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(71) Applicants: UPL CORPORATION LIMITED

[MU/MU]; 6th Floor, Suite 157B, Harbor Front Building,
President John Kennedy Street, Port Louis (MU). UPL EU-
ROPE LTD. [GB/GB]; The Centre, 1st Floor, Birchwood
Park, Warrington Cheshire WA3 6YN (GB).

(72) Inventors: MATHADEEN, Prileen; 7 Sunbury Office

Park, Douglas, Saunders Drive, La Lucia Ridge, 4019 Dur-
ban (ZA). PIROTTE, Alan; Rue de Renory 26/1, 4102
Ougrée (BE).

(74) Agent: HGF; 1 City Walk, Leeds West, Yorkshire LS11

9DX (GB).

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(54) Title: LIQUID COMPOSITION COMPRISING A NEONICTONOID

(57) Abstract: Disclosed herein is a stable liquid agrochemical composition. Also disclosed is a process of preparing the liquid agrochemical composition, use of the liquid compositions for controlling the pests and a method of controlling pests using the liquid agrochemical composition.

WO 2022/189592 A1

LIQUID COMPOSITION COMPRISING A NEONICTONOID

Field of the disclosure: The present disclosure relates to liquid agrochemical compositions comprising neonicotinoid insecticides, a process of preparing the liquid agrochemical compositions, use of the liquid compositions for controlling the pests and a method of controlling pests using the liquid agrochemical compositions.

Background:

Neonicotinoid pesticides have unique mechanism of action. Unlike pesticides that evaporate or disperse shortly after application, neonicotinoids are systemic pesticides. They have reduced toxicity compared to organophosphates and carbamates that provide similar broad-spectrum control against numerous crop-damaging insects. Neonicotinoids paralyze insects by blocking a pathway that transmits nerve impulses in the insects' central nervous system. Neonicotinoids are used to control a wide variety of insects. The commonly used neonicotinoids available are imidacloprid, acetamiprid, clothianidin, dinotefuran, nitenpyram, thiacloprid, and thiamethoxam.

Acetamiprid is a neonicotinoid pesticide used in foliar as well as seed treatment applications. Acetamiprid is slightly water soluble and hence its liquid formulations often exhibit stability problems. Suspension concentrate (SC), emulsifiable concentrate (EC) and Microemulsion (ME) formulations of Acetamiprid are known to have stability problems. Emulsifiable concentrates are the stable liquid, homogeneous liquid formulations that comprise an insecticidal active ingredient, a solvent and emulsifying agent. When diluted with water, they form an emulsion after dilution in water. A stable suspension comprises active constituent(s) with water as the continuous phase and is intended for dilution with water before use. Micro-emulsions comprise an active ingredient, oil- and water, and are to be applied directly or after dilution in water.

Suspension concentrate (SC) formulations comprising acetamiprid are known to be prone to rapid crystal formation, gelling, caking and settling. Emulsifiable concentrate (EC) formulations comprising acetamiprid are known to suffer crystallization upon dilution with water and cause nozzle choking. Microemulsion (ME) comprising acetamiprid too face stability issues and requires large amount of surfactant to achieve thermodynamic stability. These problems further aggravate when formulators try to achieve high loading of active ingredients in liquid formulations of acetamiprid alone or in combination with other active ingredients that can withstand extreme temperature, especially low temperatures.

There is a need to develop stable agrochemical compositions comprising neonicotinoid insecticides that do not suffer stability issues and are stable at low temperature.

Objective of the disclosure:

5 An objective of the present disclosure is to provide stable liquid agrochemical compositions comprising neonicotinoid insecticide.

Another objective of the present disclosure is to provide stable liquid agrochemical compositions comprising high loading neonicotinoid insecticides alone or in combination with an additional pesticide.

10 Yet another objective of the present disclosure is to provide stable liquid agrochemical compositions comprising high loading neonicotinoid insecticides alone or in combination with an additional pesticide, capable of withstanding low temperature.

Yet another objective of the present disclosure is to provide a process of preparing liquid agrochemical compositions comprising high loading neonicotinoid insecticide alone or in combination with an additional pesticide.

Summary of the disclosure:

15 In an aspect, the present disclosure provides a liquid agrochemical composition comprising:

- (a) at least one neonicotinoid insecticide;
- (b) at least one low polarity amide solvent; and
- (c) at least one surfactant with HLB value from about 10 to about 18.

In another aspect, the present disclosure provides a liquid agrochemical composition comprising:

- 20
- (a) at least one neonicotinoid insecticide;
 - (b) at least one low polarity amide solvent;
 - (c) at least one surfactant with HLB value from 10 to about 18; and
 - (d) an additional pesticide.

25 In yet another aspect, the present disclosure provides a process of preparing the liquid agrochemical composition, wherein the process comprises: combining at least one neonicotinoid insecticide with at least one low polarity amide solvent and at least one surfactant having HLB value from about 10 to about 18.

In another aspect, the present disclosure provides a use of a liquid agrochemical composition comprising:

- 30
- (a) at least one neonicotinoid insecticide;
 - (b) at least one low polarity amide solvent; and

- (c) at least one surfactant with HLB value from about 10 to about 18, for controlling pests.

In another aspect, the present disclosure provides the use of the liquid agrochemical composition for controlling pests by applying to the plant or to the locus at which the plant is growing or intended to be grown or to a plant propagation material, or the habitat area.

In another aspect, the present disclosure provides a method of controlling pests, said method comprising applying to a plant or to a locus at which the plant is growing or intended to be grown or to a plant propagation material, or an habitat area, a liquid agrochemical composition comprising:

- (a) at least one neonicotinoid insecticide;
- (b) at least one low polarity amide solvent; and
- (c) at least one surfactant with HLB value from about 10 to about 18.

In another aspect, the present disclosure provides a kit comprises a plurality of components, each of which components may include at least one, or more, of the ingredients of the liquid composition according to the present disclosure.

Additional features and advantages of the present disclosure will be apparent from the detailed description that follows, which illustrates by way of example, the most preferred features of the present disclosure which are not to be construed as limiting the scope of the disclosure described herein.

Detailed Description of the disclosure:

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

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure pertains. In the case of conflict, the present document, including definitions will prevail.

Recitation of ranges of values are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. The endpoints of all ranges are included within the range and independently combinable. As used herein, all numerical values or numerical ranges include integers within such ranges and fractions of the values or the integers within ranges unless the context clearly indicates otherwise. Thus, for example, reference to a range of 90-100%, includes 91%, 92%, 93%, 94%, 95%, 95%, 97%, etc., as well as 91.1%, 91.2%,

91.3%, 91.4%, 91.5%, etc., 92.1%, 92.2%, 92.3%, 92.4%, 92.5%, etc., and so forth. All methods described herein can be performed in a suitable order unless otherwise indicated herein or otherwise clearly contradicted by context.

