

TITLE

FUNGICIDAL AMIDES

FIELD OF THE INVENTION

This invention relates to certain amides, their *N*-oxides, salts and compositions, and methods
 5 of using them as fungicides.

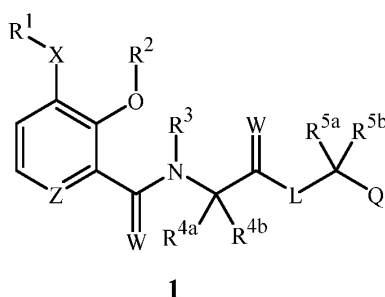
BACKGROUND OF THE INVENTION

The control of plant diseases caused by fungal plant pathogens is extremely important in
 achieving high crop efficiency. Plant disease damage to ornamental, vegetable, field, cereal and
 fruit crops can cause significant reduction in productivity and thereby result in increased costs to
 10 the consumer. Many products are commercially available for these purposes, but the need
 continues for new compounds which are more effective, less costly, less toxic, environmentally
 safer or have different sites of action.

PCT Patent Publications WO 2019/068812, WO 2019/068809, WO 2018/129237,
 WO 2018/129238 and WO 2019/224160 discloses picolinamide derivatives and their use as
 15 fungicides.

SUMMARY OF THE INVENTION

This invention is directed to compounds of Formula **1** (including all stereoisomers),
N-oxides, and salts thereof, agricultural compositions containing them and their use as fungicides:



20 wherein

Z is N or CR⁶;

each W is independently O or S;

X is O or NR⁷;

R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆
 25 cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₆ alkylcarbonyl, C₂-C₆ haloalkylcarbonyl,
 C₂-C₆ alkoxy carbonyl or C₂-C₆ haloalkoxy carbonyl;

- R^2 is H, $C(=W)NH_2$, $C(=O)R^8$, $C(=O)OR^9$, $S(=O)_mR^8$, $S(=O)_mOR^9$, $S(=O)_mNR^{10}R^{11}$,
 $CH_2C(=O)R^8$, $CH_2C(=O)OR^9$, $CH_2OC(=O)R^8$, $CH_2OC(=O)OR^9$,
 $CH_2NR^{12}C(=O)R^8$, $CH_2NR^{12}C(=O)OR^9$, $P(=W)R^{13}R^{14}$, $P(=W)(OR^{13})R^{14}$ or
 $P(=W)(OR^{13})OR^{14}$; or C_1 - C_6 alkyl, C_2 - C_6 alkenyl or C_1 - C_6 haloalkyl, each
5 optionally substituted with up to 3 substituents independently selected from R^{15} ; or
benzyl or phenethyl, each ring optionally substituted with up to 3 substituents
independently selected from R^{16} ; or tetrahydropyranyl, tetrahydrofuranyl,
pyrrolidinyl, 1,3-dioxolanyl or piperidinyl;
 R^3 is H, $CH(=O)$, $C(=O)R^{17}$, $C(=O)OR^{17}$ or OR^{17} ; or C_1 - C_6 alkyl or C_1 - C_6 haloalkyl; or
10 R^2 and R^3 are taken together with the atoms to which they are attached to form a 6-
membered nonaromatic ring containing ring members selected from carbon atoms
and optionally up to 1 ring member selected from $C(=O)$ or $C(=S)$, and optionally
substituted with up to 3 substituents independently selected from halogen, C_1 - C_2
alkyl, C_1 - C_2 haloalkyl, C_1 - C_2 alkoxy and C_1 - C_2 haloalkoxy;
15 R^{4a} is H, cyano, hydroxy, halogen, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkoxy, C_1 - C_3
haloalkoxy, C_2 - C_3 alkoxyalkyl, C_2 - C_3 haloalkoxyalkyl, C_1 - C_3 alkylsulfinyl or
 C_1 - C_3 alkylsulfonyl;
 R^{4b} is H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkoxy or C_2 - C_3 alkoxyalkyl;
L is O or NR^{18} ;
20 R^{5a} and R^{5b} are each independently H, cyano, hydroxy, halogen, C_1 - C_6 alkyl, C_1 - C_6
haloalkyl, C_2 - C_6 alkenyl, C_2 - C_6 haloalkenyl, C_2 - C_6 alkynyl, C_2 - C_6 haloalkynyl,
 C_3 - C_6 cycloalkyl or C_3 - C_6 halocycloalkyl; or
 R^{5a} and R^{5b} are taken together with the atom to which they are attached to form a 3-to
7- membered nonaromatic carbocyclic ring, the ring optionally substituted with up
25 to 3 substituents independently selected from halogen, C_1 - C_2 alkyl, C_1 - C_2 haloalkyl,
 C_1 - C_2 alkoxy and C_1 - C_2 haloalkoxy;
Q is phenyl optionally substituted with up to 5 substituents independently selected from
 R^{19} ; or
30 Q is a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected
from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up
to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents
independently selected from R^{19} ; or
Q is a 3- to 7-membered nonaromatic ring or a 7- to 14-membered bicyclic ring system,
each ring or ring system containing ring members selected from carbon atoms and

optionally up to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, wherein up to 2 ring members are independently selected from C(=O), C(=S), S(=O) and S(=O)₂, each ring or ring system optionally substituted with up to 5 substituents independently selected from R¹⁹;

5 R⁶ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₂-C₄ haloalkynyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl;

R⁷ is H, cyano, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

10 R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₁-C₆ alkylamino, C₁-C₆ haloalkylamino, C₂-C₆ alkoxyalkyl, C₂-C₆ alkylthioalkyl; or phenyl;

m is 1 or 2;

R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₆ alkoxyalkyl or C₂-C₆ alkylthioalkyl;

15 R¹⁰ and R¹¹ are each independently H, CH(=O), C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₄-C₈ alkylcycloalkyl or C₄-C₈ cycloalkylalkyl;

R¹² is H, cyano, CH(=O), C₁-C₃ alkyl or C₁-C₃ haloalkyl;

20 R¹³ and R¹⁴ are each independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl;

each R¹⁵ is independently cyano, hydroxy, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;

each R¹⁶ is independently halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;

25 R¹⁷ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl or C₂-C₆ alkoxyalkyl;

R¹⁸ is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl;

30 each R¹⁹ is independently cyano, halogen, hydroxy, nitro, CH(=O), C(=O)OH, NR^{20a}R^{20b}, C(=O)NR^{20a}R^{20b}, C(=S)NR^{20a}R^{20b}, C(R²¹)=NR²², N=CR²³NR^{24a}R^{24b} or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₃-C₆ cycloalkenyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ cycloalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ alkylaminosulfinyl, C₁-C₆ alkylaminosulfonyl, C₁-C₆ alkylsulfonyloxy, C₂-C₆ alkenylsulfonyloxy, C₂-C₆ alkylcarbonyl, C₃-C₆ alkenylcarbonyl, C₃-C₆

- alkynylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₃-C₆ alkenyloxy carbonyl, C₃-C₆ alkynyloxy carbonyl, C₄-C₇ cycloalkoxy carbonyl, C₂-C₆ alkylcarbonyloxy, C₃-C₆ alkenylcarbonyloxy, C₃-C₆ alkynylcarbonyloxy, C₄-C₇ cycloalkylcarbonyloxy, C₂-C₆ alkoxy carbonyloxy or C₃-C₆ alkenyloxy carbonyloxy, each optionally substituted with up to 4 substituents independently selected from R²⁵;
- each R^{20a} is independently H, cyano, hydroxy, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₂-C₄ haloalkynyl, C₁-C₄ alkoxy, C₂-C₄ alkoxyalkyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylsulfonyl, C₂-C₄ alkylthioalkyl, C₂-C₄ alkylsulfonylalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₃-C₅ alkenylcarbonyl, C₃-C₅ alkynylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₅ alkoxy carbonyl, C₃-C₅ alkoxy carbonylalkyl, C₂-C₅ alkylaminocarbonyl or C₃-C₅ dialkylaminocarbonyl;
- each R^{20b} is independently H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ hydroxyalkyl, C₂-C₆ cyanoalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₄-C₈ alkylcycloalkyl, C₄-C₈ cycloalkylalkyl, C₂-C₆ alkoxyalkyl, C₂-C₆ haloalkoxyalkyl, C₂-C₆ alkylthioalkyl or C₂-C₆ alkylaminoalkyl;
- each R²¹ is independently H, cyano, halogen, methyl, methoxy, methylthio or methoxycarbonyl;
- each R²² is independently hydroxy or NR^{26a}R^{26b}; or C₁-C₄ alkoxy, C₂-C₄ alkenyloxy, C₂-C₄ alkynyloxy or C₂-C₄ alkylcarbonyloxy, each optionally substituted with up to 1 substituent selected from cyano, halogen, hydroxy and C(=O)OH;
- each R²³ is independently H, methyl, methoxy or methylthio;
- each R^{24a} and R^{24b} is independently H or C₁-C₄ alkyl; or
- R^{24a} and R^{24b} are taken together to form a 4- to 6-membered fully saturated heterocyclic ring, each ring containing ring members, in addition to the connecting nitrogen atom, selected from carbon atoms and up to 2 heteroatoms independently selected from up to 2 O, up to 2 S and up to 2 N atoms, each ring optionally substituted with up to 2 methyl groups;
- each R²⁵ is independently amino, cyano, halogen, hydroxy, nitro, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₂-C₄ alkoxyalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl,

- C₁-C₄ haloalkylsulfonyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₂-C₅ alkoxy carbonyl, C₃-C₁₅ trialkylsilyl or C₃-C₁₅ halotrialkylsilyl;
each U is independently a direct bond, O, S(=O)_n, NR²⁷, C(=O)O, C(=O)N(R²⁸) or C(=S)N(R²⁹), wherein the atom to the left is connected to Q, and the atom to the right is connected to V;
n is 0, 1 or 2;
each V is independently a direct bond; or C₁-C₆ alkylene, C₂-C₆ alkenylene, C₃-C₆ alkynylene, C₃-C₆ cycloalkylene or C₃-C₆ cycloalkenylene, wherein up to 1 carbon atom is C(=O), each optionally substituted with up to 3 substituents independently selected from halogen, cyano, nitro, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;
each T is independently phenyl optionally substituted with up to 5 substituents independently selected from R³⁰; or
each T is independently a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents independently selected from R³⁰; or
each T is independently a 3- to 7-membered nonaromatic heterocyclic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, wherein up to 2 ring members are independently selected from C(=O), C(=S), S(=O) and S(=O)₂, each ring optionally substituted with up to 5 substituents independently selected from R³⁰;
each R^{26a} is independently H, C₁-C₄ alkyl or C₂-C₄ alkylcarbonyl;
each R^{26b} is independently H, cyano, C₁-C₅ alkyl, C₂-C₅ alkylcarbonyl, C₂-C₅ haloalkylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₅ alkoxy carbonyl, C₃-C₅ alkoxy carbonylalkyl, C₂-C₅ alkylaminocarbonyl or C₃-C₅ dialkylaminocarbonyl; or R^{26a} and R^{26b} are taken together to form a 5- to 6-membered fully saturated heterocyclic ring, each ring containing ring members, in addition to the connecting nitrogen atom, selected from carbon atoms and up to 2 heteroatoms independently selected from up to 2 O, up to 2 S and up to 2 N atoms, each ring optionally substituted with up to 2 methyl groups;

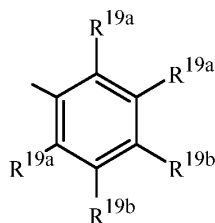
each R^{27} , R^{28} and R^{29} is independently H, cyano, hydroxy, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_2 - C_4 alkylcarbonyl, C_2 - C_4 haloalkylcarbonyl, C_2 - C_4 alkoxy carbonyl or C_2 - C_4 haloalkoxy carbonyl; and

each R^{30} is independently halogen, cyano, hydroxy, nitro, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_2 - C_4 alkenyl, C_1 - C_4 alkoxy, C_2 - C_4 alkylcarbonyl or C_2 - C_4 alkoxy carbonyl;

provided that:

(a) when R^1 is C_1 - C_6 alkyl or C_1 - C_6 haloalkyl, X is O, Z is N, each W is O, L is O, R^{5a} is C_1 - C_6 alkyl, R^{5b} is H and Q is phenyl, then Q is substituted with at least one R^{19} substituent; and

(b) when R^1 is C_1 - C_6 alkyl or C_1 - C_6 haloalkyl, X is O, Z is N, each W is O, L is O, R^{5a} is C_1 - C_6 alkyl and R^{5b} is H, then Q is other than



wherein

each R^{19a} is independently H, halogen or C_1 - C_6 alkyl;

each R^{19b} is independently H or -U-V-T;

each U and V is a direct bond; or

each U is O and each V is a direct bond; or

each U is a direct bond and each V is C_1 - C_6 alkylene;

each T is independently phenyl optionally substituted with up to 5 substituents independently selected from R^{30} ; or

each T is independently a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents independently selected from R^{30} ; and

each R^{30} is independently halogen, cyano, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_4 alkoxy or C_2 - C_4 alkylcarbonyl.

More particularly, this invention pertains to a compound of Formula **1** (including all stereoisomers), an *N*-oxide or a salt thereof.

This invention also relates to a fungicidal composition comprising (a) a compound of the invention (i.e. in a fungicidally effective amount); and (b) at least one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents.

5 This invention also relates to a fungicidal composition comprising (a) a compound of the invention; and (b) at least one other fungicide (e.g., at least one other fungicide having a different site of action).

This invention further relates to a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed, a fungicidally effective amount of a compound of the invention (e.g., as a composition described
10 herein).

This invention also relates to a composition comprising a compound of Formula **1**, an *N*-oxide, or a salt thereof, and at least one invertebrate pest control compound or agent.

DETAILS OF THE INVENTION

As used herein, the terms “comprises,” “comprising,” “includes,” “including,” “has,”
15 “having,” “contains,” “containing,” “characterized by” or any other variation thereof, are intended to cover a non-exclusive inclusion, subject to any limitation explicitly indicated. For example, a composition, mixture, process, method, article, or apparatus that comprises a list of elements is not necessarily limited to only those elements but may include other elements not expressly listed or inherent to such composition, mixture, process, method, article, or apparatus.

20 The transitional phrase “consisting of” excludes any element, step, or ingredient not specified. If in the claim, such would close the claim to the inclusion of materials other than those recited except for impurities ordinarily associated therewith. When the phrase “consisting of” appears in a clause of the body of a claim, rather than immediately following the preamble, it limits only the element set forth in that clause; other elements are not excluded from the claim as
25 a whole.

The transitional phrase “consisting essentially of” is used to define a composition, method or apparatus that includes materials, steps, features, components, or elements, in addition to those literally disclosed, provided that these additional materials, steps, features, components, or elements do not materially affect the basic and novel characteristic(s) of the claimed invention.
30 The term “consisting essentially of” occupies a middle ground between “comprising” and “consisting of”.

Where applicants have defined an invention or a portion thereof with an open-ended term such as “comprising,” it should be readily understood that (unless otherwise stated) the description

should be interpreted to also describe such an invention using the terms “consisting essentially of” or “consisting of.”

Further, unless expressly stated to the contrary, “or” refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

Also, the indefinite articles “a” and “an” preceding an element or component of the invention are intended to be nonrestrictive regarding the number of instances (i.e. occurrences) of the element or component. Therefore “a” or “an” should be read to include one or at least one, and the singular word form of the element or component also includes the plural unless the number is obviously meant to be singular.

The term “agronomic” refers to the production of field crops such as for food and fiber and includes the growth of maize or corn, soybeans and other legumes, rice, cereal (e.g., wheat, oats, barley, rye and rice), leafy vegetables (e.g., lettuce, cabbage, and other cole crops), fruiting vegetables (e.g., tomatoes, pepper, eggplant, crucifers and cucurbits), potatoes, sweet potatoes, grapes, cotton, tree fruits (e.g., pome, stone and citrus), small fruit (e.g., berries and cherries) and other specialty crops (e.g., canola, sunflower and olives).

The term “nonagronomic” refers to other than field crops, such as horticultural crops (e.g., greenhouse, nursery or ornamental plants not grown in a field), residential, agricultural, commercial and industrial structures, turf (e.g., sod farm, pasture, golf course, lawn, sports field, etc.), wood products, stored product, agro-forestry and vegetation management, public health (i.e. human) and animal health (e.g., domesticated animals such as pets, livestock and poultry, undomesticated animals such as wildlife) applications.

The term “crop vigor” refers to rate of growth or biomass accumulation of a crop plant. An “increase in vigor” refers to an increase in growth or biomass accumulation in a crop plant relative to an untreated control crop plant. The term “crop yield” refers to the return on crop material, in terms of both quantity and quality, obtained after harvesting a crop plant. An “increase in crop yield” refers to an increase in crop yield relative to an untreated control crop plant.

The term “biologically effective amount” refers to the amount of a biologically active compound (e.g., a compound of Formula 1 or a mixture with at least one other fungicidal compound) sufficient to produce the desired biological effect when applied to (i.e. contacted with) a fungus to be controlled or its environment, or to a plant, the seed from which the plant is grown, or the locus of the plant (e.g., growth medium) to protect the plant from injury by the fungal disease or for other desired effect (e.g., increasing plant vigor).

As referred to in the present disclosure and claims, “plant” includes members of Kingdom Plantae, particularly seed plants (Spermatopsida), at all life stages, including young plants (e.g., germinating seeds developing into seedlings) and mature, reproductive stages (e.g., plants producing flowers and seeds). Portions of plants include geotropic members typically growing
5 beneath the surface of the growing medium (e.g., soil), such as roots, tubers, bulbs and corms, and also members growing above the growing medium, such as foliage (including stems and leaves), flowers, fruits and seeds.

As referred to herein, the term “seedling”, used either alone or in a combination of words means a young plant developing from the embryo of a seed.

10 As referred to herein, the term “broadleaf” used either alone or in words such as “broadleaf crop” means dicot or dicotyledon, a term used to describe a group of angiosperms characterized by embryos having two cotyledons.

As referred to in this disclosure, the terms “fungal pathogen” and “fungal plant pathogen” include pathogens in the Ascomycota, Basidiomycota and Zygomycota phyla, and the fungal-like
15 Oomycota class that are the causal agents of a broad spectrum of plant diseases of economic importance, affecting ornamental, turf, vegetable, field, cereal and fruit crops. In the context of this disclosure, “protecting a plant from disease” or “control of a plant disease” includes preventative action (interruption of the fungal cycle of infection, colonization, symptom development and spore production) and/or curative action (inhibition of colonization of plant host
20 tissues).

As used herein, the term “mode of action” (MOA) is as define by the Fungicide Resistance Action Committee (FRAC), and is used to distinguish fungicides according to their biochemical mode of action in the biosynthetic pathways of plant pathogens, and their resistance risk. FRAC-defined modes of actions include (A) nucleic acids metabolism, (B) cytoskeleton and
25 motor protein, (C) respiration, (D) amino acids and protein synthesis, (E) signal transduction, (F) lipid synthesis or transport and membrane integrity or function, (G) sterol biosynthesis in membranes, (H) cell wall biosynthesis, (I) melanin synthesis in cell wall, (P) host plant defense induction, (U) unknown mode of action, (M) chemicals with multi-site activity and (BM) biologicals with multiple modes of action. Each mode of action (i.e. letters A through BM)
30 contain one or more subgroups (e.g., A includes subgroups A1, A2, A3 and A4) based either on individual validated target sites of action, or in cases where the precise target site is unknown, based on cross resistance profiles within a group or in relation to other groups. Each of these subgroups (e.g., A1, A2, A3 and A4) is assigned a FRAC code which is a number and/or letter. For example, the FRAC code for subgroup A1 is 4. Additional information on target sites and

FRAC codes can be obtained from publicly available databases maintained, for example, by FRAC.

As used herein, the term “cross resistance” refers to the phenomenon that occurs when a pathogen develops resistance to one fungicide and simultaneously becomes resistant to one or more other fungicides. These other fungicides are typically, but not always, in the same chemical class or have the same target site of action, or can be detoxified by the same mechanism.

Generally when a molecular fragment (i.e. radical) is denoted by a series of atom symbols (e.g., C, H, N, O and S) the implicit point or points of attachment will be easily recognized by those skilled in the art. In some instances herein, particularly when alternative points of attachment are possible, the point or points of attachment may be explicitly indicated by a hyphen (“-”).

As used herein, the term “alkylating agent” refers to a chemical compound in which a carbon-containing radical is bound through a carbon atom to leaving group such as halide or sulfonate, which is displaceable by bonding of a nucleophile to said carbon atom. Unless otherwise indicated, the term “alkylating” does not limit the carbon-containing radical to alkyl; the carbon-containing radicals in alkylating agents include the variety of carbon-bound substituent radicals specified, for example, for R^{5a} and R^{5b}.

In the above recitations, the term “alkyl”, used either alone or in compound words such as “alkylthio” or “haloalkyl” includes straight-chain and branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, and the different butyl, pentyl and hexyl isomers. “Alkenyl” includes straight-chain and branched alkenes such as ethenyl, 1-propenyl, 2-propenyl, and the different butenyl, pentenyl and hexenyl isomers. “Alkenyl” also includes polyenes such as 1,2-propadienyl and 2,4-hexadienyl. “Alkynyl” includes straight-chain and branched alkynes such as ethynyl, 1-propynyl, 2-propynyl, and the different butynyl, pentynyl and hexynyl isomers. “Alkynyl” can also include moieties comprised of multiple triple bonds such as 2,5-hexadiynyl. “Alkylene” denotes a straight-chain or branched alkanediyl. Examples of “alkylene” include CH₂, CH₂CH₂, CH(CH₃), CH₂CH₂CH₂, CH₂CH(CH₃), and the different butylene isomers. “Alkenylene” denotes a straight-chain or branched alkenediyl containing one olefinic bond. Examples of “alkenylene” include CH=CH, CH₂CH=CH, CH=C(CH₃) and the different butenylene isomers. “Alkynylene” denotes a straight-chain or branched alkynediyl containing one triple bond. Examples of “alkynylene” include CH₂C≡C, C≡CCH₂, and the different butynylene, pentynylene or hexynylene isomers. The term “cycloalkylene” denotes a cycloalkanediyl ring. Examples of “cycloalkylene” include cyclobutanediyl, cyclopentanediyl and cyclohexanediyl. The term

“cycloalkenylene” denotes a cycloalkenediyl ring containing one olefinic bond. Examples of “cycloalkenylene” include cyclopropenediyl and cyclopentenediyl.

“Alkoxy” includes, for example, methoxy, ethoxy, *n*-propyloxy, *i*-propyloxy, and the different butoxy, pentoxy and hexyloxy isomers. “Alkenyloxy” includes straight-chain and
 5 branched alkenyl attached to and linked through an oxygen atom. Examples of “alkenyloxy” include $\text{H}_2\text{C}=\text{CHCH}_2\text{O}$ and $\text{CH}_3\text{CH}=\text{CHCH}_2\text{O}$. “Alkynyloxy” includes straight-chain and branched alkynyl attached to and linked through an oxygen atom. Examples of “alkynyloxy” include $\text{HC}\equiv\text{CCH}_2\text{O}$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{O}$.

The term “alkylthio” includes straight-chain and branched alkylthio moieties such as
 10 methylthio, ethylthio, and the different propylthio and butylthio isomers. “Alkylsulfinyl” includes both enantiomers of an alkylsulfinyl group. Examples of “alkylsulfinyl” include $\text{CH}_3\text{S}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{S}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(=\text{O})$, $(\text{CH}_3)_2\text{CHS}(=\text{O})$, and the different butylsulfinyl isomers. Examples of “alkylsulfonyl” include $\text{CH}_3\text{S}(=\text{O})_2$, $\text{CH}_3\text{CH}_2\text{S}(=\text{O})_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(=\text{O})_2$, $(\text{CH}_3)_2\text{CHS}(=\text{O})_2$, and the different butylsulfonyl isomers.

“Alkylthioalkyl” denotes alkylthio substitution on alkyl. Examples of “alkylthioalkyl”
 15 include CH_3SCH_2 , $\text{CH}_3\text{SCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{SCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{SCH}_2$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2$; “alkylsulfinylalkyl” and “alkylsulfonylalkyl” include the corresponding sulfoxides and sulfones, respectively.

“Alkylamino” includes an NH radical substituted with a straight-chain or branched alkyl
 20 group. Examples of “alkylamino” include $\text{CH}_3\text{CH}_2\text{NH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}$, and $(\text{CH}_3)_2\text{CHCH}_2\text{NH}$. “Alkylaminoalkyl” denotes alkylamino substitution on alkyl. Examples of “alkylaminoalkyl” include CH_3NHCH_2 , $\text{CH}_3\text{NHCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{NHCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHCH}_2$ and $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_2$.

“Alkylcarbonyl” denotes a straight-chain or branched alkyl group bonded to a $\text{C}(=\text{O})$
 25 moiety. Examples of “alkylcarbonyl” include $\text{CH}_3\text{C}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})$ and $(\text{CH}_3)_2\text{CHC}(=\text{O})$. The terms “alkenylcarbonyl” and “alkynylcarbonyl” are likewise defined. Examples of “alkenylcarbonyl” include $\text{H}_2\text{C}=\text{CHCH}_2\text{C}(=\text{O})$ and $\text{CH}_3\text{CH}_2\text{CH}=\text{CHC}(=\text{O})$. Examples of “alkynylcarbonyl” include $\text{HC}\equiv\text{CCH}_2\text{C}(=\text{O})$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{C}(=\text{O})$. “Alkoxy carbonyl” includes a $\text{C}(=\text{O})$ moiety substituted with a straight-chain or branched alkoxy
 30 group. Examples of “alkoxy carbonyl” include $\text{CH}_3\text{OC}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{OC}(=\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC}(=\text{O})$, $(\text{CH}_3)_2\text{CHOC}(=\text{O})$, and the different butoxy- and pentoxy carbonyl isomers. The terms “alkenyloxy carbonyl” and “alkynyloxy carbonyl” are likewise defined. Examples of “alkenyloxy carbonyl” include $\text{H}_2\text{C}=\text{CHCH}_2\text{OC}(=\text{O})$ and $\text{CH}_3\text{CH}_2\text{CH}=\text{CHOC}(=\text{O})$. Examples of “alkynyloxy carbonyl” include $\text{HC}\equiv\text{CCH}_2\text{OC}(=\text{O})$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{OC}(=\text{O})$.

“Alkylaminocarbonyl” denotes a straight-chain or branched alkyl group bonded to a NHC(=O) moiety. Examples of “alkylaminocarbonyl” include $\text{CH}_3\text{NHC(=O)}$, $\text{CH}_3\text{CH}_2\text{NHC(=O)}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHC(=O)}$, $(\text{CH}_3)_2\text{CHNHC(=O)}$, and the different butylamino- and pentylaminocarbonyl isomers. Examples of “dialkylaminocarbonyl” include
 5 $(\text{CH}_3)_2\text{N(=O)}$, $(\text{CH}_3\text{CH}_2)_2\text{NC(=O)}$, $\text{CH}_3\text{CH}_2(\text{CH}_3)\text{NC(=O)}$, $(\text{CH}_3)_2\text{CH}(\text{CH}_3)\text{NC(=O)}$ and $\text{CH}_3\text{CH}_2\text{CH}_2(\text{CH}_3)\text{NC(=O)}$.

The term “alkylsulfonyloxy” denotes an alkylsulfonyl group bonded to an oxygen atom. Examples of “alkylsulfonyloxy” include $\text{CH}_3\text{S(=O)}_2\text{O}$, $(\text{CH}_3)_2\text{CHS(=O)}_2\text{O}$, $\text{CH}_3\text{CH}_2\text{S(=O)}_2\text{O}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S(=O)}_2\text{O}$, and the different butylsulfonyloxy, pentylsulfonyloxy and
 10 hexylsulfonyloxy isomers. The term “alkenylsulfonyloxy” is likewise defined. Examples of “alkenylsulfonyloxy” include $\text{H}_2\text{C=CHCH}_2\text{CH}_2\text{S(=O)}_2\text{O}$ and $(\text{CH}_3)_2\text{C=CHCH}_2\text{S(=O)}_2\text{O}$.

“Alkylaminosulfonyl” denotes a straight-chain or branched alkyl group bonded to a NHS(=O)_2 moiety. Examples of “alkylaminosulfonyl” include $\text{CH}_3\text{CH}_2\text{NHS(=O)}_2$ and $(\text{CH}_3)_2\text{CHNHS(=O)}_2$. Examples of “alkylaminosulfinyl” include $\text{CH}_3\text{CH}_2\text{NHS(=O)}$ and
 15 $(\text{CH}_3)_2\text{CHNHS(=O)}$.

“Alkoxyalkyl” denotes alkoxy substitution on alkyl. Examples of “alkoxyalkyl” include CH_3OCH_2 , $\text{CH}_3\text{OCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2$. “Alkoxyalkoxy” denotes alkoxy substitution on another alkoxy moiety. Examples of
 “alkoxyalkoxy” include $\text{CH}_3\text{OCH}_2\text{O}$, $\text{CH}_3\text{OCH}_2\text{O}$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{O}$.

The term “alkylcarbonyloxy” denotes a straight-chain or branched alkyl bonded to a C(=O)O moiety. Examples of “alkylcarbonyloxy” include $\text{CH}_3\text{CH}_2\text{C(=O)O}$ and $(\text{CH}_3)_2\text{CHC(=O)O}$. The terms “alkenylcarbonyloxy” and “alkynylcarbonyloxy” are likewise defined. Examples of “alkenylcarbonyloxy” include $\text{H}_2\text{C=CHCH}_2\text{CH}_2\text{C(=O)O}$ and $(\text{CH}_3)_2\text{C=CHCH}_2\text{C(=O)O}$. Examples of “alkynylcarbonyloxy” include $\text{HC}\equiv\text{CCH}_2\text{CH}_2\text{C(=O)O}$
 25 and $\text{CH}_3\text{C}\equiv\text{CCH}(\text{CH}_3)\text{C(=O)O}$. The term “alkoxycarbonyloxy” denotes a straight-chain or branched alkoxy bonded to a C(=O)O moiety. Examples of “alkoxycarbonyloxy” include $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC(=O)O}$ and $(\text{CH}_3)_2\text{CHOC(=O)O}$. The term “alkenyloxycarbonyloxy” denotes a straight-chain or branched alkenyloxy bonded to a C(=O)O moiety. Examples of
 “alkenyloxycarbonyloxy” include $\text{H}_2\text{C=CHCH}_2\text{OC(=O)O}$ and $\text{CH}_3\text{CH}_2\text{CH=CHOC(=O)O}$. The
 30 term “alkoxycarbonylalkyl” denotes alkoxycarbonyl substitution on alkyl. Examples of “alkoxycarbonylalkyl” include $\text{CH}_3\text{CH}_2\text{OC(=O)CH}_2$, $(\text{CH}_3)_2\text{CHOC(=O)CH}_2$ and $\text{CH}_3\text{OC(=O)CH}_2\text{CH}_2$.

The term “cycloalkyl” denotes a saturated carbocyclic ring consisting of between 3 to 6 carbon atoms linked to one another by single bonds. Examples of “cycloalkyl” include

cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl. The term “cycloalkylalkyl” denotes cycloalkyl substitution on an alkyl group. Examples of “cycloalkylalkyl” include cyclopropylmethyl, cyclopentylethyl, and other cycloalkyl moieties bonded to straight-chain or branched alkyl groups. The term “alkylcycloalkyl” denotes alkyl substitution on a cycloalkyl moiety and includes, for example, ethylcyclopropyl, *i*-propylcyclobutyl, methylcyclopentyl and methylcyclohexyl. “Cycloalkenyl” includes groups such as cyclopentenyl and cyclohexenyl as well as groups with more than one double bond such as 1,3- or 1,4-cyclohexadienyl.

The term “cycloalkoxy” denotes cycloalkyl attached to and linked through an oxygen atom including, for example, cyclopentyloxy and cyclohexyloxy.

“Cycloalkylcarbonyl” denotes cycloalkyl bonded to a C(=O) group including, for example, cyclopropylcarbonyl and cyclopentylcarbonyl. “Cycloalkylcarbonyloxy” denotes cycloalkylcarbonyl attached to and linked through an oxygen atom. Examples of “cycloalkylcarbonyloxy” include cyclohexylcarbonyloxy and cyclopentylcarbonyloxy. The term “cycloalkoxycarbonyl” means cycloalkoxy bonded to a C(=O) group, for example, cyclopropyloxycarbonyl and cyclopentyloxycarbonyl.

The term “halogen”, either alone or in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” includes fluorine, chlorine, bromine or iodine. Further, when used in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of “haloalkyl” or “alkyl substituted with halogen” include CF₃, ClCH₂, CF₃CH₂ and CF₃CCl₂. The terms “haloalkenyl”, “haloalkynyl”, “haloalkoxy”, “haloalkylsulfonyl”, “halocycloalkyl”, and the like, are defined analogously to the term “haloalkyl”. Examples of “haloalkenyl” include Cl₂C=CHCH₂ and CF₃CH₂CH=CHCH₂. Examples of “haloalkynyl” include HC≡CCHCl, CF₃C≡C, CCl₃C≡C and FCH₂C≡CCH₂. Examples of “haloalkoxy” include CF₃O, CCl₃CH₂O, F₂CHCH₂CH₂O and CF₃CH₂O. Examples of “haloalkylsulfonyl” include CF₃S(=O)₂, CCl₃S(=O)₂, CF₃CH₂S(=O)₂ and CF₃CF₂S(=O)₂. Examples of “halocycloalkyl” include 2-chlorocyclopropyl, 2-fluorocyclobutyl, 3-bromocyclopentyl and 4-chlorocyclohexyl.

“Cyanoalkyl” denotes an alkyl group substituted with one cyano group. Examples of “cyanoalkyl” include NCCH₂, NCCH₂CH₂ and CH₃CH(CN)CH₂. “Hydroxyalkyl” denotes an alkyl group substituted with one hydroxy group. Examples of “hydroxyalkyl” include HOCH₂CH₂, CH₃CH₂(OH)CH and HOCH₂CH₂CH₂CH₂.

“Trialkylsilyl” includes 3 branched and/or straight-chain alkyl radicals attached to and linked through a silicon atom, such as trimethylsilyl, triethylsilyl and *tert*-butyldimethylsilyl.

The total number of carbon atoms in a substituent group is indicated by the “C_i-C_j” prefix where i and j are numbers from 1 to 15. For example, C₁-C₄ alkylsulfonyl designates methylsulfonyl through butylsulfonyl; C₂ alkoxyalkyl designates CH₃OCH₂; C₃ alkoxyalkyl designates, for example, CH₃CH(OCH₃), CH₃OCH₂CH₂ or CH₃CH₂OCH₂; and C₄ alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including CH₃CH₂CH₂OCH₂ and CH₃CH₂OCH₂CH₂.

The term “unsubstituted” in connection with a group such as a ring or ring system means the group does not have any substituents other than its one or more attachments to the remainder of Formula 1. The term “optionally substituted” means that the number of substituents can be zero. Unless otherwise indicated, optionally substituted groups may be substituted with as many optional substituents as can be accommodated by replacing a hydrogen atom with a non-hydrogen substituent on any available carbon or nitrogen atom. Commonly, the number of optional substituents (when present) ranges from 1 to 3. As used herein, the term “optionally substituted” is used interchangeably with the phrase “substituted or unsubstituted” or with the term “(un)substituted.”

The number of optional substituents may be restricted by an expressed limitation. For example, the phrase “optionally substituted with up to 5 substituents independently selected from R¹⁹” means that 0, 1, 2, 3, 4 or 5 substituents can be present (if the number of potential connection points allows). When a range specified for the number of substituents (e.g., p being an integer from 0 to 3 in Exhibit A) exceeds the number of positions available for substituents on a ring (e.g., 1 position available for (R¹⁹)_p on Q-11 in Exhibit A), the actual higher end of the range is recognized to be the number of available positions.

When a compound is substituted with a substituent bearing a subscript that indicates the number of said substituents can vary (e.g., (R¹⁹)_p in Exhibit A wherein p is 1 to 3), then said substituents are independently selected from the group of defined substituents, unless otherwise indicated. When a variable group is shown to be optionally attached to a position, for example (R¹⁹)_p in Exhibit A wherein p may be 0, then hydrogen may be at the position even if not recited in the definition of the variable group.

Naming of substituents in the present disclosure uses recognized terminology providing conciseness in precisely conveying to those skilled in the art the chemical structure. For sake of conciseness, locant descriptors may be omitted.

Unless otherwise indicated, a “ring” or “ring system” as a component of Formula 1 (e.g., Q) is carbocyclic or heterocyclic. The term “ring system” denotes two or more connected rings. The term “spirocyclic ring system” denotes a ring system consisting of two rings connected at a single

atom (so the rings have a single atom in common). The term “bicyclic ring system” denotes a ring system consisting of two rings sharing two or more common atoms. In a “fused bicyclic ring system” the common atoms are adjacent, and therefore the rings share two adjacent atoms and a bond connecting them.

5 The term “ring member” refers to an atom (e.g., C, O, N or S) or other moiety (e.g., C(=O), C(=S), S(=O) and S(=O)₂) forming the backbone of a ring or ring system. The term “aromatic” indicates that each of the ring atoms is essentially in the same plane and has a *p*-orbital perpendicular to the ring plane, and that $(4n + 2) \pi$ electrons, where *n* is a positive integer, are associated with the ring to comply with Hückel’s rule

10 The term “carbocyclic ring” denotes a ring wherein the atoms forming the ring backbone are selected only from carbon. Unless otherwise indicated, a carbocyclic ring can be a saturated, partially unsaturated, or fully unsaturated ring. When a fully unsaturated carbocyclic ring satisfies Hückel’s rule, then said ring is also called an “aromatic ring” or “aromatic carbocyclic ring”. “Saturated carbocyclic” refers to a ring having a backbone consisting of carbon atoms linked to
15 one another by single bonds; unless otherwise specified, the remaining carbon valences are occupied by hydrogen atoms.

As used herein, the term “partially unsaturated ring” or “partially unsaturated heterocycle” refers to a ring which contains unsaturated ring atoms and one or more double bonds but is not aromatic.

