Pesticidal Combinations

The present invention relates to the use of a defined combination of pesticidal active ingredients, and compositions thereof, and methods for using such combinations in the control or prevention of pathogenic and/or pest damage.

Certain combinations of active ingredients for controlling pathogens and pests are described in the literature. The biological properties of those known combinations are not entirely satisfactory in the areas of pathogenic control, phytotoxicity, and environmental and worker exposure, for example. In particular, in the instance a pathogen has become, or risks becoming resistant to the previously known combinations, improved methods of control or prevention are sought.

The protection of plant propagation materials (especially seeds) with active ingredients are target applications which partially address the need for a reduction of environmental and worker exposure when used alone or in conjunction with foliar or in-furrow active ingredient applications.

Various compounds of different chemical classes are widely known as plant pesticides for application in various crops of cultivated plants. However, crop tolerance and activity against phytopathogenic plant fungi do not always satisfy the needs of agricultural practice in many incidents and aspects.

There is a continuing need to provide pesticidal combinations, which provide improved, for example, biological properties, for example, synergistic properties, especially for controlling pathogens and/or pests, especially in cereal crops.

Accordingly, the present invention provides a combination comprising combination comprising (I) prochloraz, (II) metconazole, and optionally (III) metalaxyl or mefenoxam.

In a second aspect, the present invention provides a method of controlling or preventing pathogenic damage and/or pest damage in a plant propagation material, a plant, part of a plant and/or plant organ that grow at a later point in time, which comprises applying on the plant, part of the plant, plant organ, plant propagation material or a surrounding area thereof, the

combination as defined in the first aspect, in any desired sequence or simultaneously; especially on a cereal crop.

In a third aspect, the present invention provides a method of protecting a plant propagation material, a plant, part of a plant and/or plant organ that grow at a later point in time against pathogenic damage and/or pest damage by applying to the plant, part of plant, plant organ, plant propagation material or a surrounding area thereof the combination, as defined in the first aspect, in any desired sequence or simultaneously; especially on a cereal crop.

The invention also relates to a plant propagation material treated with a combination defined in the first aspect.

Further, in an embodiment the present invention relates to a method which comprises (i) treating a plant propagation material, such as a seed, with a pesticidal combination as defined in the first aspect, and (ii) planting or sowing the treated propagation material, wherein the combination protects against pathogenic damage and/or pest damage of the treated plant propagation material, part of plant plant organ and/or plant grown from the treated propagation material.

Also, in an embodiment the present invention relates to a method which comprises (i) treating a plant propagation material, such as a seed, with a combination as defined in the first aspect, and (ii) planting or sowing the treated propagation material, and (iii) achieving protection against pathogenic damage and/or pest damage of the treated plant propagation material, parts of plant, plant organ and/or plant grown from the treated propagation material.

In an embodiment of any aspects of the invention, each combination is a composition comprising, preferably of, (I) and (II) and optionally (IV) one or more customary formulation auxiliaries; and a composition comprising, preferably of, (I),(II) and ((III) and optionally (IV) one or more customary formulation auxiliaries .

In a preferred embodiment the combination is in the form of a composition, which composition further comprises (IV) one or more customary formulation auxiliaries. In a preferred embodiment, the composition is in the form of a pre-mix formulated composition.

Each combination can demonstrate synergistic activity compared to activity of compounds alone.

Controlling, preventing or protecting and its inflections, within the context of the present invention, mean reducing any undesired effect, such as

- pathogenic, such as phytopathogenic, especially fungi, infestation or attack of, and
- pathogenic damage or pest damage on,

a plant, part of the plant or plant propagation material to such a level that an improvement is demonstrated.

Each combinations according to the invention has very advantageous properties for protecting plants against (i) pathogenic, such as phytopathogenic, especially fungi, attack or infestation, which result in disease and damage to the plant and/or (ii) pest attack or damage (especially in the instance of an insecticide and/or nematicide being also present in the combination); particularly in the instance of plants, the present invention can control or prevent pathogenic damage and/or pest damage on a seed, parts of plant, plant organs and/or plant grown from the treated seed.

These properties are for example the synergistically enhanced actions of combinations of the compounds (e.g. (I), (II) and (III)), resulting in lower pathogenic damage and/or pest damage, lower rates of application, or a longer duration of action. In the instance of agriculture, the enhanced actions are found to show an improvement in the growing characteristics of a plant by, for example, higher than expected control of the pathogenic infestation and/or pest damage.

The improvement in the growing (or growth) characteristics of a plant can manifest in a number of different ways, but ultimately it results in a better product of the plant. It can, for example, manifest in improving the yield and/or vigour of the plant or quality of the harvested product from the plant, which improvement may not be connected to the control of diseases and/or pests.

As used herein the phrase "improving the yield" of a plant relates to an increase in the yield of a product of the plant by a measurable amount over the yield of the same product of the plant produced under the same conditions, but without the application of the subject

method. It is preferred that the yield be increased by at least about 0.5%, more preferred that the increase be at least about 1%, even more preferred is about 2%, and yet more preferred is about 4%, or more. Yield can be expressed in terms of an amount by weight or volume of a product of the plant on some basis. The basis can be expressed in terms of time, growing area, weight of plants produced, amount of a raw material used, or the like.

As used herein the phrase "improving the vigour" of a plant relates to an increase or improvement of the vigour rating, or the stand (the number of plants per unit of area), or the plant height, or the plant canopy, or the visual appearance (such as greener leaf colour), or the root rating, or emergence, or protein content, or increased tillering, or bigger leaf blade, or less dead basal leaves, or stronger tillers, or less fertilizer needed, or less seeds needed, or more productive tillers, or earlier flowering, or early grain maturity, or less plant verse (lodging), or increased shoot growth, or earlier germination, or any combination of these factors, or any other advantages familiar to a person skilled in the art, by a measurable or noticeable amount over the same factor of the plant produced under the same conditions, but without the application of the subject method.

When it is said that the present method is capable of "improving the yield and/or vigour" of a plant, the present method results in an increase in either the yield, as described above, or the vigor of the plant, as described above, or both the yield and the vigor of the plant.

Accordingly, the present invention also provides a method of improving the growing characterictics of a plant, which comprises applying to the plant, part of plant, and/or plant propagation material, the combination, as defined in the first aspect, in any desired sequence or simultaneously.

In an embodiment, a combination comprises, preferably is,

- prochloraz and metconazole
- prochloraz, metconazole and metalaxyl
- prochloraz, metconazole and mefenoxam

Each of the combinations of the invention can be used in the agricultural sector and related fields of use for controlling or preventing disease infestation and/or pest damage on plants.

Each of the combinations according to the present invention is effective against phytopathogenic fungi, especially occurring in plants, including seedborne fungi and belong to the following classes: Ascomycetes (e.g. Penicillium, Gaeumannomyces graminis); Basidiomycetes (e.g. the genus Hemileia, Rhizoctonia, Puccinia), Fungi imperfecti (e. g. Botrytis, Helminthosporium, Rhynchosporium, Fusarium, Septoria, Cercospora, Alternaria, Pyricularia and Pseudocercosporella herpotrichoides); Oomycetes (e. g. Phytophthora, Peronospora, Bremia, Pythium, Plasmopara); Zygomycetes (e.g., Rhizopus spp.). A combination is especially effective against Alternaria spp., Aspergillus spp., Ascochyta spp., Botrytis cinerea, Cercospora spp., Claviceps purpurea, Cochliobolus spp. (such as Cochliobolus sativus), Colletotrichum spp., Diplodia maydis, Epicoccum spp., Erysiphe graminis, Fusarium spp. (such as Fusarium culmorum, Fusarium subglutinans, Fusarium oxysporium, Fusarium solani, Fusarium graminearum, Fusarium proliferatum, Fusarium moniliforme, and Fusarium pseudograminearum), Gaeumannomyces graminis, Giberella fujikuroi, Giberella zeae, Helminthosporium graminearum, Microdochium nivale, Monographella nivalis, Penicillium spp., Puccinia spp., Pyrenophora spp. (such as Pyrenophora graminea), Peronosclerospora spp., Peronspora spp., Phakopsora pachyrhizi, Phythium spp., Phoma spp., Phomopsis spp., Rhizoctonia solani, Rhizoctonia cerealis, Septoria spp., Pseudocercosporella spp., Sclerotinia spp., Sphacelotheca reilliana, Tilletia spp., Rhizopus spp., Typhula spp., Ustilago spp., Urocystis occulta, Sphacelotheca spp. (e.g. Spacelotheca reilliani), Thielaviopsis basicola,
Typhula incarnata, Thanatephorus cucumeris, and Verticillium spp..