As used herein, “a,” “an,” “the,” and “at least one” do not denote a limitation of quantity and are intended to cover both the singular and plural, unless the context clearly indicates otherwise. For example, “an element” has the same meaning as “at least one element,” unless the context clearly indicates otherwise. The terms first, second etc. as used herein are not meant to denote any particular ordering, but simply for convenience to denote a plurality of, for example, layers. As used herein, the terms “comprising” “including,” “having,” “containing,” “involving,” and the like are to be understood to be open-ended, i.e., to mean “including” but not limited to, unless otherwise noted. “About” or “approximately” as used herein is inclusive of the stated value and means within an acceptable range of deviation for the particular value as determined by one of ordinary skill in the art, considering the measurement in question and the error associated with measurement of the particular quantity (i.e., the limitations of the measurement system). For example, “about” can mean within one or more standard deviations, or within $\pm 10\%$ or $\pm 5\%$ of the stated value. The use of any and all examples, or exemplary language (e.g., “such as”), is intended merely to better illustrate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention as used herein.

In any aspect or embodiment described hereinbelow, the phrase comprising may be replaced by the phrases “consisting of” or “consisting essentially of” or “consisting substantially of”. In these aspects or embodiment, the composition described includes or comprises, or consists of, or consists essentially of, or consists substantially of the specific components recited therein, to the exclusion of other ingredients or excipients not specifically recited therein.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

“Alkyl” means a straight or branched chain saturated aliphatic hydrocarbon having the specified number of carbon atoms, specifically 1 to 12 carbon atoms, more specifically 1 to 6 carbon atoms. Alkyl groups include, for example, groups having from 1 to 50 carbon atoms (C_1 to C_{50} alkyl).

"Alkylene" means a straight or branched chain, saturated, divalent aliphatic hydrocarbon group, (e.g., methylene (-CH₂-) or, propylene (-CH₂)₃-).

As used throughout the disclosure, the neonicotinoid insecticide or other active ingredients, includes their salts, esters, ethers, isomers, and polymorphs including solvates and hydrates. A salt includes salts that retain the biological effectiveness and properties of the active ingredient, and which are not biologically or otherwise undesirable, and include derivatives of the disclosed compounds in which the parent compound is modified by making inorganic and organic, non-toxic, acid or base addition salts thereof. The salts can be synthesized from the parent compound by conventional chemical methods. A "solvate" means the insecticide or its agriculturally acceptable salt, wherein molecules of a suitable solvent are incorporated in the crystal lattice. A suitable solvent is physiologically tolerable at the dosage administered. Examples of suitable solvents are ethanol, water and the like. When water is the solvent, the molecule is referred to as a "hydrate". The formation of solvates will vary depending on the compound and the solvate. In general, solvates are formed by dissolving the compound in the appropriate solvent and isolating the solvate by cooling or using an antisolvent. The solvate is typically dried or azeotroped under ambient conditions. In an aspect, the solvate is a hydrate.

The term "plant" refers to all physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage and fruits. The term plant includes transgenic and non-transgenic plants.

The term "locus" as used herein refers to the vicinity, area, or place in which the plants are growing, where plant propagation materials of the plants are sown (e.g., placed into the soil), and/or where plant propagation materials of the plants will be sown.

The term "plant propagation material" refers to the generative parts of a plant, such as seeds, vegetative material such as cuttings or tubers, roots, fruits, tubers, bulbs, rhizomes, and other parts of plants, germinated plants, and/or young plants, which are to be transplanted after germination or after emergence from the soil. These young plants may be protected prior to transplantation by a total or partial immersion treatment/system.

As used herein, "effective amount" is an amount of active ingredient, such as the disclosed combinations, which has an adverse effect on insects and/or which prevents diseases caused by them in a plant. The adverse effect can include killing of the insects (insecticidal), preventing growth of the insect, blocking of biosynthetic pathway(s), or a combination thereof.

As used herein, an "agriculturally acceptable salt" means a salt which is accepted for use in agricultural or horticultural use.

The low temperature stability is critical requirement of liquid agrochemical formulations such as EC and ME as they often need to be used in cold temperature regions or be exposed to cold temperatures. Precipitation of actives or freezing of such liquid formulations at low temperature in cold climatic regions leads to practical difficulties in handling the products and result in poor bio-efficacy. The

stability, particularly low temperature stability has been of great concern when liquid formulations are exposed to cold temperatures i.e. from about 20°C to about -10°C.

Surprisingly, inventors of the present disclosure have found that the liquid agrochemical compositions of stable neonicotinoid insecticide alone or in combination with additional pesticides can be obtained by incorporating a low polarity amide solvent and a surfactant with HLB value from about 10 to about 18. It was also found by the inventors that the high loading of neonicotinoid insecticides in the liquid agrochemical compositions is possible by combining low polarity amide solvent and a surfactant with HLB value from 10-18. The high loading compositions thus obtained were found to withstand extremely low temperature and to remain quite stable throughout storage as well as during application upon dilution with water.

Thus, an embodiment of the present disclosure provides a liquid agrochemical composition comprising:

- (a) at least one neonicotinoid insecticide,
- (b) at least one low polarity amide solvent, and
- (c) at least one surfactant having HLB value from 10 to 18.

According to another embodiment, the liquid agrochemical composition is stable at low temperature.

In another embodiment, the term 'low polarity amide solvent' refers to solvents comprising N-C₂₋₈ alkylpyrrolidone group and having polarity value lower than 0.350.

In another embodiment, the term 'low polarity amide solvent' refers to solvents comprising N-C₂₋₈ alkylpyrrolidone and having polarity value lower than 0.340 on Reichardt scale of polarity (E_T^N).

As used throughout the specification, the term 'low-temperature' refers to a temperature ranging from 20 °C to about -10°C.

According to an embodiment, the liquid agrochemical composition is stable at temperature lower than 20°C.

According to another embodiment, the liquid agrochemical composition is stable at temperature lower than 10°C.

According to still another embodiment, the liquid agrochemical composition is stable at temperature lower than 5°C.

According to still another embodiment, the liquid agrochemical composition is stable at temperature lower than 0°C.

According to still another embodiment, the liquid agrochemical composition is stable at temperature lower than -5°C.

According to an embodiment, the liquid agrochemical composition comprises at least one neonicotinoid insecticide.

- 5 According to another embodiment, the neonicotinoid insecticide is selected from the group comprising of acetamiprid, clothianidin, imidacloprid, nitenpyram, nithiazine, thiacloprid, thiamethoxam and combinations thereof.

According to still another embodiment, neonicotinoid insecticide comprises imidacloprid.

According to a preferred embodiment, neonicotinoid insecticide comprises acetamiprid.

- 10 According to an embodiment, the liquid agrochemical composition comprises from about 0.1% to about 90% w/w neonicotinoid insecticide of the total weight of the liquid composition.

According to another embodiment, the liquid agrochemical composition comprises from about 10% to about 80% w/w neonicotinoid insecticide of the total weight of the liquid composition.

