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(71) Applicant: UPL LTD [IN/IN]; Agrochemical Plant, Durgachak, Midnapore Dist., West Bengal, Haldia 721 602 (IN).

(72) Inventors: SHROFF, Jaidev, Rajnikant; 206, Swiss Tower, Cluster Y Jumeirah Lake Towers, P.O. Box: 33421, Dubai (AE). SHROFF, Vikram, Rajnikant; 206, Swiss Tower, Cluster Y Jumeirah Lake Towers, P.O. Box: 33421, Dubai (AE). RENGAN, Srinivasan; UPL House, 610 B/2, Bandra Village, Off Western Express Highway, Bandra (East) Maharashtra, Mumbai 400051 (IN).

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

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(54) Title: NOVEL INSECTICIDAL COMBINATIONS

(57) Abstract: An Insecticidal combination comprising at least one diamide insecticide; at least one pyrethroid selected and at least one mitochondrial complex III electron transport inhibitor.

WO 2020/044215 A1

NOVEL INSECTICIDAL COMBINATIONS

Technical field:

The present invention relates to combinations comprising a diamide insecticide.

- 5 The combination is highly suitable for controlling unwanted animal pests, such as insects, acaricides and/or nematodes.

Background of the invention:

- Loss of yield due to damage by invertebrate pests is a major problem that most agriculturists face. Modern insecticides and biological control agents are employed
10 to minimize this damage. However, with the growing resistance to insecticides, it is necessary to use newer active ingredients in combination so as to counteract resistance in insect pests.

- Diamides insecticides are relatively new group of insecticides which includes
15 flubendiamide, a highly potent lepidoptericide and chlorantraniliprole and its analogue cyantraniliprole. Evolution of diamides can be studied in article published Pest Manag Sci. 2013 Jan;69(1):7-14.

- Chlorantraniliprole and cyantraniliprole are anthranilic diamide insecticidal
20 compounds which exhibit larvicidal activity as an orally ingested toxicant by targeting and disrupting the Ca^{2+} balance and ryanodine receptor.

- Pyrethroids are known to be broad spectrum insecticides. However, with over use resistance to many pyrethroids are now reported specially in crops such as cotton
25 and other crops. There is a need for combinations with pyrethroids to increase the spectrum of control as well as the decrease the resistance.

- EP2060181B1 (Annan) teaches combinations of anthranilamide insecticides in combination with Pyrethroids. These combinations however were found to be less
30 effective specially againsts resistant and hardy pests.

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There is therefore a need in the art for combinations of anthranilamide insecticidal compounds with insecticides that help improve spectrum of control. With crop tolerances decreasing, lower use rates being imposed and increasing resistance,
5 there is a need for a combination of actives that allows for broader disease control spectrum that combines curative and preventive actives and has a lower dosage.

Therefore, embodiments of the present invention may ameliorate one or more of the above-mentioned problems:

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Therefore, embodiments of the present invention may provide combinations of insecticides that possess an enhanced efficacy over the individual active compound used in isolation.

15 Another object of the present invention is to provide an insecticide combination that causes an enhanced greening of the crops to which it is administered.

Another object of the present invention is to provide a combination that causes late senescence to the crop to which it is applied thereby resulting into an increasing
20 yield of the crop.

Yet another object of the present invention is to provide a combination that results into reduced pest pressure in the crops to which it is applied.

25 Another object of the present invention is to provide a combination that achieves increased yield in the crops to which it is applied.

Another object of the present invention is to provide an insecticidal combination that causes an enhanced insecticidal activity.

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Another object of the present invention is to provide a combination which enhances the protection to plants from attack or infestation by insects, acarids or nematodes.

Another object of the present invention is to provide a synergist for the anthranilamide insecticides.

Some or all these and other objects of the invention are can be achieved by way
5 of the invention described hereinafter.

Summary of the invention:

Thus, an aspect of the present invention can provide a combination comprising:

- 10 (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- 15 (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, α -fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, 25 biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- 30 (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
- (ii) acequinocyl;

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- (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- (iv) bifenazate.

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Yet another aspect of the present invention can provide a composition comprising:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, α -fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
 - (i) hydramethylnon;
 - (ii) acequinocyl;

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- (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- (iv) bifenazate.

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Detailed Description:

The term 'disease control' as used herein denotes control and prevention of a disease. Controlling effects include all deviation from natural development, for example: killing, retardation, decrease of the pests. The term 'plants' refers to all
10 physical parts of a plant, including seeds, seedlings, saplings, roots, tubers, stems, stalks, foliage and fruits. The term "locus" of a plant as used herein is intended to embrace the place on which the plants are growing, where the plant propagation materials of the plants are sown or where the plant propagation materials of the plants will be placed into the soil. The term "plant propagation material" is
15 understood to denote generative parts of a plant, such as seeds, vegetative material such as cuttings or tubers, roots, fruits, tubers, bulbs, rhizomes and parts of plants, germinated plants and young plants which are to be transplanted after germination or after emergence from the soil. These young plants may be protected before transplantation by a total or partial treatment by immersion.

