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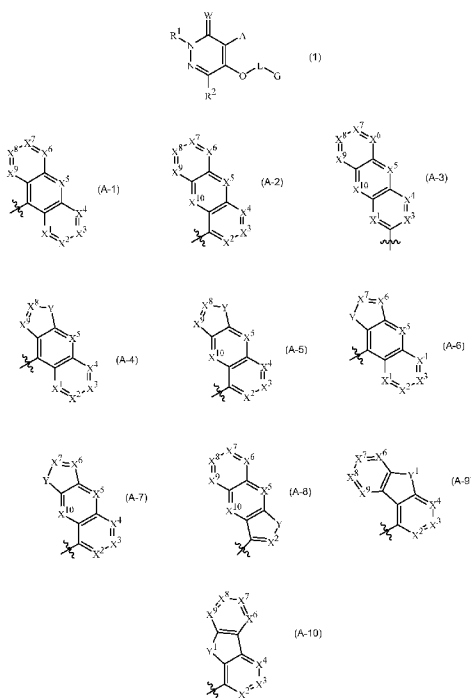
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(54) Title: NOVEL PYRIDAZINONE HERBICIDES



(57) Abstract: Disclosed are compounds of Formula 1, including all stereoisomers, *N*-oxides, and salts thereof, agricultural compositions containing them and their use as herbicides (Formula 1), wherein R^1 , R^2 , L, G and W are as defined in the disclosure, and A is selected from (Formula A-1, A-2, A-3, A-4, A-5, A-6, A-7, A-8, A-9 and A-19) and X^1 , X^2 , X^3 , X^4 , X^5 , X^6 , X^7 , X^8 , X^9 , X^{10} , Y and Y1 are as defined in the disclosure.

TITLE

NOVEL PYRIDAZINONE HERBICIDES

FIELD OF THE INVENTION

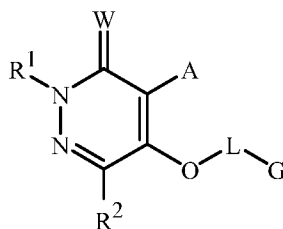
This invention relates to certain pyridazinone herbicides, their *N*-oxides, salts and compositions, and methods of their use for controlling undesirable vegetation.

BACKGROUND OF THE INVENTION

The control of undesired vegetation is extremely important in achieving high crop efficiency. Achievement of selective control of the growth of weeds especially in such useful crops as rice, soybean, sugar beet, maize, potato, wheat, barley, tomato and plantation crops, among others, is very desirable. Unchecked weed growth in such useful crops can cause significant reduction in productivity and thereby result in increased costs to the consumer. The control of undesired vegetation in noncrop areas is also important. Many products are commercially available for these purposes, but the need continues for new compounds that are more effective, less costly, less toxic, environmentally safer or have different sites of action.

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 herbicides

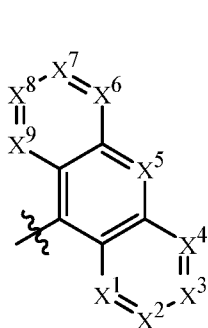
**1**

wherein

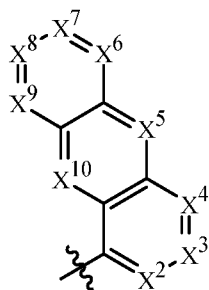
W is O or S;

R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy, benzyl or phenyl; or a 5- or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

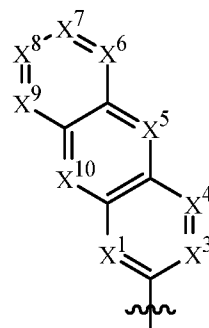
- R^2 is H, halogen, cyano, formyl, C_1 – C_7 alkyl, C_3 – C_8 alkylcarbonylalkyl, C_3 – C_8 alkoxy carbonylalkyl, C_2 – C_4 alkylcarbonyl, C_2 – C_7 alkylcarbonyloxy, C_4 – C_7 alkylcycloalkyl, C_3 – C_7 alkenyl, C_3 – C_7 alkynyl, C_1 – C_4 alkylsulfinyl, C_1 – C_4 alkylsulfonyl, C_1 – C_4 alkylamino, C_2 – C_8 dialkylamino, C_3 – C_7 cycloalkyl, C_4 – C_7 cycloalkylalkyl, C_2 – C_3 cyanoalkyl, C_1 – C_4 nitroalkyl, C_2 – C_7 haloalkoxyalkyl, C_1 – C_7 haloalkyl, C_3 – C_7 haloalkenyl, C_2 – C_7 alkoxyalkyl, C_1 – C_7 alkoxy, C_1 – C_5 alkylthio or C_2 – C_3 alkoxy carbonyl; or phenyl optionally substituted by halogen, C_1 – C_4 alkyl or C_1 – C_4 haloalkyl;
- L is a direct bond, C_1 – C_4 alkanediyl or C_2 – C_4 alkenediyl;
- G is H, $C(=O)R^5$, $C(=S)R^5$, CO_2R^6 , $C(=O)SR^6$, $S(O)_2R^5$, $CONR^7R^8$, $S(O)_2NR^7R^8$ or $P(=O)R^9R^{10}$; or C_1 – C_4 alkyl, C_2 – C_4 alkenyl, C_2 – C_4 alkynyl, C_1 – C_4 haloalkyl, C_2 – C_4 haloalkenyl, C_2 – C_4 haloalkynyl, C_2 – C_4 alkoxyalkyl, C_3 – C_6 cycloalkyl or C_4 – C_7 cycloalkylalkyl; or a 5- or 6-membered heterocyclic ring;
- A is selected from



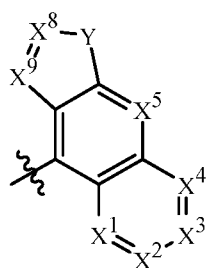
A-1



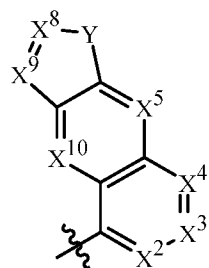
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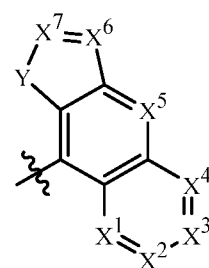
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A-4

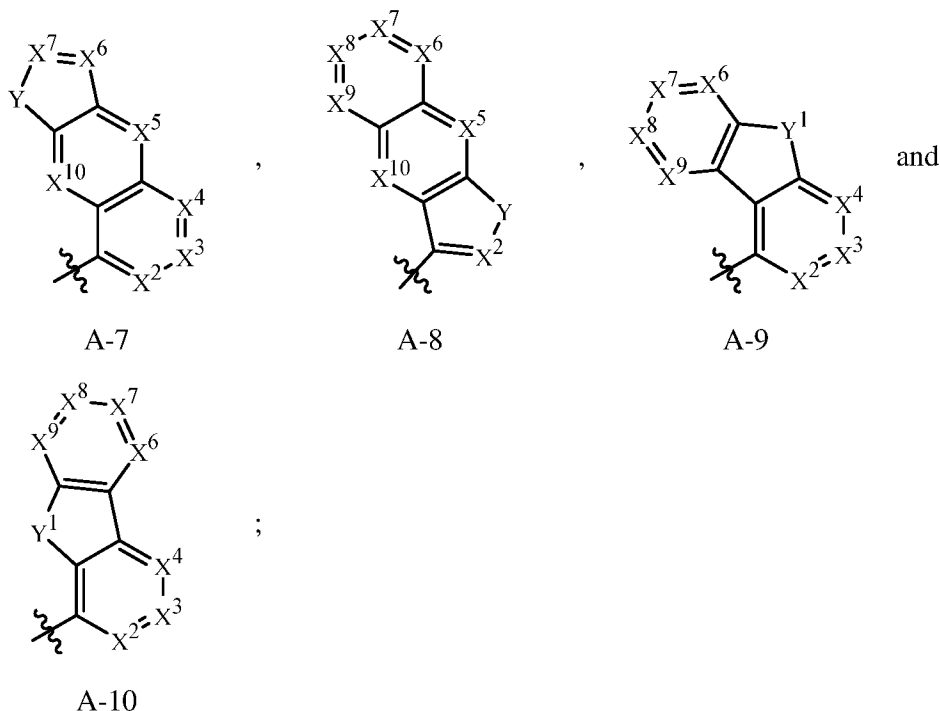


A-5



A-6

3



$X^1, X^2, X^3, X^4, X^5, X^6, X^7, X^8, X^9$ and X^{10} are each independently N or CR^3 ;
provided that no more than 4 of $X^1, X^2, X^3, X^4, X^5, X^6, X^7, X^8, X^9$ and X^{10} are N;

5 Y is O, S or NR^4 ;

Y^1 is O, S, NR^4 or $CR^{3a}R^{3b}$;

each R^3 is independently H, halogen, cyano, nitro, C_1 – C_5 alkyl, C_2 – C_5 alkenyl, C_2 – C_5 alkynyl, C_3 – C_5 cycloalkyl, C_4 – C_5 cycloalkylalkyl, C_1 – C_5 haloalkyl, C_3 – C_5 haloalkenyl, C_3 – C_5 haloalkynyl, C_2 – C_5 alkoxyalkyl, C_1 – C_5 alkoxy, C_1 – C_5 haloalkoxy, C_1 – C_5 alkylthio, C_1 – C_4 alkylsulfinyl, C_1 – C_4 alkylsulfonyl, C_1 – C_5 haloalkylthio or C_2 – C_5 alkoxy carbonyl;

10

R^{3a} is H, halogen, -CN, nitro, C_1 – C_5 alkyl, C_2 – C_5 alkenyl, C_2 – C_5 alkynyl, C_3 – C_5 cycloalkyl, C_4 – C_5 cycloalkylalkyl, C_1 – C_5 haloalkyl, C_3 – C_5 haloalkenyl, C_3 – C_5 haloalkynyl, C_2 – C_5 alkoxyalkyl, C_1 – C_5 alkoxy, C_1 – C_5 haloalkoxy, C_1 – C_5 alkylthio, C_1 – C_4 alkylsulfinyl, C_1 – C_4 alkylsulfonyl, C_1 – C_5 haloalkylthio or C_2 – C_5 alkoxy carbonyl;

15

R^{3b} is H, halogen, -CN, nitro, C_1 – C_5 alkyl, C_2 – C_5 alkenyl, C_2 – C_5 alkynyl, C_3 – C_5 cycloalkyl, C_4 – C_5 cycloalkylalkyl, C_1 – C_5 haloalkyl, C_3 – C_5 haloalkenyl, C_3 – C_5 haloalkynyl, C_2 – C_5 alkoxyalkyl, C_1 – C_5 alkoxy, C_1 – C_5 haloalkoxy, C_1 – C_5 alkylthio, C_1 – C_4 alkylsulfinyl, C_1 – C_4 alkylsulfonyl, C_1 – C_5 haloalkylthio or C_2 – C_5 alkoxy carbonyl; or

20

R^{3a} and R^{3b} are taken together as =O; or R^{3a} and R^{3b} are taken together with the carbon atom to which they are bonded to form an optionally substituted 3- to 7-membered carbocyclic ring;

R⁴ is H, C₁–C₃ alkyl or C₁–C₃ haloalkyl;

5 R⁵ and R⁷ are independently H, C₁–C₇ alkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl or C₄–C₇ cycloalkylalkyl; or phenyl, benzyl, or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C₁–C₄ alkyl or C₁–C₄ haloalkyl;

10 R⁶ is C₁–C₇ alkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₂–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl or C₄–C₇ cycloalkylalkyl; or phenyl, benzyl or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C₁–C₄ alkyl or C₁–C₄ haloalkyl;

15 R⁸ is H, C₁–C₇ alkyl, C₂–C₇ alkenyl, C₂–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₁–C₇ haloalkyl or C₂–C₇ alkoxyalkyl;

R⁹ is C₁–C₇ alkyl or C₁–C₇ alkoxy; and

R¹⁰ is C₁–C₇ alkyl or C₁–C₇ alkoxy.

20 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 herbicidal composition comprising a compound of the invention (i.e. in a herbicidally effective amount) and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents. This invention further relates to a method for controlling the growth of undesired vegetation comprising contacting the vegetation or its environment with a
25 herbicidally effective amount of a compound of the invention (e.g., as a composition described herein).

This invention also includes a herbicidal mixture comprising (a) a compound selected from Formula 1, *N*-oxides, and salts thereof, and (b) at least one additional active ingredient selected from (b1) through (b16); and salts of compounds of (b1) through (b16), as described
30 below.

DETAILS OF THE INVENTION

As used herein, the terms “comprises,” “comprising,” “includes,” “including,” “has,” “having,” “contains,” “containing,” “characterized by” or any other variation thereof, are intended to cover a non-exclusive inclusion, subject to any limitation explicitly indicated.
35 For example, a composition, mixture, process or method 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 or method.

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 a whole.

The transitional phrase “consisting essentially of” is used to define a composition or method 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. 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.

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.

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

As used herein, the term “alkylating” refers reaction in which nucleophile displaces a leaving group such as halide or sulfonate from a carbon-containing radical. Unless otherwise indicated, the term “alkylating” does not limit the carbon-containing radical to alkyl.

In the above recitations, the term “alkyl”, used either alone or in compound words such as “alkylthio” or “haloalkyl” includes straight-chain or branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, or the different butyl, pentyl or hexyl isomers. “Alkenyl” includes straight-chain or 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 or 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.

"Alkoxy" includes, for example, methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy, pentoxy and hexyloxy isomers. "Alkoxyalkyl" denotes alkoxy substitution on alkyl. Examples of "alkoxyalkyl" include CH₃OCH₂, CH₃OCH₂CH₂, CH₃CH₂OCH₂, CH₃CH₂CH₂CH₂OCH₂ and CH₃CH₂OCH₂CH₂. "Alkoxyalkoxy" denotes alkoxy substitution on alkoxy. "Alkylthio" includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. "Alkylthioalkyl" denotes alkylthio substitution on alkyl. Examples of "alkylthioalkyl" include CH₃SCH₂, CH₃SCH₂CH₂, CH₃CH₂SCH₂, CH₃CH₂CH₂CH₂SCH₂ and CH₃CH₂SCH₂CH₂. "Alkylsulfinyl" includes both enantiomers of an alkylsulfinyl group. Examples of "alkylsulfinyl" include CH₃S(O)-, CH₃CH₂S(O)-, CH₃CH₂CH₂S(O)-, (CH₃)₂CHS(O)- and the different butylsulfinyl, pentylsulfinyl and hexylsulfinyl isomers. Examples of "alkylsulfonyl" include CH₃S(O)₂-, CH₃CH₂S(O)₂-, CH₃CH₂CH₂S(O)₂-, (CH₃)₂CHS(O)₂-, and the different butylsulfonyl, pentylsulfonyl and hexylsulfonyl isomers. "Cyanoalkyl" denotes an alkyl group substituted with one cyano group. Examples of "cyanoalkyl" include NCCH₂ and NCCH₂CH₂ (alternatively identified as CH₂CH₂CN). "Nitroalkyl" denotes an alkyl group substituted with one nitro group. Examples of "nitroalkyl" include O₂NCH₂ and O₂NCH₂CH₂ (alternatively identified as CH₂CH₂NO₂). "Cyano" means NC-, and "formyl" means HC(=O)-. "Alkylamino" includes an NH radical substituted with straight-chain or branched alkyl. Examples of "alkylamino" include CH₃CH₂NH, CH₃CH₂CH₂NH, and (CH₃)₂CHCH₂NH. Examples of "dialkylamino" include (CH₃)₂N, (CH₃CH₂CH₂)₂N and CH₃CH₂(CH₃)N.

"Cycloalkyl" includes, for example, cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl. The term "cycloalkylalkyl" denotes cycloalkyl substitution on an alkyl moiety. Examples of "cycloalkylalkyl" include cyclopropylmethyl, cyclopentylethyl, and other cycloalkyl moieties bonded to straight-chain or branched alkyl groups. The term "alkylcycloalkyl" denotes an alkyl group bonded to a cycloalkyl moiety.

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 F₃C, ClCH₂, CF₃CH₂ and CF₃CCl₂. The terms "haloalkoxy", "haloalkoxyalkyl", "haloalkylthio", "haloalkenyl", "haloalkynyl",

and the like, are as defined analogously to the term “haloalkyl”. Examples of “haloalkoxy” include $\text{CF}_3\text{O}-$, $\text{CCl}_3\text{CH}_2\text{O}-$, $\text{HCF}_2\text{CH}_2\text{CH}_2\text{O}-$ and $\text{CF}_3\text{CH}_2\text{O}-$. Examples of “haloalkoxyalkyl” include CF_3OCH_2- , $\text{CCl}_3\text{CH}_2\text{OCH}_2-$, $\text{HCF}_2\text{CH}_2\text{CH}_2\text{OCH}_2-$ and $\text{CF}_3\text{CH}_2\text{OCH}_2-$. Examples of “haloalkylthio” include $\text{CCl}_3\text{S}-$, $\text{CF}_3\text{S}-$, $\text{CCl}_3\text{CH}_2\text{S}-$ and $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{S}-$. Examples of “haloalkenyl” include $(\text{Cl})_2\text{C}=\text{CHCH}_2-$ and $\text{CF}_3\text{CH}_2\text{CH}=\text{CHCH}_2-$. Examples of “haloalkynyl” include $\text{HC}\equiv\text{CCHCl}-$, $\text{CF}_3\text{C}\equiv\text{C}-$, $\text{CCl}_3\text{C}\equiv\text{C}-$ and $\text{FCH}_2\text{C}\equiv\text{CCH}_2-$.

“Alkylcarbonyl” denotes a straight-chain or branched alkyl moiety bonded to a $\text{C}(=\text{O})$ moiety. Examples of “alkylcarbonyl” include $\text{CH}_3\text{C}(=\text{O})-$, $\text{CH}_3\text{CH}_2\text{C}(=\text{O})-$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})-$, $(\text{CH}_3)_2\text{CHC}(=\text{O})-$ and the different butoxy- or pentoxycarbonyl isomers. “Alkoxy carbonyl” denotes a straight-chain or branched alkoxy moieties bonded to a $\text{C}(=\text{O})$ moiety. 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- or pentoxycarbonyl isomers. The term “alkoxy carbonylalkyl” denotes a straight-chain or branched alkoxy moiety bonded to through an alkyl moiety. The term “alkylcarbonylalkyl” denotes a straight or branched alkylcarbonyl moiety bonded through an alkyl moiety. The term “alkylcarbonyloxy” include donates an alkylcarbony moiety bonded through oxygen. Examples of alkylcarbonyloxy include $\text{CH}_3\text{C}(=\text{O})\text{O}-$, $\text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{O}-$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{O}-$ and $(\text{CH}_3)_2\text{CHC}(=\text{O})\text{O}-$. The term alkanediyl or alkenediyl refers to a linear or branched alkane or alkene linking chain respectively. Examples of alkanediyl include $-\text{CH}_2-$, $-\text{CH}_2\text{CH}(\text{CH}_3)-$ or $-\text{CH}_2\text{CH}_2\text{CH}_2-$. Examples of alkenediyl include $-\text{CH}=\text{CH}-$, $-\text{CH}_2\text{C}=\text{CH}-$ or $-\text{CH}=\text{C}(\text{CH}_3)-$. The term “adjacent” in the context of locating a substituent means “next to” or “immediately next to”.

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 7. For example, C_1-C_4 alkylsulfonyl designates methylsulfonyl through butylsulfonyl; C_2 alkoxyalkyl designates CH_3OCH_2- ; C_3 alkoxyalkyl designates, for example, $\text{CH}_3\text{CH}(\text{OCH}_3)-$, $\text{CH}_3\text{OCH}_2\text{CH}_2-$ or $\text{CH}_3\text{CH}_2\text{OCH}_2-$; and C_4 alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2-$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2-$.

When a group contains a substituent which can be hydrogen, for example R^2 or R^4 , then when this substituent is taken as hydrogen, it is recognized that this is equivalent to said group being unsubstituted. When one or more positions on a group are said to be “not substituted” or “unsubstituted”, then hydrogen atoms are attached to take up any free valency. Unless otherwise indicated as being optionally substituted, the term “phenyl” means unsubstituted phenyl. Unless otherwise indicated as being optionally substituted, the term “benzyl” means unsubstituted benzyl.

The compounds of Formula **1** wherein L is a direct bond and G is H (i.e. the “O-L-G” substituent of Formula **1** is a hydroxy moiety) are believed to be the compounds that bind to an active site on a plant enzyme or receptor causing herbicidal effect on the plant. Other compounds of Formula **1** wherein the substituents L-G form a group that can be transformed within plants or the environment to the hydroxy moiety provide similar herbicidal effects and are within the scope of the present invention. Therefore, L-G can be any derivative known in the art which does not extinguish the herbicidal activity of the compound of Formula **1** and is or can be hydrolyzed, oxidized, reduced or otherwise metabolized in plants or soil to provide the carboxylic acid function, which depending upon pH, is in the dissociated or the undissociated form. The term “ring system” denotes two or more fused rings. The term “bicyclic ring system” denotes a ring system consisting of two fused rings.

Compounds of this invention can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. Stereoisomers are isomers of identical constitution but differing in the arrangement of their atoms in space and include enantiomers, diastereomers, cis-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. The compounds of the invention may be present as a mixture of stereoisomers, individual stereoisomers or as an optically active form.

Compounds of Formula **1** typically exist in more than one form, and Formula **1** thus include all crystalline and non-crystalline forms of the compounds they represent. 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 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 of 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 of Formula 1. Preparation and isolation of a particular polymorph of a compound of 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.

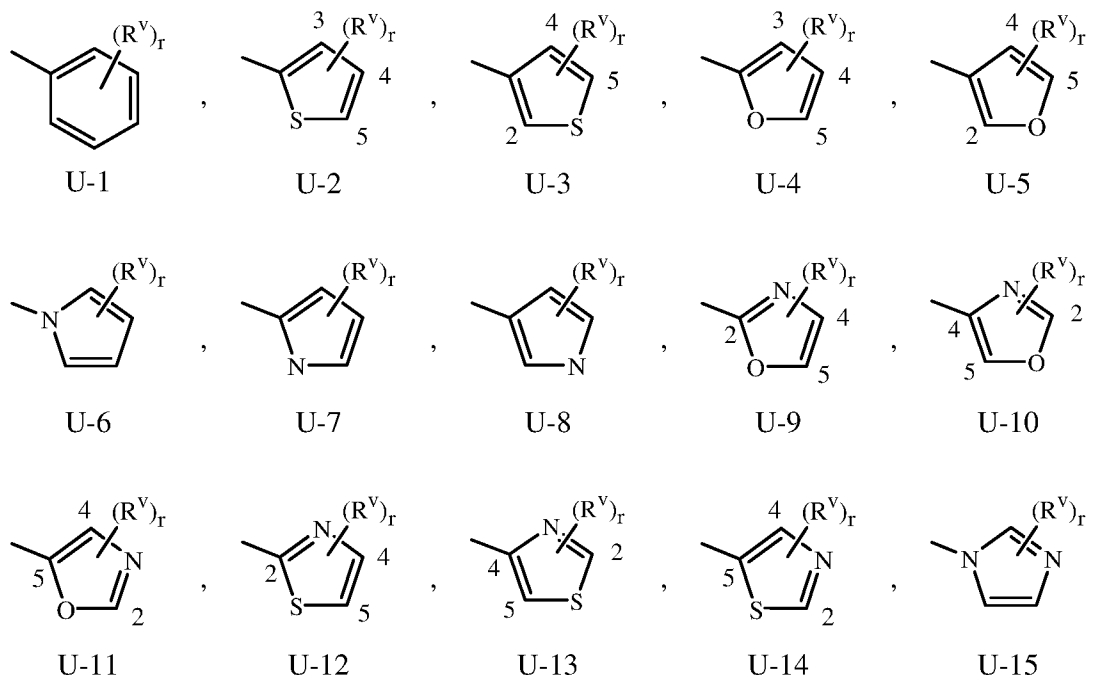
One skilled in the art will appreciate that not all nitrogen-containing heterocycles can form *N*-oxides since the nitrogen requires an available lone pair for oxidation to the oxide; one skilled in the art will recognize those nitrogen-containing heterocycles which can form *N*-oxides. One skilled in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

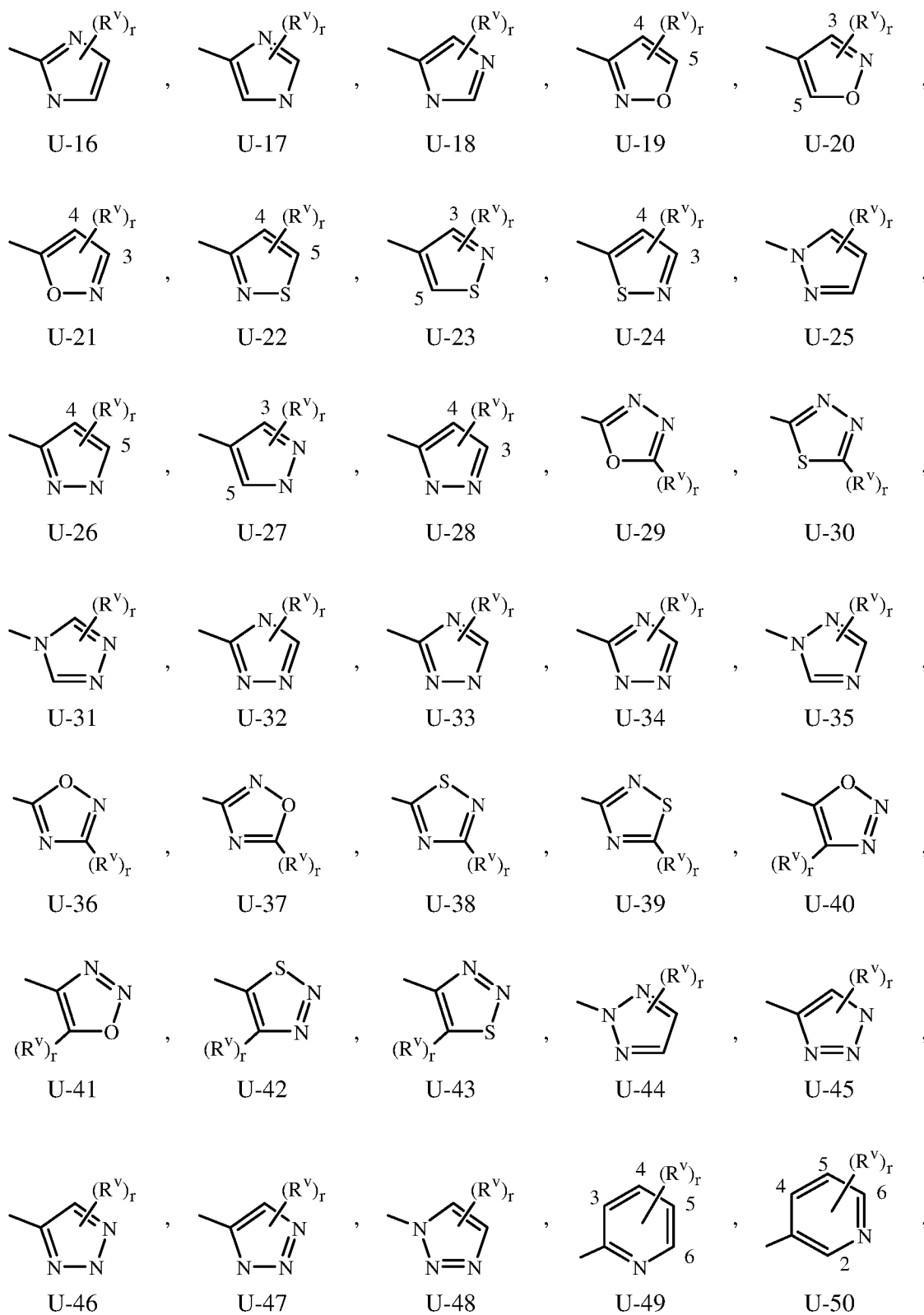
One skilled in the art recognizes that because in the environment and under physiological conditions salts of chemical compounds are in equilibrium with their corresponding nonsalt forms, salts share the biological utility of the nonsalt forms. Thus a wide variety of salts of a compound of Formula 1 are useful for control of undesired vegetation (i.e. are agriculturally suitable). The salts of a compound 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 an enolic function (e.g., when L is a direct bond and G is H), 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 agriculturally suitable salts thereof.