- 15 In a preferred embodiment, the liquid agrochemical composition comprises from about 20% to about 70% w/w neonicotinoid insecticide of the total weight of the liquid composition.

According to an embodiment, the liquid agrochemical composition comprises at least one low polarity amide solvent.

- 20 According to another embodiment, the low polarity amide solvent comprises N-C₂₋₈ alkylpyrrolidone group.

According to another embodiment, the present disclosure provides a liquid composition comprising:

- 25 (a) at least one neonicotinoid insecticide,
(b) at least one low polarity amide solvent wherein low polarity amide solvent comprises N-C₂₋₈ alkylpyrrolidone, and
(c) at least one surfactant with HLB value from 10 to about 18.

According to still another embodiment, the low polarity amide solvent is selected from the group comprising of N-butylpyrrolidone (NBP), N-octylpyrrolidone and N-ethylpyrrolidone (NEP).

- 30 According to still another embodiment, the low polarity amide solvent is selected from the group comprising of N-butylpyrrolidone (NBP) and N-ethylpyrrolidone (NEP).

According to still another embodiment of the present disclosure, the low polarity amide solvent is N-butylpyrrolidone (NBP).

According to an embodiment, the liquid agrochemical composition comprises from about 1% to about 90% w/w low polarity amide solvent of the total weight of the liquid composition.

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According to an embodiment, the liquid agrochemical composition comprises from about 10% to about 80% w/w low polarity amide solvent of the total weight of the liquid composition.

10 In a preferred embodiment, the liquid agrochemical composition comprises from about 20% to about 75% w/w low polarity amide solvent of the total weight of the liquid composition.

According to an embodiment, the liquid agrochemical composition comprises at least one surfactant with HLB ranging from about 10 to about 18.

15 According to another embodiment, the liquid agrochemical composition comprises at least one surfactant with HLB ranging from about 10 to about 18 is selected from the group comprising of sorbitan derivatives and ethylene oxide-propylene oxide (EO/PO) block copolymers.

According to an embodiment of the present disclosure, sorbitan derivatives are selected from sorbitan esters and ethoxylated sorbitan esters with HLB ranging from about 10 to about 18.

20 According to another embodiment, sorbitan derivatives are selected from the group comprising of Polyoxyethylene monooleate, Polyoxyethylene monostearate, Polyoxyethylene monolaurate, Polyoxyethylene sorbitan monolaurate, Polyoxyethylene sorbitan monolaurate, Polyoxyethylene sorbitan monopalmitate, Polyoxyethylene sorbitan monostearate, Polyoxyethylene sorbitan tristearate, Polyoxyethylene sorbitan monooleate, and Polyoxyethylene sorbitan trioleate.

According to still another embodiment, ethoxylated sorbitan ester is Polyoxyethylene sorbitan monooleate.

25 According to still another embodiment, EO/PO block copolymers with HLB ranging 10-18 are selected from the group comprising of Block Copolymer of Ethylene Oxide, Propylene Oxide and Propylene Glycol, Oxirane, methyl-, polymer with oxirane and Butyl EO/PO block polymer.

30 According to an embodiment, the liquid agrochemical composition comprises from about 0.01% w/w to about 50% w/w surfactant with HLB ranging from about 10 to about 18 of the total weight of the liquid composition.

According to another embodiment, the liquid composition comprises from about 0.1% w/w to about 40% w/w surfactant with HLB ranging from about 10 to about 18 of the total weight of the liquid composition.

5 According to still another embodiment, the liquid agrochemical composition comprises from about 0.5% w/w to about 30% w/w surfactant with HLB ranging 10-18 of the total weight of the liquid composition.

According to an embodiment, the liquid agrochemical composition may be formulated as emulsifiable concentrate, soluble liquid, microemulsion, suspension concentrate, suspoemulsion and oil dispersion.

According to an embodiment, the liquid agrochemical composition comprises:

- 10
- (a) at least one neonicotinoid insecticide,
 - (b) at least one additional pesticide,
 - (c) at least one low polarity amide solvent, and
 - (d) at least one surfactant having HLB value from about 10 to about 18.

According to an embodiment, the liquid agrochemical composition comprises additional pesticide.

15 According to an embodiment, the liquid agrochemical composition comprises one or more insecticides selected from oxadiazine insecticides, avermectin insecticides, phosphoramidothioate insecticides, phenylpyrazole insecticides, benzoylurea insecticides, pyrethroid insecticides, their salts, esters, optically active isomers and combinations thereof.

20 According to an embodiment, the liquid agrochemical composition comprises one or more insecticide selected from oxadiazine insecticide such as indoxacarb, avermectin insecticides such as abamectin, doramectin, emamectin, eprinomectin, ivermectin and selamectin; phosphoramidothioate insecticides such as acephate, methamidophos, monocrotophos; phenylpyrazole insecticides such as flupyrzofos, pyraclofos, pyrolan, ethiprole, fipronil, flufiprole; pyridylpyrazole insecticides such as chlorantraniliprole, cyantraniliprole, cyclaniliprole, tetrachlorantraniliprole, tetraniliprole; benzoyl urea

25 insecticide such as lufenuron, novaluron, dibenzuron, chlorfuazuron; pyrethroid insecticides such as bifenthrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, fenvalerate and transfluthrin.

30 According to another embodiment, the liquid agrochemical composition comprises from about 1% w/w to about 90% w/w neonicotinoid insecticide, 1% w/w to about 40% w/w additional insecticide, from about 20% w/w to 90% w/w about low polarity amide solvent and from about 0.1% w/w to about 10% w/w surfactant with HLB value ranging from 10 to about 18.

According to still another embodiment, the liquid agrochemical composition comprises from about 1% w/w to 90% w/w acetamiprid, 1% w/w to 40% w/w emamectin-benzoate, from about 20% w/w to 90% w/w low polarity amide solvent comprises n-butylpyrrolidone and from about 0.1% w/w to 10% w/w surfactant with HLB value ranging from 10-18.

- 5 According to still another embodiment, the liquid agrochemical composition comprises from about 1% w/w to 90% w/w acetamiprid, 1% w/w to 40% w/w indoxacarb, from about 20% w/w to 90% w/w low polarity amide solvent comprising n-butylpyrrolidone and from about 0.1% w/w to 10% w/w surfactant with HLB value ranging from 10 to about 18.

- 10 According to an embodiment, the liquid agrochemical composition may further comprise one or more additional solvents.

According to another embodiment, the additional solvent is selected from the group comprising of a non-polar water-immiscible solvent or a polar aprotic water miscible organic solvent.

- 15 According to still another embodiment, additional solvent in the liquid composition is selected from polar and non-polar water-immiscible solvents, substituted or unsubstituted aromatic or aliphatic hydrocarbons and alkyl esters of plant oils or mixtures thereof.