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Surprisingly, the insecticidal and/or acaricidal and/or antimicrobial activity or and/or the plant-invigorating activity and/or the yield-enhancing activity of the active compound combinations according to the invention was found to be significantly higher than the sum of the activities of the individual active compounds.

25 It has surprisingly been found that the addition of at least one mitochondrial complex III electron transport inhibitor to the combination of a pyrethroid insecticide with either a diamide insecticide or a phenylpyrazole insecticide leads to a surprising, unexpected and synergistic enhancement in the efficacy of the combination of a pyrethroid insecticide with either a diamide insecticide or a
30 phenylpyrazole insecticide.

Thus, in an aspect, the present invention provides a combination comprising:

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- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- 5 (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, 10 beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, α -fenshiqueluzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, 15 kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, 20 terallethrin, tetramethylfluthrin, tralocylthrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
- (ii) acequinocyl;
- 25 (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- (iv) bifenazate.

In an embodiment, it was surprising that the addition of bifenazate to the combination of diamide insecticides with at least another pyrethroid selected from 30 bifenthrin or kappa bifenthrin resulted in a surprising enhancement of the efficacy.

These surprising advantages of the combinations of the invention were not observed when the mitochondrial complex III electron transport inhibitor were not present in the combination. Therefore, these unexpected advantages of the combination of the present invention could be attributed to the inclusion of the
 5 mitochondrial complex III electron transport inhibitors to a combination comprising a pyrethroid insecticide with either a diamide insecticide or a phenylpyrazole insecticide.

In an aspect, the combinations of the present invention may be admixed with at least one agrochemically acceptable excipient to prepare a composition according
 10 to the present invention.

Thus, in another aspect, the present invention can provide a composition comprising:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
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- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenethrin, α -fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin,
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resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, traloccythrin, transfluthrin, or valerate; and
 (c) at least one mitochondrial complex III electron transport inhibitor selected from:

- 5 (i) hydramethylnon;
- (ii) acequinocyl;
- (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- 10 (iv) bifenazate.

The combinations and/or compositions according to the present invention may be used to control insect pests at a locus.

15 Therefore, in an aspect, the present invention provides a method of controlling insect pests at a locus, said method comprising applying to the locus a combination or a composition comprising:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- 20 (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenethrin, d-fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrin, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin,
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- momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, traloccythrin, transfluthrin, or valerate; and
- 5 (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
 - (ii) acequinocyl;
 - 10 (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
 - (iv) bifenazate.
- (d) an agrocheically acceptable adjuvant

15 Each of the aspects described above may have one or more embodiments.

Each of the embodiments described hereinafter may apply to one or all of the aspects described hereinabove. These embodiments are intended to be read as being preferred features of one or all of the aspects described hereinabove. Each

20 of the embodiments described hereinafter applies to each of the aspects described hereinabove individually.

In an embodiment, the diamide insecticide or the pyridylpyrazole insecticide may be selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor or

25 tetraniliprole.

In an embodiment, the diamide insecticide is chlorantraniliprole.

30 In an embodiment, the diamide insecticide is cyantraniliprole.

In an embodiment, the diamide insecticide is flubendiamide.

In an embodiment, the pyrethroid insecticide may be selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, 5 chlorempenthrin, cyclothrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, α -fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, 10 fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, 15 tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate.

In an embodiment, the pyrethroid insecticide is bifenthrin or kappa-bifenthrin.

20 In an embodiment, the pyrethroid insecticide is cyhalothrin, gamma-cyhalothrin, or lambda-cyhalothrin.

In an embodiment, the pyrethroid insecticide is cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, or zeta-cypermethrin.

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In an embodiment, the pyrethroid insecticide is permethrin.

In an embodiment, the mitochondrial complex III electron transport inhibitor is hydramethylnon.

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In an embodiment, the mitochondrial complex III electron transport inhibitor is acequinocyl.

In an embodiment, the mitochondrial complex III electron transport inhibitor is bifujunzhi.

- 5 In an embodiment, the mitochondrial complex III electron transport inhibitor is fluacrypyrim.

In an embodiment, the mitochondrial complex III electron transport inhibitor is flufenoxystrobin.

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In an embodiment, the mitochondrial complex III electron transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the mitochondrial complex III electron transport inhibitor is bifenazate.

The amount of a composition according to the invention to be applied, will depend on various factors, such as the subject of the treatment, such as, for example plants, soil or seeds; the type of treatment, such as, for example spraying, dusting
20 or seed dressing; the purpose of the treatment, such as, for example prophylactic or therapeutic or the application time or the pest pressure or intensity. This amount of the combinations of the present invention to be applied can be readily deduced by a skilled agronomist.

- 25 In an embodiment, the combinations of the present invention include the following preferred combinations.

In an embodiment, each individual row appearing in the table below represents the combinations in an embodiment of the present invention.

30

In the following table, the term bifenthrin means bifenthrin or its isomer kappa-bifenthrin; cyhalothrin means cyhalothrin or any of its isomers gamma-cyhalothrin,

or lambda-cyhalothrin; cypermethrin means cypermethrin or any of its isomers alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, or zeta-cypermethrin.

