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(54) **Titre : COMPOSITIONS PESTICIDES SYNERGIQUES ET PROCEDES D'ADMINISTRATION DE PRINCIPES ACTIFS**
(54) **Title: SYNERGISTIC PESTICIDAL COMPOSITIONS AND METHODS FOR DELIVERY OF ACTIVE INGREDIENTS**

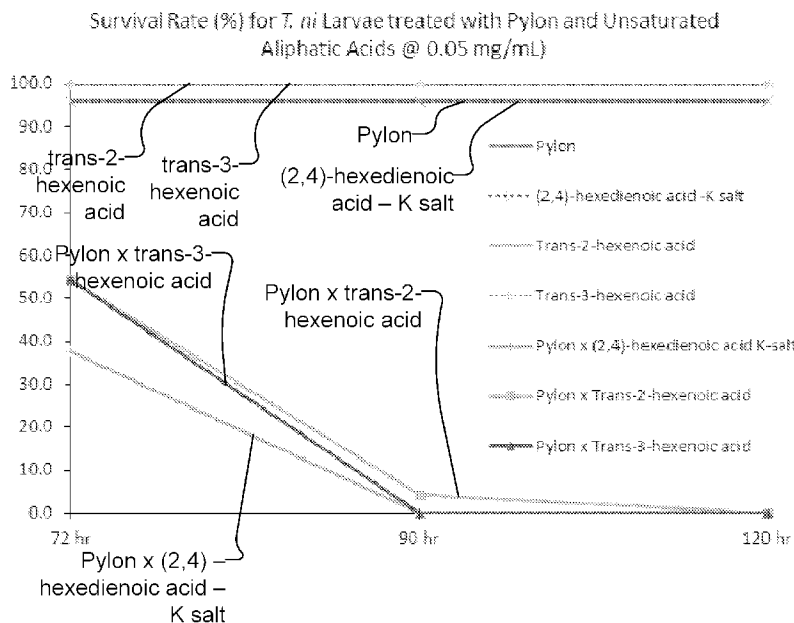


FIG. 3

(57) **Abrégé/Abstract:**

Compositions and methods for increasing the efficacy of pesticidal compositions are described herein, including synergistic pesticidal compositions and methods for delivery of pesticidal active ingredients. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of fungicides. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of nematocides. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of insecticides. Methods for enhancing the activity pesticidal active ingredients in pesticidal compositions in use are also described.

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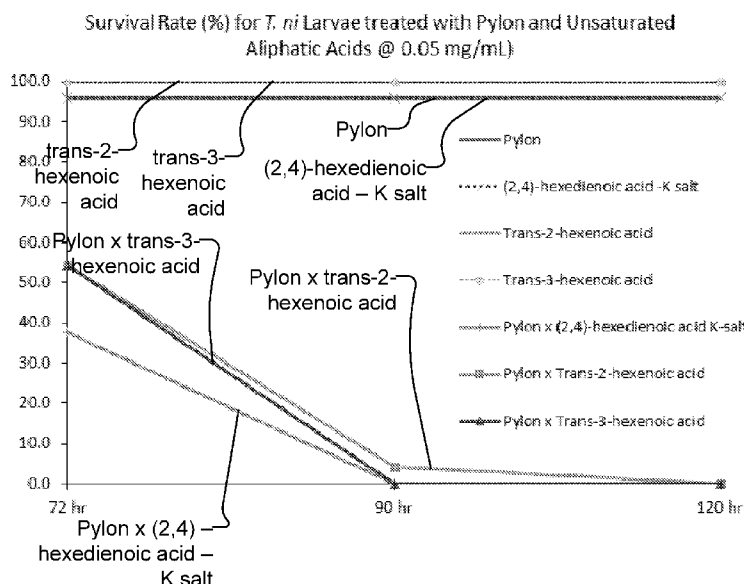


FIG. 3

(57) Abstract: Compositions and methods for increasing the efficacy of pesticidal compositions are described herein, including synergistic pesticidal compositions and methods for delivery of pesticidal active ingredients. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of fungicides. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of nematocides. Some pesticidal compositions and methods as described are directed to compositions and methods for increasing the efficacy of insecticides. Methods for enhancing the activity pesticidal active ingredients in pesticidal compositions in use are also described.

[Continued on next page]



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SYNERGISTIC PESTICIDAL COMPOSITIONS AND METHODS FOR DELIVERY OF ACTIVE INGREDIENTS

REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to, and the benefit of, US provisional patent application Nos. 62/566269 filed 29 September 2017; 62/580964 filed 2 November 2017; and 62/585827 filed 14 November 2017, all entitled SYNERGISTIC PESTICIDAL COMPOSITIONS AND METHODS FOR DELIVERY OF ACTIVE INGREDIENTS, all of which are incorporated by reference herein in their entireties.

TECHNICAL FIELD

[0002] An embodiment of the present invention is related to compositions and methods for increasing the efficacy of pesticidal compositions. More particularly, some embodiments are related to synergistic pesticidal compositions and methods for delivery of pesticidal active ingredients. Some embodiments of the present invention are directed to compositions and methods for increasing the efficacy of fungicides. Some embodiments of the present invention are directed to compositions and methods for increasing the efficacy of nematicides. Some embodiments of the present invention are directed to compositions and methods for increasing the efficacy of insecticides. Further embodiments of the present invention are directed to methods for enhancing the activity of pesticidal active ingredients in pesticidal compositions.

BACKGROUND

[0003] Pesticides, including fungicides, herbicides, nematicides and insecticides, are important compositions for use in domestic, agricultural, industrial and commercial settings, such as to provide for control of unwanted pests and/or pathogens. Providing for effective pest control is of high importance in many such settings, since pests and/or other pathogens if not controlled can cause loss and or destruction of crops or other plants, or harm to animals, humans or other beneficial or desired organisms. There remains a need for environmentally safe and effective pesticides, including fungicides, nematicides and insecticides, or compounds that enhance the efficacy of pesticides, including fungicides, nematicides and insecticides, and for methods of enhancing the efficacy of pesticides including fungicides, nematicides and insecticides, so that pesticides can be used in a more environmentally safe and effective manner.

[0004] In agricultural settings, for example, a variety of plant pests, such as insects, worms, nematodes, fungi, and plant pathogens such as viruses and bacteria, are known to cause significant damage to seeds and ornamental and crop plants. Chemical pesticides have generally been used, but many of these are expensive and potentially toxic to humans, animals, and/or the environment and may persist long after

they are applied. Therefore it is typically beneficial to farmers, consumers and the surrounding environment to use the least amount of chemical pesticides as possible, while continuing to control pest growth in order to maximize crop yield. In a growing number of cases, chemical pesticide use has also resulted in growing resistance to certain chemical pesticides by pest organisms, leading to reduced effectiveness, requiring greater doses of pesticidal chemicals, or even failure of certain types of pesticides as viable control agents. As a result, many chemical pesticides are being phased out or otherwise restricted from use.

[0005] Natural or biologically-derived pesticidal compounds have been proposed for use in place of some chemical pesticides, in order to attempt to reduce the toxicity, health and environmental risks associated with chemical pesticide use. However, some natural or biologically-derived pesticides have proven less efficacious or consistent in their performance in comparison with competing chemical pesticides, which has limited their adoption as control agents in pesticide markets.

[0006] Therefore, there remains a need to provide improved pesticides and pesticidal compositions to allow for effective, economical and environmentally and ecologically safe control of insect, plant, fungal, nematode, mollusk, mite, viral and bacterial pests. In particular, there remains a need to provide for pesticidal compositions that desirably minimize the amount of pesticidal agents or pesticidal active ingredients required to obtain desired or acceptable levels of control of pests in use.

[0007] Accordingly, there remains a need to provide synergistic pesticidal compositions that desirably minimize the use of pesticidal agents or pesticidal active ingredients through synergistic efficacy, to provide for desired pest control performance in use. However, large-scale experimental drug combination studies in non-agricultural fields have found that synergistic combinations of drug pairs are extremely complex and rare, with only a 4-10% probability of finding synergistic drug pairs [Yin et al., PLOS 9:e93960 (2014); Cokol et al., Mol. Systems Biol. 7:544 (2011)]. In fact, a systematic screening of about 120,000 two-component drug combinations based on reference-listed drugs found fewer than 10% synergistic pairs, as well as only 5% synergistic two-component pairs for fluconazole, a triazole fungicidal compound related to certain azole agricultural fungicide compounds [Borisy et al., Proc. Natl Acad. Sci. 100:7977-7982 (2003)].

[0008] The foregoing examples of the related art and limitations related thereto are intended to be illustrative and not exclusive. Other limitations of the related art will become apparent to those of skill in the art upon consideration of the present disclosure.

BRIEF SUMMARY

[0009] In one embodiment according to the present disclosure, a synergistic pesticidal composition is

provided, comprising a pesticidal active ingredient; and a C6-C10 unsaturated aliphatic acid (including an unsaturated C6, C7, C8, C9 or C10 aliphatic acid) or an agriculturally compatible salt thereof, wherein the C6-C10 unsaturated aliphatic acid comprises at least one unsaturated C-C bond and wherein a ratio of the concentrations by weight of said pesticidal active ingredient and said C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about 1:5000 and 5000:1, and more particularly between about 1:2000 and 2000:1. In another embodiment, a synergistic pesticidal composition is provided, comprising a pesticidal active ingredient; and a C11 unsaturated aliphatic acid or an agriculturally compatible salt thereof, comprising at least one unsaturated C-C bond, wherein a ratio of the concentrations by weight of said pesticidal active ingredient and said C11 unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about 1:5000 and 5000:1, and more particularly between about 1:2000 and 2000:1. In yet a further embodiment, a synergistic pesticidal composition is provided, comprising a pesticidal active ingredient; and a C12 unsaturated aliphatic acid or an agriculturally compatible salt thereof, comprising at least one unsaturated C-C bond, wherein a ratio of the concentrations by weight of said pesticidal active ingredient and said C12 unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about 1:5000 and 5000:1, and more particularly between about 1:2000 and 2000:1.

[0010] In a further embodiment, a method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism is provided, comprising: providing at least one pesticidal active ingredient active for said at least one target pest organism; adding a synergistically effective concentration of at least one C6-C10 unsaturated aliphatic acid comprising at least one unsaturated C-C bond, or an agriculturally acceptable salt thereof, to said pesticidal active ingredient to provide a synergistic pesticidal composition; and applying said synergistic pesticidal composition in a pesticidally effective concentration to control said at least one target pest organism. In some embodiments, the synergistic pesticidal composition may comprise a C6-C10 unsaturated aliphatic acid or a biologically compatible salt thereof, wherein said salt comprises at least one of an agriculturally, aquatic life, or mammal-compatible salt, for example. In another embodiment, a method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism is provided, comprising: providing at least one pesticidal active ingredient active for said at least one target pest organism; adding a synergistically effective concentration of at least one C11 unsaturated aliphatic acid, or an agriculturally acceptable salt thereof, to said pesticidal active ingredient to provide a synergistic pesticidal composition; and applying said synergistic pesticidal composition in a pesticidally effective concentration to control said at least one target pest organism. In some embodiments, the synergistic pesticidal composition may comprise a C11 unsaturated aliphatic acid or a biologically compatible salt thereof, wherein said salt comprises at least

one of an agriculturally, aquatic life, or mammal-compatible salt, for example. In a further embodiment, a method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism is provided, comprising: providing at least one pesticidal active ingredient active for said at least one target pest organism; adding a synergistically effective concentration of at least one C12 unsaturated aliphatic acid, or an agriculturally acceptable salt thereof, to said pesticidal active ingredient to provide a synergistic pesticidal composition; and applying said synergistic pesticidal composition in a pesticidally effective concentration to control said at least one target pest organism. In some embodiments, the synergistic pesticidal composition may comprise a C12 unsaturated aliphatic acid or a biologically compatible salt thereof, wherein said salt comprises at least one of an agriculturally, aquatic life, or mammal-compatible salt, for example.

[0011] In another embodiment according to the present disclosure, a pesticidal composition is provided, comprising: one or more pesticidal agents; and one or more unsaturated C6-C10 aliphatic acids or agriculturally compatible salts thereof having at least one unsaturated C-C bond, wherein said one or more unsaturated C6-C10 aliphatic acids produce a synergistic effect on the pesticidal activity of the pesticidal composition in comparison to the pesticidal activity of the pesticidal agent alone and are present in a respective synergistically active concentration ratio by weight between about 1:5000 and 5000:1, and more particularly between about 1:2000 and 2000:1. In some such embodiments, a C11 unsaturated aliphatic acid or agriculturally compatible salts thereof may be provided. In some further such embodiments, a C12 unsaturated aliphatic acid or agriculturally compatible salts thereof may be provided. In a further embodiment, a method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism is provided, comprising: providing at least one pesticidal active ingredient active for said at least one target pest organism; adding a synergistically effective concentration of at least one C6-C10 unsaturated aliphatic acid or an agriculturally acceptable salt thereof to provide a synergistic pesticidal composition; mixing said synergistic pesticidal composition with at least one formulation component comprising a surfactant to form a synergistic pesticidal concentrate; diluting said synergistic pesticidal concentrate with water to form a synergistic pesticidal emulsion; and applying said synergistic pesticidal emulsion at a pesticidally effective concentration and rate to control said at least one target pest organism. In some such embodiments, a C11 unsaturated aliphatic acid or agriculturally compatible salts thereof may be provided. In some further such embodiments, a C12 unsaturated aliphatic acid or agriculturally compatible salts thereof may be provided.

[0012] In some embodiments, the synergistic pesticidal composition may comprise a ratio of the concentrations by weight of said pesticidal active ingredient and said C6-C10 unsaturated aliphatic acid

or an agriculturally compatible salt thereof is between about at least one of: 1:10,000 and 10,000:1, 1:5000 and 5000:1, 1:2500 and 2500:1, 1:1500 and 1500:1, 1:1000 and 1000, 1:750 and 750:1, 1:500 and 500:1, 1:400 and 400:1, 1:300 and 300:1, 1:250 and 250:1, 1:200 and 200:1, 1:150 and 150:1, 1:100 and 100:1, 1:90 and 90:1, 1:80 and 80:1, 1:70 and 70:1, 1:60 and 60:1, 1:50 and 50:1, 1:40 and 40:1, 1:30 and 30:1, 1:25 and 25:1, 1:20 and 20:1, 1:15 and 15:1, 1:10 and 10:1, 1:9 and 9:1, 1:8 and 8:1, 1:7 and 7:1, 1:6 and 6:1, 1:5 and 5:1, 1:4 and 4:1, 1:3 and 3:1, 1:2 and 2:1, 1:1.5 and 1.5:1, and 1.25 and 1.25:1. In a particular such embodiment, the concentration ratios of the pesticidal active ingredient and said C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof in the synergistic pesticidal composition are advantageously chosen so as to produce a synergistic effect against at least one target pest or pathogen. In some embodiments, the concentration ratios of the pesticidal active ingredient(s) and at least one C11 unsaturated aliphatic acid or agriculturally compatible salts thereof in the synergistic pesticidal composition may be advantageously chosen so as to produce a synergistic effect against at least one target pest or pathogen. In some further embodiments, the concentration ratios of the pesticidal active ingredient(s) and at least one C12 unsaturated aliphatic acid or agriculturally compatible salts thereof in the synergistic pesticidal composition may be advantageously chosen so as to produce a synergistic effect against at least one target pest or pathogen.

[0013] In some embodiments, the synergistic pesticidal composition comprises a pesticidal active ingredient and a C6-C10 (including C6, C7, C8, C9 or C10) unsaturated aliphatic acid which comprises at least one of: a trans-unsaturated C-C bond and a cis-unsaturated C-C bond. In a further such embodiment, the C6-C10 unsaturated aliphatic acid comprises at least one of: a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, and trans-9 unsaturated bond. In yet another embodiment, a synergistic pesticidal composition is provided where the C6-C10 unsaturated aliphatic acid comprises at least one of: a cis-2, cis-3, cis-4, cis-5, cis-6, cis-7, cis-8, and cis-9 unsaturated bond. In some such embodiments, the pesticidal composition comprises a C11 unsaturated aliphatic acid or agriculturally compatible salt thereof, comprising at least one of: a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, trans-9, trans-10, a cis-2, cis-3, cis-4, cis-5, cis-6, cis-7, cis-8, cis-9, and cis-10 unsaturated bond. In some further such embodiments, the pesticidal composition comprises a C12 unsaturated aliphatic acid or agriculturally compatible salt thereof, comprising at least one of: a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, trans-9, trans-10, trans-11, a cis-2, cis-3, cis-4, cis-5, cis-6, cis-7, cis-8, cis-9, cis-10, and cis-11 unsaturated bond.

[0014] In some particular such embodiments, the synergistic pesticidal composition may additionally comprise at least one C6-C12 saturated aliphatic acid, such as one or more of hexanoic, heptanoic, octanoic, nonanoic, decanoic, undecanoic and dodecanoic acid, for example. In some further such

embodiments, the synergistic pesticidal composition may additionally comprise at least one second C6-C10 unsaturated aliphatic acid. In some further embodiments, the pesticidal composition may additionally comprise at least one second C11 or C12 unsaturated aliphatic acid.

[0015] In some embodiments, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring aliphatic acid, such as may be present in, or extracted, fractionated or derived from a natural plant or animal material, for example. In one such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise one or more naturally occurring aliphatic acids provided in a plant extract or fraction thereof. In another such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise one or more naturally occurring aliphatic acids provided in an animal extract or product, or fraction thereof. In one such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring aliphatic acid comprised in a plant oil extract, such as one or more of coconut oil, palm oil, palm kernel oil, corn oil, or fractions or extracts therefrom. In another such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring aliphatic acid comprised in an animal extract or product, such as one or more of cow's milk, goat's milk, beef tallow, and/or cow or goat butter, or fractions or extracts thereof for example. In a particular embodiment, at least one C6-C10 unsaturated aliphatic acid may be provided in an extract, fraction, or derivative of one or more plant oil extract, such as one or more of coconut oil, palm oil, palm kernel oil, corn oil, or fractions, derivatives, or extracts therefrom. In some further embodiments, the pesticidal composition may comprise at least one C11 or C12 unsaturated aliphatic acid provided in an extract or fraction of one or more plant or animal materials.

[0016] In some embodiments, the synergistic pesticidal composition exhibits a synergistic inhibition of growth of at least one target pest organism. In some embodiments, the synergistic pesticidal composition comprises a pesticidally effective concentration of the pesticidal active ingredient, and the C6-C10 unsaturated aliphatic acid. In some further embodiments, the synergistic pesticidal composition comprises a pesticidal active ingredient, and a synergistic concentration of the C6-C10 unsaturated aliphatic acid. In some embodiments, the synergistic pesticidal composition has an FIC Index value (fractional inhibitory concentration index value) of less than 1 according to a growth inhibition assay for inhibition of growth of at least one target pest or pathogen organism. In some embodiments, the synergistic pesticidal composition has an FIC Index value of less than 0.75. In a further embodiment, the synergistic pesticidal composition has an FIC Index value of 0.5 or less. In some such embodiments, the one or more unsaturated aliphatic acid may comprise a C11 unsaturated aliphatic acid or agriculturally compatible salt thereof. In some further such embodiments, the one or more unsaturated aliphatic acid may comprise a C12 unsaturated aliphatic acid or agriculturally compatible salt thereof.

[0017] In some embodiments, the pesticidal active ingredient may comprise at least one of a chemical pesticide and a naturally-derived pesticidal oil or extract. In a further aspect, the pesticidal active ingredient may comprise at least one of: a fungicide, nematocide, insecticide, acaricide, herbicide, and bacteriocide.

5 [0018] In any such embodiments, the synergistic pesticidal composition may comprise a C6-C10 unsaturated aliphatic acid having at least one carboxylic acid group, and which may be linear or branched. In some embodiments, the C6-C10 unsaturated aliphatic acid may comprise a linear monocarboxylic acid. In some embodiments, the C6-C10 unsaturated aliphatic acid may comprise one or more of cis and trans isomers. In an embodiment, the C6-C10 unsaturated aliphatic acid may be
10 unsubstituted or substituted. In some embodiments, the C6-C10 unsaturated aliphatic acid may be mono-unsaturated or polyunsaturated, i.e. containing one, two or more unsaturated carbon-carbon (C-C) bonds respectively. In some embodiments, the C6-C10 unsaturated aliphatic acid may comprise at least one of: a trans- unsaturated C-C bond, a cis- unsaturated C-C bond, and a plurality of conjugated unsaturated C-C bonds. In some embodiments, the one or more unsaturated aliphatic acid may comprise a C11
15 unsaturated aliphatic acid that may be linear or branched, substituted or unsubstituted, comprise one or more of cis and trans isomers, be monounsaturated or polyunsaturated, or comprise at least one of a trans-unsaturated C-C bond, a cis- unsaturated C-C bond, and a plurality of conjugated unsaturated C-C bonds. In some further such embodiments, the one or more unsaturated aliphatic acid may comprise a C12 unsaturated aliphatic acid that may be linear or branched, substituted or unsubstituted, comprise one or
20 more of cis and trans isomers, be monounsaturated or polyunsaturated, or comprise at least one of a trans-unsaturated C-C bond, a cis- unsaturated C-C bond, and a plurality of conjugated unsaturated C-C bonds.

[0019] In some further embodiments, the C6-C10 (including C6, C7, C8, C9 or C10) unsaturated aliphatic acid may comprise at least one of: a trans- hexenoic acid, a cis- hexenoic acid, a hexa-dienoic acid, a hexynoic acid, a trans- heptenoic acid, a cis- heptenoic acid, a hepta-dienoic acid, a heptynoic
25 acid, a trans- octenoic acid, a cis- octenoic acid, an octa-dienoic acid, an octynoic acid, a trans- nonenoic acid, a cis- nonenoic acid, a nona-dienoic acid, a nonynoic acid, a trans- decenoic acid, a cis- decenoic acid, a deca-dienoic acid, and a decynoic acid. In another embodiment, the C6-C10 unsaturated aliphatic acid may comprise at least one of: a trans- hexenoic acid, a cis- hexenoic acid, a hexa-dienoic acid other than 2,4-hexadienoic acid, a hexynoic acid, a trans- heptenoic acid, a cis- heptenoic acid, a hepta-dienoic
30 acid, a heptynoic acid, a trans- octenoic acid, a cis- octenoic acid, an octa-dienoic acid, an octynoic acid, a trans- nonenoic acid, a cis- nonenoic acid, a nona-dienoic acid, a nonynoic acid, a trans- decenoic acid, a cis- decenoic acid, a deca-dienoic acid, and a decynoic acid. In some embodiments, the one or more unsaturated aliphatic acid may comprise at least one of a C11 or C12 unsaturated aliphatic acid, such as a

cis -undecenoic, trans- undecanoic, cis- dodecenoic, trans -dodecenoic, undeca-dienoic, dodeca-dienoic, undecynoic, or dodecynoic acid, for example.

[0020] In some embodiments, the synergistic pesticidal composition may comprise one or more agriculturally compatible or acceptable salts of a C6-C10 unsaturated aliphatic acid. In one such embodiment, such agriculturally compatible or acceptable salts may comprise one or more of potassium, sodium, calcium, aluminum, other suitable metal salts, ammonium, and other agriculturally acceptable salts of C6-C10 unsaturated aliphatic acids, for example. In another embodiment, the synergistic pesticidal composition may comprise a C6-C10 unsaturated aliphatic acid or a biologically compatible salt thereof, wherein said salt comprises at least one of an agriculturally, aquatic life, or mammal-compatible salt, for example. In some embodiments, the pesticidal composition may comprise one or more agriculturally compatible or acceptable salts of one or one or more C11 or C12 saturated or unsaturated aliphatic acid.

[0021] However, in some other embodiments, the synergistic pesticidal composition may comprise a pesticidal active ingredient and a C6-C10 unsaturated aliphatic acid, wherein the C6-C10 unsaturated aliphatic acid comprises at least one unsaturated C-C bond and wherein a ratio of the concentrations by weight of said pesticidal active ingredient and said C6-C10 unsaturated aliphatic acid is between about 1:5000 and 5000:1, and more particularly between about 1:2000 and 2000:1. In one such embodiment, the C6-C10 unsaturated aliphatic acid may exclude agriculturally acceptable salts or other salt forms of the C6-C10 unsaturated aliphatic acids. In a particular such embodiment, the synergistic pesticidal composition may exclude such salts for desired applications for which the acid forms of the C6-C10 unsaturated aliphatic acids may be preferred. In one such application, it is known that accumulation of an undesirably high concentration of salts in some soils can be detrimental to the productivity or fertility of the soil, and accordingly, an embodiment specifically excluding salt forms of the C6-C10 unsaturated aliphatic acids may be particularly desirable in such salt sensitive soil applications, for example.

[0022] In another embodiment, the synergistic pesticidal composition may comprise a pesticidal active ingredient and a C6-C10 unsaturated aliphatic acid, and may further comprise at least one C6-C10 saturated aliphatic acid, such as at least one of hexanoic, heptanoic, octanoic, nonanoic and decanoic acid, for example. In an alternative embodiment, the synergistic pesticidal composition may comprise a pesticidal active ingredient and at least one C6-C10 unsaturated aliphatic acid but explicitly excluding 2,4-hexadienoic acid. In some such embodiments, the one or more unsaturated aliphatic acid may comprise a C11 unsaturated aliphatic acid. In some further such embodiments, the one or more unsaturated aliphatic acid may comprise a C12 unsaturated aliphatic acid.

[0023] In some embodiments of the present disclosure, a synergistic pesticidal composition may

comprise at least one C6-C10 unsaturated aliphatic acid and at least one pesticidal active ingredient selected from the list comprising:

A) Respiration inhibitors selected from:

inhibitors of complex III at Q_o site: azoxystrobin (II-1), coumethoxy-strobin,
 5 coumoxystrobin, dimoxystrobin (II-2), enestroburin, fenamin-strobin,
 fenoxystrobin/flufenoxystrobin, fluoxastrobin (II-3), kresoxim-methyl (II-4), metominostrobin,
 orysastrobin (II-5), picoxystrobin (II-6), pyraclostrobin (II-7), pyrame- tostrobin, pyraoxystrobin,
 trifloxystrobin (II-8), 2-[2-(2,5-dimethyl-phenoxy-methyl)-phenyl]-3-methoxy- acrylic acid
 methyl ester and 2-(2-(3-(2,6-dichlorophenyl)-1-methyl-allylideneamino-oxymethyl)-phe- nyl)-2-
 10 methoxyimino-N-methyl-acetamide, pyribencarb, triclopyricarb/chlorodincarb, famoxadone,
 fenamidone;

Inhibitors of complex III at Q_i site: cyazofamid, amisulbrom, [(3S,6S,7R,8R)-8-benzyl-3-
 [(3-acetoxy- 4-methoxy-pyridine-2-carbonyl)-amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-
 methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[[3-(acetoxymethoxy)-4-methoxy-pyridine-2-
 15 carbonyl]amino]-6-methyl- 4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate, [(3S,6S,7R,8R)-8-
 benzyl-3-[(3-isobutoxycarbony-loxy-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-
 dioxo-1,5-dioxonan-7-yl] 2-methylpro- panoate, [(3S,6S,7R,8R)-8-benzyl-3-[[3-(1,3-
 benzodioxol5-ylmethoxy)-4-methoxy-pyridine-2-carbon-yl]amino]-6-methyl-4,9-dioxo1,5-
 dioxonan-7-yl] 2-methylpropanoate; (3S,6S,7R,8R)-3-[[3-(hydroxy-4- methoxy-2-
 20 pyridinyl)carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenyl-methyl)-1,5-dioxonan-7-yl 2-
 methylpropanoate;

Inhibitors of complex II: benodanil, benzovindiflupyr (II-9), bixafen (II-10), boscalid (II-11),
 carboxin, fenfuram, fluopyram (II-12), flutolanil, fluxapyroxad (II-13), furametpyr, isofetamid,
 isopyrazam (II-14), mepronil, oxycarboxin, penflufen (II-15), penthiopyrad (II-16), sedaxane (II-
 25 17), tecloftalam, thifluzamide, N-(4'-trifluoromethylthiobiphenyl-2-yl)-3-difluoromethyl-1-
 methyl-1H-pyrazole-4-carboxamide, N-(2-(1,3,3-trimethyl-butyl)-phenyl)-1,3-dimethyl-5-fluoro-
 1H-pyrazole-4-carboxamide, 3-(difluorome- thyl)-1-methyl-N-(1,1,3-trimethylindan-4-
 yl)pyrazole-4-carboxamide, 3-(trifluoromethyl)-1-methyl- N-(1,1,3-trimethylindan-4-yl)pyrazole-
 4-carboxamide, 1,3-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 3-
 30 (trifluoromethyl)-1,5-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 1,3,5-
 trimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, N-(7-fluoro-1,1,3-trime- thyl-
 indan-4-yl)-1,3-dimethyl-pyrazole-4-carboxamide, N-[2-(2,4-dichlorophenyl)-2-methoxy-1-
 methyl- ethyl]-3-(difluoromethyl)-1-methyl-pyrazole-4-carboxamide;

Other respiration inhibitors: diflumetorim, (5,8-difluoroquinazolin-4-yl)-{ 2-[2-fluoro-4-(4-

trifluoromethylpyridin-2-yloxy)-phenyl]-ethyl}-amine; binapacryl, dinobuton, dinocap, fluazinam (II-18); ferimzone; fentin salts such as fentin-acetate, fentin chloride or fentin hydroxide; ametoctradin (II-19); and silthiofam;

B) Sterol biosynthesis inhibitors (SBI fungicides) selected from:

5 C14 demethylase inhibitors (DMI fungicides): azaconazole, bitertanol, bromuconazole, cyproconazole (II-20), difenoconazole (II-21), diniconazole, diniconazole-M, epoxiconazole (II-22), fenbuconazole, fluquinconazole (II-23), flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, metconazole (II-24), myclobutanil, oxpoconazole, paclobutrazole, penconazole, propiconazole (II-25), prothioconazole (II-26), simeconazole, tebuconazole (II-27),
10 tetraconazole, triadimefon, triadimenol, triticonazole, uniconazole; imazalil, pefurazoate, prochloraz, triflumizol; fenarimol, nuarimol, pyrifenox, triforine, [3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)isoxazol-4-yl]-(3-pyridyl)methanol;

Delta14-reductase inhibitors: aldimorph, dodemorph, dodemorphacetate, fenpropimorph, tridemorph, fenpropidin, piperalin, spiroxamine;

15 Inhibitors of 3-keto reductase: fenhexamid;

C) Nucleic acid synthesis inhibitors selected from:

phenylamides or acyl amino acid fungicides: benalaxyl, benalaxyl-M, kiralaxyl, metalaxyl, metalaxyl-M (mefenoxam) (II-38), ofurace, oxadixyl;

20 others nucleic acid inhibitors: hymexazole, oethilinone, oxolinic acid, bupirimate, 5-fluorocytosine, 5-fluoro-2-(p-tolylmethoxy)pyrimidin-4-amine, 5-fluoro-2-(4-fluorophenylmethoxy)pyrimidin-4-amine;

D) Inhibitors of cell division and cytoskeleton selected from:

tubulin inhibitors: benomyl, carbendazim, fuberidazole, thiabendazole, thiophanate-methyl (II-39); 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)-[1,2,4]triazolo[1,5-a]pyrimidine
25

other cell division inhibitors: diethofencarb, ethaboxam, pencycuron, fluopicolide, zoxamide, metrafenone (II-40), pyriofenone;

E) Inhibitors of amino acid and protein synthesis selected from:

methionine synthesis inhibitors (anilino-pyrimidines): cyprodinil, mepanipyrim, Pyrimethanil (II-41);
30

protein synthesis inhibitors: blasticidin-S, kasugamycin, kasugamycin hydrochloride-hydrate, mildiomycin, streptomycin, oxytetracyclin, polyoxine, validamycin A;

F) Signal transduction inhibitors selected from:

MAP / histidine kinase inhibitors: fluoroimid, iprodione, procymidone, vinclozolin,

fenpiclonil, fludioxonil;

G protein inhibitors: quinoxifen;

G) Lipid and membrane synthesis inhibitors selected from:

Phospholipid biosynthesis inhibitors: edifenphos, iprobenfos, pyrazophos, isoprothiolane;

5 propamocarb, propamocarb-hydrochloride;

lipid peroxidation inhibitors: dicloran, quintozone, tecnazene, tolclofos-methyl, biphenyl, chloroneb, etridiazole;

phospholipid biosynthesis and cell wall deposition: dimethomorph (II-42), flumorph, mandipropamid (II-43), pyrimorph, benthiavalicarb, iprovalicarb, valifenalate, N-(1-(1-(4-cyano-phenyl)ethanesulfonyl)-but-2-yl) carbamic acid-(4-fluorophenyl) ester;

10

acid amide hydrolase inhibitors: oxathiapiprolin;

H) Inhibitors with Multi Site Action selected from:

inorganic active substances: Bordeaux mixture, copper acetate, copper hydroxide, copper oxychloride (II-44), basic copper sulfate, sulfur;

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thio- and dithiocarbamates: ferbam, mancozeb (II-45), maneb, metam, metiram (II-46), propineb, thiram, zineb, ziram;

organochlorine compounds: anilazine, Chlorothalonil (II-47), captafol, captan, folpet, dichlofluanid, dichlorophen, hexachlorobenzene, pentachlorophenol and its salts, phthalide, tolylfluanid, N-(4-chloro-2-nitro-phenyl)-N-ethyl-4-methyl-benzenesulfonamide;

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guanidines and others: guanidine, dodine, dodine free base, guazatine, guazatine-acetate, iminoc-tadine, iminoctadine-triacetate, iminoctadine-tris(albesilate), dithianon, 2,6-dimethyl-1H,5H-[1,4]dithii- no[2,3-c:5,6-c']dipyrrole-1,3,5,7(2H,6H)-tetraone (II-48);

I) Cell wall synthesis inhibitors selected from:

inhibitors of glucan synthesis: validamycin, polyoxin B;

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melanin synthesis inhibitors: pyroquilon, tricyclazole, carpropamid, dicyclomet, fenoxanil;

J) Plant defence inducers selected from:

acibenzolar-S-methyl, probenazole, isotianil, tiadinil, prohexadione-calcium; fosetyl, fosetyl-aluminum, phosphorous acid and its salts (II-49);

K) Unknown mode of action selected from: bronopol, chinomethionat, cyflufenamid, cymoxanil,

