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(54) Title: AGRICULTURAL COMPOSITION

(57) Abstract: The subject invention provides compositions and mixtures comprising fluensulfone, fipronil and azoxystrobin and uses thereof.

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AGRICULTURAL COMPOSITION

This application claims benefit of U.S. Provisional Application No. 62/684,547, filed June 13, 2018, the entire content of which is hereby incorporated by reference herein.

Throughout this application, various publications are cited. Disclosures of the documents and publications referred to herein are hereby incorporated in their entireties by reference into this application.

FIELD OF THE PRESENT SUBJECT MATTER

The present subject matter relates to mixtures and compositions comprising fluensulfone, fipronil and azoxystrobin, as well as preparation and uses thereof.

BACKGROUND OF THE PRESENT SUBJECT MATTER

Crop protection is critical from early stages of crop development. Preventing pests and diseases at the root of the crop during root development leads to increased crop health and yield.

Young roots are most sensitive and there is a need to develop multi-functional mixtures with broad spectrum activity against pests and diseases which affect the crop during the crop's early developmental stages.

Roots are highly affected by nematodes, insects and pathogens at the locus of the plant.

Fluensulfone (5-chloro-2-(3,4,4-trifluorobut-3-en-1-ylsulfonyl)-1,3-thiazole) is a nematocide which has a significantly reduced environmental impact with low toxicity to non-target insects and mammals. Fluensulfone's mode of action is distinct from currently available nematicides and therefore presents a promising new chemical entity for crop protection.

Insecticide and fungicide are also required for improving root development.

Fipronil ((RS)-5-amino-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-(trifluoromethylsulfinyl)-1H-pyrazole-3-carbonitrile) and azoxystrobin (methyl (2E)-2-

(2-{[6-(2-cyanophenoxy)pyrimidin-4-yl]oxy}phenyl)-3-methoxyacrylate) are well-known pesticides which may be used for protecting root from pests and plant pathogen infections.

Based on the above, there is a need in the art to find a simple and uniform solution for protecting a crop at the critical stage of its growth, for improving the development of the root system and for promoting better and more efficient of rooting in crop.

There is a need in the art to develop a broad spectrum treatment which is effective for controlling multi-pest attacks on crops in a simple and effective way.

SUMMARY OF THE PRESENT SUBJECT MATTER

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention provides a stable composition for controlling nematode, enhancing plant development, regulating plant growth, preventing plant and/or soil disease, and/or controlling plant and/or soil disease, wherein the composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention further provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, and (v) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, (v) an organic carrier, and (vi) at least one physically stabilizing additive, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, (v) an organic carrier, and (vi) a physically stabilizing system, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention also provides the use of polyvinylpyrrolidone for stabilizing a composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention also provides the use of a combination of polyvinylpyrrolidone and

polyalkylene oxide block copolymer for stabilizing a composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention provides a method for controlling nematode, enhancing plant development, regulating plant growth, preventing plant and/or soil disease, and/or controlling plant and/or soil disease, wherein the method comprises applying an effective amount of any one of the mixtures or compositions disclosed herein to the plant, a locus of the plant or propagation material of the plant so as to thereby control nematode, enhance development of the plant, regulate the growth of the plant, prevent plant and/or soil disease, and/or control plant and/or soil disease.

The present invention provides a method for controlling nematode, enhancing plant development, regulating plant growth, preventing plant and/or soil disease, and/or controlling plant and/or soil disease, wherein the method comprises applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to the plant, a locus of the plant or propagation material of the plant so as to thereby control nematode, enhance development of the plant, regulate the growth of the plant, prevent plant and/or soil disease, and/or control plant and/or soil disease.

The invention provides a process for preparing the stable composition described herein, wherein the process comprises the steps of: (1) milling a dispersion of fipronil and azoxystrobin in water, (2) dissolving fluensulfone in an organic carrier to obtain a solution, (3) preparing an emulsion from the solution obtained in step (2), and (4) preparing suspoemulsion composition from the dispersion obtained from step (1) and the emulsion obtained from step (3).

DETAILED DESCRIPTION OF THE PRESENT SUBJECT MATTER

Definitions

Prior to setting forth the present subject matter in detail, it may be helpful to provide definitions of certain terms to be used herein. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as is commonly understood by one of skill in the art to which this subject matter pertains.

As used herein, the term "broad spectrum" is used to describe efficiency against a wide range of diseases and infections of the plant, the locus thereof or propagation material thereof.

As used herein, the term "stable" when used in connection with physical stabilization or when used in connection with a composition means that no significant crystallization and/or thickening was observed after at least 2 weeks of storage at a temperature of at least 50°C. The term "stable" when used in connection with suspoemulsion means no crystallization and/or thickening was observed after at least 2 weeks of storage at a temperature of at least 50°C.

Stability is assessed according to CIPAC test protocols. Physical stability of the composition is tested using CIPAC methodologies MT 36.3- Emulsion (5%) 342 ppm water (2 h) test; MT 185-Wet Sieve Test; MT 148.1- Pourability; MT 39.3-Storage Stability 0ºC; and MT 184-Suspensibility.

CIPAC test is standard in the relevant industry for assessing before and after storage stability. Stability can be assessed under normal storage conditions which is after two years storage at room temperature. Stability can also be assessed under accelerated storage conditions which is after 2 weeks storage at 54°C or equivalent or after 8 weeks at 40°C or after 12 weeks at 35°C.

As used herein, the term "effective" when used to describe a method for controlling of undesired pest, such as nematodes, means that the method provides a good level of control of the undesired pest without significantly interfering with the normal growth and development of the crop.

As used herein, the term "effective amount" when used in connection with an active component refers to an amount of the active component that, when ingested, contacted with or sensed, is sufficient to achieve a good level of control or activity.

As used herein, the term “effective amount” when used in connection with a non-active component, i.e. additive, such as polymer and organic carrier, refers to an amount of the additive that is sufficient to improve the stability of the composition.

As used herein, the term "agriculturally acceptable carrier" means carrier which are known and accepted in the art for the formation of compositions for agricultural or horticultural use.

As used herein, the term “adjuvant” is broadly defined as any substance that itself is not an active ingredient but which enhances or is intended to enhance the effectiveness of the pesticide with which it is used. Adjuvants may be understood to include, but are not limited to, spreading agents, penetrants, compatibility agents, and drift retardants.

As used herein, the term "agriculturally acceptable inert additives" is defined as any substance that itself is not an active ingredient but is added to the composition such as thickening agent, sticking agents, surfactants, anti-oxidation agent, anti-foaming agents and thickeners.

As used herein, the term “tank mix” means that two or more chemical pesticides or compositions are mixed in the spray tank at the time of spray application.

As used herein, the term “ready mix” means a composition that may be applied to plants directly after dilution. The composition comprises the combination of the active ingredients.

As used herein the term "plant" includes reference to the whole plant, plant organ (e.g., leaves, stems, twigs, roots, trunks, limbs, shoots, fruits etc.), and propagation material or plant cells.

As used herein the term "plant" includes reference to agricultural crops including field crops (soybean, maize, wheat, rice, etc.), vegetable crops (potatoes, cabbages, etc.), fruits (peach, etc.), semi-perennial crops (sugarcane) and perennial crops (coffee and guava)

As used herein the term "propagation material" is to be understood to denote all the generative parts of the plant such as seeds and spores, vegetative structures such as bulbs, corms, tubers, rhizomes, roots stems, basal shoots, stolons and buds.

As used herein, the term "locus" includes not only areas where the pest may already be developed, but also areas where pest have yet to emerge, and also to areas under cultivation.

As used herein the term “ha” refers to hectare.

As used herein, the term “mixture” or “combination” refers, but is not limited to, a combination in any physical form, e.g., blend, solution, suspension, dispersion, emulsion, alloy, or the like.

The term "enhancing crop plants" as used herein means improving one or more of plant quality, plant vigor, nutrient uptake, root system, tolerance to stress factors, and/or yield in a plant to which the mixture or composition described herein has been applied as compared to a control plant grown under the same conditions except to which the mixture or composition described herein has not been applied..

The term "enhancing roots system" as used herein means the roots system is improved qualitatively or quantitatively in plant to which the mixture or composition described herein has been applied as compared to the roots systems in a control plant grown under the same conditions except to which the mixture or composition described herein has not been applied. Enhanced roots systems include but are not limited to improved visual appearance and composition of the roots system (*i.e.*, improved color, density, and uniformity), increased root growth, a more developed root system, stronger and healthier roots, improved plant stand, and increased roots system weight.

The term "improving plant quality" as used herein means that one or more traits are improved qualitatively or quantitatively in a plant to which the mixture or composition described herein has been applied as compared to the same trait in a control plant grown under the same conditions except to which the mixture or composition described herein has not been applied. Such traits include but are not limited to improved visual appearance and composition of the plant (*i.e.*, improved color, density, uniformity, compactness),

reduced ethylene (reduced production and/or inhibition of reception), improved visual appearance and composition of harvested material (*i.e.*, seeds, fruits, leaves, vegetables, shoot/stem/cane),), improved carbohydrate content (*i.e.*, increased quantities of sugar and/or starch, improved sugar acid ratio, reduction of reducing sugars, increased rate of development of sugar), improved protein content, improved oil content and composition, improved nutritional value, reduction in anti-nutritional compounds, increased nutrient uptake, stronger and healthier roots, improved organoleptic properties (*i.e.*, improved taste), improved consumer health benefits (*i.e.*, increased levels of vitamins and antioxidants), improved post-harvest characteristics (*i.e.*, enhanced shelf-life and/or storage stability, easier processability, easier extraction of compounds), and/or improved seed quality (*i.e.*, for use in following seasons).

As used herein, the term "plant growth regulation" or "regulating plant growth" includes restricting vertical stem growth, promoting root growth, stunting, increasing stem diameter and stem-wall thickness, and the like.

As used herein, the term “mixture” or “combination” refers, but is not limited to, a combination in any physical form, e.g., blend, solution, alloy, or the like.

As used herein, the term "plants" refers to any and all physical parts of a plant, including but not limited to seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage, and fruits.

As used herein, the term "surfactant” means an agriculturally acceptable material which imparts emulsifiability, stability, spreading, wetting, dispersibility or other surface-modifying properties. Examples of suitable surfactants include non-ionic, anionic, cationic and ampholytic surfactants.

The term “a” or “an” as used herein includes the singular and the plural, unless specifically stated otherwise. Therefore, the terms “a,” “an” or “at least one” can be used interchangeably in this application.

Throughout the application, descriptions of various embodiments use the term “comprising”; however, it will be understood by one of skill in the art, that in some specific instances, an embodiment can alternatively be described using the language “consisting essentially of” or “consisting of.”

For purposes of better understanding the present teachings and in no way limiting the scope of the teachings, unless indicated to the contrary, the numerical parameters set forth in the following specification and attached claims are approximations that may vary depending upon the desired properties sought to be obtained. At the very least, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. In this regard, use of the term "about" herein specifically includes ±10% from the indicated values in the range. In addition, the endpoints of all ranges directed to the same component or property herein are inclusive of the endpoints, are independently combinable, and include all intermediate points and ranges.