S No.	Diamide or Pyridylpyrazole insecticide	Pyrethroid insecticide	Mitochondrial complex III electron transport inhibitor
1	Chlorantraniliprole	Bifenthrin	Hydramethylnon
2	Chlorantraniliprole	Bifenthrin	Acequinocyl
3	Chlorantraniliprole	Bifenthrin	Bifujunzhi
4	Chlorantraniliprole	Bifenthrin	Fluacrypyrim
5	Chlorantraniliprole	Bifenthrin	Flufenoxystrobin
6	Chlorantraniliprole	Bifenthrin	Pyriminostrobin
7	Chlorantraniliprole	Bifenthrin	Bifenazate
8	Chlorantraniliprole	Cyhalothrin	Hydramethylnon
9	Chlorantraniliprole	Cyhalothrin	Acequinocyl
10	Chlorantraniliprole	Cyhalothrin	Bifujunzhi
11	Chlorantraniliprole	Cyhalothrin	Fluacrypyrim
12	Chlorantraniliprole	Cyhalothrin	Flufenoxystrobin
13	Chlorantraniliprole	Cyhalothrin	Pyriminostrobin
14	Chlorantraniliprole	Cyhalothrin	Bifenazate
15	Chlorantraniliprole	Cypermethrin	Hydramethylnon
16	Chlorantraniliprole	Cypermethrin	Acequinocyl
17	Chlorantraniliprole	Cypermethrin	Bifujunzhi
18	Chlorantraniliprole	Cypermethrin	Fluacrypyrim
19	Chlorantraniliprole	Cypermethrin	Flufenoxystrobin
20	Chlorantraniliprole	Cypermethrin	Pyriminostrobin
21	Chlorantraniliprole	Cypermethrin	Bifenazate
22	Chlorantraniliprole	Permethrin	Hydramethylnon
23	Chlorantraniliprole	Permethrin	Acequinocyl
24	Chlorantraniliprole	Permethrin	Bifujunzhi
25	Chlorantraniliprole	Permethrin	Fluacrypyrim

26	Chlorantraniliprole	Permethrin	Flufenoxystrobin
27	Chlorantraniliprole	Permethrin	Pyriminostrobin
28	Chlorantraniliprole	Permethrin	Bifenazate
29	Cyantraniliprole	Bifenthrin	HydramethylNon
30	Cyantraniliprole	Bifenthrin	Acequinocyl
31	Cyantraniliprole	Bifenthrin	Bifujunzhi
32	Cyantraniliprole	Bifenthrin	Fluacrypyrim
33	Cyantraniliprole	Bifenthrin	Flufenoxystrobin
34	Cyantraniliprole	Bifenthrin	Pyriminostrobin
35	Cyantraniliprole	Bifenthrin	Bifenazate
36	Cyantraniliprole	Cyhalothrin	HydramethylNon
37	Cyantraniliprole	Cyhalothrin	Acequinocyl
38	Cyantraniliprole	Cyhalothrin	Bifujunzhi
39	Cyantraniliprole	Cyhalothrin	Fluacrypyrim
40	Cyantraniliprole	Cyhalothrin	Flufenoxystrobin
41	Cyantraniliprole	Cyhalothrin	Pyriminostrobin
42	Cyantraniliprole	Cyhalothrin	Bifenazate
43	Cyantraniliprole	Cypermethrin	HydramethylNon
44	Cyantraniliprole	Cypermethrin	Acequinocyl
45	Cyantraniliprole	Cypermethrin	Bifujunzhi
46	Cyantraniliprole	Cypermethrin	Fluacrypyrim
47	Cyantraniliprole	Cypermethrin	Flufenoxystrobin
48	Cyantraniliprole	Cypermethrin	Pyriminostrobin
49	Cyantraniliprole	Cypermethrin	Bifenazate
50	Cyantraniliprole	Permethrin	HydramethylNon
51	Cyantraniliprole	Permethrin	Acequinocyl
52	Cyantraniliprole	Permethrin	Bifujunzhi
53	Cyantraniliprole	Permethrin	Fluacrypyrim
54	Cyantraniliprole	Permethrin	Flufenoxystrobin
55	Cyantraniliprole	Permethrin	Pyriminostrobin

