

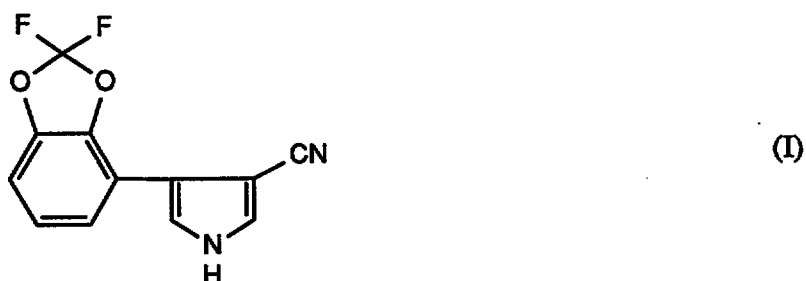
PF/5-18430/A

Microbicidal compositions

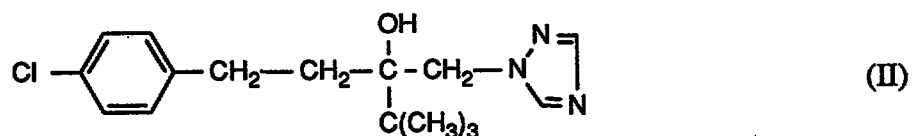
The present invention relates to microbicidal mixtures with a synergistically increased effect against plant diseases and against attack by microorganisms of plant propagation material or other vegetable or animal material, and to processes for using such mixtures, in particular for seed dressing.

In particular, the invention relates to the control, or prevention, of diseases on cereal seed.

It has been found that a combination of the active substance component I),
4-(2,2-difluoro-1,3-benzodioxol-7-yl)-1H-pyrrole-3-carbonitrile, of the formula I



with the active substance component II),
 α -[2-(4-chlorophenyl)ethyl]- α -(1,1-dimethylethyl)- β -(1H-1,2,4-triazolyl)-1-ethanol, of the
formula II



or with one of its salts results in synergistically increased activity in the control and prevention of plant diseases.

EP-A-206,999 describes the compound of the formula I as a fungicidal active ingredient. It is distinguished mainly as a contact fungicide.

The compound of the formula II is described in EP-A-40,345 as a fungicidal active ingredient.

The abovementioned salts of the compound of the formula II can be prepared by reacting the base with acids.

The following may be mentioned amongst the acids which can be used for preparing salts of the formula II:

hydrohalic acid such as hydrofluoric acid, hydrochloric acid, hydrobromic acid or hydroiodic acid, and also sulfuric acid, phosphoric acid, nitric acid, and organic acids such as acetic acid, trifluoroacetic acid, trichloroacetic acid, propionic acid, glycolic acid, thiocyanic acid, lactic acid, succinic acid, citric acid, benzoic acid, cinnamic acid, oxalic acid, formic acid, benzenesulfonic acid, p-toluenesulfonic acid, methanesulfonic acid, salicylic acid, p-aminosalicylic acid, 2-phenoxybenzoic acid, 2-acetoxybenzoic acid or 1,2-naphthalenedisulfonic acid.

The term salts also includes metal complexes of the basic component II. These complexes are composed of the organic molecule on which they are based and an inorganic or organic metal salt, for example the halides, nitrates, sulfates, phosphates, acetates, trifluoroacetates, trichloroacetates, propionates, tartrates, sulfonates, salicylates, benzoates etc. of the elements of the second main group such as calcium and magnesium and of the third and fourth main group such as aluminium, tin or lead, and also of the first to eighth sub-group such as chromium, manganese, iron, cobalt, nickel, copper, zinc etc. The sub-group elements of the 4th period are preferred. The metals can exist in the various valencies which they may assume. The metal complexes can have one or more nuclei, i.e. they can contain one or more organic molecule portions as ligands.

The fact that the total action of a fungicidal active ingredient can be broadened by adding another fungicide with a different spectrum of action is known to the person skilled in the art.

However, it has been found, surprisingly, that the combination of the active substances I and II results in an unexpectedly greatly enhanced action against seed-borne and soil-borne fungi. The enhanced action, which is achieved by the combination according to the invention, is decidedly greater than the activity to be expected by addition of the

actions of the two individual components, that is to say, the activity is synergistically increased.

The present invention allows, for example, seed dressing to be carried out with substantially smaller amounts of biocides as previously customary, and therefore represents an essential enrichment of the art.

The invention not only relates to the use of mixtures of components I and II in connection with seed but also to the application of the individual components in immediate succession.