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dazomet, debacarb, diclomezine, difenzoquat, difenzoquat-methylsulfate, diphenylamin, fenpyrazamine, flumetover, flusulfamide, flutianil, methasulfocarb, nitrapyrin, nitrothal-isopropyl, oxathiapiprolin, tolprocarb, 2-[3,5- bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}- 1,3-thiazol-2-yl)piperidin-1-yl]ethanone, 2-[3,5-bis-(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-fluoro-6-(prop-2-yn-1-

yl-oxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl)piperidin-1-yl]-ethanone, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-chloro-6-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, oxin-copper, proquinazid, tebufloquin, tecloftalam, triazoxide, 2-butoxy-6-iodo-3-propylchromen-4-one, N-(cyclopropylmethoxyimino-(6-difluoro-methoxy-2,3-difluoro-phenyl)-methyl)-2-phenyl acetamide, N'-(4-(4-chloro-3-trifluoromethyl-phenoxy)-2,5-dimethylphenyl)-N-ethyl-N-methyl formamidine, N'-(4-(4-fluoro-3-trifluoromethyl-phenoxy)-2,5-dimethyl-phenyl)-N-ethyl-N-methyl formamidine, N'-(2-methyl-5-trifluoromethyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, N'-(5-difluoromethyl-2-methyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, methoxyacetic acid 6-tert-butyl-8-fluoro-2,3-dimethyl-quinolin-4-yl ester, 3-[5-(4-methylphenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine, 3-[5-(4-chloro-phenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine (pyrisoxazole), N-(6-methoxy-pyridin-3-yl) cyclopropanecarboxylic acid amide, 5-chloro-1-(4,6-dimethoxy-pyrimidin-2-yl)-2-methyl-1H-benzimidazole, 2-(4-chloro-phenyl)-N-[4-(3,4-dimethoxy-phenyl)-isoxazol-5-yl]-2-prop-2-ynyloxy-acetamide, ethyl (Z)-3-amino-2-cyano-3-phenyl-prop-2-enoate, tertbutyl N-[6-[[[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]-amino]oxymethyl]-2-pyridyl]carbamate, pentyl N-[6-[[[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]amino]oxymethyl]-2-pyridyl]carbamate, 2-[2-[(7,8-difluoro-2-methyl-3-quinolyl)oxy]-6-fluoro-phenyl]propan-2-ol, 2-[2-fluoro-6-[(8-fluoro-2-methyl-3-quinolyl)oxy]phenyl]propan-2-ol, 3-(5-fluoro-3,3,4,4-tetramethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4-difluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4,5-trifluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline;

L) Antifungal biopesticides selected from: *Ampelomyces quisqualis*, *Aspergillus flavus*, *Aureobasidium pullulans*, *Bacillus pumilus* (II-50), *Bacillus subtilis* (II-51), *Bacillus subtilis* var. *amyloliquefaciens* (II-52), *Candida oleophila* I-82, *Candida saitoana*, *Clonostachys rosea* f. *catenulata*, also named *Gliocladium catenulatum*, *Coniothyrium minitans*, *Cryphonectria parasitica*, *Cryptococcus albidus*, *Metschnikowia fructicola*, *Microdochium dimerum*, *Phlebiopsis gigantea*, *Pseudozyma flocculosa*, *Pythium oligandrum* DV74, *Reynoutria sachlinensis*, *Talaromyces flavus* V117b, *Trichoderma asperellum* SKT-1, *T. atroviride* LC52, *T. harzianum* T-22, *T. harzianum* TH 35, *T. harzianum* T-39; *T. harzianum* and *T. viride*, *T. harzianum* ICC012 and *T. viride* ICC080; *T. polysporum* and *T. harzianum*; *T. stromaticum*, *T. virens* GL-21, *T. viride*, *T. viride* TV1, *Ulocladium oudemansii* HRU3;

M) Growth regulators selected from: abscisic acid, amidochlor, ancymidol, 6-benzylaminopurine, brassinolide, butralin, chlormequat (chlormequat chloride), choline chloride, cyclanilide, daminozide, dikegulac, dimethipin, 2,6-dimethylpuridine, ethephon, flumetralin, flurprimidol,

fluthiacet, forchlorfenuron, gibberellic acid, inabenfide, indole-3-acetic acid, maleic hydrazide, mefluidide, mepiquat (mepiquat chloride) (II-54), naphthaleneacetic acid, N-6-benzyladenine, paclobutrazol, prohexadione (prohexadione-calcium, II-55), prohydrojasmon, thidiazuron, triapenthenol, tributyl phosphorotrithioate, 2,3,5-tri-iodobenzoic acid, trinex-apac-ethyl and uniconazole;

N) Herbicides selected from:

acetamides: acetochlor, alachlor, butachlor, dimethachlor, dimethenamid, flufenacet, mefenacet, me- tolachlor, metazachlor, napropamide, naproanilide, pethoxamid, pretilachlor, propachlor, thenylchlor;

amino acid derivatives: bilanafos, glyphosate, glufosinate, sulfosate;
aryloxyphenoxypropionates: clodinafop, cyhalofop-butyl, fenoxaprop, fluazifop, haloxyfop, metamifop, propaquizafop, quizalofop, quizalofop-P-tefuryl;

Bipyridyls: diquat, paraquat;

(thio)carbamates: asulam, butylate, carbetamide, desmedipham, dimepiperate, eptam (EPTC), esprocarb, molinate, orbencarb, phenmedipham, prosulfocarb, pyributicarb, thiobencarb, triallate;

cyclohexanediones: butoxydim, clethodim, cycloxydim, profoxydim, sethoxydim, tepraloxydim, tralkoxydim;

dinitroanilines: benfluralin, ethalfluralin, oryzalin, pendimethalin, prodiamine, trifluralin;

diphenyl ethers: acifluorfen, aclonifen, bifenox, diclofop, ethoxyfen, fomesafen, lactofen, oxyfluorfen; - hydroxybenzonitriles: bomoxynil, dichlobenil, ioxynil;

imidazolinones: imazamethabenz, imazamox, imazapic, imazapyr, imazaquin, imazethapyr;

phenoxy acetic acids: clomeprop, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4-DB, dichlorprop, MCPA, MCPA-thioethyl, MCPB, Mecoprop;

pyrazines: chloridazon, flufenpyr-ethyl, fluthiacet, norflurazon, pyridate;

pyridines: aminopyralid, clopyralid, diflufenican, dithiopyr, fluridone, fluroxypyr, picloram, picolinafen, thiazopyr;

sulfonyl ureas: amidosulfuron, azimsulfuron, bensulfuron, chlorimuronethyl, chlorsulfuron, cinosul- furon, cyclosulfamuron, ethoxysulfuron, flazasulfuron, flucetosulfuron, flupyrasulfuron, foramsulfuron, halosulfuron, imazosulfuron, iodosulfuron, mesosulfuron, metazosulfuron, metsulfuron-methyl, nico- sulfuron, oxasulfuron, primisulfuron, prosulfuron, pyrazosulfuron, rimsulfuron, sulfometuron, sulfosul- furon, thifensulfuron, triasulfuron, tribenuron, trifloxysulfuron, triflusulfuron, tritosulfuron, 1-((2-chloro- 6-propyl-imidazo[1,2-b]pyridazin-3-

yl)sulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea;

triazines: ametryn, atrazine, cyanazine, dimethametryn, ethiozin, hexazinone, metamitron, metribuzin, prometryn, simazine, terbuthylazine, terbutryn, triaziflam;

ureas: chlorotoluron, daimuron, diuron, fluometuron, isoproturon, linuron,
5 methabenzthiazuron, tebuthiuron;

other acetolactate synthase inhibitors: bispyribac-sodium, cloransulam-methyl, diclosulam, florasulam, flucarbazone, flumetsulam, metosulam, ortho-sulfamuron, penoxsulam, propoxycarbazone, pyribam- benz-propyl, pyribenzoxim, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyriothiobac, pyroxasulfone, py- roxsulam;

10 other herbicides: amicarbazone, aminotriazole, anilofos, beflubutamid, benazolin, bencarbazone, benfluresate, benzofenap, bentazone, benzobicyclon, bicyclopyrone, bromacil, bromobutide, butafenacil, butamifos, cafenstrole, carfentrazone, cinidon-ethyl, chlorthal, cinmethylin, clomazone, cumyluron, cyprosulfamida, dicamba, difenzoquat, diflufenzopyr, Drechslera monoceras, endothal, ethofumesate, etobenzanid, fenoxasulfone, fentrazamide,
15 flumiclorac-pentyl, flumioxazin, flupoxam, flurochloridone, flurtamone, indanofan, isoxaben, isoxaflutole, lenacil, propanil, propyzamide, quinclorac, quinmerac, mesotrione, methyl arsonic acid, naptalam, oxadiargyl, oxadiazon, oxaziclomefone, pentoxazone, pinoxaden, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazoxyfen, pyrazolynate, quinoclaminate, saflufenacil, sulcotrione, sulfentrazone, terbacil, tefuryltrione, tembotrione, thiencarbazone, topramezone, (3-
20 [2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-trifluoromethyl-3,6-dihydro-2H-pyrimidin-1-yl)-phenoxy]-pyridin-2-yl)-acetic acid ethyl ester, 6-amino-5-chloro-2-cyclopropyl-pyrimidine-4-carboxylic acid methyl ester, 6-chloro-3-(2-cyclopropyl-6-methyl-phenoxy)-pyridazin-4-ol, 4-amino-3-chloro-6-(4-chloro-phenyl)-5-fluoro-pyridine-2-carboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-pyridine-2-carboxylic acid methyl ester, and 4-amino-3-chloro-6-(4-chloro-3-dimethylamino-2-fluoro-phenyl)-pyridine-2-carboxylic acid methyl ester;
25 O) Insecticides selected from:

organo(thio)phosphates: acephate, azamethiphos, azinphos-methyl, chlorpyrifos, chlorpyrifos-methyl, chlorfenvinphos, diazinon, dichlorvos, dicrotophos, dimethoate, disulfoton, ethion, fenitrothion, fenthion, isoxathion, malathion, methamidophos, methidathion, methyl-
30 parathion, mevinphos, monocrotophos, oxydemeton-methyl, paraoxon, parathion, phenthoate, phosalone, phosmet, phos- phamidon, phorate, phoxim, pirimiphos-methyl, profenofos, prothiofos, sulprophos, tetrachlorvinphos, terbufos, triazophos, trichlorfon;

carbamates: alanycarb, aldicarb, bendiocarb, benfuracarb, carbaryl, carbofuran, carbosulfan, fenox- ycarb, furathiocarb, methiocarb, methomyl, oxamyl, pirimicarb, propoxur, thiodicarb,

triazamate;

pyrethroids: allethrin, bifenthrin, cyfluthrin, cyhalothrin, cyphenothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, zetacypermethrin, deltamethrin, esfenvalerate, etofenprox, fenpropathrin, fen-valerate, imiprothrin, lambda-cyhalothrin, permethrin, prallethrin, pyrethrin I and II, resmethrin, silafluofen, tau-fluvalinate, tefluthrin, tetramethrin, tralomethrin, transluthrin, profluthrin, dimefluthrin;

insect growth regulators: a) chitin synthesis inhibitors: benzoylureas: chlorfluazuron, cyramazin, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, teflubenzuron, triflumuron; buprofezin, diofenolan, hexythiazox, etoxazole, clofentazine; b) ecdysone antagonists: halofenozide, methoxyfenozide, tebufenozide, azadirachtin; c) juvenoids: pyriproxyfen, methoprene, fenoxycarb; d) lipid biosynthesis inhibitors: spirotetramat, spiromesifen, spirotetramat;

nicotinic receptor agonists/antagonists compounds: clothianidin, dinotefuran, flupyradifurone, imidacloprid, thiamethoxam, nitenpyram, acetamiprid, thiacloprid, 1-2-chloro-thiazol-5-ylmethyl-2-nitrimino-3,5-dimethyl-[1,3,5]triazinane;

GABA antagonist compounds: endosulfan, ethiprole, fipronil, vaniliprole, pyrafluprole, pyriprole, 5-amino-1-(2,6-dichloro-4-methyl-phenyl)-4-sulfinamoyl-1H-pyrazole-3-carbothioic acid amide;

mitochondrial electron transport inhibitor (METI) I acaricides: fenazaquin, pyridaben, tebufenpyrad, tolfenpyrad, flufenerim;

METI II and III compounds: acequinocyl, fluacyprim, hydramethylnon;

Uncouplers: chlorfenapyr;

oxidative phosphorylation inhibitors: cyhexatin, diafenthiuron, fenbutatin oxide, propargite;

moulting disruptor compounds: cryomazine;

mixed function oxidase inhibitors: piperonyl butoxide;

sodium channel blockers: indoxacarb, metaflumizone;

ryanodine receptor inhibitors: chlorantraniliprole, cyantraniliprole, fluben-diamide, N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanyli-

dene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(difluoromethyl)pyrazole-3-carboxamide; N-[4,6-di-bromo-2-[(di-2-propyl-lambda-4-sulfanyl-idene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-cyano-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dibromo-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide;

others: benclothiaz, bifenazate, cartap, flonicamid, pyridalyl, pymetrozine, sulfur, thiocyclam, cyenopyrafen, flupyrzofos, cyflumetofen, amidoflumet, imicyafos, bistrifluron, pyrifluquinazon, 1,1'-[(3S,4R,4aR,6S,6aS,12R,12aS,12bS)-4-[[[(2-cyclopropylacetyl)oxy]-methyl]-1,3,4,4a,5,6,6a,12,12a,12b-decahydro-12-hydroxy-4,6a,12b-trimethyl-11-oxo-9-(3-pyridinyl)-2H,11H-naphtho[2,1-b]pyrano[3,4-e]pyran-3,6-diyl] cyclopropaneacetic acid ester; fluensulfone, fluoroalkenyl thioethers; and

P) ribonucleic acid (RNA) and associated compounds including double-stranded RNA (dsRNA), microRNA (miRNA) and small interfering RNA (siRNA); bacteriophages.

In some such embodiments, the synergistic pesticidal composition may comprise one or more pesticidal active ingredient, such as selected from the list above, and one or more C11 unsaturated aliphatic acid or agriculturally acceptable salt thereof. In some further such embodiments, the synergistic pesticidal composition may comprise one or more pesticidal active ingredient, such as selected from the list above, and one or more C12 unsaturated aliphatic acid or agriculturally acceptable salt thereof.

[0024] In some embodiments, synergistic pesticidal compositions may be provided, where the pesticidal active ingredient comprises at least one pesticidal natural oil selected from: neem oil, karanja oil, clove oil, clove leaf oil, peppermint oil, spearmint oil, mint oil, cinnamon oil, thyme oil, oregano oil, rosemary oil, geranium oil, lime oil, lavender oil, anise oil, lemongrass oil, tea tree oil, apricot kernel oil, bergamot oil, carrot seed oil, cedar leaf oil, citronella oil, clove bud oil, coriander oil, coconut oil, eucalyptus oil, evening primrose oil, fennel oil, ginger oil, grapefruit oil, nootkatone(+), grapeseed oil, lavender oil, marjoram oil, pine oil, scotch pine oil, and/or garlic oil and/or components, derivatives and/or extracts of one or more pesticidal natural oil, or a combination thereof. In some further embodiments, synergistic pesticidal compositions may be provided which comprise additional active components other than the principal one or more pesticidal active ingredients, wherein such additional active components may comprise one or more additional efficacies and/or synergistic effects on the pesticidal efficacy of the composition, such as but not limited to adjuvants, synergists, agonists, activators, or combinations thereof, for example. In one such embodiment, such additional active components may optionally comprise naturally occurring compounds or extracts or derivatives thereof. In other embodiments, the pesticidal active ingredient may comprise at least one organic, certified organic, US Department of

Agriculture (“USDA”) National Organic Program compliant (“NOP-compliant”) such as may be included in the US Environmental Protection Agency FIFRA 25b, list of ingredients published dated December 2015 by the US EPA entitled “Active Ingredients Eligible for Minimum Risk Pesticide Products”, the US EPA FIFRA 4a list published August 2004 entitled “List 4A - Minimal Risk Inert Ingredients” or the US EPA FIFRA 4b list published August 2004 entitled “List 4B - Other ingredients for which EPA has sufficient information”, for example, Organic Materials Review Institute listed (“OMRI-listed”) or natural pesticidal active ingredient, for example.

[0025] In some embodiments, the pesticidal active ingredient may comprise at least one of: neem oil, karanja oil and extracts or derivatives thereof. In further exemplary such embodiments, the pesticidal active ingredient may comprise at least one extract or active component of neem oil or karanja oil, such as but not limited to: azadirachtin, azadiradione, azadirone, nimbin, nimbidin, salannin, deacetylsalannin, salannol, maliantriol, gedunin, karanjin, pongamol, or derivatives thereof, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Exemplary embodiments are illustrated in referenced figures of the drawings. It is intended that the embodiments and figures disclosed herein are to be considered illustrative rather than restrictive.

[0027] FIG. 1 illustrates general carbonyl alkene structures (1), (2), (3), (4), (5), and (6) associated with an exemplary C6-C10 unsaturated aliphatic acid, or agriculturally acceptable salt thereof, according to an embodiment of the present disclosure.

[0028] FIG. 2 illustrates an exemplary 96 well microtiter plate showing a color transition of a resazurin dye between colors indicating absence and presence of growth of a representative pest or pathogen, in accordance with a synergistic growth inhibition assay according to an embodiment of the present disclosure.

[0029] FIGS. 3-5 illustrate the observed survival rate (percent of original insects still surviving) for *Trichoplusia ni* (cabbage looper caterpillar) over time for in-vitro testing on a modified McMorran artificial diet to which treatments of Pylon® insecticide (containing chlorfenapyr as the pesticidal active ingredient) and exemplary unsaturated aliphatic acids (and salts) alone are shown in comparison with the corresponding survival rates for treatments with a synergistic pesticidal composition combining Pylon® insecticide with each of the exemplary unsaturated aliphatic acids (and salts) at three concentrations (shown in FIG. 3, 4, and 5 respectively), according to an embodiment of the present invention.

DETAILED DESCRIPTION OF SEVERAL EMBODIMENTS

[0030] Throughout the following description specific details are set forth in order to provide a more thorough understanding to persons skilled in the art. However, well known elements may not have been shown or described in detail to avoid unnecessarily obscuring the disclosure. Accordingly, the description and drawings are to be regarded in an illustrative, rather than a restrictive, sense.

DEFINITIONS

[0031] 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 invention belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the invention, suitable methods and materials are described herein.

[0032] All applications, publications, patents and other references, citations cited herein are incorporated by reference in their entirety. In case of conflict, the specification, including definitions, will control.

[0033] As used herein, the singular forms "a", "and," and "the" include plural referents unless the context clearly indicates otherwise.

[0034] 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.

[0035] As used herein, "plant" embraces individual plants or plant varieties of any type of plants, in particular agricultural, silvicultural and ornamental plants.

[0036] As used herein, the terms "pest" or "pests" or grammatical equivalents thereof, are understood to refer to organisms, e.g., including pathogens, that negatively affect a host or other organism—such as a plant or an animal—by colonizing, damaging, attacking, competing with them for nutrients, infesting or infecting them, as well as undesired organisms that infest human structures, dwellings, living spaces or foodstuffs. Pests include but are not limited to fungi, weeds, nematodes, acari, and arthropods, including insects, arachnids and cockroaches. It is understood that the terms "pest" or "pests" or grammatical equivalents thereof can refer to organisms that have negative effects by infesting plants and seeds, and commodities such as stored grain.

[0037] As used herein, the terms "pesticide" or "pesticidal" or grammatical equivalents thereof, are

understood to refer to any composition or substance that can be used in the control of any agricultural, natural environmental, and domestic/household pests. The terms "control" or "controlling" are meant to include, but are not limited to, any killing, inhibiting, growth regulating, or pestistatic (inhibiting or otherwise interfering with the normal life cycle of the pest) activities of a composition against a given pest. These terms include for example sterilizing activities which prevent the production or normal development of seeds, ova, sperm or spores, cause death of seeds, sperm, ova or spores, or otherwise cause severe injury to the genetic material. Further activities intended to be encompassed within the scope of the terms "control" or "controlling" include preventing larvae from developing into mature progeny, modulating the emergence of pests from eggs including preventing eclosion, degrading the egg material, suffocation, interfering with mycelial growth, reducing gut motility, inhibiting the formation of chitin, disrupting mating or sexual communication, preventing feeding (antifeedant) activity, and interfering with location of hosts, mates or nutrient-sources. The term "pesticide" includes fungicides, herbicides, nematocides, insecticides and the like. The term "pesticide" encompasses, but is not limited to, naturally occurring compounds as well as so-called "synthetic chemical pesticides" having structures or formulations that are not naturally occurring, where pesticides may be obtained by various means including, but not limited to, extraction from biological sources, chemical synthesis of the compound, and chemical modification of naturally occurring compounds obtained from biological sources.

[0038] As used herein, the terms "insecticidal" and "acaridical" or "aphicidal" or grammatical equivalents thereof, are understood to refer to substances having pesticidal activity against organisms encompassed by the taxonomical classification of root term and also to refer to substances having pesticidal activity against organisms encompassed by colloquial uses of the root term, where those colloquial uses may not strictly follow taxonomical classifications. The term "insecticidal" is understood to refer to substances having pesticidal activity against organisms generally known as insects of the phylum Arthropoda, class Insecta. Further as provided herein, the term is also understood to refer to substances having pesticidal activity against other organisms that are colloquially referred to as "insects" or "bugs" encompassed by the phylum Arthropoda, although the organisms may be classified in a taxonomic class different from the class Insecta. According to this understanding, the term "insecticidal" can be used to refer to substances having activity against arachnids (class Arachnida), in particular mites (subclass Acari/Acarina), in view of the colloquial use of the term "insect." The term "acaridical" is understood to refer to substances having pesticidal activity against mites (Acari/Acarina) of the phylum Arthropoda, class Arachnida, subclass Acari/Acarina. The term "aphicidal" is understood to refer to substances having pesticidal activity against aphids (Aphididae) of the phylum Arthropoda, class Insecta, family Aphididae. It is understood that all these terms are encompassed by the term "pesticidal" or "pesticide" or grammatical equivalents. It is understood that these terms are not necessarily mutually

exclusive, such that substances known as "insecticides" can have pesticidal activity against organisms of any family of the class Insecta, including aphids, and organisms that are encompassed by other colloquial uses of the term "insect" or "bug" including arachnids and mites. It is understood that "insecticides" can also be known as acaricides if they have pesticidal activity against mites, or aphicides if they have

5 pesticidal activity against aphids.

[0039] As used herein, the terms "control" or "controlling" or grammatical equivalents thereof, are understood to encompass any pesticidal (killing) activities or pestistatic (inhibiting, repelling, deterring, and generally interfering with pest functions to prevent the damage to the host plant) activities of a pesticidal composition against a given pest. Thus, the terms "control" or "controlling" or grammatical

10 equivalents thereof, not only include killing, but also include such activities as repelling, deterring, inhibiting or killing egg development or hatching, inhibiting maturation or development, and chemisterilization of larvae or adults. Repellant or deterrent activities may be the result of compounds that are poisonous, mildly toxic, or non-poisonous to pests, or may act as pheromones in the environment.

[0040] As used herein, the term "pesticidally effective amount" generally means the amount of the

15 inventive mixtures or of compositions comprising the mixtures needed to achieve an observable effect on growth, including the effects of necrosis, death, retardation, prevention, and removal, destruction, or otherwise diminishing the occurrence and activity of the target pest organism. The pesticidally effective amount can vary for the various mixtures / compositions used in the invention. A pesticidally effective amount of the mixtures / compositions will also vary according to the prevailing conditions such as

20 desired pesticidal effect and duration, weather, target species, locus, mode of application, and the like.

[0041] As used herein, agriculturally compatible or acceptable salts, aquatic life, or mammal-compatible salt can be one or more of potassium, sodium, calcium, aluminum, other suitable metal salts, ammonium, and other agriculturally acceptable salts of C6-C10 unsaturated aliphatic acids, for example.

[0042] As used herein, where a range of values is provided, it is understood that each intervening value,

25 to the tenth of the unit of the lower limit unless the context clearly dictates otherwise, between the upper and lower limit of that range and any other stated or intervening value within that stated range is encompassed within embodiments of the invention. The upper and lower limits of these smaller ranges may independently define a smaller range of values, and it is to be understood that these smaller ranges are intended to be encompassed within embodiments of the invention, subject to any specifically

30 excluded limit in the stated range.

[0043] In one embodiment according to the present disclosure, a synergistic pesticidal composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof), and at least one pesticidal active ingredient. As used herein, all references to a C6-C10 unsaturated aliphatic acid include

all unsaturated aliphatic acids having between 6 and 10 carbon atoms, e.g. C6, C7, C8, C9 or C10, and any combination or subcombination thereof, e.g. C6 and C8, C7 and C10, C6, C9 and C10, and so on. In some embodiments, the effective dose of the pesticidal active ingredient when used in combination with the C6-C10 unsaturated aliphatic acid is lower than the effective dose of the pesticidal active ingredient when used alone (i.e. a smaller amount of pesticidal active can still control pests when used in a synergistic composition together with the C6-C10 unsaturated aliphatic acid). In some embodiments, a pesticidal active ingredient that is not effective against a particular species of pest can be made effective against that particular species when used in a synergistic composition together with a C6-C10 unsaturated aliphatic acid. In some such embodiments, the pesticidal composition may comprise a C11 unsaturated aliphatic acid or agriculturally compatible salt thereof. In some further such embodiments, the pesticidal composition may comprise a C12 unsaturated aliphatic acid or agriculturally compatible salt thereof.

[0044] Without being bound by any particular theory, it is believed that the one or more C6-C10 unsaturated aliphatic acids according to some embodiments of the present disclosure act as cell permeabilizing agents, and when combined with a suitable pesticidal active ingredient, may desirably facilitate the entry of the pesticidal active ingredient into the cells of a target pest or pathogen, thereby desirably providing for a synergistic activity of such a synergistic pesticidal composition. All eukaryotic cell membranes, including for example fungal cell membranes and the cell membranes of insects and nematodes are biochemically similar in that they all comprise a lipid bilayer which is comprised of phospholipids, glycolipids and sterols, as well as a large number of proteins (Cooper & Hausmann 2013). The amphipathic structure of the lipid bilayer and the polarity of membrane proteins restricts passage of extracellular compounds across the membrane and allows compartmentalization of internal organelles from the intracellular environment. Without being bound by theory, it is believed that the C6-C10 unsaturated aliphatic acids according to some embodiments disclosed herein will act as cell permeabilizing agents, and when combined with a suitable pesticidal active ingredient may desirably act to enhance the entry of the active ingredient (such as but not limited to fungicidal, insecticidal, acaricidal, molluscicidal, bactericidal and nematocidal actives) into the cells and/or into the intracellular organelles or intracellular bodies of a target pest or pathogen (such as but not limited to fungi, insects, acari, mollusks, bacteria and nematodes, respectively). In a further embodiment, without being bound by theory, it is believed that the size and/or polarity of many pesticidal molecules prevents and/or limits the pesticidal active ingredient from crossing the cellular membrane, but that the addition of a C6-C10 unsaturated aliphatic acid in accordance with some embodiments of the present disclosure may desirably compromise the pest cell membrane's lipid bilayer and protein organization such as to create membrane gaps, and/or increase the membrane fluidity, such as to allow the pesticidal active to more effectively enter the cell and/or intracellular organelles of the pest cells. In some particular exemplary embodiments,

without being bound to a particular theory, it is believed that the at least one unsaturated C-C bond in the C6-C10 unsaturated aliphatic acid may desirably compromise, or alter the integrity of a pest cell membrane such as the lipid bilayer integrity and protein organization such as to create membrane gaps, and/or increase the membrane fluidity, such as to allow the pesticidal active to more effectively enter the cell and/or intracellular organelles of the pest cells, for example.

[0045] In another aspect, without being bound to any particular theory, it is believed that the C6-C10 unsaturated aliphatic acids (or agriculturally acceptable salt thereof) according to some embodiments of the present disclosure act as at least one of a potentiator, synergist, adjuvant and/or agonist when combined with a suitable pesticidal active ingredient, thereby desirably providing for a synergistic activity of such a synergistic pesticidal composition against a target pest or pathogen.

[0046] Without being bound by any particular theory, in some embodiments of the present invention, it is believed that the one or more C6-C10 unsaturated aliphatic acids act to compromise or alter the integrity of the lipid bilayer and protein organization of cellular membranes in target pest organisms. Further, it is also believed that in some embodiments one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of action that is dependent upon interaction with one or more components of the cellular membrane of a target pest. In some such embodiments, one or more C6-C10 unsaturated aliphatic acids may be particularly adapted for combining to form a synergistic pesticidal composition, demonstrating synergistic efficacy, with pesticidal actives which have a mode of action dependent on interaction with a cellular membrane protein. In one such embodiment, the cellular membrane protein may comprise one or more cytochrome complexes, such as a cytochrome bc1 complex or a cytochrome p450 complex, for example. Accordingly, in one aspect, synergistic pesticidal compositions according to some embodiments of the present invention may desirably be selected to comprise one or more C6-C10 unsaturated aliphatic acids, and one or more pesticidal active having a pesticidal mode of action that is dependent upon interaction with one or more components of the cellular membrane of a target pest, such as a cellular membrane protein, for example. In one aspect, one or more C11 or C12 unsaturated aliphatic acids is provided in combination with one or more pesticidal active having a pesticidal mode of action that is dependent upon interaction with one or more components of the cellular membrane of a target pest, such as a cellular membrane protein, for example.

[0047] In a particular embodiment, one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of

action interacting with (such as by inhibiting one or more receptor sites) the cellular membrane cytochrome bc1 complex (also known as the cytochrome complex III), such as fungicidal actives collectively referred to as Group 11 actives by the Fungicide Resistance Action Committee (FRAC), including e.g. azoxystrobin, coumoxystrobin, enoxastrobin, flufenoxystrobin, picoxystrobin, pyraoxystrobin, mandestrobin, pyraclostrobin, pyrametostrobin, triclopyricarb, kresoxim-methyl trifloxystrobin, dimoxystrobin, fenaminstrobin, metominostrobin, orysastrobin, famoxadone, fluoxastrobin, fenamidone, or pyribencar. In one such embodiment, a synergistic pesticidal composition may be selected comprising one or more C6-C10 unsaturated aliphatic acid and a pesticidal active having a pesticidal mode of action interacting with the cellular cytochrome bc1 complex, such as a strobilurin pesticidal active. In alternative such embodiments, the synergistic pesticidal composition comprises one or more C11 or C12 unsaturated aliphatic acids.

[0048] In another particular embodiment, one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of action interacting with (such as by inhibiting one or more receptor sites) the cellular membrane cytochrome p450 complex, such as to inhibit sterol biosynthesis, as is the case with exemplary fungicidal actives collectively referred to as FRAC Group 3 actives, including e.g. triforine, pyrifenoxy, pyrisoxazole, fenarimol, nuarimol, imazalil, oxpoconazole, pefurazoate, prochloraz, triflumizole, azaconazole, bitertanol, bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, etaconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, metconazole, myclobutanil, penconazole, propiconazole, simeconazole, tebuconazole, tetraconazole, triadimefon, triadimenol, triticonazole, or prothioconazole. In one such embodiment, a synergistic pesticidal composition may be selected comprising one or more C6-C10 unsaturated aliphatic acid and a pesticidal active having a pesticidal mode of action interacting with the cellular cytochrome p450 complex, such as an azole or triazole pesticidal active, for example. In alternative such embodiments, the synergistic pesticidal composition comprises one or more C11 or C12 unsaturated aliphatic acids.

[0049] In another particular embodiment, one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of action interacting with (such as by inhibiting one or more receptor sites) the cellular membrane, such as to uncouple oxidative phosphorylation, as is the case with exemplary insecticidal actives collectively referred to as Group 13 actives by the Insecticide Resistance Action Committee

(IRAC), including e.g. quinoxifen or proquinazid. In one such embodiment, a synergistic pesticidal composition may be selected comprising one or more C6-C10 unsaturated aliphatic acid and a pesticidal active having a pesticidal mode of action interacting with the cellular membrane, such as a pyrrole insecticidal active, an example of which is chlorfenapyr. In alternative such embodiments, the synergistic
5 pesticidal composition comprises one or more C11 or C12 unsaturated aliphatic acids.

[0050] Without being bound by any particular theory, in some further embodiments of the present invention, it is believed that one or more C6-C10 unsaturated aliphatic acids act to compromise or alter the integrity of the lipid bilayer and protein organization of cellular membranes in target pest organisms, and by so doing are effective to increase at least one of the fluidity and permeability of a cellular
10 membrane of a target pest organism, which may desirably increase permeability and/or transport of a pesticidal active through the cellular membrane, for example. Further, it is also believed that in some embodiments one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of action that is dependent upon
15 transport across one or more cellular membrane of a target pest, such as to interact with a target site inside a cell or an intracellular organelle of the target pest. In some such embodiments, a synergistic pesticidal composition according to an embodiment of the present invention, demonstrating synergistic efficacy, may comprise one or more C6-C10 unsaturated aliphatic acid, and one or more pesticidal active having a mode of action dependent on transport across a cellular membrane. Accordingly, in one aspect,
20 synergistic pesticidal compositions according to some embodiments of the present invention may desirably be selected to comprise one or more C6-C10 unsaturated aliphatic acids, and one or more pesticidal active having a pesticidal mode of action that is dependent upon interaction with a target site within a cell or intracellular organelle of a target pest, such as a cellular membrane protein, for example. In alternative such embodiments, the synergistic pesticidal composition comprises one or more C11 or
25 C12 unsaturated aliphatic acids.

[0051] In a particular embodiment, one or more C6-C10 unsaturated aliphatic acids are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives having a pesticidal mode of action interacting with (such as by inhibiting one or more receptors) at a target site across a cellular
30 membrane of a target pest, such as fungicidal actives collectively referred to as FRAC Group 9 and Group 12 actives, for example, including e.g. cyprodinil, mepanipyrim, pyrimethanil, fenpiclonil or fludioxonil. In one such embodiment, a synergistic pesticidal composition may be selected comprising one or more C6-C10 unsaturated aliphatic acid and a pesticidal active having a pesticidal mode of action

interacting with a target site within a cellular membrane of a target pest, such as one or more of an anilinopyrimidine such as cyprodinil, and a phenylpyrrole such as fludioxonil, for example. In alternative such embodiments, the synergistic pesticidal composition comprises one or more C11 or C12 unsaturated aliphatic acids.

5 [0052] Without being bound by any particular theory, in some yet further embodiments of the present invention, it is believed that one or more C6-C10 unsaturated aliphatic acids act to compromise or alter the integrity of the lipid bilayer and protein organization of cellular membranes in target pest organisms, and by so doing are effective to increase at least one of the fluidity and permeability of a cellular membrane of a target pest organism, which may desirably increase permeability and/or transport of a
10 pesticidal active through the cellular membrane, for example. Further, it is also believed that in some preferred embodiments one or more C6-C10 unsaturated aliphatic acids having unsaturated C-C bonds at one or more of the second (2-), third (3-) and terminal ((n-1)-) locations in the aliphatic acid carbon chain are particularly adapted for combination to form synergistic pesticidal compositions according to embodiments of the invention, which demonstrate synergistic efficacy, with pesticidal actives. In some
15 particular such embodiments, one or more C6-C10 aliphatic acids comprising an unsaturated C-C bond at one or more of the 2-,3- and (n-1)- locations (wherein n is the number of carbons in the unsaturated aliphatic acid) may desirably be particularly adapted for forming synergistic pesticidal compositions in combination with one or more pesticidal active having a pesticidal mode of action that is dependent upon interaction with a cellular membrane component of a target pest, or dependent upon transport across one
20 or more cellular membrane of a target pest (such as to interact with a target site inside a cell or an intracellular organelle of the target pest). In some such embodiments, a synergistic pesticidal composition according to an embodiment of the present invention, demonstrating synergistic efficacy, may comprise one or more C6-C10 unsaturated aliphatic acid having an unsaturated C-C bond at one or more of the 2-, 3- and terminal ((n-1)-) locations in the aliphatic acid carbon chain, and one or more
25 pesticidal active having a mode of action dependent on interaction with a target pest cellular membrane component, or on transport across a target pest cellular membrane. In alternative such embodiments, the synergistic pesticidal composition comprises one or more C11 or C12 unsaturated aliphatic acids having an unsaturated C-C bond at one or more of the 2-, 3- and terminal ((n-1)-).