56	Cyantraniliprole	Permethrin	Bifenazate
57	Flubendiamide	Bifenthrin	Hydramethylnon
58	Flubendiamide	Bifenthrin	Acequinocyl
59	Flubendiamide	Bifenthrin	Bifujunzhi
60	Flubendiamide	Bifenthrin	Fluacrypyrim
61	Flubendiamide	Bifenthrin	Flufenoxystrobin
62	Flubendiamide	Bifenthrin	Pyriminostrobin
63	Flubendiamide	Bifenthrin	Bifenazate
64	Flubendiamide	Cyhalothrin	Hydramethylnon
65	Flubendiamide	Cyhalothrin	Acequinocyl
66	Flubendiamide	Cyhalothrin	Bifujunzhi
67	Flubendiamide	Cyhalothrin	Fluacrypyrim
68	Flubendiamide	Cyhalothrin	Flufenoxystrobin
69	Flubendiamide	Cyhalothrin	Pyriminostrobin
70	Flubendiamide	Cyhalothrin	Bifenazate
71	Flubendiamide	Cypermethrin	Hydramethylnon
72	Flubendiamide	Cypermethrin	Acequinocyl
73	Flubendiamide	Cypermethrin	Bifujunzhi
74	Flubendiamide	Cypermethrin	Fluacrypyrim
75	Flubendiamide	Cypermethrin	Flufenoxystrobin
76	Flubendiamide	Cypermethrin	Pyriminostrobin
77	Flubendiamide	Cypermethrin	Bifenazate
78	Flubendiamide	Permethrin	Hydramethylnon
79	Flubendiamide	Permethrin	Acequinocyl
80	Flubendiamide	Permethrin	Bifujunzhi
81	Flubendiamide	Permethrin	Fluacrypyrim
82	Flubendiamide	Permethrin	Flufenoxystrobin
83	Flubendiamide	Permethrin	Pyriminostrobin
84	Flubendiamide	Permethrin	Bifenazate

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In an embodiment, the present invention may provide a combination comprising the three insecticides as listed in each individual row from row 1 to row 84 in the table above.

5 Thus in an embodiment, the present invention may provide combinations or compositions comprising:

- 10 (a) at least one diamide insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor or tetraniliprole;
- (b) at least one pyrethroid selected from bifenthrin or kappa bifenthrin; and
- (c) bifenazate.

15 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

20 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

25 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is bifenazate.

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In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is bifenazate.

- 20 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 25 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 30 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is bifenazate.

In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is chlorantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is bifenazate.

- 20 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 25 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 30 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is bifenazate.

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In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is bifenazate.

- 20 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 25 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 30 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is bifenazate.

In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is cyantraniliprole, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is bifenazate.

- 20 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 25 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 30 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is bifenthrin, and the mitochondrial complex III transport inhibitor is bifenazate.

In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cyhalothrin, and the mitochondrial complex III transport inhibitor is bifenazate.

- 20 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 25 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 30 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is cypermethrin, and the mitochondrial complex III transport inhibitor is bifenazate.

In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is fluacrypyrim.

- 5 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is flufenoxystrobin.

- 10 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is pyriminostrobin.

- 15 In an embodiment, the diamide or pyridylpyrazole insecticide is flubendiamide, the pyrethroid insecticide is permethrin, and the mitochondrial complex III transport inhibitor is bifentazate.

- 20 In an embodiment, the total amount of diamide insecticidal compound in the composition may typically be in the range of 0.1 to 99% by weight, preferably 0.2 to 90% by weight. The total amount of pyrethroid in the composition may be in the range of 0.1 to 99% by weight. The total amount of bifentazate in the composition may be in the range of 0.1 to 99% by weight.

- 25 In an embodiment, the constituent fungicides of the combination of the present invention may be admixed in ratio of (1-80): (1-80): (1-80) of the, anthranilamide insecticidal compound, pyrethroid compound and bifentazate respectively.

In an embodiment, the combinations or compositions or methods of the present invention comprise at least a fourth agrochemical active ingredient.

- 30 In an embodiment, the additional agrochemical active ingredient is a fungicide.

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In an embodiment, the fungicide is a strobilurin fungicide. In this embodiment, the addition of a strobilurin fungicide has been found to be specifically beneficial and potentiating.

- 5 In an embodiment, the strobilurin fungicide is selected from fluoxastrobin, mandestrobin, pyribencarb, azoxystrobin, bifujunzhi, coumoxystrobin, enoxastrobin, flufenoxystrobin, jiaxiangjunzhi, picoxystrobin, pyraoxystrobin, pyraclostrobin, pyrametostrobin, triclopyricarb, dimoxystrobin, fenaminstrobin, metominostrobin, orysastrobin, kresoxim-methyl, and trifloxystrobin.

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In an embodiment, the strobilurin fungicide is azoxystrobin.

In an embodiment, the strobilurin fungicide is bifujunzhi.

- 15 In an embodiment, the strobilurin fungicide is flufenoxystrobin.

In an embodiment, the strobilurin fungicide is jiaxiangjunzhi.

In an embodiment, the strobilurin fungicide is picoxystrobin.

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In an embodiment, the strobilurin fungicide is kresoxim-methyl.

In an embodiment, the strobilurin fungicide is trifloxystrobin.

- 25 In an embodiment, the combinations of the present invention may be applied to the locus either simultaneously or sequentially, such that the diamide insecticide or the pyridylpyrazole insecticide, the pyrethroid insecticide and the mitochondrial complex III electron transport inhibitor may be applied in a tank mix or as a pre-mixed composition.

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Thus, in this aspect, the present invention provides a tank-mix comprising:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- 5 (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, 10 beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, α -fenshiloquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japotheins, 15 kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, 20 terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
- (ii) acequinocyl;
- 25 (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- (iv) bifenazate.

