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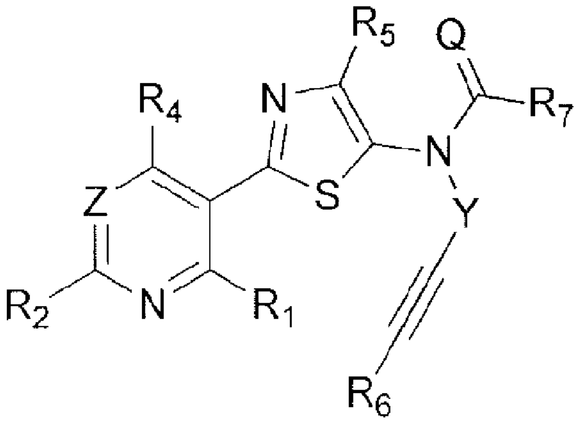
(54) Title: PESTICIDAL COMPOSITIONS AND RELATED METHODS



(I)

(57) **Abstract:** A pesticidal composition comprises a compound of formula I or any agriculturally acceptable salt thereof, wherein Ri, R_2, R_4, R_5, R_6, R_7, Z, Q, and Y are as described herein. A method of controlling pests comprises applying the pesticidal composition near a population of pests, or to an area to control pests.

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TITLE OF THE INVENTION

PESTICIDAL COMPOSITIONS AND RELATED METHODS

PRIORITY CLAIM

This application claims the benefit of the filing date of United States Provisional Patent Application Serial Number 61/894,281, filed October 22, 2013, for "PESTICIDAL COMPOSITIONS AND RELATED METHODS."

TECHNICAL FIELD

This disclosure relates to the field of compounds having pesticidal utility 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, insecticides, miticides, and/or molluscicides.

BACKGROUND

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 world-wide 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.

DISCLOSURE

DEFINITIONS

The examples given in the definitions are non-exhaustive and must not be construed as limiting the present disclosure. It is understood that a substituent should comply with chemical bonding rules and steric compatibility constraints in relation to the particular molecule to which it is attached.

"Alkyl" means and includes an acyclic, saturated, branched or unbranched hydrocarbon. Non-limiting examples may include methyl, ethyl, propyl, isopropyl, 1-butyl, 2-butyl, isobutyl, tert-butyl, pentyl, 2-methylbutyl, 1,1-dimethylpropyl, hexyl, heptyl, octyl, nonyl, or decyl.

"Cycloalkyl" means and includes a monocyclic or polycyclic saturated hydrocarbon. Non-limiting examples may include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclodecyl, norbornyl, bicycle[2.2.2]octyl, or decahydronapthyl.

"Alkenyl" means and includes an acyclic, branched or unbranched hydrocarbon containing at least one carbon-carbon double bond. Non-limiting examples may include ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, or decenyl.

"Cycloalkenyl" means and includes a monocyclic or polycyclic hydrocarbon containing at least one carbon-carbon double bond. Non-limiting examples may include cyclopentenyl, cyclohexenyl, cycloheptenyl, cyclooctenyl, or cyclodecenyl.

"Alkynyl" means and includes acyclic, branched **or** unbranched hydrocarbon containing at least one carbon-carbon triple bond. Non-limiting examples may include ethynyl, propargyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, or decynyl.

"Cycloalkynyl" means and includes a monocyclic or polycyclic hydrocarbon containing at least one carbon-carbon triple bond. Non-limiting examples may include cycloheptynyl, cyclooctynyl, or cyclodecynyl.

"Aryl" means and includes an aromatic compound with or without any substitution. Non-limiting examples may include phenyl or naphthyl.

"Alkoxy" means and includes an alky] group containing at least one carbon-oxygen single bond. Non-limiting examples may include methoxy, ethoxy, propoxy, butoxy, cyclopropoxy, cyclobutoxy, or cyclopentoxy.

"Alkenyloxy" means and includes an alkenyl containing at least one carbon-oxygen single bond. Non-limiting examples may include allyloxy, butenyloxy, pentenyloxy, hexenyloxy, heptenyioxy, octenyloxy, nonenyloxy, or decenyloxy

"Alkynyloxy" means and includes an alkynyl containing at least one carbon-oxygen single bond. Non-limiting examples may include pentynyloxy, hexynyloxy, heptynyloxy, octynyloxy, nonynyloxy, or decynyloxy.

"Cycloalkoxy" means and includes a cycloalkyl containing at least one carbon-oxygen single bond. Non-limiting examples may include cyclopropyloxy, cyclobutyloxy, cyclopentyloxy, cyclohexyloxy, cycloheptyloxy, cyclooctyloxy, cyclodecyloxy, norbornyloxy, or bicyclo[2.2.2]octyloxy.

"Cyclohaloalkyl" means and includes a monocyclic or polycyclic, saturated substituent comprising carbon, halogen, and hydrogen. Non-limiting examples may include 1-chlorocyclopropyl, 1-chlorocyclobutyl, or 1-dichlorocyclopentyl.

"Cycloalkenyloxy" means and include a cycloalkenyl further consisting of a carbon-oxygen single bond. Non-limiting examples may include cyclobutenyloxy, cyclopentenyloxy, cyclohexenyloxy, cycloheptenyloxy, cyclooctenyloxy, cyclodecenyloxy, norbornenyloxy, or bicyclo *[2.2.2]* octenyloxy.

"Alkylthio" means and includes an alkyl group containing at least one carbon-sulfur single bond.

"Haloalkylthio" means and includes an alkyl group containing at least one carbon-sulfur single bond and halogen atom.

"Halo" or **"halogen"** means and includes fluorine, chlorine, bromine, or iodine.

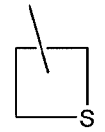
"Haloalkyl" means and includes an alkyl group substituted with at least one halogen atom.

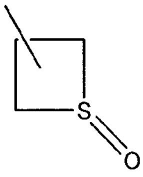
"Haloalkoxy" means and includes an alkoxy group substituted with at least one halogen atom.

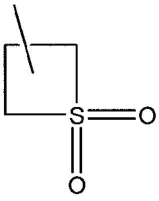
"Heteroatom" means and includes sulfur (S), oxygen (O), or nitrogen (N) atom.

"Heteroalkyl" means and includes an alkyl containing at least one sulfur (S), oxygen (O), or nitrogen (N) atom.

"Heterocyclyl" means a cyclic substituent that may be fully saturated, partially unsaturated, or fully unsaturated, where the cyclic structure contains at least one carbon and at least one heteroatom, where said heteroatom is nitrogen, sulfur, or oxygen. In the case of sulfur, that atom can be in other oxidation states such as a sulfoxide and sulfone. Examples of aromatic heterocyclyls include, but are not limited to, benzofuranyl, benzoisothiazolyl, benzoisoxazolyl, benzoxazolyl, benzothienyl, benzothiazolyl, cinnolinyl, furanyl, imidazolyl, indazolyl, indolyl, isoindolyl, isoquinolinyl, isothiazolyl, isoxazolyl, oxadiazolyl, oxazolinyl, oxazolyl, phthalazinyl, pyrazinyl, pyrazolinyl, pyrazolyl, pyridazinyl, pyridyl, pyrimidinyl, pyrrolyl, quinazolinyl, quinolinyl, quinoxalinyl, tetrazolyl, thiazolinyl, thiazolyl, thienyl, triazinyl, and triazolyl. Examples of fully saturated heterocyclyls include, but are not limited to, piperazinyl, piperidinyl, morpholinyl, pyrrolidinyl, oxetanyl, terrahydrofuranyl, tetrahydrothienyl and tetrahydropyranyl. Examples of partially unsaturated heterocyclyls include, but are not limited to, 1,2,3,4-tetrahydroquinolinyl, 4,5-dihydro-oxazolyl, 4,5-dihydro-177-pyrazolyl, 4,5-dihydro-isoxazolyl, and 2,3-dihydro-[l,3,4]-oxadiazolyl. Additional examples include the following


thietanyl


thietanyl-oxide


thietanyl-dioxide.

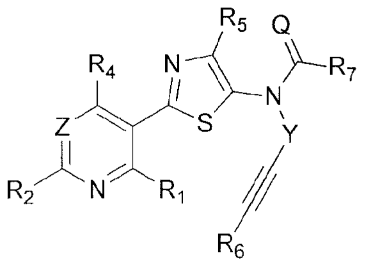
"Pesticidally effective amount" means and includes an amount of active material that causes an adverse effect to the at least one insect, wherein the adverse effect may include deviations from natural development, killing, regulation, or the like.

"Control" or grammatical variations thereof means and includes regulating the number of living insects or regulating the number of viable eggs of the insects, or both.

"Synergistic effect" or grammatical variations thereof means and includes a cooperative action encountered in a combination of two or more active agents in which the combined activity of the two or more active agents exceeds the sum of the activity of each active agent alone.

PESTICIDAL COMPOUNDS

In one particular embodiment, a pesticidal composition comprises a compound of formula **I,** or any agriculturally acceptable salt thereof:



I

wherein:

R_1, R_2, and R , are independently hydrogen, F, CI, Br, I, substituted or unsubstituted C,-C_6 alkyl, or substituted or unsubstituted C_1-C_6 haloalkyl, C_3-Ci_0 cycloalkyl, or C_3-C_{10} halocycloalkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, wherein each said R_{15} R_2, and R4, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, C,-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_1-C_6 haloalkyl, C_3-C_{10} cycloalkyl, or C_3-C_{10} halocycloalkyl, each of which may be substituted and may optionally be substituted with R_{10};

R_3 is hydrogen, F, CI, Br, I, CN, $N0_2$, substituted or unsubstituted C_1-C_6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, C_2-C_6 alkynyl, substituted or unsubstituted C_1-C_6 alkoxy, substituted or unsubstituted C_3-C_{10} cycloalkyl, substituted or unsubstituted C_1-C_6 haloalkyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C,-C_{20} heterocyclyl, OR,o, C(=X,)R,o, C(=X,)OR_{10}, C(=X,)N(R,o)2, N(R,o)2, N(R,o)C(=X_1)R_{10}, SR,o, $S(O)_nOR_{10}$, or R_{10}S(0>JR,o, wherein each said R_3, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, C_1-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_1-C_6 haloalkyl, C_2-C_6 haloalkenyl, C_1-C_6 haloalkyloxy, C_2-C_6 haloalkenyloxy, C_3-C_{10} cycloalkyl, C_3-Ci_0 cycloalkenyl, C_3-Ci_0 halocycloalkyl, C_3-C_{10} halocycloalkenyl, OR_{10}, S(O)„OR_{10}, C_6-C_{20} aryl, or C_1-C_{20} heterocyclyl, each of which may be substituted, and may optionally be substituted with R_{10};

R_5 is selected from hydrogen, F, CI, Br, I, CN, $N0_2$, substituted or unsubstituted C_1-C_6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_1-C_6 alkoxy, C_3-C_{10} cycloalkyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C_1-C_{20} heterocyclyl, OR_{10}, C(=X,)R_{10}, C(=X,)OR_{10}, C(=X,)N(R_{10})2, N(R_{10})$_2$, N(R_{10})C(=X_1)R_{10}, $S(O)_nR_{10}$, $S(O)_nOR_{10}$, or $R_{10}S(0)_n$Rio, wherein each said R_5, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, C_1-C_6 alkyl, C_2-C_6 alkenyl, C,-C_6 haloalkyl, C_2-C_6 haloalkenyl, C,-C_6 haloalkyloxy, C_2-C_6 haloalkenyloxy, C_3-C_{10} cycloalkyl, C_3-C_{10} cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, OR_{10}, $S(O)_nOR_{10}$, C_6-C_{20} aryl, or C_1-C_{20} heterocyclyl, each of which may be substituted, and may optionally be substituted with R_{10};

Y is a bond or is substituted or unsubstituted C_1- C_6 alkyl, or substituted or unsubstituted C_2-C_6 alkenyl,

Except where Y is a bond, wherein each Y, when substituted, has one or more substituents selected from hydrogen, F, CI, Br, I, CN, $N0_2$, C_1-C_6 alkyl, C_2-C_6 alkenyl, C,-C_6 haloalkyl, C_2-C_6 haloalkenyl, C_1-C_6 haloalkyloxy, or C_3-C_{10} cycloalkyl; optionally Y and R_7 may be connected in a cyclic arrangement, where optionally such arrangement may have one or more heteroatoms selected from O, S, or N, in the cyclic structure connecting Y and R_7;

R<, is selected from hydrogen, substituted or unsubstituted C,-C_6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_2-C_6 alkynyl, substituted or unsubstituted C_3-C_{10} cycloalkyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C_1-C_{2}o heterocycly], C_1-C_6 alkyi C_6-C_2o aryl (wherein the alkyi and aryl can independently be substituted or unsubstituted), C_1-C_6 alkyl-(C_3-C_{10} cyclohaloalkyl) wherein the alkyi and cyclohaloalkyl can independently be substituted or unsubstituted, or C_1-C_6 alkyl-(C_3-C_{10} cycloalkyl) wherein the alkyi and cycloalkyl may independently be substituted or unsubstituted, bauwherein each ¾ , when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, *CJ-C* $_6$ alkyi, C_2-C_6 alkenyl, C_2-C_6 alkynyl, Ci-C_6 haloalkyl, C_1-C_6 alkoxy, C_2-C_6 haloalkenyl, C_1-C_6 haloalkyloxy, C_2-C_3 haioalkenyloxy, C_3-C,o cycloalkyl, C_3-Ci$_0$ cycloalkenyl, C_3-C,o halocycloalkyl, C_3-C_{10} halocycloalkenyl, OR_{10}, $S(O)_n$ORi$_0$, C_6-C_{20} aryl, Ci-C_2oheterocyclyl, or Ri$_0$ aryl , each of which may be substituted, and may optionally be substituted with R_{10};

R_7 is R_9 or $R_8S(0)_nR_9$;

R_8 is substituted or unsubstituted C_2-Ci$_2$ alkenyl, substituted or unsubstituted C_1-C_{12} alkyi, substituted or unsubstituted C_3-C_{10} cycloalkyl, or substituted or unsubstituted Q-Qoheterocyclyl, wherein each said R_8, when substituted, has one or more substituents selected from F, CI, Br, I, Ci-C_6 alkyi, C_2-C_6 alkenyl, Ci-C_6 haloalkyl, C_3-Ci$_0$ cycloalkyl, C_3-C]$_0$ halocycloalkyl, OR_{10}, $S(O)_n$Ri$_0$, C_6-C_{20} aryl, or Ci-C_{20} heterocyclyl, each of which may be substituted, and may optionally be substituted with R,$_0$;

R_9 is selected from hydrogen, substituted or unsubstituted Ci-C_6 alkyi, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_1-C_6 alkoxy, substituted or unsubstituted C_3-C_{10} cycloalkyl, substituted or unsubstituted haloalkyl, substituted or unsubstituted C_3-Ci$_0$ halocycloalkyl, substituted or unsubstituted C_3-C_{10} cycloalkenyl, substituted or unsubstituted C_6-C_{20} aryl, or substituted or unsubstituted C_1-C_{20} heterocyclyl, wherein each said R_9, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, C,-C_6 alkyi, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C,-C_6 haloalkyl, C_2-C_6 haloalkenyl, C_2-C_6 haloalkynyl, Ci-C_6 haloalkyloxy, C_2-C_6 haioalkenyloxy, C_3-C_{10} cycloalkyl, C_3-C_{10} cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, oxo, OR_{10}, $S(O)_nR_{10}$, C_6-C_{20} aryl, or C_1-C_2o heterocyclyl, each of which may be substituted, and may optionally be substituted with R_{10};

R_{10} is selected from hydrogen, CN, substituted or unsubstituted C_1-C_6 alkyi, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_1-C_6 alkoxy, substituted or unsubstituted C_2-C_6 alkenyloxy, substituted or unsubstituted C_3-Cio cycloalkyl, substituted or unsubstituted C3-C10 cycloalkenyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C,-C_{20} heterocyclyl, substituted or unsubstituted S(0)„C_1-C_6 alkyi, or substituted or unsubstituted N(Ci-C_6alkyl)$_2$, wherein each said R_{10}, when substituted, has one or more substituents selected from F, CI, Br, I, CN, N(¾, C_1-C_6 alkyl, C_2-C_6 alkenyl, C,-C_6 haloalkyl, C_2-C_6 haloalkenyl, C_1-C_6 haloalkyloxy, C_2-C_6 haioalkenyloxy, C_3-C_{10} cycloalkyl, C_3-C_{10} cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, OC_1-C_6 alkyl, OC,-C_6 haloalkyl, $S(0)_n$C,-C_6alkyl, $S(0)_nOC_1$-C_6 alkyl, C_6-C_{20} aryl, or C_1-C_{20} heterocyclyl;

Qand X_1 are independently oxygen (O) or sulfur (S);

n is 0, 1, or 2; and

Z is N or C-R_3.

In another embodiment, R_1, R_2, and R_4 are hydrogen.

In another embodiment R_3 is hydrogen, F, CI, Br, or I, preferably hydrogen or F.

In another embodiment, R_5 is selected from F, CI, Br, I, or unsubstituted C_l-C_6 alkyl, preferably, Cl or CH_3.

In another embodiment, Y-C≡C-Re is CH_2C≡CH or CH(C¾)C ≡CH.

In another embodiment, R_7 is (Ci-C_6)alkylS(0) $_n$(C_1-C_6)alkyl, (C,-C_6)alkylS(0) $_n$(C,-C_6)haloalkyl, or (C, -C_6)alkylS(0) $_n$(C, -C_6)alkyl(C_3-C_6)halocycloalkyl.

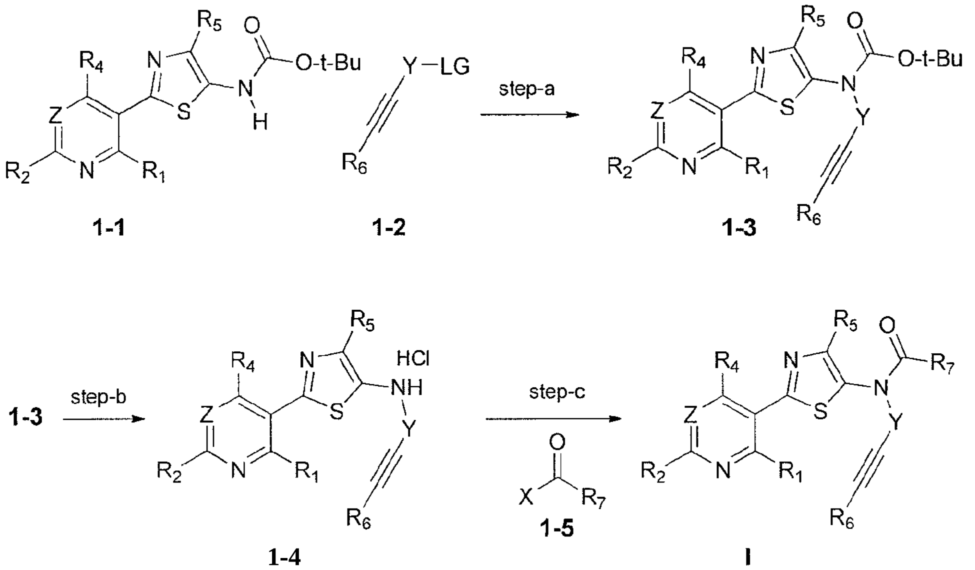
Q and **X_1** are independently oxygen (O).

n is 0 or 1.

Z is C-R_3

In one embodiment, the compound of formula **I** (whereY is substituted or unsubstituted C_l- C_6 alkyl, or substituted or unsubstituted $_{C\,2\text{-}C\,6}$ alkenyl) may be prepared as shown in **Scheme 1.**

Scheme 1



In step a of **Scheme 1,** a tert-butoxy carbamate compound **1-1** (prepared as described in the PCT Application No. WO 201 0/129497A1) may be treated with a base in an aprotic solvent at a temperature from about -78°C to about 120°C, followed by reaction with an electrophile **1-2,** wherein LG may be a halogen, such as CI, Br and I, or an alkyl or aryl sulfonate, and wherein Y is substituted or unsubstituted C_l- C_6 alkyl, or substituted or unsubstituted C_2-C_6 alkenyl, to afford a thiazole compound **1-3.** Non-limiting examples of suitable aprotic solvents may include /v^-dimethylformamide (DMF), tetrahydrofuran (THF), dioxane, dimethylsulfoxide (DMSO), diglyme, monoglyme, or *N*-methylpyrrolidinone (NMP). Non-limiting examples of suitable bases may include sodium hydride, potassium tert-butoxide, alkyl lithium reagents such as tert-BuLi, «-BuLi and alkylmagnesium halides, or other metal hydrides.

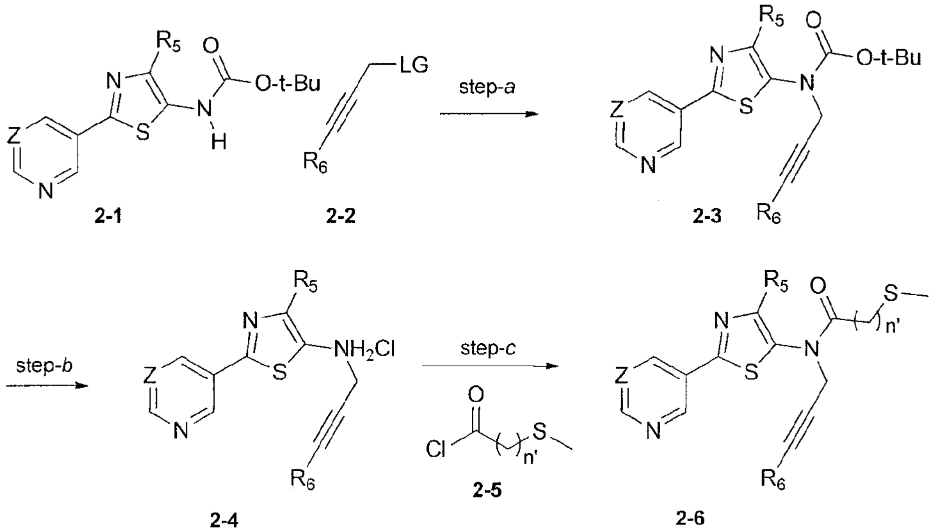
In step b of **Scheme 1,** the thiazole compound **1-3** may be reacted with acid, such as hydrogen chloride (HC1), in a solvent, such as dioxane, to afford the corresponding salt such as HC1 salt **1-4.** Non-limiting examples of other suitable acids may include trifluoroacetic acid (TFA), hydrogen bromide (HBr), or mineral acids such as sulfuric acid (H_2S0_4).

In step c of **Scheme 1,** the amines **1-4** may be treated with an acid chloride or an acid anhydride **1-5** in the presence of a base, such as triethylamine, or 7V^V'-4-dimethylaminopyridine (DMAP) in an aprotic solvent, such as methylene chloride ($CH_2C 1_2$), at a temperature from about -80°C to about 100°C to provide the corresponding compounds of the formula **(1).** Non-limiting examples of other suitable bases may include Hiinig's base, metal hydrides, or alkali hydroxides.

Alternatively, in step c of **Scheme 1,** the thiazoles **1-4** may be treated with an acid compound **1-5,** where X is OH, in the presence of an amide coupling agent, such as l-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (EDC), dicyclohexyl carbodiimide (DCC) or diisopropyl carbodiimide (DIC), and a base, such as DMAP or triethylamine, in an aprotic solvent, such as $CH_2C 1_2$ or DMF, to provide the compounds of formula **I.**

In one embodiment, the compound of formula **2-6** (where Z is N, CH or CF, R_5 is methyl or CI, and R_6 is hydrogen or methyl, n' is 1 or 2) may be prepared as shown in **Scheme 2.**

Scheme 2



The *tert*-butoxy carbamate compound **(2-1)** may be prepared as described in the PCT Application No. WO 201 0/129497A1 , where Z is CF, R_5 is methyl or CI. The /erf-butoxy carbamates **(2-1)** may be prepared as described in the PCT Application No. WO 20 I0/129497A I, where Z is CH and R_5 is methyl. The *lert-butoxy* carbamates **(2-1)** may be prepared according to **Scheme** 4, where Z is CH and R_5 is CI. The ter/-butoxy carbamates **(2-1)** may be prepared as described in the PCT Application No.

WO 20 10/129497A1, where Z is N and R_5 is methyl. The *tert*-butoxy carbamates **(2-1)** may be prepared as described in the PCT Application No. WO 2010/129497A1 or **Scheme** 4, where Z is N and R_5 is CI.

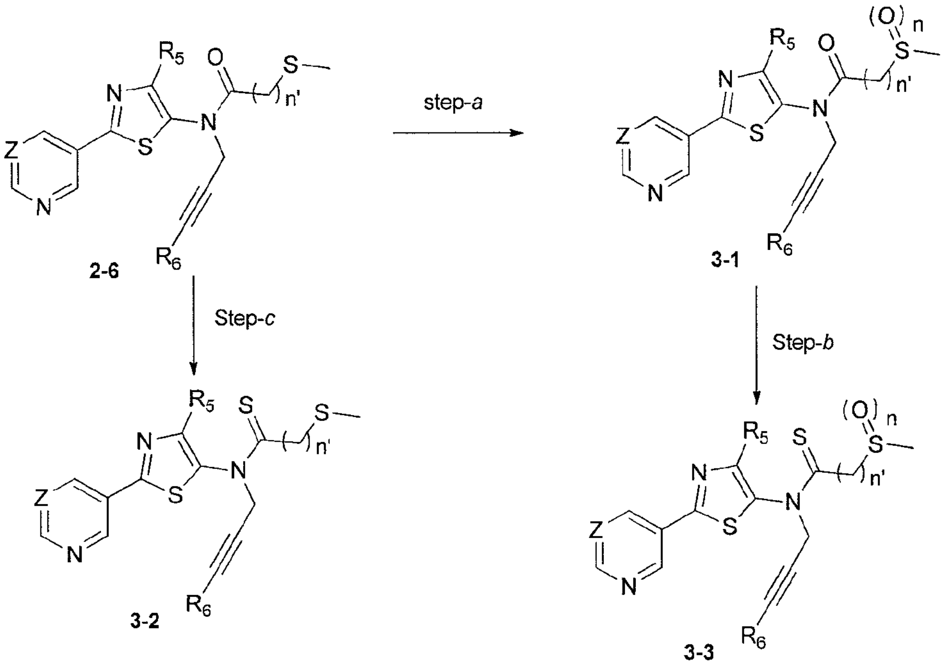
In step a of **Scheme** *2*, one equivalent of the *tert*-butoxy carbamate compound **(2-1)** (Z = N, CH, or CF; R_5 = Me or CI) may be treated with a base, such as sodium hydride (from about 0.9 eq to about 1.2 eq), in an aprotic solvent, such as DMF (at concentrations between about 0.01 M to about 4 M), at a temperature from about -78°C to about 120°C, followed by addition of an electrophile **(2-2),** wherein R_6 is hydrogen or methyl (about 0.9 eq to about 4 eq), and wherein LG may be a halogen, such as CI, Br and I, or a mesylate or other leaving groups, to provide the amide compound **(2-3)** (Z = N, CH, or CF; R_5 = Me or CI; R_6 = H or Me). Non-limiting examples of other suitable solvents may include THF, dioxane, DMSO, diglyme, monoglyme, or NMP. Non-limiting examples of other suitable bases may include potassium *tert*-butoxide, alkyl lithium reagents such *tert*-BuLi, w-BuLi, alkyl magnesium halides, or other metal hydrides.

In step b of **Scheme 2,** one equivalent of the amide compound **(2-3)** (Z = N or CH or CF; R_5 = Me or CI; R_6 = H or Me) may be treated with an acid such as HCl (from about 1 mol eq and to about 100 mol eq) in a solvent such as dioxane (at a concentration between about 0.001 M to about 10 M) to provide the corresponding HCl salt **(2-4)** (Z = N, CH, or CF; R_5 = Me or CI; R_6 = H or Me). Non-limiting examples of other suitable acids may include TFA, HBr, or mineral acids such as H_2S0_4. It is appreciated that the HCl salt **(2-4)** may be free base and that the resultant amine may be suitable for subsequent chemical operations.

In step c of **Scheme 2,** the HCl salt **(2-4)** (Z= N, CH, or CF; R_5 = Me or CI, R_6 = H or Me) may be treated with about 1 eq to about 4 eq of **2-5,** where x is CI, in the presence of a base such as triethylamine (from about 2 eq to about 10 eq) in an aprotic solvent such as CH2CI2 (at concentrations between about 0.001 M to about 5 M) at a temperature from about -80°C to about 100°C to provide the corresponding amide compound **(2-6).** Non-limiting examples of other suitable bases may include Hiinig' s base, metal hydrides, or metal hydroxides.

In one embodiment, the compound of formula **3-2** may be prepared as shown in **Scheme 3.**

Scheme 3



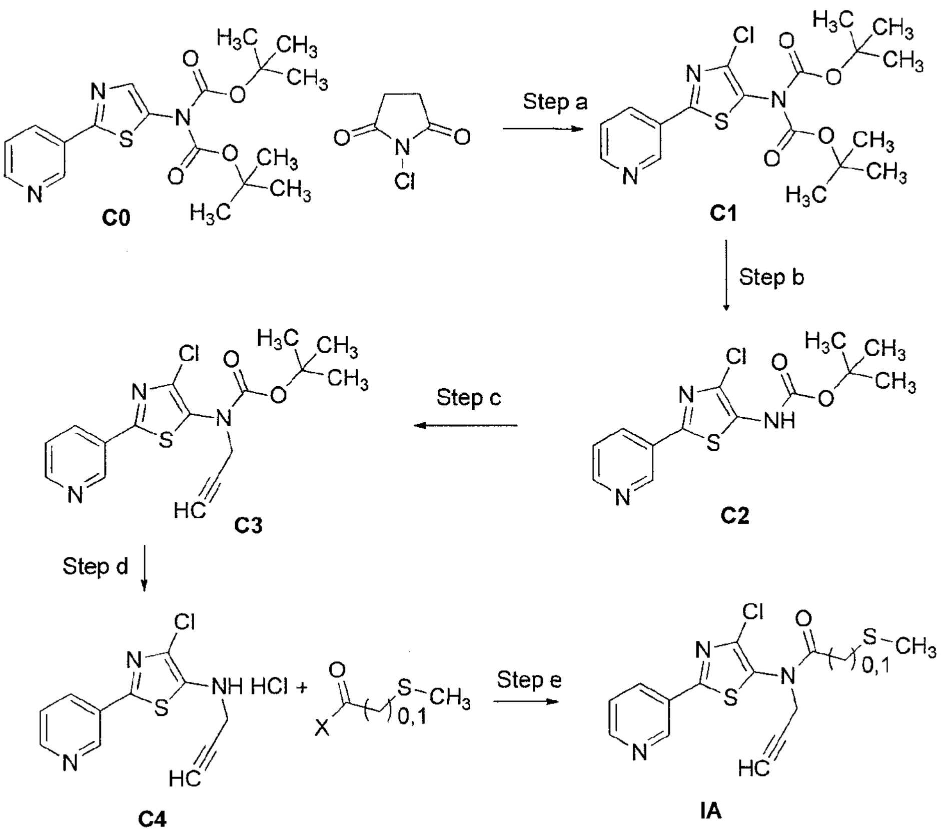
In step a of **Scheme 3,** the sulfoxide or sulfone compound **3-1** (Z = N, CH, or CF; **R**$_5$ = Me or CI; **R**$_6$ = Me or H; n = 1 or 2; n' = 1or 2) may be prepared by reacting one equivalent of corresponding sulfide compound **2-6** (Z = N, CH, or CF; **R**$_5$ = Me or CI , n' = **1** or 2) with about 1 eq or about 2.0 to 2.5 eq, respectively, of an oxidant such as NaB0 $_3$-4H$_2$0 in a solvent such as acetic acid (between a concentration of about 0.001 M to 2 M) at a temperature from about -20°C to 120°C as described in the PCT Application No. WO 201 0/129497A1 .

In step c of **Scheme 3,** the amide compound **2-6** (Z = N, CH, or CF; **R**$_5$ = Me or CI, **R**$_6$ = H or Me; n' =1, 2) may be converted to the corresponding thioamide compound **3-2** (Z = N, CH or CF; **R**$_5$ = Me or CI , **R**$_5$ = H or Me; n' = 1 or 2) by reacting with a source of sulfur such as Lawesson's reagent (from about 1 eq to about 10 eq) in a presence of a solvent such as diglyme (at a concentration between about 0.001 M to about 5 M) at a temperature from about -20°C to about 200°C

Alternatively, as shown in step b of **Scheme 3,** the sulfoxide or sulfone **3-1** (Z = N, CH, or CF; **R**$_5$ = Me or CI , **R**$_6$ = H, Me; n = 1 or 2; n' = 1 or 2) may be treated with a source of sulfur such as Lawesson's reagent (from about 1 eq to about 10 eq) in a presence of a solvent such as diglyme (at a concentration between about 0.001 M to about 5 M) at a temperature of from about -20°C to about 200°C to provide thioamide compound **3-3** (Z = N, CH, or CF; **R**$_5$ = Me or CI , *Rf,=* H or Me; n = 1 or 2; n' = 1 or 2).

In one embodiment, the compound of formula 1A may be prepared as shown in **Scheme** 4.

Scheme 4



In step a of **Scheme** 4, thiazole compound C I may be prepared by reacting thiazole compound C O with a chlorination reagent such as N-chlorosuccinimide in a solvent, such as acetonitrile at a temperature of about 65°C.

In step b of **Scheme** 4, one of the Boc-protecting group of compound C I may be removed by treating with an acid such as trifluoroacetic acid (TFA) in a polar aprotic solvent such as CH_2C1_2 at ambient temperature to provide thiazole compound C2.

In step c of **Scheme** 4, thiazole compound C3 may be prepared by reacting the TV-Boc-protected carbamate compound C2 in a polar aprotic solvent such as DMF with a base such as sodium hydride and then an electrophile such as 3-bromoprop-l-yne, at a temperature fi-om about -20°C to about 50°C.

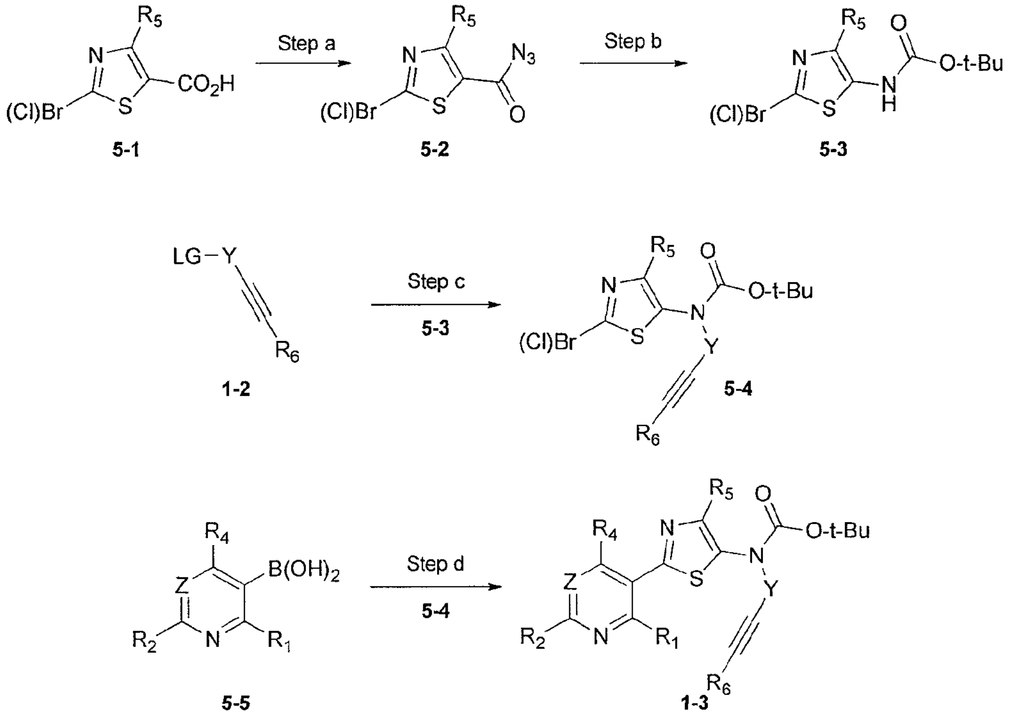
In step d of **Scheme** 4, the Boc protecting group of thiazole compoundC3 may be removed by treating with a strong acid such as hydrochloric acid in dioxane to provide a corresponding salt such as an HC1 salt, of 4-chloro-iV-(prop-2-yn-l -yl)-2-(pyridin-3-yl) thiazol-5-amine (C4).