When R^5 , R^6 or R^7 is a 5- or 6-membered nitrogen-containing heterocyclic ring, it may be attached to the remainder of Formula 1 through any available carbon or nitrogen ring atom, unless otherwise described. As noted above, R^5 , R^6 or R^7 can be (among others) phenyl optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention. An example of phenyl optionally substituted with one to five substituents is the ring illustrated as U-1 in Exhibit 1, wherein R^v is as a substituent on R^5 , R^6 or R^7 as defined in the Summary of the Invention, and r is an integer.

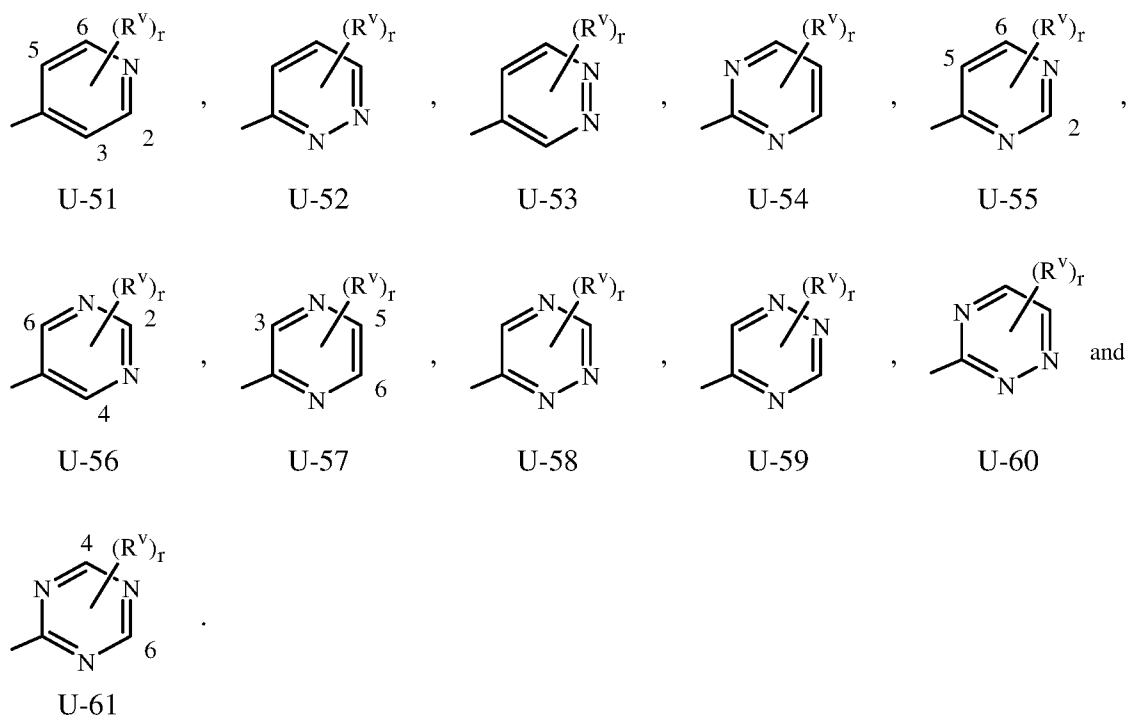
As noted above, R^5 , R^6 or R^7 can be (among others) a 5- or 6-membered heterocyclic ring, which may be saturated or unsaturated, optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention. Examples of a 5- or 6-membered unsaturated aromatic heterocyclic ring optionally substituted with from one or more substituents include the rings U-2 through U-61 illustrated in Exhibit 1 wherein R^v is any substituent as defined in the Summary of the Invention on R^5 , R^6 or R^7 (i.e. halogen, C_1 - C_4 alkyl or C_1 - C_4 haloalkyl) and r is an integer from 0 to 4, limited by the number of available positions on each U group. As U-29, U-30, U-36, U-37, U-38, U-39, U-40, U-41, U-42 and U-43 have only one available position, for these U groups r is limited to the integers 0 or 1, and r being 0 means that the U group is unsubstituted and a hydrogen is present at the position indicated by $(R^v)_r$.

Exhibit 1





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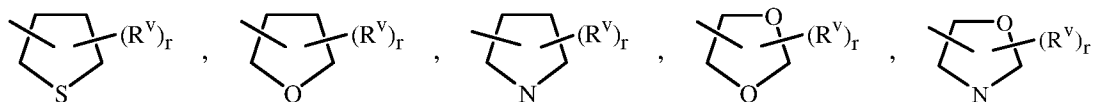


Note that when R^5 , R^6 or R^7 is a 5- or 6-membered saturated or unsaturated non-aromatic heterocyclic ring optionally substituted with one or more substituents selected from the group of substituents as defined in the Summary of the Invention for R^5 , R^6 or R^7 , one or two carbon ring members of the heterocycle can optionally be in the oxidized form of a carbonyl moiety.

Examples of a 5- or 6-membered heterocyclic ring that is saturated or non-aromatic unsaturated heterocyclic ring containing ring members selected from up to two O atoms and up to two S atoms, and optionally substituted on carbon atom ring members with up to five halogen atoms includes the rings T-1 through T-35 as illustrated in Exhibit 2. Note that when the attachment point on the T group is illustrated as floating, the T group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the T group by replacement of a hydrogen atom. The optional substituents corresponding to R^v can be attached to any available carbon or nitrogen by replacing a hydrogen atom. For these T rings, r is typically an integer from 0 to 4, limited by the number of available positions on each T group. The term “optionally substituted” means “substituted or unsubstituted”. Note that when T^2 is N, the nitrogen atom can complete its valence by substitution with either H or the substituents corresponding to R^v as defined in the Summary of the Invention on R^5 , R^6 or R^7 . Exemplary values for R^1 include T-1, T-2, T-7 and T-9 (i.e. when R^1 is, among other, a 5- or 6-membered saturated or partially saturated heterocyclic ring containing

ring members selected from carbon and up to 1 O and 1 S") and T-28 through T-31 where T² is O or S.

Exhibit 2



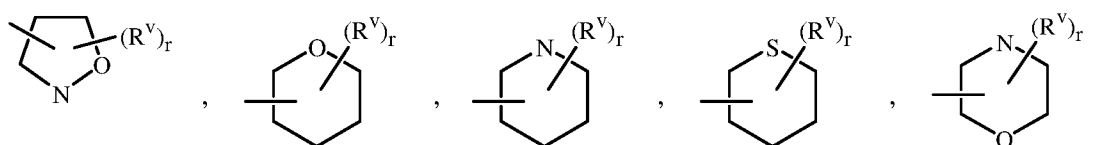
T-1

T-2

T-3

T-4

T-5



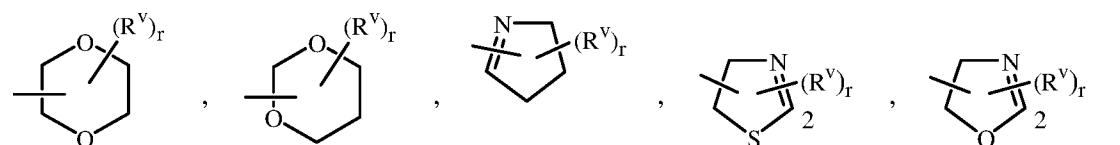
T-6

T-7

T-8

T-9

T-10



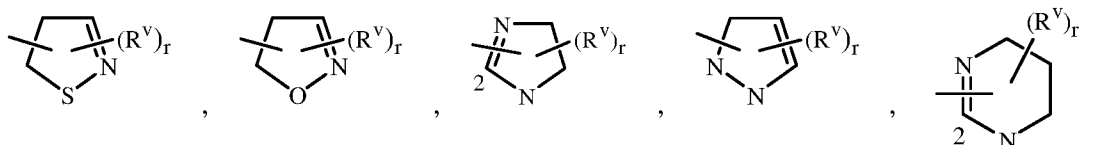
T-11

T-12

T-13

T-14

T-15



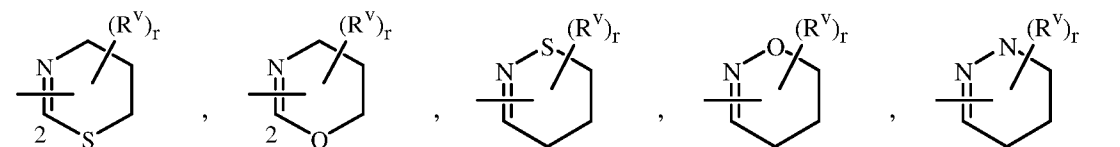
T-16

T-17

T-18

T-19

T-20



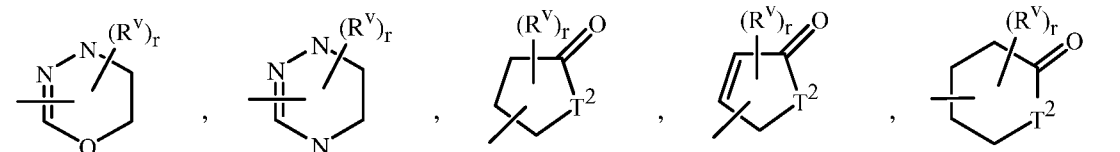
T-21

T-22

T-23

T-24

T-25



T-26

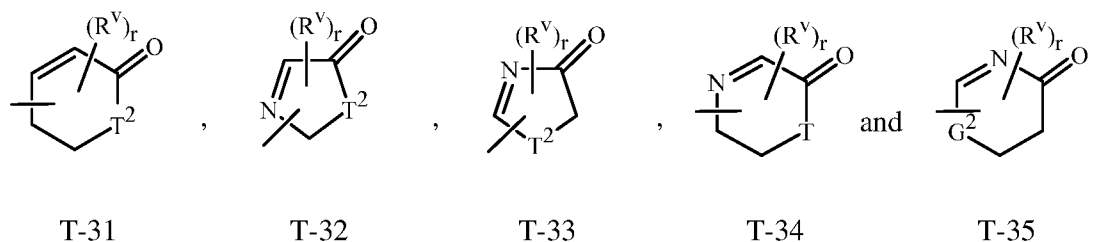
T-27

T-28

T-29

T-30

14



Although R^v groups are shown in the structures U-1 through U-61, it is noted that they do not need to be present since they are optional substituents. Note that when R^v is H when attached to an atom, this is the same as if said atom is unsubstituted. The nitrogen atoms that require substitution to fill their valence are substituted with H or R^v . Note that when the attachment point between $(R^v)_r$ and the U group is illustrated as floating, $(R^v)_r$ can be attached to any available carbon atom or nitrogen atom of the U group. Note that when the attachment point on the U group is illustrated as floating, the U group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the U group by replacement of a hydrogen atom. Note that some U groups can only be substituted with less than 4 R^v groups (e.g., U-2 through U-5, U-7 through U-48, and U-52 through U-61).

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.

Embodiments of the present invention as described in the Summary of the Invention include (where Formula 1 as used in the following Embodiments includes *N*-oxides and salts thereof):

Embodiment 1. A compound of Formula 1, *N*-oxides and salts thereof, compositions containing them, and methods of their use for controlling undesired vegetation as described in the Summary of the Invention.

Embodiment 2. A compound of Embodiment 1 wherein R^1 is H, C_1 – C_7 alkyl, C_3 – C_8 alkylcarbonylalkyl, C_3 – C_8 alkoxy carbonylalkyl, C_4 – C_7 alkylcycloalkyl, C_3 – C_7 alkenyl, C_3 – C_7 alkynyl, C_3 – C_7 cycloalkyl, C_4 – C_7 cycloalkylalkyl, C_2 – C_3 cyanoalkyl, C_1 – C_4 nitroalkyl, C_2 – C_7 haloalkoxyalkyl, C_1 – C_7 haloalkyl, C_3 – C_7 haloalkenyl, C_2 – C_7 alkoxyalkyl, C_3 – C_7 alkylthioalkyl, C_1 – C_7 alkoxy, benzyl or phenyl.

Embodiment 3. A compound of any one of Embodiments 1 or 2 wherein R^1 is H, C_1 – C_7 alkyl, C_3 – C_8 alkoxy carbonylalkyl, C_4 – C_7 alkylcycloalkyl, C_3 – C_7 cycloalkyl, C_4 – C_7 cycloalkylalkyl, C_2 – C_3 cyanoalkyl, C_1 – C_4 nitroalkyl, C_2 – C_7

haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy or benzyl.

Embodiment 4. A compound of Embodiment 3 wherein R¹ is C₁–C₄ alkyl, C₃–C₄ cycloalkyl, C₂–C₃ cyanoalkyl, C₁–C₃ haloalkyl or C₂–C₄ alkoxyalkyl.

5 Embodiment 5. A compound of Embodiment 4 wherein R¹ is C₁–C₃ alkyl, NCCH₂CH₂–, C₁–C₂ haloalkyl or 2-methoxyethyl.

Embodiment 6. A compound of Embodiment 5 wherein R¹ is methyl, ethyl, *n*-propyl or 2-methoxyethyl.

Embodiment 7. A compound of Embodiment 6 wherein R¹ is methyl or ethyl.

10 Embodiment 8. A compound of Embodiment 6 wherein R¹ is methyl.

Embodiment 9. A compound of Embodiment 1 wherein R¹ is other than H.

Embodiment 10. A compound of Embodiment 1 wherein R¹ is other than phenyl.

Embodiment 11. A compound of any one of Embodiments 1 through 10 wherein W is O.

15 Embodiment 12. A compound of Formula 1 or any one of Embodiments 1 through 11 wherein A is selected from A-1, A-4 and A-6.

Embodiment 13. A compound of Formula 1 or Embodiment 12 wherein A is A-1.

Embodiment 14. A compound of Formula 1 or Embodiment 12 wherein A is A-4.

Embodiment 15. A compound of Formula 1 or Embodiment 12 wherein A is A-6.

20 Embodiment 16. A compound of Formula 1 or Embodiment 12 wherein A is A-1 and X¹, X², X³, X⁴, X⁵, X⁶, X⁷, X⁸ and X⁹ are each independently CR³.

Embodiment 17. A compound of Formula 1 or Embodiment 12 wherein A is A-1 and X¹, X², X³, X⁴, X⁵, X⁶, X⁷, X⁸ and X⁹ are each CH.

25 Embodiment 18. A compound of any one of Embodiments 1 through 17 wherein R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₂–C₈ dialkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₁–C₇ alkoxy or C₁–C₅ alkylthio.

30 Embodiment 19. A compound of Embodiment 18 wherein R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl or C₁–C₇ alkoxy.

Embodiment 20. A compound of Embodiment 19 wherein R² is H, halogen, cyano, C₁–C₄ alkyl, C₃–C₅ cycloalkyl, C₁–C₃ haloalkyl, C₂–C₄ alkoxyalkyl or C₁–C₃ alkoxy.

Embodiment 21. A compound of Embodiment 20 wherein R² is H, halogen, cyano, C₁–C₃ alkyl, cyclopropyl, C₁–C₂ haloalkyl, methoxy or ethoxy.

Embodiment 22. A compound of Embodiment 21 wherein R² is H, Cl, Br, I, cyano, methyl or methoxy.

Embodiment 23. A compound of Embodiment 22 wherein R² is H, Cl, methyl or methoxy.

Embodiment 24. A compound of Embodiment 23 wherein R² is Cl or methyl.

Embodiment 25. A compound of any one of Embodiments 1 through 23 wherein R² is other than H.

Embodiment 26. A compound of any one of Embodiments 1 through 17 wherein R² is other than phenyl.

Embodiment 27. A compound of Embodiment 18 wherein R² is halogen, C₁–C₇ alkyl, C₁–C₄ alkylamino, C₂–C₈ dialkylamino or C₃–C₇ cycloalkyl.

Embodiment 28. A compound of Embodiment 27 wherein R² is C₁–C₄ alkylamino or C₂–C₈ dialkylamino.

Embodiment 29. A compound of Formula 1 or any one of Embodiments 1 through 28 wherein L is a direct bond.

Embodiment 30. A compound of Formula 1 or any one of Embodiments 1 through 28 wherein L is a direct bond and G is H, C(=O)R⁵, C(=S)R⁵, CO₂R⁶, C(=O)SR⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₂–C₄ alkynyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ haloalkynyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl.

Embodiment 31. A compound of Embodiment 30 wherein G is H, C(=O)R⁵, CO₂R⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl.

Embodiment 32. A compound of Embodiment 31 wherein G is H, C(=O)R⁵, CO₂R⁶ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₁–C₄ haloalkyl, C₂–C₄ alkoxyalkyl or C₃–C₆ cycloalkyl.

Embodiment 33. A compound of Embodiment 32 wherein G is H, C(=O)R⁵ or CO₂R⁶; or C₂–C₄ alkoxyalkyl or C₃–C₆ cycloalkyl.

Embodiment 34. A compound of Embodiment 33 wherein G is H.

Embodiment 35. A compound of Embodiment 33 wherein G is C(=O)R⁵.

Embodiment 36. A compound of Embodiment 33 wherein G is CO₂R⁶.

Embodiment 37. A compound of Embodiment 33 wherein G is C₂–C₄ alkoxyalkyl.

Embodiment 38. A compound of Embodiment 33 wherein G is C₃–C₆ cycloalkyl.

Embodiment 39. A compound of Formula 1 or any one of Embodiments 1 through 28 wherein L is C₁–C₂ alkanediyl or C₂–C₃ alkenediyl.

Embodiment 40. A compound of Embodiment 39 wherein L is C₁–C₂ alkanediyl.

5 Embodiment 41. A compound of Embodiment 39 wherein L is C₂–C₃ alkenediyl.

Embodiment 42. A compound of Embodiment 39 wherein L is –CH₂– or –CH=CH–.

Embodiment 43. A compound of Embodiment 42 wherein L is –CH₂–.

Embodiment 44. A compound of Formula 1 or any one of Embodiments 1 through 43 wherein each R³ is independently H, halogen, C₁–C₃ alkyl, C₃–C₄ cycloalkyl, 10 C₁–C₃ haloalkyl or C₁–C₃ alkoxy.

Embodiment 45. A compound of Embodiment 44 wherein each R³ is independently H, halogen, C₁–C₂ alkyl, cyclopropyl or C₁–C₂ haloalkyl.

Embodiment 46. A compound of Embodiment 45 wherein each R³ is independently H, halogen, methyl, ethyl or CF₃.

15 Embodiment 47. A compound of Embodiment 46 wherein each R³ is independently H, F, Cl, Br or methyl.

Embodiment 48. A compound of Embodiment 47 wherein each R³ is H.

20 Embodiments of this invention, including Embodiments 1–48 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 1–48 above as well as any other embodiments described herein, and any combination thereof, pertain to 25 the compositions and methods of the present invention.

Embodiment A. A compound of Formula 1, *N*-oxides and salts thereof, compositions containing them, and methods of their use for controlling undesired vegetation wherein

30 R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy, benzyl or phenyl;

W is O;

35 A is selected from A-1, A-4 and A-6;

L is a direct bond;

G is H, C(=O)R⁵, C(=S)R⁵, CO₂R⁶, C(=O)SR⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₂–C₄ alkynyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ haloalkynyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl;

- 5 R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₂–C₈ dialkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₁–C₇ alkoxy or C₁–C₅ alkylthio; and
- 10 each R³ is independently H, halogen, C₁–C₃ alkyl, C₃–C₄ cycloalkyl, C₁–C₃ haloalkyl or C₁–C₃ alkoxy.

Embodiment B. A compound of Embodiment A wherein

- 15 R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy or benzyl;

A is A-1;

- 20 G is H, C(=O)R⁵, CO₂R⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl;
- R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl or C₁–C₇ alkoxy; and
- 25 each R³ is independently H, halogen, C₁–C₂ alkyl, cyclopropyl or C₁–C₂ haloalkyl.

Embodiment C. A compound of Embodiment B wherein

- 30 R¹ is C₁–C₄ alkyl, C₃–C₄ cycloalkyl, C₂–C₃ cyanoalkyl, C₁–C₃ haloalkyl or C₂–C₄ alkoxyalkyl;
- G is H, C(=O)R⁵, CO₂R⁶ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₁–C₄ haloalkyl, C₂–C₄ alkoxyalkyl or C₃–C₆ cycloalkyl;
- R² is H, halogen, cyano, C₁–C₄ alkyl, C₃–C₅ cycloalkyl, C₁–C₃ haloalkyl, C₂–C₄ alkoxyalkyl or C₁–C₃ alkoxy; and
- 35 each R³ is independently H, halogen, methyl, ethyl or CF₃.

Embodiment D. A compound of Embodiment C wherein

R¹ is methyl, ethyl, *n*-propyl or 2-methoxyethyl;

G is H, C(=O)R⁵ or CO₂R⁶; or C₂–C₄ alkoxyalkyl or C₃–C₆ cycloalkyl;

R² is H, Cl, Br, I, -CN, methyl or methoxy; and

each R³ is independently H, F, Cl, Br or methyl.

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

4-(9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 1);

6-chloro-4-(10-chloro-9-anthracenyl)-5-hydroxy-2-methyl-3(2*H*)-pyridazinone
(Compound 2); and

10 4-(10-bromo-9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone
(Compound 3).

15 This invention also relates to a method for controlling undesired vegetation comprising applying to the locus of the vegetation herbicidally effective amounts of the compounds of the invention (e.g., as a composition described herein). Of note as embodiments relating to methods of use are those involving the compounds of embodiments described above. Compounds of the invention are particularly useful for selective control of weeds in crops such as wheat, barley, maize, soybean, sunflower, cotton, oilseed rape and rice, and specialty crops such as sugarcane, citrus, fruit and nut crops.

20 Also noteworthy as embodiments are herbicidal compositions of the present invention comprising the compounds of embodiments described above.

25 This invention also includes a herbicidal mixture comprising (a) a compound selected from Formula 1, *N*-oxides, and salts thereof, and (b) at least one additional active ingredient selected from (b1) photosystem II inhibitors, (b2) acetohydroxy acid synthase (AHAS) inhibitors, (b3) acetyl-CoA carboxylase (ACCase) inhibitors, (b4) auxin mimics, (b5) 5-enol-pyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, (b6) photosystem I electron diverters, (b7) protoporphyrinogen oxidase (PPO) inhibitors, (b8) glutamine synthetase (GS) inhibitors, (b9) very long chain fatty acid (VLCFA) elongase inhibitors, (b10) auxin transport inhibitors, (b11) phytoene desaturase (PDS) inhibitors, (b12) 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, (b13) homogentisate solanesyltransferase (HST) inhibitors, (b14) cellulose biosynthesis inhibitors, (b15) other herbicides including mitotic disruptors, organic arsenicals, asulam, bromobutide, cinmethylin, cumyluron, dazomet, difenzoquat, dymron, etobenzanid, flurenol, fosamine, fosamine-ammonium, hydantocidin, metam, methyl dymron, oleic acid, oxaziclomefone, 30 pelargonic acid and pyributicarb, and (b16) herbicide safeners; and salts of compounds of (b1) through (b16).
35

“Photosystem II inhibitors” (b1) are chemical compounds that bind to the D-1 protein at the Q_B-binding niche and thus block electron transport from Q_A to Q_B in the chloroplast thylakoid membranes. The electrons blocked from passing through photosystem II are transferred through a series of reactions to form toxic compounds that disrupt cell membranes and cause chloroplast swelling, membrane leakage, and ultimately cellular destruction. The Q_B-binding niche has three different binding sites: binding site A binds the triazines such as atrazine, triazinones such as hexazinone, and uracils such as bromacil, binding site B binds the phenylureas such as diuron, and binding site C binds benzothiadiazoles such as bentazon, nitriles such as bromoxynil and phenyl-pyridazines such as pyridate. Examples of photosystem II inhibitors include ametryn, amicarbazone, atrazine, bentazon, bromacil, bromofenoxim, bromoxynil, chlorbromuron, chloridazon, chlorotoluron, chloroxuron, cumyluron, cyanazine, daimuron, desmedipham, desmetryn, dimefuron, dimethametryn, diuron, ethidimuron, fenuron, fluometuron, hexazinone, ioxynil, isoproturon, isouron, lenacil, linuron, metamitron, methabenzthiazuron, metobromuron, metoxuron, metribuzin, monolinuron, neburon, pentanochlor, phenmedipham, prometon, prometryn, propanil, propazine, pyridafol, pyridate, siduron, simazine, simetryn, tebuthiuron, terbacil, terbumeton, terbuthylazine, terbutryn and trietazine.

“AHAS inhibitors” (b2) are chemical compounds that inhibit acetohydroxy acid synthase (AHAS), also known as acetolactate synthase (ALS), and thus kill plants by inhibiting the production of the branched-chain aliphatic amino acids such as valine, leucine and isoleucine, which are required for protein synthesis and cell growth. Examples of AHAS inhibitors include amidosulfuron, azimsulfuron, bensulfuron-methyl, bispribac-sodium, cloransulam-methyl, chlorimuron-ethyl, chlorsulfuron, cinosulfuron, cyclosulfamuron, diclosulam, ethametsulfuron-methyl, ethoxysulfuron, flazasulfuron, florasulam, flucarbazone-sodium, flumetsulam, flupyrsulfuron-methyl, flupyrsulfuron-sodium, foramsulfuron, halosulfuron-methyl, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazethapyr, imazosulfuron, iodosulfuron-methyl (including sodium salt), iofensulfuron (2-iodo-*N*-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide), mesosulfuron-methyl, metazosulfuron (3-chloro-4-(5,6-dihydro-5-methyl-1,4,2-dioxazin-3-yl)-*N*-[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-1-methyl-1*H*-pyrazole-5-sulfonamide), metosulam, metsulfuron-methyl, nicosulfuron, oxasulfuron, penoxsulam, primisulfuron-methyl, propoxycarbazone-sodium, propyrisulfuron (2-chloro-*N*-[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-6-propylimidazo[1,2-*b*]pyridazine-3-sulfonamide), prosulfuron, pyrazosulfuron-ethyl, pyribenzoxim, pyriftalid, pyriminobac-methyl, pyriathiobac-sodium, rimsulfuron, sulfometuron-methyl, sulfosulfuron, thiencarbazone, thifensulfuron-methyl, triafamone (*N*-[2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)carbonyl]-6-

fluorophenyl]-1,1-difluoro-*N*-methylmethanesulfonamide), triasulfuron, tribenuron-methyl, trifloxysulfuron (including sodium salt), triflusulfuron-methyl and tritosulfuron.

“ACCCase inhibitors” (b3) are chemical compounds that inhibit the acetyl-CoA carboxylase enzyme, which is responsible for catalyzing an early step in lipid and fatty acid synthesis in plants. Lipids are essential components of cell membranes, and without them, new cells cannot be produced. The inhibition of acetyl CoA carboxylase and the subsequent lack of lipid production leads to losses in cell membrane integrity, especially in regions of active growth such as meristems. Eventually shoot and rhizome growth ceases, and shoot meristems and rhizome buds begin to die back. Examples of ACCCase inhibitors include alloxydim, butoxydim, clethodim, clodinafop, cycloxydim, cyhalofop, diclofop, fenoxaprop, fluazifop, haloxyfop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxym and tralkoxydim, including resolved forms such as fenoxaprop-P, fluazifop-P, haloxyfop-P and quizalofop-P and ester forms such as clodinafop-propargyl, cyhalofop-butyl, diclofop-methyl and fenoxaprop-P-ethyl.

Auxin is a plant hormone that regulates growth in many plant tissues. “Auxin mimics” (b4) are chemical compounds mimicking the plant growth hormone auxin, thus causing uncontrolled and disorganized growth leading to plant death in susceptible species. Examples of auxin mimics include aminocyclopyrachlor (6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid) and its methyl and ethyl esters and its sodium and potassium salts, aminopyralid, benazolin-ethyl, chloramben, clacifos, clomeprop, clopyralid, dicamba, 2,4-D, 2,4-DB, dichlorprop, fluroxypyr, halauxifen (4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid), halauxifen-methyl (methyl 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylate), MCPA, MCPB, mecoprop, picloram, quinclorac, quinmerac, 2,3,6-TBA, triclopyr, and methyl 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-5-fluoro-2-pyridinecarboxylate.