30 The method of control of the present invention may be carried out by spraying the suggested tank mixes, or the individual insecticides may be formulated as a kit-of-

parts containing various components that may be mixed as instructed prior to spraying.

In an embodiment, the present invention provides a kit-of-parts comprising a plurality of components, wherein said plurality of components comprises:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenethrin, α -fanshiliuquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japoethrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, traloccythrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
 - (i) hydramethylnon;
 - (ii) acequinocyl;
 - (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and

(iv) bifenazate.

In an embodiment, the kit-of-parts comprises an instructions manual, said instructions manual comprising instructions directing a user to admix the components before being used.

In an embodiment, the components of the present invention may be packaged such that the components may be packaged separately and then tank mixed before the spraying.

In another embodiment, the components of the present invention may be packaged such that the active components may be packaged separately, whereas other additives are packaged separately, such that the two maybe tank mixed at the time of spraying.

In an embodiment, the constituents of the composition of the present invention may be tank mixed and sprayed at the locus of the pest infestation, or may be alternatively be mixed with surfactants and then sprayed.

In an embodiment, the constituents of the composition of the present invention may be used for foliar application, ground or applications to plant propagation materials.

In an embodiment, the compositions of the present invention may typically be produce by mixing the actives in the composition with an inert carrier, and adding surfactants and other adjuvants and carriers as needed and formulated into solid, or liquid formulations, including but not limited to wettable powders, granules, dusts, Soluble (liquid) concentrates, suspension concentrates, oil in water emulsion, water in oil emulsion, emulsifiable concentrates, capsule suspensions, ZC formulations, oil dispersions or other known formulation types. The composition may also be used for treatment of a plant propagation material such as seeds etc.

Examples of the solid carrier used in formulation include fine powders or granules such as minerals such as kaolin clay, attapulgite clay, bentonite, montmorillonite, acid white clay, pyrophyllite, talc, diatomaceous earth and calcite; natural organic materials such as corn rachis powder and walnut husk powder; synthetic organic materials such as urea; salts such as calcium carbonate and ammonium sulfate; 5 synthetic inorganic materials such as synthetic hydrated silicon oxide; and as a liquid carrier, aromatic hydrocarbons such as xylene, alkylbenzene and methylnaphthalene; alcohols such as 2-propanol, ethyleneglycol, propylene glycol, and ethylene glycol monoethyl ether; ketones such as acetone, cyclohexanone and 10 isophorone; vegetable oil such as soybean oil and cotton seed oil; petroleum aliphatic hydrocarbons, esters, dimethylsulfoxide, acetonitrile and water.

Examples of the surfactant include anionic surfactants such as alkyl sulfate ester salts, alkylaryl sulfonate salts, dialkyl sulfosuccinate salts, polyoxyethylene 15 alkylaryl ether phosphate ester salts, lignosulfonate salts and naphthalene sulfonate formaldehyde polycondensates; and nonionic surfactants such as polyoxyethylene alkyl aryl ethers, polyoxyethylene alkylpolyoxypropylene block copolymers and sorbitan fatty acid esters and cationic surfactants such as alkyltrimethylammonium salts.

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Examples of the other formulation auxiliary agents include water-soluble polymers such as polyvinyl alcohol and polyvinylpyrrolidone, polysaccharides such as Arabic gum, alginic acid and the salt thereof, CMC (carboxymethyl- cellulose), Xanthan gum, inorganic materials such as aluminum magnesium silicate and alumina sol, 25 preservatives, coloring agents and stabilization agents such as PAP (acid phosphate isopropyl) and BHT.

In an embodiment the insect pests controlled by the combinations of the present invention may belong to the class Insecta, Arachnida and Nematoda. Exemplary 30 pests may include: from the order Lepidoptera, pests such as *Acleris* spp., *Adoxophyes* spp., *Aegeria* spp., *Agrotis* spp., *Alabama argillaceae*, *Amylois* spp., *Anticarsia gemmatilis*, *Archips* spp., *Argyrotaenia* spp., *Autographa* spp.,