[0053] In some embodiments according to the present disclosure, a synergistic pesticidal composition
30 accordingly to the present invention comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof), as an exemplary cell permeabilizing agent, in combination with a pesticide. In some embodiments, the synergistic composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof), as an exemplary cell permeabilizing agent, in combination with a

fungicide. In some embodiments, the synergistic composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof), as an exemplary cell permeabilizing agent, in combination with a nematicide. In some embodiments, the synergistic composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof), as an exemplary cell permeabilizing agent, in combination with an insecticide. In some such embodiments, the unsaturated aliphatic acid is a C11 or C12 unsaturated aliphatic acid.

[0054] In one such embodiment, without being bound to a particular theory, it is believed that the C6-C10 unsaturated aliphatic acid may act as a cellular membrane delivery agent, so as to improve the entry of and/or bioavailability or systemic distribution of a pesticidal active ingredient within a target pest cell and/or within a pest intracellular organelle, such by facilitating the pesticidal active ingredient in passing into the mitochondria of the pest cells, for example. In some other embodiments, without being bound by a particular theory, the C6-C10 unsaturated aliphatic acid may further provide for synergistic interaction with one or more additional compounds provided as part of the pesticidal composition, such as an additional C6-C10 saturated aliphatic acid, or one or more C6-C10 unsaturated aliphatic acids, or one or more additional active ingredients or adjuvants, so as to provide for synergistic enhancement of a pesticidal effect provided by the at least one pesticidal active ingredient, for example.

[0055] In another aspect, without being bound to any particular theory, it is believed that the one or more C6-C10 unsaturated aliphatic acids (or agriculturally acceptable salt thereof) according to some embodiments of the present disclosure act as at least one of a potentiator, synergist, adjuvant and/or agonist when combined with a suitable pesticidal ingredient, thereby desirably providing for a synergistic activity of such a synergistic pesticidal composition against a target pest or pathogen.

[0056] In some embodiments, the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) comprises an aliphatic carbonyl alkene. In some embodiments, the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) comprises at least one C6-C10 unsaturated aliphatic acid having at least one carboxyl group and at least one unsaturated C-C bond. In another embodiment, the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) comprises at least two C6-C10 unsaturated aliphatic acids having at least one carboxyl group and at least one unsaturated C-C bond. In yet another embodiment, the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) comprises at least one carboxylic acid group and at least one of a double or triple C-C bond. In a further embodiment, a synergistic pesticidal composition is provided comprising at least one pesticidal active ingredient, and at least one C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) having at least one carboxylic acid group and at least one unsaturated C-C bond, in combination with at least one C6-C10 saturated aliphatic acid (or agriculturally acceptable salt thereof).

[0057] In some embodiments, the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) comprises an aliphatic carbonyl alkene having one of the general structures (1), (2), (3), (4), (5) and (6) as shown in FIG. 1. In some embodiments, the C6-C10 unsaturated aliphatic acid may comprise an agriculturally acceptable salt form thereof. In yet another embodiment, the C6-C10 unsaturated aliphatic acid may be provided as a plant extract or oil, or fraction thereof, containing the at least one C6-C10 saturated or unsaturated aliphatic acid, for example.

[0058] In some embodiments, the composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) and a fungicidal active ingredient. In some embodiments, the effective dose of the fungicidal active ingredient when used in combination with the C6-C10 unsaturated aliphatic acid is lower than the effective dose of the fungicidal active ingredient when used alone (i.e. a smaller amount of fungicidal active can still control fungi when used in a composition together with the C6-C10 unsaturated aliphatic acid). In some embodiments, a fungicidal active ingredient that is not effective against a particular species of fungi (such as at a particular concentration that is below a lower limit of efficacy for a particular fungi, or for a particular species of fungi which may be at least partially resistant or tolerant to the particular fungicidal active ingredient when applied alone) can be made effective against that particular species when used in a composition together with a C6-C10 unsaturated aliphatic acid.

[0059] In some embodiments, the composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) and a nematocidal active ingredient. In some embodiments, the effective dose of the nematocidal active ingredient when used in combination with the C6-C10 unsaturated aliphatic acid is lower than the effective dose of the nematocidal active ingredient when used alone (i.e. a smaller amount of nematocidal active can still control nematodes when used in a composition together with the C6-C10 unsaturated aliphatic acid). In some embodiments, a nematocidal active ingredient that is not effective against a particular species of nematode (such as at a particular concentration that is below a lower limit of efficacy for a particular nematode, or for a particular species of nematode which may be at least partially resistant or tolerant to the particular nematocidal active ingredient when applied alone) can be made effective against that particular species when used in a composition together with a C6-C10 unsaturated aliphatic acid.

[0060] In some embodiments, the composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) and an insecticidal active ingredient. In some embodiments, the effective dose of the insecticidal active ingredient when used in combination with the C6-C10 unsaturated aliphatic acid is lower than the effective dose of the insecticidal active ingredient when used alone (i.e. a smaller amount of insecticidal active can still control insects when used in a composition together with

the C6-C10 unsaturated aliphatic acid). In some embodiments, an insecticidal active ingredient that is not effective against a particular species of insect (such as at a particular concentration that is below a lower limit of efficacy for a particular insect, or for a particular species of insect which may be at least partially resistant or tolerant to the particular insecticidal active ingredient when applied alone) can be made

5 effective against that particular species when used in a composition together with a C6-C10 unsaturated aliphatic acid. In further embodiments, the C6-C10 unsaturated aliphatic acid may desirably provide for a synergistic increased efficacy of at least one of an acaricidal, molluscicidal, bactericidal or virucidal active ingredient such that the composition is pesticidally effective against one or more of an acari, mollusk, bacterial or viral pest, for example.

10 **[0061]** In some embodiments, the composition comprises a C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) and a pesticidal natural or essential oil, for example, neem oil. In some embodiments, the pesticidal natural oil may comprise one or more of: neem oil, karanja oil, clove oil, peppermint oil, mint oil, cinnamon oil, thyme oil, oregano oil, geranium oil, lime oil, lavender oil, anise oil, and/or garlic oil and/or components, derivatives and/or extracts of one or more pesticidal natural
15 oil, or a combination of the foregoing, for example. In some embodiments, the pesticidal natural oil is neem oil or a component or derivative thereof. In another embodiment, the pesticidal natural oil comprises karanja oil or a component or derivative thereof. In another embodiment, the pesticidal natural oil comprises thyme oil or a component or derivative thereof.

[0062] In other embodiments, the pesticidal natural oil may comprise any natural oil or oil mixture that
20 includes one or more constituents common to two or more of the pesticidal natural oils listed above (i.e. neem oil, karanja oil, clove oil, peppermint oil, cinnamon oil, thyme oil, oregano oil, garlic oil, anise oil, geranium oil, lime oil, lavender oil), including, but not limited to, thymol (found in oregano oil and thyme oil), p-cymene (found in oregano oil and thyme oil), 1,8-cineole (found in thyme oil and peppermint oil), eugenol (found in clove oil and cinnamon oil), limonene (found in cinnamon, peppermint, and lime oil),
25 alpha-pinene (found in cinnamon oil, geranium oil, and lime oil), carvacrol (found in oregano oil, thyme oil, and clove oil), gamma-terpinene (found in oregano oil and lime oil), geraniol (found in thyme oil and geranium oil), alpha-Terpineol (found in thyme oil and anise oil), beta-caryophyllene (found in clove oil, cinnamon oil, and peppermint oil) and linalool (found in thyme oil, cinnamon oil and geranium oil, amongst others). In other embodiments, the pesticidal natural oil may comprise any oil having as a
30 constituent one of the following compounds, or a combination of the following compounds: azadirachtin, nimbin, nimbinin, salannin, gedunin, geraniol, geranial, gamma-terpinene, alpha-terpineol, beta-caryophyllene, terpinen-4-ol, myrcenol-8, thuyanol-4, benzyl alcohol, cinnamaldehyde, cinnamyl acetate, alpha-pinene, geranyl acetate, citronellol, citronellyl formate, isomenthone, 10-epi-gamma-eudesmol, 1,5-

dimethyl-1-vinyl-4-hexenylbutyrate, 1,3,7-octatriene, eucalyptol, camphor, diallyl disulfide, methyl allyl trisulfide, 3-vinyl-4H-1,2 dithiin, 3-vinyl-1,2 dithiole-5-cyclohexane, diallyl trisulfide, anethole, methyl chavicol, anisaldehyde, estragole, linalyl acetate, geranial, beta-pinene, thymol, carvacrol, p-cymene, beta-myrcene, alpha-myrcene, 1,8-cineole, eugenol, limonene, alpha-pinene, menthol, menthone, and

5 linalool.

[0063] In further embodiments, the pesticidal natural oil may comprise one or more suitable plant essential oils or extracts or fractions thereof disclosed herein including, without limitation: alpha- or beta-pinene; alpha-campholenic aldehyde; alpha.-citronellol; alpha-iso-amyl-cinnamic (e.g., amyl cinnamic aldehyde); alpha-pinene oxide; alpha-cinnamic terpinene; alpha-terpineol (e.g., 1-methyl-4-isopropyl-1-cyclohexen-8-ol); lambda-terpinene; achillea; aldehyde C16 (pure); allicin; alpha-phellandrene; amyl cinnamic aldehyde; amyl salicylate; anethole; anise; aniseed; anisic aldehyde; basil; bay; benzyl acetate; benzyl alcohol; bergamot (e.g., *Monardia fistulosa*, *Monarda didyma*, *Citrus bergamia*, *Monarda punctata*); bitter orange peel; black pepper; borneol; calamus; camphor; cananga oil (e.g., java); cardamom; carnation (e.g., *dianthus caryophyllus*); carvacrol; carveol; cassia; castor; cedar (e.g., hinoki);

10 cedarwood; chamomile; cineole; cinnamaldehyde; cinnamic alcohol; cinnamon; cis-pinane; citral (e.g., 3,7-dimethyl-2,6-octadienal); citronella; citronellal; citronellol dextro (e.g., 3-7-dimethyl-6-octen-1-ol); citronellol; citronellyl acetate; citronellyl nitrile; citrus unshiu; clary sage; clove (e.g., *eugenia caryophyllus*); clove bud; coriander; corn; cotton seed; d-dihydrocarvone; decyl aldehyde; diallyl disulfide; diethyl phthalate; dihydroanethole; dihydrocarveol; dihydrolinalool; dihydromyrcene;

20 dihydromyrcenol; dihydromyrcenyl acetate; dihydroterpineol; dimethyl salicylate; dimethyloctanal; dimethyloctanol; dimethyloctanyl acetate; diphenyl oxide; dipropylene glycol; d-limonene; d-pulegone; estragole; ethyl vanillin (e.g., 3-ethoxy-4-hydrobenzaldehyde); eucalyptol (e.g., cineole); eucalyptus citriodora; eucalyptus globulus; eucalyptus; eugenol (e.g., 2-methoxy-4-allyl phenol); evening primrose; fenchol; fennel; ferniol.TM.; fish; florazon (e.g., 4-ethyl-.alpha., .alpha.-dimethyl-benzenepropanal);

25 galaxolide; geraniol (e.g., 2-trans-3,7-dimethyl-2,6-octadien-8-ol); geraniol; geranium; geranyl acetate; geranyl nitrile; ginger; grapefruit; guaiacol; guaiacwood; gurjun balsam; heliotropin; herbanate (e.g., 3-(1-methyl-ethyl) bicyclo(2,2,1) hept-5-ene-2-carboxylic acid ethyl ester); hiba; hydroxycitronellal; i-carvone; i-methyl acetate; ionone; isobutyl quinoline (e.g., 6-secondary butyl quinoline); isobornyl acetate; isobornyl methylether; isoeugenol; isolongifolene; jasmine; jojoba; juniper berry; lavender;

30 lavandin; lemon grass; lemon; lime; limonene; linalol oxide; linalol; linalyl acetate; linseed; litsea cubeba; l-methyl acetate; longifolene; mandarin; mentha; menthane hydroperoxide; menthol crystals; menthol laevo (e.g., 5-methyl-2-isopropyl cyclohexanol); menthol; menthone laevo (e.g., 4-isopropyl-1-methyl cyclohexan-3-one); methyl anthranilate; methyl cedryl ketone; methyl chavicol; methyl hexyl ether; methyl ionone; mineral; mint; musk ambrette; musk ketone; musk xylo; mustard (also known as

allylisothio-cyanate); myrcene; nerol; neryl acetate; nonyl aldehyde; nutmeg (e.g., myristica fragrans); orange (e.g., citrus aurantium dulcis); orris (e.g., iris florentina) root; para-cymene; para-hydroxy phenyl butanone crystals (e.g., 4-(4-hydroxyphenyl)-2-butanone); passion palmarosa oil (e.g., cymbopogon martini); patchouli (e.g., pogostemon cablin); p-cymene; pennyroyal oil; pepper; peppermint (e.g., mentha piperita); perillaldehyde; petitgrain (e.g., citrus aurantium amara); phenyl ethyl alcohol; phenyl ethyl propionate; phenyl ethyl-2-methylbutyrate; pimento berry; pimento leaf; pinane hydroperoxide; pinanol; pine ester; pine needle; pine; pinene; piperonal; piperonyl acetate; piperonyl alcohol; plinol; plinyl acetate; pseudo ionone; rhodinol; rhodinyl acetate; rosalin; rose; rosemary (e.g., rosmarinus officinalis); ryu; sage; sandalwood (e.g., santalum album); sandenol; sassafras; sesame; soybean; spearmint; spice; spike lavender; spirantol; starflower; tangerine; tea seed; tea tree; terpenoid; terpeneol; terpinolene; terpinyl acetate; tert-butylcyclohexyl acetate; tetrahydrolinalool; tetrahydrolinalyl acetate; tetrahydromyrcenol; thulasi; thyme; thymol; tomato; trans-2-hexenol; trans-anethole and metabolites thereof; turmeric; turpentine; vanillin (e.g., 4-hydroxy-3-methoxy benzaldehyde); vetiver; vitalizair; white cedar; white grapefruit; wintergreen (methyl salicylate) oils, and the like.

[0064] In some embodiments, the effective dose of a pesticidal natural oil when used in combination with the C6-C10 unsaturated aliphatic acid (or agriculturally acceptable salt thereof) is lower than the effective dose of the pesticidal natural oil when used alone (i.e. a smaller amount of pesticidal natural oil can still control pests when used in a composition together with a C6-C10 unsaturated aliphatic acid). In some embodiments, an essential oil that is not effective against a particular species of pest can be made effective against that particular species when used in a composition together with a C6-C10 unsaturated aliphatic acid.

[0065] In some embodiments, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring unsaturated aliphatic acid, such as may be present in, or extracted, fractionated or derived from a natural plant or animal material, for example. In one such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise one or more naturally occurring aliphatic acids provided in a plant extract or fraction thereof. In another such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise one or more naturally occurring aliphatic acids provided in an animal extract or product, or fraction thereof. In one such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring aliphatic acid comprised in a plant oil extract, such as one or more of coconut oil, palm oil, palm kernel oil, corn oil, or fractions or extracts therefrom. In another such embodiment, the at least one C6-C10 unsaturated aliphatic acid may comprise a naturally occurring aliphatic acid comprised in an animal extract or product, such as one or more of cow's milk, goat's milk, beef tallow, and/or cow or goat butter, or fractions or extracts thereof for example. In a particular

embodiment, at least one C6-C10 unsaturated aliphatic acid may be provided as a component of one or more natural plant or animal material, or extract or fraction or derivative thereof.

[0066] In some embodiments, an emulsifier or other surfactant may be used in preparing pesticidal compositions according to aspects of the present disclosure. Suitable surfactants can be selected by one skilled in the art. Examples of surfactants that can be used in some embodiments of the present disclosure include, but are not limited to sodium lauryl sulfate, saponin, ethoxylated alcohols, ethoxylated fatty esters, alkoxyated glycols, ethoxylated fatty acids, ethoxylated castor oil, glyceryl oleates, carboxylated alcohols, carboxylic acids, ethoxylated alkylphenols, fatty esters, sodium dodecylsulfide, other natural or synthetic surfactants, and combinations thereof. In some embodiments, the surfactant(s) are non-ionic surfactants. In some embodiments, the surfactant(s) are cationic or anionic surfactants. In some embodiments, a surfactant may comprise two or more surface active agents used in combination. The selection of an appropriate surfactant depends upon the relevant applications and conditions of use, and selection of appropriate surfactants are known to those skilled in the art.

[0067] In one aspect, a pesticidal composition according to some embodiments of the present disclosure comprises one or more suitable carrier or diluent component. A suitable carrier or diluent component can be selected by one skilled in the art, depending on the particular application desired and the conditions of use of the composition. Commonly used carriers and diluents may include ethanol, isopropanol, isopropyl myristate, other alcohols, water and other inert carriers, such as but not limited to those listed by the EPA as a Minimal Risk Inert Pesticide Ingredients (4A) (the list of ingredients published dated December 2015 by the US EPA FIFRA 4a list published August 2004 entitled "List 4A - Minimal Risk Inert Ingredients") or, for example, Inert Pesticide Ingredients (4B) (the US EPA FIFRA 4b list published August 2004 entitled "List 4B - Other ingredients for which EPA has sufficient information") or under EPA regulation 40 CFR 180.950 dated May 24, 2002, each of which is hereby incorporated herein in its entirety for all purposes including for example, citric acid, lactic acid, glycerol, castor oil, benzoic acid, carbonic acid, ethoxylated alcohols, ethoxylated amides, glycerides, benzene, butanol, 1-propanol, hexanol, other alcohols, dimethyl ether, and polyethylene glycol.

[0068] In one embodiment according to the present disclosure, a method of enhancing the efficacy of a pesticide is provided. In one aspect, a method of enhancing the efficacy of a fungicide is provided. In another aspect, a method of enhancing the efficacy of a nematocide is provided. In a further aspect, a method of enhancing the efficacy of an insecticide is provided.

[0069] In one such embodiment, the method comprises providing a synergistic pesticidal composition comprising a pesticidal active ingredient and at least one C6-C10 unsaturated aliphatic acid and exposing a pest to the resulting synergistic composition. In a particular exemplary embodiment, without being

bound by any particular theory, the at least one C6-C10 unsaturated aliphatic acid is functional as a cell permeabilizing agent. In one aspect, the method comprises providing a fungicidal composition comprising a fungicidal active ingredient and at least one C6-C10 unsaturated aliphatic acid and exposing a fungus to the resulting synergistic composition. In another aspect, the method comprises providing a
5 nematicidal composition comprising a nematicidal active ingredient and at least one C6-C10 unsaturated aliphatic acid and exposing a nematode to the resulting synergistic composition. In a further aspect, the method comprises providing an insecticidal composition comprising an insecticidal active ingredient and at least one C6-C10 unsaturated aliphatic acid and exposing an insect to the resulting synergistic composition.

10 **[0070]** In one embodiment according to the present disclosure, the at least one C6-C10 unsaturated aliphatic acid provided in a pesticidal composition comprises an unsaturated aliphatic carbonyl alkene. In a particular such embodiment, without being bound by any particular theory, the at least one C6-C10 unsaturated aliphatic acid is functional as a cell permeabilizing agent. In one such embodiment, the cell permeabilizing agent comprises a carbonyl alkene having the general structure (1), (2), (3), (4), (5) or (6)
15 as shown in FIG. 1. In a further embodiment, the cell permeabilizing agent comprises at least one unsaturated aliphatic acid comprising at least one carboxylic group and having at least one unsaturated C-C bond.

[0071] In one exemplary embodiment, a method comprises providing a synergistic pesticidal composition comprising a pesticidal active ingredient and at least one C6-C10 unsaturated aliphatic acid
20 which may desirably be functional as a cell permeabilizing or cell membrane disturbing agent, and exposing a pest to the synergistic pesticidal composition to increase the amount of the pesticidal active ingredient that enters cells of the pest. In some such embodiments, the pesticidal active is a fungicide and the pest is a fungus, and without being bound by a particular theory, the C6-C10 unsaturated aliphatic acid cell permeabilizing agent allows the fungicide to pass more easily through the fungal cell walls and
25 membranes. In some such embodiments, the pesticide is a nematicide and the pest is a nematode, and without being bound by a particular theory, the C6-C10 unsaturated aliphatic acid cell permeabilizing agent allows the nematicide to pass more easily through the nematode cell membranes. In some such embodiments, the pesticide is an insecticide, and without being bound by a particular theory, the C6-C10 unsaturated aliphatic acid cell permeabilizing agent allows the insecticide to pass more easily through
30 insect cuticle, chitin membrane, or cell or intracellular membranes.

[0072] In some embodiments, in addition to the actual synergistic action with respect to pesticidal activity, certain synergistic pesticidal compositions according to embodiments of the present disclosure can also desirably have further surprising advantageous properties. Examples of such additional

advantageous properties may comprise one or more of: more advantageous degradability in the environment; improved toxicological and/or ecotoxicological behaviour such as reduced aquatic toxicity or toxicity to beneficial insects, for example.

[0073] In a further aspect, for any of the embodiments described above or below providing for a synergistic pesticidal composition comprising at least one pesticidal active and one or more C6-C10 unsaturated aliphatic acid or salt thereof, in an alternative embodiment, the synergistic pesticidal composition may alternatively comprise at least one pesticidal active and one or more C11 unsaturated aliphatic acid or salt thereof. In another aspect, for any of the embodiments described above providing for a synergistic pesticidal composition comprising at least one pesticidal active and one or more C6-C10 unsaturated aliphatic acid or salt thereof, in an alternative embodiment, the synergistic pesticidal composition may alternatively comprise at least one pesticidal active and one or more C12 unsaturated aliphatic acid or salt thereof.

EXPERIMENTAL METHODS

[0074] In accordance with an embodiment of the present disclosure, the combination of a C6-C10 unsaturated aliphatic acid and a pesticidal active ingredient produces a synergistic pesticidal composition demonstrating a synergistic pesticidal effect. In some embodiments, the synergistic action between the pesticidal active ingredient, and the C6-C10 unsaturated aliphatic acid components of the pesticidal compositions according to embodiments of the present disclosure was tested using a Synergistic Growth Inhibition Assay, which is derived from and related to a checkerboard assay as is known in the art for testing of combinations of antimicrobial agents. In the Synergistic Growth Inhibition Assay used in accordance with some embodiments of the present disclosure, multiple dilutions of combinations of pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents are tested in individual cells for inhibitory activity against a target pest or pathogenic organism. In one such embodiment, the combinations of pesticidal active ingredient and C6-C10 unsaturated aliphatic acid agents may preferably be tested in decreasing concentrations. In a further such embodiment, the combinations of pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents may be tested in increasing concentrations. These multiple combinations of the pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents may be prepared in 96-well microtiter plates. In one such embodiment, the Synergistic Growth Inhibition Assay then comprises rows which each contain progressively decreasing concentrations of the pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents to test for the MIC of the agents in combination at which growth of the target pest or pathogen is inhibited. Thus,

each well of the microtiter plate is a unique combination of the two agents, at which inhibitory efficacy of the combination against the target pest or pathogen can be determined.

[0075] A method of determining and quantifying synergistic efficacy is by calculation of the “Fractional Inhibitory Concentration Index” or FIC index, as is known in the art for determining synergy between two antibiotic agents (see for example M.J. Hall et al., “The fractional inhibitory concentration (FIC) index as a measure of synergy”, J Antimicrob Chem., 11 (5):427-433, 1983, for example). In one embodiment according to the present disclosure, for each row of microtiter cells in the Synergistic Growth Inhibition Assay, the FIC index is calculated from the lowest concentration of the pesticidal active ingredient and C6-C10 unsaturated aliphatic acid agents necessary to inhibit growth of a target pest or pathogen. The FIC of each component is derived by dividing the concentration of the agent present in that well of the microtiter plate by the minimal inhibitory concentration (MIC) needed of that agent alone to inhibit growth of the target pest or pathogen. The FIC index is then the sum of these values for both agents in that well of the microtiter plate. The FIC index is calculated for each row as follows:

$$\text{FIC}_{\text{index}} = \text{MIC}_a / \text{MIC}_A + \text{MIC}_b / \text{MIC}_B$$

where MIC_a , MIC_b are the minimal inhibitory concentration (MIC) of compounds A and B, respectively, when combined in the mixture of the composition, and MIC_A , MIC_B are the MIC of compounds A and B, respectively, when used alone. Fractional inhibitory concentration indices may then used as measure of synergy. When the lowest FIC index obtained in a microtiter plate in this way is less than 1 ($\text{FIC}_{\text{index}} < 1$), the combination of the pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents exhibits synergism, and indicates a synergistic pesticidal composition. When the FIC index is equal to 1, the combination is additive. FIC index values of greater than 4 are considered to exhibit antagonism.

[0076] In a particular embodiment, when the FIC index is equal or less than 0.5, the combination of the pesticidal active ingredient and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents exhibits strong synergism. For example, in one embodiment, an FIC index of 0.5 may correspond to a synergistic pesticidal composition comprising a pesticidal agent at $\frac{1}{4}$ of its individual MIC, and a C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agent at $\frac{1}{4}$ of its individual MIC.

[0077] In some embodiments of the present disclosure, the exemplary Synergistic Growth Inhibition Assay was conducted starting with an initial composition comprising a pesticidal active ingredient agent at its individual MIC and a C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agent at its individual MIC in the first well of a row on a 96 well microtiter plate. Then, serial dilutions of these initial compositions in successive wells in the row of the microtiter plate were used to assay the pesticidal composition under the same conditions to determine the concentration of the composition combining the

two agents corresponding to the microtiter well in which growth inhibition of the target pest or organism ceases. The minimal inhibitory concentrations of each individual pesticidal active ingredient agent (compound A) and each of the one or more C6-C10 unsaturated aliphatic acid agent (as compound B) were determined in parallel with the compositions combining the two agents.

5 [0078] In some embodiments, *Fusarium oxysporum* was used as a representative pest organism or pathogen to determine synergy in pesticidal compositions comprising a pesticidal active ingredient agent and a C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agent. Resazurin dye (also known as Alamar blue dye) was used as an indicator to determine the presence of growth or inhibition of growth of *Fusarium oxysporum* in the wells of the 96 well microtiter plates used in the exemplary Synergistic
10 Growth Inhibition Assay. In addition to the color change of the resazurin dye in the presence of growth of the *Fusarium oxysporum*, an optical or visual examination of the microtiter well may also be made to additionally determine the presence of growth or inhibition of growth of the *Fusarium oxysporum*.

[0079] In other embodiments, *Botrytis cinerea* was used as a representative pest organism or pathogen to determine synergy in pesticidal compositions comprising a pesticidal active ingredient and a C6-C10 (or
15 alternatively C11 or C12) unsaturated aliphatic acid agent. Similarly to as described above, Resazurin was used as an indicator of growth or inhibition of growth of *Botrytis cinerea* in the exemplary Synergistic Growth Inhibition Assay. In addition to the color change of the resazurin, an optical or visual examination of the microtiter well may also be made to additionally determine the presence of growth or inhibition of growth of the *Botrytis cinerea*.

20 [0080] Alternatively, other suitable representative pest or pathogen organisms may be used to determine synergy of combinations of pesticidal active ingredient agents and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents in accordance with embodiments of the present disclosure. For example, other representative fungal pathogens may be used, such as but not limited to *Leptosphaeria maculans*, *Sclerotinia spp.* and *Verticillium spp.* In yet other examples, suitable non-fungal representative
25 pests or pathogens may be used, such as insect, acari, nematode, bacterial, viral, mollusc or other pests or pathogens suitable for use in an MIC growth inhibition assay test method.

[0081] All examples detailed below were tested according to the exemplary Synergistic Growth Inhibition Assay described above, using routine techniques for MIC determination known to those of skill in the art. Stock solutions of the pesticidal active ingredient agents and the C6-C10 (or alternatively C11
30 or C12) unsaturated aliphatic acid agents were initially prepared in 100% dimethylsulfoxide ("DMSO"), and diluted to 10% DMSO using sterile potato dextrose broth (PDB) before further serial dilution to obtain the test solution concentrations for use in the microtiter plate wells, with exceptions in particular experimental examples noted in detail below. Accordingly, the maximum concentration of DMSO in the

test solutions was limited to 10% DMSO or less, which was separately determined to be non-inhibitory to the growth of the representative fungal pests used in the test.

[0082] A culture of the representative fungal pathogen, namely *Fusarium oxysporum* or *Botrytis cinerea*, for example, is grown to exponential phase in potato dextrose broth (PDB). A 20 uL aliquot of
5 homogenized mycelium from the culture is transferred to a well of a 96 well microtiter plate, and incubated for 1 day with 180 uL of the test solution comprising the pesticidal and aliphatic acid agents in combination at a range of dilutions, to allow the mycelium to grow. Following the incubation, 10 uL of resazurin dye is added to each well and the color in the solution is compared to the color of the test
10 solution at the same concentrations in wells without mycelial culture inoculum to control for effects of the test solution alone. The resazurin dye appears blue for wells with only the initial 20 uL culture where growth has been inhibited, and appears pink for wells where mycelial growth has occurred, as shown in FIG. 2, where the transition from blue to pink color can be clearly seen in each of the uppermost 4 rows of microtiter wells (labelled as 1-4 in FIG. 2) as the concentration of the pesticidal and C6-C10 (or alternatively C11 or C12) unsaturated aliphatic acid agents in the test solution decreases from left to right.
15 In addition to the color change of the resazurin dye, growth or absence of growth of the mycelial culture is also observed visually or optically.

[0083] In accordance with this assay method, the Minimum Inhibitory Concentration is the lowest concentration at which growth is inhibited, and corresponds to the microtiter well in which the dye color is the same as for the control without culture and without growth, and/or in which a visual and/or optical
20 inspection confirm that growth is inhibited.

EXAMPLES

Example 1: Growth inhibition of *Fusarium oxysporum* by pyraclostrobin in combination with several exemplary C6-C10 unsaturated aliphatic acids (or agriculturally acceptable salts thereof)

25 Sample preparation:

[0084] 10 mg of pyraclostrobin (available from Santa Cruz Biotechnology of Dallas, TX as stock # 229020) was dissolved in 10 mL dimethylsulfoxide (DMSO) and the resulting solution was diluted 2-fold in DMSO to give a concentration of 0.5 mg/mL. This solution was diluted 10-fold in potato dextrose broth (PDB) to give a concentration of 0.05 mg/mL in 10% DMSO/90% PDB. The solubility of
30 pyraclostrobin in 10% DMSO/90% PDB was determined to be 0.0154 mg/mL using high performance liquid chromatography (HPLC).

[0085] A solution of (2E,4E)-2,4-hexadienoic acid, potassium salt, was prepared by dissolving 2 g of

(2E,4E)-2,4-hexadienoic acid, potassium salt, in 20 mL of PDB which was diluted further by serial dilution in PDB. A solution of (2E,4E)-2,4-hexadienoic acid (available from Sigma-Aldrich as stock #W342904) was prepared by dissolving 20 mg of (2E,4E)-2,4-hexadienoic acid in 1 mL DMSO and adding 0.1 mL to 0.9 mL PDB resulting in a 2 mg/mL solution of (2E,4E)-2,4-hexadienoic acid in 10% DMSO/90% PDB which was diluted further by serial dilution in PDB.

[0086] A solution of trans-2-hexenoic acid (available from Sigma-Aldrich as stock #W316903) was prepared by dissolving 100 mg trans-2-hexenoic acid in 1 mL DMSO and adding 0.1 mL to 0.9 mL PDB resulting in a 10 mg/mL solution in 10% DMSO/90% PDB which was diluted further by serial dilution in PDB. A solution of trans-3-hexenoic acid (available from Sigma-Aldrich as stock #W317004) was prepared by adding 20 uL trans-3-hexenoic acid to 1980 uL PDB and the resulting solution was serially diluted in PDB. The density of trans-3-hexenoic acid was assumed to be 0.963 g/mL.

[0087] Combinations of pyraclostrobin and one or more exemplary C6-C10 saturated or unsaturated aliphatic acids (and agriculturally acceptable salts thereof) were prepared by adding 0.5 mL of 0.0308 mg/mL pyraclostrobin to 0.5 mL of 1.25 mg/mL (2E,4E)-2,4-hexadienoic acid, potassium salt, (combination 1), 0.5 mL of 0.25 mg/mL (2E,4E)-2,4-hexadienoic acid (combination 2), 0.5 mL of 0.625 mg/mL (2E,4E)-2,4-hexadienoic acid (combination 3), 0.5 mL of 1.25 mg/mL of trans-2-hexenoic acid (combination 4), or 0.5 mL of 0.6019 mg/mL trans-3-hexenoic acid (combination 5). Each combination was tested over a range of 2-fold dilutions in the Synergistic Growth Inhibition Assay detailed above, observed following a 24 hour incubation period, and the FIC Index for each combination calculated, as shown below in Table 1.

Table 1: Growth inhibition of *Fusarium oxysporum* by pyraclostrobin in combination with several exemplary unsaturated aliphatic acids (or agriculturally acceptable salts thereof).

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Pyraclostrobin		0.0154			
		(2E,4E)-2,4-hexadienoic acid, potassium salt		0.625		
		(2E,4E)-2,4-hexadienoic acid		0.125		
		Trans-2-hexenoic acid		0.3125		
		Trans-3-hexenoic acid		0.3125		

1	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid, potassium salt	0.00385	0.1563	40	0.50
2	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.00385	0.03125	20	0.50
3	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.001925	0.03906	8	0.44
4	Pyraclostrobin	Trans-2-hexenoic acid	0.00385	0.1563	40	0.75
5	Pyraclostrobin	Trans-3-hexenoic acid	0.00385	0.07813	20	0.50

Example 2: Growth inhibition of *Fusarium oxysporum* by fludioxonil in combination with several exemplary unsaturated aliphatic acids (or agriculturally acceptable salts thereof)

5 Sample preparation:

[0088] 20 mg of fludioxonil (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China) was dissolved in 10 mL dimethylsulfoxide (DMSO) and the resulting solution was diluted 2-fold in DMSO to give a concentration of 1 mg/mL. This solution was diluted 10-fold in potato dextrose broth (PDB) to give a concentration of 0.1 mg/mL in 10% DMSO/90% PDB. The solubility of fludioxonil in 10% DMSO/90% PDB was determined to be 0.0154 mg/mL using HPLC.

[0089] A solution of (2E,4E)-2,4-hexadienoic acid, potassium salt, was prepared by dissolving 2 g of (2E,4E)-2,4-hexadienoic acid, potassium salt, in 20 mL of PDB which was diluted further by serial dilution in PDB. A solution of (2E,4E)-2,4-hexadienoic acid (available from Sigma-Aldrich as #W342904) was prepared by dissolving 20 mg of (2E,4E)-2,4-hexadienoic acid in 1 mL DMSO and adding 0.1 mL to 0.9 mL PDB resulting in a 2 mg/mL solution of (2E,4E)-2,4-hexadienoic acid in 10% DMSO/90% PDB which was diluted further by serial dilution in PDB.