- 20 According to an embodiment, the liquid composition comprises the additional polar solvent selected from the group comprising of cyclohexanone; dibasic esters such as, but not limited to, dimethyl 2-methylglutarate, and a dibasic ester mixture composed of dimethyl glutarate, dimethyl succinate and dimethyl adipate; glycol ethers and polyalkylene diglycol ethers such as, but not limited to, dipropylene glycol methyl ether; alkylene carbonates such as, but not limited to, propylene carbonate; methyl-5-(dimethylamino)-2-methyl-5-oxopentanoate; ketones such as, but not limited to, cyclopentanone and cyclohexanone; water-miscible polar aprotic solvents include, for example, alkyl lactates, isopropyl lactate, alkyl carbonates, polyethylene glycols, polyethylene glycol alkyl ethers, monopropylene glycol, polypropylene glycols, and polypropylene glycol alkyl ethers, or mixtures thereof.

- 25 According to an embodiment, the additional solvent in the liquid composition is fatty acid ester solvent such as C₆-C₁₄ fatty acid ester prepared from plant oils.

- 30 According to an embodiment, additional solvent in the liquid composition is selected from one or more of aromatic hydrocarbons derived from benzene, such as, for example, toluene, xylenes, mesitylene, diisopropylbenzene and its higher homologs, indane and naphthalene derivatives, such as 1-methylnaphthalene, 2-methylnaphthalene; C₅-C₁₂ aliphatic hydrocarbons (straight, branched or cyclic), such as, pentane, hexane, cyclohexane, octane, 2-ethylhexane, decane; C₄-C₁₀ aliphatic alcohols (straight or branched), such as butan-1-ol, hexanol, 2-ethyl butanol, heptanol, octanol, 2-octanol, and 2-ethylhexanol; and aromatic alcohols such as benzyl alcohol.

According to an embodiment, solvent in the liquid composition is selected from mineral oils.

According to an embodiment, solvent in the liquid composition is selected from water-miscible polar aprotic solvents including, for example, from alkyl lactates, isopropyl lactate, alkyl carbonates, polyethylene glycols, polyethylene glycol alkyl ethers, monopropylene glycol, polypropylene glycols, and polypropylene glycol alkyl ethers, or mixtures thereof.

According to an embodiment, the liquid composition comprises from about 1% w/w to about 99% w/w additional solvent of the total weight of the liquid composition.

According to another embodiment, the liquid composition comprises from about 10% w/w to about 90% w/w additional solvent of the total weight of the liquid composition.

According to another embodiment, the additional solvent comprises water.

According to preferred embodiment of the present disclosure, the liquid composition comprises from about 30% w/w to about 80% w/w solvent of the total weight of the liquid composition.

According to an embodiment, the liquid composition may include one or more adjuvants selected from surfactants (emulsifier), crop oil, fertilizers, dispersing agents, compatibility agents, defoamers, antimicrobial agents, antioxidants, correctives, and spray colorants (dyes).

According to an embodiment, the liquid composition comprises antioxidant selected from the group comprising of butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tertiary butylhydroquinone (TBHQ) and propyl gallate (PG) and mixtures thereof.

According to another embodiment, the liquid composition comprises defoamer selected from the group comprising of silicone-based compounds, alcohols, glycol ethers, mineral spirits, acetylene diols, polysiloxanes, organosiloxanes, siloxane glycols, reaction products of silicon dioxide and organosiloxane polymer, polydimethylsiloxanes or polyalkylene glycols alone or in combination.

According to an embodiment, the liquid composition optionally comprises from about 0.1% w/w to about 40% w/w of one or more adjuvants of the total weight of the emulsifiable concentrate composition.

According to an embodiment, the liquid composition optionally comprises from about 0.5% w/w to about 30% w/w of one or more adjuvants of the total weight of the emulsifiable concentrate composition.

According to an embodiment, the liquid composition comprises from about 0.1% w/w to about 90% w/w neonicotinoid insecticide, from 0.01% w/w to about 90% w/w low polarity amide solvent, from about 0.01% w/w to about 50% w/w surfactant with HLB value from about 10 to about 18 of the total weight of the liquid composition.

- 5 According to another embodiment, the liquid composition comprises from about 1% w/w to about 40% w/w neonicotinoid insecticide, 10% w/w to about 80% w/w low polarity amide solvent, from about 0.01% w/w to about 30% w/w surfactant with HLB value from about 10 to about 18 of the total weight of the liquid composition.

- 10 According to another embodiment, the liquid composition comprises from about 1% w/w to about 40% w/w neonicotinoid insecticide, 20% w/w to about 75% w/w low polarity amide solvent, from about 0.01% w/w to about 20% w/w surfactant with HLB value from about 10 to about 18 of the total weight of the liquid composition.

- 15 According to another embodiment of the present invention, the liquid composition comprises from about 0.1% w/w to about 90% w/w acetamiprid, 0.01% w/w to about 90% w/w low polarity amide solvent comprising n-butylpyrrolidone, from about 0.01% w/w to about 50% w/w surfactant with HLB value ranging from about 10 to about 18 comprising polyoxyethylene sorbitan monooleate of the total weight of the liquid composition.

Unless the context otherwise requires, the liquid agrochemical composition as described in any of the embodiments in this specification may be Microemulsion (ME).

- 20 Unless the context otherwise requires, the liquid agrochemical composition as described in any of the embodiments in this specification may be Soluble Liquid (SL).

Unless the context otherwise requires, the liquid agrochemical composition as described in any of the embodiments in this specification may be Emulsifiable Concentrate (EC).

- 25 In an embodiment, the present disclosure provides a process of preparing the liquid agrochemical composition, wherein the process comprises: combining at least one neonicotinoid insecticide with at least one low polarity amide solvent and at least one surfactant having HLB value from about 10 to about 18.

In an embodiment, the present disclosure provides a process of preparing a soluble liquid agrochemical composition, wherein the process comprises:

- 30 combining at least one neonicotinoid insecticide with at least one low polarity amide solvent to obtain a mixture;

combining water and a surfactant with HLB value ranging from about 10 to about 18 with the mixture;
and

homogenizing the mixture at least one neonicotinoid insecticide, at least one low polarity amide solvent, water and the surfactant to obtain the soluble liquid agrochemical composition.

- 5 In an embodiment, the present disclosure provides a process of preparing an emulsifiable concentrate agrochemical composition, wherein the process comprises:

combining at least one neonicotinoid insecticide with at least one low polarity amide solvent to obtain a mixture;

combining water and a surfactant with HLB value ranging from about 10 to about 18 with the mixture;

- 10 and

homogenizing the mixture at least one neonicotinoid insecticide, at least one low polarity amide solvent, water and the surfactant to obtain the emulsifiable concentrate agrochemical composition.

In an embodiment, the present disclosure provides a process of preparing a microemulsion agrochemical composition, wherein the process comprises:

- 15 combining water and at least one neonicotinoid insecticide to obtain a mixture

combining a surfactant with HLB value ranging from about 10 to about 18 with the mixture; and

homogenizing the mixture at least one neonicotinoid insecticide, at least one low polarity amide solvent, water and the surfactant to obtain the microemulsion agrochemical composition.