Busseola fusca, Cadra cautella, Carposina nipponensis, Chilo spp., Choristoneura
 spp., Clysia ambiguella, Cnaphalocrocis spp., Cnephasia spp., Cochylis spp.,
 Coleophora spp., Crocidolomia spp., Cryptophlebia leucotreta, Crysodeixis
 includens, Cydia spp., Diatraea spp., Diparopsis castanea, Earias spp.,
 5 Elasmopalpus spp., Ephestia spp., Eucosma spp., Eupoecilia ambiguella,
 Euproctis spp., Euxoa spp., Grapholita spp., Hedya nubiferana, Heliothis spp.,
 Hellula undalis, Hyphantria cunea, Keiferia lycopersicella, Leucoptera scitella,
 Lithocollethis spp., Lobesia botrana, Lymantria spp., Lyonetia spp., Malacosoma
 spp., Mamestra brassicae, Manduca sexta, Operophtera spp., Ostrinia nubilalis,
 10 Pammene spp., Pandemis spp., Panolis flammea, Pectinophora gossypiella,
 Phthorimaea operculella, Pieris rapae, Pieris spp., Plutella xylostella, Prays spp.,
 Scirpophaga spp., Sesamia spp., Sparganothis spp., Spodoptera spp.,
 Synanthedon spp., Thaumetopoea spp., Tortrix spp., Trichoplusia ni and
 Yponomeuta spp.; from the order Coleoptera, pest such as Agriotes spp.,
 15 Anthonomus spp., Atomaria linearis, Ceutorhynchus spp., Chaetocnema tibialis,
 Cosmopolites spp., Curculio spp., Dermestes spp., Diabrotica spp., Epilachna
 spp., Eremnus spp., Gonocephalum spp., Heteronychus spp., Leptinotarsa
 decemlineata, Lissorhoptrus spp., Melolontha spp., Oryzaephilus spp.,
 Otorhynchus spp., Phlyctinus spp., Phyllotreta spp., Popillia spp., Protostrophus
 20 spp., Psylliodes spp., Rhizopertha spp., Scarabeidae, Sitophilus spp., Sitotroga
 spp., Tenebrio spp., Tribolium spp. and Trogoderma spp.; from the order
 Orthoptera, pests such as Blatta spp., Blattella spp., Gryllotalpa spp., Leucophaea
 maderae, Locusta spp., Periplaneta spp. and Schistocerca spp.; from the order
 Isoptera, pests such as Reticulitermes spp.; from the order Psocoptera pest such
 25 as, Liposcelis spp.; from the order Anoplura, pests such as Haematopinus spp.,
 Linognathus spp., Pediculus spp., Pemphigus spp. and Phylloxera spp.; from the
 order Mallophaga pests such as Damalinae spp. and Trichodectes spp.; from the
 order Thysanoptera, pests such as Frankliniella spp., Hercinothrips spp.,
 Taeniothrips spp., Thrips palmi, Thrips tabaci and Scirtothrips aurantii; from the
 30 order Heteroptera, pests such as Dichelops melacanthus, Distantiella theobroma,
 Dysdercus spp., Euchistus spp., Eurygaster spp., Leptocorisa spp., Nezara spp.,
 Piesma spp., Rhodnius spp., Sahlbergella singularis, Scotinophara spp. and

Triatoma spp.; from the order Homoptera, insect pests such as Aleurothrixus floccosus, Aleyrodes brassicae, Aonidiella spp., Aphididae, Aphis spp., Aspidiotus spp., Bemisia tabaci, Ceroplaster spp., Chrysomphalus aonidium, Chrysomphalus dictyospermi, Coccus hesperidum, Empoasca spp., Eriosoma larigerum,
 5 Erythroneura spp., Gascardia spp., Laodelphax spp., Lecanium corni, Lepidosaphes spp., Macrosiphus spp., Myzus spp., Nephrotettix spp., Nilaparvata spp., Paratoria spp., Pemphigus spp., Planococcus spp., Pseudaulacaspis spp., Pseudococcus spp., Psylla spp., Pulvinaria aethiopica, Quadraspidiotus spp., Rhopalosiphum spp., Saissetia spp., Scaphoideus spp., Schizaphis spp., Sitobion
 10 spp., Trialeurodes vaporariorum, Trioza erytreae and Unaspis citri; from the order Hymenoptera, insect pests such as Acromyrmex, Athalia rosae, Atta spp., Cephus spp., Diprion spp., Diprionidae, Gilpinia polytoma, Hoplocampa spp., Lasius spp., Monomorium pharaonis, Neodiprion spp., Solenopsis spp. and Vespa spp.; from the order Diptera, insect pests such as Antherigona soccata, Bibio hortulanus,
 15 Ceratitis spp., Chrysomyia spp., Culex spp., Cuterebra spp., Dacus spp., Delia spp., Drosophila melanogaster, Liriomyza spp., Melanagromyza spp., Orseolia spp., Oscinella frit, Pegomyia hyoscyami, Phorbia spp., Rhagoletis pomonella, Sciara spp.; from the order Acarina, pests such as Acarus siro, Aceria sheldoni, Aculus schlehtendali, Amblyomma spp., Argas spp., Brevipalpus spp., Bryobia
 20 praetiosa, Calipitimerus spp., Chorioptes spp., Dermanyssus gallinae, Eotetranychus carpini, Eriophyes spp., Hyalomma spp., Olygonychus pratensis, Ornithodoros spp., Panonychus spp., Phyllocoptura spp. (such as Phyllocoptura oleivora), Polyphagotarsonemus latus, Psoroptes spp., Rhipicephalus spp., Rhizoglyphus spp., Sarcoptes spp., Tarsonemus spp. and Tetranychus spp.; and
 25 from the class Nematoda, the species of Meloidogyne spp. (for example, Meloidogyne incognita and Meloidogyne javanica), Heterodera spp. (for example, Heterodera glycines, Heterodera schachtii, Heterodera avenae and Heterodera trifolii), Globodera spp. (for example, Globodera rostochiensis), Radopholus spp. (for example, Radopholus similis), Rotylenchulus spp., Pratylenchus spp. (for
 30 example, Pratylenchus neglectans and Pratylenchus penetrans), Aphelenchoides spp., Helicotylenchus spp., Hoplolaimus spp., Paratrichodorus spp., Longidorus spp., Nacobbus spp., Subanguina spp. Belonlaimus spp., Criconemella spp.,

Criconemoides spp., Ditylenchus spp., Dolichodorus spp., Hemicriconemoides spp., Hemicyclophora spp., Hirschmaniella spp., Hypsoperine spp., Macroposthonia spp., Melinius spp., Punctodera spp., Quinisulcius spp., Scutellonema spp., Xiphinema spp., and Tylenchorhynchus spp.