In step e of **Scheme** 4, the 4-chloro-yV-(prop-2-yn-l -yl)-2-(pyridin-3-yl) thiazol-5-amine HC1 salt (C4) may be reacted with 3-(methylthio)propanoyl chloride in a solvent such as tetrahydrofuran

(THF) in the presence of a base such as DMAP, at a temperature from about -20°C to about 60°C, to provide the compound **(IA).**

In one embodiment, the compound of formula **1-3** may be prepared as shown in **Scheme 5.**

Scheme 5



In step a of **Scheme 5,** an acid compound of the formula **5-1** (wherein R_5 is Me or CI) may be treated with diphenylphosphoryl azide (DPPA) and a base such as triethylamine in an aprotic solvent, such as toluene, at room temperature to afford the corresponding acylazide **5-2.** In step b of **Scheme 5,** acyl azide of the formula **5-2** may be heated to about 100°C in the presence of a an alcohol, such as *tert*-butanol, to give the corresponding iert-butyl carbamate of the formula **5-3.** In Step c of **Scheme 5,** tert-butyl carbamates of the formula **5-3** may be treated with a base in an aprotic solvent at a temperature from about -78°C to about 120°C, followed by reaction with an electrophile **1-2,** wherein LG may be a halogen, such as CI, Br and I, or an alkyl or aryl sulfonate, to afford a thiazole compound **5-4.** Non-limiting examples of suitable aprotic solvents may include *N*,N-dimethylformamide (DMF), tetrahydrofuran (THF), dioxane, dimethylsulfoxide (DMSO), diglyme, monoglyme, or iV-methylpyrrolidinone (NMP). Non-limiting examples of suitable bases may include sodium hydride, potassium tert-butoxide, alkyl lithium reagents such as /ert-BuLi, *n*-BuLi and alkylmagnesium halides, or other metal hydrides. In step d of **Scheme 5,** the thiazole compounds of formula **5-4,** wherein R5 and R6 are as previously defined, may be allowed to react under Suzuki coupling conditions with a boronic acid of formula **5-5,** wherein Z, R1, R2 and R4 are as previously defined, to provide the thiazoles of formula **1-3.**

PESTICIDALLY ACCEPTABLE ACID ADDITION SALTS, SALT DERIVATIVES, SOLVATES, ESTER DERIVATIVES, POLYMORPHS, ISOTOPES, RADIONUCLIDES and STEREOISOMERS

In some embodiments, the compound of formula **I** may be formulated into pesticidally acceptable acid addition salts. By way of a non-limiting example, an amine function can form salts with hydrochloric, hydrobromic, sulfuric, phosphoric, acetic, benzoic, citric, malonic, salicylic, malic, fumaric, oxalic, succinic, tartaric, lactic, gluconic, ascorbic, maleic, aspartic, benzenesulfonic, methanesulfonic, ethanesulfonic, hydroxymethanesulfonic, hydroxyethanesulfonic, and trifluoroacetic acids. Additionally, by way of a non-limiting example, an acid function can form salts including those derived from alkali or alkaline earth metals and those derived from ammonia and amines. Examples of preferred cations include sodium, potassium, and magnesium.

In some embodiments, the compound of formula **I** may be formulated into salt derivatives. By way of a non-limiting example, a salt derivative can be prepared by contacting a free base with a sufficient amount of the desired acid to produce a salt. A free base may be regenerated by treating the salt with a suitable dilute aqueous base solution such as dilute aqueous sodium hydroxide (NaOH), potassium carbonate, ammonia, and sodium bicarbonate. As an example, in many cases, a pesticide, such as 2.4-D, is made more water-soluble by converting it to its dimethylamine salt.

In further embodiments, the compound of formula **I** may be formulated into stable complexes with a solvent, such that the complex remains intact after the non-complexed solvent is removed. These complexes are often referred to as "solvates." However, it is particularly desirable to form stable hydrates with water as the solvent.

In some embodiments, the compound of formula **I** may be made into ester derivatives. These ester derivatives can then be applied in the same manner as the invention disclosed in this document is applied.

In some embodiments, the compound of formula **I** may be made as various crystal polymorphs. Polymorphism is important in the development of agrochemicals since different crystal polymorphs or structures of the same molecule can have vastly different physical properties and biological performances.

In further embodiments, the compound of formula **I** may be made with different isotopes. Of particular importance are molecules having ^{2}H (also known as deuterium) in place of ^{1}H.

In some embodiments, the compound of formula **I** may be made with different radionuclides. Of particular importance are molecules having ^{13}C or ^{14}C.

In some embodiments, the e compound of formula **I** may exist as one or more stereoisomers. Thus, certain molecules can be produced as racemic mixtures. It will be appreciated by those skilled in the art that one stereoisomer may be more active than the other stereoisomers. Individual stereoisomers may be obtained by known selective synthetic procedures, by conventional synthetic procedures using resolved starting materials, or by conventional resolution procedures. Certain molecules disclosed in this document can exist as two or more isomers. The various isomers include geometric isomers, diastereomers, and enantiomers. Thus, the molecules disclosed in this document include geometric isomers, racemic mixtures, individual stereoisomers, and optically active mixtures. It will be appreciated by those skilled in the art that one isomer may be more active than the others. The structures disclosed in the present disclosure are drawn in only one geometric form for clarity, but are intended to represent all geometric forms of the molecule.

PESTICIDAL COMPOSITIONS

In one particular embodiment, a pesticidal composition comprises the compound of formula **I,** or any agriculturally acceptable salt thereof.

In some embodiments, a pesticidal composition comprises the compound of formula **I** or any agriculturally acceptable salt thereof, and a phytologically-acceptable inert carrier (e.g., solid carrier, or liquid carrier).

In one embodiment, the pesticidal composition may further comprise at least one additive selected from surfactant, a stabilizer, an emetic agent, a disintegrating agent, an antifoaming agent, a wetting agent, a dispersing agent, a binding agent, dyes, or fillers.

In some embodiments, the pesticidal compositions may be in the form of solid. Non-limiting examples of the solid forms may include power, 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 further embodiments, the pesticidal compositions may be in the form of liquid dispersion, wherein the compound of formula **I** may be dispersed in water or other agriculturally suitable liquid carrier.

In yet further embodiments, the 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 an organic solvent for the pesticidal compositions.

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, nematicidal, rodenticidal, and/or virucidal properties.

Furthermore, 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.

INSECTICIDES

Non-limiting examples of insecticides that may be used in combination with the compound of formula **I** may include 1,2-dichloropropane, abamectin, acephate, acetamiprid, acethion, acetoprole, acrinathrin, acrylonitrile, alanycarb, aldicarb, aldoxycarb, aldrin, allethrin, allosamidin, allyxycarb, alpha-cypermethrin, alpha-ecdysone, α/ρ/ω-endosulfan, amidithion, aminocarb, amiton, amiton oxalate, amitraz, anabasine, athidathion, azadirachtin, azamethiphos, azinphos-ethyl, azinphos-methyl, azothoate, barium hexafluorosilicate, barthrin, bendiocarb, benfUracarb, bensultap, beta-cyfluthrin, zeta-cypermethrin, bifenthrin, bioallethrin, bioethanomefhrin, biopermethrin, bistrifluron, borax, boric acid, bromfenvinfos, bromocyclen, bromo-DDT, bromophos, bromophos-efhyl, bufencarb, buprofezin, butacarb, butathiofos, butocarboxim, butonate, butoxycarboxim, cadusafos, calcium arsenate, calcium polysulfide, camphechlor, carbanolate, carbaryl, carbofiiran, carbon disulfide, carbon tetrachloride, carbophenothion, carbosulfan, cartap, cartap hydrochloride, chlorantraniliprole, chlorbicyclen, chlordane, chlordecone, chlordimeform, chlordimeform hydrochloride, chlorethoxyfos, chlorfenapyr, chlorfenvinphos, chlorfluazuron, chlormephos, chlorofoiTn, chloropicrin, chloϕ hoxim, chlorprazophos, chloipyrifos, chlorpyrifos-methyl, chlorthiophos, chromafenozide, cinerin I, cinerin II, cinerins, cismethrin, cloethocarb, closantel, clothianidin, copper acetoarsenite, copper arsenate, copper naphfhenate, copper oleate, coumaphos, coumithoate, crotamiton, crotoxyphos, crafomate, cryolite, cyanofenphos, cyanophos, cyanthoate, cyantraniliprole, cyclethrin, cycloprothrin, cyfluthrin, cyhalothrin, cypermethrin, cyphenothrin, cyromazine, cythioate, DDT, decarbofliran, deltamethrin, demephion, demephion-O, demephion-S, demeton, demeton-methyl, demeton-O, demeton-O-methyl, demeton-S, demeton-S-methyl, demeton- S -methylsulphon, diafenthiuron, dialifos, diatomaceous earth, diazinon, dicapthon, dichlofenthion, dichlorvos, dicresyl, dicrotophos, dicyclanil, dieldrin, diflubenzuron, dilor, dimefluthrin, dimefox, dimetan, dimethoate, dimethrin, dimethylvinphos, dimetilan, dinex, dinex-diclexine, dinoprop, dinosam, dinotefuran, diofenolan, dioxabenzofos, dioxacarb, dioxathion, disulfoton, dithicrofos, d-limonene, DNOC, DNOC-ammonium, DNOC-potassium, DNOC-sodium, doramectin, ecdysterone, emamectin, emamectin benzoate, EMPC, empenthrin, endosulfan, endothion, endrin, EPN, epofenonane, eprinomectin, esdepallethrine, esfenvalerate, etaphos, ethiofencarb, ethion, ethiprole, ethoate-methyl, ethoprophos, ethyl formate, ethyl-DDD, ethylene dibromide, ethylene dichloride, ethylene oxide, etofenprox, etrimfos, EXD, famphur, fenamiphos, fenazaflor, fenchlorphos, fenethacarb, fenfluthrin, fenitrothion, fenobucarb, fenoxacrim, fenoxycarb, fenpirithrin, fenpropathrin, fensulfothion, fenthion, fenthion-ethyl, fenvalerate, fipronil, flonicamid, flubendiamide (additionally resolved isomers thereof), flucofuron, flucycloxuron, flucythrinate, flufenerim, flufenoxuron, flufenprox, fluvalinate, fonofos, formetanate, formetanate hydrochloride, formothion, formparanate, formparanate hydrochloride, fosmethilan, fospirate, fosthietan, fufenozide, furathiocarb, furethrin, gamma-cyhalothrin. gamma-HCH, halfenprox, halofenozide, HCH, HEOD, heptachlor, heptenophos, heterophos, hexaflumuron, HHDN, hydramethylnon, hydrogen cyanide, hydroprene, hyquincarb. imidacloprid, imiprothrin, indoxacarb, iodomethane, IPSP, isazofos, isobenzan, isocarbophos, isodrin, isofenphos,

isofenphos-methyl, isoprocarb, isoprothiolane, isothioate, isoxathion, ivermectin, jasmolin I, jasmolin II, jodfenphos, juvenile hormone I, juvenile hormone II, juvenile hormone III, kelevan, kinoprene, lambda-cyhalothrin, lead arsenate, lepimectin, leptophos, lindane, lirimfos, lufenuron, lythidathion, malafhion, malonoben, mazidox, mecarbam, mecarphon, menazon, meperfluthrin, mephosfolan, mercurous chloride, mesulfenfos, metaflumizone, methacrifos, methamidophos, methidathion, methiocarb, methocrotophos, methomyl, methoprene, methothrin, methoxychlor, methoxyfenozide, methyl bromide, methyl isothiocyanate, metlrylchloroform, methylene chloride, metofluthrin, metolcarb, metoxadiazone, mevinphos, mexacarbate, milbemectin, milbemycin oxime, mipafox, mirex, molosultap, monocrotophos, monomehypo, monosultap, morphothion, moxidectin, naftalofos, naled, naphthalene, nicotine, nifluridide, nitenpyram, nithiazine, nitrilacarb, novaluron, noviflumuron, omethoate, oxamyl, oxydemeton-methyl, oxydeprofos, oxydisulfoton, para-dichlorobenzene, parathion, parathion-methyl, penfluron, pentachlorophenol, permethrin, phenkapton, phenothrin, phenthoate, phorate, phosalone, phosfolan, phosmet, phosnichlor, phosphamidon, phosphine, phoxim, phoxim-methyl, pirimetaphos, pirimicarb, pirimiphos-ethyl, pkimiphos-rnethyl, potassium arsenite, potassium thiocyanate, pp'-DDT, prallethrin, precocene I, precocene II, precocene III, primidophos, profenofos, profluralin, profluthrin, promacyl, promecarb, propaphos, propetamphos, propoxur, prothidathion, prothiofos, prothoate, protrifenbute, pymetrozine, pyraclofos, pyrafluprole, pyrazophos, pyresmethrin, pyrethrin I, pyrethrin II, pyrethrins, pyridaben, pyridalyl, pyridaphenthion, pyrifluquinazon, pyrimidifen, pyrimitate, pyriprole, pyriproxyfen, quassia, quinalphos, quinalphos-methyl, quinothion, rafoxanide, resmethrin, rotenone, ryania, sabadiUa, schradan, selamectin, silafluofen, silica gel, sodium arsenite, sodium fluoride, sodium hexafluorosilicate, sodium thiocyanate, sophamide, spinetoram, spinosad, spiromesifen, spirotetramat, sulcofuron, sulcofuron-sodium, sulfluramid, sulfotep, sulfoxaflor, sulfury] fluoride, sulprofos, tau-fluvalinate, tazimcarb, TDE, tebufenozide, tebufenpyrad, tebupirimfos, teflubenzuron, tefluthrin, temephos, TEPP, terallethrin, terbufos, tetrachloroethane, tetrachlorvinphos, tetramethrin, tetramethylfluthrin, theta-cypenriethrin, thiacloprid, thiamethoxam, thicrofos, thiocarboxime, thiocyclam, thiocyclam oxalate, thiodicarb, thiofanox, thiometon, thiosultap, thiosultap-disodium, thiosultap-monosodium, thuringiensin, tolfenpyrad, tralomethrin, transfluthrin, transpermethrin, triarathene, triazamate, triazophos, trichlorfon, trichlormetaphos-3, trichloronat, trifenofos, triflumuron, trimethacarb, triprene, vamidothion, vaniliprole, XMC, xylylcarb, zeta-cypermethrin, or zolaprofos.

ACAR1CIDES

Non-limiting examples of acaricides that may be used in combination with the compound of formula **I** may include acequinocyl, amidoflumet, arsenous oxide, azobenzene, azocyclotin, benomyl, benoxafos, benzoximate, benzyl benzoate, bifenazate, binapacryl, bromopropylate, chinomethionat, chlorbenside, chlorfenethol, chlorfenson, chlorfensulphide, chlorobenzilate, chloromebuform, chloromethiuron, chloropropylate, clofentezine, cyenopyrafen, cyflumetofen, cyhexatin, dichlofluanid, dicofol, dienochlor, diflovidazin, dinobuton, dinocap, dinocap-4, dinocap-6, dinocton, dinopenton, dinosulfon, dinoterbon, diphenyl sulfone, disulfiram, dofenapyn, etoxazole, fenazaquin, fenbutatin oxide, fenothiocarb, fenpyroximate, fenson, fentrifanil, fluaciypyrirn, fluazuron, flubenzimine, fluenetil, flumethrin, fluorbenside, hexythiazox, mesulfen, MNAF, nikkomycins, proclonol, propargite, quintiofos, spirodiclofen, sulfiram, sulfur, tetradifon, tetranactin, tetrasul, or thioquinox.

NEMATICIDES

Non-limiting examples of nematicides that may be used in combination with the compound of formula **I** may include 1,3-dichloropropene, benclothiaz, dazomet, dazomet-sodium, DBCP, DCIP, diamidafos, fluensulfone, fosthiazate, furfural, imicyafos, isamidofos, isazofos, metam, metam-ammonium, metam-potassium, metam-sodium, phosphocarb, or thionazin.

FUNGICIDES

Non-limiting examples of fungicides that may be used in combination with the compound of formula **I** may include (3-ethoxypropyl)mercury bromide, 2-methoxyethylmercury chloride, 2-phenylphenol, 8-hydroxyquinoline sulfate, 8-phenylmercurioxyquinoline, acibenzolar, acibenzolar-S-methyl, acypetacs, acypetacs-copper, acypetacs-zinc, aldimorph, allyl alcohol, ametoctradin, amisulbrom, ampropylfos, anilazine, aureofungin, azaconazole, azithiram, azoxystrobin, barium polysulfide, benalaxyl, benalaxyl-M, benodanil, benomyl, benquinox, bentaluron, benthiavalicarb, benthiavalicarb-isopropyl, benzalkonium chloride, benzamacril, benzamacril-isobutyl, benzamorf, benzohydroxamic acid, bethoxazin, binapacryl, biphenyl, bitertanol, bithionol, bixafen, blasticidin-S, Bordeaux mixture, boscalid, bromuconazole, bupirimate, Burgundy mixture, buthiobate, butylamine, calcium polysulfide, captafol, captan, carbamorph, carbendazim, carboxin, carpropamid, carvone, Cheshunt mixture, chinomethionat, chlobenthiazone, chloraniformethan, chloranil, chlorfenazole, chlorodinitronaphthalene, chloroneb, chloropicrin, chlorothalonil, chlorquinox, chlozolinate, climbazole, clotrimazole, copper acetate, copper carbonate, basic, copper hydroxide, copper naphthenate, copper oleate, copper oxychloride, copper silicate, copper sulfate, copper zinc chromate, cresol, cufraneb, cuprobam, cuprous oxide, cyazofamid, cyclafuramid, cycloheximide, cyflufenamid, cymoxanil, cypendazole, cyproconazole, cyprodinil, dazomet, dazomet-sodium, DBCP, debacarb, decafentin, dehydroacetic acid, dichlofluanid, dichlone, dichlorophen, dichlozoline, diclobutrazol, diclocymet, diclomezine, diclomezine-sodium, dicloran, diethofencarb, diethyl pyrocarbonate, difenoconazole, diflumetorim, dimethirimol, dimethomorph, dimoxystrobin, diniconazole, diniconazole-M, dinobuton, dinocap, dinocap-4, dinocap-6, dinocton, dinopenton, dinosulfon, dinoterbon, dipbenylamine, dipyrithione, disulfiram, ditalimfos, dithianon, DNOC, DNOC-ammonium, DNOC-potassium, DNOC-sodium, dodemorph, dodemorph acetate, dodemorph benzoate, dodicin, dodicin-sodium, dodine, drazoxolon, edifenphos, epoxiconazole, etaconazole, etem, ethaboxam, ethirimol, ethoxyquin, ethylmercury 2,3-dihydroxypropyl mercaptide, ethylmercury acetate, ethylmercury bromide, ethylmercury chloride, ethylmercury phosphate, etridiazole, famoxadone, fenamidone, fenaminosulf, fenapanil, fenarimol, fenbuconazole, fenfuram, fenhexamid, fenitropan, fenoxanil, fenpiclonil, fenpropidin, fenpropimorph, fentin, fentin chloride, fentin hydroxide, ferbam, ferimzone, fluazinam, fludioxonil, flumetover, flumorph, fluopicolide, fluopyram, fluoroimide, fluotrimazole, fluoxastrobin, fluquinconazole, flusilazole, flusulfamide, flutianil, flutolanil, flutriafol, fluxapyroxad, folpet, formaldehyde, fosetyl, fosetyl-aluminium, Albendazole, furalaxyl, furametpyr, furcarbanil, furconazole, furconazole-cis, furfural, furmecyclox, furophanate, glyodin, griseofulvin, guazatine, halacrinate, hexachlorobenzene, hexachlorobutadiene, hexaconazole, hexylthiofos, hydrargaphen, hymexazol, imazalil, imazalil nitrate, imazalil sulfate, imibenconazole, iminoctadine, iminoctadine triacetate, iminoctadine trialbesilate, iodomethane, ipconazole, iprobenfos, iprodione, iprovalicarb, isoprothiolane, isopyrazam, isotianil, isovaledione, kasugamycin, kresoxim-methyl, mancopper, mancozeb, mandipropamid, maneb, mebenil, mecarbiiizid, mepanipyrim, mepronil, meptyldinocap, mercuric chloride, mercuric oxide, mercurous chloride, metalaxyl, metalaxyl-M, metam, metam-ammonium, metam-potassium, metam-sodium, metazoxolon, metconazole, methasulfocarb, methfuroxam, methyl bromide, methyl isothiocyanate, methylmercury benzoate, methylmercury dicyandiamide, methylmercury pentachlorophenoxide, metiram, metominostrobin, metrafenone, metsulfovax, milneb, myclobutanil, myclozolin, N-(ethylmercury)-p-toluenesulphonanilide, nabam, natamycin, nitrostyrene, nitrothal-isopropyl, nuarimol, OCH, octhilinone, ofurace, orysastrobin, oxadixyl, oxine-copper, oxpoconazole, oxpoconazole fumarate, oxycarboxin, pefurazoate, penconazole, pencycuron, penflufen, pentachlorophenol, penthiopyrad, phenylmercuriurea, phenylmercury acetate, phenylmercury chloride, phenylmercury derivative of pyrocatechol, phenylmercury nitrate, phenylmercury salicylate, phosdiphen, phthalide, picoxystrobin, piperalin, polycarbamate, polyoxins, polyoxorim, polyoxorim-zinc, potassium azide, potassium polysulfide, potassium thiocyanate, probenazole, prochloraz, procymidone, propamocarb, propamocarb hydrochloride, propiconazole, propineb, proquinazid, prothiocarb, prothiocarb hydrochloride, prothioconazole, pyracarbolid, pyiaclostrobin, pyraclostrobin, pyrametostrobin, pyraoxystrobin, pyrazophos, pyribencarb, pyridinitril, pyrifenox, pyrimethanil, pyriofenone, pyroquilon, pyroxychlor, pyroxyfur, quinacetol, quinacetol sulfate, quinazamid, quinconazole, quinoxyfen, quintozene, rabenzazole, salicylanilide, sedaxane, silthiofam, simeconazole, sodium azide, sodium orthophenylphenoxide, sodium pentachlorophenoxide, sodium polysulfide, spiroxamine, streptomycin, sulfur, sultropen, TCMTB, tebuconazole, tebufloquin, tecloftalam, tecnazene, tecoram, tetraconazole, thiabendazole, thiadifluor, thicyofen, thifluzamide, thiochlorfenphim, thiomersal, thiophanate, thiophanate-methyl, thioquinox, thiram, tiadinil, tioxymid, tolclofos-methyl, tolylfluanid, tolylmercury acetate, triadimefon, triadimenol, triamiphos, triarimol, triazbutil, triazoxide, tributyltin oxide, trichlamide, tricyclazole, tridemorph, trifloxystrobin, triflumizole, triforine, triticonazole, uniconazole, uniconazole-P, validamycin, valifenalate, vinclozolin, zarilamid, zinc naphthenate, zineb, ziram, or zoxamide.

HERBICIDES

Non-limiting examples of herbicides that may be used in combination the compound of formula **I** may include 2,3,6-TBA, 2,3,6-TBA-dimethylammonium, 2,3,6-TBA-sodium, 2,4,5-T, 2,4,5-T-2-butoxypropyl, 2,4,5-T-2-ethylhexyl, 2,4,5-T-3-butoxypropyl, 2,4,5-TB, 2,4,5-T-butometyl, 2,4,5-T-butotyl, 2,4,5-T-butyl, 2,4,5-T-isobutyl, 2,4,5-T-isoctyl, 2,4,5-T-isopropyl, 2,4,5-T-methyl, 2,4,5-T-pentyl, 2,4,5-T-sodium, 2,4,5-T-triethylammonium, 2,4,5-T-trolamine, 2,4-D, 2,4-D-2-butoxypropyl, 2,4-D-2-ethylhexyl, 2,4-D-3-butoxypropyl, 2,4-D-ammonium, 2,4-DB, 2,4-DB-butyl, 2,4-DB-dimethylammonium, 2,4-DB-isoctyl, 2,4-DB-potassium, 2,4-DB-sodium, 2,4-D-butotyl, 2,4-D-butyl, 2,4-D-diethylammonium, 2,4-D-dimethylammonium, 2,4-D-diolamine, 2,4-D-dodecylammonium, 2,4-DEB, 2,4-DEP, 2,4-D-ethyl, 2,4-D-heptylammonium, 2,4-D-isobutyl, 2,4-D-isoctyl, 2,4-D-isopropyl, 2,4-D-isopropylammonium, 2,4-D-lithium, 2,4-D-meptyl, 2,4-D-methyl, 2,4-D-octyl, 2,4-D-pentyl, 2,4-D-potassium, 2,4-D-propyl, 2,4-D-sodium, 2,4-D-tefuryl, 2,4-D-tetradecylammonium, 2,4-D-triethylammonium, 2,4-D-tris(2-hydroxypropyl)ammonium, 2,4-D-trolamine, 3,4-DA, 3,4-DB, 3,4-DP, 4-CPA, 4-CPB, 4-CPP, acetochlor, acifluorfen, acifluorfen-methyl, acifluorfen-sodium, aclonifen, acrolein, alachlor, allidochlor, alloxydim, alloxydim-sodium, allyl alcohol, alorac, ametridione, ametryn, amibuzin, amicarbazone, amidosulfuron, aminocyclopyrachlor, aminocyclopyrachlor-methyl, aminocyclopyTachlor-potassium, aminopyralid, aminopyralid-potassium, aminopyralid-tris(2-hydroxypropyl)ammonium, amiprofos-methyl, amitrole, ammonium sulfamate, anilofos, anisuron, asulam, asulam-potassium, asulam-sodium, atraton, atrazine, azafenidin, azimsulfuron, aziprotryne, barban, BCPC, beflubutamid, benazolin, benazolin-dimethylammonium, benazolin-ethyl, benazolin-potassium, bencarbazone, benfluralin, benfuresate, bensulfuron, bensulfuron-methyl, bensulide, bentazone, bentazone-sodium, benzadox, benzadox-ammonium, benzfendizone, benzipram, benzobicyclon, benzofenap, benzofluor, benzoylprop, benzoylprop-ethyl, benzthiazuron, bicyclopyrone, bifenox, bilanafos, bilanafos-sodium, bispyribac, bispyribac-sodium, borax, bromacil, bromacil-lithiuin, bromacil-sodium, bromobonil, bromobutide, bromofenoxim, bromoxynil, bromoxynil butyrate, bromoxynil heptanoate, bromoxynil octanoate, bromoxynil-potassium, brompyrazon, butachlor, butafenacil, butamifos, butenachlor, buthidazole, buthiuron, butralin, butroxydim, buturon, butylate, cacodylic acid, cafenstrole, calcium chlorate, calcium cyanamide, cambendichlor, carbasulam, carbetamide, carboxazole, carfentrazone, carfentrazone-ethyl, CDEA, CEPC, chlomethoxyfen, chloramben, chloramben- ammonium, chloramben-diolamine, chloramben-methyl, chloramben-methylammonium, chloramben-sodium, chloranocry], chlorazifop, chlorazifop-propargyl, chlorazine, chlorbromuron, chlorbufam, chloreturon, chlorfenac, chlorfenac-sodium, chlorfenprop, chlorfenprop-methyl, chlorflurazole, chlorflurenol, chlorflurenol-methyl, chloridazon, chlorimuron, chlorimuron-ethyl, chlornitrofen, chloropon, chlorotoluron, chloroxuron, chloroxynil, chloiprocarb, chlorpropham, chlorsulfuron, chlorthal, chlorthal-dimethyl, chlorthal-monomethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, cisanilide, clethodim, cliodinate, clodinafop, clodinafop-propargyl, clofop, clofop-isobutyl, clomazone, clomeprop, cloprop, cloproxydim, clopyralid, clopyralid-methyl, clopyralid-olamine, clopyralid-potassium, clopyralid-tris(2-hydroxypropyl)amraonium, cloransulam, cloransulam-methyl, CMA, copper sulfate, CPMF, CPPC, credazine, cresol, cumyluron, cyanamide, cyanatryn, cyanazine, cycloate, cyclosulfamuron, cycloxydim, cycluron, cyhalofop, cyhalofop-butyl, cyperquat, cyperquat chloride, cyprazine, cyprazole, cypromid, daimuron, dalapon, dalapon-calcium, dalapon-magnesium, dalapon- sodium, dazomet, dazomet-sodium, delachlor, desmedipham, desmetryn, di-allate, dicamba, dicamba-dimethylammonium, dicamba-diolamine, dicamba-isopropylammonium, dicamba-methyl, dicamba-olamine, dicamba-potassium, dicamba-sodium, dicamba-trolamine, dichlobenil, dichloralurea, dichlormate, dichlorprop, dichlorprop-2-ethylhexyl, dichlorprop-butotyl, dichlorprop-dimethylammonium, dichlorprop-ethylanllnonium, dichlorprop-isoctyl, dichloϕ rop-methyl, dichlorprop-P, dichlorprop-P-dimethylammonium, dichloϕ rop-potassium, dichloϕ rop-sodium, diclofop, diclofop-methyl, diclosulam, diethamquat, diethamquat dichloride, diethatyl, diethatyl-ethyl, difenopenten, difenopenten-ethyl, difenoxuron, difenzoquat, difenzoquat metilsulfate, diflufenican, diflufenzopyr, diflufenzopyr-sodium, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimexano, dimidazon, dinitramine, dinofenate, dinoprop, dinosam, dinoseb, dinoseb acetate, dinoseb-ammonium, dinoseb-diolamine, dinoseb-sodium, dinoseb-trolamine, dinoterb, dinoterb acetate, diphacinone-sodium, diphenamid, dipropetryn, diquat, diquat dibromide, disul, disul-sodium, dithiopyr, diuron, DMPA, DNOC, DNOC-ammonium, DNOC-potassium, DNOC-sodium, DSMA, EBEP, eglinazine, eglinazine-ethyl, endothal, endothal-diammonium, endothal-dipotassium, endothal-disodium, epronaz, EPTC, erbon, esprocarb, ethalfluralin, ethametsulfuron, ethametsulfuron-methyl, ethidimuron, ethiolate, ethofumesate, ethoxyfen, ethoxyfen-ethyl, ethoxysulfuron, etinofen, etnipromid, etobenzanid, EXD, fenasulam, fenoprop, fenoprop-3-butoxypropyl, fenoprop-butometyl, fenoprop-butotyl, fenoprop-butyl, fenoprop-isoctyl, fenoprop-methyl, fenoprop-potassium, fenoxaprop, fenoxaprop-ethyl, fenoxaprop-P, fenoxaprop-P-ethyl, fenoxasulfone, fenteracol, fenthiaprop, fenthiaprop-ethyl, fentrazamide, fenuron, fenuron TCA, ferrous sulfate, flamprop, flamprop-isopropyl, flamprop-M, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop, fluazifop-butyl, fluazifop-methyl, fluazifop-P, fluazifop-P-butyl, fluazolate, flucarbazone, flucarbazone-sodium, flucetosulfuron, fluchloralin, flufenacet, flufenican, flufenpyr, flufenpyr-ethyl, flumetsulam, flumezin, flumiclorac, flumiclorac-pentyl, flumioxazin, flumipropyn, fluometuron, fluorodifen, fluoroglycofen, fluoroglycofen-ethyl, fluoromidine, fluoronirrofen, fluothiuron, flupoxam, flupropacil, flupropanate, flupropanate-sodium, flupyrsulfuron, flupyrsulfuron-methyl-sodium, fluridone, flurochloridone, fluroxypyr, fluroxypyr-butometyl, fluroxypyr-meptyl, flurtamone, fluthiacet, fluthiacet-methyl, fomesafen, fomesafen-sodium, foramsulfuron, fosamine, fosamine-ammonium, furyloxyfen, glufosinate, glufosinate-ammonium, glufosinate-P, glufosinate-P-aminonium, glufosinate-P-sodium, glyphosate, glyphosate-diammonium, glyphosate-dimethylarnmonium, glyphosate-isopropylammonium, glyphosate-monoammonium, glyphosate-potassium, glyphosate-sesquisodium, glyphosate-trimesium, halosafen, halosulfuron,

halosulfuron-methyl, haloxydine, haloxyfop, haloxyfop-etotyl, haloxyfop-methyl, haloxyfop-P, haloxyfop-P-etotyl, haloxyfop-P-methyl, haloxyfop-sodium, hexachloroacetone, hexaflurate, hexazinone, imazamethabenz, imazamethabenz-methyl, imazamox, imazamox-ammonium, imazapic, imazapic-ammonium, imazapyr, imazapyr-isopropylammonium, imazaquin, imazaquin-ammonium, imazaquin-methyl, imazaquin-sodium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, indaziflam, iodobonil, iodomethane, iodosulfuron, iodosulfuron-methyl-sodium, ioxynil, ioxynil octanoate, ioxynil-lithium, ioxynil-sodium, ipazine, ipfencarbazone, iprymidam, isocarbamid, isocil, isomethiozin, isonoruron, isopolinate, isopropalin, isoproturon, isouron, isoxaben, isoxachlortole, isoxaflutole, isoxapyrifop, karbutilate, ketospiradox, lactofen, lenacil, linuron, MAA, MAMA, MCPA, MCPA-2-ethylhexyl, MCPA-butotyl, MCPA-butyl, MCPA-dimethylammonium, MCPA-diolamine, MCPA-ethyl, MCPA-isobutyl, MCPA-isoctyl, MCPA-isopropyl, MCPA-methyl, MCPA-olamine, MCPA-potassiutn, MCPA-sodium, MCPA-thioethyl, MCPA-trolamine, MCPB, MCPB-ethyl, MCPB-methyl, MCPB-sodium, mecoprop, mecoprop-2-ethylhexyl, mecoprop-dimethylammonium, mecoprop-diolamine, mecoprop-ethadyl, mecoprop-isoctyl, mecoprop-methyl, mecoprop-P, mecoprop-P-dimethylammonium, mecoprop-P-isobutyl, mecoprop-potassium, mecoprop-P-potassium, mecoprop-sodium, mecoprop-trolamine, medinoterb, medinoterb acetate, mefenacet, mefluidide, mefluidide-diolamine, mefluidide -potassium, mesoprazine, mesosulmron, mesosulfuron-methyl, mesotrione, metam, metam-ammonium, metamifop, metamitron, metam-potassium, metam-sodium, metazachlor, metazosulfuron, metflurazon, methabenzthiazuron, methalpropalin, methazole, methiobencarb, methiozolin, methiuron, methometon, methoprotryne, methyl bromide, methyl isothiocyanate, methyldymron, metobenzuron, metolachlor, metosulam, metoxuron, metribuzin, metsulfuron, metsulfiiron-methyl, molinate, monalide, monisouron, monochloroacetic acid, monolinuron, monuron, monuron TCA, morfamquat, morfamquat dichloride, MSMA, naproanilide, napropamide, naptalam, naptalam-sodium, neburon, nicosulfuron, nipyraclofen, nitralin, nitrofen, nitrofluorfen, norflurazon, noruron, OCH, orbencarb, ortho-dichlorobenzene, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxapyrazon, oxapyrazon-dimolamine, oxapyrazon-sodium, oxasulfuron, oxaziclomefone, oxyfluorfen, parafluron, paraquat, paraquat dichloride, paraquat dimetilsulfate, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentachlorophenol, pentanochlor, pentoxazone, perfluidone, pethoxamid, phenisopham, phenmedipham, pbenmedipham-ethyl, phenobenzuron, phenylmercury acetate, picloram, picloram-2-ethylhexyl, picloram-isoctyl, picloram-methyl, picloram-olamine, picloram-potassium, picloram-triethylammonium, picloram-tris(2-hydroxypropyl)ammonium, picolinafen, pinoxaden, piperophos, potassium arsenite, potassium azide, potassium cyanate, pretilachlor, primisulfuron, primisulfiiron-methyl, procyazine, prodiamine, profluazol. profluralin, profoxydim, proglinazine, proglinazine-ethyl, prometon, prometryn, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propoxycarbazone-sodium, propyrisulfuron, propyzamide, prosulfalin, prosulfocarb, prosulfuron, proxan, proxan- sodium, prynachlor, pydanon, pyraclonil, pyraflufen, pyraflufen-ethyl, pyrasulfotole, pyrazolynate, pyrazosulfuron, pyrazosulfuron-ethy], pyrazoxyfen, pyribenzoxini, pyributicarb, pyriclor, pyridafol, pyridate, pyriftalid, pyriminobac, pyriminobac-methyl, pyrimisulfan, pyrithiobac, pyrithiobac-sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinoclamine, quinonamid, quizalofop, quizalofop-ethyl, quizalofop-P, quizalofop-P-ethy], quizalofop-P-tefuryl, rhodethanil, rimsulfuron, saflufenacil, sebuthylazine, secbumeton, sethoxydim, siduron, simazine, simeton, simetryn, SMA, S-metolachlor, sodium arsenite, sodium azide, sodium chlorate, sulcotrione, sulfallate, sulfentrazone, sulfometuron, sulfometuron-methyl, sulfosulfuron, sulfuric acid, sulglycapin, swep, TCA, TCA-ammonium, TCA-calcium, TCA-ethadyl, TCA-magnesium, TCA-sodium, tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxydim, terbacil, terbucarb, terbuchlor, terbumeton, terbuthylazine, terbutryn, tetrafluron, thenylchlor, thiazafluron, thiazopyr, thidiazimin, thidiazuron, thiencarbazone, thiencarbazone-methyl, thifensulfuron, thifensulfuron-methyl, thiobencarb, tiocarbazil, tioclorim, topramezone, tralkoxydim, tri-allate, triasulfiaron, triaziflam, tribenuron, tribenuron-methyl, tricamba, triclopyr, triclopyr-butotyl, triclopyr-ethyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifloxysulfuron- sodium, trifluralin, triflusulfuron, triflusulfuron-methyl, trifop, trifop-methyl, trifopsime, trihydroxytriazine, trimeturon, tripropindan, tritac, tritosulfuron, vernolate, or xylachlor.

