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(71) Applicant: UPL LIMITED [IN/IN]; UPL House, 610 B/2, off Western Express Highway, Bandra Village, Bandra-East, Maharashtra, Mumbai 400051 (IN).

(72) Inventors: CHOKASHI, Kalpesh Parimal; UPL Limited, UPL House, 610 B/2, Off Western Express Highway, Bandra Village, Bandra-East, Maharashtra, Mumbai 400051 (IN). SHARMA, Shiv Kumar; UPL Limited, UPL House, 610 B/2, Off Western Express Highway, Bandra Village, Bandra-East, Maharashtra, Mumbai 400051 (IN). DAS, Kuntal; UPL Limited, UPL House, 610 B/2, Off Western Express Highway, Bandra Village, Bandra-East, Maharashtra, Mumbai 400051 (IN).

(74) Agent: MAJUMDAR, Subhatosh et al.; S. Majumdar & Co., 5, Harish Mukherjee Road, West Bengal, Kolkata 700 025 (IN).

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(54) Title: FUNGICIDAL COMPOSITION

(57) Abstract: The present invention relates to a composition comprising cinnamaldehyde. The present invention more particularly relates to an aqueous emulsion comprising cinnamaldehyde, a process for preparation and a method of use thereof.

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FUNGICIDAL COMPOSITION

Field of Invention

The present invention relates to a composition comprising cinnamaldehyde. The present invention more particularly relates to an aqueous emulsion comprising
5 cinnamaldehyde, a process for preparation and a method of use thereof.

Background of the invention

Cinnamaldehyde is an α , β -unsaturated aldehyde, abundant in cinnamon and widely used in spices, pharmaceuticals, agriculture, daily chemicals, feed, paper and food processing.

10 Emulsions generally refer to heterogeneous systems that comprise two immiscible liquids. In agriculture, emulsions provide formulation vehicles for delivery of herbicides, insecticides, fungicides, bactericides, and fertilizers.

Aqueous emulsions (EW) are important in agriculture as a means of formulating oil-based systems in a more environmentally attractive form than the conventional
15 emulsifiable concentrate (EC) where less solvent is sometimes possible per unit active ingredient and also as a precursor to suspension-emulsions (SEs) or suspo-emulsions which consist of a mixture of an oil-in-water and a suspension concentrate (SC). Such EW products tend to have lower skin and eye toxicity ratings than the corresponding EC products.

20 There is a continuous need to improve the safety characteristics of pesticides that are applied to plants intended for human and animal consumption. In order to achieve the goal of providing a safer pesticide, users must: (1) use environmentally safe actives, such as essential oils; and (2) if using essential oils, then they must include an environmentally safe emulsion system. It is therefore the goal of the
25 invention to present a more environmentally friendly approach as compared to

commercially available formulation with the aim of controlling fungal diseases in plantations.

Cinnamaldehyde is useful for treating black sigatoka in banana and is described for example in WO2018116027. Such formulation is commercially available in the
5 form of an emulsifiable concentrate (EC).

In view of the above-described technical problems, an object of the present invention is to provide an oil-in-water type emulsion which reliably achieves stability on storage, and a method for producing the oil-in-water type emulsion. Particularly, to overcome some of the disadvantages of EC formulation such as skin
10 irritation and flammability issues and cost, present inventors developed an EW formulation which is environmentally friendly and economically feasible formulation.

Summary of the invention

In an aspect the present invention provides a composition comprising:

- 15 a) a discrete oil phase comprising cinnamaldehyde; and
 b) a continuous aqueous phase comprising water soluble ingredient,
 wherein said oil phase comprises at least one water dispersible ingredient.

In an aspect the present invention provides a composition comprising:

- a) a discrete oil phase comprising cinnamaldehyde;
20 b) a continuous aqueous phase comprising water soluble ingredients;
 wherein said oil phase comprises at least one water dispersible ingredient
 and
 c) an agrochemically acceptable excipients.

In an aspect the present invention provides an aqueous emulsion comprising:

- 25 a) a discrete oil phase comprising cinnamaldehyde; and

- b) a continuous aqueous phase comprising water soluble ingredients;
wherein said oil phase comprises at least one water dispersible ingredient.

In another aspect the present invention provides use of aqueous emulsion comprising cinnamaldehyde for controlling fungal disease.

- 5 In another aspect the present invention provides a method of controlling fungal diseases by contacting the plant with an aqueous emulsion comprising cinnamaldehyde.

Detail description of the invention

10 For the purposes of the following detailed description, it is to be understood that the invention may assume various alternative variations and step sequences, except where expressly specified to the contrary. Moreover, other than in any operating examples, or where otherwise indicated, all numbers expressing, for example, quantities of materials/ingredients used in the specification are to be understood as being modified in all instances by the term "about".

- 15 Thus, before describing the present invention in detail, it is to be understood that this invention is not limited to particularly exemplified composition/systems or process parameters that may of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments of the invention only and is not intended to limit the scope of the invention in any
20 manner. The use of examples anywhere in this specification including examples of any terms discussed herein is illustrative only, and in no way limits the scope and meaning of the invention or of any exemplified term. Likewise, the invention is not limited to various embodiments given in this specification. Unless otherwise defined, all technical and scientific terms used herein have the same meaning as
25 commonly understood by one of ordinary skill in the art to which this invention pertains. In the case of conflict, the present document, including definitions will control.

It must be noted that, as used in this specification, the singular forms “a,” “an” and “the” include plural referents unless the content clearly dictates otherwise. The terms “preferred” and “preferably” refer to embodiments of the invention that may afford certain benefits, under certain circumstances.

- 5 As used herein, the terms “comprising”, “comprises”, “including,” “having,” “containing,” “involving,” and the like are to be understood to be open-ended, i.e., to mean including but not limited to.

The term 'plants' refers to all physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage and fruits. The 'locus' is intended to
10 include soil, seeds, and seedlings as well as established vegetation. The term 'disease control' as used herein denotes control and prevention of a disease.

As used herein, the term “stable” refers to chemical and/or physical stabilization of an active compound. The stability tests described herein are conducted according to established Collaborative international Pesticides Analytical Council (CIPAC)
15 methodologies.

Cinnamaldehyde used in the present invention can be from cinnamon oil or synthetic technical.

It has now been found that when cinnamaldehyde is applied in the form of a particular aqueous emulsion (EW), it exhibits much lower eye and skin irritation,
20 and phytotoxicity. Additionally, EW being a water-based system is easy to tank mix with other active components/fertilizer as compared to the solvent based EC system.

The present composition is therefore environmentally friendly, highly effective, low in toxicity and cost effective. The present compositions comprising
25 cinnamaldehyde having antimicrobial property and can be used for prevention and control of various plant fungal diseases.

In an aspect the present invention provides a composition comprising:

- a) a discrete oil phase comprising cinnamaldehyde and
 - b) a continuous aqueous phase comprising a water-soluble ingredient
- wherein said oil phase comprises at least one water dispersible ingredient.