20 The terms “heterocyclic ring” or “heterocycle” denotes a ring wherein at least one of the atoms forming the ring backbone is other than carbon. Unless otherwise indicated, a heterocyclic ring can be a saturated, partially unsaturated, or fully unsaturated ring. When a fully unsaturated heterocyclic ring satisfies Hückel’s rule, then said ring is also called a “heteroaromatic ring” or aromatic heterocyclic ring. “Saturated heterocyclic ring” refers to a heterocyclic ring containing
25 only single bonds between ring members.

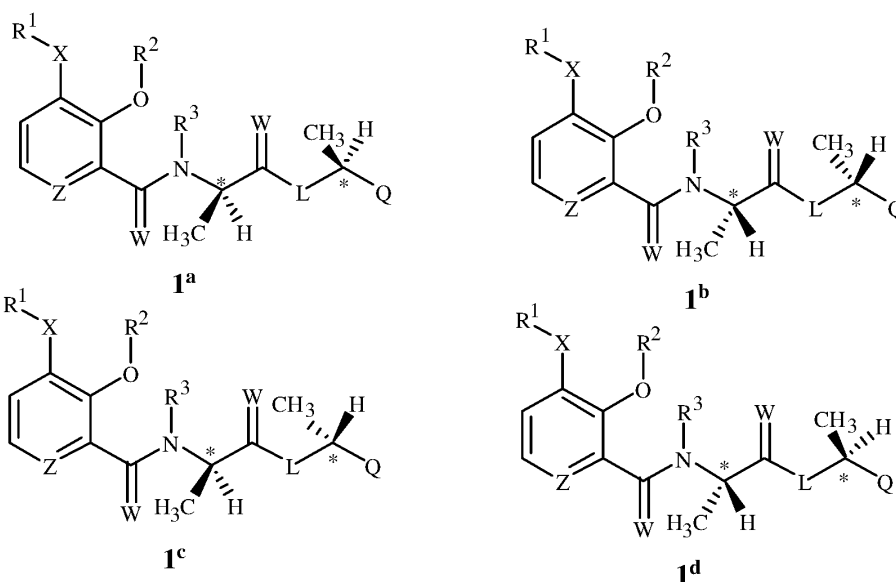
Unless otherwise indicated, heterocyclic rings and ring systems are attached to the remainder of Formula **1** through any available carbon or nitrogen atom by replacement of a hydrogen on said carbon or nitrogen atom.

30 A wide variety of synthetic methods are known in the art to enable preparation of aromatic and nonaromatic heterocyclic rings and ring systems; for extensive reviews see the eight volume set of *Comprehensive Heterocyclic Chemistry*, A. R. Katritzky and C. W. Rees editors-in-chief, Pergamon Press, Oxford, 1984 and the twelve volume set of *Comprehensive Heterocyclic Chemistry II*, A. R. Katritzky, C. W. Rees and E. F. V. Scriven editors-in-chief, Pergamon Press, Oxford, 1996.

Compounds of this invention can exist as one or more stereoisomers. Stereoisomers are isomers of identical constitution but differing in the arrangement of their atoms in space and include enantiomers, diastereomers, *cis*- and *trans*-isomers (also known as geometric isomers) and atropisomers. Atropisomers result from restricted rotation about single bonds where the rotational barrier is high enough to permit isolation of the isomeric species. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. For a comprehensive discussion of all aspects of stereoisomerism, see Ernest L. Eliel and Samuel H. Wilen, *Stereochemistry of Organic Compounds*, John Wiley & Sons, 1994.

Compounds of this invention may be present as a mixture of stereoisomers, individual stereoisomers, or as an optically active form. Unless the structural formula or the language of this application specifically designate a particular *cis*- or *trans*-isomer, or a configuration of a chiral center, the scope of the present invention is intended to cover all such isomers per se, as well as mixtures of *cis*- and *trans*-isomers, mixtures of enantiomers and diastereomers, as well as racemic mixtures. Molecular depictions drawn herein follow standard conventions for depicting stereochemistry. To indicate stereoconfiguration, bonds rising from the plane of the drawing and towards the viewer are denoted by solid wedges wherein the broad end of the wedge is attached to the atom rising from the plane of the drawing towards the viewer. Bonds going below the plane of the drawing and away from the viewer are denoted by dashed wedges wherein the narrow end of the wedge is attached to the atom further away from the viewer. Constant width lines indicate bonds with a direction opposite or neutral relative to bonds shown with solid or dashed wedges; constant width lines also depict bonds in molecules or parts of molecules in which no particular stereoconfiguration is intended to be specified.

Compounds of Formula **1** according to the present invention may comprise at least two chiral centers at the carbon atoms to which the substituents R^{4a} and R^{4b} are attached and the substituents to which R^{5a} and R^{5b} are attached. Accordingly, each chiral carbon can exist in either an *R*- or *S*-configuration. For example, when R^{4a} and R^{5a} are methyl and R^{4b} and R^{5b} are H, four enantiomers are possible, *S,S*; *R,R*; *S,R*; and *R,S*. These four enantiomers are depicted below as Formulae **1a** through **1d** wherein the chiral centers are identified with an asterisk (*).



Compositions of this invention include compounds of Formula **1** comprising racemic mixtures, for example, equal amounts of the enantiomers of Formulae **1^a**, **1^b**, **1^c** and **1^d**. In addition, this invention includes compositions that are enriched compared to the racemic mixture in an enantiomer of Formula **1**, for example, enriched in one or more of the enantiomers of Formulae **1^a**, **1^b**, **1^c** and **1^d**. Also included are the essentially pure enantiomers of compounds of Formula **1**.

When enantiomerically enriched, one enantiomer is present in greater amounts than the other, and the extent of enrichment can be defined by an expression of enantiomeric excess (“ee”), which is defined as $(2x-1) \cdot 100\%$, where x is the mole fraction of the dominant enantiomer in the mixture (e.g., an ee of 20% corresponds to a 60:40 ratio of enantiomers).

In a preferred embodiment the compositions of this invention have at least a 50% enantiomeric excess; more preferably at least a 75% enantiomeric excess; still more preferably at least a 90% enantiomeric excess; and the most preferably at least a 95% enantiomeric excess of the more active isomer. Of note are enantiomerically pure embodiments of the more active isomer. Among the possible enantiomeric forms Formula **1** compounds, of particular note is the substantially pure *S*-isomer at the carbon atom to which substituents R^{4a} and R^{4b} are attached.

One skilled in the art will appreciate that not all nitrogen-containing heterocycles can form *N*-oxides since the nitrogen requires an available lone pair for oxidation to the oxide; one skilled in the art will recognize those nitrogen-containing heterocycles which can form *N*-oxides. One skilled in the art will also recognize that tertiary amines can form *N*-oxides. Synthetic methods

for the preparation of *N*-oxides of heterocycles and tertiary amines are very well-known by one skilled in the art including the oxidation of heterocycles and tertiary amines with peroxy acids such as peracetic and 3-chloroperbenzoic acid (MCPBA), hydrogen peroxide, alkyl hydroperoxides such as *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethyldioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example: T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748–750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18–20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149–161, A. R. Katritzky, Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285–291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390–392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

One skilled in the art recognizes that because in the environment and under physiological conditions salts of chemical compounds are in equilibrium with their corresponding nonsalt forms, salts share the biological utility of the nonsalt forms. Thus a wide variety of salts of the compounds of Formula **1** are useful for control of invertebrate pests. The salts of the compounds of Formula **1** include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. When a compound of Formula **1** contains an acidic moiety such as a carboxylic acid or phenol, salts also include those formed with organic or inorganic bases such as pyridine, triethylamine or ammonia, or amides, hydrides, hydroxides or carbonates of sodium, potassium, lithium, calcium, magnesium or barium. Accordingly, the present invention comprises compounds selected from Formula **1**, *N*-oxides and suitable salts thereof.

Compounds selected from Formula **1**, stereoisomers, tautomers, *N*-oxides, and salts thereof, typically exist in more than one form, and Formula **1** thus includes all crystalline and non-crystalline forms of the compounds that Formula **1** represents. Non-crystalline forms include embodiments which are solids such as waxes and gums as well as embodiments which are liquids such as solutions and melts. Crystalline forms include embodiments which represent essentially a single crystal type and embodiments which represent a mixture of polymorphs (i.e. different crystalline types). The term “polymorph” refers to a particular crystalline form of a chemical compound that can crystallize in different crystalline forms, these forms having different

arrangements and/or conformations of the molecules in the crystal lattice. Although polymorphs can have the same chemical composition, they can also differ in composition due to the presence or absence of co-crystallized water or other molecules, which can be weakly or strongly bound in the lattice. Polymorphs can differ in such chemical, physical and biological properties as crystal shape, density, hardness, color, chemical stability, melting point, hygroscopicity, suspensibility, dissolution rate and biological availability. One skilled in the art will appreciate that a polymorph of a compound represented by Formula **1** can exhibit beneficial effects (e.g., suitability for preparation of useful formulations, improved biological performance) relative to another polymorph or a mixture of polymorphs of the same compound represented by Formula **1**. Preparation and isolation of a particular polymorph of a compound represented by Formula **1** can be achieved by methods known to those skilled in the art including, for example, crystallization using selected solvents and temperatures. For a comprehensive discussion of polymorphism see R. Hilfiker, Ed., *Polymorphism in the Pharmaceutical Industry*, Wiley-VCH, Weinheim, 2006.

Embodiments of the present invention as described in the Summary of the Invention include those described below. In the following Embodiments, Formula **1** includes stereoisomers, *N*-oxides, and salts thereof, and reference to “a compound of Formula **1**” includes the definitions of substituents specified in the Summary of the Invention unless further defined in the Embodiments.

- Embodiment 1. A compound of Formula **1** wherein Z is N.
- Embodiment 2. A compound of Formula **1** wherein Z is CR⁶.
- Embodiment 3. A compound of Formula **1** or Embodiments 1 or 2 wherein each W is O.
- Embodiment 4. A compound of Formula **1** or Embodiments 1 or 2 wherein each W is S.
- Embodiment 5. A compound of Formula **1** or any one of Embodiments 1 through 3 wherein X is O.
- Embodiment 6. A compound of Formula **1** or any one of Embodiments 1 through 3 wherein X is NR⁷.
- Embodiment 7. A compound of Formula **1** or any one of Embodiments 1 through 6 wherein R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₆ cycloalkyl, C₂-C₆ alkylcarbonyl, C₂-C₆ haloalkylcarbonyl, C₂-C₆ alkoxy carbonyl or C₂-C₆ haloalkoxy carbonyl.
- Embodiment 8. A compound of Embodiment 7 wherein R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl.
- Embodiment 9. A compound of Embodiment 8 wherein R¹ is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

Embodiment 10. A compound of Embodiment 9 wherein R^1 is H, $C(=O)H$, methyl or methylcarbonyl.

Embodiment 11. A compound of Embodiment 9 wherein R^1 is methyl or ethyl.

Embodiment 12. A compound of Embodiment 11 wherein R^1 is methyl.

5 Embodiment 13. A compound of Formula **1** or any one of Embodiments 1 through 12 wherein when R^2 is separate (i.e. not taken together with R^3 to form a ring), then R^2 is H, $C(=W)NH_2$, $C(=O)R^8$, $C(=O)OR^9$, $CH_2C(=O)R^8$, $CH_2C(=O)OR^9$, $CH_2OC(=O)R^8$, $CH_2OC(=O)OR^9$, $CH_2NR^{12}C(=O)R^8$ or $CH_2NR^{12}C(=O)OR^9$; or C_1 - C_3 alkyl or C_1 - C_3 haloalkyl, each optionally substituted with up to 3 substituents independently selected from R^{15} ; or benzyl, tetrahydropyranyl or tetrahydrofuranyl.

10 Embodiment 14. A compound of Embodiment 13 wherein R^2 is H, $C(=W)NH_2$, $C(=O)R^8$, $C(=O)OR^9$, $CH_2C(=O)R^8$, $CH_2C(=O)OR^9$, $CH_2OC(=O)R^8$, $CH_2OC(=O)OR^9$, $CH_2NR^{12}C(=O)R^8$ or $CH_2NR^{12}C(=O)OR^9$; or methyl or halomethyl, each optionally substituted with up to 1 substituent selected from R^{15} ; or benzyl.

15 Embodiment 15. A compound of Embodiment 14 wherein R^2 is H, $C(=O)R^8$, $C(=O)OR^9$, $CH_2C(=O)R^8$, $CH_2C(=O)OR^9$, $CH_2OC(=O)R^8$, $CH_2OC(=O)OR^9$ or benzyl.

Embodiment 16. A compound of Embodiment 15 wherein R^2 is H, $C(=O)R^8$ or $C(=O)OR^9$.

Embodiment 17. A compound of Embodiment 16 wherein R^2 is H or $C(=O)R^8$.

20 Embodiment 18. A compound of Embodiment 17 wherein R^2 is H.

Embodiment 19. A compound of Formula **1** or any one of Embodiments 1 through 18 wherein when R^3 is separate (i.e. not taken together with R^2 to form a ring), then R^3 is H, $CH(=O)$, $C(=O)R^{17}$ or $C(=O)OR^{17}$.

Embodiment 20. A compound of Embodiment 19 wherein R^3 is H, $CH(=O)$ or $C(=O)R^{17}$.

25 Embodiment 21. A compound of Embodiment 20 wherein R^3 is H or $CH(=O)$.

Embodiment 22. A compound of Embodiment 21 wherein R^3 is H.

Embodiment 23. A compound of Formula **1** or any one of Embodiments 1 through 22 wherein when R^2 and R^3 are taken together with the atoms to which they are attached to form a 6-membered nonaromatic ring, then said ring contains ring members selected from carbon atoms and optionally up to 1 ring member selected from $C(=O)$, the ring optionally substituted with up to 3 substituents independently selected from halogen, methyl, halomethyl and methoxy.

30 Embodiment 24. A compound of Embodiment 23 wherein R^2 and R^3 are taken together with the atoms to which they are attached to form a 6-membered nonaromatic ring

containing ring members selected from carbon atoms, the ring optionally substituted with up to 3 substituents independently selected from halogen and methyl.

- Embodiment 25. A compound of Formula **1** or any one of Embodiments 1 through 24 wherein R^{4a} is H, cyano, halogen, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkoxy or C₂-C₃ alkoxyalkyl.
- Embodiment 26. A compound of Embodiment 25 wherein R^{4a} is H, halogen, C₁-C₃ alkyl, or C₁-C₃ haloalkyl.
- Embodiment 27. A compound of Embodiment 26 wherein R^{4a} is H or C₁-C₂ alkyl.
- Embodiment 28. A compound of Embodiment 27 wherein R^{4a} is H or methyl.
- Embodiment 29. A compound of Embodiment 28 wherein R^{4a} is H.
- Embodiment 30. A compound of Embodiment 28 wherein R^{4a} is methyl.
- Embodiment 31. A compound of Formula **1** or any one of Embodiments 1 through 30 wherein R^{4b} is H, C₁-C₃ alkyl or C₁-C₃ haloalkyl.
- Embodiment 32. A compound of Embodiment 31 wherein R^{4b} is H or C₁-C₂ alkyl.
- Embodiment 33. A compound of Embodiment 32 wherein R^{4b} is H or methyl.
- Embodiment 34. A compound of Embodiment 33 wherein R^{4b} is H.
- Embodiment 35. A compound of Embodiment 33 wherein R^{4b} is methyl.
- Embodiment 36. A compound of Formula **1** or any one of Embodiments 1 through 35 wherein R^{4a} is methyl and R^{4b} is H.
- Embodiment 37. A compound of Formula **1** or any one of Embodiments 1 through 36 wherein L is O.
- Embodiment 38. A compound of Formula **1** or any one of Embodiments 1 through 36 wherein L is NR¹⁸.
- Embodiment 39. A compound of Formula **1** or any one of Embodiments 1 through 38 wherein when R^{5a} and R^{5b} are separated (i.e. they are not taken together to form a ring), then R^{5a} and R^{5b} are each independently H, cyano, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl.
- Embodiment 40. A compound of Embodiment 39 wherein R^{5a} and R^{5b} are each independently H, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₃-C₆ cycloalkyl.
- Embodiment 41. A compound of Embodiment 40 wherein R^{5a} and R^{5b} are each independently H, C₁-C₆ alkyl or C₃-C₆ cycloalkyl.
- Embodiment 41a. A compound of Embodiment 41 wherein R^{5a} and R^{5b} are each independently H, C₁-C₃ alkyl or cyclopropyl.

Embodiment 42. A compound of Embodiment 41 wherein R^{5a} and R^{5b} are each independently H or C_1 - C_3 alkyl.

Embodiment 43. A compound of Embodiment 42 wherein R^{5a} and R^{5b} are each independently H, methyl, ethyl or isopropyl.

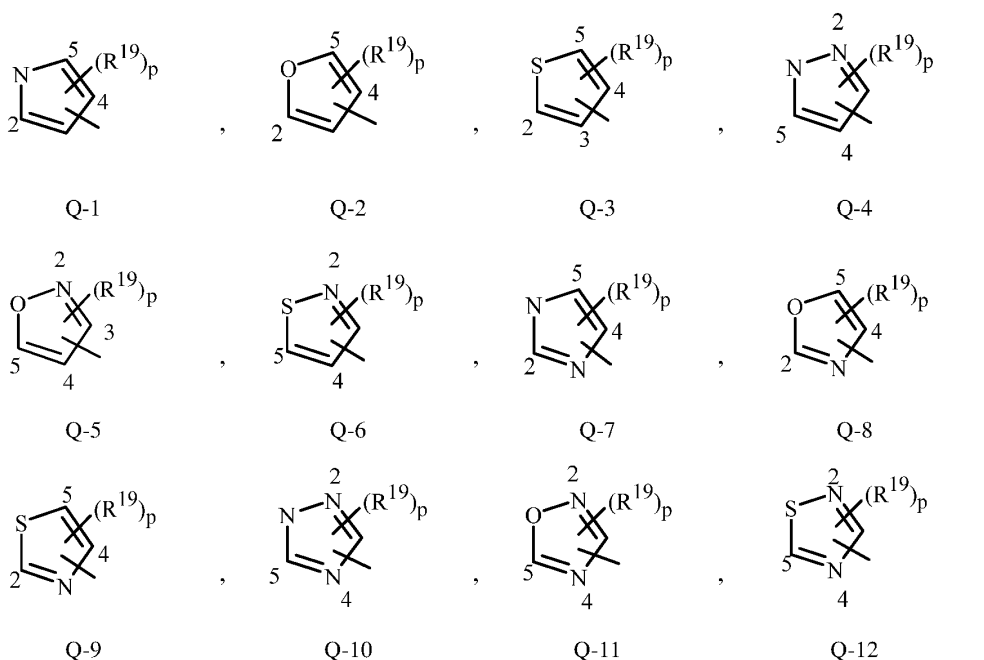
5 Embodiment 43a. A compound of Embodiment 43 wherein R^{5a} and R^{5b} are each independently H or methyl.

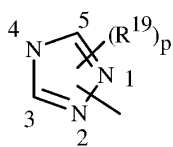
Embodiment 44. A compound of Embodiment 43a wherein R^{5a} is methyl and R^{5b} is H.

Embodiment 45. A compound of Formula **1** or any one of Embodiments 1 through 43a wherein when R^{5a} and R^{5b} are taken together with the atom to which they are
 10 attached to form a ring, then said ring is a 3-to 6- membered nonaromatic carbocyclic ring, the ring optionally substituted with up to 2 substituents independently selected from halogen, methyl, halomethyl or methoxy. C_1 - C_2 alkoxy and C_1 - C_2 haloalkoxy.

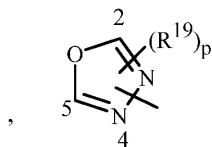
Embodiment 46. A compound of Formula **1** or any one of Embodiments 1 through 45
 15 wherein Q is selected from Q-1 through Q-68 as depicted in Exhibit A

Exhibit A

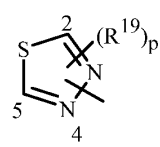




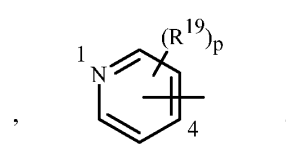
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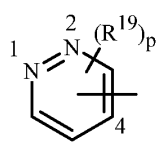
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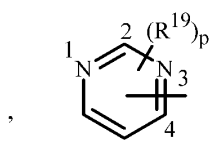
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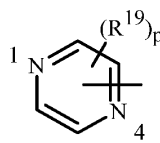
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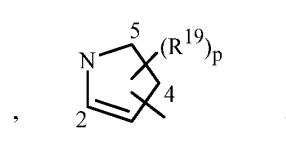
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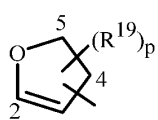
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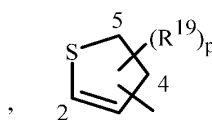
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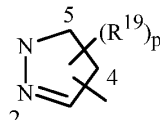
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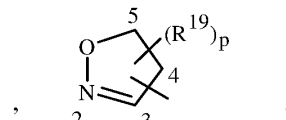
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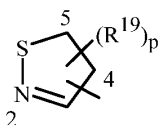
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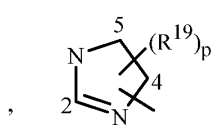
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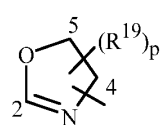
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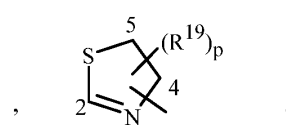
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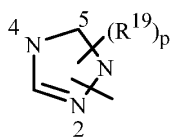
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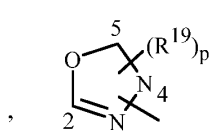
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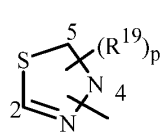
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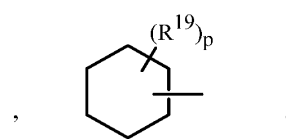
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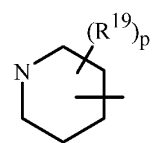
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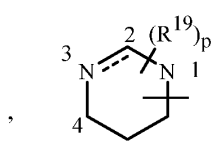
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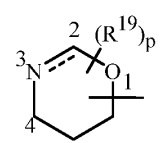
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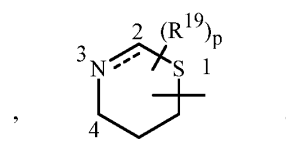
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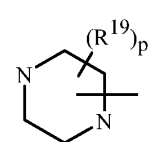
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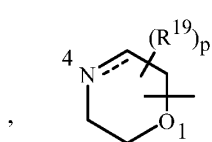
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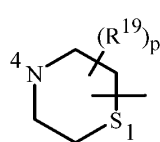
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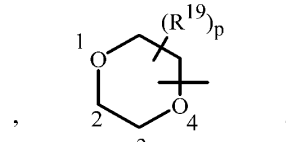
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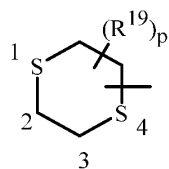
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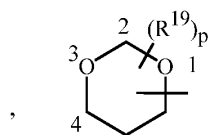
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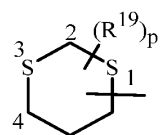
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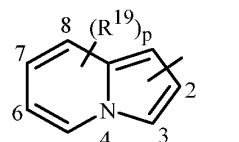
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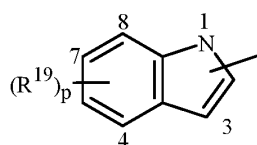
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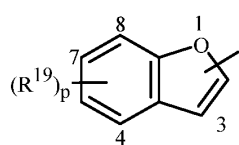
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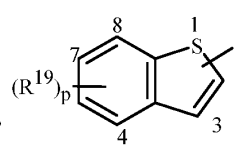
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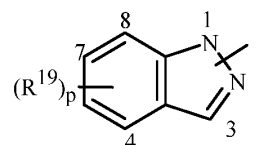
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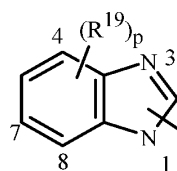
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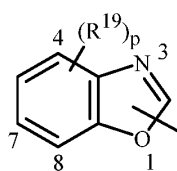
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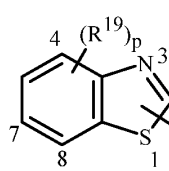
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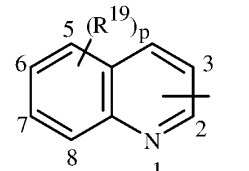
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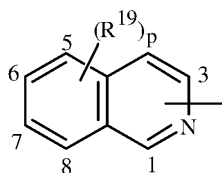
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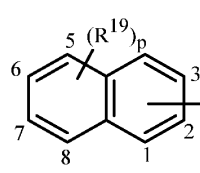
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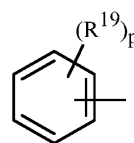
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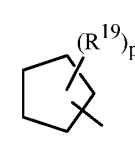
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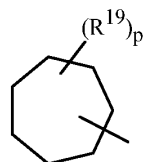
Q-54



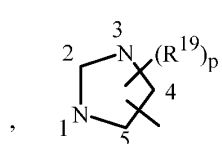
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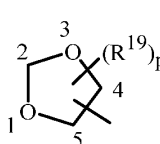
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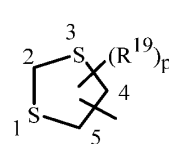
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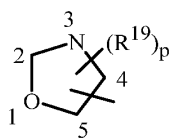
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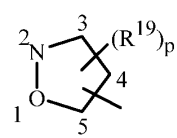
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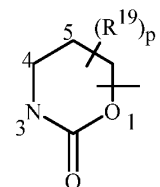
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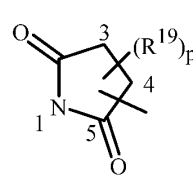
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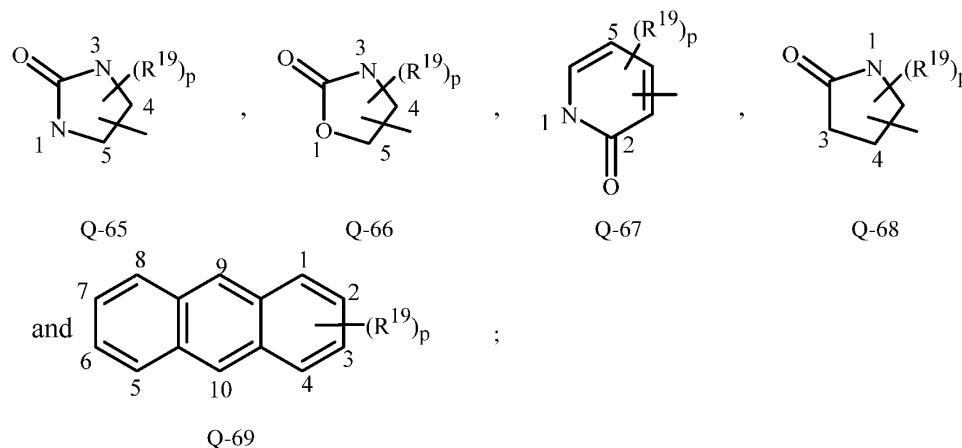
Q-62



Q-63



Q-64



wherein the floating bond is connected to Formula **1** through any available carbon or nitrogen atom of the depicted ring or ring system; and p is 0, 1, 2 or 3.

Embodiment 47. A compound of Embodiment 46 wherein p is 0, 1 or 2.

Embodiment 47a. A compound of Embodiment 47 wherein p is 1 or 2.

5 Embodiment 48. A compound of Embodiment 47 wherein p is 0 or 1.

Embodiment 49. A compound of Embodiment 48 wherein p is 0.

Embodiment 50. A compound of Embodiment 48 wherein p is 1.

Embodiment 51. A compound of Embodiment 46 wherein Q is Q-1 through Q-9, Q-16 through Q-19, Q-32, Q-33, Q-45, Q-46, Q-47, Q-52 through Q-57 or Q-69.

10 Embodiment 51a. A compound of Embodiment 51 wherein Q is Q-69.

Embodiment 52. A compound of Embodiment 51 wherein Q is Q-16, Q-32, Q-33, Q-52 through Q-55 or Q-57.

Embodiment 53. A compound of Embodiment 52 wherein Q is Q-32, Q-33, Q-53, Q-54 or Q-55.

15 Embodiment 54. A compound of Embodiment 53 wherein Q is Q-32, Q-54 or Q-55.

Embodiment 54a. A compound of Embodiment 54 wherein Q is Q-32 or Q-55.

Embodiment 55. A compound of Embodiment 54 wherein Q is Q-32.

Embodiment 56. A compound of Embodiment 54 wherein Q is Q-54.

Embodiment 57. A compound of Embodiment 54 wherein Q is Q-55.

20 Embodiment 58. A compound of Formula **1** or any one of Embodiments 1 through 54a wherein Q is Q-55 (i.e. phenyl) substituted at the 2- and 4-positions with substituents independently selected from R¹⁹; or Q is Q-55 substituted at the 2-position with a

substituent selected from R¹⁹; or Q is Q-55 substituted at the 4-position with a substituent selected from R¹⁹; or Q is Q-55 unsubstituted.

Embodiment 59. A compound of Embodiment 58 wherein Q is Q-55 substituted at the 2-position with a substituent selected from R¹⁹; or Q is Q-55 substituted at the 4-position with a substituent selected from R¹⁹; or Q is Q-55 unsubstituted.

Embodiment 60. A compound of Embodiment 59 wherein Q is Q-55 substituted at the 2-position with a substituent selected from R¹⁹; or Q is Q-55 substituted at the 4-position with a substituent selected from R¹⁹.

Embodiment 60a. A compound of Embodiment 60 wherein Q is Q-55 substituted at the 4-position with a substituent selected from R¹⁹.

Embodiment 61. A compound of Formula **1** or any one of Embodiments 1 through 55 wherein Q is Q-32 substituted at the 2-position with a substituent selected from R¹⁹; or Q is Q-32 substituted at the 4-position with a substituent selected from R¹⁹; or Q is Q-32 unsubstituted.

Embodiment 62. A compound of Embodiment 61 wherein Q is Q-32 substituted at the 4-position with a substituent selected from R¹⁹; or Q is Q-32 unsubstituted.

Embodiment 63. A compound of Formula **1** or any one of Embodiments 1 through 62 wherein R⁶ is H, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxyalkyl.

Embodiment 64. A compound of Embodiment 63 wherein R⁶ is H, methyl, halomethyl, methylcarbonyl or methoxycarbonyl.

Embodiment 65. A compound of Embodiment 64 wherein R⁶ is H, methyl, methylcarbonyl or methoxycarbonyl.

Embodiment 66. A compound of Embodiment 65 wherein R⁶ is H or methyl.

Embodiment 67. A compound of Embodiment 66 wherein R⁶ is H.

Embodiment 68. A compound of Formula **1** or any one of Embodiments 1 through 67 wherein R⁷ is H, cyano, methyl or halomethyl.

Embodiment 69. A compound of Embodiment 68 wherein R⁷ is H or methyl.

Embodiment 70. A compound of Embodiment 69 wherein R⁷ is H.

Embodiment 71. A compound of Formula **1** or any one of Embodiments 1 through 70 wherein R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₁-C₆ alkylamino or C₂-C₆ alkoxyalkyl.

Embodiment 72. A compound of Embodiment 71 wherein R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl.

- Embodiment 73. A compound of Embodiment 72 wherein R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl.
- Embodiment 74. A compound of Embodiment 73 wherein R⁸ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkoxyalkyl.
- 5 Embodiment 75. A compound of Embodiment 74 wherein R⁸ is H, C₁-C₂ alkyl or C₂-C₄ alkoxyalkyl.
- Embodiment 76. A compound of Embodiment 75 wherein R⁸ is H or methyl.
- Embodiment 76a. A compound of Embodiment 76 wherein R⁸ is methyl.
- Embodiment 77. A compound of Formula **1** or any one of Embodiments 1 through 76a
10 wherein R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl.
- Embodiment 78. A compound of Embodiment 77 wherein R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl.
- Embodiment 79. A compound of Embodiment 78 wherein R⁹ is H, C₁-C₃ alkyl, C₁-C₃
15 haloalkyl or C₂-C₄ alkoxyalkyl.
- Embodiment 80. A compound of Embodiment 79 wherein R⁹ is H or methyl.
- Embodiment 81. A compound of Formula **1** or any one of Embodiments 1 through 80
wherein R¹⁰ and R¹¹ are each independently H, CH(=O), C₁-C₆ alkyl, C₁-C₆
haloalkyl, C₂-C₆ alkenyl or C₃-C₆ cycloalkyl.
- 20 Embodiment 82. A compound of Embodiment 81 wherein R¹⁰ and R¹¹ are each independently H, CH(=O), C₁-C₆ alkyl or C₁-C₆ haloalkyl.
- Embodiment 83. A compound of Embodiment 82 wherein R¹⁰ and R¹¹ are each independently H, CH(=O), C₁-C₃ alkyl or C₁-C₃ haloalkyl.
- Embodiment 84. A compound of Embodiment 83 wherein R¹⁰ and R¹¹ are each
25 independently H, CH(=O) or methyl.
- Embodiment 85. A compound of Embodiment 84 wherein R¹⁰ and R¹¹ are each independently H or methyl.
- Embodiment 86. A compound of Formula **1** or any one of Embodiments 1 through 85
wherein R¹² is H, cyano, CH(=O), methyl or halomethyl.
- 30 Embodiment 87. A compound of Embodiment 86 wherein R¹² is H, cyano, CH(=O) or methyl.
- Embodiment 88. A compound of Embodiment 87 wherein R¹² is H, cyano or methyl.
- Embodiment 89. A compound of Embodiment 88 wherein R¹² is H or methyl.

- Embodiment 90. A compound of Formula **1** or any one of Embodiments 1 through 89 wherein R^{13} and R^{14} are each independently C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.
- Embodiment 91. A compound of Embodiment 90 wherein R^{13} and R^{14} are each independently methyl or halomethyl.
- 5 Embodiment 92. A compound of Formula **1** or any one of Embodiments 1 through 91 wherein each R^{15} is independently cyano, hydroxy or methoxy.
- Embodiment 93. A compound of Embodiment 92 wherein each R^{15} is independently methoxy.
- 10 Embodiment 94. A compound of Formula **1** or any one of Embodiments 1 through 93 wherein each R^{16} is independently halogen, C_1 - C_2 alkyl, C_1 - C_2 haloalkyl or C_1 - C_2 alkoxy.
- Embodiment 95. A compound of Embodiment 94 wherein each R^{16} is independently halogen, methyl, halomethyl or methoxy.
- Embodiment 96. A compound of Embodiment 95 wherein each R^{16} is independently
15 halogen or methyl.
- Embodiment 97. A compound of Formula **1** or any one of Embodiments 1 through 96 wherein R^{17} is H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_3 - C_6 cycloalkyl or C_2 - C_6 alkoxyalkyl.
- Embodiment 98. A compound of Embodiment 97 wherein R^{17} is H, C_1 - C_3 alkyl, C_3 - C_6
20 cycloalkyl or C_2 - C_6 alkoxyalkyl.
- Embodiment 99. A compound of Embodiment 98 wherein R^{17} is H, C_1 - C_3 alkyl or C_2 - C_6 alkoxyalkyl.
- Embodiment 100. A compound of Embodiment 99 wherein R^{17} is H or methyl.
- Embodiment 101. A compound of Formula **1** or any one of Embodiments 1 through 100
25 wherein R^{18} is H, $C(=O)H$, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl or C_2 - C_4 alkylcarbonyl.
- Embodiment 102. A compound of Embodiment 101 wherein R^{18} is H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl or C_2 - C_4 alkylcarbonyl.
- Embodiment 103. A compound of Embodiment 102 wherein R^{18} is H or C_1 - C_3 alkyl.
- Embodiment 104. A compound of Embodiment 103 wherein R^{18} is H or methyl.
- 30 Embodiment 105. A compound of Formula **1** or any one of Embodiments 1 through 104 wherein each R^{19} is independently cyano, halogen, nitro, $NR^{20a}R^{20b}$, $C(=O)NR^{20a}R^{20b}$ or -U-V-T; or C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_3 - C_6 cycloalkyl, C_1 - C_6 alkoxy, C_2 - C_6 alkenyloxy, C_2 - C_6 alkynyloxy, C_3 - C_6 cycloalkoxy, C_1 - C_6 alkylthio, C_1 - C_6 alkylsulfonyl, C_2 - C_6 alkylcarbonyl, C_3 - C_6 alkenylcarbonyl,

C₄-C₇ cycloalkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₃-C₆ alkenyloxy carbonyl, C₂-C₆ alkylcarbonyloxy, C₃-C₆ alkenylcarbonyloxy or C₂-C₆ alkoxy carbonyloxy, each optionally substituted with up to 4 substituents independently selected from R²⁵.

5 Embodiment 106. A compound of Embodiment 105 wherein each R¹⁹ is independently cyano, halogen, NR^{20a}R^{20b} or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₃-C₆ cycloalkoxy, C₂-C₆ alkylcarbonyl, C₃-C₆ alkenylcarbonyl, C₂-C₆ alkoxy carbonyl or C₂-C₆ alkylcarbonyloxy, each optionally substituted with up to 3 substituents
10 independently selected from R²⁵.

Embodiment 107. A compound of Embodiment 106 wherein each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₃-C₆ cycloalkoxy, C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl, each optionally substituted with up to 3 substituents independently
15 selected from R²⁵.

Embodiment 108. A compound of Embodiment 107 wherein each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl or C₁-C₆ alkoxy, each optionally substituted with up to 3 substituents independently
20 selected from R²⁵.

Embodiment 109. A compound of Embodiment 108 wherein each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl or C₃-C₆ cycloalkyl, each optionally substituted with up to 3 substituents independently selected from R²⁵.

Embodiment 110. A compound of Embodiment 109 wherein each R¹⁹ is independently halogen or -U-V-T; or C₁-C₃ alkyl or C₃-C₆ cycloalkyl, each optionally substituted with up to 3 substituents independently selected from R²⁵.
25

Embodiment 110a. A compound of Embodiment 110 wherein each R¹⁹ is independently halogen, -U-V-T, C₁-C₃ alkyl, trifluoromethyl or C₃-C₆ cycloalkyl.

