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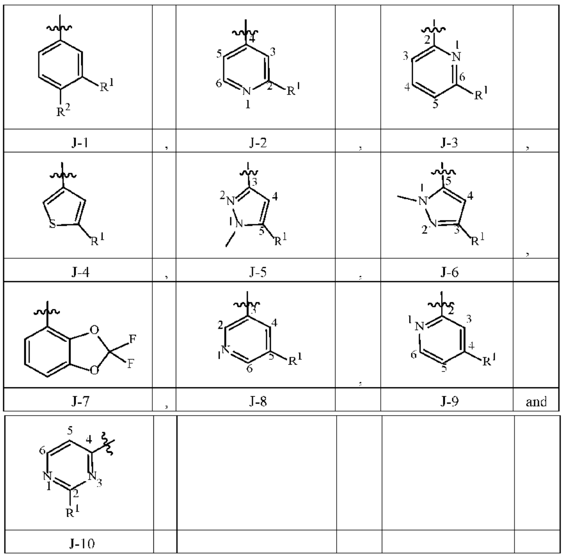
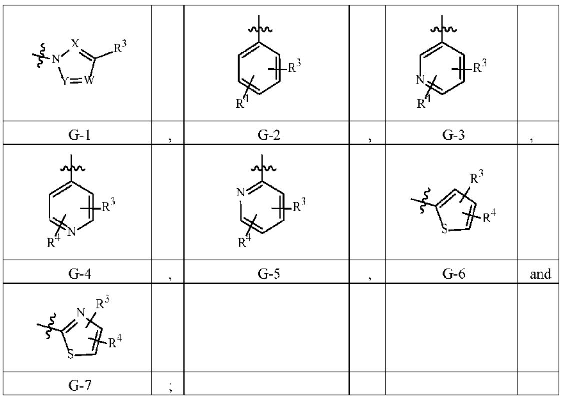
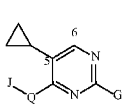
(54) Title: SUBSTITUTED CYCLOPROPYLPYRIMIDNE HERBICIDES



J-1 , J-2 , J-3 , J-4 , J-5 , J-6 , J-7 , J-8 , J-9 and J-10



G-1 , G-2 , G-3 , G-4 , G-5 , G-6 and G-7 ;



(I)

(57) **Abstract:** Disclosed are compounds of Formula I, including all stereoisomers, N-oxides, and salts thereof, agricultural compositions containing them and their use as herbicides, wherein J is selected from the group consisting of J-1 to J-10, G is selected from the group consisting of G-1 to G7, and R^1, R^2, R^3, R^4, R^5, W, X, Y and Q are as defined in the disclosure.

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TITLE

SUBSTITUTED CYCLOPROPYLPYRIMIDINE HERBICIDES

FIELD OF THE INVENTION

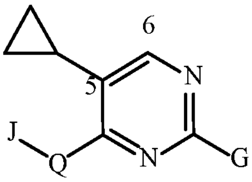
This invention relates to certain substituted cyclopropylpyrimidine herbicides, their *N*-oxides, salts and compositions, and methods of their use for controlling undesirable vegetation.

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

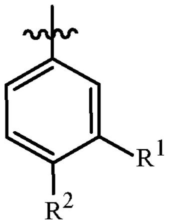
This invention is directed to compounds of Formula **1**, all stereoisomers, *N*-oxides, and salts thereof, agricultural compositions containing them and their use as herbicides:



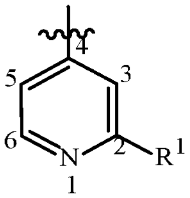
1

wherein

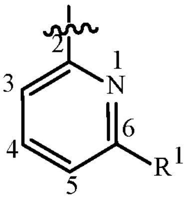
J is selected from the group consisting of



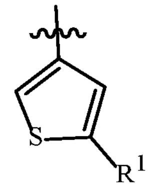
J-1 ,



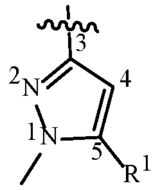
J-2 ,



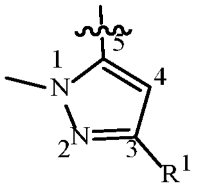
J-3 ,



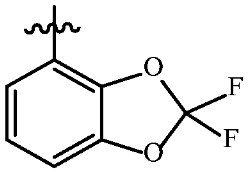
J-4 ,



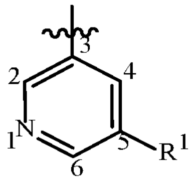
J-5 ,



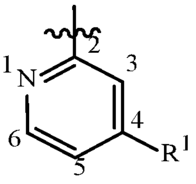
J-6 ,



J-7 ,

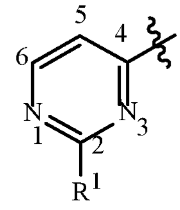


J-8 ,



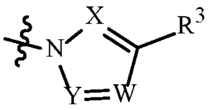
J-9

and

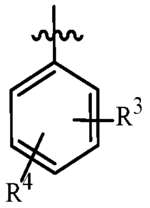


J-10

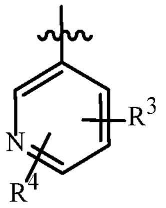
G is selected from the group consisting of



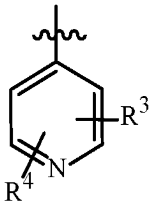
G-1 ,



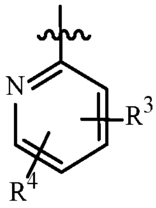
G-2 ,



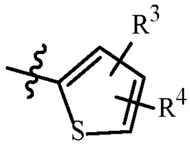
G-3 ,



G-4 ,

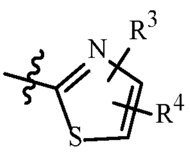


G-5 ,



G-6

and



G-7 ;

R^1 is halogen, C_1–C_4 haloalkyl, C_1–C_4 haloalkoxy, C_1–C_4 alkoxy, C_1–C_4 haloalkenyl, C_1–C_4 haloalkynyl, C_1–C_4 haloalkenyloxy, C_1–C_4 haloalkynyloxy, C_1–C_4 haloalkylthio, C_1–C_4 alkylthio or -CN;

R^2 is H or halogen;

W, X, and Y are independently N or CR^5;

R^3 is C_1–C_5 alkyl, halogen, -CN, C_3–C_5 alkenyl, C_3–C_5 alkynyl, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy or C_1–C_5 alkylthio;

R^4 is H, C_1–C_5 alkyl, halogen, -CN, C_1–C_5 haloalkyl, C_1–C_5 alkoxy or C_1–C_5 alkylthio;

Q is O, S, $-CH_2-$ or -(C=O)-;

R^5 is H, C_1–C_5 alkyl, halogen, -CN, C_3–C_5 alkenyl, C_3–C_5 alkynyl, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy or C_1–C_5 alkylthio.

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 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 (b17), and salts of compounds of (b1) through (b17), as described 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. 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 CH_3OCH_2, $CH_3OCH_2CH_2$, $CH_3CH_2OCH_2$, $CH_3CH_2CH_2CH_2OCH_2$ and $CH_3CH_2OCH_2CH_2$. "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 CH_3SCH_2, $CH_3SCH_2CH_2$, $CH_3CH_2SCH_2$, $CH_3CH_2CH_2CH_2SCH_2$ and $CH_3CH_2SCH_2CH_2$. "Alkylsulfinyl" includes both enantiomers of an alkylsulfinyl group. Examples of "alkylsulfinyl" include $CH_3S(O)$-, $CH_3CH_2S(O)$-, $CH_3CH_2CH_2S(O)$-, $(CH_3)_2CHS(O)$- and the different butylsulfinyl, pentylsulfinyl and hexylsulfinyl isomers. Examples of "alkylsulfonyl" include $CH_3S(O)_2$-, $CH_3CH_2S(O)_2$-, $CH_3CH_2CH_2S(O)_2$-, $(CH_3)_2CHS(O)_2$-, and the different butylsulfonyl, pentylsulfonyl and hexylsulfonyl isomers. "Cyanoalkyl" denotes an alkyl group substituted with one cyano group. Examples of "cyanoalkyl" include $NCCH_2$ and $NCCH_2CH_2$ (alternatively identified as CH_2CH_2CN). "Nitroalkyl" denotes an alkyl group substituted with one nitro group. Examples of "nitroalkyl" include $(NO_2)CH_2$ and $(NO_2)CH_2CH_2$ (alternatively identified as $CH_2CH_2(NO_2)$). "Cyano" means -CN, and "formyl" means HC(=O)-. "Alkylamino" includes an NH radical substituted with straight-chain or branched alkyl. Examples of "alkylamino" include CH_3CH_2NH, $CH_3CH_2CH_2NH$, and $(CH_3)_2CHCH_2NH$. Examples of "dialkylamino" include $(CH_3)_2N$, $(CH_3CH_2CH_2)_2N$ and $CH_3CH_2(CH_3)N$.

"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" donotes 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 F_3C, $ClCH_2$, CF_3CH_2 and CF_3CCl_2. The terms "haloalkoxy", "haloalkoxyalkyl", "haloalkylthio", "haloalkenyl", "haloalkynyl", and the like, are as defined analogously to the term "haloalkyl". Examples of "haloalkoxy" include CF_3O-, CCl_3CH_2O-, $HCF_2CH_2CH_2O$- and CF_3CH_2O-. Examples of "haloalkoxyalkyl" include CF_3OCH_2-, $CCl_3CH_2OCH_2$-, $HCF_2CH_2CH_2OCH_2$- and $CF_3CH_2OCH_2$-. Examples of "haloalkylthio" include CCl_3S-, CF_3S-, CCl_3CH_2S- and $ClCH_2CH_2CH_2S$-. Examples of "haloalkenyl" include $(Cl)_2C{=}CHCH_2$- and $CF_3CH_2CH{=}CHCH_2$-. Examples of "haloalkynyl" include $HC{\equiv}CCHCl$-, $CF_3C{\equiv}C$-, $CCl_3C{\equiv}C$- and $FCH_2C{\equiv}CCH_2$-.