Advantageous mixing ratios of the two active substances are I:II = 10:1 to 1:20, particularly I:II = 10:1 to 1:12 and very particularly I:II = 4:1 to 1:2. Other advantageous mixing ratios are I:II = 5:2 to 2:5 or 5:3, 3:2, 1:1.

The combination of the active ingredients I and II according to the invention achieves a useful contact action and systemic and long-term action in the control of the seed- and soil-borne plant diseases. The combinations according to the invention destroy the microorganisms on the stored goods and on propagation material, in particular on seed, and developing plants are protected against attack by the soil-borne microorganisms.

The mixtures according to the invention are active against phytopathogenic fungi which belong to the following classes: Ascomycetes [for example the genera Erysiphe, Sclerotinia, Monilinia, Helminthosporium (= Drechslera), Mycosphaerella, Pyrenophora]; Basidiomycetes (for example the genera Ustilago, Puccinia, Tilletia, Rhizoctonia); Fungi imperfecti (for example the genera Fusarium, Botrytis, Pyricularia, Septoria, Phoma, Alternaria). The combinations according to the invention are particularly effective in seed treatment (fruit, tubers, grains), and the action against Fusarium nivale on wheat is particularly pronounced. However, they are also suitable for direct treatment of the soil or of the plant or individual parts of the plant. They are compatible with plants and are ecologically acceptable.

When used, the mixture according to the invention is normally employed together with the adjuvants customary in the art of formulation. The active ingredients of the formulae I and II are processed in the known manner to give, for example, emulsion concentrates, spreadable pastes, directly sprayable or dilutable solutions, dilute emulsions, wettable

powders, soluble powders, dusts, granules, and also for encapsulation in, for example, polymeric substances. The application methods such as spraying, misting, atomising, broadcasting, brushing on or pouring, and the nature of the composition are adapted to suit the intended aims and prevailing circumstances. In general, favourable application rates of 0.0005 to not more than 0.5 kg in each case, in particular 0.001-0.01 kg of active ingredient I and II per 100 kg of goods to be protected. However, the application conditions depend greatly on the nature (surface area, consistency, moisture content) of the goods and of the environmental factors to which it is exposed.

The stored goods and stock which can be protected with the mixture according to the invention and, in particular, propagation material, specifically seeds, are intended to mean, in the context of the present invention, natural substances of vegetable and/or animal origin and the processing products thereof which are intended to be preserved over a prolonged period, for example the plants and the parts of these plants which are mentioned below and which have been harvested from the natural cycle of life (stalks, leaves, tubers, seeds, fruits, grains) and which are in the freshly harvested state or in processable form (pre-dried, moistened, compressed, comminuted, ground, roasted, etc). However, they also include the protection of utilisable timber, be it in the form of raw timber or in the form of finished products (building timber, furniture, electricity pylons, barriers and the like). These furthermore include natural products of animal origin which are intended to be preserved, for example hides, skins, hairs and the like.

Vegetable target crops in the context of this invention are, for example, the following plant species: cereals: (wheat, barley, rye, oats, rice, sorghum, maize and related species); beet (sugar and fodder beet); pulses: (beans, lentils, soybeans, peas, coffee); oil crops: (oilseed rape, mustard, poppy, sunflowers); cucurbits: (cucumbers, pumpkin, melons); fibre plants: (cotton, flax); various vegetables: (lettuce, various cabbages, spinach, carrots, onions, tomatoes, potatoes, bell peppers); ornamental plants: (tulips, daffodils, dahlias, chrysanthemums and other flowers) and kitchen herbs and their seeds.

A preferred process for applying the mixture according to the invention consists in spraying or wetting the separated-off plant material with a liquid preparation, or in mixing the plant material with a solid preparation of the active ingredients. These preservation processes are part of the present invention, as are the wood, the stored goods and stock, or propagation material, which have been treated with this mixture of I and II. The last-mentioned term propagation material includes generative plant material such as seed

and vegetative plant material such as cuttings and tuber (for example potatoes).

The active substances of the formulae I and II are used according to the invention in the form of formulations and can be used, if appropriate, together with other carriers which are customary in the art of formulation, surfactants or other additives which provide advantages on application.

Suitable carriers and additions can be solid or liquid and correspond to the substances which are expedient in the art of formulation, for example natural or regenerated mineral substances, solvents, dispersants, wetting agents, tackifiers, thickeners, binders or fertilisers.

In a particularly preferred process, the seed kernels, tubers, fruits or other plant material to be protected (also, for example, wood) are coated with the mixture of the compounds of the formulae I and II either by allowing the material to absorb a liquid preparation of the active substances or applying a layer of a liquid or solid preparation to the material. In addition, other types of application are possible in specific cases, for example the targeted treatment of plant sections or of twigs which are intended for propagation.