Embodiment 111. A compound of Embodiment 110 wherein each R¹⁹ is independently halogen, -U-V-T, C₁-C₃ alkyl or C₃-C₆ cycloalkyl.

30 Embodiment 112. A compound of Embodiment 111 wherein each R¹⁹ is independently halogen, -U-V-T or C₃-C₆ cycloalkyl.

Embodiment 113. A compound of Embodiment 112 wherein each R¹⁹ is independently halogen or -U-V-T, cyclopropyl or cyclohexyl.

Embodiment 114. A compound of Embodiment 113 wherein each R¹⁹ is independently -U-V-T, cyclopropyl or cyclohexyl.

Embodiment 115. A compound of Embodiment 114 wherein each R¹⁹ is independently -U-V-T or cyclohexyl.

5 Embodiment 116. A compound of Formula **1** or any one of Embodiments 1 through 115 wherein each R^{20a} is independently H, cyano, hydroxy, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₂-C₄ haloalkynyl, C₂-C₄ alkylcarbonyl, C₂-C₅ alkoxycarbonyl or C₃-C₅ dialkylaminocarbonyl.

10 Embodiment 117. A compound of Embodiment 116 wherein each R^{20a} is independently H, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₂-C₄ alkylcarbonyl, C₂-C₅ alkoxycarbonyl or C₃-C₅ dialkylaminocarbonyl.

Embodiment 118. A compound of Embodiment 117 wherein each R^{20a} is independently H, C₁-C₂ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl.

15 Embodiment 119. A compound of Embodiment 118 wherein each R^{20a} is independently H or C₁-C₂ alkyl.

Embodiment 120. A compound of Formula **1** or any one of Embodiments 1 through 119 wherein each R^{20b} is independently H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₃-C₆ cycloalkyl, C₄-C₈ cycloalkylalkyl, C₂-C₄ alkoxyalkyl, C₂-C₄ haloalkoxyalkyl or C₂-C₄ alkylaminoalkyl.

20 Embodiment 121. A compound of Embodiment 120 wherein each R^{20b} is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₃-C₆ cycloalkyl or C₂-C₄ alkoxyalkyl.

Embodiment 122. A compound of Embodiment 121 wherein each R^{20b} is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkoxyalkyl.

Embodiment 123. A compound of Formula **1** or any one of Embodiments 1 through 122 wherein each R²¹ is independently H, cyano, halogen, methyl or methoxy.

Embodiment 124. A compound of Embodiment 123 wherein each R²¹ is independently H or methyl.

30 Embodiment 125. A compound of Formula **1** or any one of Embodiments 1 through 124 wherein each R²² is independently hydroxy, NR^{26a}R^{26b}, C₁-C₂ alkoxy, C₂-C₄ alkenyloxy or C₂-C₄ alkylcarbonyloxy.

Embodiment 126. A compound of Embodiment 125 wherein each R²² is independently hydroxy, NR^{26a}R^{26b} or C₁-C₄ alkoxy.

Embodiment 127. A compound of Embodiment 126 wherein each R²² is independently hydroxy, NR^{26a}R^{26b} or methoxy.

Embodiment 128. A compound of Formula **1** or any one of Embodiments 1 through 127 wherein each R²³ is independently H or methyl.

5 Embodiment 129. A compound of Embodiment 128 wherein each R²³ is H.

Embodiment 130. A compound of Formula **1** or any one of Embodiments 1 through 129 wherein when each R^{24a} and R^{24b} is separate (i.e. not taken together to form a ring), then each R^{24a} and R^{24b} is independently H, methyl or ethyl.

10 Embodiment 131. A compound of Embodiment 130 wherein each R^{24a} and R^{24b} is independently H or methyl.

Embodiment 132. A compound of Formula **1** or any one of Embodiments 1 through 131 wherein when R^{24a} and R^{24b} are taken together to form a 4- to 6-membered fully saturated heterocyclic ring, then said ring contains ring members, in addition to the connecting nitrogen atom, selected from carbon atoms and up to 1 heteroatom
15 selected from up to 1 O, up to 1 S and up to 1 N atom, each ring optionally substituted with up to 2 methyl groups.

Embodiment 133. A compound of Embodiment 132 wherein R^{24a} and R^{24b} are taken together to form an azetidiny, morpholinyl, pyrrolidinyl, piperidinyl, piperazinyl, or thiomorpholinyl ring, each ring optionally substituted with up to 2 methyl groups.

20 Embodiment 134. A compound of Formula **1** or any one of Embodiments 1 through 133 wherein each R²⁵ is independently cyano, halogen, hydroxy, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₃ alkoxy, C₁-C₃ haloalkoxy, C₂-C₃ alkoxyalkoxy, C₁-C₃ alkylthio, C₁-C₃ alkylsulfonyl, C₂-C₃ alkylcarbonyl, C₂-C₃ haloalkylcarbonyl, C₂-C₃ alkoxy carbonyl or C₃-C₁₅ trialkylsilyl.

25 Embodiment 135. A compound of Embodiment 134 wherein each R²⁵ is independently cyano, halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy, C₁-C₂ alkylthio, C₂-C₃ alkylcarbonyl, C₂-C₃ haloalkylcarbonyl, C₂-C₃ alkoxy carbonyl or C₃-C₁₅ trialkylsilyl.

30 Embodiment 136. A compound of Embodiment 135 wherein each R²⁵ is independently cyano, halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy or C₂-C₃ alkylcarbonyl.

Embodiment 137. A compound of Embodiment 136 wherein each R²⁵ is independently cyano, halogen, methyl, halomethyl, cyclopropyl, methoxy or methylcarbonyl.

Embodiment 138. A compound of Embodiment 137 wherein each R²⁵ is independently halogen.

Embodiment 139. A compound of Formula **1** or any one of Embodiments 1 through 138 wherein each U is independently a direct bond, O, S(=O)_n or NR²⁷.

5 Embodiment 140. A compound of Embodiment 139 wherein each U is independently a direct bond, O or NR²⁷.

Embodiment 141. A compound of Embodiment 140 wherein each U is independently a direct bond or O.

Embodiment 142. A compound of Embodiment 141 wherein each U is a direct bond.

10 Embodiment 143. A compound of Formula **1** or any one of Embodiments 1 through 142 wherein each V is independently a direct bond; or C₁-C₆ alkylene, C₂-C₆ alkenylene or C₃-C₆ alkynylene, wherein up to 1 carbon atom is C(=O), each optionally substituted with up to 2 substituents independently selected from halogen, cyano, nitro, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy.

15 Embodiment 144. A compound of Embodiment 143 wherein each V is independently a direct bond; or C₁-C₃ alkylene, wherein up to 1 carbon atom is C(=O), optionally substituted with up to 2 substituents independently selected from halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy.

20 Embodiment 145. A compound of Embodiment 144 wherein each V is independently a direct bond or C₁-C₃ alkylene.

Embodiment 146. A compound of Embodiment 145 wherein each V is independently a direct bond or C₁-C₂ alkylene.

Embodiment 147. A compound of Embodiment 146 wherein each V is independently a direct bond or CH₂.

25 Embodiment 148. A compound of Embodiment 147 wherein each V is a direct bond.

30 Embodiment 149. A compound of Formula **1** or any one of Embodiments 1 through 148 wherein each T is independently phenyl optionally substituted with up to 3 substituents independently selected from R³⁰; or a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 3 substituents independently selected from R³⁰; or a 3- to 6-membered nonaromatic heterocyclic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, wherein up to

2 ring members are independently selected from C(=O) and S(=O)₂, each ring optionally substituted with up to 3 substituents independently selected from R³⁰.

5 Embodiment 150. A compound of Embodiment 149 wherein each T is independently phenyl optionally substituted with up to 3 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl, thiazolyl, oxazolyl, isoxazolyl, thienyl, piperidinyl, morpholinyl or piperazinyl, each optionally substituted with up to 3 substituents independently selected from R³⁰.

10 Embodiment 151. A compound of Embodiment 150 wherein each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl or oxazolyl, each optionally substituted with up to 2 substituents independently selected from R³⁰.

15 Embodiment 152. A compound of Embodiment 151 wherein each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰; or pyridinyl or pyrazolyl, each optionally substituted with up to 2 substituents independently selected from R³⁰.

Embodiment 153. A compound of Embodiment 152 wherein each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰; or pyrazolyl optionally substituted with up to 2 substituents independently selected from R³⁰.

20 Embodiment 154. A compound of Embodiment 153 wherein each T is phenyl optionally substituted with up to 2 substituents independently selected from R³⁰.

Embodiment 155. A compound of Embodiment 154 wherein each T is phenyl optionally substituted with up to 1 substituent selected from R³⁰.

Embodiment 156. A compound of Embodiment 155 wherein each T is phenyl.

25 Embodiment 157. A compound of Formula **1** or any one of Embodiments 1 through 156 wherein when each R^{26a} is separate (i.e. not taken together with R^{26b} to form a ring), then each R^{26a} is independently H, methyl or methylcarbonyl.

30 Embodiment 158. A compound of Formula **1** or any one of Embodiments 1 through 157 wherein when each R^{26b} is separate (i.e. not taken together with R^{26a} to form a ring), then each R^{26b} is independently H, cyano, methyl, methylcarbonyl or methoxycarbonyl.

Embodiment 159. A compound of Formula **1** or any one of Embodiments 1 through 158 wherein when R^{26a} and R^{26b} are taken together to form a 5- to 6-membered fully saturated heterocyclic ring, then said ring contains ring members, in addition to the

connecting nitrogen atom, selected from carbon atoms and up to 1 heteroatom selected from up to 1 O, up to 1 S and up to 1 N atom, each ring optionally substituted with up to 2 methyl groups.

5 Embodiment 160. A compound of Embodiment 159 wherein R^{26a} and R^{26b} are taken together to form an azetidiny, morpholinyl, pyrrolidinyl, piperidinyl, piperazinyl or thiomorpholinyl ring, each ring optionally substituted with up to 2 methyl groups.

Embodiment 161. A compound of Formula **1** or any one of Embodiments 1 through 160 wherein each R²⁷, R²⁸ and R²⁹ is independently H, cyano, C₁-C₂ alkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

10 Embodiment 162. A compound of Embodiment 161 wherein each R²⁷, R²⁸ and R²⁹ is independently H, cyano, methyl, methylcarbonyl or methoxycarbonyl.

Embodiment 163. A compound of Embodiment 162 wherein each R²⁷, R²⁸ and R²⁹ is independently H, methyl or methylcarbonyl.

15 Embodiment 164. A compound of Formula **1** or any one of Embodiments 1 through 163 wherein each R³⁰ is independently halogen, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

Embodiment 165. A compound of Embodiment 164 wherein each R³⁰ is independently halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

20 Embodiment 166. A compound of Embodiment 165 wherein each R³⁰ is independently halogen, methyl, halomethyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

Embodiment 167. A compound of Embodiment 166 wherein each R³⁰ is independently halogen, trifluoromethyl or C₂-C₄ alkoxy carbonyl.

25 Embodiments of this invention, including Embodiments 1-167 above as well as any other embodiments described herein, can be combined in any manner, and the descriptions of variables in the embodiments pertain not only to the compounds of Formula **1** but also to the starting compounds and intermediate compounds useful for preparing the compounds of Formula **1**. In addition, embodiments of this invention, including Embodiments 1-167 above as well as any other embodiments described herein, and any combination thereof, pertain to the compositions and
30 methods of the present invention.

Combinations of Embodiments 1-167 are illustrated by:

Embodiment A. A compound of Formula **1** wherein

W is O;

R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl;

R² is H, C(=W)NH₂, C(=O)R⁸, C(=O)OR⁹, CH₂C(=O)R⁸, CH₂C(=O)OR⁹,
CH₂OC(=O)R⁸, CH₂OC(=O)OR⁹, CH₂NR¹²C(=O)R⁸ or CH₂NR¹²C(=O)OR⁹; or
C₁-C₃ alkyl or C₁-C₃ haloalkyl, each optionally substituted with up to 3 substituents
independently selected from R¹⁵; or benzyl, tetrahydropyranyl or tetrahydrofuranyl;

R³ is H, CH(=O) or C(=O)R¹⁷; or

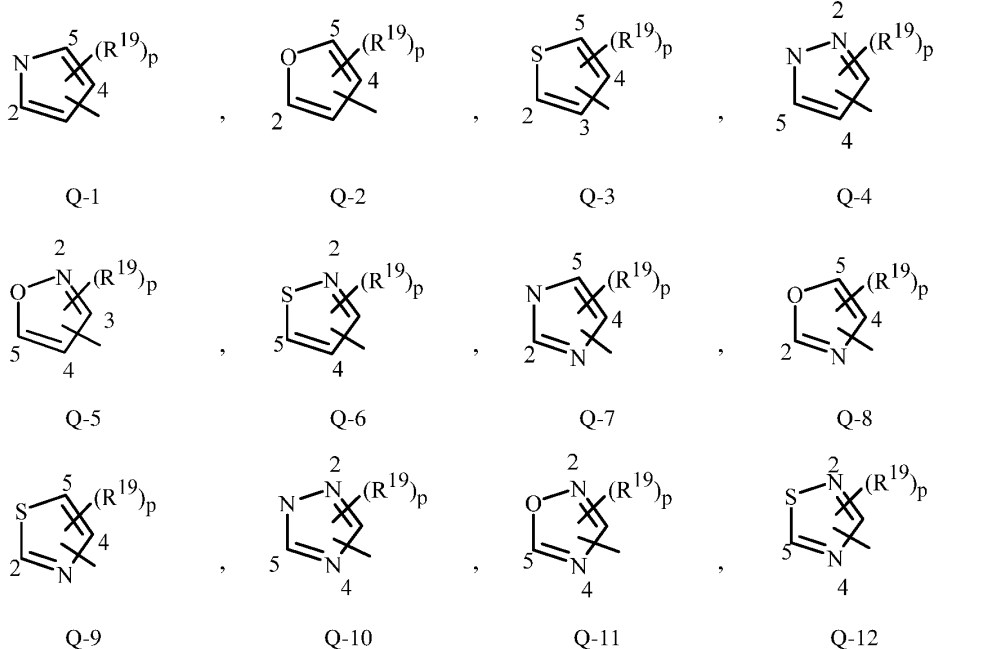
R² and R³ are taken together with the atoms to which they are attached to form a
6-membered nonaromatic ring containing ring members selected from carbon atoms,
the ring optionally substituted with up to 3 substituents independently selected from
halogen and methyl;

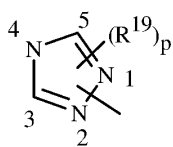
R^{4a} is H, cyano, halogen, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkoxy or C₂-C₃ alkoxyalkyl;

R^{4b} is H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

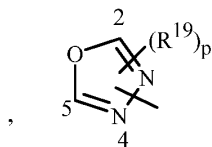
R^{5a} and R^{5b} are each independently H, cyano, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl,
C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl;

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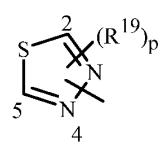




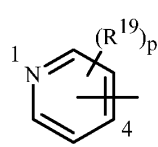
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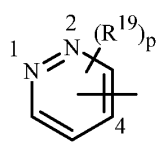
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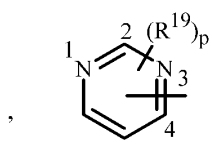
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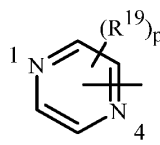
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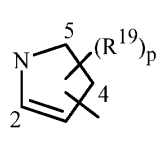
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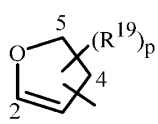
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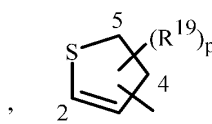
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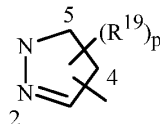
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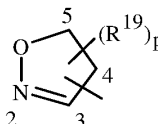
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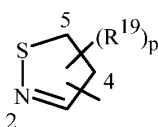
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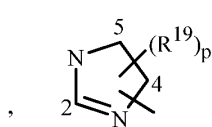
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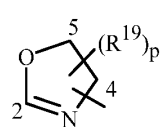
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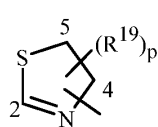
Q-25



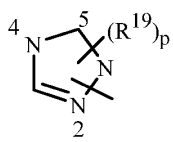
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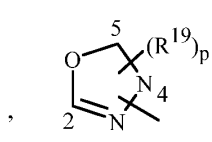
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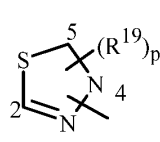
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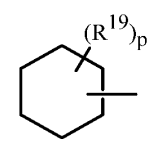
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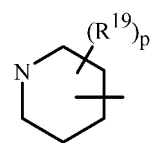
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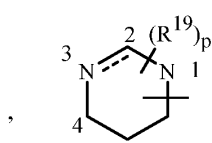
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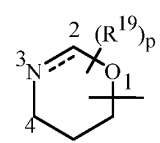
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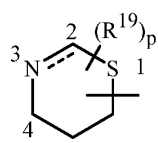
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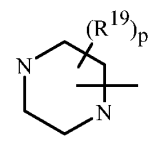
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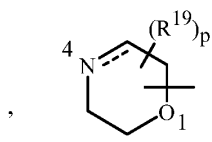
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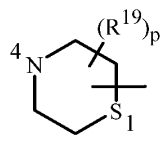
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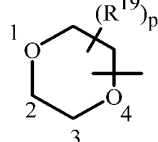
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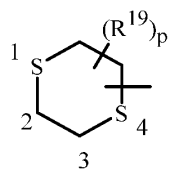
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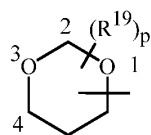
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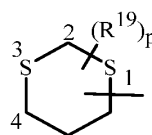
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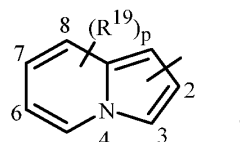
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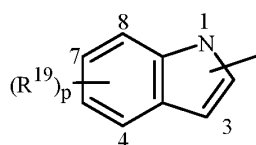
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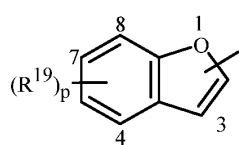
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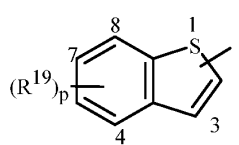
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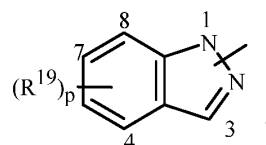
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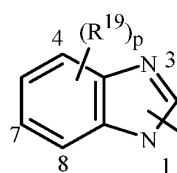
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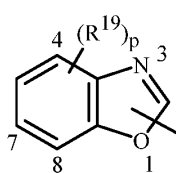
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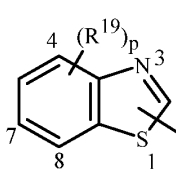
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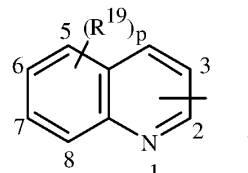
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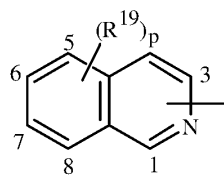
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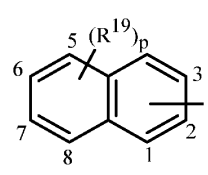
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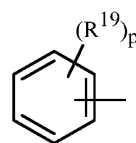
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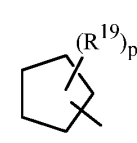
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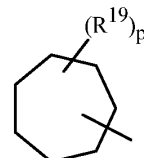
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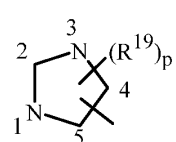
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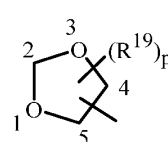
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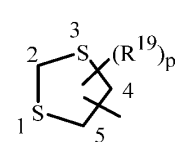
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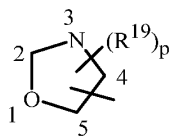
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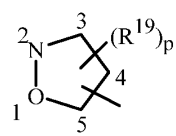
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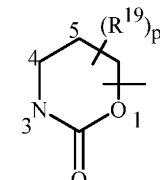
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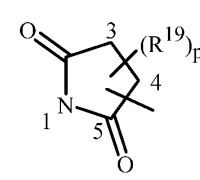
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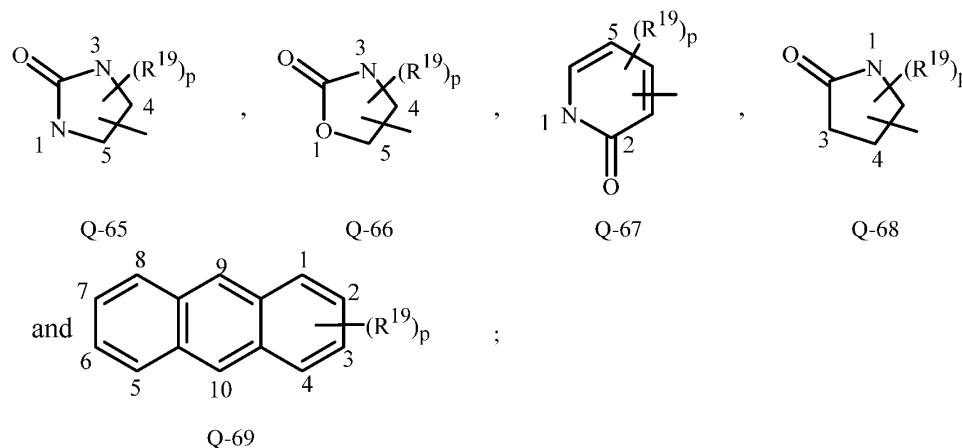
Q-62



Q-63



Q-64



wherein the floating bond is connected to Formula **1** through any available carbon or nitrogen atom of the depicted ring or ring system; and p is 0, 1, 2 or 3;

R⁶ is H, methyl, halomethyl, methylcarbonyl or methoxycarbonyl;

R⁷ is H, cyano, methyl or halomethyl;

5 R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R¹² is H, cyano, CH(=O), methyl or halomethyl;

each R¹⁵ is independently cyano, hydroxy or methoxy;

10 R¹⁷ is H, C₁-C₃ alkyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R¹⁸ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkylcarbonyl;

each R¹⁹ is independently cyano, halogen, nitro, NR^{20a}R^{20b}, C(=O)NR^{20a}R^{20b} or

-U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ cycloalkoxy, C₁-C₆ alkylthio,

15 C₁-C₆ alkylsulfonyl, C₂-C₆ alkylcarbonyl, C₃-C₆ alkenylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₆ alkoxycarbonyl, C₃-C₆ alkenyloxycarbonyl, C₂-C₆ alkylcarbonyloxy, C₃-C₆ alkenylcarbonyloxy or C₂-C₆ alkoxycarbonyloxy, each optionally substituted with up to 4 substituents independently selected from R²⁵;

each R^{20a} is independently H, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄

20 alkynyl, C₂-C₄ alkylcarbonyl, C₂-C₅ alkoxycarbonyl or C₃-C₅

dialkylaminocarbonyl;

each R^{20b} is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkenyl, C₂-C₄

haloalkenyl, C₃-C₆ cycloalkyl or C₂-C₄ alkoxyalkyl;

- each R²⁵ is independently cyano, halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy, C₁-C₂ alkylthio, C₂-C₃ alkylcarbonyl, C₂-C₃ haloalkylcarbonyl, C₂-C₃ alkoxycarbonyl or C₃-C₁₅ trialkylsilyl;
- each U is independently a direct bond, O, S(=O)_n or NR²⁷;
- 5 each V is independently a direct bond; or C₁-C₃ alkylene, wherein up to 1 carbon atom is C(=O), optionally substituted with up to 2 substituents independently selected from halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;
- each T is independently phenyl optionally substituted with up to 3 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl,
- 10 thiazolyl, oxazolyl, isoxazolyl, thienyl, piperidinyl, morpholinyl or piperazinyl, each optionally substituted with up to 3 substituents independently selected from R³⁰;
- each R²⁷ is independently H, cyano, methyl, methylcarbonyl or methoxycarbonyl; and
- each R³⁰ is independently halogen, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl.
- 15 Embodiment B. A compound of Embodiment A wherein
- Z is N;
- X is O;
- R¹ is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxycarbonyl;
- 20 R² is H, C(=O)R⁸, C(=O)OR⁹, CH₂C(=O)R⁸, CH₂C(=O)OR⁹, CH₂OC(=O)R⁸, CH₂OC(=O)OR⁹ or benzyl;
- R³ is H, CH(=O) or C(=O)R¹⁷;
- R^{4a} is H, halogen, C₁-C₃ alkyl, or C₁-C₃ haloalkyl;
- R^{4b} is H or C₁-C₂ alkyl;
- 25 R^{5a} and R^{5b} are each independently H, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₃-C₆ cycloalkyl;
- Q is Q-1 through Q-9, Q-16 through Q-19, Q-32, Q-33, Q-45, Q-46, Q-47, Q-52 through Q-57 or Q-69;
- R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl;
- 30 R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl;
- R¹⁷ is H or methyl;
- R¹⁸ is H or C₁-C₃ alkyl;
- each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₃-C₆ cycloalkoxy,

- C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl, each optionally substituted with up to 3 substituents independently selected from R²⁵;
 each R²⁵ is independently cyano, halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy or C₂-C₃ alkylcarbonyl;
 5 each U is independently a direct bond, O or NR²⁷;
 each V is independently a direct bond or C₁-C₃ alkylene;
 each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl or oxazolyl, each optionally substituted with up to 2 substituents independently selected
 10 from R³⁰; and
 each R³⁰ is independently halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.
- Embodiment C. A compound of Embodiment B wherein
- R¹ is H, C(=O)H, methyl or methylcarbonyl;
 15 R² is H, C(=O)R⁸ or C(=O)OR⁹;
 R³ is H;
 R^{4a} is H or C₁-C₂ alkyl;
 R^{4b} is H or methyl;
 L is O;
 20 R^{5a} and R^{5b} are each independently H, C₁-C₃ alkyl or cyclopropyl;
 Q is Q-16, Q-32, Q-33, Q-52 through Q-55 or Q-57;
 p is 0, 1 or 2;
 R⁸ is H, C₁-C₂ alkyl or C₂-C₄ alkoxyalkyl;
 R⁹ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkoxyalkyl;
 25 each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl or C₃-C₆ cycloalkyl, each optionally substituted with up to 3 substituents independently selected from R²⁵;
 each R²⁵ is independently cyano, halogen, methyl, halomethyl, cyclopropyl, methoxy or methylcarbonyl;
 each U is independently a direct bond or O;
 30 each V is independently a direct bond or C₁-C₂ alkylene;
 each T is independently phenyl or pyrazolyl, each optionally substituted with up to 2 substituents independently selected from R³⁰; and
 each R³⁰ is independently halogen, methyl, halomethyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.

Embodiment D. A compound of Embodiment C wherein

- R¹ is methyl;
- R² is H or C(=O)R⁸;
- R^{4a} is methyl;
- 5 R^{4b} is H;
- R^{5a} and R^{5b} are each independently H, methyl, ethyl or isopropyl;
- Q is Q-32, Q-54 or Q-55;
- R⁸ is H or methyl;
- each R¹⁹ is independently halogen or -U-V-T; or C₁-C₃ alkyl or C₃-C₆ cycloalkyl, each
- 10 optionally substituted with up to 3 substituents independently selected from R²⁵;
- each R²⁵ is independently halogen;
- each V is independently a direct bond or CH₂; and
- each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰.

15 Embodiment E. A compound of Embodiment D wherein

- R^{5a} is H, methyl, ethyl or isopropyl;
- R^{5b} is H;
- Q is Q-32 or Q-55;
- R⁸ is methyl;
- 20 each R¹⁹ is independently halogen, -U-V-T, C₁-C₃ alkyl, trifluoromethyl or C₃-C₆ cycloalkyl; and
- each R³⁰ is independently halogen, trifluoromethyl or C₂-C₄ alkoxy carbonyl.

Specific embodiments include compounds of Formula **1** selected from the group consisting of:

- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexylethyl ester (Compound 29);
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylethyl ester (Compound 30);
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester (Compound 31);
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester (Compound 32);
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexyl-2-methylpropyl ester (Compound 62);

N-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-(4-cyclopropylphenyl)ethyl ester (Compound 66);
N-[[3-[(acetyloxy)methoxy]-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester (Compound 77);
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-valine 1-(4-cyclohexylphenyl)ethyl ester (Compound 79);
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexylpropyl ester (Compound 83);
N-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylpropyl ester (Compound 84);
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine (1*S*)-1-cyclohexylethyl ester (Compound 87);
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine (1*S*)-1-(4-cyclohexylphenyl)ethyl ester (Compound 95);
N-[[4-(formylamino)-3-hydroxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester (Compound 97);
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)propyl ester (Compound 100); and
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-phenylcyclohexyl)ethyl ester (Compound 104).

In addition to the embodiments described above, this invention also provides a fungicidal composition comprising a compound of Formula **1** (including all stereoisomers, *N*-oxides, and salts thereof), and at least one other fungicide. Of note as embodiments of such compositions are compositions comprising a compound corresponding to any of the compound embodiments described above.

This invention also provides a fungicidal composition comprising a compound of Formula **1** (including all stereoisomers, *N*-oxides, and salts thereof) (i.e. in a fungicidally effective amount), and at least one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents. Of note as embodiments of such compositions are compositions comprising a compound corresponding to any of the compound embodiments described above.

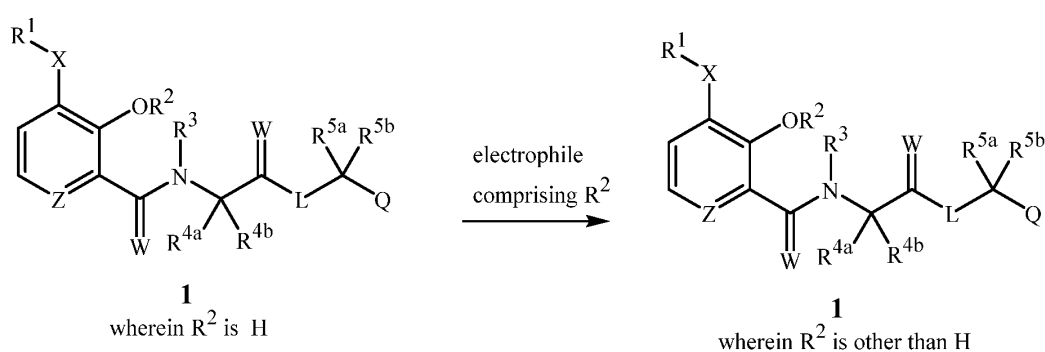
This invention provides a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to a plant seed, a fungicidally effective amount of a compound of Formula **1** (including all stereoisomers, *N*-oxides, and salts thereof). Of note as embodiments of such methods are methods comprising applying a

fungicidally effective amount of a compound corresponding to any of the compound embodiments describe above. Of particular note are embodiments where the compounds are applied as compositions of this invention.

One or more of the following methods and variations as described in Schemes 1-11 can be used to prepare the compounds of Formula **1**. The definitions of R^1 , X, Z, R^2 , W, R^3 , R^{4a} , R^{4b} , L, R^{5a} , R^{5b} and Q in the compounds of Formulae **1-10** below are as defined above in the Summary of the Invention unless otherwise noted. Compounds of Formulae **1a**, **1a-1** and **1a'** are various subsets of Formula **1**, and all substituents for Formulae **1a**, **1a-1** and **1a'** are as defined above for Formula **1** unless otherwise noted.

As shown in Scheme 1, compounds of Formula **1** wherein R^2 is other than H can be prepared from the corresponding compounds of Formula **1** wherein R^2 is H by reaction with an electrophile comprising R^2 . In this context the expression “electrophile comprising R^2 ” means a chemical compound capable of transferring an R^2 moiety to a nucleophile (i.e. the oxygen atom in Formula **1** when R^2 is H). Particularly useful electrophiles include alkyl halides and acid halides. For example, acid chlorides of formula $ClC(=O)R^8$ react with compounds of Formula **1** wherein R^2 is H to provide compounds of Formula **1** wherein R^2 is $C(=O)R^8$. The reaction is typically conducted in the presence of an acid scavenger and a suitable organic solvent such as dichloromethane, tetrahydrofuran, acetonitrile, acetone, *N,N*-dimethylformamide, and mixtures thereof. Suitable acid scavengers comprise, for example, amine bases such as triethylamine, *N,N*-diisopropylethylamine and pyridine, hydroxides such as sodium and potassium hydroxide and carbonates such as sodium carbonate and potassium carbonate. Present Example 2 illustrates the method of Scheme 1 for the preparation of a compound of Formula **1** wherein R^2 is $C(=O)CH_3$.

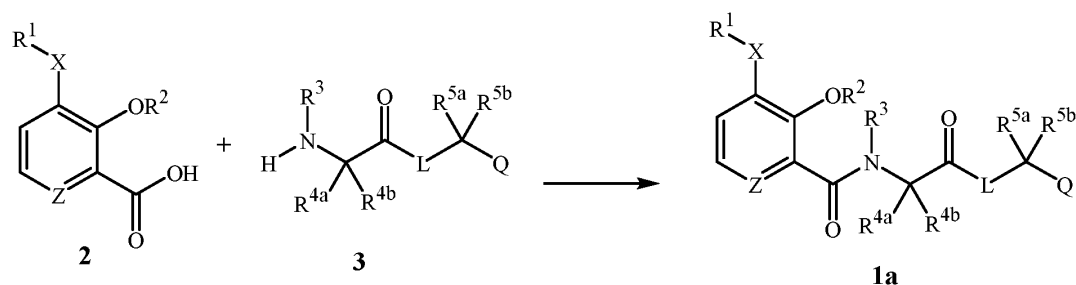
Scheme 1



As shown in Scheme 2, Compounds of Formula **1a** (i.e. Formula **1** wherein W is O) can be prepared by reacting a carboxylic acid of Formula **2** with an amine of Formula **3**. The reaction

proceeds via activation of the carboxylic acid of Formula **2** followed by coupling with the amine of Formula **3**. Activation of the carboxylic acid takes place with the aid of a coupling reagent, or alternatively by conversion of the carboxylic acid to the acid halide. For example, compounds of Formulae **2** and **3** can be reacted in the presence of a peptide coupling reagent. Useful coupling reagents include, for example, benzotriazol-1-yl-oxy-tris-pyrrolidinophosphonium hexafluorophosphate (PyBOP®), *O*-(7-azabenzotriazol-1-yl)-*N,N,N',N'*-tetramethyluronium hexafluorophosphate (HATU) and 2-(1*H*-benzotriazol-1-yl)-1,1,3,3-tetramethyluronium hexafluorophosphate (HBTU). The reaction is typically run in a polar aprotic solvent such as *N,N*-dimethylformamide, tetrahydrofuran or dichloromethane and in the presence of a base such as pyridine, triethylamine or *N,N*-diisopropylethylamine. In certain instances it can be advantageous to use polymer-supported coupling reagents, such as polymer bound dicyclohexyl carbodiimide (DCC). Alternatively, a carboxylic acid of Formula **2** can be reacted with a halogenating reagent such as thionyl chloride, oxalyl chloride, phosphorus trichloride, phosphorus oxychloride or phosphorus pentachloride in a solvent such as dichloromethane or toluene and optionally in the presence of a catalytic amount of *N,N*-dimethylformamide to provide the corresponding acid chloride. The coupling step typically includes a base such as triethylamine, *N,N*-diisopropylethylamine and pyridine. A wide variety of synthetic methods are known in the art to enable the formation amide bonds from carboxylic acids and amines; for an extensive review of coupling conditions, including solid-supported strategies, see *Chemical Society Review* **2009**, 38, 606-631; *Chemical Society Review* **2014**, 00, 1-29; *Journal of Saudi Chemical Society* **2012**, 16, 97-116; and *Tetrahedron* **2005**, 61, 10827-10852.

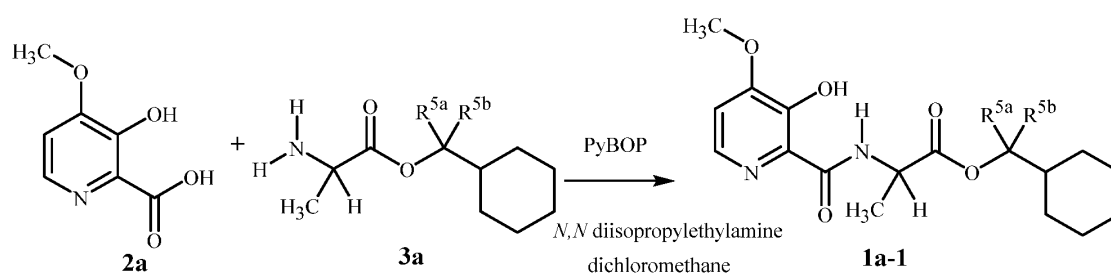
Scheme 2



Scheme 3 illustrates a specific example of the general method of Scheme 2 for the preparation of a compound of Formula **1a-1** (i.e. Formula **1a** wherein Z is N , R^1 is CH_3 , R^2 is H , R^3 is H , R^{4a} is CH_3 , R^{4b} is H , L is O and Q is cyclohexyl, i.e. **Q-32**). In this method a compound of Formula **2a** (i.e. Formula **2** wherein Z is N , R^1 is CH_3 and R^2 is H) is reacted with an amine of Formula **3a** (i.e. Formula **3** wherein R^3 is H , R^{4a} is CH_3 , R^{4b} is H , L is O and Q is cyclohexyl,

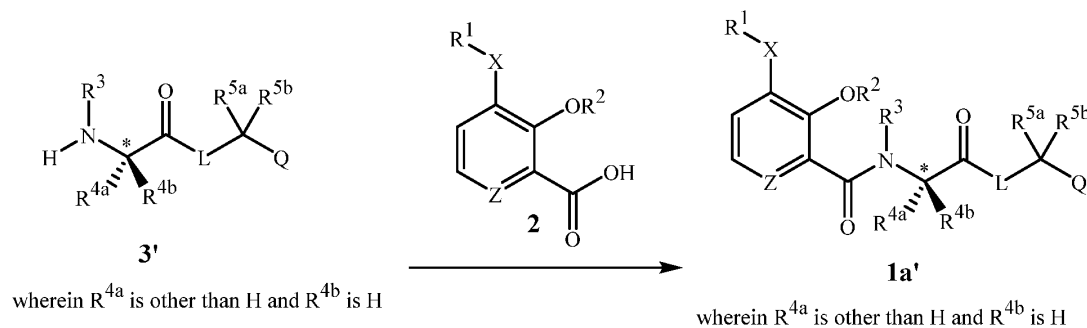
i.e. Q-32) in the presence of PyBOP and *N,N*-diisopropylethylamine, in dichloromethane. The method of Scheme 3 is illustrated in Example 1, Step C.