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The compositions of the present invention can be used in agricultural lands such as fields, paddy fields, lawns and orchards or in non-agricultural lands. The present invention may be used to control pests in agricultural lands for cultivating the plants without any phytotoxicity to the plant.

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

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Japanese arborvitae, fir wood, hemlock, juniper, Pinus, Picea, and Taxus cuspidate, etc.

In an aspect the present invention may provide a method of improving the yield of a crop, said method comprising, applying to the locus of the crop a combination comprising:

- (a) at least one diamide insecticide;
- (b) at least pyrethroid selected from bifenthrin or kappa bifenthrin; and
- (c) bifenazate.

The combinations of the present invention may be sold as a pre-mix composition or a kit of parts such that individual actives may be mixed before spraying. Alternatively, the kit of parts may contain the bifenazate and a pyrethroid selected from either bifenthrin or kappa bifenthrin and the diamide insecticide may be admixed with an adjuvant such that the two components may be tank mixed before spraying.

The composition of the present invention may be applied simultaneously as a tank mix or a formulation or may be applied sequentially. The application may be made to the soil before emergence of the plants, either pre-planting or post-planting. The application may be made as a foliar spray at different timings during crop development.

As demonstrated, the addition of bifenazate to a combination of diamide insecticidal compound which are combined with pyrethroids, greatly improved the disease control as well as improved yield and demonstrated a synergistic effect.

While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The invention should therefore not be limited by the above described

embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention.

Example 1:

- 5 Trials were conducted to test the efficacy of the combination of Chlorantraniliprole + Bifenthrin + Bifenazate on mites in Brinjal:

Table : 1

Sr. No.	Treatments	Dose (gm. ai/ha)	% mortality			
			3 DAA	7 DAA	10 DAA	14 DAA
T-1	Chlorantraniliprole + Bifenthrin + Bifenazate	22.5 + 40 + 90	84	93.1	93.1	81
T-2	Chlorantraniliprole + Bifenthrin + Bifenazate	30+60+120	86	96	94.1	88
T3	Chlorantraniliprole	30	9.9	8.9	7.9	10.9
T-4	Bifenthrin	40	75	80	75	65
T-5	Bifenazate	150	65	95.1	85	75
T-6	Control	0		0	0	0

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Conclusion:

Chlorantraniliprole + Bifenthrin + Bifenazate at the dosage of 22.5+40+90

And 30+60+120 showed synergistic increased control of Brinjal mites than solo application of Chlorantraniliprole, Bifenthrin and Bifenazate.

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Example 2:

Trials were conducted to test the efficacy of the combination of Chlorantraniliprole + Bifenthrin + Bifenazate on *Lucinodes arbonalis* in Brinjal:

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Table : 2

Sr. No.	Treatments	Dose (gm. ai/ha)	% mortality			
			3 DAA	7 DAA	10 DAA	14 DAA
T-1	Chlorantraniliprole + Bifenthrin + Bifenazate	22.5 + 40 + 90	84	93.1	94.1	81
T-2	Chlorantraniliprole + Bifenthrin + Bifenazate	30+60+120	86	96	94.1	88
T3	Chlorantraniliprole	30	80	90.1	89.1	79
T-4	Bifenthrin	40	55	65	53	41
T-5	Bifenazate	150	9.9	12	10.9	7.9
T-6	Control	0		0	0	0

Conclusion:

- 10 Chlorantraniliprole + Bifenthrin + Bifenazate at the dosage of 22.5+40+90
And 30+60+120 showed synergistic increased control of *Lucinodes arbonalis* than solo application of Chlorantraniliprole, Bifenthrin and Bifenazate.

CLAIMS

1) An Insecticidal combination comprising:

- 5 (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- 10 (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclothrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin,
- 15 cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, d-fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japothrins, kadethrin, methothrin, metofluthrin,
- 20 epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- 25 (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
- 30 (ii) acequinocyl;

- (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
- (iv) bifenazate.

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2) An Insecticidal composition comprising

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cycloethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, d-fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japothrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
 - i. hydramethylnon;

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- ii. acequinocyl;
 - iii. a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
 - 5 iv. bifenazate.
- (d) an agrochemically acceptable adjuvant.

3) The combination as claimed in claim 1 wherein said combination comprises:

- (a) at least one diamide insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor or tetraniliprole;
- 10 (b) at least one pyrethroid selected from bifenthrin or kappa bifenthrin; and
- (c) bifenazate.