“EPSP synthase inhibitors” (b5) are chemical compounds that inhibit the enzyme, 5-enol-pyruvylshikimate-3-phosphate synthase, which is involved in the synthesis of aromatic amino acids such as tyrosine, tryptophan and phenylalanine. EPSP inhibitor herbicides are readily absorbed through plant foliage and translocated in the phloem to the growing points. Glyphosate is a relatively nonselective postemergence herbicide that belongs to this group. Glyphosate includes esters and salts such as ammonium, isopropylammonium, potassium, sodium (including sesquisodium) and trimesium (alternatively named sulfosate).

“Photosystem I electron diverters” (b6) are chemical compounds that accept electrons from Photosystem I, and after several cycles, generate hydroxyl radicals. These radicals are extremely reactive and readily destroy unsaturated lipids, including membrane fatty acids and chlorophyll. This destroys cell membrane integrity, so that cells and organelles “leak”,

leading to rapid leaf wilting and desiccation, and eventually to plant death. Examples of this second type of photosynthesis inhibitor include diquat and paraquat.

“PPO inhibitors” (b7) are chemical compounds that inhibit the enzyme protoporphyrinogen oxidase, quickly resulting in formation of highly reactive compounds in plants that rupture cell membranes, causing cell fluids to leak out. Examples of PPO inhibitors include acifluorfen-sodium, azafenidin, benzfendazole, bifenox, butafenacil, carfentrazone, carfentrazone-ethyl, chlomethoxyfen, cinidon-ethyl, fluazolate, flufenpyr-ethyl, flumiclorac-pentyl, flumioxazin, fluoroglycofen-ethyl, fluthiacet-methyl, fomesafen, halosafen, lactofen, oxadiargyl, oxadiazon, oxyfluorfen, pentoxazone, proflumazone, pyraclostrobin, pyraflufen-ethyl, saflufenacil, sulfentrazone, thidiazimin, trifludimoxazin (dihydro-1,5-dimethyl-6-thioxo-3-[2,2,7-trifluoro-3,4-dihydro-3-oxo-4-(2-propyn-1-yl)-2H-1,4-benzoxazin-6-yl]-1,3,5-triazine-2,4(1*H*,3*H*)-dione) and tiafenacil (methyl *N*-[2-[[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2*H*)-pyrimidinyl]-4-fluorophenyl]thio]-1-oxopropyl]-β-alaninate).

“GS inhibitors” (b8) are chemical compounds that inhibit the activity of the glutamine synthetase enzyme, which plants use to convert ammonia into glutamine. Consequently, ammonia accumulates and glutamine levels decrease. Plant damage probably occurs due to the combined effects of ammonia toxicity and deficiency of amino acids required for other metabolic processes. The GS inhibitors include glufosinate and its esters and salts such as glufosinate-ammonium and other phosphinothricin derivatives, glufosinate-P ((2*S*)-2-amino-4-(hydroxymethylphosphinyl)butanoic acid) and bilanaphos.

“VLCFA elongase inhibitors” (b9) are herbicides having a wide variety of chemical structures, which inhibit the elongase. Elongase is one of the enzymes located in or near chloroplasts which are involved in biosynthesis of VLCFAs. In plants, very-long-chain fatty acids are the main constituents of hydrophobic polymers that prevent desiccation at the leaf surface and provide stability to pollen grains. Such herbicides include acetochlor, alachlor, anilofos, butachlor, cafenstrole, dimethachlor, dimethenamid, diphenamid, fenoxasulfone (3-[[[(2,5-dichloro-4-ethoxyphenyl)methyl]sulfonyl]-4,5-dihydro-5,5-dimethylisoxazole), fentrazamide, flufenacet, indanofan, mefenacet, metazachlor, metolachlor, naproanilide, napropamide, napropamide-M ((2*R*)-*N,N*-diethyl-2-(1-naphthalenyloxy)propanamide), pethoxamid, piperophos, pretilachlor, propachlor, propisochlor, pyroxasulfone, and thienylchlor, including resolved forms such as *S*-metolachlor and chloroacetamides and oxyacetamides.

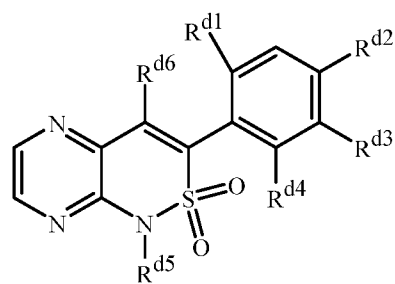
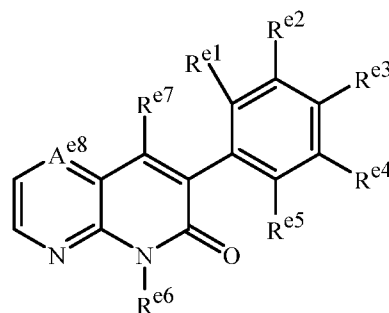
“Auxin transport inhibitors” (b10) are chemical substances that inhibit auxin transport in plants, such as by binding with an auxin-carrier protein. Examples of auxin transport inhibitors include diflufenzopyr, naptalam (also known as *N*-(1-naphthyl)phthalamic acid and 2-[(1-naphthalenylamino)carbonyl]benzoic acid).

“PDS inhibitors” (b11) are chemical compounds that inhibit carotenoid biosynthesis pathway at the phytoene desaturase step. Examples of PDS inhibitors include beflubutamid, diflufenican, fluridone, flurochloridone, flurtamone norflurzon and picolinafen.

“HPPD inhibitors” (b12) are chemical substances that inhibit the biosynthesis of synthesis of 4-hydroxyphenyl-pyruvate dioxygenase. Examples of HPPD inhibitors include benzobicyclon, benzofenap, bicyclopyrone (4-hydroxy-3-[[2-[(2-methoxyethoxy)methyl]-6-(trifluoromethyl)-3-pyridinyl]carbonyl]bicyclo[3.2.1]oct-3-en-2-one), fenquinotrione (2-[[8-chloro-3,4-dihydro-4-(4-methoxyphenyl)-3-oxo-2-quinoxaliny]carbonyl]-1,3-cyclohexanedione), isoxachlortole, isoxaflutole, mesotrione, pyrasulfotole, pyrazolynate, pyrazoxyfen, sulcotrione, tefuryltrione, tembotrione, tolpypalate (1-[[1-ethyl-4-[3-(2-methoxyethoxy)-2-methyl-4-(methylsulfonyl)benzoyl]-1H-pyrazol-5-yl]oxy]ethyl methyl carbonate), topramezone, 5-chloro-3-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-1-(4-methoxyphenyl)-2(1*H*)-quinoxalinone, 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5(2*H*,4*H*)-dione, 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-(3-methoxyphenyl)-3-(3-methoxypropyl)-4(3*H*)-pyrimidinone, 2-methyl-*N*-(4-methyl-1,2,5-oxadiazol-3-yl)-3-(methylsulfinyl)-4-(trifluoromethyl)benzamide and 2-methyl-3-(methylsulfonyl)-*N*-(1-methyl-1*H*-tetrazol-5-yl)-4-(trifluoromethyl)benzamide.

“HST inhibitors” (b13) disrupt a plant’s ability to convert homogentisate to 2-methyl-6-solanyl-1,4-benzoquinone, thereby disrupting carotenoid biosynthesis. Examples of HST inhibitors include cyclopyrimorate (6-chloro-3-(2-cyclopropyl-6-methylphenoxy)-4-pyridazinyl 4-morpholinecarboxylate), haloxydine, pyriclor, 3-(2-chloro-3,6-difluorophenyl)-4-hydroxy-1-methyl-1,5-naphthyridin-2(1*H*)-one, 7-(3,5-dichloro-4-pyridinyl)-5-(2,2-difluoroethyl)-8-hydroxypyrido[2,3-*b*]pyrazin-6(5*H*)-one and 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone.

HST inhibitors also include compounds of Formulae **A** and **B**.

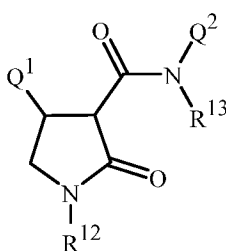
**A****B**

wherein R^{d1} is H, Cl or CF_3 ; R^{d2} is H, Cl or Br; R^{d3} is H or Cl; R^{d4} is H, Cl or CF_3 ; R^{d5} is CH_3 , CH_2CH_3 or CH_2CHF_2 ; and R^{d6} is OH, or $-OC(=O)-i-Pr$; and R^{e1} is H, F, Cl, CH_3 or CH_2CH_3 ; R^{e2} is H or CF_3 ; R^{e3} is H, CH_3 or CH_2CH_3 ; R^{e4} is H, F or Br; R^{e5} is Cl,

CH₃, CF₃, OCF₃ or CH₂CH₃; R^{e6} is H, CH₃, CH₂CHF₂ or C≡CH; R^{e7} is OH, -OC(=O)Et, -OC(=O)-*i*-Pr or -OC(=O)-*t*-Bu; and A^{e8} is N or CH.

“Cellulose biosynthesis inhibitors” (b14) inhibit the biosynthesis of cellulose in certain plants. They are most effective when applied preemergence or early postemergence on young or rapidly growing plants. Examples of cellulose biosynthesis inhibitors include chlorthiamid, dichlobenil, flupoxam, indaziflam (*N*²-[(1*R*,2*S*)-2,3-dihydro-2,6-dimethyl-1*H*-inden-1-yl]-6-(1-fluoroethyl)-1,3,5-triazine-2,4-diamine), isoxaben and triaziflam.

“Other herbicides” (b15) include herbicides that act through a variety of different modes of action such as mitotic disruptors (e.g., flamprop-M-methyl and flamprop-M-isopropyl), organic arsenicals (e.g., DSMA, and MSMA), 7,8-dihydropteroate synthase inhibitors, chloroplast isoprenoid synthesis inhibitors and cell-wall biosynthesis inhibitors. Other herbicides include those herbicides having unknown modes of action or do not fall into a specific category listed in (b1) through (b14) or act through a combination of modes of action listed above. Examples of other herbicides include aclonifen, asulam, amitrole, bromobutide, cinmethylin, clomazone, cumyluron, daimuron, difenzoquat, etobenzanid, fluometuron, flurenol, fosamine, fosamine-ammonium, dazomet, dymron, ipfencarbazone (1-(2,4-dichlorophenyl)-*N*-(2,4-difluorophenyl)-1,5-dihydro-*N*-(1-methylethyl)-5-oxo-4*H*-1,2,4-triazole-4-carboxamide), metam, methyl dymron, oleic acid, oxaziclomefone, pelargonic acid, pyributicarb and 5-[(2,6-difluorophenyl)methoxy]methyl]-4,5-dihydro-5-methyl-3-(3-methyl-2-thienyl)isoxazole. “Other herbicides” (b15) also include a compound of Formula (b15A)



(b15A)

wherein

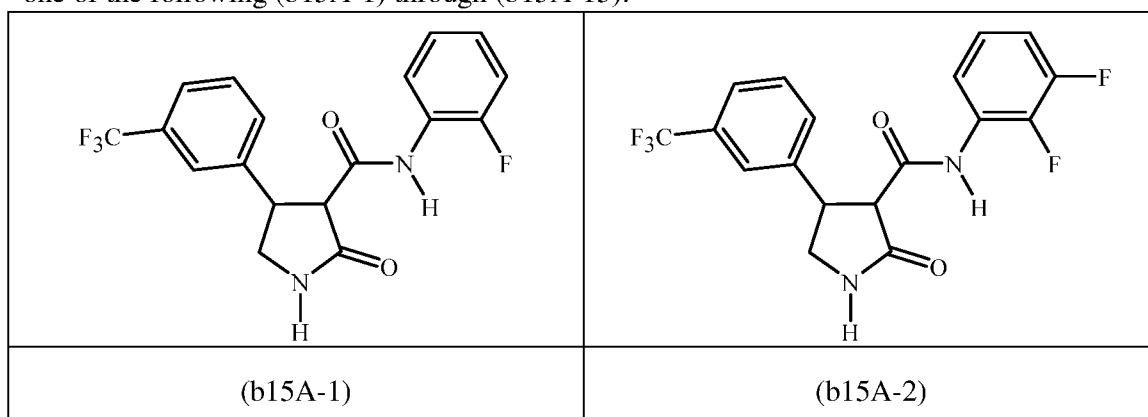
R¹² is H, C₁–C₆ alkyl, C₁–C₆ haloalkyl or C₄–C₈ cycloalkyl;

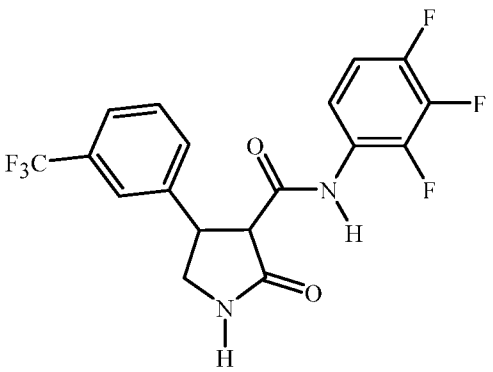
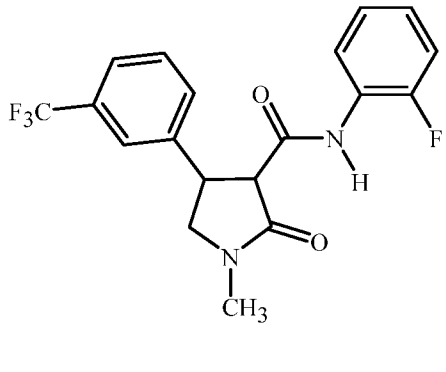
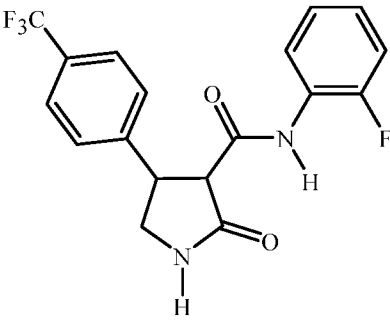
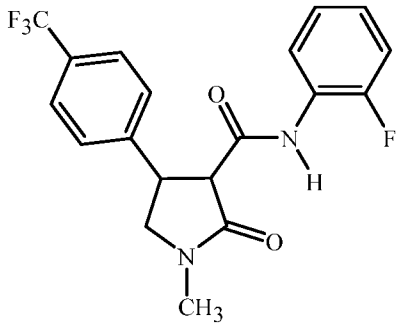
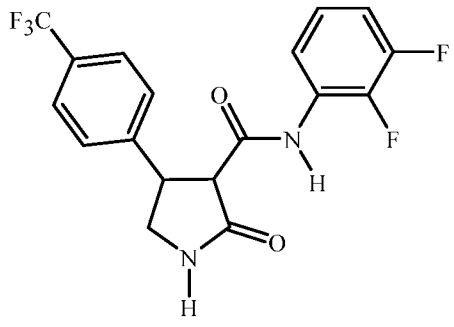
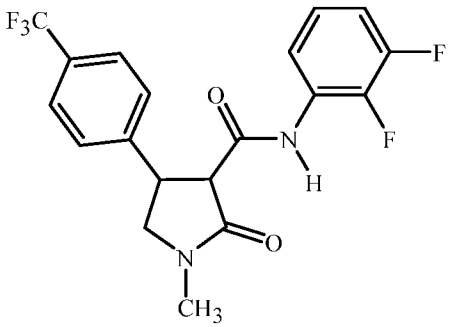
R¹³ is H, C₁–C₆ alkyl or C₁–C₆ alkoxy;

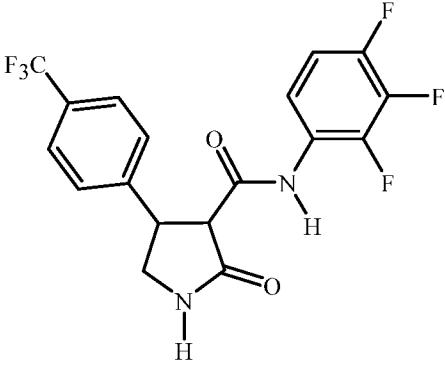
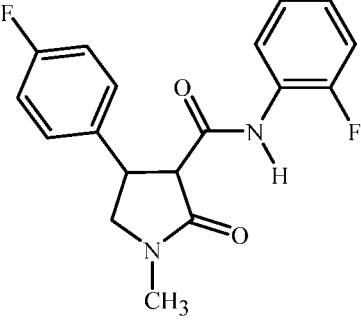
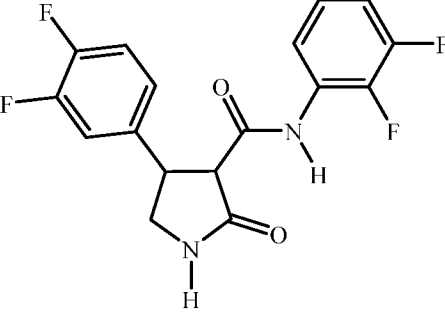
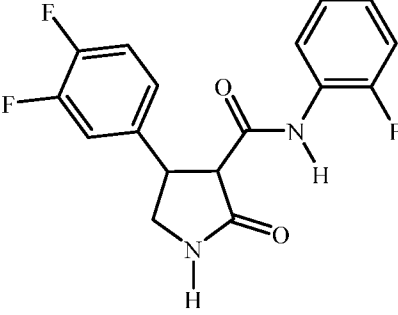
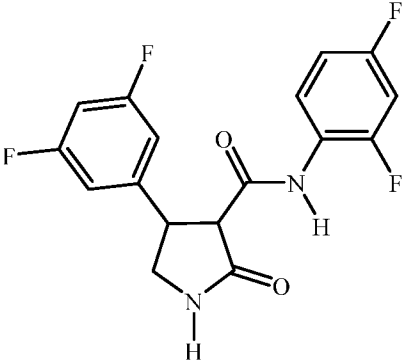
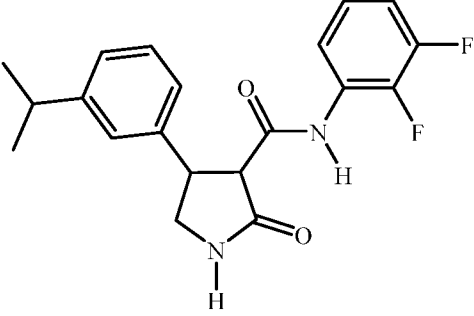
Q¹ is an optionally substituted ring system selected from the group consisting of phenyl, thienyl, pyridinyl, benzodioxolyl, naphthyl, naphthalenyl, benzofuranyl, furanyl, benzothiophenyl and pyrazolyl, wherein when substituted said ring system is substituted by 1 to 3 R¹⁴;

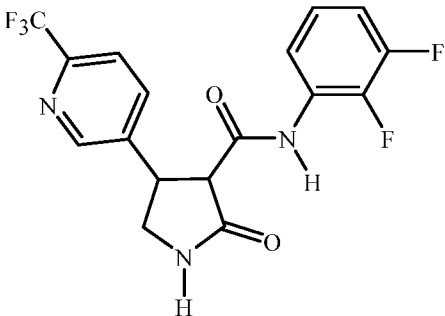
Q² is an optionally substituted ring system selected from the group consisting of phenyl, pyridinyl, benzodioxolyl, pyridinonyl, thiadiazolyl, thiazolyl, and oxazolyl, wherein when substituted said ring system is substituted by 1 to 3 R¹⁵; each R¹⁴ is independently halogen, C₁–C₆ alkyl, C₁–C₆ haloalkyl, C₁–C₆ alkoxy, C₁–C₆ haloalkoxy, C₃–C₈ cyaloalkyl, cyano, C₁–C₆ alkylthio, C₁–C₆ alkylsulfinyl, C₁–C₆ alkylsulfonyl, SF₅, NHR¹⁷; or phenyl optionally substituted by 1 to 3 R¹⁶; or pyrazolyl optionally substituted by 1 to 3 R¹⁶; each R¹⁵ is independently halogen, C₁–C₆ alkyl, C₁–C₆ haloalkyl, C₁–C₆ alkoxy, C₁–C₆ haloalkoxy, cyano, nitro, C₁–C₆ alkylthio, C₁–C₆ alkylsulfinyl, C₁–C₆ alkylsulfonyl; each R¹⁶ is independently halogen, C₁–C₆ alkyl or C₁–C₆ haloalkyl; R¹⁷ is C₁–C₄ alkoxycarbonyl.

In one Embodiment wherein “other herbicides” (b15) also include a compound of Formula (b15A), it is preferred that R¹² is H or C₁–C₆ alkyl; more preferably R¹² is H or methyl. Preferably R¹³ is H. Preferably Q¹ is either a phenyl ring or a pyridinyl ring, each ring substituted by 1 to 3 R¹⁴; more preferably Q¹ is a phenyl ring substituted by 1 to 2 R¹⁴. Preferably Q² is a phenyl ring substituted by 1 to 3 R¹⁵; more preferably Q² is a phenyl ring substituted by 1 to 2 R¹⁵. Preferably each R¹⁴ is independently halogen, C₁–C₄ alkyl, C₁–C₃ haloalkyl, C₁–C₃ alkoxy or C₁–C₃ haloalkoxy; more preferably each R¹⁴ is independently chloro, fluoro, bromo, C₁–C₂ haloalkyl, C₁–C₂ haloalkoxy or C₁–C₂ alkoxy. Preferably each R¹⁵ is independently halogen, C₁–C₄ alkyl, C₁–C₃ haloalkoxy; more preferably each R¹⁵ is independently chloro, fluoro, bromo, C₁–C₂ haloalkyl, C₁–C₂ haloalkoxy or C₁–C₂ alkoxy. Specifically preferred as “other herbicides” (b15) include any one of the following (b15A-1) through (b15A-15):

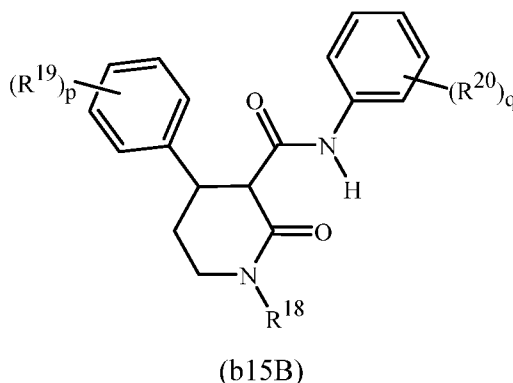


	
(b15A-3)	(b15A-4)
	
(b15A-5)	(b15A-6)
	
(b15A-7)	(b15A-8)

	
(b15A-9)	(b15A-10)
	
(b15A-11)	(b15A-12)
	
(b15A-13)	(b15A-14)

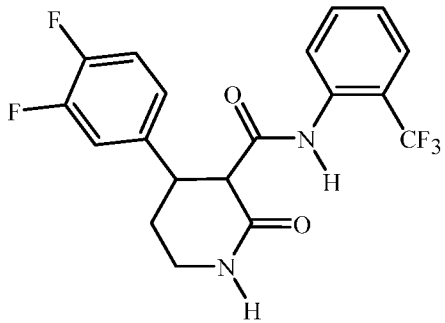
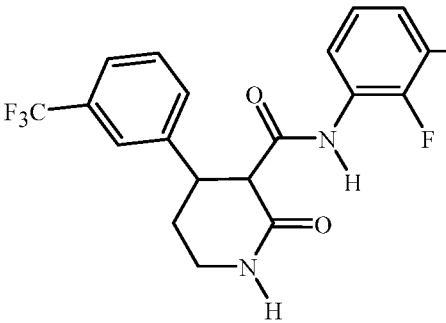
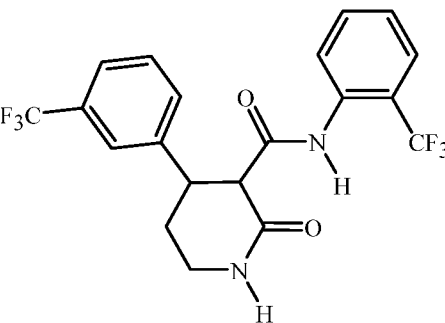
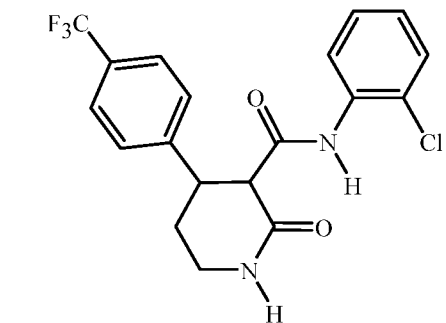
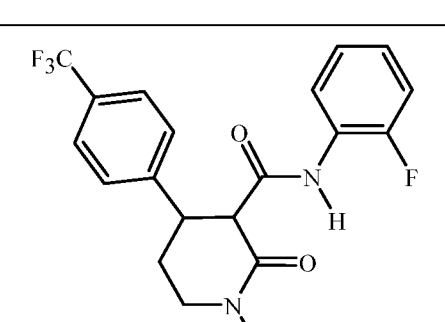
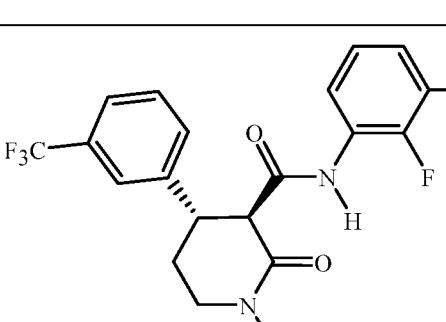
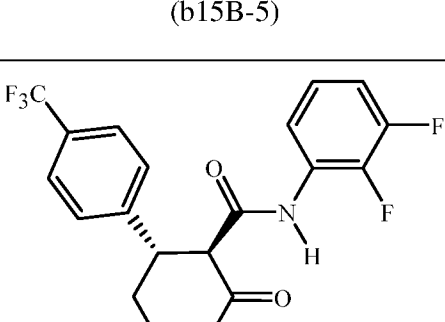
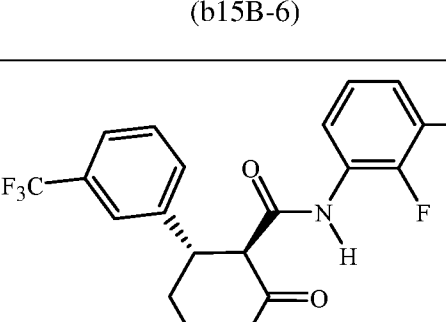
	
(b15A-15)	