- 5 In an embodiment, the present composition comprising from about 1 to 80 % by weight of cinnamaldehyde.

In another embodiment, the composition comprises cinnamaldehyde in an amount from about 1% to about 80% by weight, preferably from about 10% to about 60% by weight of the composition, more preferably from about 10% to about 50% by weight of the composition, still more preferably from about 10% to about 40% by weight of the composition.

10

In an embodiment, the composition of invention comprises cinnamaldehyde in an amount from about 10% to about 35% by weight of the composition.

In an embodiment, the composition of invention comprises cinnamaldehyde in an amount from about 25% to about 35% by weight of the composition.

15

In an embodiment, the composition of invention comprises cinnamaldehyde in an amount from about 10% to about 30% by weight of the composition.

In an embodiment the continuous aqueous phase of composition comprises from about 5 to about 90% of water.

20 Typically, the composition comprises from about 5% to about 80% w/w, preferably from about 10% to about 70% w/w and especially preferably from about 30% to about 60% w/w of water, based on the total weight of the composition.

In an embodiment the composition comprises from about 0.5 to 25% by weight, especially from 1 to 10% by weight of water-soluble ingredient/agent or water dispersible ingredient.

25

In an embodiment the oil phase of the composition comprises a water dispersible ingredient and aqueous phase comprises a water-soluble ingredient.

In an embodiment the water dispersible ingredient and water-soluble ingredient is selected from non-ionic and an anionic surfactant.

- 5 Examples of non-ionic surfactant include, but not limited to, polyarylphenol polyethoxy ethers, polyalkylphenol polyethoxy ethers, methyl oxirane polymer with oxirane, polyglycol ether derivatives of saturated fatty acids, polyglycol ether derivatives of unsaturated fatty acids, polyglycol ether derivatives of aliphatic alcohols, polyglycol ether derivatives of cycloaliphatic alcohols, fatty acid esters of
- 10 polyoxyethylene sorbitan for example polysorbate 20, 60, and 80 (Tween 20, 60 and 80), alkoxyated vegetable oils, castor oil, alkoxyated acetylenic diols, polyalkoxyated alkylphenols, fatty acid alkoxyates, sorbitan alkoxyates, sorbitol esters, C₈-C₂₂ alkyl or alkenyl polyglycosides, polyalkoxy styrylaryl ethers, alkylamine oxides, block copolymer ethers, polyalkoxyated fatty glyceride,
- 15 polyalkylene glycol ethers, linear aliphatic or aromatic polyesters, organo silicones, polyaryl phenols, sorbitol ester alkoxyates, polyalkylene oxide block copolymers, acrylic copolymers and mono- and diesters of ethylene glycol or combinations thereof.

- Examples of anionic surfactants include but not limited to, alcohol sulfates, alcohol
- 20 ether sulfates, alkylaryl ether sulfates, alkylaryl sulfonates such as alkylbenzene sulfonates and alkyl naphthalene sulfonates and salts thereof, alkyl sulfonates, mono- or di-phosphate esters of polyalkoxyated alkyl alcohols or alkylphenols, mono- or di-sulfosuccinate esters of C₁₂-C₁₅ alkanols or polyalkoxyated C₁₂-C₁₅ alkanols, alcohol ether carboxylates, phenolic ether carboxylates, polybasic acid
- 25 esters of ethoxylated polyoxyalkylene glycols consisting of oxybutylene or the residue of tetrahydrofuran, sulfoalkylamides and salts thereof such as N-methyl-N-oleoyltaurate sodium salt, polyoxyalkylene alkylphenol carboxylates, polyoxyalkylene alcohol carboxylates alkyl polyglycoside/alkenyl succinic anhydride condensation products, alkyl ester sulfates, naphthalene sulfonates,

naphthalene formaldehyde condensates, alkyl sulfonamides, sulfonated aliphatic polyesters, sulfate esters of styrylphenyl alkoxylates, and sulfonate esters of styryl phenyl alkoxylates and their corresponding sodium, potassium, calcium, magnesium, zinc, ammonium, alkylammonium, diethanolammonium, or
 5 triethanolammonium salts, salts of ligninsulfonic acid such as the sodium, potassium, magnesium, calcium or ammonium salt, polyarylphenol polyalkoxyether sulfates and polyarylphenol polyalkoxyether phosphates, and sulfated alkyl phenol ethoxylates, phosphated alkyl phenol ethoxylates or combinations thereof.

10 The compositions of the present invention further comprises at least one co-solvent selected from isopropyl myristate, isopropyl palmitate, isopropyl acetate, isopropyl lanolin, isopropyl stearate, isopropylamine, isopropylamine salt of oleoylisopropanolamide, isopropylamine sulfate, 4-isopropylidene-1-methylcyclohexene, 4,4'-isopropylidenediphenol C₍₁₂₋₁₅₎-alkyl phosphates,
 15 isopropyl naphthalenesulfonic acid or sodium salt, isopropylsulfamic acid or combinations thereof.

In an embodiment, the formulations can further comprise agriculturally acceptable surfactants, dispersants, polymers, wetting agents, other suitable liquid carriers, adjuvants, stabilizers, pH modifiers, anti-freeze agents, suspending agents,
 20 emulsifiers, antifoam agents, pH stabilising agents, preservatives and the like.

In some embodiments, the surface-active substances and dispersing agents that are suitable for the composition include, tristyrylphenol ethoxylates, for example Soprophor® TS-10, EO/PO/EO block copolymers, for example Pluronic EP 10500, Pluronic F-108, Pluronic F-38, Pluronic P-105 and/or sodium salts of sulfonated
 25 naphthalenesulfonic acid-formaldehyde condensation products, alkyl naphthalene sulfonate (ANS) condensate for example Morwet D-425 or Orotan SN, lignosulfonates, PO/EO butanol copolymers, Alttox polymeric surfactants for example Atlox G-5000, block copolymers of polyhydroxystearic acid and polyalkylene glycols, for example Atlox 4912 or 4914 or partially hydrolysed or

fully hydrolysed polyvinyl acetate, for example Mowiol 18-88 or Mowiol 4-88; Polymers such as such polyvinyl alcohols, xanthan gum, polyvinylpyrrolidone, gel-forming carraagheenans, water-soluble gelatine and casein, superabsorbent polymers such polyacrylamides and polyacrylates based polymers, Semi-synthetic or fully- synthetic peptide/protein-based superabsorbent polymers such as collagen-based synthetic polymers, elastin-like polypeptides, polyaspartic acid, polyaspartates, polyglutamic acid, polyglutamate, Semi-synthetic or fully-synthetic polysaccharide: carboxymethyl starch, sulfoethyl starch, carboxymethyl cellulose, sulfoethyl cellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, methylcellulose, chitosan; cross-linked polysaccharides such as CMS cross-linked with multi- functional carboxylic acids or multi-functional epoxides and the like.