In an embodiment, the combination is controlling a damage caused by Fusarium spp. (such as Fusarium culmorum, Fusarium subglutinans, Fusarium oxysporium, Fusarium solani, Fusarium graminearum, Fusarium proliferatum, and Fusarium moniliforme and Fusarium pseudograminearum), Ustilago spp., and/or Pyrenophora spp. (such as Pyrenophora graminea) phytopathogenic fungi.

In an embodiment, further active ingredient(s) can be used for better control of pests with a combination according to the present invention. Such further active ingredients can be other fungicides, insecticides, acaricides, nematicides. Examples of suitable other fungicides are strobilurins (such as trifloxystrobin, fluoxastrobin, azoxystrobin, and pyraclostrobin) for use with each of the following combination

- prochloraz and metconazole

- prochloraz, metconazole and metalaxyl
- prochloraz, metconazole and mefenoxam

In the event each combination of the invention (see immediately above) also includes a pesticide other than fungicide (such as thiamethoxam, abamectin, clothianidin, imidacloprid, tefluthrin, lambda-cyhalothrin) then the pesticide spectrum of the combination is broadened to include pest control, such as control of pests selected from Nematoda, Insecta and Arachnida. In that instance, the combination can also be applied on the pest to control or prevent pest damage and protect the desired material (e.g. plant and part of plant) from pest damage.

Examples of pests include:

from the order Lepidoptera, for example, Acleris spp., Adoxophyes spp., Aegeria spp., Agrotis spp., Alabama argillaceae, Amylois spp., Anticarsia gemmatalis, Archips spp., Argyrotaenia spp., Autographa spp., Busseola fusca, Cadra cautella, Carposina nipponensis, Chilo spp., Choristoneura spp., Clysia ambiguella, Cnaphalocrocis spp., Cnephasia spp., Cochylis spp., Coleophora spp., Crocidolomia spp., Cryptophlebia leucotreta, Crysodeixis includens, Cydia spp., Diatraea spp., Diparopsis castanea, Earias spp., Elasmopalpus spp., Ephestia spp., Eucosma spp., Eupoecilia ambiguella, Euproctis spp., Euxoa spp., Grapholita spp., Hedya nubiferana, Heliothis spp., Hellula undalis, Hyphantria cunea, Keiferia lycopersicella, Leucoptera scitella, Lithocollethis spp., Lobesia botrana, Lymantria spp., Lyonetia spp., Malacosoma spp., Mamestra brassicae, Manduca sexta, Operophtera spp., Ostrinia nubilalis, Pammene spp., Pandemis spp., Panolis flammea, Pectinophora gossypiella, Phthorimaea operculella, Pieris rapae, Pieris spp., Plutella xylostella, Prays spp., Scirpophaga spp., Sesamia spp., Sparganothis spp., Spodoptera spp., Synanthedon spp., Thaumetopoea spp., Tortrix spp., Trichoplusia ni and Yponomeuta spp.;

from the order Coleoptera, for example, Agriotes spp., Anthonomus spp., Atomaria linearis, Ceutorhynchus spp., Chaetocnema tibialis, Cosmopolites spp., Curculio spp., Dermestes spp., Diabrotica spp., Epilachna spp., Eremnus spp., Gonocephalum spp., Heteronychus spp., Leptinotarsa decemlineata, Lissorhoptrus spp., Melolontha spp., Orycaephilus spp., Otiorhynchus spp., Phlyctinus spp., Phyllotreta spp., Popillia spp., Protostrophus spp., Psylliodes spp., Rhizopertha spp., Scarabeidae, Sitophilus spp., Sitotroga spp., Tenebrio spp., Tribolium spp. and Trogoderma spp.;

from the order Orthoptera, for example, Blatta spp., Blattella spp., Gryllotalpa spp., Leucophaea maderae, Locusta spp., Periplaneta spp. and Schistocerca spp.;

from the order Isoptera, for example, Reticulitermes spp.;

from the order Psocoptera, for example, Liposcelis spp.;
from the order Anoplura, for example, Haematopinus spp., Linognathus spp., Pediculus spp., Pemphigus spp. and Phylloxera spp.;
from the order Mallophaga, for example, Damalinea spp. and Trichodectes spp.;
from the order Thysanoptera, for example, Frankliniella spp., Hercinothrips spp., Taeniothrips spp., Thrips palmi, Thrips tabaci and Scirtothrips aurantii;
from the order Heteroptera, for example, Dichelops melacanthus, Distantiella theobroma, Dysdercus spp., Euchistus spp., Eurygaster spp., Leptocorisa spp., Nezara spp., Piesma spp., Rhodnius spp., Sahlbergella singularis, Scotinophara spp. and Triatoma spp.;
from the order Homoptera, for example, Aleurothrixus floccosus, Aleyrodes brassicae, Aonidiella spp., Aphididae, Aphis spp., Aspidiotus spp., Bemisia tabaci, Ceroplaster spp., Chrysomphalus aonidium, Chrysomphalus dictyospermi, Coccus hesperidum, Empoasca spp., Eriosoma larigerum, Erythroneura spp., Gascardia spp., Laodelphax spp., Lecanium corni, Lepidosaphes spp., Macrosiphus spp., Myzus spp., Nephotettix spp., Nilaparvata spp., Paratoria spp., Pemphigus spp., Planococcus spp., Pseudaulacaspis spp., Pseudococcus spp., Psylla spp., Pulvinaria aethiopica, Quadraspidiotus spp., Rhopalosiphum spp., Saissetia spp., Scaphoideus spp., Schizaphis spp., Sitobion spp., Trialeurodes vaporariorum, Trioza erytreae and Unaspis citri;
from the order Hymenoptera, for example, Acromyrmex, Athalia rosae, Atta spp., Cephus spp., Diprion spp., Diprionidae, Gilpinia polytoma, Hoplocampa spp., Lasius spp., Monomorium pharaonis, Neodiprion spp., Solenopsis spp. and Vespa spp.;
from the order Diptera, for example, Antherigona soccata, Bibio hortulanus, , Ceratitis spp., Chrysomyia spp., Culex spp., Cuterebra spp., Dacus spp., Delia spp., Drosophila melanogaster, , Liriomyza spp., , Melanagromyza spp., , Orseolia spp., Oscinella frit, Pegomyia hyoscyami, Phorbia spp., Rhagoletis pomonella, Sciara spp.,;
from the order Acarina, for example, Acarus siro, Aceria sheldoni, Aculus schlechtendali, Amblyomma spp., Argas spp., , Brevipalpus spp., Bryobia praetiosa, Calipitrimerus spp., Chorioptes spp., Dermanyssus gallinae, Eotetranychus carpini, Eriophyes spp., Hyalomma spp., Olygonychus pratensis, Ornithodoros spp., Panonychus spp., Phyllocoptruta oleivora, Polyphagotarsonemus latus, Psoroptes spp., Rhipicephalus spp., Rhizoglyphus spp., Sarcoptes spp., Tarsonemus spp. and Tetranychus spp.; and
from the class Nematoda, for example, the species of Meloidogyne spp. (for example, Meloidogyne incoginita and Meloidogyne javanica), Heterodera spp. (for example, Heterodera glycines, Heterodera schachtii, Heterodora avenae and Heterodora trifolii), Globodera spp. (for

example, Globodera rostochiensis), Radopholus spp. (for example, Radopholus similes), Rotylenchulus spp., Pratylenchus spp. (for example, Pratylenchus neglectans and Pratylenchus penetrans), Aphelenchoides spp., Helicotylenchus spp., Hoplolaimus spp., Paratrichodorus spp., Longidorus spp., Nacobbus spp., Subanguina spp. Belonlaimus spp., Criconemella spp., Criconemoides spp. Ditylenchus spp., Dolichodorus spp., Hemicriconemoides spp., Hemicycliophora spp., Hirschmaniella spp., Hypsoperine spp., Macroposthonia spp., Melinius spp., Punctodera spp., Quinisulcius spp., Scutellonema spp., Xiphinema spp., and Tylenchorhynchus spp.

