or 2 and R is halogen, C₁-C₄-alkyl or C₁-C₄-haloalkyl, it being possible for the radicals R to be different if n is 2, or a salt or adduct thereof,

and

- b) component II, wherein component II is a N-acetyl benzamide of the formula





where:

R^1 and R^3 independently of one another are each halogen or C_1 - C_4 -alkyl;

R^2 is cyano, C_1 - C_4 -alkyl, C_2 - C_4 -alkenyl, C_2 - C_4 -alkynyl or C_1 - C_4 -alkoxy;

R^4 is hydrogen or C_1 - C_4 -alkyl;

R^5 is C_2 - C_4 -alkyl;

R^6 is thiocyano, isothiocyano or halogen,

or a salt or adduct thereof,

in a synergistically effective amount.

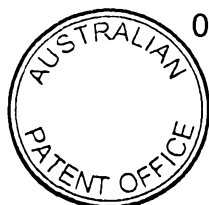
2. A fungicidal mixture as claimed in claim 1, wherein the weight ratio of component I to component II, or a salt or adduct thereof, is from 10:1 to 0.01:1.

3. A method for controlling harmful fungi, which comprises treating the harmful fungi, their habitat, or the plants, seeds, soils, areas, materials or spaces to be kept free from them with component I, as set forth in claim 1 and the component II, or a salt or adduct thereof, as set forth in claim 1, in a synergistically effective manner.

4. A method as claimed in claim 3, wherein component I, as set forth in claim 1 and component II, or a salt or adduct thereof, as set forth in claim 1 are applied simultaneously or in succession.

5. A method as claimed in claim 3 or 4, wherein component I, as set forth in claim 1 is applied in an amount of from 0.01 to 2.5 kg/ha.

6. A method as claimed in any one of claims 3 to 5, wherein component II, or a salt or adduct thereof, as set forth in claim 1 is applied in an amount of from 0.01 to 10 kg/ha.



7. The use of component I, as set forth in claim 1 for preparing a fungicidally effective synergistic mixture as claimed in claim 1.

8. The use of component II, or a salt or adduct thereof, as set forth in claim 1 for preparing a fungicidally effective synergistic mixture as claimed in claim 1.

9. A fungicidal mixture as claimed in claim 1, when used according to the method of claim 3, the mixture being conditioned in two parts, one part comprising component I, as set forth in claim 1 in a solid or liquid carrier and the other part comprising component II, or a salt or adduct thereof, as set forth in claim 1 in a solid or liquid carrier.

10. A fungicidal mixture according to claim 1 wherein the phenyl benzyl ether derivative of formula Id is as substantially as hereinbefore described with reference to Table 1.

11. A fungicidal mixture according to claim 1 wherein the N-acetylbenzamide of formula II is as substantially as hereinbefore described with reference to the tabulated examples at page 4, lines 36 to 43.

12. A method for controlling harmful fungi according to claim 3 substantially as hereinbefore described with reference to the Use Example and Tables 2 and 3.

DATED this 18th day of December 2001

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