



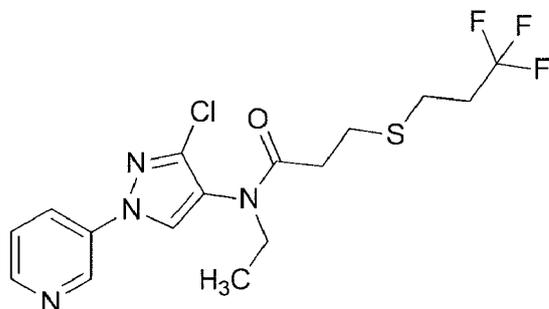
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- (71) Applicant: **DOW AGROSCIENCES LLC** [US/US];  
9330 Zionsville Road, Indianapolis, Indiana 46268 (US).
- (72) Inventors: **GOMEZ, Luis E.**; 261 Wyndotte Dr., Carmel,  
Indiana 46032 (US). **HUNTER, Ricky**; 342 West Tansey  
Crossing, Westfield, Indiana 46074 (US). **SHAW, Mike**;  
14203 Dove Drive, Carmel, Indiana 46033 (US).  
**TRULLINGER, Tony K.**; 644 Zephyr Way, Westfield,

Indiana 46074 (US). **KUBISZAK, Mary E.**; 3125 North  
675 West, Thorntown, Indiana 46071 (US). **HERBERT,  
John**; 592 Conner Creek Dr., Fishers, Indiana 46038 (US).

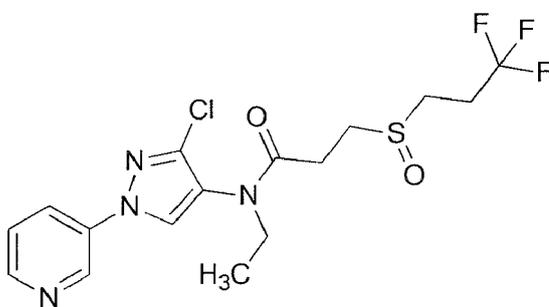
- (74) Agent: **CATAXINOS, Edgar R.**; PO Box 2550, Salt Lake  
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[Continued on next page]

(54) Title: SYNERGISTIC PESTICIDAL COMPOSITIONS AND RELATED METHODS



I



II

(57) Abstract: A pesticidal composition comprises a syner-  
gistically effective amount of a ryanodine receptor modulator  
compound and a pesticide selected from N (3 chloro 1 (pyridin  
3 yl) 1H pyrazol 4 yl) N ethyl 3 ((3,3,3  
trifluoropropyl)thio)propanamide (I), N (3 chloro 1 (pyridin 3  
yl) 1H pyrazol 4 yl) N ethyl-3 ((3,3,3  
trifluoropropyl)sulfinyl)propanamide (II), or any agricultur-  
ally acceptable salt thereof. A method of controlling pests  
comprises applying the pesticidal composition near a popula-  
tion of pests. A method of protecting a plant from infestation  
and attack by insects comprises contacting the plant with the  
synergistic pesticidal composition.



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— *with amended claims and statement (Art. 19(1))*

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## SYNERGISTIC PESTICIDAL COMPOSITIONS AND RELATED METHODS

## PRIORITY CLAIM

This application claims the benefit of the filing of United States Provisional  
5 Patent Application Serial No. 61/894,016, filed October 22, 2013, for “SYNERGISTIC  
PESTICIDAL COMPOSITIONS AND RELATED METHODS.”

## TECHNICAL FIELD

This disclosure relates to the field of compounds having pesticidal utility  
10 against pests in Phyla Nematoda, Arthropoda, and/or Mollusca, processes to produce  
such compounds and intermediates used in such processes. These compounds may be  
used, for example, as nematicides, acaricides, miticides, and/or molluscicides.

## BACKGROUND

15 Controlling pest populations is essential to human health, modern agriculture,  
food storage, and hygiene. There are more than ten thousand species of pests that  
cause losses in agriculture and the worldwide agricultural losses amount to billions of  
U.S. dollars each year. Accordingly, there exists a continuous need for new pesticides  
and for methods of producing and using such pesticides.

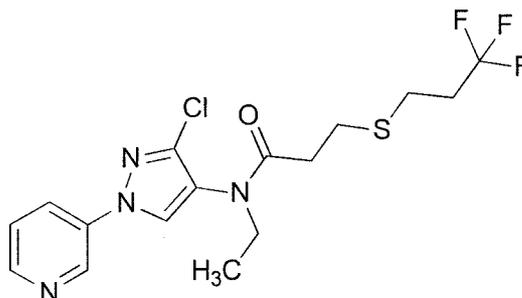
20 The Insecticide Resistance Action Committee (IRAC) has classified  
insecticides into categories based on the best available evidence of the mode of action  
of such insecticides. Insecticides in the IRAC Mode of Action Group 28 are ryanodine  
receptor modulators, which target the nerve and muscles of the affected insects. The  
insecticides in this class are believed to activate muscle ryanodine receptors, leading to  
25 contraction and paralysis of the affected insects. Examples of insecticides in this class  
are diamides, such as chlorantraniliprole, cyantraniliprole, cyclaniliprole, and  
flubendiamide.

Chlorantraniliprole (3-bromo-*N*-[4-chloro-2-methyl-6-[(methylamino)  
carbonyl] phenyl]-1-(3-chloro-2-pyridinyl)-1*H*-pyrazole-5-carboxamide) is an  
30 anthranilic diamine insecticide. It has been reported as an insecticide to control a broad  
range of pests belonging to the Order *Lepidoptera* and some *Coleoptera*, *Diptera* and  
*Isoptera* species.

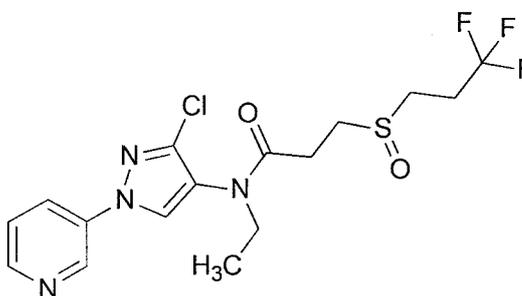


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(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl) sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof.



I



II

5

It is appreciated that a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio) propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl) sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof may be oxidized  
10 to the corresponding sulfone in the presence of oxygen.

As shown in the examples, the existence of synergistic effect is determined using the method described in Colby S. R., "Calculating Synergistic and Antagonistic Responses of Herbicide Combinations," Weeds, 1967, 15, 20-22.

15 Surprisingly, it has been found that the pesticidal composition of the present disclosure has superior pest control at lower levels of the combined concentrations of the ryanodine receptor modulator compound and the pesticide (I), (II), or any agriculturally acceptable salt thereof employed than that which may be achieved when the ryanodine receptor modulator compound and the pesticide (I), (II), or any  
20 agriculturally acceptable salt thereof are applied alone. In other words, the synergistic pesticidal composition is not a mere admixture of two active compounds resulting in

the aggregation of the properties of the active compounds employed in the composition.

In some embodiments, the pesticidal compositions may comprise a synergistically effective amount of a pesticide selected from (I), (II), or any agriculturally acceptable salt thereof in combination with cyantraniliprole. In other  
 5       embodiments, the pesticidal compositions may comprise a synergistically effective amount of a pesticide selected from (I), (II), or any agriculturally acceptable salt thereof in combination with chlorantraniliprole.

TABLE 1A

No.	Range of the Weight Ratio of Pesticide I or II to Ryanodine Receptor Modulator Compound
1	20:1 to 1:20
2	15:1 to 1:15
3	10:1 to 1:10
4	5:1 to 1:5
5	4:1 to 1:4
6	3:1 to 1:3
7	2:1 to 1:2
8	1:1

10

Table 1A shows weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator in the synergistic pesticidal compositions. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 20:1 and about 1:20. In some  
 15       embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 15:1 and about 1:15. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 10:1 and about 1:10. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 5:1  
 20       and about 1:5. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 4:1 and about 1:4. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 3:1 and about 1:3. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between

about 2:1 and about 1:2. In some embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be about 1:1. Additionally, the weight ratio limits of the pesticide to ryanodine receptor modulator compound in the aforementioned embodiments may be interchangeable. By way of non-limiting example, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be between about 1:3 and about 20:1.

Weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator envisioned to be synergistic pesticidal compositions may be depicted as  $X:Y$ ; wherein  $X$  is the parts by weight of the pesticide (I), (II), or any agriculturally acceptable salt thereof, and  $Y$  is the parts by weight of the ryanodine receptor modulator. The numerical range of the parts by weight for  $X$  is  $0 < X \leq 20$  and the parts by weight for  $Y$  is  $0 < Y \leq 20$  as shown graphically in TABLE 1B. By way of non-limiting example, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be about 20:1.

15

TABLE 1B

Ryanodine Receptor Modulator (Y) Parts by weight	20	$X,Y$		$X,Y$					
	15	$X,Y$	$X,Y$		$X,Y$				
	10	$X,Y$		$X,Y$					
	5	$X,Y$	$X,Y$	$X,Y$	$X,Y$				
	4	$X,Y$		$X,Y$		$X,Y$	$X,Y$		
	3	$X,Y$	$X,Y$		$X,Y$	$X,Y$	$X,Y$	$X,Y$	
	2	$X,Y$		$X,Y$		$X,Y$		$X,Y$	
	1	$X,Y$	$X,Y$	$X,Y$	$X,Y$	$X,Y$	$X,Y$	$X,Y$	
		1	2	3	4	5	10	15	20
		Pesticide (I or II) (X) Parts by weight							

Ranges of weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator envisioned to be synergistic pesticidal compositions may be depicted as  $X_1:Y_1$  to  $X_2:Y_2$ , wherein  $X$  and  $Y$  are defined as above. In one particular embodiment, the range of weight ratios may be  $X_1:Y_1$  to  $X_2:Y_2$ , wherein  $X_1 > Y_1$  and  $X_2 < Y_2$ . By way of non-limiting example, the range of weight ratios of the pesticide to the ryanodine receptor modulator compound may be between about 3:1 and about 1:3. In some embodiments, the range of weight ratios may be  $X_1:Y_1$  to  $X_2:Y_2$ , wherein  $X_1 > Y_1$  and  $X_2 > Y_2$ . By way of non-limiting example, the

20

range of weight ratios of the pesticide to the ryanodine receptor modulator compound may be between about 15:1 and about 3:1. In further embodiments, the range of weight ratios may be  $X_1:Y_1$  to  $X_2:Y_2$ , wherein  $X_1 < Y_1$  and  $X_2 < Y_2$ . By way of non-limiting example, the range of weight ratios of the pesticide to the ryanodine receptor modulator compound may be between about 1:3 and about 1:20.