"Alkylcarbonyl" denotes a straight-chain or branched alkyl moiety bonded to a C(=O) moiety. Examples of "alkylcarbonyl" include $CH_3C(=O)$-, $CH_3CH_2C(=O)$-, $CH_3CH_2CH_2C(=O)$- and $(CH_3)_2CHC(=O)$-. "Alkoxycarbonyl" denotes a straight-chain or branched alkoxy moieties bonded to a C(=O) moiety. Examples of "alkoxycarbonyl" include $CH_3OC(=O)$-, $CH_3CH_2OC(=O)$-, $CH_3CH_2CH_2OC(=O)$-, $(CH_3)_2CHOC(=O)$- and the different butoxy- or pentoxycarbonyl isomers. C(=O) or C(O) designates carbonyl. The term "alkoxycarbonylalkyl" denotes a straight-chain or branched alkoxycarbonyl moiety bonded through an alkyl moiety. The term "alkylcarbonylalkyl" denotes a straight or branched alkylcarbonyl moiety bonded through an alkyl moiety. The term "alkylcarbonyloxy" donates an alkylcarbony moiety bonded through oxygen. Examples of alkylcarbonyloxy include $CH_3C(=O)O$-, $CH_3CH_2C(=O)O$-, $CH_3CH_2CH_2C(=O)O$- and $(CH_3)_2CHC(=O)$-. The term alkanediyl or alkenediyl refers to a linear or branched alkane or alkene linking chain respectively. Examples of alkanediyl include $–CH_2–$, $–CH_2CH(CH_3)–$ and $–CH_2CH_2CH_2–$. Examples of alkenediyl include $–CH=CH–$, $–CH_2C=CH–$ and $–CH=C(CH_3)–$. 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 8. For example, C_1–C_4 alkylsulfonyl designates methylsulfonyl through butylsulfonyl; C_3–C_8 alkylcarbonylalkyl can be, for example, CH_3COCH_2-, $CH_3COCH_2CH_2$- or $CH_3CH_2CH_2COCH_2CH_2CH_2CH_2$-; C_4–C_7 alkylcycloalkyl can be, for example, methylcyclopropyl, methylcyclobutyl, ethylcyclopropyl, or propylcyclobutyl; C_2 alkoxyalkyl designates CH_3OCH_2-; C_3 alkoxyalkyl designates, for example, $CH_3CH(OCH_3)$-, $CH_3OCH_2CH_2$- or $CH_3CH_2OCH_2$-; 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 $CH_3CH_2CH_2OCH_2$- and $CH_3CH_2OCH_2CH_2$-.

When a group contains a substituent which can be hydrogen, for example R^2 or R^5, 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.

When a compound is substituted with a substituent bearing a subscript that indicates the number of said substituents can exceed 1, said substituents (when they exceed 1) are independently selected from the group of defined substituents.When a functional group or a compound is shown to be optionally substituted with a substituent, the said functional group or compound may be unsubstituted or substituted. 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.

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 to the presence or absence of co-crystallized water or other molecules, which can be weakly or strongly bound in the lattice. Polymorphs can differ in such chemical, physical and biological properties as crystal shape, density, hardness, color, chemical stability, melting point, hygroscopicity, suspensibility, dissolution rate and biological availability. One skilled in the art will appreciate that a polymorph of a compound 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, 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.

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

Embodiment 1. A compound of Formula **1**, stereoisomers, N-oxides, and salts thereof, agricultural compositions containing them and their use as herbicides as described in the Summary of the Invention.

Embodiment 2. A compound of Formula **1** or Embodiment 1 wherein J is J-1, J-2, J-3, J-5, J-6, J-8,J-9 or J-10.

Embodiment 2a. A compound of Formula **1** or Embodiment 2 wherein J is J-1, J-2 or J-3.

Embodiment 2b. A compound of Embodiment 2a wherein J is J-1.

Embodiment 2c. A compound of Embodiment 2a wherein J is J-2.

Embodiment 2d. A compound of Embodiment 2a wherein J is J-3.

Embodiment 2e. A compound of Formula **1** or Embodiment 2 wherein J is J-5, J-6 or J-8.

Embodiment 2f. A compound of Embodiment 2e wherein J is J-5.

Embodiment 2g. A compound of Embodiment 2e wherein J is J-6.

Embodiment 2h. A compound of Embodiment 2e wherein J is J-8.

Embodiment 3. A compound of Formula **1** or any one of the preceding Embodiments wherein G is G-1, G-2, G-3, G-4 or G-7.

Embodiment 3a. A compound of Embodiment 3 wherein G is G-1, G-2, G-3 or G-7.

Embodiment 3aa. A compound of Embodiment 3a wherein G is G-1, G-2 or G-3.

Embodiment 3b. A compound of Embodiment 3a where G is G-1 wherein W, X, and Y are independently N or CR^6.

Embodiment 3c. A compound of Embodiment 3b wherein X is N, Y is CR^6 and W is CR^6.

Embodiment 3d. A compound of Embodiment 3b wherein X is CR^6, Y is N and W is CR^6.

Embodiment 3dd. A compound of Embodiment 3b wherein X is CR^6, Y is CR^6 and W is N.

Embodiment 3e. A compound of Embodiment 3b wherein X is CR^6, Y is CR^6 and W is CR^6.

Embodiment 3f. A compound of Embodiment 3b wherein X is N, Y is N and W is CR^6.

Embodiment 3g. A compound of Embodiment 3 wherein G is G-2.

Embodiment 3h. A compound of Embodiment 3 wherein G is G-3.

Embodiment 3i. A compound of Embodiment 3 wherein G is G-4.

Embodiment 3j. A compound of Embodiment 3 wherein G is G-7.

Embodiment 4. A compound of Formula **1** or any one of the preceding Embodiments wherein R^1 is halogen, C_1–C_4 haloalkyl, C_1–C_4 haloalkoxy, C_1–C_4 alkoxy or C_1–C_4 haloalkylthio.

Embodiment 4a. A compound of Embodiment 4 wherein R^1 is C_1–C_4 haloalkyl or C_1–C_4 haloalkoxy.

Embodiment 4b. A compound of Embodiment 4a wherein R^1 is CF_3 or OCF_3.

Embodiment 4c. A compound of Embodiment 4a wherein R^1 is C_1–C_4 haloalkyl.

Embodiment 4d. A compound of Embodiment 4c wherein R^1 is CF_3.

Embodiment 4e. A compound of Embodiment 4a wherein R^1 is C_1–C_4 haloalkoxy.

Embodiment 4f. A compound of Embodiment 4e wherein R^1 is OCF_3.

Embodiment 5. A compound of Formula **1** or any one of the preceding Embodiments wherein R^2 is H.

Embodiment 5a. A compound of Formula **1** or any one of the preceding Embodiments wherein R^2 is halogen.

Embodiment 6. A compound of Formula **1** or any one of the preceding Embodiments wherein R^3 is C_1–C_5 alkyl, halogen, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy or C_1–C_5 haloalkoxy.

Embodiment 6a. A compound of Embodiment 6 wherein R^3 is C_1–C_5 alkyl, halogen, C_1–C_5 haloalkyl, C_1–C_5 alkoxy or C_1–C_5 haloalkoxy.

Embodiment 6b. A compound of Embodiment 6a wherein R^3 is halogen, C_1–C_5 haloalkyl or C_1–C_5 haloalkoxy.

Embodiment 6c. A compound of Embodiment 6b wherein R^3 is halogen or C_1–C_5 haloalkyl.

Embodiment 6d. A compound of Embodiment 6c wherein R^3 is halogen.

Embodiment 6e. A compound of Embodiment 6c wherein R^3 is C_1–C_5 haloalkyl.

Embodiment 6f. A compound of Embodiment 6c wherein R^3 is F, Cl or CF_3.

Embodiment 6g. A compound of Embodiment 6f wherein R^3 is CF_3.

Embodiment 6h. A compound of Embodiment 6f wherein R^3 is F.

Embodiment 6i. A compound of Embodiment 6f wherein R^3 is Cl.

Embodiment 7. A compound of Formula **1** or any one of the preceding Embodiments wherein R^4 is H, C_1–C_5 alkyl, halogen, -CN, C_1–C_5 haloalkyl, C_1–C_5 alkoxy or C_1–C_5 alkylthio.

Embodiment 7a. A compound of Embodiment 7 wherein R^4 is H, halogen, -CN or C_1–C_5 haloalkyl.

Embodiment 7b. A compound of Embodiment 7a wherein R^4 is H, halogen, -CN or CF_3.

Embodiment 7c. A compound of Embodiment 7b wherein R^4 is H.

Embodiment 8. A compound of Formula **1** or any one of the preceding Embodiments wherein Q is O, S, -CH_2- or –(C=O)-.

Embodiment 8a. A compound of Embodiment 8 wherein Q is O or -CH_2-.

Embodiment 8b. A compound of Embodiment 8a wherein Q is O.

Embodiment 8c. A compound of Embodiment 8a wherein Q is -CH_2-.

Embodiment 8d. A compound of Embodiment 8 wherein Q is S.

Embodiment 9. A compound of Formula **1** or any one of the preceding Embodiments wherein R^5 is H, C_1–C_5 alkyl, halogen, -CN, C_3–C_5 alkenyl, C_3–C_5 alkynyl, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy or C_1–C_5 alkylthio.

Embodiment 9a. A compound of Embodiment 9 wherein R^5 is H, C_1–C_5 alkyl or halogen.

Embodiment 9b. A compound of Embodiment 9a wherein R^5 is H.

Embodiment 9c. A compound of Embodiment 9a wherein R^5 is C_1–C_3 alkyl.

Embodiment 9d. A compound of Embodiment 9a wherein R^5 is halogen.

Embodiments of this invention, including Embodiments 1–9d 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 1–9d above as well as any other embodiments described herein, and any combination thereof, pertain to the compositions and methods of the present invention.

Combinations of Embodiments 1–9d are illustrated by:

Embodiment X. A compound of Formula **1** as described in the Summary of the Invention wherein

J is J-1, J-2, J-3, J-5, J-6, J-8, J-9 or J-10; and

G is G-1, G-2, G-3 or G-7.

Embodiment XX. A compound of Embodiment X wherein

R^1 is C_1–C_4 haloalkyl or C_1–C_4 haloalkoxy;

R^3 is halogen or C_1–C_5 haloalkyl;
R^4 is H; and
Q is O or -CH_2-.

Embodiment XXX. A compound of Embodiment XX wherein
Q is O.

Embodiment A1. A compound of Embodiment X wherein
J is J-1, J-2 or J-3;
R^1 is CF_3 or OCF_3; and
R^3 is F, Cl or CF_3.

Embodiment A2. A compound of Embodiment A1 wherein
J is J-1; and
R^2 is H or halogen.

Embodiment A3. A compound of Embodiment A2 wherein
R^2 is H.

Embodiment A4. A compound of Embodiment A1 wherein
J is J-2; and
R^1 is CF_3.

Embodiment A5. A compound of Embodiment A1 wherein
J is J-3; and
R^1 is CF_3.

Embodiment A6. A compound of Embodiment X wherein
G is G-1, G-2 or G-3.

Embodiment A7. A compound of Embodiment A6 wherein
G is G-1;
X is N;
Y is CH;
W is CH; and
R^5 is CF_3.

Embodiment A8. A compound of Embodiment A6 wherein

G is G-2; and
R^3 is CF_3.

Embodiment A11. A compound of Embodiment A6 wherein
G is G-3; and
R^3 is CF_3.

Embodiment B1. A compound of Embodiment X wherein
J is J-5, J-6 or J-8;
R^1 is CF_3 or OCF_3; and
R^3 is F, Cl, CF_3.

Embodiment B2. A compound of Embodiment B1 wherein
J is J-5.

Embodiment B3. A compound of Embodiment B1 wherein
J is J-6.

Embodiment B4. A compound of Embodiment B1 wherein
J is J-8.

Embodiment C. A compound of Summary of the Invention wherein Q is O..