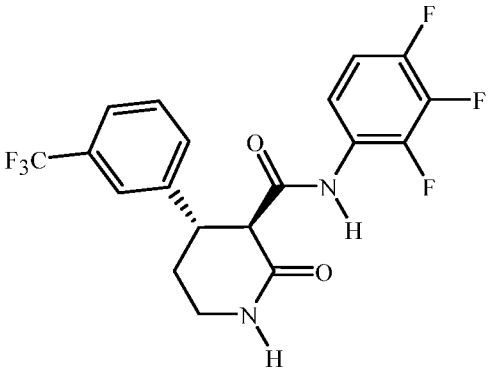
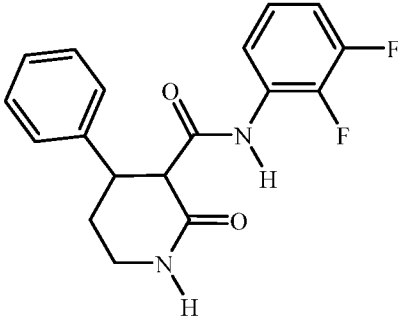
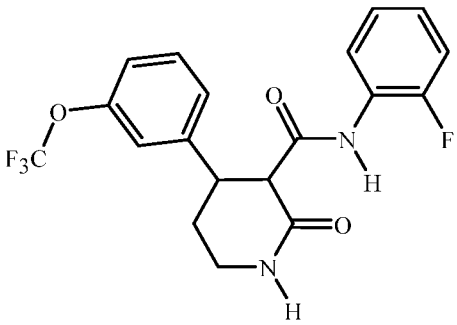
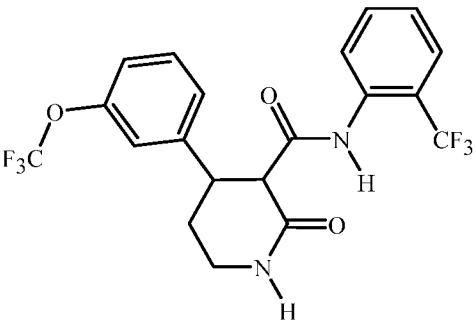
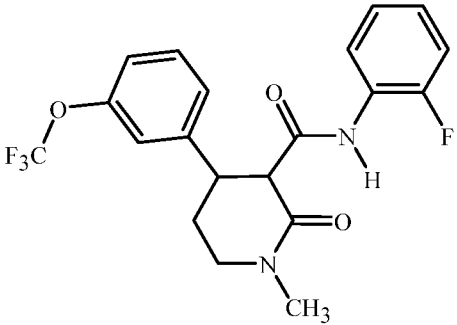
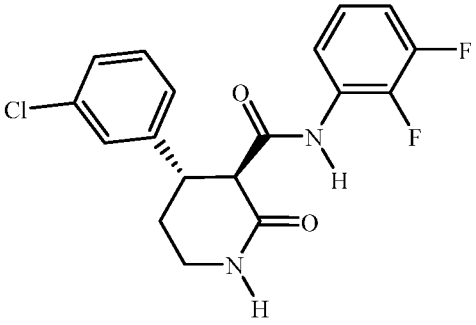
“Other herbicides” (b15) also include a compound of Formula (b15B)

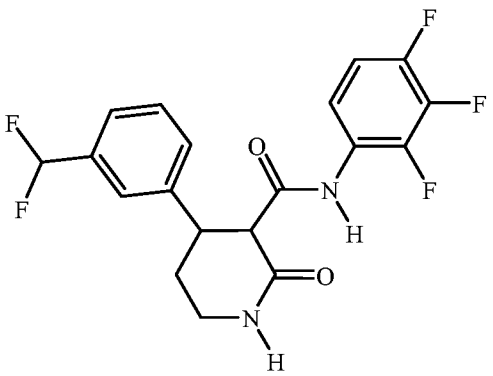
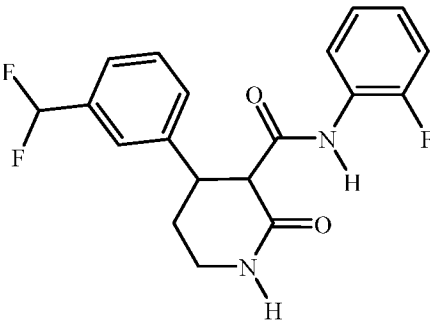
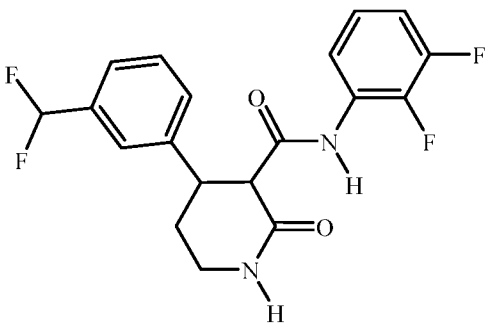
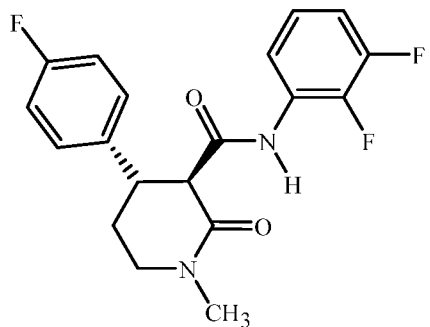
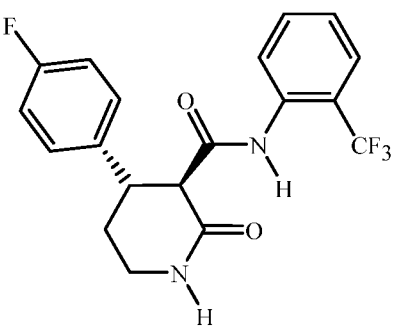


wherein

- 5 R^{18} is H, C_1 – C_6 alkyl, C_1 – C_6 haloalkyl or C_4 – C_8 cycloalkyl;
 each R^{19} is independently halogen, C_1 – C_6 haloalkyl or C_1 – C_6 haloalkoxy;
 p is an integer of 0, 1, 2 or 3;
 each R^{20} is independently halogen, C_1 – C_6 haloalkyl or C_1 – C_6 haloalkoxy; and
 q is an integer of 0, 1, 2 or 3.
- 10 In one Embodiment wherein “other herbicides” (b15) also include a compound of Formula (b15B), it is preferred that R^{18} is H, methyl, ethyl or propyl; more preferably R^{18} is H or methyl; most preferably R^{18} is H. Preferrably each R^{19} is independently chloro, fluoro, C_1 – C_3 haloalkyl or C_1 – C_3 haloalkoxy; more preferably each R^{19} is independently chloro, fluoro, C_1 fluoroalkyl (i.e. fluoromethyl, difluoromethyl or trifluoromethyl) or C_1
- 15 fluoroalkoxy (i.e. trifluoromethoxy, difluoromethoxy or fluoromethoxy). Preferably each R^{20} is independently chloro, fluoro, C_1 haloalkyl or C_1 haloalkoxy; more preferably each R^{20} is independently chloro, fluoro, C_1 fluoroalkyl (i.e. fluoromethyl, difluoromethyl or trifluoromethyl) or C_1 fluoroalkoxy (i.e. trifluoromethoxy, difluoromethoxy or fluoromethoxy). Specifically preferred as “other herbicides” (b15) include any one of the
- 20 following (b15B-1) through (b15B-19):

	
(b15B-1)	(b15B-2)
	
(b15B-3)	(b15B-4)
	
(b15B-5)	(b15B-6)
	

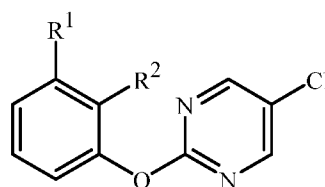
(b15B-7)	(b15B-8)
	
(b15B-9)	(b15B-10)
	
(b15B-11)	(b15B-12)
	
(b15B-13)	(b15B-14)

	
(b15B-15)	(b15B-16)
	
(b15B-17)	(b15B-18)
	
(b15B-19)	

“Herbicide safeners” (b16) are substances added to a herbicide formulation to eliminate or reduce phytotoxic effects of the herbicide to certain crops. These compounds protect crops from injury by herbicides but typically do not prevent the herbicide from controlling undesired vegetation. Examples of herbicide safeners include but are not limited to benoxacor, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfamide, daimuron, dichlormid, dicyclonon, dietholate, dimepiperate, fenchlorazole-ethyl, fencloirim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone,

naphthalic anhydride, oxabetrinil, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide and *N*-(aminocarbonyl)-2-fluorobenzenesulfonamide, 1-bromo-4-[(chloromethyl)sulfonyl]benzene, 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2,2-dichloro-1-(2,2,5-trimethyl-3-oxazolidinyl)-ethanone and 2-methoxy-*N*-[[4-[(methylamino)carbonyl]amino]phenyl]sulfonyl]-benzamide.

Another Embodiment wherein “other herbicides” (b15) also include a compound of Formula (b15C),



(b15C)

wherein R¹ is Cl, Br or CN; and R² is C(=O)CH₂CH₂CF₃, CH₂CH₂CH₂CH₂CF₃ or 3-CHF₂-isoxazol-5-yl.

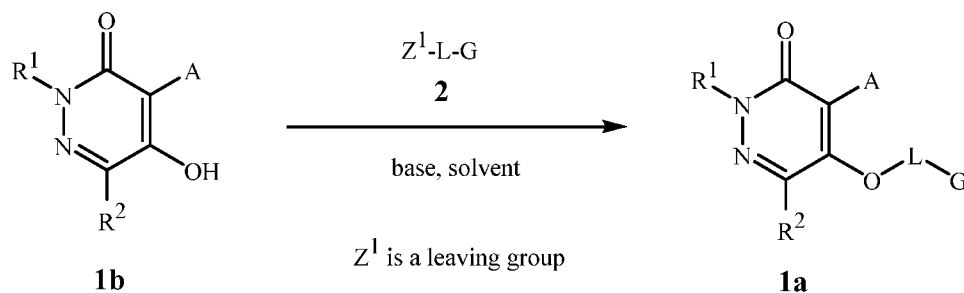
Preferred for better control of undesired vegetation (e.g., lower use rate such as from greater-than-additive effects, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of atrazine, azimsulfuron, beflubutamid, *S*-beflubutamid, benzisothiazolinone, carfentrazone-ethyl, chlorimuron-ethyl, chlorsulfuron-methyl, clomazone, clopyralid potassium, cloransulam-methyl, 2-[(2,4-dichlorophenyl)methyl]-4,4-dimethyl-isoxazolidinone, 2-[(2,5-dichlorophenyl)methyl]-4,4-dimethyl-isoxazolidinone, ethametsulfuron-methyl, flumetsulam, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5-(2*H*,4*H*)-dione, flupyrsulfuron-methyl, fluthiacet-methyl, fomesafen, imazethapyr, lenacil, mesotrione, metribuzin, metsulfuron-methyl, pethoxamid, picloram, pyroxasulfone, quinclorac, rimsulfuron, *S*-metolachlor, sulfentrazone, thifensulfuron-methyl, triflusulfuron-methyl and tribenuron-methyl.

One or more of the following methods and variations as described in Schemes 1–16 can be used to prepare compounds of Formula 1. The definitions of groups R¹, R², W, A, L and G in the compounds of Formulae 1–29 are as defined above in the Summary of the Invention unless otherwise noted. Formulae 1a, 1b and 1c are subsets of compounds of Formula 1, and all substituents for Formulae 1a, 1b and 1c are as defined above for Formula 1 unless otherwise noted.

As shown in Scheme 1, pyridazinones of Formula 1a (a subset of compounds of Formula 1 where W is O, and L and G are as defined above, but L is other than a direct bond

and G is other than hydrogen) can be made by reacting substituted 5-hydroxy-3(2*H*)-pyridazinones of Formula **1b** (i.e. Formula **1** wherein W is O, L is a direct bond and G is H) with a suitable electrophilic reagent of Formula **2** (i.e. Z¹-L-G where Z¹ is a leaving group, alternatively known as a nucleofuge, such as a halogen) in the presence of base in an appropriate solvent. Some examples of reagent classes representing Formula **2** wherein Z¹ is Cl and L is a direct bond include acid chlorides (G is -(C=O)R⁵), chloroformates (G is -CO₂R⁶), carbamoyl chlorides (G is -CONR⁷R⁸), sulfonyl chlorides (G is -S(O)₂R⁵) and chlorosulfonamides (G is -S(O)₂NR⁷R⁸). Examples of suitable bases for this reaction include, but are not limited to, potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride or potassium *tert*-butoxide and, depending on the specific base used, appropriate solvents can be protic or aprotic and used anhydrous or as aqueous mixtures. Preferred solvents for this reaction include acetonitrile, methanol, ethanol, tetrahydrofuran, diethyl ether, 1,2-dimethoxyethane, dioxane, dichloromethane or *N,N*-dimethylformamide. The reaction can be performed at a range of temperatures, typically ranging from 0 °C to the reflux temperature of the solvent.

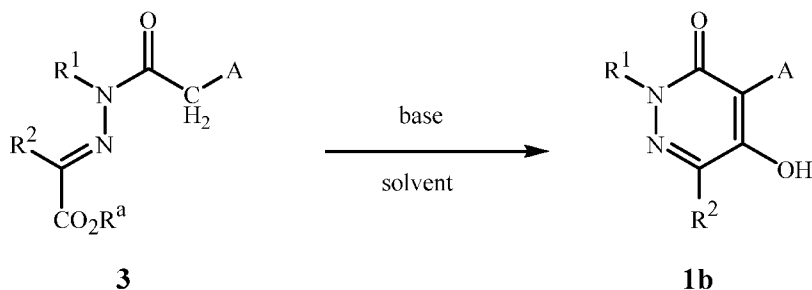
Scheme 1



Substituted 5-hydroxy-3(2*H*)-pyridazinones of Formula **1b** can be prepared as outlined in Scheme 2 by cyclization of hydrazide esters of Formula **3** (where R^a is alkyl, typically methyl or ethyl) in the presence of base and solvent. Suitable bases for this reaction include but are not limited to potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride, potassium *t*-butoxide or 1,8-diazabicyclo[5.4.0]undec-7-ene. Depending on the specific base used, appropriate solvents can be protic or aprotic and used anhydrous or as aqueous mixtures. Solvents for this cyclization include acetonitrile, methanol, ethanol, tetrahydrofuran, diethyl ether, dioxane, 1,2-dimethoxyethane, dichloromethane or *N,N*-dimethylformamide. Temperatures for this cyclization generally range from 0 °C to the reflux temperature of the solvent. Literature methods for cyclizing hydrazide ester intermediates of formula CH₃(CO₂C₂H₅)C=NNCH₃C(=O)CH₂Ar (where Ar is a substituted phenyl instead of the bicyclic ring system shown in Formula **3**) to the corresponding 4-aryl-5-hydroxy-pyridazinones are disclosed in U.S. Pat. Nos. 8,541,414 and 8,470,738. The same

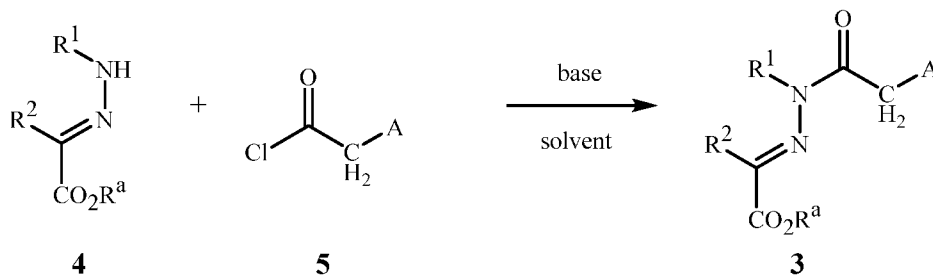
conditions reported in these patents are applicable to cyclizing hydrazone esters of Formula **3** to pyridazinones of Formula **1b**.

Scheme 2



- 5 Substituted hydrazone esters of Formula **3** can be prepared as outlined in Scheme 3 by coupling a hydrazone ester of Formula **4** (where R^a is alkyl, typically methyl or ethyl) with an acid chloride of Formula **5** in the presence of base and solvent. Preferred bases for this reaction are usually tertiary amines such as triethylamine or Hunig's base, but other bases can also be used, including *N,N*-dimethylaminopyridine, potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride or potassium *t*-butoxide. Depending on the specific base used, appropriate solvents can be protic or aprotic where the reaction takes place under anhydrous conditions or as aqueous mixtures under Schotten-Baumann conditions. Solvents that are used for this acylation on nitrogen include acetonitrile, tetrahydrofuran, diethyl ether, dioxane, toluene, 1,2-dimethoxyethane, dichloromethane or *N,N*-dimethylformamide. Temperatures for this reaction can range from 0 °C to the reflux temperature of the solvent. Methods to make related hydrazone ester intermediates of formula $CH_3(CO_2C_2H_5)C=NNCH_3C(=O)Ar$ (where Ar is a substituted phenyl) have been published in the patent literature, see U.S. Pat. Nos. 8,541,414 and 8,470,738, and U.S. Patent Application Publication 2010/0267561. The procedures disclosed in these patent publications are directly applicable to making intermediates useful for preparing the present compounds as depicted in Scheme 3.

Scheme 3



- 25 Hydrazone esters of Formula **4** are readily accessible by reaction of an appropriately substituted hydrazine of formula R^1NHNH_2 with a ketone or aldehyde ester of formula

$R^2(C=O)CO_2R^a$ (where R^a is typically methyl or ethyl) in a suitable solvent such as ethanol, methanol, acetonitrile or dioxane or dichloromethane at temperatures generally ranging from 0 to 80 °C. U.S. Patent Application Publications 2007/0112038 and 2005/0256123 disclose procedures for forming the hydrazone from methylhydrazine and the keto ester

5 $CH_3(C=O)CO_2C_2H_5$.

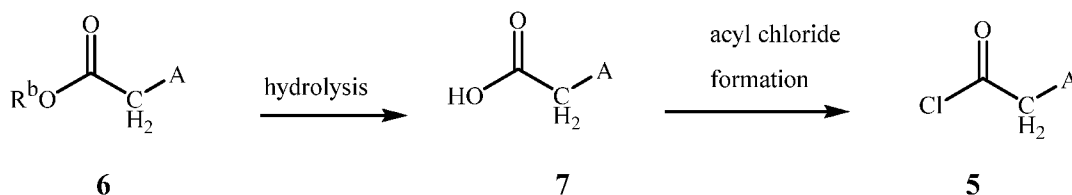
As shown in Scheme 4, acetyl chlorides of Formula **5** can be prepared from the corresponding acetic acid esters of Formula **6** wherein R^b is typically methyl or ethyl via ester hydrolysis and acid chloride formation. Standard methods for this transformation are known in the literature. For example, ester hydrolysis can be achieved by heating an

10 alcoholic solution of an ester of Formula **6** with an aqueous solution of an alkali metal hydroxide, following by acidification with a mineral acid. The carboxylic acid of Formula **7** formed can then be converted to the corresponding acyl chloride of Formula **5** by treatment with oxalyl chloride and a catalytic amount of *N,N*-dimethylformamide in an inert solvent such as dichloromethane. *J. Heterocyclic Chem.* **1983**, 20(6), 1697–1703; *J. Med. Chem.*

15 **2007**, 50(1), 40–64; and PCT Patent Publications WO 2005/012291, WO 98/49141 and WO 98/49158 disclose hydrolysis of benzofuran- and benzothiophene-acetate esters to the corresponding acetic acids. *Monatshefte für Chemie* **1968**, 99(2) 715–720 and patent publications WO 2004046122, WO 2009/038974 and JP09077767 disclose conversion of benzofuran- and benzothiophene-acetic acids to the corresponding acid chlorides.

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Scheme 4

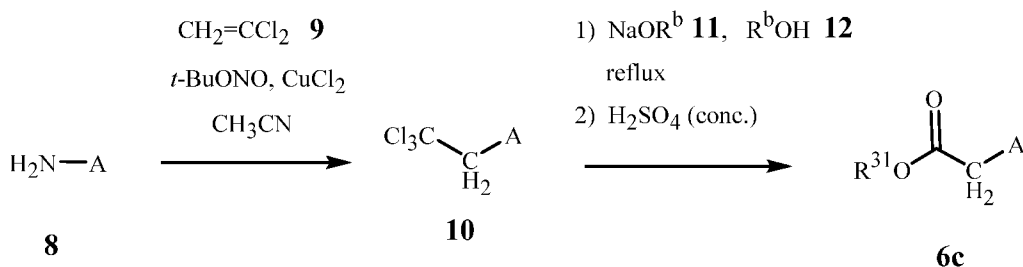


As shown in Scheme 5, heteroarylacetic acid derivatives of Formula **6c** can be prepared from appropriately substituted heteroaryl amines of Formula **8**. According to this method, amines of Formula **8** are diazotized (preferably with *t*-butyl nitrite in the presence of cupric chloride in acetonitrile) in the presence of 1,1-dichloroethene (**9**) to give the

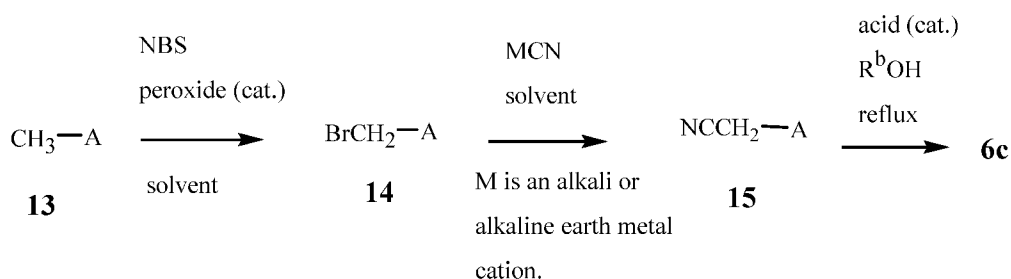
25 corresponding trichloroethylheterocycle of Formula **10**. The trichloroethylheterocycle of Formula **10** are then heated with an appropriate alkali or alkaline earth alkoxide such as a sodium alkoxide of Formula **11**, in a suitable solvent such as an alcohol of Formula **12**, followed by acidification such as with concentrated sulfuric acid to provide the heterocyclic

30 acetic acid esters of Formula **6c**. This method is taught in *Pest. Manag. Sci.* **2011**, 67, 1499–1521 and U.S. Pat. No. 5,376,677.

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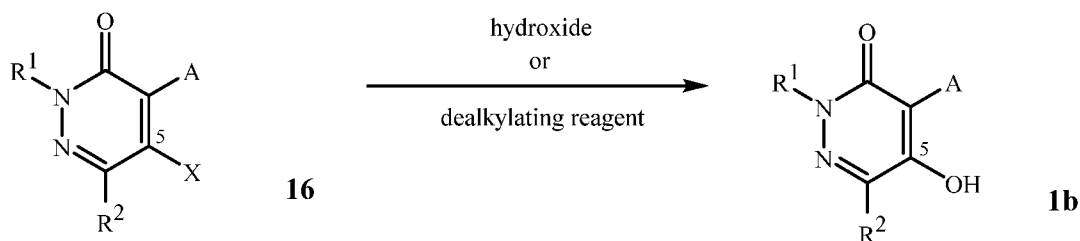
Scheme 5

An alternative method for making heteroaryl acetic acid esters of Formula **6c** is outlined in Scheme 6. As taught by the method in *Pest. Manag. Sci.* **2011**, 67, 1499–1521, methyl heterocycles of Formula **13** can be brominated with *N*-bromosuccinimide (NBS) under free radical conditions (e.g., benzoyl peroxide as catalyst) in an inert solvent such as dichloromethane, dichloroethane or tetrachloromethane to give heteroaryl methyl bromides of Formula **14**. Displacement of the bromine with cyanide by reacting compounds of Formula **14** with an alkali or alkaline cyanide (e.g., potassium cyanide) affords the heteroaryl acetonitriles of Formula **15** that can be hydrolyzed with esterification to the acetates of Formula **6c** by heating in acidic alcohol (e.g., HCl in methanol or ethanol), generally at the reflux temperature of the solvent. Alcohol R^bOH is a lower alkanol.

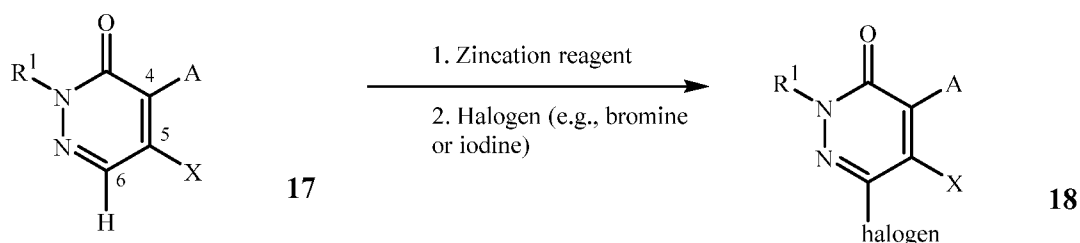
Scheme 6

Hydrolysis of leaving groups at the 5-position of the pyridazinone ring can be accomplished as shown in Scheme 7. When the X group is lower alkoxy, lower alkylsulfide (sulfoxide or sulfone), halide or *N*-linked azole, it can be removed by hydrolysis with basic reagents such as tetrabutylammonium hydroxide in solvents such as tetrahydrofuran, dimethoxyethane or dioxane at temperatures from 0 to 120 °C. Other hydroxide reagents useful for this hydrolysis include potassium, lithium and sodium hydroxide (see, for example, WO 2009/086041). When the X group is lower alkoxy, hydrolysis of the X group can also be accomplished with dealkylation reagents such as boron tribromide or morpholine (see, for example, WO 2009/086041, WO 2013/160126 and WO 2013/050421).

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Scheme 7

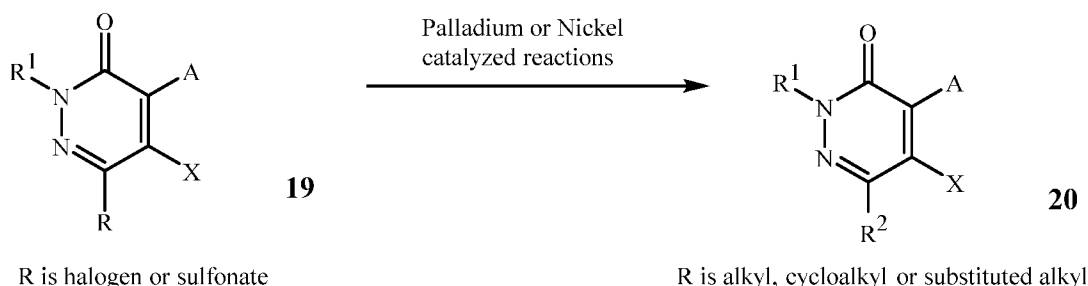
Introduction of a halogen at the 6-position of the pyridazinone can be accomplished by zincation followed by halogenation. For conditions, reagents and examples of zincation of pyridazinones, see Verhelst, T., Ph.D. thesis, University of Antwerp, 2012. Typically the pyridazinone of Formula **17** is treated in tetrahydrofuran with a solution of Zn(TMP)-LiCl or Zn(TMP)₂-MgCl₂-LiCl (i.e. 2,2,6,6-Bis(tetramethylpiperidine)zinc, magnesium chloride, lithium chloride complex in toluene/tetrahydrofuran) at -20 to 30 °C to form a zinc reagent. Subsequent addition of bromine, N-bromosuccinimide or iodine provides compounds of Formula **18** (wherein R² is Br or I, respectively). Reagents such as trichloroisocyanuric acid or 1,3-dichloro-5,5-dimethylhydantoin give a compound of Formula **18** (wherein R² is Cl). This method is shown in Scheme 8. For preparation of a variety of appropriate zincation reagents, see Wunderlich, S. Ph.D. thesis, University of Munich, 2010 and references cited therein, as well as WO 2008/138946 and WO 2010/092096. Zincation at the 6-position of the pyridazinone ring can be accomplished in the presence of aromatic/heteroaromatic substituents, alkoxy substituents or halogen at the 4-position of the pyridazinone ring, or in the presence of halogen or alkoxy substituents at the 5-position of the pyridazinone ring.

Scheme 8

The R² substituent of compounds of Formula **19** (wherein R² is halogen or sulfonate) can be further transformed into other functional groups. Compounds wherein R² is alkyl, cycloalkyl or substituted alkyl can be prepared by transition metal catalyzed reactions of compounds of Formula **19** as shown in Scheme 9. For reviews of these types of reactions, see: E. Negishi, *Handbook of Organopalladium Chemistry for Organic Synthesis*, John Wiley and Sons, Inc., New York, **2002**, N. Miyaura, *Cross-Coupling Reactions: A Practical Guide*, Springer, New York, **2002**, H. C. Brown et al., *Organic Synthesis via Boranes*, Aldrich Chemical Co., Milwaukee, Vol. 3, **2002**, Suzuki et al., *Chemical Reviews* **1995**, 95,

2457-2483 and Molander et al., *Accounts of Chemical Research* **2007**, 40, 275-286. Also see Tetrahedron Organic Chemistry Series Vol. 26: *Palladium in Heterocyclic Chemistry*, 2nd Ed., Gribble and Li, editors, Elsevier, Amsterdam, 2007. For a review of Buchwald-Hartwig chemistry see Yudin and Hartwig, *Catalyzed Carbon-Heteroatom Bond Formation*,
 5 2010, Wiley, New York.