Table 1C shows weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound in the synergistic pesticidal compositions, according to particular embodiments of the present disclosure. In some particular embodiments, the weight ratio of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound may be no more than about 256:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 72:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 32:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 16:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 8:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 6:1. In further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 4:1. In yet further embodiments, the weight ratio of the pesticide to the ryanodine receptor modulator compound may be no more than about 2:1.

TABLE 1C

Dose Rate Of Pesticide (I or II) (weight %)	Dose Rate of Ryanodine Receptor Modulator (weight %)	Weight Ratio of Pesticide (I or II) to Ryanodine Receptor Modulator
0.04	0.000156	$\leq 256:1$
0.0025	0.0000347	$\leq 72:1$
0.0025	0.0000781	$\leq 32:1$
0.0025	0.000156	$\leq 16:1$
0.0025	0.0003125	$\leq 8:1$
0.000625	0.0000781	$\leq 8:1$

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Dose Rate Of Pesticide (I or II) (weight %)	Dose Rate of Ryanodine Receptor Modulator (weight %)	Weight Ratio of Pesticide (I or II) to Ryanodine Receptor Modulator
0.000625	0.000104	≤ 6:1
0.000625	0.000156	≤ 4:1
0.000625	0.0003125	≤ 2:1

The weight ratio of the pesticide (I), (II), or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound in the synergistic pesticidal composition may be varied and different from those described in Table 1A, Table 1B, and Table 1C. One skilled in the art recognizes that the synergistic effective amount of the combination of active compounds may vary accordingly to various prevailing conditions. Non-limiting examples of such prevailing conditions may include the type of pests, the type of crops, the mode of application, the application timing, the weather conditions, the soil conditions, the topographical character, or the like. It is understood that one skilled in the art may readily determine the synergistic effective amount of the ryanodine receptor modulator compound and the pesticide (I), (II), or any agriculturally acceptable salt thereof accordingly to the prevailing conditions.

In some embodiments, the pesticidal compositions may comprise a synergistically effective amount of cyantraniliprole in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl) propanamide (II), or any agriculturally acceptable salt thereof.

In other embodiments, the pesticidal compositions may comprise a synergistically effective amount of chlorantraniliprole in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof.

In alternative embodiments, the pesticidal composition may comprise a synergistically effective amount of a ryanodine receptor modulator compound in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-

1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I),  
*N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)  
sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof, and a  
phytologically-acceptable inert carrier (*e.g.*, solid carrier, or liquid carrier).

5           In further embodiments, the pesticidal composition may further comprise at  
least one additive selected from a surfactant, a stabilizer, an emetic agent, a  
disintegrating agent, an antifoaming agent, a wetting agent, a dispersing agent, a  
binding agent, dye, filler, or combinations thereof.

          In particular embodiments, each of the pesticides (a ryanodine receptor  
10 modulator compound, and a pesticide selected from *N*-(3-chloro-1-  
(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I),  
*N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)  
sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof) may be  
formulated separately as a wettable powder, emulsifiable concentrate, aqueous or liquid  
15 flowable, suspension concentrate or any one of the conventional formulations used for  
pesticides, and then tank-mixed in the field with water or other liquid for application as  
a liquid spray mixture. When desired, the separately formulated pesticides may also be  
applied sequentially.

          In some embodiments, the synergistic pesticidal composition may be  
20 formulated into a more concentrated primary composition, which is then diluted with  
water or other diluent before use. In such embodiments, the synergistic pesticidal  
composition may further comprise a surface active agent.

          In one particular embodiment, the method of protecting a plant from infestation  
and attack by insects comprises contacting the plant with a pesticidal composition  
25 comprising a synergistically effective amount of a ryanodine receptor modulator  
compound in combination with a pesticide selected from *N*-(3-chloro-1-  
(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I),  
*N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)  
sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof.

30           In some embodiments, the pesticidal compositions may be in the form of solid.  
Non-limiting examples of the solid forms may include powder, dust or granular  
formulations.

In other embodiments, the pesticidal compositions may be in the form of liquid formulation. Examples of the liquid forms may include, but not limited to, dispersion, suspension, emulsion or solution in appropriate liquid carrier. In particular  
5 dispersion, wherein the synergistic pesticidal compositions may be dispersed in water or other agriculturally suitable liquid carrier.

In certain embodiments, the synergistic pesticidal compositions may be in the form of solution in an appropriate organic solvent. In one embodiment, the spray oils, which are widely used in agricultural chemistry, may be used as the organic solvent for  
10 the synergistic pesticidal compositions.

In one particular embodiment, the method of controlling pests comprises applying a pesticidal composition near a population of pests, wherein the pesticidal composition comprises a synergistically effective amount of a ryanodine receptor modulator compound in combination with a pesticide selected from  
15 *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof.

The control of pests may be achieved by applying a pesticidally effective  
20 amount of the synergistic pesticidal compositions in form of sprays, topical treatment, gels, seed coatings, microcapsulations, systemic uptake, baits, eartags, boluses, foggers, fumigants aerosols, dusts, or the like.

These disclosed pesticidal compositions may be used, for example, as nematicides, acaricides, miticides, and/or molluscicides.

25 The pesticidal composition of the present disclosure may be used to control a wide variety of insects. As a non-limiting example, in one or more embodiments, the pesticidal composition may be used to control one or more members of at least one of Phylum Arthropoda, Phylum Nematoda, Subphylum Chelicerata, Subphylum Myriapoda, Subphylum Hexapoda, Class Insecta, Class Arachnida, and Class  
30 Symphyla. In at least some embodiments, the method of the present disclosure may be used to control one or more members of at least one of Class Insecta and Class Arachnida.

As a non-limiting example, in one or more embodiments, the method of the present disclosure may be used to control one or more members of at least one of Phylum Arthropoda, Phylum Nematoda, Subphylum Chelicerata, Subphylum Myriapoda, Subphylum Hexapoda, Class Insecta, Class Arachnida, and Class  
5 Symphyla. In at least some embodiments, the method of the present disclosure may be used to control one or more members of at least one of Class Insecta and Class Arachnida.

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Coleoptera* (beetles) including, but not limited to,  
10 *Acanthoscelides* spp. (weevils), *Acanthoscelides obtectus* (common bean weevil), *Agrius planipennis* (emerald ash borer), *Agriotes* spp. (wireworms), *Anoplophora glabripennis* (Asian longhorned beetle), *Anthonomus* spp. (weevils), *Anthonomus grandis* (boll weevil), *Aphidius* spp., *Apion* spp. (weevils), *Apogonia* spp. (grubs), *Ataenius spretulus* (Black Turfgrass Ataenius), *Atomaria linearis* (pygmy mangold  
15 beetle), *Aulacophore* spp., *Bothynoderes punctiventris* (beet root weevil), *Bruchus* spp. (weevils), *Bruchus pisorum* (pea weevil), *Cacoesia* spp., *Callosobruchus maculatus* (southern cow pea weevil), *Carpophilus hemipteras* (dried fruit beetle), *Cassida vittata*, *Cerosterna* spp., *Cerotoma* spp. (chrysomelids), *Cerotoma trifurcata* (bean leaf  
20 beetle), *Ceutorhynchus* spp. (weevils), *Ceutorhynchus assimilis* (cabbage seedpod weevil), *Ceutorhynchus napi* (cabbage curculio), *Chaetocnema* spp. (chrysomelids), *Colaspis* spp. (soil beetles), *Conoderus scalaris*, *Conoderus stigmaticus*, *Conotrachelus nenuphar* (plum curculio), *Cotinus nitidis* (Green June beetle), *Crioceris asparagi* (asparagus beetle), *Cryptolestes ferrugineus* (rusty grain beetle), *Cryptolestes pusillus* (flat grain beetle), *Cryptolestes turcicus* (Turkish grain beetle), *Ctenicera* spp.  
25 (wireworms), *Curculio* spp. (weevils), *Cyclocephala* spp. (grubs), *Cylindrocephalus adspersus* (sunflower stem weevil), *Deporaus marginatus* (mango leaf-cutting weevil), *Dermestes lardarius* (larder beetle), *Dermestes maculatus* (hide beetle), *Diabrotica* spp. (chrysomelids), *Epilachna varivestis* (Mexican bean beetle), *Faustinus cubae*, *Hylobius pales* (pales weevil), *Hypera* spp. (weevils), *Hypera postica* (alfalfa weevil),  
30 *Hyperdoes* spp. (Hyperodes weevil), *Hypothenemus hampei* (coffee berry beetle), *Ips* spp. (engravers), *Lasioderma serricornis* (cigarette beetle), *Leptinotarsa decemlineata* (Colorado potato beetle), *Liogenys fuscus*, *Liogenys suturalis*, *Lissorhoptrus*

*oryzophilus* (rice water weevil), *Lyctus* spp. (wood beetles/powder post beetles),  
*Maecolaspis joliveti*, *Megascelis* spp., *Melanotus communis*, *Meligethes* spp.,  
*Meligethes aeneus* (blossom beetle), *Melolontha melolontha* (common European  
cockchafer), *Oberea brevis*, *Oberea linearis*, *Oryctes rhinoceros* (date palm beetle),  
5 *Oryzaephilus mercator* (merchant grain beetle), *Oryzaephilus surinamensis*  
(sawtoothed grain beetle), *Otiorhynchus* spp. (weevils), *Oulema melanopus* (cereal leaf  
beetle), *Oulema oryzae*, *Pantomorus* spp. (weevils), *Phyllophaga* spp. (May/June  
beetle), *Phyllophaga cuyabana* (chrysomelids), *Phynchites* spp., *Popillia japonica*  
(Japanese beetle), *Prostephanus truncates* (larger grain borer), *Rhizopertha dominica*  
10 (lesser grain borer), *Rhizotrogus* spp. (European chafer), *Rhynchophorus* spp.  
(weevils), *Scolytus* spp. (wood beetles), *Shenophorus* spp. (Billbug), *Sitona lineatus*  
(pea leaf weevil), *Sitophilus* spp. (grain weevils), *Sitophilus granaries* (granary  
weevil), *Sitophilus oryzae* (rice weevil), *Stegobium paniceum* (drugstore beetle),  
*Tribolium* spp. (flour beetles), *Tribolium castaneum* (red flour beetle), *Tribolium*  
15 *confusum* (confused flour beetle), *Trogoderma variable* (warehouse beetle), and  
*Zabrus tenebioides*.