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

5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine; (Compound 1)

5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[4-(trifluoromethyl)phenyl]pyrimidine; (Compound 5)

5-cyclopropyl-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]-4-[[2-(trifluoromethyl)-4-pyridinyl]oxy]pyrimidine; (Compound 9)

5-cyclopropyl-4-[3-(trifluoromethoxy)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine; (Compound 10)

5-cyclopropyl-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]-4-[[6-(trifluoromethyl)-2-pyridinyl]oxy]pyrimidine; (Compound 8) and

5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[6-(trifluoromethyl)-3-pyridinyl]pyrimidine. (Compound 13)

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.

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

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) dehydrooritate dehydrogenase (DHODH) inhibitors, (b16) 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, (b17) herbicide safeners, and salts of compounds of (b1) through (b17).

"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, bispyribac-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, pyrithiobac-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.

"ACCase 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 ACCase inhibitors include alloxydim, butroxydim, clethodim, clodinafop, cycloxydim, cyhalofop, diclofop, fenoxaprop, fluazifop, haloxyfop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxydim 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, 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)-2-Pyridinecarboxylic 2-propyn-1-yl ester (CAS No. 2251111-17-6), 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)-2-Pyridinecarboxylic cyanomethyl ester (CAS No. 2251111-18-7), aminopyralid, benazolin-ethyl, chloramben, clacyfos, 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, paraquat and 1-(2-carboxyethyl)-4-(2-pyrimidinyl)pyridazinium (CAS No. 2285384-11-2).

"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, benzfendizone, bifenox, butafenacil, carfentrazone, carfentrazone-ethyl, chlomethoxyfen, 3-[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]-4-fluorophenyl]-4,5-dihydro-5-methyl-5-Isoxazolecarboxylic ethyl ester (CAS No. 1949837-17-5), cinidon-ethyl, fluazolate, flufenoximacil, flufenpyr-ethyl, flumiclorac-pentyl, flumioxazin, fluoroglycofen-ethyl, fluthiacet-methyl, fomesafen, halosafen, lactofen, oxadiargyl, oxadiazon, oxyfluorfen, pentoxazone, profluazol, pyraclonil, pyraflufen-ethyl, saflufenacil, sulfentrazone, thidiazimin, trifludimoxazin (dihydro-1,5-dimehyl-6-thioxo-3-[2,2,7-trifluoro-3,4-dihydro-3-oxo-4-(2-propyn-1-yl)-2*H*-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 ((2R)-*N*,*N*-diethyl-2-(1-naphthalenyloxy)propanamide), pethoxamid, piperophos, pretilachlor, propachlor, propisochlor, pyroxasulfone, and thenylchlor, 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).

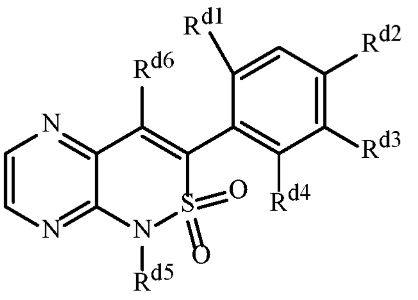
"PDS inhibitors" (b11) are chemical compounds that inhibit carotenoid biosynthesis pathway at the phytoene desaturase step. Examples of PDS inhibitors include beflubutamid, diflufenican, fluridone, flurochloridone, flurtamone norflurzon and picolinafen.

"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-quinoxalinyl]carbonyl]-1,3-cyclohexanedione), flusulfinam, iptriazopyrid, isoxachlortole, isoxaflutole, mesotrione, pyrasulfotole, pyrazolynate, pyrazoxyfen, sulcotrione, tefuryltrione, tembotrione, tolpyralate (1-[[1-ethyl-4-[3-(2-methoxyethoxy)-2-methyl-4-(methylsulfonyl)benzoyl]-1*H*-pyrazol-5-

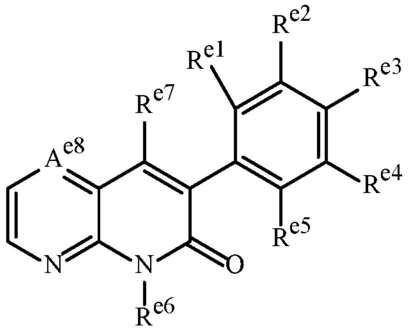
yl]oxy]ethyl methyl carbonate), topramezone, 5-chloro-3-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-1-(4-methoxyphenyl)-2(1*H*)-quinoxalinone, 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5(2*H*,4*H*)-dione, 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 (homogentisate solanesyltransferase) 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



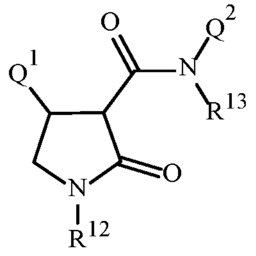
B

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, CH_3, CF_3, OCF_3 or CH_2CH_3; R^{e6} is H, CH_3, CH_2CHF_2 or $C\equiv CH$; 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.

"DHODH (dihydroorotate dehydrogenase) inhibitors" (b15) act through inhibiting catalysis of the fourth step of pyrimidine biosynthesis in plant systems. Inhibition of pyrimidine biosynthesis leads to the cessation of plant growth. Examples of DOHDH inhibitors include tetflupyrolimet ((3*S*,4*S*)-N-(2-fluorophenyl)-1-methyl-2-oxo-4-[3-(trifluoromethyl)phenyl]-3-pyrrolidinecarboxamide) and (3*S*,4*R*)-N-(2,3-difluorophenyl)-1-methyl-4-[1-methyl-5-(trifluoromethyl)-1H-pyrazol-3-yl]-2-oxo-3-pyrrolidinecaboxamide.

"Other herbicides" (b16) 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, bixlozone, broclozone, bromobutide, cinmethylin, clomazone, cumyluron, daimuron, difenzoquat, dimesulfazet, epyrifenacil, 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, methyldymron, oleic acid, oxaziclomefone, pelargonic acid, pyributicarb, 2,5-anhydro-3,4-dideoxy-4-[[[(5S)-3-(3,5-difluorophenyl)-5-ethenyl-4,5-dihydro-5-isoxazolyl]carbonyl]amino]-threo-Pentonic methyl ester (CAS No. 27499989-21-6) and 5-[[(2,6-difluorophenyl)methoxy]methyl]-4,5-dihydro-5-methyl-3-(3-methyl-2-thienyl)isoxazole. "Other herbicides" (b16) also include a compound of Formula (b16A)



(b16A)

wherein

R^{12} is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_4–C_8 cycloalkyl;

R^{13} is H, C_1–C_6 alkyl or C_1–C_6 alkoxy;

Q^1 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 R^{14};

Q^2 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 R^{15};

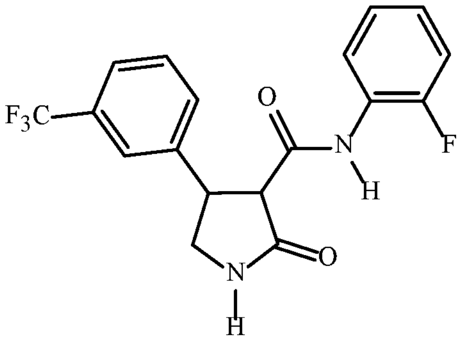
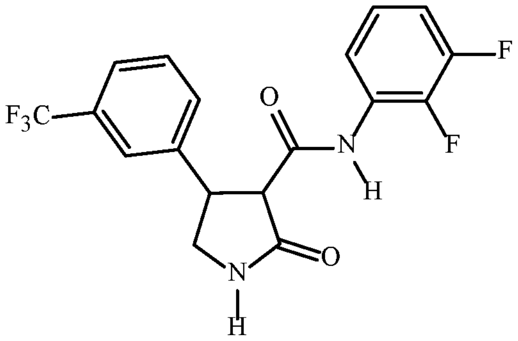
each R^{14} is independently halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_3–C_8 cyaloalkyl, cyano, C_1–C_6 alkylthio, C_1–C_6 alkylsulfinyl, C_1–C_6 alkylsulfonyl, SF_5, NHR^{17}; or phenyl optionally substituted by 1 to 3 R^{16}; or pyrazolyl optionally substituted by 1 to 3 R^{16};

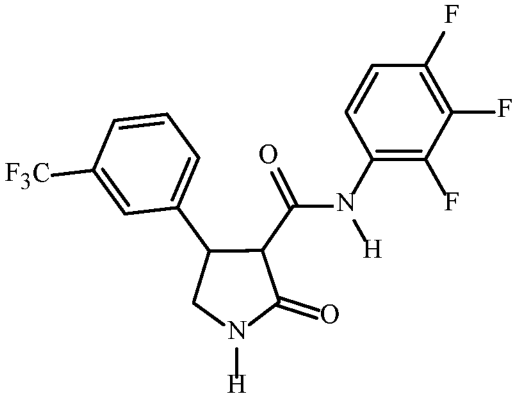
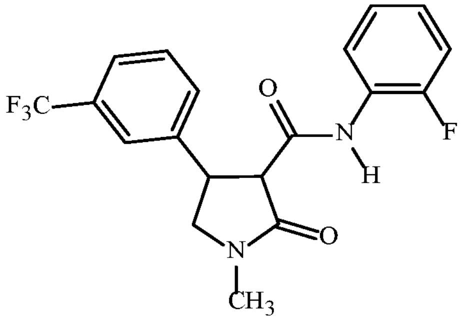
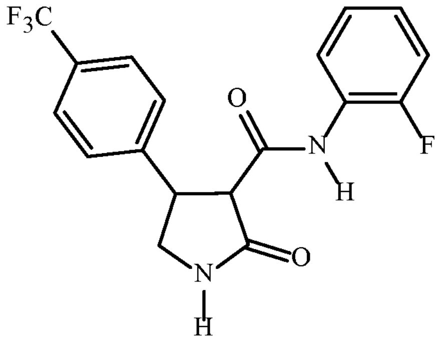
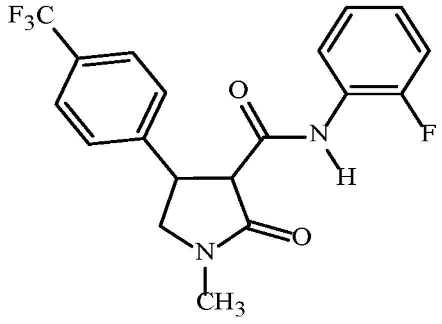
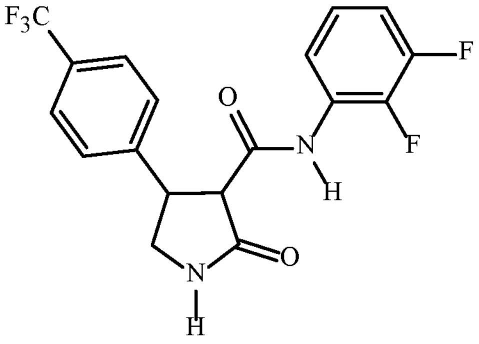
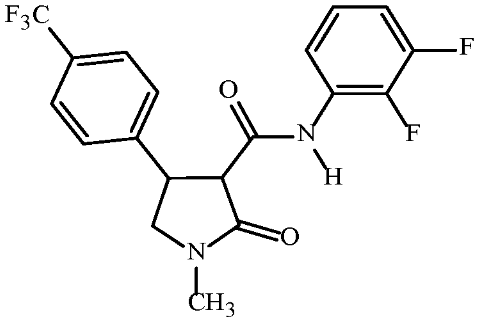
each R^{15} is independently halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, cyano, nitro, C_1–C_6 alkylthio, C_1–C_6 alkylsulfinyl, C_1–C_6 alkylsulfonyl;