[0090] A solution of trans-2-hexenoic acid (available from Sigma-Aldrich as stock #W316903) was prepared by dissolving 100 mg trans-2-hexenoic acid in 1 mL DMSO and adding 0.1 mL to 0.9 mL PDB resulting in a 10 mg/mL solution in 10% DMSO/90% PDB which was diluted further by serial dilution in PDB. A solution of trans-3-hexenoic acid (available from Sigma-Aldrich as stock #W317004) was prepared by adding 20 μ L trans-3-hexenoic acid to 1980 μ L PDB and the resulting solution was serially diluted in PDB. The density of trans-3-hexenoic acid was assumed to be 0.963 g/mL.

[0091] Combinations of compounds A and B as shown below in Table 2 were prepared by adding 0.5 mL of 9.63×10^{-4} mg/mL fludioxonil to each of 0.5 mL of 0.625 mg/mL (2E,4E)-2,4-hexadienoic acid, potassium salt, (combination 1), 0.5 mL of 0.25 mg/mL (2E,4E)-2,4-hexadienoic acid (combination 2), 0.5 mL of 0.625 mg/mL of trans-2-hexenoic acid (combination 3), and 0.5 mL of 0.6019 mg/mL trans-3-hexenoic acid (combination 4). Each combination was tested over a range of 2-fold dilutions in the

synergistic growth inhibition assay, observed following a 24 hour incubation period, and the FIC Index for each combination calculated, as shown below in Table 2.

Table 2: Growth inhibition of *Fusarium oxysporum* by fludioxonil in combination with several exemplary unsaturated aliphatic acids (or agriculturally acceptable salts thereof).

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Fludioxonil		4.8125×10^{-4}			
		(2E,4E)-2,4-hexadienoic acid, potassium salt		0.625		
		(2E,4E)-2,4-hexadienoic acid		0.125		
		Trans-2-hexenoic acid		0.3125		
		Trans-3-hexenoic acid		0.3125		
1	Fludioxonil	(2E,4E)-2,4-hexadienoic acid, potassium salt	6.0188×10^{-5}	0.03906	649	0.19
2	Fludioxonil	(2E,4E)-2,4-hexadienoic acid	6.0188×10^{-5}	0.01563	260	0.25
3	Fludioxonil	Trans-2-hexenoic acid	1.2038×10^{-4}	0.07813	649	0.5
4	Fludioxonil	Trans-3-hexenoic acid	1.2038×10^{-4}	0.07813	649	0.5

Example 3: Growth inhibition of *Fusarium oxysporum* by fludioxonil in combination with several exemplary unsaturated aliphatic acids:

Sample preparation:

- 10 **[0092]** 20 mg fludioxonil (available from Shanghai Terpon Chemical Co. Ltd., of Shanghai, China) was dissolved in 10 mL dimethylsulfoxide (DMSO) and the resulting solution was diluted 2-fold in DMSO to give a concentration of 1 mg/mL. This solution was diluted 10-fold in potato dextrose broth (PDB) to give a concentration of 0.1 mg/mL in 10% DMSO/90% PDB. The solubility of fludioxonil in 10% DMSO/90% PDB was determined to be 0.0154 mg/mL using HPLC.
- 15 **[0093]** Stock solutions of several exemplary C6-C10 unsaturated aliphatic acids as Compound B for testing individual MICs were prepared at 25 uL/mL in DMSO by adding 25 uL of each Compound B to 975 uL DMSO, followed by 10-fold dilution in PDB, for each of 3-octenoic acid (available from Sigma-Aldrich as stock #CDS000466), trans-2-octenoic acid (available from Sigma-Aldrich as stock #CDS000466), 9-decenoic acid (available from Sigma-Aldrich as #W366005), 3-decenoic acid (available from Sigma-Aldrich as stock #CDS000299), and trans-2-decenoic acid (available from TCI America as stock #D0098).
- 20

[0094] For testing in combination with fludioxonil, solutions of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid were prepared at 0.78 uL/mL in DMSO by adding 3.125 uL of each Compound B to 2 mL of DMSO, followed by 2-fold dilution in DMSO to give 0.78 uL/mL. Solutions of 3-decenoic acid and trans-2-decenoic acid were prepared similarly, but applying a further 2-fold dilution in DMSO to give a concentration of 0.39 uL/mL in DMSO.

[0095] Each of these resulting stock solutions were then diluted 10-fold in PDB to give solutions of 0.078 uL/mL for each of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid, and to give solutions of 0.039 uL/mL for each of 3-decenoic acid and trans-2-decenoic acid, all in 10% DMSO/90% PDB.

[0096] Combinations of the exemplary Compound B components with fludioxonil were prepared by adding 0.5 mL of 0.078 uL/mL of each of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid or 0.039 uL/mL of each of 3-decenoic acid and trans-2-decenoic acid, to 0.5 mL of 4.813×10^{-4} mg/mL fludioxonil obtained from serial dilution of 0.0154 mg/mL of fludioxonil in 10% DMSO/90% PDB, as prepared above, with PDB. The density of 3-octenoic acid was assumed to be 0.938 g/mL. The density of trans-2-octenoic acid was assumed to be 0.955 g/mL. The density of 3-decenoic acid was assumed to be 0.939 g/mL. The density of trans-2-decenoic acid was assumed to be 0.928 g/mL. The density of 9-decenoic acid was assumed to be 0.918 g/mL.

[0097] Each combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following a 24 hour incubation period, and the FIC Index for each combination calculated, as shown below in Table 3.

Table 3: Growth inhibition of *Fusarium oxysporum* by fludioxonil in combination with several exemplary unsaturated aliphatic acids.

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Fludioxonil		2.4063×10^{-4}			
		3-Octenoic acid		0.1466		
		Trans-2-octenoic acid		0.1492		
		3-Decenoic acid		0.07336		
		Trans-2-decenoic acid		0.03625		
		9-Decenoic acid		0.07172		
1	Fludioxonil	3-Octenoic acid	1.2031×10^{-4}	0.01832	152	0.63
2	Fludioxonil	Trans-2-octenoic acid	1.2031×10^{-4}	0.01865	155	0.63

3	Fludioxonil	3-Decenoic acid	1.2031×10^{-4}	0.00917	76	0.63
4	Fludioxonil	Trans-2-decenoic acid	1.2031×10^{-4}	0.00906	75	0.75
5	Fludioxonil	9-Decenoic acid	1.2031×10^{-4}	0.01793	149	0.75

Example 4: Growth inhibition of *Fusarium oxysporum* by thyme oil in combination with several exemplary unsaturated aliphatic acids

5 Sample preparation:

[0098] 12.5 mg of thyme oil (available from Sigma-Aldrich as stock #W306509) was dissolved in 1 g dimethylsulfoxide (DMSO) and the resulting solution was diluted 10-fold in PDB to give a concentration of 1.25 mg/mL 10% DMSO/90% PDB.

[0099] Stock solutions of several exemplary C6-C10 unsaturated aliphatic acids as Compound B for testing individual MICs were prepared at 25 μ L/mL by adding 25 μ L of each of 3-octenoic acid (available from Sigma-Aldrich as stock #CDS000466), trans-2-octenoic acid (available from Sigma-Aldrich), 9-decenoic acid (available from Sigma-Aldrich as stock #W366005), 3-decenoic acid (available from Sigma-Aldrich as stock #CDS000299), and trans-2-decenoic acid (available from TCI America as stock #D0098), to 975 μ L DMSO followed by 10-fold dilution in PDB.

[0100] Stock solutions of the exemplary C6-C10 unsaturated aliphatic acids as Compound B for testing in combination with thyme oil were prepared by adding 3.125 μ L of each of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid, to 2 mL of DMSO followed by 2-fold dilution in DMSO to give a 0.78 μ L/mL concentration stock solution. Solutions of 3-decenoic acid and trans-2-decenoic acid were prepared similarly, but applying a further 2-fold dilution in DMSO to give a concentration of 0.39 μ L/mL.

[0101] Each of these resulting stock solutions were then diluted 10-fold dilution in PDB to give solutions of 0.078 μ L/mL (for each of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid) and 0.039 μ L/mL (for 3-decenoic acid and trans-2-decenoic acid) in 10% DMSO/90% PDB.

[0102] Combinations of the exemplary Compound B components with thyme oil were prepared by adding 0.5 mL of 0.078 μ L/mL of each of 3-octenoic acid, trans-2-octenoic acid, and 9-decenoic acid or 0.039 μ L/mL of each of 3-decenoic acid and trans-2-decenoic acid, to 0.5 mL of 1.25 mg/mL thyme oil in 10% DMSO/90% PDB. The density of 3-octenoic acid was assumed to be 0.938 g/mL. The density of trans-2-octenoic acid was assumed to be 0.955 g/mL. The density of 3-decenoic acid was assumed to be 0.939 g/mL. The density of trans-2-decenoic acid was assumed to be 0.928 g/mL. The density of 9-

decenoic acid was assumed to be 0.918 g/mL.

[0103] Each combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following a 24 hour incubation period, and the FIC Index for each combination calculated, as shown below in Table 4.

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Table 4: Growth inhibition of *Fusarium oxysporum* by thyme oil in combination with several exemplary unsaturated aliphatic acids.

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Thyme oil		1.25			
		3-Octenoic acid		0.14656		
		Trans-2-octenoic acid		0.14922		
		3-Decenoic acid		0.07336		
		Trans-2-decenoic acid		0.03625		
		9-Decenoic acid		0.07172		
1	Thyme oil	3-Octenoic acid	0.3125	0.01832	0.059	0.38
2	Thyme oil	Trans-2-octenoic acid	0.3125	0.01865	0.060	0.38
3	Thyme oil	3-Decenoic acid	0.3125	0.00917	0.029	0.38
4	Thyme oil	Trans-2-decenoic acid	0.3125	0.00906	0.029	0.50
5	Thyme oil	9-Decenoic acid	0.3125	0.01793	0.057	0.50

Example 5: Growth inhibition of *Botrytis cinerea* by neem oil limonoid extract (extracted from cold-pressed neem oil) and Fortune Aza Technical (azadirachtin extract) in combination with various exemplary unsaturated aliphatic acids

Sample preparation:

[0104] An extract of limonoids was prepared from cold-pressed neem oil using solvent extraction with hexane and methanol to prepare a neem oil limonoid extract. Fortune Aza Technical pesticide containing 14% azadirachtin (extracted from neem seed/kernel source) was obtained from Fortune Biotech Ltd. of Secunderabad, India.

[0105] Solutions of neem oil limonoid extract and Fortune Aza Technical were prepared at 5 mg/mL in DMSO followed by ten-fold dilution in PDB to give a concentration of 0.5 mg/mL in 10% DMSO/90% PDB.

[0106] Stock solutions of 3-octenoic acid and trans-2-octenoic acid as Compound B for testing of individual MICs were prepared at 25 µL/mL by adding 25 µL of each Compound B to 975 µL DMSO followed by 10-fold dilution in PDB.

- [0107] For testing in combination with neem oil limonoid extract and Fortune Aza Technical, stock solutions of 3-octenoic acid and trans-2-octenoic acid were prepared at 6.25 $\mu\text{L/mL}$ by adding 62.5 μL of the respective compound to 937.5 μL of DMSO followed by 10-fold dilution in PDB (ratio 11.7). Stock solutions of 3-octenoic acid and trans-2-octenoic acid were prepared at 3.125 $\mu\text{L/mL}$ for testing in combination by adding 31.25 μL of the respective compound to 968.75 μL of DMSO followed by 10-fold dilution in PDB (ratio 6.0 or 5.9). Stock solutions of 3-octenoic acid and trans-2-octenoic acid at 0.625 $\mu\text{L/mL}$ for testing in combination were prepared by adding 6.25 μL of the respective compound to 993.75 μL of DMSO followed by 10-fold dilution in PDB (ratio 1.2). The density of 3-octenoic acid was assumed to be 0.938 g/mL. The density of trans-2-octenoic acid was assumed to be 0.955 g/mL.
- [0108] Combinations were prepared by adding 0.5 mL of 6.25 $\mu\text{L/mL}$, 3.125 $\mu\text{L/mL}$, or 0.625 $\mu\text{L/mL}$ 3-octenoic acid or trans-2-octenoic acid, as prepared above (as Compound B), to 0.5 mL neem oil limonoid extract or Fortune Aza Technical at 0.5 mg/mL in 10% DMSO/90% PDB (as Compound A) for testing in the synergistic growth inhibition assay. Each combination was observed following a 24 hour incubation period, and the FIC Index for each combination calculated, as shown below in Tables 5 and 6.

Table 5: Growth inhibition of *Botrytis cinerea* by limonoid extract from cold-pressed neem oil in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Neem oil limonoid extract		0.25			
		3-octenoic acid		0.14656		
		Trans-2-octenoic acid		0.07461		
1	Neem oil limonoid extract	3-octenoic acid	0.0078125	0.09160	11.7	0.66
2	Neem oil limonoid extract	3-octenoic acid	0.015625	0.09160	5.9	0.69
3	Neem oil limonoid extract	3-octenoic acid	0.0625	0.07656	1.2	0.75
4	Neem oil limonoid extract	Trans-2-octenoic acid	0.0078125	0.04663	6.0	0.66
5	Neem oil limonoid extract	Trans-2-octenoic acid	0.03125	0.03730	1.2	0.63

Table 6: Growth inhibition of *Botrytis cinerea* by Fortune Aza Technical in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Fortune Aza Tech.		0.25			
		3-octenoic acid		0.14656		
		Trans-2-octenoic acid		0.07461		
1	Fortune Aza Tech.	3-octenoic acid	0.0078125	0.09160	11.7	0.66
2	Fortune Aza Tech.	3-octenoic acid	0.015625	0.09160	5.9	0.69
3	Fortune Aza Tech.	3-octenoic acid	0.0625	0.07656	1.2	0.75
4	Fortune Aza Tech.	Trans-2-octenoic acid	0.0078125	0.04663	6.0	0.66
5	Fortune Aza Tech.	Trans-2-octenoic acid	0.03125	0.03730	1.2	0.63

Sample Preparation for Examples 6-11

[0109] For each of experimental Examples 6-11 described below, concentrated stock solutions, and diluted working solutions were prepared for each of the exemplary pesticidal active ingredients as Component A, and each of the exemplary unsaturated aliphatic acids as Component B, in accordance with the following descriptions:

Compound A Pesticidal Active Ingredients:

[0110] Concentrated stock solutions were prepared by dissolving pesticidal active ingredient in 100% dimethylsulfoxide (DMSO), which were then diluted 10-fold in potato dextrose broth (PDB) to give a working stock solution, as described below:

[0111] Pyraclostrobin (available from Santa Cruz Biotech, Dallas, TX, USA, as stock # SC-229020): A 0.5 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.05 mg/mL working stock solution, for which an effective solubilized concentration of 0.015 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.015 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0112] Azoxystrobin (available from Sigma-Aldrich, St. Louis, MO, USA, as stock #31697): A 1.75 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.175 mg/mL working stock solution, for which an effective solubilized concentration of 0.15 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.15 mg/mL effective concentration

working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0113] Chlorothalonil (available from Chem Service Inc., West Chester, PA, USA, as stock #N-11454): A 0.5 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.05 mg/mL working stock solution, for which an effective solubilized concentration of 0.002 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.002 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0114] Fludioxonil (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China): A 1.05 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.105 mg/mL working stock solution, for which an effective solubilized concentration of 0.021 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.021 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0115] Cyprodinil (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China): A 1.37 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.137 mg/mL working stock solution, for which an effective solubilized concentration of 0.009 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.009 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0116] Metalaxyl: A 3.32 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.332 mg/mL working stock solution, for which an effective solubilized concentration of 0.316 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.316 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0117] Difenoconazole (available from Santa Cruz Biotech, Dallas, TX, USA, as stock no. SC-204721): A 1.3 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.13 mg/mL working stock solution, for which an effective solubilized concentration of 0.051 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.051 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0118] Propiconazole (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China): A 1.0

mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.10 mg/mL working stock solution, for which an effective solubilized concentration of 0.089 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.089 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0119] Epoxiconazole (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China): A 2.5 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.25 mg/mL working stock solution, for which an effective solubilized concentration of 0.03 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.025 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0120] Tebuconazole (available from Shanghai Terppon Chemical Co. Ltd., of Shanghai, China): A 5.0 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a nominal 0.50 mg/mL working stock solution, for which an effective solubilized concentration of 0.45 mg/mL was verified using high performance liquid chromatography (HPLC). This 0.45 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0121] Thyme oil (available from Sigma-Aldrich, St. Louis, MO, USA as stock #W306509), garlic oil (available from New Directions Aromatics, Mississauga, ON, Canada), lemongrass oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OL123), wintergreen oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OW134), peppermint oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OP1531), spearmint oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #AS132), clove leaf oil (available from New Directions Aromatics, Mississauga, ON, Canada), cinnamon leaf oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OC2131), tea tree oil (available from Newco Natural Technology, Calgary, AB, Canada), geranium oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OW134), peppermint oil (available from Xenex Labs, Coquitlam, BC, Canada as stock #OG1042), rosemary oil (available from Xenex Labs of Coquitlam, BC, Canada as stock #OR131), and oregano oil (available from New Directions Aromatics, Mississauga, ON, Canada): A 100 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 10 mg/mL concentration. This 10 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0122] Nootkatone(+) (available from Alfa Aesar, Ward Hill, MA, USA as stock #A19166): A 10 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of

1.0 mg/mL concentration. This 1.0 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

Neem oil limonoid extract: An extract of limonoids was prepared from cold-pressed neem oil using solvent extraction with hexane and methanol to prepare a neem oil limonoid extract. A 5 mg/mL stock solution of neem oil limonoid extract in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 0.5 mg/mL concentration. This 0.5 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0123] Fortune Aza Technical: Fortune Aza Technical™ pesticide containing 14% azadirachtin (extracted from neem seed/kernel source) was obtained from Fortune Biotech Ltd. of Secunderabad, India. A 5 mg/mL stock solution of Fortune Aza Technical in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 0.5 mg/mL concentration. This 0.5 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0124] Karanja oil flavonoid extract: An extract of flavonoids was prepared from cold-pressed karanja oil by solvent extraction. A 5 mg/mL stock solution of karanja oil flavonoid extract in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 0.5 mg/mL concentration. This 0.5 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0125] Salannin: Salannin was extracted and purified from cold-pressed neem oil by solvent extraction. A 1 mg/mL stock solution of salannin in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 0.1 mg/mL concentration. This 0.1 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

Compound B Unsaturated Aliphatic Acids:

[0126] Concentrated stock solutions were prepared by dissolving each exemplary unsaturated aliphatic acid in 100% dimethylsulfoxide (DMSO), which were then diluted 10-fold in potato dextrose broth (PDB) to give a working stock solution, as described below:

[0127] Trans-2-hexenoic acid, trans-3-hexenoic acid, cis-3-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 3-octenoic acid, 7-octenoic acid, 3-decenoic acid, cis-3-decenoic acid, 9-decenoic acid, trans-2-nonenic acid, 3-nonenic acid, (9Z)-octadecenoic acid (oleic

acid) (all available from Sigma-Aldrich, St. Louis, MO, USA), trans-2-decenoic acid (available from TCI America, Portland, OR, USA as stock #D0098), cis-2-decenoic acid (available from BOC Sciences, Sirley, NY, USA), and trans-2-undecenoic acid (available from Alfa Aesar, Ward Hill, MA, USA as stock #L-11579): A 50 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a
 5 working stock solution of 5 mg/mL concentration. This 5 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0128] (2E,4E)-2,4-hexadienoic acid (available from Sigma-Aldrich, St. Louis, MO, USA): A 20 mg/mL stock solution in 100% DMSO was diluted 10-fold in PDB to provide a working stock solution of 2
 10 mg/mL concentration. This 2 mg/mL effective concentration working stock solution was used for further serial dilution in PDB to the required individual concentrations as specified in Tables 7-62 below.

[0129] The working stock solutions for each Compound A and Compound B component were then serially diluted to test the individual MIC of each pesticidal active ingredient (as Compound A), each unsaturated aliphatic acid (as Compound B), and the combined MIC of each combination of Compound
 15 A and Compound B, according to the synergistic growth inhibition assay described above.

Example 6: Growth inhibition of *Fusarium oxysporum* by pyraclostrobin, azoxystrobin, fludioxonil, cyprodinil, difenoconazole, epoxiconazole, and tebuconazole, in combination with various exemplary unsaturated aliphatic acids

[0130] Working solutions of pyraclostrobin, azoxystrobin, fludioxonil, cyprodinil, difenoconazole, epoxiconazole, and tebuconazole were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 7-12
 20 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-3-hexenoic acid, 4-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 7-octenoic acid, 3-decenoic
 25 acid, 9-decenoic acid, trans-2-nonenoic acid, 3-nonenoic acid, trans-2-decenoic acid, and trans-2-undecenoic acid, (as Compound B), were each prepared as described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 7-12 below.

[0131] Each individual compound and combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following an incubation period of 48 hours, and the FIC
 30 Index for each combination calculated, as shown in Tables 7-12 below.

Table 7: Growth inhibition of *Fusarium oxysporum* by pyraclostrobin, in combination with various

exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Pyraclostrobin		0.015			
		(2E,4E)-2,4-hexadienoic acid		0.025		
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		5-Hexenoic acid		0.3125		
		3-Heptenoic acid		0.15625		
		Trans-2-octenoic acid		0.3125		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.3125		
		3-Decenoic acid		0.3125		
		9-Decenoic acid		0.3125		
1	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.00375	0.0625	17	0.50
2	Pyraclostrobin	Trans-3-hexenoic acid	0.001875	0.078125	42	0.38
3	Pyraclostrobin	4-Hexenoic acid	0.00375	0.15625	42	0.75
4	Pyraclostrobin	5-Hexenoic acid	0.00375	0.039062	10	0.38
5	Pyraclostrobin	3-Heptenoic acid	0.001875	0.078125	42	0.63
6	Pyraclostrobin	Trans-2-octenoic acid	0.001875	0.019531	10	0.19
7	Pyraclostrobin	Trans-3-octenoic acid	0.001875	0.019531	10	0.25
8	Pyraclostrobin	7-Octenoic acid	0.001875	0.019531	10	0.19
9	Pyraclostrobin	3-Decenoic acid	0.00375	0.078125	21	0.50
10	Pyraclostrobin	9-Decenoic acid	0.00375	0.039062	10	0.38

Table 8: Growth inhibition of *Fusarium oxysporum* by azoxystrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Azoxystrobin		0.15			
		Trans-3-hexenoic acid		0.3125		
		3-Heptenoic acid		0.15625		
		Trans-2-nonenoic acid		0.15625		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.3125		

1	Azoxystrobin	Trans-3-hexenoic acid	0.001875	0.078125	2	0.50
2	Azoxystrobin	3-Heptenoic acid	0.001875	0.019531	1	0.25
3	Azoxystrobin	Trans-2-nonenoic acid	0.0375	0.039062	1	0.50
4	Azoxystrobin	3-Decenoic acid	0.001875	0.019531	1	0.38
5	Azoxystrobin	9-Decenoic acid	0.00375	0.039062	1	0.50

Table 9: Growth inhibition of *Fusarium oxysporum* by fludioxonil and cyprodinil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Fludioxonil		0.021			
	Cyprodinil		0.009			
		3-Heptenoic acid		0.15625		
		3-Decenoic acid		0.15625		
1	Fludioxonil	3-Heptenoic acid	0.039062	0.00525	7	0.50
2	Fludioxonil	3-Decenoic acid	0.039062	0.00525	7	0.50
3	Cyprodinil	3-Decenoic acid	0.00225	0.019531	9	0.38

- 5 **Table 10:** Growth inhibition of *Fusarium oxysporum* by difenoconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Difenoconazole		0.051			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		3-Heptenoic acid		0.15625		
		Trans-2-octenoic acid		0.15625		
		3-Octenoic acid		0.15625		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.3125		
		Trans-2-nonenoic acid		0.3125		
		Trans-2-decenoic acid		0.078125		
		9-Decenoic acid		0.15625		
1	Difenoconazole	Trans-3-hexenoic acid	0.006375	0.078125	12	0.38
2	Difenoconazole	4-Hexenoic acid	0.01275	0.15625	12	0.75
3	Difenoconazole	3-Heptenoic acid	0.006375	0.078125	12	0.63
4	Difenoconazole	Trans-2-octenoic acid	0.01275	0.039062	3	0.50
5	Difenoconazole	3-Octenoic acid	0.01275	0.019531	1.5	0.38
6	Difenoconazole	Trans-3-octenoic acid	0.01275	0.039062	3	0.50
7	Difenoconazole	7-Octenoic acid	0.01275	0.039062	3	0.50
8	Difenoconazole	Trans-2-nonenoic acid	0.01275	0.039062	3	0.38

9	Difenoconazole	Trans-2-decenoic acid	0.01275	0.019531	1.5	0.50
10	Difenoconazole	9-Decenoic acid	0.01275	0.039062	3	0.50

Table 11: Growth inhibition of *Fusarium oxysporum* by epoxiconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Epoxiconazole		0.03			
		Trans-3-hexenoic acid		0.15625		
		3-Heptenoic acid		0.15625		
		Trans-2-octenoic acid		0.15625		
		3-Octenoic acid		0.15625		
		3-Decenoic acid		0.078125		
1	Epoxiconazole	Trans-3-hexenoic acid	0.0075	0.078125	10	0.75
2	Epoxiconazole	3-Heptenoic acid	0.0075	0.039062	5	0.50
3	Epoxiconazole	Trans-2-octenoic acid	0.0075	0.039062	5	0.50
4	Epoxiconazole	3-Octenoic acid	0.0075	0.039062	5	0.50
5	Epoxiconazole	3-Decenoic acid	0.0075	0.039062	5	0.75

- 5 **Table 12:** Growth inhibition of *Fusarium oxysporum* by tebuconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tebuconazole		0.225			
		Trans-2-octenoic acid		0.3125		
		3-Octenoic acid		0.15625		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.15625		
		Trans-2-nonenoic acid		0.3125		
		3-Nonenoic acid		0.15625		
		Trans-2-decenoic acid		0.15625		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.15625		
1	Tebuconazole	Trans-2-octenoic acid	0.05625	0.039062	0.7	0.38
2	Tebuconazole	3-Octenoic acid	0.05625	0.019531	0.3	0.38
3	Tebuconazole	Trans-3-octenoic acid	0.05625	0.039062	0.7	0.50
4	Tebuconazole	7-Octenoic acid	0.05625	0.039062	0.7	0.50
5	Tebuconazole	Trans-2-nonenoic acid	0.028125	0.019531	0.7	0.19
6	Tebuconazole	3-Nonenoic acid	0.05625	0.019531	0.3	0.38
7	Tebuconazole	Trans-2-decenoic acid	0.05625	0.019531	0.3	0.38
8	Tebuconazole	9-Decenoic acid	0.05625	0.039062	0.7	0.75

9	Tebuconazole	Trans-2-undecenoic acid	0.05625	0.019531	0.3	0.38
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Example 7: Growth inhibition of *Sclerotinia sclerotiorum* by pyraclostrobin, azoxystrobin, chlorothalonil, fludioxonil, difenoconazole, propiconazole, epoxiconazole, and tebuconazole, in combination with various exemplary unsaturated aliphatic acids

5 [0132] Working solutions of pyraclostrobin, azoxystrobin, chlorothalonil, fludioxonil, difenoconazole, propiconazole, epoxiconazole, and tebuconazole were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 13-22 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-2-hexenoic acid, trans-3-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 3-octenoic acid, 7-octenoic acid, 3-decenoic acid, cis-3-hexenoic acid, 9-decenoic acid, trans-2-nonenic acid, 3-nonenic acid, (9Z)-octadecenoic acid, trans-2-decenoic acid, cis-2-decenoic acid, and trans-2-undecenoic acid (as Compound B), were each prepared as described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 13-22 below.

15 [0133] Each individual compound and combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following an incubation period of 7 days, and the FIC Index for each combination calculated, as shown in Tables 13-22 below.

Table 13: Growth inhibition of *Sclerotinia sclerotiorum* by pyraclostrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Pyraclostrobin		0.0075			
		(2E,4E)-2,4-hexadienoic acid		0.125		
		Trans-2-hexenoic acid		0.15625		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.078125		
		Trans-3-octenoic acid		0.039062		
		7-Octenoic acid		0.039062		
		Trans-2-nonenic acid		0.019531		
		3-Nonenic acid		0.019531		
		Trans-2-decenoic acid		0.019531		
		3-Decenoic acid		0.039062		

		9-Decenoic acid		0.039062		
		Trans-2-undecenoic acid		0.019531		
		(9Z)-octadecenoic acid		5.0		
1	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.001875	0.015625	8	0.38
2	Pyraclostrobin	Trans-2-hexenoic acid	0.000937	0.009765	10	0.19
3	Pyraclostrobin	Trans-3-hexenoic acid	0.000937	0.019531	21	0.25
4	Pyraclostrobin	5-Hexenoic acid	0.000937	0.019531	21	0.25
5	Pyraclostrobin	3-Heptenoic acid	0.000937	0.009766	10	0.25
6	Pyraclostrobin	Trans-2-octenoic acid	0.000469	0.004882	10	0.19
7	Pyraclostrobin	3-Octenoic acid	0.000469	0.004882	10	0.13
8	Pyraclostrobin	Trans-3-octenoic acid	0.000469	0.004882	10	0.19
9	Pyraclostrobin	7-Octenoic acid	0.000469	0.004882	10	0.19
10	Pyraclostrobin	Trans-2-nonenoic acid	0.000469	0.004882	10	0.31
11	Pyraclostrobin	3-Nonenoic acid	0.000469	0.004882	10	0.31
12	Pyraclostrobin	Trans-2-decenoic acid	0.000937	0.002441	3	0.25
13	Pyraclostrobin	3-Decenoic acid	0.000234	0.002441	10	0.09
14	Pyraclostrobin	9-Decenoic acid	0.000469	0.004882	10	0.19
15	Pyraclostrobin	Trans-2-undecenoic acid	0.000469	0.004882	10	0.31
16	Pyraclostrobin	(9Z)-octadecenoic acid	0.00375	2.5	667	1.00

Table 14: Growth inhibition of *Sclerotinia sclerotiorum* by pyraclostrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Pyraclostrobin		0.00375			
		Trans-3-hexenoic acid		0.15625		
		Cis-3-hexenoic acid		0.15625		
		Trans-2-decenoic acid		0.019531		
		Cis-2-decenoic acid		0.019531		
1	Pyraclostrobin	Trans-3-hexenoic acid	0.001875	0.039062	21	0.75
2	Pyraclostrobin	Cis-3-hexenoic acid	0.001875	0.039062	21	0.75
3	Pyraclostrobin	Trans-2-decenoic acid	0.0009375	0.002441	3	0.38
4	Pyraclostrobin	Cis-2-decenoic acid	0.0009375	0.002441	3	0.38

5

Table 15: Growth inhibition of *Sclerotinia sclerotiorum* by azoxystrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Azoxystrobin		0.15			

		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		3-Octenoic acid		0.039062		
		Trans-3-octenoic acid		0.039062		
		3-Nonenoic acid		0.039062		
		Trans-2-decenoic acid		0.009766		
		3-Decenoic acid		0.039062		
		9-Decenoic acid		0.039062		
1	Azoxystrobin	Trans-3-hexenoic acid	0.0375	0.039062	1	0.50
2	Azoxystrobin	5-Hexenoic acid	0.0375	0.039062	1	0.50
3	Azoxystrobin	3-Heptenoic acid	0.0375	0.019531	0.5	0.50
4	Azoxystrobin	3-Octenoic acid	0.0375	0.019531	0.5	0.75
5	Azoxystrobin	Trans-3-octenoic acid	0.01875	0.009766	0.5	0.38
6	Azoxystrobin	3-Nonenoic acid	0.0375	0.019531	0.5	0.75
7	Azoxystrobin	Trans-2-decenoic acid	0.0375	0.004882	0.1	0.75
8	Azoxystrobin	3-Decenoic acid	0.01875	0.009766	0.5	0.38
9	Azoxystrobin	9-Decenoic acid	0.01875	0.009766	0.5	0.38

Table 16: Growth inhibition of *Sclerotinia sclerotiorum* by chlorothalonil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Chlorothalonil		3.125×10^{-5}			
		Trans-2-nonenoic acid		0.039062		
		3-Nonenoic acid		0.039062		
		9-Decenoic acid		0.039062		
1	Chlorothalonil	Trans-2-nonenoic acid	3.906×10^{-6}	0.009766	2500	0.38
2	Chlorothalonil	3-Nonenoic acid	7.813×10^{-6}	0.019531	2500	0.75
3	Chlorothalonil	9-Decenoic acid	7.813×10^{-6}	0.019531	2500	0.75

5 **Table 17:** Growth inhibition of *Sclerotinia sclerotiorum* by fludioxonil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Fludioxonil		0.000164			
		Trans-2-octenoic acid		0.078125		
		3-Octenoic acid		0.078125		
		Trans-2-nonenoic acid		0.078125		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.039062		
		9-Decenoic acid		0.15625		

1	Fludioxonil	Trans-2-octenoic acid	8.203×10^{-5}	0.019531	238	0.75
2	Fludioxonil	3-Octenoic acid	8.203×10^{-5}	0.019531	238	0.75
3	Fludioxonil	Trans-2-nonenoic acid	8.203×10^{-5}	0.009766	119	0.63
4	Fludioxonil	3-Nonenoic acid	8.203×10^{-5}	0.009766	119	0.63
5	Fludioxonil	Trans-2-decenoic acid	8.203×10^{-5}	0.009766	119	0.75
6	Fludioxonil	9-Decenoic acid	8.203×10^{-5}	0.019531	238	0.63

Table 18: Growth inhibition of *Sclerotinia sclerotiorum* by difenoconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Difenoconazole		0.0255			
		Trans-2-octenoic acid		0.078125		
		Trans-2-nonenoic acid		0.039062		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.019531		
		3-decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.039062		
1	Difenoconazole	Trans-2-octenoic acid	0.006375	0.019531	3.1	0.50
2	Difenoconazole	Trans-2-nonenoic acid	0.006375	0.009766	1.5	0.50
3	Difenoconazole	3-Nonenoic acid	0.006375	0.009766	1.5	0.38
4	Difenoconazole	Trans-2-decenoic acid	0.006375	0.009766	1.5	0.75
5	Difenoconazole	3-Decenoic acid	0.006375	0.019531	3.1	0.75
6	Difenoconazole	9-Decenoic acid	0.006375	0.019531	3.1	0.50
7	Difenoconazole	Trans-2-undecenoic acid	0.006375	0.009766	1.5	0.50

5 **Table 19:** Growth inhibition of *Sclerotinia sclerotiorum* by propiconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Propiconazole		0.089			
		3-Heptenoic acid		0.078125		
		Trans-2-nonenoic acid		0.019531		
		Trans-2-decenoic acid		0.019531		
		9-Decenoic acid		0.039062		
		Trans-2-undecenoic acid		0.039062		
1	Propiconazole	3-Heptenoic acid	0.02225	0.019531	0.9	0.50
2	Propiconazole	Trans-2-nonenoic acid	0.02225	0.009766	0.4	0.75

3	Propiconazole	Trans-2-decenoic acid	0.02225	0.009766	0.4	0.75
4	Propiconazole	9-Decenoic acid	0.02225	0.009766	0.9	0.38
5	Propiconazole	Trans-2-undecenoic acid	0.02225	0.009766	0.4	0.75

Table 20: Growth inhibition of *Sclerotinia sclerotiorum* by epoxiconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Epoxiconazole		0.03			
		Trans-2-nonenoic acid		0.019531		
		Trans-2-decenoic acid		0.019531		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
1	Epoxiconazole	Trans-2-nonenoic acid	0.0075	0.009766	1.3	0.75
2	Epoxiconazole	Trans-2-decenoic acid	0.0075	0.009766	1.3	0.75
3	Epoxiconazole	3-Decenoic acid	0.0075	0.019531	2.6	0.50
4	Epoxiconazole	9-Decenoic acid	0.0075	0.019531	2.6	0.50

- 5 **Table 21:** Growth inhibition of *Sclerotinia sclerotiorum* by tebuconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tebuconazole		0.1125			
		Trans-3-hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		Trans-2-nonenoic acid		0.039062		
		3-Nonenoic acid		0.039062		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.039062		
1	Tebuconazole	Trans-3-hexenoic acid	0.05625	0.039062	0.7	0.75
2	Tebuconazole	3-Heptenoic acid	0.05625	0.019531	0.3	0.75
3	Tebuconazole	Trans-2-nonenoic acid	0.028125	0.004882	0.2	0.38
4	Tebuconazole	3-Nonenoic acid	0.05625	0.009766	0.2	0.75
5	Tebuconazole	3-Decenoic acid	0.028125	0.009766	0.3	0.38
6	Tebuconazole	9-Decenoic acid	0.028125	0.009766	0.3	0.38
7	Tebuconazole	Trans-2-undecenoic acid	0.05625	0.009766	0.2	0.75

Table 22: Growth inhibition of *Sclerotinia sclerotiorum* by tebuconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tebuconazole		0.1125			
		Trans-3-octanoic acid		0.039062		
		Trans-2-decenoic acid		0.019531		
1	Tebuconazole	Trans-3-octanoic acid	0.028125	0.019531	0.7	0.75
2	Tebuconazole	Trans-2-decenoic acid	0.028125	0.004882	0.2	0.50

Example 8: Growth inhibition of *Botrytis cinerea* by pyraclostrobin, azoxystrobin, chlorothalonil, cyprodinil, metalaxyl, epoxiconazole, and tebuconazole, in combination with various exemplary unsaturated aliphatic acids

- 5 [0134] Working solutions of pyraclostrobin, azoxystrobin, chlorothalonil, cyprodinil, metalaxyl, epoxiconazole, and tebuconazole were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 23-30 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-2-hexenoic acid, trans-3-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 3-octenoic acid, 7-
 10 octenoic acid, 3-decenoic acid, 9-decenoic acid, trans-2-nonenoic acid, 3-nonenoic acid, (9Z)-octadecenoic acid, trans-2-decenoic acid, and trans-2-undecenoic acid (as Compound B), were each prepared as described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 23-30 below.