In this context, the compounds of the formulae I and II are used in unaltered form or, preferably, together with the adjuvants customary in the art of formulation, and they are therefore processed in a known fashion to give emulsion concentrates and spreadable pastes (for example for the protection of wood), directly sprayable or dilutable solutions, dilute emulsions, wettable powders, soluble powders, dusts, granules, and also encapsulations, for example in polymeric substances. The application methods such as spraying, misting, atomising, broadcasting, brushing on or pouring as well as the nature of the compositions are selected to suit the intended aims and the prevailing conditions. In general, advantageous application rates in the case of field treatment are 5 g to 5 kg of active ingredient (a.i.) of the formulae I and II per ha; preferably 10 g to 2 kg of a.i./ha, particularly preferably 20 g to 600 g of a.i./ha.

The formulations, i.e. the compositions, preparations or products which contain the active substance of the formulae I and II and, if appropriate, a solid or liquid additive, are prepared in a known manner, for example by intimately mixing and/or grinding the active substances with extenders, for example solvents, solid carriers and, if appropriate, surface-active compounds (surfactants).

The following may be suitable as solvents: aromatic hydrocarbons, preferably the fractions C_8 to C_{12} , for example xylene mixtures or substituted naphthalenes, phthalic esters such as dibutyl phthalate or dioctyl phthalate, aliphatic hydrocarbons such as cyclohexane or paraffins, alcohols and glycols as well as their ethers and esters such as ethylene glycol monomethyl ether, ketones such as cyclohexanone, strongly polar solvents such as N-methyl-2-pyrrolidone, dimethyl sulfoxide or dimethylformamide, and epoxidised and unepoxidised vegetable oils or soya oil; or water.

Solid carriers, for example for dusts and dispersible powders, which can be used are calcite, talc, kaolin, montmorillonite or attapulgite, highly-disperse silica or absorbent polymers. Suitable granulated, adsorptive granule carriers are pumice, brick grit, sepiolite or bentonite, and examples of suitable non-sorptive carriers are calcite or dolomite.

Depending on the nature of the active substances of the formulae I and II to be formulated, surface-active compounds which are suitable are non-ionic, cationic and/or anionic surfactants which have good emulsifying, dispersing and wetting properties. Surfactants are also understood as meaning mixtures of surfactants.

The surfactants customary in the art of formulation are mentioned, inter alia, in the following publications:

"McCutcheon's Detergents and Emulsifiers Annual" MC Publishing Corp., Glen Rock, New Jersey, 1988.

M. and J. Ash, "Encyclopedia of Surfactants", Vol. I-III, Chemical Publishing Co., New York, 1980-1981.

Other particularly expedient additives which are advantageous on application are natural or synthetic phospholipids from the series of the cephalins and lecithins, for example phosphatidylethanolamine, phosphatidylserine, phosphatidylglycerine, lysolecithin.

As a rule, the agrochemical products contain 0.1 to 99 %, in particular 0.1 to 95 %, of active substance of the formula I, 99.9 to 1 %, in particular 99.9 to 5 %, of a solid or liquid additive, and 0 to 25 %, in particular 0.1 to 25 %, of a surfactant.

While concentrated compositions are more preferred as commercially available goods,

dilute compositions are generally used by the consumer.

Such (agro)chemical compositions are part of the present invention.

The examples which follow are intended to illustrate the invention, "active substance" meaning a mixture of compound I and compound II in a particular ratio of 10:1 to 1:11 in the mixture.

<u>Wettable powder</u>	a)	b)	c)
Active substance [I:II = 3:2(a), 1:1(b), 1:11(c)]	25 %	50 %	75 %
Na ligninsulfonate	5 %	5 %	-
Na lauryl sulfate	3 %	-	5 %
Na diisobutylphthalenesulfonate	-	6 %	10 %
Octylphenol polyethylene glycol ether (7-8 mol of ethylene oxide)	-	2 %	-
Highly-disperse silica	5 %	10 %	10 %
Kaolin	62 %	27 %	-

The active substance is intimately mixed with the additives and the mixture is ground thoroughly in a suitable mill. This gives wettable powders which can be diluted with water to give suspensions of any desired concentration. Such slurries can be used for wet-dressing or moist-dressing material which is capable of propagation, for example cereal seed or tubers of plants.

Emulsion concentrate

Active substance (I:II = 2:5)	10 %
Octylphenol polyethylene glycol ether (4-5 mol of ethylene oxide)	3 %
Ca dodecylbenzenesulfonate	3 %
Castor oil polyglycol ether (35 mol of ethylene oxide)	4 %
Cyclohexanone	30 %
Xylene mixture	50 %

Emulsions of any desired concentration which can be employed in crop protection but also

in the protection of wood can be prepared from this concentrate by dilution with water.