It is further understood that where a parameter range is provided, all integers within that range, and tenths thereof, are also provided by the invention. For example, "0.1% to 50%" includes 0.1 %, 0.2 %, 0.3 %, 0.4 % etc. up to 50 %.

Compositions

Fluensulfone, fipronil and azoxystrobin have been studied and used for many years. For many crops, there is a need for a combination of different pesticides for improving root development and efficiency of rooting.

Preparing a stable, ready to use composition comprising fluensulfone, fipronil and azoxystrobin is a challenge. Due to solubility limitation, formulating fluensulfone, which requires an organic carrier, with fipronil and azoxystrobin, require an aqueous carrier, is challenging.

The present invention provides a stable composition comprising fluensulfone, fipronil and azoxystrobin.

The composition of the present invention is unexpectedly more efficient in controlling nematode. The composition is also unexpectedly more efficient in regulating plant growth and enhancing plant development, including, for example, enhancing root development. The composition is ready to use after dilution.

The composition of the present invention provides a number of advantages over tank

mixes comprising fluensulfone, fipronil and azoxystrobin. These advantages include, but are not limited to, simplicity of use, stability, reduced amount of solvents and increased effectiveness.

The present invention provides a stable, broad spectrum composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of an insecticide, and (iii) an effective amount of a fungicide.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising: (i) fluensulfone, (ii) fipronil and (iii) azoxystrobin.

In some embodiments, the fungicide is a strobilurin fungicide.

In some embodiments, the insecticide is a phenypyrazole insecticide.

In some embodiments, the strobilurin fungicide is azoxystrobin.

In some embodiments, the phenylpyrazole insecticide is fipronil.

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a stable, broad spectrum composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a stable, broad spectrum composition for use on sugar cane, wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a stable, broad spectrum composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, and (iv) an agriculturally acceptable carrier.

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of

azoxystrobin, (iv) at least one physically stabilizing additive, (v) an aqueous carrier, and (vi) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a stable composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil (iii) an effective amount of azoxystrobin, (iv) a physically stabilizing system, (v) an aqueous carrier, and (vi) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention further provides a stable, broad spectrum composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, and (v) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and fluensulfone in dissolved in the organic carrier.

The present invention further provides a stable suspoemulsion composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, and (v) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a stable, broad spectrum composition for controlling pests wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising: (i) fluensulfone, (ii) fipronil and (iii) azoxystrobin.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil,

and (iii) an effective amount of azoxystrobin.

The present invention provides a broad spectrum, stable, ready to dilute composition for use on sugar cane, wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, and (iv) an agriculturally acceptable carrier.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) at least one physically stabilizing additive, (v) an aqueous carrier, and (vi) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil (iii) an effective amount of azoxystrobin, (iv) a physically stabilizing system, (v) an aqueous carrier, and (vi) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, and (v) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and fluensulfone in dissolved in the organic carrier.

The present invention provides a broad spectrum, stable, ready to dilute composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, (iii) an effective amount of azoxystrobin, (iv) an aqueous carrier, and (v) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

The present invention provides a broad spectrum, stable, ready to dilute composition for controlling pests wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

In some embodiments, the pests are nematode. In some embodiments, the pests are insects. In some embodiments, the pests are fungi. In some embodiments, the pests are nematodes, insects and fungi.

The present invention provides a stable composition for controlling nematodes wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention also provides a stable, broad spectrum composition for enhancing crop plant, wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention also provides a stable, broad spectrum composition for enhancing plant development, wherein the composition comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

In some embodiments, the composition enhances root development. In some embodiments, the composition enhances the root system of the plant. In some embodiments, the composition enhances plant quality. In some embodiments, the composition enhances plant vigor. In some embodiments, the composition enhances plant yield. In some embodiments, the composition prevents root damage. In some embodiments, the composition improves rooting.

The present invention provides a stable, broad spectrum composition for regulating plant growth, wherein the composition comprises (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

In some embodiments, the composition is a ready mix composition. In some embodiments, the composition is a ready to dilute composition.

The present invention provides a stable, ready mix, broad spectrum composition for, enhancing nematode controlling, enhancing root systems, enhancing crop plants development and vigor and improving plant potential yield by preventing root damage and improving rooting, wherein the composition comprises (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention provides a stable, ready mix composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention provides a stable, ready mix composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin, wherein the azoxystrobin and fipronil are suspended in the aqueous carrier and fluensulfone is dissolved in the organic carrier.

The present invention provides a stable, ready mix composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil (iii) an effective amount of azoxystrobin, (iv) at least one physically stabilizing additive, (v) an aqueous carrier and (vi) an organic carrier, wherein the azoxystrobin and fipronil are suspended in the aqueous carrier and fluensulfone is dissolved in the organic carrier.

The present invention provides a stable, ready mix composition comprising (i) an effective amount of fluensulfone (ii) an effective amount of fipronil (iii) an effective amount of azoxystrobin, (iv) a physically stabilizing system, (v) an aqueous carrier, and (vi) an organic carrier, wherein the azoxystrobin and fipronil are suspended in the aqueous carrier and fluensulfone is dissolved in the organic carrier.

The present invention provides a stable, ready mix, broad spectrum composition for, enhancing root systems, enhancing crop plants development and vigor and improving plant potential yield by preventing root damage and improving rooting, wherein the composition comprises (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

In some embodiments, the total amount of fluensulfone, fipronil and azoxystrobin in the

composition is greater than 200 grams per liter. In some embodiments, the total amount of fluensulfone, fipronil and azoxystrobin in the composition is greater than 300 grams per liter. In some embodiments, the total amount of fluensulfone, fipronil and azoxystrobin in the composition is from 200 grams per liter to 500 grams per liter.

In some embodiments, the fluensulfone is at least 30% by weight of the organic carrier

In some embodiments, the fluensulfone is at least 40% by weight of the organic carrier.

In some embodiments, the fluensulfone is at least 50% by weight of the organic carrier.

In some embodiments, the composition comprises a stable ratio of ingredients.

In some embodiments, the composition comprises an aqueous carrier.

In some embodiments, the fipronil is suspended in the aqueous carrier.

In some embodiments, the azoxystrobin is suspended in the aqueous carrier.

In some embodiments, the composition comprises an organic carrier.

In some embodiments, the fluensulfone is dissolved in the organic carrier.

In some embodiment, the composition is a suspoemulsion. In some embodiment, the composition is a suspoemulsion comprising an organic carrier. In some embodiments, in the suspoemulsion, the fluensulfone is dissolved in the organic carrier.

In some embodiments, the composition is a suspoemulsion composition comprising an aqueous carrier and an organic carrier, wherein the fipronil and the azoxystrobin are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

In some embodiments, the fluensulfone is at least 30% by weight of the organic carrier.

In some embodiments, the fluensulfone is at least 40% by weight of the organic carrier.

In some embodiments, the fluensulfone is at least 50% by weight of the organic carrier.

In some embodiments, the organic carrier is an amide.

In some embodiments, the organic carrier is a fatty acid amide.

In some embodiments, the fatty acid amide is selected from the group consisting of alkylamines of C6 - C18 carboxylic acids and alkanolamines of C6 - C18 carboxylic acids.

In some embodiments, the organic carrier is a fatty acid amide derivative. In some embodiments, the fatty acid amide derivative is selected from a group consisting of alkylamines and alkanolamines with C6 - C18 carboxylic acids.

In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the N,N-dialkyl fatty acid amide derivative is dimethylamide of C10 fatty acid. In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide. In some embodiments, the fatty acid amide is N,N-dimethyl-decanamide.

In some embodiments, the organic carrier is Genagen® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the organic carrier is an amide solvent. In some embodiment, amide solvent is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the amide solvent is N,N-dimethyl-decanamide. In some embodiments, the solvent is Genagen ® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the composition comprises at least one physically stabilizing additive. In some embodiments, the composition comprises a physically stabilizing system.

In some embodiments, the physically stabilizing system is a combination of polyvinylpyrrolidone and polyalkylene oxide block copolymer.

In some embodiments, the physically stabilizing additive is polyvinylpyrrolidone. In some embodiments, the stabilizing additive is a polyalkylene oxide block copolymer. In some embodiments, the physically stabilizing additives are polyvinylpyrrolidone and a polyalkylene oxide block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is di block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is tri block copolymer.

Polyalkylene oxide refers to polyethylene oxide, polypropylene oxide, polybutylene oxide and combination thereof.

In some embodiments, the polyalkylene oxide block copolymer is alkylated.

In some embodiments, the polyalkylene oxide block copolymer is di-alkylated.

In some embodiments, the polyalkylene oxide block copolymer is Poloxamer.

In some embodiments, the tri block copolymer is polyethylene oxide /polypropylene oxide/polyethylene oxide.

In some embodiments the physically stabilizing system is a combination of polyvinylpyrrolidone and a polyalkylene oxide block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is Synperonic PE/F 68.

In some embodiments, the polyvinylpyrrolidone is PVP K-30.

In some embodiments, the composition comprises at least one agriculturally acceptable carrier.

In some embodiments, the composition further comprises one or more components including, but not limited to, solvents, solubilizers, and surfactants.

In some embodiments, the composition requires a lower amount of solvents than known tank mixes.

In one embodiment, the composition comprises fluensulfone in an amount ranging from about 1% to 60% by weight based on the total weight of the composition, preferably about 5% to 40% by weight based on the weight of the total composition, preferably from about 5% to 30% by weight based on the total weight of the composition, more preferably from about 10% to 20% by weight based on the total weight of the composition, and most preferably from about 14% to 18 % by weight based on the total weight of the composition

based on the total weight of the composition.

In some embodiments, the composition comprises fluensulfone in an amount of about 15% by weight based on the total weight of the composition.

In some embodiments, the composition comprises fluensulfone in an amount of about 16% by weight based on the total weight of the composition.

In some embodiments, the composition comprises fipronil in an amount ranging from about 1% to 50% by weight based on the total weight of the composition, preferably from about 1% to 40% by weight based on the total weight of the composition, preferably from about 3% to 20% by weight based on the total weight of the composition, more preferably from about 4% to 8% by weight based on the total weight of the composition, more preferably from about 5% to 7% by weight based on the total weight of the composition.

In some embodiments, the composition comprises fipronil in an amount of about 6% by weight based on the total weight of the composition.

In some embodiments, the composition comprises fipronil in an amount of about 6.4% by weight based on the total weight of the composition.

In one embodiment, the composition comprises azoxystrobin in an amount ranging from about 0.1% to 50% by weight based on the total weight of the composition, preferably from about 0.1% to 20% by weight based on the total weight of the composition, preferably from about 0.5% to 10% by weight based on the total weight of the composition, preferably from about 1% to 5% by weight based on the total weight of the composition, preferably from about 1.5% to 3% by weight based on the total weight of the composition.

In some embodiments, the composition comprises azoxystrobin in an amount of about 1.8 % by weight based on the total weight of the composition.