Other suitable liquid carriers that may be employed in the composition may include water miscible/soluble ingredienst or organic solvents. The water-miscible ingredient as used herein refers to ingredients which are miscible with water, i.e. they do not separate into different layers. Suitable example of such carriers are glycol, such as propylene glycol, ethylene glycol, diethylene glycol, 1,2-propylene glycol, tripropylene glycol, polyvinylalcohol, polyvinylpyrrolidone, alcohol, such as methanol, ethanol, isopropanol, n-propanol. Preferably, the water-miscible solvent is a glycol, more preferably propylene glycol.

Examples of anti-freezing agents are glycerin, ethylene glycol, propylene glycol, preferably propylene glycol and typically, used in a concentration of from 0.5 to 10 % by weight of the composition.

Suitable antifoaming agents or defoamers employed to stop any unwanted foam include but not limited to, silicone-based compounds, alcohols, glycol ethers, mineral spirits, acetylene diols, polysiloxanes, polydimethylsiloxane, organosiloxanes, siloxane glycols, reaction products of silicon dioxide and organosiloxane polymer, polydimethylsiloxanes or polyalkylene glycols alone or in combination. Preferred defoamer and /or antifoam include AGNIQUE DFM 111S; SAG-10; SAG-1000AP; SAG-1529; SAG-1538; SAG-1571; SAG-1572; SAG-

1575; SAG-2001; SAG-220; SAG-290; SAG-30; SAG-30E; SAG-330; SAG-47; SAG-5440; SAG-7133; SAG-770; antifoam OR 10, antifoam OR 90 and the like.

Examples of thickeners/viscosity modifier include silicates such as meal silicates, sodium carboxymethyl cellulose, methyl cellulose, ethyl cellulose, polyvinylalcohol, polyvinylpyrrolidone, sodium alginate, Sodium poly acrylate, xanthan gum, welan gum, gum arabic, montmorillonite, lignosulfonates, hydroxy methyl cellulose, dextrin, starch, microcrystalline cellulose (MCC) and Exilva or combinations thereof and can be used in an amount of from 0.1 to 15 % by weight of the formulation.

10 The preservatives that inhibit the growth of micro-organisms such as bacteria and fungi include silica, biocide for example Proxel GXL, microcrystalline cellulose (MCC).

The present compositions can further comprise one or more pesticides or other ingredients, which may be dissolved or dispersed in the composition and may be selected from acaricides, bactericides, fungicides, insecticides, herbicides, herbicide safeners, insect attractants, insect repellents, plant activators, plant growth regulators or synergists.

In some embodiments, the composition comprising cinnamaldehyde in combination with a fungicide selected from a DMI fungicide, Qol fungicide, contact fungicide, SDHI fungicide, polysaccharide or its derivatives.

In an embodiment of the invention and with the goal of reducing costs, the active ingredients derived from plant extracts may also be obtained through a process of synthesis. For example, cinnamaldehyde an active ingredient may be available from cinnamon oil derived from cinnamon or it may be chemically synthesised, used in industrial quantities as a perfume or flavouring agent. When chemically synthesised cinnamaldehyde is used, it will have all the advantages of the claimed composition at a lower cost and making cost effective formulation similar to that of currently available synthesised fungicides, making it more accessible to the final user.

The present invention accordingly provides the following examples of compositions (all figures in % by weight, based on the complete formulation):

In an embodiment the present invention provides a composition comprising

- i) 20 to 60 % of cinnamaldehyde
- 5 ii) 1 to 8 % of at least one non-ionic surfactant
- iii) 1 to 8% of Isopropyl Myristate and
- iv) 40 to 60% of water

In an embodiment, the present composition comprising

- i) 25 to 35 % of cinnamaldehyde
- 10 ii) 1 to 8 % of a non-ionic surfactant
- iii) 1 to 8% of isopropyl myristate and
- iv) 40 to 60% of water

In an embodiment, the present composition comprising

- i) 25 to 35 % of cinnamaldehyde
- 15 ii) 2 to 8 % of castor oil
- iii) 0.1 to 5% of an anionic surfactant
- iv) 1 to 8% of isopropyl myristate and
- v) 40 to 60% of water.

In an embodiment, the present composition comprising

- 20 i) 25 to 50% of cinnamon oil
- ii) 1 to 8 % of non-ionic surfactant
- iii) 1 to 8% of isopropyl myristate and
- iv) 40 to 60% of water

In an embodiment the present composition is an aqueous emulsion (EW).

- 25 In an embodiment, the present invention provides a process for preparation of a composition comprising cinnamaldehyde, particularly an aqueous emulsion.

According to the present invention the process for preparation of a composition comprises

- a) preparing an oil phase by mixing cinnamaldehyde and suitable water dispersible ingredients.
- 5 b) preparing an aqueous phase by dissolving suitable water-soluble ingredients in water.
- c) emulsifying an oil phase in the aqueous phase to obtain an aqueous emulsion.

10 Optionally additional agrochemically acceptable ingredients may be added in the process before or after the emulsification step.

The present compositions/formulations are stable even when stored for a relatively long period, exhibit no phase and found to have a high degree of chemical stability upon testing 14 days AHS and real time study for about 12 months and even after 18 months.

- 15 Typically, the present compositions are capable of controlling phytopathogenic fungi on a plant or propagation material thereof. Accordingly, the present invention provides a fungicidal composition comprising fungicidally effective amount of cinnamaldehyde.

Accordingly, the present invention provides a fungicide composition comprising:

- 20 a) a discrete oil phase comprising cinnamaldehyde and
b) a continuous aqueous phase comprising a water-soluble ingredient
wherein said oil phase comprises at least one water dispersible ingredient.

In an embodiment the present invention provides fungicide compositions comprising cinnamaldehyde which are effective for controlling fungicidal
25 infections/diseases in plants.

In another embodiment, the present invention describes an eco-friendly stable EW formulation comprising cinnamaldehyde having excellent stability in accelerated conditions and good fungicidal efficacy and is easy to employ in the field.

In an embodiment the invention provides use of EW formulation comprising
5 cinnamaldehyde for controlling and/or preventing fungal disease.

The compositions according to the present invention are thus useful in combating, preventing or controlling phytopathogenic diseases which comprises applying an aqueous emulsion containing cinnamaldehyde to a phytopathogen, to the locus of a phytopathogen, or to a plant susceptible to attack by a phytopathogen, or to
10 propagation material or parts thereof.

In another embodiment the present invention provides a method for controlling or preventing or suppressing the growth of phytopathogenic fungi comprising contacting or applying the present composition containing fungicidally effective amounts of cinnamaldehyde to the locus of a phytopathogen.

15 The compositions/formulations according to the present invention are effective for the following plant diseases which may include:

Disease in rice: Blast (*Pyricularia Oryzae*), *Helminthosporium* leaf spot (*Cochliobolus miyabeanus*), sheath blight (*Rhizoctonia solani*) , and bakanae disease (*Gibberella fujikuroi*).