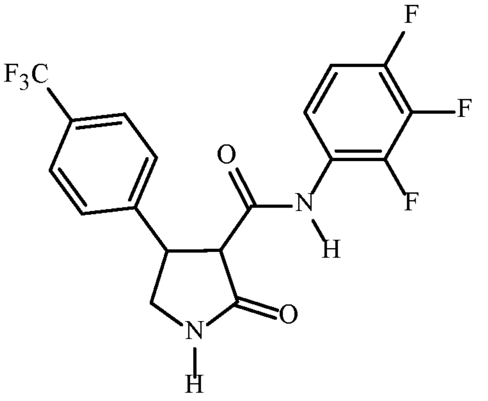
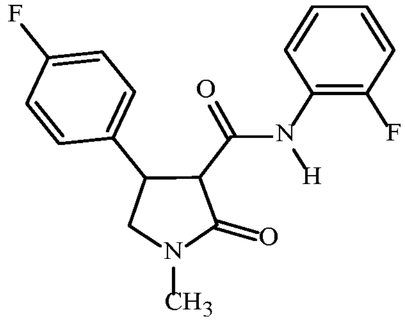
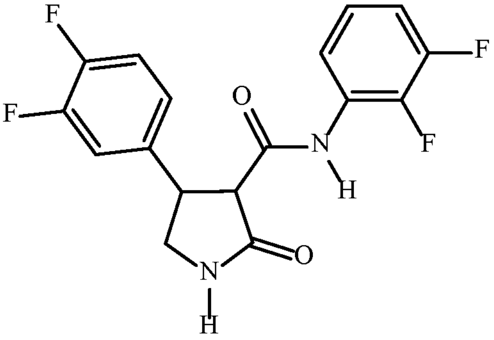
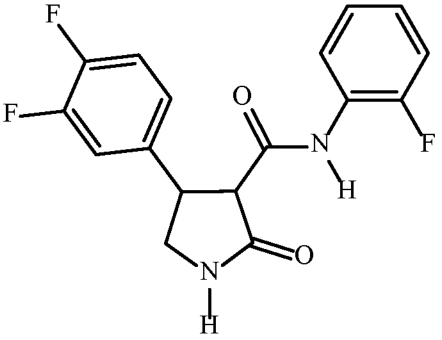
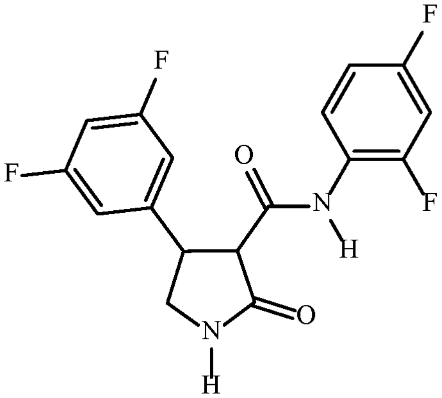
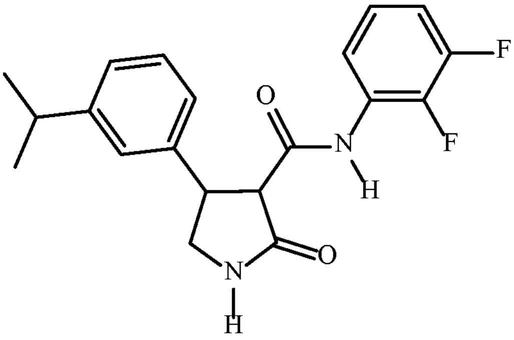
each R^{16} is independently halogen, C_1–C_6 alkyl or C_1–C_6 haloalkyl;

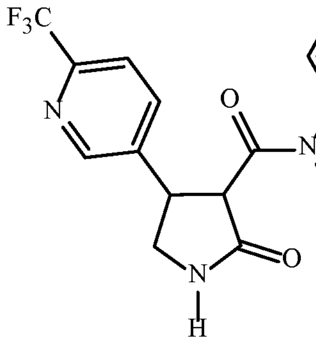
R^{17} is C_1–C_4 alkoxycarbonyl.

In one Embodiment wherein “other herbicides” (b16) also include a compound of Formula (b16A), it is preferred that R^{12} is H or C_1–C_6 alkyl; more preferably R^{12} is H or methyl. Preferrably R^{13} is H. Preferably Q^1 is either a phenyl ring or a pyridinyl ring, each ring substituted by 1 to 3 R^{14}; more preferably Q^1 is a phenyl ring substituted by 1 to 2 R^{14}. Preferably Q^2 is a phenyl ring substituted by 1 to 3 R^{15}; more preferably Q^2 is a phenyl ring substituted by 1 to 2 R^{15}. Preferably each R^{14} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy or C_1–C_3 haloalkoxy; more preferably each R^{14} is independently chloro, fluoro, bromo, C_1–C_2 haloalkyl, C_1–C_2 haloalkoxy or C_1–C_2 alkoxy. Preferrably each R^{15} is independently halogen, C_1–C_4 alkyl, C_1–C_3 haloalkoxy; more preferably each R^{15} is independently chloro, fluoro, bromo, C_1–C_2 haloalkyl, C_1–C_2 haloalkoxy or C_1–C_2 alkoxy. Specifically preferred as “other herbicides” (b16) include any one of the following (b16A-1) through (b16A-15):

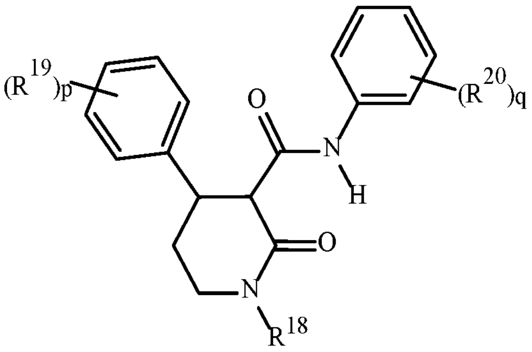
	
(b16A-1)	(b16A-2)

	
(b16A-3)	(b16A-4)
	
(b16A-5)	(b16A-6)
	
(b16A-7)	(b16A-8)

	
(b16A-9)	(b16A-10)
	
(b16A-11)	(b16A-12)
	
(b16A-13)	(b16A-14)

	
(b16A-15)	.

"Other herbicides" (b16) also include a compound of Formula (b16B)



(b16B)

wherein

R^{18} is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_4–C_8 cycloalkyl;

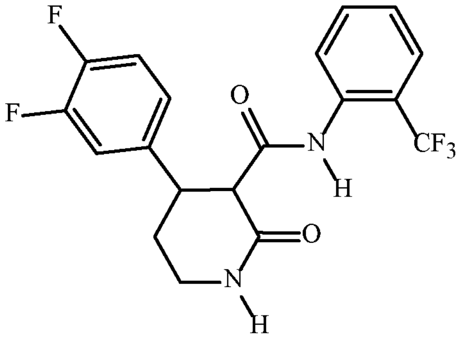
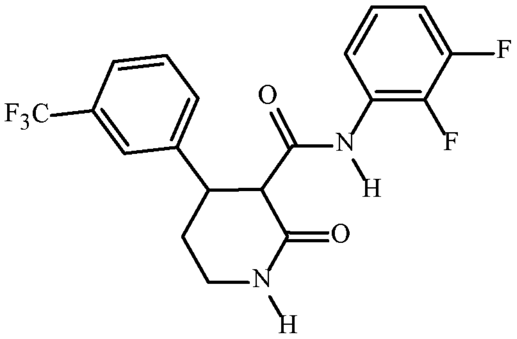
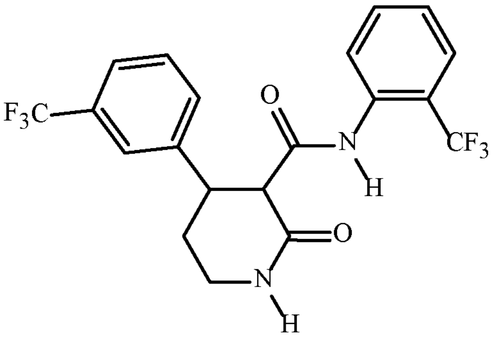
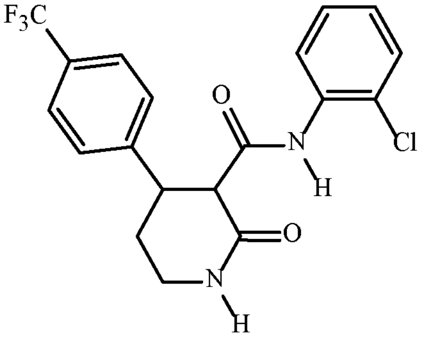
each R^{19} is independently halogen, C_1–C_6 haloalkyl or C_1–C_6 haloalkoxy;

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.

In one Embodiment wherein "other herbicides" (b16) 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 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, difluorormethyl or trifluromethyl) or C_1 fluoroalkoxy (i.e. trifluoromethoxy, difluoromethoxy or fluoromethoxy). Specifically preferred as “other herbicides” (b16) include any one of the following (b15B-1) through (b16B-19):

	
(b16B-1)	(b16B-2)
	