In some embodiments, the composition comprises azoxystrobin in an amount of about 1.9 % by weight based on the total weight of the composition.

In some embodiments, the composition comprises azoxystrobin in an amount of 1.86 %

by weight based on the total weight of the composition.

In some embodiments, the composition comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to fipronil in the composition is about 5:1, preferably is about 3:1, more preferably is about 2.5:1. In some embodiments, the weight ratio of fluensulfone to fipronil is from about 5:1 to about 1:1.

In some embodiments, the composition comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the composition is about 20:1, preferably is about 10:1, more preferably is about 8.5:1. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the composition is from about 20:1 to about 1.5:1.

In some embodiments, the composition comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fipronil to azoxystrobin in the composition is about 7:1, preferably is about 5:1, more preferably is about 3.4:1. In some embodiments, the weight ratio of fipronil to azoxystrobin in the composition is from about 8:1 to about 1:1.

In some embodiments, the composition comprises a stable weight ratio of ingredients. In one embodiment, the weight ratio of fluensulfone to fipronil to azoxystrobin is about 8.5:3.4:1.

In some embodiments, the composition comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to the combination of fipronil and azoxystrobin is from about 4:1 to about 1:1.

In some embodiments, the composition is liquid.

In some embodiments, the composition comprises fluensulfone in an amount ranging from about 10 to 600 g/l, preferably about 50 to 400 g/l, preferably from about 50 to 300 g/l, more preferably from about 100 to 200 g/l, and most preferably from about 140 to 180 g/l. In some embodiments, the composition comprises fluensulfone in an amount of about 150 g/l. In some embodiments, the composition comprises fluensulfone in an amount of about 160g/l.

In some embodiments, the composition comprises fipronil in an amount ranging from about 10 to 500 g/l, preferably from about 10 to 400 g/l, preferably from about 30 to 200 g/l, more preferably from about 40 to 80 g/l, more preferably from about 50 to 70 g/l. In some embodiments, the composition comprises fipronil in an amount of about 60 g/l. In some embodiments, the composition comprises fipronil in an amount of about 64 g/l.

In one embodiment, the composition comprises azoxystrobin in an amount ranging from about 1 to 500 g/l, preferably from about 1 to 200 g/l, preferably from about 5 to 100 g/l, preferably from about 10 to 50 g/l, preferably from about 15 to 30 g/l. In some embodiments, the composition comprises azoxystrobin in an amount of about 18 g/l. In some embodiments, the composition comprises azoxystrobin in an amount of 19 g/l.

In one embodiment, the composition comprises fluensulfone in an amount ranging from about 130 g to about 300 g, preferably in amount of about 160 g.

In some embodiments, the composition comprises fluensulfone in an amount ranging from about 100 g to about 300 g.

In some embodiments, the composition comprises fipronil in an amount ranging from about 40 g to about 80 g, preferably in amount of about 64 g.

In some embodiments, the composition comprises azoxystrobin in an amount ranging from about 10 g to about 30 g, preferably in amount of about 19 g.

In some embodiments, the composition comprises (i) 160 g of fluensulfone, (ii) 64 g of fipronil, and (iii) 19 g of azoxystrobin.

In some embodiments, the composition comprises fluensulfone in an amount ranging from about 130 g/l to about 300 g/l, preferably in amount of about 160 g/l.

In some embodiments, the composition comprises fipronil in an amount ranging from about 40 g/l to about 80 g/l, preferably in amount of about 64 g/l.

In some embodiments, the composition comprises azoxystrobin in an amount ranging from about 10 g/l to about 30 g/l, preferably in amount of about 19 g/l.

In some embodiments, the present invention provides a composition comprising:

a) from 100 to 300 g/l of fluensulfone;

b) from 40 to 80 g/l of fipronil; and

d) from 10 to 30 g/l of azoxystrobin;

wherein the total amount of fluensulfone, fipronil and azoxstrobin is greater than 200 g/L.

The present invention provides a stable, broad spectrum composition comprising (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil and (iii) 19 g/l of azoxystrobin.

The present invention provides a stable, broad spectrum composition for use on sugar cane, wherein the composition comprises (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil and (iii) 19 g/l of azoxystrobin.

In one embodiment, the amount of physically stabilizing additive in the composition ranges from about 1% to about 5% by weight based on the total weight of the composition,

In one embodiment, the amount of polyvinylpyrrolidone in the composition ranges from about 1% to about 5% by weight based on the total weight of the composition.

In some embodiments, the amount of polyvinylpyrrolidone in the composition is about 1.4% by weight based on the total weight of the composition.

In one embodiment, the amount of polyalkylene oxide block copolymer in the composition ranges from about 1% to about 5% by weight based on the total weight of the composition.

In one embodiment, the amount of polyalkylene oxide block copolymer in the composition is about 2.8 % by weight based on the total weight of the composition.

In one embodiment, the total amount of physically stabilizing system in the composition ranges from about 2% to about 10% by weight based on the total weight of the composition, more preferably is about 4.2% by weight based on the total weight of the composition.

In some embodiments, the composition comprises additional at least one solvent.

In some embodiments, the total amount of organic carrier in the composition ranges from about 5 to about 50% by weight based on the total weight of the composition, preferably from about to about 20% by weight based on the total weight of the composition, more preferably about 15% by weight based on the total weight of the composition

In some embodiments, the total amount of aqueous carrier in the composition ranges from about 10 to about 70% by weight based on the total weight of the composition, preferably from about 20 to about 60% by weight based on the total weight of the composition, more preferably about 50 % by weight based on the total weight of the composition.

In a further embodiment, the composition comprises one or more additional surfactants, which can include but are not limited to alkali metal, alkaline earth metal and ammonium salts of aromatic sulfonic acids, such as ligninsoulfonic acid, phenolsulfonic acid, naphthalenesulfonic acid, dibutylnaphthalene-sulfonic acid, and fatty acids, alkylsulfonates, alkyl aryl sulfonates, alkyl sulfates, lauryl ether sulfates, fatty alcohol sulfates, and sulfated hexa-, hepta-, and octa- decanolates, sulfated fatty alcohol glycol ethers, furthermore condensates of naphthalene or of naphthalenesulfonic acid with phenol and formaldehyde, polyoxyethylene octylphenyl ether, ethoxylated isooctylphenol, octylphenol, nonylphenol, alkylphenyl polyglycol ethers, tributylphenyl polyglycol ether, tristearyl phenyl polyglycol ether, Iso-tridecyl alcohol polyglycol ether (Genapol® x-080, Clariant, Switzerland), alkoxylated fatty alcohols, alkoxylated alcohols ether, alkylaryl polyether alcohols, alcohol and fatty alcohol/ethylene oxide condensates, castor oil ethoxylate (Emulsogen® el-400, Clariant, Switzerland), tallow amine ethoxylate (Terwet® 3780, Huntsman, U.S.A.), epoxidized vegetable oils, polyoxyethylene alkyl ethers, ethoxylated polyoxypropylene, ethoxylated polysorbate, lauryl alcohol polyglycol ether acetal, sorbitol esters, lignin-sulfite waste liquid and proteins, denatured proteins, polysaccharides (e.g. methylcellulose), hydrophobically modified starches, polyvinyl alcohols, polycarboxylates, polyalkoxylates, polyvinylamines, dodecylbenzene sulphonate-isopropylamine (Libramul® IPA, Libra Specialty Chemicals, LTD., United Kingdom), and any salts thereof.

In a preferred embodiment, the composition is packaged within a single vessel and is ready to use directly after dilution.

The present invention provides a stable composition comprising (i) 160 g/l of fluensulfone (ii) 64 g/l of fipronil (iii) 19 g/l of azoxystrobin, (iv) 15 g/l of polyvinylpyrrolidone and (v) 30 g/l polyalkylene oxide block copolymer, wherein the azoxystrobin and fipronil are suspended in the aqueous carrier and fluensulfone in soluble in the organic carrier.

The present invention provides a stable composition comprising (i) 160 g/l of fluensulfone, (ii) 65 g/l of fipronil, (iii) 19 g/l of azoxystrobin, (iv) 15 g/l of PVP K-30, (v) 30 g/l Synperonic PE/F 68, (vi) an aqueous carrier, and (vii) an organic carrier, wherein the azoxystrobin and the fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

In some embodiments, the organic carrier is an amide.

In some embodiments, the organic carrier is a fatty acid amide.

In some embodiments, the fatty acid amide is selected from the group consisting of alkylamines of C6 - C18 carboxylic acids and alkanolamines of C6 - C18 carboxylic acids.

In some embodiments, the organic carrier is a fatty acid amide derivative. In some embodiments, the fatty acid amide derivative is selected from a group consisting of alkylamines and alkanolamines with C6 - C18 carboxylic acids.

In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the N,N-dialkyl fatty acid amide derivative is dimethylamide of C10 fatty acid. In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide. In some embodiments, the fatty acid amide is N,N-dimethyl-decanamide.

In some embodiments, the organic carrier is Genagen® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the organic carrier is an amide solvent. In some embodiment,

amide solvent is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the amide solvent is N,N-dimethyl-decanamide. In some embodiments, the solvent is Genagen ® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

The present composition may further comprise one or more additional agriculturally acceptable inert additives, as known in the art, including but not limited to solid diluents, liquid diluents, wetting agents, adhesives, thickening agents, anti-foaming agent, preservative, wetting agent, anti-oxidation agent, binders, fertilizers, or anti-freeze agents. In addition, the present composition may also further comprise additional crop protection agents known in the art, for example pesticides, safeners, agents for controlling phytopathogenic fungi or bacteria, and the like.

Anti-foaming agents can include but are not limited to nonionic aqueous emulsion of polydimethylsiloxane.

Thickeners can include but are not limited to xanthan gum.

Anti-oxidation agents can include but are not limited to butyl hydroxytoluene.

The present composition may further comprise additional agriculturally adjuvant.

In some embodiments, the composition comprises sodium dioctyl sulphosuccinate. In some embodiments the amount of sodium dioctyl sulphosuccinate in the composition is 0.1% to 1% by weight based on the total weight of the composition. In some embodiments the amount of sodium dioctyl sulphosuccinate in the composition is 0.46 % by weight based on the total weight of the composition.

In some embodiments, the composition comprises polydimethylsiloxanes. In some embodiments, the amount of polydimethylsiloxanes in the composition is 0.1% to 1% by weight based on the total weight of the composition. In some embodiments, the amount of polydimethylsiloxanes in the composition is 0.56 % by weight based on the total weight of the composition.

In some embodiments, the composition comprises butyl hydroxytoluene. In some embodiments, the amount of butyl hydroxytoluene in the composition is 0.01% to 0.5%

by weight based on the total weight of the composition. In some embodiments, the amount of butyl hydroxytoluene in the composition is 0.19% by weight based on the total weight of the composition.

In some embodiments, the composition comprises epoxidized soya-bean oil. In some embodiments, the amount of epoxidized soya-bean oil in the composition is 0.01 % to 0.5% by weight based on the total weight of the composition. In some embodiments, the amount of epoxidized soya-bean oil in the composition is 0.19% by weight based on the total weight of the composition.