20 Diseases in wheat: powdery mildew (*Erysiphe graminis*) , *Fusarium* head blight (*Fusarium graminearum*, *F. avenaceum*, *F. culmorum*, *Microdochium nivale*) , rust (*Puccinia striiformis*, *P. graminis*, *P. recondita*) , pink snow mold (*Micronectriella nivale*), *Typhula* snow blight (*Typhula* sp .) , loose smut (*Ustilago tritici*) , bunt (*Tilletia caries*) , eyespot (*Pseudocercospora herpotrichoides*) , leaf blotch 3h,
25 (*Mycosphaerella graminicola*) , glume blotch (*Stagonospora nodorum*) , septoria, and yellow spot (*Pyrenophora tritici-repentis*) .

Diseases of barley: powdery mildew (*Erysiphe graminis*), Fusarium head blight (*Fusarium graminearum*, *F. avenacerum*, *F. culmorum*, *Microdochium nivale*), rust - (*Puccinia striiformis*, *P. graminis*, *P. hordei*) , loose smut (*Ustilago nuda*) , scald (*Rhynchosporium secalis*) , net blotch (*Pyrenophora teres*), spot blotch (5 *Cochliobolus sativus*), leaf stripe (*Pyrenophora graminea*) , and *Rhizoctonia* damping-off (*Rhizoctonia solani*) .

Diseases in corn: smut (*Ustilago maydis*), brown spot (*Cochliobolus heterostrophus*), copper spot (*Gloeocercospora sorghi*), southern rust (*Puccinia polysora*), gray leaf spot (*Cercospora zeae-maydis*), white spot (*Phaeosphaeria mydis* and/or *Pantoea ananatis*) and *Rhizoctonia* damping-off (*Rhizoctonia solani*). 10

Diseases of citrus: melanose (*Diaporthe citri*), scab (*Elsinoe fawcetti*), penicillium rot (*Penicillium digitatum*, *P. italicum*), and brown rot (*Phytophthora parasitica*, *Phytophthora citrophthora*) .

Diseases of apple: blossom blight (*Monilinia mali*), canker (*Valsa ceratosperma*), 15 powdery mildew (*Podosphaera leucotricha*), *Alternaria* leaf spot (*Alternaria alternata* apple pathotype) , scab (*Venturia inaequalis*) , powdery mildew, bitter rot (*Colletotrichum acutatum*), crown rot (*Phytophthora cactorum*), blotch (*Diplocarpon mali*) , and ring rot (*Botryosphaeria berengeriana*) .

Diseases of pear: scab (*Venturia nashicola*, *V. pirina*) , powdery mildew, black spot 20 (*Alternaria alternata* Japanese pear pathotype) , rust (*Gymnosporangium 3h, haraeum*) , and *phytophthora* fruit rot (*Phytophthora cactorum*).

Diseases of peach: brown rot (*Monilinia fructicola*), powdery mildew, scab (*Cladosporium carpophilum*), and phomopsis rot (*Phomopsis* sp.).

Diseases of grape: anthracnose (*Elsinoe ampelina*) , ripe rot (*Glomerella cingulata*), 25 powdery mildew (*Uncinula necator*) , rust (*Phakopsora ampelopsidis*) , black rot (*Guignardia bidwellii*), botrytis, and downy mildew (*Plasmopara viticola*) .

Diseases of Japanese persimmon: anthracnose (*Gloeosporium kaki*) , and leaf spot (*Cercospora kaki*, *Mycosphaerella nawae*) .

- 5 Diseases of gourd: anthracnose (*Colletotrichum lagenarium*) , powdery mildew (*Sphaerotheca fuliginea*), gummy stem blight (*Mycosphaerella melonis*), *Fusarium* wilt (*Fusarium oxysporum*) , downy mildew (*Pseudoperonospora cubensis*) tA *Phytophthora* rot (*Phytophthora* sp.) , and damping-off (*Pythium* sp .).

Diseases of tomato: early blight (*Alternaria solani*) , leaf mold (*Cladosporium fulvum*) , and late blight (*Phytophthora infestans*) .

- 10 Diseases of eggplant: brown spot (*Phomopsis vexans*) , and powdery mildew 3 (*Erysiphe cichoracearum*) Diseases of cruciferous vegetables: *Alternaria* leaf spot (*Alternaria japonica*) , white spot (*Cercospora brassicae*) , clubroot (*Plasmodiophora brassicae*) , and downy mildew (*Peronospora parasitica*) .

Diseases of onion: rust (*Puccinia allii*), and downy mildew (*Peronospora destructor*).

- 15 Diseases of soybean: purple seed stain (*Cercospora kikuchii*) , sphaceloma scab (*Elsinoe glycines*) , pod and stem blight (*Diaporthe phaseolorum* var. *sojae*) , septoria brown spot (*Septoria glycines*), frog-eye leaf spot (*Cercospora sojae*), rust (*Phakopsora pachyrhizi*) , Yellow rust, brown stem rot (*Phytophthora sojae*), and - *Rhizoctonia* damping-off (*Rhizoctonia solani*) .

- 20 Diseases of kidney bean: anthracnose (*Colletotrichum lindemthianum*). Diseases of peanut: leaf spot (*Cercospora personata*), brown leaf spot (*Cercospora arachidicola*) and southern blight (*Sclerotium rolfsii*).

Diseases of garden pea: powdery mildew (*Erysiphe pisi*) , and root rot (*Fusarium solani* f. sp. *pisi*) .

Diseases of potato: early blight (*Alternaria solani*), late blight (*Phytophthora tA infestans*), pink rot (*Phytophthora erythroseptica*), and powdery scab (*Spongospora subterranean f. sp. subterranea*).

5 Diseases of strawberry: powdery mildew (*Sphaerotheca humuli*), and anthracnose (*Glomerella cingulata*).

Diseases of tea: net blister blight (*Exobasidium reticulatum*), white scab (*Elsinoe 3 leucospila*), gray blight (*Pestalotiopsis sp.*), and anthracnose (*Colletotrichumtheae sinensis*) .

10 Diseases of tobacco: brown spot (*Alternaria longipes*), powdery mildew (*Erysiphe cichoracearum*), anthracnose (*Colletotrichum tabacum*), downy mildew 4h, (*Peronospora tabacina*) , and black shank (*Phytophthora nicotianae*).

Diseases of rapeseed: sclerotinia rot (*Sclerotinia sclerotiorum*) , and Rhizoctonia damping-off (*Rhizoctonia solani*) . Diseases of cotton: Rhizoctonia damping-off (*Rhizoctonia solani*) .

15 Diseases of sugar beat: *Cercospora* leaf spot (*Cercospora beticola*) , leaf blight (*Thanatephorus cucumeris*), Root rot (*Thanatephorus cucumeris*), and *Aphanomyces* root rot (*Aphanomyces cochlioides*) .