Scheme 3



One skilled in the art will recognize that the method of Scheme 2 can also be practiced with chiral starting materials to obtain certain chiral compounds of Formula **1**. For example, as shown in Scheme 4, amines of Formula **3'** wherein R^{4a} is other than H and R^{4b} is H (e.g., (*S*)-configured amines) can be reacted with carboxylic acids of Formula **2** to provide isomers Formula **1a'** wherein the chiral center is identified with an asterisk (*). One skilled in the art will recognize it may be advantageous to perform the method of Scheme 4 when the amine of Formula **3'** is protected.

Scheme 4

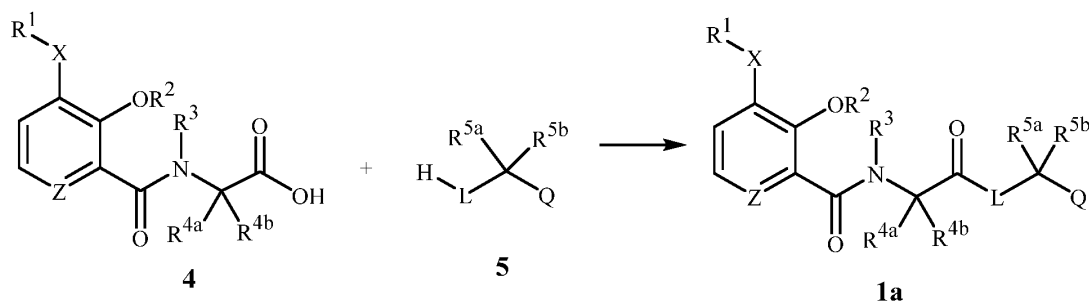


As shown in Scheme 5, compounds of Formula **1a** (i.e. Formula **1** wherein W is O) can also be prepared from carboxylic acids of Formula **4** and compounds of Formula **5**. When L is O, reaction conditions involve contacting compounds of Formulae **4** and Formula **5** in the presence of an acid catalyst, for example, concentrated sulfuric acid or *p*-toluenesulfonic acid under dehydrative conditions such as heating in toluene or xylenes with use of a Dean-Stark trap to remove water formed in the reaction. For representative procedures see *Organic Syntheses* **1943**, 2, 264-265; and *Tetrahedron* **2002**, 58(41), 8179-8188. Alternatively, a condensation coupling reagent, such as dicyclohexyl carbodiimide (DCC) can be used in the presence of a catalytic

amount of *N,N*-dimethyl-4-pyridinamine (DMAP) in a solvent such as dichloromethane. Other condensation coupling reagents are also useful, such as 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (EDC), carbonyldiimidazole (CDI), diisopropylcarbodiimide (DIC), 2-(1*H*-benzotriazole-1-yl)-1,1,3,3-tetramethylaminium tetrafluoroborate (TBTU) and O-(benzotriazol-1-yl)-*N,N,N',N'*-tetramethyluronium hexafluorophosphate (HBTU). For representative references, see *Angew. Chem., Int. Ed. Engl.* **1978**, 17(7), 522-524; and *Organic Letters* **2011**, 13(12), 2988-2991; and *J. Am. Chem. Soc.*, **2007**, 129, 14775-14779.

When L is NR¹⁸, reaction conditions analogous to those described in Scheme 2 can be used.

Scheme 5



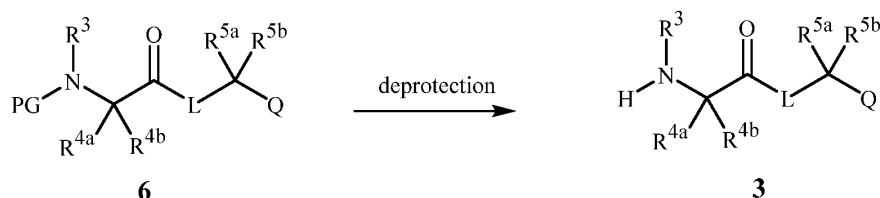
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Amines of Formula **3** can be prepared from corresponding *N*-protected compounds of Formula **6** wherein PG is an amine protecting group via a deprotection reaction as shown in Scheme 6. A wide array of amine protecting groups are suitable for the method of Scheme 6 (see, for example, T. W. Greene and P. G. M. Wuts, *Protective Groups in Organic Synthesis*, 2nd ed.; Wiley: New York, **1991**). Particularly useful protecting groups include, but are not limited to, *tert*-butoxycarbonyl (Boc) and benzyloxycarbonyl (Cbz). Removal of the protecting group (PG) can be accomplished with acids such as trifluoroacetic acid in dichloromethane or with hydrochloric acid in methanol or dioxane. Treatment with trimethylsilyl iodide then methanol can also be used for Boc deprotection, especially where other deprotection methods are too harsh for the substrate. Deprotection reactions of this type are well-known in the chemistry literature; see, for example, *Journal of the Chemical Society, Chemical Communications* **1979**, 11, 495-496; *Journal of Organic Chemistry* **2014**, 79, 11792-11796; *Journal of Peptide Research* **2001**, 58(4), 338-341; and *International Journal of Peptide and Protein Research* **1978**, 12(5), 258-268. After deprotection, the amine of Formula **3** can be isolated as its acid salt (e.g., HCl) or the free amine by general methods known in the art. The method of Scheme 6 wherein PG is *tert*-butoxycarbonyl (Boc) is illustrated in Example 1, Step B.

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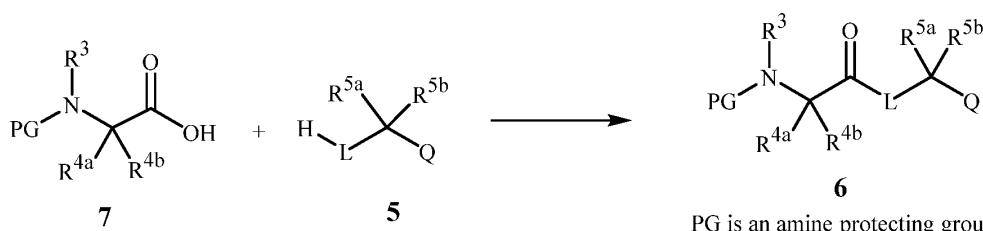
Scheme 6



PG is an amine protecting group

As shown in Scheme 7, compounds of Formula **6** can be prepared by reacting compounds of acids of Formula **7** and compounds of Formula **5** analogous to the methods described in Schemes 2 and 5 for L equal to NR¹⁸ and O, respectively. The method of Scheme 7 for L being O is illustrated in Example 1, Step A.

Scheme 7

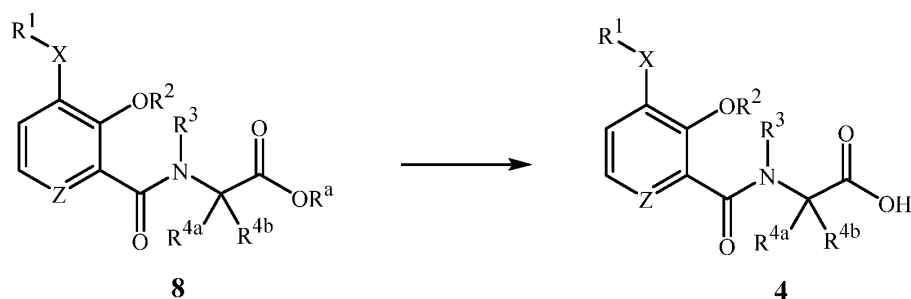


PG is an amine protecting group

As shown in Scheme 8, carboxylic acids of Formula **4** can be prepared from the corresponding esters of Formula **8** using a variety of methods reported in the chemical literature, including nucleophilic cleavage under anhydrous conditions or hydrolysis involving the use of either acids or bases (see T. W. Greene and P. G. M. Wuts, *Protective Groups in Organic Synthesis*, 2nd ed., John Wiley & Sons, Inc., New York, 1991, pp. 224–269 for a review of methods). Base-catalyzed hydrolytic conditions are typically preferred for preparing carboxylic acids of Formula **4** from the corresponding esters. Suitable bases include alkali metals such as lithium, sodium or potassium hydroxide. For example, the esters can be dissolved in an alcohol such as methanol or a mixture of water and methanol and treated with sodium hydroxide or potassium hydroxide at a temperature between about 25 and 45 °C. The product can be isolated by adjusting the pH to about 1 to 3 and then filtering or extracting, optionally after removal of the organic solvent by evaporation.

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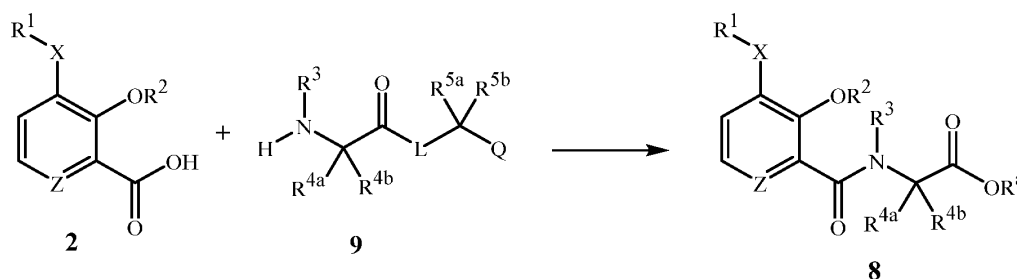
Scheme 8



wherein R^a is lower alkyl such as methyl or ethyl

As shown in Scheme 9, compounds of Formula **8** can be prepared by reacting a carboxylic acid of Formula **2** with an amine of Formula **9** in a manner analogous to the method of Scheme 2.

Scheme 9



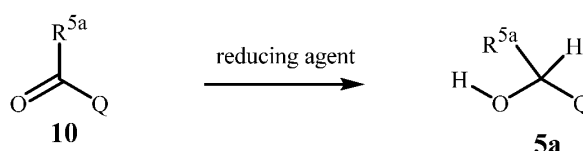
wherein R^a is lower alkyl such as methyl or ethyl

General methods useful for preparing compounds of Formula **5** are well known in the art. For example, as shown in Scheme 10, reduction of ketones of Formula **10** using a reducing agent such as lithium aluminum hydride or a borane/tetrahydrofuran complex in an aprotic solvent such as tetrahydrofuran or diethyl ether at a temperature ranging from -78°C to 25°C provides compounds of Formula **6a** (Formula **6** wherein L is O and R^{5b} is H). These types of transformations are well-known in the literature; see, for example, March and Smith, *March's Advanced Organic Chemistry*, 5th ed., John Wiley & Sons, Inc., New York, 2001, Chapter 19. Ketones of Formula **10** are commercially available and can be prepared by known literature methods.

Enantioselective reduction of ketones of Formula **10** to their corresponding enantiopure alcohols of Formula **6** can be achieved with borane-tetrahydrofuran, borane-dimethyl sulfide (BMS) or catecholborane and a chiral oxazaborolidine as catalyst (CBS catalyst). For relevant

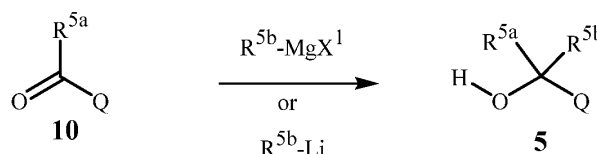
references, see *J. Am. Chem. Soc.* **1987**, 109, 5551; and *Angew. Chem., Int. Ed. Engl.* **1998**, 37, 1986.

Scheme 10



As shown in Scheme 11, compounds of Formula **5** can also be prepared by reacting an organolithium or Grignard reagent with a compound of Formula **10**. The reaction is typically conducted in a suitable solvent such as diethyl ether, tetrahydrofuran or toluene at a temperature between about -78 to 20 °C. The compounds of Formula **5** can be isolated by quenching the reaction mixture with aqueous acid, extracting with an organic solvent and concentrating.

Scheme 11



wherein X^1 is Cl, Br or I

Compounds of Formula **1** prepared by the methods described above wherein W is O can be converted to the corresponding thioamides wherein W is S using a variety of standard thiolating reagents such as phosphorus pentasulfide or 2,4-bis(4-methoxyphenyl)-1,3-dithia-2,4-diphosphetane-2,4-disulfide (Lawesson's reagent). Reactions of this type are well-known see, for example, *Heterocycles* **1995**, 40, 271-278; *J. Med. Chem.* **2008**, 51, 8124-8134; *J. Med. Chem.* **1990**, 33, 2697-706; *Synthesis* **1989**, (5), 396-3977; *J. Chem. Soc., Perkin Trans. 1*, **1988**, 1663-1668; *Tetrahedron* **1988** 44, 3025-3036; and *J. Org. Chem.* **1988** 53(6), 1323-1326.

Chiral compounds of Formula **1** can be obtained from a racemic mixture of Formula **1** compounds through the utilization of well-known chiral chromatography separation methods. For extensive reviews of chiral separation methods see the *Chiral Separations: Methods and Protocols* (Methods in Molecular Biology), 2nd ed., 2013 Edition, by Gerhard K. E. Scriba (Editor).

It is recognized by one skilled in the art that various functional groups can be converted into others to provide different compounds of Formula **1**. For example, compounds of Formula **1**, or

intermediates for their preparation, may contain aromatic nitro groups, which can be reduced to amino groups, and then converted via reactions well-known in the art (e.g., Sandmeyer reaction) to various halides. By similar known reactions, aromatic amines (anilines) can be converted via diazonium salts to phenols, which can then be alkylated to prepare compounds of Formula **1** with alkoxy substituents. Likewise, aromatic halides such as bromides or iodides prepared via the Sandmeyer reaction can react with alcohols under copper-catalyzed conditions, such as the Ullmann reaction or known modifications thereof, to provide compounds of Formula **1** that contain alkoxy substituents. Additionally, some halogen groups, such as fluorine or chlorine, can be displaced with alcohols under basic conditions to provide compounds of Formula **1** containing the corresponding alkoxy substituents. Compounds of Formula **1** or precursors thereof containing a halide, preferably bromide or iodide, are particularly useful intermediates for transition metal-catalyzed cross-coupling reactions to prepare compounds of Formula **1**. These types of reactions are well documented in the literature; see, for example, Tsuji in *Transition Metal Reagents and Catalysts: Innovations in Organic Synthesis*, John Wiley and Sons, Chichester, 2002; Tsuji in *Palladium in Organic Synthesis*, Springer, 2005; and Miyaura and Buchwald in *Cross Coupling Reactions: A Practical Guide*, 2002; and references cited therein

One skilled in the art will recognize that, in some cases, after introduction of the reagents depicted in the individual schemes, additional routine synthetic steps not described in detail may be needed to complete the synthesis of compounds of Formula **1**. One skilled in the art will also recognize that it may be necessary to perform a combination of the steps illustrated in the above schemes in an order other than that implied by the particular sequence presented to prepare the compounds of Formula **1**.

It is recognized that some reagents and reaction conditions described above for preparing compounds of Formula **1** may not be compatible with certain functionalities present in the intermediates. In these instances, the incorporation of protection/deprotection sequences or functional group interconversions into the synthesis will aid in obtaining the desired products. The use and choice of the protecting groups will be apparent to one skilled in chemical synthesis (see, for example, Greene, T. W.; Wuts, P. G. M. *Protective Groups in Organic Synthesis*, 2nd ed.; Wiley: New York, 1991).

One skilled in the art will also recognize that compounds of Formula **1** and the intermediates described herein can be subjected to various electrophilic, nucleophilic, radical, organometallic, oxidation, and reduction reactions to add substituents or modify existing substituents.

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are,

therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Steps in the following Examples illustrate a procedure for each step in an overall synthetic transformation, and the starting material for each step may not have necessarily been prepared by a particular preparative run whose procedure is described in other Examples or Steps.

- 5 Percentages are by weight except for chromatographic solvent mixtures or where otherwise indicated. Parts and percentages for chromatographic solvent mixtures are by volume unless otherwise indicated. ¹H NMR spectra are reported in ppm downfield from tetramethylsilane; “s” means singlet, “br s” means broad singlet, “d” means doublet, “dd” means doublet of doublets, “t” means triplet, “q” means quartet and “m” means multiplet. ¹⁹F NMR spectra are reported in
10 ppm using trichlorofluoromethane as the reference.

EXAMPLE 1

Preparation of *N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylethyl ester (Compound 30)

- Step A: Preparation of *N*-[(1,1-dimethylethoxy)carbonyl]-L-alanine 1-cyclohexylethyl
15 ester

To a mixture of α -methylcyclohexanemethanol (2.0 g, 15.62 mmol) in dichloromethane (35 mL) at 0 °C was added *N*-[(1,1-dimethylethoxy)carbonyl]-L-alanine (3.54 g, 18.75 mmol), *N'*-(ethylcarbonimidoyl)-*N,N*-dimethyl-1,3-propanediamine monohydrochloride (7.46 g, 39.06 mmol) and *N,N*-dimethyl-4-pyridinamine (0.38 g, 3.12 mmol). The reaction mixture was
20 allowed to warm to room temperature, stirred for 24 h, and then concentrated under reduced pressure. The resulting material was purified by silica gel chromatography (eluting with a gradient of 0 to 5% ethyl acetate in hexanes) to provide the title compound as an oil (2.1 g).

¹H NMR (CDCl₃): δ 5.05 (s, 1H), 4.80-4.70 (m, 1H), 4.35-4.25 (m, 1H), 1.80-1.70 (m, 2H), 1.70-1.60 (m, 2H), 1.50-1.40 (m, 10H), 1.40-1.30 (m, 3H), 1.30-1.10 (m, 6H), 1.10-0.90 (m, 2H).

- 25 Step B: Preparation of L-alanine 1-cyclohexylethyl ester hydrochloride (1:1)

To a mixture of *N*-[(1,1-dimethylethoxy)carbonyl]-L-alanine 1-cyclohexylethyl ester (i.e. the product of Step B) (2.0 g, 6.69 mmol) in methanol (20 mL) at 0 °C was added acetyl chloride. The reaction mixture was stirred at room temperature for 5 h, and then concentrated under reduced pressure. The resulting material was diluted with toluene/chloroform and distilled to provide the
30 title compound as an oil (1.8 g).

¹H NMR (CDCl₃): δ 4.77-4.74 (m, 1H), 3.55-3.50 (m, 1H), 1.76-1.74(m, 3H), 1.70-1.66 (m, 2H), 1.46-1.44 (m, 1H), 1.35-1.32 (m, 3H), 1.22-1.16 (m, 6H), 1.02-0.96 (m, 2H).

Step C: Preparation of *N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylethyl ester

To a mixture of L-alanine 1-cyclohexylethyl ester hydrochloride (1:1) (i.e. the product of Step C) (1.5 g, 7.54 mmol) in dichloromethane (25 mL) was added 3-hydroxy-4-methoxy-pyridine-2-carboxylic acid (1.27 g, 7.54 mmol). The reaction mixture was cooled to 0 °C, and then *N,N*-diisopropylethylamine (3.88 g, 30.15 mmol) and (benzotriazol-1-yloxy) tripyrrolidinophosphonium hexafluorophosphate (PyBOP) (5.83 g, 11.31 mmol) were added. The reaction mixture was allowed to gradually warm to room temperature and stirred for 5 h, and then diluted with ethyl acetate (15 mL) and water (20.0 mL). The layers were separated, and the organic layer was washed with saturated aqueous sodium chloride solution, dried over magnesium sulfate, filtered and the filtrate was concentrated under reduced pressure. The resulting material was purified by silica gel chromatography (eluting with a gradient of 0 to 25% ethyl acetate in hexanes) to provide the title compound, a compound of the present invention, as an oil (1.20 g). ¹H NMR (CDCl₃): δ 12.16 (s, 1H), 8.55 (d, 1H), 8.00 (d, 1H), 6.87 (d, 1H), 4.82-4.75 (m, 1H), 4.70-4.63 (m, 1H), 3.95 (s, 3H), 1.82-1.60 (m, 5H), 1.60-1.40 (m, 4H), 1.30-0.90 (m, 8H).

EXAMPLE 2

Preparation of *N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexylethyl ester (Compound 29)

To a mixture of 1 *N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylethyl ester (i.e. the product of Example 1) (0.20 g, 0.57 mmol) in dichloromethane (8 mL) at 0 °C was added triethylamine (0.15 mL, 1.14 mmol), followed by *N,N*-dimethylaminopyridine (0.006 g, 0.057 mmol) and acetyl chloride (0.053 mL, 0.74 mmol). The reaction mixture was allowed to warm to room temperature and stirred for 2 h. The reaction mixture was diluted with ethyl acetate (35 mL) and washed with water (20 mL) and saturated aqueous sodium chloride solution. The organic layer was dried over magnesium sulfate, filtered and the filtrate was concentrated under reduced pressure. The resulting material was purified by silica gel chromatography (eluting with a gradient of 0 to 20% ethyl acetate in hexanes) to provide the title compound, a compound of the present invention, as an oil (0.15 g). ¹H NMR (CDCl₃): δ 8.56 (br s, 1H), 8.33 (d, 1H), 7.00 (d, 1H), 4.85-4.55 (m, 2H), 3.90 (s, 3H), 2.40 (s, 3H), 1.80-1.60 (m, 5H), 1.55-1.40 (m, 4H), 1.25-0.90 (m, 10H).

Formulation/Utility

A compound of Formula **1** of this invention (including *N*-oxides and salts thereof) will generally be used as a fungicidal active ingredient in a composition, i.e. formulation, with at least

one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents, which serve as a carrier. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature.

5 Useful formulations include both liquid and solid compositions. Liquid compositions include solutions (including emulsifiable concentrates), suspensions, emulsions (including microemulsions, oil-in-water emulsions, flowable concentrates and/or suspoemulsions) and the like, which optionally can be thickened into gels. The general types of aqueous liquid
10 compositions are soluble concentrate, suspension concentrate, capsule suspension, concentrated emulsion, microemulsion, oil-in-water emulsion, flowable concentrate and suspoemulsion. The general types of nonaqueous liquid compositions are emulsifiable concentrate, microemulsifiable concentrate, dispersible concentrate and oil dispersion.

 The general types of solid compositions are dusts, powders, granules, pellets, prills, pastilles, tablets, filled films (including seed coatings) and the like, which can be water-dispersible
15 (“wettable”) or water-soluble. Films and coatings formed from film-forming solutions or flowable suspensions are particularly useful for seed treatment. Active ingredient can be (micro)encapsulated and further formed into a suspension or solid formulation; alternatively the entire formulation of active ingredient can be encapsulated (or “overcoated”). Encapsulation can control or delay release of the active ingredient. An emulsifiable granule combines the advantages
20 of both an emulsifiable concentrate formulation and a dry granular formulation. High-strength compositions are primarily used as intermediates for further formulation.

 Sprayable formulations are typically extended in a suitable medium before spraying. Such liquid and solid formulations are formulated to be readily diluted in the spray medium, usually water, but occasionally another suitable medium like an aromatic or paraffinic hydrocarbon or
25 vegetable oil. Spray volumes can range from about one to several thousand liters per hectare, but more typically are in the range from about ten to several hundred liters per hectare. Sprayable formulations can be tank mixed with water or another suitable medium for foliar treatment by aerial or ground application, or for application to the growing medium of the plant. Liquid and dry formulations can be metered directly into drip irrigation systems or metered into the furrow
30 during planting. Liquid and solid formulations can be applied onto seeds of crops and other desirable vegetation as seed treatments before planting to protect developing roots and other subterranean plant parts and/or foliage through systemic uptake.

 The formulations will typically contain effective amounts of active ingredient, diluent and surfactant within the following approximate ranges which add up to 100 percent by weight.

	Weight Percent		
	<u>Active Ingredient</u>	<u>Diluent</u>	<u>Surfactant</u>
Water-Dispersible and Water-soluble Granules, Tablets and Powders	0.001–90	0–99.999	0–15
Oil Dispersions, Suspensions, Emulsions, Solutions (including Emulsifiable Concentrates)	1–50	40–99	0–50
Dusts	1–25	70–99	0–5
Granules and Pellets	0.001–95	5–99.999	0–15
High Strength Compositions	90–99	0–10	0–2

Solid diluents include, for example, clays such as bentonite, montmorillonite, attapulgite and kaolin, gypsum, cellulose, titanium dioxide, zinc oxide, starch, dextrin, sugars (e.g., lactose, sucrose), silica, talc, mica, diatomaceous earth, urea, calcium carbonate, sodium carbonate and bicarbonate, and sodium sulfate. Typical solid diluents are described in Watkins et al., *Handbook of Insecticide Dust Diluents and Carriers*, 2nd Ed., Dorland Books, Caldwell, New Jersey.

Liquid diluents include, for example, water, *N,N*-dimethylalkanamides (e.g., *N,N*-dimethylformamide), limonene, dimethyl sulfoxide, *N*-alkylpyrrolidones (e.g., *N*-methylpyrrolidinone), alkyl phosphates (e.g., triethyl phosphate), ethylene glycol, triethylene glycol, propylene glycol, dipropylene glycol, polypropylene glycol, propylene carbonate, butylene carbonate, paraffins (e.g., white mineral oils, normal paraffins, isoparaffins), alkylbenzenes, alkylnaphthalenes, glycerine, glycerol triacetate, sorbitol, aromatic hydrocarbons, dearomatized aliphatics, alkylbenzenes, alkylnaphthalenes, ketones such as cyclohexanone, 2-heptanone, isophorone and 4-hydroxy-4-methyl-2-pentanone, acetates such as isoamyl acetate, hexyl acetate, heptyl acetate, octyl acetate, nonyl acetate, tridecyl acetate and isobornyl acetate, other esters such as alkylated lactate esters, dibasic esters, alkyl and aryl benzoates and γ -butyrolactone, and alcohols, which can be linear, branched, saturated or unsaturated, such as methanol, ethanol, *n*-propanol, isopropyl alcohol, *n*-butanol, isobutyl alcohol, *n*-hexanol, 2-ethylhexanol, *n*-octanol, decanol, isodecyl alcohol, isooctadecanol, cetyl alcohol, lauryl alcohol, tridecyl alcohol, oleyl alcohol, cyclohexanol, tetrahydrofurfuryl alcohol, diacetone alcohol, cresol and benzyl alcohol. Liquid diluents also include glycerol esters of saturated and unsaturated fatty acids (typically C₆–C₂₂), such as plant seed and fruit oils (e.g., oils of olive, castor, linseed,

sesame, corn (maize), peanut, sunflower, grapeseed, safflower, cottonseed, soybean, rapeseed, coconut and palm kernel), animal-sourced fats (e.g., beef tallow, pork tallow, lard, cod liver oil, fish oil), and mixtures thereof. Liquid diluents also include alkylated fatty acids (e.g., methylated, ethylated, butylated) wherein the fatty acids may be obtained by hydrolysis of glycerol esters from
5 plant and animal sources, and can be purified by distillation. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950.

The solid and liquid compositions of the present invention often include one or more surfactants. When added to a liquid, surfactants (also known as “surface-active agents”) generally modify, most often reduce, the surface tension of the liquid. Depending on the nature of the
10 hydrophilic and lipophilic groups in a surfactant molecule, surfactants can be useful as wetting agents, dispersants, emulsifiers or defoaming agents.

Surfactants can be classified as nonionic, anionic or cationic. Nonionic surfactants useful for the present compositions include, but are not limited to: alcohol alkoxylates such as alcohol alkoxylates based on natural and synthetic alcohols (which may be branched or linear) and
15 prepared from the alcohols and ethylene oxide, propylene oxide, butylene oxide or mixtures thereof; amine ethoxylates, alkanolamides and ethoxylated alkanolamides; alkoxylated triglycerides such as ethoxylated soybean, castor and rapeseed oils; alkylphenol alkoxylates such as octylphenol ethoxylates, nonylphenol ethoxylates, dinonyl phenol ethoxylates and dodecyl phenol ethoxylates (prepared from the phenols and ethylene oxide, propylene oxide, butylene
20 oxide or mixtures thereof); block polymers prepared from ethylene oxide or propylene oxide and reverse block polymers where the terminal blocks are prepared from propylene oxide; ethoxylated fatty acids; ethoxylated fatty esters and oils; ethoxylated methyl esters; ethoxylated tristyrilphenol (including those prepared from ethylene oxide, propylene oxide, butylene oxide or mixtures thereof); fatty acid esters, glycerol esters, lanolin-based derivatives, polyethoxylate esters such as
25 polyethoxylated sorbitan fatty acid esters, polyethoxylated sorbitol fatty acid esters and polyethoxylated glycerol fatty acid esters; other sorbitan derivatives such as sorbitan esters; polymeric surfactants such as random copolymers, block copolymers, alkyd peg (polyethylene glycol) resins, graft or comb polymers and star polymers; polyethylene glycols (pegs); polyethylene glycol fatty acid esters; silicone-based surfactants; and sugar-derivatives such as
30 sucrose esters, alkyl polyglycosides and alkyl polysaccharides.

Useful anionic surfactants include, but are not limited to: alkylaryl sulfonic acids and their salts; carboxylated alcohol or alkylphenol ethoxylates; diphenyl sulfonate derivatives; lignin and lignin derivatives such as lignosulfonates; maleic or succinic acids or their anhydrides; olefin sulfonates; phosphate esters such as phosphate esters of alcohol alkoxylates, phosphate esters of

alkylphenol alkoxyates and phosphate esters of styryl phenol ethoxyates; protein-based surfactants; sarcosine derivatives; styryl phenol ether sulfate; sulfates and sulfonates of oils and fatty acids; sulfates and sulfonates of ethoxylated alkylphenols; sulfates of alcohols; sulfates of ethoxylated alcohols; sulfonates of amines and amides such as *N,N*-alkyltaurates; sulfonates of benzene, cumene, toluene, xylene, and dodecyl and tridecylbenzenes; sulfonates of condensed naphthalenes; sulfonates of naphthalene and alkyl naphthalene; sulfonates of fractionated petroleum; sulfosuccinamates; and sulfosuccinates and their derivatives such as dialkyl sulfosuccinate salts.

Useful cationic surfactants include, but are not limited to: amides and ethoxylated amides; amines such as *N*-alkyl propanediamines, tripropylenetriamines and dipropylenetetramines, and ethoxylated amines, ethoxylated diamines and propoxylated amines (prepared from the amines and ethylene oxide, propylene oxide, butylene oxide or mixtures thereof); amine salts such as amine acetates and diamine salts; quaternary ammonium salts such as quaternary salts, ethoxylated quaternary salts and diquaternary salts; and amine oxides such as alkyl dimethylamine oxides and bis-(2-hydroxyethyl)-alkylamine oxides.

Also useful for the present compositions are mixtures of nonionic and anionic surfactants or mixtures of nonionic and cationic surfactants. Nonionic, anionic and cationic surfactants and their recommended uses are disclosed in a variety of published references including *McCutcheon's Emulsifiers and Detergents*, annual American and International Editions published by McCutcheon's Division, The Manufacturing Confectioner Publishing Co.; Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964; and A. S. Davidson and B. Milwidsky, *Synthetic Detergents*, Seventh Edition, John Wiley and Sons, New York, 1987.

Compositions of this invention may also contain formulation auxiliaries and additives, known to those skilled in the art as formulation aids (some of which may be considered to also function as solid diluents, liquid diluents or surfactants). Such formulation auxiliaries and additives may control: pH (buffers), foaming during processing (antifoams such as polyorganosiloxanes), sedimentation of active ingredients (suspending agents), viscosity (thixotropic thickeners), in-container microbial growth (antimicrobials), product freezing (antifreezes), color (dyes/pigment dispersions), wash-off (film formers or stickers), evaporation (evaporation retardants), and other formulation attributes. Film formers include, for example, polyvinyl acetates, polyvinyl acetate copolymers, polyvinylpyrrolidone-vinyl acetate copolymer, polyvinyl alcohols, polyvinyl alcohol copolymers and waxes. Examples of formulation auxiliaries and additives include those listed in *McCutcheon's Volume 2: Functional Materials*,

annual International and North American editions published by McCutcheon's Division, The Manufacturing Confectioner Publishing Co.; and PCT Publication WO 03/024222.

The compound of Formula **1** and any other active ingredients are typically incorporated into the present compositions by dissolving the active ingredient in a solvent or by grinding in a liquid or dry diluent. Solutions, including emulsifiable concentrates, can be prepared by simply mixing the ingredients. If the solvent of a liquid composition intended for use as an emulsifiable concentrate is water-immiscible, an emulsifier is typically added to emulsify the active-containing solvent upon dilution with water. Active ingredient slurries, with particle diameters of up to 2,000 μm can be wet milled using media mills to obtain particles with average diameters below 3 μm . Aqueous slurries can be made into finished suspension concentrates (see, for example, U.S. 3,060,084) or further processed by spray drying to form water-dispersible granules. Dry formulations usually require dry milling processes, which produce average particle diameters in the 2 to 10 μm range. Dusts and powders can be prepared by blending and usually grinding (such as with a hammer mill or fluid-energy mill). Granules and pellets can be prepared by spraying the active material upon preformed granular carriers or by agglomeration techniques. See Browning, "Agglomeration", *Chemical Engineering*, December 4, 1967, pp 147-48, *Perry's Chemical Engineer's Handbook*, 4th Ed., McGraw-Hill, New York, 1963, pp 8-57 and following, and WO 91/13546. Pellets can be prepared as described in U.S. 4,172,714. Water-dispersible and water-soluble granules can be prepared as taught in U.S. 4,144,050, U.S. 3,920,442 and DE 3,246,493. Tablets can be prepared as taught in U.S. 5,180,587, U.S. 5,232,701 and U.S. 5,208,030. Films can be prepared as taught in GB 2,095,558 and U.S. 3,299,566.

One embodiment of the present invention relates to a method for controlling fungal pathogens, comprising diluting the fungicidal composition of the present invention (a compound of Formula **1** formulated with surfactants, solid diluents and liquid diluents or a formulated mixture of a compound of Formula **1** and at least one other fungicide) with water, and optionally adding an adjuvant to form a diluted composition, and contacting the fungal pathogen or its environment with an effective amount of said diluted composition.

Although a spray composition formed by diluting with water a sufficient concentration of the present fungicidal composition can provide sufficient efficacy for controlling fungal pathogens, separately formulated adjuvant products can also be added to spray tank mixtures. These additional adjuvants are commonly known as "spray adjuvants" or "tank-mix adjuvants", and include any substance mixed in a spray tank to improve the performance of a pesticide or alter the physical properties of the spray mixture. Adjuvants can be anionic or nonionic surfactants, emulsifying agents, petroleum-based crop oils, crop-derived seed oils, acidifiers, buffers,

thickeners or defoaming agents. Adjuvants are used to enhancing efficacy (e.g., biological availability, adhesion, penetration, uniformity of coverage and durability of protection), or minimizing or eliminating spray application problems associated with incompatibility, foaming, drift, evaporation, volatilization and degradation. To obtain optimal performance, adjuvants are selected with regard to the properties of the active ingredient, formulation and target (e.g., crops, insect pests).

The amount of adjuvants added to spray mixtures is generally in the range of about 2.5% to 0.1 % by volume. The application rates of adjuvants added to spray mixtures are typically between about 1 to 5 L per hectare. Representative examples of spray adjuvants include: Adigor® (Syngenta) 47% methylated rapeseed oil in liquid hydrocarbons, Silwet® (Helena Chemical Company) polyalkyleneoxide modified heptamethyltrisiloxane and Assist® (BASF) 17% surfactant blend in 83% paraffin based mineral oil.

One method of seed treatment is by spraying or dusting the seed with a compound of the invention (i.e. as a formulated composition) before sowing the seeds. Compositions formulated for seed treatment generally comprise a film former or adhesive agent. Therefore typically a seed coating composition of the present invention comprises a biologically effective amount of a compound of Formula 1 and a film former or adhesive agent. Seeds can be coated by spraying a flowable suspension concentrate directly into a tumbling bed of seeds and then drying the seeds. Alternatively, other formulation types such as wetted powders, solutions, suspoemulsions, emulsifiable concentrates and emulsions in water can be sprayed on the seed. This process is particularly useful for applying film coatings on seeds. Various coating machines and processes are available to one skilled in the art. Suitable processes include those listed in P. Kusters et al., *Seed Treatment: Progress and Prospects*, 1994 BCPC Mongraph No. 57, and references listed therein.

For further information regarding the art of formulation, see T. S. Woods, "The Formulator's Toolbox – Product Forms for Modern Agriculture" in *Pesticide Chemistry and Bioscience, The Food–Environment Challenge*, T. Brooks and T. R. Roberts, Eds., Proceedings of the 9th International Congress on Pesticide Chemistry, The Royal Society of Chemistry, Cambridge, 1999, pp. 120-133. Also see U.S. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10-41; U.S. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138–140, 162–164, 166, 167 and 169–182; U.S. 2,891,855, Col. 3, line 66 through Col. 5, line 17 and Examples 1-4; Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81-96; Hance et al., *Weed Control Handbook*, 8th Ed.,

Blackwell Scientific Publications, Oxford, 1989; and *Developments in formulation technology*, PJB Publications, Richmond, UK, 2000.

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways. Active ingredient refers to the compounds in Index Tables A-F disclosed herein. Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are, therefore, to be constructed as merely illustrative, and not limiting of the disclosure in any way whatsoever.