Each of the combinations of the invention can be formulated for a particular use. Preferably, each combination is formulated for protecting cultivated plants or their propagation materials. Accordingly, each combination of the invention can be applied to the plant in a conventional manner, such as foliar spray. Advantageously, each of the combinations are formulated for plant propagation material, such as seed, treatment applications for controlling or preventing damage by pests and/or pathogens, which are found in agriculture and forestry, and can particularly damage the plant in the early stages of its development.

Further, the present invention also envisages soil application of the combinations of the invention to control the soil-dwelling pests and/or soil-borne pathogens. Methods of applying to the soil can be via any suitable method, which ensures that the combination penetrates the soil, for example, nursery tray application, in furrow application, soil drenching, soil injection, drip irrigation, application through sprinklers or central pivot, incorporation into soil (broad cast or in band) are such methods.

The benefits from the invention can also be achieved either by (i) treating plant propagation material with a combinaton or (ii) applying to the locus where control is desired, generally the planting site, the combination, or both (i) and (ii).

The term "plant propagation material" is understood to denote all the generative parts of the plant, such as seeds, which can be used for the multiplication of the latter and vegetative plant materials such as cuttings and tubers (for example, potatoes). Accordingly, as used herein, part of a plant includes propagation material. There may be mentioned, *e.g.*, the seeds (in the strict sense), roots, fruits, tubers, bulbs, rhizomes, parts of plants. Germinated plants and young plants, which are to be transplanted after germination or after emergence from the soil,

may also be mentioned. These young plants may be protected before transplantation by a total or partial treatment by immersion.

Parts of plant and plant organs that grow at later point in time are any sections of a plant that develop from a plant propagation material, such as a seed. Parts of plant, plant organs, and plants can also benefit from the pathogenic and/or pest damage protection achieved by the application of each combination on to the plant propagation material. In an embodiment, certain parts of a plant and certain plant organs that grow at later point in time can also be considered as plant propagation material, which can themselves be applied (or treated) with the combination; and consequently, the plant, further parts of the plant and further plant organs that develop from the treated parts of plant and treated plant organs can also benefit from the pathogenic and/or pest damage protection achieved by the application of each combinations on to the certain parts of plant and certain plant organs.

Methods for applying or treating pesticidal active ingredients and mixtures thereof on to plant propagation material, especially seeds, are known in the art, and include dressing, coating, pelleting and soaking application methods of the propagation material. In a preferred embodiment, the combination is applied or treated on to the plant propagation material by a method such that the germination is not induced; generally seed soaking induces germination because the moisture content of the resulting seed is too high. Accordingly, examples of suitable methods for applying (or treating) a plant propagation material, such as a seed, is seed dressing, seed coating or seed pelleting and alike.

It is preferred that the plant propagation material is a seed. Although it is believed that the present method can be applied to a seed in any physiological state, it is preferred that the seed be in a sufficiently durable state that it incurs no damage during the treatment process. Typically, the seed would be a seed that had been harvested from the field; removed from the plant; and separated from any cob, stalk, outer husk, and surrounding pulp or other non-seed plant material. The seed would preferably also be biologically stable to the extent that the treatment would cause no biological damage to the seed. It is believed that the treatment can be applied to the seed at any time between harvest of the seed and sowing of the seed or during the sowing process (seed directed applications). The seed may also be primed either before or after the treatment.

Even distribution of the active ingredients and adherence thereof to the seeds is desired during propagation material treatment. Treatment could vary from a thin film (dressing) of the formulation containing the active ingredient(s) on a plant propagation material, such as a seed, where the original size and/or shape are recognizable to an intermediary state (such as a coating) and then to a thicker film (such as pelleting with many layers of different materials (such as carriers, for example, clays; different formulations, such as of other active ingredients; polymers; and colourants) where the original shape and/or size of the seed is no longer recognisable.

An aspect of the present invention includes application of the active ingredients onto the plant propagation material in a targeted fashion, including positioning the active ingredients onto the entire plant propagation material or on only parts thereof, including on only a single side or a portion of a single side. One of ordinary skill in the art would understand these application methods from the description provided in EP954213B1 and WO06112700.

Application of the combinations described herein onto plant propagation material also includes protecting the plant propagation material treated with the combination of the present invention by placing one or more pesticide-containing particles next to a pesticide-treated seed, wherein the amount of pesticide is such that the pesticide-treated seed and the pesticide-containing particles together contain an Effective Dose of the pesticide and the pesticide dose contained in the pesticide-treated seed is less than or equal to the Maximal Non-Phytotoxic Dose of the pesticide. Such techniques are known in the art, particularly in WO2005/120226.

Application of the combinations of active ingredients onto the seed also includes controlled release coatings on the seeds, wherein the active compounds are incorporated into materials that release the active compounds over time. Examples of controlled release seed treatment technologies are generally known in the art and include polymer films, waxes, or other seed coatings, wherein the active compounds may be incorporated into the controlled release material or applied between layers of materials, or both.

In an embodiment, the present invention may involve:

(a) treating plant propagation material with a combination of the invention,

(b) germinating or growing said plant propagation material to produce a plant,

(c) harvesting plant material from said plant, and

(d) achieving a reduction in the mycotoxin contamination of (a) the plant grown from the treated plant propagation material and/or (b) harvested plant material.

Accordingly, the combinations of the invention can contribute to a reduction in the mycotoxin contamination of (a) the plant grown from the treated plant propagation material and/or (b) harvested plant material.

The mycotoxin contamination is preferably caused by fungi, such as one or more *Fusarium* species (such as one or more of Fusarium graminearum, Fusarium culmorum, Fusarium subglutinans, Fusarium oxysporium, Fusarium solani, Fusarium proliferatum, and Fusarium moniliforme) infestation of the plant propagation material.

In an embodiment, the mycotoxin is one or more of a fumonisin and trichothecene, preferably the mycotoxin is deoxynivalenol and/or zearalenon.

The method for reducing mycotoxin contamination of a plant and/or harvested plant material is suitable for a number of useful crops including, but not limited to cereals (wheat, barley, rye, oats, maize (or corn), rice, sorghum and related crops), leguminous plants (beans, lentils, peas, soybeans, peanuts and related crops), oil plants (rape, mustard, sunflowers and related plants), cucumber plants (marrows, cucumbers, melons and related plants), vegetables (spinach, lettuce, asparagus, cabbages, carrots, eggplants, onions, pepper, tomatoes, potatoes, paprika and related plants). Harvested plant material obtained from plants treated using the method of the invention will have less mycotoxin contamination than harvested plant material from untreated plants. In an embodiment, the crop is one producing a product for human consumption, such as small grain cereals, maize, oats, and peanuts; preferably the crop is selected from maize and wheat.

In a particular embodiment of the invention, plant or harvested plant material has at least 10% less mycotoxin, more preferable at least 20% less mycotoxin, more preferably at least 30% less mycotoxin, more preferably at least 40% less mycotoxin, more preferably at least 50% less mycotoxin, more preferably at least 60% less mycotoxin, more preferably at least 70% less mycotoxin and more preferably at least 80% less mycotoxin contamination than harvested plant material from untreated plants. The plant propagation material treatment with the compound of formula I or defined combinations thereof of the invention preferably provide a

reduction of between 20 to 60, more preferably between 30 to 50; %, in mycotoxin compared to treatments by other fungicides.