20 Diseases of rose: black spot (*Diplocarpon rosae*) , powdery mildew (*Sphaerotheca pannosa*) , and downy mildew (*Peronospora sparsa*) . Diseases of chrysanthemum and asteraceous plants: downy mildew (*Bremia lactucae*), leaf blight (*Septoria chrysanthemi-indici*) , and white rust (*Puccinia horiana*).

A Diseases of various groups: diseases caused by *Pythium* spp. (*Pythium aphanidermatum*, *Pythium debarianum*, *Pythium graminicola*, *Pythium irregulare*, *Pythium ultimum*), gray mold. (*Botrytis cinerea*), and Sclerotinia rot (*Sclerotinia sclerotiorum*).
25

Disease of Japanese radish: *Alternaria* leaf spot (*Alternaria brassicicola*).

Diseases of turfgrass: dollar spot (*Sclerotinia homeocarpa*), and brown patch and large patch (*Rhizoctonia solani*).

Disease of banana: Black sigatoka (*Mycosphaerella fijiensis*), Yellow sigatoka 4h, (*Mycosphaerella musicola*).

- 5 Disease of sunflower: downy mildew (*Plasmopara halstedii*) .

Seed diseases or diseases in the early stages of the growth of various plants caused - by *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp., *Gibberella* spp., *Tricoderma* spp., *Thielaviopsis* spp., *Rhizopus* spp., *Mucor* spp., *Corticium* spp., *Phoma* spp., *Rhizoctonia* spp. and *Diplodia* spp.

- 10 Viral diseases of various plants mediated by *Polymixa* spp. or *Olpidium* spp. and so on.

In some embodiment present composition is used for controlling target disease for example Black Sigatoka, Ascomycetes (Powdery mildew) in banana, fruits and vegetables. In one embodiment, the fungal disease is powdery mildew (*Podosphaera xanthii*). In some embodiments, the fungal disease is powdery mildew (*Podosphaera xanthii*) in Cucumber. In some embodiments, the composition is highly efficacious for protecting the plant from powdery mildew (*Erysiphe cichoracearum*) in cucurbitis, particularly powdery mildew (*Podosphaera xanthii*) in cucumber.

20

In one embodiment, the fungal disease is Early Blight (*Alternaria solani*). In some embodiments, the fungal disease is Early Blight (*Alternaria solani*). in Tomato. In some embodiments, the composition is highly efficacious for protecting the plant from Early Blight (*Alternaria solani*).

25

In one embodiment, the fungal disease is Leaf Blight (*Stemphylium*). In some embodiments, the fungal disease is Leaf Blight (*Stemphylium*) in Onion. In some embodiments, the composition is effective for protecting the plant from Leaf Blight

(*Stemphylium*).

In one embodiment, the fungal disease is Sheath Blight (*Rhizoctonia solani*). In some embodiments, the fungal disease is Sheath Blight (*Rhizoctonia solani*) in Rice. In some embodiments, the composition is effective for protecting the plant from Sheath Blight (*Rhizoctonia solani*).

In one embodiment, the fungal disease is Black Sigatoka (*Mycosphaerella fijiensis*). In some embodiments, the fungal disease is Black Sigatoka (*Mycosphaerella fijiensis*) in Banana. In some embodiments, the composition is effective for protecting the plant from Black Sigatoka (*Mycosphaerella fijiensis*).

In some embodiments, the fungal disease is Scab (*Venturia inaequalis*) in Apple. In some embodiments, the fungal disease is powdery mildew (*Podosphaera xanthii*) in Okra.

In some embodiments, the fungal disease is Leaf Spots (*Alternaria brassicae*) in Cauliflower/Cabbage.

In some embodiments, the fungal disease is Powdery Mildew (*Leveillula Taurica*) in Chilli.

In some embodiments, the fungal disease is Damping off (*Pythium ultimum*) in Vegetable crops.

In some embodiments, the fungal disease is Fusariosis (*Fusarium oxysporum*) in Pineapple.

In some embodiments, the fungal disease is Grey Mold (*Botrytis cinerea*) in Grapes/ Berrys.

In some embodiments, the fungal disease is Chocolate spot (*Botrytis cinerea*) in Bean.

In some embodiments, the fungal disease is Leaf Blotch (*Zymoseptoria tritici*) in Wheat.

In some embodiments, the fungal disease is Black Leg (*Phoma lingam*) in Brassica.

In some embodiments, the fungal disease is White Mold (*Sclerotinia sclerotiorum*) in OSR.

In some embodiments, the fungal disease is ASR (*Phakopsora*) in Soybean.

In some embodiments, the disease is leaf spot (*Septoria glycines*) in soybean.

- 5 In some embodiments, the fungal disease is Rust (*Puccinia*) in cereal.

In one embodiment the present invention provides a cost-effective EW formulation which can be used for treating fungal diseases in banana plant.

The present invention may be used to control above mentioned diseases in agricultural crops without any phytotoxicity to the plant.

- 10 Examples of the crops on which the present compositions can be used include but are not limited to corn, rice, wheat, barley, rye, oat, sorghum, cotton, soybean, peanut, buckwheat, beet, rapeseed, sunflower, sugar cane, tobacco, etc.; vegetables: solanaceous vegetables such as eggplant, tomato, pimento, pepper, A potato, etc., cucurbit vegetables such as cucumber, pumpkin, zucchini, water melon, melon,
- 15 squash, etc., cruciferous vegetables such as radish, white turnip, horseradish, kohlrabi, Chinese cabbage, cabbage, leaf mustard, broccoli, cauliflower, etc., asteraceous vegetables such as burdock, crown daisy, artichoke, lettuce, etc, liliaceous vegetables such as green onion, onion, garlic, and asparagus, 4h, ammiaceous vegetables such as carrot, parsley, celery, parsnip, etc.,
- 20 chenopodiaceous vegetables such as spinach, Swiss chard, etc., lamiaceous vegetables such as *Perilla frutescens*, mint, basil, etc, strawberry, sweet potato, *Dioscorea japonica*, colocasia, etc., flowers, foliage plants, turf grasses, fruits: pome fruits such apple, pear, quince, etc, stone fleshy fruits such as peach, plum, - nectarine, *Prunus mume*, cherry fruit, apricot, prune, etc., citrus fruits such as
- 25 orange, lemon, lime, grapefruit, etc., nuts such as chestnuts, walnuts, hazelnuts, almond, pistachio, cashew nuts, macadamia nuts, etc. berries such as blueberry, cranberry, blackberry, raspberry, etc., grape, kaki fruit, olive, plum, banana, coffee, date palm, coconuts, etc., trees other than fruit trees; tea, mulberry, flowering plant, trees such as ash, birch, dogwood, *Eucalyptus*, *Ginkgo biloba*, lilac, maple,

Quercus, poplar, Judas tree, Liquidambar formosana, plane tree, zelkova, Japanese arborvitae, fir wood, hemlock, juniper, Pinus, Picea, and Taxus cuspidate, etc.

In an embodiment the present invention provides an aqueous emulsion which comprises cinnamaldehyde as active ingredient, for controlling or prevention of the
5 black sigatoka in a banana infected by said disease or potentially infected by it.