BIOPESTICIDES

The compound of formula **1** may also be used in combination (such as in a compositional mixture, or a simultaneous or sequential application) with one or more biopesticides. The term "biopesticide" is used for microbial biological pest control agents that are applied in a similar manner to chemical pesticides. Commonly these are bacterial, but there are also examples of fungal control agents, including *Trichoderma* spp. and *Ampelomyces quisqualis* (a control agent for grape powdery mildew). *Bacillus subtilis* are used to control plant pathogens. Weeds and rodents have also been controlled with microbial agents. One well-known insecticide example is *Bacillus tlnrringiensis,* a bacteria] disease of Lepidoptera, Coleoptera, and Diptera. Because it has little effect on other organisms, it is considered more environmentally friendly than synthetic pesticides. Biological insecticides include products based on:

1. entomopathogenic fungi *{e.g. Metarhizium anisopliae);*
2. entomopathogenic nematodes *(e.g. Steinernema feltiae);* and
3. entomopathogenic viruses (e.g. *Cydia pomonella* granulovirus).

Other examples of entomopathogenic organisms include, but are not limited to, baculoviruses, bacteria and other prokaryotic organisms, fungi, protozoa and Microsproridia. Biologically derived insecticides include, but not limited to, rotenone, veratridine, as well as microbial toxins; insect tolerant or resistant plant varieties; and organisms modified by recombinant DNA technology to either produce insecticides or to convey an insect resistant property to the genetically modified organism. In one embodiment, the molecules of Formula One may be used with one or more biopesticides in the area of seed treatments and soil amendments. *The Manual of Biocontrol Agents* gives a review of the available biological insecticide (and other biology-based control) products. Copping L.G. (ed.) (2004). *The Manual of Biocontrol Agents* (formerly the *Biopesticide Manual)* 3rd Edition. British Crop Production Council (BCPC), Farnham, Surrey UK.

OTHER ACTIVE COMPOUNDS

The compound of formula I may also be used in combination (such as in a compositional mixture, or a simultaneous or sequential application) with one or more of the following:

1. 3-(4-chloro-2,6-dimethylphenyl)-4-hydroxy-8-oxa-l-azaspiro[4,5]dec-3-en-2-one;
2. 3-(4'-chloro-2,4-dimethyl[l,l'-biphenyl]-3-yl)-4-hydroxy-8-oxa-l-azaspiiO [4,5]dec-3-en-2-one;
3. 4-[[(6-chloro-3-pyridinyl)memyl]methylamino]-2(5ii)-furanone;
4. 4-[[(6-chloro-3-pyridinyl)methyl]cyclopropylamino]-2(5//)-furanone;
5. 3-chloro-Af2-[(15)-l-methyl-2-(methylsulfonyl)ethyl]-M-[2-methyl-4-[l,2,2,2-tetrafluoro-l-(trifluoromethyl)ethyl]phenyl]-l ,2-benzenedicarboxamide;
6. 2-cyano-/V-ethyl-4-fluoro-3-methoxy-benenesulfonamide;
7. 2-cyano-7V-ethyl-3-methoxy-benzenesulfonamide;
8. 2-cyano-3-dif]uoromethoxy-JV-ethyl-4-fluoro-benzenesulfonamide;
9. 2-cyano-3-fluoromemoxy-N-ethyl-benzenesulfonamide;
10. 2-cyano-6-fluoro-3-methoxy-A^7V-dimethyl-benzenesulfonamide;
11. 2-cyano-/V-ethyl-6-fluoro-3-methoxy-/V-methyl-benzenesulfonamide;
12. 2-cyano-3-difluoromethoxy-A',/V-dimethylbenzenesulfon-amide;
13. 3-(difluoromethyl)-yV-[2-(3,3-dimethylbutyl)phenyl]-l-methyl-li/-pyrazole-4-carboxamide;
14. #-ethyl-2,2-di]iiethylpropionamide-2-(2,6-dichloro-a,a,a-ti-ifluoro-p-tolyl) hydrazone;
15. A'-ethyl-2,2-dichloro-l-methylcyclopropane-carboxamide-2-(2,6-dichloro-a,a,a-trifluoro-/?-tolyl) hydrazone nicotine;
16. 0 -{(E-)-[2-(4-chloro-phenyl)-2-cyano-l-(2-trifluoromethylphenyl)-vinyl]}.S-methyl thiocarbonate;
17. (E)-M-[(2-chloro-l,3-thiazol-5-ylmethyl)]-A/2-cyano-M-methylacetamidine;
18. l-(6-chloropyridin-3-ylmethyl)-7-methyl-8-nitro-l,2,3,5,6,7-hexahydro-imidazo[l,2-a]pyridin-5-ol;
19. 4-[4-chlorophenyl-(2-butylidine-hydrazono)methyl)]phenyl mesylate; and
20. N-ethyl-2,2-dichloro-l-methylcyclopropanecarboxamide-2-(2,6-dichloro-a,a,a-trifluoro-/!-tolyl)hydrazone.

The compound of formula 1 may also be used in combination (such as in a compositional mixture, or a simultaneous or sequential application) with one or more compounds in the following groups: algicides, antifeedants, avicides, bactericides, bird repellents, chemosterilants, herbicide safeners, insect attractants, insect repellents, mammal repellents, mating disrupters, molluscicides, plant activators, plant growth regulators, rodenticides, or virucides.

SYNERGISTIC MIXTURES AND SYNERGISTS

The compound of formula **I** may be used in combination with at least one other insecticides to form a synergistic mixture where the mode of action of such compounds compared to the mode of action of the compound of formula **I** are the same, similar, or different. Examples of modes of action may include, but are not limited to: acetylcholinesterase inhibitor; sodium channel modulator; chitin biosynthesis inhibitor; GABA-gated chloride channel antagonist; GABA and glutamate-gated chloride channel agonist; acetylcholine receptor agonist; MET I inhibitor; Mg-stimulated ATPase inhibitor; nicotinic acetylcholine receptor; Midgut membrane disrupter; oxidative phosphorylation disrupter, or ryanodine receptor (RyRs).

Additionally, the compound of formula **I** may be used in combination with at least one of fungicides, acaricides, herbicides or nematicides to form a synergistic mixture.

Furthermore, the compound of formula **I** may be used in combination with other active compounds, such as the compounds under the heading "OTHER ACTIVE COMPOUNDS," algicides, avicides, bactericides, molluscicides, rodenticides, virucides, herbicide safeners, adjuvants, and/or surfactants to form a synergistic mixture. Moreover, the following compounds are known as synergists and may be used in combination with the compound of formula **I**: piperonyl butoxide, piprotal, propyl isome, sesamex, sesamolin, sulfoxide, and tribufos.

FORMULATIONS

A pesticide is rarely suitable for application in its pure form. It is usually necessary to add other substances so that the pesticide can be used at the required concentration and in an appropriate form, permitting ease of application, handling, transportation, storage, and maximum pesticide activity. Thus, pesticides are formulated into, for example, baits, concentrated emulsions, dusts, emulsifiable concentrates, fumigants, gels, granules, microencapsulations, seed treatments, suspension concentrates, suspoemulsions, tablets, water soluble liquids, water dispersible granules or dry flowables, wettable powders, and ultra low volume solutions. For further information on formulation types see "Catalogue of Pesticide Formulation Types and International Coding System" Technical Monograph n°2, 5th Edition by CropLife International (2002).

Pesticides are applied most often as aqueous suspensions or emulsions prepared from concentrated formulations of such pesticides. Such water-soluble, water-suspendable, or emulsifiable formulations are either solids, usually known as wettable powders, or water dispersible granules, or liquids usually known as emulsifiable concentrates, or aqueous suspensions. Wettable powders, which may be compacted to form water dispersible granules, comprise an intimate mixture of the pesticide, a carrier, and surfactants. The concentration of the pesticide is usually from about 10% to about 90% by weight. The carrier is usually selected from among the attapulgite clays, the montmorillonite clays, the diatomaceous earths, or the purified silicates. Effective surfactants, comprising from about 0.5% to about 10% of the wettable powder, are found among sulfonated lignins, condensed naphthalenesulfonates, naphthalenesulfonates, alkylbenzenesulfonates, alkyl sulfates, and non-ionic surfactants such as ethylene oxide adducts of alkyl phenols.

Emulsifiable concentrates of pesticides comprise a convenient concentration of a pesticide, such as from about 50 to about 500 grams per liter of liquid dissolved in a carrier that is either a water miscible solvent or a mixture of water-immiscible organic solvent and emulsifiers. Useful organic solvents include aromatics, especially xylenes and petroleum fractions, especially the high-boiling naphthalenic and olefinic portions of petroleum such as heavy aromatic naphtha. Other organic solvents may also be used, such as the terpenic solvents including rosin derivatives, aliphatic ketones such as cyclohexanone, and complex alcohols such as 2-ethoxyethanol. Suitable emulsifiers for emulsifiable concentrates are selected from conventional anionic and non-ionic surfactants.

Aqueous suspensions comprise suspensions of water-insoluble pesticides dispersed in an aqueous carrier at a concentration in the range from about 5% to about 50% by weight. Suspensions are prepared by finely grinding the pesticide and vigorously mixing it into a carrier comprised of water and surfactants. Ingredients, such as inorganic salts and synthetic or natural gums may also be added, to increase the density and viscosity of the aqueous carrier. It is often most effective to grind and mix the pesticide at the same time by preparing the aqueous mixture and homogenizing it in an implement such as a sand mill, ball mill, or piston-type homogenizer.

Pesticides may also be applied as granular compositions that are particularly useful for applications to the soil. Granular compositions usually contain from about 0.5% to about 10% by weight of the pesticide, dispersed in a carrier that comprises clay or a similar substance. Such compositions are usually prepared by dissolving the pesticide in a suitable solvent and applying it to a granular carrier which has been pre-formed to the appropriate particle size, in the range of from about 0.5 to about 3 mm. Such compositions may also be formulated by making a dough or paste of the carrier and compound and crushing and drying to obtain the desired granular particle size.

Dusts containing a pesticide are prepared by intimately mixing the pesticide in powdered form with a suitable dusty agricultural carrier, such as kaolin clay, ground volcanic rock, and the like. Dusts can suitably contain from about 1% to about 10% of the pesticide. They can be applied as a seed dressing or as a foliage application with a dust blower machine.

It is equally practical to apply a pesticide in the form of a solution in an appropriate organic solvent, usually petroleum oil, such as the spray oils, which are widely used in agricultural chemistry.

Pesticides can also be applied in the form of an aerosol composition. In such compositions the pesticide is dissolved or dispersed in a carrier, which is a pressure-generating propellant mixture. The aerosol composition is packaged in a container from which the mixture is dispensed through an atomizing valve.

Pesticide baits are formed when the pesticide is mixed with food or an attractant or both. When the pests eat the bait they also consume the pesticide. Baits may take the form of granules, gels, flowable powders, liquids, or solids. They can be used in pest harborages.

Fumigants are pesticides that have a relatively high vapor pressure and hence can exist as a gas in sufficient concentrations to kill pests in soil or enclosed spaces. The toxicity of the fumigant is proportional to its concentration and the exposure time. They are characterized by a good capacity for diffusion and act by penetrating the pest's respiratory system or being absorbed through the pest's cuticle. Fumigants are applied to control stored product pests under gas proof sheets, in gas sealed rooms or buildings or in special chambers.

Pesticides can be microencapsulated by suspending the pesticide particles or droplets in plastic polymers of various types. By altering the chemistry of the polymer or by changing factors in the processing, microcapsules can be formed of various sizes, solubility, wall thicknesses, and degrees of penetrability. These factors govern the speed with which the active ingredient within is released, which in turn, affects the residual performance, speed of action, and odor of the product.

Oil solution concentrates are made by dissolving pesticide in a solvent that will hold the pesticide in solution. Oil solutions of a pesticide usually provide faster knockdown and kill of pests than other formulations due to the solvents themselves having pesticidal action and the dissolution of the waxy covering of the integument increasing the speed of uptake of the pesticide. Other advantages of oil solutions include better storage stability, better penetration of crevices, and better adhesion to greasy surfaces.

Another embodiment is an oil-in-water emulsion, wherein the emulsion comprises oily globules which are each provided with a lamellar liquid crystal coating and are dispersed in an aqueous phase, wherein each oily globule comprises at least one compound which is agriculturally active, and is individually coated with a monolamellar or oligolamellar layer comprising: (1) at least one non-ionic lipophilic surface-active agent, (2) at least one non-ionic hydrophilic surface-active agent and (3) at least one ionic surface-active agent, wherein the globules having a mean particle diameter of less than 800 nanometers. Further information on the embodiment is disclosed in U.S. patent publication 20070027034 published February 1, 2007, having Patent Application serial number 11/495,228. For ease of use, this embodiment will be referred to as "OIWE."

For further information consult "Insect Pest Management" 2nd Edition by D. Dent, copyright CAB International (2000). Additionally, for more detailed information consult "Handbook of Pest Control - The Behavior, Life History, and Control of Household Pests" by Arnold Mallis, 9th Edition, copyright 2004 by G1E Media Inc.

OTHER FORMULATION COMPONENTS

Generally, when the compound of formula **1** or any agriculturally acceptable salt thereof, are used in a formulation, such formulation can also contain other components. These components include, but are not limited to, (this is a non-exhaustive and non-mutually exclusive list) wetters, spreaders, stickers, penetrants, buffers, sequestering agents, drift reduction agents, compatibility agents, anti-foam agents, cleaning agents, and emulsifiers. A few components are described forthwith.

A wetting agent is a substance that when added to a liquid increases the spreading or penetration power of the liquid by reducing the interfacial tension between the liquid and the surface on which it is spreading. Wetting agents are used for two main functions in agrochemical formulations: during processing and manufacture to increase the rate of wetting of powders in water to make concentrates for soluble liquids or suspension concentrates; and during mixing of a product with water in a spray tank to reduce the wetting time of wettable powders and to improve the penetration of water into water-dispersible granules. Examples of wetting agents used in wettable powder, suspension concentrate, and water-dispersible granule formulations are: sodium lauryl sulfate; sodium dioctyl sulfosuccinate; alkyl phenol ethoxylates; and aliphatic alcohol ethoxylates.

A dispersing agent is a substance which adsorbs onto the surface of particles and helps to preserve the state of dispersion of the particles and prevents them from reaggregating. Dispersing agents are added to agrochemical formulations to facilitate dispersion and suspension during manufacture, and to ensure the particles redisperse into water in a spray tank. They are widely used in wettable powders, suspension concentrates and water-dispersible granules. Surfactants that are used as dispersing agents have the ability to adsorb strongly onto a particle surface and provide a charged or steric barrier to reaggregation of particles. The most commonly used surfactants are anionic, non-ionic, or mixtures of the two types. For wettable powder formulations, the most common dispersing agents are sodium lignosulfonates. For suspension concentrates, very good adsorption and stabilization are obtained using polyelectrolytes, such as sodium naphthalene sulfonate formaldehyde condensates. Tristyrylphenol ethoxylate phosphate esters are also used. Non-ionics such as alkylarylethylene oxide condensates and EO-PO block copolymers are sometimes combined with anionics as dispersing agents for suspension concentrates. In recent years, new types of very high molecular weight polymeric surfactants have been developed as dispersing agents. These have very long hydrophobic 'backbones' and a large number of ethylene oxide chains forming the 'teeth' of a 'comb' surfactant. These high molecular weight polymers can give very good long-term stability to suspension concentrates because the hydrophobic backbones have many anchoring points onto the particle surfaces. Examples of dispersing agents used in agrochemical formulations are: sodium lignosulfonates; sodium naphthalene sulfonate formaldehyde condensates; tristyrylphenol ethoxylate phosphate esters; aliphatic alcohol ethoxylates; alky] ethoxylates; EO-PO block copolymers; and graft copolymers.

An emulsifying agent is a substance which stabilizes a suspension of droplets of one liquid phase in another liquid phase. Without the emulsifying agent the two liquids would separate into two immiscible liquid phases. The most commonly used emulsifier blends contain alkylphenol or aliphatic alcohol with twelve or more ethylene oxide units and the oil-soluble calcium salt of dodecylbenzenesulfonic acid. A range of hydrophile-lipophile balance ("HLB") values from 8 to 18 will normally provide good stable emulsions. Emulsion stability can sometimes be improved by the addition of a small amount of an EO-PO block copolymer surfactant.

A solubilizing agent is a surfactant which will form micelles in water at concentrations above the critical micelle concentration. The micelles are then able to dissolve or solubilize water-insoluble materials inside the hydrophobic part of the micelle. The types of surfactants usually used for solubilization are non-ionics, sorbitan monooleates, sorbitan monooleate efhoxylates, and methyl oleate esters.

Surfactants are sometimes used, either alone or with other additives such as mineral or vegetable oils as adjuvants to spray-tank mixes to improve the biological performance of the pesticide on the target. The types of surfactants used for bioenhancement depend generally on the nature and mode of action of the pesticide. However, they are often non-ionics such as: alkyl efhoxylates; linear aliphatic alcohol ethoxylates; aliphatic amine ethoxylates.

A carrier or diluent in an agricultural formulation is a material added to the pesticide to give a product of the required strength. Carriers are usually materials with high absorptive capacities, while diluents are usually materials with low absorptive capacities. Carriers and diluents are used in the formulation of dusts, wettable powders, granules and water-dispersible granules.

Organic solvents are used mainly in the formulation of emulsifiable concentrates, oil-in-water emulsions, suspoemulsions, and ultra low volume formulations, and to a lesser extent, granular formulations. Sometimes mixtures of solvents are used. The first main groups of solvents are aliphatic paraffinic oils such as kerosene or refined paraffins. The second main group (and the most common) comprises the aromatic solvents such as xylene and higher molecular weight fractions of C9 and CIO aromatic solvents. Chlorinated hydrocarbons are useful as cosolvents to prevent crystallization of pesticides when the formulation is emulsified into water. Alcohols are sometimes used as cosolvents to increase solvent power. Other solvents may include vegetable oils, seed oils, and esters of vegetable and seed oils.

Thickeners or gelling agents are used mainly in the formulation of suspension concentrates, emulsions and suspoemulsions to modify the rheology or flow properties of the liquid and to prevent separation and settling of the dispersed particles or droplets. Thickening, gelling, and anti-settling agents generally fall into two categories, namely water-insoluble particulates and water-soluble polymers. It is possible to produce suspension concentrate formulations using clays and silicas. Examples of these types of materials, include, but are not limited to, montmorillonite, bentonite, magnesium aluminum silicate, and attapulgite. Water-soluble polysaccharides have been used as thickening-gelling agents for many years. The types of polysaccharides most commonly used are natural extracts of seeds and seaweeds or are synthetic derivatives of cellulose. Examples of these types of materials include, but are not limited to, guar gum; locust bean gum; cairageenam; alginates; methyl cellulose; sodium carboxymethyl cellulose (SCMC); hydroxyethyl cellulose (HEC). Other types of anti-settling agents are based on modified starches, polyacrylates, polyvinyl alcohol and polyethylene oxide. Another good anti-settling agent is xanthan gum.

Microorganisms can cause spoilage of formulated products. Therefore preservation agents are used to eliminate or reduce their effect. Examples of such agents include, but are not limited to: propionic acid and its sodium salt; sorbic acid and its sodium or potassium salts; benzoic acid and its sodium salt; p-hydroxybenzoic acid sodium salt; methyl />-hydroxybenzoate; and 1,2-benzisothiazolin-3-one (BIT).

The presence of surfactants often causes water-based formulations to foam during mixing operations in production and in application through a spray tank. In order to reduce the tendency to foam, anti-foam agents are often added either during the production stage or before filling into bottles. Generally, there are two types of anti-foam agents, namely silicones and non-silicones. Silicones are usually aqueous emulsions of dimethyl polysiloxane, while the non-silicone anti-foam agents are water-insoluble oils, such as octanol and nonanol, or silica. In both cases, the function of the anti-foam agent is to displace the surfactant from the air-water interface.

"Green" agents *(e.g.,* adjuvants, surfactants, solvents) can reduce the overall environmental footprint of crop protection formulations. Green agents are biodegradable and generally derived from natural and/or sustainable sources, *e.g.* plant and animal sources. Specific examples are: vegetable oils, seed oils, and esters thereof, also alkoxylated alkyl polyglucosides.

For further information, see "Chemistry and Technology of Agrochemical Formulations" edited by D.A. Knowles, copyright 1998 by Kluwer Academic Publishers. Also see "Insecticides in Agriculture and Environment - Retrospects and Prospects" by A.S. Perry, I. Yamamoto, I. Ishaaya, and R. Perry, copyright 1998 by Springer-Verlag.

PEST1CIDAL ACTIVITIES

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

In one particular embodiment, a method of controlling pests comprises applying a pesticidal composition comprising a compound of formula **I** or any agriculturally acceptable salt thereof near a population of pests.

The compounds of formula **I** are generally used in amounts from about 0.01 grams per hectare to about 5000 grams per hectare to provide control. Amounts from about 0.1 grams per hectare to about 500 grams per hectare are generally preferred, and amounts from about 1 gram per hectare to about 50 grams per hectare are generally more preferred.

The area to which the compound of formula **I** is applied can be any area inhabited (or maybe inhabited, or traversed by) a pest, for example: where crops, trees, fruits, cereals, fodder species, vines, turf and ornamental plants, are growing; where domesticated animals are residing; the interior or exterior surfaces of buildings (such as places where grains are stored), the materials of construction used in building (such as impregnated wood), and the soil around buildings. Particular crop areas to use a molecule of Formula One include areas where apples, corn, sunflowers, cotton, soybeans, canola, wheat, rice, sorghum, barley, oats, potatoes, oranges, alfalfa, lettuce, strawberries, tomatoes, peppers, crucifers, pears, tobacco, almonds, sugar beets, beans and other valuable crops are growing or the seeds thereof are going to be planted. It is also advantageous to use ammonium sulfate with the compound of formula I when growing various plants.

Controlling pests generally means that pest populations, pest activity, or both, are reduced in an area. This can come about when: pest populations are repulsed from an area; when pests are incapacitated in or around an area; or pests are exterminated, in whole, or in part, in or around an area. Of course, a combination of these results can occur. Generally, pest populations, activity, or both are desirably reduced more than fifty percent, preferably more than 90 percent. Generally, the area is not in or on a human; consequently, the locus is generally a non-human area.

The compound of formula **1** may be used in mixtures, applied simultaneously or sequentially, alone or with other compounds to enhance plant vigor *(e.g.* to grow a better root system, to better withstand stressful growing conditions). Such other compounds are, for example, compounds that modulate plant ethylene receptors, most notably 1-methylcyclopropene (also known as 1-MCP). Furthermore, such molecules may be used during times when pest activity is low, such as before the plants that are growing begin to produce valuable agricultural commodities. Such times include the early planting season when pest pressure is usually low.

The compound of formula I can be applied to the foliar and fruiting portions of plants to control pests. The molecules will either come in direct contact with the pest, or the pest will consume the pesticide when eating leaf, fruit mass, or extracting sap, that contains the pesticide. The compound of formula I can also be applied to the soil, and when applied in this manner, root and stem feeding pests can be controlled. The roots can absorb a molecule taking it up into the foliar portions of the plant to control above ground chewing and sap feeding pests.

Generally, with baits, the baits are placed in the ground where, for example, termites can come into contact with, and/or be attracted to, the bait. Baits can also be applied to a surface of a building, (horizontal, vertical, or slant surface) where, for example, ants, termites, cockroaches, and flies, can come into contact with, and/or be attracted to, the bait. Baits can comprise a compound of formula I.

The compound of formula I can be encapsulated inside, or placed on the surface of a capsule. The size of the capsules can range from nanometer size (about 100-900 nanometers in diameter) to micrometer size (about 10-900 microns in diameter).

Because of the unique ability of the eggs of some pests to resist certain pesticides, repeated applications of the compound of formula I may be desirable to control newly emerged larvae.

Systemic movement of pesticides in plants may be utilized to control pests on one portion of the plant by applying (for example, by spraying an area) the compound of formula **1** to a different portion of the plant. For example, control of foliar-feeding insects can be achieved by drip irrigation or furrow application, by treating the soil with, for example, pre- or post-planting soil drench, or by treating the seeds of a plant before planting.

Seed treatment can be applied to all types of seeds, including those from which plants genetically modified to express specialized traits will germinate. Representative examples include those expressing proteins toxic to invertebrate pests, such as *Bacillus thuringiensis* or other insecticidal toxins, those expressing herbicide resistance, such as "Roundup Ready" seed, or those with "stacked" foreign genes expressing insecticidal toxins, herbicide resistance, nutrition-enhancement, drought resistance, or any other beneficial traits. Furthermore, such seed treatments with the compound of formula **I** may further enhance the ability of a plant to better withstand stressful growing conditions. This results in a healthier, more vigorous plant, which can lead to higher yields at harvest time. Generally, about 1 gram of the compound of formula **I** to about 500 grams per 100,000 seeds is expected to provide good benefits, amounts from about 10 grams to about 100 grams per 100,000 seeds is expected to provide better benefits, and amounts from about 25 grams to about 75 grams per 100,000 seeds is expected to provide even better benefits.

It should be readily apparent that the compound of formula **I** may be used on, in, or around plants genetically modified to express specialized traits, such as *Bacillus thuringiensis* or other insecticidal toxins, or those expressing herbicide resistance, or those with "stacked" foreign genes expressing insecticidal toxins, herbicide resistance, nutrition-enhancement, or any other beneficial traits.

The compound of formula **I** may be used for controlling endoparasites and ectoparasites in the veterinary medicine sector or in the field of non-human animal keeping. The compound of formula **I** are applied, such as by oral administration in the form of, for example, tablets, capsules, drinks, granules, by dermal application in the form of, for example, dipping, spraying, pouring on, spotting on, and dusting, and by parenteral administration in the form of, for example, an injection.

The compound of formula **I** may also be employed advantageously in livestock keeping, for example, cattle, sheep, pigs, chickens, and geese. They may also be employed advantageously in pets such as, horses, dogs, and cats. Particular pests to control would be fleas and ticks that are bothersome to such animals. Suitable formulations are administered orally to the animals with the drinking water or feed. The dosages and formulations that are suitable depend on the species.

The compound of formula **I** may also be used for controlling parasitic worms, especially of the intestine, in the animals listed above.

The compound of formula **I** may also be employed in therapeutic methods for human health care. Such methods include, but are limited to, oral administration in the form of, for example, tablets, capsules, drinks, granules, and by dermal application.

Pests around the world have been migrating to new environments (for such pest) and thereafter becoming a new invasive species in such new environment. The compound of formula I may also be used on such new invasive species to control them in such new environment.

The compound of formula I may also be used in an area where plants, such as crops, are growing *(e.g.* pre-planting, planting, pre-harvesting) and where there are low levels (even no actual presence) of pests that can commercially damage such plants. The use of such molecules in such area is to benefit the plants being grown in the area. Such benefits, may include, but are not limited to, improving the health of a plant, improving the yield of a plant *(e.g.* increased biomass and/or increased content of valuable ingredients), improving the vigor of a plant *(e.g.* improved plant growth and/or greener leaves), improving the quality of a plant *(e.g.* improved content or composition of certain ingredients), and improving the tolerance to abiotic and/or biotic stress of the plant.

Before a pesticide can be used or sold commercially, such pesticide undergoes lengthy evaluation processes by various governmental authorities (local, regional, state, national, and international). Voluminous data requirements are specified by regulatory authorities and must be addressed through data generation and submission by the product registrant or by a third party on the product registrant's behalf, often using a computer with a connection to the World Wide Web. These governmental authorities then review such data and if a determination of safety is concluded, provide the potential user or seller with product registration approval. Thereafter, in that locality where the product registration is granted and supported, such user or seller may use or sell such pesticide.

The compound of formula **1** can be tested to determine its efficacy against pests. Furthermore, mode of action studies can be conducted to determine if said molecule has a different mode of action than other pesticides. Thereafter, such acquired data can be disseminated, such as by the internet, to third parties.

The disclosed pesticidal composition comprising a compound of formula I may be used to control a wide variety of pests.

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 Lyriomiza sativae, *Caliothrips phaseoli, Paratrioza cockerel, Spodoptera exigua, Myzus persicae, Nilaparvata lugens,* and *Bemisia tabaci.*

In additional 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 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 further embodiments, the method of the present disclosure may be used to control members of the Order *Coleoptera* (beetles) including, but not limited to, *Acanlhoscelides spp.* (weevils), *Acanthoscelides obtectus* (common bean weevil), Agrilus *planipennis* (emerald ash borer), *Agriotes spp.* (wirewonns), *Anoplophora glabripennis* (Asian longhorned beetle), *Anthonomm spp.* (weevils), *Anthonomm grandis* (boll weevil), *Aphidius spp., Apion spp.* (weevils), *Apogonia spp.* (grubs), *Ataenius spretuhis* (Black Turfgrass Ataenius), *Atomaria linearis* (pygmy mangold beetle), *Aulacophore spp., Bothynoderes puncliventris* (beet root weevil), *Bruchus spp.* (weevils), *Brvchus pisorum* (pea weevil), *Cacoesia spp., Callosobruchus maculatus* (southern cow pea weevil), *Carpophilus hemipteras* (dried fruit beetle), *Cassida vittata, Cerosterna spp., Cerotoma spp.* (chrysomelids), *Cerotoma trifiircata* (bean leaf beetle), *Ceutorhynchus spp.* (weevils), *Ceutorhynchus assimilis* (cabbage seedpod weevil), *Ceutorhynchus napi* (cabbage curculio), *Chaetocnema spp.* (chrysomelids), *Colaspis spp.* (soil beetles), *Conoderus scalaris, Conoderus stigmosus, Conotrachelus nenuphar* (plum curculio), *Cotinus nitidis* (Green June beetle), *Crioceris asparagi* (asparagus beetle), *Cryptolestes ferrugineus* (rusty grain beetle), *Ctyptolestes pusillus* (flat grain beetle), *Cryptolestes turcicus* (Turkish grain beetle), *Ctenicera spp.* (wireworms), *Curculio spp.* (weevils), *Cyclocephala spp.* (grubs), *Cylindrocpturus adspersus* (sunflower stem weevil), *Deporaus marginatus* (mango leaf-cutting weevil), *Dermestes lardarius* (larder beetle), *Dermestes maculates* (hide beetle), *Diabrotica spp.* (chrysomelids), *Epilachna varivestis* (Mexican bean beetle), *Faustinus cubae, Hylobius pales* (pales weevil), *Hypera spp.* (weevils), *Hypera postica* (alfalfa weevil), *Hyperdoes spp.* (Hyperodes weevil), *Hypothenemus hampei* (coffee berry beetle), *Ips spp.* (engravers), *Lasioderma serricorne* (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), *Oiyzaephilus 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* (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), *Slegobium paniceum* (drugstore beetle), *Tribolium spp.* (flour beetles), *Tribolium castaneum* (red flour beetle), *Tribolium confusum* (confused flour beetle), *Trogoderma variabile* (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 control members of the Order *Dictyoptera* (cockroaches) including, but is not limited to, *Blattella germanica* (German cockroach), *Blatta orientalis* (oriental cockroach), *Parcoblatta pennylvanica, Periplaneta americana* (American cockroach), *Periplaneta aiistraloasiae* (Australian cockroach), *Periplaneta brunnea* (brown cockroach), *Periplaneta fuliginosa* (smokybrown cockroach), *Pyncoselus suninamensis* (Surinam 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 leafininer), *Agromyza spp.* (leaf miner flies), *Anastrepha spp.* (fruit flies), *Anaslrepha* *suspense!* (Caribbean fruit fly), *Anopheles spp.* (mosquitoes), *Batrocera spp.* (fruit flies), *Bactrocera cucurbitae* (melon fly), *Bactrocera dorsalis* (oriental fruit fly), *Ceratitis spp.* (fruit flies), *Ceratitis capitata* (Mediterranean fruit fly), *Chrysops spp.* (deer flies), *Cochliomyia spp.* (screwworms), *Contarinia spp.* (Gall midges), *Culex spp.* (mosquitoes), *Dasineura spp.* (gall midges), *Dasineiira 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* (hom fly), *Hylemyia spp.* (root maggots), *Hypoderma lineatum* (common cattle grub), *Liriomyza spp.* (leafminer flies), *Liriomyza brassica* (serpentine leafminer), *Melophagus oviniis* (sheep ked), *Musca spp.* (muscid flies), *Musca aiitumnalis* (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* (true bugs) including, but is not limited to, *Acrosternum hilare* (green stink bug), *Blissus leucopterus* (chinch bug), *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), *Maconellicoccus hirsutus, Neurocolpus longirostris, Nezara viridula* (southern green stink bug), *Phytocoris spp.* (plant bugs), *Phytocoris californicus, Phytocoris relativus, Piezodorus guildingi, 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 *Homoptera* (aphids, scales, whiteflies, leaflhoppers) including, but is not limited to, *Aaythosiphon pisum* (pea aphid), *Adelges spp.* (adelgids), *Aleurodes proletella* (cabbage whitefly), *Aleurodicus disperses, Aleurothrixus floccosus* (woolly whitefly), *Aluacaspis spp., Amrasca bigutella bigutella, Aphrophora spp.* (leafhoppers), *Aonidiella awantii* (California red scale), *Aphis spp.* (aphids), *Aphis gossypii* (cotton aphid), *Aphis pomi* (apple aphid), *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* ¾c.(scales), *Chrysomphalus spp.* (scales), *Coccus spp.* (scales), *Dysaphis plantaginea* (rosy apple aphid), *Empoasca spp.* (leafhoppers), *Eriosoma lanigerum* (woolly apple aphid), *lcerya purchasi* (cottony cushion scale), *Idioscopus nitidulus* (mango leafhopper), *Laodelphax striatellus* (smaller brown planthopper), *Lepidosaphes spp., Macrosiphum spp., Macrosiphum euphorbiae* (potato aphid), *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), *Parlaloria 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), *Pseudococcus spp.* (mealybugs), *Pseudococcus brevipes* (pine apple mealybug), *Ouadraspidiotus perniciosus* (San Jose scale), *Rhapalosiphum spp.* (aphids), *Rhapalosiphum maida* (corn leaf aphid), *Rhapalosiphum 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.* (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 bees) including, but not limited to, *Acromyrrmex spp., Athalia rosae, Atta spp.* (leafcutting ants), *Camponotus spp.* (carpenter ants), *Diprion spp.* (sawflies), *Formica spp.* (ants), *Iridomyrmex humilis* (Argentine ant), *Monomorium ssp., Monomorium minumum* (little black ant), *Monomorium pharaonis* (Pharaoh ant), *Neodiprion spp.* (sawflies), *Pogonomyrmex spp.* (harvester ants), *Polistes spp.* (paper wasps), *Solenopsis spp.* (fire ants), *Tapoinoma sessile* (odorous house ant), *Tetranomorium spp.* (pavement ants), *Vespula spp.* (yellowjackets), 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 formosanus* (Formosan subterranean termite), *Comitermes spp.* (nasute termites), *Cryptotermes spp.* (drywood termites), *Heterotermes spp.* (desert subterranean tennites), *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, Procornitermes spp., Reticulitermes spp.* (subterranean termites), *Reticulitermes banyulensis, Reticulitermes grassei, Reticulitermes flavipes* (eastern subterranean termite), *Reticulitermes hageni, Reticulitermes hesperus* (western subterranean termite), *Reticulitermes sanlonensis, Reticulitermes speraius, Reticulitermes tibialis, Reticulitermes virginicus, Schedorhinotermes spp.,* and *Zootermopsis spp.* (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 janala, Adoxophyes spp., Adoxophyes orana, Agrotis spp.* (cutworms), *Agrotis ipsilon* (black cutworm), *Alabama argillacea* (cotton leafworm), *Amorbia cuneana, Amyelosis transitella* (navel orangeworm), *Anacamptodes* *defectaria, Anarsia lineatella* (peach twig borer), *Anomis sabulifera* (jute looper), *Anticarsia gemmatalis* (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 leafberforator), *Caloptilia spp.* (leaf miners), *Capua reticiilana, Carposina niponensis* (peach fruit moth), *Chilo spp., Chlumetia transversa* (mango shoot borer), *Choristoneura rosaceana* (obliquebanded leafroller), *Chrysodebcis spp., Cnaphalocerus medinalis* (grass leafroller), *Colias spp., Conpomorpha cramerella, Cossus cossus* (carpenter moth), *Crambus spp.* (Sod webworms), *Cydiafunebrana* (plum fruit moth), *Cydia molesta* (oriental fruit moth), *Cydia nignicana* (pea moth), *Cydia pomonella* (codling moth), *Dama diducta, Diaphania spp.* (stem borers), *Diatraea spp.* (stalk borers), *Diatraea saccharalis* (sugarcane borer), *Diatraea graniosella* (southwester 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* (tobbaco moth), *Ephestia kuehnietta* (Mediterranean flour moth), *Epimeces spp., Epinotia aporema, Erionota thrax* (banana skipper), *Eupoecilia ambiguella* (grape berry moth), *Euxoa aiailiaris* (army cutworm), *Feltia spp.* (cutworms), *Gortyna spp.* (stemborers), *Grapholita molesta* (oriental fruit moth), *Hedylepta indicata* (bean leaf webber), *Helicoverpa spp.* (noctuid moths), *Helicoverpa armigera* (cotton bollworm), *Helicoverpa zea* (bollworm/com 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, Lithocollectis spp., Lobesia botrana* (grape fruit moth), *Loxagrotis spp.* (noctuid moths), *Loxagrotis albicosta* (western bean cutworm), *Lymantria dispar* (gypsy moth), *Lyonetia elerkella* (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), *Operophthera brumata* (winter moth), *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), *Phyllocnisitis citrella, Phyllonorycter spp.* (leafminers), *Pieris rapae* (imported cabbageworm), *Plathypena scabra, Plodia interpimctella* (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.* (stemborers), *Sesamia inferens* (pink rice stem borer), *Sesamia 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 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* (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 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, *Haematopinus spp.* (cattle and hog lice), *Linognathas 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).