In some embodiments, the composition comprises N,N-dimethyl-decanamide. In some embodiments, the amount of N,N-dimethyl-decanamide in the composition is from 1% to 30% by weight based on the total weight of the composition. In some embodiments, the amount of N,N-dimethyl-decanamide in the composition is from 10% to 20% by weight based on the total weight of the composition. In some embodiments, the amount of N,N-dimethyl-decanamide in the composition is from 13% to 16% by weight based on the total weight of the composition. In some embodiments, the amount of N,N-dimethyl-decanamide in the composition is 14.4% by weight based on the total weight of the composition.

In some embodiments, the composition comprises butyl block copolymer. In some embodiments, the amount of butyl block copolymer in the composition is 1% to 5% by weight based on the total weight of the composition. In some embodiments, the amount of butyl block copolymer in the composition is 2.8% by weight based on the total weight of the composition.

In some embodiments, the composition comprises xanthan gum. In some embodiments, the amount of xanthan gum in the composition is 0.01% to 0.5% by weight based on the total weight of the composition. In some embodiments, the amount of xanthan gum in the composition is 0.15% by weight based on the total weight of the composition.

In some embodiments, the composition comprises (benzyloxy)methanol. In some embodiments, the amount of (benzyloxy)methanol in the composition is 0.01% by weight based on the total weight of the composition.

In some embodiments, the composition comprises 1,2-benzisothiazolin-3-one/sodium hydroxide. In some embodiments, the amount of 1,2-benzisothiazolin-3-one/sodium hydroxide in the composition is 0.01% by weight based on the total weight of the composition.

In some embodiments, the composition comprise water. In some embodiments, the water is soft water. In some embodiments, the amount of water in the composition is 30% to 80% by weight based on the total weight of the composition. In some embodiments, the amount of water in the composition is 45% to 60% by weight based on the total weight of the composition. In some embodiments, the amount of water in the composition is about 54% by weight based on the total weight of the composition.

The present invention also provides a stable, composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of organic carrier and

(v) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier.

The present invention also provides a stable composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of organic carrier and

(v) water,

wherein the amount of fluensulfone in the organic carrier is at least 40% by weight of the organic carrier.

The present invention also provides a stable composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of organic carrier and
(v) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 40% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of organic carrier and
(v) water,

wherein the amount of fluensulfone in the organic carrier is at least 30% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of organic carrier and
(v) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 30% by weight of the organic carrier.

The present invention also provides a stable, composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of organic carrier and
(v) water,

wherein the amount of fluensulfone in the organic carrier is at least 50% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of organic carrier and
(v) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 50% by weight of the organic carrier.

The present invention also provides a stable, composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of polymer,
(v) an effective amount organic carrier, and
(vi) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount of organic carrier, and

(vi) water,

wherein the amount of fluensulfone in the organic carrier is at least 40% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount organic carrier and

(vi) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 40% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount of organic carrier and

(vi) water,

wherein the amount of fluensulfone in the organic carrier is at least 30% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount of organic carrier and

(vi) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 30% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount of organic carrier, and

(vi) water,

wherein the amount of fluensulfone in the organic carrier is at least 50% by weight of the organic carrier.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polymer,

(v) an effective amount of organic carrier and

(vi) water,

wherein the azoxystrobin and the fipronil are suspended in water and the fluensulfone is dissolved in the organic carrier and wherein the amount of fluensulfone in the organic carrier is at least 50% by weight of the organic carrier.

In some embodiments, the organic carrier is an amide.

In some embodiments, the organic carrier is a fatty acid amide.

In some embodiments, the fatty acid amide is selected from the group consisting of alkylamines of C6 - C18 carboxylic acids and alkanolamines of C6 - C18 carboxylic

acids.

In some embodiments, the organic carrier is a fatty acid amide derivative. In some embodiments, the fatty acid amide derivative is selected from a group consisting of alkylamines and alkanolamines with C6 - C18 carboxylic acids.

In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the N,N-dialkyl fatty acid amide derivative is dimethylamide of C10 fatty acid. In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide. In some embodiments, the fatty acid amide is N,N-dimethyl-decanamide.

In some embodiments, the organic carrier is Genagen® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the organic carrier is an amide solvent. In some embodiment, amide solvent is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the amide solvent is N,N-dimethyl-decanamide. In some embodiments, the solvent is Genagen ® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of polyvinylpyrrolidone,
(v) an effective amount of N,N-dimethyl-decanamide, and
(vi) water.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,
(ii) an effective amount of fipronil,
(iii) an effective amount of azoxystrobin,
(iv) an effective amount of polymer,

(v) an effective amount of N,N-dimethyl-decanamide, and

(vi) water.

The present invention also provides a stable, broad spectrum composition comprising:

(i) an effective amount of fluensulfone,

(ii) an effective amount of fipronil,

(iii) an effective amount of azoxystrobin,

(iv) an effective amount of polyvinylpyrrolidone,

(v) an effective amount of N,N-dimethyl-decanamide, and

(vi) water.

In some embodiments, the weight ratio of fluensulfone to fipronil to azoxystrobin is about 8.5:3.4:1.

The present invention also provides a stable, broad spectrum composition comprising:

(i) about 15% by weight of fluensulfone,

(ii) about 6% by weight of fipronil,

(iii) about 1.86% by weight of azoxystrobin,

(iv) about 1.4% by weight of polyvinylpyrrolidone,

(v) about 14.4% by weight of N,N-dimethyl-decanamide,
and

(vi) 54% by weight of soft water.

The present invention also provides a stable, broad spectrum composition comprising:

(i) 15% by weight of fluensulfone,

(ii) 6% by weight of fipronil,

(iii) 1.86% by weight of azoxystrobin,

(iv) 1.4% by weight of polyvinylpyrrolidone,

(v) 2.8 % by weight of polyalkylene oxide block copolymer,

(vi) 0.46 % by weight of sodium dioctyl sulphosuccinate,

(vii) 0.56 % by weight of polydimethylsiloxanes,

(viii) 0.19% by weight of butyl hydroxytoluene,

(ix) 0.19% by weight of epoxidized soya-bean oil,

(x) 14.4% by weight of N,N-dimethyl-decanamide,

(xi) 2.8% by weight of butyl block copolymer,

(xii) 0.15% by weight of xanthan gum,

(xiii) 0.01% by weight of (benzyloxy)methanol,

(xiv) 0.01% by weight of 1,2-benzisothiazolin-3-one/sodium hydroxide and

(xv) 54% by weight of soft water.

In some embodiments, the composition comprises one or more additional active ingredient (s). In some embodiments, the composition comprises one or more additional non-active ingredient(s).

Stabilization of the composition

It is a challenge to formulate a stable composition comprising three active ingredients each requiring different and specific conditions for stability. The present composition is most challenging due to the limited solubility of fluensulfone in organic carriers and the variable solubility of fipronil the organic carrier selected for the composition.

In the present invention, we surprisingly found, without being limited to any hypothesis/ assumption, that combining the active ingredients with polyvinylpyrrolidone and/or polyalkylene oxide block copolymer reduces interference between the active ingredients and improves stability of the composition.

Without being limited to any theory, we hypothesize that the polyvinylpyrrolidone is absorbed to the fipronil particle and reduces solubility of fipronil in the organic carrier. In addition, the organic carrier may also be stabilized and be covered by polyalkylene oxide block copolymer.

The present invention also provides the use of polyvinyl pyrrolidone for stabilizing a composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention also provides the use of polyvinyl pyrrolidone for stabilizing a suspoemulsion composition comprising (i) an effective amount of fluensulfone, (ii) an

effective amount of fipronil and (iii) an effective amount of azoxystrobin,

The present invention also provides the use of combination of polyvinylpyrrolidone and polyalkylene oxide block copolymer for stabilizing a suspoemulsion composition comprising i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

Mixture of fluensulfone, fipronil and azoxystrobin and uses thereof.

The present invention provides a pesticidal mixture comprising any one of the compositions disclosed herein.

The present invention provides a pesticidal mixture for use on sugar cane, wherein the pesticidal mixture comprises any one of the compositions disclosed herein.

The present invention provides a pesticidal mixture for use on sugar cane, wherein the pesticidal mixture comprises (i) an effective amount of fluensulfone (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

The present invention provides a pesticidal mixture comprising (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil and (iii) 19 g/l of azoxystrobin.

The present invention provides a pesticidal mixture for use on sugar cane, wherein the pesticidal mixture comprises (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil and (iii) 19 g/l of azoxystrobin.

The present invention provides an agricultural mixture comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides an agricultural mixture comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin, wherein the weight ratio of fluensulfone:fipronil:azoxystrobin is about 8.5:3.4:1.

The present invention provides an agricultural mixture comprising (i) fluensulfone, (ii)

fipronil, and (iii) azoxystrobin in a weight ratio of about 8.5:3.4:1.

The present invention provides an agricultural mixture comprising (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil, and (iii) 19 g/l of azoxystrobin.

The present invention provides an agricultural mixture comprising (i) 160 g of fluensulfone, (ii) 64 g of fipronil, and (iii) 19 g of azoxystrobin.

The present invention provides an agricultural mixture for use on sugar cane wherein the agricultural mixture comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) fluensulfone, (ii) fipronil, and (iii) azoxystrobin in a weight ratio of about 8.5:3.4:1.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) 160 g of fluensulfone, (ii) 64 g of fipronil, and (iii) 19 g of azoxystrobin.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin, and wherein the weight ratio of fluensulfone:fipronil:azoxystrobin is about 8.5:3.4:1.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin, and wherein the weight ratio of fluensulfone to fipronil and azoxystrobin is about 4:1 to 1:1.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin, and wherein the weight ratio of fluensulfone to fipronil and azoxystrobin is about 2:1.

The present invention provides an agricultural mixture for use on sugar cane, wherein the

agricultural mixture comprises (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin, and wherein the weight ratio of fluensulfone to fipronil and azoxystrobin is about 1.93:1.

The present invention provides an agricultural mixture for use on sugar cane, wherein the agricultural mixture comprises (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil, and (iii) 19 g/l of azoxystrobin.

In some embodiments, the mixture comprises fluensulfone in an amount ranging from about 130 g to about 300 g, preferably in amount of about 160 g.

In some embodiments, the mixture comprises fluensulfone in an amount ranging from about 100 g to about 300 g.

In some embodiments, the mixture comprises fipronil in an amount ranging from about 40 g to about 80 g, preferably in amount of about 64 g.

In some embodiment, the mixture comprises azoxystrobin in an amount ranging from about 10 g to about 30 g, preferably in amount of about 19 g.

In some embodiments, the mixture comprises (i) 160 g of fluensulfone, (ii) 64 g of fipronil, and (iii) 19 g of azoxystrobin.

In some embodiments, the mixture comprises fluensulfone in an amount ranging from about 130 g/l to about 300 g/l, preferably in amount of about 160 g/l.