Example A

High Strength Concentrate

Compound 29	98.5%
silica aerogel	0.5%
synthetic amorphous fine silica	1.0%

10

Example B

Wettable Powder

Compound 30	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
montmorillonite (calcined)	23.0%

Example C

Granule

Compound 31	10.0%
attapulgit granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25–50 sieves)	90.0%

Example D

Extruded Pellet

Compound 32	25.0%
anhydrous sodium sulfate	10.0%
crude calcium ligninsulfonate	5.0%
sodium alkylnaphthalenesulfonate	1.0%
calcium/magnesium bentonite	59.0%

60

Example EEmulsifiable Concentrate

Compound 62	10.0%
polyoxyethylene sorbitol hexoleate	20.0%
C ₆ -C ₁₀ fatty acid methyl ester	70.0%

Example FMicroemulsion

Compound 66	5.0%
polyvinylpyrrolidone-vinyl acetate copolymer	30.0%
alkylpolyglycoside	30.0%
glyceryl monooleate	15.0%
water	20.0%

Example GSeed Treatment

Compound 77	20.00%
polyvinylpyrrolidone-vinyl acetate copolymer	5.00%
montan acid wax	5.00%
calcium ligninsulfonate	1.00%
polyoxyethylene/polyoxypropylene block copolymers	1.00%
stearyl alcohol (POE 20)	2.00%
polyorganosilane	0.20%
colorant red dye	0.05%
water	65.75%

Example HFertilizer Stick

Compound 79	2.50%
pyrrolidone-styrene copolymer	4.80%
tristyrylphenyl 16-ethoxylate	2.30%
talc	0.80%
corn starch	5.00%
slow-release fertilizer	36.00%
kaolin	38.00%
water	10.60%

Example ISuspension Concentrate

Compound 83	35%
butyl polyoxyethylene/polypropylene block copolymer	4.0%
stearic acid/polyethylene glycol copolymer	1.0%
styrene acrylic polymer	1.0%
xanthan gum	0.1%
propylene glycol	5.0%
silicone based defoamer	0.1%
1,2-benzisothiazolin-3-one	0.1%
water	53.7%

Example JEmulsion in Water

Compound 84	10.0%
butyl polyoxyethylene/polypropylene block copolymer	4.0%
stearic acid/polyethylene glycol copolymer	1.0%
styrene acrylic polymer	1.0%
xanthan gum	0.1%
propylene glycol	5.0%
silicone based defoamer	0.1%
1,2-benzisothiazolin-3-one	0.1%
aromatic petroleum based hydrocarbon	20.0
water	58.7%

Example KOil Dispersion

Compound 87	25%
polyoxyethylene sorbitol hexaoleate	15%
organically modified bentonite clay	2.5%
fatty acid methyl ester	57.5%

Example LSuspoemulsion

Compound 95	10.0%
imidacloprid	5.0%

butyl polyoxyethylene/polypropylene block copolymer	4.0%
stearic acid/polyethylene glycol copolymer	1.0%
styrene acrylic polymer	1.0%
xanthan gum	0.1%
propylene glycol	5.0%
silicone based defoamer	0.1%
1,2-benzisothiazolin-3-one	0.1%
aromatic petroleum based hydrocarbon	20.0%
water	53.7%

Water-soluble and water-dispersible formulations are typically diluted with water to form aqueous compositions before application. Aqueous compositions for direct applications to the plant or portion thereof (e.g., spray tank compositions) typically contain at least about 1 ppm or more (e.g., from 1 ppm to 100 ppm) of the compound(s) of this invention.

5 Seed is normally treated at a rate of from about 0.001 g (more typically about 0.1 g) to about 10 g per kilogram of seed (i.e. from about 0.0001 to 1% by weight of the seed before treatment). A flowable suspension formulated for seed treatment typically comprises from about 0.5 to about 70% of the active ingredient, from about 0.5 to about 30% of a film-forming adhesive, from about 0.5 to about 20% of a dispersing agent, from 0 to about 5% of a thickener, from 0 to about 5% of
10 a pigment and/or dye, from 0 to about 2% of an antifoaming agent, from 0 to about 1% of a preservative, and from 0 to about 75% of a volatile liquid diluent.

The compounds of this invention are useful as plant disease control agents. The present invention therefore further comprises a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the plant
15 seed to be protected, an effective amount of a compound of the invention or a fungicidal composition containing said compound. The compounds and/or compositions of this invention provide control of diseases caused by a broad spectrum of fungal plant pathogens in the Ascomycota, Basidiomycota, Zygomycota phyla, and the fungal-like Oomycata class. They are effective in controlling a broad spectrum of plant diseases, particularly foliar pathogens of
20 ornamental, turf, vegetable, field, cereal, and fruit crops. These pathogens include but are not limited to those listed in Table 1-1. For Ascomycetes and Basidiomycetes, names for both the sexual/teleomorph/perfect stage as well as names for the asexual/anamorph/imperfect stage (in parentheses) are listed where known. Synonymous names for pathogens are indicated by an equal sign. For example, the sexual/teleomorph/perfect stage name *Phaeosphaeria nodorum* is followed

by the corresponding asexual/anamorph/imperfect stage name *Stagnospora nodorum* and the synonymous older name *Septoria nodorum*.

Table 1-1

Ascomycetes in the order Pleosporales including <i>Alternaria solani</i> , <i>A. alternata</i> and <i>A. brassicae</i> , <i>Guignardia bidwellii</i> , <i>Venturia inaequalis</i> , <i>Pyrenophora tritici-repentis</i> (<i>Dreschlera tritici-repentis</i> = <i>Helminthosporium tritici-repentis</i>) and <i>Pyrenophora teres</i> (<i>Dreschlera teres</i> = <i>Helminthosporium teres</i>), <i>Corynespora cassiicola</i> , <i>Phaeosphaeria nodorum</i> (<i>Stagonospora nodorum</i> = <i>Septoria nodorum</i>), <i>Cochliobolus carbonum</i> and <i>C. heterostrophus</i> , <i>Leptosphaeria biglobosa</i> and <i>L. maculans</i> ;
Ascomycetes in the order Mycosphaerellales including <i>Mycosphaerella graminicola</i> (<i>Zymoseptoria tritici</i> = <i>Septoria tritici</i>), <i>M. berkeleyi</i> (<i>Cercosporidium personatum</i>), <i>M. arachidis</i> (<i>Cercospora arachidicola</i>), <i>Passalora sojae</i> (<i>Cercospora sojae</i>), <i>Cercospora zae-maydis</i> and <i>C. beticola</i> ;
Ascomycetes in the order Erysiphales (the powdery mildews) such as <i>Blumeria graminis</i> f.sp. <i>tritici</i> and <i>Blumeria graminis</i> f.sp. <i>hordei</i> , <i>Erysiphe polygoni</i> , <i>E. necator</i> (= <i>Uncinula necator</i>), <i>Podosphaera fuliginea</i> (= <i>Sphaerotheca fuliginea</i>), and <i>Podosphaera leucotricha</i> (= <i>Sphaerotheca fuliginea</i>);
Ascomycetes in the order Helotiales such as <i>Botryotinia fuckeliana</i> (<i>Botrytis cinerea</i>), <i>Oculimacula yallundae</i> (= <i>Tapesia yallundae</i> ; anamorph <i>Helgardia herpotrichoides</i> = <i>Pseudocercospora herpotrichoides</i>), <i>Monilinia fructicola</i> , <i>Sclerotinia sclerotiorum</i> , <i>Sclerotinia minor</i> , and <i>Sclerotinia homoeocarpa</i> ;
Ascomycetes in the order Hypocreales such as <i>Giberella zae</i> (<i>Fusarium graminearum</i>), <i>G. moniliformis</i> (<i>Fusarium moniliforme</i>), <i>Fusarium solani</i> and <i>Verticillium dahliae</i> ;
Ascomycetes in the order Eurotiales such as <i>Aspergillus flavus</i> and <i>A. parasiticus</i> ;
Ascomycetes in the order Diaporthales such as <i>Cryptosphaera viticola</i> (= <i>Phomopsis viticola</i>), <i>Phomopsis longicolla</i> , and <i>Diaporthe phaseolorum</i> ;
Other Ascomycete pathogens including <i>Magnaporthe grisea</i> , <i>Gaeumannomyces graminis</i> , <i>Rhynchosporium secalis</i> , and anthracnose pathogens such as <i>Glomerella acutata</i> (<i>Colletotrichum acutatum</i>), <i>G. graminicola</i> (<i>C. graminicola</i>) and <i>G. lagenaria</i> (<i>C. orbiculare</i>);
Basidiomycetes in the order Uredinales (the rusts) including <i>Puccinia recondita</i> , <i>P. striiformis</i> , <i>Puccinia hordei</i> , <i>P. graminis</i> and <i>P. arachidis</i> , <i>Hemileia vastatrix</i> and <i>Phakopsora pachyrhizi</i> ;
Basidiomycetes in the order Ceratobasidiales such as <i>Thanatophorum cucumeris</i> (<i>Rhizoctonia solani</i>) and <i>Ceratobasidium oryzae-sativae</i> (<i>Rhizoctonia oryzae</i>);
Basidiomycetes in the order Polyporales such as <i>Athelia rolfsii</i> (<i>Sclerotium rolfsii</i>);
Basidiomycetes in the order Ustilaginales such as <i>Ustilago maydis</i> ;

Zygomycetes in the order Mucorales such as <i>Rhizopus stolonifer</i> ;
Oomycetes in the order Pythiales, including <i>Phytophthora infestans</i> , <i>P. megasperma</i> , <i>P. parasitica</i> , <i>P. sojae</i> , <i>P. cinnamomi</i> and <i>P. capsici</i> , and <i>Pythium</i> pathogens such as <i>Pythium aphanidermatum</i> , <i>P. graminicola</i> , <i>P. irregulare</i> , <i>P. ultimum</i> and <i>P. dissoticum</i> ;
Oomycetes in the order <i>Peronosporales</i> such as <i>Plasmopara viticola</i> , <i>P. halstedii</i> , <i>Peronospora hyoscyami</i> (= <i>Peronospora tabacina</i>), <i>P. manshurica</i> , <i>Hyaloperonospora parasitica</i> (= <i>Peronospora parasitica</i>), <i>Pseudoperonospora cubensis</i> and <i>Bremia lactucae</i> ;
and other genera and species closely related to all of the above pathogens.

In addition to their fungicidal activity, the compositions or combinations also have activity against bacteria such as *Erwinia amylovora*, *Xanthomonas campestris*, *Pseudomonas syringae*, and other related species. By controlling harmful microorganisms, the compounds of the invention are useful for improving (i.e. increasing) the ratio of beneficial to harmful microorganisms in contact with crop plants or their propagules (e.g., seeds, corms, bulbs, tubers, cuttings) or in the agronomic environment of the crop plants or their propagules.

Compounds of the invention are useful in treating all plants, plant parts and seeds. Plant and seed varieties and cultivars can be obtained by conventional propagation and breeding methods or by genetic engineering methods. Genetically modified plants or seeds (transgenic plants or seeds) are those in which a heterologous gene (transgene) has been stably integrated into the plant's or seed's genome. A transgene that is defined by its particular location in the plant genome is called a transformation or transgenic event.

Genetically modified plant cultivars which can be treated according to the invention include those that are resistant against one or more biotic stresses (pests such as nematodes, insects, mites, fungi, etc.) or abiotic stresses (drought, cold temperature, soil salinity, etc.), or that contain other desirable characteristics. Plants can be genetically modified to exhibit traits of, for example, herbicide tolerance, insect-resistance, modified oil profiles or drought tolerance.

Treatment of genetically modified plants and seeds with compounds of the invention may result in super-additive or enhanced effects. For example, reduction in application rates, broadening of the activity spectrum, increased tolerance to biotic/abiotic stresses or enhanced storage stability may be greater than expected from just simple additive effects of the application of compounds of the invention on genetically modified plants and seeds.

Compounds of this invention are useful in seed treatments for protecting seeds from plant diseases. In the context of the present disclosure and claims, treating a seed means contacting the seed with a biologically effective amount of a compound of this invention, which is typically formulated as a composition of the invention. This seed treatment protects the seed from soil-

borne disease pathogens and generally can also protect roots and other plant parts in contact with the soil of the seedling developing from the germinating seed. The seed treatment may also provide protection of foliage by translocation of the compound of this invention or a second active ingredient within the developing plant. Seed treatments can be applied to all types of seeds, including those from which plants genetically transformed to express specialized traits will germinate. Representative examples include those expressing proteins toxic to invertebrate pests, such as *Bacillus thuringiensis* toxin or those expressing herbicide resistance such as glyphosate acetyltransferase, which provides resistance to glyphosate. Seed treatments with compounds of this invention can also increase vigor of plants growing from the seed.

Compounds of this invention and their compositions, both alone and in combination with other fungicides, nematicides and insecticides, are particularly useful in seed treatment for crops including, but not limited to, maize or corn, soybeans, cotton, cereal (e.g., wheat, oats, barley, rye and rice), potatoes, vegetables and oilseed rape.

Furthermore, the compounds of this invention are useful in treating postharvest diseases of fruits and vegetables caused by fungi and bacteria. These infections can occur before, during and after harvest. For example, infections can occur before harvest and then remain dormant until some point during ripening (e.g., host begins tissue changes in such a way that infection can progress); also infections can arise from surface wounds created by mechanical or insect injury. In this respect, the compounds of this invention can reduce losses (i.e. losses resulting from quantity and quality) due to postharvest diseases which may occur at any time from harvest to consumption. Treatment of postharvest diseases with compounds of the invention can increase the period of time during which perishable edible plant parts (e.g., fruits, seeds, foliage, stems, bulbs, tubers) can be stored refrigerated or un-refrigerated after harvest, and remain edible and free from noticeable or harmful degradation or contamination by fungi or other microorganisms. Treatment of edible plant parts before or after harvest with compounds of the invention can also decrease the formation of toxic metabolites of fungi or other microorganisms, for example, mycotoxins such as aflatoxins.

Plant disease control is ordinarily accomplished by applying an effective amount of a compound of this invention either pre- or post-infection, to the portion of the plant to be protected such as the roots, stems, foliage, fruits, seeds, tubers or bulbs, or to the media (soil or sand) in which the plants to be protected are growing. The compounds can also be applied to seeds to protect the seeds and seedlings developing from the seeds. The compounds can also be applied through irrigation water to treat plants. Control of postharvest pathogens which infect the produce before harvest is typically accomplished by field application of a compound of this invention, and

in cases where infection occurs after harvest the compounds can be applied to the harvested crop as dips, sprays, fumigants, treated wraps and box liners.

The compounds can also be applied using an unmanned aerial vehicle (UAV) for the dispensation of the compositions disclosed herein over a planted area. In some embodiments the planted area is a crop-containing area. In some embodiments, the crop is selected from a monocot or dicot. In some embodiments, the crop is selected from rice, corn, barley, soybean, wheat, vegetable, tobacco, tea tree, fruit tree and sugar cane. In some embodiments, the compositions disclosed herein are formulated for spraying at an ultra-low volume. Products applied by drones may use water or oil as the spray carrier. Typical spray volume (including product) used for drone applications globally. 5.0 liters/ha – 100 liters/ha (approximately 0.5-10 gpa). This includes the range of ultra low spray volume (ULV) to low spray volume (LV). Although not common there may be situations where even lower spray volumes could be used as low as 1.0 liter/ha (0.1 gpa).

Rates of application for these compounds (i.e. a fungicidally effective amount) can be influenced by factors such as the plant diseases to be controlled, the plant species to be protected, ambient moisture and temperature and should be determined under actual use conditions. One skilled in the art can easily determine through simple experimentation the fungicidally effective amount necessary for the desired level of plant disease control. Foliage can normally be protected when treated at a rate of from less than about 1 g/ha to about 5,000 g/ha of active ingredient. Seed and seedlings can normally be protected when seed is treated at a rate of from about 0.001 g (more typically about 0.1 g) to about 10 g per kilogram of seed.

Compounds of the present invention may also be useful for increasing vigor of a crop plant. This method comprises contacting the crop plant (e.g., foliage, flowers, fruit or roots) or the seed from which the crop plant is grown with a compound of Formula 1 in amount sufficient to achieve the desired plant vigor effect (i.e. biologically effective amount). Typically the compound of Formula 1 is applied in a formulated composition. Although the compound of Formula 1 is often applied directly to the crop plant or its seed, it can also be applied to the locus of the crop plant, i.e. the environment of the crop plant, particularly the portion of the environment in close enough proximity to allow the compound of Formula 1 to migrate to the crop plant. The locus relevant to this method most commonly comprises the growth medium (i.e. medium providing nutrients to the plant), typically soil in which the plant is grown. Treatment of a crop plant to increase vigor of the crop plant thus comprises contacting the crop plant, the seed from which the crop plant is grown or the locus of the crop plant with a biologically effective amount of a compound of Formula 1.

Increased crop vigor can result in one or more of the following observed effects: (a) optimal crop establishment as demonstrated by excellent seed germination, crop emergence and crop stand; (b) enhanced crop growth as demonstrated by rapid and robust leaf growth (e.g., measured by leaf area index), plant height, number of tillers (e.g., for rice), root mass and overall dry weight of vegetative mass of the crop; (c) improved crop yields, as demonstrated by time to flowering, duration of flowering, number of flowers, total biomass accumulation (i.e. yield quantity) and/or fruit or grain grade marketability of produce (i.e. yield quality); (d) enhanced ability of the crop to withstand or prevent plant disease infections and arthropod, nematode or mollusk pest infestations; and (e) increased ability of the crop to withstand environmental stresses such as exposure to thermal extremes, suboptimal moisture or phytotoxic chemicals.

The compounds of the present invention may increase the vigor of treated plants compared to untreated plants by preventing and/or curing plant diseases caused by fungal plant pathogens in the environment of the plants. In the absence of such control of plant diseases, the diseases reduce plant vigor by consuming plant tissues or sap, or transmitting plant pathogens such as viruses. Even in the absence of fungal plant pathogens, the compounds of the invention may increase plant vigor by modifying metabolism of plants. Generally, the vigor of a crop plant will be most significantly increased by treating the plant with a compound of the invention if the plant is grown in a nonideal environment, i.e. an environment comprising one or more aspects adverse to the plant achieving the full genetic potential it would exhibit in an ideal environment.

Of note is a method for increasing vigor of a crop plant wherein the crop plant is grown in an environment comprising plant diseases caused by fungal plant pathogens. Also of note is a method for increasing vigor of a crop plant wherein the crop plant is grown in an environment not comprising plant diseases caused by fungal plant pathogens. Also of note is a method for increasing vigor of a crop plant wherein the crop plant is grown in an environment comprising an amount of moisture less than ideal for supporting growth of the crop plant.

Compounds of this invention can also be mixed with one or more other biologically active compounds or agents including fungicides, insecticides, nematocides, bactericides, acaricides, herbicides, herbicide safeners, growth regulators such as insect molting inhibitors and rooting stimulants, chemosterilants, semiochemicals, repellents, attractants, pheromones, feeding stimulants, plant nutrients, other biologically active compounds or entomopathogenic bacteria, virus or fungi to form a multi-component pesticide giving an even broader spectrum of agricultural protection. Thus the present invention also pertains to a composition comprising a compound of Formula 1 (in a fungicidally effective amount) and at least one additional biologically active compound or agent (in a biologically effective amount) and can further comprise at least one of a

surfactant, a solid diluent or a liquid diluent. The other biologically active compounds or agents can be formulated in compositions comprising at least one of a surfactant, solid or liquid diluent. For mixtures of the present invention, one or more other biologically active compounds or agents can be formulated together with a compound of Formula 1, to form a premix, or one or more other
5 biologically active compounds or agents can be formulated separately from the compound of Formula 1, and the formulations combined together before application (e.g., in a spray tank) or, alternatively, applied in succession.

As mentioned in the Summary of the Invention, one aspect of the present invention is a fungicidal composition comprising (i.e. a mixture or combination of) a compound of Formula 1,
10 an *N*-oxide, or a salt thereof (i.e. component a), and at least one other fungicide (i.e. component b). Of note is such a combination where the other fungicidal active ingredient has different site of action from the compound of Formula 1. In certain instances, a combination with at least one other fungicidal active ingredient having a similar spectrum of control but a different site of action will be particularly advantageous for resistance management. Thus, a composition of the present
15 invention can further comprise a fungicidally effective amount of at least one additional fungicidal active ingredient having a similar spectrum of control but a different site of action.

Of note is a composition which in addition to the Formula 1 compound of component (a), includes as component (b) at least one fungicidal compound selected from the group consisting of the FRAC-defined mode of action (MOA) classes (A) nucleic acid synthesis, (B) mitosis and
20 cell division, (C) respiration, (D) amino acid and protein synthesis, (E) signal transduction, (F) lipid synthesis and membrane integrity, (G) sterol biosynthesis in membranes, (H) cell wall biosynthesis in membranes, (I) melanin synthesis in cell wall, (P) host plant defense induction, multi-site contact activity and unknown mode of action.

FRAC-recognized or proposed target sites of action along with their FRAC target site codes
25 belonging to the above MOA classes are (A1) RNA polymerase I, (A2) adenosine deaminase, (A3) DNA/RNA synthesis (proposed), (A4) DNA topoisomerase, (B1-B3) β -tubulin assembly in mitosis, (B4) cell division (proposed), (B5) delocalization of spectrin-like proteins, (C1) complex I NADH oxidoreductase, (C2) complex II: succinate dehydrogenase, (C3) complex III: cytochrome *bc*1 (ubiquinol oxidase) at Qo site, (C4) complex III: cytochrome *bc*1 (ubiquinone
30 reductase) at Qi site, (C5) uncouplers of oxidative phosphorylation, (C6) inhibitors of oxidative phosphorylation, ATP synthase, (C7) ATP production (proposed), (C8) complex III: cytochrome *bc*1 (ubiquinone reductase) at Qx (unknown) site, (D1) methionine biosynthesis (proposed), (D2-D5) protein synthesis, (E1) signal transduction (mechanism unknown), (E2-E3) MAP/histidine kinase in osmotic signal transduction, (F2) phospholipid biosynthesis, methyl transferase, (F3)

lipid peroxidation (proposed), (F4) cell membrane permeability, fatty acids (proposed), (F6) microbial disrupters of pathogen cell membranes, (F7) cell membrane disruption (proposed), (G1) C14- demethylase in sterol biosynthesis , (G2) $\Delta 14$ -reductase and $\Delta 8 \rightarrow \Delta 7$ -isomerase in sterol biosynthesis, (G3) 3-keto reductase, C4-demethylation, (G4) squalene epoxidase in sterol biosynthesis, (H3) trehalase and inositol biosynthesis, (H4) chitin synthase, (H5) cellulose synthase, (I1) reductase in melanin biosynthesis and (I2) dehydratase in melanin biosynthesis.

Of particular note is a composition which in addition to the Formula **1** compound of component (a), includes as component (b) at least one fungicidal compound selected from the group consisting of the classes (b1) methyl benzimidazole carbamate (MBC) fungicides; (b2) dicarboximide fungicides; (b3) demethylation inhibitor (DMI) fungicides; (b4) phenylamide fungicides; (b5) amine/morpholine fungicides; (b6) phospholipid biosynthesis inhibitor fungicides; (b7) succinate dehydrogenase inhibitor fungicides; (b8) hydroxy(2-amino-)pyrimidine fungicides; (b9) anilinopyrimidine fungicides; (b10) *N*-phenyl carbamate fungicides; (b11) quinone outside inhibitor (QoI) fungicides; (b12) phenylpyrrole fungicides; (b13) azanaphthalene fungicides; (b14) lipid peroxidation inhibitor fungicides; (b15) melanin biosynthesis inhibitor-reductase (MBI-R) fungicides; (b16) melanin biosynthesis inhibitor-dehydratase (MBI-D) fungicides; (b17) sterol biosynthesis inhibitor (SBI): Class III fungicides; (b18) squalene-epoxidase inhibitor fungicides; (b19) polyoxin fungicides; (b20) phenylurea fungicides; (b21) quinone inside inhibitor (QiI) fungicides; (b22) benzamide and thiazole carboxamide fungicides; (b23) enopyranuronic acid antibiotic fungicides; (b24) hexopyranosyl antibiotic fungicides; (b25) glucopyranosyl antibiotic: protein synthesis fungicides; (b26) glucopyranosyl antibiotic: trehalase and inositol biosynthesis fungicides; (b27) cyanoacetamideoxime fungicides; (b28) carbamate fungicides; (b29) oxidative phosphorylation uncoupling fungicides; (b30) organo tin fungicides; (b31) carboxylic acid fungicides; (b32) heteroaromatic fungicides; (b33) phosphonate fungicides; (b34) phthalamic acid fungicides; (b35) benzotriazine fungicides; (b36) benzene-sulfonamide fungicides; (b37) pyridazinone fungicides; (b38) thiophene-carboxamide fungicides; (b39) complex I NADH oxidoreductase inhibitor fungicides; (b40) carboxylic acid amide (CAA) fungicides; (b41) tetracycline antibiotic fungicides; (b42) thiocarbamate fungicides; (b43) benzamide fungicides; (b44) microbial fungicides; (b45) Q_xI fungicides; (b46) plant extract fungicides; (b47) host plant defense induction fungicides; (b48) multi-site contact activity fungicides; (b49) fungicides other than fungicides of classes (b1) through (b48); and salts of compounds of classes (b1) through (b48).

Further descriptions of these classes of fungicidal compounds are provided below.

(b1) "Methyl benzimidazole carbamate (MBC) fungicides" (FRAC code 1) inhibit mitosis by binding to β -tubulin during microtubule assembly. Inhibition of microtubule assembly can disrupt cell division, transport within the cell and cell structure. Methyl benzimidazole carbamate fungicides include benzimidazole and thiophanate fungicides. The benzimidazoles include
 5 benomyl, carbendazim, fuberidazole and thiabendazole. The thiophanates include thiophanate and thiophanate-methyl.

(b2) "Dicarboximide fungicides" (FRAC code 2) inhibit a MAP/histidine kinase in osmotic signal transduction. Examples include chlozolate, iprodione, procymidone and vinclozolin.

(b3) "Demethylation inhibitor (DMI) fungicides" (FRAC code 3) (Sterol Biosynthesis
 10 Inhibitors (SBI): Class I) inhibit C14-demethylase, which plays a role in sterol production. Sterols, such as ergosterol, are needed for membrane structure and function, making them essential for the development of functional cell walls. Therefore, exposure to these fungicides results in abnormal growth and eventually death of sensitive fungi. DMI fungicides are divided
 15 between several chemical classes: azoles (including triazoles and imidazoles), pyrimidines, piperazines, pyridines and triazolinthiones. The triazoles include azaconazole, bitertanol, bromuconazole, cyproconazole, difenoconazole, diniconazole (including diniconazole-M), epoxiconazole, etaconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, imibenconazole, ipconazole, mefentrifluconazole, metconazole, myclobutanil, penconazole, propiconazole, quinconazole, simeconazole, tebuconazole, tetraconazole,
 20 triadimefon, triadimenol, triticonazole, uniconazole, uniconazole-P, α -(1-chlorocyclopropyl)- α -[2-(2,2-dichlorocyclopropyl)ethyl]-1*H*-1,2,4-triazole-1-ethanol, *rel*-1-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-1*H*-1,2,4-triazole, *rel*-2-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-
 25 thione, and *rel*-1-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-5-(2-propen-1-ylthio)-1*H*-1,2,4-triazole. The imidazoles include econazole, imazalil, oxpoconazole, prochloraz, pefurazoate and triflumizole. The pyrimidines include fenarimol, nuarimol and triarimol. The piperazines include triforine. The pyridines include buthiobate, pyrifenoxy, pyrisoxazole (3-[(3*R*)-5-(4-chlorophenyl)-2,3-dimethyl-3-isoxazolidinyl]pyridine, mixture of 3*R*,5*R*- and 3*R*,5*S*-isomers) and (α *S*)-[3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-4-
 30 isoxazolyl]-3-pyridinemethanol. The triazolinthiones include prothioconazole and 2-[2-(1-chlorocyclopropyl)-4-(2,2-dichlorocyclopropyl)-2-hydroxybutyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione. Biochemical investigations have shown that all of the above mentioned fungicides are DMI fungicides as described by K. H. Kuck et al. in *Modern Selective Fungicides - Properties*,

Applications and Mechanisms of Action, H. Lyr (Ed.), Gustav Fischer Verlag: New York, 1995, 205-258.

(b4) “Phenylamide fungicides” (FRAC code 4) are specific inhibitors of RNA polymerase in Oomycete fungi. Sensitive fungi exposed to these fungicides show a reduced capacity to incorporate uridine into rRNA. Growth and development in sensitive fungi is prevented by exposure to this class of fungicide. Phenylamide fungicides include acylalanine, oxazolidinone and butyrolactone fungicides. The acylalanines include benalaxyl, benalaxyl-M (also known as kiralaxyl), furalaxyl, metalaxyl and metalaxyl-M (also known as mefenoxam). The oxazolidinones include oxadixyl. The butyrolactones include ofurace.

(b5) “Amine/morpholine fungicides” (FRAC code 5) (SBI: Class II) inhibit two target sites within the sterol biosynthetic pathway, $\Delta^8 \rightarrow \Delta^7$ isomerase and Δ^{14} reductase. Sterols, such as ergosterol, are needed for membrane structure and function, making them essential for the development of functional cell walls. Therefore, exposure to these fungicides results in abnormal growth and eventually death of sensitive fungi. Amine/morpholine fungicides (also known as non-DMI sterol biosynthesis inhibitors) include morpholine, piperidine and spiroketal-amine fungicides. The morpholines include aldimorph, dodemorph, fenpropimorph, tridemorph and trimorphamide. The piperidines include fenpropidin and piperalin. The spiroketal-amines include spiroxamine.

(b6) “Phospholipid biosynthesis inhibitor fungicides” (FRAC code 6) inhibit growth of fungi by affecting phospholipid biosynthesis. Phospholipid biosynthesis fungicides include phosphorothiolate and dithiolane fungicides. The phosphorothiolates include edifenphos, iprobenfos and pyrazophos. The dithiolanes include isoprothiolane.

(b7) “Succinate dehydrogenase inhibitor (SDHI) fungicides” (FRAC code 7) inhibit Complex II fungal respiration by disrupting a key enzyme in the Krebs Cycle (TCA cycle) named succinate dehydrogenase. Inhibiting respiration prevents the fungus from making ATP, and thus inhibits growth and reproduction. SDHI fungicides include phenylbenzamide, furan carboxamide, oxathiin carboxamide, thiazole carboxamide, pyrazole-4-carboxamide, pyridine carboxamide, phenyl oxoethyl thiophene amides and pyridinylethyl benzamides. The benzamides include benodanil, flutolanil and mepronil. The furan carboxamides include fenfuram. The oxathiin carboxamides include carboxin and oxycarboxin. The thiazole carboxamides include thifluzamide. The pyrazole-4-carboxamides include benzovindiflupyr (*N*-[9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide), bixafen, fluindapyr, fluxapyroxad (3-(difluoromethyl)-1-methyl-*N*-(3',4',5'-trifluoro[1,1'-biphenyl]-2-yl)-1*H*-pyrazole-4-carboxamide), furametpyr, isoflucypram,

isopyrazam (3-(difluoromethyl)-1-methyl-*N*-[1,2,3,4-tetrahydro-9-(1-methylethyl)-1,4-methano-naphthalen-5-yl]-1*H*-pyrazole-4-carboxamide), penflufen (*N*-[2-(1,3-dimethylbutyl)phenyl]-5-fluoro-1,3-dimethyl-1*H*-pyrazole-4-carboxamide), penthiopyrad, pydiflumetofen, sedaxane (*N*-[2-[1,1'-bicyclopropyl]-2-ylphenyl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide),
 5 *N*-[2-(1*S*,2*R*)-[1,1'-bicyclopropyl]-2-ylphenyl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide, 3-(difluoromethyl)-*N*-(2,3-dihydro-1,1,3-trimethyl-1*H*-inden-4-yl)-1-methyl-1*H*-pyrazole-4-carboxamide, *N*-[2-(2,4-dichlorophenyl)-2-methoxy-1-methylethyl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide and *N*-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-*N*-[[2-(1-methylethyl)phenyl]methyl]-1*H*-pyrazole-4-carboxamide. The pyridine
 10 carboxamides include boscalid. The phenyl oxoethyl thiophene amides include isofetamid (*N*-[1,1-dimethyl-2-[2-methyl-4-(1-methylethoxy)phenyl]-2-oxoethyl]-3-methyl-2-thiophenecarboxamide). The pyridinylethyl benzamides include fluopyram.

(b8) "Hydroxy-(2-amino-)pyrimidine fungicides" (FRAC code 8) inhibit nucleic acid synthesis by interfering with adenosine deaminase. Examples include bupirimate, dimethirimol
 15 and ethirimol.

(b9) "Anilinopyrimidine fungicides" (FRAC code 9) are proposed to inhibit biosynthesis of the amino acid methionine and to disrupt the secretion of hydrolytic enzymes that lyse plant cells during infection. Examples include cyprodinil, mepanipyrim and pyrimethanil.

(b10) "*N*-Phenyl carbamate fungicides" (FRAC code 10) inhibit mitosis by binding to β -tubulin and disrupting microtubule assembly. Inhibition of microtubule assembly can disrupt cell
 20 division, transport within the cell and cell structure. Examples include diethofencarb.

(b11) "Quinone outside inhibitor (QoI) fungicides" (FRAC code 11) inhibit Complex III mitochondrial respiration in fungi by affecting ubiquinol oxidase. Oxidation of ubiquinol is blocked at the "quinone outside" (Q_o) site of the cytochrome bc_1 complex, which is located in the
 25 inner mitochondrial membrane of fungi. Inhibiting mitochondrial respiration prevents normal fungal growth and development. Quinone outside inhibitor fungicides include methoxyacrylate, methoxycarbamate, oximinoacetate, oximinoacetamide and dihydrodioxazine fungicides (collectively also known as strobilurin fungicides), and oxazolidinedione, imidazolinone and benzylcarbamate fungicides. The methoxyacrylates include azoxystrobin, coumoxystrobin
 30 (methyl (αE)-2-[[3-butyl-4-methyl-2-oxo-2*H*-1-benzopyran-7-yl)oxy]methyl]- α -(methoxymethylene)benzeneacetate), enoxastrobin (methyl (αE)-2-[[[(*E*)-[(2*E*)-3-(4-chlorophenyl)-1-methyl-2-propen-1-ylidene]amino]oxy]methyl]- α -(methoxymethylene)benzeneacetate) (also known as enestroburin), flufenoxystrobin (methyl (αE)-2-[[2-chloro-4-(trifluoromethyl)-phenoxy]methyl]- α -(methoxymethylene)benzeneacetate), picoxystrobin, and pyraoxystrobin

(methyl (αE) -2-[[[3-(4-chlorophenyl)-1-methyl-1*H*-pyrazol-5-yl]oxy]methyl]- α -(methoxy-methylene)benzeneacetate). The methoxycarbamates include pyraclostrobin, pyrametostrobin (methyl N -[2-[[[1,4-dimethyl-3-phenyl-1*H*-pyrazol-5-yl]oxy]methyl]phenyl]- N -methoxycarbamate) and triclopyricarb (methyl N -methoxy- N -[2-[[[3,5,6-trichloro-2-pyridinyl]oxy]methyl]phenyl]carbamate). The oximinoacetates include kresoxim-methyl and trifloxystrobin. The oximinoacetamides include dimoxystrobin, fenaminstrobin ((αE) -2-[[[(E) -[($2E$)-3-(2,6-dichlorophenyl)-1-methyl-2-propen-1-ylidene]amino]oxy]methyl]- α -(methoxyimino)- N -methylbenzeneacetamide), metominostrobin, orysastrobin and α -[methoxyimino]- N -methyl-2-[[[1-[3-(trifluoromethyl)phenyl]ethoxy]imino]methyl]benzeneacetamide. The dihydrodioxazines include fluoxastrobin. The oxazolidinediones include famoxadone. The imidazolinones include fenamidone. The benzylcarbamates include pyribencarb. Class (b11) also includes mandestrobin (2-[(2,5-dimethylphenoxy)methyl]- α -methoxy- N -benzeneacetamide).

(b12) "Phenylpyrrole fungicides" (FRAC code 12) inhibit a MAP/histidine kinase associated with osmotic signal transduction in fungi. Fenpiclonil and fludioxonil are examples of this fungicide class.

(b13) "Azanaphthalene fungicides" (FRAC code 13) are proposed to inhibit signal transduction by a mechanism which is as yet unknown. They have been shown to interfere with germination and/or appressorium formation in fungi that cause powdery mildew diseases. Azanaphthalene fungicides include aryloxyquinolines and quinazolinones. The aryloxyquinolines include quinoxifen. The quinazolinones include proquinazid.

(b14) "Lipid peroxidation inhibitor fungicides" (FRAC code 14) are proposed to inhibit lipid peroxidation which affects membrane synthesis in fungi. Members of this class, such as etridiazole, may also affect other biological processes such as respiration and melanin biosynthesis. Lipid peroxidation fungicides include aromatic hydrocarbon and 1,2,4-thiadiazole fungicides. The aromatic hydrocarbon fungicides include biphenyl, chloroneb, dicloran, quintozone, tecnazene and tolclofos-methyl. The 1,2,4-thiadiazoles include etridiazole.

(b15) "Melanin biosynthesis inhibitors-reductase (MBI-R) fungicides" (FRAC code 16.1) inhibit the naphthal reduction step in melanin biosynthesis. Melanin is required for host plant infection by some fungi. Melanin biosynthesis inhibitors-reductase fungicides include isobenzofuranone, pyrroloquinolinone and triazolobenzothiazole fungicides. The isobenzofuranones include fthalide. The pyrroloquinolinones include pyroquilon. The triazolobenzothiazoles include tricyclazole.

(b16) "Melanin biosynthesis inhibitors-dehydratase (MBI-D) fungicides" (FRAC code 16.2) inhibit scytalone dehydratase in melanin biosynthesis. Melanin is required for host plant

infection by some fungi. Melanin biosynthesis inhibitors-dehydratase fungicides include cyclopropanecarboxamide, carboxamide and propionamide fungicides. The cyclopropanecarboxamides include carpropamid. The carboxamides include diclocymet. The propionamides include fenoxanil.