- [0135] Each individual compound and combination was tested over a range of 2-fold dilutions in the
 15 synergistic growth inhibition assay, observed following an incubation period of 48 hours, and the FIC Index for each combination calculated, as shown in Tables 23-30 below.

Table 23: Growth inhibition of *Botrytis cinerea* by pyraclostrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Pyraclostrobin		0.001875			
		(2E,4E)-2,4-hexadienoic acid		0.0625		
		Trans-2-hexenoic acid		0.078125		
		Trans-3-hexenoic acid		0.15625		
		4-Hexenoic acid		0.3125		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		

		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.078125		
		7-Octenoic acid		0.078125		
		Trans-2-nonenic acid		0.078125		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.019531		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.15625		
		Trans-2-undecenoic acid		0.15625		
1	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.000469	0.007812	17	0.38
2	Pyraclostrobin	Trans-2-hexenoic acid	0.000937	0.009766	10	0.63
3	Pyraclostrobin	Trans-3-hexenoic acid	0.000469	0.009766	21	0.31
4	Pyraclostrobin	4-Hexenoic acid	0.000937	0.019531	21	0.56
5	Pyraclostrobin	5-Hexenoic acid	0.000469	0.009766	21	0.31
6	Pyraclostrobin	3-Heptenoic acid	0.000469	0.004882	10	0.31
7	Pyraclostrobin	Trans-2-octenoic acid	0.000234	0.002441	10	0.19
8	Pyraclostrobin	3-Octenoic acid	0.000234	0.002441	10	0.16
9	Pyraclostrobin	Trans-3-octenoic acid	0.000469	0.004882	10	0.31
10	Pyraclostrobin	7-Octenoic acid	0.000469	0.004882	10	0.31
11	Pyraclostrobin	Trans-2-nonenic acid	0.000469	0.004882	10	0.31
12	Pyraclostrobin	3-Nonenoic acid	0.000469	0.004882	10	0.31
13	Pyraclostrobin	Trans-2-decenoic acid	0.000469	0.004882	10	0.50
14	Pyraclostrobin	3-Decenoic acid	0.000234	0.004882	21	0.19
15	Pyraclostrobin	9-Decenoic acid	0.000234	0.002441	10	0.14
16	Pyraclostrobin	Trans-2-undecenoic acid	0.000937	0.009766	10	0.56

Table 24: Growth inhibition of *Botrytis cinerea* by pyraclostrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Pyraclostrobin		0.001875			
		(2E,4E)-2,4-hexadienoic acid		0.0625		
		Trans-2-hexenoic acid		0.039062		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.078125		
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.078125		
		7-Octenoic acid		0.039062		
		Trans-2-nonenic acid		0.039062		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.078125		

		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.078125		
1	Pyraclostrobin	(2E,4E)-2,4-hexadienoic acid	0.000234	0.003906	17	0.19
2	Pyraclostrobin	Trans-2-hexenoic acid	0.000234	0.002441	10	0.19
3	Pyraclostrobin	Trans-3-hexenoic acid	0.000469	0.009766	21	0.31
4	Pyraclostrobin	5-Hexenoic acid	0.000469	0.009766	21	0.38
5	Pyraclostrobin	3-Heptenoic acid	0.000469	0.004882	10	0.19
6	Pyraclostrobin	Trans-2-octenoic acid	0.000234	0.002441	10	0.19
7	Pyraclostrobin	3-Octenoic acid	0.000469	0.004882	10	0.31
8	Pyraclostrobin	7-Octenoic acid	0.000234	0.002441	10	0.19
9	Pyraclostrobin	Trans-2-nonenic acid	0.000234	0.002441	10	0.19
10	Pyraclostrobin	3-Nonenoic acid	0.000469	0.004882	10	0.31
11	Pyraclostrobin	Trans-2-decenoic acid	0.000234	0.002441	10	0.16
12	Pyraclostrobin	3-Decenoic acid	0.000234	0.004882	21	0.19
13	Pyraclostrobin	9-Decenoic acid	0.000234	0.002441	10	0.16
14	Pyraclostrobin	Trans-2-undecenoic acid	0.000234	0.002441	10	0.16

Table 25: Growth inhibition of *Botrytis cinerea* by azoxystrobin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Azoxystrobin		0.075			
		Trans-2-hexenoic acid		0.15625		
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		5-Hexenoic acid		0.3125		
		Trans-2-octenoic acid		0.078125		
		3-Octenoic acid		0.078125		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.15625		
		Trans-2-nonenic acid		0.039062		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.039062		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.078125		
1	Azoxystrobin	Trans-2-hexenoic acid	0.0375	0.039062	1	0.75
3	Azoxystrobin	Trans-3-hexenoic acid	0.0375	0.078125	2	0.75
4	Azoxystrobin	4-Hexenoic acid	0.0375	0.078125	2	0.75
5	Azoxystrobin	5-Hexenoic acid	0.0375	0.078125	2	0.75
6	Azoxystrobin	Trans-2-octenoic acid	0.009375	0.009766	1	0.25

7	Azoxystrobin	3-Octenoic acid	0.01875	0.019531	1	0.50
8	Azoxystrobin	Trans-3-octenoic acid	0.01875	0.019531	1	0.38
9	Azoxystrobin	7-Octenoic acid	0.01875	0.019531	1	0.38
10	Azoxystrobin	Trans-2-nonenic acid	0.01875	0.019531	1	0.75
11	Azoxystrobin	3-Nonenoic acid	0.01875	0.019531	1	0.50
12	Azoxystrobin	Trans-2-decenoic acid	0.009375	0.009766	1	0.38
13	Azoxystrobin	3-Decenoic acid	0.009375	0.019531	2	0.38
14	Azoxystrobin	9-Decenoic acid	0.01875	0.019531	1	0.50
15	Azoxystrobin	Trans-2-undecenoic acid	0.01875	0.019531	1	0.50

Table 26: Growth inhibition of *Botrytis cinerea* by chlorothalonil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Chlorothalonil		1.758×10^{-5}			
		Trans-2-nonenic acid		0.019531		
		9-Decenoic acid		0.039062		
1	Chlorothalonil	Trans-2-nonenic acid	4.395×10^{-6}	0.004882	1111	0.50
2	Chlorothalonil	9-Decenoic acid	4.395×10^{-6}	0.019531	4444	0.75

5 **Table 27:** Growth inhibition of *Botrytis cinerea* by cyprodinil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Cyprodinil		0.0045			
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.078125		
		3-Octenoic acid		0.078125		
		7-Octenoic acid		0.078125		
		Trans-2-nonenic acid		0.078125		
		3-Nonenoic acid		0.078125		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.078125		
1	Cyprodinil	3-Heptenoic acid	0.001125	0.039062	35	0.75
2	Cyprodinil	Trans-2-octenoic acid	0.001125	0.039062	35	0.75
3	Cyprodinil	3-Octenoic acid	0.001125	0.039062	35	0.75
4	Cyprodinil	7-Octenoic acid	0.000562	0.019531	35	0.38
5	Cyprodinil	Trans-2-nonenic acid	0.001125	0.039062	35	0.75
6	Cyprodinil	3-Nonenoic acid	0.001125	0.039062	35	0.75
7	Cyprodinil	3-Decenoic acid	0.000562	0.039062	69	0.63
8	Cyprodinil	9-Decenoic acid	0.000562	0.019531	35	0.38

9	Cyprodinil	Trans-2-undecenoic acid	0.000562	0.019531	35	0.38
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Table 28: Growth inhibition of *Botrytis cinerea* by metalaxyl, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Metalaxyl		0.316			
		3-Nonenoic acid		0.078125		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.078125		
1	Metalaxyl	3-Nonenoic acid	0.079	0.039062	0.5	0.75
2	Metalaxyl	9-Decenoic acid	0.079	0.039062	0.5	0.75
3	Metalaxyl	Trans-2-undecenoic acid	0.079	0.039062	0.5	0.75

5 **Table 29:** Growth inhibition of *Botrytis cinerea* by epoxiconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Epoxiconazole		0.03			
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.15625		
		3-Octenoic acid		0.078125		
		Trans-3-octenoic acid		0.078125		
		Trans-2-nonenic acid		0.15625		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.078125		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.15625		
		Trans-2-undecenoic acid		0.078125		
		(9Z)-octadecenoic acid		5.0		
1	Epoxiconazole	3-Heptenoic acid	0.0075	0.039062	5	0.75
2	Epoxiconazole	Trans-2-octenoic acid	0.0075	0.039062	5	0.50
3	Epoxiconazole	3-Octenoic acid	0.0075	0.039062	5	0.75
4	Epoxiconazole	Trans-3-octenoic acid	0.0075	0.039062	5	0.75
5	Epoxiconazole	Trans-2-nonenic acid	0.00375	0.019531	5	0.25
6	Epoxiconazole	3-Nonenoic acid	0.00375	0.019531	5	0.38
7	Epoxiconazole	Trans-2-decenoic acid	0.00375	0.019531	5	0.38
8	Epoxiconazole	3-Decenoic acid	0.001875	0.019531	10	0.31
9	Epoxiconazole	9-Decenoic acid	0.00375	0.019531	5	0.25
10	Epoxiconazole	Trans-2-undecenoic acid	0.0075	0.039062	5	0.75
11	Epoxiconazole	(9Z)-octadecenoic acid	0.015	2.5	167	1.00

Table 30: Growth inhibition of *Botrytis cinerea* by tebuconazole, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tebuconazole		0.1125			
		5-Hexenoic acid		0.15625		
		Trans-2-octenoic acid		0.039062		
		Trans-2-decenoic acid		0.039062		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.039062		
		Trans-2-undecenoic acid		0.039062		
		(9Z)-octadecenoic acid		5.0		
1	Tebuconazole	5-Hexenoic acid	0.028125	0.039062	1.4	0.50
2	Tebuconazole	Trans-2-octenoic acid	0.014062	0.009766	0.7	0.38
3	Tebuconazole	Trans-2-decenoic acid	0.028125	0.019531	0.7	0.75
4	Tebuconazole	3-Decenoic acid	0.028125	0.019531	0.7	0.50
5	Tebuconazole	9-Decenoic acid	0.014062	0.019531	1.4	0.63
6	Tebuconazole	Trans-2-undecenoic acid	0.028125	0.019531	0.7	0.75
7	Tebuconazole	(9Z)-octadecenoic acid	0.015	2.5	44	1.00

- 5 **Example 9:** Growth inhibition of *Fusarium oxysporum* by thyme oil, garlic oil, lemongrass oil, wintergreen oil, peppermint oil, spearmint oil, clove leaf oil, cinnamon leaf oil, tea tree oil, geranium oil, oregano oil, rosemary oil, and nootkatone(+), in combination with various exemplary unsaturated aliphatic acids.

- [0136] Working solutions of thyme oil, garlic oil, lemongrass oil, wintergreen oil, peppermint oil, spearmint oil, clove leaf oil, cinnamon leaf oil, tea tree oil, geranium oil, oregano oil, rosemary oil, and nootkatone(+) were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 31-45 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-2-hexenoic acid, trans-3-hexenoic acid, 4-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 3-octenoic acid, 7-octenoic acid, 3-decenoic acid, 9-decenoic acid, trans-2-nonenoic acid, 3-nonenoic acid, (9Z)-octadecenoic acid, trans-2-decenoic acid, and trans-2-undecenoic acid, (as Compound B), were each prepared as described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 31-45 below.

- [0137] Each individual compound and combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following an incubation period of 48 hours, and the FIC

Index for each combination calculated, as shown in Tables 31-45 below.

Table 31: Growth inhibition of *Fusarium oxysporum* by thyme oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Thyme oil		1.25			
		(2E,4E)-2,4-hexadienoic acid		0.25		
		Trans-2-hexenoic acid		0.15625		
		Trans-3-hexenoic acid		0.3125		
		5-Hexenoic acid		0.3125		
		3-Heptenoic acid		0.15625		
		Trans-2-octenoic acid		0.078125		
		3-Octenoic acid		0.15625		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.15625		
		Trans-2-nonenoic acid		0.078125		
		3-Nonenoic acid		0.15625		
		3-Decenoic acid		0.15625		
		Trans-2-decenoic acid		0.078125		
		9-Decenoic acid		0.3125		
		Trans-2- undecenoic acid		0.15625		
1	Thyme oil	(2E,4E)-2,4-hexadienoic acid	0.3125	0.03125	0.10	0.38
2	Thyme oil	Trans-2-hexenoic acid	0.3125	0.078125	0.25	0.75
3	Thyme oil	Trans-3-hexenoic acid	0.15625	0.039062	0.25	0.25
4	Thyme oil	5-Hexenoic acid	0.15625	0.039062	0.25	0.25
5	Thyme oil	3-Heptenoic acid	0.3125	0.039062	0.13	0.50
6	Thyme oil	Trans-2-octenoic acid	0.3125	0.039062	0.13	0.75
7	Thyme oil	3-Octenoic acid	0.3125	0.039062	0.13	0.50
8	Thyme oil	Trans-3-octenoic acid	0.3125	0.039062	0.13	0.50
9	Thyme oil	7-Octenoic acid	0.3125	0.039062	0.13	0.50
10	Thyme oil	Trans-2-nonenoic acid	0.3125	0.039062	0.13	0.75
11	Thyme oil	3-Nonenoic acid	0.3125	0.039062	0.13	0.50
12	Thyme oil	Trans-2-decenoic acid	0.3125	0.039062	0.06	0.50
13	Thyme oil	3-Decenoic acid	0.15625	0.019531	0.13	0.25
14	Thyme oil	9-Decenoic acid	0.3125	0.039062	0.13	0.38
15	Thyme oil	Trans-2- undecenoic acid	0.3125	0.078125	0.25	0.75

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Table 32: Growth inhibition of *Fusarium oxysporum* by thyme oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
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					Compound A	
	Thyme oil		0.625			
		4-Hexenoic acid		0.3125		
	Thyme oil	4-Hexenoic acid	0.078125	0.039062	0.13	0.25

Table 33: Growth inhibition of *Fusarium oxysporum* by garlic oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Garlic oil		2.5			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		3-Heptenoic acid		0.15625		
1	Garlic oil	Trans-3-hexenoic acid	0.3125	0.15625	0.5	0.63
2	Garlic oil	4-Hexenoic acid	0.3125	0.15625	0.5	0.63
3	Garlic oil	3-Heptenoic acid	0.15625	0.078125	0.5	0.56

- 5 **Table 34:** Growth inhibition of *Fusarium oxysporum* by lemongrass oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Lemongrass oil		1.25			
		Trans-2-hexenoic acid		0.15625		
		3-Octenoic acid		0.15625		
1	Lemongrass oil	Trans-2-hexenoic acid	0.3125	0.078125	0.25	0.75
2	Lemongrass oil	3-Octenoic acid	0.3125	0.039062	0.13	0.50

Table 35: Growth inhibition of *Fusarium oxysporum* by wintergreen oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Wintergreen oil		10			
		Trans-3-hexenoic acid		0.3125		
		3-Decenoic acid		0.15625		
1	Wintergreen oil	Trans-3-hexenoic acid	0.625	0.15625	0.25	0.56
2	Wintergreen oil	3-Decenoic acid	0.625	0.078125	0.13	0.56

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Table 36: Growth inhibition of *Fusarium oxysporum* by peppermint oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Peppermint oil		5.0			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		3-Decenoic acid		0.15625		
1	Peppermint oil	Trans-3-hexenoic acid	1.25	0.15625	0.13	0.75
2	Peppermint oil	4-Hexenoic acid	1.25	0.15625	0.13	0.75
3	Peppermint oil	3-Decenoic acid	1.25	0.078125	0.06	0.75

Table 37: Growth inhibition of *Fusarium oxysporum* by spearmint oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Spearmint oil		5.0			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		5-Hexenoic acid		0.15625		
		Trans-2-nonenic acid		0.15625		
		3-Decenoic acid		0.15625		
		9-Decenoic acid		0.3125		
1	Spearmint oil	Trans-3-hexenoic acid	1.25	0.15625	0.13	0.75
2	Spearmint oil	4-Hexenoic acid	1.25	0.15625	0.13	0.75
3	Spearmint oil	5-Hexenoic acid	1.25	0.039062	0.03	0.50
4	Spearmint oil	Trans-2-nonenic acid	1.25	0.039062	0.03	0.50
5	Spearmint oil	3-Decenoic acid	1.25	0.078125	0.06	0.75
6	Spearmint oil	9-Decenoic acid	1.25	0.039062	0.03	0.38

- 5 **Table 38:** Growth inhibition of *Fusarium oxysporum* by clove leaf oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Clove leaf oil		1.25			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		7-Octenoic acid		0.3125		
		Trans-2-nonenic acid		0.3125		
		Trans-2-decenoic acid		0.15625		
		3-Decenoic acid		0.3125		
1	Clove leaf oil	Trans-3-hexenoic acid	0.3125	0.15625	0.50	0.75

2	Clove leaf oil	4-Hexenoic acid	0.3125	0.15625	0.50	0.75
3	Clove leaf oil	7-Octenoic acid	0.3125	0.039062	0.13	0.38
4	Clove leaf oil	Trans-2-nonenic acid	0.3125	0.039062	0.06	0.38
5	Clove leaf oil	Trans-2-decenoic acid	0.3125	0.019531	0.06	0.38
6	Clove leaf oil	3-Decenoic acid	0.3125	0.078125	0.25	0.50

Table 39: Growth inhibition of *Fusarium oxysporum* by cinnamon leaf oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Cinnamon leaf oil		1.25			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		5-Hexenoic acid		0.3125		
		Trans-2-octenoic acid		0.15625		
		Trans-3-octenoic acid		0.15625		
		7-Octenoic acid		0.3125		
		3-Decenoic acid		0.3125		
1	Cinnamon leaf oil	Trans-3-hexenoic acid	0.3125	0.15625	0.50	0.75
2	Cinnamon leaf oil	4-Hexenoic acid	0.3125	0.15625	0.50	0.75
3	Cinnamon leaf oil	5-Hexenoic acid	0.3125	0.039062	0.13	0.38
4	Cinnamon leaf oil	Trans-2-octenoic acid	0.3125	0.039062	0.13	0.50
5	Cinnamon leaf oil	Trans-3-octenoic acid	0.3125	0.039062	0.13	0.50
6	Cinnamon leaf oil	7-Octenoic acid	0.3125	0.039062	0.13	0.38
7	Cinnamon leaf oil	3-Decenoic acid	0.3125	0.078125	0.25	0.50

- 5 **Table 40:** Growth inhibition of *Fusarium oxysporum* by tea tree oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tea tree oil		5.0			
		Trans-3-hexenoic acid		0.3125		
1	Tea tree oil	Trans-3-hexenoic acid	0.625	0.15625	0.25	0.63

Table 41: Growth inhibition of *Fusarium oxysporum* by geranium oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Tea tree oil		2.5			

		4-Hexenoic acid		0.3125		
1	Tea tree oil	4-Hexenoic acid	0.625	0.15625	0.25	0.75

Table 42: Growth inhibition of *Fusarium oxysporum* by oregano oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Oregano oil		1.25			
		3-Heptenoic acid		0.15625		
		3-Nonenoic acid		0.15625		
		3-Decenoic acid		0.15625		
		9-Decenoic acid				
1	Oregano oil	3-Heptenoic acid	0.078125	0.078125	1.00	0.56
2	Oregano oil	3-Nonenoic acid	0.15625	0.019531	0.13	0.25
3	Oregano oil	3-Decenoic acid	0.15625	0.078125	0.50	0.63
4	Oregano oil	9-Decenoic acid	0.15625	0.039062	0.25	0.25

- 5 **Table 43:** Growth inhibition of *Fusarium oxysporum* by oregano oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Oregano oil		1.25			
		Trans-2-hexenoic acid		0.3125		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.15625		
		3-Octenoic acid		0.15625		
		7-Octenoic acid		0.15625		
		Trans-2-Decenoic acid		0.078125		
		Trans-2-undecenoic acid				
1	Oregano oil	Trans-2-hexenoic acid	0.15625	0.039062	0.25	0.25
2	Oregano oil	Trans-3-hexenoic acid	0.3125	0.078125	0.25	0.75
3	Oregano oil	5-Hexenoic acid	0.3125	0.078125	0.25	0.75
4	Oregano oil	3-Heptenoic acid	0.3125	0.039062	0.13	0.50
5	Oregano oil	3-Octenoic acid	0.3125	0.039062	0.13	0.50
6	Oregano oil	7-Octenoic acid	0.3125	0.039062	0.13	0.50
7	Oregano oil	Trans-2-Decenoic acid	0.3125	0.019531	0.06	0.50
8	Oregano oil	Trans-2-undecenoic acid	0.3125	0.078125	0.25	0.75

Table 44: Growth inhibition of *Fusarium oxysporum* by rosemary oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Rosemary oil		5.0			
		Trans-3-hexenoic acid		0.3125		
		4-Hexenoic acid		0.3125		
		Trans-2-octenoic acid		0.078125		
		3-Decenoic acid		0.15625		
1	Rosemary oil	Trans-3-hexenoic acid	0.625	0.15625	0.25	0.63
2	Rosemary oil	4-Hexenoic acid	0.625	0.15625	0.25	0.63
3	Rosemary oil	Trans-2-octenoic acid	0.625	0.039062	0.06	0.63
4	Rosemary oil	3-Decenoic acid	0.625	0.078125	0.13	0.63

Table 45: Growth inhibition of *Fusarium oxysporum* by nootkatone(+), in combination with various an exemplary unsaturated aliphatic acid

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Nootkatone (+)		0.5			
		3-Decenoic acid		0.15625		
1	Nootkatone (+)	3-Decenoic acid	0.0625	0.078125	1.3	0.63

- 5 **Example 10:** Growth inhibition of *Sclerotinia sclerotiorum* by thyme oil, garlic oil, lemongrass oil, wintergreen oil, peppermint oil, spearmint oil, clove leaf oil, Fortune Aza Technical azadirachtin extract, and oregano oil, in combination with various exemplary unsaturated aliphatic acids.

[0138] Working solutions of thyme oil, garlic oil, lemongrass oil, wintergreen oil, peppermint oil, spearmint oil, clove leaf oil, Fortune Aza Technical azadirachtin extract, and oregano oil were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 46-54 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-2-hexenoic acid, trans-3-hexenoic acid, 4-hexenoic acid, 5-hexenoic acid, 3-heptenoic acid, trans-2-octenoic acid, trans-3-octenoic acid, 3-octenoic acid, 7-octenoic acid, 3-decenoic acid, 9-decenoic acid, trans-2-nonenoic acid, 3-nonenoic acid, (9Z)-octadecenoic acid, trans-2-decenoic acid, and trans-2-undecenoic acid, (as Compound B), were each prepared as described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 46-54 below.

[0139] Each individual compound and combination was tested over a range of 2-fold dilutions in the synergistic growth inhibition assay, observed following an incubation period of 7 days, and the FIC Index for each combination calculated, as shown in Tables 46-54 below.

Table 46: Growth inhibition of *Sclerotinia sclerotiorum* by thyme oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Thyme oil		0.625			
		Trans-3-hexenoic acid		0.15625		
		4-Hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		Trans-3-octenoic acid		0.078125		
		7-Octenoic acid		0.039062		
		3-Nonenoic acid		0.078125		
		3-Decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.078125		
1	Thyme oil	Trans-3-hexenoic acid	0.3125	0.039062	0.13	0.75
2	Thyme oil	4-Hexenoic acid	0.3125	0.039062	0.13	0.75
3	Thyme oil	5-Hexenoic acid	0.3125	0.039062	0.13	0.75
4	Thyme oil	3-Heptenoic acid	0.3125	0.019531	0.06	0.75
5	Thyme oil	Trans-3-octenoic acid	0.3125	0.009766	0.03	0.63
6	Thyme oil	7-Octenoic acid	0.3125	0.009766	0.03	0.75
7	Thyme oil	3-Nonenoic acid	0.15625	0.004882	0.03	0.31
8	Thyme oil	3-Decenoic acid	0.15625	0.009766	0.06	0.50
9	Thyme oil	9-Decenoic acid	0.15625	0.009766	0.06	0.38
10	Thyme oil	Trans-2-undecenoic acid	0.3125	0.009766	0.03	0.63

5 **Table 47:** Growth inhibition of *Sclerotinia sclerotiorum* by garlic oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Garlic oil		0.625			
		Trans-3-hexenoic acid		0.15625		
		4-Hexenoic acid		0.15625		
		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.078125		
		7-Octenoic acid		0.078125		
		3-Nonenoic acid		0.078125		
		Trans-2-decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
1	Garlic oil	Trans-3-hexenoic acid	0.3125	0.039062	0.13	0.75
2	Garlic oil	4-Hexenoic acid	0.3125	0.039062	0.13	0.75

3	Garlic oil	Trans-2-octenoic acid	0.15625	0.009766	0.06	0.50
4	Garlic oil	3-Octenoic acid	0.3125	0.019531	0.06	0.75
5	Garlic oil	7-Octenoic acid	0.3125	0.009766	0.03	0.63
6	Garlic oil	3-Nonenoic acid	0.3125	0.009766	0.03	0.63
7	Garlic oil	Trans-2-decenoic acid	0.3125	0.009766	0.03	0.75
8	Garlic oil	9-Decenoic acid	0.3125	0.019531	0.06	0.75

Table 48: Growth inhibition of *Sclerotinia sclerotiorum* by lemongrass oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Lemongrass oil		0.625			
		(2E,4E)-2,4-hexadienoic acid		0.0625		
		Trans-2-hexenoic acid		0.078125		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.039062		
		Trans-3-octenoic acid		0.039062		
		7-Octenoic acid		0.039062		
		3-Nonenoic acid		0.039062		
		9-Decenoic acid		0.039062		
1	Lemongrass oil	(2E,4E)-2,4-hexadienoic acid	0.3125	0.015625	0.05	0.75
2	Lemongrass oil	Trans-2-hexenoic acid	0.3125	0.009766	0.03	0.63
3	Lemongrass oil	Trans-3-hexenoic acid	0.3125	0.019531	0.06	0.63
4	Lemongrass oil	5-Hexenoic acid	0.3125	0.019531	0.06	0.63
5	Lemongrass oil	3-Heptenoic acid	0.3125	0.009766	0.03	0.63
6	Lemongrass oil	Trans-2-octenoic acid	0.3125	0.009766	0.03	0.75
7	Lemongrass oil	3-Octenoic acid	0.3125	0.009766	0.03	0.75
8	Lemongrass oil	Trans-3-octenoic acid	0.3125	0.004882	0.02	0.63
9	Lemongrass oil	7-Octenoic acid	0.3125	0.004882	0.02	0.63
10	Lemongrass oil	3-Nonenoic acid	0.3125	0.004882	0.02	0.63
11	Lemongrass oil	9-Decenoic acid	0.3125	0.009766	0.03	0.75

5 **Table 49:** Growth inhibition of *Sclerotinia sclerotiorum* by wintergreen oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Wintergreen oil		10			

		Trans-2-octenoic acid		0.039062		
		9-Decenoic acid		0.039062		
6	Wintergreen oil	Trans-2-octenoic acid	1.25	0.019531	0.02	0.63
11	Wintergreen oil	9-Decenoic acid	1.25	0.019531	0.02	0.63

Table 50: Growth inhibition of *Sclerotinia sclerotiorum* by peppermint oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Peppermint oil		2.5			
		Trans-3-hexenoic acid		0.3125		
		5-Hexenoic acid		0.15625		
		3-Octenoic acid		0.078125		
		3-Nonenoic acid		0.078125		
		9-Decenoic acid		0.039062		
1	Peppermint oil	Trans-3-hexenoic acid	1.25	0.039062	0.03	0.63
2	Peppermint oil	5-Hexenoic acid	1.25	0.039062	0.03	0.75
3	Peppermint oil	3-Octenoic acid	1.25	0.019531	0.02	0.75
4	Peppermint oil	3-Nonenoic acid	1.25	0.009766	0.01	0.63
5	Peppermint oil	9-Decenoic acid	0.625	0.009766	0.02	0.50

- 5 **Table 51:** Growth inhibition of *Sclerotinia sclerotiorum* by spearmint oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Spearmint oil		2.5			
		Trans-2-hexenoic acid		0.078125		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.078125		
		Trans-2-octenoic acid		0.078125		
		3-Octenoic acid		0.15625		
		7-Octenoic acid		0.078125		
		Trans-2-nonenoic acid		0.039062		
		3-Nonenoic acid		0.15625		
		3-Decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
1	Spearmint oil	Trans-2-hexenoic acid	1.25	0.019531	0.02	0.75
2	Spearmint oil	Trans-3-hexenoic acid	1.25	0.039062	0.03	0.75
3	Spearmint oil	5-Hexenoic acid	1.25	0.039062	0.03	0.75
4	Spearmint oil	3-Heptenoic acid	1.25	0.019531	0.02	0.75
5	Spearmint oil	Trans-2-octenoic acid	1.25	0.019531	0.02	0.75

6	Spearmint oil	3-Octenoic acid	1.25	0.019531	0.02	0.63
7	Spearmint oil	7-Octenoic acid	1.25	0.009766	0.01	0.63
8	Spearmint oil	Trans-2-nonenic acid	1.25	0.009766	0.01	0.75
9	Spearmint oil	3-Nonenoic acid	1.25	0.009766	0.01	0.56
10	Spearmint oil	3-Decenoic acid	1.25	0.019531	0.02	0.75
11	Spearmint oil	9-Decenoic acid	1.25	0.019531	0.02	0.75

Table 52: Growth inhibition of *Sclerotinia sclerotiorum* by clove leaf oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Clove leaf oil		2.5			
		3-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.15625		
1	Clove leaf oil	3-Decenoic acid	0.3125	0.019531	0.06	0.38
2	Clove leaf oil	Trans-2-undecenoic acid	0.3125	0.019531	0.06	0.25

- 5 **Table 53:** Growth inhibition of *Sclerotinia sclerotiorum* by Fortune Aza Technical, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Aza Technical		0.5			
		Trans-2-undecenoic acid		0.078125		
1	Aza Technical	Trans-2-undecenoic acid	0.125	0.019531	0.16	0.50

Table 54: Growth inhibition of *Sclerotinia sclerotiorum* by oregano oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Oregano oil		0.625			
		(2E,4E)-2,4-hexadienoic acid		0.125		
		Trans-2-hexenoic acid		0.078125		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		3-Heptenoic acid		0.15625		
		Trans-2-octenoic acid		0.039062		
		3-Octenoic acid		0.039062		
		Trans-3-octenoic acid		0.039062		

		7-Octenoic acid		0.039062		
		Trans-2-nonenic acid		0.039062		
		3-Nonenoic acid		0.039062		
		3-Decenoic acid		0.039062		
		9-Decenoic acid		0.039062		
1	Oregano oil	(2E,4E)-2,4-hexadienoic acid	0.15625	0.015625	0.10	0.38
2	Oregano oil	Trans-2-hexenoic acid	0.15625	0.019531	0.13	0.50
3	Oregano oil	Trans-3-hexenoic acid	0.15625	0.039062	0.25	0.50
4	Oregano oil	5-Hexenoic acid	0.15625	0.039062	0.25	0.50
5	Oregano oil	3-Heptenoic acid	0.15625	0.019531	0.13	0.38
6	Oregano oil	Trans-2-octenoic acid	0.15625	0.019531	0.13	0.75
7	Oregano oil	3-Octenoic acid	0.15625	0.019531	0.13	0.75
8	Oregano oil	Trans-3-octenoic acid	0.15625	0.019531	0.13	0.75
9	Oregano oil	7-Octenoic acid	0.15625	0.019531	0.13	0.75
10	Oregano oil	Trans-2-nonenic acid	0.078125	0.009766	0.13	0.38
11	Oregano oil	3-Nonenoic acid	0.15625	0.019531	0.13	0.75
12	Oregano oil	3-Decenoic acid	0.078125	0.009766	0.13	0.38
13	Oregano oil	9-Decenoic acid	0.078125	0.009766	0.13	0.38

Example 11: Growth inhibition of *Botrytis cinerea* by oregano oil, nootkatone(+), spearmint oil, rosemary oil, thyme oil, salannin, karanja oil flavonoid extract, and neem oil limonoid extract, in combination with various exemplary unsaturated aliphatic acids.