In some embodiments, the mixture comprises fipronil in an amount ranging from about 40 g/l to about 80 g/l, preferably in amount of about 64 g/l.

In some embodiments, the mixture comprises azoxystrobin in an amount ranging from about 10 g/l to about 30 g/l, preferably in amount of about 19 g/l. In some embodiments, the mixture comprises azoxystrobin in an amount ranging from 10 g/l to 30 g/l.

In some embodiments, the present invention provides a mixture comprising:

a) from 100 to 300 g of fluensulfone;

b) from 40 to 80 g of fipronil; and

d) from 10 to 30 g of azoxystrobin;

wherein the total amount of fluensulfone, fipronil and azoxstrobin in the mixture is greater than 200 g.

In some embodiments, the present invention provides a mixture comprising:

a) from 100 g/l to 300 g/l of fluensulfone;

b) from 40 g/l to 80 g/l of fipronil; and

d) from 10 g/l to 30 g/l of azoxystrobin;

wherein the total amount of fluensulfone, fipronil and azoxstrobin in the mixture is greater than 200 g/l.

In some embodiments, the mixture comprises (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil, and (iii) 19 g/l of azoxystrobin.

In some embodiments, the mixture comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to fipronil in the mixture is about 5:1, preferably is about 3:1, more preferably is about 2.5:1. In some embodiments, weight ratio of fluensulfone to fipronil is from about 5:1 to about 1:1.

In some embodiments, the mixture comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the mixture is about 20:1, preferably is about 10:1, more preferably is about 8.5:1. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the mixture is from about 20:1 to about 1.5:1.

In some embodiments, the mixture comprises a stable weight ratio of ingredients. In some embodiments, the weight ratio of fipronil to azoxystrobin in the mixture is about 7:1, preferably is about 5:1, more preferably is about 3.4:1. In some embodiments, the weight ratio of fipronil to azoxystrobin in the mixture is from about 8:1 to about 1:1.

In some embodiments, the mixture comprises a stable weight ratio of ingredients. In one embodiment, the weight ratio of fluensulfone to fipronil to azoxystrobin in the mixture is about 8.5:3.4:1.

In some embodiments, the mixture comprises an effective weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to fipronil in the mixture is about 5:1, preferably is about 3:1, more preferably is about 2.5:1. In some embodiments, weight ratio of fluensulfone to fipronil in the mixture is from about 5:1 to about 1:1.

In some embodiments, the mixture comprises an effective weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the mixture is about 20:1, preferably is about 10:1, more preferably is about 8.5:1. In some embodiments, the weight ratio of fluensulfone to azoxystrobin in the mixture is from about 20:1 to about 1.5:1.

In some embodiments, the mixture comprises an effective weight ratio of ingredients. In some embodiments, the weight ratio of fipronil to azoxystrobin in the mixture is about 7:1, preferably is about 5:1, more preferably is about 3.4:1. In some embodiments, the weight ratio of fipronil to azoxystrobin in the mixture is from about 8:1 to about 1:1.

In some embodiments, the mixture comprises an effective weight ratio of ingredients. In one embodiment, the weight ratio of fluensulfone to fipronil to azoxystrobin in the mixture is about 8.5:3.4:1.

In some embodiments, the mixture comprises an effective weight ratio of ingredients. In some embodiments, the weight ratio of fluensulfone to the combination of fipronil and azoxystrobin is from about 4:1 to about 1:1.

In some embodiments, effective weight ratio refers to the weight ratio at which efficacy of fluensulfone for controlling nematodes is improved and/or at which plant development is enhanced, wherein enhanced plant development includes, but is not limited to, enhanced root systems and/or shoot of the crop plant and/or plant vigor and/or plant potential yield.

It was found that by combining fluensulfone with fipronil and azoxystrobin, the efficacy

of fluensulfone for controlling nematodes is improved. It was also found that applying a composition comprising fluensulfone, fipronil and azoxystrobin enhances plant development, including, but not limited to, enhancing the root systems and/or shoot of the crop plant and/or plant vigor and/or plant potential yield.

In some embodiments, plant vigor is assessed using the relative vigor index. In some embodiments, plant vigor is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

In some embodiments, enhancement in root system is measured by root weight. In some embodiments, root weight is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

In some embodiments, enhancement in shoot is measured by shoot weight. In some embodiments, shoot weight is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

The present invention provides a mixture comprising (i) an amount of fluensulfone, (ii) an amount of fipronil and (iii) an amount of azoxystrobin.

In some embodiments, the amount of fluensulfone, the amount of fipronil and the amount of azoxystrobin when applied together is more effective than when each agent at the same amount is applied alone.

In some embodiments, the amount of fluensulfone in the mixture is less than the pesticidally effective amount of fluensulfone than when fluensulfone is used alone.

In some embodiments, the amount of fipronil in the mixture is less than the pesticidally effective amount of fipronil than when fipronil is used alone.

In some embodiments, the amount of azoxystrobin in the mixture is less than the pesticidally effective amount of azoxystrobin when azoxystrobin is used alone.

The present invention provides a synergistic mixture comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

In some embodiments, in the synergistic mixture, the weight ratio of fluensulfone to fipronil to azoxystrobin is about 8.5:3.4:1.

In some embodiments, in the synergistic mixture, the weight ratio of fluensulfone to fipronil in the mixture is about 5:1, preferably is about 3:1, more preferably is about 2.5:1.

In some embodiments in the synergistic mixture, the weight ratio of fluensulfone to azoxystrobin in the mixture is about 20:1, preferably is about 10:1, more preferably is about 8.5:1.

In some embodiments, in the synergistic mixture, the weight ratio of fipronil to azoxystrobin in the mixture is about 7:1, preferably is about 5:1, more preferably is about 3.4:1.

In some embodiments, the mixture or synergistic mixture comprises one or more additional active ingredient (s). In some embodiments, the mixture or synergistic mixture comprises one or more additional non-active ingredient(s).

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

In some embodiments, the mixture is synergistic for enhancing crop plant. In some embodiments, the mixture is synergistic for enhancing plant development. In some embodiments, the mixture is synergistic for enhancing root system. In some embodiments, the mixture is synergistic for improving plant quality. In some embodiments, the mixture is synergistic for regulating plant growth. In some embodiments, the mixture is synergistic for controlling nematodes.

In the field of agriculture, it is often understood that the term “synergy” is as defined by Colby S. R. in an article entitled "Calculation of the synergistic and antagonistic responses of herbicide combinations" published in the journal Weeds, 1967, 15, p. 20-22. The action expected for a given combination of two active components can be calculated as follows:

$$E = X + Y - \frac{XY}{100}$$

The action expected for a given combination of three active components can be calculated as follows:

$$E = X + Y + Z - \frac{XY + XZ + YZ}{100} + \frac{XYZ}{10000}$$

in which E represents the expected effect, e.g. percentage of pest control, for the combination of the three active ingredient at defined doses (for example equal to x, y and z respectively), X is the effect, e.g. percentage of pest control, observed for compound (I) at a defined dose (equal to x), Y is the effect, e.g. percentage of pest control, observed for compound (II) at a defined dose (equal to y), Z is the effect, e.g. percentage of pest control, observed for compound (III) at a defined dose (equal to z). When the effect, e.g. percentage of pest control, observed for the combination is greater than the expected effect, there is a synergistic effect.

In some embodiments, the mixture comprises an organic carrier.

In some embodiments, the organic carrier is an amide.

In some embodiments, the organic carrier is a fatty acid amide.

In some embodiments, the fatty acid amide is selected from the group consisting of alkylamines of C6 - C18 carboxylic acids and alkanolamines of C6 - C18 carboxylic acids.

In some embodiments, the organic carrier is a fatty acid amide derivative. In some embodiments, the fatty acid amide derivative is selected from a group consisting of alkylamines and alkanolamines with C6 - C18 carboxylic acids.

In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the N,N-dialkyl fatty acid amide derivative is dimethylamide of C10 fatty acid. In some embodiments, the fatty acid amide is an N,N-dialkyl fatty acid amide. In some embodiments, the fatty acid amide is N,N-dimethyl-decanamide.

In some embodiments, the organic carrier is Genagen® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the organic carrier is an amide solvent. In some embodiment, amide solvent is an N,N-dialkyl fatty acid amide derivative. In some embodiments, the amide solvent is N,N-dimethyl-decanamide. In some embodiments, the solvent is Genagen ® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant.

In some embodiments, the mixture comprises at least one physically stabilizing additive. In some embodiments, the mixture comprises a physically stabilizing system.

In some embodiments, the physically stabilizing system is a combination of polyvinylpyrrolidone and polyalkylene oxide block copolymer.

In some embodiments, the physically stabilizing additive is polyvinylpyrrolidone. In some embodiments, the stabilizing additive is a polyalkylene oxide block copolymer. In some embodiments, the physically stabilizing additives are polyvinylpyrrolidone and a polyalkylene oxide block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is di block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is tri block copolymer.

Polyalkylene oxide refers to polyethylene oxide, polypropylene oxide, polybutylene oxide and combination thereof.

In some embodiments, the polyalkylene oxide block copolymer is alkylated.

In some embodiments, the polyalkylene oxide block copolymer is di-alkylated.

In some embodiments, the polyalkylene oxide block copolymer is Poloxamer.

In some embodiments, the tri block copolymer is polyethylene oxide /polypropylene oxide/polyethylene oxide.

In some embodiments the physically stabilizing system is a combination of polyvinylpyrrolidone and a polyalkylene oxide block copolymer.

In some embodiments, the polyalkylene oxide block copolymer is Synperonic PE/F 68.

In some embodiments, the polyvinylpyrrolidone is PVP K-30.

The mixtures described herein may be a tank mix or a diluted form of any one of the compositions described herein.

In some embodiments, the mixture is a tank mix.

In some embodiments, the mixture comprises any one of the compositions described herein wherein the composition is diluted.

The present invention also contemplates methods of making a mixture comprising (i) fluensulfone, (ii) fipronil, (iii) azoxystrobin, (vi) an organic carrier, and (v) a physically stabilizing additive, wherein the method comprises mixing the fluensulfone, fipronil, azoxystrobin, organic carrier and physically stabilizing additive, in any order, to obtain the mixture.

Method of Use

The present invention provides a method for controlling nematodes comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance nematode control.

The present invention provides a method for enhancing nematode control comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance nematode control.

The present invention provides a method for enhancing root systems and/or enhancing crop plants development and/or enhancing crop plants vigor and/or improving plant potential yield comprising applying an effective amount of the any one of the mixtures or compositions disclosed herein to one or more plants, the locus thereof or propagation material thereof.

The present invention provides a method for enhancing plant development comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance plant development.

The present invention provides a method for enhancing root system comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance the root system.

The present invention provides a method for enhancing plant vigor comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance plant vigor.

The present invention provides a method for improving plant potential yield comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby improve plant potential yield.

The present invention provides a method for regulating plant growth comprising applying an effective amount of the any one of the compositions or the mixtures disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby regulate plant growth.

The present invention provides a method for controlling nematodes comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance nematode control.

The present invention provides a method for enhancing nematode control comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance nematode control.