In other embodiments, the method of the present disclosure may also be used to control members of the Order *Dermaptera* (earwigs).

In additional embodiments, the method of the present disclosure may be used to  
20 control members of the Order *Dictyoptera* (cockroaches) including, but is not limited  
to, *Blattella germanica* (German cockroach), *Blatta orientalis* (oriental cockroach),  
*Parcoblatta pennsylvanica*, *Periplaneta americana* (American cockroach), *Periplaneta*  
*australasiae* (Australian cockroach), *Periplaneta brunnea* (brown cockroach),  
*Periplaneta fuliginosa* (smokybrown cockroach), *Pyncoselus suninamensis* (Surinam  
25 cockroach), and *Supella longipalpa* (brownbanded cockroach).

In further embodiments, the method of the present disclosure may be used to  
control members of the Order *Diptera* (true flies) including, but is not limited to, *Aedes*  
spp. (mosquitoes), *Agromyza frontella* (alfalfa blotch leafminer), *Agromyza* spp. (leaf  
miner flies), *Anastrepha* spp. (fruit flies), *Anastrepha suspensa* (Caribbean fruit fly),  
30 *Anopheles* spp. (mosquitoes), *Bactrocera* spp. (fruit flies), *Bactrocera cucurbitae*  
(melon fly), *Bactrocera dorsalis* (oriental fruit fly), *Ceratitidis* spp. (fruit flies), *Ceratitidis*  
*capitata* (Mediterranean fruit fly), *Chrysops* spp. (deer flies), *Cochliomyia* spp.

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(screwworms), *Contarinia* spp. (Gall midges), *Culex* spp. (mosquitoes), *Dasineura* spp. (gall midges), *Dasineura brassicae* (cabbage gall midge), *Delia* spp., *Delia platura* (seedcorn maggot), *Drosophila* spp. (vinegar flies), *Fannia* spp. (filth flies), *Fannia canicularis* (little house fly), *Fannia scalaris* (latrine fly), *Gasterophilus intestinalis* (horse bot fly), *Gracillia perseae*, *Haematobia irritans* (horn fly), *Hylemyia* spp. (root maggots), *Hypoderma lineatum* (common cattle grub), *Liriomyza* spp. (leafminer flies), *Liriomyza brassica* (serpentine leafminer), *Liriomyza sativae* (vegetable leafminer), *Melophagus ovinus* (sheep ked), *Musca* spp. (muscid flies), *Musca autumnalis* (face fly), *Musca domestica* (house fly), *Oestrus ovis* (sheep bot fly), *Oscinella frit* (frit fly), *Pegomyia betae* (beet leafminer), *Phorbia* spp., *Psila rosae* (carrot rust fly), *Rhagoletis cerasi* (cherry fruit fly), *Rhagoletis pomonella* (apple maggot), *Sitodiplosis mosellana* (orange wheat blossom midge), *Stomoxys calcitrans* (stable fly), *Tabanus* spp. (horse flies), and *Tipula* spp. (crane flies).

In other embodiments, the method of the present disclosure may be used to control members of the Order *Hemiptera* Sub-order *Heteroptera* (true bugs) including, but is not limited to, *Acrosternum hilare* (green stink bug), *Blissus leucopterus* (chinch bug), *Bragada hilaris*, *Calocoris norvegicus* (potato mirid), *Cimex hemipterus* (tropical bed bug), *Cimex lectularius* (bed bug), *Dagbertus fasciatus*, *Dichelops furcatus*, *Dysdercus suturellus* (cotton stainer), *Edessa meditabunda*, *Eurygaster maura* (cereal bug), *Euschistus heros*, *Euschistus servus* (brown stink bug), *Helopeltis antonii*, *Helopeltis theivora* (tea blight plantbug), *Lagynotomus* spp. (stink bugs), *Leptocorisa oratorius*, *Leptocorisa varicornis*, *Lygus* spp. (plant bugs), *Lygus hesperus* (western tarnished plant bug), *Lygus lineolaris* (tarnished plant bug), *Maconellicoccus hirsutus*, *Neurocolpus longirostris*, *Nezara viridula* (southern green stink bug), *Phytocoris* spp. (plant bugs), *Phytocoris californicus*, *Phytocoris relativus*, *Piezodorus guildinii* (redbanded stink bug), *Poecilocapsus lineatus* (fourlined plant bug), *Psallus vaccinicola*, *Pseudacysta perseae*, *Scaptocoris castanea*, and *Triatoma* spp. (bloodsucking conenose bugs/kissing bugs).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Hemiptera*, Sub-orders *Auchenorrhyncha* (Free-living Hemipterans) and *Sternorrhyncha* (Plant-parasitic Hemipterans) (aphids, scales, whiteflies, leafhoppers) including, but is not limited to, *Acrythosiphon pisum* (pea

aphid), *Adelges* spp. (adelgids), *Aleurodes proletella* (cabbage whitefly), *Aleurodicus*  
*dispersus*, *Aleurothrixus floccosus* (woolly whitefly), *Aluacaspis* spp., *Amrasca*  
*bigutella bigutella*, *Aphrophora* spp. (leafhoppers), *Aonidiella aurantii* (California red  
 scale), *Aphis* spp. (aphids), *Aphis gossypii* (cotton aphid), *Aphis pomi* (apple aphid),  
 5 *Aulacorthum solani* (foxglove aphid), *Bemisia* spp. (whiteflies), *Bemisia argentifolii*,  
*Bemisia tabaci* (sweetpotato whitefly), *Brachycolus noxius* (Russian aphid),  
*Brachycorynella asparagi* (asparagus aphid), *Brevennia rehi*, *Brevicoryne brassicae*  
 (cabbage aphid), *Ceroplastes* spp. (scales), *Ceroplastes rubens* (red wax scale),  
*Chionaspis* spp. (scales), *Chrysomphalus* spp. (scales), *Chrysomphalus aonidum*  
 10 (Florida red scale) *Coccus* spp. (scales), *Coccus pseudomagnoliarum* (citricola scale),  
*Dysaphis plantaginea* (rosy apple aphid), *Empoasca* spp. (leafhoppers), *Eriosoma*  
*lanigerum* (woolly apple aphid), *Icerya purchasi* (cottony cushion scale), *Idioscopus*  
*nitidulus* (mango leafhopper), *Laodelphax striatellus* (smaller brown planthopper),  
*Lepidosaphes* spp., *Macrosiphum* spp., *Macrosiphum euphorbiae* (potato aphid),  
 15 *Macrosiphum granarium* (English grain aphid), *Macrosiphum rosae* (rose aphid),  
*Macrosteles quadrilineatus* (aster leafhopper), *Mahanarva frimbiolata*, *Metopolophium*  
*dirhodum* (rose grain aphid), *Mictis longicornis*, *Myzus* spp., *Myzus persicae* (green  
 peach aphid), *Nephotettix* spp. (leafhoppers), *Nephotettix cinctipes* (green leafhopper),  
*Nilaparvata lugens* (brown planthopper), *Paratrioza cockerelli* (tomato psyllid),  
 20 *Parlatoria pergandii* (chaff scale), *Parlatoria ziziphi* (ebony scale), *Peregrinus maidis*  
 (corn delphacid), *Philaenus* spp. (spittlebugs), *Phylloxera vitifoliae* (grape phylloxera),  
*Physokermes piceae* (spruce bud scale), *Planococcus* spp. (mealybugs), *Planococcus*  
*citri* (citrus mealybug), *Planococcus ficus* (grape mealybug), *Pseudococcus* spp.  
 (mealybugs), *Pseudococcus brevipes* (pine apple mealybug), *Quadraspidiotus*  
 25 *perniciosus* (San Jose scale), *Rhopalosiphum* spp. (aphids), *Rhopalosiphum maidis*  
 (corn leaf aphid), *Rhopalosiphum padi* (oat bird-cherry aphid), *Saissetia* spp. (scales),  
*Saissetia oleae* (black scale), *Schizaphis graminum* (greenbug), *Sitobion avenae*  
 (English grain aphid), *Sogatella furcifera* (white-backed planthopper), *Therioaphis* spp.  
 (aphids), *Toumeyella* spp. (scales), *Toxoptera* spp. (aphids), *Trialeurodes* spp.  
 30 (whiteflies), *Trialeurodes vaporariorum* (greenhouse whitefly), *Trialeurodes*  
*abutiloneus* (bandedwing whitefly), *Unaspis* spp. (scales), *Unaspis yanonensis*

(arrowhead scale), and *Zulia entreriana*. In at least some embodiments, the method of the present disclosure may be used to control *Myzus persicae*.

In other embodiments, the method of the present disclosure may be used to control members of the Order *Hymenoptera* (ants, wasps, and sawflies) including, but not limited to, *Acromyrmex* spp., *Athalia rosae*, *Atta* spp. (leafcutting ants),  
5 *Camponotus* spp. (carpenter ants), *Diprion* spp. (sawflies), *Formica* spp. (ants), *Iridomyrmex humilis* (Argentine ant), *Monomorium* spp., *Monomorium minimum* (little black ant), *Monomorium pharaonis* (Pharaoh ant), *Neodiprion* spp. (sawflies), *Pogonomyrmex* spp. (harvester ants), *Polistes* spp. (paper wasps), *Solenopsis* spp. (fire  
10 ants), *Tapinoma sessile* (odorous house ant), *Tetranomorium* spp. (pavement ants), *Vespula* spp. (yellow jackets), and *Xylocopa* spp. (carpenter bees).