Black Sigatoka is caused by the *Mycosphaerella fijiensis* fungus and is considered the biggest leaf disease affecting banana and plantain crops all around the world, causing losses of up to 100% of the crop. This disease causes serious issues for the plant's growth, which suffers severe deterioration in the area of the leaf, affecting
10 the productivity of the crop since it decreases its capacity to photosynthesise. Therefore, the plant is not able to get the necessary nutrients it needs from the leaves in order to feed the bunch of bananas. In consequence, the fruit ripens prematurely, which makes it unsuitable for export and this causes large economic losses.

The present invention thus provides an effective method of controlling the diseases
15 afflicting banana crops in plantations, and more specifically to the group of fungus diseases caused by the *Mycosphaerella fijiensis* fungus.

The composition can be applied using the same conventional system for applying treatments, preferably by means of spraying or may be fumigating the field (land or aerial) or it can be foliar application. Typically, EW formulation of the present
20 invention is diluted with sufficient amount of water and sprayed on the crop in order to control the target fungal disease.

The present invention further provides use of aqueous emulsion comprising cinnamaldehyde for the treatment and/or prevention of the Black Sigatoka fungal disease in a banana infected by said disease or potentially infected by it. Preferably,
25 in this use, cinnamaldehyde is used alone as the active ingredient in the absence of any other essential oil.

One of the advantages of the composition of the present invention is that cinnamaldehyde used can be obtained from cinnamon oil or chemically synthesized material and it is compatible with synthesised chemical fungicides commonly used for controlling sigatoka. This way, in the embodiments of the invention,
5 cinnamaldehyde and/or the composition may be used in combination with another fungicide known to a person skilled in the art.

Alternatively, the present invention provides a method for controlling/ treating black sigatoka disease in banana which comprises applying to the foliage of the plants a fungicidally effective amount of cinnamaldehyde.

10 The compositions can be applied directly to the plant by, for example, spraying either at the time when the fungus has begun to appear on the plant, or before the appearance of fungus as a protective measure. In both such cases the preferred mode of application is by foliar spraying. It is generally important to obtain good control of fungi in the early stages of plant growth as this is the time when the plant can be
15 most severely damaged.

Typically the present composition is applied in the range from 0.05 g a.i./L to 5 g a.i. /L, preferably 0.05 g a.i./L to 3 g a.i. /L, more preferably 0.05 g a.i./L to 2 g a.i. /L for most efficient anti-fungal effect.

Typically, the concentration of cinnamaldehyde in the formulation is in the range
20 from 100g/L to 500g/L.

In another preferred embodiment, the present formulation of cinnamaldehyde can be applied to the affected locus in an amount from about 1.0 L/Ha to about 6.0 L/Ha, preferably from about 1.0 L/Ha to about 4.0 L/Ha, more preferably about 1.0 L/Ha to about 3.0 L/Ha.

25 In an embodiment the composition of the present invention can be packaged as a kit-of-parts. In an embodiment a kit-of-parts may contain various components of

the formulation of the present invention that may can be mixed as instructed prior to spraying.

Accordingly, one aspect of the present invention can provide a mufti-pack fungicidal product for controlling black sigatoka at a locus comprising components
5 of the present invention and a manual. The instruction manual includes instructions for administering the composition of the present composition.

In an embodiment the combination kit is packed in a package or a carton, in another embodiment, the instruction manual may be printed on said package or carton or may be printed on a booklet that may be included within the package or the carton.

10 Advantages of present EW formulations are;

- 1) Reduced dermal toxicity
- 2) Less irritant to skin & eyes
- 3) Less phytotoxicity
- 4) Not inflammable
- 15 5) Environmentally safe
- 6) Good chemical stability
- 7) Economic as water is the solvent system
- 8) Reasonably good for tank mixing as it is aqueous base system
- 9) Providing sustainable agriculture with zero residue solution

20 Further advantages of the invention include:

- a) It is new and environmentally safe solution which is especially efficient for controlling fungal diseases, showing acceptable effectiveness levels, no phytotoxicity and high biodegradability.
- b) The present formulation has reduced dermal toxicity and lower potential for
25 harming the environment.
- c) The present EW formulation that is effectively applied in treatments and is less likely to damage tender plant foliage because it does not contain the solvents used in emulsifiable concentrates (EC).

- d) In an EW the continuous phase is water (as opposed to an organic solvent for ECs) which offers the benefit of lower phytotoxicity, no flashpoint concern, ease of handling, low cost to farmer/grower, and a lower environmental impact.
- 5 e) Finally, the composition of the invention is a stable EW formulation, which is free from solvents which are used in EC formulations.

However, it should be understood that the scope of the present invention is not limited by the examples in any manner. It will be appreciated by any person skilled in this art that the present invention includes aforesaid examples and further can be

10 modified and - altered within the technical scope of the present invention. Subsequently, use of ranges of numbers expressly includes any possible sub-domains and any other individual numeric values or said whole numbers within these ranges, unless the context expressly indicated otherwise. This applies in all circumstances to all number ranges and in any context throughout this application.

15 For example, a range of numbers from 10 to 60% includes 15 to 55%, 20-50%, 25-45%, 30-40%, 35-40% and so on.

The invention will be illustrated with reference to the following examples.

EXAMPLES

Example 1

Ingredients	Amount (%)
Cinnamaldehyde	31
Propylene Glycol	5
Polysorbate 80	5
Methyl-oxirane polymer with oxirane	5
Isopropyl Myristate	4
Water	Q. S.
Total	100

Process:

Propylene glycol was added in sufficient water and stirred for 30-45 min in a vessel. Polysorbate 80 was then added under stirring and the solution was stirred for 30-45 min to obtain aqueous solution. In a separate vessel, cinnamaldehyde, methyl-oxirane polymer with oxirane and isopropyl myristate were added, stirred for 30-45 min and added to an aqueous solution to obtain EW formulation.

Example 2

Ingredients	Amount (%)
Cinnamaldehyde	31
Isopropyl Myristate	5
Castor oil	5.5
Calcium salt of Alkyl Benzene Sulfonate	0.5
Water	Q. S.
Total	100

Process: In vessel-1, Cinnamic aldehyde was added followed by addition of isopropyl Myristate, castor oil, calcium salt of Alkyl Benzene Sulfonate (CABS 60) and the mixture was stirred for 30-45 min. Aqueous phase was prepared in vessel 2 by adding polyvinyl pyrrolidone in water. The solution of vessel 1 was added into vessel-2 under continuous stirring to obtain an emulsion (EW).

Example 3

Ingredients	Amount (%)
Cinnamaldehyde	51.5
Propylene Glycol	5
Polysorbate 80	4
Methyl-oxirane polymer with oxirane	5
Isopropyl Myristate	5
Water	Q. S.