Scheme 9

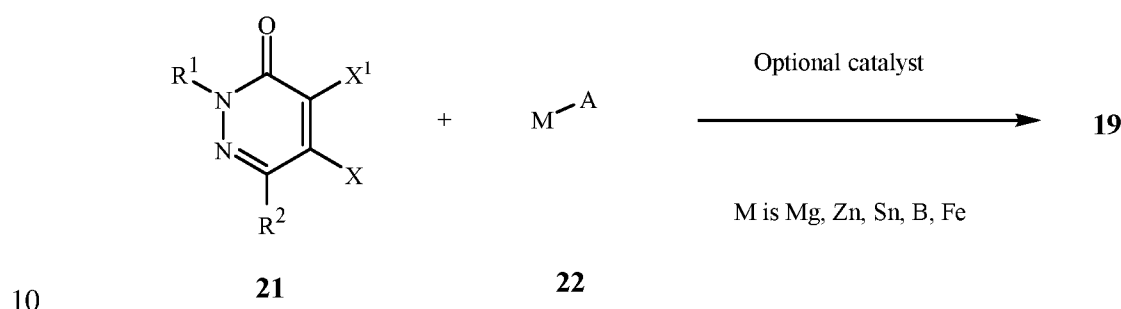


Related synthetic methods for the introduction of other functional groups at the R² position of Formula **21** are known in the art. Copper catalyzed reactions are useful for
 10 introducing the CF₃ group. For a comprehensive recent review of reagents for this reaction see Wu, Neumann and Beller in *Chemistry: An Asian Journal*, **2012**, ASAP, and references cited therein. For introduction of a sulfur containing substituent at this position, see methods disclosed in WO 2013/160126. For introduction of a cyano group, see WO 2014/031971. For introduction of a nitro group, see *J. Am. Chem. Soc.* **2009**, 12898. For
 15 introduction of a fluoro substituent, see *J. Am. Chem. Soc.* **2014**, 3792.

Compounds of Formula **19** can be prepared by reaction of organometallic reagents of Formula **22** with pyridazinones of Formula **21** with a reactive group at the 4-position, as shown in Scheme 10. Depending upon the leaving group a transition metal catalyst may be desirable. When the leaving group is lower alkoxy, *N*-linked azole (such as pyrazole or
 20 triazole) or sulfonate, no catalyst is required, and reaction directly with a magnesium reagent or lithium reagent can take place at the 4-position. This reaction can be done in a variety of solvents which do not react with organomagnesium reagents. Typical reaction conditions include tetrahydrofuran as the solvent, a reaction temperature of -20 to 65 °C, and an excess of the organomagnesium or organolithium reagent. When the reactive group at the
 25 4-position is halogen, a transition metal catalyst and ligand are helpful. A variety of different coupling partners can be used, including boron (Suzuki Reaction), tin (Stille Reaction), and zinc (Negishi reaction); these reactions can be catalyzed by palladium and nickel catalysts with a wide variety of ligands. Conditions for these reactions are known in the art; see, for example, *Palladium-Catalyzed Coupling Reactions: Practical Aspects and
 30 Future Development* Edited by Arpad Molnar, Wiley, 2013 and references cited within. The organomagnesium reagents used in the non-catalyzed process can be prepared by direct

insertion of magnesium into a carbon-halogen bond (optionally in the presence of a lithium halide), by a Grignard exchange reaction with an *i*-propylmagnesium halide (optionally in the presence of a lithium halide), or by transformation of an organolithium reagent by reaction with a magnesium salt such as magnesium bromide etherate. A variety of groups which are inert toward the organomagnesium reagents can be present at R² and at the 5-position of the pyridazinone in these reactions. Compounds of Formula **21** can be prepared according to methods found in Knochel et al. *Angew.* **2011**, 50, 9794-9824, and *Heterocycles* **2014**, 88, 827-844.

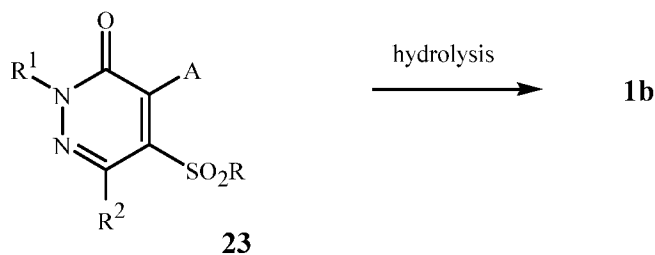
Scheme 10



Compounds of Formula **21** are known in the art or can be prepared by methods described by Maes and Lemiere in *Comprehensive Heterocyclic Chemistry III Volume 8*, Katritsky, Ramsden, Scriven and Taylor editors and references cited therein. See also Verhelst, Ph.D. thesis University of Antwerp and references cited therein. Functional group transformations on pyridazinones are also described in Stevenson et. al. *J. Heterocyclic Chem.* **2005**, 42, 427; U.S. Pat. No. 6,077,953; WO 2009/086041 and references cited therein; U.S. Pat. No. 2,782,195; WO 2013/160126; and WO 2013/050421.

Compounds of Formula **1b** can also be prepared by hydrolysis of sulfones of Formula **23** in aqueous base. Suitable bases include sodium, potassium or tetrabutylammonium hydroxide. Typical reaction temperatures range from 0 to 80 °C, and typical reaction times are 1–12 hours. This method is shown in Scheme 11.

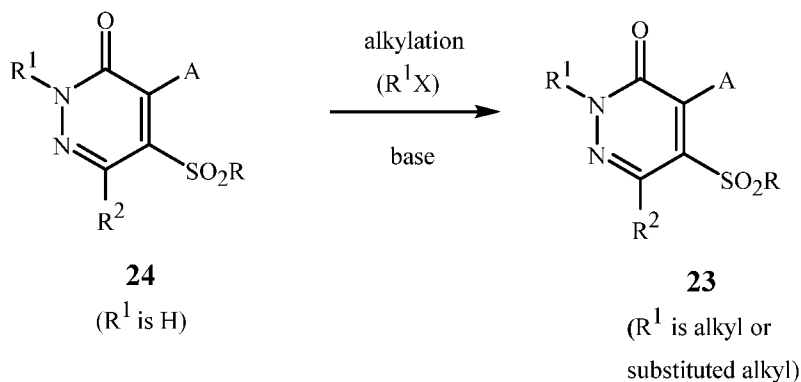
Scheme 11



Compounds of Formula **23** can be prepared by the alkylation of compounds of Formula **24** wherein R¹ is H with alkyl halides and sulfonates. Typical bases useful in this

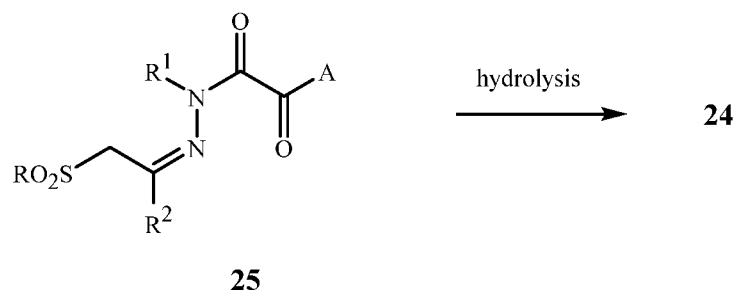
method include potassium, sodium or cesium carbonate. Typical solvents include acetonitrile, tetrahydrofuran or *N,N*-dimethylformamide as shown in Scheme 12.

Scheme 12



- 5 Compounds of Formula **24** can be prepared by the cyclization of compounds of Formula **25** by treatment with base. Typical bases useful in this method include potassium, sodium or cesium carbonate. Typical solvents include acetonitrile, tetrahydrofuran or *N,N*-dimethylformamide as shown in Scheme 13.

Scheme 13

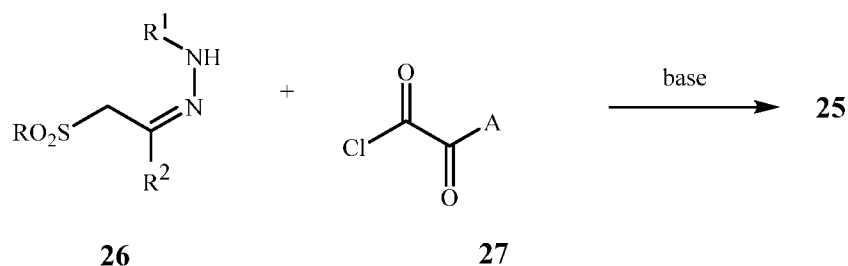


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Compounds of Formula **25** can be prepared by the method shown in Scheme 14. In this method, compounds of Formula **26** are coupled with compounds of Formula **27** in the presence of a base. Bases useful in this method include triethylamine, sodium or potassium carbonate, pyridine or diisopropylethylamine.

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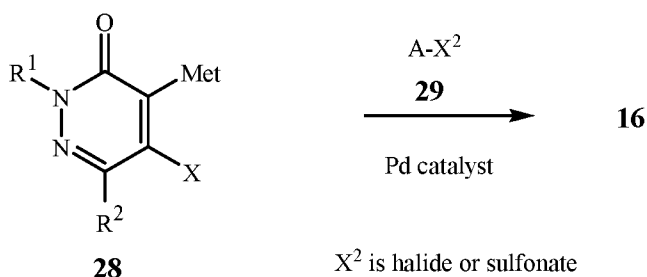
Scheme 14



Compounds of Formula **26** can be prepared by methods known in the art.

Compounds of Formula **16** can be prepared by coupling reactions of organometallic pyridazinone coupling partners of Formula **28** with heteroaryl halides and sulfonates of Formula **29**. The organometallic coupling partner can be, for example, an organozinc, organomagnesium, organotin, or organoboron reagent. Palladium catalysts such as palladium tetrakis (triphenylphosphine) and those generated from other palladium sources, such as Pd₂dba₃ and Pd(OAc)₂, and a phosphine or N-heterocyclic carbene ligand can be used in the coupling procedures (Maes et al. *J. Org. Chem.* **2011**, 76, 9648-9659). Palladium precatalysts based on dialkyl biarylphosphine ligands, such as X-Phos, S-Phos and Ru-Phos (Buchwald *et al. Angew. Chem. Int. Ed.*, **2013**, 52(2), 615-619.), or precatalysts derived from N-heterocyclic carbene ligands such as PEPPSI-i-Pr and PEPPSI-i-Pent (Organ *et al. Eur. J. Org. Chem.* 2010, 4343–4354) can effect this coupling as well. The reaction can be carried out in solvents such as tetrahydrofuran, dimethoxyethane, N-Methyl-2-pyrrolidone and dioxane. Coupling partners may be either heterocyclic halides or sulfonates. A particularly useful class of coupling partners for the reaction are those based on nonaflates (OSO₂C₄F₉) of heteroaromatic compounds. Halogenated heterocyclic coupling partners are commercially available or known in the literature. Other useful classes of heterocyclic halides and synthetic routes are given in Tetrahedron Organic Chemistry Series Vol. 26: *Palladium in Heterocyclic Chemistry*, 2nd Ed., Gribble and Li, editors, Elsevier, Amsterdam, 2007.

Scheme 15

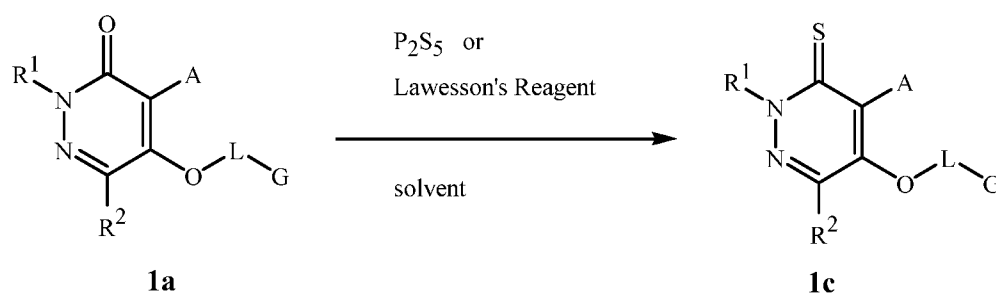


Zincation of the 4-position of a pyridazinone can be accomplished with zincation reagents such as 2,2,6,6-Bis(tetramethylpiperidine)zinc, magnesium chloride, lithium chloride complex in toluene/tetrahydrofuran (i.e. Zn(TMP)-LiCl or Zn(TMP)₂-MgCl₂-LiCl).

Magnesiumation of this position can also be accomplished by treatment with Mg(TMP)-LiCl. See Verhelst, T., Ph.D. thesis, University of Antwerp, 2012 for conditions for pyridazinone metallation and for palladium catalyzed cross-coupling of 4-zincated and 4-magnesiated pyridazinones. The synthesis and cross-coupling conditions for 4-stannylpyridazinones are known from Stevenson et. al. *J. Heterocyclic Chem.* **2005**, 42, 427.

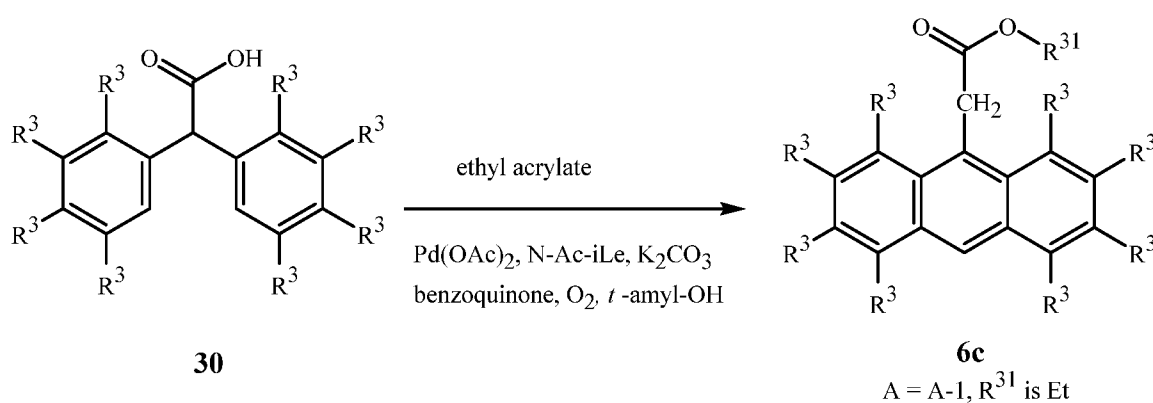
As shown in Scheme 16, pyridazinones of Formula **1a** (a subset of compounds of Formula **1** where W is O) can be thionated to give the corresponding thiones of Formula **1c** (i.e. Formula **1** wherein W is S) with a thionation reagent that is generally phosphorus pentasulfide in pyridine or Lawesson's reagent (2,4-bis-(4-methoxyphenyl)-1,3-dithia-2,4-diphosphetane 2,4-disulfide) in an appropriate solvent (e.g., toluene, tetrahydrofuran or dioxane) at temperatures generally ranging 0 °C to room temperature.

Scheme 16



Compounds of Formula **6c**, wherein A=A-1 and R³¹=Et, can be prepared by the reaction of di-aryl acetic acids of Formula **30** with ethyl acrylate in the presence of palladium(II) acetate, benzoquinone, N-acetyl-isoleucine, and potassium carbonate in *tert*-amyl alcohol under an oxygen atmosphere, using procedures described in *Angew. Chem. Int. Ed.*, **2016**, 55, 8652-8655 and as depicted in Scheme 17.

Scheme 17



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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 a valuable resource that illustrates the interconversion of functional groups in a simple and straightforward fashion, see Larock, R. C., *Comprehensive Organic Transformations: A Guide to Functional Group Preparations*, 2nd Ed., Wiley-VCH, New York, 1999. For example, intermediates for the preparation of compounds of Formula **1** may contain aromatic nitro groups, which can be reduced to amino groups, and then be converted via reactions well known in the art

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such as the Sandmeyer reaction, to various halides, providing compounds of Formula 1. The above reactions can also in many cases be performed in alternate order

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 recognize that, in some cases, after the introduction of a given reagent as depicted in any individual scheme, it may be necessary to perform additional routine synthetic steps not described in detail 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 presented to prepare the compounds of Formula 1.

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 non-limiting Examples are illustrative of the invention. 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. 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. All NMR spectra are reported in CDCl₃ downfield from tetramethylsilane at 500 MHz unless otherwise indicated where s means singlet, brs means broad singlet, d means doublet, t means triplet and m means multiplet.

SYNTHESIS EXAMPLE 1

Preparation of 4-(9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone
(Compound 1)

Step A: Preparation of 4-(9-anthracenyl)-6-chloro-5-methoxy-2-methyl-3(2*H*)-pyridazinone

To a solution of 2,2,6,6-tetramethylpiperidinylmagnesium chloride lithium chloride complex solution (1.0 M in tetrahydrofuran/toluene, 38.0 mL, 38.0 mmol) was added a

solution of zinc chloride (10 mL of a 1.9 M solution in 2-methyltetrahydrofuran, 19.0 mmol) at a temperature below 15 °C using an ice-water cooling bath. The resulting solution was stirred at 5 °C for 15 min and at 25 °C for 45 min. The resulting solution of bis(2,2,6,6-tetramethylpiperidiny)zinc, lithium chloride, magnesium chloride complex was then transferred to an addition funnel and added dropwise to a suspension of 6-chloro-5-methoxy-2-methyl-3(2*H*)-pyridazinone (3.0 g, 17.2 mmol) and tetrahydrofuran (86 mL) at -40 °C. The resulting solution was stirred at -40 °C for 15 min, warmed to 5 °C, and stirred at 5 °C for 45 min. The solution was treated successively with 9-bromoanthracene (4.2 g, 16.3 mmol), and SPhos pre-catalyst-G2 (chloro(2-dicyclohexylphosphino-2',6'-dimethoxy-1,1'-biphenyl)[2-(2'-amino-1,1'-biphenyl)]palladium(II), 1.2 g, 1.7 mmol). The resulting dark brown solution was heated at the reflux temperature of the solvent for 3 h, cooled to ambient temperature, and concentrated. The residue was partitioned between ethyl acetate and saturated aqueous ammonium chloride solution, the resulting aqueous layer was extracted with ethyl acetate, and the combined organic layers were washed successively with water and brine, dried over anhydrous MgSO₄, filtered and concentrated to give 8.63 g of a yellow oil. The oil was purified by silica gel (330 g) column chromatography eluting with a gradient of 0% to 100% ethyl acetate in hexanes to provide 3.35 g of the title compound as an oily solid.

¹H NMR δ 8.57 (s, 1H), 8.08–8.03 (m, 2H), 7.69–7.63 (m, 2H), 7.53–7.45 (m, 4H), 3.82 (s, 3H), 3.05 (s, 3H).

Step B: Preparation of 4-(9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone

A mixture of 2.15 g (6.1 mmol) of the product from Step A and morpholine (12 mL) was heated at 100 °C for 2 h. The resulting reaction mixture was concentrated and the residue was triturated with diethyl ether. After filtration, the resulting solid was washed with diethyl ether and dried on a fritted funnel. The resulting solid was suspended in aqueous 1 N hydrochloric acid (ca. 30 mL), stirred for 2 h at ambient temperature, and filtered. The solid was washed with water and dried under vacuum to give 1.50 g of the title compound, a compound of this invention, as a light yellow solid.

¹H NMR (DMSO-*d*₆) δ 8.70 (s, 1H), 8.15 (d, 2H), 7.68 (d, 2H), 7.52 (t, 2H), 7.45 (t, 2H), 5.75 (s, 1H), 3.67 (s, 3H).

SYNTHESIS EXAMPLE 2

Preparation of 6-chloro-4-(10-chloro-9-anthracenyl)-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 2)

Step A: Preparation of 6-chloro-4-(10-chloro-9-anthracenyl)-5-methoxy-2-methyl-3(2*H*)-pyridazinone

A solution of the product of Step A of Synthesis Example 1 (143 mg, 0.41 mmol), *N*-chlorosuccinimide (65 mg, 0.49 mmol) and chloroform (4 mL) was stirred at room temperature for 15 h. The resulting solution was diluted with dichloromethane and washed twice with water, the organic layer was dried over anhydrous MgSO₄, filtered and concentrated to give 160 mg of the title compound as a yellow glass. The crude product was used in the next step without further purification.

¹H NMR δ 8.60 (d, 2H), 7.69 (d, 2H), 7.62 (distorted t, 2H), 7.53 (distorted t, 2H), 3.82 (s, 3H), 3.09 (s, 3H).

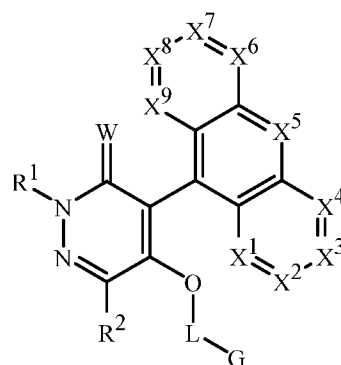
Step B: Preparation of 6-chloro-4-(10-chloro-9-anthracenyl)-5-hydroxy-2-methyl-3(2*H*)-pyridazinone

A suspension of 155 mg of the product of Step A and morpholine (1 mL) was heated at 100 °C for 2 h. The resulting mixture was diluted with diethyl ether (5 mL), stirred for 30 min, and the resulting supernatant liquid was decanted away from the solid product. The solid product was partitioned between dichloromethane and aqueous 1 N hydrochloric acid, the organic layer was dried over anhydrous MgSO₄, filtered, and concentrated to give 120 mg of the title compound, a compound of this invention, as a yellow solid.

¹H NMR (DMSO-*d*₆) δ 8.52 (d, 2H), 7.61 (d, 2H), 7.74 (distorted t, 2H), 7.56 (distorted t, 2H), 3.67 (s, 3H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to (960) can be prepared. The following abbreviations are used in the Tables which follow: *t* means tertiary, *s* means secondary, *n* means normal, *i* means iso, *c* means cyclo, Me means methyl, Et means ethyl, Pr means propyl, Bu means butyl, *i*-Pr means isopropyl, *c*-Pr means cyclopropyl, *t*-Bu means tertiary butyl, Ph means phenyl, OMe means methoxy, OEt means ethoxy, SMe means methylthio, -CN means cyano, -NO₂ means nitro, TMS means trimethylsilyl, SOMe means methylsulfinyl, C₂F₅ means CF₂CF₃ and SO₂Me means methylsulfonyl.