In certain embodiments, the method of the present disclosure may be used to control members of the Order *Isoptera* (termites) including, but not limited to, *Coptotermes* spp., *Coptotermes curvignathus*, *Coptotermes frenchii*, *Coptotermes*  
15 *formosanus* (Formosan subterranean termite), *Cornitermes* spp. (nasute termites), *Cryptotermes* spp. (drywood termites), *Heterotermes* spp. (desert subterranean termites), *Heterotermes aureus*, *Kalotermes* spp. (drywood termites), *Incistitermes* spp. (drywood termites), *Macrotermes* spp. (fungus growing termites), *Marginitermes* spp. (drywood termites), *Microcerotermes* spp. (harvester termites), *Microtermes obesi*,  
20 *Procornitermes* spp., *Reticulitermes* spp. (subterranean termites), *Reticulitermes banyulensis*, *Reticulitermes grassei*, *Reticulitermes flavipes* (eastern subterranean termite), *Reticulitermes hageni*, *Reticulitermes hesperus* (western subterranean termite), *Reticulitermes santonensis*, *Reticulitermes speratus*, *Reticulitermes tibialis*, *Reticulitermes virginicus*, *Schedorhinotermes* spp., and *Zootermopsis* spp.  
25 (rotten-wood termites).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Lepidoptera* (moths and butterflies) including, but not limited to, *Achoea janata*, *Adoxophyes* spp., *Adoxophyes orana*, *Agrotis* spp. (cutworms), *Agrotis ipsilon* (black cutworm), *Alabama argillacea* (cotton leafworm),  
30 *Amorbia cuneana*, *Amyelosis transitella* (navel orangeworm), *Anacamptodes defectaria*, *Anarsia lineatella* (peach twig borer), *Anomis sabulifera* (jute looper), *Anticarsia gemmatilis* (velvetbean caterpillar), *Archips argyrospila* (fruittree

leafroller), *Archips rosana* (rose leaf roller), *Argyrotaenia* spp. (tortricid moths), *Argyrotaenia citrana* (orange tortrix), *Autographa gamma*, *Bonagota cranaodes*, *Borbo cinnara* (rice leaf folder), *Bucculatrix thurberiella* (cotton leaf perforator), *Caloptilia* spp. (leaf miners), *Capua reticulana*, *Carposina niponensis* (peach fruit moth), *Chilo* spp., *Chlumetia transversa* (mango shoot borer), *Choristoneura* 5 *rosaceana* (obliquebanded leafroller), *Chrysodeixis* spp., *Cnaphalocerus medinalis* (grass leafroller), *Colias* spp., *Conpomorpha cramerella*, *Cossus cossus* (carpenter moth), *Crambus* spp. (Sod webworms), *Cydia funebrana* (plum fruit moth), *Cydia molesta* (oriental fruit moth), *Cydia nignicana* (pea moth), *Cydia pomonella* (codling moth), *Darna diducta*, *Diaphania* spp. (stem borers), *Diatraea* spp. (stalk borers), 10 *Diatraea saccharalis* (sugarcane borer), *Diatraea graniosella* (southwestern corn borer), *Earias* spp. (bollworms), *Earias insulata* (Egyptian bollworm), *Earias vitella* (rough northern bollworm), *Ecdytopopha aurantianum*, *Elasmopalpus lignosellus* (lesser cornstalk borer), *Epiphysias postruttana* (light brown apple moth), *Ephestia* spp. (flour moths), *Ephestia cautella* (almond moth), *Ephestia elutella* (tobacco moth), *Ephestia kuehniella* (Mediterranean flour moth), *Epimeces* spp., *Epinotia aporema*, *Erionota thrax* (banana skipper), *Eupoecilia ambiguella* (grape berry moth), *Euxoa auxiliaris* (army cutworm), *Feltia* spp. (cutworms), *Gortyna* spp. (stem borers), *Grapholita molesta* (oriental fruit moth), *Hedylepta indicata* (bean leaf webber), *Helicoverpa* spp. 20 (noctuid moths), *Helicoverpa armigera* (cotton bollworm), *Helicoverpa zea* (bollworm/corn earworm), *Heliothis* spp. (noctuid moths), *Heliothis virescens* (tobacco budworm), *Hellula undalis* (cabbage webworm), *Indarbela* spp. (root borers), *Keiferia lycopersicella* (tomato pinworm), *Leucinodes orbonalis* (eggplant fruit borer), *Leucoptera malifoliella*, *Lithocolletis* spp., *Lobesia botrana* (grape fruit moth), 25 *Loxagrotis* spp. (noctuid moths), *Loxagrotis albicosta* (western bean cutworm), *Lymantria dispar* (gypsy moth), *Lyonetia clerkella* (apple leaf miner), *Mahasena corbetti* (oil palm bagworm), *Malacosoma* spp. (tent caterpillars), *Mamestra brassicae* (cabbage armyworm), *Maruca testulalis* (bean pod borer), *Metisa plana* (bagworm), *Mythimna unipuncta* (true armyworm), *Neoleucinodes elegantalis* (small tomato borer), *Nymphula depunctalis* (rice caseworm), *Operophtera brumata* (winter moth), 30 *Ostrinia nubilalis* (European corn borer), *Oxydia vesulia*, *Pandemis cerasana* (common currant tortrix), *Pandemis heparana* (brown apple tortrix), *Papilio*

*demodocus*, *Pectinophora gossypiella* (pink bollworm), *Peridroma* spp. (cutworms),  
*Peridroma saucia* (variegated cutworm), *Perileucoptera coffeella* (white coffee  
leafminer), *Phthorimaea operculella* (potato tuber moth), *Phyllocnistis citrella*,  
*Phyllonorycter* spp. (leafminers), *Pieris rapae* (imported cabbageworm), *Plathypena*  
5 *scabra*, *Plodia interpunctella* (Indian meal moth), *Plutella xylostella* (diamondback  
moth), *Polychrosis viteana* (grape berry moth), *Prays endocarpa*, *Prays oleae* (olive  
moth), *Pseudaletia* spp. (noctuid moths), *Pseudaletia unipunctata* (armyworm),  
*Pseudoplusia includens* (soybean looper), *Rachiplusia nu*, *Scirpophaga incertulas*,  
*Sesamia* spp. (stem borers), *Sesamia inferens* (pink rice stem borer), *Sesamia*  
10 *nonagrioides*, *Setora nitens*, *Sitotroga cerealella* (Angoumois grain moth),  
*Sparganothis pilleriana*, *Spodoptera* spp. (armyworms), *Spodoptera exigua* (beet  
armyworm), *Spodoptera fugiperda* (fall armyworm), *Spodoptera oridania* (southern  
armyworm), *Synanthedon* spp. (root borers), *Thecla basilides*, *Thermisia gemmatalis*,  
*Tineola bisselliella* (webbing clothes moth), *Trichoplusia ni* (cabbage looper), *Tuta*  
15 *absoluta*, *Yponomeuta* spp., *Zeuzera coffeae* (red branch borer), and *Zeuzera pyrina*  
(leopard moth). In at least some embodiments, the method of the present disclosure  
may be used to control *Spodoptera exigua*.

The method of the present disclosure may be used to also control members of  
the Order *Mallophaga* (chewing lice) including, but not limited to, *Bovicola ovis*  
20 (sheep biting louse), *Menacanthus stramineus* (chicken body louse), and *Menopon*  
*gallinea* (common hen louse).

In additional embodiments, the method of the present disclosure may be used to  
control members of the Order *Orthoptera* (grasshoppers, locusts, and crickets)  
including, but not limited to, *Anabrus simplex* (Mormon cricket), *Gryllotalpidae* (mole  
25 crickets), *Locusta migratoria*, *Melanoplus* spp. (grasshoppers), *Microcentrum retinerve*  
(angularwinged katydid), *Pterophylla* spp. (kaydids), *chistocerca gregaria*, *Scudderia*  
*furcata* (forktailed bush katydid), and *Valanga nigricorni*.

In other embodiments, the method of the present disclosure may be used to  
control members of the Order *Phthiraptera* (sucking lice) including, but not limited to,  
30 *Haematopinus* spp. (cattle and hog lice), *Linognathus ovillus* (sheep louse), *Pediculus*  
*humanus capitis* (human body louse), *Pediculus humanus humanus* (human body lice),  
and *Pthirus pubis* (crab louse).

In particular embodiments, the method of the present disclosure may be used to control members of the Order *Siphonaptera* (fleas) including, but not limited to, *Ctenocephalides canis* (dog flea), *Ctenocephalides felis* (cat flea), and *Pulex irritans* (human flea).

5 In additional embodiments, the method of the present disclosure may be used to control members of the Order *Thysanoptera* (thrips) including, but not limited to, *Caliothrips fasciatus* (bean thrips), *Caliothrips phaseoli*, *Frankliniella fusca* (tobacco thrips), *Frankliniella occidentalis* (western flower thrips), *Frankliniella shultzei*, *Frankliniella williamsi* (corn thrips), *Heliothrips haemorrhoidalis* (greenhouse thrips),  
10 *Rhipiphorothrips cruentatus*, *Scirtothrips* spp., *Scirtothrips citri* (citrus thrips), *Scirtothrips dorsalis* (yellow tea thrips), *Taeniothrips rhopalantennalis*, *Thrips* spp., *Thrips tabaci* (onion thrips), and *Thrips hawaiiensis* (Hawaiian flower thrips).

The method of the present disclosure may be used to also control members of the Order *Thysanura* (bristletails) including, but not limited to, *Lepisma* spp.  
15 (silverfish) and *Thermobia* spp. (firebrats).