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, *Frankliniella fusca* (tobacco thrips), *Frankliniella occidentalis* (western flower thrips), *Frankliniella shultzei, Frankliniella williamsi* (corn thrips), *Heliothrips haemorrhaidalis* (greenhouse thrips), *Riphiphorothrips cruentatus, Scirtothrips spp., Scirtothrips citri* (citrus thrips), *Scirtothrips dorsalis* (yellow tea thrips), *Taeniothrips rhopalantennalis,* and *Thrips spp.*

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.* (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* (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), *Eotetranycus spp., Eotetranychus carpini* (yellow spider mite), *Epitimerus spp., Eriophyes spp., Ixodes spp.* (ticks)^ *Metatetranycus 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), *Polyphagotarsonemun latus* (broad mite), *Rhipicephalus sanguineus* (brown dog tick), *Rhizoglyphus spp.* (bulb mites), *Sarcoptes scabiei* (itch mite), *Tegolophus perseaflorae, 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), *Ditylenchusspp.* (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, Homoptera, Hemiptera, Thysanoptera, Isoptera, Orthoptera, Diptera, Hymenoptera,* and *Siphonaptera,* and at least one mite in the Order *Acari.*

INSECTICIDAL TESTING

Example A: Bioassay for Green Peach Aphid *(Myzus persicae)* (GPA) (MYZUPE)

The green peach aphid ***(Myzus persicae)*** is the most significant aphid pest of peach trees, causing decreased growth, shriveling of the leaves, and the death of various tissues. It is also hazardous because it acts as a vector for the transport of plant viruses, such as potato virus Y and potato leafroll virus to members of the nightshade/potato family Solanaceae, and various mosaic viruses to many other food crops. GPA attacks such plants as broccoli, burdock, cabbage, carrot, cauliflower, daikon, eggplant, green beans, lettuce, macadamia, papaya, peppers, sweet potatoes, tomatoes, watercress, and zucchini, among other plants. GPA also attacks many ornamental crops such as carnation, chrysanthemum, flowering white cabbage, poinsettia, and roses. GPA has developed resistance to many pesticides.

Cabbage seedlings grown in 7.6 cm pots, with 2-3 small (3-5 cm) true leaves, were used as test substrate. The seedlings were infested with 20-50 GPA (wingless adult and nymph stages) one day prior to chemical application. Four pots with individual seedlings were used for each treatment. Test compounds (2 mg) were dissolved in 2 mL of acetone/methanol (1:1) solvent, forming stock solutions of 1000 ppm test compound. The stock solutions were diluted 5X with 0.025% Tween 20 in H_20 to obtain the solution at 200 ppm test compound. A hand-held aspirator-type sprayer was used for spraying a solution to both sides of cabbage leaves until runoff. Reference plants (solvent check) were sprayed with the diluent only containing 20% by volume of acetone/methanol (1:1) solvent. Treated plants were held in a holding room for three days at approximately 25°C and ambient relative humidity (RH) prior to grading. Evaluation was conducted by counting the number of live aphids per plant under a microscope. Percent control was measured by using Abbott's correction formula (W.S. Abbott, "A Method of Computing the Effectiveness of an Insecticide" J. Econ. Entomol. 18 (1925), pp.265-267) as follows.

Corrected % Control = 100 * (X - **Y**) / X

where

X = No. of live aphids on solvent check plants and

Y = No. of live aphids on treated plants

The results are indicated in the table entitled **"TABLE 2. Biological Data for Green Peach Aphid (GPA) (MYZUPE) and Sweetpotato Whitefly-crawler (WF) (BEM1TA)"** (See Table Section).

Example B: Insecticidal test for Sweetpotato Whitefly-crawler *(Bemisia tabaci)* (WF) (BEMITA) in foliar spray assay

The sweetpotato whitefly *{Bemisia tabaci)* has been reported as a serious pest of cultivated crops world-wide. It has an extremely wide host range attacking more than 500 species of plants from 63 plant families. Weeds often serve as alternate hosts of crop pests. Direct feeding damage is caused by the piercing and sucking sap from the foliage of plants. This feeding causes weakening and early wilting of the plant and reduces the plant growth rate and yield. Indirect damage results by the accumulation of honeydew produced by the whiteflies. Honeydew serves as a substrate for the growth of black sooty mold on leaves and fruit reducing photosynthesis and lessens the market value of the plant or yield. Damage is also caused when sweetpotato whitefly vectors plant viruses. The sweetpotato whitefly is considered the most common and important whitefly vector of plant viruses worldwide.

Cotton plants (Gossypium hirsutum) grown in 7.6 cm pots, with 1 small (4-5 cm) true leaves, were used as test substrate. The plants were infested with 200-400 whitefly eggs 4-5 days prior to chemical application. Four pots with individual plants were used for each treatment. Test compounds (2 mg) were dissolved in 1 mL of acetone solvent, forming stock solutions of 2000 ppm test compound. The stock solutions were diluted 10X with 0.025% Tween 20 in H20 (diluents) to obtain the solution at 200 ppm test compound. A hand-held aspirator-type sprayer was used for spraying a solution to both sides of cotton leaves until runoff. Reference plants (solvent check) were sprayed with the diluent only containing 10% by volume of acetone solvent. Treated plants were held in a holding room for 9 days at approximately 25°C and ambient relative humidity (RH) prior to grading. Evaluation was conducted by counting the number of live 3-4 nymph stage per plant under a microscope. Percent control was measured by using Abbott's correction formula (W.S. Abbott, "A Method of Computing the Effectiveness of an Insecticide" J. Econ. Entomol. 18 (1925), pp.265-267) as follows.

Corrected % Control = 100 * (X - Y) / X

where

X = No. of live nymphs on solvent check plants and

Y = No. of live nymphs on treated plants.

The results are indicated in the table entitled **"TABLE 2. Biological Data for Green Peach Aphid (GPA) (MYZUPE) and Sweetpotato Whitefly-crawler (WF) (BEMITA)"** (See Table Section). The mortality efficiency of the disclosed pesticidal compounds against GPA and WF insects was rated as shown in **TABLE 1.**

TABLE 1: Mortality Rating for Green Peach Aphid and Whitefly

% Control (or Mortality)	Rating
80–100	A
More than 0 – Less than 80	B
Not Tested	C
No activity noticed in this bioassay	D

TABLE 2: Biological Data for GPA (MYZUPE) and WF-crawler (BEMITA)

No.	Insect Species	
	GPA 200 ppm	WF 200 ppm
F2	A	A
F3	A	A
F4	A	A
F5	A	A
F6	A	A
F7	A	A
F8	A	A
F9	A	A
C3	A	A
P1	A	A
P2	A	A
P3	A	A
P4	A	A
P5	A	A
P6	C	A
P7	A	A
P8	A	A
P10	A	A
P16	A	A
P17	A	A
P19	A	A
P22	A	A
P31	A	A

No.	Insect Species	
	GPA 200 ppm	**WF 200 ppm**
P32	A	A
FA1	A	A
FA2	A	A
FA3	A	A
FA4	A	A
FA5	A	A
FA6	A	A
FA7	A	A
FA8	A	A
FA9	A	A
FA10	A	A
FA11	A	A
FA12	A	A
FA13	A	A
FA14	A	A
CA1	B	B
CA2	B	B
CA3	D	C
CA4	C	C
CA5	B	B
CA6	B	D
CA7	A	A
CA8	B	A
CA9	A	A
CA10	C	C
CA11	C	C
CA12	A	A
CA13	C	C
CA14	B	B
CA15	C	C
CA16	C	C

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 invention.

EXAMPLES

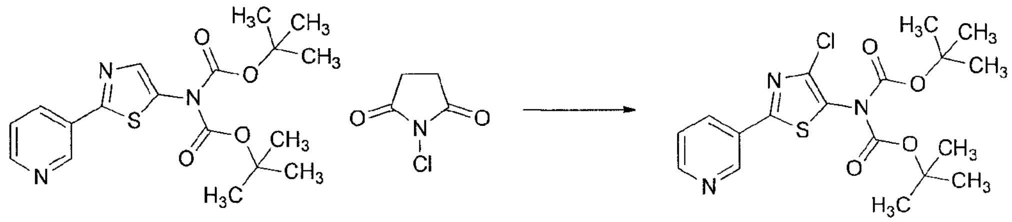
These examples are for illustration purposes and are not to be construed as limiting the disclosure to only the embodiments disclosed in these examples.

Starting materials, reagents, and solvents that were obtained from commercial sources were used without further purification. Anhydrous solvents were purchased as SURE/SEAL™ from Aldrich and were used as received. Melting points were obtained on a Thomas Hoover Unimelt capillary melting point apparatus or an OptiMelt Automated Melting Point System from Stanford Research Systems and are uncorrected. Examples using "room temperature" were conducted in climate controlled laboratories with temperatures of from about 20°C to about 24°C. Molecules are given their known names, named according to naming programs within ISIS Draw, ChemDraw or ACD Name Pro. If such programs are unable to name a molecule, the molecule is named using conventional naming rules. ^{1}H NMR spectral data are in ppm (δ) and were recorded at 300, 400 or 600 MHz. ^{13}C NMR spectral data are in ppm (δ) and were recorded at 75, 100 or 150 MHz. ^{19}F NMR spectral data are in ppm (δ) and were recorded at 376 MHz, unless otherwise stated.

Example 1

Preparation of AyV-di-iert-butoxycarbonyl(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)amine

Compound C1

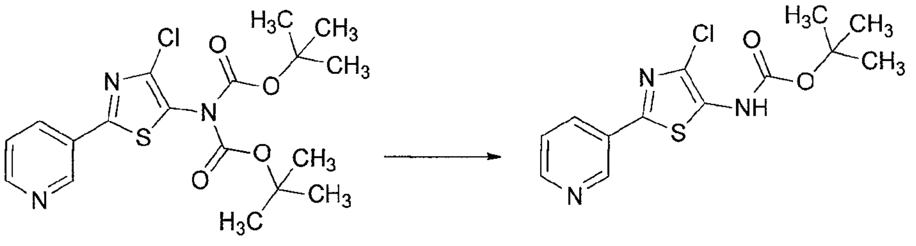


C1

N-chlorosuccinimide (14.4 g, 108 mmol) was added to a solution of AyV-di-ferf-butoxycarbonyl (2-(pyridin-3-yl)thiazol-5-yl)amine (prepared as described in the PCT Application No. WO 2010/129497A1) (19.0 g, 50.3 mmol) in acetonitrile (MeCN, 250 mL) in a round bottom flask equipped with heating mantle, reflux condenser and nitrogen inlet. The mixture was heated to about 65°C for one hour. Then, the mixture was cooled to room temperature (about 22°C) and concentrated under reduced pressure to a volume of about 20 mL. The residue was diluted with ethyl acetate (EtOAc) and diethyl ether, washed with saturated aqueous sodium bicarbonate ($NaHC0_3$), dried over magnesium sulfate ($MgS0_4$), and then concentrated under reduced pressure to give a brown solid. The solid was purified on silica gel eluting with hexanes and EtOAc to give the title compound (**C1**) as a yellow-orange solid (12.5 g, 60%). ^{1}H NMR (400 MHz, Chloroform-;/) δ 9.12 (d, *J* = 2.2 Hz, 1H), 8.70 (dd, *J* = 4.8, 1.7 Hz, 1H), 8.22 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.43 (dd, *J* = 8.0, 4.8 Hz, 1H), 1.49 (s, 18H). ^{13}C NMR (101 MHz, $CDC1_3$) δ 161.56, 151.54, 149.44, 147.04, 137.98, 133.05, 129.69, 128.74, 123.76, 84.51, 27.75. ES1MS *m/z*: 412 ([M-H]$^-$).

Example 2

Preparation of *tert*-butyl (4-chloro-2-(pyridin-3-yl)thiazol-5-yl)carbamate Compound C2

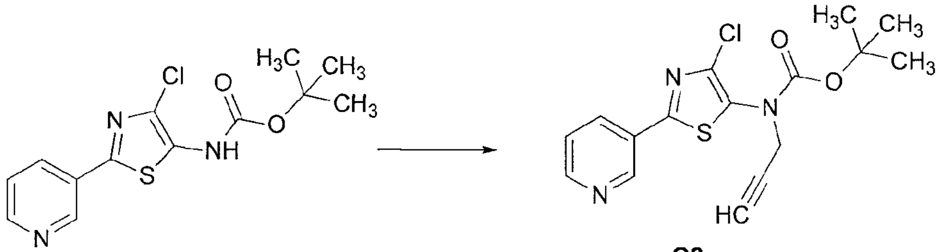


C1 C2

TFA (25 mL) was added to a solution of AyV-di-tert-butoxycarbonyl (4-chloro-2-(pyridin-3-yl)thiazol-5-yl)amine **(CI)** (10 g, 24.28 rnmol) in CH_2Cl_2 (250 mL). After stirring for 15 minutes, the reaction was poured portion wise into 600 mL of water containing 20 g of sodium carbonate (Na_2C0_3) and stirred vigorously for 10 minutes. The mixture was transferred to a separatory funnel and the organic layer was separated, dried with sodium sulfate (Na_2S0_4), and concentrated under reduced pressure to give a red solid. The solid was purified on silica gel eluting with hexanes and EtOAc to give the title compound **(C2)** as a beige solid (3.5 g, 46% yield). ^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.11 (d, *J* = 2.4 Hz, 1H), 8.63 (dd, *J* = 4.8, 1.7 Hz, 1H), 8.15 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.79 (s, 1H), 7.36 (dd, *J* = 8.0, 4.8 Hz, 1H), 1.55 (s, 9H). ^{13}C NMR (101 MHz, CDC13) δ 153.99, 152.01, 150.32, 146.49, 132.53, 129.73, 129.24, 123.71, 123.14, 83.13, 28.16. ESIMS *m/z* 310 ([M-Hp).

Example 3

Preparation of *tert*-butyl (4-chloro-2-(pyridin-3-yl)thiazol-5-yl)(prop-2-yn-l-yl)carbamate Compound C3 (Method A)

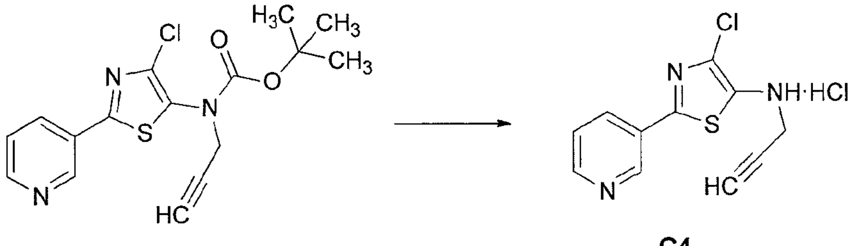


C2 C3

Sodium hydride (60% oil suspension, 0.404 g, 10.1 mmol) was added to an ice cold solution of tert-buty](4-chloro-2-(pyridin-3-yl)thiazol-5-yl)carbamate **(C2)** (3.00 g, 9.62 mmol) in DMF (5 mL). The resulting brown-yellow mixture was stirred at room temperature for 10 minutes, and 3-bromoprop-l -yne was added (1.37 g, 11.6 mmol). The mixture was stirred at about 0°C to 5°C for 30 minutes, and the ice bath removed. After stirring for additional four hours at room temperature, the reaction was quenched with saturated aqueous ammonium chloride (NH_4CI) and diluted with EtOAc. The organic phase was separated, and the aqueous phase was extracted with EtOAc (3 x 50 mL). The combined EtOAc extract was dried over $MgS0_4$, filtered, and concentrated under reduced pressure to give the title compound **(C3)** as a brown solid (2.78g, 78%) having a melting point of about 74°C to 76°C. ^{1}H NMR (400 MHz, Chloroform-J) δ 9.11 (d, *J* = 2.2 Hz, 1H), 8.69 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.21 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.40 (dd, *J* = 8.1, 4.9 Hz, 1H), 4.43 (d, *J* = 2.5 Hz, 2H), 2.33 (t, *J* = 2.5 Hz, 1H), 1.47 (s, 9H). ES1MS *m/z* 350.50 ([M+H]$^+$).

Example 4

Preparation of 4-chloro-*N*-(prop-2-yn-1-yl)-2-(pyridin-3-yl)thiazol-5-amine, HCl Compound C4



C3

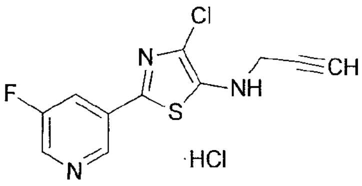
C4

To a solution of tert-butyl(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)(prop-2-yn-l -yl)carbamate **(C3)** (2.00 g, 5.72 mmol) in dry dioxane (2 mL) was added a solution of 4M HCl in dioxane (10.0 mL, 40.0 mmol). A drying tube was attached to the flask, and the mixture stirred at room temperature for 36 hours. The orange-yellow solid was filtered and washed with diethyl ether (10 mL) followed by hexanes (10 mL), and dried under high vacuum to give the title compound **(C4)** as an orange solid (1.55 g, 90%) having a melting point of more than about 250°C. ^{1}H NMR (400 MHz, ^-DMSO) δ 9.11-8.88 (m, 1H), 8.62 (dd, J = 5.2, 1.5 Hz, 1H), 8.37 (ddd, *J* = 8.1, 2.3, 1.4 Hz, 1H), 7.68 (ddd, *J* = 8.1, 5.2, 0.8 Hz, 1H), 4.75 (bs, 3.95 (d, *J* = 2.5 Hz, 2H), 3.27 (t, *J* = 2.4 Hz, 1H) (NH not observed). ESIMS *m/z*: 250.49 ([M-HC1+H]$^+$).

The following molecules were made in accordance with the procedures disclosed in **Example 4**:

4-Chloro-2-(5-fluoropyridin-3-yl)-/V-(prop-2-yn-l-yl)thiazol-5-amine hydrochloride

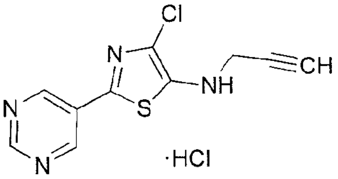
(Compound CAl)



CA1

Compound CAl was isolated as a brown solid (0.992 g, 86%): mp 141-154°C; ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.82 (t, *J* = 1.6 Hz, 1H), 8.57 (d, *J* = 2.4 Hz, 1H), 8.03 (td, *J* = 2.8, 9.8 Hz, 1H), 6.59 (bs, 2H), 3.99 (d, *J* = 2.4 Hz, 2H), 3.31 (t, *J* = 2.4 Hz, 1H); ESIMS *m/z* 268 ([M + H]$^+$).

4-ChIoro-/V-(prop-2-yn-l-yl)-2-(pyriniidin-5-yl)thiazol-5-amine hydrochloride (Compound CA2)

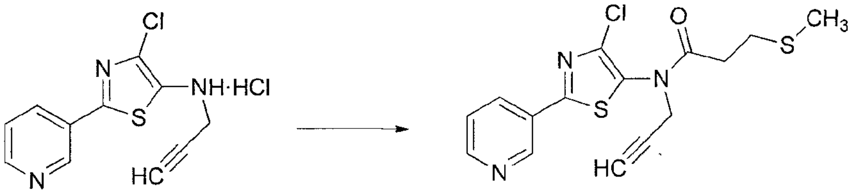


CA2

Compound CA2 was isolated as a brown solid (0.997 g, 81%): mp 214-215°C; 'H NMR (400 MHz, DMSO-d_6) δ 9.16 (s, 1H), 9.13 (s, 2H), 6.45 (bs, 2H), 4.00 (d, *J* = 2.4 Hz, 2H), 3.32 (t, *J* = 2.4 Hz, 1H); ESIMS *m/z* 251 (**[M** + H]$^+$).

Example 5

Preparation of iV-(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)-3-(methylthio)-7V-(prop-2-yn-l-yl) propanamide using Method 1 Compound F7

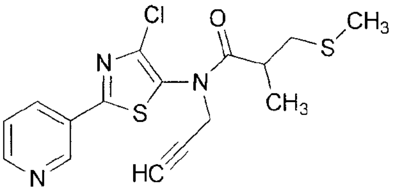


C4 **F7**

To a solution of 4-chloro-A/-(prop-2-yn-l-yl)-2-(pyridin-3-yl)thiazol-5-amine, HC1 (0.120 g, 0.419 mmol) **(C4)** and DMAP (0. 102 g, 0.839 mmol) in THF (3 mL) was added 3-(methylthio)propanoyl chloride (0.0639 g, 0.46 1 mmol). The resulting mixture was stirred at 50°C for 1 hour and diluted with saturated aqueous NH_4C 1 and EtOAc. The organic phase was separated, and the aqueous phase extracted with EtOAc (2 x 50 mL). The combined EtOAc extract was dried over $MgS0_4$, filtered, and concentrated under reduced pressure to give a brown gum. This gum was purified on silica gel eluting with mixtures of CH_2C 1_2 and methanol to give the title compound **(F7)** as a light brown gum (0.077 g, 52%).

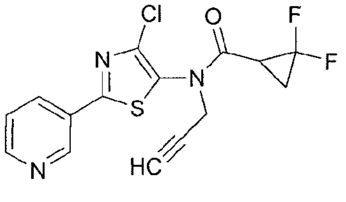
The following molecules were made in accordance with the procedures disclosed in **Example 5 (Method** 1):

iV-(4-chloiO-2-(pyridin-3-yl)thiazol-5-yl)-2-methyl-3-(methylthio)-yV-(prop-2-yn-l-yl) propanamide (Compound F9)



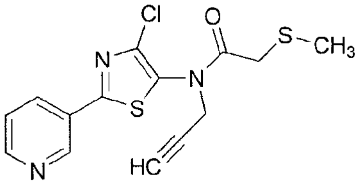
F9

N-(4-chJoro-2-(pyridin-3-yl)thiazol-5-yl)-2,2-dinuoro-iV-(prop-2-yn-l-yl)cyclo-propanecarboxamide (Compound F5)



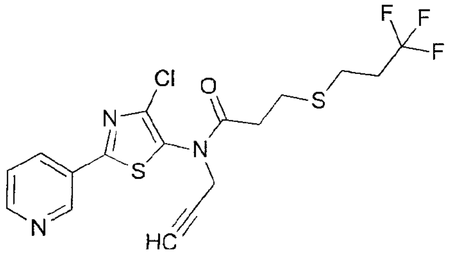
F5

N-(4-ChIoro-2-(pyridin-3-yI)thiazol-5-yl)-2-(niethylthio)-jV-(prop-2-yn-l-yl)acetamide (Compound F4)



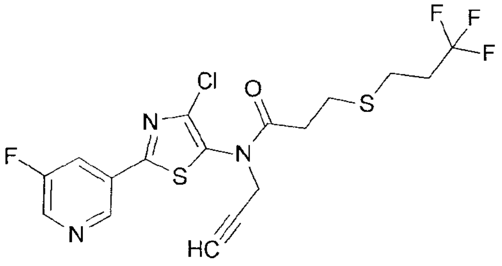
F4

iV-(4-Chloro-2-(pyridin-3-yl)thiazol-5-yl)-A'-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl)thio) propanamide (Compound FA1)



FA1

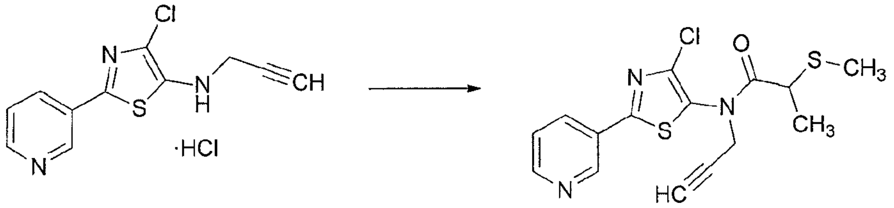
yV-(4-Chloro-2-(5-fluoropyridin-3-yl)thiazol-5-yI)-/V-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl) thio)propanamide (Compound FA2)



FA2

Example 6

Preparation ofiV-(4-chIoro-2-(pyridin-3-yl)thiazol-5-yl)-2-(methylthio)-A'-(prop-2-yn-l-yl) propanamide using Method 2 Compound F6

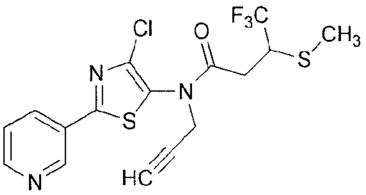


C4 **F6**

To a solution of 4-chloro-/V-(prop-2-yn-l-yl)-2-(pyridin-3-yl)thiazol-5-amine, HC1 **(C4)** (0.100 g, 0.349 mmol), 2-(methylthio)propanoic acid (0.504 g, 0.419 mmol) and DMAP (0.850 mg, 0.699 mmol) in DMF (3 mL) was added W-((emylimino)methylene)-7V3^V3-dimethylpropane-l,3-diamine, HC1 (0.100 g, 0.524 mmol). The resulting mixture was stirred at room temperature for two hours. The mixture was diluted with saturated aqueous NH$_4$C 1 and EtOAc. The organic phase was separated and the aqueous phase extracted with EtOAc (2 x 50 mL). The combined EtOAc extract was dried over MgS0$_4$, filtered, and concentrated under reduced pressure to give the title compound as a light brown gum (0.0970 g, 79%).

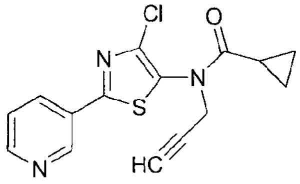
The following molecules were made in accordance with the procedures disclosed in **Example 6 (Method 2):**

/V-(4-Chloro-2-(pyridin-3-yl)thiazol-5-yl)-4,4,4-trifluoro-3-(methylthio)-A'-(prop-2-yn-l-yl) butanamide (Compound F3)



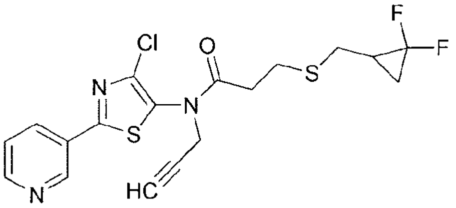
F3

N-(4-Chloro-2-(pyridin-3-yl)thiazoi-5-yl)-A'-(prop-2-yn-l-y))cycIopropane carboxamide (Compound F2)



F2

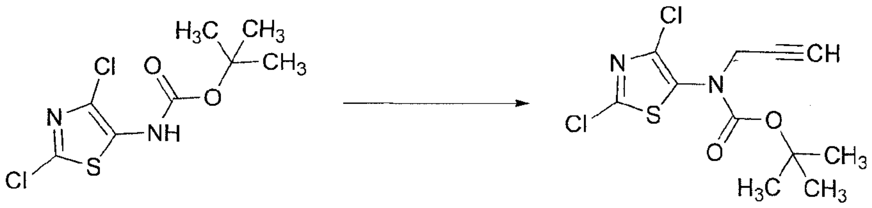
7Y-(4-Chloro-2-(pyridiii-3-yl)thiazol-5-yl)-3-(((2,2-difluorocyclopropyl) methyl) thio)-*N*-(prop-2-yn-l-yl)propanamide (Compound F8)



F8

Example 7

Preparation of tert-butyl (2,4-dichlorothiazol-5-yl)(prop-2-yn-l-yl)carbamate Compound CA3

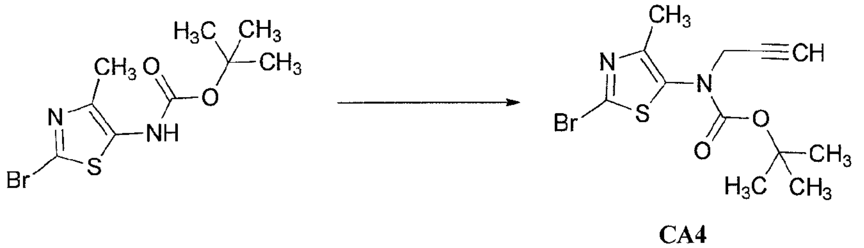


CA3

To a stirred solution of *tert*-butyl (2,4-dichlorothiazol-5-yl)carbamate (prepared as described in the PCT Application No. WO 2010/129497A1) (8.50 g, 31.6 mmol) in dry DMF (100 mL) was added sodium hydride (NaH, 60% in oil, 1.51 g, 34.7 mmol) portion-wise at 0°C and the mixture stirred for 30 minutes. To the mixture was added propargyl bromide (4.47 g, 37.9 mmol), stirred for 5 minutes, warmed to room temperature, and stirred for additional 3 hours. The reaction mixture was quenched with saturated aqueous NH_4Cl and extracted with EtOAc (3 × 100 mL). The combined organic layer was washed with water (3 × 100 mL) and brine (1 × 100 mL), dried over anhydrous Na_2S0_4, filtered and concentrated under reduced pressure to give a brown residue. This residue was purified by flash column chromatography using 10-30% EtOAc/hexanes as eluent to afford the title compound as an off-white solid (5.80 g, 59%): ^1H NMR (400 MHz, CDCL) δ 4.36 (d, *J* = 2.0 Hz, 2H), 2.32 (t, *J* = 2.4 Hz, 1H), 1.46 (s, 9H); IR (KBr) 3304, 2933, 1681, 1539, 1357, 1288, 1219, 1157 cm^{-1}; ESIMS *m/z* 251 ([M + H]$^+$).

The following molecules were made in accordance with the procedures disclosed in **Example** 7:

***tert*-Butyl (2-bromo-4-methylthiazol-5-yl)(prop-2-yn-l-yl)carbamate (Compound CA4)**

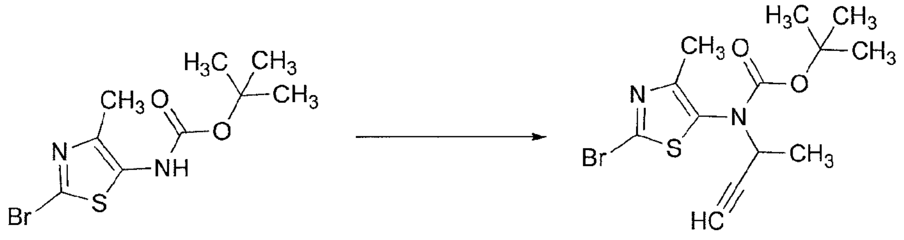


CA4

Coumpound CA4 was synthesized from *tert*-butyl (2-bromo-4-methyMiiazol-5-yi)carbamate (prepared as descrtibed in in the PCT Application No. WO 2010/129497A1) and was isolated as an off-white solid (2.6 g, 82%): mp 82-86°C; ^1H NMR (400 MHz, $CDC1_3$) δ 4.28 (s, 2H), 2.30 (*t*, *J* = 2.4 Hz, 1H), 2.26 (s, 3H), 1.43 (s, 9H); ESIMS *m/z* 333 ([M + H]$^+$).

Example 8

Preparation of *tert*-butyl (2-bromo-4-methylthiazol-5-yl)(but-3-yn-2-yl)carbamate Compound CA5

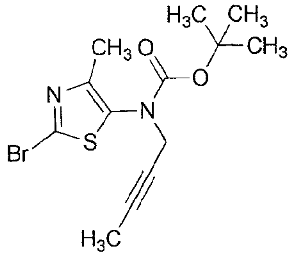


CA5

To a stirred solution of tert-butyl (2-bromo-4-methylthiazol-5-yl)carbamate (0.300 g, 1.02 mmol) in THF (5.0 mL) was added but-3-yn-2-ol (0.120 g, 2.04 mmol), triphenylphosphine (0.530 g, 2.04 mmol), and diisopropylazodiimide (DIAD, 0.410 g, 2.04 mmol) slowly at 0°C under argon atmosphere. The reaction mixture was stirred under argon atmosphere at room temperature for 16 hours. The reaction mixture was quenched with cold water (50 mL), concentrated under reduced pressure and extracted with EtOAc (3 × 50 mL). The combined organic layer was washed with brine (2 × 50 mL). The layer was dried over anhydrous Na_2S0_4, concentrated under reduced pressure, and purified by flash column chromatography to provide the title compound as a dark brown gum (0.200 g, 58%): ^1H NMR (400 MHz, $CDC1_3$) δ 5.27 - 5.25 (m, 1H), 2.31 (d, *J* = 2.0 Hz, 1H), 2.23 (s, 3H), 1.40 (s, 9H), 1.34 (d, *J* = 7.2 Hz, 3H); IR (KBr) 3302, 3265, 2980, 2931, 1712, 1564, 1477, 1454, 1415 cm^{-1}; ESIMS *m/z* 345 ([M + H]$^+$).

The following compound **was** made in accordance with the procedures disclosed in **Example 8**:

/erf-Butyl (2-bromo-4-methylthiazol-5-yl)(but-2-yn-l-yl)carbamate (Compound CA6)

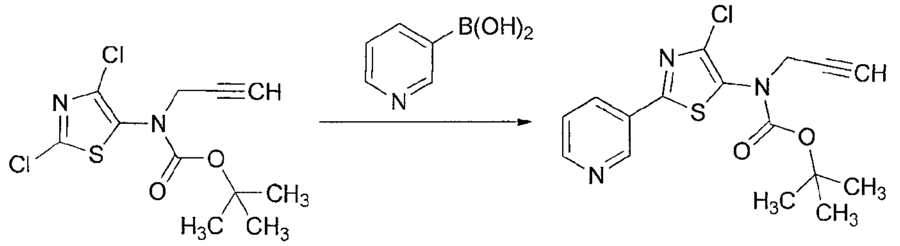


CA6

Compound CA6 was isolated as a brown gum (0.20 g, 58%): ^{1}H NMR (400 MHz, CDC1$_3$) δ 4.22 (s, 2H), 2.24 (s, 3H), 1.80 (s, 3H), 1.42 (s, 9H); IR (KBr) 2978, 2922, 2376, 2345, 2225, 1716, 1568, 154 1, 1473 cm^{-1}; ESIMS *m/z* 345 ([M + H]$^+$).

Example 9

Preparation of *tert*-butyl (4-chloro-2-(pyridin-3-yl)thiazol-5-yl)(prop-2-yn-l-yl)carbamate Compound C3 (Method B)

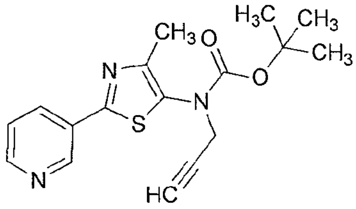


CA3 **C3**

To a stirred solution of *tert*-butyl (2,4-dichlorothiazol-5-yl)(prop-2-yn-l-yl)carbamate (2.00 g, 6.50 mmol) in 1,2-dimethoxyethane/water (4:1 ratio) was added pyridin-3-ylboronic acid (0.958 g, 7.80 mmol) followed by Na$_2$C0$_3$ (2.08g, 19.5 mmol) at room temperature under argon atmosphere. The reaction mixture was purged with argon; tetrakis(triphenylphosphine)palladium(0) (Pd(PPh$_3$)$_4$, 0.36 g, 0.32 mmol) added, and heated at U0°C for 5 hours. The reaction mixture was cooled at room temperature, diluted with water (50 mL) and was extracted with EtOAc (3 × 50 mL). The combined organic layer was washed with brine (2 × 20 mL), dried over anhydrous Na$_2$S0$_4$, and was concentrated under reduced pressure. The crude residue was purified by flash column chromatography using 10-100% EtOA^exanes as eluent to afford the title compound as a white solid (1.0 g, 44% yield): mp 69-72°C; ^{1}H NMR (400 MHz, CDCI$_3$) δ 9.1 1 (d, 7 = 2.0 Hz, 1H), 8.69 (dd, *J* = 1.6, 4.8 Hz, 1H), 8.2 1 (td, *J* = 2.0, 8.0 Hz, 1H), 7.40 (ddd, J = 0.8, 4.8, 8.0 Hz, 1H), 4.43 (*d, J* = 2.0 Hz, 2H), 2.33 (t, *J* = 2.4 Hz, 1H), 1.47 (s, 9H); ESIMS *m/z* 350 ([M + H]$^+$).