<u>Dusts</u>	a)	b)	c)
Active substance [I:II = 4:1 (a); 7:1 (b) and 1:1 (c)]	5 %	8 %	4 %
Talc	95 %	-	-
Kaolin	-	92 %	-
Ground rock	-	-	96 %

Ready-for-use dusts are obtained by mixing the active substance with the carrier and grinding the mixture on a suitable mill. Such powders can be used for dry-dressing seed.

Extruder granules

Active substance (I:II = 7:8)	15 %
Na ligninsulfonate	2 %
Carboxymethylcellulose	1 %
Kaolin	82 %

The active substance is mixed with the additives and the mixture is ground and moistened with water. This mixture is extruded and subsequently dried in a stream of air.

Coated granules

Active substance (I:II = 3:5)	8 %
Polyethylene glycol (MW 200)	3 %
Kaolin	89 %
(MW = molecular weight)	

In a mixer, the kaolin which has been moistened with polyethylene glycol is coated evenly with the finely ground active substance. In this manner, dust-free coated granules are obtained.

Suspension concentrate

Active substance (I:II = 2:3)	40 %
Propylene glycol	10 %
Nonylphenol polyethylene glycol ether (15 mol of ethylene oxide)	6 %

Na ligninsulfonate	10 %
Carboxymethylcellulose	1 %
Silicone oil	
(in the form of a 75 % aqueous emulsion)	1 %
Water	32 %

The finely ground active substance is mixed intimately with the additives. In this manner, a suspension concentrate is obtained from which suspensions of any desired strength can be prepared by dilution with water. Such dilute suspensions can be used for treating live plants and vegetable or animal products by spraying, watering or immersing and thus protecting them against attack by microorganisms.

Biological Examples

In the case of fungicides, a synergistic effect is present when the fungicidal action of the active substance combination is greater than the total of the actions of the individually applied active substances.

The expected action E for a given active substance combination, for example of two fungicides, is described by the so-called COLBY formula and can be calculated as follows (COLBEY, LR. "Calculating synergistic and antagonistic responses of herbicide combination". Weeds 15, pages 20-22.2) (LIMPEL and al., 1962 "Weeds control by... certain combinations". Proc. NEWCL, Vol. 16, pp. 48-53):

(g of a.i./hl = grams of active substance per hectolitre spray liquor)

X = % action by fungicide I with p g of a.i./ha

Y = % action by fungicide II with q g of a.i./ha

E = expected action of fungicides I and II with p+q g of a.i./ha application rate (additive action),

then Colby's formula reads: $E = X + Y - \frac{X \cdot Y}{100}$

If the actually observed action (O) is greater than the expected action, then the action of the combination is superadditive, i.e. a synergistic effect is present.

Example 1: Fungicidal action against pathogen causing stripe disease (*Helminthosporium gramineum*) on winter barley seed

Winter barley (cv. Hauter) which is infected with *Helminthosporium gramineum* is harvested from the field. The malt agar test reveals that 95 % of the seed is infected. This seed is treated with mixtures of the active ingredients as shown in the following table. The ingredients are first dispersed in water and the dispersion is sprayed onto the seed which is on a rotating disc. This procedure corresponds to methods which are customary in practice. Untreated seed of the same origin is used as a control.

Batches of 100 grains are sown, at a depth of 2 cm, in seed dishes (45 x 35 x 10 cm) which are filled with sterile field soil. The test is set up in three replications. The seed dishes are moistened and kept for 28 days at 2°C, with the exclusion of light. They are then transferred to a greenhouse 18°C/12°C (day/night). 56 days after sowing, the disease level is evaluated (% diseased plants). At this point in time, plants which are infested with *H. gramineum* show typical chlorotic stripes on the first leaf. The percentage of diseased plants in the treatments is established in relation to the percentage of diseased, but untreated plants and expressed as % diseased with fungus.

Table 1

Treatment No.	g of active ingredient/ 100 kg of seed		Diseased with fungus (%)	Effect E (calculated) (%) (COLBY)	Effect 0 (found) (%)
	Component I	Component II			
Comparison 1	-	-	100	-	-
2	0.43	-	68	-	32
3	1.7	-	43	-	57
4	3.4	-	38	-	62
5	-	0.5	85	-	15
6	-	1.0	79	-	21
7	-	2.0	58	-	42
8	0.43	0.5	55	42	45
9	0.43	1.0	49	46	51
10	1.7	2.0	22	75	78
11	3.4	0.5	26	68	74
12	3.4	1.0	25	70	75
13	3.4	2.0	12	78	88

As can be seen from Table 1, the treatments Nos. 8-13, in which components I and II had been varied in a broad range of the mixing ratios, show a markedly increased, i.e.

synergistic, effect.