TABLE 1



W=O, R¹=Me, R²=Me, L-G=H and the remaining variables are defined below

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	CH	CH	CF	CH	CH	CH	CH
CH	CH	CH	CH	CCl	CH	CH	CH	CH
CH	CH	CH	CH	CBr	CH	CH	CH	CH
CH	CH	CH	CH	Cl	CH	CH	CH	CH
CH	CH	CH	CH	COCH ₃	CH	CH	CH	CH
CH	CH	CH	CH	CCF ₃	CH	CH	CH	CH
CH	CH	CH	CH	COCF ₂ H	CH	CH	CH	CH
CH	CH	CH	CH	COCF ₃	CH	CH	CH	CH
CH	CH	CH	CH	CCH ₃	CH	CH	CH	CH
CH	CH	CH	CH	CCCH ₂ CH ₃	CH	CH	CH	CH
CH	CH	CH	CH	CNO ₂	CH	CH	CH	CH
CH	CH	CH	CH	N	CH	CH	CH	CH
CH	CF	CH	CH	CH	CH	CH	CH	CH
CH	CCl	CH	CH	CH	CH	CH	CH	CH
CH	CBr	CH	CH	CH	CH	CH	CH	CH
CH	Cl	CH	CH	CH	CH	CH	CH	CH
CH	COCH ₃	CH	CH	CH	CH	CH	CH	CH
CH	CCF ₃	CH	CH	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	CH	CH	CH	CH
CH	COCF ₃	CH	CH	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CH	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CH	CH	CH	CH
CH	N	CH	CH	CH	CH	CH	CH	CH
CH	CH	CH	CF	CH	CH	CH	CH	CH
CH	CH	CH	CCl	CH	CH	CH	CH	CH
CH	CH	CH	CBr	CH	CH	CH	CH	CH
CH	CH	CH	Cl	CH	CH	CH	CH	CH
CH	CH	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CH	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	CH	CH	CH	CH
CH	CH	CH	COCF ₃	CH	CH	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CH	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CH	CH	CH	CH
CH	CH	CH	N	CH	CH	CH	CH	CH
CH	CF	CH	CH	CH	CH	CH	CF	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CF	CH	CH	CH	CH	CH	CCl	CH
CH	CF	CH	CH	CH	CH	CH	CBr	CH
CH	CF	CH	CH	CH	CH	CH	Cl	CH
CH	CF	CH	CH	CH	CH	CH	COCH ₃	CH
CH	CF	CH	CH	CH	CH	CH	CCF ₃	CH
CH	CF	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	CF	CH	CH	CH	CH	CH	COCF ₃	CH
CH	CF	CH	CH	CH	CH	CH	CCH ₃	CH
CH	CF	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH
CH	CF	CH	CH	CH	CH	CH	CNO ₂	CH
CH	CF	CH	CH	CH	CH	CH	N	CH
CH	CCl	CH	CH	CH	CH	CH	CCl	CH
CH	CCl	CH	CH	CH	CH	CH	CBr	CH
CH	CCl	CH	CH	CH	CH	CH	Cl	CH
CH	CCl	CH	CH	CH	CH	CH	COCH ₃	CH
CH	CCl	CH	CH	CH	CH	CH	CCF ₃	CH
CH	CCl	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	CCl	CH	CH	CH	CH	CH	COCF ₃	CH
CH	CCl	CH	CH	CH	CH	CH	CCH ₃	CH
CH	CCl	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH
CH	CCl	CH	CH	CH	CH	CH	CNO ₂	CH
CH	CCl	CH	CH	CH	CH	CH	N	CH
CH	CBr	CH	CH	CH	CH	CH	CBr	CH
CH	CBr	CH	CH	CH	CH	CH	Cl	CH
CH	CBr	CH	CH	CH	CH	CH	COCH ₃	CH
CH	CBr	CH	CH	CH	CH	CH	CCF ₃	CH
CH	CBr	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	CBr	CH	CH	CH	CH	CH	COCF ₃	CH
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CH	CBr	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH
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CH	Cl	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	Cl	CH	CH	CH	CH	CH	COCF ₃	CH
CH	Cl	CH	CH	CH	CH	CH	CCH ₃	CH
CH	Cl	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	Cl	CH	CH	CH	CH	CH	CNO ₂	CH
CH	Cl	CH	CH	CH	CH	CH	N	CH
CH	COCH ₃	CH	CH	CH	CH	CH	COCH ₃	CH
CH	COCH ₃	CH	CH	CH	CH	CH	CCF ₃	CH
CH	COCH ₃	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	COCH ₃	CH	CH	CH	CH	CH	COCF ₃	CH
CH	COCH ₃	CH	CH	CH	CH	CH	CCH ₃	CH
CH	COCH ₃	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH
CH	COCH ₃	CH	CH	CH	CH	CH	CNO ₂	CH
CH	COCH ₃	CH	CH	CH	CH	CH	N	CH
CH	CCF ₃	CH	CH	CH	CH	CH	CCF ₃	CH
CH	CCF ₃	CH	CH	CH	CH	CH	COCF ₂ H	CH
CH	CCF ₃	CH	CH	CH	CH	CH	COCF ₃	CH
CH	CCF ₃	CH	CH	CH	CH	CH	CCH ₃	CH
CH	CCF ₃	CH	CH	CH	CH	CH	CCCH ₂ CH ₃	CH
CH	CCF ₃	CH	CH	CH	CH	CH	CNO ₂	CH
CH	CCF ₃	CH	CH	CH	CH	CH	N	CH
CH	COCF ₂ H	CH	CH	CH	CH	CH	COCF ₂ H	CH
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CH	N	CH	CH	CH	CH	CH	N	CH
CH	CF	CH	CH	CCl	CH	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
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CH	CBr	CH	CH	CCl	CH	CH	CH	CH
CH	Cl	CH	CH	CCl	CH	CH	CH	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	CH	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	CH	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CNO ₂	CH	CH	CCl	CH	CH	CH	CH
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CH	CCF ₃	CH	CH	CBr	CH	CH	CH	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	CH	CH
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CH	CCH ₃	CH	CH	CBr	CH	CH	CH	CH
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CH	CF	CH	CH	CCl	CH	CH	CCF ₃	CH
CH	CF	CH	CH	CCl	CH	CH	COCF ₂ H	CH
CH	CF	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	CF	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	CF	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	CF	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	CF	CH	CH	CCl	CH	CH	N	CH
CH	CCl	CH	CH	CCl	CH	CH	CCl	CH
CH	CCl	CH	CH	CCl	CH	CH	CBr	CH
CH	CCl	CH	CH	CCl	CH	CH	Cl	CH
CH	CCl	CH	CH	CCl	CH	CH	COCH ₃	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
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CH	CBr	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
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CH	Cl	CH	CH	CCl	CH	CH	CCF ₃	CH
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CH	Cl	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	Cl	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	Cl	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	Cl	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	Cl	CH	CH	CCl	CH	CH	N	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	COCH ₃	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	CCF ₃	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	COCF ₂ H	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	COCH ₃	CH	CH	CCl	CH	CH	N	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	CCF ₃	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	COCF ₂ H	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CCF ₃	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	CCF ₃	CH	CH	CCl	CH	CH	N	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	COCF ₂ H	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	COCF ₂ H	CH	CH	CCl	CH	CH	N	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	COCF ₃	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	COCF ₃	CH	CH	CCl	CH	CH	N	CH
CH	CCH ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CH	CCH ₃	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	CCH ₃	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	CCH ₃	CH	CH	CCl	CH	CH	N	CH
CH	CCCH ₂ CH ₃	CH	CH	CCl	CH	CH	CCCH ₂ CH ₃	CH
CH	CCCH ₂ CH ₃	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	CCCH ₂ CH ₃	CH	CH	CCl	CH	CH	N	CH
CH	C-NO ₂	CH	CH	CCl	CH	CH	CNO ₂	CH
CH	C-NO ₂	CH	CH	CCl	CH	CH	N	CH
CH	N	CH	CH	CCl	CH	CH	N	CH
CH	CF	CH	CH	CBr	CH	CH	CF	CH
CH	CF	CH	CH	CBr	CH	CH	CCl	CH
CH	CF	CH	CH	CBr	CH	CH	CBr	CH
CH	CF	CH	CH	CBr	CH	CH	Cl	CH
CH	CF	CH	CH	CBr	CH	CH	COCH ₃	CH
CH	CF	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	CF	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	CF	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	CF	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	CF	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	CF	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CF	CH	CH	CBr	CH	CH	N	CH
CH	CCl	CH	CH	CBr	CH	CH	CCl	CH
CH	CCl	CH	CH	CBr	CH	CH	CBr	CH
CH	CCl	CH	CH	CBr	CH	CH	Cl	CH
CH	CCl	CH	CH	CBr	CH	CH	COCH ₃	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CCl	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	CCl	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	CCl	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	CCl	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	CCl	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	CCl	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CCl	CH	CH	CBr	CH	CH	N	CH
CH	CBr	CH	CH	CBr	CH	CH	CBr	CH
CH	CBr	CH	CH	CBr	CH	CH	Cl	CH
CH	CBr	CH	CH	CBr	CH	CH	COCH ₃	CH
CH	CBr	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	CBr	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	CBr	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	CBr	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	CBr	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	CBr	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CBr	CH	CH	CBr	CH	CH	N	CH
CH	Cl	CH	CH	CBr	CH	CH	Cl	CH
CH	Cl	CH	CH	CBr	CH	CH	COCH ₃	CH
CH	Cl	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	Cl	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	Cl	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	Cl	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	Cl	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	Cl	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	Cl	CH	CH	CBr	CH	CH	N	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	COCH ₃	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	COCH ₃	CH	CH	CBr	CH	CH	N	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	CCF ₃	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CCF ₃	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CCF ₃	CH	CH	CBr	CH	CH	N	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	COCF ₂ H	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	COCF ₂ H	CH	CH	CBr	CH	CH	N	CH
CH	COCF ₃	CH	CH	CBr	CH	CH	COCF ₃	CH
CH	COCF ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	COCF ₃	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	COCF ₃	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	COCF ₃	CH	CH	CBr	CH	CH	N	CH
CH	CCH ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CH	CCH ₃	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	CCH ₃	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CCH ₃	CH	CH	CBr	CH	CH	N	CH
CH	CCCH ₂ CH ₃	CH	CH	CBr	CH	CH	CCCH ₂ CH ₃	CH
CH	CCCH ₂ CH ₃	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CCCH ₂ CH ₃	CH	CH	CBr	CH	CH	N	CH
CH	CNO ₂	CH	CH	CBr	CH	CH	CNO ₂	CH
CH	CNO ₂	CH	CH	CBr	CH	CH	N	CH
CH	N	CH	CH	CBr	CH	CH	N	CH
CH	CH	CH	CF	CH	CF	CH	CH	CH
CH	CH	CH	CCl	CH	CF	CH	CH	CH
CH	CH	CH	CBr	CH	CF	CH	CH	CH
CH	CH	CH	Cl	CH	CF	CH	CH	CH
CH	CH	CH	COCH ₃	CH	CF	CH	CH	CH
CH	CH	CH	CCF ₃	CH	CF	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	CF	CH	CH	CH
CH	CH	CH	COCF ₃	CH	CF	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CF	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CF	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CF	CH	CH	CH
CH	CH	CH	N	CH	CF	CH	CH	CH
CH	CH	CH	CCl	CH	CCl	CH	CH	CH
CH	CH	CH	CBr	CH	CCl	CH	CH	CH
CH	CH	CH	Cl	CH	CCl	CH	CH	CH
CH	CH	CH	COCH ₃	CH	CCl	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CH	CH	CCF ₃	CH	CCl	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	CCl	CH	CH	CH
CH	CH	CH	COCF ₃	CH	CCl	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CCl	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CCl	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CCl	CH	CH	CH
CH	CH	CH	N	CH	CCl	CH	CH	CH
CH	CH	CH	CBr	CH	CBr	CH	CH	CH
CH	CH	CH	Cl	CH	CBr	CH	CH	CH
CH	CH	CH	COCH ₃	CH	CBr	CH	CH	CH
CH	CH	CH	CCF ₃	CH	CBr	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	CBr	CH	CH	CH
CH	CH	CH	COCF ₃	CH	CBr	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CBr	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CBr	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CBr	CH	CH	CH
CH	CH	CH	N	CH	CBr	CH	CH	CH
CH	CH	CH	Cl	CH	Cl	CH	CH	CH
CH	CH	CH	COCH ₃	CH	Cl	CH	CH	CH
CH	CH	CH	CCF ₃	CH	Cl	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	Cl	CH	CH	CH
CH	CH	CH	COCF ₃	CH	Cl	CH	CH	CH
CH	CH	CH	CCH ₃	CH	Cl	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	Cl	CH	CH	CH
CH	CH	CH	CNO ₂	CH	Cl	CH	CH	CH
CH	CH	CH	N	CH	Cl	CH	CH	CH
CH	CH	CH	COCH ₃	CH	COCH ₃	CH	CH	CH
CH	CH	CH	CCF ₃	CH	COCH ₃	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	COCH ₃	CH	CH	CH
CH	CH	CH	COCF ₃	CH	COCH ₃	CH	CH	CH
CH	CH	CH	CCH ₃	CH	COCH ₃	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	COCH ₃	CH	CH	CH
CH	CH	CH	CNO ₂	CH	COCH ₃	CH	CH	CH
CH	CH	CH	N	CH	COCH ₃	CH	CH	CH
CH	CH	CH	CCF ₃	CH	CCF ₃	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	CCF ₃	CH	CH	CH
CH	CH	CH	COCF ₃	CH	CCF ₃	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CCF ₃	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CCF ₃	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CH	CH	CNO ₂	CH	CCF ₃	CH	CH	CH
CH	CH	CH	N	CH	CCF ₃	CH	CH	CH
CH	CH	CH	COCF ₂ H	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	COCF ₃	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	CCH ₃	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	CNO ₂	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	N	CH	COCF ₂ H	CH	CH	CH
CH	CH	CH	COCF ₃	CH	COCF ₃	CH	CH	CH
CH	CH	CH	CCH ₃	CH	COCF ₃	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	COCF ₃	CH	CH	CH
CH	CH	CH	CNO ₂	CH	COCF ₃	CH	CH	CH
CH	CH	CH	N	CH	COCF ₃	CH	CH	CH
CH	CH	CH	CCH ₃	CH	CCH ₃	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CCH ₃	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CCH ₃	CH	CH	CH
CH	CH	CH	N	CH	CCH ₃	CH	CH	CH
CH	CH	CH	CCCH ₂ CH ₃	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	CH	CH	N	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	CH	CH	CNO ₂	CH	CNO ₂	CH	CH	CH
CH	CH	CH	N	CH	CNO ₂	CH	CH	CH
CH	CH	CH	N	CH	N	CH	CH	CH
CH	CF	CH	CH	CH	CF	CH	CH	CH
CH	CCl	CH	CH	CH	CF	CH	CH	CH
CH	CBr	CH	CH	CH	CF	CH	CH	CH
CH	Cl	CH	CH	CH	CF	CH	CH	CH
CH	COCH ₃	CH	CH	CH	CF	CH	CH	CH
CH	CCF ₃	CH	CH	CH	CF	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	CF	CH	CH	CH
CH	COCF ₃	CH	CH	CH	CF	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CF	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CF	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CF	CH	CH	CH
CH	N	CH	CH	CH	CF	CH	CH	CH
CH	CCl	CH	CH	CH	CCl	CH	CH	CH
CH	CBr	CH	CH	CH	CCl	CH	CH	CH
CH	Cl	CH	CH	CH	CCl	CH	CH	CH
CH	COCH ₃	CH	CH	CH	CCl	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CCF ₃	CH	CH	CH	CCl	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	CCl	CH	CH	CH
CH	COCF ₃	CH	CH	CH	CCl	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CCl	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CCl	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CCl	CH	CH	CH
CH	N	CH	CH	CH	CCl	CH	CH	CH
CH	CBr	CH	CH	CH	CBr	CH	CH	CH
CH	Cl	CH	CH	CH	CBr	CH	CH	CH
CH	COCH ₃	CH	CH	CH	CBr	CH	CH	CH
CH	CCF ₃	CH	CH	CH	CBr	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	CBr	CH	CH	CH
CH	COCF ₃	CH	CH	CH	CBr	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CBr	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CBr	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CBr	CH	CH	CH
CH	N	CH	CH	CH	CBr	CH	CH	CH
CH	Cl	CH	CH	CH	Cl	CH	CH	CH
CH	COCH ₃	CH	CH	CH	Cl	CH	CH	CH
CH	CCF ₃	CH	CH	CH	Cl	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	Cl	CH	CH	CH
CH	COCF ₃	CH	CH	CH	Cl	CH	CH	CH
CH	CCH ₃	CH	CH	CH	Cl	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	Cl	CH	CH	CH
CH	CNO ₂	CH	CH	CH	Cl	CH	CH	CH
CH	N	CH	CH	CH	Cl	CH	CH	CH
CH	COCH ₃	CH	CH	CH	COCH ₃	CH	CH	CH
CH	CCF ₃	CH	CH	CH	COCH ₃	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	COCH ₃	CH	CH	CH
CH	COCF ₃	CH	CH	CH	COCH ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	COCH ₃	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	COCH ₃	CH	CH	CH
CH	CNO ₂	CH	CH	CH	COCH ₃	CH	CH	CH
CH	N	CH	CH	CH	COCH ₃	CH	CH	CH
CH	CCF ₃	CH	CH	CH	CCF ₃	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	CCF ₃	CH	CH	CH
CH	COCF ₃	CH	CH	CH	CCF ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CCF ₃	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CCF ₃	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	CNO ₂	CH	CH	CH	CCF ₃	CH	CH	CH
CH	N	CH	CH	CH	CCF ₃	CH	CH	CH
CH	COCF ₂ H	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	COCF ₃	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	CCH ₃	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	CNO ₂	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	N	CH	CH	CH	COCF ₂ H	CH	CH	CH
CH	COCF ₃	CH	CH	CH	COCF ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	COCF ₃	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	COCF ₃	CH	CH	CH
CH	CNO ₂	CH	CH	CH	COCF ₃	CH	CH	CH
CH	N	CH	CH	CH	COCF ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CCH ₃	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CCH ₃	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CCH ₃	CH	CH	CH
CH	N	CH	CH	CH	CCH ₃	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CH	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	N	CH	CH	CH	CCCH ₂ CH ₃	CH	CH	CH
CH	CNO ₂	CH	CH	CH	CNO ₂	CH	CH	CH
CH	N	CH	CH	CH	CNO ₂	CH	CH	CH
CH	N	CH	CH	CH	N	CH	CH	CH
CH	CF	CH	CF	CH	CH	CH	CH	CH
CH	CCl	CH	CF	CH	CH	CH	CH	CH
CH	CBr	CH	CF	CH	CH	CH	CH	CH
CH	Cl	CH	CF	CH	CH	CH	CH	CH
CH	COCH ₃	CH	CF	CH	CH	CH	CH	CH
CH	CCF ₃	CH	CF	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	CF	CH	CH	CH	CH	CH
CH	COCF ₃	CH	CF	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CF	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CF	CH	CH	CH	CH	CH
CH	CNO ₂	CH	CF	CH	CH	CH	CH	CH
CH	N	CH	CF	CH	CH	CH	CH	CH
CH	CF	CH	CCl	CH	CH	CH	CH	CH
CH	CCl	CH	CCl	CH	CH	CH	CH	CH
CH	CBr	CH	CCl	CH	CH	CH	CH	CH
CH	Cl	CH	CCl	CH	CH	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	COCH ₃	CH	CCl	CH	CH	CH	CH	CH
CH	CCF ₃	CH	CCl	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	CCl	CH	CH	CH	CH	CH
CH	COCF ₃	CH	CCl	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CCl	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CCl	CH	CH	CH	CH	CH
CH	CNO ₂	CH	CCl	CH	CH	CH	CH	CH
CH	N	CH	CCl	CH	CH	CH	CH	CH
CH	CF	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CCl	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CBr	CH	COCH ₃	CH	CH	CH	CH	CH
CH	Cl	CH	COCH ₃	CH	CH	CH	CH	CH
CH	COCH ₃	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CCF ₃	CH	COCH ₃	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	COCH ₃	CH	CH	CH	CH	CH
CH	COCF ₃	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CCH ₃	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CNO ₂	CH	COCH ₃	CH	CH	CH	CH	CH
CH	N	CH	COCH ₃	CH	CH	CH	CH	CH
CH	CF	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CCl	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CBr	CH	CCH ₃	CH	CH	CH	CH	CH
CH	Cl	CH	CCH ₃	CH	CH	CH	CH	CH
CH	COCH ₃	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CCF ₃	CH	CCH ₃	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	CCH ₃	CH	CH	CH	CH	CH
CH	COCF ₃	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CNO ₂	CH	CCH ₃	CH	CH	CH	CH	CH
CH	N	CH	CCH ₃	CH	CH	CH	CH	CH
CH	CF	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CCl	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CBr	CH	CCF ₃	CH	CH	CH	CH	CH
CH	Cl	CH	CCF ₃	CH	CH	CH	CH	CH
CH	COCH ₃	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CCF ₃	CH	CCF ₃	CH	CH	CH	CH	CH
CH	COCF ₂ H	CH	CCF ₃	CH	CH	CH	CH	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CH	COCF ₃	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CCCH ₂ CH ₃	CH	CCF ₃	CH	CH	CH	CH	CH
CH	CNO ₂	CH	CCF ₃	CH	CH	CH	CH	CH
CH	N	CH	CCF ₃	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	CF	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	C-Cl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	CCH ₃	CH	CH	CH	CH	CH	CH
CF	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CH	CCH ₃	CF	CH	CH	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CH	CCH ₃	CCl	CH	CH	CH	CH	CH	CH
CBr	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CH	CH	CH	CCH ₃	CH
CCl	CCH ₃	CH	CH	CH	CH	CH	CCl	CH
CCl	CCH ₃	CH	CH	CH	CH	CH	CF	CH
CCl	CCl	CH	CH	CH	CH	CH	CCH ₃	CH
CCl	CF	CH	CH	CH	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CH	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CH	CH	CH	CCl	CH
CBr	CCH ₃	CH	CH	CH	CH	CH	CF	CH
CBr	CCl	CH	CH	CH	CH	CH	CCH ₃	CH
CBr	CF	CH	CH	CH	CH	CH	CCH ₃	CH
CF	CH	CH	CH	CCl	CH	CH	CH	CH
CH	CH	CF	CH	CCl	CH	CH	CH	CH
CCl	CH	CH	CH	CCl	CH	CH	CH	CH
CH	CH	C-Cl	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH	CH	CH
CH	CH	CCH ₃	CH	CCl	CH	CH	CH	CH
CF	CCH ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CCH ₃	CF	CH	CCl	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CCl	CH	CH	CH	CH
CH	CCH ₃	CCl	CH	CCl	CH	CH	CH	CH
CBr	CCH ₃	CH	CH	CCl	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CCl	CCH ₃	CH	CH	CCl	CH	CH	CCl	CH

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹
CCl	CCH ₃	CH	CH	CCl	CH	CH	CF	CH
CCl	CCl	CH	CH	CCl	CH	CH	CCH ₃	CH
CCl	CF	CH	CH	CCl	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CCl	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CCl	CH	CH	CCl	CH
CBr	CCH ₃	CH	CH	CCl	CH	CH	CF	CH
CBr	CCl	CH	CH	CCl	CH	CH	CCH ₃	CH
CBr	CF	CH	CH	CCl	CH	CH	CCH ₃	CH
CF	CH	CH	CH	CBr	CH	CH	CH	CH
CH	CH	CF	CH	CBr	CH	CH	CH	CH
CCl	CH	CH	CH	CBr	CH	CH	CH	CH
CH	CH	C-Cl	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH	CH	CH
CH	CH	CCH ₃	CH	CBr	CH	CH	CH	CH
CF	CCH ₃	CH	CH	CBr	CH	CH	CH	CH
CH	CCH ₃	CF	CH	CBr	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CBr	CH	CH	CH	CH
CH	CCH ₃	CCl	CH	CBr	CH	CH	CH	CH
CBr	CCH ₃	CH	CH	CBr	CH	CH	CH	CH
CCl	CCH ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CCl	CCH ₃	CH	CH	CBr	CH	CH	CCl	CH
CCl	CCH ₃	CH	CH	CBr	CH	CH	CF	CH
CCl	CCl	CH	CH	CBr	CH	CH	CCH ₃	CH
CCl	CF	CH	CH	CBr	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CBr	CH	CH	CCH ₃	CH
CBr	CCH ₃	CH	CH	CBr	CH	CH	CCl	CH
CBr	CCH ₃	CH	CH	CBr	CH	CH	CF	CH
CBr	CCl	CH	CH	CBr	CH	CH	CCH ₃	CH
CBr	CF	CH	CH	CBr	CH	CH	CCH ₃	CH

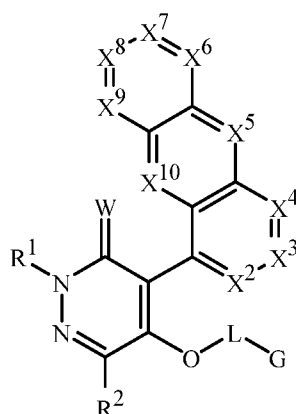
This disclosure also includes TABLES 2 through 48 wherein the Header Row Phrase in TABLE 1 (i.e. “W=O, R¹=Me, R²=Me, L-G=H”) is replaced with the Header Row Phrase listed in the respective TABLE, and the remaining variables are as defined in TABLE 1.

TABLE	Header Row Phrase
2	W=O, R ¹ =Me, R ² =Cl, L-G=H
3	W=O, R ¹ =Me, R ² =Br, L-G=H
4	W=O, R ¹ =Me, R ² =OCH ₃ , L-G=H
5	W=O, R ¹ =Et, R ² =CH ₃ , L-G=H
6	W=O, R ¹ =Et, R ² =Cl, L-G=H

7	$W=O, R^1=Et, R^2=Br, L-G=H$
8	$W=O, R^1=Et, R^2=OCH_3, L-G=H$
9	$W=O, R^1=CH_2CH_2OCH_3, R^2=CH_3, L-G=H$
10	$W=O, R^1=CH_2CH_2OCH_3, R^2=Cl, L-G=H$
11	$W=O, R^1=CH_2CH_2OCH_3, R^2=Br, L-G=H$
12	$W=O, R^1=CH_2CH_2OCH_3, R^2=OCH_3, L-G=H$
13	$W=O, R^1=Me, R^2=CH_3, L-G=C(O)CH_3$
14	$W=O, R^1=Me, R^2=Cl, L-G=C(O)CH_3$
15	$W=O, R^1=Me, R^2=Br, L-G=C(O)CH_3$
16	$W=O, R^1=Me, R^2=OCH_3, L-G=C(O)CH_3$
17	$W=O, R^1=Et, R^2=CH_3, L-G=C(O)CH_3$
18	$W=O, R^1=Et, R^2=Cl, L-G=C(O)CH_3$
19	$W=O, R^1=Et, R^2=Br, L-G=C(O)CH_3$
20	$W=O, R^1=Et, R^2=OCH_3, L-G=C(O)CH_3$
21	$W=O, R^1=CH_2CH_2OCH_3, R^2=CH_3, L-G=C(O)CH_3$
22	$W=O, R^1=CH_2CH_2OCH_3, R^2=Cl, L-G=C(O)CH_3$
23	$W=O, R^1=CH_2CH_2OCH_3, R^2=Br, L-G=C(O)CH_3$
24	$W=O, R^1=CH_2CH_2OCH_3, R^2=OCH_3, L-G=C(O)CH_3$
25	$W=O, R^1=Me, R^2=CH_3, L-G=C(O)CH_2CH_3$
26	$W=O, R^1=Me, R^2=Cl, L-G=C(O)CH_2CH_3$
27	$W=O, R^1=Me, R^2=Br, L-G=C(O)CH_2CH_3$
28	$W=O, R^1=Me, R^2=OCH_3, L-G=C(O)CH_2CH_3$
29	$W=O, R^1=Et, R^2=CH_3, L-G=C(O)CH_2CH_3$
30	$W=O, R^1=Et, R^2=Cl, L-G=C(O)CH_2CH_3$
31	$W=O, R^1=Et, R^2=Br, L-G=C(O)CH_2CH_3$
32	$W=O, R^1=Et, R^2=OCH_3, L-G=C(O)CH_2CH_3$
33	$W=O, R^1=CH_2CH_2OCH_3, R^2=CH_3, L-G=C(O)CH_2CH_3$
34	$W=O, R^1=CH_2CH_2OCH_3, R^2=Cl, L-G=C(O)CH_2CH_3$
35	$W=O, R^1=CH_2CH_2OCH_3, R^2=Br, L-G=C(O)CH_2CH_3$
36	$W=O, R^1=CH_2CH_2OCH_3, R^2=OCH_3, L-G=C(O)CH_2CH_3$
37	$W=O, R^1=Me, R^2=CH_3, L-G=C(O)OCH_3$
38	$W=O, R^1=Me, R^2=Cl, L-G=C(O)OCH_3$
39	$W=O, R^1=Me, R^2=Br, L-G=C(O)OCH_3$
40	$W=O, R^1=Me, R^2=OCH_3, L-G=C(O)OCH_3$
41	$W=O, R^1=Et, R^2=CH_3, L-G=C(O)OCH_3$
42	$W=O, R^1=Et, R^2=Cl, L-G=C(O)OCH_3$
43	$W=O, R^1=Et, R^2=Br, L-G=C(O)OCH_3$

44	$W=O, R^1=Et, R^2=OCH_3, L-G= C(O)OCH_3$
45	$W=O, R^1=CH_2CH_2OCH_3, R^2=CH_3, L-G= C(O)OCH_3$
46	$W=O, R^1=CH_2CH_2OCH_3, R^2=Cl, L-G= C(O)OCH_3$
47	$W=O, R^1=CH_2CH_2OCH_3, R^2=Br, L-G= C(O)OCH_3$
48	$W=O, R^1=CH_2CH_2OCH_3, R^2=OCH_3, L-G= C(O)OCH_3$

TABLE 49



$W=O, R^1=CH_3, R^2=CH_3, L-G=H$ and the remaining variables are defined below

X^2	X^3	X^4	X^5	X^6	X^7	X^8	X^9	X^{10}
CH	CH	CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	CCl	CH	CH	CH	CH	CH	CH
CF	CH	CCl	CH	CH	CH	CH	CH	CH
CCl	CH	CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CCl	CH	CH	CH	CH	CH	CH
CH	CH	CBr	CH	CH	CH	CH	CH	CH
CF	CH	CBr	CH	CH	CH	CH	CH	CH
CCl	CH	CBr	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CBr	CH	CH	CH	CH	CH	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CCl	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CBr	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CCl	CH	CH	CH

63

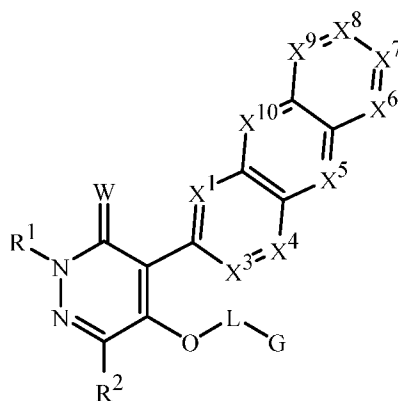
CCH ₃	CH	CH	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CCl

This disclosure also includes TABLES 50 through 56 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 49. For example, in TABLE 50, the Header Row Phrase is “W=O, R¹=CH₃, R²=Cl, L-G=H” and the remaining variables are defined below”.

TABLE	Header Row Variable
50	R ² =Cl
51	R ² =OCH ₃
52	R ¹ =CH ₂ CH ₃
53	R ¹ =CH ₂ CH ₃ , R ² =Cl
54	R ¹ =CH ₂ CH ₃ , R ² =OCH ₃
55	R ¹ =CH ₂ CH ₂ OCH ₃
56	R ¹ =CH ₂ CH ₂ OCH ₃ , R ² =Cl

5

TABLE 57



W=O, R¹=CH₃, R²=CH₃, L-G=H and the remaining variables are defined below

X ¹	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹	X ¹⁰
CH	CH	CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CH
CH	CH	CCl	CH	CH	CH	CH	CH	CH
CF	CH	CCl	CH	CH	CH	CH	CH	CH

64

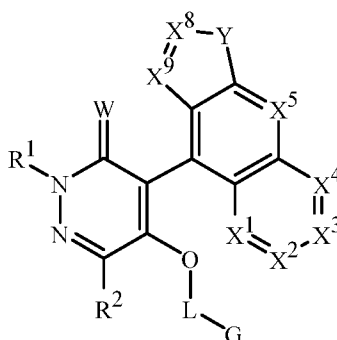
CCl	CH	CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CCl	CH	CH	CH	CH	CH	CH
CH	CH	CBr	CH	CH	CH	CH	CH	CH
CF	CH	CBr	CH	CH	CH	CH	CH	CH
CCl	CH	CBr	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CBr	CH	CH	CH	CH	CH	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CCl	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CBr	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CCl	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CH	CH	CCl

This disclosure also includes TABLES 58 through 65 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 57. For example, in TABLE 58, the Header Row Phrase is “W=O, R¹=CH₃, R²=Cl, L-G=H and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
58	R ² =Cl	62	R ¹ =CH ₂ CH ₃ , R ² =OCH ₃
59	R ² =OCH ₃	63	R ¹ =CH ₂ CH ₂ OCH ₃
60	R ¹ =CH ₂ CH ₃	64	R ¹ =CH ₂ CH ₂ OCH ₃ , R ² =Cl
61	R ¹ =CH ₂ CH ₃ , R ² =Cl	65	R ¹ =CH ₂ CH ₂ OCH ₃ , R ² =OCH ₃

5

TABLE 66



W=O, R¹=CH₃, R²=CH₃, Y=O, L-G=H and the remaining variables are defined below

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁸	X ⁹
CH	CH	CH	CH	CH	CH	CH
CH	CF	CH	CH	CH	CH	CH
CH	CCl	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CH	CH
CH ₃	CH	CH	CH	CH	CH	CH
CH ₃	CF	CH	CH	CH	CH	CH
CH ₃	CCl	CH	CH	CH	CH	CH
CH ₃	CCH ₃	CH	CH	CH	CH	CH
Cl	CH	CH	CH	CH	CH	CH
Cl	CF	CH	CH	CH	CH	CH
Cl	CCl	CH	CH	CH	CH	CH
Cl	CCH ₃	CH	CH	CH	CH	CH
CH	CH	CH	CH	CCl	CH	CH
CH	CF	CH	CH	CCl	CH	CH
CH	CCl	CH	CH	CCl	CH	CH
CH	CCH ₃	CH	CH	CCl	CH	CH
CH	CH	CH	CH	CBr	CH	CH
CH	CF	CH	CH	CBr	CH	CH
CH	CCl	CH	CH	CBr	CH	CH
CH	CCH ₃	CH	CH	CBr	CH	CH
CH	CCH ₃	CCH ₃	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CCH ₃	CH	CH
CH	CCH ₃	CH	CCH ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CCH ₃	CH
CH	CCH ₃	CH	CH	CH	CBr	CH
CH	CCH ₃	CH	CH	CH	CCl	CH
CH	CCH ₃	CH	CH	CH	CH	CBr
CH	CCH ₃	CH	CH	CH	CH	CCl
CH	CCH ₃	CH	CH	CH	CH	CCH ₃

This disclosure also includes TABLE 67 through 74 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 66.