The present invention provides a method for enhancing crop plant comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance the crop plant.

The present invention provides a method for enhancing plant development comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby enhance plant development.

In some embodiments, enhancing plant development comprises enhancing root system. In some embodiments, enhancing plant development comprises enhancing plant vigor. In some embodiments, enhancing plant development comprises improving plant potential yield. In some embodiment, enhancing plant development comprises enhancing potential yield.

In some embodiments, the method enhances root development. In some embodiments, the method enhances the root system of the plant. In some embodiments, the method enhances plant quality. In some embodiments, the method enhances plant vigor. In some embodiments, the method enhances plant yield. In some embodiments, the method prevents root damage. In some embodiments, the method improves rooting.

The present invention provides a method for regulating plant growth comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby regulate plant growth.

In some embodiments, plant vigor is assessed using the relative vigor index. In some embodiments, plant vigor is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

In some embodiments, enhancement in root system is measured by root weight. In some embodiments, root weight is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

In some embodiments, enhancement in shoot is measured by shoot weight. In some embodiments, shoot weight is increased by at least 1%, 5%, 10, 20%, 30%, 40%, 50%, 60%, 70%, 80%, or 90%.

The present invention provides a method for preventing plant and/or soil disease

comprising applying an effective amount of the any one of the mixtures or compositions disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby prevent plant and/or soil disease.

The present invention provides a method for controlling plant and/or soil disease comprising applying an effective amount of the any one of the mixtures or compositions disclosed herein to one or more plants, the locus thereof or propagation material thereof so as to thereby control plant and/or soil disease.

The present invention provides a method for controlling plant and/or soil disease comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby control plant and/or soil disease.

The present invention provides a method for preventing plant and/or soil disease comprising applying (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin to one or more plants, the locus thereof or propagation material thereof so as to thereby prevent plant and/or soil disease.

The methods of the present invention refer to any plant and/or soil diseases, including but not limited to Sugarcane weevil (Sphenophorus levis), Lesion nematode (Pratylenchus zeae), Root Knot nematode (Meloidogyne javanica), Black root rot (Thielaviopsis paradoxa), and Heterotermes tenuis and Ceratocystis paradoxa.

In some embodiments, the method is effective on plant and/or root system affected by plant and/or soil diseases, including but not limited to plant and/or soil diseases caused by Sugarcane weevil (Sphenophorus levis), Lesion nematode (Pratylenchus zeae), Root Knot nematode (Meloidogyne javanica), Black root rot (Thielaviopsis paradoxa), and Heterotermes tenuis and Ceratocystis paradoxa.

In some embodiments, the method, the mixtures and the compositions disclosed herein is effective on plant and/or root system affected by plant and/or soil diseases caused by Sugarcane weevil (Sphenophorus levis), Lesion nematode (Pratylenchus zeae), Root Knot nematode (Meloidogyne javanica), Heterotermes tenuis and Ceratocystis paradoxa.

The methods of the present invention refer to any crop plants, including but not limited to monocotyledons such as sugar cane, cereals, rice, maize (corn), and/or; or dicotyledon crop such as beets (such as sugar beet or fodder beet); fruits (such as pomes, stone fruits, or soft fruits, for example apples, pears, plums, peaches, almonds, cherries, strawberries, raspberries, or blackberries); leguminous plants (such as beans, lentils, peas, or soybeans); oil plants (such as rape, mustard, poppy, olives, sunflowers, coconut, castor oil plants, cocoa beans, or groundnuts); cucumber plants (such as marrows, cucumbers or melons); fiber plants (such as cotton, flax, hemp, or jute); citrus fruits (such as oranges, lemons, grapefruit, or mandarins); vegetables (such as spinach, lettuce, cabbages, carrots, tomatoes, potatoes, cucurbits, or paprika); lauraceae (such as avocados, cinnamon, or camphor); tobacco; nuts; coffee; tea; vines; hops; durian; bananas; natural rubber plants; and ornamentals (such as flowers, shrubs, broad-leaved trees, or evergreens, for example conifers).

In one embodiment the plants are monocotyledonous plants, more preferably, cereals, in particular wheat or barley. In a specific embodiment, the cereal crop is wheat. In another specific embodiment, the cereal crop is triticale. In another specific embodiment, the cereal crop is rye. In another specific embodiment, the cereal crop is oat. In a further embodiment, the cereal crop is barley. In another embodiment, the crop plants are rice plants. In still another embodiment, the crop plants are sugar cane plants. In yet another embodiment, the crop plants are corn plants.

In some embodiments, the sugar cane is plant cane.

In some embodiments, the sugar cane is ratoon sugarcane.

In another embodiment, the crop plants are dicotyledonous plants. In one embodiment, the crop plants are oil seed rape plants.

In some embodiments, the fluensulfone is applied at an amount from about 1 g/ha to about 1000 g/ha. In some embodiments, the fluensulfone is applied at an amount from about 100 g/ha to about 700 g/ha. In some embodiments, the fluensulfone is applied at an amount from about 100 g/ha to about 200 g/ha. In some embodiments, the fluensulfone is applied at an amount from about 300 g/ha to about 400 g/ha. In some embodiments, the

fluensulfone is applied at an amount from about 600 g/ha to about 700 g/ha. In some embodiments, the fluensulfone is applied at an amount of about 160 g/ha. In some embodiments, the fluensulfone is applied at an amount of about 320 g/ha. In some embodiments, the fluensulfone is applied at an amount of about 640 g/ha.

In some embodiments, the fipronil is applied at an amount from about 1 g/ha to about 500 g/ha. In some embodiments, the fipronil is applied at an amount from about 50 g/ha to about 300 g/ha. In some embodiments, the fipronil is applied at an amount from about 50 g/ha to about 80 g/ha. In some embodiments, the fipronil is applied at an amount from about 100 g/ha to about 150 g/ha. In some embodiments, the fipronil is applied at an amount from about 225 g/ha to about 275 g/ha. In some embodiments, the fipronil is applied at an amount of about 64 g/ha. In some embodiments, the fipronil is applied at an amount of about 128 g/ha. In some embodiments, the fipronil is applied at an amount of about 256 g/ha.

In some embodiments, the azoxystrobin is applied at an amount from about 1 g/ha to about 100 g/ha. In some embodiments, the azoxystrobin is applied at an amount from about 10 g/ha to about 80 g/ha. In some embodiments, the azoxystrobin is applied at an amount from about 15 g/ha to about 25 g/ha. In some embodiments, the azoxystrobin is applied at an amount from about 35 g/ha to about 45 g/ha. In some embodiments, the azoxystrobin is applied at an amount from about 70 g/ha to about 80 g/ha. In some embodiments, the azoxystrobin is applied at an amount of about 19 g/ha. In some embodiments, the azoxystrobin is applied at an amount of about 38 g/ha. In some embodiments, the azoxystrobin is applied at an amount of about 76 g/ha.

The rate of application of the present composition may vary within wide limits and depends upon the nature of the soil, the method of application, the prevailing climatic conditions, and other factors governed by the method of application and the time of application. In one embodiment, the composition is generally applied at a rate of about 2 to about 5 L/ha. In a preferred embodiment the composition is applied at a rate of about 2.5 to 4 L/ha. In a preferred embodiment the composition is applied at a rate of about 3 to 4 L/ha. In a specific embodiment the composition is applied at a rate of about 2.5 L/ha. In another specific embodiment the composition is applied at a rate of about 4 L/ha. In

another specific embodiment the composition is applied at a rate of about 3.5 L/ha, In another specific embodiment the composition is applied at a rate of about 3 L/ha.

In some embodiments, the composition is applied at a rate of about 1.6 to 2.0 L/ha.

In some embodiments, the volume of mixture for sugarcane is 200 L/ha.

In some embodiments the compositions and/or mixtures disclosed herein are applied before planting.

In some embodiments, the compositions and/or mixtures disclosed herein are applied at the time of planting.

In some embodiments, the mixtures and/or compositions described herein are applied as a soil application.

In some embodiments, soil application refers to furrow application.

In some embodiments, the application is by ground spraying.

In some embodiments, the sugarcane is plant cane and the composition or mixture disclosed herein is applied in the planting furrow with ground equipment.

In some embodiments, the sugarcane is ratoon sugarcane and the composition or mixture disclosed herein is applied in the planting line using a tractor sprayer.

In some embodiments, the composition or mixture disclosed herein is applied with drop size of 150 a 300 μ (micra) VMD.

In some embodiments, the composition or mixture disclosed herein is applied with a drop density of 40 drops/cm^2 or higher.

In some embodiments, the composition or mixture disclosed herein is applied at a temperature up to 30ºC.

In some embodiments, the composition or mixture disclosed herein is applied when the relative humidity of the air is 50% or higher.

In some embodiments, the composition or mixture disclosed herein is applied when the wind speed is between 3 and 10 km/h.

In some embodiments, the method comprises diluting any one of the mixtures or compositions described herein prior to application. In some embodiments, the mixture or composition is diluted with water. In some embodiments, the mixture or composition is diluted with an agriculturally acceptable carrier. In some embodiments, the mixture or composition is diluted with an agriculturally acceptable carrier other than water.

In some embodiments, the method comprises applying any one of the mixtures or compositions described herein with one or more additional active ingredient(s). In some embodiments, the method comprises applying any one of the mixtures or compositions described herein with one or more additional non-active ingredient(s).

The present invention provides use of any one of the mixtures or compositions disclosed herein for controlling nematode, enhancing plant development, regulating plant growth, preventing plant and/or soil disease, and/or controlling plant and/or soil disease.

In some embodiments, the use comprises applying any one of the mixtures or compositions disclosed herein to the plant, a locus of the plant or propagation material of the plant.

The present invention provides use of (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil, and (iii) an effective amount of azoxystrobin for controlling nematode, enhancing plant development, regulating plant growth, preventing plant and/or soil disease, and/or controlling plant and/or soil disease.

In some embodiments, the use comprises applying the fluensulfone, the fipronil, and the azoxystrobin to the plant, a locus of the plant or propagation material of the plant.

Preparation of the composition described herein

The invention provides a process for preparing the stable composition described herein, wherein the process comprises the steps of: (1) milling a dispersion of fipronil and azoxystrobin in water, (2) dissolving fluensulfone in an organic carrier to obtain a solution, (3) preparing an emulsion from the solution obtained in step (2), and (4)

preparing suspoemulsion composition from the dispersion obtained from step (1) and the emulsion obtained from step (3).

In some embodiments, step (1) is performed in the presence of at least one physically stabilizing additive. In some embodiments, the physically stabilizing additive is polyvinylpyrrolidone.

In some embodiments, the organic carrier used in step (2) is N, N dimethyl fatty acid amide derivative.

The invention provides a method for preparing the stable, broad spectrum composition described herein, wherein the method comprises the steps of: (1) milling a dispersion of fipronil and azoxystrobin in water in the presence of polyvinylpyrrolidone; (2) dissolving fluensulfone in N, N dimethyl fatty acid amide derivative to obtain a solution; (3) preparing an emulsion from the solution obtained in step (2) and (4) preparing suspoemulsion composition from the obtained dispersion from step (1) and emulsion of step (3).