In another embodiment, the process of combining at least one neonicotinoid insecticide with at least one
20 low polarity amide solvent to obtain a mixture involves stirring.

In still another embodiment, the process of combining at least one neonicotinoid insecticide with water to obtain a mixture involves stirring.

In still another embodiment, the process of combining at least one neonicotinoid insecticide, water and at least one low polarity amide solvent to obtain a mixture involves stirring.

- 25 In still another embodiment, wherein the liquid agrochemical composition comprises at least one neonicotinoid insecticide, and an additional pesticide, the process comprises combining at least one neonicotinoid insecticide, and the additional pesticide with at least one low polarity amide solvent.

According to an embodiment, the homogenization comprises particle size reduction.

According to another embodiment, the particle size reduction is done by applying shear to the mixture
30 of active ingredients, low polarity amide solvent and surfactant with HLB ranging from 10-18 and optionally other auxiliary agents. Suitable devices for applying shear include any high shear devices, e.g. high shear mixers, such as Ultra-Turrax apparatus, and dissolvers, static mixers, e.g. systems having mixing nozzles, bead mills, vibratory mills, agitator bead mills, colloid mills, cone mills, circulating mills (agitator ball mills with pin grinding system), disk mills, annular chamber mills, double cone mills,
35 sprocket dispersers or homogenizers and other homogenizers.

According to an embodiment, the liquid composition is intended to be diluted with water (or a water-based liquid) to form the corresponding end-use agrochemical formulations, typically spray formulations.

According to an embodiment, the liquid composition has a pH ranging from 5-7.

- 5 According to an embodiment, the liquid composition has a variation in pH of no more than 20% when at 54°C between 24 hours and 28 days.

According to an embodiment of the present invention, the liquid composition has a variation in pH of no more than 10% when at 54°C between 24 hours and 28 days.

- 10 According to an embodiment of the present invention, the liquid composition has a variation in pH of no more than 5% when at 54°C between 24 hours and 28 days.

According to an embodiment, the liquid composition provides a formulation that allows the active compounds to be taken up by the plant/the target organisms.

According to an embodiment, the liquid composition is used as the source of active agrochemical ingredients and is diluted to form end-use formulations, typically spray formulations.

- 15 In an embodiment, the dilution may be with water at from 1 to 10,000, particularly 10 to 1,000, times the total weight of the composition to form the spray formulation.

In an embodiment, in the diluted composition, the agrochemical active concentration may be in the range from about 0.001 wt.% to about 1 wt.% of the total spray formulation.

- 20 In an embodiment, the spray formulations can be made by simple dilution of the liquid agrochemical compositions.

In another embodiment, the spray formulations can be made by combining individual components used in preparing the liquid agrochemical compositions and water.

- 25 Typically, such end use mixing is carried out in the tank from which the formulation is sprayed, or alternatively in a holding tank for filling the spray tank. Such mixing and mixtures are typically termed tank mixing and tank mixtures.

According to another embodiment, provided is a method of controlling pests, said method comprising applying to a plant or to a locus at which the plant is growing or intended to be grown or to a plant propagation material, or an habitat area, a liquid composition comprising:

- 30 (a) at least one neonicotinoid insecticide;
(b) at least one low polarity amide solvent; and
(c) at least one surfactant with HLB value from 10-18.

According to another embodiment, the method of controlling pests comprises applying the liquid compositions comprising acetamiprid.

According to another embodiment of the present invention, the method of controlling pests comprises applying the liquid compositions comprising acetamiprid and the additional pesticides.

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

- 25 According to an embodiment, the kit comprising liquid composition comprises a plurality of components, each of which components may include at least one, or more, of the ingredients of the liquid composition.

- The compositions described throughout the present disclosure are insecticidally active and are stable. It has been found that the combination of low polarity amide solvent and a surfactant with HLB ranging from about 10 to about 18 provides excellent stability over time and at various temperatures, and even
- 30 when said liquid composition is subjected to shear forces for example on mixing. Also, the liquid composition obtained has excellent suspensibility, dispersibility, very low or no sedimentation and little particle degradation.

All the features described in this disclosure may be combined with any of the other aspects or embodiments, in any combination.

These and other advantages of the disclosure may become more apparent from the examples set forth herein below. These examples are provided merely as illustrations of the disclosure and are not intended to be construed as a limitation thereof.

All tests and physical properties listed have been determined at atmospheric pressure and room temperature (i.e. 25°C), unless otherwise stated herein, or unless otherwise stated in the referenced test methods and procedures.

10 Examples

Example 1: Acetamiprid 200g/L Soluble Liquid (SL) (working example)

The materials in Table 1 were used to prepare a 200 g/L soluble liquid composition of Acetamiprid.

Table 1

Ingredients	Quantity (g/l)
Acetamiprid Technical	200
N-butylpyrrolidone	654.5
Polyoxyethylene sorbitan monooleate (HLB value 15)	43
Silicone antifoam	2
Water	Q. S.

654.5g N-butylpyrrolidone was charged in a mixing vessel followed by addition of 200g acetamiprid and mixed until dissolved. Water was added to the same mixing vessel to obtain a mixture. 43g polyoxyethylene sorbitan monooleate and 2g silicone antifoam were added to the mixture and homogenized for about 5 minutes to obtain soluble liquid formulation.

20 Stability Data

The composition of Example-1 was taken for physico-chemical study at various testing conditions such as ambient temperature (at room temperature) testing, and at low temperature. Testing at low temperature was performed after keeping the composition of Example-1 for 7 days at 0°C, oven stability performed as accelerated heat stability (AHS) after keeping sample in oven for 2 weeks at 54°C and also for 8 weeks at 40°C. The low temperature study was performed as per CIPAC method no. 39.3 wherein compositions were maintained at 0°C for 1 h and the volume of any separated solid or oily matter was then recorded. Storage at 0°C is continued for 7 days, any solid matter is settled by centrifuging and its volume recorded. In all the four stability conditions, composition of Example-1 remained as clear yellowish liquid. Density of the composition remained at about 1, and degradation of active remained within acceptable range. Persistent foam in the composition remained within acceptable range. And pH of the composition was found to be around 7 in all the conditions.

Table 2

Parameters	Specification	Ambient (25°C)	Low Temperature Stability (0°C) 7 days	Oven Stability (54°C) 2 weeks
Appearance	Clear Yellowish liquid	Clear Yellowish liquid	Clear Yellowish liquid	Clear Yellowish liquid
Active Ingredient content – Acetamiprid	188->212g/l	196.48	194.68	196.55
Density @ 25°C	1.024±0.005g/cm ³	1.025	1.025	1.025
pH @ 1% distilled water	06-08	7.39	7.38	7.39
Persistent Foam	Max 40ml	Nil	Nil	Nil

Example 2: Acetamiprid 120 g/l + Emamectin Benzoate 15 g/l ME (working example)

The materials in Table 3 were used to prepare Acetamiprid 120 g/l + Emamectin Benzoate 15 g/l ME.