- 5 **[0140]** Working solutions of oregano oil, nootkatone(+), spearmint oil, rosemary oil, thyme oil, salannin, karanja oil flavonoid extract, and neem oil limonoid extract, were each prepared as described above (as Compound A) and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 55-62 below. Working solutions of (2E,4E)-2,4-hexadienoic acid, trans-2-hexenoic acid, trans-3-hexenoic acid, 5-hexenoic acid, trans-2-octenoic acid, 7-octenoic acid, 3-decenoic acid, 9-decenoic acid, and trans-2-decenoic acid, (as Compound B), were each prepared as
- 10 described above, and were serially diluted in PDB to the individual required concentrations for MIC testing as shown in Tables 55-62 below.

- [0141]** Each individual compound and combination was tested over a range of 2-fold dilutions in the growth inhibition assay, observed following an incubation period of 48 hours, and the FIC Index for each
- 15 combination calculated, as shown in Tables 55-62 below.

Table 55: Growth inhibition of *Botrytis cinerea* by oregano oil, in combination with various exemplary unsaturated aliphatic acids

Combin	Compound A	Compound B	MIC (A)	MIC (B)	Ratio	FIC
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Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Oregano oil		0.625			
		Trans-2-decenoic acid		0.039062		
		3-Decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
		Trans-2-undecenoic acid		0.039062		
1	Oregano oil	Trans-2-decenoic acid	0.078125	0.019531	0.25	0.63
2	Oregano oil	3-Decenoic acid	0.078125	0.019531	0.25	0.63
3	Oregano oil	9-Decenoic acid	0.078125	0.039062	0.50	0.63
4	Oregano oil	Trans-2-undecenoic acid	0.078125	0.019531	0.25	0.63

Table 56: Growth inhibition of *Botrytis cinerea* by nootkatone(+), in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Nootkatone(+)		0.125			
		Trans-2-decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
1	Nootkatone(+)	Trans-2-decenoic acid	0.03125	0.019531	0.63	0.75
2	Nootkatone(+)	9-Decenoic acid	0.015625	0.019531	1.25	0.63

- 5 **Table 57:** Growth inhibition of *Botrytis cinerea* by spearmint oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/ Compound A	FIC Index
	Spearmint oil		2.5			
		(2E,4E)-2,4-hexadienoic acid		0.125		
		Trans-2-hexenoic acid		0.15625		
		Trans-3-hexenoic acid		0.15625		
		5-Hexenoic acid		0.15625		
		Trans-2-octenoic acid		0.078125		
		7-Octenoic acid		0.15625		
		Trans-2-decenoic acid		0.039062		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
1	Spearmint oil	(2E,4E)-2,4-hexadienoic acid	0.625	0.0625	0.10	0.75
2	Spearmint oil	Trans-2-hexenoic acid	0.625	0.019531	0.03	0.38
3	Spearmint oil	Trans-3-hexenoic acid	0.625	0.039062	0.06	0.50
4	Spearmint oil	5-Hexenoic acid	0.625	0.039062	0.06	0.50

5	Spearmint oil	Trans-2-octenoic acid	0.625	0.019531	0.03	0.50
6	Spearmint oil	7-Octenoic acid	0.625	0.019531	0.03	0.38
7	Spearmint oil	Trans-2-decenoic acid	0.625	0.019531	0.03	0.75
8	Spearmint oil	3-Decenoic acid	0.625	0.019531	0.03	0.50
9	Spearmint oil	9-Decenoic acid	0.625	0.039062	0.06	0.75

Table 58: Growth inhibition of *Botrytis cinerea* by rosemary oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Rosemary oil		5			
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
1	Rosemary oil	3-Decenoic acid	0.3125	0.019531	0.06	0.31
2	Rosemary oil	9-Decenoic acid	0.3125	0.039062	0.13	0.56

5 **Table 59:** Growth inhibition of *Botrytis cinerea* by thyme oil, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Thyme oil		0.625			
		Trans-2-octenoic acid		0.039062		
		3-Decenoic acid		0.078125		
		9-Decenoic acid		0.078125		
1	Thyme oil	Trans-2-octenoic acid	0.078125	0.019531	0.25	0.63
2	Thyme oil	3-Decenoic acid	0.078125	0.019531	0.25	0.63
3	Thyme oil	9-Decenoic acid	0.078125	0.039062	0.50	0.63

Table 60: Growth inhibition of *Botrytis cinerea* by salannin, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Salannin		0.05			
		9-Decenoic acid		0.078125		
1	Salannin	9-Decenoic acid	0.0125	0.039062	3	0.75

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Table 61: Growth inhibition of *Botrytis cinerea* by karanja oil flavonoid extract, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Karanja oil flavonoid extract		0.5			
		Trans-2 decenoic acid		0.039062		
		9-Decenoic acid		0.078125		
1	Karanja oil flavonoid extract	Trans-2 decenoic acid	0.0125	0.019531	0.16	0.75
2	Karanja oil flavonoid extract	9-Decenoic acid	0.0625	0.019531	0.31	0.38

Table 62: Growth inhibition of *Botrytis cinerea* by neem oil limonoid extract, in combination with various exemplary unsaturated aliphatic acids

Combination	Compound A	Compound B	MIC (A) (mg/mL)	MIC (B) (mg/mL)	Ratio Compound B/Compound A	FIC Index
	Neem oil limonoid extract		0.5			
		9-Decenoic acid		0.078125		
1	Neem oil limonoid extract	9-Decenoic acid	0.125	0.039062	0.31	0.75

- 5 **Example 12:** In-vitro insecticidal efficacy against *Trichoplusia ni* by chlorfenapyr (active ingredient in Pylon® insecticide), in combination with various exemplary unsaturated aliphatic acids (and agriculturally acceptable salts thereof)

Sample preparation:

- [0142] Chlorfenapyr, a halogenated pyrrole synthetic miticide-insecticide, is the active ingredient in Pylon® insecticide (available from BASF Corp., Research Triangle Park, NC, USA), and is present as 21.4% w/w of the Pylon® liquid formulation. Pylon® liquid formulation was diluted in water to form a 2 mg/mL Pylon® stock solution (containing 0.428 mg/mL of chlorfenapyr).

- [0143] A stock solution was prepared for each of trans-2-hexenoic acid and trans-3-hexenoic acid (both available from Sigma-Aldrich, St. Louis, MO, USA), by dissolving each exemplary unsaturated aliphatic acid in 100% dimethylsulfoxide (DMSO) at a concentration of 20 mg/mL (20,000 ppm). A stock solution for the potassium salt of (2E,4E)-2,4-hexadienoic acid was prepared by dissolving the salt in water to form a 20 mg/mL (20,000 ppm) solution.

[0144] An artificial diet suitable for *Trichoplusia ni* (cabbage looper caterpillar) was prepared according to the modified McMorran artificial diet recipe known in the entomology field (containing agar, casein,

potassium hydroxide, alphacel, Wesson's salt mix, sugar, toasted wheat germ, choline chloride, ascorbic acid, methyl paraben, aureomycin, linseed oil and vitamin solution).

[0145] The Pylon® stock solutions was diluted in 35 mL of the artificial diet to produce a concentration of 0.0016 mg/mL for each Pylon® treatment, and each of the unsaturated aliphatic acid (and salt) stock solutions were diluted in 35 mL of the artificial diet at concentrations of 0.05 mg/mL, 0.15 mg/mL, and 0.30 mg/mL, for each unsaturated aliphatic acid (and salt) treatment, and combinations of Pylon® and each aliphatic acid (and salt) were added to the artificial diet at the same concentrations for each combination treatment. The treated artificial diet was then used to fill each well of a 24-well treatment plate with approximately 0.5 mL of artificial diet, which was allowed to solidify at room temperature and stored overnight at approximately 4C. The following day, freshly hatched *Trichoplusia ni* (cabbage looper) larvae (hatched from eggs obtained from the Natural Resource Canada insect research facility in Sault-Ste-Marie, ON, Canada) were added to each well of the plate, and their survival rate was monitored at 72 hours, and every 24 hours for up to 144 hours (6 days) in total, to determine the insecticidal efficacy of the Pylon® treatment alone, each unsaturated aliphatic acid (and salt) alone, and each combination of Pylon® and unsaturated aliphatic acid (and salt). Each experiment contained 3 replicates, and was repeated at least 3 times.

[0146] The observed survival rate for the larvae at each time interval for the Pylon® and unsaturated aliphatic acid (and salt) treatments alone are shown in comparison with the corresponding survival rates for the combination treatments for each of the three concentrations of the unsaturated aliphatic acids (and salt) in Figures 3-5.

[0147] The aggregate results showing the insecticidal efficacy (which is equal to $(100\% - (\text{survival rate}))$) for each treatment are shown below in Tables 63-65 (corresponding to unsaturated aliphatic acid and salt concentrations of 0.05 mg/mL, 0.15 mg/mL, and 0.30 mg/mL, respectively).

[0148] The observed efficacy rate $(1 - (\text{survival rate}))$ of individual and combination treatments was used to evaluate the efficacy data in Tables 63-65 for synergistic effects in the combination of Pylon® and the exemplary unsaturated aliphatic acids (and salt), using the Colby Formula (also referred to as the Abbott Formula), per S. R. Colby, Calculating Synergistic and Antagonistic Responses of Herbicide Combinations, Weeds, Vol. 15, No. 1 (Jan. 1967), as is well known in the agricultural experimental field for determining synergism between two or more compounds. In accordance with the Colby Formula, the expected efficacy, E (%), of a combination treatment of compounds A and B in concentrations a and b, respectively, can be determined by evaluating:

$$E = x + y - (xy/100); \text{ where:}$$

x = efficacy (%) of compound A alone, applied at concentration a;

y = efficacy (%) of compound B alone, applied at concentration b.

[0149] The existence and extent of synergy present in a combination treatment can be determined according to the Colby Formula by evaluating a Synergy Factor, $SF = (\text{Observed efficacy}) / (\text{Expected efficacy})$. For values of $SF > 1$, synergistic efficacy is shown in the observed efficacy of the combination of compounds, with increasing synergy present as the SF increases above 1. While for $SF < 1$, antagonism is present and for $SF=1$, the efficacy of the compounds is merely additive. Tables 63-65 show the Synergy Factor calculated according to the above Colby Formula for the observed insecticidal efficacy of each combination treatment between Pylon® and the tested exemplary unsaturated aliphatic acids (and salt). As shown in Tables 63-65, the combination of Pylon® insecticide at 0.0016 mg/mL (equivalent to 0.00034 mg/mL of chlorfenapyr as the insecticidal active ingredient) with exemplary unsaturated aliphatic acid (and salt) concentrations between 0.05 mg/mL and 0.30 mg/mL produced synergistic efficacy factors of between 4 and 24 times, relative to the expected efficacy of the individual components, thus indicating strong evidence of the synergistic pesticidal efficacy of the combinations, according to an embodiment of the invention.

Table 63: Expected and Observed Efficacy (%) at 0.05 mg/mL Unsaturated Aliphatic Acid (salt) Concentration

Treatment	72hr Exp.	72hr Obs.	72hr Synergy Factor	90hr Exp.	90hr Obs.	90hr Synergy Factor	120hr Exp.	120hr Obs.	120hr Synergy Factor
Pylon®	-	4	-	-	4	-	-	4	-
2,4-hexenoic acid-Ksalt	-	4	-	-	4	-	-	4	-
Trans-2-hexenoic acid	-	0	-	-	0	-	-	0	-
Trans-3-hexenoic acid	-	0	-	-	0	-	-	0	-
Pylon® x 2,4-hex acid K-salt	8	62	8	8	100	12	8	100	12
Pylon® x Trans-2-hex. acid	4	46	11	4	96	23	4	100	24
Pylon® x Trans-3-hex. acid	4	46	11	4	100	24	4	100	24

Table 64: Expected and Observed Efficacy (%) at 0.15 mg/mL Unsaturated Aliphatic Acid (salt) Concentration

Treatment	72hr Exp.	72hr Obs.	72hr Synergy Factor	90hr Exp.	90hr Obs.	90hr Synergy Factor	120hr Exp.	120hr Obs.	120hr Synergy Factor
Pylon®	-	4	-	-	4	-	-	4	-
2,4-hexenoic acid-Ksalt	-	4	-	-	4	-	-	4	-
Trans-2-hexenoic acid	-	0	-	-	0	-	-	0	-
Trans-3-hexenoic acid	-	0	-	-	4	-	-	4	-
Pylon® x 2,4-hex acid K-salt	4	67	16	4	96	23	4	96	12
Pylon® x Trans-2-hex. Acid	4	50	12	4	75	18	4	79	19
Pylon® x Trans-3-hex. Acid	4	50	12	8	83	10	8	96	12

Table 65: Expected and Observed Efficacy (%) at 0.30 mg/mL Unsaturated Aliphatic Acid (salt)
Concentration

Treatment	72hr Exp.	72hr Obs.	72hr Synergy Factor	90hr Exp.	90hr Obs.	90hr Synergy Factor	120hr Exp.	120hr Obs.	120hr Synergy Factor
Pylon®	-	4	-	-	4	-	-	4	-
2,4-hexenoic acid-Ksalt	-	13	-	-	13	-	-	4	-
Trans-2-hexenoic acid	-	0	-	-	0	-	-	0	-
Trans-3-hexenoic acid	-	4	-	-	4	-	-	0	-
Pylon® x 2,4-hex acid K-salt	16	58	4	16	92	6	16	92	6
Pylon® x Trans-2-hex. Acid	8	67	8	8	100	12	4	100	24
Pylon® x Trans-3-hex. Acid	8	50	6	8	96	12	4	100	24

Example 13: In-planta insecticidal efficacy against *Trichoplusia ni* by chlorfenapyr (active ingredient in Pylon® insecticide), in combination with various exemplary unsaturated aliphatic acids (and agriculturally acceptable salts thereof)

Sample preparation:

[0150] Chlorfenapyr, a halogenated pyrrole synthetic miticide-insecticide, was provided as the active

ingredient in Pylon® insecticide (available from BASF Corp., Research Triangle Park, NC, USA), and is present as 21.4% w/w of the Pylon® liquid formulation. Pylon® liquid formulation was diluted in water to form a 0.187 mg/mL Pylon® treatment solution (containing 0.0400 mg/mL of chlorfenapyr).

5 A stock solution was prepared for trans-2-hexenoic acid (available from Sigma-Aldrich, St. Louis, MO, USA), by dissolving trans-2-hexenoic acid in 100% dimethylsulfoxide (DMSO) at a concentration of 20 mg/mL. A stock solution for the potassium salt of (2E,4E)-2,4-hexadienoic acid was prepared by dissolving the salt in water to form a 20 mg/mL (20,000 ppm) solution. Combined treatment solutions were prepared by adding stock solution of each of the exemplary unsaturated aliphatic acid and salt to the Pylon® treatment solution, to provide a combined treatment solution having a Pylon® concentration of
10 0.187 mg/mL and concentrations of the exemplary unsaturated aliphatic acid (or salt) of 0.06 mg/mL.

[0151] Green cabbage plants (*Brassica oleracea* var. capitata, Danish Ballhead cultivar) were grown from seed (available from West Coast Seeds, Delta, BC, Canada) in potting soil for 4 weeks in a pest-free indoor growing environment. At 4 weeks of age, each cabbage plant was sprayed with 10 mL of treatment solution using a hand pump sprayer bottle, and allowed to dry. After the treatment solution
15 sprays had dried on the leaves of the cabbage plants, 15-30 first instar *Trichoplusia ni* (cabbage looper) larvae (hatched from eggs obtained from the Natural Resource Canada insect research facility in Sault-Ste-Marie, ON, Canada) were placed directly on the leaves of each cabbage plant. The treated cabbage plants were then placed in nylon isolation tents and kept in an indoor growing environment and the larvae were left to feed on the plants. In one set of cabbage plants, the larvae were left to feed for 48 hours, and
20 then the number of surviving larvae were observed and survival rates (%) were determined. In a second separate set of cabbage plants, the larvae were left to feed for 72 hours, and then the number of surviving larvae were observed and survival rates (%) were determined. Each experiment was repeated at least 3 times.

[0152] The aggregate results showing the insecticidal efficacy (which is equal to $(100\% - (\text{observed survival rate}))$) for each treatment are shown below in Tables 66-67 (corresponding to observation
25 intervals of 48 hours and 72 hours for the two sets of plants, both with unsaturated aliphatic acid and salt concentrations of 0.06 mg/mL and Pylon® concentration of 0.187 mg/mL). The observed insecticidal efficacy rate in percent (equal to $100\% - (\text{survival rate})$) of individual and combination treatments was used to evaluate the efficacy data in Tables 66-67 for synergistic effects in the combination of Pylon®
30 and the exemplary unsaturated aliphatic acids (and salt), using the Colby Formula (also referred to as the Abbott Formula), per S. R. Colby, Calculating Synergistic and Antagonistic Responses of Herbicide Combinations, Weeds, Vol. 15, No. 1 (Jan. 1967), as is well known in the agricultural experimental field for determining synergism between two or more compounds. In accordance with the Colby Formula, the

expected efficacy, E (%), of a combination treatment of compounds A and B in concentrations a and b, respectively, can be determined by evaluating:

$$E = x + y - (xy/100); \text{ where:}$$

x = efficacy (%) of compound A alone, applied at concentration a;

5 y = efficacy (%) of compound B alone, applied at concentration b.

The existence and extent of synergy present in a combination treatment can be determined according to the Colby Formula by evaluating a Synergy Factor, $SF = (\text{Observed efficacy}) / (\text{Expected efficacy})$. For values of $SF > 1$, synergistic efficacy is shown in the observed efficacy of the combination of compounds, with increasing synergy present as the SF increases above 1. While for $SF < 1$, antagonism is present and for $SF=1$, the efficacy of the compounds is merely additive. Tables 66-67 show the Synergy Factor calculated according to the above Colby Formula for the observed insecticidal efficacy of each combination treatment between Pylon® and the tested exemplary unsaturated aliphatic acid (and salt). As shown in Tables 66-67, the combination of Pylon® insecticide at 0.187 mg/mL (equivalent to 0.0400 mg/mL of chlorfenapyr as the pesticidal active ingredient) with exemplary unsaturated aliphatic acid (and salt) concentration of 0.06 mg/mL produced synergistic efficacy factors of between 1.14 and 1.25, relative to the expected efficacy of the individual components, thus indicating evidence of the synergistic pesticidal efficacy of the combinations, according to an embodiment of the invention.

Table 66: Expected and Observed Efficacy (%) in-planta against *Trichoplusia ni* at 0.187 mg/mL Pylon® and 0.06 mg/mL exemplary unsaturated aliphatic acid (and salt) concentrations, after 48 hours

Treatment	Observed Efficacy (%)	Expected Efficacy (%)	Synergy Factor
Pylon	87	-	-
2,4-hexadienoic acid, K-salt	13	-	-
Trans-2-hexenoic acid	0	-	-
Pylon x 2,4-hexadienoic acid, K-salt	100	88	1.14
Pylon x Trans-2-hexenoic acid	100	87	1.15

Table 67: Expected and Observed Efficacy (%) in-planta against *Trichoplusia ni* at 0.187 mg/mL Pylon® and 0.06 mg/mL exemplary unsaturated aliphatic acid (and salt) concentrations, after 72 hours

Treatment	Observed Efficacy (%)	Expected Efficacy (%)	Synergy Factor
Pylon	80	-	-

2,4-hexadienoic acid, K-salt	0	-	-
Trans-2-hexenoic acid	0	-	-
Pylon x 2,4-hexadienoic acid, K-salt	100	80	1.25
Pylon x Trans-2-hexenoic acid	100	81	1.23

5 **[0153]** The foregoing examples using representative fungal and insect species demonstrate that a large number of C6-C10, including C6, C7, C8, C9 and C10, and C11 unsaturated aliphatic acids have a synergistic effect when used in combination with an insecticidal or fungicidal active agent. Based on the foregoing results and the fact that the cell membranes of eukaryotic cells share a similar lipid bilayer structure, it can be soundly predicted that C6-C10 unsaturated aliphatic acids, as well as C11 and C12

10 unsaturated aliphatic acids will have a synergistic effect when used in combination with active ingredients, including fungicidal, insecticidal, acaricidal, molluscicidal, bactericidal and nematocidal actives, to control target pests including fungi, insects, acari, mollusks, bacteria and nematodes.

[0154] In some embodiments according to the present disclosure, the combination of a C6-C10 unsaturated aliphatic acid (and agriculturally acceptable salts thereof in some particular embodiments)

15 and a pesticidal active ingredient produces a synergistic pesticidal composition demonstrating a synergistic effect. That is, when used in combination, the C6-C10 unsaturated aliphatic acid and the pesticidal active ingredient have an efficacy that is greater than would be expected by simply adding the efficacy of the pesticidal active ingredient and the C6-C10 unsaturated aliphatic acid when used alone. In some alternative embodiments, the unsaturated aliphatic acid or agriculturally acceptable salt thereof may

20 comprise a C11 unsaturated aliphatic acid or agriculturally acceptable salt thereof. In some further alternative embodiments, the unsaturated aliphatic acid or agriculturally acceptable salt thereof may comprise a C12 unsaturated aliphatic acid or agriculturally acceptable salt thereof.

[0155] While a number of exemplary aspects and embodiments have been discussed above, those of skill in the art will recognize certain modifications, permutations, additions and sub-combinations thereof. It

25 is therefore intended that the following appended claims and claims hereafter introduced are to be given the broadest interpretation consistent with the disclosure as a whole.

WHAT IS CLAIMED IS:

1. A synergistic pesticidal composition comprising
a pesticidal active ingredient; and
5 a C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof;
wherein the C6-C10 unsaturated aliphatic acid comprises at least one unsaturated C-C bond; and
wherein a weight ratio of the concentrations of said pesticidal active ingredient and said C6-C10
unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about 1:5000
and 5000:1.
10
2. A synergistic pesticidal composition comprising
a pesticidal active ingredient; and
a C6-C10 unsaturated aliphatic acid;
wherein the C6-C10 unsaturated aliphatic acid comprises at least one unsaturated C-C bond; and
15 wherein a weight ratio of the concentrations of said pesticidal active ingredient and said C6-C10
unsaturated aliphatic acid is between about 1:5000 and 5000:1.
3. The synergistic pesticidal composition according to claim 1, wherein the C6-C10 unsaturated
aliphatic acid comprises at least one of: a trans- unsaturated C-C bond, a cis- unsaturated C-C
20 bond, and a plurality of conjugated unsaturated C-C bonds.
4. The synergistic pesticidal composition according to claim 1, wherein the C6-C10 unsaturated
aliphatic acid comprises at least one of:
a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, and trans-9, cis-2, cis-3, cis-4,
25 cis-5, cis-6, cis-7, cis-8, and cis-9 unsaturated bond.
5. The synergistic pesticidal composition according to claim 1, wherein the C6-C10 unsaturated
aliphatic acid comprises at least one of:
a trans- hexenoic acid, a cis- hexenoic acid, a hexa-dienoic acid, a hexynoic acid, a trans-
30 heptenoic acid, a cis- heptenoic acid, a hepta-dienoic acid, a heptynoic acid, a trans- octenoic acid,
a cis- octenoic acid, an octa-dienoic acid, an octynoic acid, a trans- nonenoic acid, a cis- nonenoic
acid, a nona-dienoic acid, a nonynoic acid, a trans- decenoic acid, a cis- decenoic acid, a deca-
dienoic acid, and a decynoic acid.

6. The synergistic pesticidal composition according to claim 1, wherein the synergistic pesticidal composition has an FIC Index value of less than 1.
7. The synergistic pesticidal composition according to claim 1, wherein the synergistic pesticidal composition has an FIC Index value of less than 0.75.
8. The synergistic pesticidal composition according to claim 1, wherein the synergistic pesticidal composition has an FIC Index value of 0.5 or less.
9. The synergistic pesticidal composition according to claim 1, wherein said composition exhibits a synergistic inhibition of growth of at least one target pest organism.
10. The synergistic pesticidal composition according to claim 1, wherein said composition comprises a pesticidally effective concentration of said pesticidal active ingredient, and said C6-C10 unsaturated aliphatic acid or agriculturally compatible salt thereof.
11. The synergistic pesticidal composition according to claim 1, wherein said agriculturally compatible salt thereof comprises at least one of a potassium, sodium, calcium, aluminum and ammonium salt of a C6-C10 unsaturated aliphatic acid.
12. The synergistic pesticidal composition according to claim 1, wherein said pesticidal active ingredient comprises at least one selected from the list comprising:
 - A) Respiration inhibitors selected from:
 - inhibitors of complex III at Q_o site: azoxystrobin (II-1), coumethoxy-strobin, coumoxystrobin, dimoxystrobin (II-2), enestroburin, fenamin-strobin, fenoxystrobin/flufenoxystrobin, fluoxastrobin (II-3), kresoxim-methyl (II-4), metominostrobin, orysastrobin (II-5), picoxystrobin (II-6), pyraclostrobin (II-7), pyrame- tostrobin, pyraoxystrobin, trifloxystrobin (II-8), 2-[2-(2,5-dimethyl-phenoxy-methyl)-phenyl]-3-methoxy- acrylic acid methyl ester and 2-(2-(3-(2,6-dichlorophenyl)-1-methyl-allylideneamino-oxymethyl)-phe- nyl)-2-methoxyimino-N-methyl-acetamide, pyribencarb, triclopyricarb/chlorodincarb, famoxadone, fenamidone;
 - Inhibitors of complex III at Q_i site: cyazofamid, amisulbrom, [(3S,6S,7R,8R)-8-benzyl-3-[(3-acetoxy- 4-methoxy-pyridine-2-carbonyl)-amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[[3-(acetoxymethoxy)-4-methoxy-pyridine-2-

carbonyl]amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[(3-isobutoxycarbonyloxy-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[(3-(1,3-benzodioxol-5-ylmethoxy)-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate; (3S,6S,7R,8R)-3-[[3-(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenyl-methyl)-1,5-dioxonan-7-yl 2-methylpropanoate;

Inhibitors of complex II: benodanil, benzovindiflupyr (II-9), bixafen (II-10), boscalid (II-11), carboxin, fenfuram, fluopyram (II-12), flutolanil, fluxapyroxad (II-13), furametpyr, isofetamid, isopyrazam (II-14), mepronil, oxycarboxin, penflufen (II-15), penthiopyrad (II-16), sedaxane (II-17), tecloftalam, thifluzamide, N-(4'-trifluoromethylthiobiphenyl-2-yl)-3-difluoromethyl-1-methyl-1H-pyrazole-4-carboxamide, N-(2-(1,3,3-trimethyl-butyl)-phenyl)-1,3-dimethyl-5-fluoro-1H-pyrazole-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 3-(trifluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 1,3-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 3-(trifluoromethyl)-1,5-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 1,3,5-trimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, N-(7-fluoro-1,1,3-trimethylindan-4-yl)-1,3-dimethyl-pyrazole-4-carboxamide, N-[2-(2,4-dichlorophenyl)-2-methoxy-1-methyl-ethyl]-3-(difluoromethyl)-1-methyl-pyrazole-4-carboxamide;

Other respiration inhibitors: diflumerimor, (5,8-difluoroquinazolin-4-yl)-{2-[2-fluoro-4-(4-trifluoromethylpyridin-2-yloxy)-phenyl]-ethyl}-amine; binapacryl, dinobuton, dinocap, fluazinam (II-18); ferimzone; fentin salts such as fentin-acetate, fentin chloride or fentin hydroxide; ametoctradin (II-19); and silthiofam;

B) Sterol biosynthesis inhibitors (SBI fungicides) selected from:

C14 demethylase inhibitors (DMI fungicides): azaconazole, bitertanol, bromuconazole, cyproconazole (II-20), difenoconazole (II-21), diniconazole, diniconazole-M, epoxiconazole (II-22), fenbuconazole, fluquinconazole (II-23), flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, metconazole (II-24), myclobutanil, oxpoconazole, paclobutrazole, penconazole, propiconazole (II-25), prothioconazole (II-26), simeconazole, tebuconazole (II-27), tetraconazole, triadimefon, triadimenol, triticonazole, uniconazole; imazalil, pefurazoate, prochloraz, triflumizol; fenarimol, nuarimol, pyrifenoxy, triforine, [3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)isoxazol-4-yl]-(3-pyridyl)methanol;

Delta14-reductase inhibitors: aldimorph, dodemorph, dodemorphacetate, fenpropimorph, tridemorph, fenpropidin, piperalin, spiroxamine;

Inhibitors of 3-keto reductase: fenhexamid;

C) Nucleic acid synthesis inhibitors selected from:

phenylamides or acyl amino acid fungicides: benalaxyl, benalaxyl-M, kiralaxyl, metalaxyl, metalaxyl-M (mefenoxam) (II-38), ofurace, oxadixyl;

5 others nucleic acid inhibitors: hymexazole, oethilinone, oxolinic acid, bupirimate, 5-fluorocytosine, 5-fluoro-2-(p-tolylmethoxy)pyrimidin-4-amine, 5-fluoro-2-(4-fluorophenylmethoxy)pyrimidin-4-amine;

D) Inhibitors of cell division and cytoskeleton selected from:

10 tubulin inhibitors: benomyl, carbendazim, fuberidazole, thiabendazole, thiophanate-methyl (II-39); 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)-[1,2,4]triazolo[1,5-a]pyrimidine

other cell division inhibitors: diethofencarb, ethaboxam, pencycuron, fluopicolide, zoxamide, metrafenone (II-40), pyriofenone;

E) Inhibitors of amino acid and protein synthesis selected from:

15 methionine synthesis inhibitors (anilino-pyrimidines): cyprodinil, mepanipyrin, Pymethanil (II-41);

protein synthesis inhibitors: blasticidin-S, kasugamycin, kasugamycin hydrochloride-hydrate, mildiomycin, streptomycin, oxytetracyclin, polyoxine, validamycin A;

F) Signal transduction inhibitors selected from:

20 MAP / histidine kinase inhibitors: fluoroimid, iprodione, procymidone, vinclozolin, fenpiclonil, fludioxonil;

G protein inhibitors: quinoxifen;

G) Lipid and membrane synthesis inhibitors selected from:

25 Phospholipid biosynthesis inhibitors: edifenphos, iprobenfos, pyrazophos, isoprothiolane; propamocarb, propamocarb-hydrochloride;

lipid peroxidation inhibitors: dicloran, quintozone, tecnazene, tolclofos-methyl, biphenyl, chloroneb, etridiazole;

30 phospholipid biosynthesis and cell wall deposition: dimethomorph (II-42), flumorph, mandipropamid (II-43), pyrimorph, benthiavalicarb, iprovalicarb, valifenalate, N-(1-(1-(4-cyano-phenyl)ethanesulfonyl)-but-2-yl) carbamic acid-(4-fluorophenyl) ester;

acid amide hydrolase inhibitors: oxathiapiprolin;

H) Inhibitors with Multi Site Action selected from:

inorganic active substances: Bordeaux mixture, copper acetate, copper hydroxide, copper oxychloride (II-44), basic copper sulfate, sulfur;

thio- and dithiocarbamates: ferbam, mancozeb (II-45), maneb, metam, metiram (II-46), propineb, thiram, zineb, ziram;

organochlorine compounds: anilazine, Chlorothalonil (II-47), captafol, captan, folpet, dichlofluanid, dichlorophen, hexachlorobenzene, pentachlorophenole and its salts, phthalide, tolylfluanid, N-(4-chloro-2-nitro-phenyl)-N-ethyl-4-methyl-benzenesulfonamide;

guanidines and others: guanidine, dodine, dodine free base, guazatine, guazatine-acetate, iminocytadine, iminoctadine-triacetate, iminoctadine-tris(albesilate), dithianon, 2,6-dimethyl-1H,5H-[1,4]dithiin-2-one, 2,3,5,6-tetrakis(methylthio)-2,3,5,6-tetraene (II-48);

I) Cell wall synthesis inhibitors selected from:

inhibitors of glucan synthesis: validamycin, polyoxin B;

melanin synthesis inhibitors: pyroquilon, tricyclazole, carpropamid, dicyclomet, fenoxanil;

J) Plant defence inducers selected from:

acibenzolar-S-methyl, probenazole, isotianil, tiadinil, prohexadione-calcium; fosetyl, fosetyl-aluminum, phosphorous acid and its salts (II-49);

K) Unknown mode of action selected from: bronopol, chinomethionat, cyflufenamid, cymoxanil, dazomet, debacarb, diclomezine, difenzoquat, difenzoquat-methylsulfate, diphenylamin, fenpyrazamine, flumetover, flusulfamide, flutianil, methasulfocarb, nitrapyrin, nitrothal-isopropyl, oxathiapiprolin, tolprocarb, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-fluoro-6-(prop-2-yn-1-yl-oxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]-ethanone, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-chloro-6-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, oxin-copper, proquinazid, tebufloquin, tecloftalam, triazoxide, 2-butoxy-6-iodo-3-propylchromen-4-one, N-(cyclopropylmethoxyimino-(6-difluoro-methoxy-2,3-difluoro-phenyl)-methyl)-2-phenyl acetamide, N'-(4-(4-chloro-3-trifluoromethyl-phenoxy)-2,5-dimethylphenyl)-N-ethyl-N-methyl formamidine, N'-(4-(4-fluoro-3-trifluoromethyl-phenoxy)-2,5-dimethylphenyl)-N-ethyl-N-methyl formamidine, N'-(2-methyl-5-trifluoromethyl-4-(3-trimethylsilyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, N'-(5-difluoromethyl-2-methyl-4-(3-trimethylsilyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, methoxyacetic acid 6-tert-butyl-8-fluoro-2,3-dimethyl-quinolin-4-yl ester, 3-[5-(4-methylphenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine, 3-[5-(4-chloro-phenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine (pyrisoxazole), N-(6-methoxy-pyridin-3-yl) cyclopropanecarboxylic acid amide, 5-chloro-1-(4,6-dimethoxy-pyrimidin-2-yl)-2-methyl-1H-benzimidazole, 2-(4-chloro-phenyl)-N-[4-(3,4-dimethoxy-phenyl)-isoxazol-5-yl]-2-propyl-