In further embodiments, the method of the present disclosure may be used to control members of the Order *Acari* (mites and ticks) including, but not limited to, *Acarapsis woodi* (tracheal mite of honeybees), *Acarus* spp. (food mites), *Acarus siro* (grain mite), *Aceria mangiferae* (mango bud mite), *Aculops* spp., *Aculops lycopersici*  
20 (tomato russet mite), *Aculops pelekasi*, *Aculus pelekassi*, *Aculus schlechtendali* (apple rust mite), *Amblyomma americanum* (lone star tick), *Boophilus* spp. (ticks), *Brevipalpus obovatus* (privet mite), *Brevipalpus phoenicis* (red and black flat mite), *Demodex* spp. (mange mites), *Dermacentor* spp. (hard ticks), *Dermacentor variabilis* (american dog tick), *Dermatophagoides pteronyssinus* (house dust mite), *Eotetranychus*  
25 spp., *Eotetranychus carpini* (yellow spider mite), *Epitimerus* spp., *Eriophyes* spp., *Ixodes* spp. (ticks), *Metatetranychus* spp., *Notoedres cati*, *Oligonychus* spp., *Oligonychus coffee*, *Oligonychus ilicus* (southern red mite), *Panonychus* spp., *Panonychus citri* (citrus red mite), *Panonychus ulmi* (European red mite), *Phyllocoptruta oleivora* (citrus rust mite), *Polyphagotarsonemum latus* (broad mite),  
30 *Rhipicephalus sanguineus* (brown dog tick), *Rhizoglyphus* spp. (bulb mites), *Sarcoptes scabiei* (itch mite), *Tegolophus perseae-florae*, *Tetranychus* spp., *Tetranychus urticae* (twospotted spider mite), and *Varroa destructor* (honey bee mite).

In additional embodiments, the method of the present disclosure may be used to control members of the Order *Nematoda* (nematodes) including, but not limited to, *Aphelenchoides* spp. (foliar nematodes), *Belonolaimus* spp. (sting nematodes), *Criconemella* spp. (ring nematodes), *Dirofilaria immitis* (dog heartworm), *Ditylenchus* spp. (stem and bulb nematodes), *Heterodera* spp. (cyst nematodes), *Heterodera zeae* (corn cyst nematode), *Hirschmanniella* spp. (root nematodes), *Hoplolaimus* spp. (lance nematodes), *Meloidogyne* spp. (root knot nematodes), *Meloidogyne incognita* (root knot nematode), *Onchocerca volvulus* (hook-tail worm), *Pratylenchus* spp. (lesion nematodes), *Radopholus* spp. (burrowing nematodes), and *Rotylenchus reniformis* (kidney-shaped nematode).

In at least some embodiments, the method of the present disclosure may be used to control at least one insect in one or more of the Orders *Lepidoptera*, *Coleoptera*, *Hemiptera*, *Thysanoptera*, *Isoptera*, *Orthoptera*, *Diptera*, *Hymenoptera*, and *Siphonaptera*, and at least one mite in the Order *Acari*.

In some embodiments, the method of controlling an insect may comprise applying a pesticidal composition near a population of insects, wherein the pesticidal composition comprises a synergistically effective amount of a ryanodine receptor modulator compound in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof, and wherein the insect is selected from a sap feeding brown stink bug, *Euschistus servus* (Say), a lepidopteran diamond back moth, *Plutella xylostella* (Linnaeus), and a combination thereof.

In one embodiment, the method of controlling an insect may comprise applying a pesticidal composition near a population of insects, wherein the pesticidal composition comprises a synergistically effective amount of cyantraniliprole in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof, and wherein the insect is selected from a sap feeding brown stink bug, *Euschistus servus* (Say), a

lepidopteran diamond back moth, *Plutella xylostella* (Linnaeus), and a combination thereof.

In another embodiment, the method of controlling an insect may comprise applying a pesticidal composition near a population of insects, wherein the pesticidal composition comprises a synergistically effective amount of chlorantraniliprole in combination with a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio) propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof, and wherein the insect is selected from a sap feeding brown stink bug, *Euschistus servus* (Say), a lepidopteran diamond back moth, *Plutella xylostella* (Linnaeus), and a combination thereof.

In a particular embodiment of the present disclosure, the pesticidal composition may be used in conjunction (such as, in a compositional mixture, or a simultaneous or sequential application) with one or more compounds having acaricidal, algicidal, avicidal, bactericidal, fungicidal, herbicidal, insecticidal, molluscicidal, nematocidal, rodenticidal, and/or virucidal properties.

In certain embodiments of the present disclosure, the pesticidal composition may be used in conjunction (such as, in a compositional mixture, or a simultaneous or sequential application) with one or more compounds that are antifeedants, bird repellents, chemosterilants, herbicide safeners, insect attractants, insect repellents, mammal repellents, mating disrupters, plant activators, plant growth regulators, and/or synergists.

The pesticidal compositions of the present disclosure show a synergistic effect, providing superior pest control at lower pesticidally effective amounts of the combined active compounds than when a ryanodine receptor modulator compound or a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof is used alone.

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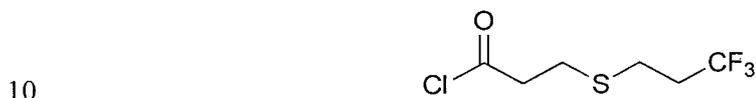
The pesticidal compositions of the present disclosure may have high synergistic pest control and allow for a lower effective dosage rate, an increased environmental safety, and a reduced incidence of pest resistance.

The following examples serve to explain embodiments of the present invention in more detail. These examples should not be construed as being exhaustive or exclusive as to the scope of this disclosure.

## EXAMPLES

## Example 1

Preparation of 3-((3,3,3-trifluoropropyl)thio)propanoyl chloride



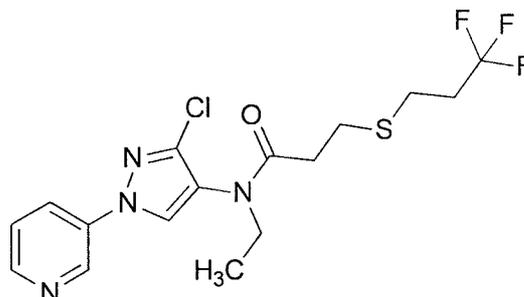
A dry five-liter round bottom flask equipped with magnetic stirrer, nitrogen inlet, reflux condenser, and thermometer, was charged with 3-((3,3,3-trifluoropropyl)thio)propanoic acid (prepared as described in the PCT Publication No. WO 2013/062981 to Niyaz et al.) (188 g, 883 mmol) in dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>) (3 L). Thionyl chloride (525 g, 321 ml, 4.42 mol) was added dropwise over 50 minutes. The reaction mixture was heated to reflux (about 36°C) for two hours, then cooled to room temperature (about 22°C). The resulting mixture was concentrated under vacuum on a rotary evaporator, followed by distillation (40 Torr, product collected at a temperature of from about 123°C to about 127°C) to provide the title compound as a clear colorless liquid (177.3 g, 86%): <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 3.20 (t, *J* = 7.1 Hz, 2H), 2.86 (t, *J* = 7.1 Hz, 2H), 2.78 – 2.67 (m, 2H), 2.48 – 2.31 (m, 2H); <sup>19</sup>F NMR (376 MHz, CDCl<sub>3</sub>) δ -66.42, -66.43, -66.44, -66.44.

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## Example 2

Preparation of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I)

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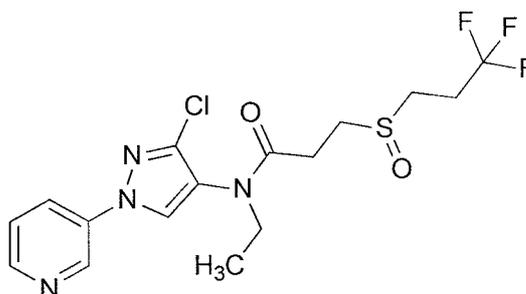
To a solution of 3-chloro-*N*-ethyl-1-(pyridin-3-yl)-1*H*-pyrazol-4-amine (prepared as described in the U.S. Publication No. 2012/0110702 to Yap et al.) (10.0 g, 44.9 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (100 mL), at a temperature of about 0°C and under N<sub>2</sub>, was added pyridine (5.45 mL, 67.4 mmol), 4-dimethylaminopyridine (DMAP) (2.74 g, 22.45 mmol), and 3-((3,3,3-trifluoropropyl)thio) propanoyl chloride (9.91 g, 44.9 mmol), sequentially. The reaction was warmed to room temperature and stirred for one hour. The reaction mixture was poured into water (100 mL), and the resulting mixture was stirred for five minutes. The mixture was transferred to a separatory funnel, and the layers were separated. The aqueous phase was extracted with CH<sub>2</sub>Cl<sub>2</sub> (3x50 mL), and the combined organic extracts were dried over sodium sulfate (Na<sub>2</sub>SO<sub>4</sub>), filtered, and concentrated *in vacuo*. The crude product was purified *via* normal phase flash chromatography (0% to 100% EtOAc/CH<sub>2</sub>Cl<sub>2</sub>) to provide the desired product as a pale yellow solid (17.21 g, 89%): IR (thin film) 1659 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.95 (d, *J* = 2.6 Hz, 1H), 8.63 (dd, *J* = 4.7, 1.3 Hz, 1H), 8.05 (ddd, *J* = 8.3, 2.7, 1.4 Hz, 1H), 7.96 (s, 1H), 7.47 (dd, *J* = 8.3, 4.8 Hz, 1H), 3.72 (q, *J* = 7.1 Hz, 2H), 2.84 (t, *J* = 7.2 Hz, 2H), 2.66 (m, 2H), 2.37 (t, *J* = 7.2 Hz, 2H), 2.44 (m, 2H), 1.17 (t, *J* = 7.2 Hz, 3H); ESIMS *m/z* 409 ([M+2H]<sup>+</sup>).