Table 3

Ingredients	Quantity (g/l)
Acetamiprid (98%)	122.4
Emamectin Benzoate (95,1%)	16.0
Butylated hydroxyanisole	7.0
Propylene Glycol	12.5
Butan-1-ol (AR Grade)	38.5

N, Butylpyrrolidone	764.8
Polyoxyethylene(20) sorbitan monooleate (HLB value 15)	8.0
Silicone antifoam	0.3
Water	Q. S.

12.5g of propylene glycol was charged in a mixing vessel followed by the addition of 38.5g Butan-1-ol under agitation to obtain a mixture. 7g butylated hydroxyanisole and water were added to the mixture and mixed for around 5 minutes. In the same mixture, 16g Emamectin-benzoate was added under continuous mixture followed by addition of 764.8g n-butylpyrrolidone. Further 122.4g acetamiprid was added and mixed for around 30 minutes until dissolved completely. 8g polyoxyethylene(20) sorbitan monooleate and 0.3g silicone antifoam was added and mixed to obtain microemulsion.

Stability Data

The composition of Example-2 was taken for physico-chemical study at various testing conditions such as ambient temperature (at room temperature) testing, and at low temperature. Testing at low temperature was performed after keeping the composition of Example-2 in refrigerator for 7 days at 0°C, oven stability was performed as accelerated heat stability (AHS) testing after keeping sample in oven for 2 weeks at 54°C and also for 8 weeks at 40°C. In all the four stability conditions, composition of Example-2 remained as homogeneous and transparent liquid. Density of the composition remained as 0.993, Degradation of active remained within acceptable range. Persistent foam in the composition remained within acceptable range. And pH of the composition was found to be around 6 in all the conditions.

Table-4

Test	Specifications	Ambient	Low temperature (0°C) 7 days	Oven Stability (54°C) 2 weeks	Oven Stability (40°C) 8 weeks
Physical State	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent
Density	0.993 ± 0.005 g/ml	0.993	0.993	0.993	0.993
Active ingredient content- Acetamiprid	114 – 126 g/l	123.98	122.30	123.50	123.91

Active ingredient content - Emamectin Benzoate	12.75 – 17.25 g/l	14.50	14.49	13.94	15.66
Persistent Foam (1% dil. @ 1min.)	Max. 60 ml	40	-	45	40
pH (1% in 342ppm)	-	6.06	6.04	6.10	6.08

Example 3: Acetamiprid 146 + Indoxacarb 54 emulsifiable concentrate (EC)

The materials in Table 5 were used to prepare Acetamiprid 146 + Indoxacarb 54 emulsifiable concentrate (EC).

5 Table 5

Ingredients	Quantity (g/l)
Acetamiprid Technical	149.00 g
Indoxacarb Technical	56.84 g
n-butylpyrrolidone	350.00 g
Cyclohexanone	360.00 g
Butyl EO.PO block polymer	100.00 g

360g cyclohexanone was charged in a mixing vessel. 350g n-butylpyrrolidone was added to the same mixing vessel under continuous agitation. Further, 56.84g indoxacarb and 149g acetamiprid were added under continuous stirring to obtain a mixture. Further 100g butyl EO.PO block polymer and remaining
10 60g cyclohexanone were added to the mixture and mixed for around 30 minutes to obtain emulsifiable concentrate.

Stability Data

The composition of Example-3 was taken for physico-chemical study at various testing conditions such as ambient (at room temperature) testing, low temperature testing performed after keeping the
15 composition of Example-3 in refrigerator for 7 days at 0°C, oven stability performed as accelerated heat stability (AHS) after keeping sample in oven for 2 weeks at 54°C and also for 8 weeks at 40°C. In all the four stability conditions, composition of Example-1 remained as homogeneous and transparent liquid. Density of the composition maintained as 1.02. Degradation of active remained within acceptable range. Persistent foam in the composition remained within acceptable range. And pH of the composition
20 was found to be around 5 in all the conditions.

Table-6

	Specifications	Ambient	Low temperature stability (0°C) 7 days	Oven Stability (54°C) 2 weeks	Oven Stability (40°C) 8 weeks
Physical State Aspect	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent	Liquid Homogenous & Transparent
Density	1.020 ± 0.005 g/ml	1.02	1.02	1.02	1.021
Active ingredient content- Acetamiprid	137 – 154 g/l	146.74	146.72	146.20	145.11
Active ingredient content - Indoxacarb	49 – 59 g/l	54.52	54.55	53.44	52.59
Persistent Foam (1% dil. @ 1min.)	Max. 40 ml	6	6	5	6
pH (1% in distilled water)	-	5.26	5.32	5.1	5.14

Stability upon dilution

- 5 The compositions of Example 1-3 were tested for dilution stability wherein each composition was diluted with standard water to make 1% dilution aliquot. The stability of the diluted composition was assessed at various time intervals. Further assessment was done after 24.5 hours post re-emulsifying the compositions. This was also repeated twice. The composition of Example-1 remained as homogeneous and stable liquid throughout in all the above specified time intervals. Similarly, composition of Exampel-
- 10 2 and Example-3 remained quite stable without any noticeable cream or oil formation.

Table-7

	Emulsion (0.5hr) (Std. H ₂ O A @ 1% dil.)	Emulsion (0.5hr) (Std. H ₂ O D @ 1% dil.)	Emulsion (2.0hr) (Std. H ₂ O A @ 1% dil.)	Emulsion (2.0hr) (Std. H ₂ O D @ 1% dil.)	Re- emulsification – (24.5hr) (Std. H ₂ O A @ 1% dil.)	Re- emulsification – (24.5hr) (Std. H ₂ O D @ 1% dil.)
Example 1	Homogeneous & stable	Homogeneous & stable	Homogeneous & stable	Homogeneous & stable	Homogeneous & stable	Homogeneous & stable
Example 2	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil
Example 3	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil	No Cream, No oil

Std. H₂O A stands for CIPAC Standard water A with 20 ppm hardness; Std. H₂O D stands for CIPAC Standard water D with 342ppm hardness.

Screening of solvents and surfactants suitable for liquid composition stable at low temperature

Example 4-7 are for compositions of ME formulation of acetamiprid and Emamectin-benzoate. Various solvent and surfactant were tried in preparing neonicotinoid based liquid compositions that remain stable at low temperature. The Compositions were taken for dilution stability study as per CIPAC 41.1 wherein said compositions were diluted in water and allowed to stand for 24 hours after which the quantity and nature of any separated material were assessed. Composition of Example-4 was prepared using anionic/non-ionic blend of surfactants with HLB value 9.6. On performing dilution stability, 1ml crème and some oil observed after 0.5. Thus, it failed in test and could not be considered for further stability testing. Composition of Example-5 was prepared using salt of dodecylbenzene sulfonate having HLB 8.6. BHA remained immiscible in the solvent. Composition failed to form ME formulation and was therefore, found to be unsuitable for low temperature testing. Similarly, composition of Example-6 and Example-7 were prepared using dimethylsulfoxide (DMSO) and propylene carbonate respectively. Both compositions exhibited crystallization in dilution stability testing which indicated crystal formation upon keeping at 0°C.