Seed can be treated by applying thereto the at least one active ingredients of component (I) and at least one component (II) in any desired sequence or simultaneously.

The seed treatment occurs to an unsown seed, and the term "unsown seed" is meant to include seed at any period between the harvest of the seed and the sowing of the seed in the ground for the purpose of germination and growth of the plant.

Treatment to an unsown seed is not meant to include those practices in which the active ingredient is applied to the soil but would include any application practice that would target the seed during the planting process.

Preferably, the treatment occurs before sowing of the seed so that the sown seed has been pre-treated with the combination. In particular, seed coating or seed pelleting are preferred in the treatment of the combinations according to the invention. As a result of the treatment, the active ingredients in each combination are adhered on to the seed and therefore available for pathogenic and/or pest control.

The treated seeds can be stored, handled, sowed and tilled in the same manner as any other active ingredient treated seed.

Each of the combinations according to the present invention are suitable for plants of the crops: cereals (wheat, barley, rye, oats, corn, rice, sorghum, triticale and related crops); beet (sugar beet and fodder beet); leguminous plants (beans, lentils, peas, soybeans); oil plants (rape, mustard, sunflowers); cucumber plants (marrows, cucumbers, melons); fibre plants (cotton, flax, hemp, jute); vegetables (spinach, lettuce, asparagus, cabbages, carrots, onions, tomatoes, potatoes, paprika); as well as ornamentals (flowers, shrubs, broad-leaved trees and evergreens, such as conifers). Especially suitable are wheat, barley, rye, oats, rice, sorghum, triticale, corn, and soybean.

Suitable target crops also include transgenic crop plants of the foregoing types. The transgenic crop plants used according to the invention are plants, or propagation material

thereof, which are transformed by means of recombinant DNA technology in such a way that they are - for instance - capable of synthesizing selectively acting toxins as are known, for example, from toxin-producing invertebrates, especially of the phylum Arthropoda, as can be obtained from Bacillus thuringiensis strains; or as are known from plants, such as lectins; or in the alternative capable of expressing a herbicidal or fungicidal resistance. Examples of such toxins, or transgenic plants which are capable of synthesizing such toxins, have been disclosed, for example, in EP-A-0 374 753, WO 93/07278, WO 95/34656, EP-A-0 427 529 and EP-A-451 878 and are incorporated by reference in the present application.

Each of the combinations according to the present invention is particularly well suited for combating pathogens in cereals, such as wheat, barley, rye or oats; maize; rice; soybean; turf; sugarbeet; oil seed rape; potatoes; pulse crops, such as peas, lentils or chickpea; and sunflower.

In an embodiment, the combination azoxystrobin, fludioxonil and difenoconazole is useful for cereal crops, such as wheat, barley, rye, oats, corn, rice, sorghum and triticale.

Each of the combinations according to the present invention is particularly effective against rusts; powdery mildews; leafspot species; early blights; stalk rots; molds and post harvest dieseases; especially against Puccinia in cereals; Phakopsora in soybeans; Hemileia in coffee; Phragmidium in roses; Alternaria in potatoes, tomatoes and cucurbits; Sclerotinia in vegetables, sunflower and oil seed rape; black rot, red fire, powdery mildew, grey mold and dead arm disease in vine; Botrytis cinerea in fruits; Monilinia spp. in fruits and Penicillium spp. in fruits.

Each of the combinations is especially useful for controlling plant diseases, such as: Alternaria species in fruit and vegetables; Ascochyta species in pulse crops; Botrytis cinerea (gray mold) in strawberries, tomatoes, sunflower and grapes; Cercospora arachidicola in groundnuts; Cochliobolus sativus in cereals; Colletotrichum species in pulse crops; Erysiphe cichoracearum and Sphaerotheca fuliginea in cucurbits; Erysiphe graminis in cereals; Fusarium graminearum in cereals and maize; Fusarium culmorum; F. avenaceum; F. cerealis; F. equiseti; F. langsethiae; F. poae; F. sporotrichioides; or F. tricinctum in cereals; Fusarium spp. in cotton, millet, rice, soybean, sugarbeet, potatoes and vegetables; Fusarium moniliforme in maize; Fusarium proliferatum in maize; Fusarium subglutinans in maize; Fusarium

oxysporum in maize; Gäumannomyces graminis in cereals and lawns; Giberella fujikuroi in rice; Helminthosporium maydis in maize; Helminthosporium oryzae in rice; Helminthosporium solani on potatoes; Hemileia vastatrix on coffee; Microdochium nivale in wheat and rye; Mycosphaerella pinoides in peas; Phakopsora pachyrhizi in soybean; Puccinia species in cereals; Phragmidium mucronatum in roses; Phoma spp. in sugarbeet; Phoma exigua in potatoes; Pythium spp. in cereals, cotton, maize and soybean; Plasmopara halstedii in sunflowers; Pyrenophora graminea in barley; Pyricularia oryzae in rice; Rhizoctonia species in cotton, soybean, cereals, maize, potatoes, rice and lawns; Sclerotinia homeocarpa in lawns; Septoria spp. in cereals; Sphacelotheca reilliana in maize; Tilletia species in cereals; Typhula incarnata in barley; Uncinula necator, Guignardia bidwellii and Phomopsis viticola in vines; Urocystis occulta in rye; Ustilago species in cereals and maize; Monilinia fructicola on stone fruits; Monilinia fructigena on fruits; Monilinia laxa on stone fruits; Penicillium digitatum on citrus; Penicillium expansum on apples; and Penicillium italicum on citrus.

The mass ratio of active ingredient compounds in each combination is selected as to give the desired, for example, synergistic action. In general, the mass ratio would vary depending on the specific active ingredient and how many active ingredients are present in the combination. Generally, the mass ratio between any two active ingredients is from 100:1 to 1:100, including from 99:1, 98:2, 97:3, 96:4, 95:5, 94:6, 93:7, 92:8, 91:9, 90:10, 89:11, 88:12, 87:13, 86:14, 85:15, 84:16, 83:17, 82:18, 81:19, 80:20, 79:21, 78:22, 77:23, 76:24, 75:25, 74:26, 73:27, 72:28, 71:29, 70:30, 69:31, 68:32, 67:33, 66:34, 65:45, 64:46, 63:47, 62:48, 61:49, 60:40, 59:41, 58:42, 57:43, 56:44, 55:45, 54:46, 53:47, 52:48, 51:49, 50:50, 49:51, 48:52, 47:53, 46:54, 45:55, 44:56, 43:57, 42:58, 41:59, 40:60, 39:61, 38:62, 37:63, 36:64, 35:65, 34:66, 33:67, 32:68, 31:69, 30:70, 29:71, 28:72, 27:73, 26:74, 25:75, 24:76, 23:77, 22:78, 21:79, 20:80, 19:81, 18:82, 17:83, 16:84, 15:85, 14:86, 13:87, 12:88, 11:89, 10:90, 9:91, 8:92, 7:93, 6:94, 5:95, 4:96, 3:97, 2:98, to 1:99. Preferred mass ratios between any two components of present invention are from 75:1 to 1:75, more preferably, 50:1 to 1.50, especially 25:1 to 1:25, advantageously 10:1 to 1:10, such as 5:1 to 1:5.

The rates of application (use) of a combination vary, for example, according to type of use, type of crop, the specific active ingredients in the combination, type of plant propagation material (if appropriate), but is such that the active ingredients in the combination is an effective amount to provide the desired enhanced action (such as disease or pest control) and

can be determined by trials and routine experimentation known to one of ordinary skill in the art.

Generally for foliar or soil treatments, application rates can vary from 0.05 to 3 kg per hectare (g/ha) of active ingredients.

Generally for seed treatments, application rates can vary from 0.5 to 1000g / 100kg of seeds of active ingredients.