5 (b17) “Sterol Biosynthesis Inhibitor (SBI): Class III fungicides (FRAC code 17) inhibit 3-ketoreductase during C4-demethylation in sterol production. SBI: Class III inhibitors include hydroxylanilide fungicides and amino-pyrazolinone fungicides. Hydroxylanilides include fenhexamid. Amino-pyrazolinones include fenpyrazamine (*S*-2-propen-1-yl 5-amino-2,3-di-

10 (b18) “Squalene-epoxidase inhibitor fungicides” (FRAC code 18) (SBI: Class IV) inhibit squalene-epoxidase in the sterol biosynthesis pathway. Sterols such as ergosterol are needed for membrane structure and function, making them essential for the development of functional cell walls. Therefore exposure to these fungicides results in abnormal growth and eventually death of sensitive fungi. Squalene-epoxidase inhibitor fungicides include thiocarbamate and allylamine
15 fungicides. The thiocarbamates include pyributicarb. The allylamines include naftifine and terbinafine.

(b19) “Polyoxin fungicides” (FRAC code 19) inhibit chitin synthase. Examples include polyoxin.

(b20) “Phenylurea fungicides” (FRAC code 20) are proposed to affect cell division.
20 Examples include pencycuron.

(b21) “Quinone inside inhibitor (QiI) fungicides” (FRAC code 21) inhibit Complex III mitochondrial respiration in fungi by affecting ubiquinone reductase. Reduction of ubiquinone is blocked at the “quinone inside” (Q_i) site of the cytochrome *bc*₁ complex, which is located in the inner mitochondrial membrane of fungi. Inhibiting mitochondrial respiration prevents normal
25 fungal growth and development. Quinone inside inhibitor fungicides include cyanoimidazole and sulfamoyltriazole fungicides. The cyanoimidazoles include cyazofamid. The sulfamoyltriazoles include amisulbrom.

(b22) “Benzamide and thiazole carboxamide fungicides” (FRAC code 22) inhibit mitosis by binding to β -tubulin and disrupting microtubule assembly. Inhibition of microtubule assembly
30 can disrupt cell division, transport within the cell and cell structure. The benzamides include zoxamide. The thiazole carboxamides include ethaboxam.

(b23) “Enopyranuronic acid antibiotic fungicides” (FRAC code 23) inhibit growth of fungi by affecting protein biosynthesis. Examples include blastidicin-S.

(b24) “Hexopyranosyl antibiotic fungicides” (FRAC code 24) inhibit growth of fungi by affecting protein biosynthesis. Examples include kasugamycin.

(b25) “Glucopyranosyl antibiotic: protein synthesis fungicides” (FRAC code 25) inhibit growth of fungi by affecting protein biosynthesis. Examples include streptomycin.

5 (b26) “Glucopyranosyl antibiotic: trehalase and inositol biosynthesis fungicides” (FRAC code 26) inhibit trehalase and inositol biosynthesis. Examples include validamycin.

(b27) “Cyanoacetamideoxime fungicides (FRAC code 27) include cymoxanil.

(b28) “Carbamate fungicides” (FRAC code 28) are considered multi-site inhibitors of fungal growth. They are proposed to interfere with the synthesis of fatty acids in cell membranes, which
10 then disrupts cell membrane permeability. Propamacarb, iodocarb, and prothiocarb are examples of this fungicide class.

(b29) “Oxidative phosphorylation uncoupling fungicides” (FRAC code 29) inhibit fungal respiration by uncoupling oxidative phosphorylation. Inhibiting respiration prevents normal fungal growth and development. This class includes 2,6-dinitroanilines such as fluazinam, and
15 dinitrophenyl crotonates such as dinocap, meptyldinocap and binapacryl.

(b30) “Organo tin fungicides” (FRAC code 30) inhibit adenosine triphosphate (ATP) synthase in oxidative phosphorylation pathway. Examples include fentin acetate, fentin chloride and fentin hydroxide.

(b31) “Carboxylic acid fungicides” (FRAC code 31) inhibit growth of fungi by affecting
20 deoxyribonucleic acid (DNA) topoisomerase type II (gyrase). Examples include oxolinic acid.

(b32) “Heteroaromatic fungicides” (Fungicide Resistance Action Committee (FRAC) code 32) are proposed to affect DNA/ribonucleic acid (RNA) synthesis. Heteroaromatic fungicides include isoxazoles and isothiazolones. The isoxazoles include hymexazole and the isothiazolones include othilinone.

25 (b33) “Phosphonate fungicides” (FRAC code 33) include phosphorous acid and its various salts, including fosetyl-aluminum.

(b34) “Phthalamic acid fungicides” (FRAC code 34) include teclofthalam.

(b35) “Benzotriazine fungicides” (FRAC code 35) include triazoxide.

(b36) “Benzene-sulfonamide fungicides” (FRAC code 36) include flusulfamide.

30 (b37) “Pyridazinone fungicides” (FRAC code 37) include diclomezine.

(b38) “Thiophene-carboxamide fungicides” (FRAC code 38) are proposed to affect ATP production. Examples include silthiofam.

(b39) “Complex I NADH oxidoreductase inhibitor fungicides” (FRAC code 39) inhibit electron transport in mitochondria and include pyrimidinamines such as diflumetorim, and pyrazole-5-carboxamides such as tolfenpyrad.

(b40) “Carboxylic acid amide (CAA) fungicides” (FRAC code 40) inhibit cellulose synthase which prevents growth and leads to death of the target fungus. Carboxylic acid amide fungicides include cinnamic acid amide, valinamide and other carbamate, and mandelic acid amide fungicides. The cinnamic acid amides include dimethomorph, flumorph and pyrimorph (3-(2-chloro-4-pyridinyl)-3-[4-(1,1-dimethylethyl)phenyl]-1-(4-morpholinyl)-2-propene-1-one). The valinamide and other carbamates include bentiavalicarb, bentiavalicarb-isopropyl, iprovalicarb, tolprocarb (2,2,2-trifluoroethyl *N*-[(1*S*)-2-methyl-1-[[4-methylbenzoyl]amino]methyl]propyl]-carbamate) and valifenalate (methyl *N*-[(1-methylethoxy)carbonyl]-L-valyl-3-(4-chlorophenyl)-β-alaninate) (also known as valiphenal). The mandelic acid amides include mandipropamid, *N*-[2-[4-[[3-(4-chlorophenyl)-2-propyn-1-yl]oxy]-3-methoxyphenyl]ethyl]-3-methyl-2-[(methylsulfonyl)amino]butanamide and *N*-[2-[4-[[3-(4-chlorophenyl)-2-propyn-1-yl]oxy]-3-methoxyphenyl]ethyl]-3-methyl-2-[(ethylsulfonyl)amino]butanamide.

(b41) “Tetracycline antibiotic fungicides” (FRAC code 41) inhibit growth of fungi by affecting protein synthesis. Examples include oxytetracycline.

(b42) “Thiocarbamate fungicides” (FRAC code 42) include methasulfocarb.

(b43) “Benzamide fungicides” (FRAC code 43) inhibit growth of fungi by delocalization of spectrin-like proteins. Examples include pyridinylmethyl benzamide fungicides such as fluopicolide (now FRAC code 7, pyridinylethyl benzamides).

(b44) “Microbial fungicides” (FRAC code 44) disrupt fungal pathogen cell membranes. Microbial fungicides include *Bacillus* species such as *Bacillus amyloliquefaciens* strains QST 713, FZB24, MB1600, D747 and the fungicidal lipopeptides which they produce.

(b45) “Q_xI fungicides” (FRAC code 45) inhibit Complex III mitochondrial respiration in fungi by affecting ubiquinone reductase at an unknown (Q_x) site of the cytochrome *bc*₁ complex. Inhibiting mitochondrial respiration prevents normal fungal growth and development. Q_xI fungicides include triazolopyrimidylamines such as ametoctradin (5-ethyl-6-octyl[1,2,4]triazolo[1,5-*a*]pyrimidin-7-amine).

(b46) “Plant extract fungicides” are proposed to act by cell membrane disruption. Plant extract fungicides include terpene hydrocarbons and terpene alcohols such as the extract from *Melaleuca alternifolia* (tea tree).

(b47) “Host plant defense induction fungicides” (FRAC code P) induce host plant defense mechanisms. Host plant defense induction fungicides include benzothiadiazoles, benzisothiazole

and thiadiazole-carboxamide fungicides. The benzothiadiazoles include acibenzolar-S-methyl. The benzisothiazoles include probenazole. The thiadiazole-carboxamides include tiadinil and isotianil.

(b48) "Multi-site contact fungicides" inhibit fungal growth through multiple sites of action and have contact/preventive activity. This class of fungicides includes: (b48.1) "copper fungicides" (FRAC code M1)", (b48.2) "sulfur fungicides" (FRAC code M2), (b48.3) "dithiocarbamate fungicides" (FRAC code M3), (b48.4) "phthalimide fungicides" (FRAC code M4), (b48.5) "chloronitrile fungicides" (FRAC code M5), (b48.6) "sulfamide fungicides" (FRAC code M6), (b48.7) multi-site contact "guanidine fungicides" (FRAC code M7), (b48.8) "triazine fungicides" (FRAC code M8), (b48.9) "quinone fungicides" (FRAC code M9), (b48.10) "quinoxaline fungicides" (FRAC code M10) and (b48.11) "maleimide fungicides" (FRAC code M11). "Copper fungicides" are inorganic compounds containing copper, typically in the copper(II) oxidation state; examples include copper oxychloride, copper sulfate and copper hydroxide, including compositions such as Bordeaux mixture (tribasic copper sulfate). "Sulfur fungicides" are inorganic chemicals containing rings or chains of sulfur atoms; examples include elemental sulfur. "Dithiocarbamate fungicides" contain a dithiocarbamate molecular moiety; examples include mancozeb, metiram, propineb, ferbam, maneb, thiram, zineb and ziram. "Phthalimide fungicides" contain a phthalimide molecular moiety; examples include folpet, captan and captafol. "Chloronitrile fungicides" contain an aromatic ring substituted with chloro and cyano; examples include chlorothalonil. "Sulfamide fungicides" include dichlofluanid and tolyfluanid. Multi-site contact "guanidine fungicides" include, guazatine, iminoctadine albesilate and iminoctadine triacetate. "Triazine fungicides" include anilazine. "Quinone fungicides" include dithianon. "Quinoxaline fungicides" include quinomethionate (also known as chinomethionate). "Maleimide fungicides" include fluoroimide.

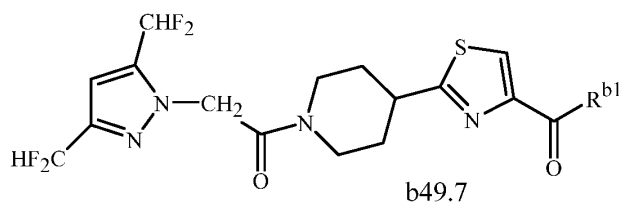
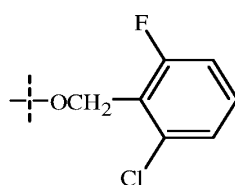
(b49) "Fungicides other than fungicides of classes (b1) through (b48)" include certain fungicides whose mode of action may be unknown. These include: (b49.1), "phenyl-acetamide fungicides" (FRAC code U6), (b49.2) "aryl-phenyl-ketone fungicides" (FRAC code U8), (b49.3) "guanidine fungicides" (FRAC code U12), (b49.4) "thiazolidine fungicides" (FRAC code U13), (b49.5) "pyrimidinone-hydrazone fungicides" (FRAC code U14) and (b49.6) compounds that bind to oxysterol-binding protein as described in PCT Patent Publication WO 2013/009971. The phenyl-acetamides include cyflufenamid and *N*-[[[(cyclopropylmethoxy)amino][6-(difluoromethoxy)-2,3-difluorophenyl]-methylene]benzeneacetamide. The aryl-phenyl ketones include benzophenones such as metrafenone, and benzoylpyridines such as pyriofenone (5-chloro-2-methoxy-4-methyl-3-pyridinyl)(2,3,4-trimethoxy-6-methylphenyl)methanone). The

guanidines include dodine. The thiazolidines include flutianil ((2*Z*)-2-[[2-fluoro-5-(trifluoromethyl)phenyl]thio]-2-[3-(2-methoxyphenyl)-2-thiazolidinylidene]acetonitrile). The pyrimidinonehydrazones include ferimzone. The (b49.6) class includes oxathiapiprolin (1-[4-[4-[5-(2,6-difluorophenyl)-4,5-dihydro-3-isoxazolyl]-2-thiazolyl]-1-piperidinyl]-2-[5-methyl-3-(trifluoromethyl)-1*H*-pyrazol-1-yl]ethanone) and its *R*-enantiomer which is 1-[4-[4-[5*R*-(2,6-difluorophenyl)-4,5-dihydro-3-isoxazolyl]-2-thiazolyl]-1-piperidinyl]-2-[5-methyl-3-(trifluoromethyl)-1*H*-pyrazol-1-yl]ethanone (Registry Number 1003319-79-6). The (b49) class also includes bethoxazin, flometoquin (2-ethyl-3,7-dimethyl-6-[4-(trifluoromethoxy)phenoxy]-4-quinolinyl methyl carbonate), fluoroimide, neo-asozin (ferric methanearsonate), picarbutrazox (1,1-dimethylethyl *N*-[6-[[[(*Z*)-1-methyl-1*H*-tetrazol-5-yl]phenylmethylene]amino]oxy]methyl]-2-pyridinyl]carbamate), pyrrolnitrin, quinomethionate, tebufloquin (6-(1,1-dimethylethyl)-8-fluoro-2,3-dimethyl-4-quinolinyl acetate), tolnifanide (*N*-(4-chloro-2-nitrophenyl)-*N*-ethyl-4-methylbenzenesulfonamide), 2-butoxy-6-iodo-3-propyl-4*H*-1-benzopyran-4-one, 3-butyne-1-yl, *N*-[6-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-pyridinyl]carbamate, (*N*-(4-chloro-2-nitrophenyl)-*N*-ethyl-4-methylbenzenesulfonamide), *N*'-[4-[4-chloro-3-(trifluoromethyl)phenoxy]-2,5-dimethylphenyl]-*N*-ethyl-*N*-methylmethanimidamide, *N*-[(cyclopropylmethoxy)amino][6-(difluoromethoxy)-2,3-difluorophenyl]methylene]benzeneacetamide, 2,6-dimethyl-1*H*,5*H*-[1,4]dithiino[2,3-*c*:5,6-*c'*]dipyrrole-1,3,5,7(2*H*,6*H*)-tetrone, 5-fluoro-2-[(4-methylphenyl)methoxy]-4-pyrimidinamine, 5-fluoro-2-[(4-fluorophenyl)methoxy]-4-pyrimidinamine and 4-fluorophenyl *N*-[1-[[[1-(4-cyanophenyl)ethyl]sulfonyl]methyl]propyl]carbamate, pentyl *N*-[6-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-pyridinyl]carbamate, pentyl *N*-[4-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-thiazolyl]carbamate and pentyl *N*-[6-[[[(*Z*)-(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-pyridinyl]carbamate. The (b46) class further includes mitosis- and cell division-inhibiting fungicides besides those of the particular classes described above (e.g., (b1), (b10) and (b22)).

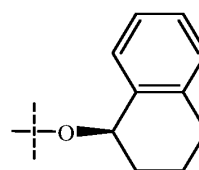
Additional "Fungicides other than fungicides of classes (1) through (46)" whose mode of action may be unknown, or may not yet be classified include a fungicidal compound selected from components (b49.7) through (b49.13), as shown below.

Component (b49.7) relates to a compound of Formula b49.7

79

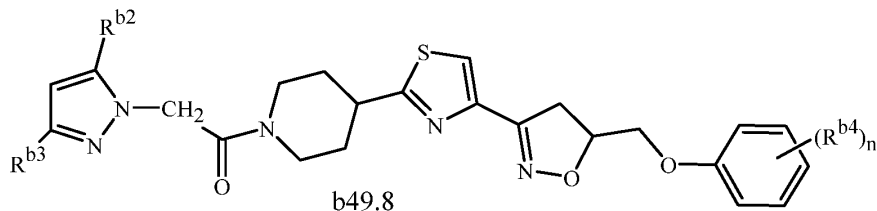
wherein R^{b1} is

or



Examples of a compound of Formula b49.7 include (b49.7a) (2-chloro-6-fluorophenyl)methyl 2-[1-[2-[3,5-bis(difluoromethyl)-1*H*-pyrazol-1-yl]acetyl]-4-piperidinyl]-4-thiazolecarboxylate (Registry Number 1299409-40-7) and (b49.7b) (1*R*)-1,2,3,4-tetrahydro-1-naphthalenyl 2-[1-[2-[3,5-bis(difluoromethyl)-1*H*-pyrazol-1-yl]acetyl]-4-piperidinyl]-4-thiazolecarboxylate (Registry Number 1299409-42-9). Methods for preparing compounds of Formula b46.2 are described in PCT Patent Publications WO 2009/132785 and WO 2011/051243.

Component (b49.8) relates to a compound of Formula b49.8

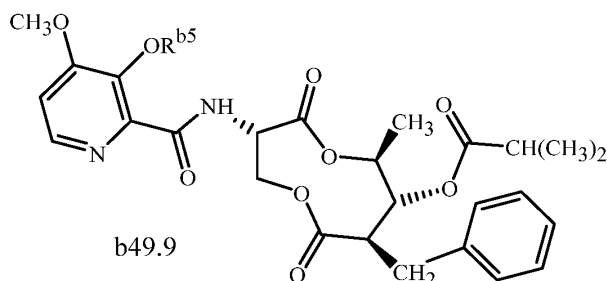


wherein R^{b2} is CH₃, CF₃ or CHF₂; R^{b3} is CH₃, CF₃ or CHF₂; R^{b4} is halogen or cyano; and n is 0, 1, 2 or 3.

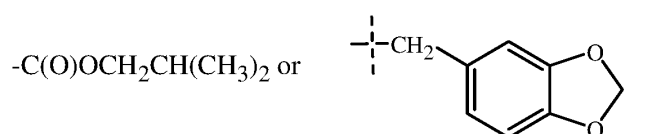
Examples of a compound of Formula b49.8 include (b49.8a) 1-[4-[4-[5-[(2,6-difluorophenoxy)-methyl]-4,5-dihydro-3-isoxazolyl]-2-thiazolyl]-1-piperidinyl]-2-[5-methyl-3-(trifluoromethyl)-1*H*-pyrazol-1-yl]ethanone. Methods for preparing compounds of Formula b49.8 are described in PCT Patent Application PCT/US11/64324.

Component (b4799) relates to a compound of Formula b49.9

80

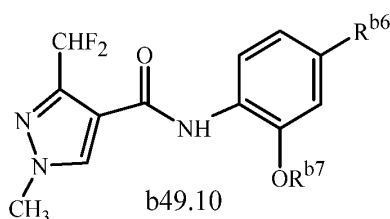


wherein R^{b5} is $-\text{CH}_2\text{OC}(\text{O})\text{CH}(\text{CH}_3)_2$, $-\text{C}(\text{O})\text{CH}_3$, $-\text{CH}_2\text{OC}(\text{O})\text{CH}_3$,



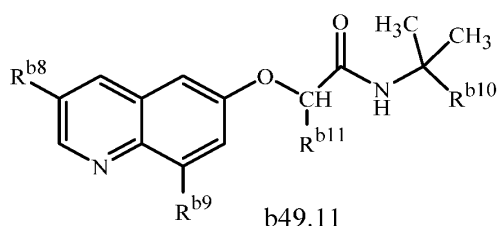
Examples of a compound of Formula b49.9 include (b49.9a) [[4-methoxy-2-[[[(3*S*,7*R*,8*R*,9*S*)-9-methyl-8-(2-methyl-1-oxopropoxy)-2,6-dioxo-7-(phenylmethyl)-1,5-dioxonan-3-yl]amino]-carbonyl]-3-pyridinyl]oxy]methyl 2-methylpropanoate (Registry Number 517875-34-2; common name fempicoxamid), (b49.9b) (3*S*,6*S*,7*R*,8*R*)-3-[[[3-(acetyloxy)-4-methoxy-2-pyridinyl]-carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate (Registry Number 234112-93-7), (b49.9c) (3*S*,6*S*,7*R*,8*R*)-3-[[[3[(acetyloxy)methoxy]-4-methoxy-2-pyridinyl]carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate (Registry Number 517875-31-9), (b49.9d) (3*S*,6*S*,7*R*,8*R*)-3-[[[4-methoxy-3-[(2-methylpropoxy)carbonyl]oxy]-2-pyridinyl]carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate (Registry Number 328256-72-0), and (b49.9e) *N*-[[3-(1,3-benzodioxol-5-ylmethoxy)-4-methoxy-2-pyridinyl]carbonyl]-*O*-[2,5-dideoxy-3-*O*-(2-methyl-1-oxopropyl)-2-(phenylmethyl)L-arabinonoyl]-L-serine, (1→4′)-lactone (Registry Number 1285706-70-8). Methods for preparing compounds of Formula b49.9 are described in PCT Patent Publications WO 99/40081, WO 2001/014339, WO 2003/035617 and WO 2011044213.

Component (b49.10) relates to a compound of Formula b49.10



wherein R^{b6} is H or F, and R^{b7} is -CF₂CHF₂CF₃ or -CF₂CF₂H. Examples of a compound of Formula b49.10 are (b49.10a) 3-(difluoromethyl)-*N*-[4-fluoro-2-(1,1,2,3,3,3-hexafluoropropoxy)phenyl]-1-methyl-1*H*-pyrazole-4-carboxamide (Registry Number 1172611-40-3) and (b49.10b) 3-(difluoromethyl)-1-methyl-*N*-[2-(1,1,2,2-tetrafluoroethoxy)phenyl]-1*H*-pyrazole-4-carboxamide (Registry Number 923953-98-4). Compounds of Formula 49.10 can be prepared by methods described in PCT Patent Publication WO 2007/017450.

Component b49.11 relates a compound of Formula b49.11



wherein

- 10 R^{b8} is halogen, C₁-C₄ alkoxy or C₂-C₄ alkynyl;
 R^{b9} is H, halogen or C₁-C₄ alkyl;
 R^{b10} is C₁-C₁₂ alkyl, C₁-C₁₂ haloalkyl, C₁-C₁₂ alkoxy, C₂-C₁₂ alkoxyalkyl, C₂-C₁₂ alkenyl, C₂-C₁₂ alkynyl, C₄-C₁₂ alkoxyalkenyl, C₄-C₁₂ alkoxyalkynyl, C₁-C₁₂ alkylthio or C₂-C₁₂ alkylthioalkyl;
 15 R^{b11} is methyl or -Y^{b13}-R^{b12};
 R^{b12} is C₁-C₂ alkyl; and
 Y^{b13} is CH₂, O or S.

Examples of compounds of Formula b49.11 include (b49.11a) 2-[(3-bromo-6-quinolinyloxy)-*N*-(1,1-dimethyl-2-butyn-1-yl)-2-(methylthio)acetamide, (b49.11b) 2[(3-ethynyl-6-quinolinyloxy)-*N*-(1,1-dimethyl-2-butyn-1-yl)-2-(methylthio)acetamide, (b49.11c) *N*-(1,1-dimethyl-2-butyn-1-yl)-2-[(3-ethynyl-6-quinolinyloxy)-2-(methylthio)acetamide, (b49.11d) 2-[(3-bromo-8-methyl-6-quinolinyloxy)-*N*-(1,1-dimethyl-2-propyn-1-yl)-2-(methylthio)acetamide and (b49.11e) 2-[(3-bromo-6-quinolinyloxy)-*N*-(1,1-dimethylethyl)-butanamide. Compounds of Formula b49.11, their use as fungicides and methods of preparation are generally known; see, for example, PCT Patent Publications WO 2004/047538, WO 2004/108663, WO 2006/058699, WO 2006/058700, WO 2008/110355, WO 2009/030469, WO 2009/049716 and WO 2009/087098.

Component 49.12 relates to *N*'-[4-[[3-[(4-chlorophenyl)methyl]-1,2,4-thiadiazol-5-yl]oxy]-2,5-dimethylphenyl]-*N*-ethyl-*N*-methylmethanimidamide, which is believed to inhibit C24-methyl transferase involved in the biosynthesis of sterols.

Component 49.13 relates to (1*S*)-2,2-bis(4-fluorophenyl)-1-methylethyl *N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alaninate (Registry Number 1961312-55-9, common name florylpicoxamid), which is believed to be a Quinone inside inhibitor (QiI) fungicide (FRAC code 21) inhibiting the Complex III mitochondrial respiration in fungi.

Therefore of note is a mixture (i.e. composition) comprising a compound of Formula **1** and at least one fungicidal compound selected from the group consisting of the aforescribed classes (1) through (49). Also of note is a composition comprising said mixture (in fungicidally effective amount) and further comprising at least one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents. Of particular note is a mixture (i.e. composition) comprising a compound of Formula **1** and at least one fungicidal compound selected from the group of specific compounds listed above in connection with classes (1) through (49). Also of particular note is a composition comprising said mixture (in fungicidally effective amount) and further comprising at least one additional surfactant selected from the group consisting of surfactants, solid diluents and liquid diluents.

Examples of component (b) fungicides include acibenzolar-S-methyl, aldimorph, ametctradin, amisulbrom, anilazine, azaconazole, azoxystrobin, benalaxyl (including benalaxyl-M), benodanil, benomyl, benthiavalicarb (including benthiavalicarb-isopropyl), benzovindiflupyr, bethoxazin, binapacryl, biphenyl, bitertanol, bixafen, blasticidin-S, boscalid, bromuconazole, bupirimate, buthiobate, captafol, captan, carbendazim, carboxin, carpropamid, chloroneb, chlorothalonil, chlozolate, clotrimazole, copper hydroxide, copper oxychloride, copper sulfate, coumoxystrobin, cyazofamid, cyflufenamid, cymoxanil, cyproconazole, cyprodinil, dichlofluanid, diclocymet, diclomezine, dicloran, diethofencarb, difenoconazole, diflumetorim, dimethirimol, dimethomorph, dimoxystrobin, diniconazole (including diniconazole-M), dinocap, dithianon, dithiolanes, dodemorph, dodine, econazole, edifenphos, enoxastrobin (also known as enestroburin), epoxiconazole, etaconazole, ethaboxam, ethirimol, etridiazole, famoxadone, fenamidone, fenarimol, fenaminstrobin, fenbuconazole, fenfuram, fenhexamid, fenoxanil, fenpiclonil, fenpropidin, fenpropimorph, fenpyrazamine, fentin acetate, fentin chloride, fentin hydroxide, ferbam, ferimzone, flometoquin, florylpicoxamid, fluazinam, fludioxonil, flufenoxystrobin, fluindapyr, flumorph, fluopicolide, fluopyram, flouroimide, fluoxastrobin, fluquinconazole, flusilazole, flusulfamide, flutianil, flutolanil, flutriafol, fluxapyroxad, folpet, fthalide, fuberidazole, furalaxyl, furametpyr, guazatine, hexaconazole,

hymexazole, imazalil, imibenconazole, iminoctadine albesilate, iminoctadine triacetate, iodocarb, ipconazole, iprobenfos, iprodione, iprovalicarb, isoconazole, isofetamid, isoprothiolane, isoflucypram, isopyrazam, isotianil, kasugamycin, kresoxim-methyl, mancozeb, mandepropamid, mandestrobin, maneb, mepanipyrim, mepronil, meptyldinocap, metalaxyl (including metalaxyl-M/mefenoxam), mefentrifluconazole, metconazole, methasulfocarb, metiram, metominostrobin, metrafenone, miconazole, myclobutanil, naftifine, neo-asozin, nuarimol, octhilinone, ofurace, orysastrobin, oxadixyl, oxathiapiprolin, oxolinic acid, oxpoconazole, oxycarboxin, oxytetracycline, pefurazoate, penconazole, pencycuron, penflufen, penthiopyrad, phosphorous acid (including salts thereof, e.g., fosetyl-aluminum), picarbutrazox, picoxystrobin, piperalin, polyoxin, probenazole, prochloraz, procymidone, propamacarb, propiconazole, propineb, proquinazid, prothiocarb, prothioconazole, pyraclostrobin, pyrametostrobin, pyraoxystrobin, pyrazophos, pyribencarb, pyributicarb, pyrifenoxy, pyrimethanil, pyriofenone, pyrisoxazole, pyroquilon, pyrrolnitrin, quinconazole, quinomethionate, quinoxifen, quintozone, sedaxane, silthiofam, simeconazole, spiroxamine, streptomycin, sulfur, tebuconazole, tebufloquin, teclofthalam, tecnazene, terbinafine, tetraconazole, thiabendazole, thifluzamide, thiophanate, thiophanate-methyl, thiram, tiadinil, tolclofos-methyl, tolnifanide, tolprocab, tolyfluanid, triadimefon, triadimenol, triarimol, triticonazole, triazoxide, tribasic copper sulfate, tricyclazole, tricypyricarb, tridemorph, trifloxystrobin, triflumizole, triforine, trimorphamide, uniconazole, uniconazole-P, validamycin, valifenalate (also known as valiphenal), vinclozolin, zineb, ziram, zoxamide, (3*S*,6*S*,7*R*,8*R*)-3-[[[3-[(acetyloxy)methoxy]-4-methoxy-2-pyridinyl]carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate, (3*S*,6*S*,7*R*,8*R*)-3-[[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate, *N*-[[3-(1,3-benzodioxol-5-ylmethoxy)-4-methoxy-2-pyridinyl]carbonyl]-*O*-[2,5-dideoxy-3-*O*-(2-methyl-1-oxopropyl)-2-(phenylmethyl)-*L*-arabinonoyl]-*L*-serine, (1→4')-lactone, *N*-[2-(1*S*,2*R*)-[1,1'-bicyclopropyl]-2-ylphenyl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide, 2-[(3-bromo-6-quinolinyl)oxy]-*N*-(1,1-dimethyl-2-butyne-1-yl)-2-(methylthio)acetamide, 2-[(3-bromo-6-quinolinyl)oxy]-*N*-(1,1-dimethylethyl)butanamide, 2-[(3-bromo-8-methyl-6-quinolinyl)oxy]-*N*-(1,1-dimethyl-2-propyne-1-yl)-2-(methylthio)acetamide, 2-butoxy-6-iodo-3-propyl-4*H*-1-benzopyran-4-one, 3-butyne-1-yl *N*-[6-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-pyridinyl]-carbamate, α-(1-chlorocyclopropyl)-α-[2-(2,2-dichlorocyclopropyl)ethyl]-1*H*-1,2,4-triazole-1-ethanol, 2-[2-(1-chlorocyclopropyl)-4-(2,2-dichlorocyclopropyl)-2-hydroxybutyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione, (α*S*)-[3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-4-isoxazolyl]-3-pyridinemethanol, *rel*-1-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-

oxiranyl)methyl]-1*H*-1,2,4-triazole, *rel*-2-[[*(2R,3S)*-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl)methyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione, *rel*-1-[[*(2R,3S)*-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl)methyl]-5-(2-propen-1-ylthio)-1*H*-1,2,4-triazole, 3-[5-(4-chlorophenyl)-2,3-dimethyl-3-isoxazolidinyl]pyridine, (2-chloro-6-fluorophenyl)methyl 2-[1-[2-
5 [3,5-bis(difluoromethyl)-1*H*-pyrazol-1-yl]acetyl]-4-piperidinyl]-4-thiazolecarboxylate, *N*'-[4-
[[3-[(4-chlorophenyl)methyl]-1,2,4-thiadiazol-5-yl]oxy]-2,5-dimethylphenyl]-*N*-ethyl-*N*-methyl-
methanimidamide, *N*-[2-[4-[[3-(4-chlorophenyl)-2-propyn-1-yl]oxy]-3-methoxyphenyl]ethyl]-3-
methyl-2-[(methylsulfonyl)amino]butanamide, *N*-[2-[4-[[3-(4-chlorophenyl)-2-propyn-1-
yl]oxy]-3-methoxyphenyl]ethyl]-3-methyl-2-[(ethylsulfonyl)amino]butanamide, *N*'-[4-[4-chloro-
10 3-(trifluoromethyl)phenoxy]-2,5-dimethylphenyl]-*N*-ethyl-*N*-methylmethanimidamide, *N*-
cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-*N*-[[2-(1-methylethyl)phenyl]methyl]-1*H*-
pyrazole-4-carboxamide, *N*-[[[(cyclopropylmethoxy)amino][6-(difluoromethoxy)-2,3-difluoro-
phenyl]methylene]benzeneacetamide, *N*-[2-(2,4-dichlorophenyl)-2-methoxy-1-methylethyl]-3-
(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide, *N*-(3',4'-difluoro[1,1'-biphenyl]-2-yl)-3-
15 (trifluoromethyl)-2-pyrazinecarboxamide, 3-(difluoromethyl)-*N*-(2,3-dihydro-1,1,3-trimethyl-
1*H*-inden-4-yl)-1-methyl-1*H*-pyrazole-4-carboxamide, 3-(difluoromethyl)-*N*-[4-fluoro-2-
(1,1,2,3,3,3-hexafluoropropoxy)phenyl]-1-methyl-1*H*-pyrazole-4-carboxamide, 5,8-difluoro-*N*-
[2-[3-methoxy-4-[[4-(trifluoromethyl)-2-pyridinyl]oxy]phenyl]ethyl]-4-quinazolinamine, 3-
(difluoromethyl)-1-methyl-*N*-[2-(1,1,2,2-tetrafluoroethoxy)phenyl]-1*H*-pyrazole-4-carbox-
20 amide, 1-[4-[4-[5*R*-[(2,6-difluorophenoxy)methyl]-4,5-dihydro-3-isoxazolyl]-2-thiazolyl]-1-
piperidinyl]-2-[5-methyl-3-(trifluoromethyl)-1*H*-pyrazol-1-yl]ethanone, *N*-(1,1-dimethyl-2-
butyn-1-yl)-2-[(3-ethynyl-6-quinolinyloxy)-2-(methylthio)acetamide, 2,6-dimethyl-1*H*,5*H*-
[1,4]dithiino[2,3-*c*:5,6-*c'*]dipyrrole-1,3,5,7(2*H*,6*H*)-tetrone, 2-[(3-ethynyl-6-quinolinyloxy)-
N-[1-(hydroxymethyl)-1-methyl-2-propyn-1-yl]-2-(methylthio)acetamide, 4-fluorophenyl *N*-[1-
25 [[[1-(4-cyanophenyl)ethyl]sulfonyl]methyl]propyl]carbamate, 5-fluoro-2-[(4-fluorophenyl)-
methoxy]-4-pyrimidinamine, 5-fluoro-2-[(4-methylphenyl)methoxy]-4-pyrimidinamine,
(3*S*,6*S*,7*R*,8*R*)-3-[[[4-methoxy-3-[(2-methylpropoxy)carbonyl]oxy]-2-pyridinyl]carbonyl]-
amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl-2-methylpropanoate,
 α -(methoxyimino)-*N*-methyl-2-[[[1-[3-(trifluoromethyl)phenyl]ethoxy]imino]methyl]benzene-
30 acetamide, [[4-methoxy-2-[[[(3*S*,7*R*,8*R*,9*S*)-9-methyl-8-(2-methyl-1-oxopropoxy)-2,6-dioxo-7-
(phenylmethyl)-1,5-dioxonan-3-yl]amino]carbonyl]-3-pyridinyl]oxy]methyl 2-methylpropan-
oate, pentyl *N*-[6-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]oxy]methyl]-2-
pyridinyl]carbamate, pentyl *N*-[4-[[[(1-methyl-1*H*-tetrazol-5-yl)phenylmethylene]amino]-

oxy)methyl]-2-thiazolyl]carbamate, and pentyl *N*-[6-[[[(*Z*)-(1-methyl-1*H*-tetrazol-5-yl)phenyl-methylene]amino]oxy)methyl]-2-pyridinyl]carbamate and (1*R*)-1,2,3,4-tetrahydro-1-naphthalenyl 2-[1-[2-[3,5-bis(difluoromethyl)-1*H*-pyrazol-1-yl]acetyl]-4-piperidinyl]-4-thiazolecarboxylate. Therefore of note is a fungicidal composition comprising as component (a) a compound of

5 Formula **1** (or an *N*-oxide or salt thereof) and as component (b) at least one fungicide selected from the preceding list.

Of particular note are combinations of compounds of Formula 1 (or an *N*-oxide or salt thereof) (i.e. Component (a) in compositions) with azoxystrobin, benzovindiflupyr, bixafen, captan, carpropamid, chlorothalonil, copper hydroxide, copper oxychloride, copper sulfate,

10 cymoxanil, cyproconazole, cyprodinil, diethofencarb, difenoconazole, dimethomorph, epoxiconazole, ethaboxam, fenarimol, fenhexamid, fluazinam, fludioxonil, fluindapyr, fluopyram, flusilazole, flutianil, flutriafol, fluxapyroxad, folpet, iprodione, isofetamid, isoflucypram, isopyrazam, kresoxim-methyl, mancozeb, mandestrobin, meptyldinocap, metalaxyl (including metalaxyl-M/mefenoxam), mefentrifluconazole, metconazole, metrafenone,

15 myclobutanil, oxathiapiprolin, penflufen, penthiopyrad, phosphorous acid (including salts thereof, e.g., fosetyl-aluminum), picoxystrobin, propiconazole, proquinazid, prothioconazole, pyraclostrobin, pyrimethanil, sedaxane, spiroxamine, sulfur, tebuconazole, thiophanate-methyl, trifloxystrobin, zoxamide, α -(1-chlorocyclopropyl)- α -[2-(2,2-dichlorocyclopropyl)ethyl]-1*H*-1,2,4-triazole-1-ethanol, 2-[2-(1-chlorocyclopropyl)-4-(2,2-dichlorocyclopropyl)-2-hydroxy-

20 butyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione, *N*-[2-(2,4-dichlorophenyl)-2-methoxy-1-methyl-ethyl]-3-(difluoromethyl)-1-methyl-1*H*-pyrazole-4-carboxamide, 3-(difluoromethyl)-*N*-(2,3-dihydro-1,1,3-trimethyl-1*H*-inden-4-yl)-1-methyl-1*H*-pyrazole-4-carboxamide, 1-[4-[4-[5*R*-(2,6-difluorophenyl)-4,5-dihydro-3-isoxazolyl]-2-thiazolyl]-1-piperidinyl]-2-[5-methyl-3-(trifluoromethyl)-1*H*-pyrazol-1-yl]ethanone, 1,1-dimethylethyl *N*-[6-[[[(1-methyl-1*H*-tetrazol-5-

25 yl)phenylmethylene]amino]oxy)methyl]-2-pyridinyl]carbamate, 2,6-dimethyl-1*H*,5*H*-[1,4]dithiino[2,3-*c*:5,6-*c'*]dipyrrole-1,3,5,7(2*H*,6*H*)-tetrone, 5-fluoro-2-[(4-fluorophenyl)methoxy]-4-pyrimidinamine, 5-fluoro-2-[(4-methylphenyl)methoxy]-4-pyrimidinamine, (α *S*)-[3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-4-isoxazolyl]-3-pyridinemethanol, *rel*-1-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-1*H*-1,2,4-triazole, *rel*-2-[[2*R*,3*S*]-3-

30 (2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-1,2-dihydro-3*H*-1,2,4-triazole-3-thione, and *rel*-1-[[2*R*,3*S*]-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-2-oxiranyl]methyl]-5-(2-propen-1-ylthio)-1*H*-1,2,4-triazole (i.e. as Component (b) in compositions).