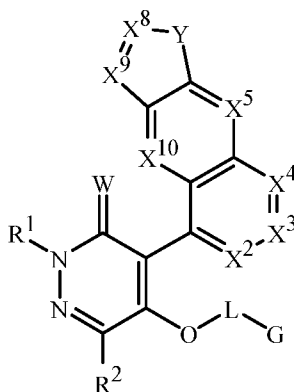
For example, the Header Row Phrase in TABLE 67 is “W=O, R¹=CH₃, R²=CH₃, Y=S,

5 L-G=H and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
67	Y=S	69	R ² =Cl
68	Y=NCH ₃	70	R ² =Cl, Y=S

TABLE	Header Row Variable	TABLE	Header Row Variable
71	$R^2=Cl, Y=NCH_3$	73	$R^2=OCH_3, Y=S$
72	$R^2=OCH_3$	74	$R^2=OCH_3, Y=NCH_3$

TABLE 75



$W=O, R^1=CH_3, R^2=CH_3, Y=O, L-G=H$ and the remaining variables are defined below

X^2	X^3	X^4	X^5	X^8	X^9	X^{10}
CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH
CH	CH	CH	CCl	CH	CH	CH
CF	CH	CH	CCl	CH	CH	CH
CCl	CH	CH	CCl	CH	CH	CH
CCH ₃	CH	CH	CCl	CH	CH	CH
CH	CH	CH	CBr	CH	CH	CH
CF	CH	CH	CBr	CH	CH	CH
CCl	CH	CH	CBr	CH	CH	CH
CCH ₃	CH	CH	CBr	CH	CH	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CCH ₃	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CCH ₃	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CCH ₃	CH
CCH ₃	CH	CH	CH	CH	CH	CBr

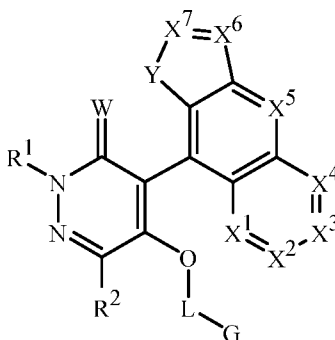
CCH₃ CH CH CH CH CH CCl
 CCH₃ CH CH CH CH CH CCH₃

This disclosure also includes TABLE 76 through 83 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 75. For example, the Header Row Phrase in TABLE 76 is “W=O, R¹=CH₃, R²=CH₃, Y=S, L-G=H) and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
76	Y=S	80	R ² =Cl, Y=NCH ₃
77	Y=NCH ₃	81	R ² =OCH ₃
78	R ² =Cl	82	R ² =OCH ₃ , Y=S
79	R ² =Cl, Y=S	83	R ² =OCH ₃ , Y=NCH ₃

5

TABLE 84



W=O, R¹=CH₃, R²=CH₃, Y=O, L-G=H and the remaining variables are defined below

X ¹	X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷
CH	CH	CH	CH	CH	CH	CH
CH	CF	CH	CH	CH	CH	CH
CH	CCl	CH	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CH	CH
CH ₃	CH	CH	CH	CH	CH	CH
CH ₃	CF	CH	CH	CH	CH	CH
CH ₃	CCl	CH	CH	CH	CH	CH
CH ₃	CCH ₃	CH	CH	CH	CH	CH
Cl	CH	CH	CH	CH	CH	CH
Cl	CF	CH	CH	CH	CH	CH
Cl	CCl	CH	CH	CH	CH	CH
Cl	CCH ₃	CH	CH	CH	CH	CH
CH	CH	CH	CH	CCl	CH	CH
CH	CF	CH	CH	CCl	CH	CH
CH	CCl	CH	CH	CCl	CH	CH

68

CH	CCH ₃	CH	CH	CCl	CH	CH
CH	CH	CH	CH	CBr	CH	CH
CH	CF	CH	CH	CBr	CH	CH
CH	CCl	CH	CH	CBr	CH	CH
CH	CCH ₃	CH	CH	CBr	CH	CH
CH	CCH ₃	CCH ₃	CH	CH	CH	CH
CH	CCH ₃	CH	CH	CCH ₃	CH	CH
CH	CCH ₃	CH	CCH ₃	CH	CH	CH
CH	CCH ₃	CH	CH	CH	CCH ₃	CH
CH	CCH ₃	CH	CH	CH	CBr	CH
CH	CCH ₃	CH	CH	CH	CCl	CH
CH	CCH ₃	CH	CH	CH	CH	CBr
CH	CCH ₃	CH	CH	CH	CH	CCl
CH	CCH ₃	CH	CH	CH	CH	CCH ₃

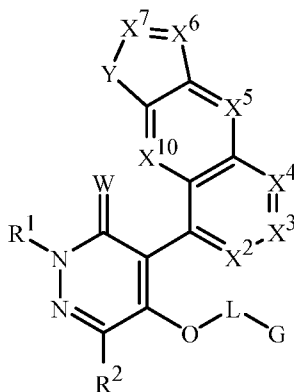
This disclosure also includes TABLES 85 through 92 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 84.

For example, the Header Row Phrase in TABLE 85 is “W=O, R¹=CH₃, R²=CH₃, Y=S, L-G=H) and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
85	Y=S	89	R ² =Cl, Y=NCH ₃
86	Y=NCH ₃	90	R ² =OCH ₃
87	R ² =Cl	91	R ² =OCH ₃ , Y=S
88	R ² =Cl, Y=S	92	R ² =OCH ₃ , Y=NCH ₃

5

TABLE 93



W=O, R¹=CH₃, R²=CH₃, L-G=H, Y=O and the remaining variables are defined below

X ²	X ³	X ⁴	X ⁵	X ⁶	X ⁷	X ¹⁰
CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH

69

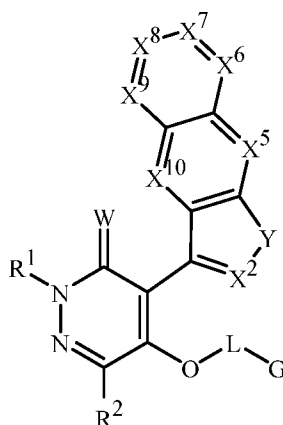
CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH
CH	CH	CH	CCl	CH	CH	CH
CF	CH	CH	CCl	CH	CH	CH
CCl	CH	CH	CCl	CH	CH	CH
CCH ₃	CH	CH	CCl	CH	CH	CH
CH	CH	CH	CBr	CH	CH	CH
CF	CH	CH	CBr	CH	CH	CH
CCl	CH	CH	CBr	CH	CH	CH
CCH ₃	CH	CH	CBr	CH	CH	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CCH ₃	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CCH ₃	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CCH ₃	CH
CCH ₃	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CCl
CCH ₃	CH	CH	CH	CH	CH	CCH ₃

This disclosure also includes TABLES 94 through 101 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 93. For example, the Header Row Phrase in TABLE 94 is “W=O, R¹=CH₃, R²=CH₃, L-G=H, Y=S) and the remaining variablese are defined below”.

TABLE	Header Row Variable
94	Y=S
95	Y=NCH ₃
96	R ² =Cl
97	R ² =Cl, Y=S
98	R ² =Cl, Y=NCH ₃
99	R ² =OCH ₃
100	R ² =OCH ₃ , Y=S
101	R ² =OCH ₃ , Y=NCH ₃

70

TABLE 102



1

W=O, R¹=CH₃, R²=CH₃, L-G=H, Y=O and the remaining variables are defined below

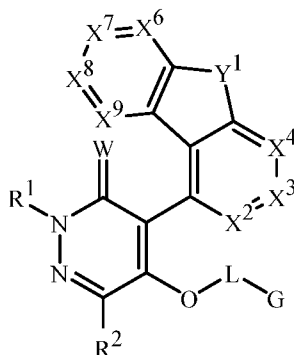
X ²	X ⁵	X ⁶	X ⁷	X ⁸	X ⁹	X ¹⁰
CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH
CCH ₃	CCl	CH	CH	CH	CH	CH
CCH ₃	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CBr	CH	CH	CH
CCH ₃	CH	CH	CCl	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CCl

This disclosure also includes TABLES 103 through 110 wherein the specific variable listed
 5 in each TABLE replaces the corresponding variable in the Header Row Phrase of
 TABLE 102. For example, in TABLE 103 the Header Row Phrase is “W=O, R¹=CH₃,
 R²=CH₃, L-G=H, Y=S) and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
103	Y=S	106	R ² =Cl, Y=S
104	Y=NCH ₃	107	R ² =Cl, Y=NCH ₃
105	R ² =Cl	108	R ² =OCH ₃

TABLE	Header Row Variable	TABLE	Header Row Variable
109	$R^2=OCH_3$, $Y=S$	110	$R^2=OCH_3$, $Y=NCH_3$

TABLE 111



$W=O$, $R^1=CH_3$, $R^2=CH_3$, $L-G=H$, $Y^1=O$ and the remaining variables are defined below

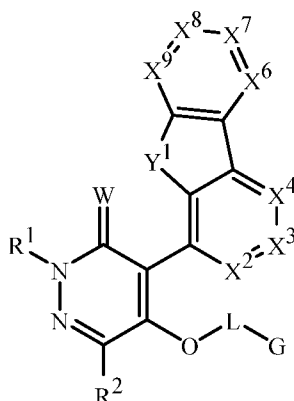
X^2	X^3	X^4	X^6	X^7	X^8	X^9
CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH
CH	CH	CH	CH	CH	CCl	CH
CF	CH	CH	CH	CH	CCl	CH
CCl	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CCl	CH
CH	CH	CH	CH	CH	CBr	CH
CF	CH	CH	CH	CH	CBr	CH
CCl	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CBr	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CCH ₃	CH
CCH ₃	CH	CH	CCH ₃	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH
CCH ₃	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CCH ₃	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CCl
CCH ₃	CH	CH	CH	CH	CH	CCH ₃

This disclosure also includes TABLES 112 through 122 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 111. For example, the Header Row Phrase in TABLE 112 is “W=O, R¹=CH₃, R²=CH₃, L-G=H, Y¹=S and the remaining variables are defined below”.

TABLE	Header Row Variable	TABLE	Header Row Variable
112	Y ¹ =S	118	R ² =Cl, Y ¹ =C(O)
113	Y ¹ =NCH ₃	119	R ² =OCH ₃
114	Y ¹ =C(O)	120	R ² =OCH ₃ , Y ¹ =S
115	R ² =Cl	121	R ² =OCH ₃ , Y ¹ =NCH ₃
116	R ² =Cl, Y ¹ =S	122	R ² =OCH ₃ , Y ¹ =C(O)
117	R ² =Cl, Y ¹ =NCH ₃		

5

TABLE 123



W=O, R¹=CH₃, R²=CH₃, L-G=H, Y¹=O and the remaining variables are defined below

X ²	X ³	X ⁴	X ⁶	X ⁷	X ⁸	X ⁹
CH	CH	CH	CH	CH	CH	CH
CF	CH	CH	CH	CH	CH	CH
CCl	CH	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CH
CH	CH	CH	CH	CH	CCl	CH
CF	CH	CH	CH	CH	CCl	CH
CCl	CH	CH	CH	CH	CCl	CH
CCH ₃	CH	CH	CH	CH	CCl	CH
CH	CH	CH	CH	CH	CBr	CH
CF	CH	CH	CH	CH	CBr	CH
CCl	CH	CH	CH	CH	CBr	CH
CCH ₃	CH	CH	CH	CH	CBr	CH
CCH ₃	CCH ₃	CH	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CH	CCH ₃	CH

CCH ₃	CH	CH	CCH ₃	CH	CH	CH
CCH ₃	CH	CCH ₃	CH	CH	CH	CH
CCH ₃	CH	CBr	CH	CH	CH	CH
CCH ₃	CH	CCl	CH	CH	CH	CH
CCH ₃	CH	CH	CH	CBr	CH	CH
CCH ₃	CH	CH	CH	CCl	CH	CH
CCH ₃	CH	CH	CH	CCH ₃	CH	CH
CCH ₃	CH	CH	CH	CH	CH	CBr
CCH ₃	CH	CH	CH	CH	CH	CCl
CCH ₃	CH	CH	CH	CH	CH	CCH ₃

This disclosure also includes TABLES 124 through 134 wherein the specific variable listed in each TABLE replaces the corresponding variable in the Header Row Phrase of TABLE 123. For example, the header Row in TABLE 124 is “W=O, R¹=CH₃, R²=CH₃, L-G=H, Y¹=S and the remaining variables are defined below”.

Table	Header Row Variable	Table	Header Row Variable
124	Y ¹ =S	130	R ² =Cl, Y ¹ =C(O)
125	Y ¹ =NCH ₃	131	R ² =OCH ₃
126	Y ¹ =C(O)	132	R ² =OCH ₃ , Y ¹ =S
127	R ² =Cl	133	R ² =OCH ₃ , Y ¹ =NCH ₃
128	R ² =Cl, Y ¹ =S	134	R ² =OCH ₃ , Y ¹ =C(O)
129	R ² =Cl, Y ¹ =NCH ₃		

5 A compound of this invention will generally be used as a herbicidal 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 serves 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.

10 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 compositions are soluble concentrate, suspension concentrate, capsule suspension, concentrated emulsion, microemulsion, oil-in-water emulsion, flowable concentrate and suspo-emulsion. The general types of nonaqueous liquid compositions are emulsifiable concentrate, microemulsifiable concentrate, dispersible concentrate and oil dispersion.

15 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 (“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 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 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 during planting.

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	0.001–99	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 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 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 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 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 tristyrylphenol (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 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, alkyl 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 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 alkoxyates, phosphate esters of alkylphenol alkoxyates and phosphate esters of styryl phenol ethoxylates; 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, pages 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.

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. See also 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. Compound numbers refer to compounds in Index Table A. 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. Percentages are by weight except where otherwise indicated.

Example A

High Strength Concentrate

Compound 1	98.5%
silica aerogel	0.5%
synthetic amorphous fine silica	1.0%

Example B

Wettable Powder

Compound 1	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
montmorillonite (calcined)	23.0%

Example C

Granule

Compound 1	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 1	25.0%
anhydrous sodium sulfate	10.0%

crude calcium ligninsulfonate	5.0%
sodium alkylnaphthalenesulfonate	1.0%
calcium/magnesium bentonite	59.0%

Example EEmulsifiable Concentrate

Compound 1	10.0%
polyoxyethylene sorbitol hexoleate	20.0%
C ₆ -C ₁₀ fatty acid methyl ester	70.0%

Example FMicroemulsion

Compound 1	5.0%
polyvinylpyrrolidone-vinyl acetate copolymer	30.0%
alkylpolyglycoside	30.0%
glyceryl monooleate	15.0%
water	20.0%

Example GSuspension Concentrate

Compound 1	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 HEmulsion in Water

Compound 1	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 IOil Dispersion

Compound 1	25%
polyoxyethylene sorbitol hexaoleate	15%
organically modified bentonite clay	2.5%
fatty acid methyl ester	57.5%

The present disclosure also includes Examples A through I above except that “Compound 1” is replaced with “Compound 2”, “Compound 3”, “Compound 4”, “Compound 5”, “Compound 6”, “Compound 7”, “Compound 8”, “Compound 9” or “Compound 10”.

Test results indicate that the compounds of the present invention are highly active preemergent and/or postemergent herbicides and/or plant growth regulants. The compounds of the invention generally show highest activity for postemergence weed control (i.e. applied after weed seedlings emerge from the soil) and preemergence weed control (i.e. applied before weed seedlings emerge from the soil). Many of them have utility for broad-spectrum pre- and/or postemergence weed control in areas where complete control of all vegetation is desired such as around fuel storage tanks, industrial storage areas, parking lots, drive-in theaters, air fields, river banks, irrigation and other waterways, around billboards and highway and railroad structures. Many of the compounds of this invention, by virtue of selective metabolism in crops versus weeds, or by selective activity at the locus of physiological inhibition in crops and weeds, or by selective placement on or within the environment of a mixture of crops and weeds, are useful for the selective control of grass and broadleaf weeds within a crop/weed mixture. One skilled in the art will recognize that the preferred combination of these selectivity factors within a compound or group of compounds can readily be determined by performing routine biological and/or biochemical assays. Compounds of this invention may show tolerance to important agronomic crops including, but is not limited to, alfalfa, barley, cotton, wheat, rape, sugar beets, corn (maize), sorghum, soybeans, rice, oats, peanuts, vegetables, tomato, potato, perennial plantation crops including coffee, cocoa, oil palm, rubber, sugarcane, citrus, grapes, fruit trees, nut trees, banana, plantain, pineapple, hops, tea and forests such as eucalyptus and conifers (e.g., loblolly pine), and turf species (e.g., Kentucky bluegrass, St. Augustine grass, Kentucky fescue and Bermuda grass). Compounds of this invention can be used in crops genetically transformed or bred to incorporate resistance to herbicides, express proteins toxic to invertebrate pests (such as *Bacillus thuringiensis* toxin), and/or express other useful traits. Those skilled in the art will appreciate that not all compounds are equally effective against all weeds. Alternatively, the subject compounds are useful to modify plant growth.

As the compounds of the invention have both preemergent and postemergent herbicidal activity, to control undesired vegetation by killing or injuring the vegetation or reducing its growth, the compounds can be usefully applied by a variety of methods involving contacting a herbicidally effective amount of a compound of the invention, or a composition comprising said compound and at least one of a surfactant, a solid diluent or a liquid diluent, to the foliage or other part of the undesired vegetation or to the environment of the undesired vegetation such as the soil or water in which the undesired vegetation is growing or which surrounds the seed or other propagule of the undesired vegetation. Undesired vegetation includes at least one selected from the group consisting of grass weeds and broadleaf weeds. Undesired vegetation is selected from the group consisting of annual bluegrass, Benghal dayflower, blackgrass, black nightshade, broadleaf signalgrass, Canada thistle, cheat, common cocklebur (*Xanthium pensylvanicum*), common ragweed, corn poppies, field violet, giant foxtail, goosegrass, green foxtail, guinea grass, hairy beggarticks, herbicide-resistant black grass, horseweed, Italian rye grass, jimsonweed, Johnson grass (*Sorghum halepense*), large crabgrass, little seed canary grass, morning glory, Pennsylvania smartweed, pitted morning glory, prickly sida, quackgrass, redroot pigweed, shattercane, shepherd's purse, silky windgrass, sunflower (as weed in potato), wild buckwheat (*Polygonum convolvulus*), wild mustard (*Brassica kaber*), wild oat (*Avena fatua*), wild pointsettia, yellow foxtail, and yellow nutsedge (*Cyperus esculentus*).

A herbicidally effective amount of the compounds of this invention is determined by a number of factors. These factors include: formulation selected, method of application, amount and type of vegetation present, growing conditions, etc. In general, a herbicidally effective amount of compounds of this invention is about 0.001 to 20 kg/ha with a preferred range of about 0.004 to 1 kg/ha. One skilled in the art can easily determine the herbicidally effective amount necessary for the desired level of weed control.

In one common embodiment, a compound of the invention is applied, typically in a formulated composition, to a locus comprising desired vegetation (e.g., crops) and undesired vegetation (i.e. weeds), both of which may be seeds, seedlings and/or larger plants, in contact with a growth medium (e.g., soil). In this locus, a composition comprising a compound of the invention can be directly applied to a plant or a part thereof, particularly of the undesired vegetation, and/or to the growth medium in contact with the plant.

Although most typically, compounds of the invention are used to control undesired vegetation, contact of desired vegetation in the treated locus with compounds of the invention may result in super-additive or enhanced effects with genetic traits in the desired vegetation, including traits incorporated through genetic modification. For example, resistance to phytophagous insect pests or plant diseases, tolerance to biotic/abiotic stresses or storage stability may be greater than expected from the genetic traits in the desired vegetation.

Compounds of this invention can also be mixed with one or more other biologically active compounds or agents including herbicides, herbicide safeners, fungicides, insecticides, nematocides, bactericides, acaricides, 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. Mixtures of the compounds of the invention with other herbicides can broaden the spectrum of activity against additional weed species, and suppress the proliferation of any resistant biotypes. Thus the present invention also pertains to a composition comprising a compound of Formula 1 (in a herbicidally 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 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.

A mixture of one or more of the following herbicides with a compound of this invention may be particularly useful for weed control: acetochlor, acifluorfen and its sodium salt, aclonifen, acrolein (2-propenal), alachlor, alloxymid, ametryn, amicarbazone, amidosulfuron, aminocyclopyrachlor and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), aminopyralid, amitrole, ammonium sulfamate, anilofos, asulam, atrazine, azimsulfuron, beflubutamid, benazolin, benazolin-ethyl, bencarbazone, benfluralin, benfuresate, bensulfuron-methyl, bensulide, bentazone, benzobicyclon, benzofenap, bicyclopyrone, bifenox, bilanafos, bispyribac and its sodium salt, bromacil, bromobutide, bromofenoxim, bromoxynil, bromoxynil octanoate, butachlor, butafenacil, butamifos, butralin, butroxydim, butylate, cafenstrole, carbetamide, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, chlorotoluron, chlorpropham, chlorsulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, clacyfos, clefoxydim, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclopyrimorate, cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, isooctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, daimuron, dalapon, dalapon-sodium, dazomet, 2,4-DB and its dimethylammonium, potassium and sodium salts, desmedipham, desmetryn, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium

salts, dichlobenil, dichlorprop, diclofop-methyl, diclosulam, difenzoquat metilsulfate, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethylarsinic acid and its sodium salt, dinitramine, dinoterb, diphenamid, diquat dibromide, dithiopyr, diuron, DNOC, endothal,

5 EPTC, esprocarb, ethalfluralin, ethametsulfuron-methyl, ethiozin, ethofumesate, ethoxyfen, ethoxysulfuron, etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fenoxasulfone, fenquino-trione, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, flufenacet,

10 flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium, glufosinate-P, glyphosate and its salts such as ammonium, isopropylammonium, potassium,

15 sodium (including sesquisodium) and trimesium (alternatively named sulfosate), halauxifen, halauxifen-methyl, halosulfuron-methyl, haloxyfop-etotyl, haloxyfop-methyl, hexazinone, hydantocidin, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, indaziflam, iofensulfuron, iodosulfuron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium,

20 ipfencarbazone, isoproturon, isouron, isoxaben, isoxaflutole, isoxachlortole, lactofen, lenacil, linuron, maleic hydrazide, MCPA and its salts (e.g., MCPA-dimethylammonium, MCPA-potassium and MCPA-sodium, esters (e.g., MCPA-2-ethylhexyl, MCPA-butotyl) and thioesters (e.g., MCPA-thioethyl), MCPB and its salts (e.g., MCPB-sodium) and esters (e.g., MCPB-ethyl), mecoprop, mecoprop-P, mefenacet, mefluidide, mesosulfuron-methyl,

25 mesotrione, metam-sodium, metamifop, metamitron, metazachlor, metazosulfuron, methabenzthiazuron, methylarsonic acid and its calcium, monoammonium, monosodium and disodium salts, methyl-dymron, metobenzuron, metobromuron, metolachlor, S-metolachlor, metosulam, metoxuron, metribuzin, metsulfuron-methyl, molinate, monolinuron, naproanilide, napropamide, napropamide-M, naptalam, neburon, nicosulfuron, norflurazon,

30 orbencarb, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxasulfuron, oxaziclomefone, oxyfluorfen, paraquat dichloride, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentanochlor, pentoxazone, perfluidone, pethoxamid, pethoxyamid, phenmedipham, picloram, picloram-potassium, picolinafen, pinoxaden, piperophos, pretilachlor, primisulfuron-methyl, pro-diamine, profoxydim, prometon, prometryn, propachlor, propanil,

35 propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyrisulfuron, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyri-thiobac, pyri-thiobac-sodium,

pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimsulfuron, saflufenacil, sethoxydim, siduron, simazine, simetryn, sulcotrione, sulfentrazone, sulfometuron-methyl, sulfosulfuron, 2,3,6-TBA, TCA, TCA-sodium, tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxym, 5 terbacil, terbutolol, terbutylazine, terbutryn, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron-methyl, thiobencarb, tiafenacil, tiocarbaryl, tolpyralate, topramezone, tralkoxydim, tri-allate, triafamone, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifludimoxazin, trifluralin, triflusulfuron-methyl, tritosulfuron, vernolate, 3-(2-chloro-3,6-10 difluorophenyl)-4-hydroxy-1-methyl-1,5-naphthyridin-2(1*H*)-one, 5-chloro-3-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-1-(4-methoxyphenyl)-2(1*H*)-quinoxalinone, 2-chloro-*N*-(1-methyl-1*H*-tetrazol-5-yl)-6-(trifluoromethyl)-3-pyridinecarboxamide, 7-(3,5-dichloro-4-pyridinyl)-5-(2,2-difluoroethyl)-8-hydroxypyrido[2,3-*b*]pyrazin-6(5*H*)-one, 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone), 5-[[2,6-15 difluorophenyl)methoxy]methyl]-4,5-dihydro-5-methyl-3-(3-methyl-2-thienyl)isoxazole (previously methioxolin), 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5(2*H*,4*H*)-dione, methyl 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-5-fluoro-2-pyridinecarboxylate, 2-methyl-3-(methylsulfonyl)-*N*-(1-methyl-1*H*-tetrazol-5-yl)-4-(trifluoromethyl)benzamide and 2-methyl-20 *N*-(4-methyl-1,2,5-oxadiazol-3-yl)-3-(methylsulfinyl)-4-(trifluoromethyl)benzamide. Other herbicides also include bioherbicides such as *Alternaria destruens* Simmons, *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc., *Drechslera monoceras* (MTB-951), *Myrothecium verrucaria* (Albertini & Schweinitz) Ditmar: Fries, *Phytophthora palmivora* (Butl.) Butl. and *Puccinia thlaspeos* Schub.

25 Preferred for better control of undesired vegetation (e.g., lower use rate such as from enhanced effects, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of atrazine, azimsulfuron, *S*-bifluthiamid, benzisothiazolinone, carfentrazone-ethyl, chlorimuron-ethyl, chloresulfuron-methyl, 30 clomazone, clopyralid potassium, cloransulam-methyl, 2-[(2,4-dichlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone, 2-[(2,5-dichlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone, ethametsulfuron-methyl, flumetsulam, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5-(2*H*,4*H*)-dione, flupyr-sulfuron-methyl, fluthiacet-methyl, 35 fomesafen, imazethapyr, lenacil, mesotrione, metribuzin, metsulfuron-methyl, pethoxamid, picloram, pyroxasulfone, quinclorac, rimsulfuron, *S*-metolachlor, sulfentrazone, thifensulfuron-methyl, triflusulfuron-methyl and tribenuron-methyl.