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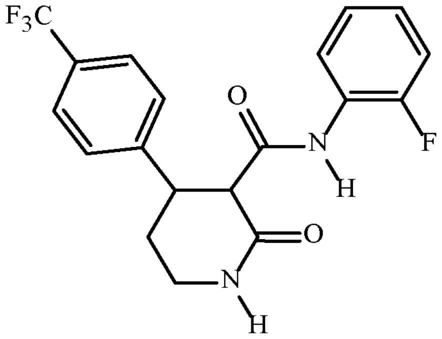
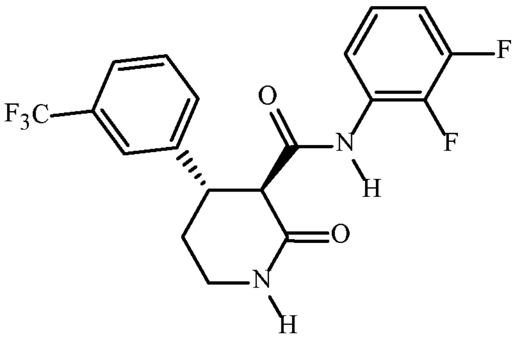
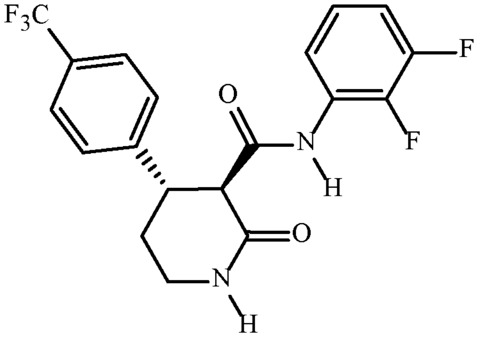
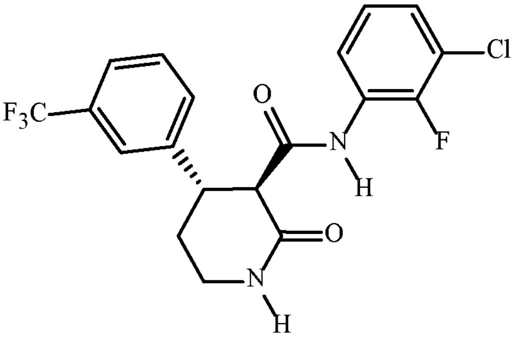
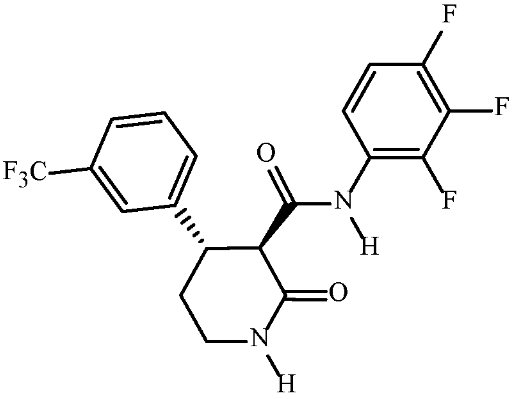
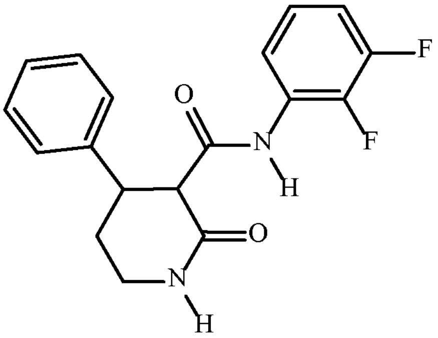
	
(b16B-5)	(b16B-6)

	
(b16B-7)	(b16B-8)
	
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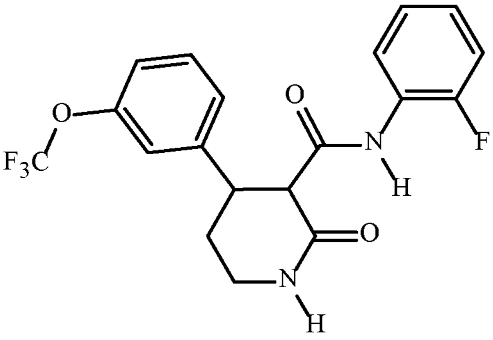
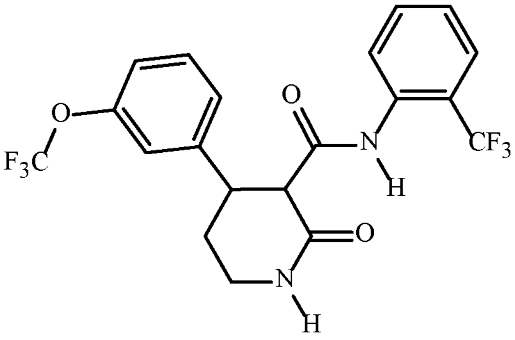
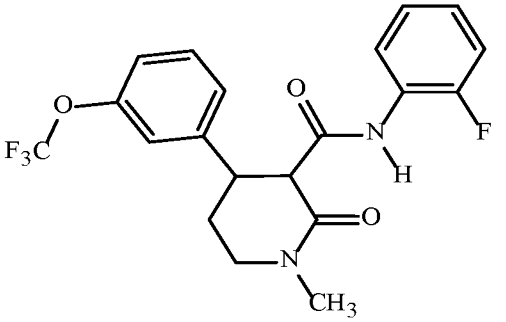
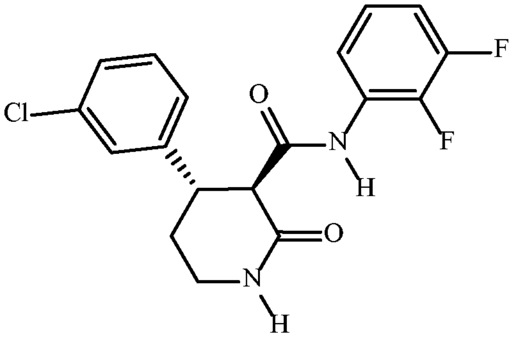
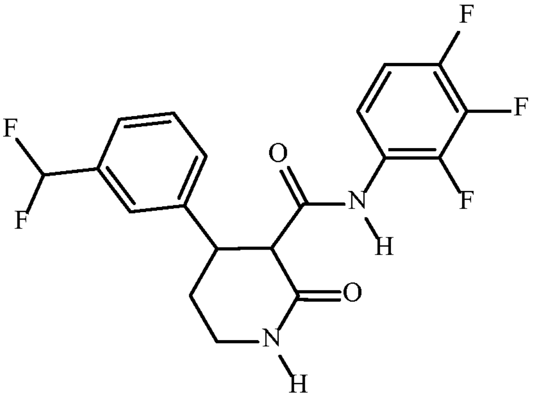
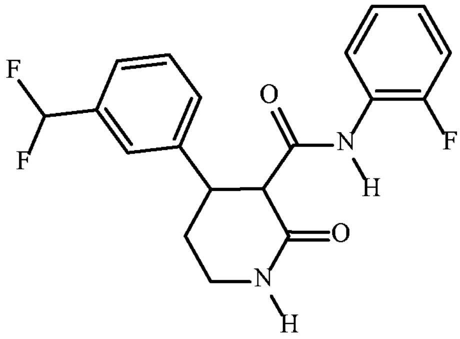
	
(b16B-11)	(b16B-12)

	
(b16B-13)	(b16B-14)
	
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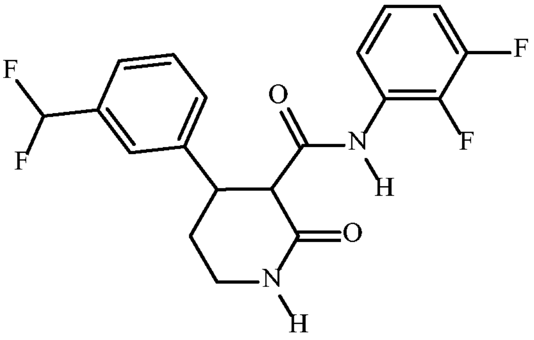
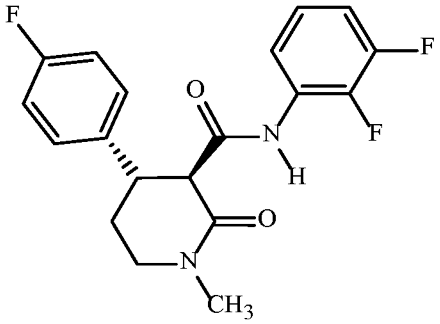
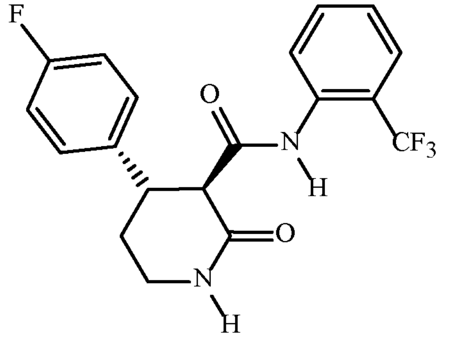
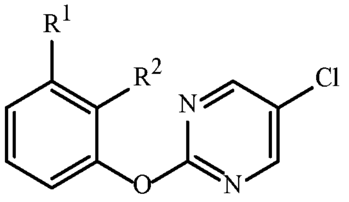
	
(b16B-17)	(b16B-18)

	
(b16B-19)	.

Another Embodiment wherein "other herbicides" (b16) also include a compound of Formula (b16C),



(b16C)

wherein R^1 is Cl, Br or CN; and R^2 is $C(=O)CH_2CH_2CF_3$, $CH_2CH_2CH_2CH_2CF_3$ or 3-CHF_2-isoxazol-5-yl.

"Herbicide safeners" (b17) 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, fenclorim, 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.

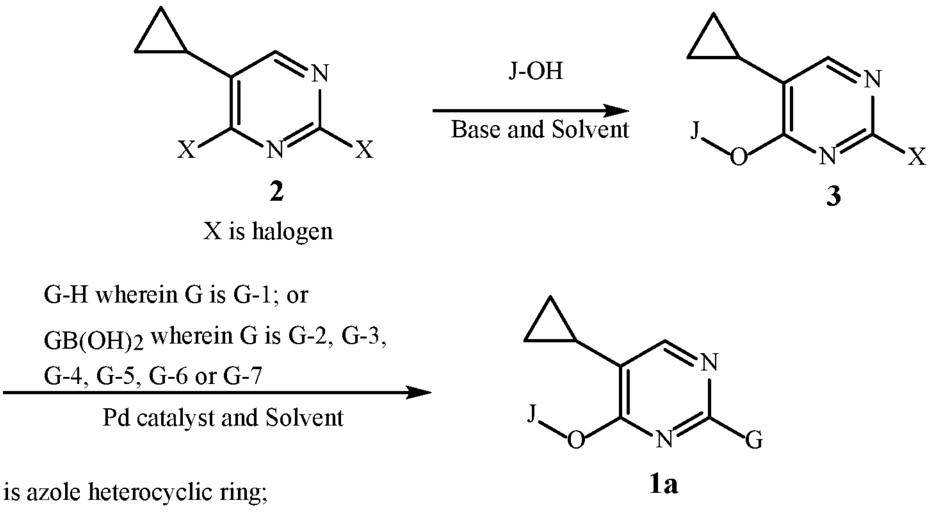
Preferred for better control of undesired vegetation (e.g., lower use rate such as from greater-than-additive effects, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)- 2-Pyridinecarboxylic 2-propyn-1-yl ester (CAS No. 2251111-17-6), 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)- 2-Pyridinecarboxylic cyanomethyl ester (CAS No. 2251111-18-7), 2,5-anhydro-3,4-dideoxy-4-[[[(5S)-3-(3,5-difluorophenyl)-5-ethenyl-4,5-dihydro-5-isoxazolyl]carbonyl]amino]-threo-Pentonic methyl ester (CAS No. 27499989-21-6), atrazine, azimsulfuron, beflubutamid, beflubutamid-M, bixlozone, broclozone, benzisothiazolinone, 1-(2-carboxyethyl)-4-(2-pyrimidinyl)pyridazinium (CAS No. 2285384-11-2) and salts thereof, carfentrazone-ethyl, chlorimuron-ethyl, 3-[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]-4-fluorophenyl]-4,5-dihydro-5-methyl-5-isoxazolecarboxylic ethyl ester (CAS No. 1949837-17-5), chlorsulfuron-methyl, 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, 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 1–5 can be used to prepare the compounds of Formula **1**. The definitions of X, J and G in the compounds of Formulae **1**–**11** below are as defined above in the Summary of the Invention unless otherwise noted. Compounds of Formulae **1a**, **1b**, **1c, 1d** and **1e** are various subsets of the compounds of Formula **1**.