Examples of other biologically active compounds or agents with which compounds of this invention can be formulated are: invertebrate pest control compounds or agents such as

abamectin, acephate, acetamiprid, acrinathrin, afidopyropen
 ([[(3*S*,4*R*,4*aR*,6*S*,6*aS*,12*R*,12*aS*,12*bS*)-3-[(cyclopropylcarbonyl)oxy]-1,3,4,4*a*,5,6,6*a*,12,12*a*,12*b*-
 decahydro-6,12-dihydroxy-4,6*a*,12*b*-trimethyl-11-oxo-9-(3-pyridinyl)-2*H*,11*H*-naphtho[2,1-
b]pyrano[3,4-*e*]pyran-4-yl)methyl cyclopropanecarboxylate), amidoflumet (S-1955), avermectin,
 5 azadirachtin, azinphos-methyl, bifenthrin, bifenazate, buprofezin, carbofuran, cartap,
 chlorantraniliprole, chlorfenapyr, chlorfluazuron, chlorpyrifos, chlorpyrifos-methyl,
 chromafenozide, clothianidin, cyantraniliprole (3-bromo-1-(3-chloro-2-pyridinyl)-*N*-[4-cyano-2-
 methyl-6-[(methylamino)carbonyl]phenyl]-1*H*-pyrazole-5-carboxamide), cyclaniliprole (3-
 bromo-*N*-[2-bromo-4-chloro-6-[(1-cyclopropylethyl)amino]carbonyl]phenyl]-1-(3-chloro-2-
 10 pyridinyl)-1*H*-pyrazole-5-carboxamide), cycloxaprid ((5*S*,8*R*)-1-[(6-chloro-3-pyridinyl)methyl]-
 2,3,5,6,7,8-hexahydro-9-nitro-5,8-epoxy-1*H*-imidazo[1,2-*a*]azepine), cyflumetofen, cyfluthrin,
 beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, cypermethrin, cyromazine, deltamethrin,
 diafenthiuron, diazinon, dieldrin, diflubenzuron, dimefluthrin, dimethoate, dinotefuran,
 diofenolan, emamectin, endosulfan, esfenvalerate, ethiprole, fenothiocarb, fenoxycarb,
 15 fenpropathrin, fenvalerate, fipronil, flonicamid, flubendiamide, flucythrinate, flufenoxystrobin
 (methyl (α *E*)-2-[[2-chloro-4-(trifluoromethyl)phenoxy]methyl]- α -(methoxymethylene)benzene-
 acetate), fluensulfone (5-chloro-2-[(3,4,4-trifluoro-3-buten-1-yl)sulfonyl]thiazole), flupiprole (1-
 [2,6-dichloro-4-(trifluoromethyl)phenyl]-5-[(2-methyl-2-propen-1-yl)amino]-4-[(trifluoro-
 methyl)sulfinyl]-1*H*-pyrazole-3-carbonitrile), flupyradifurone (4-[[[(6-chloro-3-pyridinyl)-
 20 methyl](2,2-difluoroethyl)amino]-2(5*H*)-furanone), tau-fluvalinate, flufenerim (UR-50701),
 flufenoxuron, fonophos, halofenozide, heptafluthrin ([2,3,5,6-tetrafluoro-4-(methoxymethyl)-
 phenyl]methyl 2,2-dimethyl-3-[(1*Z*)-3,3,3-trifluoro-1-propen-1-yl]cyclopropanecarboxylate),
 hexaflumuron, hydramethylnon, imidacloprid, indoxacarb, isofenphos, lufenuron, malathion,
 meperfluthrin ([2,3,5,6-tetrafluoro-4-(methoxymethyl)phenyl]methyl (1*R*,3*S*)-3-(2,2-dichloro-
 25 ethenyl)-2,2-dimethylcyclopropanecarboxylate), metaflumizone, metaldehyde, methamidophos,
 methidathion, methomyl, methoprene, methoxychlor, methoxyfenozide, metofluthrin,
 milbemycin oxime, momfluorothrin ([2,3,5,6-tetrafluoro-4-(methoxymethyl)phenyl]methyl-3-(2-
 cyano-1-propen-1-yl)-2,2-dimethylcyclopropanecarboxylate), monocrotophos, nicotine,
 nitenpyram, nithiazine, novaluron, noviflumuron (XDE-007), oxamyl, pyflubumide (1,3,5-
 30 trimethyl-*N*-(2-methyl-1-oxopropyl)-*N*-[3-(2-methylpropyl)-4-[2,2,2-trifluoro-1-methoxy-1-
 (trifluoromethyl)ethyl]phenyl]-1*H*-pyrazole-4-carboxamide), parathion, parathion-methyl,
 permethrin, phorate, phosalone, phosmet, phosphamidon, pirimicarb, profenofos, profluthrin,
 pymetrozine, pyrafluprole, pyrethrin, pyridalyl, pyrifluquinazon, pyriminostrobin (methyl (α *E*)-

2-[[[2-[(2,4-dichlorophenyl)amino]-6-(trifluoromethyl)-4-pyrimidinyl]oxy]methyl]- α -(methoxy-methylene)benzeneacetate), pyriprole, pyriproxyfen, rotenone, ryanodine, spinetoram, spinosad, spirotetramat, sulfoxaflor, sulprofos, tebufenozide, teflubenzuron, tefluthrin, terbufos, tetrachlorvinphos, tetramethylfluthrin, thiacloprid, thiamethoxam, thiodicarb, thiosultap-sodium, tolfenpyrad, tralomethrin, triazamate, trichlorfon and triflumuron; and biological agents including entomopathogenic bacteria, such as *Bacillus thuringiensis* subsp. *aizawai*, *Bacillus thuringiensis* subsp. *kurstaki*, and the encapsulated delta-endotoxins of *Bacillus thuringiensis* (e.g., Cellcap, MPV, MPVII); entomopathogenic fungi, such as green muscardine fungus; and entomopathogenic virus including baculovirus, nucleopolyhedro virus (NPV) such as HzNPV, AfNPV; and granulosis virus (GV) such as CpGV.

Compounds of this invention and compositions thereof can be applied to plants genetically transformed to express proteins toxic to invertebrate pests (such as *Bacillus thuringiensis* delta-endotoxins). The effect of the exogenously applied fungicidal compounds of this invention may provide an enhanced effect with the expressed toxin proteins.

General references for agricultural protectants (i.e. insecticides, fungicides, nematocides, acaricides, herbicides and biological agents) include *The Pesticide Manual, 13th Edition*, C. D. S. Tomlin, Ed., British Crop Protection Council, Farnham, Surrey, U.K., 2003 and *The BioPesticide Manual, 2nd Edition*, L. G. Copping, Ed., British Crop Protection Council, Farnham, Surrey, U.K., 2001.

For embodiments where one or more of these various mixing partners are used, the weight ratio of these various mixing partners (in total) to the compound of Formula **1** is typically between about 1:3000 and about 3000:1. Of note are weight ratios between about 1:300 and about 300:1 (for example ratios between about 1:30 and about 30:1). One skilled in the art can easily determine through simple experimentation the biologically effective amounts of active ingredients necessary for the desired spectrum of biological activity. It will be evident that including these additional components may expand the spectrum of diseases controlled beyond the spectrum controlled by the compound of Formula **1** alone.

In certain instances, combinations of a compound of this invention with other biologically active (particularly fungicidal) compounds or agents (i.e. active ingredients) can result in a greater-than-additive (i.e. enhanced) effect. Reducing the quantity of active ingredients released in the environment while ensuring effective pest control is always desirable. When an enhanced effect of fungicidal active ingredients occurs at application rates giving agronomically satisfactory levels of fungal control, such combinations can be advantageous for reducing crop production cost and decreasing environmental load.

Also in certain instances, combinations of a compound of the invention with other biologically active compounds or agents can result in a less-than-additive (i.e. safening) effect on organisms beneficial to the agronomic environment. For example, a compound of the invention may safen a herbicide on crop plants or protect a beneficial insect species (e.g., insect predators, 5 pollinators such as bees) from an insecticide.

Fungicides of note for formulation with compounds of Formula **1** to provide mixtures useful in seed treatment include but are not limited to amisulbrom, azoxystrobin, boscalid, carbendazim, carboxin, cymoxanil, cyproconazole, difenoconazole, dimethomorph, florylpicoxamid, fluazinam, fludioxonil, flufenoxystrobin, fluquinconazole, fluopicolide, fluoxastrobin, flutriafol, 10 fluxapyroxad, ipconazole, iprodione, metalaxyl, mefenoxam, mefentrifluconazole, metconazole, myclobutanil, paclobutrazole, penflufen, picoxystrobin, prothioconazole, pyraclostrobin, sedaxane, silthiofam, tebuconazole, thiabendazole, thiophanate-methyl, thiram, trifloxystrobin and triticonazole.

Invertebrate pest control compounds or agents with which compounds of Formula **1** can be 15 formulated to provide mixtures useful in seed treatment include but are not limited to abamectin, acetamiprid, acrinathrin, afidopyropen, amitraz, avermectin, azadirachtin, bensultap, bifenthrin, buprofezin, cadusafos, carbaryl, carbofuran, cartap, chlorantraniliprole, chlorfenapyr, chlorpyrifos, clothianidin, cyantraniliprole, cyclaniliprole, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, zeta-cypermethrin, cyromazine, deltamethrin, dieldrin, dinotefuran, diofenolan, emamectin, 20 endosulfan, esfenvalerate, ethiprole, etofenprox, etoxazole, fenothiocarb, fenoxycarb, fenvalerate, fipronil, flonicamid, flubendiamide, fluensulfone, flufenoxuron, flufiprole, flupyradifurone, fluvalinate, formetanate, fosthiazate, heptafluthrin, hexaflumuron, hydramethylnon, imidacloprid, indoxacarb, lufenuron, meperfluthrin, metaflumizone, methiocarb, methomyl, methoprene, 25 methoxyfenozide, momfluorothrin, nitenpyram, nithiazine, novaluron, oxamyl, pyflubumide, pymetrozine, pyrethrin, pyridaben, pyriminostrobin, pyridalyl, pyriproxyfen, ryanodine, spinetoram, spinosad, spirotetramat, sulfoxaflor, tebufenozide, tetramethrin, tetramethylfluthrin, thiacloprid, thiamethoxam, thiodicarb, thiosultap-sodium, tralomethrin, triazamate, triflumuron, *Bacillus thuringiensis* delta-endotoxins, strains of *Bacillus* 30 *thuringiensis* and strains of *Nucleo polyhydrosis* viruses.

Compositions comprising compounds of Formula **1** useful for seed treatment can further comprise bacteria and fungi that have the ability to provide protection from the harmful effects of plant pathogenic fungi or bacteria and/or soil born animals such as nematodes. Bacteria exhibiting nematicidal properties may include but are not limited to *Bacillus firmus*, *Bacillus cereus*,

Bacillus subtilis and *Pasteuria penetrans*. A suitable *Bacillus firmus* strain is strain CNCM I-1582 (GB-126) which is commercially available as BioNem™. A suitable *Bacillus cereus* strain is strain NCMM I-1592. Both *Bacillus* strains are disclosed in US 6,406,690. Other suitable bacteria exhibiting nematocidal activity are *B. amyloliquefaciens* IN937a and *B. subtilis* strain GB03. Bacteria exhibiting fungicidal properties may include but are not limited to *B. pumilus* strain GB34. Fungal species exhibiting nematocidal properties may include but are not limited to *Myrothecium verrucaria*, *Paecilomyces lilacinus* and *Purpureocillium lilacinum*.

Seed treatments can also include one or more nematocidal agents of natural origin such as the elicitor protein called harpin which is isolated from certain bacterial plant pathogens such as *Erwinia amylovora*. An example is the Harpin-N-Tek seed treatment technology available as N-Hibit™ Gold CST.

Seed treatments can also include one or more species of legume-root nodulating bacteria such as the microsymbiotic nitrogen-fixing bacteria *Bradyrhizobium japonicum*. These inoculants can optionally include one or more lipo-chitooligosaccharides (LCOs), which are nodulation (Nod) factors produced by rhizobia bacteria during the initiation of nodule formation on the roots of legumes. For example, the Optimize® brand seed treatment technology incorporates LCO Promoter Technology™ in combination with an inoculant.

Seed treatments can also include one or more isoflavones which can increase the level of root colonization by mycorrhizal fungi. Mycorrhizal fungi improve plant growth by enhancing the root uptake of nutrients such as water, sulfates, nitrates, phosphates and metals. Examples of isoflavones include, but are not limited to, genistein, biochanin A, formononetin, daidzein, glycitein, hesperetin, naringenin and pratensein. Formononetin is available as an active ingredient in mycorrhizal inoculant products such as PHC Colonize® AG.

Seed treatments can also include one or more plant activators that induce systemic acquired resistance in plants following contact by a pathogen. An example of a plant activator which induces such protective mechanisms is acibenzolar-*S*-methyl.

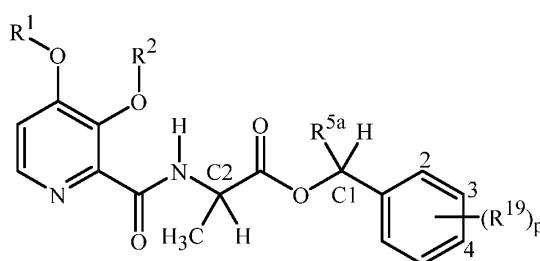
The following TESTS demonstrate the control efficacy of compounds of this invention on specific pathogens. The pathogen control protection afforded by the compounds is not limited, however, to these species. See Index Tables A-F below for compound descriptions. The following abbreviations are used in the Index Tables: Me means methyl, Et means ethyl, *i*-Pr means *iso*-propyl, *c*-Pr means cyclopropyl, *t*-Bu means *tert*-butyl, *c*-hexyl means cyclohexyl, *c*-heptyl means cycloheptyl, Ph means phenyl, Bn means benzyl, NO₂ means nitro, MeO means methoxy and EtO means ethoxy. The abbreviation “Cmpd. No.” stands for “Compound Number”, and the abbreviation “Ex.” stands for “Example” and is followed by a number indicating in which

example the compound is prepared. The numerical value reported in the column “MS” is the molecular weight of the highest isotopic abundance positively charged parent ion (M+1) formed by addition of H⁺ (molecular weight of 1) to the molecule having the highest isotopic abundance, or the highest isotopic abundance negatively charged ion (M–1) formed by loss of H⁺ (molecular weight of 1). The presence of molecular ions containing one or more higher atomic weight isotopes of lower abundance (e.g., ³⁷Cl, ⁸¹Br) is not reported. The reported MS peaks were observed by mass spectrometry using electrospray ionization (ESI) or atmospheric pressure chemical ionization (APCI).

In Index Tables A through F, all of the compounds contain two asymmetric carbon atoms which are identified as C1 and C2 in the Markush structures for each of the Index Tables. In the column “Isomer”, the stereo configuration of carbon atom C2 is indicated as *S* (*sinister*), which denotes the absolute chirality of carbon C2 based on the Cahn–Ingold–Prelog system. Also in the column “Isomer”, the stereo configuration of carbon atom C1 is indicated as asterisk “*” which denotes isomer A (a stereocenter of fixed but unknown stereochemistry i.e. either *R*- or *S*-configuration, but believed to be *S*-configuration), or double asterisk “**” which denotes isomer B (a stereocenter of fixed but unknown stereochemistry i.e. either *R*- or *S*-configuration, but opposite of isomer A and believed to be *R*-configuration). The abbreviation *Rac* denotes racemic chiral carbon.

One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). In a preferred embodiment the compounds of this invention, including the compounds described in Index Tables A-F, have the stereo configuration (1*S*, 2*S*).

INDEX TABLE A



Cmpd.						
No.	Isomer	R ¹	R ²	R ^{5a}	(R ¹⁹) _p	MS
1	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-Ph	421 (M+1)
2	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-Ph	421 (M+1)

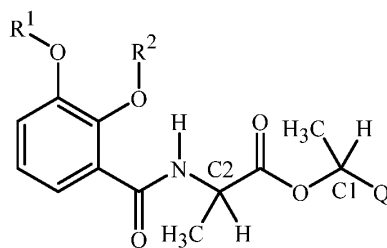
Cmpd.						
No.	Isomer	R ¹	R ²	R ^{5a}	(R ¹⁹) _p	MS
3	1*,2 <i>S</i>	CH ₃	H	CH ₃	3-Ph	421 (M+1)
4	1**,2 <i>S</i>	CH ₃	H	CH ₃	3-Ph	421 (M+1)
11	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(4-F-Bn)	495 (M+1)
12	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn, 4-F	453 (M+1)
13	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn)	453 (M+1)
15	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-F	405 (M+1)
16	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-NO ₂	388 (M-1)
17	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-CF ₃	411 (M-1)
18	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-CF ₃	455 (M+1)
19	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-NO ₂	455 (M+Na+1)
20	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-NO ₂	433 (M+1)
21	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-NO ₂	391 (M+1)
22	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(4-F-Bn)	495 (M+1)
23	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn, 4-F	453 (M+1)
24	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn, 4-F	453 (M+1)
25	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	519 (M-1)
26	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	477 (M-1)
27	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	522 (M+1)
28	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	478 (M-1)
31	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -hexyl	469 (M+1)
32	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -hexyl	427 (M+1)
33	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-C≡N	413 (M+1)
34	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-C≡N	368 (M-1)
35	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-CF ₃	453 (M-1)
36	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-CF ₃	411 (M-1)
37	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-Bn, 4-F	495 (M+1)
38	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-Bn, 4-F	495 (M+1)
39	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn)	453 (M+1)
40	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn)	455 (M+1)
41	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn), 4-F	471 (M+1)
42	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn), 4-F	471 (M+1)

Cmpd.						
No.	Isomer	R ¹	R ²	R ^{5a}	(R ¹⁹) _p	MS
47	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-(4-EtOC(=O)-1 <i>H</i> -pyrazol-1-yl)	525 (M+1)
48	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-(3-EtOC(=O)-1 <i>H</i> -pyrazol-1-yl)	525 (M+1)
49	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-(3-EtOC(=O)-1 <i>H</i> -pyrazol-1-yl)	481 (M-1)
50	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-(4-EtOC(=O)-1 <i>H</i> -pyrazol-1-yl)	481 (M-1)
53	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-cyclohexyloxy	441 (M-1)
54	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-Bn), 4-F	471 (M+1)
55	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-PhO)	455 (M+1)
57	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(4-F-PhO)	497 (M+1)
58	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(4-F-Bn), 4-F	513 (M+1)
59	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-PhO)	455 (M+1)
60	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-PhO)	455 (M+1)
61	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-(4-F-PhO)	497 (M+1)
64	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -pentyl	455 (M+1)
65	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -pentyl	413 (M+1)
66	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -Pr	383 (M-1)
68	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>n</i> -hexyl	427 (M-1)
69	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-(Me ₃ SiC≡C)	441 (M+1)
71	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -Pr	428 (M+1)
72	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	Et	4- <i>c</i> -hexyl	439 (M-1)
73	1**,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -hexyl	427 (M+1)
74	1*,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -hexyl	427 (M+1)
77	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	MeC(=O)OCH ₂	CH ₃	4- <i>c</i> -hexyl	499 (M+1)
78	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4-CH≡C	369 (M+1)
80	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-(Me ₃ SiC≡C)	483 (M+1)
81	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-PhO, 4-F	455 (M+1)
82	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-(4-F-PhO), 4-F	473 (M+1)
85	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-PhO, 4-F	497 (M+1)
86	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -hexyl	469 (M+1)
89	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2,4-di-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	614 (M+1)
90	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2,4-di-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	656 (M+1)
93	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn, 4-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	569 (M+1)
94	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-Bn, 4-(3-CF ₃ -1 <i>H</i> -pyrazol-1-yl)	611 (M+1)

Cmpd.						
No.	Isomer	R ¹	R ²	R ^{5a}	(R ¹⁹) _p	MS
95	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -hexyl	469 (M+1)
96	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	<i>i</i> -Pr	4- <i>c</i> -hexyl	497 (M+1)
100	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	Et	4- <i>c</i> -hexyl	483 (M+1)
105	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-PhO	437 (M+1)
106	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-PhO	437 (M+1)
107	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-PhO	479 (M+1)
108	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-PhO	479 (M+1)
109	1*,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn	435 (M+1)
110	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-Bn	477 (M+1)
111	1**,2 <i>S</i>	CH ₃	H	CH ₃	2-Bn	435 (M+1)
112	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2-Bn	477 (M+1)
117	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>i</i> -Pr	430 (M+1)
118	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>i</i> -Pr	388 (M+1)
119	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CF ₃	4- <i>c</i> -hexyl	521 (M+1)
120	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CF ₃	4- <i>c</i> -hexyl	479 (M+1)
121	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>t</i> -Bu	443 (M+1)
123	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>t</i> -Bu	400 (M-1)
128	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-(<i>c</i> -hexyl-CH ₂)	483 (M+1)
129	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4-(<i>c</i> -hexyl-CH ₂)	483 (M+1)
130	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₂ CH ₃	4- <i>c</i> -hexyl	484 (M+1)
131	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₂ CH ₃	4- <i>c</i> -hexyl	484 (M+1)
132	1**,2 <i>S</i>	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₂ CH ₃	4- <i>c</i> -hexyl	542 (M+1)
133	1*,2 <i>S</i>	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₂ CH ₃	4- <i>c</i> -hexyl	542 (M+1)
134	1**,2 <i>S</i>	CH ₃	CH ₃ (=O)OCH ₂	CH ₂ CH ₃	4- <i>c</i> -hexyl	514 (M+1)
135	1*,2 <i>S</i>	CH ₃	CH ₃ (=O)OCH ₂	CH ₂ CH ₃	4- <i>c</i> -hexyl	514 (M+1)
136	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	Ph(=O)	CH ₃	4- <i>c</i> -hexyl	531 (M+1)
137	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3-(4,4-dimethylcyclohexyloxy)	513 (M+1)
138	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3-(4,4-dimethylcyclohexyloxy)	471 (M+1)
139	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	2,4-di-Ph	497 (M+1)
140	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	2,4-di-Ph	539 (M+1)
141	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3,5-di-Ph	539 (M+1)
142	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3,5-di-Ph	497 (M+1)

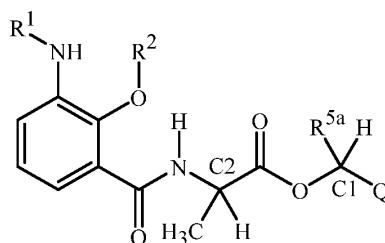
Cmpd.						
No.	Isomer	R ¹	R ²	R ^{5a}	(R ¹⁹) _p	MS
143	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)OCH ₂	CH ₃	2,4-di-Ph	569 (M+1)
144	1**,2 <i>S</i>	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₃	4- <i>c</i> -hexyl	527 (M+1)
145	1*,2 <i>S</i>	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₃	4- <i>c</i> -hexyl	527 (M+1)
146	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)OCH ₂	CH ₃	4- <i>c</i> -hexyl	499 (M+1)
147	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)OCH ₂	CH ₃	4- <i>c</i> -hexyl	499 (M+1)
148	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3,5-di-(OCH ₂ CH=CH ₂)	499 (M+1)
149	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3,5-di-(OCH ₂ CH=CH ₂)	457 (M+1)
150	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃	CH ₃	4- <i>c</i> -hexyl	442 (M+1)
151	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3,5-di-(<i>c</i> -Pr)	467 (M+1)
152	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3,5-di-(<i>c</i> -Pr)	425 (M+1)
153	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₂ =CHCH ₂	CH ₃	4- <i>c</i> -hexyl	467 (M+1)
154	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	<i>i</i> -PrC(=O)	CH ₃	4- <i>c</i> -hexyl	497 (M+1)
155	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	4-MeO-PhCH ₂	CH ₃	4- <i>c</i> -hexyl	547 (M+1)
156	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	MeS(=O) ₂	CH ₃	4- <i>c</i> -hexyl	506 (M+1)
157	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	3- <i>c</i> -Pr	427 (M+1)
158	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	3- <i>c</i> -Pr	385 (M+1)
159	1- <i>Rac</i> ,2 <i>S</i>	CH ₃	H	CN	-	356 (M+1)

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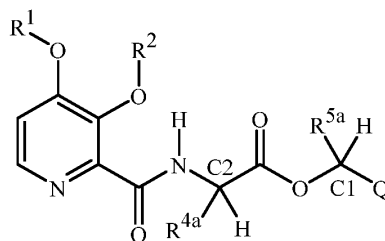
Cmpd. No.	Isomer	R ¹	R ²	Q	MS
5	1*,2 <i>S</i>	CH ₃	H	2-benzylphenyl	432 (M-1)
6	1**,2 <i>S</i>	CH ₃	H	2-benzylphenyl	432 (M-1)
7	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	2-benzylphenyl	474 (M-1)
8	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	2-benzylphenyl	432 (M-1-OAc)
91	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	<i>c</i> -hexyl	348 (M-1)
92	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	<i>c</i> -hexyl	390 (M-1)

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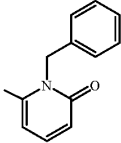
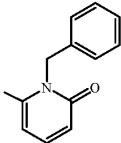


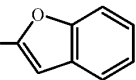
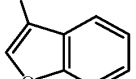
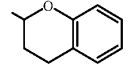
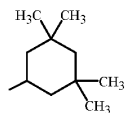
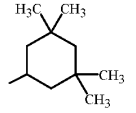
Cmpd.		R ¹	R ²	R ^{5a}	Q	MS
No.	Isomer					
9	1- <i>rac</i> ,2 <i>S</i>	H	H	CH ₃	2-benzylphenyl	419 (M+1)
10	1- <i>rac</i> ,2 <i>S</i>	CH ₃ C(=O)	H	CH ₃	2-benzylphenyl	459 (M-1)
97	1- <i>rac</i> ,2 <i>S</i>	CH(=O)	H	CH ₃	4- <i>c</i> -hexylphenyl	437 (M-1)
160	1- <i>rac</i> ,2 <i>S</i>	CH(=O)	H	CH ₃	3-(4,4-dimethylcyclohexyloxy)phenyl	483 (M+1)
161	1- <i>rac</i> ,2 <i>S</i>	CH(=O)	H	CH ₃	3,5-di-Ph-phenyl	507 (M-1)
162	1- <i>rac</i> ,2 <i>S</i>	CH(=O)	H	CH ₃	9-anthracenyl	455 (M-1)
163	1- <i>rac</i> ,2 <i>S</i>	CH(=O)	H	CH ₃	3,5-di-(CH ₂ =CHCH ₂ O)-Ph	469 (M+1)

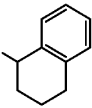
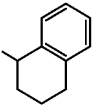
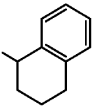
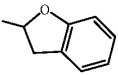
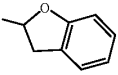
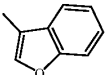
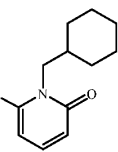
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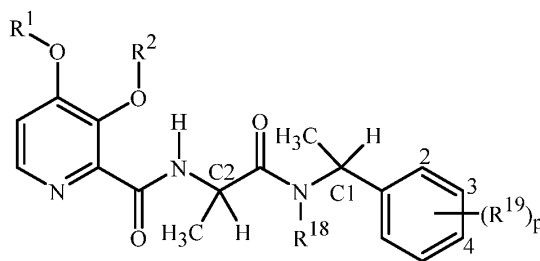
Cmpd.		R ¹	R ²	R ^{4a}	R ^{5a}	Q	MS
No.	Isomer						
14	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	4-pyridinyl	346 (M+1)
29 (Ex. 2)	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	<i>c</i> -hexyl	393 (M+1)
30 (Ex. 1)	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	<i>c</i> -hexyl	351 (M+1)
43	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	1-adamantanyl	445 (M+1)
44	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	1-adamantanyl	403 (M+1)
45	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	<i>c</i> -hexyl	<i>c</i> -hexyl	417 (M-1)
46	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	<i>c</i> -hexyl	<i>c</i> -hexyl	461 (M+1)

Cmpd.		R ¹	R ²	R ^{4a}	R ^{5a}	Q	MS
No.	Isomer						
51	1*,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	<i>c</i> -hexyl	351 (M+1)
52	1**,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	<i>c</i> -hexyl	351 (M+1)
56	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	5-Br-2-thienyl	429 (M-1)
62	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	<i>i</i> -Pr	<i>c</i> -hexyl	421 (M+1)
63	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	<i>i</i> -Pr	<i>c</i> -hexyl	379 (M-1)
67	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	5-Br-2-thienyl	471 (M+1)
70	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	<i>i</i> -Pr	CH ₃	4-(<i>c</i> -hexyl)-Ph	456 (M+1)
75	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	2-naphthalenyl	437 (M+1)
76	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	2-naphthalenyl	395 (M+1)
79	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	<i>i</i> -Pr	CH ₃	4-(<i>c</i> -hexyl)-Ph	497 (M+1)
83	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	Et	<i>c</i> -hexyl	407 (M+1)
84	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	Et	<i>c</i> -hexyl	363 (M-1)
87	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	<i>c</i> -hexyl	393 (M+1)
88	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	<i>c</i> -hexyl	393 (M+1)
101	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	<i>c</i> -heptyl	407 (M+1)
102	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	<i>c</i> -heptyl	363 (M-1)
103	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	4-(Ph)- <i>c</i> -hexyl	427 (M+1)
104	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	4-(Ph)- <i>c</i> -hexyl	469 (M+1)
113	1**,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	1-naphthalenyl	395 (M+1)
114	1*,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	1-naphthalenyl	395 (M+1)
115	1**,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	1-naphthalenyl	437 (M+1)
116	1*,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	1-naphthalenyl	437 (M+1)
122	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃		494 (M+1)
124	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃		452 (M+1)

Cmpd.		R ¹	R ²	R ^{4a}	R ^{5a}	Q	MS
No.	Isomer						
125	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃		385 (M+1)
126	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃	<i>c</i> -hexyl	351 (M+1)
127	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	CH ₃		386 (M+1)
164	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		401 (M+1)
165	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	4,4-di-(Me)- <i>c</i> -hexyl	422 (M+1)
166	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	3-Cl-5-CF ₃ -2-pyridinyl	448 (M+1)
167	(1*,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	365 (M+1)
168	(1*,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	407 (M+1)
169	(1**,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	407 (M+1)
170	(1*,2 <i>S</i>)	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	465 (M+1)
171	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃		449 (M+1)
172	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		406 (M-1)
173	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	4,4-di-(Me)- <i>c</i> -hexyl	379 (M+1)
174	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	9-anthracenyl	487 (M+1)
175	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	9-anthracenyl	445 (M+1)
176	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	4-(<i>t</i> -Bu)- <i>c</i> -hexyl	405 (M-1)
177	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	1-(Ph)-2-(<i>i</i> -Bu)-1 <i>H</i> -pyrazol-4-yl	509 (M+1)
178	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	1-(Ph)-2-(<i>i</i> -Bu)-1 <i>H</i> -pyrazol-4-yl	467 (M+1)

Cmpd.		R ¹	R ²	R ^{4a}	R ^{5a}	Q	MS
No.	Isomer						
179	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃	4-CF ₃ - <i>c</i> -hexyl	419 (M+1)
180	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	4-CF ₃ - <i>c</i> -hexyl	462 (M+1)
181	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃	4-(<i>t</i> -Bu)- <i>c</i> -hexyl	450 (M+1)
182	(1** <i>,</i> 2 <i>S</i>)	CH ₃	H	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	365 (M+1)
183	(1*,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		399 (M+1)
184	(1** <i>,</i> 2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		399 (M+1)
185	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃		441 (M+1)
186	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃		429 (M+1)
187	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		385 (M-1)
188	(1** <i>,</i> 2 <i>S</i>)	CH ₃	<i>i</i> -PrC(=O)OCH ₂	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	465 (M+1)
189	(1*,2 <i>S</i>)	CH ₃	CH ₃ C(=O)OCH ₂	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	437 (M+1)
190	(1** <i>,</i> 2 <i>S</i>)	CH ₃	CH ₃ C(=O)OCH ₂	CH ₃	CH ₂ CH ₃	<i>c</i> -hexyl	437 (M+1)
191	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	CH ₃ C(=O)	CH ₃	CH ₃		427 (M+1)
192	(1- <i>rac</i> ,2 <i>S</i>)	CH ₃	H	CH ₃	CH ₃		458 (M+1)

INDEX TABLE E



Cmpd. No.	Isomer	R ¹	R ²	R ¹⁸	(R ¹⁹) _p	MS
98	1- <i>rac</i> ,2 <i>S</i>	CH ₃	H	CH ₃	4- <i>c</i> -hexyl	440 (M+1)
99	1- <i>rac</i> ,2 <i>S</i>	CH ₃	CH ₃ C(=O)	CH ₃	4- <i>c</i> -hexyl	483 (M+1)

INDEX TABLE F

Cmpd. No.	Isomer	Structure	MS
193	1- <i>rac</i> ,2 <i>S</i>		441 (M+1)
194	1 **,2 <i>S</i>		453 (M+1)
195	1 **,2 <i>S</i>		453 (M+1)

BIOLOGICAL EXAMPLES OF THE INVENTION

General protocol for preparing test suspensions for Tests A-G: the test compounds were first dissolved in acetone in an amount equal to 3% of the final volume and then suspended at the desired concentration (in ppm) in acetone and purified water (50/50 mix by volume) containing
5 250 ppm of the surfactant PEG400 (polyhydric alcohol esters). The resulting test suspensions were then used in Tests A-G.

TEST A

The test solution was sprayed to the point of run-off on soybean seedlings. The following day the seedlings were inoculated with a spore suspension of *Phakopsora pachyrhizi* (the causal agent of Asian soybean rust) and incubated in a saturated atmosphere at 22 °C for 24 h, and then
10 moved to a growth chamber at 22 °C for 8 days, after which time visual disease ratings were made.

TEST B

The test solution was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Puccinia recondita* f. sp. *tritici* (the causal agent of wheat leaf rust) and incubated in a saturated atmosphere at 20 °C for 24 h, and
15 then moved to a growth chamber at 20 °C for 6 days, after which time disease ratings were made.

TEST C

The test solution was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Zymoseptoria tritici* (the causal agent of wheat leaf blotch) and incubated in a saturated atmosphere at 24 °C for 48 h, and then moved to
20 a growth chamber at 20 °C for 17 days, after which time disease ratings were made.

TEST D

The test solution was sprayed to the point of run-off on grape seedlings. The following day the seedlings were inoculated with a spore suspension of *Plasmopara viticola* (the causal agent of grape downy mildew) and incubated in a saturated atmosphere at 20 °C for 24 h, and then moved
25 to a growth chamber at 20 °C for 6 days, and again incubated in a saturated atmosphere at 20 °C for 24 h, after which time disease ratings were made.

TEST E

The test suspension was sprayed to the point of run-off on tomato seedlings. The following day the seedlings were inoculated with a spore suspension of *Botrytis cinerea* (the causal agent of tomato Botrytis) and incubated in a saturated atmosphere at 20 °C for 48 h, and then moved to a growth chamber at 24 °C for 3 days, after which time visual disease ratings were made.

TEST F

The test suspension was sprayed to the point of run-off on tomato seedlings. The following day the seedlings were inoculated with a spore suspension of *Phytophthora infestans* (the causal agent of tomato late blight) and incubated in a saturated atmosphere at 20 °C for 24 H, and then moved to a growth chamber at 20 °C for 5 days, after which time visual disease ratings were made.

TEST G

The test solution was sprayed to the point of run-off on wheat seedlings. The following day the seedlings were inoculated with a spore suspension of *Erysiphe graminis* f. sp. *tritici*, (the causal agent of wheat powdery mildew) and incubated in growth chamber a saturated atmosphere at 20 °C for 8 days, after which time disease ratings were made.

Results for Tests A-G are given in Table A below. A rating of 100 indicates 100% disease control and a rating of 0 indicates no disease control (relative to the controls). A dash (–) indicates the compound was not tested.