In the event, the combination comprises the active ingredients (I) prochloraz and (II) metconazole, the application rates for tend to be 5 – 30 g/100kg of seeds of (I); and 2 - 10 g/100kg of seeds of (II).

in the event, the combination comprises the active ingredients (I) prochloraz, (II) metconazole and (III) metalaxyl, the application rates for tend to 5 – 30 g/100kg of seeds of (I); 2 - 10 g/100kg of seeds of (II); and 2-10 g/100kg of seeds of (III).

in the event, the combination comprises the active ingredients (I) prochloraz, (II) metconazole and (III) mefenoxam, the application rates for tend to be 5 – 30 g/100kg of seeds of (I); 2 - 10 g/100kg of seeds of (II); and 1-5 g/100kg of seeds of (III).

The plant propagation material treated by each combination of the present invention can be, therefore, resistant to disease and/or pest damage; accordingly, the present invention also provides a pathogenic and/or pest resistant plant propagation material which is treated with each combination and consequently at least the active ingredients thereof are adhered on the propagation material, such as seed.

The seed treatment combinations and compositions can also comprise or may be applied together and/or sequentially with further active compounds. These further useful active compounds can be fertilizers or micronutrient donors (such as Mo, Zn and / or Co) or other preparations that influence plant growth, such as inoculants (e.g. a strain of nitrogen-fixing bacteria), plant inducers (e.g. nod factors – see US2005187107, which hereby is incorporated).

In a preferred embodiment of the invention, soybean seeds and transgenic soybean seeds are treated with a combination of the present invention. In addition, the soybean seeds may be inoculated with an appropriate strain of nitrogen-fixing bacteria for the purpose of promoting plant growth. Preferably, seeds may be inoculated with an effective bacterial strain such as Rhizobium spp. or Azospirillium spp. before sowing. The primary effect of such bacteria is in the fixation of atmospheric nitrogen into a useable form for the plant. Rhizobia bacteria, for example, is especially preferred in order to form nodules on the plant roots that are sustained by the plant and in turn provide nitrogen for the plant as mentioned above.

In a further embodiment, a soybean plant propagation material is treated with a plant inducer, e.g. a nod factor derived from Bradyrhizobium japonicum, Sinorhizobium fredii, Sinorhizobium meliloti, Bradyrhizobium sp. (Arachis), or Rhizobium leguminosarum biovar phaseoli, viceae, or trifolii.

In an aspect, the present invention also envisages use of the combinations of the present invention with glyphospate tolerant plants, especially glyphospate tolerant soybean plants, in particular for the control of asian soybean rust. Accordingly, the present invention provides a method comprising (α) applying a combination (A) to a glyphosate tolerant plant propagation material, preferably soybean propagation material, and (β) applying a pesticidal composition (B) to the resulting plant, part of plant and/or the locus thereof one or more times (i) before emergence, (ii) after emergence, or (iii) both (i) and (ii), provided that combination (A) is as defined in the first aspect; and pesticide composition (B) comprises glyphosate. Generally, glyphosate-containing composition can be applied, if applied only once, at a rate of 960 g ae/ha; if applied twice the rate can vary from 1200 to 1680 g ae/ha. The rates and number of applications vary according to the particular conditions. Preferably, the composition (B) is applied three times with an application rate of 960, 720 and 400 g ae/ha respectively. In an embodiment, the present invention controls, prevents or treats *Phakopsora pachyrhizi* and/or *P. meibomiae*, especially *Phakopsora pachyrhizi*.

Each of the combinations of the present invention may also comprise alkali metal, alkaline earth metal, metal, or ammonium salts. Zinc chloride and alkali metal, alkaline earth metal, or ammonium salts of mineral acids, especially nitrates, phosphates, sulfates, chlorides, and carbonates of sodium, potassium, ammonium, magnesium, and calcium are preferred.

Each of the combinations of the present invention may additionally comprise micronutrients to aid in the nourishment and health of the plant and/or plant propagation material. Suitable micronutrients include, but are not limited to, chlorine (Cl), zinc (ZN), boron (B), copper (Cu), iron (Fe), manganese (Mn) or molybdenum (Mo). Micronutrients may be supplied in chelate form.

Depending upon the particular plant propagation material to be treated, the conditions under which it is to be stored, and the soil and weather conditions under which it is expected to germinate and grow, the combinations of the present invention may include a wide spectrum of one or more additives. Such additives include, but are not limited to, uv-protectants, pigments, dyes, extenders such as flour, dispersing agents, excipients, anti-freezing agents, preservatives, herbicidal safeners, seed safeners, seed conditioners, micronutients, fertilizers, biocontrol agents, surfactants, sequestering agents, plasticizers, colorants, brighteners, emulsifiers, flow agents such as calcium stearate, talc and vermiculite, coalescing agents, defoaming agents, humectants, thickeners, waxes, bactericides, insecticides, pesticides, and fillers such as cellulose, glass fibers, clay, kaolin, talc, pulverized tree bark (e.g., Douglas fir bark or alderbark), calcium carbonate and wood meal, and odor-modifying agents. Typical excipients include finely divided mineral substances such as pumice, attapulgite, bentonite, kaoline zeolite, diatomite, and other clays, modified diatomaceous adsorbents, charcoal, vermiculite, finely divided organic substances such as peat moss, wood powder, and the like. Such additives are commercially available and known in the art.

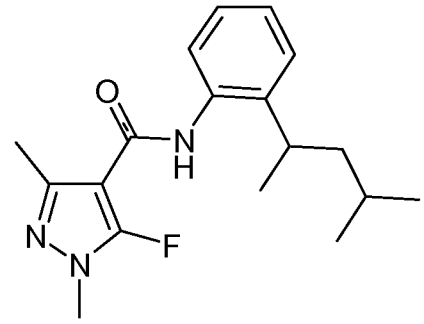
A single pesticidal active ingredient may have activity in more than one area of pest control, for example, a pesticide may have fungicide, insecticide and nematicide activity. Specifically, aldicarb is known for insecticide, acaricide and nematicide activity, while metam is known for insecticide, herbicide, fungicide and nematicide activity, and thiabendazole and captan can provide nematicide and fungicide activity.

Each of the combinations of the present invention may be mixed with one or more other pesticides, such as other fungicides, insecticides and nematicides.

Examples of other pesticides include triazole derivatives, strobilurins, carbamate (including thiocarbamate), benzimidazoles (thiabendazole, thiophante-methyl), N-trihalomethylthio compounds (captan), substituted benzenes, carboxamides, phenylamides and phenylpyrroles,

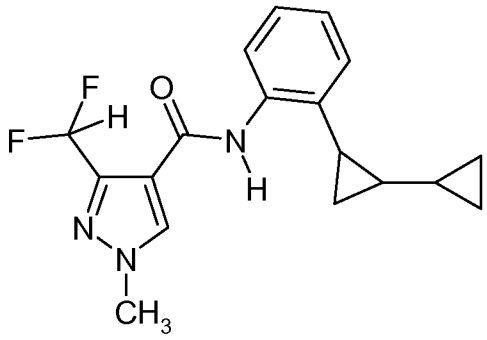
and mixtures thereof; and neonicotinoids, biological fermentation products (e.g. abamectin, emamectin), carbamates and pyrethroids.

Specific examples of fungicides are benalaxyl, benalaxy-M, captan, fuberidazole, bitertanol, cyproconazole, pencycuron, azoxystrobin, pyraclostrobin, fluoxastrobin, trifloxystrobin, a compound of formula X



(X),

a compound of formula (A)



(A).

Specific examples of insecticides are thiamethoxam, clothianidin, imidacloprid, abamectin, lambda-cyhalothrin, fipronil, tefluthrin, beta-cyfluthrin, thiodicarb, chlorantraniliprole, flubendamide (3-iodo-*N'*-(2-mesyl-1,1-dimethylethyl)-*N*-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-*o*-tolyl}phthalamide).

Abamectin and thiodicarb are also useful for controlling nematodes.