- ynyloxy-acetamide, ethyl (Z)-3-amino-2-cyano-3-phenyl-prop-2-enoate, tertbutyl N-[6-[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]-amino]oxymethyl]-2-pyridyl]carbamate, pentyl N-[6-[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]amino]oxymethyl]-2-pyridyl]carbamate, 2-[2-[(7,8-difluoro-2-methyl-3-quinolyl)oxy]-6-fluoro-phenyl]propan-2-ol, 2-[2-fluoro-6-[(8-fluoro-2-methyl-3-quinolyl)oxy]phenyl]propan-2-ol, 3-(5-fluoro-3,3,4,4-tetramethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4-difluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4,5-trifluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline;
- L) Antifungal biopesticides selected from: *Ampelomyces quisqualis*, *Aspergillus flavus*, *Aureobasidium pullulans*, *Bacillus pumilus* (II-50), *Bacillus subtilis* (II-51), *Bacillus subtilis* var. *amyloliquefaciens* (II-52), *Candida oleophila* I-82, *Candida saitoana*, *Clonostachys rosea* f. *catenulata*, also named *Gliocladium catenulatum*, *Coniothyrium minitans*, *Cryphonectria parasitica*, *Cryptococcus albidus*, *Metschnikowia fructicola*, *Microdochium dimerum*, *Phlebiopsis gigantea*, *Pseudozyma flocculosa*, *Pythium oligandrum* DV74, *Reynoutria sachlinensis*, *Talaromyces flavus* V117b, *Trichoderma asperellum* SKT-1, *T. atroviride* LC52, *T. harzianum* T-22, *T. harzianum* TH 35, *T. harzianum* T-39; *T. harzianum* and *T. viride*, *T. harzianum* ICC012 and *T. viride* ICC080; *T. polysporum* and *T. harzianum*; *T. stromaticum*, *T. virens* GL-21, *T. viride*, *T. viride* TV1, *Ulocladium oudemansii* HRU3;
- M) Growth regulators selected from: abscisic acid, amidochlor, ancymidol, 6-benzylaminopurine, brassinolide, butralin, chlormequat (chlormequat chloride), choline chloride, cyclanilide, daminozide, dikegulac, dimethipin, 2,6-dimethylpuridine, ethephon, flumetralin, flurprimidol, fluthiacet, forchlorfenuron, gibberellic acid, inabenfide, indole-3-acetic acid, maleic hydrazide, mefluidide, mepiquat (mepiquat chloride) (II-54), naphthaleneacetic acid, N-6-benzyladenine, paclobutrazol, prohexadione (prohexadione-calcium, II-55), prohydrojasmon, thidiazuron, triapenthenol, tributyl phosphorotrithioate, 2,3,5-tri-iodobenzoic acid, trinex-apac-ethyl and uniconazole;
- N) Herbicides selected from:
- acetamides: acetochlor, alachlor, butachlor, dimethachlor, dimethenamid, flufenacet, mefenacet, metolachlor, metazachlor, napropamide, naproanilide, pethoxamid, pretilachlor, propachlor, thienylchlor;
- amino acid derivatives: bilanafos, glyphosate, glufosinate, sulfosate;
- aryloxyphenoxypropionates: clodinafop, cyhalofop-butyl, fenoxaprop, fluazifop, haloxyfop, metamifop, propaquizafop, quizalofop, quizalofop-P-tefuryl;
- Bipyridyls: diquat, paraquat;
- (thio)carbamates: asulam, butylate, carbetamide, desmedipham, dimepiperate, eptam

(EPTC), esprocarb, molinate, orbencarb, phenmedipham, prosulfocarb, pyributicarb, thiobencarb, triallate;

cyclohexanediones: butoxydim, clethodim, cycloxydim, profoxydim, sethoxydim, tepraloxym, tralkoxydim;

5 dinitroanilines: benfluralin, ethalfluralin, oryzalin, pendimethalin, prodiamine, trifluralin;

diphenyl ethers: acifluorfen, aclonifen, bifenoxy, diclofop, ethoxyfen, fomesafen, lactofen, oxyfluorfen; - hydroxybenzonitriles: bomoxynil, dichlobenil, ioxynil;

imidazolinones: imazamethabenz, imazamox, imazapic, imazapyr, imazaquin, imazethapyr;

10 phenoxy acetic acids: clomeprop, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4-DB, dichlorprop, MCPA, MCPA-thioethyl, MCPB, Mecoprop;

pyrazines: chloridazon, flufenpyr-ethyl, fluthiacet, norflurazon, pyridate;

pyridines: aminopyralid, clopyralid, diflufenican, dithiopyr, fluridone, fluroxypyr, picloram, picolinafen, thiazopyr;

15 sulfonyl ureas: amidosulfuron, azimsulfuron, bensulfuron, chlorimuronethyl, chlorsulfuron, cinosul- furon, cyclosulfamuron, ethoxysulfuron, flazasulfuron, flucetosulfuron, flupyr- sulfuron, foramsulfuron, halosulfuron, imazosulfuron, iodosulfuron, mesosulfuron, metazosulfuron, metsulfuron-methyl, nico- sulfuron, oxasulfuron, primisulfuron, prosulfuron, pyrazosulfuron, rimsulfuron, sulfometuron, sulfosul- furon, thifensulfuron, triasulfuron, tribenuron, trifloxysulfuron, triflusulfuron, tritosulfuron, 1-((2-chloro- 6-propyl-imidazo[1,2-b]pyridazin-3-yl)sulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea;

triazines: ametryn, atrazine, cyanazine, dimethametryn, ethiozin, hexazinone, metamitron, metribuzin, prometryn, simazine, terbuthylazine, terbutryn, triaziflam;

ureas: chlorotoluron, daimuron, diuron, fluometuron, isoproturon, linuron, methabenzthiazuron, tebuthiuron;

25 other acetolactate synthase inhibitors: bispyribac-sodium, cloransulam-methyl, diclosulam, florasulam, flucarbazone, flumetsulam, metosulam, ortho-sulfamuron, penoxsulam, propoxycarbazone, pyribam- benz-propyl, pyribenzoxim, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyri- thiobac, pyroxasulfone, py- roxsulam;

30 other herbicides: amicarbazone, aminotriazole, anilofos, beflubutamid, benazolin, bencarbazone, benfluresate, benzofenap, bentazone, benzobicyclon, bicyclopyrone, bromacil, bromobutide, butafenacil, butamifos, cafenstrole, carfentrazone, cinidon-ethyl, chlorthal, cinmethylin, clomazone, cumyluron, cyprosulfam- mide, dicamba, difenzoquat, diflufenzopyr, Drechslera monoceras, endothal, ethofumesate, etobenzanid, fenoxasulfone, fentrazamide,

flumiclorac-pentyl, flumioxazin, flupoxam, flurochloridone, flurtamone, indanofan, isoxaben, isoxaflutole, lenacil, propanil, propyzamide, quinclorac, quinmerac, mesotrione, methyl arsonic acid, naptalam, oxadiargyl, oxadiazon, oxaziclomefone, pentoxazone, pinoxaden, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazoxyfen, pyrazolynate, quinochloramine, saflufenacil,

5 sulcotrione, sulfentrazone, terbacil, tefuryltrione, tembotrione, thiencarbazone, topramezone, (3-[2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-trifluoromethyl-3,6-dihydro-2H-pyrimidin-1-yl)-phenoxy]-pyridin-2-yl)-acetic acid ethyl ester, 6-amino-5-chloro-2-cyclopropyl-pyrimidine-4-carboxylic acid methyl ester, 6-chloro-3-(2-cyclopropyl-6-methyl-phenoxy)-pyridazin-4-ol, 4-amino-3-chloro-6-(4-chloro-phenyl)-5-fluoro-pyridine-2-carboxylic acid, 4-amino-3-chloro-6-

10 (4-chloro-2-fluoro-3-methoxy-phenyl)-pyridine-2-carboxylic acid methyl ester, and 4-amino-3-chloro-6-(4-chloro-3-dimethylamino-2-fluoro-phenyl)-pyridine-2-carboxylic acid methyl ester;

O) Insecticides selected from:

organo(thio)phosphates: acephate, azamethiphos, azinphos-methyl, chlorpyrifos, chlorpyrifos-methyl, chlorfenvinphos, diazinon, dichlorvos, dicrotophos, dimethoate, disulfoton,

15 ethion, fenitrothion, fenthion, isoxathion, malathion, methamidophos, methidathion, methyl-parathion, mevinphos, monocrotophos, oxydemeton-methyl, paraoxon, parathion, phenthoate, phosalone, phosmet, phos-phamidon, phorate, phoxim, pirimiphos-methyl, profenofos, prothiofos, sulprophos, tetrachlorvinphos, terbufos, triazophos, trichlorfon;

carbamates: alanycarb, aldicarb, bendiocarb, benfuracarb, carbaryl, carbofuran, carbosulfan,

20 fenoxycarb, furathiocarb, methiocarb, methomyl, oxamyl, pirimicarb, propoxur, thiodicarb, triazamate;

pyrethroids: allethrin, bifenthrin, cyfluthrin, cyhalothrin, cyphenothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, zeta-cypermethrin, deltamethrin, esfenvalerate, etofenprox, fenpropathrin, fen-valerate, imiprothrin, lambda-cyhalothrin, permethrin, prallethrin, pyrethrin I

25 and II, resmethrin, silafluofen, tau-fluvalinate, tefluthrin, tetramethrin, tralomethrin, transfluthrin, profluthrin, dimefluthrin;

insect growth regulators: a) chitin synthesis inhibitors: benzoylureas: chlorfluazuron, cyramazin, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, teflubenzuron, triflumuron; buprofezin, diofenolan, hexythiazox, etoxazole, clofentazine; b)

30 ecdysone antagonists: halofenozide, methoxyfenozide, tebufenozide, azadirachtin; c) juvenoids: pyriproxyfen, methoprene, fenoxycarb; d) lipid biosynthesis inhibitors: spirotetramat, spiromesifen, spirotetramat;

nicotinic receptor agonists/antagonists compounds: clothianidin, dinotefuran, flupyradifurone, imidacloprid, thiamethoxam, nitenpyram, acetamiprid, thiacloprid, 1-2-chloro-

thiazol-5-ylmethyl)-2-nitrimino-3,5-dimethyl-[1,3,5]triazinane;

GABA antagonist compounds: endosulfan, ethiprole, fipronil, vanilprole, pyrafluprole, pyriprole, 5-amino-1-(2,6-dichloro-4-methyl-phenyl)-4-sulfinamoyl-1H-pyrazole-3-carbothioic acid amide;

- 5 mitochondrial electron transport inhibitor (METI) I acaricides: fenazaquin, pyridaben, tebufenpyrad, tolfenpyrad, flufenimer;
- METI II and III compounds: acequinocyl, fluacyprim, hydramethylnon;
- Uncouplers: chlorfenapyr;
- oxidative phosphorylation inhibitors: cyhexatin, diafenthiuron, fenbutatin oxide, propargite;
- 10 moulting disruptor compounds: cryomazine;
- mixed function oxidase inhibitors: piperonyl butoxide;
- sodium channel blockers: indoxacarb, metaflumizone;
- ryanodine receptor inhibitors: chlorantraniliprole, cyantraniliprole, fluben-diamide, N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-
- 15 (trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-trifluoromethylpyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-
- 20 (trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(difluoromethyl)pyrazole-3-carboxamide; N-[4,6-dibromo-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-cyano-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dibromo-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide;
- 25 others: benclonthiaz, bifenazate, cartap, flonicamid, pyridalyl, pymetrozine, sulfur, thiocyclam, cy-enopyrafen, flupyrzofos, cyflumetofen, amidoflumet, imicyafos, bistrifluron, pyrifluquinazon, 1,1'-[(3S,4R,4aR,6S,6aS,12R,12aS,12bS)-4-[(2-cyclopropylacetyl)oxy]-methyl]-1,3,4,4a,5,6,6a,12,12a,12b-decahydro-12-hydroxy-4,6a,12b-trimethyl-11-oxo-9-(3-pyridinyl)-2H,11H-naphtho[2,1-b]pyrano[3,4-e]pyran-3,6-diyl cyclopropaneacetic acid ester; fluensulfone, fluoroalkenyl thioethers; and
- 30 P) ribonucleic acid (RNA) and associated compounds including double-stranded RNA (dsRNA), microRNA (miRNA) and small interfering RNA (siRNA); bacteriophages.

13. The synergistic pesticidal composition according to claim 1, wherein a weight ratio of the concentrations of said pesticidal active ingredient and said C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about at least one of: 1:10,000 and 10,000:1, 1:5000 and 5000:1, 1:2500 and 2500:1, 1:1500 and 1500:1, 1:1000 and 1000, 1:750 and 750:1, 1:500 and 500:1, 1:400 and 400:1, 1:300 and 300:1, 1:250 and 250:1, 1:200 and 200:1, 1:150 and 150:1, 1:100 and 100:1, 1:90 and 90:1, 1:80 and 80:1, 1:70 and 70:1, 1:60 and 60:1, 1:50 and 50:1, 1:40 and 40:1, 1:30 and 30:1, 1:25 and 25:1, 1:20 and 20:1, 1:15 and 15:1, 1:10 and 10:1, 1:9 and 9:1, 1:8 and 8:1, 1:7 and 7:1, 1:6 and 6:1, 1:5 and 5:1, 1: and 4:1, 1:3 and 3:1, 1:2 and 2:1, 1:1.5 and 1.5:1, and 1.25 and 1.25:1.
14. The synergistic pesticidal composition according to claim 1, wherein said pesticidal active ingredient comprises at least one pesticidal natural oil selected from the list comprising: neem oil, karanja oil, clove oil, peppermint oil, mint oil, cinnamon oil, thyme oil, oregano oil, geranium oil, lime oil, lavender oil, anise oil, and/or garlic oil and/or components, derivatives and/or extracts of one or more pesticidal natural oil, or a combination thereof.
15. The synergistic pesticidal composition according to claim 1, wherein said pesticidal active ingredient comprises at least one USDA NOP-compliant or OMRI-listed natural pesticidal active ingredient.
16. The synergistic pesticidal composition according to claim 1, wherein said pesticidal active ingredient comprises at least one of: neem oil, karanja oil and extracts or derivatives thereof.
17. The synergistic pesticidal composition according to claim 11, wherein said pesticidal active ingredient comprises at least one extract or active component of neem oil or karanja oil selected from: azadirachtin, azadiradione, azadirone, nimbin, nimbidin, salannin, deacetylsalannin, salannol, maliantriol, gedunin, karanjin, pongamol, or derivatives thereof.
18. A method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism comprising:
 providing at least one pesticidal active ingredient active for said at least one target pest organism;
 adding a synergistically effective concentration of at least one C6-C10 unsaturated aliphatic

acid comprising at least one unsaturated C-C bond, or an agriculturally acceptable salt thereof, to said pesticidal active ingredient to provide a synergistic pesticidal composition; and

applying said synergistic pesticidal composition in a pesticidally effective concentration to control said at least one target pest organism.

5

19. The method according to claim 18, wherein the C6-C10 unsaturated aliphatic acid comprises at least one of: a trans- unsaturated C-C bond, a cis- unsaturated C-C bond, and a plurality of conjugated unsaturated C-C bonds.

10 20. The method according to claim 18, wherein the C6-C10 unsaturated aliphatic acid comprises at least one of:

a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, and trans-9, cis-2, cis-3, cis-4, cis-5, cis-6, cis-7, cis-8, and cis-9 unsaturated bond.

15 21. The method according to claim 18, wherein the C6-C10 unsaturated aliphatic acid comprises at least one of:

20 a trans- hexenoic acid, a cis- hexenoic acid, a hexa-dienoic acid, a hexynoic acid, a trans- heptenoic acid, a cis- heptenoic acid, a hepta-dienoic acid, a heptynoic acid, a trans- octenoic acid, a cis- octenoic acid, an octa-dienoic acid, an octynoic acid, a trans- nonenoic acid, a cis- nonenoic acid, a nona-dienoic acid, a nonynoic acid, a trans- decenoic acid, a cis- decenoic acid, a deca-dienoic acid, and a decynoic acid.

25 22. The method according to claim 18, wherein a weight ratio of said synergistically effective concentration of said C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof and said pesticidal active ingredient is between about at least one of: 1:10,000 and 10,000:1, 1:5000 and 5000:1, 1:2500 and 2500:1, 1:1500 and 1500:1, 1:1000 and 1000, 1:750 and 750:1, 1:500 and 500:1, 1:400 and 400:1, 1:300 and 300:1, 1:250 and 250:1, 1:200 and 200:1, 1:150 and 150:1, 1:100 and 100:1, 1:90 and 90:1, 1:80 and 80:1, 1:70 and 70:1, 1:60 and 60:1, 1:50 and 50:1, 1:40 and 40:1, 1:30 and 30:1, 1:25 and 25:1, 1:20 and 20:1, 1:15 and 15:1, 1:10 and 10:1, 1:9 and 9:1, 1:8 and 8:1, 1:7 and 7:1, 1:6 and 6:1, 1:5 and 5:1, 1: and 4:1, 1:3 and 3:1, 1:2 and 2:1, 1:1.5 and 1.5:1, and 1.25 and 1.25:1.

30

23. The method according to claim 18, wherein the synergistic pesticidal composition has an FIC Index value of less than 1.

24. The method according to claim 18, wherein the synergistic pesticidal composition has an FIC Index value of less than 0.75.
- 5 25. The method according to claim 18, wherein the synergistic pesticidal composition has an FIC Index value of 0.5 or less.
26. A pesticidal composition comprising:
 one or more pesticidal agents; and
 10 one or more unsaturated C6-C10 aliphatic acids or agriculturally compatible salts thereof, having at least one unsaturated C-C bond,
 wherein said one or more unsaturated C6-C10 aliphatic acids produce a synergistic effect on the pesticidal activity of the pesticidal composition in comparison to the pesticidal activity of the pesticidal agent alone and are present in a respective synergistically active weight concentration
 15 ratio between about 1:2000 and 2000:1.
27. The pesticidal composition according to claim 26, wherein said synergistically active weight concentration ratio of said pesticidal agent and said C6-C10 unsaturated aliphatic acid or an agriculturally compatible salt thereof is between about at least one of: 1:10,000 and 10,000:1,
 20 1:5000 and 5000:1, 1:2500 and 2500:1, 1:1500 and 1500:1, 1:1000 and 1000, 1:750 and 750:1, 1:500 and 500:1, 1:400 and 400:1, 1:300 and 300:1, 1:250 and 250:1, 1:200 and 200:1, 1:150 and 150:1, 1:100 and 100:1, 1:90 and 90:1, 1:80 and 80:1, 1:70 and 70:1, 1:60 and 60:1, 1:50 and 50:1, 1:40 and 40:1, 1:30 and 30:1, 1:25 and 25:1, 1:20 and 20:1, 1:15 and 15:1, 1:10 and 10:1, 1:9 and 9:1, 1:8 and 8:1, 1:7 and 7:1, 1:6 and 6:1, 1:5 and 5:1, 1: and 4:1, 1:3 and 3:1, 1:2 and 2:1, 1:1.5
 25 and 1.5:1, and 1.25 and 1.25:1.
28. The pesticidal composition according to claim 26, wherein the unsaturated C6-C10 aliphatic acid comprises at least one of: a trans-2, trans-3, trans-4, trans-5, trans-6, trans-7, trans-8, and trans-9, cis-2, cis-3, cis-4, cis-5, cis-6, cis-7, cis-8, and cis-9 unsaturated bond.
 30
29. The synergistic pesticidal composition according to claim 26, wherein the C6-C10 unsaturated aliphatic acid comprises at least one of:
 a trans- hexenoic acid, a cis- hexenoic acid, a hexa-dienoic acid, a hexynoic acid, a trans- heptenoic acid, a cis- heptenoic acid, a hepta-dienoic acid, a heptynoic acid, a trans- octenoic

acid, a cis- octenoic acid, an octa-dienoic acid, an octynoic acid, a trans- nonenoic acid, a cis- nonenoic acid, a nona-dienoic acid, a nonynoic acid, a trans- decenoic acid, a cis- decenoic acid, a deca-dienoic acid, and a decynoic acid.

- 5 30. The pesticidal composition according to claim 26, wherein the synergistic effect of the pesticidal agent in combination with the unsaturated C6-C10 aliphatic acid or agriculturally acceptable salt thereof has an FIC Index value of less than 1.
- 10 31. The pesticidal composition according to claim 26, wherein the synergistic effect of the pesticidal agent in combination with the unsaturated C6-C10 aliphatic acid or agriculturally acceptable salt thereof has an FIC Index value of less than 0.75.
- 15 32. The pesticidal composition according to claim 26, wherein the synergistic effect of the pesticidal agent in combination with the unsaturated C6-C10 aliphatic acid or agriculturally acceptable salt thereof has an FIC Index value of 0.5 or less.
33. The pesticidal composition according to claim 26, wherein said pesticidal agent comprises at least one selected from the list comprising:
- 20 A) Respiration inhibitors selected from:
- inhibitors of complex III at Q_o site: azoxystrobin (II-1), coumethoxy-strobin, coumoxystrobin, dimoxystrobin (II-2), enestroburin, fenamin-strobin, fenoxystrobin/flufenoxystrobin, fluoxastrobin (II-3), kresoxim-methyl (II-4), metominostrobin, orysastrobin (II-5), picoxystrobin (II-6), pyraclostrobin (II-7), pyrame- tostrobin, pyraoxystrobin, trifloxystrobin (II-8), 2-[2-(2,5-dimethyl-phenoxy-methyl)-phenyl]-3-methoxy- acrylic acid methyl ester and 2-(2-(3-(2,6-dichlorophenyl)-1-methyl-allylideneamino-oxymethyl)-phe- nyl)-2-
- 25 methoxyimino-N-methyl-acetamide, pyribencarb, triclopyricarb/chlorodincarb, famoxadone, fenamidone;
- Inhibitors of complex III at Q_i site: cyazofamid, amisulbrom, [(3S,6S,7R,8R)-8-benzyl-3- [(3-acetoxy- 4-methoxy-pyridine-2-carbonyl)-amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-
- 30 methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[[3-(acetoxymethoxy)-4-methoxy-pyridine-2-carbonyl]amino]-6-methyl- 4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate, [(3S,6S,7R,8R)-8-benzyl-3-[(3-isobutoxycarbony-loxy-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpro- panoate, [(3S,6S,7R,8R)-8-benzyl-3-[[3-(1,3-benzodioxol5-ylmethoxy)-4-methoxy-pyridine-2-carbon-yl]amino]-6-methyl-4,9-dioxo1,5-

dioxonan-7-yl] 2-methylpropanoate; (3S,6S,7R,8R)-3-[[3-hydroxy-4-methoxy-2-pyridinyl]carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenyl-methyl)-1,5-dioxonan-7-yl 2-methylpropanoate;

Inhibitors of complex II: benodanil, benzovindiflupyr (II-9), bixafen (II-10), boscalid (II-11),
 5 carboxin, fenfuram, fluopyram (II-12), flutolanil, fluxapyroxad (II-13), furametpyr, isofetamid,
 isopyrazam (II-14), mepronil, oxycarboxin, penflufen (II-15), penthiopyrad (II-16), sedaxane (II-
 17), tecloftalam, thifluzamide, N-(4'-trifluoromethylthiobiphenyl-2-yl)-3-difluoromethyl-1-
 methyl-1H-pyrazole-4-carboxamide, N-(2-(1,3,3-trimethyl-butyl)-phenyl)-1,3-dimethyl-5-fluoro-
 1H-pyrazole-4-carboxamide, 3-(difluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-
 10 yl)pyrazole-4-carboxamide, 3-(trifluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-
 4-carboxamide, 1,3-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 3-
 (trifluoromethyl)-1,5-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, 1,3,5-
 trimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide, N-(7-fluoro-1,1,3-trimethyl-
 indan-4-yl)-1,3-dimethyl-pyrazole-4-carboxamide, N-[2-(2,4-dichlorophenyl)-2-methoxy-1-
 15 methyl-ethyl]-3-(difluoromethyl)-1-methyl-pyrazole-4-carboxamide;

Other respiration inhibitors: diflumetorim, (5,8-difluoroquinazolin-4-yl)-{2-[2-fluoro-4-(4-trifluoromethylpyridin-2-yl)oxy]-phenyl}-ethyl}-amine; binapacryl, dinobuton, dinocap,
 fluazinam (II-18); ferimzone; fentin salts such as fentin-acetate, fentin chloride or fentin
 hydroxide; ametocetradin (II-19); and silthiofam;

20 B) Sterol biosynthesis inhibitors (SBI fungicides) selected from:

C14 demethylase inhibitors (DMI fungicides): azaconazole, bitertanol, bromuconazole,
 cyproconazole (II-20), difenoconazole (II-21), diniconazole, diniconazole-M, epoxiconazole (II-
 22), fenbuconazole, fluquinconazole (II-23), flusilazole, flutriafol, hexaconazole,
 imibenconazole, ipconazole, metconazole (II-24), myclobutanil, oxpoconazole, paclobutrazole,
 25 penconazole, propiconazole (II-25), prothioconazole (II-26), simeconazole, tebuconazole (II-27),
 tetraconazole, triadimefon, triadimenol, triticonazole, uniconazole; imazalil, pefurazoate,
 prochloraz, triflumizol; fenarimol, nuarimol, pyrifenox, triforine, [3-(4-chloro-2-fluorophenyl)-
 5-(2,4-difluorophenyl)isoxazol-4-yl]-(3-pyridyl)methanol;

Delta14-reductase inhibitors: aldimorph, dodemorph, dodemorphacetate, fenpropimorph,
 30 tridemorph, fenpropidin, piperalin, spiroxamine;

Inhibitors of 3-keto reductase: fenhexamid;

C) Nucleic acid synthesis inhibitors selected from:

phenylamides or acyl amino acid fungicides: benalaxyl, benalaxyl-M, kiralaxyl, metalaxyl,
 metalaxyl-M (mefenoxam) (II-38), ofurace, oxadixyl;

others nucleic acid inhibitors: hymexazole, octhilinone, oxolinic acid, bupirimate, 5-fluorocytosine, 5-fluoro-2-(p-tolylmethoxy)pyrimidin-4-amine, 5-fluoro-2-(4-fluorophenylmethoxy)pyrimidin-4-amine;

D) Inhibitors of cell division and cytoskeleton selected from:

5 tubulin inhibitors: benomyl, carbendazim, fuberidazole, thiabendazole, thiophanate-methyl (II-39); 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)-[1,2,4]triazolo[1,5-a]pyrimidine

other cell division inhibitors: diethofencarb, ethaboxam, pencycuron, fluopicolide, zoxamide, metrafenone (II-40), pyriofenone;

10 E) Inhibitors of amino acid and protein synthesis selected from:

methionine synthesis inhibitors (anilino-pyrimidines): cyprodinil, mepanipyrim, Pyrimethanil (II-41);

protein synthesis inhibitors: blasticidin-S, kasugamycin, kasugamycin hydrochloride-hydrate, mildiomycin, streptomycin, oxytetracyclin, polyoxine, validamycin A;

15 F) Signal transduction inhibitors selected from:

MAP / histidine kinase inhibitors: fluoroimid, iprodione, procymidone, vinclozolin, fenpiclonil, fludioxonil;

G protein inhibitors: quinoxifen;

G) Lipid and membrane synthesis inhibitors selected from:

20 Phospholipid biosynthesis inhibitors: edifenphos, iprobenfos, pyrazophos, isoprothiolane; propamocarb, propamocarb-hydrochloride;

lipid peroxidation inhibitors: dicloran, quintozone, tecnazene, tolclofos-methyl, biphenyl, chloroneb, etridiazole;

25 phospholipid biosynthesis and cell wall deposition: dimethomorph (II-42), flumorph, mandipropamid (II-43), pyrimorph, benthiavalicarb, iprovalicarb, valifenalate, N-(1-(1-(4-cyano-phenyl)ethanesulfonyl)-but-2-yl) carbamic acid-(4-fluorophenyl) ester;

acid amide hydrolase inhibitors: oxathiapiprolin;

H) Inhibitors with Multi Site Action selected from:

30 inorganic active substances: Bordeaux mixture, copper acetate, copper hydroxide, copper oxychloride (II-44), basic copper sulfate, sulfur;

thio- and dithiocarbamates: ferbam, mancozeb (II-45), maneb, metam, metiram (II-46), propineb, thiram, zineb, ziram;

organochlorine compounds: anilazine, Chlorothalonil (II-47), captafol, captan, folpet, dichlofluanid, dichlorophen, hexachlorobenzene, pentachlorophenole and its salts, phthalide,

tolylfluanid, N-(4-chloro-2-nitro-phenyl)-N-ethyl-4-methyl-benzenesulfonamide;

guanidines and others: guanidine, dodine, dodine free base, guazatine, guazatine-acetate, iminocytidine, iminoctadine-triacetate, iminoctadine-tris(albesilate), dithianon, 2,6-dimethyl-1H,5H-[1,4]dithiino[2,3-c:5,6-c']dipyrrole-1,3,5,7(2H,6H)-tetraone (II-48);

5 I) Cell wall synthesis inhibitors selected from:

inhibitors of glucan synthesis: validamycin, polyoxin B;

melanin synthesis inhibitors: pyroquilon, tricyclazole, carpropamid, dicyclomet, fenoxanil;

J) Plant defence inducers selected from:

10 acibenzolar-S-methyl, probenazole, isotianil, tiadinil, prohexadione-calcium; fosetyl, fosetyl-aluminum, phosphorous acid and its salts (II-49);

K) Unknown mode of action selected from: bronopol, chinomethionat, cyflufenamid, cymoxanil, dazomet, debacarb, diclomezine, difenzoquat, difenzoquat-methylsulfate, diphenylamin,

fenpyrazamine, flumetover, flusulfamide, flutianil, methasulfocarb, nitrapyrin, nitrothal-isopropyl, oxathiapiprolin, tolprocarb, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-

15 [2-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-fluoro-6-(prop-2-yn-1-yl-oxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl)piperidin-1-yl]-ethanone, 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-chloro-6-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, oxin-copper, proquinazid,

20 tebufloquin, tecloftalam, triazoxide, 2-butoxy-6-iodo-3-propylchromen-4-one, N-(cyclopropylmethoxyimino-(6-difluoro-methoxy-2,3-difluoro-phenyl)-methyl)-2-phenyl acetamide, N'-(4-(4-chloro-3-trifluoromethyl-phenoxy)-2,5-dimethylphenyl)-N-ethyl-N-methyl

formamidine, N'-(4-(4-fluoro-3-trifluoromethyl-phenoxy)-2,5-dimethyl-phenyl)-N-ethyl-N-methyl formamidine, N'-(2-methyl-5-trifluoromethyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, N'-(5-difluoromethyl-2-methyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine, methoxyacetic acid 6-tert-butyl-8-fluoro-2,3-dimethyl-

quinolin-4-yl ester, 3-[5-(4-methylphenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine, 3-[5-(4-chloro-phenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine (pyrisoxazole), N-(6-methoxy-pyridin-3-yl) cyclopropanecarboxylic acid amide, 5-chloro-1-(4,6-dimethoxy-pyrimidin-2-yl)-2-methyl-

30 1H-benzimidazole, 2-(4-chloro-phenyl)-N-[4-(3,4-dimethoxy-phenyl)-isoxazol-5-yl]-2-prop-2-ynyloxy-acetamide, ethyl (Z)-3-amino-2-cyano-3-phenyl-prop-2-enoate, tertbutyl N-[6-[[[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]-amino]oxymethyl]-2-pyridyl]carbamate, pentyl N-[6-[[[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]amino]oxymethyl]-2-pyridyl]carbamate, 2-[2-[(7,8-difluoro-2-methyl-3-quinolyl)oxy]-6-fluoro-phenyl]propan-2-ol, 2-[2-fluoro-6-[(8-fluoro-

2-methyl-3-(4-nitrophenyl)oxy]phenyl]propan-2-ol, 3-(5-fluoro-3,3,4,4-tetramethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4-difluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline, 3-(4,4,5-trifluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline;

L) Antifungal biopesticides selected from: *Ampelomyces quisqualis*, *Aspergillus flavus*,

5 *Aureobasidium pullulans*, *Bacillus pumilus* (II-50), *Bacillus subtilis* (II-51), *Bacillus subtilis* var. *amyloliquefaciens* (II-52), *Candida oleophila* I-82, *Candida saitoana*, *Clonostachys rosea* f. *catenulata*, also named *Gliocladium catenulatum*, *Coniothyrium minitans*, *Cryphonectria parasitica*, *Cryptococcus albidus*, *Metschnikowia fructicola*, *Microdochium dimerum*, *Phlebiopsis gigantea*, *Pseudozyma flocculosa*, *Pythium oligandrum* DV74, *Reynoutria sachlinensis*,
10 *Talaromyces flavus* V117b, *Trichoderma asperellum* SKT-1, *T. atroviride* LC52, *T. harzianum* T-22, *T. harzianum* TH 35, *T. harzianum* T-39; *T. harzianum* and *T. viride*, *T. harzianum* ICC012 and *T. viride* ICC080; *T. polysporum* and *T. harzianum*; *T. stromaticum*, *T. virens* GL-21, *T. viride*, *T. viride* TV1, *Ulocladium oudemansii* HRU3;

M) Growth regulators selected from: abscisic acid, amidochlor, ancymidol, 6-benzylaminopurine,

15 brassinolide, butralin, chlormequat (chlormequat chloride), choline chloride, cyclanilide, daminozide, dikegulac, dimethipin, 2,6-dimethylpuridine, ethephon, flumetralin, flurprimidol, fluthiacet, forchlorfenuron, gibberellic acid, inabenfide, indole-3-acetic acid, maleic hydrazide, mefluidide, mepiquat (mepiquat chloride) (II-54), naphthaleneacetic acid, N-6-benzyladenine, paclobutrazol, prohexadione (prohexadione-calcium, II-55), prohydrojasmon, thidiazuron,
20 triapenthenol, tributyl phosphorotrithioate, 2,3,5-tri-iodobenzoic acid, trinex-apac-ethyl and uniconazole;

N) Herbicides selected from:

acetamides: acetochlor, alachlor, butachlor, dimethachlor, dimethenamid, flufenacet, mefenacet, me-tolachlor, metazachlor, napropamide, naproanilide, pethoxamid, pretilachlor,
25 propachlor, thienylchlor;

amino acid derivatives: bilanafos, glyphosate, glufosinate, sulfosate;

aryloxyphenoxypropionates: clodinafop, cyhalofop-butyl, fenoxaprop, fluazifop, haloxyfop, metamifop, propaquizafop, quizalofop, quizalofop-P-tefuryl;

Bipyridyls: diquat, paraquat;