TABLE A

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
1	250	100	89	81	36	0	0	0
2	250	99	55	73	63	0	0	0
3	250	100	99	83	32	16	0	0
4	250	99	41	28	56	31	0	0
5	250	0	0	0	73	0	39	0
6	250	0	0	0	28	0	0	0
7	250	0	0	0	35	0	0	0
8	250	0	0	0	14	0	0	0
9	250	95	91	53	97	0	76	0
10		–	–	–	–	–	–	–
11	250	0	19	13	30	0	0	0
12	250	99	97	0	83	0	0	0

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
13	250	100	100	73	50	0	0	0
14	250	0	0	12	48	0	0	0
15	250	75	19	69	39	0	0	0
16	250	13	0	76	59	0	0	0
17	150	66	41	92	23	0	0	0
18	250	62	68	93	35	0	0	0
19	250	25	0	43	41	0	0	0
20	250	0	68	64	4	0	0	0
21	250	99	77	63	14	9	0	0
22	250	100	99	85	61	0	0	0
23	250	100	97	95	44	0	0	0
24	250	97	68	5	61	0	0	0
25	250	97	0	17	41	0	0	0
26	250	73	0	47	43	0	0	0
27	250	98	99	81	38	0	0	0
28	250	99	74	90	40	0	0	0
29	250	100	99	95	17	0	33	0
30	250	100	100	97	1	0	0	0
31	250	100	100	87	1	0	0	73
32	250	100	99	86	18	0	0	0
33	250	13	0	87	66	0	0	0
34	250	0	0	13	58	0	0	0
35	250	100	100	80	68	0	0	0
36	250	100	99	81	72	0	0	0
37	250	100	99	89	29	0	0	0
38	250	0	41	53	44	0	0	0
39	250	100	100	87	16	57	0	0
40	250	92	68	4	39	9	0	0
41	250	100	100	—	70	0	24	0
42	250	100	100	—	66	0	0	0
43	250	100	100	90	71	0	0	0
44	50	75	55	—	—	—	—	—

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
45	250	100	0	39	43	0	9	0
46	250	100	68	68	22	0	0	91
47	250	99	68	51	20	0	0	0
48	250	55	55	8	4	0	0	0
49	250	97	41	0	17	0	0	0
50	250	-	68	54	-	-	-	-
51	50	100	100	-	-	-	-	-
52	50	32	9	-	-	-	-	-
53	250	56	55	22	22	0	0	0
54	250	79	68	-	55	0	0	0
55	250	100	98	-	52	0	0	13
56		-	-	-	-	-	-	-
57	250	99	98	88	16	0	0	0
58	250	98	99	86	27	0	0	0
59	250	100	100	-	66	0	0	13
60		-	-	-	-	-	-	-
61	250	0	55	0	15	0	0	0
62	50	100	93	14	74	0	0	0
63	250	100	99	79	81	16	0	0
64	50	100	99	13	86	0	0	0
65	50	100	98	-	-	-	-	-
66	250	100	100	73	93	0	0	21
67	250	13	55	36	53	0	0	0
68	250	100	95	97	46	0	40	0
69	250	100	100	94	50	0	9	0
70	250	100	100	97	63	0	24	13
71	50	89	-	-	-	-	-	-
72	250	100	92	27	62	0	0	35
73	50	0	41	-	-	-	-	-
74	50	100	99	-	-	-	-	-
75	250	100	100	100	61	0	0	0
76	250	100	100	99	93	0	0	0

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
76	250	100	100	99	42	0	0	13
78	250	100	100	82	85	0	0	0
79	250	100	100	100	11	0	0	0
80	250	100	100	98	28	0	0	0
81	250	93	68	78	53	0	0	0
82	250	95	55	79	82	0	0	0
83	250	100	100	97	27	0	0	0
84	250	100	100	57	21	0	0	0
85	250	63	79	67	62	0	0	0
86	250	73	–	65	24	0	0	0
87	250	100	–	95	21	0	47	0
88	250	99	–	58	43	0	0	0
89	250	0	0	0	16	0	0	0
90	250	0	55	0	17	0	0	0
91	250	0	0	2	96	0	0	0
92	250	0	0	0	60	0	0	0
93	250	99	74	72	0	0	0	0
94	250	38	92	82	10	0	0	0
95	250	100	100	100	1	0	0	0
96	50	94	95	–	–	–	–	–
97	250	98	92	99	100	0	99	0
98	250	89	0	59	71	0	0	0
99	250	98	68	88	39	0	0	0
100	250	100	99	88	32	0	0	0
101	50	100	68	66	86	0	0	0
102	50	100	55	0	72	0	0	0
103	250	100	100	99	74	0	0	0
104	250	100	100	93	65	0	0	0
105	250	98	28	67	–	0	0	0
106	250	100	92	90	–	16	0	0
107	250	100	98	87	–	0	0	0
108	250	43	32	75	–	0	0	0

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
109	250	100	98	85	—	98	0	0
110	250	100	99	92	—	0	0	0
111	250	97	9	56	—	16	0	0
112	250	0	55	83	—	0	0	0
113	250	90	0	42	94	0	0	0
114	250	100	100	77	63	0	0	0
115	250	89	55	86		0	0	0
116	250	100	100	95	55	0	0	0
117	250	100	100	94	71	0	0	0
118	250	100	99	86	85	0	0	0
119	250	100	99	88	27	0	0	48
120	250	99	94	95	24	0	0	0
121	250	100	100	99	50	9	0	0
122	250	100	93	82	24	0	0	0
123	250	100	100	84	57	0	24	0
124	250	100	89	38	63	0	0	0
125	250	99	90	90	67	0	0	0
126	250	0	0	10	3	0	0	0
127	250	100	99	88	72	0	0	0
128	250	95	90	83	57	0	0	0
129	250	100	100	91	32	0	0	0
130	250	96	74	12	9	0	0	0
131	250	100	96	87	6	0	0	89
132	250	75	68	30	29	0	0	0
133	250	100	99	93	24	0	0	0
134	250	97	74	64	33	0	0	0
135	250	100	98	81	29	0	0	86
136	250	60	90	0	4	0	0	0
137	250	100	100	92	11	0	0	43
138	250	95	74	63	18	0	0	0
139	—	—	—	—	—	—	—	—
140	—	—	—	—	—	—	—	—

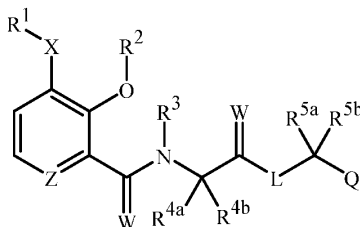
Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
141	—	—	—	—	—	—	—	—
142	—	—	—	—	—	—	—	—
143	—	—	—	—	—	—	—	—
144	250	77	86	93	35	0	0	0
145	250	100	99	94	22	0	0	0
146	250	73	91	91	31	0	0	60
147	250	100	99	95	38	0	71	94
148	—	—	—	—	—	—	—	—
149	—	—	—	—	—	—	—	—
150	—	—	—	—	—	—	—	—
151	—	—	—	—	—	—	—	—
152	—	—	—	—	—	—	—	—
153	250	100	95	24	70	0	26	0
154	250	100	98	85	48	0	0	0
155	250	100	99	98	5	0	0	0
156	250	89	68	13	7	0	17	0
157	250	100	100	86	63	0	0	0
158	250	100	100	73	94	0	0	0
159	250	0	0	0	11	0	0	0
160	250	100	92	92	98	0	80	0
161	—	—	—	—	—	—	—	—
162	—	—	—	—	—	—	—	—
163	—	—	—	—	—	—	—	—
164	250	100	99	99	0	0	0	0
165	250	100	100	97	10	0	0	0
166	250	97	68	0	15	0	0	0
167	250	100	100	90	41	0	0	0
168	250	100	100	99	31	0	0	0
169	250	100	41	83	17	0	0	35
170	250	100	100	100	32	0	0	0
171	250	100	100	80	49	0	53	0
172	250	100	100	59	41	0	76	0

Cmpd.	Rate in							
No.	ppm	Test A	Test B	Test C	Test D	Test E	Test F	Test G
173	250	100	98	66	8	0	0	0
174	—	—	—	—	—	—	—	—
175	—	—	—	—	—	—	—	—
176	250	99	89	57	14	0	0	0
177	250	0	0	0	66	0	0	0
178	250	0	0	0	57	0	0	0
179	250	100	100	99	82	0	0	-
180	250	100	99	95	51	0	26	0
181	250	100	100	100	80	0	26	0
182	250	100	0	45	15	0	0	0
183	250	100	99	98	44	0	0	0
184	250	100	99	100	64	0	0	0
185	250	100	100	100	61	0	0	0
186	250	94	100	83	14	0	0	0
187	250	97	100	96	6	0	0	0
188	250	100	68	27	43	0	0	0
189	250	100	100	98	46	0	0	26
190	250	100	74	46	43	0	0	0
191	250	100	96	89	26	0	0	21
192	250	99	90	99	57	0	0	0
193	250	87	74	3	74	0	0	0
194	250	87	68	37	18	0	0	0
195	250	100	99	83	17	0	0	0

CLAIMS

What is claimed is:

1. A compound selected from Formula 1, *N*-oxides, and salts thereof,



1

5 wherein

Z is N or CR⁶;

each W is independently O or S;

X is O or NR⁷;

10 R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₆ alkylcarbonyl, C₂-C₆ haloalkylcarbonyl, C₂-C₆ alkoxy carbonyl or C₂-C₆ haloalkoxy carbonyl;

15 R² is H, C(=W)NH₂, C(=O)R⁸, C(=O)OR⁹, S(=O)_mR⁸, S(=O)_mOR⁹, S(=O)_mNR¹⁰R¹¹, CH₂C(=O)R⁸, CH₂C(=O)OR⁹, CH₂OC(=O)R⁸, CH₂OC(=O)OR⁹, CH₂NR¹²C(=O)R⁸, CH₂NR¹²C(=O)OR⁹, P(=W)R¹³R¹⁴, P(=W)(OR¹³)R¹⁴ or P(=W)(OR¹³)OR¹⁴; or C₁-C₆ alkyl, C₂-C₆ alkenyl or C₁-C₆ haloalkyl, each optionally substituted with up to 3 substituents independently selected from R¹⁵; or benzyl or phenethyl, each ring optionally substituted with up to 3 substituents independently selected from R¹⁶; or tetrahydropyranyl, tetrahydrofuranyl, pyrrolidinyl, 1,3-dioxolanyl or piperidinyl;

20 R³ is H, CH(=O), C(=O)R¹⁷, C(=O)OR¹⁷ or OR¹⁷; or C₁-C₆ alkyl or C₁-C₆ haloalkyl;

or

25 R² and R³ are taken together with the atoms to which they are attached to form a 6-membered nonaromatic ring containing ring members selected from carbon atoms and optionally up to 1 ring member selected from C(=O) or C(=S), and optionally substituted with up to 3 substituents independently selected from halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;

R^{4a} is H, cyano, hydroxy, halogen, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkoxy, C₁-C₃ haloalkoxy, C₂-C₃ alkoxyalkyl, C₂-C₃ haloalkoxyalkyl, C₁-C₃ alkylsulfinyl or C₁-C₃ alkylsulfonyl;

30 R^{4b} is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkoxy or C₂-C₃ alkoxyalkyl;

L is O or NR¹⁸;

- R^{5a} and R^{5b} are each independently H, cyano, hydroxy, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl; or
- 5 R^{5a} and R^{5b} are taken together with the atom to which they are attached to form a 3- to 7- membered nonaromatic carbocyclic ring, the ring optionally substituted with up to 3 substituents independently selected from halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;
- Q is phenyl optionally substituted with up to 5 substituents independently selected from R¹⁹; or
- 10 Q is a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents independently selected from R¹⁹; or
- 15 Q is a 3- to 7-membered nonaromatic ring or a 7- to 14-membered bicyclic ring system, each ring or ring system containing ring members selected from carbon atoms and optionally up to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, wherein up to 2 ring members are independently selected from C(=O), C(=S), S(=O) and S(=O)₂, each ring or ring system optionally substituted with up to 5 substituents independently selected from R¹⁹;
- 20 R⁶ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₂-C₄ haloalkynyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl;
- R⁷ is H, cyano, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- 25 R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₁-C₆ alkylamino, C₁-C₆ haloalkylamino, C₂-C₆ alkoxyalkyl, C₂-C₆ alkylthioalkyl; or phenyl;
- m is 1 or 2;
- R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₂-C₆ alkoxyalkyl or C₂-C₆ alkylthioalkyl;
- 30 R¹⁰ and R¹¹ are each independently H, CH(=O), C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₄-C₈ alkylcycloalkyl or C₄-C₈ cycloalkylalkyl;
- R¹² is H, cyano, CH(=O), C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- R¹³ and R¹⁴ are each independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl;
- 35 each R¹⁵ is independently cyano, hydroxy, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;
- each R¹⁶ is independently halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy or C₁-C₂ haloalkoxy;

- R^{17} is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl or C₂-C₆ alkoxyalkyl;
- R^{18} is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl;
- 5 each R^{19} is independently cyano, halogen, hydroxy, nitro, CH(=O), C(=O)OH, NR^{20a}R^{20b}, C(=O)NR^{20a}R^{20b}, C(=S)NR^{20a}R^{20b}, C(R²¹)=NR²², N=CR²³NR^{24a}R^{24b} or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₃-C₆ cycloalkenyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ cycloalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ alkylaminosulfinyl, C₁-C₆ alkylaminosulfonyl, C₁-C₆ alkylsulfonyloxy, C₂-C₆ alkenylsulfonyloxy, C₂-C₆ alkylcarbonyl, C₃-C₆ alkenylcarbonyl, C₃-C₆ alkynylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₃-C₆ alkenyloxy carbonyl, C₃-C₆ alkynyloxy carbonyl, C₄-C₇ cycloalkoxy carbonyl, C₂-C₆ alkylcarbonyloxy, C₃-C₆ alkenylcarbonyloxy, C₃-C₆ alkynylcarbonyloxy, C₄-C₇ cycloalkylcarbonyloxy, C₂-C₆ alkoxy carbonyloxy or C₃-C₆ alkenyloxy carbonyloxy, each optionally substituted with up to 4 substituents independently selected from R²⁵;
- 10 each R^{20a} is independently H, cyano, hydroxy, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ haloalkenyl, C₂-C₄ alkynyl, C₂-C₄ haloalkynyl, C₁-C₄ alkoxy, C₂-C₄ alkoxyalkyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylsulfonyl, C₂-C₄ alkylthioalkyl, C₂-C₄ alkylsulfonylalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₃-C₅ alkenylcarbonyl, C₃-C₅ alkynylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₅ alkoxy carbonyl, C₃-C₅ alkoxy carbonylalkyl, C₂-C₅ alkylaminocarbonyl or C₃-C₅ dialkylaminocarbonyl;
- 20 each R^{20b} is independently H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ hydroxyalkyl, C₂-C₆ cyanoalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₄-C₈ alkylcycloalkyl, C₄-C₈ cycloalkylalkyl, C₂-C₆ alkoxyalkyl, C₂-C₆ haloalkoxyalkyl, C₂-C₆ alkylthioalkyl or C₂-C₆ alkylaminoalkyl;
- 25 each R²¹ is independently H, cyano, halogen, methyl, methoxy, methylthio or methoxycarbonyl;
- 30 each R²² is independently hydroxy or NR^{26a}R^{26b}; or C₁-C₄ alkoxy, C₂-C₄ alkenyloxy, C₂-C₄ alkynyloxy or C₂-C₄ alkylcarbonyloxy, each optionally substituted with up to 1 substituent selected from cyano, halogen, hydroxy and C(=O)OH;
- 35 each R²³ is independently H, methyl, methoxy or methylthio;
- each R^{24a} and R^{24b} is independently H or C₁-C₄ alkyl; or
- R^{24a} and R^{24b} are taken together to form a 4- to 6-membered fully saturated heterocyclic ring, each ring containing ring members, in addition to the

- connecting nitrogen atom, selected from carbon atoms and up to 2 heteroatoms independently selected from up to 2 O, up to 2 S and up to 2 N atoms, each ring optionally substituted with up to 2 methyl groups;
- 5 each R²⁵ is independently amino, cyano, halogen, hydroxy, nitro, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₃-C₆ cycloalkyl, C₃-C₆ halocycloalkyl, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₂-C₄ alkoxyalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylsulfonyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₂-C₅ alkoxycarbonyl, C₃-C₁₅ trialkylsilyl or C₃-C₁₅ halotrialkylsilyl;
- 10 each U is independently a direct bond, O, S(=O)_n, NR²⁷, C(=O)O, C(=O)N(R²⁸) or C(=S)N(R²⁹), wherein the atom to the left is connected to Q, and the atom to the right is connected to V;
- n is 0, 1 or 2;
- 15 each V is independently a direct bond; or C₁-C₆ alkylene, C₂-C₆ alkenylene, C₃-C₆ alkynylene, C₃-C₆ cycloalkylene or C₃-C₆ cycloalkenylene, wherein up to 1 carbon atom is C(=O), each optionally substituted with up to 3 substituents independently selected from halogen, cyano, nitro, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;
- 20 each T is independently phenyl optionally substituted with up to 5 substituents independently selected from R³⁰; or
- each T is independently a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents independently selected from R³⁰; or
- 25 each T is independently a 3- to 7-membered nonaromatic heterocyclic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, wherein up to 2 ring members are independently selected from C(=O), C(=S), S(=O) and S(=O)₂, each ring optionally substituted with up to 5 substituents independently selected from R³⁰;
- 30 each R^{26a} is independently H, C₁-C₄ alkyl or C₂-C₄ alkylcarbonyl;
- each R^{26b} is independently H, cyano, C₁-C₅ alkyl, C₂-C₅ alkylcarbonyl, C₂-C₅ haloalkylcarbonyl, C₄-C₇ cycloalkylcarbonyl, C₂-C₅ alkoxycarbonyl, C₃-C₅ alkoxycarbonylalkyl, C₂-C₅ alkylaminocarbonyl or C₃-C₅ dialkylaminocarbonyl;
- 35 or
- R^{26a} and R^{26b} are taken together to form a 5- to 6-membered fully saturated heterocyclic ring, each ring containing ring members, in addition to the connecting nitrogen atom, selected from carbon atoms and up to 2 heteroatoms

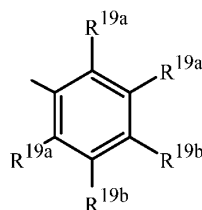
independently selected from up to 2 O, up to 2 S and up to 2 N atoms, each ring optionally substituted with up to 2 methyl groups;

each R²⁷, R²⁸ and R²⁹ is independently H, cyano, hydroxy, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkylcarbonyl, C₂-C₄ haloalkylcarbonyl, C₂-C₄ alkoxy carbonyl or C₂-C₄ haloalkoxy carbonyl; and

each R³⁰ is independently halogen, cyano, hydroxy, nitro, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₁-C₄ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl;

provided that:

- (a) when R¹ is C₁-C₆ alkyl or C₁-C₆ haloalkyl, X is O, Z is N, each W is O, L is O, R^{5a} is C₁-C₆ alkyl, R^{5b} is H and Q is phenyl, then Q is substituted with at least one R¹⁹ substituent; and
- (b) when R¹ is C₁-C₆ alkyl or C₁-C₆ haloalkyl, X is O, Z is N, each W is O, L is O, R^{5a} is C₁-C₆ alkyl and R^{5b} is H, then Q is other than



wherein

each R^{19a} is independently H, halogen or C₁-C₆ alkyl;

each R^{19b} is independently H or -U-V-T;

each U and V is a direct bond; or

each U is O and each V is a direct bond; or

each U is a direct bond and each V is C₁-C₆ alkylene;

each T is independently phenyl optionally substituted with up to 5 substituents independently selected from R³⁰; or

each T is independently a 5- to 6-membered heteroaromatic ring, each ring containing ring members selected from carbon atoms and 1 to 4 heteroatoms independently selected from up to 2 O, up to 2 S and up to 4 N atoms, each ring optionally substituted with up to 5 substituents independently selected from R³⁰; and

each R³⁰ is independently halogen, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy or C₂-C₄ alkylcarbonyl.

2. A compound Claim 1 wherein

W is O;

R¹ is H, C(=O)H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl;

R² is H, C(=W)NH₂, C(=O)R⁸, C(=O)OR⁹, CH₂C(=O)R⁸, CH₂C(=O)OR⁹,
 CH₂OC(=O)R⁸, CH₂OC(=O)OR⁹, CH₂NR¹²C(=O)R⁸ or CH₂NR¹²C(=O)OR⁹;
 or C₁-C₃ alkyl or C₁-C₃ haloalkyl, each optionally substituted with up to 3
 substituents independently selected from R¹⁵; or benzyl, tetrahydropyranyl or
 tetrahydrofurfuryl;

R³ is H, CH(=O) or C(=O)R¹⁷; or

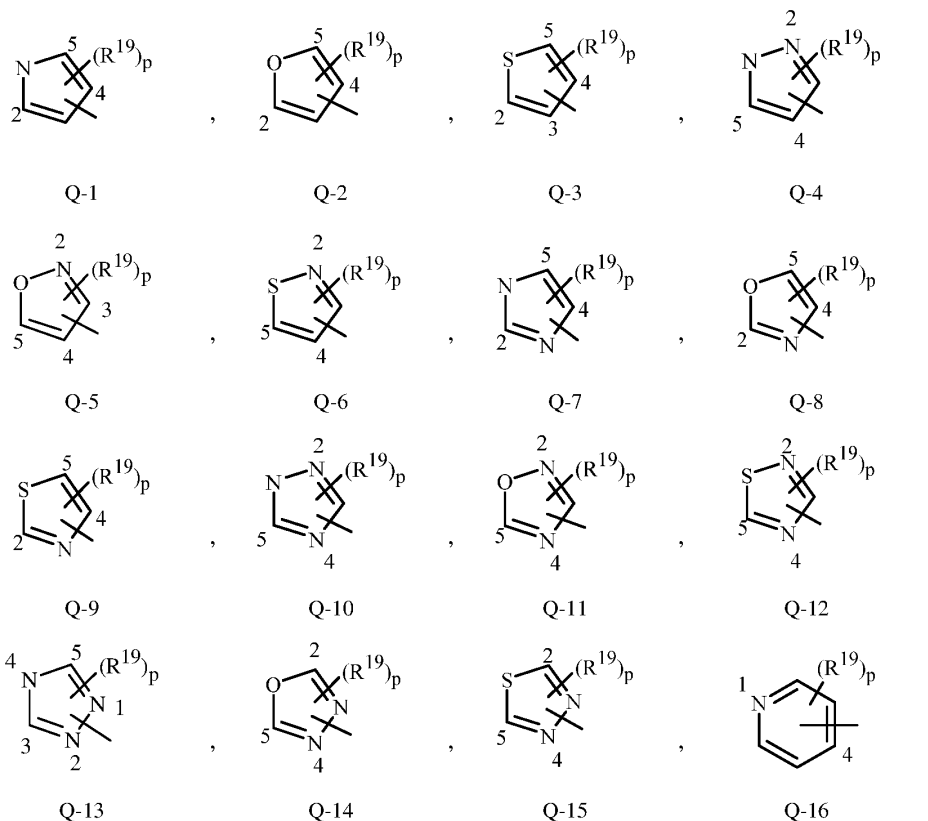
R² and R³ are taken together with the atoms to which they are attached to form a
 6-membered nonaromatic ring containing ring members selected from carbon
 atoms, the ring optionally substituted with up to 3 substituents independently
 selected from halogen and methyl;

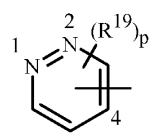
R^{4a} is H, cyano, halogen, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkoxy or C₂-C₃
 alkoxyalkyl;

R^{4b} is H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

R^{5a} and R^{5b} are each independently H, cyano, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl,
 C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₃-C₆ halocycloalkyl;

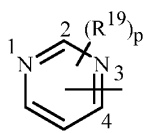
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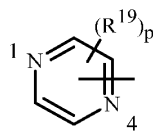
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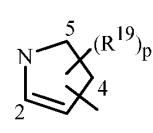
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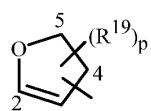
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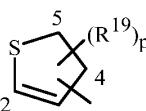
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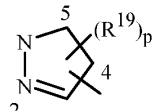
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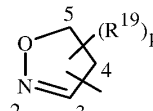
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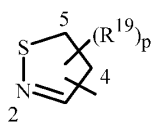
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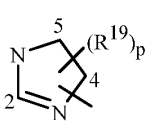
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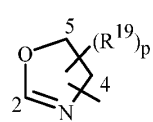
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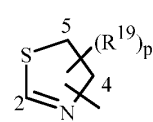
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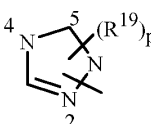
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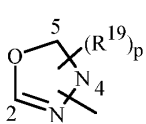
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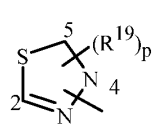
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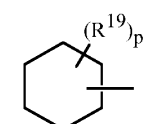
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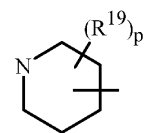
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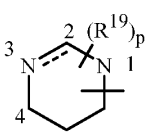
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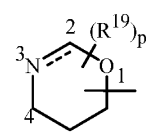
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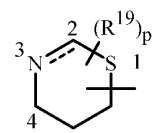
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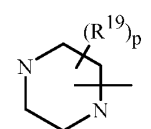
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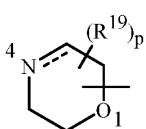
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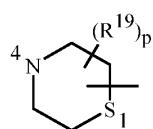
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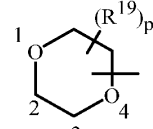
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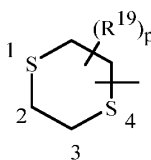
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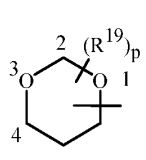
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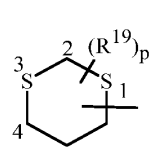
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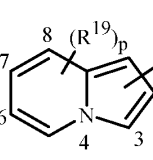
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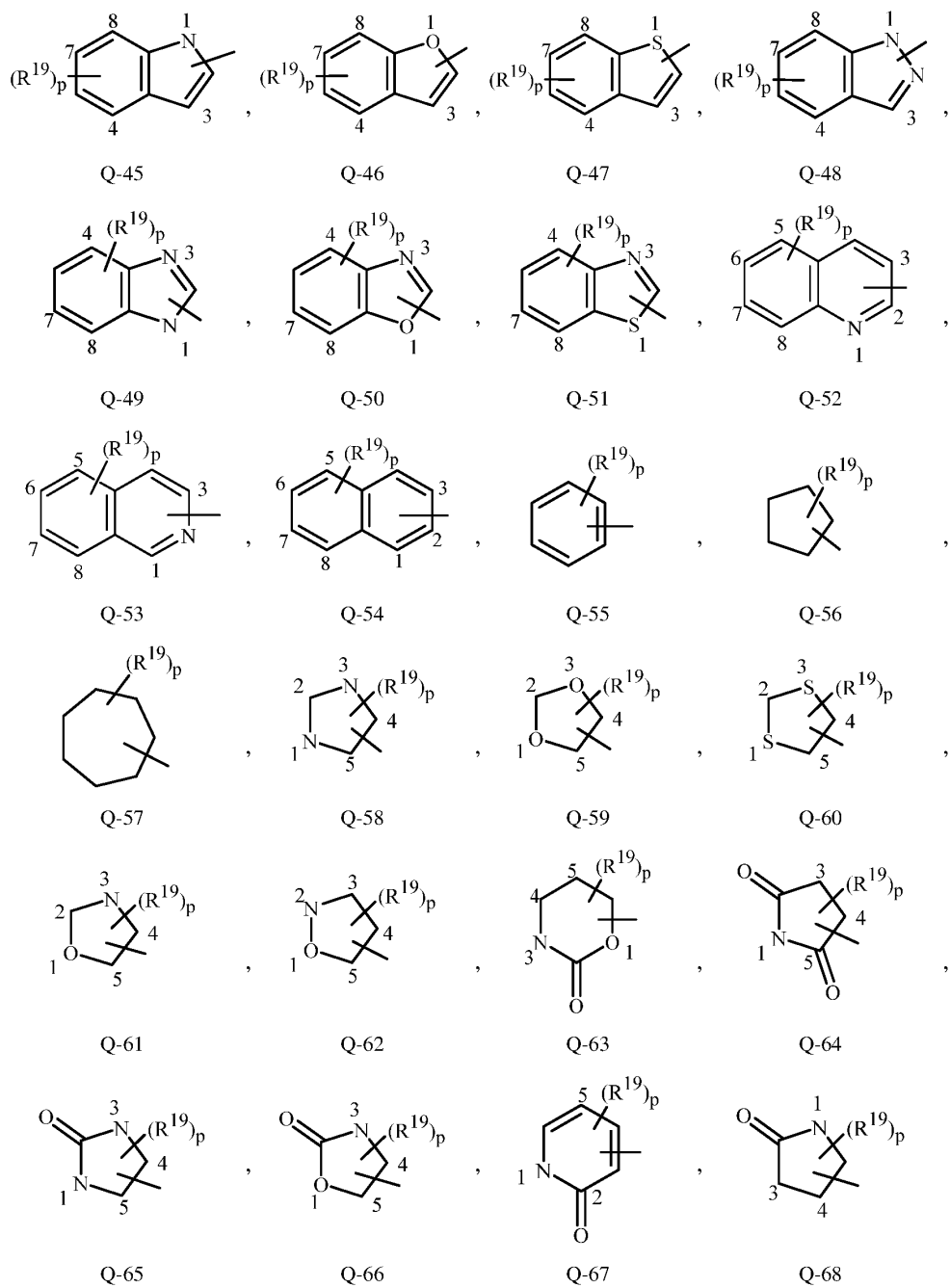
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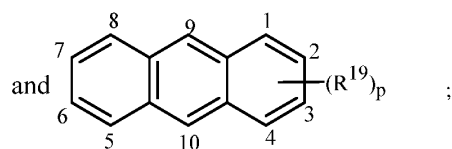
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Q-44

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Q-69

wherein the floating bond is connected to Formula **1** through any available carbon or nitrogen atom of the depicted ring or ring system; and p is 0, 1, 2 or 3;

R⁶ is H, methyl, halomethyl, methylcarbonyl or methoxycarbonyl;

R⁷ is H, cyano, methyl or halomethyl;

5 R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R¹² is H, cyano, CH(=O), methyl or halomethyl;

each R¹⁵ is independently cyano, hydroxy or methoxy;

10 R¹⁷ is H, C₁-C₃ alkyl, C₃-C₆ cycloalkyl or C₂-C₆ alkoxyalkyl;

R¹⁸ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkylcarbonyl;

each R¹⁹ is independently cyano, halogen, nitro, NR^{20a}R^{20b}, C(=O)NR^{20a}R^{20b} or

-U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆

alkoxy, C₂-C₆ alkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ cycloalkoxy, C₁-C₆

15 alkylthio, C₁-C₆ alkylsulfonyl, C₂-C₆ alkylcarbonyl, C₃-C₆ alkenylcarbonyl,

C₄-C₇ cycloalkylcarbonyl, C₂-C₆ alkoxycarbonyl, C₃-C₆ alkenyloxycarbonyl,

C₂-C₆ alkylcarbonyloxy, C₃-C₆ alkenylcarbonyloxy or C₂-C₆

alkoxycarbonyloxy, each optionally substituted with up to 4 substituents

independently selected from R²⁵;

20 each R^{20a} is independently H, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl,

C₂-C₄ alkynyl, C₂-C₄ alkylcarbonyl, C₂-C₅ alkoxycarbonyl or C₃-C₅

dialkylaminocarbonyl;

each R^{20b} is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkenyl, C₂-C₄

haloalkenyl, C₃-C₆ cycloalkyl or C₂-C₄ alkoxyalkyl;

25 each R²⁵ is independently cyano, halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ haloalkyl,

C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy, C₁-C₂ alkylthio, C₂-C₃

alkylcarbonyl, C₂-C₃ haloalkylcarbonyl, C₂-C₃ alkoxycarbonyl or C₃-C₁₅

trialkylsilyl;

each U is independently a direct bond, O, S(=O)_n or NR²⁷;

30 each V is independently a direct bond; or C₁-C₃ alkylene, wherein up to 1 carbon atom

is C(=O), optionally substituted with up to 2 substituents independently selected

from halogen, hydroxy, C₁-C₂ alkyl, C₁-C₂ alkoxy and C₁-C₂ haloalkoxy;

- each T is independently phenyl optionally substituted with up to 3 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl, thiazolyl, oxazolyl, isoxazolyl, thienyl, piperidinyl, morpholinyl or piperazinyl, each optionally substituted with up to 3 substituents independently selected from R³⁰;
- each R²⁷ is independently H, cyano, methyl, methylcarbonyl or methoxycarbonyl; and each R³⁰ is independently halogen, cyano, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₄ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.
3. A compound of Claim 2 wherein
- Z is N;
X is O;
R¹ is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl;
Z is N;
X is O;
R¹ is H, C(=O)H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl;
R² is H, C(=O)R⁸, C(=O)OR⁹, CH₂C(=O)R⁸, CH₂C(=O)OR⁹, CH₂OC(=O)R⁸, CH₂OC(=O)OR⁹ or benzyl;
R³ is H, CH(=O) or C(=O)R¹⁷;
R^{4a} is H, halogen, C₁-C₃ alkyl, or C₁-C₃ haloalkyl;
R^{4b} is H or C₁-C₂ alkyl;
R^{5a} and R^{5b} are each independently H, halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₃-C₆ cycloalkyl;
Q is Q-1 through Q-9, Q-16 through Q-19, Q-32, Q-33, Q-45, Q-46, Q-47, Q-52 through Q-57 or Q-69;
R⁸ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl;
R⁹ is H, C₁-C₆ alkyl, C₁-C₆ haloalkyl or C₂-C₆ alkoxyalkyl;
R¹⁷ is H or methyl;
R¹⁸ is H or C₁-C₃ alkyl;
each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ alkoxy, C₂-C₆ alkenyloxy, C₃-C₆ cycloalkoxy, C₂-C₆ alkylcarbonyl or C₂-C₆ alkoxy carbonyl, each optionally substituted with up to 3 substituents independently selected from R²⁵;
each R²⁵ is independently cyano, halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₃-C₆ cycloalkyl, C₁-C₂ alkoxy, C₁-C₂ haloalkoxy or C₂-C₃ alkylcarbonyl;
each U is independently a direct bond, O or NR²⁷;
each V is independently a direct bond or C₁-C₃ alkylene;

- each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰; or pyridinyl, pyrazolyl, imidazolyl, triazolyl or oxazolyl, each optionally substituted with up to 2 substituents independently selected from R³⁰; and
- 5 each R³⁰ is independently halogen, C₁-C₂ alkyl, C₁-C₂ haloalkyl, C₁-C₂ alkoxy, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.
4. A compound of Claim 3 wherein
- R¹ is H, C(=O)H, methyl or methylcarbonyl;
- R² is H, C(=O)R⁸ or C(=O)OR⁹;
- 10 R³ is H;
- R^{4a} is H or C₁-C₂ alkyl;
- R^{4b} is H or methyl;
- L is O;
- R^{5a} and R^{5b} are each independently H, C₁-C₃ alkyl or cyclopropyl;
- 15 Q is Q-16, Q-32, Q-33, Q-52 through Q-55 or Q-57;
- p is 0, 1 or 2;
- R⁸ is H, C₁-C₂ alkyl or C₂-C₄ alkoxyalkyl;
- R⁹ is H, C₁-C₃ alkyl, C₁-C₃ haloalkyl or C₂-C₄ alkoxyalkyl;
- 20 each R¹⁹ is independently halogen or -U-V-T; or C₁-C₆ alkyl or C₃-C₆ cycloalkyl, each optionally substituted with up to 3 substituents independently selected from R²⁵;
- each R²⁵ is independently cyano, halogen, methyl, halomethyl, cyclopropyl, methoxy or methylcarbonyl;
- each U is independently a direct bond or O;
- each V is independently a direct bond or C₁-C₂ alkylene;
- 25 each T is independently phenyl or pyrazolyl, each optionally substituted with up to 2 substituents independently selected from R³⁰; and
- each R³⁰ is independently halogen, methyl, halomethyl, C₂-C₄ alkylcarbonyl or C₂-C₄ alkoxy carbonyl.
5. A compound of Claim 4 wherein
- 30 R¹ is methyl;
- R² is H or C(=O)R⁸;
- R^{4a} is methyl;
- R^{4b} is H;
- R^{5a} and R^{5b} are each independently H, methyl, ethyl or isopropyl;
- 35 Q is Q-32, Q-54 or Q-55;
- R⁸ is H or methyl;

- each R¹⁹ is independently halogen or -U-V-T; or C₁-C₃ alkyl or C₃-C₆ cycloalkyl, each optionally substituted with up to 3 substituents independently selected from R²⁵; each R²⁵ is independently halogen;
- each V is independently a direct bond or CH₂; and
- 5 each T is independently phenyl optionally substituted with up to 2 substituents independently selected from R³⁰.
6. A compound of Claim 5 wherein
- R^{5a} is H, methyl, ethyl or isopropyl;
- R^{5b} is H;
- 10 Q is Q-32 or Q-55;
- R⁸ is methyl;
- each R¹⁹ is independently halogen, -U-V-T, C₁-C₃ alkyl, trifluoromethyl or C₃-C₆ cycloalkyl; and
- each R³⁰ is independently halogen, trifluoromethyl or C₂-C₄ alkoxy carbonyl.
- 15 7. A compound of Claim 1 which is selected from the group:
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexylethyl ester;
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylethyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester;
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexyl-2-methylpropyl ester;
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-(4-cyclopropylphenyl)ethyl ester;
- N*-[[3-[(acetyloxy)methoxy]-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-valine 1-(4-cyclohexylphenyl)ethyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-cyclohexylpropyl ester;
- N*-[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]-L-alanine 1-cyclohexylpropyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine (1*S*)-1-cyclohexylethyl ester;
- N*-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine (1*S*)-1-(4-cyclohexylphenyl)ethyl ester;
- N*-[[4-(formylamino)-3-hydroxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)ethyl ester;

N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-cyclohexylphenyl)propyl ester; and
N-[[3-(acetyloxy)-4-methoxy-2-pyridinyl]carbonyl]-L-alanine 1-(4-phenylcyclohexyl)ethyl ester.

8. A fungicidal composition comprising (a) a compound of Claim 1; and (b) at least one other fungicide.
9. A fungicidal composition comprising (a) a compound of Claim 1; and (b) at least one additional component selected from the group consisting of surfactants, solid diluents and
5 liquid diluents.
10. A method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed, a fungicidally effective amount of a compound of Claim 1.