In some embodiments, the polyalkylene oxide block copolymer is added in step (1).

In some embodiments, the polyalkylene oxide block copolymer is added in step (3).

In some embodiments, the polyalkylene oxide block copolymer is added in step (1) and (3).

In some embodiments, each of the described steps may further comprise additional additives.

In some embodiments, the N,N-dimethyl fatty acid amide derivative is Genagen® 4296. Genagen® 4296 is a dimethylamide based on naturally derived fatty acids from Clariant. In some embodiments, the N,N-dimethyl fatty acid amide derivative is N,N-dimethyl-decanamide.

Each embodiment disclosed herein is contemplated as being applicable to each of the other disclosed embodiments. Thus, all combinations of the various elements described herein are within the scope of the invention. In addition, the elements recited in the

composition embodiments can be used in the mixture (including synergistic mixture), method, use and process embodiments described herein and vice versa.

The following examples illustrate the practice of the present subject matter in some of its embodiments but should not be construed as limiting the scope of the present subject matter. Other embodiments will be apparent to one skilled in the art from consideration of the specification and examples. It is intended that the specification, including the examples, is considered exemplary only without limiting the scope and spirit of the present subject matter.

EXPERIMENTAL AND RESULTS SECTION

Formulating a stable composition comprising fluensulfone, fipronil and azoxystrobin is particularly challenging because fluensulfone has a limited solubility in organic carrier and the fipronil and azoxystrobin should be suspended in the aqueous carrier.

In general, the unstable suspoemulsion was found to be associated with the partial solubility of fipronil in the organic carrier which leads to crystallization. Combining of polyvinylpyrrolidone and polyalkylene oxide block copolymer provided a stable composition.

Attempts to formulate physically stable compositions comprising fluensulfone, fipronil and azoxystrobin in a liquid composition failed numerous times.

Example 1: Ready Mix Composition

One exemplary embodiment of the ready mix composition is illustrated in Table 1 below.

Table 1: Fluensulfone 160 Fipronil 64 Azoxystrobin 19 SE Composition

Raw Material	Commercial Name	CAS No.	%W/W	Quantity for 1000 liter
(±)-5-amino-1-(2,6-dichloro-α,α,α-trifluoro-p-tolyl)-4-	Fipronil	120068-37-3	6.04%	64 Kg (100%) (65 Kg for 98%)

trifluoromethylsulfinylpyrazole-3-carbonitrile				
methyl (E)-2-{2-[6-(2-cyanophenoxy)pyrimidin-4-yloxy]phenyl}-3-methoxyacrylate	Azoxystrobin	131860-33-8	1.86%	19 (100%) (20 Kg for 98%)
5-chloro-2-(3,4,4-trifluorobut-3-enylsulfonyl)-1,3-thiazole	Fluensulfone	318290-98-1	15.24%	160 (100%) (164 Kg for 97.5%)
2-Pyrrolidinone, 1-ethenyl-, homopolymer	PVP K-30	9003-39-8	1.39%	15 Kg
Triblock polymer EO-PO-EO	Synperonic PE/F 68	9003-11-6	2.79%	30 Kg
Sodium dioctyl sulphosuccinate	LANKROPOL KO2 GEROPON CYA 75	577-11-7	0.46%	5 Kg
Non-ionic aqueous emulsion of: Polydimethylsiloxanes	SILICAID AF 52-30 SILCOLAPSE 432	proprietary	0.56%	6 Kg
Butyl hydroxytoluene	Ionol CP	128-37-0	0.19%	2 Kg
Epoxidized soya-bean oil	Epoxol D65 Agnique ESO 81-G	8013-07-8	0.19%	2 Kg
N, N-DIMETHYL-DECANAMIDE	Genagen 4296 Rhdiasolv ADMA 10	14433-76-2	14.40%	155 Kg
Butyl block copolymer	Atlas G-5002L	proprietary	2.79%	30 Kg
Xanthan gum	AG RH 23	11138-66-2	0.15%	1.6 Kg
(Benzyloxy)methanol >98%	Preventol D2	14548-60-8	0.01%	0.16 Kg
1,2-Benzisothiazolin-3-one / Sodium hydroxide	Proxel GXL	2634-33-5 / 1310-73-2	0.01%	0.16 Kg

Soft Water	Soft Water		~53.93%	Up to 1000liter (~580.5 Kg)

Specification:

Appearance	-	White-off-white liquid
Fluensulfone concentration	-	150.4-169.6g/l
Fipronil concentration	-	57.6-70.4g/l
Azoxystrobin concentration	-	16.2-21.8g/l
Density	-	1.06-1.1gr/ml
pH after production	-	5-6.5
pH final formulation	-	3.5-6.0
Particle size	-	d90<7µm, inspection by microscope
Persistent Foaming (1.5%)	-	<60ml
Viscosity (S62, 12RPM, 25°c)	-	1100-2300cP

Package type:

Amraz: COEX (HDPE/EVOH) – suitable

Pachmas: COEX (PE/PA) – suitable

Preparation procedure:

Step 1: preparation of the suspension composition

Soft water was charged to the vessel. PVP K-30, Synperonic PE/L 68, Lankropol KO2 and half of the Silcolapse 432 were added and mixed until the solution was homogenous and the materials were completely dissolved. The fipronil and azoxystrobin were gradually added while mixing. A high shear homogenizer was used to obtain a homogenous mixture. The dispersion was milled in a bead mill until a particle size distribution of d90 < 3.5µm was reached. The AGRH 23 2% solution was added to the mixture while mixing to prepare the suspension composition.

Step 2: preparation of the organic carrier

The fluensulfone was heated until completely melted. The Genagen 4296 was charged to the vessel. The fluensulfone was added to the vessel while mixing and heating to 40°C. The solution was filtered (5µm filter) to achieve a clear solution. Inol and Epoxol were added and mixed until the solution was homogenous to prepare the organic carrier solution.

Step 3: preparation of an emulsion of Step 2

Water was charged to the vessel. The Atlas G-5002L, Synperonic™ PE/L 68, Lankropol KO2 and Silcolapse 432 were added and mixed until the solution was homogenous and the materials were completely dissolved. The organic carrier solution of step 2 was heated to a temperature of 45-50°C. While applying the high shear, the warmed organic carrier solution of step 2 was add using a gentle stream in three different portions. Shear was applied until a droplet size distribution of d90<1µm was reached to prepare the emulsion.

Step 4: suspoemulsion preparation

The emulsion of step 3 was charged into the reactor. The suspension of step 1 was added using slow pouring and gentle stirring. The AGRH 23 2% and water were added to achieve a viscosity of up to 2200cP (spindle 62 at 12rpm) to prepare the suspoemulsion.

The stability test results of this Fluensulfone 160 Fipronil 64 Azoxystrobin 19 SE composition are shown in Table 2 below.

Table 2: Stability of the Fluensulfone 160 Fipronil 64 Azoxystrobin 19 SE Composition

	Normal Limits	**Before storage**	**Room temp.**	**After 2 weeks at 54°C**	**After 2 weeks at 4°C**
Appearance		White homogenous suspension	Off- white homogenous formulation	Off- white homogenous formulation with small yellow residue on top.	Off- white homogenous formulation
Concentration MCW-2 (g/L)	150.4-169.6g/L	159.8 (14.8%)	158.25 (14.7%)	154.8 (14.4%)	159.7 (14.8%)
Concentration Fipronil (g/L)	57.6-70.4 g/L	(5.9%) 63.7	62.35 (5.8%)	61.25 (5.7%)	62.58 (5.8%)

Concentration Azoxystrobin (g/L)	16.15-21.85 g/L	(1.8%) 19.44	19.35 (1.8%)	18.27 (1.7%)	19.42 (1.8%)
Density (g/ml)		1.08	1.075	1.075	1.079
pH		5.18	5.29	4.02	5.21
Viscosity, cP (sp.62,12rpm)		1750	1660	1300	1690
Pourability	max 5% residue	--	2.91	Not enough material.	-
	max 0.25% rinsed residue	--	0.15		
Particles size, μm	d90<7μm	In spec (microscope)			
Persistent foam (1.5%)	<60 ml	40/4	30/0	30/0	20/0
Suspensibility MCW-2	>85	99.87	98.93%	99.15%	98.26%
Suspensibility Fipronil	>85	99.83	98.87%	99.24%	98.10%
Suspensibility Azoxystrobin	>85	104.12	97.15%	99.22%	96.13%
WSR (10%, 75μm)	2.0% maximum	0.35%	0.408%	0.04%	0.236%
Emulsion Stability (1.5%)		Ok	Ok	Ok	Ok

Efficacy testing of the mixture and composition in sugarcane

Experiments were carried out to determine the efficacy of the composition comprising fluensulfone, fipronil and azoxystrobin for (i) controlling nematodes, (ii) increasing plant crop vigor and (iii) increasing root mass.

Materials:

Fluoresulfone, (EC) emulsifiable concentrate I.a. concentration: 480.0000 g per liter of commercial product (LEGADO)

Azoxystrobin, (SC) Concentrated suspension, I.a. Concentration: 250.0000 g per liter of commercial product (MIRADOR 250 SC)

Fipronil, (WG) Dispersible granules I.a. Concentration: 800.0000 g per liter of commercial product (ALBATROSS 800 WG)

An artificial soil infestation with Meloidogyne javanica inoculates was obtained in IAPAR, with J2 nematodes and eggs (20,000 J2 and eggs per plot).

Method:

The three active ingredients, fluensulfone, fipronil and azoxystrobin, were tested on sugarcane culture for controlling Meloidogyne javanica.

A tank mix of MIL FI 0437/09 (Fluensulfone 480 g a.i./ ha EC); MIL FI 0304/05 (Fipronil 800 g a.i./ ha WG) and MIL FF 0357/05 (Azoxystrobin 250 g a.i./ ha SC) and the ready mix composition (Example 1, ADA FI 0017) (Fluensulfone 160 + Fipronil 64 + Azoxystrobin 19.7 g ai / ha SE) were applied (1-2 days after artificial soil infestation with Meloidogyne javanica) to sugarcane culture for controlling Meloidogyne javanica.

Sugarcane was planted at the time of application in the planting furrow. The ready-mix composition or tank mix was applied during the planting of the crop in a jet directed in the furrow of planting, next to the sugar cane sticks.

4 replicates of each trial were conducted.

The experimental unit consisted of plots 0.2 meters wide and 0.75 meters long (0.15 m^2). (Being considered for assessments useful area of the plot of 0.15 m^2 central). The ready-mix composition of Example 1 and the tank mix were sprayed in the planting groove once (200.00 L/ha), simulating an application range of 50 cm, before planting, when sugarcane was in the 0 stage of BBCH's overall scale.

Application equipment: Costal pressurized to CO_2 with a tip bar of Teejet type A11004VS.

Agronomic information: Early variety with high agroindustrial productivity. No tipping. It has resistance to charcoal, scalding, rust, false red streaks and mosaic; and medium resistance to red streaks, nematodes and the borer-rot complex.