15 4) The combination as claimed in claim 1 wherein said combination comprises,

- i. chlorantraniliprole, bifenthrin and fluacrypyrim;
- ii. chlorantraniliprole, bifenthrin and flufenoxystrobin;
- iii. chlorantraniliprole, bifenthrin and pyriminostrobin;
- iv. chlorantraniliprole, bifenthrin and bifenazate
- 20 v. chlorantraniliprole, cyhalothrin and fluacrypyrim;
- vi. chlorantraniliprole, cyhalothrin and flufenoxystrobin;
- vii. chlorantraniliprole, cyhalothrin and pyriminostrobin;
- viii. chlorantraniliprole, cyhalothrin and bifenazate
- ix. chlorantraniliprole, cypermethrin and fluacrypyrim;
- 25 x. chlorantraniliprole, cypermethrin and flufenoxystrobin;
- xi. chlorantraniliprole, cypermethrin and pyriminostrobin;
- xii. chlorantraniliprole, cypermethrin and bifenazate
- xiii. chlorantraniliprole, permethrin and fluacrypyrim;
- xiv. chlorantraniliprole, permethrin and flufenoxystrobin;
- 30 xv. chlorantraniliprole, permethrin and pyriminostrobin;
- xvi. chlorantraniliprole, permethrin and bifenazate

5) A method of controlling insect pests at a locus, said method comprising applying to the locus a combination or a composition comprising:

- (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin, barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclothrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, dimefluthrin, dimethrin, empenthrin, d-fanshiluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japothrins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin, pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- (c) at least one mitochondrial complex III electron transport inhibitor selected from:
- (i) hydramethylnon;
- (ii) acequinocyl;
- (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi, fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and

(iv) bifenazate.

6) A kit-of-parts comprising a plurality of components, wherein said plurality of components comprises:

- 5 (a) a diamide insecticide or a pyridylpyrazole insecticide selected from broflanilide, chlorantraniliprole, cyantraniliprole, cyclaniliprole, cyhalodiamide, flubendiamide, tetrachlorantraniliprole, tyclopyrazoflor and tetraniliprole;
- (b) a pyrethroid selected from acrinathrin, allethrin, bioallethrin, esdepallethrin,
 10 barthrin, bifenthrin, kappa bifenthrin, bioethanomethrin, brofenvalerate, brofluthrin, bromethrin, butethrin, chlorempenthrin, cyclethrin, cyclprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin,
 15 dimefluthrin, dimethrin, empenhrin, α -fenshuluquebingjuzhi, chloroprallethrin, fenfluthrin, fenpirithrin, fenpropathrin, fenvalerate, esfenvalerate, flucythrinate, fluvalinate, tau-fluvalinate, furamethrin, furethrin, heptafluthrin, imiprothrin, japotheins, kadethrin, methothrin, metofluthrin, epsilon-metofluthrin, momfluorothrin, epsilon-momfluorothrin,
 20 pentmethrin, permethrin, biopermethrin, transpermethrin, phenothrin, prallethrin, profluthrin, proparthrin, pyresmethrin, renofluthrin, meperfluthrin, resmethrin, bioresmethrin, cismethrin, tefluthrin, kappa-tefluthrin, terallethrin, tetramethylfluthrin, tralocythrin, transfluthrin, or valerate; and
- 25 (c) at least one mitochondrial complex III electron transport inhibitor selected from:
 - (i) hydramethylnon;
 - (ii) acequinocyl;
 - (iii) a methoxyacrylate strobilurin insecticide selected from bifujunzhi,
 30 fluacrypyrim, flufenoxystrobin, and pyriminostrobin; and
 - (iv) bifenazate.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2019/057186

A. CLASSIFICATION OF SUBJECT MATTER

A01N 53/00 (2006.01) A01N 43/56 (2006.01) A01N 47/24 (2006.01) A01N 43/54 (2006.01) A01N 37/36 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

PATENW, CAlus, REGISTRY, CABA, BIOSIS, INFULL, CNFULL, KRFULL, ESPACENET and GOOGLE with IPC/CPC: A01N43/56, A01N53/00, A01N47/24, A01N43/54, A01N37/36 and Keywords: Diamide, Pyridylpyrazole, Chlorantraniliprole, Pyrethroid, Bifenthrin, Mitochondrial Complex III electron transport inhibitor, Bifenazate and related terms / truncations.

Applicant (UPL LTD) and Inventor (SHROFF, JAIDEV, RAJNIKANT; SHROFF, VIKRAM, RAJNIKANT; RENGAN, SRINIVASAN) name searched in CAlus, CABA, BIOSIS, ESPACENET, GOOGLE and IP Australia internal databases.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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



Further documents are listed in the continuation of Box C



See patent family annex

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

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Name and mailing address of the ISA/AU

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

Authorised officer

Luke Sweetman
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. +61262256163

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/IB2019/057186
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/IB2019/057186	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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		WO 2011042495 A2	14 Apr 2011
		ZA 201203192 B	31 Jul 2013
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2019)			