Compounds of Formula **1a** (i.e. compounds of Formula **1** wherein Q is O) can be made by the general synthetic route outlined in Scheme 1. Reacting a cyclopropyl dihalopyrimidine of Formula **2** (wherein X is a halogen as leaving group) with an appropriately substituted phenol or hydroxy heterocycle of Formula J-OH, in the presence of a suitable base and solvent, can provide intermediates of Formula **3**. Examples of suitable bases for this reaction include but are not limited to potassium carbonate, sodium hydroxide, potassium t-butoxide, sodium hydride or potassium hydroxide, and compatible solvents include but not limited to tetrahydrofuran, acetonitrile, toluene, dioxane or *N*,*N*-dimethylformamide. Temperatures for this reaction generally range from 0° C to warming below or heating at the boiling point of the solvent. Although the halogen X at the 4-position of a pyrimidine of Formula **2** is generally favored as the leaving group over the halogen X at the 2-position, one skilled in the art will recognize that some regioisomeric side-product of intermediate **3** can form from displacement of the halogen at the 2-position and side-adduct may require separation from **3** by chromatography or recrystallization.

Cross-coupling of intermediates of Formula **3** with an azole heterocycle of Formula (G-1)H, an aryl boronic acid of Formula (G-2)B$(OH)_2$, a pyridyl boronic acid of Formula (G-3)B$(OH)_2$, (G-4)B$(OH)_2$ or (G-5)B$(OH)_2$, a thienyl boronic acid of Formula (G-6) B$(OH)_2$ or a thiazolyl boronic acid of Formula (G-7)B$(OH)_2$, in the presence of a suitable palladium catalyst in a solvent such as tetrahydrofuran, acetonitrile, toluene, dioxane or *N*,*N*-dimethylformamide or dichloromethane, affords compounds of Formula **1a**. The halogen substituent X can be chlorine, bromine or in some cases iodine. Preferable palladium catalysts include but are not limited to the commercially available chloro[2-(di-tert-butylphosphino)-2′,4′,6′-triisopropyl-1,1′-biphenyl][2-(2-aminoethyl)phenyl)] palladium(II) [t-BuXPhos palladium(II) phenethylamine chloride, tBuXPhos-Pd-G1], chloro[(tri-tert-butylphosphine)-2-(2-aminobiphenyl)] palladium(II) [P(t-Bu)3 Pd G2], methanesulfonato(2-di-t-butylphosphino-2;methanesulfonato(2-di-t-butylphosphino-2',4',6'-tri-i-propyl-1,1'-biphenyl)(2'-amino-1,1'-biphenyl-2-yl)palladium(II) [tBuXPhos-Pd-G3], 2-Dicyclohexylphosphino-2′,6′-diisopropoxybiphenyl [RuPhos], (2-Dicyclohexylphosphino-2′,6′-diisopropoxy-1,1′-biphenyl)[2-(2′-amino-1,1′-biphenyl)]palladium(II) methanesulfonate [RuPhos-G3] or $Pd_2(dba)_3$ with SPhos. Temperatures for this coupling reaction generally range from 0° C to warming below or heating at the boiling point of the solvent.

Scheme 1



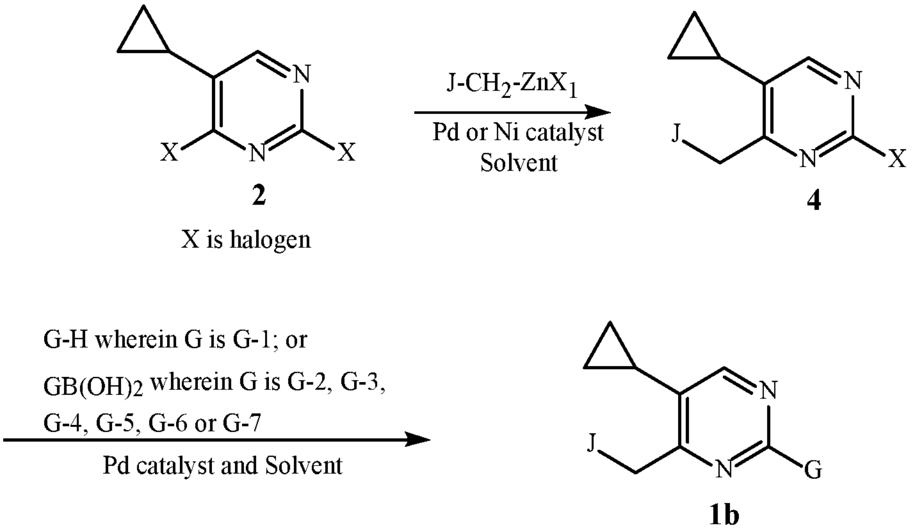
G-1 is azole heterocyclic ring;
G-2 is aryl ring;
G-3, G-4 and G-5 are 3-pyr, 4-pyr, 2-pyr ring respectively;
G-6 is thienyl ring;
G-7 is thiazolyl ring.

Compounds of Formula **1b** (i.e. compounds of Formula **1** where Q is CH_2) can be made by the general synthetic route usually referred to as a “Negishi Coupling” as outlined in Scheme 2. Reacting a cyclopropyl dihalopyrimidine of Formula **2** (where X is a halogen as leaving group) with an appropriately substituted benzyl or pyridylmethyl zinc reagent of Formula J-CH_2-ZnX_1 (X_1 is halogen) in a solvent such as tetrahydrofuran, acetonitrile, toluene, dioxane or *N*,*N*-dimethylformamide, provides an intermediate of Formula **4**.

Temperatures for this reaction generally range from –78° C to warming below or heating at the boiling point of the solvent. Although the halogen X at the 4-position of a pyrimidine of Formula **2** is usually favored as the preferred leaving group over the halogen X at the 2-position, one skilled in the art will recognize that some regioisomeric side-product of intermediate **4** can form from displacement of the halogen at the 2-position. Separation by chromatography or recrystallization may be needed to isolate the desired isomers. Reagents of Formula $J\text{-}CH_2\text{-}ZnX_1$ are readily generated from commercially available benzyl and heteroarylmethyl halides by reacting with an appropriate zinc reagent (i.e. zinc dust, $ZnCl_2$, TMPZnCl·LiCl, or $TMP_2Zn \cdot 2MgCl_2 \cdot 2LiCl$], generally in the solvent used for the coupling.

Cross-coupling of intermediates of Formula **4** with an azole heterocycle of Formula (G-1)H, an aryl boronic acid of Formula $(G\text{-}2)B(OH)_2$, a pyridyl boronic acid of Formula $(G\text{-}3)B(OH)_2$, $(G\text{-}4)B(OH)_2$ or $(G\text{-}5)B(OH)_2$, a thienyl boronic acid of Formula $(G\text{-}6)B(OH)_2$ or a thiazolyl halide of Formula $(G\text{-}7)B(OH)_2$, in the presence of a suitable palladium catalyst (as listed above for Scheme 1) in a solvent such as tetrahydrofuran, acetonitrile, toluene, dioxane or *N,N*-dimethylformamide or dichloromethane, affords compounds of Formula **1b**. The halogen substituent X can be chlorine, bromine or in some cases iodine. In the case wherein G is G-1, compounds of Formula **1b** can also be made without use of a palladium catalyst, instead by reacting an intermediate of Formula **4** with an azole of Formula (G-1)H in the presence of a base such as potassium carbonate, sodium hydride or sodium hydroxide in a compatible solvent for the particular base used. Examples of solvents include but are not limited to tetrahydrofuran, acetonitrile, toluene, dioxane or *N,N*-dimethylformamide. Temperatures for this nucleophilic displacement reaction can range from 0° C to ambient temperature to warming below or heating at the boiling point of the solvent.

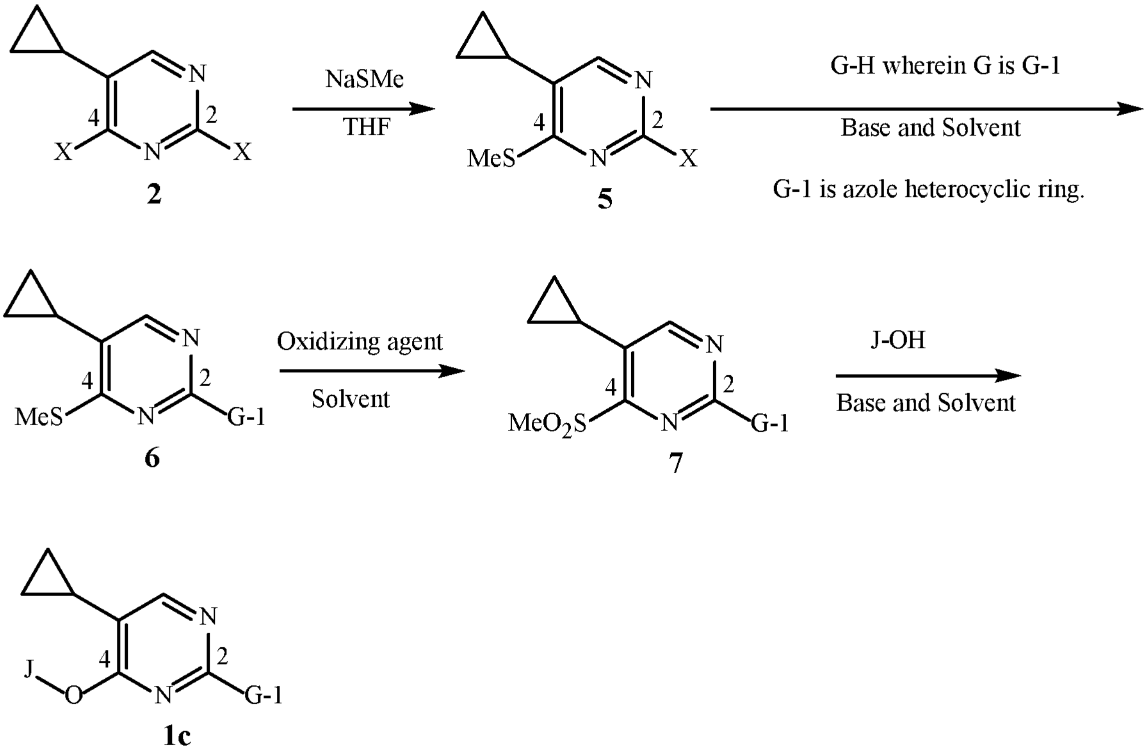
Scheme 2



G-1 is azole heterocyclic ring;
G-2 is aryl ring;
G-3, G-4 and G-5 are 3-pyr, 4-pyr, 2-pyr ring respectively;
G-6 is thienyl ring;
G-7 is thiazolyl ring.