In an embodiment, one or more of thiamethoxam, clothianidin, imidacloprid, abamectin, lambda-cyhalothrin, tefluthrin, fipronil, beta-cyfluthrin, thiodicarb, chlorantraniliprole, flubendamide (3-iodo-*N'*-(2-mesyl-1,1-dimethylethyl)-*N*-{4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-*o*-tolyl}phthalamide), azoxystrobin, pyraclostrobin, fluoxastrobin,

trifloxystrobin, fludioxonil, thiram, carboxin, pencyuron is combined with each one of:

- prochloraz and metconazole
- prochloraz, metconazole and metalaxyl
- prochloraz, metconazole and mefenoxam

In an embodiment, each combination may also be used with a biological agent, such as *Pasteuria spp.*, *Pseudomonas spp.*, *Bacillus spp.*, *Corynebacterium spp.*, *Agrobacterium spp.*, and *Paenibacillus spp.* As a non-limiting example, the bacterial biological control agents can be endoparasitic bacterium of the genus *Pasteuria, e.g. Pasteuria penetrans, Baccilus firmus, Pseudomonas cepacia, Corynebacterium paurometabolum*, *P. thornei*, *P. nishizawae*, *Candidatus Pasteuria usgae sp.* nov., or *Candidatus Pasteuria sp.* strain HG..

The compounds of the combinations (e.g. (I), (II) and optionally (III)), and any other pesticides, may be used either in pure form, i.e., as a solid active ingredient, for example, in a specific particle size, or preferably together with at least one of the auxiliary (also known as adjuvants) customary in formulation technology, such as extenders, *e.g.*, solvents or solid carriers, or surface-active compounds (surfactants), in the form of a formulation, in the present invention. Generally, the compounds (I), (II) and (III) are in the form of a formulation composition with one or more of customary formulation auxiliaries.

Therefore, each combination of compounds (e.g. (I), (II) and optionally (III)) is normally used in the form of formulations. The compounds can be applied to the locus where control is desired either simultaneously or in succession at short interval, for example on the same day, if desired together with further carriers, surfactants or other application-promoting adjuvants customarily employed in formulation technology. In a preferred embodiment, a combination is applied simultaneously.

In the event compounds of the combinations (e.g. (I), (II) and optionally (III)) are applied simultaneously in the present invention, they may be applied as a composition containing the combination, in which case each of (I), (II) and optionally (III) can be obtained from a separate formulation source and mixed together (known as a tank-mix, ready-to-apply, spray broth, or slurry), optionally with other pesticides, or (I), (II) and optionally (III) can be obtained as single formulation mixture source (known as a pre-mix, concentrate, formulated product), and optionally mixed together with other pesticides.

In an embodiment, each combination of the present invention is applied as a composition. Accordingly, the present invention includes a composition comprising, as active ingredients, (I), (II) and optionally (III), and optionally other pesticides, and optionally one or more customary formulation auxiliaries; which may be in the form of a tank-mix or pre-mix composition.

In an embodiment, each combination of (I), (II) and optionally (III), such as prochloraz & metconazole; prochloraz, metconazole & metalaxyl and prochloraz, metconazole & mefenoxam, is provided in the form of a pre-mix composition (or formulated product).

Alternative to the actual synergistic action with respect to pesticidal activity, the combinations according to the invention also can have surprising advantageous properties which can also be described, in a wider sense, as synergistic activity. Examples of such advantageous properties that may be mentioned are: advantageous behaviour during formulation and/or upon application, for example upon grinding, sieving, emulsifying, dissolving or dispensing; increased storage stability; improved stability to light; more advantageous degradability; improved toxicological and/or ecotoxicological behaviour; or any other advantages familiar to a person skilled in the art.

Examples of foliar formulation types for pre-mix compositions are:
GR: Granules
WP: wettable powders
WG: water dispersable granules (powders)
SG: water soluble granules
SL: soluble concentrates
EC: emulsifiable concentrate
EW: emulsions, oil in water
ME: micro-emulsion
SC: aqueous suspension concentrate
CS: aqueous capsule suspension
OD: oil-based suspension concentrate, and
SE: aqueous suspo-emulsion.

Whereas, examples of seed treatment formulation types for pre-mix compositions are:

WS: wettable powders for seed treatment slurry
LS: solution for seed treatment
ES: emulsions for seed treatment
FS: suspension concentrate for seed treatment
WG: water dispersible granules, and
CS: aqueous capsule suspension.

Examples of formulation types suitable for tank-mix compositions are solutions, dilute emulsions, suspensions, or a mixture thereof, and dusts.

As with the nature of the formulations, the methods of application, such as foliar, drench, spraying, atomizing, dusting, scattering, coating or pouring, are chosen in accordance with the intended objectives and the prevailing circumstances.

The tank-mix compositions are generally prepared by diluting with a solvent (for example, water) the one or more pre-mix compositions containing different pesticides, and optionally further auxiliaries.

Suitable carriers and adjuvants can be solid or liquid and are the substances ordinarily employed in formulation technology, e.g. natural or regenerated mineral substances, solvents, dispersants, wetting agents, tackifiers, thickeners, binders or fertilizers.

The formulations are prepared in known manner, e.g., by homogeneously mixing and/or grinding the active ingredients with extenders, e.g., solvents, solid carriers and, where appropriate, surface-active compounds (surfactants).

Suitable solvents are: aromatic hydrocarbons, preferably the fractions containing 8 to 12 carbon atoms, e.g. xylene mixtures or substituted naphthalenes, phthalates, such as dibutyl phthalate or dioctyl phthalate, aliphatic hydrocarbons, such as cyclohexane or paraffins, alcohols and glycols and their ethers and esters, such as ethanol, ethylene glycol, ethylene glycol monomethyl or monoethyl ether, ketones, such as cyclohexanone, strongly polar solvents, such as N-methyl-2-pyrrolidone, dimethyl sulfoxide or dimethylformamide, as well as vegetable oils or epoxidised vegetable oils, such as epoxidised coconut oil or soybean oil; or water.

The solid carriers used, e.g., for dusts and dispersible powders, are normally natural mineral fillers, such as calcite, talcum, kaolin, montmorillonite or attapulgite. In order to improve the physical properties it is also possible to add highly dispersed silicic acid or highly dispersed absorbent polymers. Suitable granulated adsorptive carriers are porous types, for example pumice, broken brick, sepiolite or bentonite, and suitable nonsorbent carriers are, for example, calcite or sand. In addition, a great number of pregranulated materials of inorganic or organic nature can be used, e.g., especially dolomite or pulverized plant residues.

Depending upon the nature of the active ingredient compounds to be formulated, suitable surface-active compounds are non-ionic, cationic and/or anionic surfactants having good emulsifying, dispersing and wetting properties. The term "surfactants" will also be understood as comprising mixtures of surfactants.

Particularly advantageous application-promoting adjuvants are also natural or synthetic phospholipids of the cephalin and lecithin series, e.g., phosphatidylethanolamine, phosphatidylserine, phosphatidylglycerol and lysolecithin.

Generally, a tank-mix formulation for foliar or soil application comprises 0.1 to 20%, especially 0.1 to 15 %, active ingredient compounds, and 99.9 to 80 %, especially 99.9 to 85 %, of a solid or liquid auxiliaries (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 20 %, especially 0.1 to 15 %, based on the tank-mix formulation.

Typically, a pre-mix formulation for foliar application comprises 0.1 to 99.9 %, especially 1 to 95 %, active ingredient compounds, and 99.9 to 0.1 %, especially 99 to 5 %, of a solid or liquid adjuvant (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 50 %, especially 0.5 to 40 %, based on the pre-mix formulation.

Normally, a tank-mix formulation for seed treatment application comprises 0.25 to 80%, especially 1 to 75 %, active ingredient compounds, and 99.75 to 20 %, especially 99 to 25 %, of a solid or liquid auxiliaries (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 40 %, especially 0.5 to 30 %, based on the tank-mix formulation.