The following molecules were made in accordance with the procedures disclosed in **Example 9:**

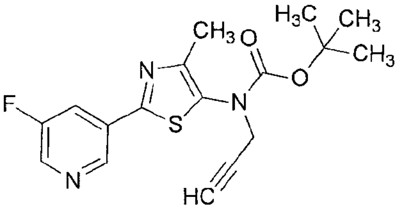
/eri-Butyl (4-methyl-2-(pyridin-3-yl)thiazol-5-yl)(prop-2-yn-l-yJ) carbamate (Compound CA7)



CA7

Compound CA7 was isolated as a brown gum (1.3 g, 50%): ^{1}H NMR (400 MHz, CDC1$_3$) δ 9.10 (s, 1H), 8.64 (t, *J* = 1.2 Hz, 1H), 8.26 - 8.18 (m, 1H), 7.36 (q, *J* = 8.0 Hz, 1H), 4.35 (s, 2H), 2.36 (s, 3H), 2.31 (t, J = 2.4 Hz, 1H), 1.45 (s, 9H); IR (KBr) 1845, 1707, 1589, 1560, 1490, 1475, 1384, 1278 cm^{-1}; ESIMS *m/z* 330 ([M + H]$^+$).

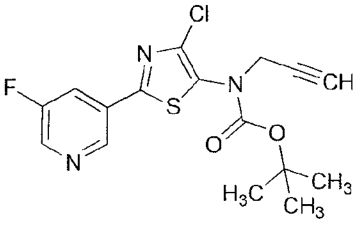
***tert*-Butyl (2-(5-fluoropyridin-3-yl)-4-methylthiazol-5-yl)(prop-2-yn-l-yl) carbamate (Compound CA8)**



CA8

Compound CA8 was isolated as an off-white solid (1.20 g, 67%): ^{1}H NMR (400 MHz, CDC1$_3$) δ 8.89 (s, 1H), 8.49 (d, *J* = 2.4 Hz, 1H), 7.97 – 7.93 (m, 1H), 4.35 (s, 2H), 2.35 (s, 3H), 2.31 (t, *J* = 2.4 Hz, 1H), 1.45 (s, 9H); ESIMS *m/z* 350 ([M + H]$^+$).

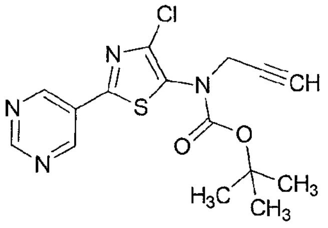
***tert*-Butyl (4-chloro-2-(5-fluoropyridin-3-yl)thiazol-5-yl)(prop-2-yn-l-yl) carbamate (Compound CA9)**



CA9

Compound CA9 was isolated as a white solid (1.0 g, 42%): mp 81-83°C; ^{1}H NMR (400 MHz, CDC1$_3$) δ 8.90 (s, 1H), 8.55 (d, *J* = 2.8 Hz, 1H), 7.97 (td, *J* = 2.4, 8.8 Hz, 1H), 4.43 (d, *J* = 2.4 Hz, 2H), 2.34 (t, *J* = 2.4 Hz, 1H), 1.47 (s, 9H); ESIMS *m/z* 368 ([M + H]$^+$).

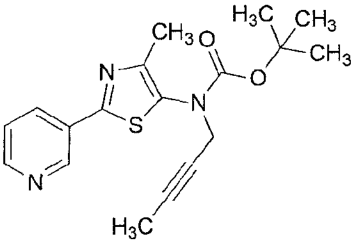
ter/-ButyI (4-chIoro-2-(pyrimidin-5-yI)thiazol-5-yl)(prop-2-yn-l-yl) carbamate (Compound CAIO)



CAIO

Compound CAIO was isolated as a white solid (1.36 g, 60%): mp 80-83°C; ^{1}H NMR (400 MHz, CDCI$_3$) δ 9.28 (s, 1H), 9.22 (s, 2H), 4.44 (d, *J* = 2.4 Hz, 2H), 2.34 (t, *J* = 2.4 Hz, 1H), 1.48 (s, 9H); ESIMS *m/z* 351 ([M + H]$^+$).

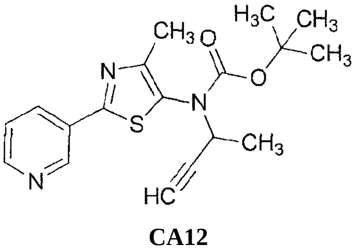
tert-Butyl but-2-yn-l-yl(4-methyl-2-(pyridin-3-yl)thiazol-5-yl)carbamate (Compound CIl)



CAIl

Compound CAIl was isolated as a brown gum (0.45 g, 56%): ^{1}H NMR (400 MHz, CDC1$_3$) δ 9.10 (s, 1H), 8.64 (q, *J* = 4.8 Hz, 1H), 8.20 - 8.17 (m, 1H), 7.36 (q, *J* = 8.0 Hz, 1H), 4.30 - 4.29 (m, 2H), 2.34 (s, 3H), 1.81 (s, 3H), 1.44 (s, 9H); IR (KBr) 2978, 2922, 2858, 2306, 2225, 1720, 1699, 1556, 1487 cm^{-1}; ESIMS *m/z* 344 ([M + H]$^+$).

terr-Butyl but-3-yn-2-yI(4-methyl-2-(pyridin-3-yl)thiazol-5-yl)carbamate (Compound CA12)

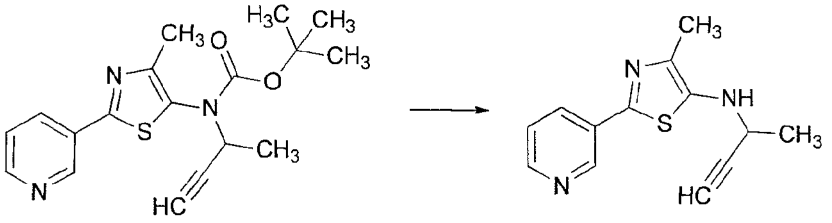


CA12

Compound CA12 was isolated as a brown solid (0.08 g, 38%): mp 110-123°C; ^{1}H NMR (400 MHz, CDCl$_3$) δ 9.12 (s, 1H), 8.64 (q, *J* = 4.8 Hz, 1H), 8.22 - 8.19 (m, 1H), 7.36 (q, *J* = 8.0 Hz, 1H), 5.33 - 5.29 (m, 1H), 2.35 (s, 1H), 2.32 (s, 3H), 1.42 (s, 9H), 1.26 (d, *J* = 6.4 Hz, 3H); ESIMS *m/z* 344 ([M + Hf).

Example 10

Preparation ofiV-(but-3-yn-2-yl)-4-methyl-2-(pyridin-3-yl)thiazol-5-ainine Compound CA13

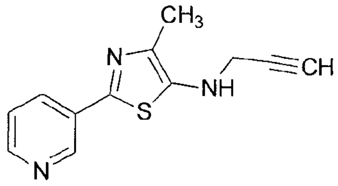


CA12 **CA13**

To a solution of *tert*-butyl but-3-yn-2-yl(4-methyl-2-(pyridin-3-yl)thiazol-5-yl) carbamate (0.780 g, 2.29 mmol) in CH_2Cl_2 (5.0 mL) wasw added TFA (5.0 mL) at room temperature under nitrogen atmosphere. The reaction mixture was stirred at room temperature for 3 hours. The reaction mixture was concentrated under reduced pressure, basified with a $NaHC0_3$ solution (25 mL), and extracted with EtOAc (3 × 25 mL). The combined organic layer was washed with brine (2 × 50 mL), dried over anhydrous Na_2S0_4, and concentrated under reduced pressure. The crude residue was triturated with hexanes (2 x 25 mL) and was dried under vacuum to afford the title compound as a yellow solid (0.55 g, 96%): ESIMS *m/z* 244 ($[M + H]^+$). The crude material was used in subsequent reactions with no further purification.

The following molecules were made in accordance with the procedures disclosed in **Example 10:**

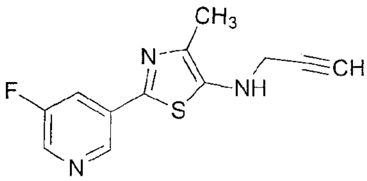
4-Methyl-A'-(prop-2-yn-l-yl)-2-(pyridin-3-yl)thiazol-5-amine (Compound CA14)



CA14

Compound CA14 was isolated as a yellow solid (0.85 g, 82%); ESIMS *m/z* 230 ($[M + H]^+$). The crude material was used in subsequent reactions with no further purification.

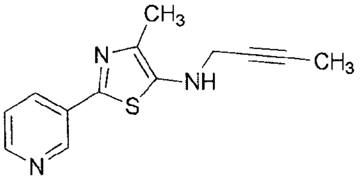
2-(5-Fluoropyridin-3-yl)-4-methyl -VV-(prop-2-yn-l-yl)thiazol-5-amine (Compound CA15)



CA1 5

Compound CA15 was isolated as a yellow solid (0.85g, 99%): ESIMS *m/z* 250 ($[M + H]^+$). The crude material was used in subsequent reactions with no further purification.

^-(But^-yn-l-yl^-methyl^-ipyridin-S-ytythiazol-S-amine (Compound CA16)

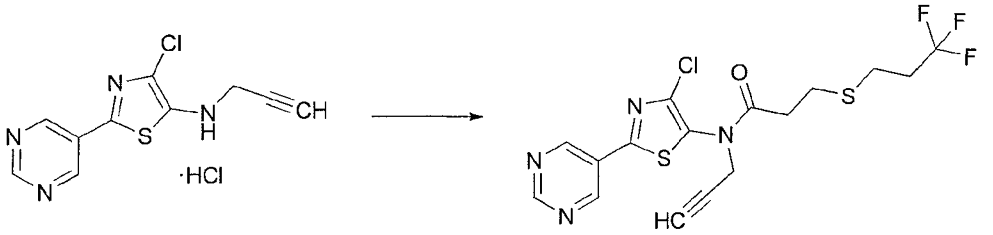


CA16

Compound CA16 was isolated as a brown gum (0.60 g, 93%): ESEVIS *m/z* 244 ([M + H]$^+$). The crude material was used in subsequent reactions with no further purification.

Example 11

Preparation of ;V-(4-chloro-2-(pyrimidin-5-yl)thiazol-5-yl)-/V-(prop-2-yn-l -yl)-3-((3$_T$3,3-trifluoropropyl)thio) propanamide Compound FA3

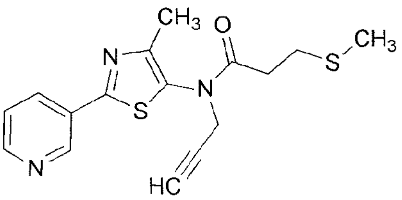


CA13 **FA3**

To a solution of 4-chloro-7V-(prop-2-yn-l-yl)-2-(pyrimidin-5-yl)thiazol-5-amine hydrochloride (0.463 g, 1.85 mmol) and DMAP (0.563 g, 4.62 mmol) in 1,2-dichloroethane (15 mL) was added 3-((3,3,3-trifluoropropyl)thio)propanoyl chloride (0.8 14 g, 3.70 mmol). The resulting mixture was stirred at room temperature fori 6 hours and diluted with EtOAc. The mixture was washed with saturated aqueous $NaHC0_3$ and brine, dried over $MgS0_4$, filtered, and concentrated under reduced pressure to give a brown gum. This gum was purified by flash column chromatography using EtOAc/hexanes as eluent to provide the title compound as a brown solid (0.225 g, 28%).

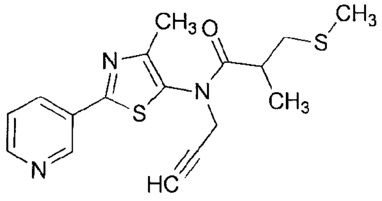
The following molecules were made in accordance with the procedures disclosed in **Example 11:**

A'-(4-Methyl-2-(pyridin-3-yl)thiazol-5-yl)-3-(niethylthio)-A'-(prop-2-yn-l-yl)propanamide (Compound P1)



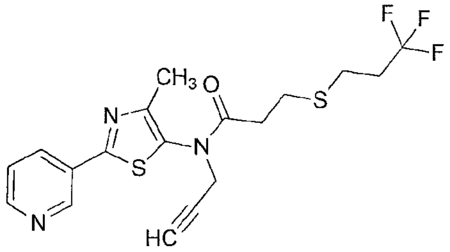
P1

2-Methyl-A^-(4-methyl-2-(pyridin-3-yl)thiazol-5-yI)-3-(methylthio)-A'-(prop-2-j'n-l-yl) propanamide (Compound P2)



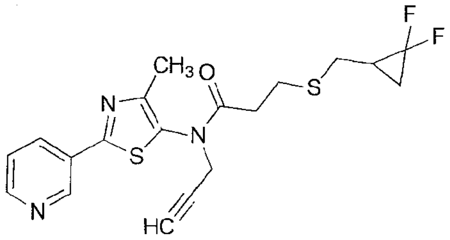
P2

^-(4-Methy)-2Kpyridin-3-yl)thiazol-5-yl)-*N*-(prop-2-yn-l-yl)-3-((3,3,3-trifIuoropropyl)thio) propanamide (Compound P6)



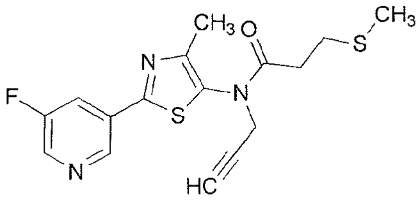
P6

3-(((2,2-Difluorocyclopropyl)methyl)thio)-A^-(4-methyl-2-(pyridin-3-yl)thiazol-5-yi)-A'-(prop-2-yn-l-yl)propanamide (Compound P10)



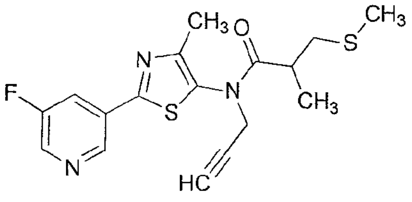
P10

A'-(2-(5-Fluoropyridin-3-yl)-4-methylthiazoI-5-yl)-3-(methyIthio)-A'-(prop-2-yn-l-yI) propanamide (Compound FA4)



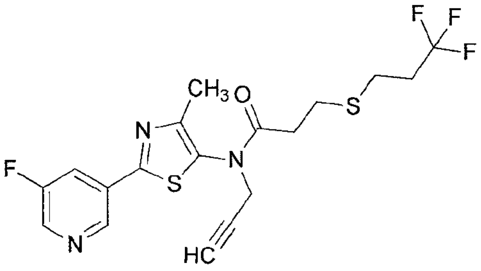
FA4

N-(2-(5-Fluoropyridin-3-yl)-4-methylthiazol-5-yI)-2-methyl-3-(^ ethylthio)-*N*-(prop-2-yn-1-yl) propanamide (Compound FA5)



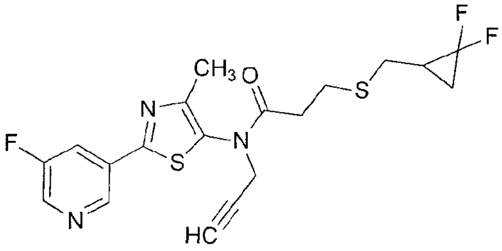
FA5

***N*-(2-(5-Fluoropyridin-3-yl)-4-methylthiazol-5-yl)-7V-(prop-2-yn-l -yl)-3-((3,3,3-trifluoropropyl) thio)propanamide (Compound P19)**



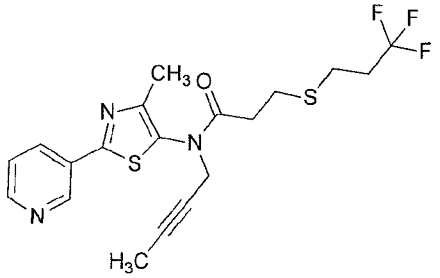
P19

3-(((2,2-Difluorocyclopropyl)methyI)thio)-7V-(2-(5-fluoropyridin-3-yl)-4-methylthiazol-5-yl)-iV-(prop-2-yn-l-yl)propanamide (Compound P22)



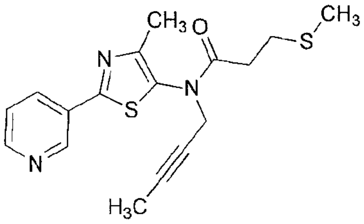
P22

N-(But-2-yn-l-yl)-A'-(4-methyl-2-(pyridin-3-yl)thiazol-5-yl)-3-((3,3,3-trifluoropropyl)thm) propanamide (Compound P16)



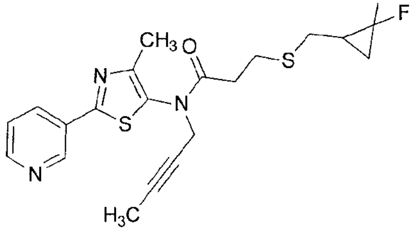
P16

7V-(But-2-yn-l-yl)-A-(4-methyl-2-(pyridin-3-yl)thiazol-5-yl)-3-(methylthio)propanamide (Compound PI7)



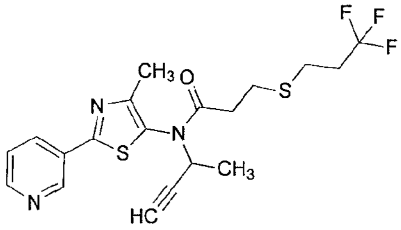
P17

yV-(But-2-yn-l-yl)-3-(((2,2-difluorocyclopropyI)methyl)thio)-7V-(4-niethyl-2-(pyridin-3-yl) thiazol-5-yl)propanamide (Compound FA14)



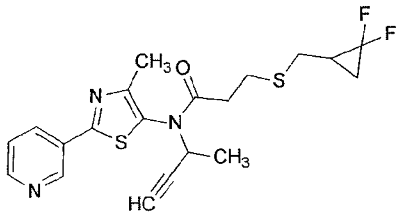
FA14

A'-(But-3-yn-2-yl)-A'-(4-methyl-2-(pyridin-3-yl)thia2ol-5-yl)-3-((3,3^-trifluoropropyl)thio) propanamide (Compound P32)



P32

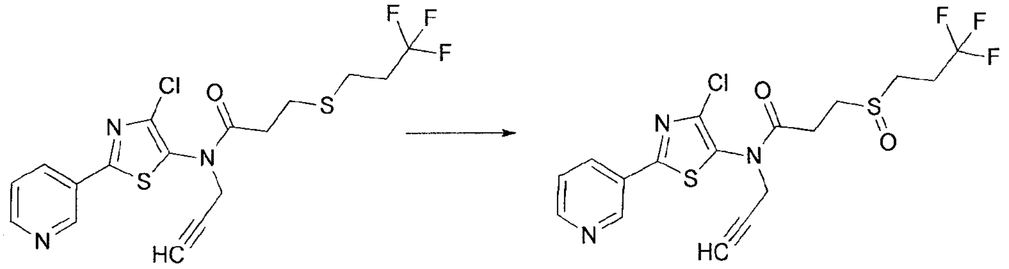
N-(But-3-yn-2-yl)0-(((2,2-difluorocyclopropyl)methyl)thio)-7V-(4-methyl-2-(pyridin-3-yI) thiazol-5-yl)propanamide (Compound P31)



P31

Example 12

Preparation of N-(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)-A'-(prop-2-yn-l-yl)-3-((3,3,3trifluoropropyl)sulfinyl)propananiide Compound FA6

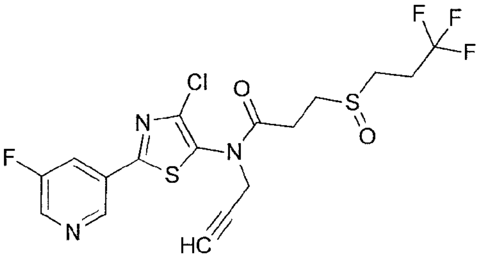


FA1 FA6

To a solution of *N*-(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)-*N*-(prop-2-yn-1-yl)-3-((3,3,3-trifluoropropyl)thio)propanamide (0.20 g, 0.46 mmol) in acetic acid (AcOH. 2.0 mL) was added sodium perborate tetrahydrate (0.060 g, 0.46 mmol) at room temperature and was stirred for 3 hours. The reaction mixture was diluted with EtOAc (100 mL), washed with water (10 mL), saturated aqueous $NaHC0_3$ (2 × 20 mL) and brine (2 × 20 mL). The separated organic layer was dried over anhydrous Na_2S0_4 and concentrated under reduced pressure. The crude residue was purified by flash column chromatography using 1-5% MeOH/CH$_2$Cl$_2$) to provide the title compound as a brown gum (0.074 mg, 36%).

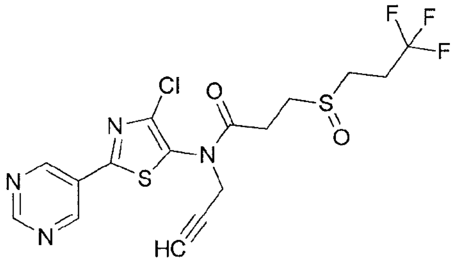
The following molecules were made in accordance with the procedures disclosed in **Example 12:**

,Y-(4-Chloro-2-(5-fluoropyridin-3-yl)thiazol-5-yl)-*N*-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl) sulfinyl)propanamide (Compound FA7)



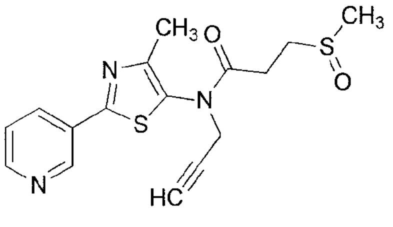
FA7

N-(4-Chloro-2-(pyrimidin-5-yl)thiazol-5-yl)-A'-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl) sulfinyl) propanamide (Compound FA8)



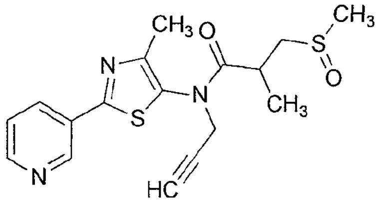
FA8

7V-(4-Methyl-2-(pyridin-3-yl)thiazol-5-yl)-3-(methylsulfinyl)-7V-(prop-2-yn-l-yl)propanamide (Compound P3)



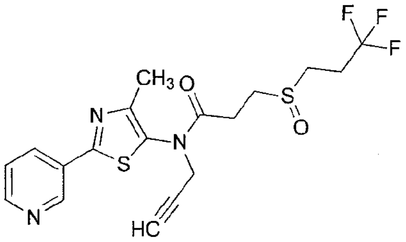
P3

2-MethyI-A£-(4-methyl-2-(pyridin-3-yl)thiazol-5-yl)-3-(methylsuIfinyl)-A'-(prop-2-yn-l -yl) propanamide (Compound P5)



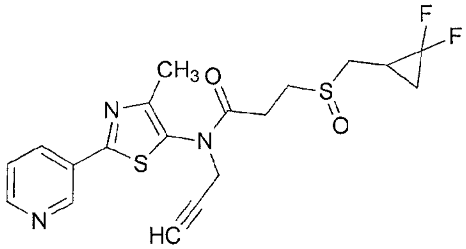
P5

W-(4-Methyl-2-(pyridin-3-yI)thiazo]-5-yl)-A'-(prop-2-yii-l-yI)-3-((3,3,34rifluoropropyl) sulfinyl) propanamide (Compound P7)



P7

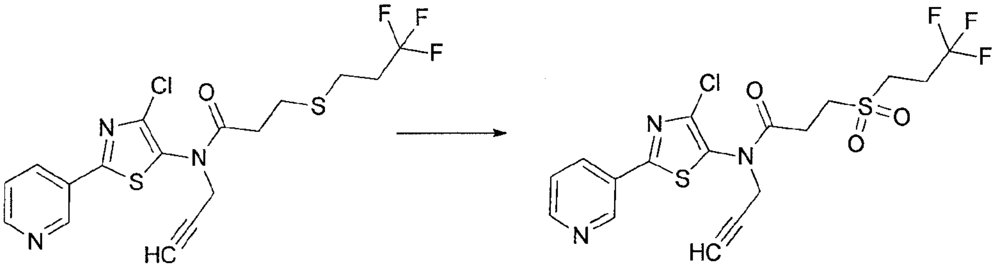
3-(((2,2-Difluorocyc)opropyI)methyl)sulfinyl)-A'-(4-methyI-2-(pyridin-3-yl)thiazoI-5-yl)-A'-(prop-2-yn-l-yl)propanamide (Compound FA9)



FA9

Example 13

Preparation of .'V-(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)-*A'*-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl)sulfonyl)propanamide Compound FA10

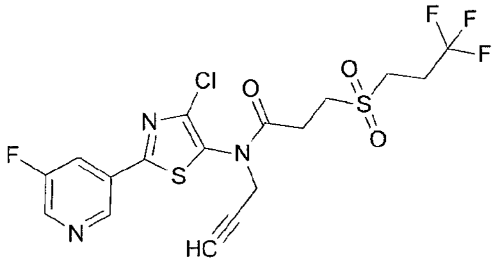


FA1 **FA10**

To a stirred solution of iV-(4-chloro-2-(pyridin-3-yl)thiazol-5-yl)-jV-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl)thio)propanamide (0.1 87 g, 0.430 mmol) in AcOH (2.0 mL) was added sodium perborate tetrahydrate (0. 139 g, 1.07 mmol) at room temperature and was stirred at 60°C for 3 hours. The reaction mixture was diluted with EtOAc (100 mL), washed with water (1 × 10 mL), saturated aqueous $NaHC0_3$ (2 × 20 mL) and brine (1 * 20 mL). The separated organic layer was dried over anhydrous Na_2S0_4 and concentrated under reduced pressure. The crude residue was purified by flash column chromatography using 10-50% EtOAc/hexanes as eluent to povide the title compound as a light brown solid (0.0520 g, 23%).

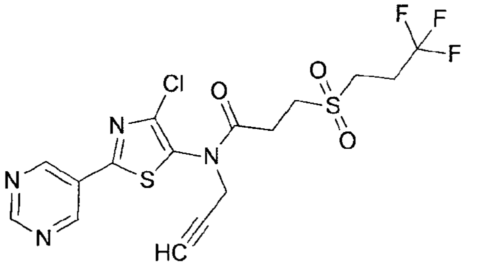
The following molecules were made in accordance with the procedures disclosed in **Example 13:**

/V-(4-Chloro-2-(5-fluoropyridin-3-yl)thiazol-5-yl)-/V-(prop-2-yn-l -yl)-3-((3,3,3-trifluoropropyl) sulfonyl)propanamide (Compound FA11)



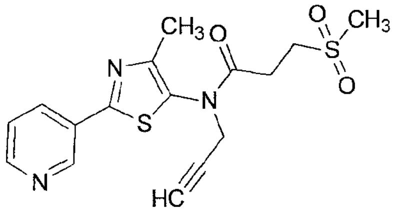
FA11

Ʌ'-(4-Chloro-2-(pyrimidin-5-yl)thiazol-5-yl)-/V-(prop-2-yn-l -yl)-3-((3,3,3-trifluoropropyl) sulfonyl)propanamide (Compound FA12)



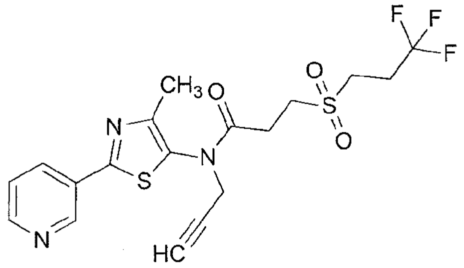
FA12

7V-(4-Methyl-2-(pyridin-3-yl)thiazo^5-yJ)-3-(methylsulfonyl)-Λ'-(prop-2-yn-l -yl) propanamide (Compound P4)



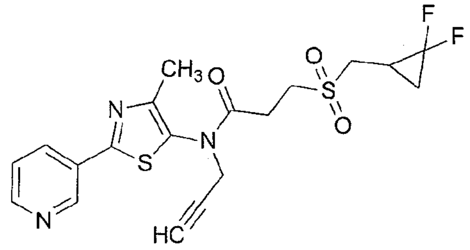
P4

A'-(4-Methyl-2-(pyridin-3-yl)thiazol-5-yl)-A/-(prop-2-yn-l-yl)-3-((3,3,3-trifluoropropyl) sulfonyl) propanamide (Compound P8)



P8

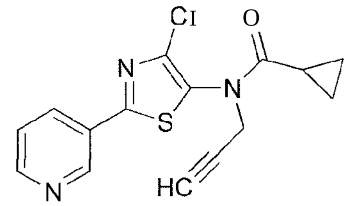
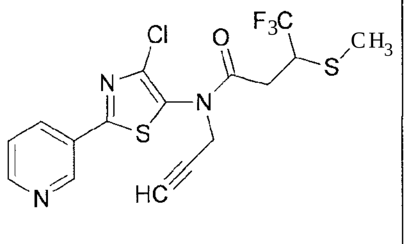
3-(((2,2-Difluorocyclopropyl)metliyl)sulfony])-A'-(4-methyl-2-(pyridin-3-yl)thiazol-5-y])-JV-(prop-2-yn-l-yl)propanamide (Compound FA13)

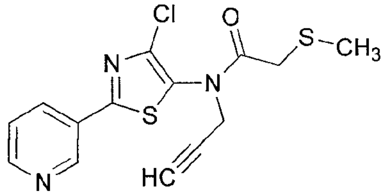
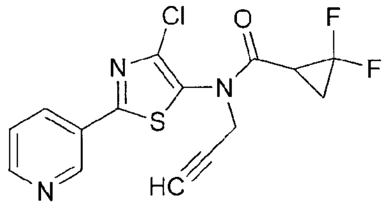
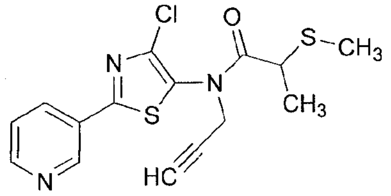
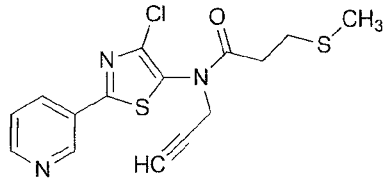


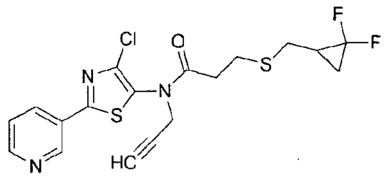
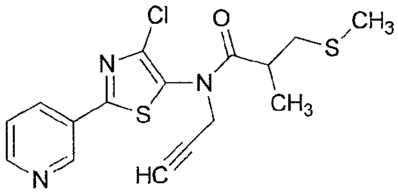
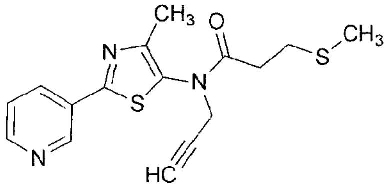
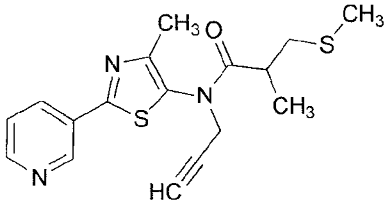
FAl 3

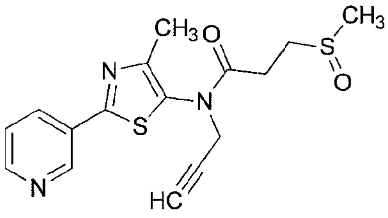
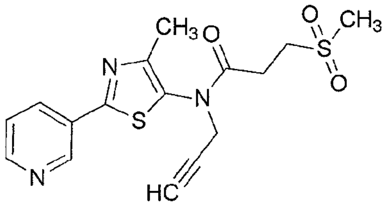
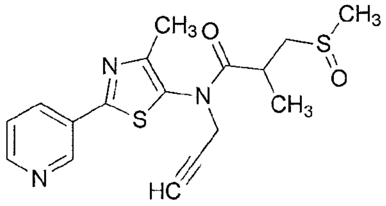
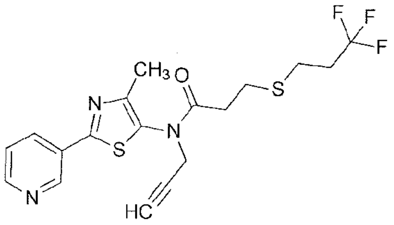
TABLE 3 shows non-limiting examples of the compound of formula **I.** Compounds F2, F3, F6, and F8 were prepared according to Example 6. Compounds F4, F5, F7, F9, FAl, and FA2 were prepared according to Example 5. Compounds FA3, FA4, FA5, FA14, PI, P2, P6, P10, P19, P22, P16, P17, P32, and P31 were prepared according to Example 11. Compounds FA6, FA7, FA8, FA9, P3, P5, and P7 were prepared according to Example 12. Compounds FA10, FA11, FA12, FAB, P4, and P8 were prepared according to Example 13.