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### Example 3

Preparation of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II)

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To a solution of *N*-(3-chloro-1-(2-pyridyl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I) (500 mg, 1.229 mmol) in hexafluoroisopropanol (5 mL) stirring at room temperature was added 30% hydrogen peroxide (523 mg, 4.92 mmol). The solution was stirred at room temperature for 15 minutes. It was quenched with saturated sodium sulfite solution and extracted with CH<sub>2</sub>Cl<sub>2</sub>. Silica gel chromatography (0%-10% MeOH/CH<sub>2</sub>Cl<sub>2</sub>) gave the title compound as white semi-solid (495 mg, 95%): IR (thin film) 1660 cm<sup>-1</sup>; <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.96 (d, *J* = 2.4 Hz, 1H), 8.64 (dd, *J* = 4.7, 1.4 Hz, 1H), 8.07 – 8.00 (m, 2H), 7.46 (ddd, *J* = 8.3, 4.8, 0.7 Hz, 1H), 3.85 – 3.61 (m, 2H), 3.23 – 3.08 (m, 1H), 3.03 – 2.76 (m, 3H), 2.74 – 2.52 (m, 4H), 1.18 (t, *J* = 7.2 Hz, 3H); ESIMS *m/z* 423 ([M+H]<sup>+</sup>).

#### Example 4

##### 15 Determination of the Existence of Synergic Effect

The method described in Colby S. R., "Calculating Synergistic and Antagonistic Responses of Herbicide Combinations," Weeds, 1967, 15, 20–22 was used to determine an existence of synergic effect between the ryanodine receptor modulator compound and the pesticide (I), (II), or any agriculturally acceptable salt thereof in the formulated pesticidal composition. In this method, the percent insect control of the formulated pesticidal composition as observed in the study was compared to the "expected" percent control (E) as calculated by equation (1) (hereinafter "Colby's equation") below:

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$$E = X + Y - \left( \frac{XY}{100} \right) \quad (1)$$

where

X is the percentage of control with the first pesticide at a given rate (p),

5 Y is the percentage of control with the second pesticide at a given rate (q), and

E is the expected control by the first and second pesticide at a rate of p+q.

If the observed percent control of the formulated pesticidal is greater than E, there is a synergistic effect between the ryanodine receptor modulator compound and the pesticide (I), (II), or any agriculturally acceptable salt thereof in the formulated  
10 pesticidal composition. If the observed percent control of the formulated pesticidal is equaled to or less than E, there is no synergistic effect between the ryanodine receptor modulator compound and the pesticide (I), (II), or any agriculturally acceptable salt thereof in the formulated pesticidal composition.

#### 15 Example 5

Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II) and Cyantraniliprole Against Brown Stink Bug, *Euschistus heros*

A pesticidal composition was prepared by thoroughly mixing about  
20 0.04 weight % of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl) propanamide (hereinafter "compound II") with about 0.000156 weight % of cyantraniliprole.

Bioassays were performed wherein different active compounds were applied to the diet of five second-instar nymphs of brown stink bug, *Euschistus heros*. The  
25 percent control determined six days after the diet treatment were as shown in TABLE 2. The percent control of the pesticidal composition against brown stink bug, *Euschistus heros*, was determined as the "Observed" action, and compared to those obtained by using about 0.04 weight % of compound II, and using about 0.000156 weight % of cyantraniliprole alone. The "Colby's Expected Action" was calculated  
30 using Colby's equation as discussed previously.

TABLE 2

Treatment for Brown Stink Bug	Dose Rate (weight %)	% Control Six Days After Treatment
Compound II	0.04	0%
Cyantraniliprole	0.000156	7%
Compound II (+) Cyantraniliprole Observed Action	0.04 + 0.000156	25%
Compound II (+) Cyantraniliprole Colby's Expected Action	0.04 + 0.000156	7%
Compound II (+) Cyantraniliprole Differences: Observed vs. Expected	0.04 + 0.000156	18%

As shown in table 2, the observed percent control of the pesticidal composition against brown stink bug (25%) was almost four times higher than the expected percentage control according to Colby's equation (7%). It was surprising and unexpected that not only there was synergistic effect between compound II and cyantraniliprole in the pesticidal composition against brown stink bug, but also the large magnitude of such synergistic effect. The pesticidal composition showed 257% improvement over the Colby's expected action against brown stink bug.

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#### Example 6

Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II) and Chlorantraniliprole Against Diamondback Moth, *Plutella xylostella*

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#### Example 6A

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.0003125 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds. Cabbage plants with about two to three new-growth-true leaf stage were treated with different pesticides using a track sprayer application at 400 L/Ha spray volume. Three second instar diamondback moths, *Plutella xylostella*, were infested onto each leaf disc. The percent control determined after three days of the treatment were as shown in table 3.

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TABLE 3

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	16.67%
Chlorantraniliprole	0.0003125	66.67%
Compound II (+) Chlorantraniliprole Observed Action	0.0025 + 0.0003125	87.5%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.0025 + 0.0003125	72.2%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0003125	15.3%

As shown in table 3, the observed percent control of the pesticidal composition against diamondback moth (87.5%) was higher than the expected percentage control according to Colby's equation (72.2%). This was 21% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.0003125 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

#### 10 Example 6B

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.0000347 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for Example 6A. The percent control determined three days after treatment were as shown in table 4.

As shown in table 4, the observed percent control of the pesticidal composition against diamondback moth (50%) was higher than the expected percentage control according to Colby's equation (37.5%). This was 33% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.0000347 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

TABLE 4

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	16.67%
Chlorantraniliprole	0.0000347	25%
Compound II (+) Chlorantraniliprole Observed Action	0.0025 + 0.0000347	50%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.0025 + 0.0000347	37.5%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0000347	12.5%

Example 6C

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.000156 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 5.

TABLE 5

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	0%
Chlorantraniliprole	0.000156	12.5%
Compound II (+) Chlorantraniliprole Observed Action	0.0025 + 0.000156	79.17%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.0025 + 0.000156	12.5%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.0025 + 0.000156	66.7%

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As shown in table 5, the observed percent control of the pesticidal composition against diamondback moth (79.17%) was significantly higher than the expected percentage control according to Colby's equation (12.5 %). This was 533% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.000156 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

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Example 6D

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.0000781 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 6.

TABLE 6

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	0%
Chlorantraniliprole	0.0000781	4.17%
Compound II (+) Chlorantraniliprole Observed Action	0.0025 + 0.0000781	41.67%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.0025 + 0.0000781	4.2%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0000781	37.5%

As shown in table 6, the observed percent control of the pesticidal composition against diamondback moth (41.67%) was significantly higher than the expected percentage control according to Colby's equation (4.2%). This was 892% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.0000781 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

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Example 6E

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound II with about 0.000104 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 7.

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TABLE 7

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.000625	16.67%
Chlorantraniliprole	0.000104	62.5%
Compound II (+) Chlorantraniliprole Observed Action	0.000625 + 0.000104	95.83%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.000625 + 0.000104	68.8%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.000625 + 0.000104	27.1%

As shown in table 7, the observed percent control of the pesticidal composition against diamondback moth (95.83%) was higher than the expected percentage control according to Colby's equation (68.8%). This was 39% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound II and about 0.000104 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

#### 10 Example 6F

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound II with about 0.000156 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 8.

As shown in table 8, the observed percent control of the pesticidal composition against diamondback moth (66.67%) was substantially higher than the expected percentage control according to Colby's equation (16.1%). This was 314% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound II and about 0.000156 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

TABLE 8

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.000625	4.17%
Chlorantraniliprole	0.000156	12.5%
Compound II (+) Chlorantraniliprole Observed Action	0.000625 + 0.000156	66.67%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.000625 + 0.000156	16.1%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.000625 + 0.000156	50.5%

## Example 6G

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound II with about 0.0000781 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 9.

As shown in table 9, the observed percent control of the pesticidal composition against diamondback moth (50%) was substantially higher than the expected percentage control according to Colby's equation (8.2%). This was 510% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound II and about 0.0000781 weight % of chlorantraniliprole showed synergistic effect against diamondback moth.

TABLE 9

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.000625	4.17%
Chlorantraniliprole	0.0000781	4.17%
Compound II (+) Chlorantraniliprole Observed Action	0.000625 + 0.0000781	50%
Compound II (+) Chlorantraniliprole Colby's Expected Action	0.000625 + 0.0000781	8.2%
Compound II (+) Chlorantraniliprole Differences: Observed vs. Expected	0.000625 + 0.0000781	41.8%

## Example 7

Synergistic Effect Of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II) and Cyantraniliprole Against Diamondback Moth, *Plutella xylostella*

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## Example 7A

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.0003125 weight % of cyantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 10.

As shown in table 10, the observed percent control of the pesticidal composition against diamondback moth (79.17%) was substantially higher than the expected percentage control according to Colby's equation (29.2%). This was 171% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.0003125 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

TABLE 10

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	0%
Cyantraniliprole	0.0003125	29.17%
Compound II (+) Cyantraniliprole Observed Action	0.0025 + 0.0003125	79.17%
Compound II (+) Cyantraniliprole Colby's Expected Action	0.0025 + 0.0003125	29.2%
Compound II (+) Cyantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0003125	50.0%

## 20 Example 7B

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.000156 weight % of cyantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 11.

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TABLE 11

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	0%
Cyantraniliprole	0.000156	25%
Compound II (+) Cyantraniliprole Observed Action	0.0025 + 0.000156	70.83%
Compound II (+) Cyantraniliprole Colby's Expected Action	0.0025 + 0.000156	25%
Compound II (+) Cyantraniliprole Differences: Observed vs. Expected	0.0025 + 0.000156	45.8%

As shown in table 11, the observed percent control of the pesticidal composition against diamondback moth (70.83%) was substantially higher than the expected percentage control according to Colby's equation (25%). This was 183% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.000156 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

#### 10 Example 7C

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound II with about 0.0000781 weight % of cyantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 12.

TABLE 12

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.0025	0%
Cyantraniliprole	0.0000781	25%
Compound II (+) Cyantraniliprole Observed Action	0.0025 + 0.0000781	66.67%
Compound II (+) Cyantraniliprole Colby's Expected Action	0.0025 + 0.0000781	25%
Compound II (+) Cyantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0000781	41.7%

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As shown in table 12, the observed percent control of the pesticidal composition against diamondback moth (66.67%) was higher than the expected percentage control according to Colby's equation (25%). This was 167% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising  
 5 0.0025 weight % of compound II and about 0.0000781 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

## Example 7D

A pesticidal composition was prepared by thoroughly mixing about 0.000625  
 10 weight % of compound II with about 0.0003125 weight % of cyantraniliprole.