Typically, a pre-mix formulation for seed treatment application comprises 0.5 to 99.9 %, especially 1 to 95 %, active ingredient compounds, and 99.5 to 0.1 %, especially 99 to 5 %, of a solid or liquid adjuvant (including, for example, a solvent such as water), where the auxiliaries can be a surfactant in an amount of 0 to 50 %, especially 0.5 to 40 %, based on the pre-mix formulation.

Whereas commercial products will preferably be formulated as concentrates (e.g., pre-mix composition (formulation)), the end user will normally employ dilute formulations (e.g., tank mix composition).

Preferred seed treatment pre-mix formulations are aqueous suspension concentrates. The formulation can be applied to the seeds using conventional treating techniques and machines, such as fluidized bed techniques, the roller mill method, rotostatic seed treaters, and drum coaters. Other methods, such as spouted beds may also be useful. The seeds may be presized before coating. After coating, the seeds are typically dried and then transferred to a sizing machine for sizing. Such procedures are known in the art.

In general, the pre-mix compositions of the invention contain 0.5 to 99.9 especially 1 to 95, advantageously 1 to 50 , %, by mass of active ingredient compounds, and 99.5 to 0.1, especially 99 to 5, %, by mass of a solid or liquid adjuvant (including, for example, a solvent such as water), where the auxiliaries (or adjuvant) can be a surfactant in an amount of 0 to 50, especially 0.5 to 40, %, by mass based on the mass of the pre-mix formulation.

A preferred embodiment is a plant propagation material treating (or protecting) composition, wherein said plant propagation material protecting composition comprises additionally a colouring agent. The plant propagation material protecting composition or mixture may also comprise at least one polymer from water-soluble and water-dispersible film-forming polymers that improve the adherence of the active ingredients to the treated plant propagation material, which polymer generally has an average molecular weight of at least 10,000 to about 100,000.

The Examples which follow serve to illustrate the invention.

Formulation Examples

Wettable powders	a)	b)	c)
active ingredients	25 %	50 %	75 %
sodium lignosulfonate	5 %	5 %	-
sodium lauryl sulfate	3 %	-	5 %
sodium diisobutylnaphthalenesulfonate	-	6 %	10 %
phenol polyethylene glycol ether (7-8 mol of ethylene oxide)	-	2 %	-
highly dispersed silicic acid	5 %	10 %	10 %
Kaolin	62 %	27 %	-

The active ingredient is thoroughly mixed with the adjuvants and the mixture is thoroughly ground in a suitable mill, affording wettable powders that can be diluted with water to give suspensions of the desired concentration.

Powders for dry seed treatment	a)	b)	c)
active ingredients	25 %	50 %	75 %
light mineral oil	5 %	5 %	5 %
highly dispersed silicic acid	5 %	5 %	-
Kaolin	65 %	40 %	-
Talcum	-		20

The active ingredient is thoroughly mixed with the adjuvants and the mixture is thoroughly ground in a suitable mill, affording powders that can be used directly for seed treatment.

Emulsifiable concentrate	
active ingredients	10 %
octylphenol polyethylene glycol ether (4-5 mol of ethylene oxide)	3 %
calcium dodecylbenzenesulfonate	3 %
castor oil polyglycol ether (35 mol of ethylene oxide)	4 %
Cyclohexanone	30 %
xylene mixture	50 %

Emulsions of any required dilution, which can be used in plant protection, can be obtained from this concentrate by dilution with water.

Dusts	a)	b)	c)
Active ingredients	5 %	6 %	4 %
Talcum	95 %	-	-
Kaolin	-	94 %	-
mineral filler	-	-	96 %

Ready-for-use dusts are obtained by mixing the active ingredient with the carrier and grinding the mixture in a suitable mill. Such powders can also be used for dry dressings for seed.

Extruder granules	
Active ingredients	15 %
sodium lignosulfonate	2 %
carboxymethylcellulose	1 %
Kaolin	82 %

The active ingredient is mixed and ground with the adjuvants, and the mixture is moistened with water. The mixture is extruded and then dried in a stream of air.

Coated granules	
Active ingredients	8 %
polyethylene glycol (mol. wt. 200)	3 %
Kaolin	89 %

The finely ground active ingredient is uniformly applied, in a mixer, to the kaolin moistened with polyethylene glycol. Non-dusty coated granules are obtained in this manner.

Suspension concentrate	
active ingredients	40 %
propylene glycol	10 %
nonylphenol polyethylene glycol ether (15 mol of ethylene oxide)	6 %
Sodium lignosulfonate	10 %
carboxymethylcellulose	1 %
silicone oil (in the form of a 75 % emulsion in water)	1 %
Water	32 %

The finely ground active ingredient is intimately mixed with the adjuvants, giving a suspension concentrate from which suspensions of any desired dilution can be obtained by dilution with

water. Using such dilutions, living plants as well as plant propagation material can be treated and protected against infestation by microorganisms, by spraying, pouring or immersion.

Flowable concentrate for seed treatment

active ingredients	40 %
propylene glycol	5 %
copolymer butanol PO/EO	2 %
Tristyrenephenole with 10-20 moles EO	2 %
1,2-benzisothiazolin-3-one (in the form of a 20% solution in water)	0.5 %
monoazo-pigment calcium salt	5 %
Silicone oil (in the form of a 75 % emulsion in water)	0.2 %
Water	45.3 %

The finely ground active ingredient is intimately mixed with the adjuvants, giving a suspension concentrate from which suspensions of any desired dilution can be obtained by dilution with water. Using such dilutions, living plants as well as plant propagation material can be treated and protected against infestation by microorganisms, by spraying, pouring or immersion.

Slow Release Capsule Suspension

28 parts of the combination, or of each of these compounds from (I), (II) and (III) separately, are mixed with 2 parts of an aromatic solvent and 7 parts of toluene diisocyanate/polymethylene-polyphenylisocyanate-mixture (8:1). This mixture is emulsified in a mixture of 1.2 parts of polyvinylalcohol, 0.05 parts of a defoamer and 51.6 parts of water until the desired particle size is achieved. To this emulsion a mixture of 2.8 parts 1,6-diaminohexane in 5.3 parts of water is added. The mixture is agitated until the polymerization reaction is completed. The obtained capsule suspension is stabilized by adding 0.25 parts of a thickener and 3 parts of a dispersing agent. The capsule suspension formulation contains 28% of the active ingredients. The medium capsule diameter is 8-15 microns. The resulting formulation is applied to seeds as an aqueous suspension in an apparatus suitable for that purpose.

Using such formulations, either straight or diluted, plant propagation material can be treated and protected against damage, for example, from pathogen(s), by, for example, spraying, pouring or immersing.

The active ingredient combinations according to the invention are distinguished by the fact that they are especially well tolerated by plants and are environmentally friendly.

In an embodiment, the combinations according to the invention can also be used to treat stored products, such as grain, for protection against pathogens and/or pests.

Each active ingredient combination according to the invention is especially advantageous for the treatment of plant propagation material.

In a preferred embodiment, each of the combinations of the present invention is a plant propagation material, preferably seed, treating composition.

In each aspect and embodiment of the invention, “consisting essentially” and inflections thereof are a preferred embodiment of “comprising” and its inflections, and “consisting of” and inflections thereof are a preferred embodiment of “consisting essentially of” and its inflections.

Use of a term in a singular form also encompasses that term in plural form and vice a versa.

The compounds (I), (II) and (III) defined in the first aspect are active ingredients for use in the agrochemical industry (also known as pesticides). A description of their structure as well as the structures of other pesticides (*e.g.*, fungicides, insecticides, nematicides) can be found in the e-Pesticide Manual, version 3.1, 13th Edition, Ed. CDC Tomlin, British Crop Protection Council, 2004-05.

The compound of formula I is described in WO 03/010149 and WO 05/58839.

The compounds of formula A and its manufacturing processes starting from known and commercially available compounds is described in WO 03/074491, WO 2006/015865 and WO 2006/015866.

The following Examples are given by way of illustration and not by way of limitation of the invention.

Examples

An unexpected effect exists whenever the action of an active ingredient combination is greater than the sum of the actions of the individual components.