50 days after application (DAT), the number of nematodes per 5 gr of roots were counted.

The studies were conducted according to IN 36/42, including sending the MAPA worksheet (until the day of each month) to the federation unit.

Parameters evaluated: Nematodes and eggs in the soil (0 and 50 DAT, days after treatment), nematodes and eggs in the roots (50 DAT), use at least 5 g of root, and report in the results counting the number of J2 + eggs per 5g of roots.

In addition, the Reproduction Factor (FR) was calculated. Plant emergence and perform the biometry of plants (50 DAT).

Tables 3-6 below show the results for the nematode control for tank mix of three active ingredients compared to the ready mix composition comprising the same three active ingredients.

Table 3.

Treatment applied	**Dose**	Number of eggs + nematodes (J2) in 5 grams of root
		50 DAT[2] 14/03/19
Testemunha inoculada	-	1840[3] b[4]
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	1333,3 mL/ha 320 g/ha 304 mL/ha	321,25 c
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	666,6 mL/ha 160 g/ha 152 mL/ha	502,5 c
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	333,3 mL/ha 80 g/ha 76 mL/ha	1060 c
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	4000 mL/ha	117,5 c
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	2000 mL/ha	285 c
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	1000 mL/ha	570 c
C.V.%		53,58

Table 4.

Traetment applied	Dose	Vigor 14/03/2019
Testemunha inoculada	-	100 f
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	1333,3 mL/ha 320 g/ha 304 mL/ha	120 c
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	666,6 mL/ha 160 g/ha 152 mL/ha	111,25 d
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	333,3 mL/ha 80 g/ha 76 mL/ha	114,5 d
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	4000 mL/ha	136,25 a
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	2000 mL/ha	130 b
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	1000 mL/ha	120 c
C.V.%	-	3,53

Table 5.

Treatment applied	Dose	Biomass 14/3/19
Testemunha inoculada	-	3,67^{ns}
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	1333,3 mL/ha 320 g/ha 304 mL/ha	4,42
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	666,6 mL/ha 160 g/ha 152 mL/ha	4,23
Fluensulfona 480 Fipronil 800 Azoxistrobina 250	333,3 mL/ha 80 g/ha 76 mL/ha	4,27
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	4000 mL/ha	4,94
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	2000 mL/ha	4,67
Fluensulfona 160 Fipronil 64 Azoxistrobina 19	1000 mL/ha	4,51

The efficacy of the composition of Example 1 (ready mix) and the tank mixes for controlling nematode, increasing vigor plant crop and increasing root mass are shown in Table 6 below. The statistical analysis of variance for the results of Table 6 is shown in Table 7.

Table 6.

Application method	Rate*	Repetition	Nematode count	Roots biomass (g)	Relative vigor index
Tank mix	High	A	460	4.6	125
Tank mix	High	B	280	4.7	115
Tank mix	High	C	225	3.9	122
Tank mix	High	D	320	4.4	118
Tank mix	Med	A	950	4.1	112
Tank mix	Med	B	560	3.9	108
Tank mix	Med	C	320	5.0	110
Tank mix	Med	D	180	4.0	115
Tank mix	Low	A	2050	4.5	118
Tank mix	Low	B	465	3.8	120
Tank mix	Low	C	1025	4.9	110
Tank mix	Low	D	700	3.9	110
Ready mix	High	A	80	4.5	140
Ready mix	High	B	150	4.9	138
Ready mix	High	C	180	5.1	132
Ready mix	High	D	60	5.3	135
Ready mix	Med	A	80	5.3	135
Ready mix	Med	B	90	4.9	125
Ready mix	Med	C	120	4.2	132
Ready mix	Med	D	130	4.3	128
Ready mix	Low	A	190	4.8	110
Ready mix	Low	B	700	4.8	130
Ready mix	Low	C	500	4.8	125
Ready mix	Low	D	890	3.7	115

* Fluensulfone/Fipronil/Azoxystrobin g/ha
High- 640/256/76; Med- 320/128/38; Low- 160/64/19

Table 7: Statistical Analysis of Variance

Statistical Analysis of Variance						
	Nematode count	P value	Roots biomass (g)	P value	Relative vigor index	P value
Tank mix	627.19	0.017	4.385	0.046	115.25	<0.001
Ready mix	284.167		7.705		128.75	

Results

Contributing to the analysis of the efficiency and agronomic feasibility of the ready mix composition of Example 1 (Fluensulfone 160 + Fipronil 64 + Azoxystrobin 19.7 g a.i./ha SE), vigor and nematode culture evaluations were carried out. Analyzing the data in Table 6, we observed a significant decrease in nematode count, a significant increase in biomass of roots and a significant increase in relative vigor index in plants treated with the ready mix composition compared to the tank mix of the same three active ingredients when applied at the same rates.

WHAT IS CLAIMED IS:

1. A stable, broad spectrum composition comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

2. The composition of claim 1, wherein the composition is a suspoemulsion.

3. The composition of claim 1 or 2, wherein composition comprises an aqueous carrier and an organic carrier wherein the azoxystrobin and fipronil are suspended in the aqueous carrier and the fluensulfone is dissolved in the organic carrier.

4. The composition of claim 3, wherein the organic carrier is N,N-dimethyl-decanamide.

5. The composition of any one of claims 1-4, wherein the composition comprises at least one physically stabilizing system.

6. The composition of claim 5, wherein the physically stabilizing system is a combination of polyvinylpyrrolidone and polyalkylene oxide block copolymer.

7. The composition of claim 5, wherein the total amount of physically stabilizing system in the composition ranges from about 2% to about 10% by weight based on the total weight of the composition.

8. The composition of any of claims 5-7, wherein total amount of physically stabilizing system in the composition is about 4.2% by weight based on the total weight of the composition.

9. The composition of claim 5, wherein the amount of polyalkylene oxide block copolymer in the composition is about 2.8 % by weight based on the total weight of the composition.

10. The composition of claim 5, wherein the amount of polyvinylpyrrolidone in the composition is about 1.4% by weight based on the total weight of the composition

11. The composition of any one of claims 1-10, wherein the weight ratio between the fluensulfone to fipronil to azoxystrobin is 8.5:3.4:1.

12. The composition of any one of claims 1-11, wherein the fluensulfone is in an amount ranging from about 1-60% by weight based on the total weight of the composition.

13. The composition of claim 12, wherein the fluensulfone is in an amount of about 15 % by weight based on the total weight of the composition based on the total weight of the composition.

14. The composition of any one of claims 1-11, wherein the fipronil is in an amount ranging from about 1-15% by weight based on the total weight of the composition.

15. The composition of claim 14, wherein the fipronil is in an amount of about 6% by weight based on the total weight of the composition based on the total weight of the composition.

16. The composition of any one of claims 1-11, wherein the azoxystrobin is in an amount ranging from about 0.1-5% by weight based on the total weight of the composition.

17. The composition of claim 16, wherein the azoxystrobin is in an amount of about 1.8 % by weight based on the total weight of the composition.

18. A mixture comprising (i) an effective amount of fluensulfone, (ii) an effective amount of fipronil and (iii) an effective amount of azoxystrobin.

19. The mixture of claim 18, wherein the mixture comprises (i) 160 g/l of fluensulfone, (ii) 64 g/l of fipronil and (iii) 19 g/l of azoxystrobin.

20. The mixture of claim 18 or 19, wherein the mixture is an agricultural mixture or a pesticidal mixture.

21. The mixture of any one of claims 18-20, wherein the mixture is for use on sugar cane.

22. The mixtures of any one of claims 18-21, wherein the weight ratio between fluensulfone to fipronil to azoxystrobin is 8.5:3.4:1.

23. A method for enhancing plant development comprising applying to the plant, a locus of the plant and/or propagation material of the plant an effective amount of the composition of any one of claims 1-17 or the mixture of any one of claims 18-22 so as to thereby enhance plant development.

24. The method of claim 23, wherein:

a) the method enhances root development,

b) the method enhances the root system of the plant,

c) the method enhances plant quality,

d) the method enhances plant vigor,

e) the method enhances plant yield,

f) the method prevents root damage, and/or

g) the method improves rooting.

25. A method for controlling nematodes comprising applying to the plant, a locus of the plant and/or propagation material of the plant an effective amount of the composition of any one of claims 1-17 or the mixture of any one of claims 18-22 so as to thereby control nematodes.

26. A method for regulating plant growth comprising applying to the plant, a locus of the plant and/or propagation material of the plant an effective amount of the composition of any one of claims 1-17 or the mixture of any one of claims 18-22 so as to thereby regulate plant growth.

27. The method of any one of claims 23-26, wherein the one or more plants are monocotyledonous plants.

28. The method of any one of claims 23-27, wherein the one or more plants is sugar cane.

29. The method of any one of claims 23-28, wherein an effective amount of the composition is applied at a rate of 3 to 4 L/ha.

30. The method of any one of claims 23-29, wherein:

a) the fluensulfone is applied at an amount from about 1 g/ha to about 1000 g/ha,

b) the fipronil is applied at an amount from about 1 g/ha to about 500 g/ha, and/or

c) the azoxystrobin is applied at an amount from about 1 g/ha to about 100 g/ha.

31. A method for preparing the stable, broad spectrum composition comprises the steps of: (1) milling a dispersion of fipronil and azoxystrobin in water in the presence of polyvinylpyrrolidone; (2) dissolving fluensulfone in N,N-dimethyl fatty acid amide derivative to obtain a solution; (3) preparing an emulsion from the solution obtained in step (2), and (4) preparing suspoemulsion composition from the obtained dispersion from step (1) and emulsion of step (3).

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/054929

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01N43/54 A01N43/78 A01N47/02 A01N25/04 A01N25/30
A01P5/00 A01P3/00 A01P7/04
ADD.
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)
A01N

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)
EPO-Internal, CHEM ABS Data, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2010/078852 A1 (ROTAM AGROCHEM INT CO LTD [CN]; DAMACENO ANTONIO CARLOS [CN] ET AL.) 15 July 2010 (2010-07-15)	1-30
A	The whole document, in particular pages 3-4	31

Y	US 2017/215423 A1 (ANDERSCH WOLFRAM [DE] ET AL) 3 August 2017 (2017-08-03)	1-30
A	paragraphs [0014], [0082], [0090]; claim 6; table 15	31

Y	CN 102 783 493 A (YUANLIN WU) 21 November 2012 (2012-11-21)	1-30
A	abstract	31

Y	US 2006/171979 A1 (CALVO JOSE-LUIS [GB] ET AL) 3 August 2006 (2006-08-03)	1-30
A	paragraphs [0026], [0029]; claim 1	31

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[X] Further documents are listed in the continuation of Box C.

[X] 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

"E" earlier application or patent but published on or after the international filing date

"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)

"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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 October 2019	05/11/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lorusso, Patrizia

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/054929

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2017/091417 A1 (MERIAL INC [US]) 1 June 2017 (2017-06-01) claim 31; example 5 -----	1-31

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/054929

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