Total	100
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- Propylene glycol, polyvinylpyrrolidone were added in sufficient water and stirred for 30-45 min in a vessel. Polysorbate 80 was then added under stirring and the solution was stirred for 30-45 min to obtain aqueous solution. In a separate vessel,
- 5 Cinnamaldehyde, Methyl-oxirane polymer with oxirane and isopropyl myristate were added, stirred for 30-45 min and added to aqueous solution to obtain EW formulation.

Example 4

Ingredients	Amount (%)
Cinnamic Oil*	36
Propylene Glycol	1 – 6
Methyl-oxirane polymer with oxirane	1 – 6
Polysorbate 80	1 – 6
Isopropyl Myristate	1 – 6
Water	Q. S.
Total	100

10

*Cinnamaldehyde Content 30 % w/w

- Process: Water was added into the manufacturing Vessel-1, Propylene Glycol was added to it under stirring. Polysorbate 80 was then added and the mixture was stirred for 30-45 min. In a separate Vessel-2, cinnamic oil, Methyl-oxirane polymer with oxirane and Isopropyl Myristate were added and stirred for 30-45 min. Slowly
- 15 Vessel-2 oil phase was added into Vessel-1 under continuous stirring. for homogeneous mixing to obtain EW formulation.

Example 5

Ingredients	Amount (%)
Cinnamaldehyde	41
Propylene Glycol	5
Methyl-oxirane polymer with oxirane	5
Polysorbate-80	5
Isopropyl Myristate	4
Water	Q. S.
Total	100

Propylene glycol was added in sufficient water and stirred for 30-45 min in a vessel. Polysorbate 80 was then added under stirring and the solution was stirred for 30-45 min to obtain aqueous solution. In a separate vessel, Cinnamaldehyde, Methyl-oxirane polymer with oxirane and isopropyl myristate were added, stirred for 30-45 min and added to aqueous solution to obtain EW formulation.

Example 6

Stability features associated with the composition developed according to the present invention were studied. The compositions of present invention as described under above examples were taken further to evaluate physicochemical parameters.

Table 1

Shelf Life study analysis of EW formulation						
Sr. No	Parameters	Specification	Results			
			Example 2 (Cinnamaldehyde 30% EW)			
			0 Day	6 Month	12 Month	18 Month

1	Description	White to off white coloured viscous liquid with marginal separation		Complies	Complies	Complies	Complies
2	Active content (% w/w)	28.5 to 31.5		30.71	30.65	30.6	30.56
3	pH of 1 % aqueous emulsion	3.5 – 5.5		4.4	4.35	4.3	3.75
4	Persistent foam in ml after 1 Min.	Maximum 60.0		Nil	Nil	Nil	Nil
5	Density at 20 °C in (g/mL)	1.02±0.02		1.0234	1.0234	1.0235	1.0235
6	Emulsion stability	5 ml EW in 95 ml Standard hard water A & C.		Complies	Complies	Complies	Complies
		Time after dilution	Limit of stability				
		0 Hrs.	Initial - emulsification complete				
		0.5 Hrs.	"Sediment", max. 1ml				
		2.0 Hrs.	"Sediment", max. 2 ml,				
			- "Free oil", max. 1.0 ml				
		24.0 Hrs.	Re-emulsification complete				
		24.5 Hrs.	"Sediment", max. 2 ml,				
			"Free oil" max. 1.0 ml				

Table 2

Sr. No	Parameters	Specification	Ambient	14 Days AHS @ 54 Week
		Example 1 (Cinnamaldehyde 30% EW)		
1	Description	White to off White Color Emulsion, after gentle agitation, the formulation shall be homogeneous	Complies	Complies
2	Active content as Cinnamaldehyde (% w/w)	31.5	31.11	31.01
3	pH of 1 % aqueous emulsion	4 to 6	3.9	3.39
4	Persistent foam in ml after 1 Min.	Maximum 60.0	Nil	Nil
5	Emulsion stability	2 ml EW in 98 ml Standard hard water A & C.	Complies the emulsion stability. The diluted emulsion was found to be stable. This stability of the composition was consistent, after 1 hour and after 24 hours at room temperature.	

Table 3

5

Sr. No	Parameters	Specification	Ambient	14 Days AHS @ 54 Week
		Example 3 (Cinnamaldehyde 50% EW)		
1	Description	White to off White Color Emulsion, after gentle agitation, the formulation shall be homogeneous	Complies	Complies
2	Active content as Cinnamaldehyde (% w/w)	48.5 to 52.5	50.98	50.89

3	pH of 1 % aqueous emulsion	3.5 to 5.5	3.89	3.75
4	Persistent foam in ml after 1 Min.	Maximum 60.0	Nil	Nil
5	Emulsion stability	2 ml EW in 98 ml Standard hard water A & C.	Complies the emulsion stability. The diluted emulsion was found to be stable. This stability of the composition was consistent, after 1 hour and after 24 hours at room temperature.	

Table 4

Sr. No	Parameters	Specification	Ambient	14 Days AHS @ 54 Week
		Example 5 (Cinnamaldehyde 40% EW)		
1	Description	White to off White Color Emulsion, after gentle agitation, the formulation shall be homogeneous	Complies	Complies
2	Active content as Cinnamaldehyde (% w/w)	38 to 42	40.62	40.91
3	pH of 1 % aqueous emulsion	3.5 to 5.5	5.79	5.12
4	Persistent foam in ml after 1 Min.	Maximum 60.0	Nil	Nil

5

10

Table 5

Sr. No	Parameters	Specification	0 Days	14 Days AHS @ 54 Week
		Example 4 (Cinnamic Oil* 30% EW)		
1	Description	White to off White Color Emulsion, after gentle agitation, the formulation shall be homogeneous	Complies	Complies
2	Active content as Cinnamaldehyde (% w/w)	28.5 to 31.5	30.38	30.37
3	pH of 1 % aqueous emulsion	4 to 6	5.69	5.64
4	Persistent foam in ml after 1 Min.	Maximum 60.0	Nil	Nil
5	Emulsion stability	2 ml EW in 98 ml Standard hard water A & C.	Complies the emulsion stability. The diluted emulsion was found to be stable. This stability of the composition was consistent, after 1 hour and after 24 hours at room temperature	

- 5 From above tables it is clear that the present compositions remained stable when tested at ambient conditions i.e. room temperature and pressure. The compositions also passed 14 days Accelerated Heat Stability (AHS) test and complies as per the specification.

CLAIMS:

1. A composition comprising:
 - a) a discrete oil phase comprising cinnamaldehyde; and
 - b) a continuous aqueous phase comprising a water soluble ingredient,
- 5 wherein said oil phase comprises at least one water dispersible ingredient.

2. The composition as claimed in claim 1 wherein said water dispersible ingredient and water-soluble ingredient is selected from at least one non-ionic surfactant and anionic surfactant.