The action to be expected E for a given active ingredient combination obeys the so-called COLBY formula and can be calculated as follows (COLBY, S.R. "Calculating synergistic and antagonistic responses of herbicide combination". Weeds, Vol. 15, pages 20-22; 1967):

ppm = milligrams of active ingredient (= a.i.) per liter of spray mixture

X = % action by active ingredient A) using p ppm of active ingredient

Y = % action by active ingredient B) using q ppm of active ingredient.

According to COLBY, the expected (additive) action of active ingredients A)+B) using p+q ppm of active ingredient is $E = X + Y - \frac{X \cdot Y}{100}$

If the action actually observed (O) is greater than the expected action (E), then the action of the combination is super-additive, i.e. there is a synergistic effect.

Inhibiting of fungal growth of the following fungi are carried out by fungal growth assays (detailed below).

Biological Example B1: prochloraz and metconazole

Fusarium graminearum (ear rot of maize): Conidia of the fungus from cryogenic storage are directly mixed into nutrient broth (PDB potato dextrose broth). After placing a (DMSO) solution of the test compounds into a microtiter plate (96-well format) the nutrient broth containing the fungal spores is added. The test plates are incubated at 24 C and the inhibition of growth is measured photometrically after 48 hrs.

The fungicide interactions in the combinations are calculated according to COLBY method, where A is prochloraz and B is metconazole. The results for A & B solo are shown in Table below and those for the combinations in a range of ratios in Table 1.

Dosage in mg active ingredient(s) / liter final medium ppm)		
A	B	Observed control in %
0.004		0
0.008		3

0.016		6
0.031		11
0.063		25
0.125		86
0.25		94
0.5		96
1.0		96
2.0		96
	0.004	2
	0.008	3
	0.016	4
	0.031	11
	0.063	23
	0.125	52
	0.25	93
	0.5	95
	1.0	96
	2.0	96

Biological Example B2: prochloraz, metconazole and metalaxyl

Fusarium graminearum (ear rot of maize): Conidia of the fungus from cryogenic storage are directly mixed into nutrient broth (PDB potato dextrose broth). After placing a (DMSO) solution of the test compounds into a microtiter plate (96-well format) the nutrient broth containing the fungal spores is added. The test plates are incubated at 24 C and the inhibition of growth is measured photometrically after 48 hrs.

The fungicide interactions in the combinations are calculated according to COLBY method, where C is metconazole and D is a mixture of prochloraz and metalaxyl in a mass ratio of 1:1. The results for C & D solo are shown in Table below and those for the combinations in a range of ratios in Table 2.

Dosage in mg active ingredient(s) / liter final medium ppm)		
C	D	Observed control in %
0.004		1

0.008		3
0.016		6
0.031		12
0.063		26
0.125		55
0.25		93
0.5		95
1.0		95
2.0		96
	0.004	2
	0.008	2
	0.016	2
	0.031	5
	0.063	12
	0.125	27
	0.25	64
	0.5	93
	1.0	95
	2.0	96

Table 1*:

mass ratio of A+B 4:1						
A [ppm]			0.125	0.063	0.031	0.016
B [ppm]			0.031	0.016	0.008	0.004
observed			83	34	12	8
expected			88	28	14	8
mass ratio of A+B 2:1						
A [ppm]		0.125	0.063	0.031	0.016	0.008
B [ppm]		0.063	0.031	0.016	0.008	0.004
observed		90	42	12	5	1
expected		89	33	14	9	5
mass ratio of A+B 1:1						
A [ppm]	0.125	0.063	0.031	0.016	0.008	0.004
B [ppm]	0.125	0.063	0.031	0.016	0.008	0.004
observed	93	63	30	9	6	3
expected	93	42	21	10	6	2
mass ratio of A+B 1:2						
A [ppm]		0.063	0.031	0.016	0.008	0.004
B [ppm]		0.125	0.063	0.031	0.016	0.008
observed		92	44	21	7	5
expected		64	32	17	7	3
mass ratio of A+B 1:4						
A [ppm]			0.031	0.016	0.008	0.004
B [ppm]			0.125	0.063	0.031	0.016
observed			74	33	13	4
expected			57	28	14	4

*Excluded are results for mixtures at rates where one of the solo test samples (i.e. A or B) gives greater than 90% control because Colby calculations under the test method would not be sufficiently reliable

Table 2*:

mass ratio of C+D 4:1						
C [ppm]			0.125	0.063	0.031	0.016
D [ppm]			0.031	0.016	0.008	0.004
observed			53.6	21.2	14.2	4
expected			57.1	28.1	13.3	7.9
mass ratio of C+D 2:1						
C [ppm]		0.125	0.063	0.031	0.016	0.008
D [ppm]		0.063	0.031	0.016	0.008	0.004
observed		73.1	29.1	10.3	5	2.1
expected		60.1	30.3	13.9	7.9	4.8
mass ratio of C+D 1:1						
C [ppm]	0.125	0.063	0.031	0.016	0.008	0.004
D [ppm]	0.125	0.063	0.031	0.016	0.008	0.004
observed	90.8	42.4	17.2	10.3	3.6	3.7
expected	67.1	35.1	16.5	8.5	4.8	3.2
mass ratio of C+D 1:2						
C [ppm]	0.125	0.063	0.031	0.016	0.008	0.004
D [ppm]	0.250	0.125	0.063	0.031	0.016	0.008
observed	93.3	61.3	26.6	17.6	4.8	4.7
expected	83.7	46.5	22.3	11.3	5.4	3.2
mass ratio of C+D 1:4						
C [ppm]		0.063	0.031	0.016	0.008	0.004
D [ppm]		0.25	0.125	0.063	0.031	0.016
observed		89.7	41	24.7	9.1	10
expected		73.4	35.9	17.4	8.3	3.8

*Excluded are results for mixtures at rates where one of the solo test samples (i.e. C or D) gives greater than 90% control because Colby calculations under the test method would not be sufficiently reliable

CLAIMS

1. A method of controlling or preventing pathogenic damage and/or pest damage in a plant propagation material, a plant, part of a plant and/or plant organ that grow at a later point in time, which comprises applying on the plant, part of the plant, plant organ, plant propagation material or a surrounding area thereof a combination comprising (I) prochloraz, (II) metconazole, and optionally (III) metalaxyl or mefenoxam.

2. A method of protecting a plant propagation material, a plant, part of a plant and/or plant organ that grow at a later point in time against pathogenic damage and/or pest damage by applying to the plant, parts of plant, plant organs, plant propagation material or a surrounding area thereof a combination, as defined in claim 1, in any desired sequence or simultaneously.

3. A method of improving the growing characterictics of a plant, which comprises applying to the plant, part of plant, plant organ and/or plant propagation material, a combination, as defined in claim 1, in any desired sequence or simultaneously.

4. The method according to to any one of claims 1 to 3 wherein the mass ratio of between any two active ingredients in the combination is from 100:1 to 1:100.

5. The method according to any one of claims 1 to 4, wherein the combination comprises (I), (II) and (III).

6. The method according to any one of claims 1 to 5, wherein the combination further comprises one or more additional fungicides.

7. The method according to any one of claims 1 to 6, wherein the combination further comprises one or more insecticides and nematicides.

8. The method according to any one of claims 1 to 7, wherein the combination, as defined in any one of claims 1 to 7, is applied simultanesously.

9. The method according to any one of claims 1 to 8, wherein the combination, as defined in any one of claims 1 to 8, is applied on plant propagation material.

10. A plant propagation material treated with the combination defined in any one of claims 1 to 8.

11. A combination comprising combination comprising (I) prochloraz, (II) metconazole, and optionally (III) metalaxyl or mefenoxam.

12. The combination according to claim 11 wherein the combination further comprises (IV) one or more customary formulation auxiliaries.

13. The combination according to either claim 11 or claim 12, wherein the combination comprises (I), (II), (III) and (IV).

14. The combination according to any one of claims 11 to 13, wherein the combination further comprises one or more other fungicides, one or more insecticides and/or one or more nematicides.