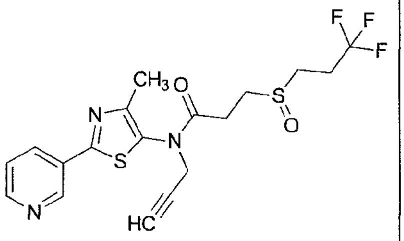
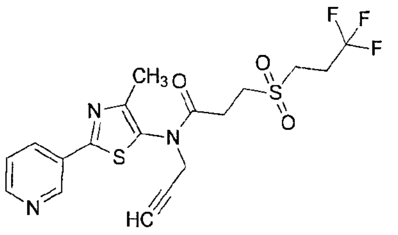
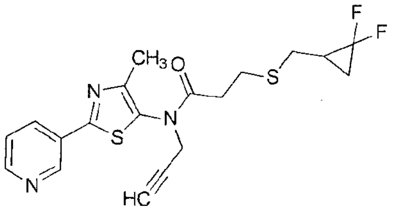
TABLE 3

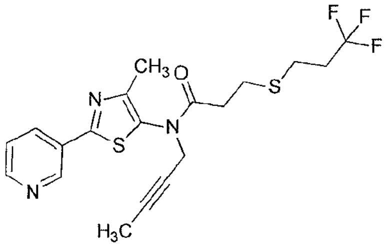
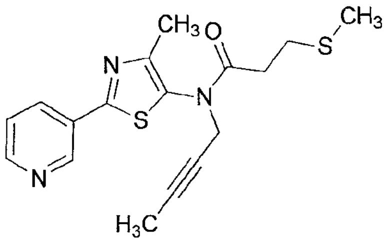
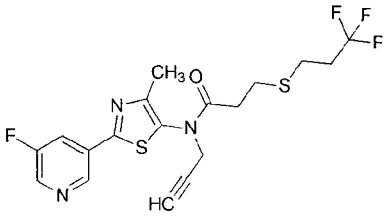
No.	Structure		ESIMS *(m/z)*	^{1}H NMR (400 MHz, Chloroform-af), IR, mp
F2		Brown Gum	318 ([M+H]$^+$)	δ 9.23 - 9.10 (m, 1H), 8.72 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.24 (ddd, J = 7.9, 2.3, 1.6 Hz, 1H), 7.43 (ddd, *J* = 8.0, 4.9, 0.8 Hz, 1H), 4.21 (m, 2H), 4.01 (dd, *J* = 6.3, 2.5 Hz, 1H), 2.32 (t, J = 2.5 Hz, 1H), 1.12 (m, 2H), 0.83 m, 2H)
F3		Brown Oil	420 ([M+Hf)	δ 9.15 (dd, *J* = 2.5, 0.9 Hz, 1H), 8.74 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.30 - 8.17 (m, 1H), 7.44 (ddd, *J* = 8.0, 4.8, 0.8 Hz, 1H), 4.95 (m, lH), 4.18 (m, 1H), 3.73 (q, J = 10.1, 9.3 Hz, 1H), 2.70 (m, 1H), 2.53 (m, 1H), 2.35 (t, *J* = 2.5 Hz, 1H), 2.29(s, 3H)]R (thin film) 3291, 2927, 1684 cm^{-1}

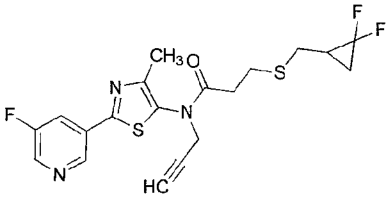
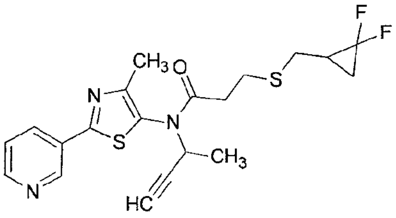
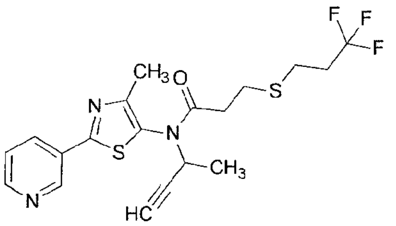
No.	Structure		ESIMS (*m/z*)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
F4		Brown Solid	338 ($[M+H]^+$)	δ 9.14 (dd, *J* = 2.3, 0.8 Hz, 1H), 8.73 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.23 (ddd, *J* = 8.0, 2.3, 1.6 Hz, 1H), 7.43 (ddd, *J* = 8.0, 4.8, 0.9 Hz, 1H), 4.96 (s, 1H), 4.12 (s, 1H), 3.21 (s, 2H), 2.34 (t, *J* = 2.5 Hz, 1H), 2.22 (s, 3H)
F5		Brown Gum	354 ($[M+H]^+$)	δ 9.16 (d, *J* = 2.3 Hz, 1H), 8.74 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.25 (dt, *J* = 8.1, 1.9 Hz, 1H), 7.45 (ddd, *J* = 8.0, 4.8, 0.8 Hz, 1H), 4.21 (m, 1H), 4.01 (dd, *J* = 6.0, 2.5 Hz, 1H), 2.39 - 2.32 (m, 2H), 2.27 (dt, *J* = 12.5, 6.8 Hz, 1H), 1.77 - 1.65 (m, 1H) IR (thin film) 3271, 3210, 3034, 1694 cm^{-1}
F6		Light Brown Oil	352 ($[M+H]^+$)	δ 9.14 (d, *J* = 2.2 Hz, 1H), 8.72 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.23 (ddd, *J* = 8.0, 2.3, 1.6 Hz, 1H), 7.43 (ddd, *J* = 8.0, 4.8, 0.9 Hz, 1H), 4.94 (d, *J* = 17.1 Hz, 1H), 4.12 (q, *J* = 7.1 Hz, 1H), 2.80 (m, 1H), 2.33 (s, 1H), 2.09 (s, 3H), 1.49 (d, *J* = 6.8 Hz, 3H) IR (thin film) 3256, 2973, 1675 cm^{-1}
F7		Brown Oil	352 ($[M+H]^+$)	δ 9.14 (dd, *J* = 2.3, 0.8 Hz, 1H), 8.74 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.24 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.44 (ddd, *J* = 8.0, 4.8, 0.9 Hz, 1H), 4.20 (bs, 1H), 3.95 (bs, 1H), 2.81 (t, *J* = 7.2 Hz, 2H), 2.56 (m, 2H), 2.33 (s, 1H), 2.08 (s, 3H) IR (thin film) 3254, 2914, 1680 cm^{-1}

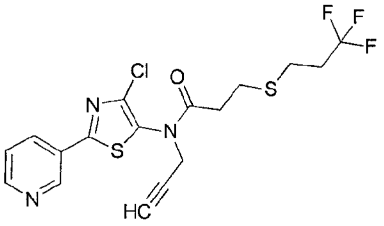
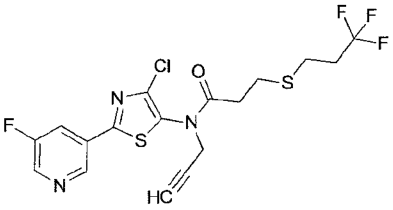
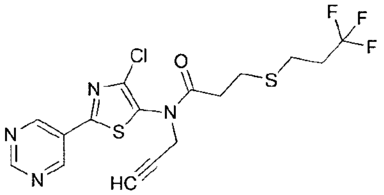
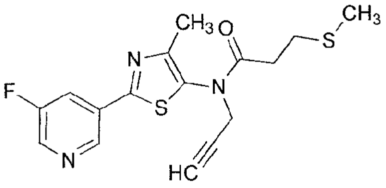
No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
F8		Brown Gum	428 ([M+H]$^+$)	δ 9.14 (dd, J = 2.4, 0.8 Hz, 1H), 8.74 (dd, J = 4.8, 1.7 Hz, 1H), 8.24 (dt, J = 8.0, 1.9 Hz, 1H), 7.44 (ddd, J = 8.0, 4.9, 0.9 Hz, 1H), 4.94 (s, 1H), 4.12 (s, 1H), 2.89 (t, J = 7.2 Hz, 2H), 2.70 - 2.53 (m, 4H), 2.33 (t, J = 2.5 Hz, 1H), 1.76 (td, J = 13.0, 12.3, 6.9 Hz, 1H), 1.49 (tdd, J = 12.1, 8.0, 4.7 Hz, 1H), 1.12 - 0.99 (m, 1H) IR (thin film) 3298, 2922, 1681IR cm^{-1}
F9		Brown Oil	366 ([M+H]$^+$)	IR (thin film) 3254, 2914, 1680 cm^{-1}
P1		Orange gum	332 ([M+H]$^+$)	δ 9.19 (s, 1H), 8.73 (s, 1H), 8.36 (d, J = 8.0 Hz, 1H), 7.55 (q, J = 8.0 Hz, 1H), 4.57 - 4.42 (m, 2H), 2.79 (t, J = 7.2 Hz, 2H), 2.61 - 2.50 (m, 2H), 2.41 (s, 3H), 2.29 (t, J = 2.4 Hz, 1H), 2.07 (s, 3H) IR (KBr) 2956, 2926, 2854, 2376, 2345, 2312, 1734, 1685, 1375 cm^{-1}
P2		Brown gum	346 ([M+H]$^+$)	δ 9.13 (s, 1H), 8.69 - 8.67 (m, 1H), 8.22 - 8.20 (m, 1H), 7.40 (q, J = 7.6 Hz, 1H), 4.72 - 4.28 (m, 2H), 2.94 - 2.83 (m, 2H), 2.47 - 2.42 (m, 4H), 2.28 (s, 1H), 2.02 (d, J = 8.0 Hz, 3H), 1.18 (s, 3H) IR (KBr) 3419, 3255, 2970, 2920, 2852, 2119, 1678, 1598, 1570 cm^{-1}

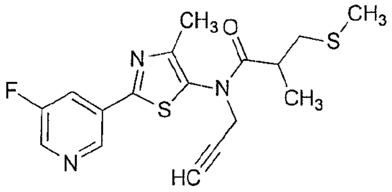
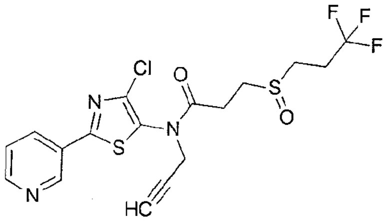
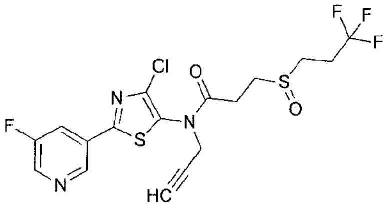
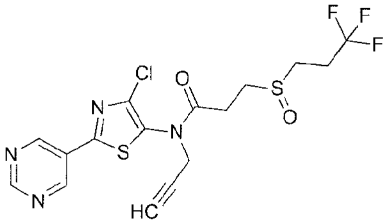
No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-d), IR, mp
P3		Yellow gum	347 ([M+H]$^+$)	δ 9.12 (s, 1H), 8.69 (q, J = 4.8 Hz, 1H), 8.22 – 8.19 (m, 1H), 7.40 (q, J = 8.0 Hz, 1H), 4.56 – 4.43 (m, 2H), 3.17 – 3.10 (m, 1H), 2.92 – 2.86 (m, 1H), 2.73 – 2.72 (m, 2H), 2.58 (s, 3H), 2.42 (s, 3H), 2.31 (t, J = 2.4 Hz, 1H) IR (KBr) 3203, 3003, 2954, 2920, 2852, 2366, 1734, 1716, 1354 cm^{-1}
P4		Brown gum	364 ([M+H]$^+$)	δ 9.12 (s, 1H), 8.69 (q, J = 4.8 Hz, 1H), 8.22 – 8.19 (m, 1H), 7.40 (q, J = 8.0 Hz, 1H), 4.56 – 4.41 (m, 2H), 3.52 – 3.41 (m, 2H), 2.96 (s, 3H), 2.76 (t, J = 6.8 Hz, 2H), 2.43 (s, 3H), 2.32 (t, J = 2.4 Hz, 1H) IR (KBr) 3431, 3261, 2960, 2922, 2850, 2119, 1732, 1683, 1552 cm^{-1}
P5		Brown gum	378 ([M+H]$^+$)	δ 9.15 (s, 1H), 8.68 (q, J = 4.8 Hz, 1H), 8.24 – 8.20 (m, 1H), 7.38 (q, J = 8.0 Hz, 1H), 4.70 – 4.27 (m, 2H), 3.83 – 3.77 (m, 1H), 3.33 – 3.29 (m, 1H), 2.92 (s, 3H), 2.91 (s, 1H), 2.48 (d, J = 12.0 Hz, 3H), 2.31 (t, J = 2.4 Hz, 1H), 1.25 (s, 3H) IR (KBr) 2924, 2852, 2351, 2310, 1681, 1633, 1591, 1552, 1435 cm^{-1}
P6		Brown gum	414 ([M+H]$^+$)	δ 9.26 (s, 1H), 8.78 (s, 1H), 8.54 (d, J = 8.0 Hz, 1H), 7.73 (q, J = 8.0 Hz, 1H), 4.70 – 4.65 (m, 2H), 2.85 (t, J = 6.8 Hz, 2H), 2.66 (t, J = 8.1 Hz, 2H), 2.48 – 2.39 (m, 2H), 2.38 (s, 3H), 2.37 – 2.33 (m, 3H) IR (KBr) 2927, 2378, 2345, 2310, 1716, 1683, 1558, 1508, 1386 cm^{-1}

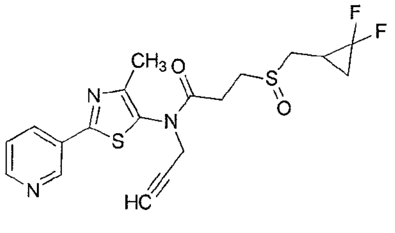
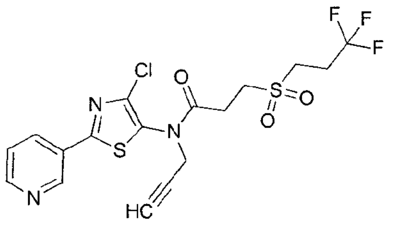
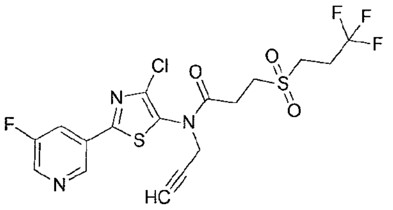
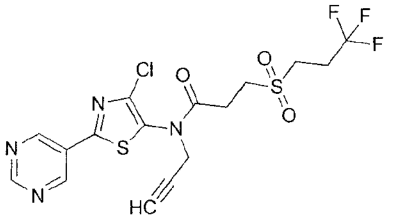
No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-d), IR, mp
P7		Yellow gum	429 ([M+H]$^+$)	δ 9.12 (s, 1H), 8.69 (q, J = 4.8 Hz, 1H), 8.22 – 8.19 (m, 1H), 7.40 (q, J = 8.0 Hz, 1H), 4.45 – 4.42 (m, 2H), 3.19 – 3.12 (m, 1H), 2.96 – 2.85 (m, 3H), 2.75 – 2.74 (m, 2H), 2.66 – 2.57 (m, 2H), 2.42 (s, 3H), 2.31 (t, J = 2.4 Hz, 1H) IR (KBr) 3313, 3226, 2926, 2854, 2349, 2115, 1668, 1589, 1394 cm^{-1}
P8		Off-white solid	446 ([M+H]$^+$)	δ 9.12 (s, 1H), 8.69 (q, J = 4.8 Hz, 1H), 8.22 – 8.19 (m, 1H), 7.40 (q, J = 8.0 Hz, 1H), 4.57 – 4.30 (m, 2H), 3.44 – 3.42 (m, 2H), 3.28 (s, 3H), 2.76 (t, J = 6.8 Hz, 2H), 2.43 (s, 3H), 2.37 (s, 1H), 2.31 (t, J = 2.4 Hz, 1H) mp 117-120°C
P10		Brown gum	408 ([M+H]$^+$)	δ 9.27 (s, 1H), 8.79 (s, 1H), 8.57 (d, J = 8.0 Hz, 1H), 7.76 (q, J = 8.0 Hz, 1H), 4.62 – 4.50 (m, 2H), 2.87 (t, J = 6.8 Hz, 2H), 2.60 (t, J = 7.6 Hz, 2H), 2.49 (t, J = 6.8 Hz, 2H), 2.42 (s, 3H), 2.30 (s, 1H), 1.80 – 1.69 (m, 1H), 1.52 – 1.42 (m, 1H), 1.08 – 1.00 (m, 1H) IR (KBr) 2927, 2378, 2345, 1734, 1716, 1683, 1653, 1647, 1558 cm^{-1}

No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
P16		Yellow gum	428 ([M+H]$^+$)	δ 9.05 (s, 1H), 8.60 (q, *J* = 4.8 Hz, 1H), 8.15 – 8.13 (m, 1H), 7.33 (q, *J* = 8.0 Hz, 1H), 4.45 – 4.27 (m, 2H), 2.77 (t, *J* = 7.2 Hz, 2H), 2.59 (t, *J* = 8.4 Hz, 2H), 2.44 – 2.33 (m, 2H), 2.32 (s, 3H), 2.31 – 2.23 (m, 2H), 1.72 (t, *J* = 4.4 Hz, 3H) IR (KBr) 2922, 1681, 1558, 1506, 1489, 1456, 1419, 1309 cm^{-1}
P17		Yellow gum	346 ([M+H]$^+$)	δ 9.06 (s, 1H), 8.60 (q, *J* = 4.8 Hz, 1H), 8.15 – 8.12 (m, 1H), 7.33 (q, *J* = 8.0 Hz, 1H), 4.45 – 4.27 (m, 2H), 2.72 (t, *J* = 7.2 Hz, 2H), 2.51 – 2.37 (m, 2H), 2.32 (s, 3H), 1.99 (s, 3H), 1.72 (t, *J* = 4.4 Hz, 3H) IR (KBr) 2958, 2920, 2852, 2378, 2306, 1734, 1716, 1683, 1473 cm^{-1}
P19		Yellow gum	432 ([M+H]$^+$)	δ 8.91 (s, 1H), 8.54 (s, 1H), 7.96 (d, *J* = 8.8 Hz, 1H), 4.56 – 4.42 (m, 2H), 2.84 (t, *J* = 6.8 Hz, 2H), 2.66 (t, *J* = 7.6 Hz, 2H), 2.49 – 2.47 (m, 2H), 2.40 (s, 3H), 2.38 – 2.30 (s, 3H) IR (KBr) 2962, 2345, 1683, 2924, 2852, 2347, 1749, 1683, 1473 cm^{-1}

No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
P22		Yellow gum	425 ([M+H]$^+$)	δ 8.84 (s, 1H), 8.47 (s, 1H), 7.92 (d, *J* = 8.8 Hz, 1H), 4.50 – 4.35 (m, 2H), 2.80 (t, *J* = 8.0 Hz, 2H), 2.55 – 2.51 (m, 2H), 2.44 – 2.34 (m, 2H), 2.33 (s, 3H), 2.22 (t, *J* = 2.4 Hz, 1H), 1.73 – 1.62 (m, 1H), 1.45 – 1.34 (m, 1H), 1.01 – 0.96 (m, 1H) IR (KBr) 2962, 2345, 1693, 1683, 12845, 1261, 1138, 1099, 1020 cm^{-1}
P31		Yellow gum	422 ([M+H]$^+$)	δ 9.10 (s, 1H), 8.69 (q, *J* = 4.8 Hz, 1H), 8.27 – 8.25 (m, 1H), 7.54 (q, *J* = 8.0 Hz, 1H), 5.54 – 5.57 (m, 1H), 3.21 – 3.17 (m, 1H), 2.78 (t, *J* = 7.2 Hz, 2H), 2.67 (t, *J* = 1.6 Hz, 2H), 2.62 – 2.55 (m, 2H), 2.47 – 2.35 (m, 2H), 2.29 (s, 1H), 1.84 – 1.69 (m, 1H), 1.59 – 1.53 (m, 1H), 1.37-1.36 (m, 3H), 1.19 – 1.15 (m, 1H) IR (KBr) 2927, 2854, 2360, 2341, 1676, 1550, 1442, 1371, 1307 cm^{-1}
P32		Yellow gum	428 ([M+H]$^+$)	(400 MHz, DMSO-d_6) δ 9.10 (s, 1H), 8.69 (q, *J* = 4.8 Hz, 1H), 8.27 – 8.25 (m, 1H), 7.54 (q, *J* = 8.0 Hz, 1H), 5.59 – 5.55 (m, 1H), 3.17 (s, 1H), 2.80 (t, *J* = 6.8 Hz, 1H), 2.66 (t, *J* = 6.8 Hz, 1H), 2.46 – 2.45 (m, 5H), 2.35 (s, 3H), 2.29 (s, 1H), 1.36 (d, *J* = 4.8 Hz, 3H) IR (KBr) 3439, 3304, 2926, 2854, 2360, 2331, 1676, 1551, 1469 cm^{-1}

No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
FA1		Brown solid	434 ([M+H]$^+$)	δ 9.14 (d, *J* = 2.0 Hz, 1H), 8.74 (dd, *J* = 1.2, 4.8 Hz, 1H), 8.24 (td, *J* = 2.0, 8.0 Hz, 1H), 7.44 (dd, *J* = 4.8, 8.0 Hz, 1H), 4.93 (bs, 1H), 4.13 (bs, 1H), 2.86 (t, *J* = 7.2 Hz, 2H), 2.70 – 2.65 (m, 2H), 2.55 (bs, 2H), 2.43 – 2.31 (m, 3H) IR (KBr) 3304, 2931, 1685, 1525, 1371, 1274, 1242 cm^{-1}
FA2		Brown solid	462 ([M+H]$^+$)	δ 8.93 (s, 1H), 8.60 (d, *J* = 2.4 Hz, 1H), 8.00 (td, *J* = 2.4, 8.8 Hz, 1H), 4.95 (bs, 1H), 4.13 (bs, 1H), 2.86 (t, *J* = 7.2 Hz, 2H), 2.70 – 2.66 (m, 2H), 2.54 (bs, 2H), 2.43 – 2.34 (m, 3H) mp 117-119°C
FA3		Brown solid	435 ([M+H]$^+$)	δ 9.33 (s, 1H), 9.25 (s, 2H), 4.95 (bs, 1H), 4.13 (bs, 1H), 2.87 (t, *J* = 7.2 Hz, 2H), 2.70 – 2.66 (m, 2H), 2.54 (s, 2H), 2.43 – 2.31 (m, 3H) mp 102-103°C
FA4		Brown gum	349 ([M+H]$^+$)	δ 8.91 (s, 1H), 8.54 (s, 1H), 7.96 (d, *J* = 8.8 Hz, 1H), 4.56 – 4.25 (m, 2H), 2.79 (t, *J* = 7.2 Hz, 2H), 2.49 (t, *J* = 6.0 Hz, 2H), 2.41 (s, 3H), 2.29 (d, *J* = 2.4 Hz, 1H), 2.06 (s, 3H) IR (KBr) 3064, 2962, 2349, 2310, 1683, 1558, 1548, 1448, 1261 cm^{-1}

No.	Structure		ESIMS (*m/z*)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
FA5		Yellow gum	363 ([M+H]$^+$)	δ 8.92 (s, 1H), 8.54 (s, 1H), 7.97 (d, *J* = 8.8 Hz, 1H), 4.74 – 4.27 (m, 2H), 2.92 – 2.83 (m, 2H), 2.47 – 2.42 (m, 4H), 2.29 (t, *J* = 2.0 Hz, 1H), 2.03 (s, 3H), 1.18 (s, 3H) IR (KBr) 3255, 3049, 2972, 2349, 1681, 1598, 1550, 1506, 1301 cm^{-1}
FA6		Brown gum	450 ([M+H]$^+$)	δ 9.14 (d, *J* = 1.6 Hz, 1H), 8.74 (dd, *J* = 1.6, 4.8 Hz, 1H), 8.23 (td, *J* = 2.0, 8.0 Hz, 1H), 7.44 (dd, *J* = 4.8, 8.0 Hz, 1H), 4.91 (bs, 1H), 4.14 (bs, 1H), 3.17 (bs, 1H), 3.01 – 2.85 (m, 3H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.67 – 2.55 (m, 2H), 2.35 (t, *J* = 2.4 Hz, 1H) IR (KBr) 2370, 2345, 1685, 1523, 1421, 1271, 1138 cm^{-1}
FA7		Brown gum	468 ([M+H]$^+$)	δ 8.93 (s, 1H), 8.61 (s, 1H), 7.99 (d, *J* = 8.8 Hz, 1H), 4.94 (bs, 1H), 4.15 (bs, 1H), 3.18 (bs, 1H), 2.99 – 2.85 (m, 3H), 2.80 (t, *J* = 6.4 Hz, 2H), 2.67 – 2.55 (m, 2H), 2.36 (s, 1H) IR (KBr) 3230, 2926, 1683, 1525, 1429, 1338, 1217 cm^{-1}
FA8		Light brown solid	451 ([M+H]$^+$)	δ 9.33 (s, 1H), 9.24 (s, 2H), 4.62 (bs, 1H), 4.16 (bs, 1H), 3.17 (bs, 1H), 2.99 – 2.83 (m, 3H), 2.79 (t, *J* = 6.8 Hz, 2H), 2.67 – 2.55 (m, 2H), 2.36 (s, 1H) mp 129–131°C

No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-*d*), IR, mp
FA9		Yellow gum	423 ([M+H]$^+$)	δ 9.11 (s, 1H), 8.69 (q, *J* = 4.8 Hz, 1H), 8.21 – 8.19 (m, 1H), 7.41 (q, *J* = 8.0 Hz, 1H), 4.54 – 4.43 (m, 2H), 3.19 – 3.11 (m, 1H), 2.98 – 2.73 (m, 5H), 2.42 (s, 3H), 2.31 (t, *J* = 2.4 Hz, 1H), 2.07 – 1.94 (m, 1H), 1.71 – 1.66 (m, 1H), 1.34 – 1.28 (m, 1H) IR (KBr) 3226, 2924, 2854, 2349, 2117, 1674, 1589, 1404, 1386 cm^{-1}
FA10		Light brown solid	466 ([M+H]$^+$)	δ 9.14 (d, *J* = 2.0 Hz, 1H), 8.75 (dd, *J* = 1.2 Hz, 4.8 Hz, 1H), 8.24 (td, *J* = 2.0 Hz, 8.0 Hz, 1H), 7.45 (dd, *J* = 4.8 Hz, 8.0 Hz, 1H), 4.91 (bs, 1H), 4.13 (bs, 1H), 3.51 – 3.40 (m, 2H), 3.28 – 3.24 (m, 2H), 2.85 (t, *J* = 6.8 Hz, 2H), 2.75 – 2.64 (m, 2H), 2.36 (t, *J* = 2.0 Hz, 1H) mp 123–127°C
FA11		Light brown solid	484 ([M+H]$^+$)	δ 8.94 (s, 1H), 8.61 (s, 1H), 8.00 (td, *J* = 2.4 Hz, 8.8 Hz, 1H), 4.93 (bs, 1H), 4.13 (bs, 1H), 3.47 (bs, 2H), 3.28 – 3.24 (m, 2H), 2.84 (t, *J* = 6.8 Hz, 2H), 2.75 – 2.64 (m, 2H), 2.37 (t, *J* = 2.0 Hz, 1H) mp 116-118°C
FA12		Light brown solid	467 ([M+H]$^+$)	δ 9.34 (s, 1H), 9.25 (s, 2H), 4.94 (bs, 1H), 4.13 (bs, 1H), 3.45 (bs, 2H), 3.28 – 3.24 (m, 2H), 2.83 (t, *J* = 6.8 Hz, 2H), 2.75 – 2.64 (m, 2H), 2.37 (s, 1H) mp 163-170°C

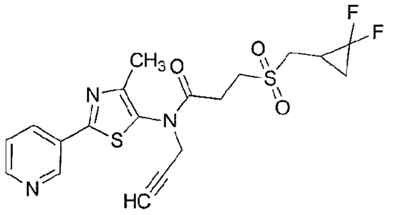
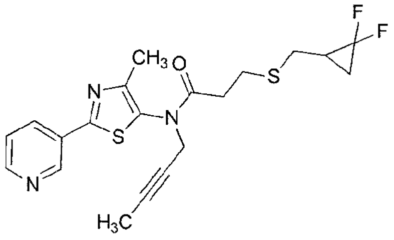
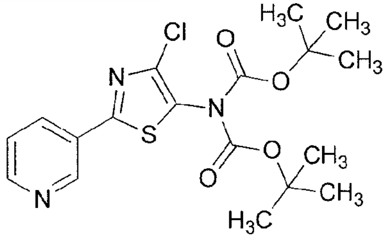
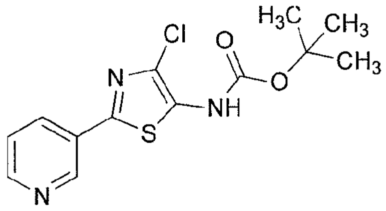
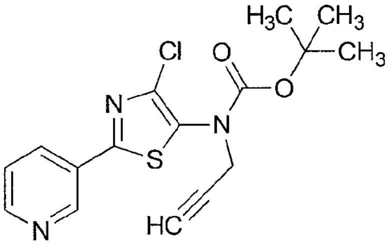
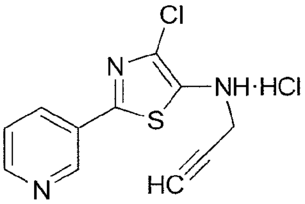
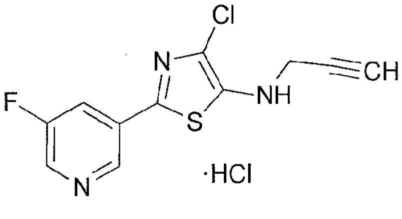
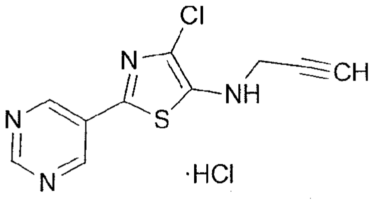
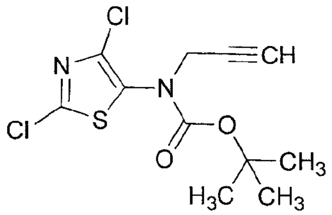
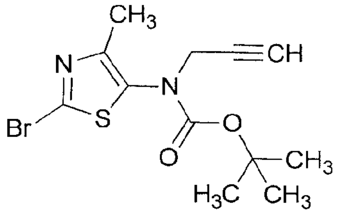
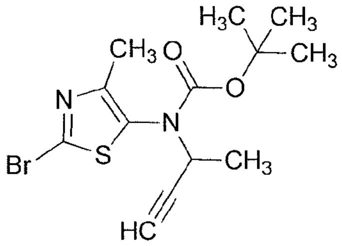
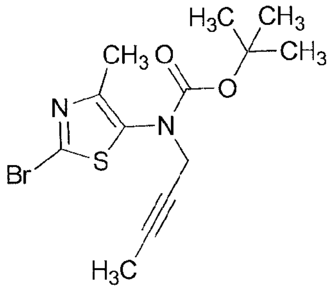
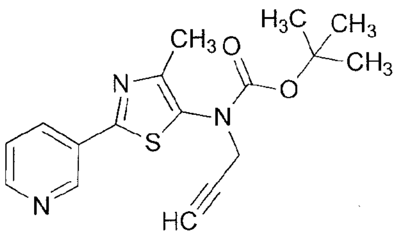
No.	Structure		ESIMS (m/z)	^{1}H NMR (400 MHz, Chloroform-d), IR, mp
FA13		Brown gum	440 ($[M+H]^+$)	δ 9.13 (s, 1H), 8.69 (q, J = 4.8 Hz, 1H), 8.24 – 8.22 (m, 1H), 7.42 (q, J = 8.0 Hz, 1H), 4.56 – 4.41 (m, 2H), 3.43 – 3.41 (m, 2H), 3.32 – 3.26 (m, 1H), 3.08 – 3.03 (m, 1H), 2.78 – 2.77 (m, 2H), 2.43 (s, 3H), 2.32 (t, J = 2.4 Hz, 1H), 2.07 – 1.98 (m, 1H), 1.77 – 1.68 (m, 1H), 1.47 – 1.41 (m, 1H) IR (KBr) 3402, 3282, 3263, 3188, 3053, 2964, 2920, 1681, 1589, 1388 cm^{-1}
FA14		Yellow gum	422 ($[M+H]^+$)	δ 9.12 (s, 1H), 8.68 (q, J = 4.8 Hz, 1H), 8.22 – 8.19 (m, 1H), 7.40 (q, J = 8.0 Hz, 1H), 4.42 – 4.38 (m, 2H), 2.86 (t, J = 7.2 Hz, 2H), 2.64 – 2.48 (m, 4H), 2.39 (s, 3H), 1.80 (t, J = 4.4 Hz, 3H), 1.79 – 1.71 (m, 1H), 1.54 – 1.43 (m, 1H), 1.07 – 1.02 (m, 1H) IR (KBr) 2956, 2922, 2854, 2376, 2310, 2233, 1680, 1554, 1471 cm^{-1}

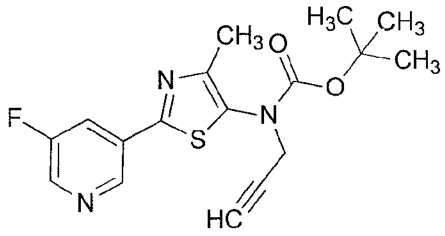
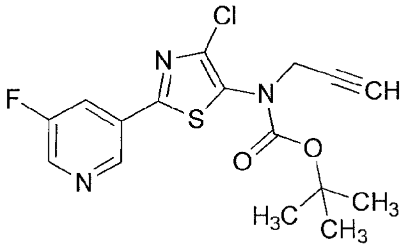
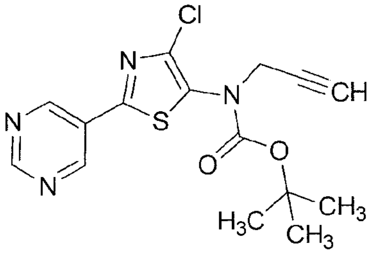
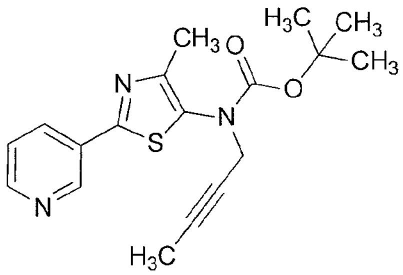
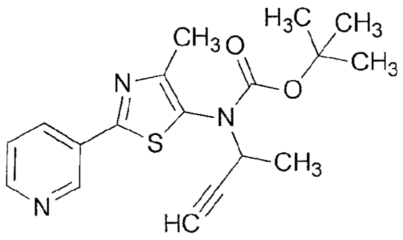
TABLE 4 shows further non-limiting examples of the compound of formula **I**.

TABLE 4

No.	Structure	Appearance	Prepared according to Example
C1		Yellow-Orange Solid	1

No.	Structure	Appearance	Prepared according to Example
C2		Beige Solid	2
C3		Brown Solid	3
C4		Orange Solid	4
CA1		Brown solid	4
CA2		Brown solid	4

No.	Structure	Appearance	Prepared according to Example
CA3		Off-white solid	7
CA4		Off-white solid	7
CA5		Dark brown gum	8
CA6		Brown gum	8
CA7		Brown gum	9

No.	Structure	Appearance	Prepared according to Example
CA8		Off-white solid	9
CA9		White solid	9
CA10		White solid	9
CA11		Brown gum	9
CA12		Brown solid	9

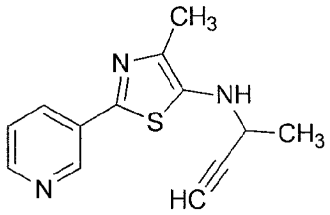
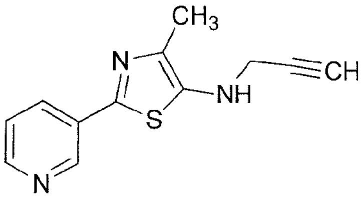
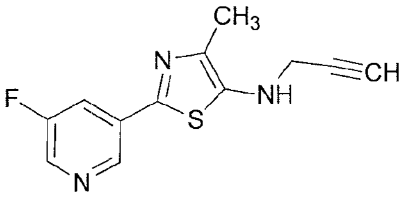
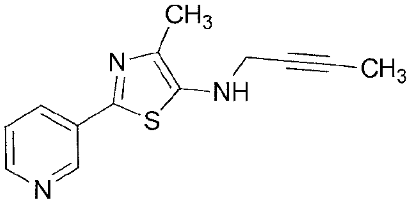
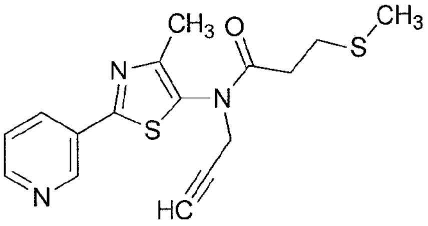
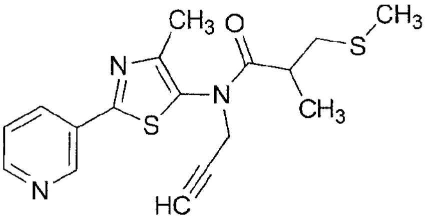
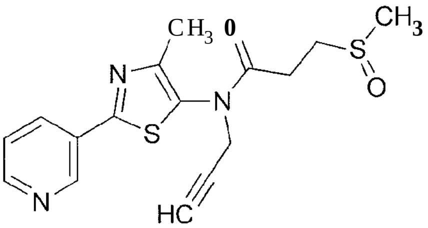
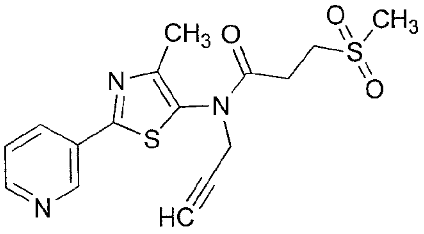
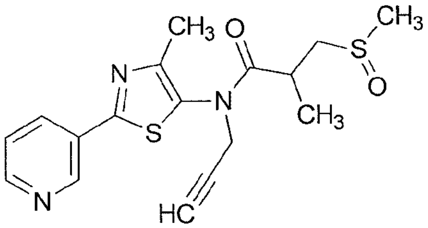
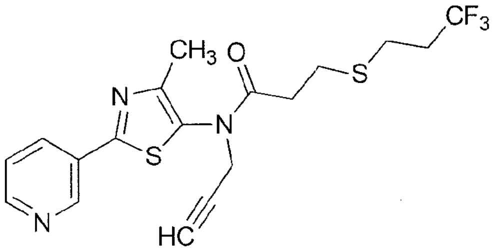
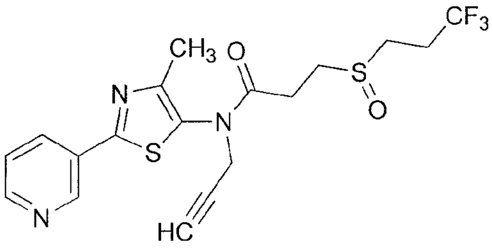
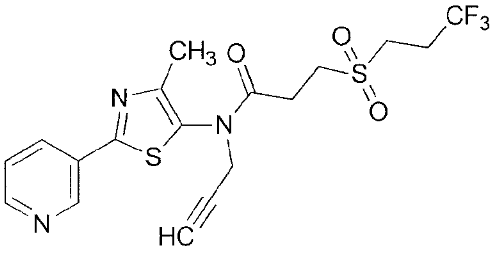
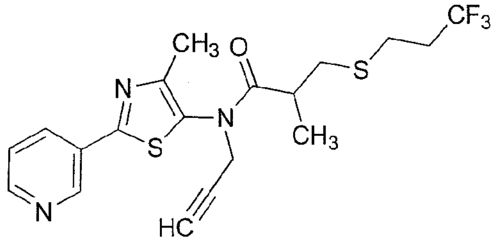
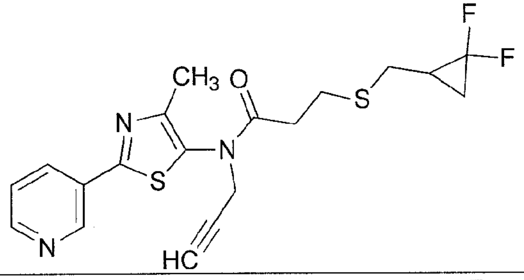
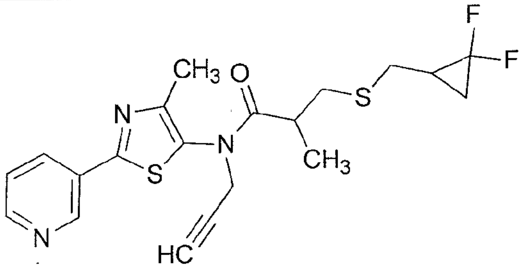
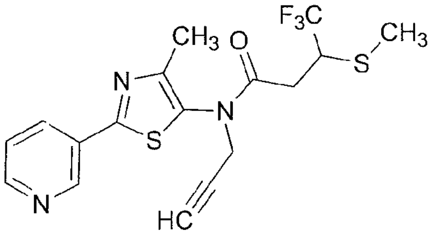
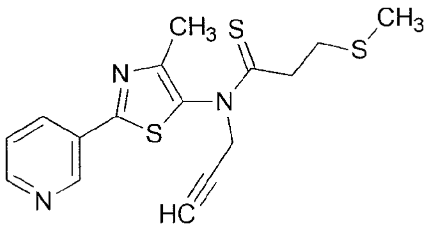
No.	Structure	Appearance	Prepared according to Example
CA13		Yellow solid	10
CAM		Yellow solid	10
CA15		Yellow solid	10
CA16		Brown gum	10

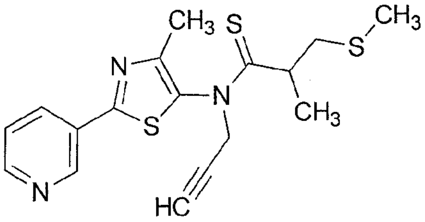
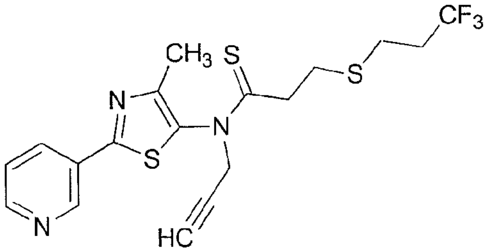
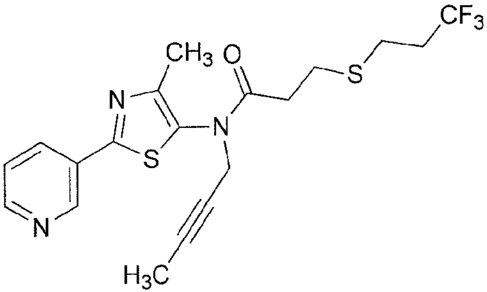
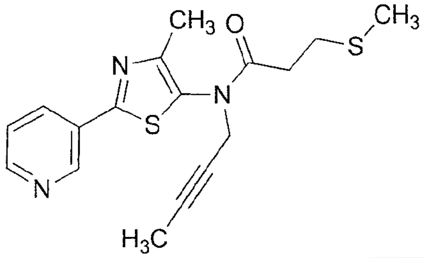
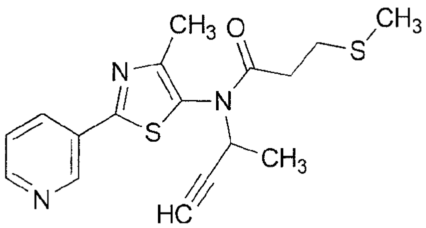
TABLE 5 shows further non-limiting examples of the compound of formula **I**.