- 10 3. The composition as claimed in claim 2 wherein said non-ionic surfactant is selected from polyarylphenol polyethoxy ethers, polyalkylphenol polyethoxy ethers, Methyl oxirane polymer with oxirane, polyglycol ether derivatives of saturated fatty acids, polyglycol ether derivatives of unsaturated fatty acids,
- 15 polyglycol ether derivatives of aliphatic alcohols, polyglycol ether derivatives of cycloaliphatic alcohols, fatty acid esters of polyoxyethylene sorbitan, alkoxyated vegetable oils, castor oil, alkoxyated acetylenic diols, polyalkoxyated alkylphenols, fatty acid alkoxyates, sorbitan alkoxyates, sorbitol esters, C₈-C₂₂ alkyl or alkenyl polyglycosides, polyalkoxy styrylaryl ethers, alkylamine oxides,
- 20 block copolymer ethers, polyalkoxyated fatty glyceride, polyalkylene glycol ethers, linear aliphatic or aromatic polyesters, organo silicones, polyaryl phenols, sorbitol ester alkoxyates, polyalkylene oxide block copolymers, acrylic copolymers and mono- and diesters of ethylene glycol or mixtures thereof; and anionic surfactant is selected from alcohol sulfates, alcohol ether sulfates, alkylaryl
- 25 ether sulfates, alkylaryl sulfonates such as alkylbenzene sulfonates and alkyl-naphthalene sulfonates and salts thereof, alkyl sulfonates, mono- or di-phosphate esters of polyalkoxyated alkyl alcohols or alkylphenols, mono- or di-sulfosuccinate esters of C₁₂-C₁₅ alkanols or polyalkoxyated C₁₂-C₁₅ alkanols, alcohol ether carboxylates, phenolic ether carboxylates, polybasic acid esters of
- 30 ethoxylated polyoxyalkylene glycols consisting of oxybutylene, sulfoalkylamides and salts thereof, polyoxyalkylene alkylphenol carboxylates, polyoxyalkylene

alcohol carboxylates, alkyl ester sulfates, naphthalene sulfonates, naphthalene formaldehyde condensates, alkyl sulfonamides, sulfonated aliphatic polyesters, sulfate esters of styrylphenyl alkoxylates, and sulfonate esters of styryl phenyl alkoxylates and salts thereof, ligninsulfonic acid or its sodium, potassium, magnesium, calcium or ammonium salt, polyarylphenol polyalkoxyether sulfates and polyarylphenol polyalkoxyether phosphates and sulfated alkyl phenol ethoxylates, phosphated alkyl phenol ethoxylates or combinations thereof.

4. The composition as claimed in claim 1 wherein cinnamaldehyde is present in an amount from about 1% to about 80% by weight of the composition.

5. The composition as claimed in claim 1 wherein water dispersible or water-soluble ingredient is present in an amount of 0.1 to 25 % by weight of the composition.

6. The composition as claimed in claim 1 further comprises a cosolvent selected from the group comprising isopropyl myristate, isopropyl palmitate, isopropyl acetate, isopropyl lanolin, isopropyl stearate, isopropylamine, isopropylamine salt of oleoylisopropanolamide, isopropylamine sulfate, 4-isopropylidene-1-methylcyclohexene, 4,4'-isopropylidenediphenol C₍₁₂₋₁₅₎-alkyl phosphates, isopropyl naphthalenesulfonic acid or sodium salt, isopropyl sulfamic acid, propylene glycol, ethylene glycol, diethylene glycol, 1,2-propylene glycol, tripropylene glycol, polyvinylalcohol or combinations thereof.

7. The composition as claimed in claim 1 wherein said composition is an aqueous emulsion (EW) formulation.

8. An aqueous emulsion (EW) comprising

- i) 20 to 60 % of cinnamaldehyde
- ii) 2 to 8 % non-ionic surfactant
- iii) 1 to 8% of isopropyl myristate and

iv) 40 to 60% of water

9. A process for preparation of a composition as claimed in claim 1 comprising

5 i) preparing an oil phase by mixing cinnamaldehyde and suitable water dispersible ingredients.

ii) preparing an aqueous phase by dissolving suitable water-soluble ingredients in water.

iii) oil phase is emulsified in the aqueous phase to obtain an emulsion.

10 10. A method for controlling or preventing phytopathogenic fungi comprising contacting or applying to a locus a composition comprising a discrete oil phase comprising cinnamaldehyde and a continuous aqueous phase comprising water soluble ingredient, wherein said oil phase comprises at least one water dispersible ingredient.

15

11. The method as claimed in claim 10 wherein said composition is an aqueous emulsion (EW) comprising 1 to 80% of cinnamaldehyde.

12. Use of an aqueous emulsion comprising cinnamaldehyde for the treatment
20 or prevention of fungal disease.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2021/058711

A. CLASSIFICATION OF SUBJECT MATTER

A01N 25/04 (2006.01) A01N 25/30 (2006.01) A01N 31/04 (2006.01) A01N 65/24 (2009.01) A01P 3/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Databases: PATENW, CAPLUS, REGISTRY, CASFORMULATIONS, CABA, AGRICOLA, BIOSIS, CROPU.IPC/CPC Marks: A01N, A01P, A01N25/04, A01N25/30, A01N31/04, A01N35/02, A01N65/24 & A01N2300/00.Keywords: Cinnamaldehyde, isopropyl myristate, emulsion, oil-in-water emulsion, o/w emulsion, microemulsion, suspoemulsion, nanoemulsion, stable/stabilised emulsion, polyoxyethylene polyoxypropylene, EO-PO copolymer, methyl oxirane polymer, fungicide, fungal disease, black sigatoka, and like terms.Applicant/inventor name search: PATENW, CAPLUS, AGRICOLA, BIOSIS, CABA, CROPU, Google, and internal databases provided by IP Australia.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"D" document cited by the applicant in the international application	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

15 December 2021

Date of mailing of the international search report

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Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
Email address: pct@ipaustalia.gov.au

Authorised officer

Andrew Tilley
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. +61262832589

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/IB2021/058711
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 108770846 A (XIAN PEAK BIOLOGICAL CHEMICAL CO LTD) 09 November 2018, automated machine translation retrieved from Espacenet on 13 December 2021. Examples 1-4, Experimental Examples 1-3, claim 9, and paragraph [0055].	1-12
X	WO 2014047021 A1 (VALENT BIOSCIENCES CORPORATION) 27 March 2014 Example 1, Tables 1 & 2, and paragraph [00019].	1-12
X	US 20160000089 A1 (DECCO WORLDWIDE POST-HARVEST HOLDINGS B.V.) 07 January 2016 Paragraphs [0058]-[0065] and claim 16.	1-12
X	CN 102526070 A (UNIV NORTHWEST A&F) 04 July 2012, automated machine translation retrieved from Espacenet on 13 December 2021. Example 4, Test Examples 1-5 and paragraphs [0067] & [0071]-[0076].	1-12
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A	WO 2018116027 A1 (DECCO WORLDWIDE POST-HARVEST HOLDINGS B.V.) 28 June 2018	

INTERNATIONAL SEARCH REPORT		International application No. PCT/IB2021/058711	
Information on patent family members			
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
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This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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