Bioassays were performed for different active compounds against diamondback moth using the same procedure as that described for example 6A. The percent control determined three days after treatment were as shown in table 13.

TABLE 13

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound II	0.000625	4.17%
Cyantraniliprole	0.0003125	29.17%
Compound II (+) Cyantraniliprole Observed Action	0.000625 + 0.0003125	100%
Compound II (+) Cyantraniliprole Colby's Expected Action	0.000625 + 0.0003125	32.1%
Compound II (+) Cyantraniliprole Differences: Observed vs. Expected	0.000625 + 0.0003125	67.9%

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As shown in table 13, the observed percent control of the pesticidal composition against diamondback moth (100%) was higher than the expected percentage control according to Colby's equation (32.1%). This was 212% improvement over the Colby's expected action. Therefore, the pesticidal composition  
 20 comprising 0.000625 weight % of compound II and about 0.0003125 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

## Example 8

Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I) and Chlorantraniliprole Against Diamondback Moth, *Plutella xylostella*

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## Example 8A

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio) propanamide (hereinafter “compound I”) with about  
10 0.0000781 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds. Cabbage plants with about two to three new-growth-true leaf stage were treated with different pesticides using a track sprayer at a rate of 400 L/Ha. Three second instar diamondback moths, *Plutella xylostella*, were infested onto each leaf disc. The percent control determined  
15 three days after treatment were as shown in table 14.

TABLE 14

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.0025	4.35%
Chlorantraniliprole	0.0000781	30.43%
Compound I (+) Chlorantraniliprole Observed Action	0.0025 + 0.0000781	82.61%
Compound I (+) Chlorantraniliprole Colby's Expected Action	0.0025 + 0.0000781	33.46%
Compound I (+) Chlorantraniliprole Differences: Observed vs. Expected	0.0025 + 0.0000781	49.51%

As shown in table 14, the observed percent control of the pesticidal composition against diamondback moth (82.61%) was higher than the expected  
20 percentage control according to Colby's equation (30.43%). This was about 147% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound I and about 0.0000781 weight % of chlorantraniliprole showed significant synergistic effect against diamondback moth, *Plutella xylostella*.

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## Example 8B

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound I with about 0.000156 weight % of chlorantraniliprole.

- 5 Bioassays were performed for different active compounds against diamondback moth, *Plutella xylostella*, according to the procedure described in example 8A. The percent control determined three days after treatment were as shown in table 15.

TABLE 15

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.000625	0%
Chlorantraniliprole	0.000156	73.91%
Compound I (+) Chlorantraniliprole Observed Action	0.000625 + 0.000156	91.30%
Compound I (+) Chlorantraniliprole Colby's Expected Action	0.000625 + 0.000156	73.91%
Compound I (+) Chlorantraniliprole Differences: Observed vs. Expected	0.000625 + 0.000156	17.39%

- 10 As shown in table 15, the observed percent control of the pesticidal composition against diamondback moth (91.30%) was higher than the expected percentage control according to Colby's equation (73.91%). This was about 23.5% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound I and about 0.000156 weight % of
- 15 chlorantraniliprole showed synergistic effect against diamondback moth, *Plutella xylostella*.

## Example 8C

- 20 A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound I with about 0.0000781 weight % of chlorantraniliprole.

Bioassays were performed for different active compounds against diamondback moth, *Plutella xylostella*, according to the procedure described in example 8A. The percent control determined three days after treatment were as shown in table 16.

TABLE 16

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.000625	0%
Chlorantraniliprole	0.0000781	30.43%
Compound I (+) Chlorantraniliprole Observed Action	0.000625 + 0.0000781	69.56%
Compound I (+) Chlorantraniliprole Colby's Expected Action	0.000625 + 0.0000781	30.43%
Compound I (+) Chlorantraniliprole Differences: Observed vs. Expected	0.000625 + 0.0000781	39.13%

As shown in table 16, the observed percent control of the pesticidal composition against diamondback moth (69.56%) was higher than the expected percentage control according to Colby's equation (30.43%). This was about 128.6% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound I and about 0.0000781 weight % of chlorantraniliprole showed significant synergistic effect against diamondback moth, *Plutella xylostella*.

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## Example 9

Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I) and Cyantraniliprole Against Diamondback Moth, *Plutella xylostella*

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## Example 9A

A pesticidal composition was prepared by thoroughly mixing about 0.0025 weight % of compound I with about 0.000156 weight % of cyantraniliprole.

Bioassays were performed for different active compounds. Cabbage plants with about two to three new-growth-true leaf stage were treated with different pesticides using a track sprayer at a rate of 400 L/Ha. Three second instar diamondback moths, *Plutella xylostella*, were infested onto each leaf disc. The percent control determined three days after treatment were as shown in table 17.

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TABLE 17

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.0025	4.35%
Cyantraniliprole	0.000156	73.91%
Compound I (+) Cyantraniliprole Observed Action	0.0025 + 0.000156	91.3%
Compound I (+) Cyantraniliprole Colby's Expected Action	0.0025 + 0.000156	75.04%
Compound I (+) Cyantraniliprole Differences: Observed vs. Expected	0.0025 + 0.000156	16.26%

As shown in table 17, the observed percent control of the pesticidal composition against diamondback moth (91.3%) was higher than the expected percentage control according to Colby's equation (75.04%). This was about 21.67% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.0025 weight % of compound II and about 0.000156 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

#### 10 Example 9B

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound I with about 0.0003125 weight % of cyantraniliprole.

Bioassays were performed for different active compounds against diamondback moth, *Plutella xylostella*, according to the procedure described in example 9A. The percent control determined three days after treatment were as shown in table 18.

As shown in table 18, the observed percent control of the pesticidal composition against diamondback moth (100%) was higher than the expected percentage control according to Colby's equation (91.30%). This was about 9.53% improvement over the Colby's expected action. Therefore, the pesticidal composition comprising 0.000625 weight % of compound II and about 0.0003125 weight % of cyantraniliprole showed synergistic effect against diamondback moth.

TABLE 18

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.000625	0%
Cyantraniliprole	0.0003125	91.30%
Compound I (+) Cyantraniliprole Observed Action	0.000625 + 0.0003125	100%
Compound I (+) Cyantraniliprole Colby's Expected Action	0.000625 + 0.0003125	91.30%
Compound I (+) Cyantraniliprole Differences: Observed vs. Expected	0.000625 + 0.0003125	8.70%

## Example 10

5 Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-  
((3,3,3-trifluoropropyl)thio)propanamide (I) and Flubendiamide Against Diamondback  
Moth, *Plutella xylostella*

A pesticidal composition was prepared by thoroughly mixing about 0.000625 weight % of compound I with about 0.0003125 weight % of flubendiamide.

10 Bioassays were performed for different active compounds against diamondback  
moth, *Plutella xylostella*, according to the procedure described in example 9A. The  
percent control determined three days after treatment were as shown in table 19.

15 As shown in table 19, the observed percent control of the pesticidal  
composition against diamondback moth (17.39%) was higher than the expected  
percentage control according to Colby's equation (8.70%). This was almost 100%  
improvement over the Colby's expected action. Therefore, the pesticidal composition  
comprising 0.0025 weight % of compound I and about 0.0003125 weight % of  
flubendiamide showed synergistic effect against diamondback moth, *Plutella  
xylostella*.

TABLE 19

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I	0.0025	0%
Flubendiamide	0.0003125	8.70%
Compound I (+) Flubendiamide Observed Action	0.0025 + 0.0003125	17.39%

Treatment for Diamondback Moth	Dose Rate (weight %)	% Control Three Days After Treatment
Compound I (+) Flubendiamide Colby's Expected Action	0.0025 + 0.0003125	8.70%
Compound I (+) Flubendiamide Differences: Observed vs. Expected	0.0025 + 0.0003125	8.69%

## Prophetic example PE-11

Synergistic Effect of *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I) or *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II) and Cyantraniliprole, Chlorantraniliprole, or Flubendiamide

A pesticidal composition may be prepared by thoroughly mixing compound I (weight %) or compound II (weight %) with cyantraniliprole, chlorantraniliprole, or flubendiamide (weight %).

The bioassays may be performed for different active compounds against brown stink bug, *Euschistus heros*, using the same procedure as that described in example 5. The percent control may be determined some time after treatment.

The bioassays may be performed for different active compounds against diamondback moth, *Plutella xylostella*, using the same procedure as that described for example 6A. The percent control may be determined some time after treatment.

The observed percent control of the pesticidal composition against brown stink bug is expected to be higher than the expected percentage control according to Colby's equation. Therefore, the pesticidal composition comprising compound I (weight %) or compound II (weight %) and cyantraniliprole, chlorantraniliprole, or flubendiamide (weight %) is expected to show synergistic effect against brown stink bug.

The observed percent control of the pesticidal composition against diamondback moth is expected to be higher than the expected percentage control according to Colby's equation. Therefore, the pesticidal composition comprising compound I (weight %) or compound II (weight %) and cyantraniliprole, chlorantraniliprole, or flubendiamide (weight %) is expected to show synergistic effect against diamondback moth.

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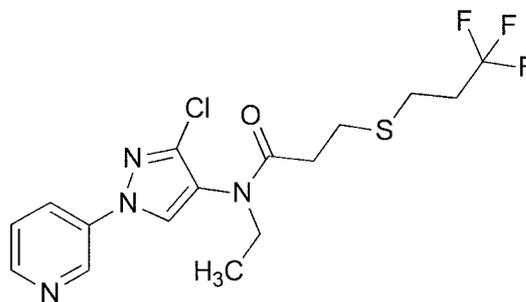
While the present disclosure may be susceptible to various modifications and alternative forms, specific embodiments have been described by way of example in detail herein. However, it should be understood that the present disclosure is not intended to be limited to the particular forms disclosed. Rather, the present disclosure is  
5 to cover all modifications, equivalents, and alternatives falling within the scope of the present disclosure as defined by the following appended claims and their legal equivalents.