30 (thio)carbamates: asulam, butylate, carbetamide, desmedipham, dimepiperate, eptam (EPTC), esprocarb, molinate, orbencarb, phenmedipham, prosulfocarb, pyributicarb, thiobencarb, triallate;

cyclohexanediones: butoxydim, clethodim, cycloxydim, profoxydim, sethoxydim, tepraloxym, tralkoxydim;

dinitroanilines: benfluralin, ethalfluralin, oryzalin, pendimethalin, prodiamine, trifluralin;

diphenyl ethers: acifluorfen, aclonifen, bifenox, diclofop, ethoxyfen, fomesafen, lactofen, oxyfluorfen; - hydroxybenzonitriles: bomoxynil, dichlobenil, ioxynil;

imidazolinones: imazamethabenz, imazamox, imazapic, imazapyr, imazaquin,
5 imazethapyr;

phenoxy acetic acids: clomeprop, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4-DB, dichlorprop, MCPA, MCPA-thioethyl, MCPB, Mecoprop;

pyrazines: chloridazon, flufenpyr-ethyl, fluthiacet, norflurazon, pyridate;

pyridines: aminopyralid, clopyralid, diflufenican, dithiopyr, fluridone, fluroxypyr, picloram,
10 picolinafen, thiazopyr;

sulfonyl ureas: amidosulfuron, azimsulfuron, bensulfuron, chlorimuronethyl, chlorsulfuron, cinosul- furon, cyclosulfamuron, ethoxysulfuron, flazasulfuron, flucetosulfuron, flupyrasulfuron, foramsulfuron, halosulfuron, imazosulfuron, iodosulfuron, mesosulfuron, metazosulfuron, metsulfuron-methyl, nico- sulfuron, oxasulfuron, primisulfuron, prosulfuron, pyrazosulfuron,
15 rimsulfuron, sulfometuron, sulfosul- furon, thifensulfuron, triasulfuron, tribenuron, trifloxysulfuron, triflusulfuron, tritosulfuron, 1-((2-chloro- 6-propyl-imidazo[1,2-b]pyridazin-3-yl)sulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea;

triazines: ametryn, atrazine, cyanazine, dimethametryn, ethiozin, hexazinone, metamitron, metribuzin, prometryn, simazine, terbuthylazine, terbutryn, triaziflam;

ureas: chlorotoluron, daimuron, diuron, fluometuron, isoproturon, linuron,
20 methabenzthiazuron, tebuthiuron;

other acetolactate synthase inhibitors: bispyribac-sodium, cloransulamethyl, diclosulam, florasulam, flucarbazone, flumetsulam, metosulam, ortho-sulfamuron, penoxsulam, propoxycarbazone, pyribam- benz-propyl, pyribenzoxim, pyriftalid, pyriminobac-methyl,
25 pyrimisulfan, pyriothiobac, pyroxasulfone, py- roxsulam;

other herbicides: amicarbazone, aminotriazole, anilofos, beflubutamid, benazolin, bencarbazone, benfluresate, benzofenap, bentazone, benzobicyclon, bicyclopypyrone, bromacil, bromobutide, butafenacil, butamifos, cafenstrole, carfentrazone, cinidon-ethyl, chlorthal, cinmethylin, clomazone, cumyluron, cyprosulfamide, dicamba, difenzoquat, diflufenzopyr, Drechslera monoceras, endothal, ethofumesate, etobenzanid, fenoxasulfone, fentrazamide,
30 flumiclorac-pentyl, flumioxazin, flupoxam, flurochloridone, flurtamone, indanofan, isoxaben, isoxaflutole, lenacil, propanil, propyzamide, quinclorac, quinmerac, mesotrione, methyl arsonic acid, naptalam, oxadiargyl, oxadiazon, oxaziclomefone, pentoxazone, pinoxaden, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazoxyfen, pyrazolynate, quinclamine, saflufenacil,

sulcotrione, sulfentrazone, terbacil, tefuryltrione, tembotrione, thiencarbazone, topramezone, (3-[2-chloro-4-fluoro-5-(3-methyl-2,6-dioxo-4-trifluoromethyl-3,6-dihydro-2H-pyrimidin-1-yl)-phenoxy]-pyridin-2-yl)-acetic acid ethyl ester, 6-amino-5-chloro-2-cyclopropyl-pyrimidine-4-carboxylic acid methyl ester, 6-chloro-3-(2-cyclopropyl-6-methyl-phenoxy)-pyridazin-4-ol, 4-amino-3-chloro-6-(4-chloro-phenyl)-5-fluoro-pyridine-2-carboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)-pyridine-2-carboxylic acid methyl ester, and 4-amino-3-chloro-6-(4-chloro-3-dimethylamino-2-fluoro-phenyl)-pyridine-2-carboxylic acid methyl ester;

O) Insecticides selected from:

organo(thio)phosphates: acephate, azamethiphos, azinphos-methyl, chlorpyrifos, chlorpyrifos-methyl, chlorfenvinphos, diazinon, dichlorvos, dicrotophos, dimethoate, disulfoton, ethion, fenitrothion, fenthion, isoxathion, malathion, methamidophos, methidathion, methyl-parathion, mevinphos, monocrotophos, oxydemeton-methyl, paraoxon, parathion, phenthoate, phosalone, phosmet, phos-phamidon, phorate, phoxim, pirimiphos-methyl, profenofos, prothiofos, sulprophos, tetrachlorvinphos, terbufos, triazophos, trichlorfon;

carbamates: alanycarb, aldicarb, bendiocarb, benfuracarb, carbaryl, carbofuran, carbosulfan, fenoxycarb, furathiocarb, methiocarb, methomyl, oxamyl, pirimicarb, propoxur, thiodicarb, triazamate;

pyrethroids: allethrin, bifenthrin, cyfluthrin, cyhalothrin, cyphenothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, zeta-cypermethrin, deltamethrin, esfenvalerate, etofenprox, fenpropathrin, fen-valerate, imiprothrin, lambda-cyhalothrin, permethrin, prallethrin, pyrethrin I and II, resmethrin, silafluofen, tau-fluvalinate, tefluthrin, tetramethrin, tralomethrin, transluthrin, profluthrin, dimefluthrin;

insect growth regulators: a) chitin synthesis inhibitors: benzoylureas: chlorfluazuron, cyramazin, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, teflubenzuron, triflumuron; buprofezin, diofenolan, hexythiazox, etoxazole, clofentazine; b) ecdysone antagonists: halofenozide, methoxyfenozide, tebufenozide, azadirachtin; c) juvenoids: pyriproxyfen, methoprene, fenoxycarb; d) lipid biosynthesis inhibitors: spirotetramat, spiromesifen, spirotetramat;

nicotinic receptor agonists/antagonists compounds: clothianidin, dinotefuran, flupyradifurone, imidacloprid, thiamethoxam, nitenpyram, acetamiprid, thiacloprid, 1-(2-chloro-5-thiazol-5-ylmethyl)-2-nitrimino-3,5-dimethyl-[1,3,5]triazine;

GABA antagonist compounds: endosulfan, ethiprole, fipronil, vaniliprole, pyrafluprole, pyriprole, 5-amino-1-(2,6-dichloro-4-methyl-phenyl)-4-sulfamoyl-1H-pyrazole-3-carbothioic acid amide;

mitochondrial electron transport inhibitor (METI) I acaricides: fenazaquin, pyridaben, tebufenpyrad, tolfenpyrad, flufenimer;

METI II and III compounds: acequinocyl, fluacyprim, hydramethylnon;

Uncouplers: chlorfenapyr;

5 oxidative phosphorylation inhibitors: cyhexatin, diafenthiuron, fenbutatin oxide, propargite;

moulting disruptor compounds: cryomazine;

mixed function oxidase inhibitors: piperonyl butoxide;

sodium channel blockers: indoxacarb, metaflumizone;

ryanodine receptor inhibitors: chlorantraniliprole, cyantraniliprole, fluben-diamide, N-[4,6-
10 dichloro- 2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyra-
zole-3-carboxamide; N-[4-chloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]- 2-(3-chloro-2-pyridyl)-5-trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda- 4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-
15 [(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(difluoromethyl)pyrazole-3-carboxamide; N-[4,6-di-bromo-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-
20 cyano-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; N-[4,6-dibromo- 2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide;

others: benclonthiaz, bifenazate, cartap, flonicamid, pyridalyl, pymetrozine, sulfur, thiocyclam, cyenopyrafen, flupyrzofos, cyflumetofen, amidoflumet, imicyafos, bistrifluron, pyrifluquinazon, 1,1'-[(3S,4R,4aR,6S,6aS,12R,12aS,12bS)-4-[[[(2-cyclopropylacetyl)oxy]-methyl]- 1,3,4,4a,5,6,6a,12,12a,12b-decahydro-12-hydroxy-4,6a,12b-trimethyl-11-oxo-9-(3-pyridinyl)-2H,11H-naphtho[2,1-b]pyrano[3,4-e]pyran-3,6-diyl] cyclopropaneacetic acid ester; fluensulfone, fluoroalkenyl thioethers; and

P) ribonucleic acid (RNA) and associated compounds including double-stranded RNA
30 (dsRNA), microRNA (miRNA) and small interfering RNA (siRNA); bacteriophages.

34. A pesticidal composition according to claim 26, wherein said one or more unsaturated C6-C10 aliphatic acids or agriculturally compatible salts thereof comprises at least one C-C double bond.

35. The pesticidal composition according to claim 26, wherein said pesticidal agent comprises at least one of: a fungicide, nematocide, insecticide, acaricide, herbicide, molluscicide, and a bacteriocide.
- 5 36. The pesticidal composition according to claim 26, wherein said pesticidal agent comprises at least one pesticidal natural oil selected from the list comprising: neem oil, karanja oil, clove oil, peppermint oil, mint oil, cinnamon oil, thyme oil, oregano oil, geranium oil, lime oil, lavender oil, anise oil, and/or garlic oil and/or components, derivatives and/or extracts of one or more pesticidal natural oil, or a combination thereof.
- 10 37. The pesticidal composition according to claim 26, wherein said pesticidal active ingredient comprises at least one USDA NOP-compliant or OMRI-listed natural pesticidal active ingredient.
38. The pesticidal composition according to claim 26, wherein said pesticidal active ingredient
15 comprises at least one of: neem oil, karanja oil and extracts or derivatives thereof.
39. The pesticidal composition according to claim 26, wherein said pesticidal active ingredient comprises at least one extract or active component of neem oil or karanja oil selected from: azadirachtin, azadiradione, azadirone, nimbin, nimbidin, salannin, deacetylsalannin, salannol,
20 maliantriol, gedunin, karanjin, pongamol, or derivatives thereof.
40. The pesticidal composition according to one of claim 1 or claim 26, wherein said at least one C6-C10 unsaturated aliphatic acid excludes 2,4-hexadienoic acid or agriculturally acceptable salts thereof.
- 25 41. A method of synergistically enhancing the pesticidal activity of at least one pesticidal active ingredient adapted to control at least one target pest organism comprising:
- providing at least one pesticidal active ingredient active for said at least one target pest organism;
- 30 adding a synergistically effective concentration of at least one C6-C10 unsaturated aliphatic acid or an agriculturally acceptable salt thereof to provide a synergistic pesticidal composition;
- mixing said synergistic pesticidal composition with at least one formulation component comprising a surfactant to form a synergistic pesticidal concentrate;
- diluting said synergistic pesticidal concentrate with water to form a synergistic pesticidal

emulsion; and

applying said synergistic pesticidal emulsion at a pesticidally effective concentration and rate to control said at least one target pest organism.

- 5 42. The synergistic pesticidal composition according to any one of claims 1-17 or 26-40, wherein said C6-C10 unsaturated aliphatic acid comprises at least one of a: C6, C7, C8, C9, and C10 unsaturated aliphatic acid.
- 10 43. The method according to any one of claims 18-25, and 41, wherein wherein said C6-C10 unsaturated aliphatic acid comprises at least one of a: C6, C7, C8, C9, and C10 unsaturated aliphatic acid.
- 15 44. The synergistic pesticidal composition or method according to any one of claims 1-43, wherein said C6-C10 unsaturated aliphatic acid comprises a straight chain C6-C10 unsaturated aliphatic acid.
- 20 45. A composition as defined in either one of claims 1 or 26, wherein the pesticidal active ingredient has a mode of action dependent on interaction with a cellular membrane or a cellular membrane protein.
- 25 46. A composition as defined in claim 45, wherein the pesticidal active ingredient
 - has a mode of action dependent on interaction with a cellular membrane protein;
 - has a mode of action dependent on interaction with a cytochrome complex;
 - has a mode of action dependent on interaction with the cellular membrane to uncouple oxidative phosphorylation;
 - has a mode of action dependent on interaction with a target site inside a cell or on an intracellular organelle of a target pest; and/or
 - has a mode of action dependent on interaction with a target site across a cellular membrane of a target pest.
- 30 47. A composition as defined in claim 45, wherein the membrane protein comprises cytochrome bc1 complex or cytochrome p450 complex.
48. A composition as defined in the claim 45, wherein the pesticidal active ingredient comprises a

Group 3, Group 9, Group 11, Group 12 or Group 13 active as defined by the Fungicide Resistance Action Committee.

49. A composition as defined in claim 48, wherein the pesticidal active ingredient comprises a strobilurin, an azole, a triazole, a pyrrole, an anilinopyrimidine, or a phenylpyrrole.
50. A composition as defined in claim 48, wherein the pesticidal active ingredient comprises azoxystrobin, coumoxystrobin, enoxastrobin, flufenoxystrobin, picoxystrobin, pyraoxystrobin, mandestrobin, pyraclostrobin, pyrametostrobin, triclopyricarb, kresoxim-methyl trifloxystrobin, dimoxystrobin, fenaminstrobin, metominostrobin, orysastrobin, famoxadone, fluoxastrobin, fenamidone, pyribencar, triforine, pyrifenoxy, pyrisoxazole, fenarimol, nuarimol, imazalil, oxpoconazole, pefurazoate, prochloraz, triflumizole, azaconazole, bitertanol, bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, etaconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, metconazole, myclobutanil, penconazole, propiconazole, simeconazole, tebuconazole, tetraconazole, triadimefon, triadimenol, triticonazole, prothioconazole, quinoxyfen, or proquinazid, chlorfenapyr, cyprodinil, mepanipyrim, pyrimethanil, fenpiclonil or fludioxonil.
51. A composition as defined in any one of claims 1-17, 26-40 and 42-50, wherein the C6-C10 unsaturated aliphatic acid has an unsaturated C-C bond at one or more of the 2-, 3- and terminal locations in the aliphatic carbon chain.
52. The synergistic pesticidal composition according to any one of claims 1-4, 6-17, 26-28, 30-40, and 42-51, wherein said C6-C10 unsaturated aliphatic acid is replaced by a C11 or C12 unsaturated aliphatic acid.
53. The method according to any one of claims 18-20, 22-25, and 41, wherein wherein said C6-C10 unsaturated aliphatic acid is replaced by a C11 or C12 unsaturated aliphatic acid.

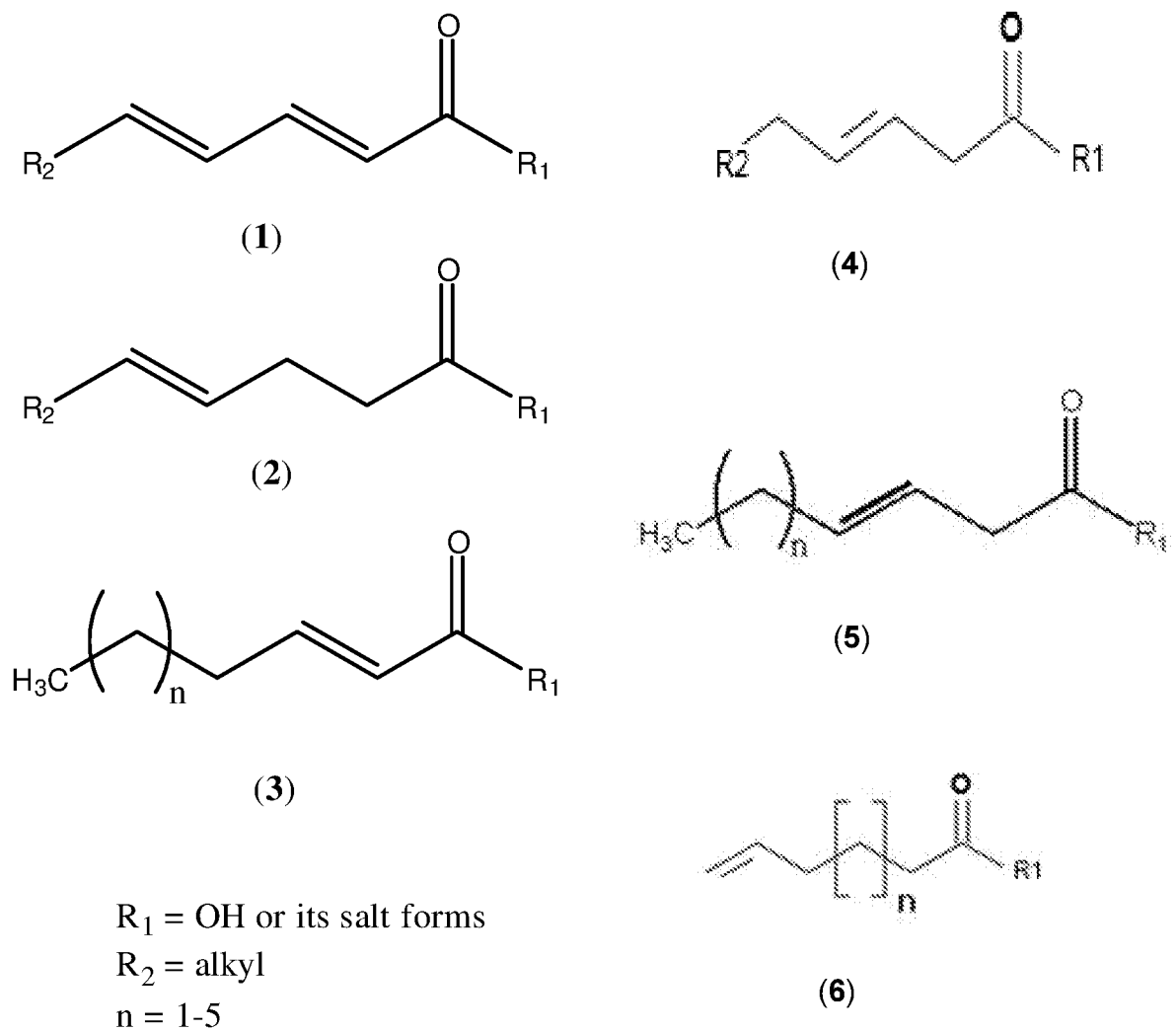
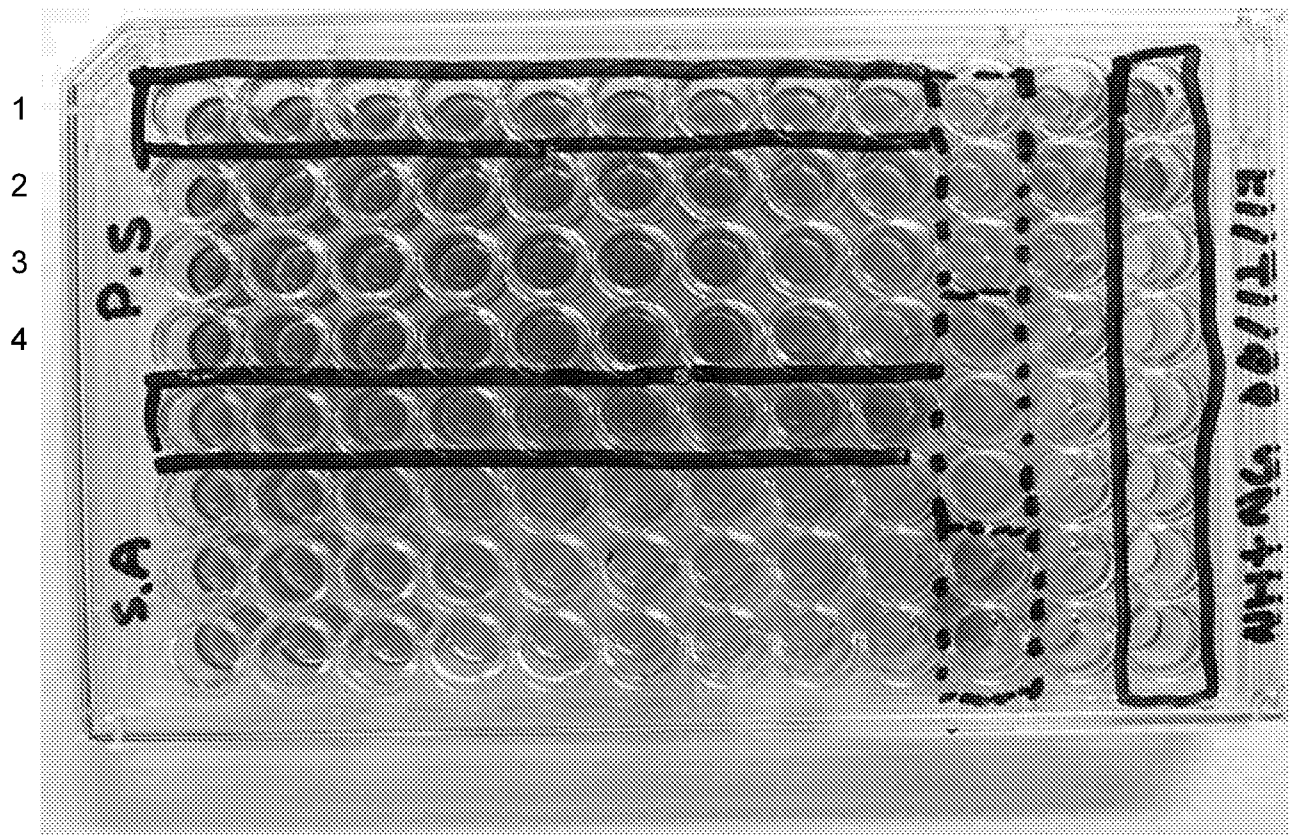


FIG. 1



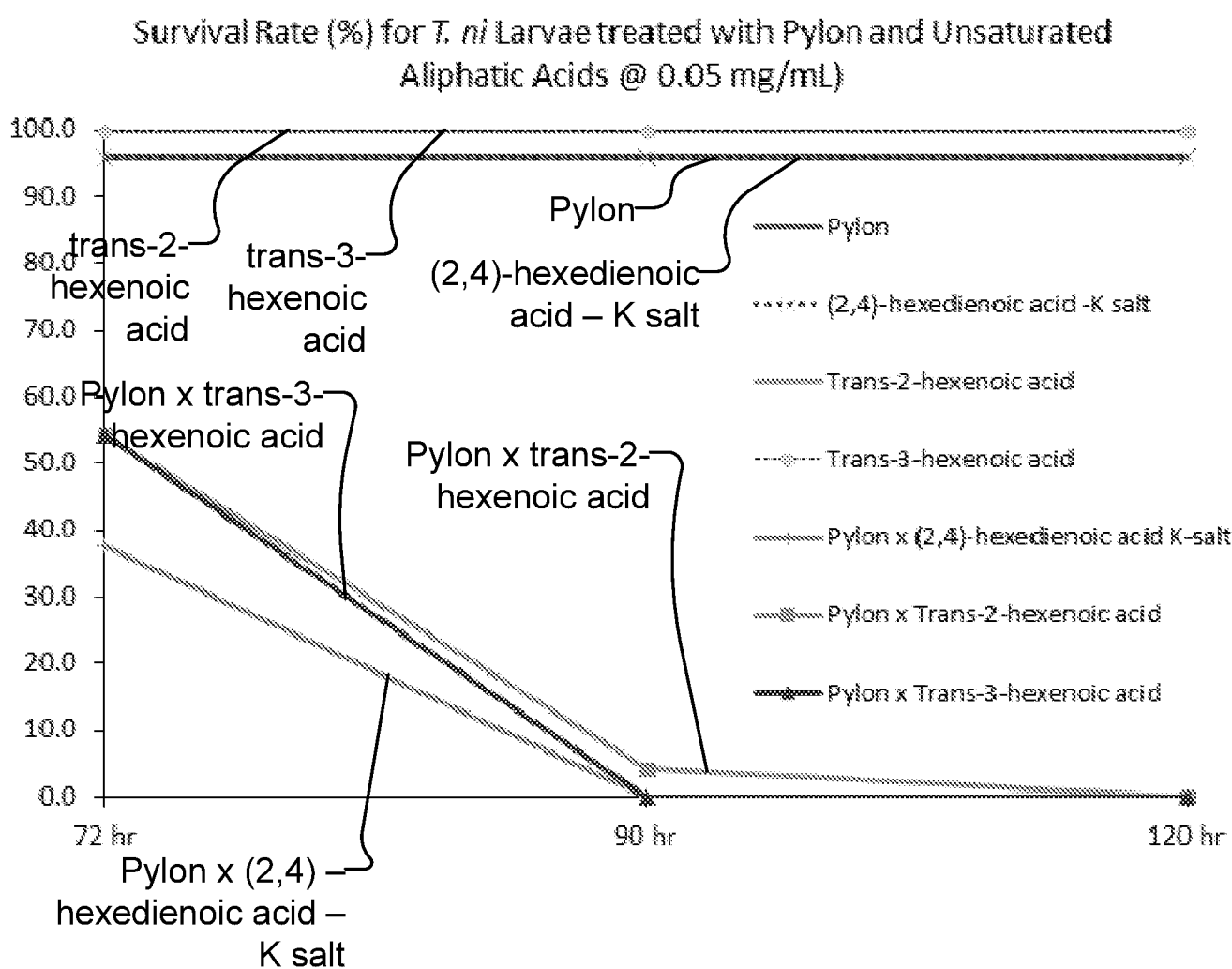


FIG. 3

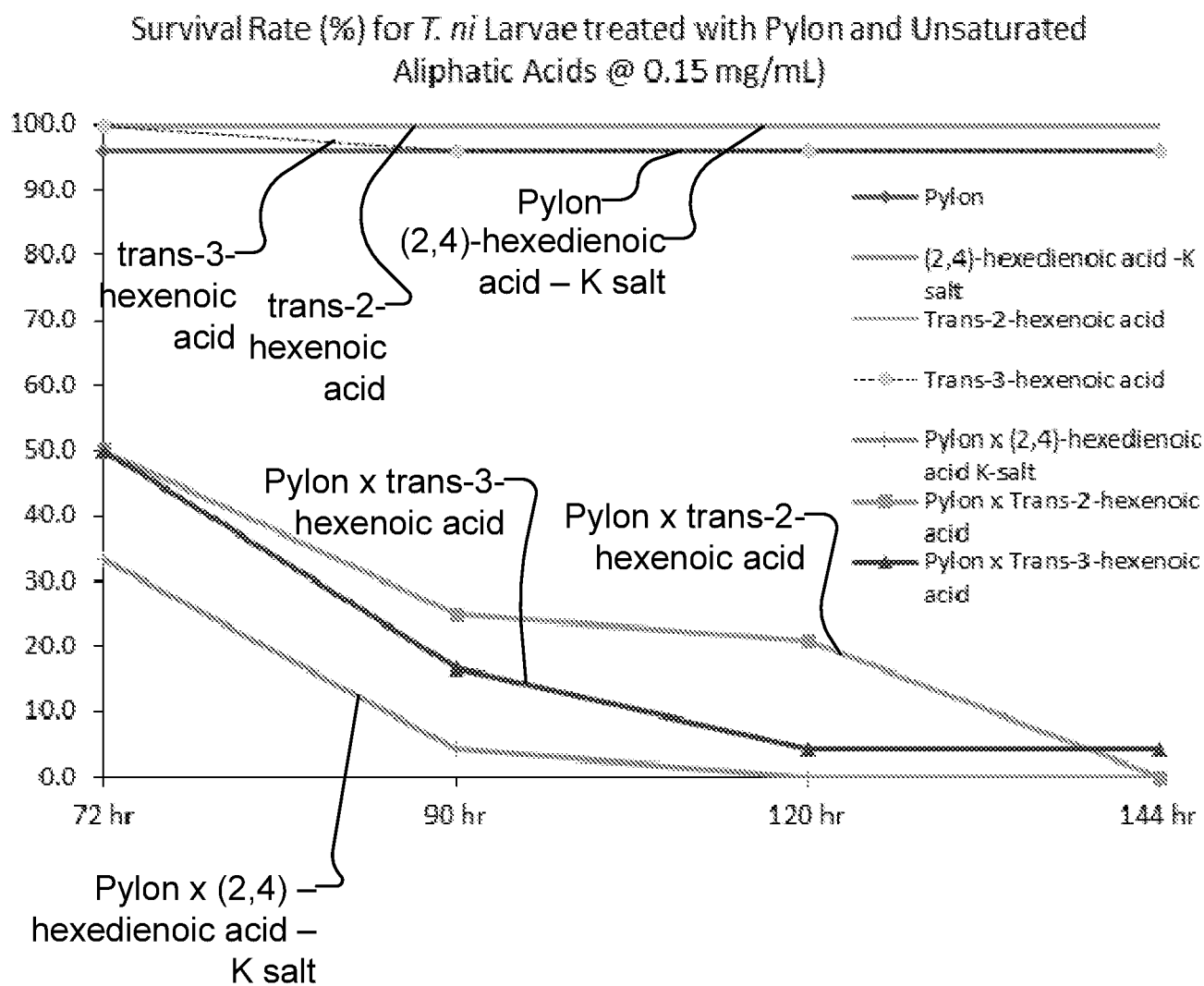


FIG. 4

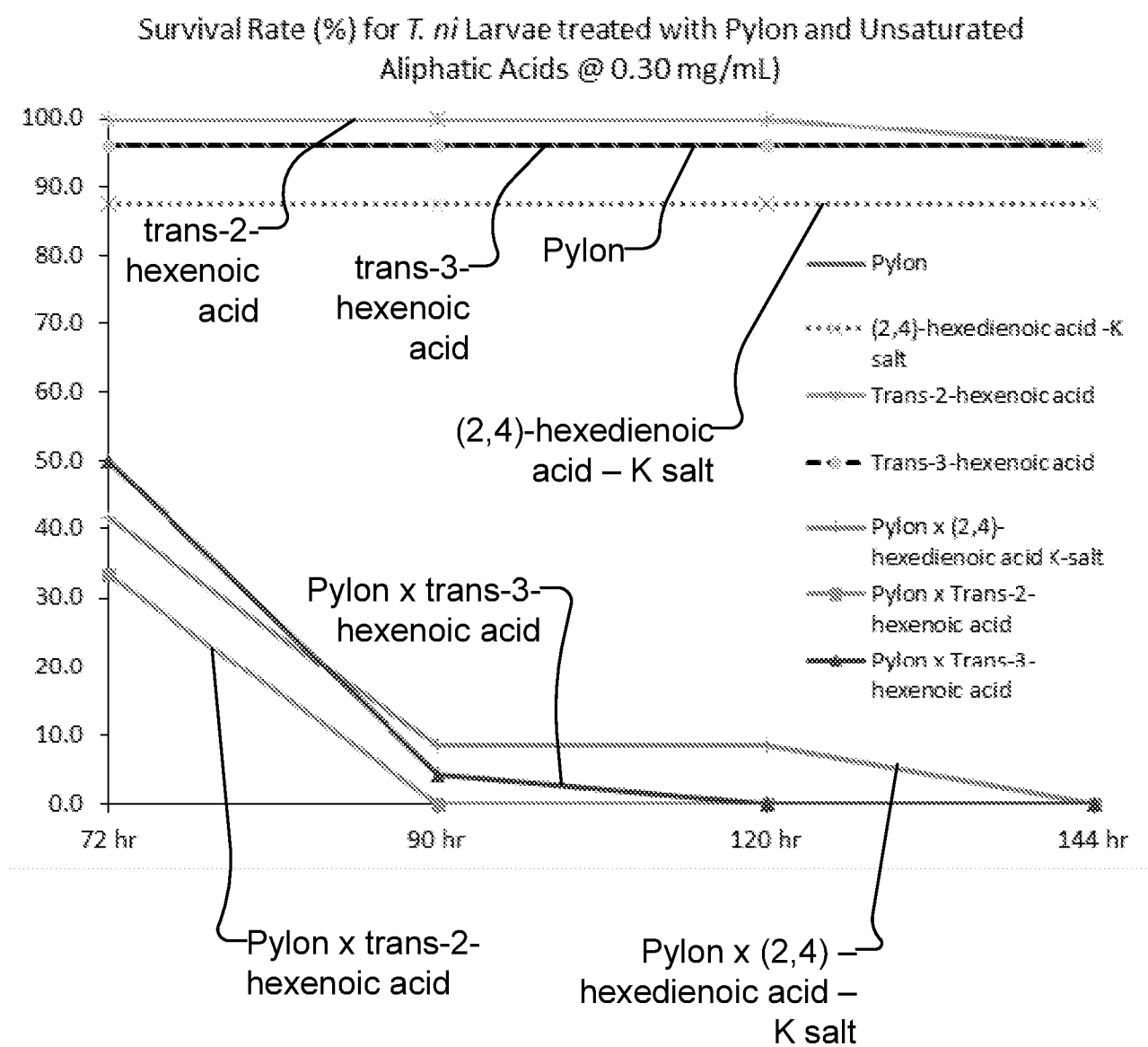


FIG. 5

Survival Rate (%) for *T. ni* Larvae treated with Pylon and Unsaturated Aliphatic Acids @ 0.05 mg/mL

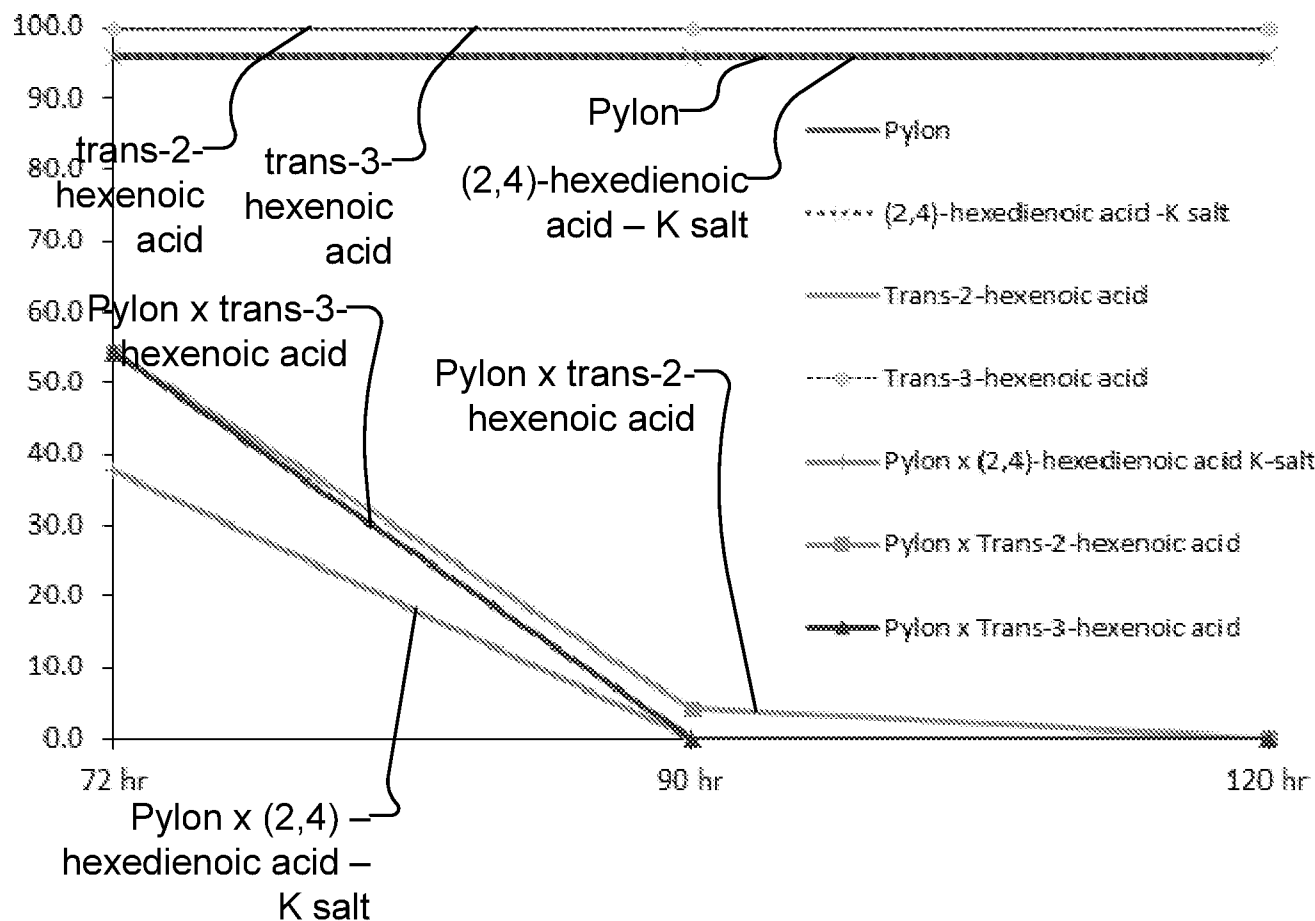


FIG. 3