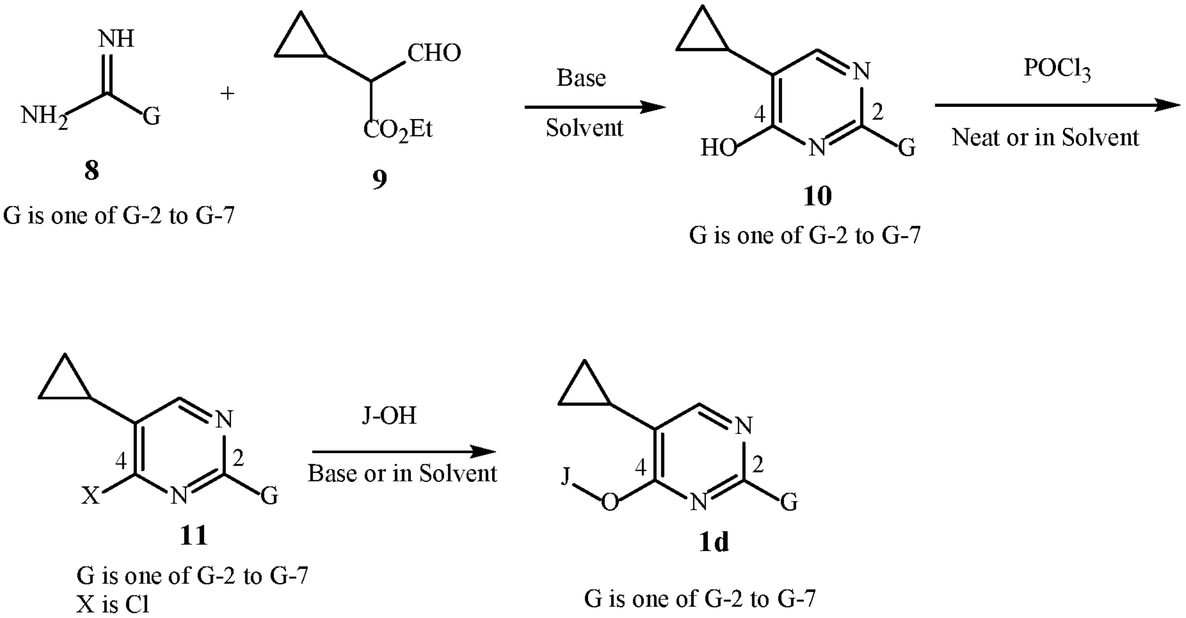
An alternative method for accessing compounds of Formula **1c** (i.e. compounds of Formula **1** where X is O and G is G-1) regioselectivity, is summarized in Scheme 3. Reacting a dihalopyrimidine or Formula **2** with sodium thiomethoxide in a solvent such as tetrahydrofuran or dioxane at a temperature ranging usually from 0° C to ambient temperature, affords intermediates of Formula **5** as the major product. This reaction can sometimes give rise to an isomeric side-product resulting from mercaptan displacement of the halogen at 2-position in various amounts where that isomeric impurity may require separation by chromatography or crystallization. Displacement of the halogen at 2- position on intermediates of Formula **5** with an azole of Formula G-1, in the presence of a base (preferably potassium carbonate, sodium hydride or sodium hydroxide) in a compatible solvent (i.e. acetonitrile, toluene, dioxane or *N*,*N*-dimethylformamide) at temperature ranging usually from ambient temperature to warming below the reflux temperature of the solvent, gives intermediates of Formula **6**. Oxidation of the compound of Formula **6** with an oxidizing agent, generally meta-chloroperoxybenzoic acid (MCPBA) in dichloromethane (DCM), affords the corresponding sulfones 7. The methyl sulfone substituent is now an activated leaving group, where upon reacting 7 with phenols and hydroxyheterocycles of Formula J-OH, in the presence of base and solvent (e.g. potassium carbonate in *N*,*N*-dimethylformamide) at ambient temperature to warming below the reflux temperature of the solvent, gives final products of Formula **1c**.

Scheme 3



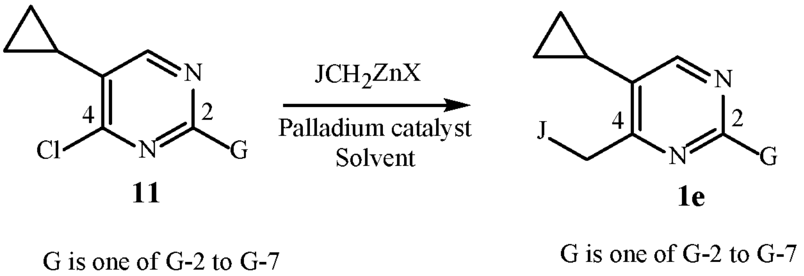
Another method for making pyrimidines of Formula **1d** (i.e. compounds of Formula **1** where X is O and G is G-2 to G-7) is outlined in Scheme 4. Reaction of an amidine of Formula **8** (which is commercially available in many cases or readily prepared by standard methods know in the art) with ethyl α-formyl-cyclopropaneacetate of Formula **9**, in the presence of an appropriate base such as sodium methoxide, potassium carbonate, or potassium t-butoxide in a solvent that includes but not limited to methanol, ethanol, dimethyl sulfoxide, *N,N*-dimethylformamide or acetonitrile, at temperatures ranging usually from ambient temperature to the reflux temperature of the solvent, affords hydroxypyrimidines of Formula **10**. Heating the compound of Formula **10** in phosphorous oxychloride (and in some cases with thionyl chloride or oxalyl chloride, optionally with a cosolvent such as toluene or dichloromethane) provides chloropyrimidines of Formula **11**. Reacting a compound of Formula **11** with an appropriately substituted phenol or hydroxy heterocycle of Formula J-OH, in the presence of a suitable base and solvent, can provide final products of Formula **1d**. Examples of suitable bases for this reaction include but are not limited to potassium carbonate, sodium hydroxide, potassium t-butoxide, sodium hydride or potassium hydroxide; and compatible solvents include but not limited to tetrahydrofuran, acetonitrile, toluene, dioxane or *N,N*-dimethylformamide. Temperatures for this reaction generally range from 0° C to warming below or heating at the boiling point of the solvent.

Scheme 4



Reaction of the chloropyrimidine of Formula **11** with an appropriately substituted benzyl or pyridylmethyl zinc reagent of Formula JCH_2ZnX (X is halogen), in a solvent such as tetrahydrofuran, acetonitrile, toluene, dioxane or *N*,*N*-dimethylformamide, also provides end products of Formula **1e**. Temperatures for this reaction generally range from –78° C to warming below or heating at the boiling point of the solvent. Reagents of Formula JCH_2ZnBr are readily generated from commercially available benzyl and heteroarylmethyl halides by reacting with an appropriate zinc reagent (i.e. zinc dust, $ZnCl_2$, $TMPZnCl{\cdot}LiCl$, or $TMP_2Zn{\cdot}2MgCl_2{\cdot}2LiCl$], generally in the solvent used for the coupling.

Scheme 5



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 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 partcular 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 $CDCl_3$ 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 5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine (Compound 1)

Step A: Preparation of 2-chloro-5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy] pyrimidine

A vial was charged with 2,4-dichloro-5-cyclopropylpyrimidine (0.5 g, 2.65 mmol), potassium carbonate (0.40 g, 2.90 mmol), and *m*-trifluoromethylphenol (0.47 g, 2.90 mmol). *N*,*N*-Dimethylformamide 13.23 mL was added and the mixture was heated at 80 °C for 1 h.

The reaction was partitioned between diethyl ether and water. The organic phase was separated, dried over magnesium sulfate, filtered, and concentrated to give 0.80 g of the title compound.

^{1}H NMR δ ppm 8.10 (s, 1H), 7.53–7.61 (m, 2H), 7.44–7.48 (m, 1H), 7.38–7.42 (m, 1H), 2.06 (m, 1H), 1.07–1.13 (m, 2H), 0.82–0.88 (m, 2H).

Step B: Preparation of 5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine

A vial was charged with 2-chloro-5-cyclopropyl-4-[3-trifluoromethyl)phenoxy]pyrimidine (i.e. the product of Step A, 0.25 g, 0.79 mmol), 3-(trifluoromethyl)-1*H*-pyrazole (0.108 g, 0.794 mmol), potassium phosphate tribasic (0.20 g, 0.95 mmol), and *t*BuXphos-G3 (0.06 g, 0.079 mmol) and purged with N_2. Dioxane (3.97 mL) was added and the vial was purged twice more with N_2 and heated at 50 °C overnight. The crude reaction was concentrated onto Celite® (diatomaceaous-earth filter aid) and purified via via silica gel column chromatography (eluting with hexanes:ethyl acetate gradient) to obtain 0.21 g of the title compound.

^{1}H NMR (600 MHz) δ ppm 8.32 (s, 1H), 8.06 (dd, 1H), 7.55–7.67 (m, 3H), 7.42–7.49 (m, 1H), 6.60 (d, 1H), 2.07–2.20 (m, 1H), 1.14 (m, 2H), 0.85–0.96 (m, 2H).

SYNTHESIS EXAMPLE 2

Preparation of 5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[4-(trifluoromethyl)phenyl]pyrimidine

Step A: Preparation of 5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[4-(trifluoromethyl)phenyl]pyrimidine (Compound 5)

A vial was charged with 2-chloro-5-cyclopropyl-4-[3-rifluoromethyl)phenoxy]pyrimidine (i.e. the product of step A of Synthesis Example 1, 0.25 g, 0.79 mmol), 4-(trifluoromethyl)phenylboronic acid (0.18 g, 0.95 mmol), potassium phosphate tribasic (0.20 g, 0.95 mmol), and Xphos Pd G2 (0.063 g, 0.079 mmol) and purged with N_2. Dioxane (3.97 mL) was added and the vial was purged twice more with N_2 and heated at 70 °C overnight. The crude reaction was concentrated onto Celite® (diatomaceaous-earth filter aid) and purified via silica gel column chromatography (eluting with a hexanes/ethyl acetate gradient) to obtain 0.19 g of the title compound.

^{1}H NMR (500 MHz) δ ppm 8.34 (s, 1H), 8.24 (d, 2H), 7.55–7.66 (m, 5H), 7.43–7.49 (m, 1H), 2.11–2.21 (m, 1H), 1.09–1.16 (m, 2H), 0.90–0.95 (m, 2H).

SYNTHESIS EXAMPLE 3

Preparation of 5-cyclopropyl-4-[[3-(trifluoromethyl)phenyl]methyl]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine (Compound 7)

Step A. Preparation of 2-chloro-5-cyclopropyl-4-[[3-(trifluoromethyl)phenyl]methyl]pyrimidine

A vial was charged with 2,4-dichloro-5-cyclopropylpyrimidine (0.5 g, 2.6 mmol), tetrakis(triphenylphosphine)palladium(0) (0.076 g, 0.066 mmol), and 13.2 mL of tetrahydrofuran. The vial was purged with N_2 and chloro[[3-(trifluoromethyl)phenyl]methyl]zinc 5.29 mL (0.5 M) was added over 1 min. The reaction was stirred at room temperature for 5 min, then heated at 65 °C overnight. The crude reaction mixture was concentrated onto Celite® (diatomaceous-earth filter aid) and purified via silica gel column chromatography (eluting with a hexanes/ethyl acetate gradient) to provide 0.47 g of the title compound.