Table-8

	Ingredients	*Ex-4	*Ex-5	*Ex-6	*Ex-7
1	Emamectin Benzoate	1.6	1.61	1.6	1.6
2	Acetamiprid	12.4	12.36	12.4	12.4
3	Water	2.1	2.15	2.1	2.1
4	BHA - Butylated Hydroxy Anisole	0.7	0.71	0.7	0.7
5	Propylene Glycol	1.3	1.26	1.3	1.3
6	Butan-1-ol (AR Grade)	3.9	3.89	3.9	3.9
7	N-Butylpyrrolidone	77	77	-	-

8	Dimethylsulfoxide (DMSO)	-	-	Qs	-
9	Propylene carbonate	-	-	-	qs
10	Silicone antifoam	0.03	0.03	0.03	0.03
11	Dodecylbenzene sulfonate salt	-	0.8	-	-
12	Anionic/Non-ionic blend	0.8	-	-	-
	Remarks	1ml crème and some oil observed after 0.5 hours when kept for dilution stability.	BHA remained immiscible in the solvent. Composition failed to form ME formulation.	Solution found turbid upon dilution. Crystals observed in low temp.	Solution crystallised upon dilution in water.

*Ex= Example

Compositions of example 8-11 are EC compositions comprising acetamiprid and indoxacarb. Composition of Example-8 was prepared using anionic/non-ionic blend of surfactants with HLB value 9.6. Similarly, composition of Example-9 was prepared using salt of dodecylbenzene sulfonate having HLB 8.6. In both the compositions, 1ml oil and 2ml crème was observed when kept for dilution stability and could not be considered for further stability testing. Composition of Example-10 and Example-11 were prepared using dimethylsulfoxide (DMSO) and propylene carbonate respectively. Both compositions exhibited crystallization in dilution stability testing which indicated crystal formation upon keeping at 0°C.

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Table-9

	Compositions	Ex-8	Ex-9	Ex-10	Ex-11
1	Acetamiprid	149.00	149.00	149.00	149.00
2	Indoxacarb	56.84	56.84	56.84	56.84
3	Cyclohexanone	360.00	360.00	360.00	360.00
4	N-Butylpyrrolidone	350.00	350.00	-	-
5	Ethopropoxylated alcohol	-	-	100.00	100.00
6	Dodecylbenzene sulfonate salt	-	100	-	-
7	Mixture of ethoxylated tristyrylphenol and of calcium dodecylbenzenesulfonate in isobutanol	100	-	-	-

8	Mixture of heavy-aromatic petroleum solvent, medium-aliphatic petroleum solvent and benzene	-	-	350	-
9	Propylene Carbonate	-	-	-	350
	Remarks	1ml oil and 2ml crème observed after 0.5 hours when kept for dilution stability.	1ml oil and 2ml crème observed after 0.5 hours when kept for dilution stability.	Active found to be insoluble in	Fine crystals observed within 3 days of formation

Compositions of example 12-15 are SL compositions comprising acetamiprid and indoxacarb. Composition of Example-12 was prepared using salt of dodecylbenzene sulfonate having HLB 8.6. Similarly, composition of Example-13 was prepared using anionic/non-ionic blend with HLB value 9.6.

5 In both the compositions, crystals observed within 24 hours when kept for dilution stability. Composition of Example-14 and Example-15 were prepared using dimethylsulfoxide (DMSO) and propylene carbonate respectively. Both compositions exhibited crystallization in dilution stability testing which indicated crystal formation upon keeping at 0°C.

Table-10

	Compositions	Ex-12	Ex-13	Ex-14	Ex-15
1	Acetamiprid Technical	200	200	200	200
2	Polyoxyethylene sorbitan monooleate	-	-	43	43
3	Silicone antifoam	2	2	-	-
4	Water	126	126	126	126
5	N-butylpyrrolidone	654.6	654.7	-	-
9	DMSO	-	-	qs	
11	Propylene Carbonate	-	-	-	qs
14	Dodecylbenzene sulfonate salt	43	-	-	-
15	Mixture of ethoxylated tristyrylphenol and of calcium dodecylbenzenesulfonate in isobutanol		43	-	-
	Remarks	Crystals observed within 24hrs.	Crystals observed within 24hrs.	Fine crystals observed	Fine crystals observed

10

Field Application Study

Crop: Sweet Orange

Location for Trial 1: Groblersdal, Limpopo in South Africa

Location for Trial 2: Mooi nooi, North West in South Africa

- 5 The effectiveness of compositions of Example-2 and Example-3 were assessed on citrus for control of mealy bugs. Mealybug causes physical and cosmetic damage to citrus fruit, making them unsuitable for export. Composition of Example-2 was tested at dosage rate of 54 ml. Composition of Example-3 was tested at dosage rate of 36 ml. The effectiveness of the compositions was studied against untreated control. The number of mealy bugs were counted per plot on 25 citrus fruits sampled per plot at various intervals viz. 7DAT (Days After Treatment), 14DAT and 21DAT. The study was performed on two different locations (Trial 1 and Trial 2) for both the compositions of Example-2 and Example-3. Composition of Example-2 and Example-3 at both doses found to control more than 96% mealy bugs and successfully protected the crop.

Table-11

15

Treatments	Dose rate/100L water	Percentage Control %					
		Trial 1			Trial 2		
		7 DAT	14 DAT	21 DAT	7 DAT	14 DAT	21 DAT
Untreated		0%	0%	0%	0%	0%	0%
Example-2	54ml	98	98	98	96	97	94
Example-3	36ml	97	98	98	96	96	97

- The effectiveness of compositions of Example-2 and Example-3 were assessed on citrus for control of red spider mites. The Red spider mite (*P. ulmi*) is one of the pests common to citrus that cause damage to older leaves and fruit. Composition of Example-2 was tested at dosage rate of 54 ml. Composition of Example-3 was tested at dosage rate of 36 ml. The effectiveness of the compositions was studied against untreated control. The number of mites counted on a 30-leaf sample per plot and percentage control of red spider mites were calculated at various intervals viz. 7DAT (Days After Treatment), 14DAT and 21DAT. The study was performed on two different locations (Trial 1 and Trial 2) for both the compositions of Example-2 and Example-3. Compositions of Example-2 and Example-3 at both doses and in both trials found to control more than 90% red spider mites and successfully protected the crop.