Compounds of this invention can also be used in combination with plant growth regulators such as aviglycine, *N*-(phenylmethyl)-1*H*-purin-6-amine, epocholeone, gibberellic acid, gibberellin A₄ and A₇, harpin protein, mepiquat chloride, prohexadione calcium, prohydrojasmon, sodium nitrophenolate and trinexapac-methyl, and plant growth modifying organisms such as *Bacillus cereus* strain BP01.

General references for agricultural protectants (i.e. herbicides, herbicide safeners, insecticides, fungicides, nematocides, acaricides 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 mixing partners are typically used in the amounts similar to amounts customary when the mixture partners are used alone. More particularly in mixtures, active ingredients are often applied at an application rate between one-half and the full application rate specified on product labels for use of active ingredient alone. These amounts are listed in references such as *The Pesticide Manual* and *The BioPesticide Manual*. 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 weeds 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 herbicidal) compounds or agents (i.e. active ingredients) can result in a greater-than-additive (i.e. enhanced) effect on weeds and/or a less-than-additive effect (i.e. safening) on crops or other desirable plants. Reducing the quantity of active ingredients released in the environment while ensuring effective pest control is always desirable. Ability to use greater amounts of active ingredients to provide more effective weed control without excessive crop injury is also desirable. When the enhanced effects of herbicidal mixtures of active ingredients occurs on weeds at application rates giving agronomically satisfactory levels of weed control, such combinations can be advantageous for reducing crop production cost and decreasing environmental load. When safening of herbicidal active ingredients occurs on crops, such combinations can be advantageous for increasing crop protection by reducing weed competition.

Of note is a combination of a compound of the invention with at least one other herbicidal active ingredient. Of particular note is such a combination where the other herbicidal active ingredient has different site of action from the compound of the invention.

In certain instances, a combination with at least one other herbicidal 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 invention can further comprise (in a herbicidally effective amount) at least one additional herbicidal active ingredient having a similar spectrum of control but a different site of action.

Compounds of this invention can also be used in combination with herbicide safeners such as allidochlor, benoxacor, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfonamide, daimuron, dichlormid, dicyclonon, dietholate, dimepiperate, fenchlorazole-ethyl, fencloirim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone naphthalic anhydride (1,8-naphthalic anhydride), oxabetrinil, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide, *N*-(aminocarbonyl)-2-fluorobenzenesulfonamide, 1-bromo-4-[(chloromethyl)sulfonyl]benzene (BCS), 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), ethyl 1,6-dihydro-1-(2-methoxyphenyl)-6-oxo-2-phenyl-5-pyrimidinecarboxylate, 2-hydroxy-*N,N*-dimethyl-6-(trifluoromethyl)pyridine-3-carboxamide, and 3-oxo-1-cyclohexen-1-yl 1-(3,4-dimethylphenyl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylate, 2,2-dichloro-1-(2,2,5-trimethyl-3-oxazolidinyl)-ethanone and 2-methoxy-*N*-[[4-[(methylamino)carbonyl]amino]phenyl]sulfonyl]-benzamide to increase safety to certain crops. Antidotally effective amounts of the herbicide safeners can be applied at the same time as the compounds of this invention, or applied as seed treatments. Therefore an aspect of the present invention relates to a herbicidal mixture comprising a compound of this invention and an antidotally effective amount of a herbicide safener. Seed treatment is particularly useful for selective weed control, because it physically restricts antidoting to the crop plants. Therefore a particularly useful embodiment of the present invention is a method for selectively controlling the growth of undesired vegetation in a crop comprising contacting the locus of the crop with a herbicidally effective amount of a compound of this invention wherein seed from which the crop is grown is treated with an antidotally effective amount of safener. Antidotally effective amounts of safeners can be easily determined by one skilled in the art through simple experimentation.

Compounds of the invention can also be mixed with: (1) polynucleotides including but not limited to DNA, RNA, and/or chemically modified nucleotides influencing the amount of a particular target through down regulation, interference, suppression or silencing of the genetically derived transcript that render a herbicidal effect; or (2) polynucleotides including but not limited to DNA, RNA, and/or chemically modified nucleotides influencing the amount of a particular target through down regulation, interference, suppression or silencing of the genetically derived transcript that render a safening effect.

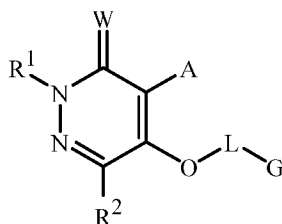
Of note is a composition comprising a compound of the invention (in a herbicidally effective amount), at least one additional active ingredient selected from the group consisting

of other herbicides and herbicide safeners (in an effective amount), and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.

Preferred for better control of undesired vegetation (e.g., lower use rate such as from enhanced effects, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of chlorimuron-ethyl, nicosulfuron, mesotrione, thifensulfuron-methyl, flupyr-sulfuron-methyl, tribenuron, pyroxasulfone, pinoxaden, tembotrione, pyrox-sulam, metolachlor and *S*-metolachlor.

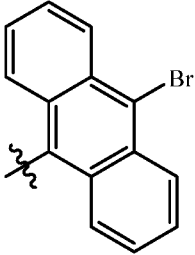
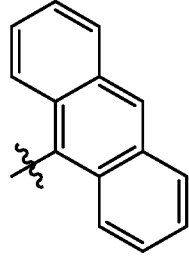
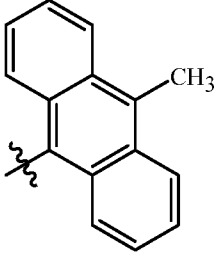
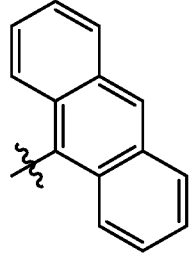
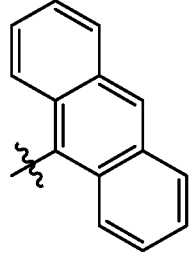
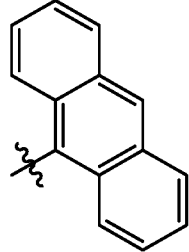
The following Tests demonstrate the control efficacy of the compounds of this invention against specific weeds. The weed control afforded by the compounds is not limited, however, to these species. See Index Table A for compound descriptions. The following abbreviations are used in the Index Table which follows: "Cmpd. No." stands for "Compound Number", "Ex." stands for "Example" and is followed by a number indicating in which example the compound is prepared. ¹H NMR spectra are reported in ppm downfield from tetramethylsilane in DMSO-*d*₆ solution unless indicated otherwise; "s" means singlet, "d" means doublet, "t" means triplet and "m" means multiplet.

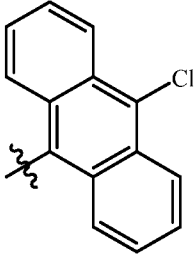
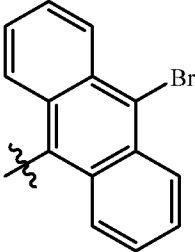
INDEX TABLE A



W is O

Cmpd. No.	R ¹	R ²	L	G	A	M.P (°C)
1 (Ex. 1)	Me	Cl	direct bond	H		236–238 *
2 (Ex. 2)	Me	Cl	direct bond	H		*

3	Me	Cl	direct bond	H		*
4	Me	Cl	direct bond	CH ₃		*
5	Me	Cl	direct bond	H		*
6	Me	Cl	direct bond	C(=O)CH ₃		*
7	Me	Cl	direct bond	H (morpholine salt)		*
8	Me	Me	direct bond	H		*

9	Me	Me	direct bond	H		*
10	Me	Me	direct bond	H		*

* See Index Table B for ^1H NMR or M.S. data.

INDEX TABLE B

Cmpd. No.	^1H NMR Data (DMSO- d_6 solution unless indicated otherwise) ^a and M.S. data
1	δ 8.70 (s, 1H), 8.15 (d, 2H), 7.68 (d, 2H), 7.52 (t, 2H), 7.45 (t, 2H), 5.75 (s, 1H), 3.67 (s, 3H).
2	δ 8.52 (d, 2H), 7.61 (d, 2H), 7.74 (distorted t, 2H), 7.56 (distorted t, 2H), 3.67 (s, 3H).
3	δ 8.53 (d, 2H), 7.80 (d, 2H), 7.74–7.71 (m, 2H), 7.56–7.53 (m, 2H), 3.67 (s, 3H).
4	(CDCl ₃) δ 8.57 (s, 1H), 8.08–8.04 (m, 2H), 7.68–7.64 (m, 2H), 7.51–7.46 (m, 4H), 3.82 (s, 3H), 3.05 (s, 3H).
5	δ 11.05 (br s, 1H), 8.44 (d, 2H), 7.70 (d, 2H), 7.58 (t, 2H), 7.47 (t, 2H), 3.68 (s, 3H), 3.16 (s, 3H).
6	(CDCl ₃) δ 8.55 (s, 1H), 8.03 (distorted d, 2H), 7.60 (distorted d, 2H), 7.49–7.42 (m, 4H), 3.91 (s, 3H), 1.68 (s, 3H).
7	335 (M–1).
8	δ 10.12 (s, 1H), 8.69 (s, 1H), 8.13 (d, 2H), 7.60 (d, 2H), 7.51 (t, 2H), 7.42 (t, 2H), 3.65 (s, 3H), 2.33 (s, 3H).
9	δ 10.23 (s, 1H), 8.52 (d, 2H), 7.74–7.70 (m, 4H), 7.57–7.52 (m, 2H), 3.65 (s, 3H), 2.32 (s, 3H).
10	δ 10.25 (s, 1H), 8.53 (d, 2H), 7.76–7.69 (m, 4H), 7.54 (dd, 2H), 3.65 (s, 3H), 2.32 (s, 3H).

^a ^1H NMR data are in ppm downfield from tetramethylsilane. Couplings are designated by (s)-singlet, (d)-doublet, (t)-triplet, (m)-multiplet.

5

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

Seeds of plant species selected from barnyardgrass (*Echinochloa crus-galli*), kochia (*Kochia scoparia*), ragweed (common ragweed, *Ambrosia elatior*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), foxtail, green (green foxtail, *Setaria viridis*), and pigweed (*Amaranthus retroflexus*) were planted into a blend of loam soil and sand and treated

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preemergence with a directed soil spray using test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these weed species and also wheat (*Triticum aestivum*), corn (*Zea mays*), blackgrass (*Alopecurus myosuroides*), and galium (catchweed bedstraw, *Galium aparine*) were planted in pots containing the same blend of loam soil and sand and treated with postemergence applications of test chemicals formulated in the same manner. Plants ranged in height from 2 to 10 cm and were in the one- to two-leaf stage for the postemergence treatment. Treated plants and untreated controls were maintained in a greenhouse for approximately 10 d, after which time all treated plants were compared to untreated controls and visually evaluated for injury. Plant response ratings, summarized in Table A, are based on a 0 to 100 scale where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table A		Compounds						
125 g ai/ha		1	2	3	5	6	7	8
15	Postemergence							
	Barnyardgrass	20	20	60	30	10	0	50
	Blackgrass	10	60	70	0	0	10	30
	Corn	0	0	10	20	0	10	10
	Foxtail, Giant	–	–	–	–	20	10	60
20	Foxtail, Green	50	60	90	30	–	–	–
	Galium	90	100	90	70	100	100	90
	Kochia	20	70	50	0	20	10	10
	Pigweed	100	100	100	90	100	100	100
	Ragweed	90	90	90	20	90	100	90
25	Ryegrass, Italian	40	80	50	50	70	60	100
	Wheat	10	30	60	0	10	0	0

Table A		Compounds						
31 g ai/ha		1	2	3	5	6	7	8
30	Postemergence							
	Barnyardgrass	0	0	20	0	0	0	10
	Blackgrass	0	0	10	0	0	0	0
	Corn	0	0	0	10	0	10	10
	Foxtail, Giant	–	–	–	–	0	0	10
	Foxtail, Green	10	10	40	0	–	–	–
35	Galium	70	20	90	20	80	70	80
	Kochia	10	10	10	0	0	0	0
	Pigweed	90	100	100	50	100	100	90
	Ragweed	80	90	80	10	90	90	90

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	Ryegrass, Italian	20	50	40	0	20	10	90
	Wheat	0	0	20	0	10	0	0
	Table A	Compounds						
	125 g ai/ha	1	2	3	5	6	7	8
5	Preemergence							
	Barnyardgrass	0	0	50	0	0	0	10
	Foxtail, Giant	-	-	-	-	10	0	10
	Foxtail, Green	0	90	80	0	-	-	-
	Kochia	20	10	50	0	0	0	0
10	Pigweed	100	100	100	60	100	100	100
	Ragweed	100	100	100	0	100	40	90
	Ryegrass, Italian	30	70	80	0	30	0	50
	Table A	Compounds						
	31 g ai/ha	1	2	3	5	6	7	8
15	Preemergence							
	Barnyardgrass	0	0	0	0	0	0	0
	Foxtail, Giant	-	-	-	-	0	0	0
	Foxtail, Green	0	0	10	0	-	-	-
	Kochia	0	0	0	0	0	0	0
20	Pigweed	100	100	100	0	80	60	100
	Ragweed	70	80	20	0	40	0	40
	Ryegrass, Italian	20	20	20	0	30	0	10

TEST B

- 25 Plant species in the flooded paddy test selected from rice (*Oryza sativa*), sedge, umbrella (small-flower umbrella sedge, *Cyperus difformis*), ducksalad (*Heteranthera limosa*), and barnyardgrass (*Echinochloa crus-galli*) were grown to the 2-leaf stage for testing. At the time of treatment, test pots were flooded to 3 cm above the soil surface, treated by application of test compounds directly to the paddy water, and then maintained at
- 30 that water depth for the duration of the test. Treated plants and controls were maintained in a greenhouse for 13 to 15 d, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

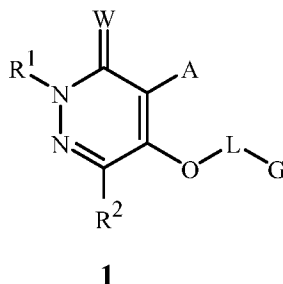
35	Table B	Compounds						
	250 g ai/ha	1	2	5	6	7	8	
	Flood							
	Barnyardgrass	20	0	0	0	0	15	

Ducksalad	85	80	90	85	100	90
Rice	0	0	0	0	0	15
Sedge, Umbrella	90	75	95	95	100	90

CLAIMS

What is claimed is:

1. A compound of Formula 1, stereoisomers, *N*-oxides, and salts thereof



5 wherein

W is O or S;

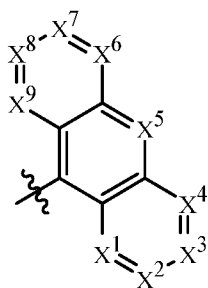
R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy, benzyl or phenyl; or a 5- or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₂–C₈ dialkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₁–C₇ alkoxy, C₁–C₅ alkylthio or C₂–C₃ alkoxy carbonyl; or phenyl optionally substituted by halogen, C₁–C₄ alkyl or C₁–C₄ haloalkyl;

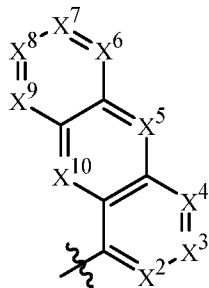
L is a direct bond, C₁–C₄ alkanediyl or C₂–C₄ alkenediyl;

G is H, C(=O)R⁵, C(=S)R⁵, CO₂R⁶, C(=O)SR⁶, S(O)₂R⁵, CONR⁷R⁸, S(O)₂NR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₂–C₄ alkynyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ haloalkynyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl; or a 5- or 6-membered heterocyclic ring;

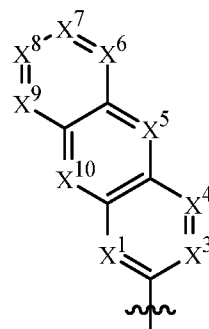
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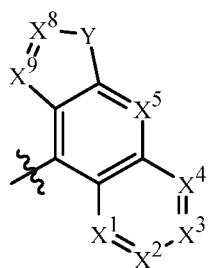
A-1



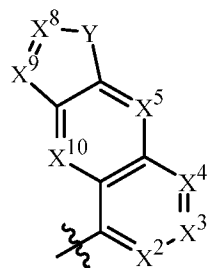
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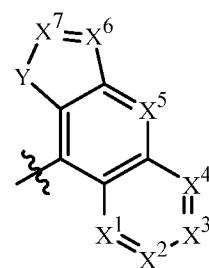
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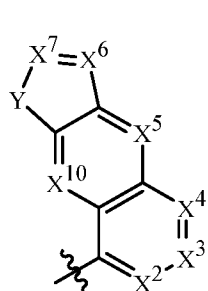
A-4



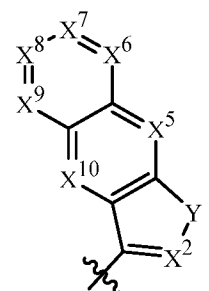
A-5



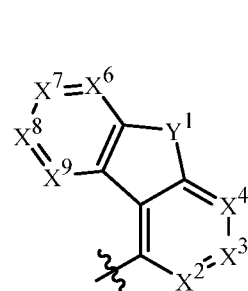
A-6



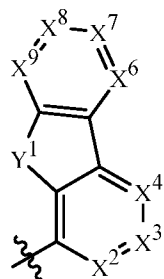
A-7



A-8



A-9



A-10

X¹, X², X³, X⁴, X⁵, X⁶, X⁷, X⁸, X⁹ and X¹⁰ are each independently N or CR³;
provided that no more than 4 of X¹, X², X³, X⁴, X⁵, X⁶, X⁷, X⁸, X⁹ and X¹⁰ are N;

Y is O, S or NR⁴;

5 Y¹ is O, S, NR⁴ or CR^{3a}R^{3b};

each R³ is independently H, halogen, cyano, nitro, C₁–C₅ alkyl, C₂–C₅ alkenyl, C₂–C₅ alkynyl, C₃–C₅ cycloalkyl, C₄–C₅ cycloalkylalkyl, C₁–C₅ haloalkyl, C₃–C₅ haloalkenyl, C₃–C₅ haloalkynyl, C₂–C₅ alkoxyalkyl, C₁–C₅ alkoxy, C₁–C₅ haloalkoxy, C₁–C₅ alkylthio, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₅ haloalkylthio or C₂–C₅ alkoxycarbonyl;

10 R^{3a} is H, halogen, -CN, nitro, C₁–C₅ alkyl, C₂–C₅ alkenyl, C₂–C₅ alkynyl, C₃–C₅ cycloalkyl, C₄–C₅ cycloalkylalkyl, C₁–C₅ haloalkyl, C₃–C₅ haloalkenyl, C₃–C₅ haloalkynyl, C₂–C₅ alkoxyalkyl, C₁–C₅ alkoxy, C₁–C₅ haloalkoxy, C₁–C₅ alkylthio, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₅ haloalkylthio or C₂–C₅ alkoxycarbonyl;

15 R^{3b} is H, halogen, -CN, nitro, C₁–C₅ alkyl, C₂–C₅ alkenyl, C₂–C₅ alkynyl, C₃–C₅ cycloalkyl, C₄–C₅ cycloalkylalkyl, C₁–C₅ haloalkyl, C₃–C₅ haloalkenyl, C₃–C₅ haloalkynyl, C₂–C₅ alkoxyalkyl, C₁–C₅ alkoxy, C₁–C₅ haloalkoxy, C₁–C₅ alkylthio, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₅ haloalkylthio or C₂–C₅ alkoxycarbonyl; or

20 R^{3a} and R^{3b} are taken together as =O; or R^{3a} and R^{3b} are taken together with the carbon atom to which they are bonded to form an optionally substituted 3- to 7-membered carbocyclic ring;

R⁴ is H, C₁–C₃ alkyl or C₁–C₃ haloalkyl;

25 R⁵ and R⁷ are independently H, C₁–C₇ alkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl or C₄–C₇ cycloalkylalkyl; or phenyl, benzyl, or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C₁–C₄ alkyl or C₁–C₄ haloalkyl;

30 R⁶ is C₁–C₇ alkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₂–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl or C₄–C₇ cycloalkylalkyl; or phenyl, benzyl or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C₁–C₄ alkyl or C₁–C₄ haloalkyl;

35 R⁸ is H, C₁–C₇ alkyl, C₂–C₇ alkenyl, C₂–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₁–C₇ haloalkyl or C₂–C₇ alkoxyalkyl;

R⁹ is C₁–C₇ alkyl or C₁–C₇ alkoxy; and

R¹⁰ is C₁–C₇ alkyl or C₁–C₇ alkoxy.

2. The compound of Claim 1 wherein

R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy, benzyl or phenyl;

W is O;

A is selected from A-1, A-4 and A-6;

L is a direct bond;

G is H, C(=O)R⁵, C(=S)R⁵, CO₂R⁶, C(=O)SR⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₂–C₄ alkynyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ haloalkynyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl;

R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₃–C₈ alkylcarbonylalkyl, C₃–C₈ alkoxy carbonylalkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₃–C₇ alkenyl, C₃–C₇ alkynyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₂–C₈ dialkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₃–C₇ haloalkenyl, C₂–C₇ alkoxyalkyl, C₁–C₇ alkoxy or C₁–C₅ alkylthio; and

each R³ is independently H, halogen, C₁–C₃ alkyl, C₃–C₄ cycloalkyl, C₁–C₃ haloalkyl or C₁–C₃ alkoxy.

3. The compound of Claim 2 wherein

R¹ is H, C₁–C₇ alkyl, C₃–C₈ alkoxy carbonylalkyl, C₄–C₇ alkylcycloalkyl, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl, C₃–C₇ alkylthioalkyl, C₁–C₇ alkoxy or benzyl;

A is A-1;

G is H, C(=O)R⁵, CO₂R⁶, CONR⁷R⁸ or P(=O)R⁹R¹⁰; or C₁–C₄ alkyl, C₂–C₄ alkenyl, C₁–C₄ haloalkyl, C₂–C₄ haloalkenyl, C₂–C₄ alkoxyalkyl, C₃–C₆ cycloalkyl or C₄–C₇ cycloalkylalkyl;

R² is H, halogen, cyano, formyl, C₁–C₇ alkyl, C₂–C₄ alkylcarbonyl, C₂–C₇ alkylcarbonyloxy, C₄–C₇ alkylcycloalkyl, C₁–C₄ alkylsulfinyl, C₁–C₄ alkylsulfonyl, C₁–C₄ alkylamino, C₃–C₇ cycloalkyl, C₄–C₇ cycloalkylalkyl, C₂–C₃ cyanoalkyl, C₁–C₄ nitroalkyl, C₂–C₇ haloalkoxyalkyl, C₁–C₇ haloalkyl, C₂–C₇ alkoxyalkyl or C₁–C₇ alkoxy; and

each R³ is independently H, halogen, C₁–C₂ alkyl, cyclopropyl or C₁–C₂ haloalkyl.

4. The compound of Claim 3 wherein
 R^1 is C_1 – C_4 alkyl, C_3 – C_4 cycloalkyl, C_2 – C_3 cyanoalkyl, C_1 – C_3 haloalkyl or C_2 – C_4 alkoxyalkyl;
 G is H, $C(=O)R^5$, CO_2R^6 or $P(=O)R^9R^{10}$; or C_1 – C_4 alkyl, C_1 – C_4 haloalkyl, C_2 – C_4 alkoxyalkyl or C_3 – C_6 cycloalkyl;
 R^2 is H, halogen, cyano, C_1 – C_4 alkyl, C_3 – C_5 cycloalkyl, C_1 – C_3 haloalkyl, C_2 – C_4 alkoxyalkyl or C_1 – C_3 alkoxy; and
each R^3 is independently H, halogen, methyl, ethyl or CF_3 .
5. The compound of Claim 4 wherein
 R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;
 G is H, $C(=O)R^5$ or CO_2R^6 ; or C_2 – C_4 alkoxyalkyl or C_3 – C_6 cycloalkyl;
 R^2 is H, Cl, Br, I, -CN, methyl or methoxy; and
each R^3 is independently H, F, Cl, Br or methyl.
6. The compound of Claim 6 selected from the group consisting of
4-(9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone;
6-chloro-4-(10-chloro-9-anthracenyl)-5-hydroxy-2-methyl-3(2*H*)-pyridazinone; and
4-(10-bromo-9-anthracenyl)-6-chloro-5-hydroxy-2-methyl-3(2*H*)-pyridazinone.
7. A herbicidal composition comprising a compound of Claim 1 and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.
8. A herbicidal composition comprising a compound of Claim 1, at least one additional active ingredient selected from the group consisting of other herbicides and herbicide safeners, and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.
9. A herbicidal mixture comprising (a) a compound of Claim 1, and (b) at least one additional active ingredient selected from (b1) photosystem II inhibitors, (b2) acetohydroxy acid synthase (AHAS) inhibitors, (b3) acetyl-CoA carboxylase (ACCase) inhibitors, (b4) auxin mimics, (b5) 5-enol-pyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, (b6) photosystem I electron diverters, (b7) protoporphyrinogen oxidase (PPO) inhibitors, (b8) glutamine synthetase (GS) inhibitors, (b9) very long chain fatty acid (VLCFA) elongase inhibitors, (b10) auxin transport inhibitors, (b11) phytoene desaturase (PDS) inhibitors, (b12) 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, (b13) homogentisate solanesyltransferase (HST) inhibitors, (b14) cellulose biosynthesis inhibitors, (b15) other herbicides including mitotic disruptors, organic arsenicals, asulam, bromobutide, cinmethylin, cumyluron, dazomet, difenzoquat, dymron, etobenzanid, flurenol, fosamine, fosamine-ammonium, hydantocidin, metam, methyldymron, oleic acid, oxaziclomefone,

pelargonic acid and pyributicarb, and (b16) herbicide safeners; and salts of compounds of (b1) through (b16).

10. A method for controlling the growth of undesired vegetation comprising contacting the vegetation or its environment with a herbicidally effective amount of a
5 compound of Claim 1.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/024742

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D403/04 C07D237/14 C07D405/04 A01N43/58
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07D

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	WO 2017/074992 A1 (DU PONT [US]) 4 May 2017 (2017-05-04) claim 1	1-10
A	----- WO 2015/168010 A1 (DU PONT [US]) 5 November 2015 (2015-11-05) claim 1	1-10
A	----- WO 2009/035150 A2 (SUMITOMO CHEMICAL CO [JP]; FUSAKA TAKAFUMI [JP]) 19 March 2009 (2009-03-19) claim 1	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

8 May 2018

Date of mailing of the international search report

17/05/2018

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Authorized officer

Baston, Eckhard

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/024742

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2017074992 A1	04-05-2017	AR 106521 A1 WO 2017074992 A1	24-01-2018 04-05-2017
WO 2015168010 A1	05-11-2015	AU 2015253505 A1 BR 112016024443 A2 CA 2946138 A1 CL 2016002731 A1 CN 106458926 A EA 201692186 A1 EP 3137456 A1 JP 2017514833 A KR 20160146963 A PE 03262017 A1 PH 12016502154 A1 SG 11201608540W A TW 201545650 A US 2017050953 A1 UY 36101 A WO 2015168010 A1	27-10-2016 15-08-2017 05-11-2015 11-08-2017 22-02-2017 28-04-2017 08-03-2017 08-06-2017 21-12-2016 18-04-2017 19-12-2016 29-11-2016 16-12-2015 23-02-2017 30-11-2015 05-11-2015
WO 2009035150 A2	19-03-2009	AR 068422 A1 AT 502926 T AU 2008297805 A1 BR PI0817103 A2 CA 2699442 A1 CN 101861306 A DK 2188264 T3 EP 2188264 A2 ES 2360169 T3 JP 5266994 B2 JP 2009084276 A KR 20100055471 A RU 2010114736 A US 2010216642 A1 WO 2009035150 A2 ZA 201001820 B	18-11-2009 15-04-2011 19-03-2009 24-03-2015 19-03-2009 13-10-2010 26-04-2011 26-05-2010 01-06-2011 21-08-2013 23-04-2009 26-05-2010 20-10-2011 26-08-2010 19-03-2009 25-05-2011