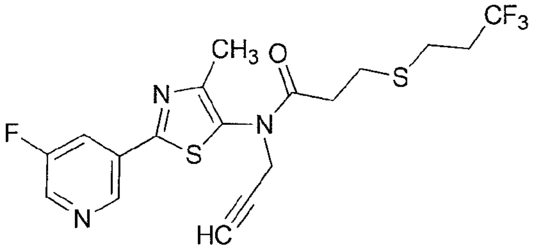
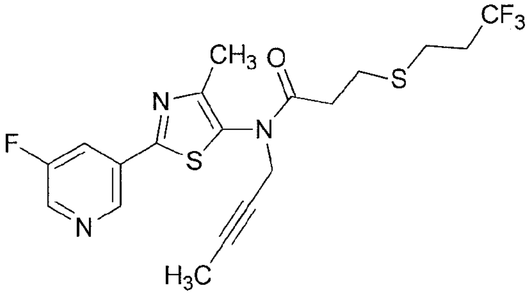
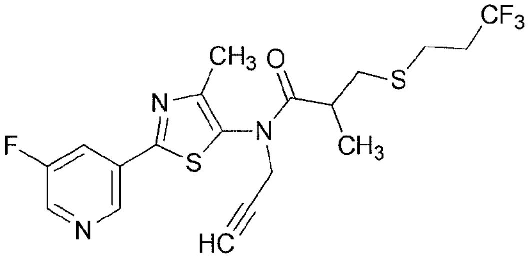
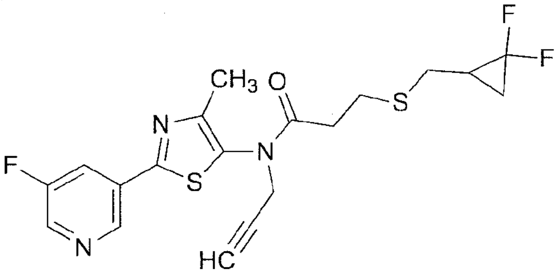
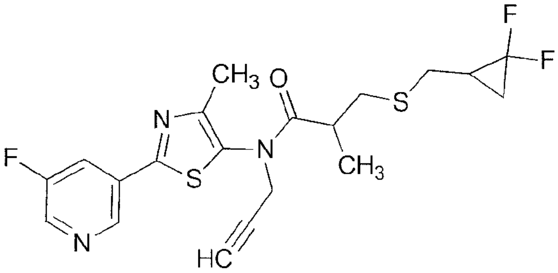
TABLE 5

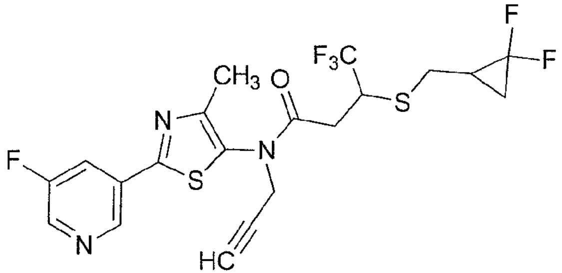
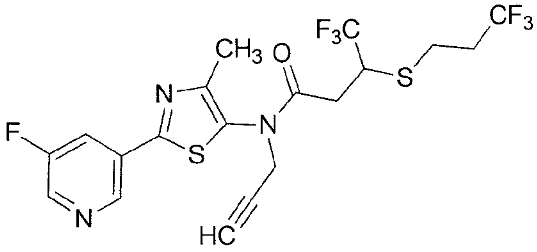
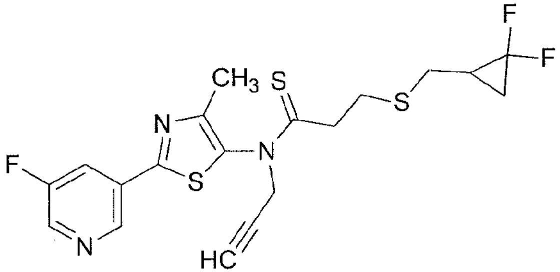
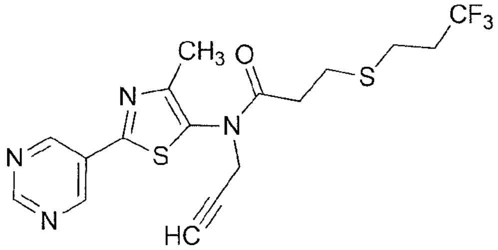
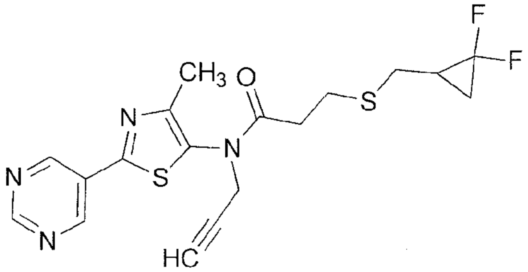
No.	**Structure**	**May be Prepared according to Example or Scheme:**
P1		Example 6
P2		Example 6
P3		Scheme 3

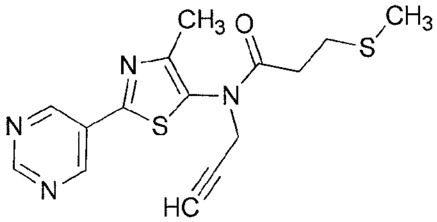
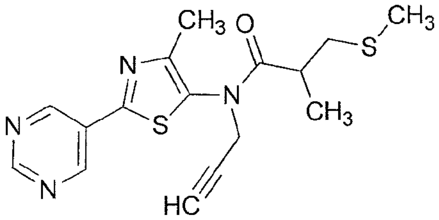
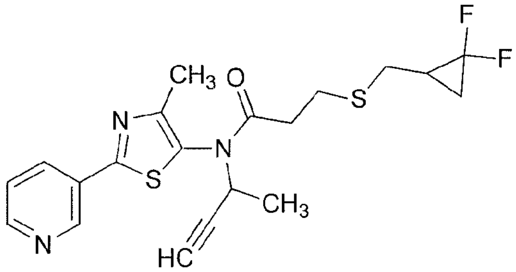
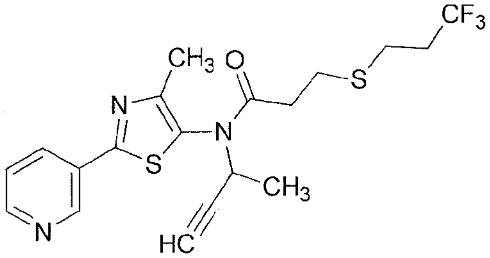
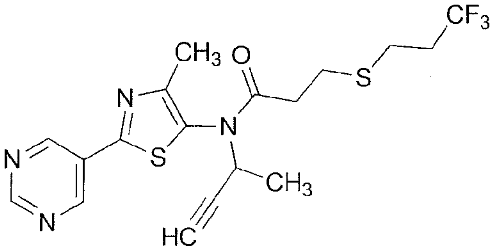
No.	Structure	May be Prepared according to Example or Scheme:
P4		Scheme 3
P5		Scheme 3
P6		Example 6
P7		Scheme 3
P8		Scheme 3

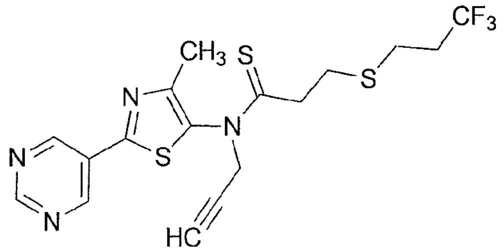
No.	Structure	May be Prepared according to Example or Scheme:
P9		Example 6
P10		Example 6
P11		Example 6
P12		Example 6
P13		Scheme 3

No.	Structure	May be Prepared according to Example or Scheme:
P14		Scheme 3
P15		Scheme 3
P16		Example 6
P17		Example 6
P18		Example 6

No.	Structure	May be Prepared according to Example or Scheme:
P19		Example 6
P20		Example 6
P21		Example 6
P22		Example 6
P23		Example 6

No.	Structure	May be Prepared according to Example or Scheme:
P24		Example 6
P25		Example 6
P26		Scheme 3
P27		Example 6
P28		Example 6

No.	Structure	May be Prepared according to Example or Scheme:
P29		Example 6
P30		Example 6
P31		Example 6
P32		Example 6
P33		Example 6

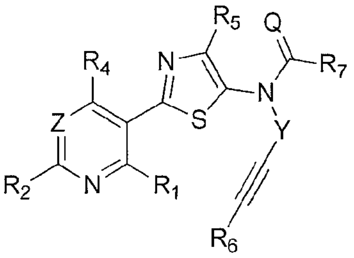
No.	Structure	May be Prepared according to Example or Scheme:
P34		Scheme 3

While this invention has been described in certain embodiments, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims

CLAIMS

We claim:

1. A pesticidal composition, comprising a compound of formula **I** or any agriculturally acceptable salt thereof:



I

wherein:

(a) **Ri, R_2,** and R 4 are independently hydrogen, F, CI, Br, I, substituted or unsubstituted C_1-C_6 alkyl, or substituted or unsubstituted C_1-C_6 haloalkyl or substituted or unsubstituted C_1-$C1_0$ cycloalkyl, substituted or unsubstituted CI-CIO halocycloalky],

wherein each said R 1, R2, and R4, when substituted, has one or more substituents selected from F, CI, Br, I, CN, N0 $_2$, C,-C 6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C,-C 6 haloalkyl, C_3-C_{10} cycloalkyl, or C_3-C_{10} halocycloalky], each of which may be substituted and may optionally be substituted with R i0;

(b) **R_3** is hydrogen, F, CI, Br, I, CN, N0 $_2$, substituted or unsubstituted Ci-C 6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_2-C_6 alkynyl, substituted or unsubstituted C_1-C_6 alkoxy, substituted or unsubstituted C_3-C_{10} cycloalkyl, substituted or unsubstituted C]-C 6 haloalkyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C,-C 20 heterocyclyl, OR$_{10}$, C(=X,)R, 0, C(=X,)OR, 0, C(=X,)N(R $_1$0)2, N (R$_{10}$)$_2$, N(¾ 0)C(=X1)¾ 0, S(O)„R10, S(0) $_n$OR,o, or R10S(O)$_n$R$_{10}$,

wherein each said R_3, when substituted, has one or more substituents selected from F, CI, Br, I, CN, N0 $_2$, Ci-Ce alkyl, C_2-C_6 alkenyl, C_1-C_6 haloalkyl, C_2-Ce haloalkenyl, C_1-C_6 haloalkyloxy, C_2-C_6 haloalkenyloxy, C_3-C_{10} cycloalkyl, C_3-C, 0 cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, ORi0, S(O)$_n$OR$_1$0, C_6-C_{20} aryl, or C_1-C_{20} heterocyclyl, each of which is unsubstituted, substituted, or substituted with R_{10};

(c) **R_5** is selected from hydrogen, F, CI, Br, I, CN, N0 $_2$, substituted or unsubstituted C_1-C_6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted Ci-C 6 alkoxy, C_3-C]0 cycloalkyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C|-C 20 heterocyclyl, OR$_1$0, C(=X,)R $_{10}$, C(=X,)OR$_{10}$, C(=X$_1$)N (R10)2, N (R,0)2, N(R $_{10}$)C(=X1)R$_1$0, SR$_1$0, S(O)$_n$OR10, or R10S(O)$_n$R10,

wherein each said R_5, **when substituted, has one or more substituents selected from** F, CI, **Br,** I, CN, **N0** $_2$, C,-C_6 **alkyl,** C_2-C_6 **alkenyl,** C_1-C_6 **haloalkyl,** C_2-C_6 **haloalkenyl,** C,-C_6 **haloalkyloxy,** C_2-C_6 **haloalkenyloxy,** C3-C10 **cycloalkyl,** C3-C10 **cycloalkenyl,** C3-C10 **halocycloalkyl,** C_3-C_{10} **halocycloalkenyl,** OR_{10}, $S(O)_n$ORi$_0$, C_6-$C_2$0 **aryl,** ^{o}r C_1-C_{20} **heterocyclyl, each of which is unsubstituted, substituted, or substituted with** R,$_0$;

(d) **Y is a bond or is substituted or unsubstituted** C_1 - C_6 **alkyl, or substituted or unsubstituted** C_2-C_6 **alkenyl, except where** Y **is a bond, wherein each** Y, **when substituted, has one or more substituents selected from hydrogen,** F, CI, **Br,** I, CN, **N0** $_2$, C_1-C_6 **alkyl,** C_2-C_6 **alkenyl,** C_1-C_6 **haloalkyl,** C_2-C_6 **haloalkenyl,** C_1-C_6 **haloalkyloxy, or** C_3-C_{10} **cycloalkyl, optionally** Y **and** R_7 **may be connected in a cyclic arrangement, where optionally such arrangement may have one or more heteroatoms selected from** O, S, **or** N, **in the cyclic structure connecting** Y **and** R7;

(e) **Re** is **selected from hydrogen, substituted or unsubstituted** C_1-C_6 **alkyl, substituted or unsubstituted** C_2-C_6 **alkenyl, substituted or unsubstituted** C_2-C_6 **alkynyl, substituted or unsubstituted** C3-$C_1$0 **cycloalkyl, substituted or unsubstituted** C_6-C_{20} **aryl, substituted or unsubstituted** C,-C_{20} **heterocyclyl,** C_1-C_6 **alkyl-(**C_3-C_{10} **cyclohaloalkyl) wherein the alkyl and cyclohalo** alky l **is independently substituted or unsubstituted, or** C_1-C_6 **alkyl-(**C_3-Ci$_0$ **cycloalkyl), wherein the alkyl and cycloalkyl is independently substituted or unsubstituted,**

wherein each Rs, **when substituted, has one or more substituents selected from** F, CI, **Br,** I, CN, **N0** $_2$, C_1-C_6 **alkyl,** C_2-C_6 **alkenyl,** C_2-C_6 **alkynyl** C,-C_6 **haloalkyl,** C,-C_6 **alkoxy,** C_2-C_6 **haloalkenyl,** C_1-C_6 **haloalkyloxy,** C_2-C_6 **haloalkenyloxy,** C_3-C_{10} **cycloalkyl,** C_3-Ci$_0$ **cycloalkenyl,** C_3-C_{10} **halocycloalkyl,** C_3-C,$_0$ **halocycloalkenyl,** OR_{10}, $S(O)_n$$OR_{10}$, C_6-C_{20} **aryl,** C_1-$C_2$0**heterocyclyl, or** Rio **aryl, each of which is unsubstituted, substituted, or substituted with** $R_{]0}$.

(f) $\mathbf{R_7}$ is R_9, $R_8S(O)_nR_9$;

(g) $\mathbf{R_8}$ **is substituted or unsubstituted** C_1-C_{12} **alkenyl, or** C_1-C_{12} **alkynyl, substituted or unsubstituted** C_1-$C_1$2 **alkyl, or substituted or unsubstituted** C_3-C_{10}**cycloalkyl,**

wherein each said R_8, **when substituted, has one or more substituents selected from** F, CI, **Br,** I, C_1-C_6 **alkyl,** C_2-C_6 **alkenyl,** C,-C_6 **haloalkyl, ,** C_3-C,$_0$ **cycloalkyl,** C_3-C_{10} **halocycloalkyl,** OR_{10}, $S(O)_n$R$_{10}$, C_6-C_{20} **aryl, or** C_1-C_{20} **heterocyclyl, each of which is unsubstituted, substituted, or substituted with** R_{10},

(h) $\mathbf{R_9}$ **is selected from hydrogen, substituted or unsubstituted** Ci-C_6 **alkyl, substituted or unsubstituted** C_2-C_6 **alkenyl, substituted or unsubstituted** C_1-C_6 **alkoxy, substituted or unsubstituted** C_3-$C_{]0}$ **cycloalkyl, substituted or unsubstituted** C_3-C_{10} **halocycloalkyl substituted, or unsubstituted** C_3-C_{10} **cycloalkenyl, substituted or unsubstituted** C_1-C_6 **haloalkyl substituted or unsubstituted** C_6-$C_2$0**aryl, or substituted or unsubstituted** C_1-C_{20} **heterocyclyl,**

wherein each said R_9, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, $C_{,}$-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_1-C_6 haloalkyl, C_2-C_6 haloalkenyl, C_2-C_6 haloalkynyl, C_1-C_6 haloalkyloxy, C_2-C_6 haloalkenyloxy, C_3-C_{10} cycloalkyl, C_3-Ci_0 cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, oxo, ORi_0, $S(O)_nR_{10}$, C_6-C_2o aryl, or C_1-C_{20} heterocyclyl, each of which is unsubstituted, substituted, or substituted with $R_{10;}$

(i) **R_{10}** is selected from hydrogen, CN, substituted or unsubstituted $C_{,}$-C_6 alkyl, substituted or unsubstituted C_2-C_6 alkenyl, substituted or unsubstituted C_1-C_6 alkoxy, substituted or unsubstituted C_2-C_6 alkenyloxy, substituted or unsubstituted C_3-Ci_0 cycloalkyl, substituted or unsubstituted C_3-C_{10} cycloalkenyl, substituted or unsubstituted C_6-C_{20} aryl, substituted or unsubstituted C_1-C_{20} heterocyclyl, substituted or unsubstituted $S(0)_nC_1$-C_6 alkyl, or substituted or unsubstituted $N(Ci$-$C_6alkyl)_2Rs$ is substituted or unsubstituted C_1-C_{12} alkenyl, substituted or unsubstituted C_1-C_{12} alkyl, or substituted or unsubstituted C_3-C_{10} cycloalkyl,

wherein each said R_{10}, when substituted, has one or more substituents selected from F, CI, Br, I, CN, $N0_2$, Ci-Cs alkyl, C_2-C_6 alkenyl, $C_{,}$-C_6 haloalkyl, C_2-C_6 haloalkenyl, $C_{,}$-C_6 haloalkyloxy, C_2-C_6 haloalkenyloxy, C_3-C_{10} cycloalkyl, C_3-C_{10} cycloalkenyl, C_3-C_{10} halocycloalkyl, C_3-C_{10} halocycloalkenyl, $OC_{,}$-C_6 alkyl, $OC_{,}$-C_6 haloalkyl, $S(0)_nC_{,}$-C_6a]kyl, $S(0)_nOC_{,}$-C_6 alkyl, C_6-C_{20} aryl, or Ci-C_{20} heterocyclyl;

(j) **Q** and X_1 are independently oxygen (O) or sulfur (S);

(k) n is 0, 1, or 2; and

(1) Z is N or C-R_3.

2. The composition of claim 1, wherein **R_1, R_2**, and **R_4** are hydrogen.

3. The composition of claim 1,wherein **R_3** is hydrogen, F, CI, Br, or 1

4. The composition of claim 1, wherein **R_3** is hydrogen or F.

5. The composition of claim 1, wherein **R_5** is selected from F, CI, Br, I, or unsubstituted $C_{,}$-C_6 alkyl.

6. The composition of claim 1, wherein **R_5** is CI or CH_3.

7. The composition of claim 1, wherein **Y-C ≡C-R«** is $CH_2C{\equiv}CH$ or $CH(CH_3)C{\equiv}CH$.

8. The composition of claim 1, wherein R_7 is $(Ci$-$C_6)$alkyl-$S(0)_n$-(Cj-C6)alkyl, (C,-C,)alkyl-S(0),HC, -C_6)haloalkyl, or $(C_1$-$C_6)$alkyl- $S(0)_{,,}$- $(C_1$-$C_6)$alkyl-$(C_{3\text{-}C6})$halocycloalkyl.

9. The composition claim 1, wherein **Q** and ***X*$_1$** are independently oxygen (O).

10. The composition claim 1, wherein **n** is 0 or 1.

11. The composition claim 1, wherein **Z** is C-R$_3$.

12. The composition of claim 1, further comprising:

(a) one or more compounds having acaricidal, algicidal, avicidal, bactericidal, fungicidal, herbicidal, insecticidal, molluscicidal, nematicidal, rodenticidal, or virucidal properties; or

(b) 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, or synergists; or

(c) both (a) and (b).

13. The composition of claim 1, further comprising one or more compounds selected from: (3-ethoxypropyl)mercury bromide, 1,2-dichloropropane, 1,3-dichloropropene, 1-methylcyclopropene, 1-naphthol, 2-(octylthio)ethanol, 2,3,5-tri-iodobenzoic acid, 2,3,6-TBA, 2,3,6-TBA-dimethylammonium, 2,3,6-TBA-lithium, 2,3,6-TBA-potassium, 2,3,6-TBA-sodium, 2,4,5-T, 2,4,5-T-2-butoxypropyl, 2,4,5-T-2-ethylhexyl, 2,4,5-T-3-butoxypropyl, 2,4,5-TB, 2,4,5-T-butometyl, 2,4,5-T-butotyl, 2,4,5-T-butyl, 2,4,5-T-isobutyl, 2,4,5-T-isoctyl, 2,4,5-T-isopropyl, 2,4,5-T-methyl, 2,4,5-T-pentyl, 2,4,5-T-sodium, 2,4,5-T-triethylammonium, 2,4,5-T-trolamine, 2,4-D, 2,4-D-2-butoxypropyl, 2,4-D-2-ethylhexyl, 2,4-D-3-butoxypropyl, 2,4-D-ammonium, 2,4-DB, 2,4-DB-butyl, 2,4-DB-dimethylammonium, 2,4-DB-isoctyl, 2,4-DB-potassium, 2,4-DB-sodium, 2,4-D-butotyl, 2,4-D-butyl, 2,4-D-diethylammonium, 2,4-D-dimethylammonium, 2,4-D-diolamine, 2,4-D-dodecylammonium, 2,4-DEB, 2,4-DEP, 2,4-D-ethyl, 2,4-D-heptylammonium, 2,4-D-isobutyl, 2,4-D-isoctyl, 2,4-D-isopropyl, 2,4-D-isopropylammonium, 2,4-D-lithium, 2,4-D-meptyl, 2,4-D-methyl, 2,4-D-octyl, 2,4-D-pentyl, 2,4-D-potassium, 2,4-D-propyl, 2,4-D-sodium, 2,4-D-tefuryl, 2,4-D-tetradecylammonium, 2,4-D-triethylammonium, 2,4-D-rris(2-hydroxypropyl)ammonium, 2,4-D-trolamine, 2iP, 2-methoxyethylmercury chloride, 2-phenylphenol, 3,4-DA, 3,4-DB, 3,4-DP, 4-aminopyridine, 4-CPA, 4-CPA-potassium, 4-CPA-sodium, 4-CPB, 4-CPP, 4-hydroxyphenethyl alcohol, 8-hydroxyquinoline sulfate, 8-phenylmercurioxyquinoline, abamectin, abscisic acid, ACC, acephate, acequinocyl, acetamiprid, acethion, acetochlor, acetophos, acetoprole, acibenzolar, acibenzolar-S-methyl, acifluorfen, acifluorfen-methyl, acifluorfen-sodium, aclonifen, acrep, acrinathrin, acrolein, acrylonitrile, acypetacs, acypetacs-copper, acypetacs-zinc, alachlor, alanycarb, albendazole, aldicarb, aldimorph, aldoxycarb, aldrin, allethrin, allicin, allidochlor, allosamidin, alloxydim, alloxydim-sodium, allyl alcohol, allyxycarb, alorac, a/j9¾a-cypermethrin, *alpha*-endosulfan, ametoctradin, ametridione, ametryn, amibuzin, amicarbazone, amicarthiazol, amidithion, amidoflumet, amidosulfuron, aminocarb, aminocyclopyrachlor, aminocyclopyrachlor-methyl, aminocyclopyrachlor-potassium, aminopyralid, aminopyralid-potassium, aminopyralid-tris(2-hydroxypropyl)ammonium, amiprofos-methyl, amiprophos, amisulbrom, amiton, amiton oxalate, amitraz, amitrole, ammonium sulfamate, ammonium a-naphthaleneacetate, amobam, ampropylfos, anabasine, ancymidol, anilazine, anilofos, anisuron, anthraquinone, antu, apholate, aramite, arsenous oxide, asomate, aspirin, asulam, asulam-potassium, asulam-sodium, athidathion, atraton, atrazine, aureofungin, aviglycine, aviglycine hydrochloride, azaconazole, azadirachtin, azafenidin, azamethiphos, azimsulfuron, azinphos-ethyl, azinphos-methyl, aziprotryne, azithiram, azobenzene, azocyclotin, azothoate, azoxystrobin, bachmedesh, barban, barium hexafluorosilicate, barium polysulfide, barthrin, BCPC, beflubutamid, benalaxyl, benalaxyl-M, benazolin, benazolin-dimethylammonium, benazolin-ethyl, benazolin-potassium, bencarbazone, benclothiaz, bendiocarb, benfluralin, benfuracarb, benfuresate, benodanil, benomyl, benoxacor, benoxafos, benquinox, bensulfuron, bensulfuron-methyl, bensulide, bensultap, bentaluron, bentazone, bentazone-sodium, benthiavalicarb, benthiavalicarb-isopropyl, benthiazole, bentranil, benzadox, benzadox-ammonium, benzalkonium chloride, benzamacril, benzamacril-isobutyl, benzamorf,