Similarly increased effects, i.e. synergistic effects, are shown in the case of snow mould (*Gerlachia nivalis*) on wheat, barley and rye, against *Ustilago nuda* on barley, against *Tilletia caries* on wheat and against other seed- and soil-borne pathogens.

Example 2: Fungicidal action against *Gerlachia nivalis*. Rye - seed treatment

For use as dry-dressing agents, the active substances extended (= diluted) with ground rocks to give a finely pulverulent mixture which guarantees uniform distribution of the seed surface.

For carrying out the seed treatment, the infected seed together with the seed-dressing agent is placed into a glass flask and the flask is sealed and shaken for 3 minutes.

Batches of 100 grains of rye are sown at a depth of 1 cm in 2 seed dishes, filled with standard soil, and the rye is grown in the greenhouse at a temperature of approx. 10°C and a relative atmospheric humidity of approx. 95 %. The daily illumination with artificial light (greenhouse lamp) is 15 hours.

Approx. 3 weeks after sowing, the plants are evaluated for disease symptoms. The application rates of the individual active substances and of the mixture as well as the test results can be seen from Table 2 below.

Example 3: Fungicidal action against *Fusarium culmorum*. Wheat-seed treatment

The active substances are applied by moist- or dry-dressing.

For carrying out the seed treatment, the infected seed and the seed-dressing agent are placed into a glass flask and the glass flask is sealed and shaken for 3 minutes.

Batches of 100 grains of wheat are sown, at a depth of 1 cm, in 2 seed dishes filled with standard soil, and the wheat is grown in the greenhouse at a temperature of approx. 18°C and 15 hours' daily exposure to artificial light.

Approx. 3 weeks after sowing, the plants are evaluated for disease symptoms.

The application rates of the individual active substances and of the mixture as well as the

test results can be seen from Table 2.

Table 2

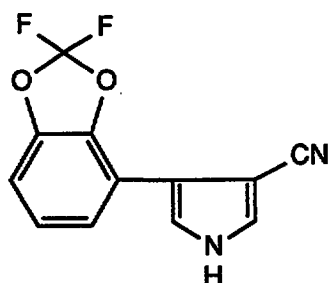
Treatment No.	mg of active ingredient/ kg of seed		Degree of effectiveness in % of the untreated control
	Component I	Component II	
Example 2 (Rye)	1.5625	-	35 %
	-	1.5625	0 %
	0.78125	0.78125	59 %
Example 3 (Wheat)	25	-	59 %
	-	25	64 %
	12.5	12.5	69 %
Untreated control	-	-	0 %



Patent claims:

1. A microbicidal composition containing at least two active substance components, in which one component I) is

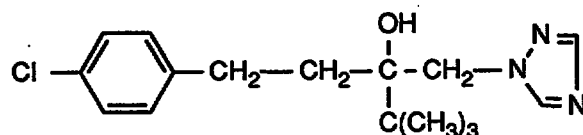
4-(2,2-difluoro-1,3-benzodioxol-7-yl)-1H-pyrrole-3-carbonitrile of the formula I



(I)

and the other component II) is

α -[2-(4-chlorophenyl)ethyl]- α -(1,1-dimethylethyl)- β -(1H-1,2,4-triazolyl)-1-ethanol, of the formula II



(II)

or one of its salts, together with a suitable carrier material.

2. A composition as claimed in claim 1, in which the ratio by weight is I:II = 10:1 to 1:20.

3. A composition as claimed in claim 2, in which the ratio by weight is I:II = 10:1 to 1:12.

4. A composition as claimed in claim 3, in which the ratio by weight is I:II = 4:1 to 1:2.

5. A method for controlling or preventing plant diseases in which a site of the plant which is diseased by, or endangered with, an infection is treated in any desired sequence or simultaneously with at least one active substance of the formula I and one active substance of the formula II.

6. A method as claimed in claim 5, in which plant propagation material is treated.



7. A method as claimed in claim 6, the propagation material being the seed.
8. A plant propagation material which has been treated by the method as claimed in claim 8.
9. A method of protecting material of animal or vegetable origin, in particular stored goods and stock as well as utilisable timber, against attack by microorganisms, which comprises treating the material to be protected in any desired sequence or simultaneously with at least one active substance of the formula I and one active substance of the formula II.
10. The material of animal or vegetable origin which has been treated by the method as claimed in claim 9.

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