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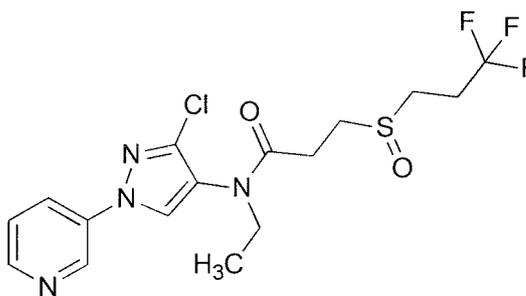
## CLAIMS

We claim:

1. A pesticidal composition comprising a synergistically effective amount  
5 of:  
a ryanodine receptor modulator compound; and  
a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-  
*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-  
10 (pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)prop  
anamide (II), or any agriculturally acceptable salt thereof.



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2. The composition of claim 1, wherein the ryanodine receptor modulator  
compound comprises chlorantraniliprole, cyantraniliprole, or a combination thereof.
3. The composition of claim 1, wherein the ryanodine receptor modulator  
20 compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole,  
flubendiamide, or mixtures thereof.

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4. The composition of claim 1, further comprising a phytologically-acceptable inert carrier.

5. The composition of claim 1, further comprising an additive selected from a surfactant, a stabilizer, an emetic agent, a disintegrating agent, an antifoaming agent, a wetting agent, a dispersing agent, a binding agent, dye, filler, and combinations thereof.

6. The composition of claim 1, further comprising one or more compounds having acaricidal, algicidal, avicidal, bactericidal, fungicidal, herbicidal, insecticidal, molluscicidal, nematocidal, rodenticidal, virucidal or combinations thereof properties.

7. The composition of claim 1, further comprising one or more compounds that are antifeedants, bird repellents, chemosterilants, herbicide safeners, insect attractants, insect repellents, mammal repellents, mating disrupters, plant activators, plant growth regulators, synergists, or combinations thereof.

8. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 256:1.

9. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 72:1.

10. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 32:1.

30

11. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 16:1.

5 12. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 8:1.

10 13. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 6:1.

15 14. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 4:1.

20 15. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 2:1.

25 16. The composition of claim 1, wherein the weight ratio of the pesticide (I), (II), or any agriculturally acceptable salt thereof and the ryanodine receptor modulator is  $X:Y$ ;

wherein,

$X$  is the parts by weight of the pesticide (I), (II), or any agriculturally acceptable salt thereof, and the numerical range is  $0 < X \leq 20$ ;

$Y$  is the parts by weight of the ryanodine receptor modulator, and the numerical range is  $0 < Y \leq 20$ .

30 17. The composition of claim 16, wherein the ranges of weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof and the ryanodine receptor modulator are  $X_1:Y_1$  to  $X_2:Y_2$ ,

wherein one of the following conditions is satisfied:

- (a)  $X_1 > Y_1$  and  $X_2 < Y_2$ ; or
- (b)  $X_1 > Y_1$  and  $X_2 > Y_2$ ; or
- (c)  $X_1 < Y_1$  and  $X_2 < Y_2$ .

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18. A method of controlling pests comprising applying the pesticidal composition of claim 1, near a population of pests, in an amount sufficient to control the pests.

10 19. The method of claim 18, wherein the pests are brown stink bug (*Euschistus heros*), diamond back moth (*Plutella xylostella*), or a combination thereof.

20. The method of claim 18, wherein the pests include a member selected from Order *Lepidoptera*, *Coleoptera*, *Diptera*, *Isoptera* species, and combinations thereof.

15

21. The method of claim 18, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, or a mixture thereof.

20 22. The method of claim 18, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole, flubendiamide, or mixtures thereof.

23. A method for protecting a plant from infestation and attack by pests, the method comprising contacting the plant with the pesticidal composition of claim 1.

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24. The method of claim 23, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, or a mixture thereof.

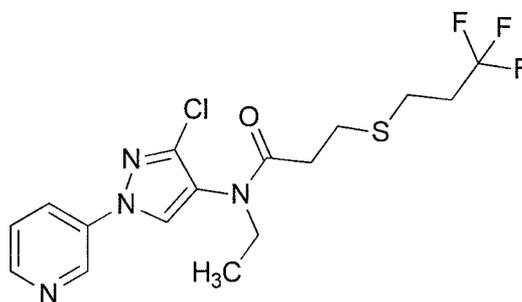
30 25. The method of claim 23, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole, flubendiamide, or mixtures thereof.

## AMENDED CLAIMS

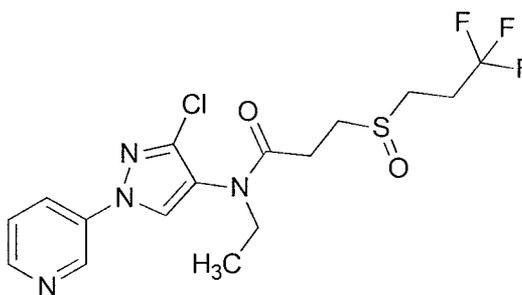
received by the International Bureau on 01 April 2015 (01.04.2015)

We claim:

1. A pesticidal composition comprising a synergistically effective amount  
5 of:  
a ryanodine receptor modulator compound; and  
a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-  
((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)- 1*H*-  
pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or  
10 any agriculturally acceptable salt thereof.



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- 15 2. The composition of claim 1, wherein the ryanodine receptor modulator  
compound comprises chlorantraniliprole, cyantraniliprole, or a combination thereof.
3. The composition of claim 1, wherein the ryanodine receptor modulator  
20 compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole,  
flubendiamide, or mixtures thereof.

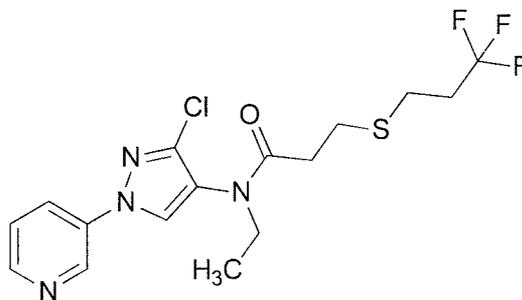
4. The composition of claim 1, further comprising a phytologically-acceptable inert carrier.

5. The composition of claim 1, further comprising an additive selected from a surfactant, a stabilizer, an emetic agent, a disintegrating agent, an antifoaming agent, a wetting agent, a dispersing agent, a binding agent, dye, filler, and combinations thereof.

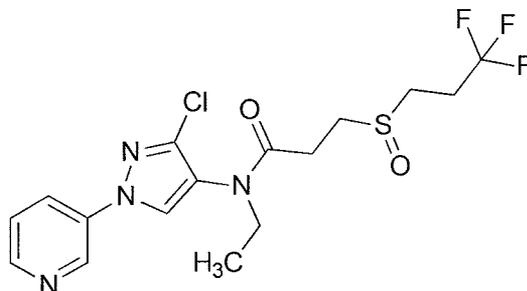
6. The composition of claim 1, further comprising one or more compounds having acaricidal, algicidal, avicidal, bactericidal, fungicidal, herbicidal, insecticidal, molluscicidal, nematocidal, rodenticidal, virucidal or combinations thereof properties.

7. The composition of claim 1, further comprising one or more compounds that are antifeedants, bird repellents, chemosterilants, herbicide safeners, insect attractants, insect repellents, mammal repellents, mating disrupters, plant activators, plant growth regulators, synergists, or combinations thereof.

8. A pesticidal composition comprising a synergistically effective amount of:  
at least one of chlorantraniliprole and cyantraniliprole; and  
a pesticide selected from *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)thio)propanamide (I), *N*-(3-chloro-1-(pyridin-3-yl)-1*H*-pyrazol-4-yl)-*N*-ethyl-3-((3,3,3-trifluoropropyl)sulfinyl)propanamide (II), or any agriculturally acceptable salt thereof.



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wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the at least one of chlorantraniliprole and cyantraniliprole is no more than about 16:1.

9. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 72:1.

10

10. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 32:1.

11. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 16:1.

12. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 8:1.

13. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 6:1.

14. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 4:1.

5 15. The composition of claim 1, wherein a weight ratio of the pesticide selected from (I), (II) or any agriculturally acceptable salt thereof to the ryanodine receptor modulator compound is no more than about 2:1.

16. The composition of claim 1, wherein the weight ratio of the pesticide  
10 (I), (II), or any agriculturally acceptable salt thereof and the ryanodine receptor modulator is  $X:Y$ ;

wherein,

$X$  is the parts by weight of the pesticide (I), (II), or any agriculturally acceptable salt thereof, and the numerical range is  $0 < X \leq 20$ ;

15  $Y$  is the parts by weight of the ryanodine receptor modulator, and the numerical range is  $0 < Y \leq 20$ .

17. The composition of claim 16, wherein the ranges of weight ratios of the pesticide (I), (II), or any agriculturally acceptable salt thereof and the ryanodine  
20 receptor modulator are  $X_1:Y_1$  to  $X_2:Y_2$ ,

wherein one of the following conditions is satisfied:

(a)  $X_1 > Y_1$  and  $X_2 < Y_2$ ; or

(b)  $X_1 > Y_1$  and  $X_2 > Y_2$ ; or

(c)  $X_1 < Y_1$  and  $X_2 < Y_2$ .

25

18. A method of controlling pests comprising applying the pesticidal composition of claim 1, near a population of pests, in an amount sufficient to control the pests.

30 19. The method of claim 18, wherein the pests are brown stink bug (*Euschistus heros*), diamond back moth (*Plutella xylostella*), or a combination thereof.

20. The method of claim 18, wherein the pests include a member selected from Order *Lepidoptera*, *Coleoptera*, *Diptera*, *Isoptera* species, and combinations thereof.

5 21. The method of claim 18, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, or a mixture thereof.

22. The method of claim 18, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole,  
10 flubendiamide, or mixtures thereof.

23. A method for protecting a plant from infestation and attack by pests, the method comprising contacting the plant with the pesticidal composition of claim 1.

15 24. The method of claim 23, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, or a mixture thereof.

25. The method of claim 23, wherein the ryanodine receptor modulator compound comprises chlorantraniliprole, cyantraniliprole, cyclaniliprole,  
20 flubendiamide, or mixtures thereof.

**STATEMENT UNDER ARTICLE 19(1) (RULE 46.4)**

Applicant has amended claim 8. The amendments to the claims have no impact on the description and the drawings