benzfendizone, benzipram, benzobicyclon, benzofenap, benzofluor, benzohydroxamic acid, benzoximate, benzoylprop, benzoylprop-ethyl, benzthiazuron, benzyl benzoate, benzyladenine, berberine, berberine chloride, fteto-cyflutnrin, feta-cypermethrin, bethoxazin, bicyclopyrone, bifenazate, bifenox, bifenthrin, bifujunzhi, bilanafos, bilanafos-sodium, binapacryl, bingqingxiao, bioallethrin, bioethanomethrin, biopermethrin, bioresmethrin, biphenyl, bisazir, bismerthiazol, bispyribac, bispyribac-sodium, bistrifluron, bitertanol, bithionol, bixafen, blasticidin-S, borax, Bordeaux mixture, boric acid, boscalid, brassinolide, brassinolide-ethyl, brevicomin, brodifacoum, brofenvalerate, brofluthrinate, bromacil, bromacil-lithium, bromacil-sodium, bromadiolone, bromethalin, bromethrin, bromfenvinfos, bromoacetamide, bromobonil, bromobutide, bromocyclen, bromo-DDT, bromofenoxim, bromophos, bromophos-ethyl, bromopropylate, bromothalonil, bromoxynil, bromoxynil butyrate, bromoxynil heptanoate, bromoxynil octanoate, bromoxynil-potassium, brompyrazon, bromuconazole, bronopol, bucarpolate, bufencarb, buminafos, bupirimate, buprofezin, Burgundy mixture, busulfan, butacarb, butachlor, butafenacil, butamifos, butathiofos, butenachlor, butethrin, buthidazole, buthiobate, buthiuron, butocarboxim, butonate, butopyronoxyl, butoxycarboxim, butralin, butroxydim, buturon, butylamine, butylate, cacodylic acid, cadusafos, cafenstrole, calcium arsenate, calcium chlorate, calcium cyanamide, calcium polysulfide, calvinphos, cambendichlor, camphechlor, camphor, captafol, captan, carbamorph, carbanolate, carbaryl, carbasulam, carbendazim, carbendazim benzenesulfonate, carbendazim sulfite, carbetamide, carbofuran, carbon disulfide, carbon tetrachloride, carbophenothion, carbosulfan, carboxazole, carboxide, carboxin, carfentrazone, carfentrazone-ethyl, carpropamid, cartap, cartap hydrochloride, carvacrol, carvone, CDEA, cellocidin, CEPC, ceralure, Cheshunt mixture, chinomethionat, chitosan, chlobenthiazone, chlomethoxyfen, chloralose, chloramben, chloramben-ammonium, chloramben-diolamine, chloramben-methyl, chloramben-methylammonium, chloramben-sodium, chloramine phosphorus, chloramphenicol, chloraniformethan, chloranil, chloranocryl, chlorantraniliprole, chlorazifop, chlorazifop-propargyl, chlorazine, chlorbenside, chlorbenzuron, chlorbicyclen, chlorbromuron, chlorbufam, chlordane, chlordecone, chlordimeform, chlordimeform hydrochloride, chlorempenthrin, chlorethoxyfos, chloreturon, chlorfenac, chlorfenac-ammonium, chlorfenac-sodium, chlorfenapyr, chlorfenazole, chlorfenethol, chlorfenprop, chlorfenson, chlorfensulphide, chlorfenvinphos, chlorfluazuron, chlorflurazole, chlorfluren, chlorfluren-methyl, chlorflurenol, chlorflurenol-methyl, chloridazon, chlorimuron, chlorimuron-ethyl, chlormephos, chlormequat, chlormequat chloride, chlornidine, chlornitrofen, chlorobenzilate, chlorodinitronaphthalenes, chloroform, chloromebuform, chloromethiuron, chloroneb, chlorophacinone, chlorophacinone-sodium, chloropicrin, chloropon, chloropropylate, chlorothalonil, chlorotoluron, chloroxuron, chloroxynil, chlorphonium, chlorphonium chloride, chlorphoxim, chlorprazophos, chlorprocarb, chlorpropham, chlorpyrifos, chlorpyrifos-methyl, chlorquinox, chlorsulfuron, chlorthal, chlorthal-dimethyl, chlorthal-monomethyl, chlorthiamid, chlorthiophos, chlozolinate, choline chloride, chromafenozide, cinerin I, cinerin II, cinerins, cinidon-ethyl, cinmethylin, cinosulfuron, ciobutide, cisanilide, cismethrin, clethodim, climbazole, cliodinate, clodinafop, clodinafop-propargyl, cloethocarb, clofencet, clofencet-potassium, clofentezine, clofibric acid, clofop, clofop-isobutyl, clomazone, clomeprop, cloprop, cloproxydim, clopyralid, clopyralid-methyl, clopyralid-olamine, clopyralid-potassium, clopyralid-tris(2-hydroxypropyl)ammonium, cloquintocet, cloquintocet-mexyl, cloransulam, cloransulam-methyl, closantel, clothianidin, clotrimazole, cloxyfonac, cloxyfonac-sodium, CMA, codlelure, colophonate, copper acetate, copper acetoarsenite, copper arsenate, copper carbonate, basic, copper hydroxide, copper naphthenate, copper oleate, copper oxychloride, copper silicate, copper sulfate, copper zinc chromate, coumachlor, coumafuryl, coumaphos, coumatetralyl, coumithoate, coumoxystrobin, CPMC, CPMF, CPPC, credazine, cresol, crimidine, crotamiton, crotoxyphos, crufomate, cryolite, cue-lure, cufraneb, cumyluron, cuprobam, cuprous oxide, curcumenol, cyanamide, cyanatryn, cyanazine, cyanofenphos, cyanophos, cyanthoate, cyantraniliprole, cyazofamid, cybutryne, cyclafuramid, cyclanilide, cyclethrin, cycloate, cycloheximide, cycloprate, cycloprothrin, cyclosulfamuron, cycloxydim, cycluron, cyenopyrafen, cyflufenamid, cyflumetofen, cyfluthiin, cyhalofop, cyhalofop-butyl, cyhalothrin, cyhexatin, cymiazole, cymiazole hydrochloride, cymoxanil, cyometrinil, cypendazole, cypermethrin, cyperquat, cyperquat chloride, cyphenothrin, cyprazine, cyprazole, cyproconazole, cyprodinil, cyprofuram, cypromid, cyprosulfamide, cyromazine, cythioate, daimuron, dalapon, dalapon-calcium, dalapon-magnesium, dalapon-sodium, daminozide, dayoutong, dazomet, dazomet-sodium, DBCP, *d*-camphor, DCIP, DCPTA, DDT, debacarb, decafentin, decarbofuran, dehydroacetic acid, delachlor, deltametlirin, demephion, demephion-O, demephion-S, demeton, demeton-methyl, demeton-O, demeton-O-methyl, demeton-S, demeton-S-methyl, demeton-S-methylsulphon, desmedipham, desmetryn, *d*-fanshiluquebingjuzhi, diafenthiuron, dialifos, di-allate, diamidafos, diatomaceous earth, diazinon, dibutyl phthalate, dibutyl succinate, dicamba, dicamba-diglycolamine, dicamba-dimethylammonium, dicamba-diolamine, dicamba-isopropylammonium, dicamba-methyl, dicamba-olamine, dicamba-potassium, dicamba-sodium, dicamba-trolamine, dicapthon, dichlobenil, dichlofenthion, dichlofluanid, dichlone, dichloralurea, dichlorbenzuron, dichlorflurenol, dichlorflurenol-methyl, dichlonnate, dichlormid, dichlorophen, dichlorprop, dichlorprop-2-ethylliexyl, dichlorprop-butotyl, dichloϕ rop-dimethylammonium, dichloϕ rop-ethylammonium, dichloϕ rop-isocty], dichloϕ rop-methyl, dich]oϕ rop-P, dichloϕ rop-P-2-ethylhexyl, dich]orprop-P-dimethylammonium, dichloϕ rop-potassium, dichlorprop-sodium, dichlorvos, dichlozoline, diclobutrazol, diclocymet, diclofop, diclofop-methyl, diclomezine, diclomezine-sodium, dicloran, diclosulam, dicofol, dicoumarol, dicresyl, dicrotophos, dicyclanil, dicyclonon, dieldrin, dienochlor, diethamquat, diethamquat dichloride, diethatyl, diethatyl-ethyl, diethofencarb, dietholate, diethyl pyrocarbonate, diethyltoluamide, difenacoum, difenoconazole, difenopenten, difenopenten-ethyl, difenoxuron, difenzoquat, difenzoquat metilsulfate, difethialone, diflovidazin, diflubenzuron, diflufenican, diflufenzopyr, diflufenzopyr-sodium, diflumetorim, dikegulac, dikegulac-sodium, dilor, dimatif, dimefiuthrin, dimefox, dimefuron, dimepiperate, dimetachlone, dimetan, dimethacarb, dimethachior, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethirimol, dimethoate, dimethomorph, dimethrin, dimethyl carbate, dimethyl phthalate, dimethylvinphos, dimetilan, dimexano, dimidazon, dimoxystrobin, dinex, dinex-diclexine, dingjunezuo, diniconazole, diniconazole-M, dinitramine, dinobuton, dinocap, dinocap-4, dinocap-6, dinocton, dinofenate, dinopenton, dinoprop, dinosam, dinoseb, dinoseb acetate, dinoseb-ammonium, dinoseb-diolamine, dinoseb-sodium, dinoseb-trolamine, dinosulfon, dinotefiiran, dinoterb, dinoterb acetate, dinoterbon, diofenolan, dioxabenzofos, dioxacarb, dioxathion, diphacinone, diphacinone-sodium, diphenamid, diphenyl sulfone, diphenylamine, dipropalin, dipropetryn, dipyrithione, diquat, diquat dibromide, disparlure, disul, disulfiram, disulfoton, disul-sodium, ditalimfos, dithianon, dithicrofos, dithioether, dithiopyr, diuron, d-limonene, DMPA, DNOC, DNOC-ammonium, DNOC-potassium, DNOC-sodium, dodemorph, dodemorph acetate, dodemorph benzoate, dodicin, dodicin hydrochloride, dodicin-sodium, dodine, dofenapyn, dominicalure, doramectin, drazoxolon, DSMA, dufulin, EBEP, EBP, ecdysterone, edifenphos, eglinazine, eglinazine-ethyl, emamectin, emamectin benzoate, EMPC, empenthrin, endosulfan, endothal, endothal-diammonium, endothal-dipotassium, endothal-disodium, endothion, endrin, enestroburin, EPN, epocholeone, epofenonane, epoxiconazole, eprinomectin, epronaz, EPTC, erbon, ergocalciferol, erlujixiancaoan, esdepallethrine, esfenvalerate, esprocarb, etacelasil, etaconazole, etaphos, etem, ethaboxam, ethachlor, ethalfluralin, ethametsulfuron, ethametsulfuron-methyl, ethaprochlor, ethephon, ethidimuron, ethiofencarb, ethiolate, ethion, ethiozin, ethiprole, ethirimol, ethoate-methyl, ethoilimesate, ethohexadiol, ethoprophos, ethoxyfen, ethoxyfen-ethyl, ethoxyquin, ethoxysuliuron, ethychlozate, ethyl formate, ethyl α-naphthaleneacetate, ethyl-DDD, ethylene, ethylene dibromide, ethylene dichloride, ethylene oxide, ethylicin, ethylmercury 2,3-dihydroxypropyl mercaptide, ethylmercury acetate, ethylmercury bromide, ethylmercury chloride, ethylmercury phosphate, etinofen, etnipromid, etobenzanid, etofenprox, etoxazole, etridiazole, etrimfos, eugenol, EXD, famoxadone, famphur, fenaiTiidone, fenaminosulf, fenamiphos, fenapanil, fenarimol, fenasulam, fenazaflor, fenazaquin, fenbuconazole, fenbutatin oxide, fenchlorazole, fenchlorazole-ethyl, fenchlorphos, fenclorim, fenethacarb, fenfluthnn, fenfuram, fenhexamid, fenitropan, fenitrothion, fenjuntong, fenobucarb, fenoprop, fenoprop-3-butoxypropyl, fenoprop-butometyl, fenoprop-butotyl, fenoprop-butyl, fenoprop-isoctyl, fenoprop-methyl, fenoprop-potassium, fenothiocarb, fenoxacrim, fenoxanil, fenoxaprop, fenoxaprop-ethyl, fenoxaprop-P, fenoxaprop-P-ethyl, fenoxasulfone, fenoxycarb, fenpiclonil, fenpirithrin, fenpropathrin, fenpropidin, fenpropimorph, fenpyrazamine, fenpyroximate, fenridazon, fenridazon-potassium, fenridazon-propyl, fenson, fensulfothion, fenteracol, fenthiaprop, fenthiaprop-ethyl, fenthion, fenthion-ethyl, fentin, fentin acetate, fentin chloride, fentin hydroxide, fentrazamide, fenrrifanil, fenuron, fenuron TCA, fenvalerate, ferbam, ferimzone, ferrous sulfate, fipronil, flamprop, flamprop-isopropyl, flamprop-M, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, flocoumafen, flometoquin, flonicamid, florasulam, fluacrypyrim, fluazifop, fluazifop-butyl, fluazifop-methyl, fluazifop-P, fluazifop-P-butyl, fluazinam, fluazolate, fluazuron, flubendiamide, flubenzimine, flucarbazone, flucarbazone-sodium, flucetosulfuron, fluchloralin, flucofuron, flucycloxuron, flucythrinate, fludioxonil, fluenetil, fluensulfone, flufenacet, flufenerim, flufenican, flufenoxuron, flufenprox, flufenpyr, flufenpyr-ethyl, flufiprole, flumethrin, flumetover, flumetralin, fiumetsulam, flumezin, flumiclorac, flumiclorac-pentyl, flumioxazin, flumipropyn, flumorph, fluometuron, fluopicolide, fluopyram, fluorbenside, fluoridamid, fluoroacetamide, fluorodifen, fluoroglycofen, fluoroglycofen-ethyl, fluoroimide, fluoromidine, fluoronitrofen, fluothiuron, fluotrimazole, fluoxastrobin, flupoxam, flupropacil, flupropadine, flupropanate, flupropanate-sodium, flupyradifiirone, flupyrsulfuron, flupyrsulfuron-methyl, flupyrsulfiiron-methyl-sodium, fluquinconazole, flurazole, flurenol, flurenol-butyl, flurenol-methyl, fluridone, flurochloridone, fluroxypyr, fluroxypyr-butometyl, fluroxypyr-meptyl, flurprimidol, flursulamid, flurtamone, flusilazole, flusulfamide, fluthiacet, fluthiacet-methyl, flutianil, flutolanil, flutriafol, fluvalinate, fluxapyroxad, fluxofenim, folpet, fomesafen, fomesafen-sodium, fonofos, foramsulfuron, forchlorfenuron, formaldehyde, formetanate, formetanate hydrochloride, formothion, formparanate, formparanate hydrochloride, fosamine, fosamine-ammonium, fosetyl, fosetyl-aluminium, fosmethilan, fospirate, fosthiazate, fosthietan, frontalin, fuberidazole, fucaojing, fucaomi, funaihecaoling, fuphenthiourea, furalane, furalaxyl, furamethrin, furametpyr, furathiocarb, furcarbanil, furconazole, furconazole-cis, furethrin, furfural, furilazole, furmecyclox, furophanate, furyloxyfen, *gamma*-cyhalothrin, *gamma*-HCH, genit, gibberellic acid, gibberellins, gliftor, glufosinate, glufosinate-ammonium, glufosinate-P, glufosinate-P-ammonium, glufosinate-P-sodium, glyodin, glyoxime, glyphosate, glyphosate-diammonium, glyphosate-dimethylammonium, glyphosate-isopropylammonium, glyphosate-monoammonium, glyphosate-potassium, glyphosate-sesquisodium, glyphosate-trimesium, glyphosine, gossyplure, grandlure, griseofulvin, guazatine, guazatine acetates, halacrinate, halfenprox, halofenozide, halosafen, halosulfuron, halosulfuron-methyl, haloxydine, haloxyfop, haloxyfop-etotyl, haloxyfop-methyl, haloxyfop-P, haloxyfop-P-etotyl, haloxyfop-P-methyl, haloxyfop-sodium, HCH, hemel, hempa, HEOD, heptachlor, heptenophos, heptopargil, heterophos, hexachloroacetone, hexachlorobenzene, hexachlorobutadiene, hexachlorophene, hexaconazole, hexaflumuron, hexaflurate, hexalure, hexamide, hexazinone, hexylthiofos, hexythiazox, HHDN, holosulf, huancaiwo, huangcaoling, huanjunzuo, hydramethylnon, hydrargaphen, hydrated lime, hydrogen cyanide, hydroprene, hymexazol, hyquincarb, IAA, IBA, icaridin, imazalil, imazalil nitrate, imazalil sulfate, imazamethabenz, imazamethabenz-methyl, imazamox, imazamox-ammonium, imazapic, imazapic-ammonium. imazapyr, imazapyr-isopropylammonium, imazaquin, imazaquin-ammonium, imazaquin-methyl, imazaquin-sodium, imazethapyr, imazethapyr-ammonium, imazosulfuron, imibenconazole, imicyafos, imidacloprid, imidaclothiz, iminoctadine, iminoctadine triacetate, iminoctadine trialbesilate, imiprothrin, inabenfide, indanofan, indaziflam, indoxacarb, inezin, iodobonil, iodocarb, iodomethane, iodosulfuron, iodosulfuron-methyl, iodosulfuron-methyl-sodium, iofensulfuron, iofensulfuron-sodium, ioxynil, ioxynil octanoate, ioxynil-lithium, ioxynil-sodium, ipazine, ipconazole, ipfencarbazone, iprobenfos, iprodione, iprovalicarb, iprymidam, ipsdienol, ipsenol, 1PSP, isamidofos, isazofos, isobenzan, isocarbamid, isocarbophos, isocil, isodrin, isofenphos, isofenphos-methyl, isolan, isomethiozin, isonoruron, isopolinate, isoprocarb, isopropalin, isoprothiolane, isoproturon, isopyrazam, isopyrimol, isothioate, isotianil, isouron, isovaledione, isoxaben, isoxachlortole, isoxadifen, isoxadifen-ethyl, isoxaflutole, isoxapyrifop, isoxathion, ivermectin, izopamfos, japonilure, japothrins, jasmolin I, jasmolin II, jasmonic acid, jiahuangchongzong, jiajizengxiaolin, jiaxiangjunzhi, jiecaowan, jiecaoxi, jodfenphos, juvenile hormone I, juvenile hormone II, juvenile hormone III, kadethrin, karbutilate, karetazan, karetazan-potassium, kasugamycin, kasugamycin hydrochloride, kejunlin, kelevan, ketospiradox, ketospiradox-potassium, kinetin, kinoprene, kresoxim-methyl, kuicaoxi, lactofen, lambda-cyhalothrin, latilure, lead arsenate, lenacil, lepimectin, leptophos, lindane, lineatin, linuron, lirimfos, litlure, looplure, lufenuron, lvdingjunzhi, lvxiancaolin, lythidathion, MAA, malathion, maleic hydrazide, malonoben, maltodextrin, MAMA, mancopper, mancozeb, mandipropamid, maneb, matrine, mazidox, MCPA, MCPA-2-ethylhexyl, MCPA-butotyl, MCPA-butyl, MCPA-dimethylammonium, MCPA-diolamine, MCPA-ethyl, MCPA-isobutyl, MCPA-isoctyl, MCPA-isopropyl, MCPA-methyl, MCPA-olamine, MCPA-potassium, MCPA-sodium, MCPA-thioethyl, MCPA-trolamine, MCPB, MCPB-ethyl, MCPB-methyl, MCPB-sodium, mebenil, mecarbam, mecarbinzid, mecarphon, mecoprop, mecoprop-2-ethylhexyl, mecoprop-dimethylammonium, mecoprop-diolamine, mecoprop-ethadyl, mecoprop-isoctyl, mecoprop-methyl, mecoprop-P, mecoprop-P-2-ethylhexyl, mecoprop-P-dimethylammonium, mecoprop-P-isobutyl, mecoprop-potassium, mecoprop-P-potassium, mecoprop-sodium, mecoprop-trolamine, medimeform, medinoterb, medinoterb acetate, medlure, mefenacet, mefenpyr, mefenpyr-diethyl, mefluidide, mefluidide-diolamine, mefluidide-potassium, megatomoic acid, menazon, mepanipyrim, meperfluthrin, mephenate, mephosfolan, mepiquat, mepiquat chloride, mepiquat pentaborate, mepronil, meptyldinocap, mercuric chloride, mercuric oxide, mercurous chloride, merphos, mesoprazine, mesosulfuron, mesosulfuron-methyl, mesotrione, mesulfen, mesulfenfos, metaflumizone, metalaxyl, metalaxyl-M, metaldehyde, metam, metam-ammonium, metamifop, metamitron, metam-potassium, metam-sodium, metazachlor, metazosulfuron, metazoxolon, metconazole, metepa, metflurazon, methabenzthiazuron, methacrifos, methalpropalin, methamidophos, methasulfocarb, methazole, methfuroxam, methidathion, methiobencarb, methiocarb, methiopyrisulfuron, methiotepa, methiozolin, methiuron, methocrotophos, methometon, methomyl, methoprene, methoprotryne, methoquin-butyl, methothrin, methoxychlor, methoxyfenozide, methoxyphenone, methyl apholate, methyl bromide, methyl eugenol, methyl iodide, methyl isothiocyanate, methylacetophos, methylchloroform, methyldymron, methylene chloride, methylmercury benzoate, methylmercury dicyandiamide, methylmercury pentachlorophenoxide, methylneodecanamide, metiram, metobenzuron, metobromuron, metofluthrin, metolachlor, metolcarb, metominostrobin, metosulam, metoxadiazone, metoxuron, metrafenone, metribuzin, metsulfovax, metsulfuron, metsulfuron-methyl, mevinphos, mexacarbate, mieshuan, milbemectin, milbemycin oxime, milneb, mipafox, mirex, MNAF, moguchun, molinate, molosultap, monalide, monisouron, monochloroacetic acid, monocrotophos, monolinuron, monosulfuron, monosulfuron-ester, monuron, monuron TCA, morfamquat, morfamquat dichloride, moroxydine, moroxydine hydrochloride, morphothion, morzid, moxidectin, MSMA, muscalure, myclobutanil, myclozolin, N-(ethylmercury)-p-toluenesulphonanilide, nabam, naftalofos, naled, naphthalene, naphthaleneacetamide, naphthalic anhydride, naphthoxyacetic acids, naproanilide, napropamide, naptalam, naptalam-sodium, natamycin, neburon, niclosamide, niclosamide-olamine, nicosulfiiron, nicotine, nifluridide, nipyraclofen, nitenpyram, nithiazine, nitralin, nitrapyrin, nitrilacarb, nitrofen, nitrofluorfen, nitrostyrene, nitrothal-isopropyl, norbormide, norflurazon, nornicotine, noruron, novaluron, noviflumuron, nuarimol, OCH, octachlorodipropyl ether, octhilinone, ofurace, omethoate, orbencarb, orfralure, ortho-dichlorobenzene, orthosulfamuron, oryctalure, orysastrobin, oryzalin, osthol, ostramone, oxabetrinil, oxadiargyl, oxadiazon, oxadixyl, oxamate, oxamyl, oxapyrazon, oxapyrazon-dimolamine, oxapyrazon-sodium, oxasulfuron, oxaziclomefone, oxine-copper, oxolinic acid, oxpoconazole, oxpoconazole fumarate, oxycarboxin, oxydemeton-methyl, oxydeprofos, oxydisulfoton, oxyfluorfen, oxymatrine, oxytetracycline, oxytetracycline hydrochloride, paclobutrazol, paichongding, para-dichlorobenzene, parafluron, paraquat, paraquat dichloride, paraquat dimetilsulfate, parathion, parathion-methyl, parinol, pebulate, pefiirazoate, pelargonic acid, penconazole, pencycuron, pendimethalin, penflufen, penfluron, penoxsulam, pentachlorophenol, pentanochlor, penthiopyrad, pentmethrin, pentoxazone, perfluidone, permethrin, pethoxamid, phenamacril, phenazine oxide, phenisopham, phenkapton, phenmedipham, phenmedipham-ethyl, phenobenzuron, phenothrin, phenproxide, phentlioate, phenylmercuriurea, phenylmercury acetate, phenylmercury chloride, phenylmercury derivative of pyrocatechol, phenylmercury nitrate, phenylmercury salicylate, phorate, phosacetim, phosalone, phosdiphen, phosfolan, phosfolan-methyl, phosglycin, phosmet, phosnichlor, phosphamidon, phosphine, phosphocarb, phosphorus, phostin, phoxim, phoxim-methyl, phthalide, picloram, picloram-2-ethylhexyl, picloram-isoctyl, picloram-methyl, picloram-olamine, picloram-potassium, picloram-triethylammonium, picloram-tris(2-hydroxypropyl)ammonium, picolinafen, picoxystrobin, pindone, pindone-sodium, pinoxaden, piperalin, piperonyl butoxide, piperonyl cyclonene, piperophos, piproctanyl, piproctanyl bromide, piprotal, pirimetaphos, pirimicarb, pirimioxyphos, pirimiphos-ethyl, pirimiphos-methyl, plifenate, polycarbamate, polyoxins, polyoxorim, polyoxorim-zinc, polythialan, potassium arsenite, potassium azide, potassium cyanate, potassium gibberellate, potassium naphthenate, potassium polysulfide, potassium thiocyanate, potassium a-naphthaleneacetate, ρρ'-ΌΌΥ, prallethrin, precocene 1, precocene II, precocene 111, pretilachlor, primidophos, primisulfuron, primisulfuron-methyl, probenazole, prochloraz, prochloraz-manganese, proclonol, procyazine, procymidone, prodiamine, profenofos, profluazol, profluralin, profluthrin, profoxydim, proglinazine, proglinazine-ethyl, prohexadione, prohexadione-calcium, prohydrojasmon, promacyl, promecarb, prometon, prometryn, promurit, propachlor, propamidine, propamidine dihydrochloride, propamocarb, propamocarb hydrochloride, propanil, propaphos, propaquizafop, propargite, proparthrin, propazine, propetamphos, propham, propiconazole, propineb, propisochlor, propoxur, propoxycarbazone, propoxycarbazone-sodium, propyl isome, propyrisulfuron, propyzamide, proquinazid, prosuler, prosulfalin, prosulfocarb, prosulfuron, prothidathion, prothiocarb, prothiocarb hydrochloride, prothioconazole, prothiofos, prothoate, protrifenbute, proxan. proxan-sodium, prynachlor, pydanon, pymetrozine, pyracarbolid, pyraclofos, pyraclonil, pyraclostrobin, pyraflufen, pyraflufen-ethyl, pyrafluprole, pyramat, pyrametostrobin, pyraoxystrobin, pyrasulfotole, pyrazolynate, pyrazophos, pyrazosulfliron, pyrazosulfuron-ethyl, pyrazothion, pyrazoxyfen, pyresmethrin, pyrethrin I, pyrethrin II, pyrethrins, pyribambenz-isopropyl, pyribambenz-propyl, pyribencarb, pyribenzoxim, pyributicarb, pyriclor, pyridaben, pyridafol, pyridalyl, pyridaphenthion, pyridate, pyridinitril, pyrifenox, pyrifluquinazon, pyriftalid, pyrimethanil, pyrimidifen, pyriminobac, pyriminobac-methyl, pyrimisulfan, pyrimitate, pyrinuron, pyriofenone, pyriprole, pyripropanol, pyriproxyfen, pyrithiobac, pyrithiobac-sodium, pyrolan, 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sodium orthophenylphenoxide, sodium pentachlorophenoxide, sodium polysulfide, sodium thiocyanate, sodium a-naphthaleneacetate, sophamide, spinetoram, spinosad, spirodiclofen, spiromesifen, spirotetramat, spiroxamine, streptomycin, streptomycin sesquisulfate, strychnine, sulcatol, sulcofuron, sulcofuron-sodium, sulcotrione, sulfallate, sulfentrazone, sulfiram, sulfluramid, sulfometuron, sulfometuron-methyl, sulfosulfuron, sulfotep, sulfoxaflor, sulfoxide, sulfoxime, sulfur, sulfuric acid, sulfuryl fluoride, sulglycapin, sulprofos, sultropen, swep, tow-fluvalinate, tavron, tazimcarb, TCA, TCA-ammonium, TCA-calcium, TCA-ethadyl, TCA-magnesium, TCA-sodium, TDE, tebuconazole, tebufenozide, tebufenpyrad, tebufloquin, tebupirimfos, tebutam, tebuthiuron, tecloftalam, tecnazene, tecoram, teflubenzuron, tefluthrin, tefiiryltrione, tembotrione, temephos, tepa, TEPP, tepraloxydim, terallethrin, terbacil, terbucarb, terbuchlor, terbufos, terbumeton, terbuthylazine, terbutryn, tetcyclacis, tetrachloroethane, tetrachlorvinphos, tetraconazole, tetradifon, tetrafluron, tetramethrin, tetramethylfluthrin, tetramine, tetranactin, tetrasul, thallium sulfate, thenylchlor, theta-cypermethrin, thiabendazole, thiacloprid, thiadifluor, thiamethoxam, thiapronil, thiazafluron, thiazopyr, thicrofos, thicyofen, tbidiazimin, thidiazuron, thiencarbazone, thiencarbazone-methyl, thifensulfuron, thifensulfuron-methyl, thifluzamide, thiobencarb, thiocarboxime, thioch!orfenphim, thiocyclam, thiocyclam hydrochloride, thiocyclam oxalate, thiodiazole-copper, thiodicarb, thiofanox, thiofluoximate, thiohempa, thiomersal, thiometon, thionazin, thiophanate, thiophanate-methyl, thioquinox, thiosemicarbazide, thiosultap, thiosultap-diammonium, thiosultap-disodium, thiosultap-monosodium, thiotepa, thiram, thuringiensin, tiadinil, tiaojiean, tiocarbazil, tioclorim, tioxymid, tirpate, tolclofos-methyl, tolfenpyrad, tolylfluanid, tolylmercury acetate, topramezone, tralkoxydim, tralocythrin, tralomethrin, tralopyril, transfluthrin, transpermethrin, tretamine, triacontanoi, triadimefon, triadimenol.

triafamone, tri-allate, triamiphos, triapenthenol, triarathene, triarimol, triasulfuron, triazamate, triazbutil, triaziflam, triazophos, triazoxide, tribenuron, tribenuron-methyl, tribufos, tributyltin oxide, tricamba, trichlamide, trichlorfon, trichlormetaphos-3, trichloronat, triclopyr, triclopyr-butoryl, triclopyr-ethyl, triclopyr-triethylammonium, tricyclazole, tridemorph, tridiphane, trietazine, triferImoϕ h, trifenofos, trifloxystrobin, trifloxysulfuron, trifloxysulfuron-sodium, triflumizole, triflumuron, trifluralin, triflusulfuron, triflusulfuron-methyl, trifop, trifop-methyl, trifopsime, triforine, trihydroxytriazine, trimedlure, trimethacarb, trimeturon, trinexapac, trinexapac-ethyl, triprene, tripropindan, triptolide, tritac, triticonazole, tritosulfuion, trunc-call, uniconazole, uniconazole-P, urbacide, uredepa, valerate, validamycin, valifenalate, valone, vamidothion, vangard, vaniliprole, vernolate, vinclozolin, warfarin, warfarin-potassium, warfarin-sodium, xiaochongliulin, xinjunan, xiwojunan, XMC, xylachlor, xylenols, xylylcarb, yishijing, zarilamid, zeatin, zengxiaoan, zeta-cypermethrin, zinc naphthenate, zinc phosphide, zinc thiazole, zineb, ziram, zolaprofos, zoxamide, zuomihuanglong, a-chlorohydrin, a-ecdysone, a-multistriatin, and a-naphthaleneacetic acid

14. The composition of claim 1, further comprising an agriculturally acceptable carrier.

15. The composition of claim 1, wherein the compound is in the form of a pesticidally acceptable acid addition salt, a salt derivative, or a hydrate.

16. The composition of claim 1, wherein the compound is a resolved stereoisomer.

17. The composition of claim 1, wherein the compound is in the form a crystal polymorph.

18. The composition of claim 1, wherein the compound comprises a ^{2}H in place of ^{1}H, or ^{13}C in place of a ^{12}C, or both.

19. The composition of claim 1, further comprising a biopesticide.

20. The composition of claim 1, further comprising at least one of the following compounds:

(a) 3-(4-chloro-2,6-dimethylphenyl)-4-hydrox7-8-oxa-l-azaspiro[4,5]dec-3-en-2-one;
(b) 3-(4'-chloro-2,4-dimethyl[l,l'-biphenyl]-3-yl)-4-hydroxy-8-oxa-l-azaspiro[4,5]dec-3-en-2-one;
(c) 4-[[(6-chloro-3-pyridinyl)methyl]methylamino]-2(5/¾-furanone;
(d) 4-[[(6-chloro-3-pyridinyl)methyl]cyclopropylamino]-2(5//)-furanone;
(e) 3-chloro-7V2-[(] 5)-l -methyl-2-(methylsulfonyl)ethyl]-M-[2-methyl-4-[l ,2,2,2-tetrafluoro-l -(trifluoromethyl)ethyl]phenyl]-] ,2-benzenedicarboxamide;
(f) 2-cyano-7V-ethyl-4-fluoro-3-methoxy-benenesulfonamide;
(g) 2-cyano-/V-ethyl-3-methoxy-benzenesulfonamide;

(h) 2-cyano-3-difluoromethoxy-iV-ethyl-4-fluoro-benzenesulfonamide;

(i) 2-cyano-3-fluoromethoxy-A/-ethyl-benzenesulfonamide;

(j) 2-cyano-6-fluoro-3-methoxy-A',^-dimethyl-benzenesulfonamide;

(k) 2-cyano-W-ethyl-6-fluoro-3-methoxy-A^-rnethyl-benzenesulfonamide;

(1) 2-cyano-3-difluoromethoxy-#,#-dirnethylbenzenesulfon-amide;

(m) 3-(difluoromethyl)-A^2-(3,3-dmeftylbuty^^ phenyl]-l-methyl-l*H*-pyrazole-4-carboxamide;

(n) *N*-emyl-2,2-dimemylpropionamide-2-(2,6-dichloro-α,α,α-trifluoro-*p*-tolyl) hydrazone;

(o) N-ethyl-2,2-dichloro-l-methylcycto^ropane-carboxamide-2-(2,6-dichloro-α,α,α-trifluoro-*p*-tolyl) hydrazone nicotine;

(p) 0-{(E-)-[2-(4-chloro-phenyl)-2-cyano-l-(2-trifluoromethylphenyl)-vinyl]}5-methyl thiocarbonate;

(q) (E)-M-[(2-chloro4,34hiazol-5-ylmethyl)]-A¾-cyano-M-methylacetamidine;

(r) l-(6-chloropyridin-3-ylmethyl)-7-methyl-8-nitro-l,23,5,6,7-hexahydro-imidazo[l,2-a]pyridin-5-ol;

(s) 4-[4-chlorophenyl-(2-butylidine-hydrazono)methyl)]pheny] mesylate; and

(t) N-Ethyl-2,2-dichloro-l-methylcyclopropanecarboxamide-2-(2,6-dichloro-a,a,a-trifluoro-/>-tolyl)hydrazine.

21. The composition of claim 1, further comprising a compound having one or more of the following modes of action: acetylcholinesterase inhibitor; sodium channel modulator; chitin biosynthesis inhibitor; GABA and glutamate-gated chloride channel antagonist; GABA and glutamate-gated chloride channel agonist; acetylcholine receptor agonist; acetylcholine receptor antagonist; MET I inhibitor; Mg-stimulated ATPase inhibitor; nicotinic acetylcholine receptor; Midgut membrane disrupter; oxidative phosphorylation disrupter, and ryanodine receptor (RyRs).

22. The composition of claim 1, further comprising a seed.

23. The composition of claim 1, further comprising a seed that has been genetically modified to express one or more specialized traits.

24. The composition of to claim 1, wherein the composition is encapsulated inside, or placed on the surface of, a capsule.

25. The composition of claim 1, wherein the composition is encapsulated inside, or placed on the surface of, a capsule, wherein the capsule has a diameter of about 100 microns to about 900 nanometers, or about 10 microns to about 900 microns.

26. The composition of claim 1, further comprising ammonium sulfate.

27. A method of controlling pest, comprising applying the composition of claim 26, to an area to control a pest, in an amount sufficient to control such pest.

28. A process comprising applying the composition of claim 1, to an area to control a pest, in an amount sufficient to control such pest.

29. The process of claim 28, wherein the pest is selected from beetles, earwigs, cockroaches, flies, aphids, scales, whiteflies, leafhoppers, ants, wasps, termites, moths, butterflies, lice, grasshoppers, locusts, crickets, fleas, thrips, bristletails, mites, ticks, nematodes, and symphylans.

30. The process of claim 28, wherein the pest is from the Phyla Nematoda or Arthropoda.

31. The process of claim 28, wherein the pest is from the Subphyla Chelicerata, Myriapoda, or Hexapoda.

32. The process of claim 28, wherein the pest is from the Class of Arachnida, Symphyla, or Insecta.

33. The process of claim 28, wherein the pest is from the Order Anoplura, Order Coleoptera, Order Dermaptera, Order Blattaria, Order Diptera, Order Hemiptera, Order Hymenoptera, Order Isoptera, Order Lepidoptera, Order Mallophaga, Order Orthoptera, Order Siphonaptera, Order Thysanoptera, Order Thysanura, Order Acarina, or Order Symphyla.

34. The process of claim 28, wherein the pest is MYZUPE or BEMITA.

35. The process of claim 28, comprising applying the composition from about 0.01 grams per hectare to about 5000 grams per hectare.

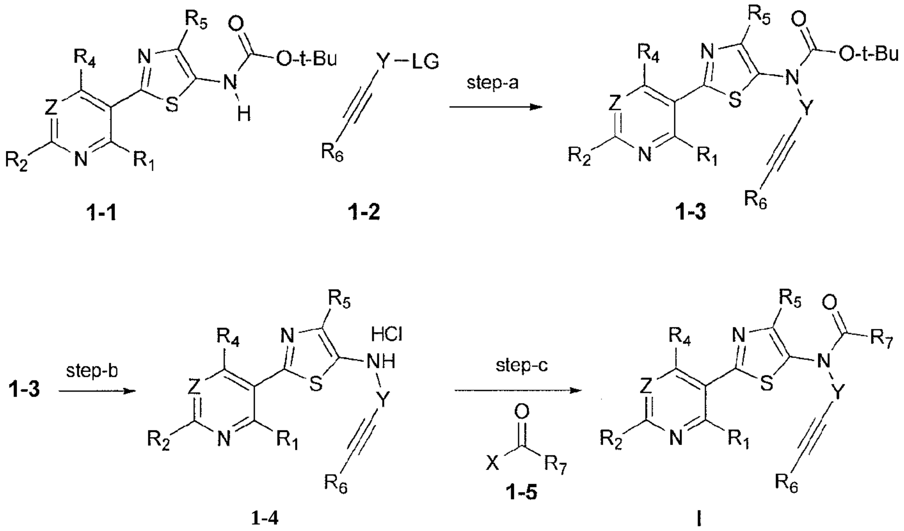
36. The process of claim 28, comprising applying the composition from about 0.1 grams per hectare to about 500 grams per hectare.

37. The process of claim 28, comprising applying the composition from about 1 gram per hectare to about 50 grams per hectare.

38. The process of claim 28, wherein the area to control a pest is an area where apples, corn, cotton, soybeans, canola, wheat, rice, sorghum, barley, oats, potatoes, oranges, alfalfa, lettuce, strawberries, tomatoes, peppers, crucifers, pears, tobacco, almonds, sugar beets, or beans, are growing, or the seeds thereof are going to be planted.

39. A process comprising applying the composition of cliam 1 to a genetically modified plant that has been genetically modified to express one or more specialized traits.

40. A method of preparing the composition of claim 1, the method comprising:



reacting a *tert*-butoxy carbamate compound of formula **1-1** with a base and then with an electrophile of formula **1-2**, wherein LG is halogen, alkyl sulfonate, or aryl sulfonate, to afford a thiazole compound of formula **1**-3;

treating the thiazole compound of formula **1-3** with an acid to afford a corresponding salt of formula **1-4;** and

reacting the salt of formula **1-4** with an acid chloride (X = CI) or a carboxylic acid (X= OH) of formula **1-5,** to provide the compound of formula **I,**

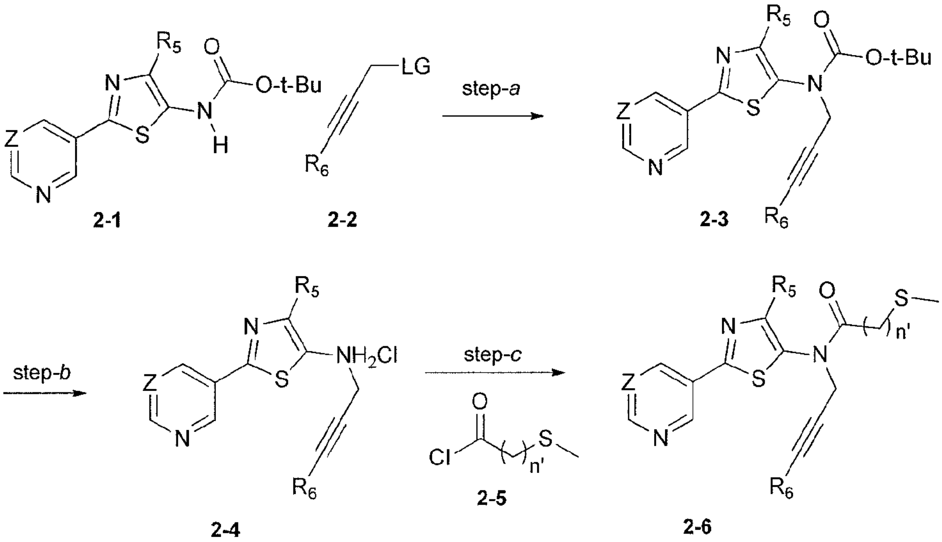
wherein **R„** R_2, R_4, R_5, R_6, **Ry, Y,** and Z are defined as in claim

41. A method of preparing the composition of claim 1, the method comprising:

reacting a *tert*-butoxy carbamate compound of formula 2-1 with a base and then with an electrophile of formula 2-2, to afford a compound of formula 2-3;

treating the compound of formula **2-3** with an acid to afford a corresponding salt of the formula **2-4;** and reacting the salt of formula **2-4** with an acid chloride of the formula **2-5,** where **n'** = 1 or 2, to provide a compound of the formula **2-6,**

wherein R_5, R_6_n', and Z, are defined as in claim 1.



42. A method of controlling pests, comprising applying the pesticidal composition of claim 1 near a population of pests.

43. The method of claim 42, wherein the pesticidal composition further comprises a phytologically-acceptable inert carrier.

44. The method of claim 42, wherein the pesticidal composition further comprises an additive selected from the group consisting of a surfactant, a stabilizer, an emetic agent, a disintegrating agent, an antifoaming agent, a wetting agent, a dispersing agent, a binding agent, dye, and filler.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/061049

A. CLASSIFICATION OF SUBJECT MATTER

AOIN 43/56(2006.01)i, AOIN 43/40(2006.01)i, AOIN 33/10(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
AOIN 43/56; A01P 7/00; A01N 43/78; A01N 43/54; A61K 31/44; A01N 25/00; C07D 417/14; C07D 401/04; A01N 43/40; A01N 33/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: 2-(pyridin-3-yl)thiazol-5-amine, pesticide, insecticide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	W0 2010-129497 Al (DOW AGROSCIENCES LLC) 11 November 2010 See abstract ; claims 2-3 ; and table 1.	1-44
A	WO 2013-010946 A2 (BASF SE) 24 January 2013 See abstract ; and claims 1-2, 6, 13-20 .	1-44
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A	US 2011-0319428 Al (FUBLEIN, MARTIN et al.) 29 December 2011 See abstract ; and claims 1-3 , 5-6 .	1-44
A	WO 2012-108511 Al (NISSAN CHEMICAL INDUSTRIES, LTD.) 16 August 2012 See abstract ; and claims 1-3 , 5, 10.	1-44

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

Date of the actual completion of the international search
26 January 2015 (26.01.2015)

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INTERNATIONAL SEARCH REPORT

information on patent family members

International application No.

PCT/US2014/061049

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