Table-12

Treatments	Percentage Control %
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	Dose rate/100L water						
		Trial 1			Trial 2		
		7 DAT	14 DAT	21 DAT	7 DAT	14 DAT	21 DAT
Untreated		0%	0%	0%	0%	0%	0%
Example-2	54ml	97	98	98	96	96	97
Example-3	36ml	98	98	98	96	97	94

Therefore, inventors of the present disclosure successfully stabilized various liquid composition of neonicotinoid insecticides alone and in combination with other pesticides using a low polarity amide solvent and a surfactant with HLB ranging from 10-18. The combination of low polarity amide solvent and a surfactant with HLB ranging from about 10 to about 18 successfully stabilized neonicotinoid insecticide in the composition as well as imparted low temperature stability to the composition. The stable liquid composition also exhibited stability upon dilution. The liquid compositions were found to be highly efficacious in controlling pests. It is to be understood that the disclosure is not to be limited to the details of the above embodiments, which are described by way of example only.

We claim:

1. A liquid agrochemical composition comprising:
 - (d) at least one neonicotinoid insecticide;
 - 5 (e) at least one low polarity amide solvent; and
 - (f) at least one surfactant with HLB value ranging from about 10 to about 18.
2. The liquid composition as claimed in claim 1 wherein the neonicotinoid insecticide is selected from the group comprising of acetamiprid, clothianidin, imidacloprid, nitenpyram, nithiazine,
10 thiacloprid, thiamethoxam and combinations thereof.
3. The liquid composition as claimed in claim 1 wherein the composition comprises from about 0.1% w/w to about 90% w/w neonicotinoid insecticide of the total weight of the liquid composition.
15
4. The liquid composition as claimed in claim 1 wherein the low polarity amide solvent comprises N-C₂₋₈ alkylpyrrolidone group.
5. The liquid composition as claimed in claim 1 wherein the composition comprises from 0.01%
20 w/w to about 90% w/w low polarity amide solvent of the total weight of the liquid composition.
6. The liquid composition as claimed in claim 1 and claim 3 wherein said low polarity amide solvent is selected from the group comprising of N-butylpyrrolidone (NBP), N-octylpyrrolidone and N-ethylpyrrolidone (NEP).
25
7. The liquid composition as claimed in claim 1 wherein the composition comprises from about 0.01% w/w to about 50% w/w surfactant with HLB value from about 10 to about 18 of the total weight of the liquid composition.
- 30 8. The liquid composition as claimed in claim 1 wherein surfactant with HLB value ranging from about 10 to about 18 is selected from the group comprising of polyoxyethylene monooleate, polyoxyethylene monostearate, polyoxyethylene monolaurate, sodium oleate, triethanolamine oleate, polyoxyethylene sorbitan monolaurate, polyoxyethylene sorbitan monolaurate, polyoxyethylene sorbitan monopalmitate, polyoxyethylene sorbitan monostearate,
35 polyoxyethylene sorbitan tristearate, polyoxyethylene sorbitan monooleate, polyoxyethylene

sorbitan trioleate, block copolymer of ethylene oxide, propylene oxide, block copolymer of ethylene oxide, propylene oxide and propylene glycol.

9. The liquid composition as claimed in claim 1 wherein said composition comprises from about 0.1% w/w to about 90% w/w neonicotinoid insecticide, 0.01% w/w to about 90% w/w low polarity amide solvent, from about 0.01% w/w to about 50% w/w surfactant with HLB value from about 10 to about 18 of the total weight of the liquid composition.
10. The liquid composition as claimed in claim 1 wherein said composition is in the form of emulsifiable concentrate, soluble liquid, microemulsion, suspension concentrate, suspoemulsion or oil dispersion.
11. The liquid agrochemical composition as claimed in claim 1 further comprising an additional pesticide.
12. The liquid composition as claimed in claim 8 wherein the additional pesticide is selected from the group comprising of oxadiazine insecticides, avermectin insecticides, phosphoramidothioate insecticides, phenyl pyrazole insecticides, diamide insecticides, benzoylurea insecticides, pyrethroid insecticides, their salts, esters, optically active isomers and combinations thereof.
13. The liquid composition as claimed in claim 11 wherein the additional pesticide is selected from one or more from the group comprising of indoxacarb, abamectin, emamectin, ivermectin, acephate, monocrotophos, flupyrzofos, pyraclofos, ethiprole, fipronil, chlorantraniliprole, cyantraniliprole, tetraniliprole, lufenuron, novaluron, dibenzuron, chlorfuazuron, bifenthrin, cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, beta-cypermethrin, deltamethrin, fenvalerate and transfluthrin.
14. A liquid agrochemical composition comprising from about 1% w/w to 90% w/w acetamiprid, 1% w/w to 40% w/w emamectin-benzoate, from about 20% w/w to 90% w/w low polarity amide solvent comprises n-butylpyrrolidone and from about 0.1% w/w to 10% w/w surfactant with HLB value ranging from 10-18.
15. A liquid agrochemical composition comprising from about 1% w/w to 90% w/w acetamiprid, 1% w/w to 40% w/w indoxacarb, from about 20% w/w to 90% w/w low polarity amide solvent

comprising n-butylpyrrolidone and from about 0.1% w/w to 10% w/w surfactant with HLB value ranging from 10 to about 18.

- 5 16. A process of preparing a liquid agrochemical composition, wherein the process comprises:
combining at least one neonicotinoid insecticide with at least one low polarity amide solvent
and at least one surfactant having HLB value from about 10 to about 18.
- 10 17. A method of controlling pests, said method comprising applying to a plant or to a locus at which
the plant is growing or intended to be grown or to a plant propagation material, or an habitat
area, a liquid agrochemical composition comprising:
(a) at least one neonicotinoid insecticide;
(b) at least one low polarity amide solvent; and
(c) at least one surfactant with HLB value from about 10 to about 18.
- 15 18. Use of a liquid agrochemical composition comprising:
at least one neonicotinoid insecticide;
at least one low polarity amide solvent; and
at least one surfactant with HLB value from about 10 to about 18, for controlling pests.
- 20 19. Use of a liquid agrochemical composition comprising:
at least one neonicotinoid insecticide;
at least one low polarity amide solvent; and
at least one surfactant with HLB value from about 10 to about 18, for controlling pests selected
from planococcus citri and panonychus citri.

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. A01N43/40 A01N43/86 A01N47/40 A01N51/00 A01N43/90 A01N43/38 A01N25/30 A01N25/22 A01P7/00 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, WPI Data, CHEM ABS Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	example 23	1-19

X	CN 108 782 585 A (JIANGSU ROTAM CHEMISTRY CO LTD) 13 November 2018 (2018-11-13)	1-7, 9-13, 16-18
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Y	example 35	1-19

X	CN 105 580 830 A (SHAANXI MEIBANG PESTICIDES CO) 18 May 2016 (2016-05-18)	1-11, 16-18
Y	example 37	1-19

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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "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	
14 June 2022	24/06/2022	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Habermann, Jörg	

INTERNATIONAL SEARCH REPORT

International application No

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