^{1}H NMR (500 MHz) δ ppm 8.23 (s, 1H), 7.48–7.56 (m, 2H), 7.40–7.47 (m, 2H), 4.33 (s, 2H) 1.70–1.79 (m, 1H), 0.99–1.06 (m, 2H), 0.64–0.70 (m, 2H).

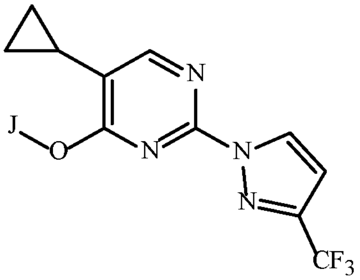
Step B. Preparation of 5-cyclopropyl-4-[[3-(trifluoromethyl)phenyl]methyl]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine

A vial was charged with 2-chloro-5-cyclopropyl-4-[[3-(trifluoromethyl)phenyl]methyl]pyrimidine (i.e. the product of Step A)(0.25 g, 0.79 mmol), 3-(trifluoromethyl)-1*H*-pyrazole (0.11 g, 0.794 mmol), potassium phosphate tribasic (0.20 g, 0.95 mmol), and *t*BuXphos Pd G3 (0.063 g, 0.079 mmol) and purged with N_2. Dioxane 3.97 mL was added and the vial was purged 2x more with N_2 and heated at 50 °C overnight. The crude reaction mixture was concentrated onto Celite® (diatomaceous-earth filter aid) and purified via silica gel column chromatography (eluting with a hexanes/ethyl acetate gradient) to obtain 0.19 g of the title compound.

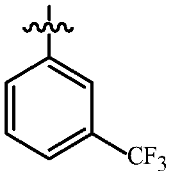
^{1}H NMR (500 MHz) δ ppm 8.52–8.60 (m, 1H), 8.44 (s, 1H), 7.56–7.62 (m, 1H), 7.53 (d, 1H), 7.41–7.50 (m, 2H), 6.71 (d, 1H), 4.43 (s, 2H), 1.79–1.86 (m, 1H), 1.03–1.11 (m, 2H), 0.68–0.76 (m, 2H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to 18 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, $-NO_2$ means nitro, TMS means trimethylsilyl, SOMe means methylsulfinyl, C_2F_5 means CF_2CF_3 and SO_2Me means methylsulfonyl.

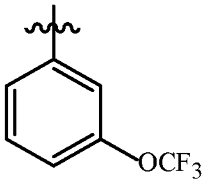
Table 1



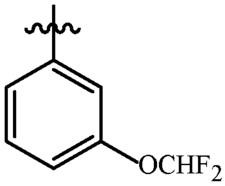
J is



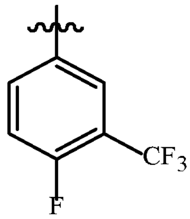
J-1-a



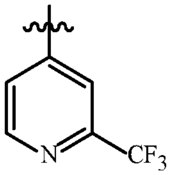
J-1-b



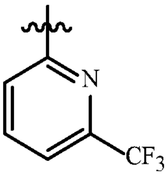
J-1-c



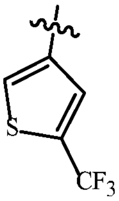
J-1-d



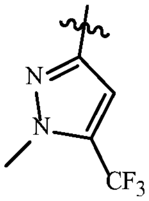
J-2-a



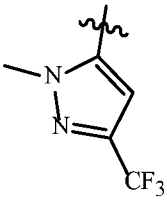
J-3-a



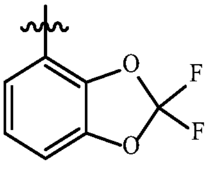
J-4-a



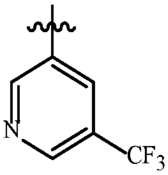
J-5-a



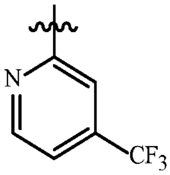
J-6-a



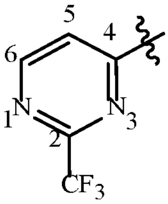
J-7



J-8-a



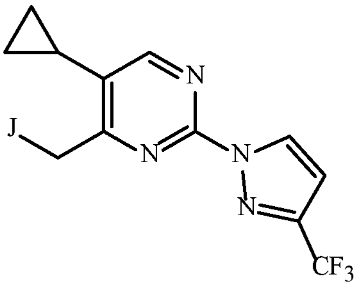
J-9-a



J-10-a

5 The present disclosure also includes Tables 2 through 18.

Table 2



J is as defined in Table 1

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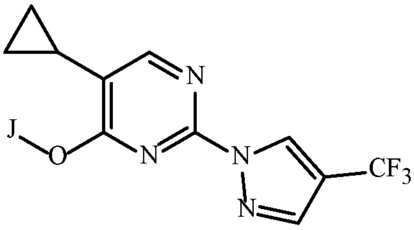

J is as defined in Table 1

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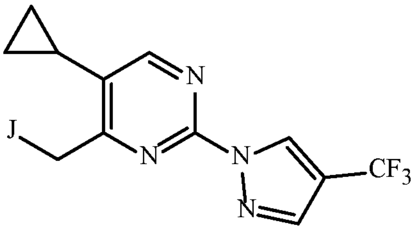

J is as defined in Table 1

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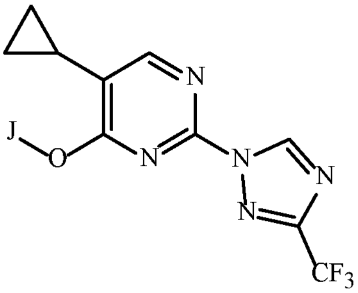

J is as defined in Table 1

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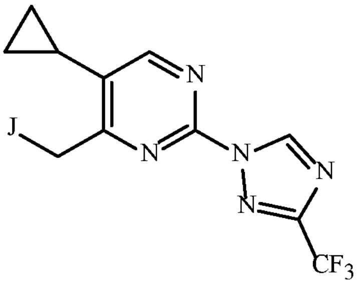

J is as defined in Table 1

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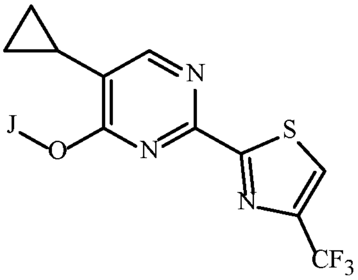

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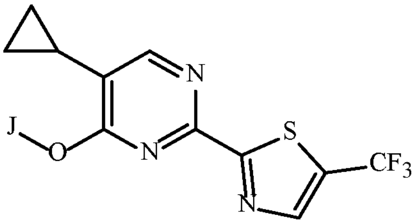

J is as defined in Table 1

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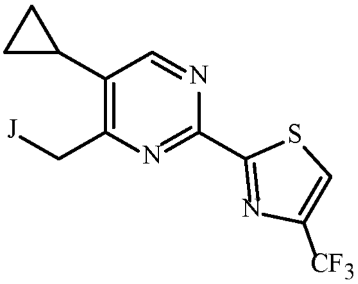

J is as defined in Table 1

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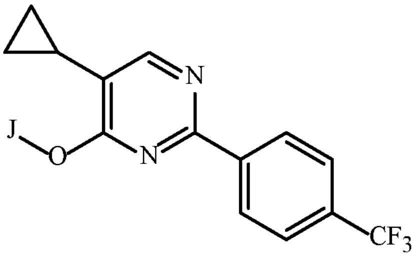

J is as defined in Table 1

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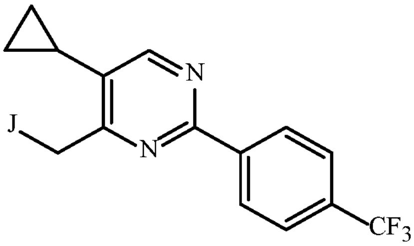
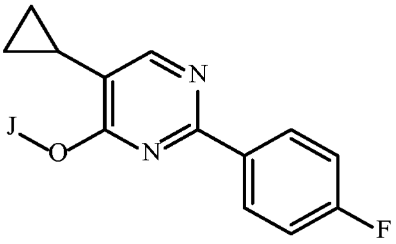


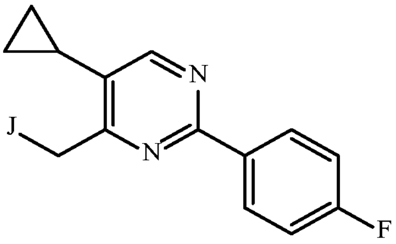
J is as defined in Table 1

Table 12



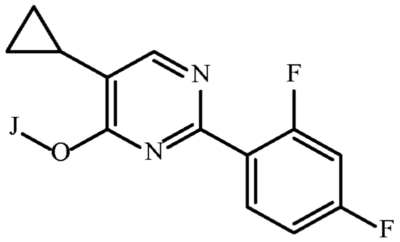
J is as defined in Table 1

Table 13



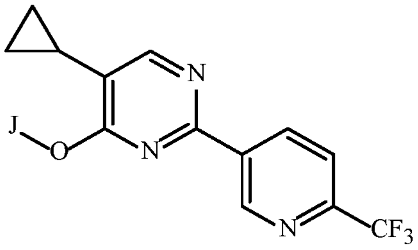
J is as defined in Table 1

Table 14



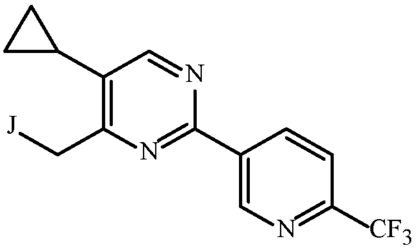
J is as defined in Table 1

Table 15



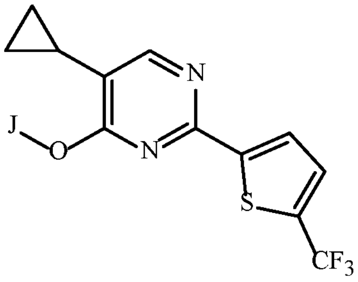
J is as defined in Table 1

Table 16



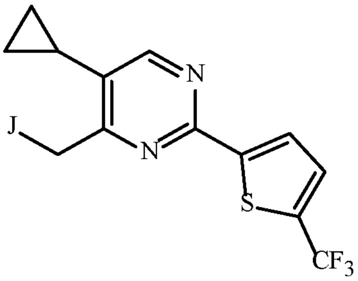
J is as defined in Table 1

Table 17



J is as defined in Table 1

Table 18



J is as defined in Table 1

Formulation/Utility

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.

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.

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 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		
	Active Ingredient	Diluent	Surfactant
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 C_6–C_{22}), 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, alkyd peg (polyethylene glycol) resins, graft or comb polymers and star polymers; polyethylene glycols (pegs); polyethylene glycol fatty acid esters; silicone-based surfactants; and sugar-derivatives such as sucrose esters, alkyl polyglycosides and alkyl polysaccharides.

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

Emulsifiable Concentrate

Compound 1	10.0%
polyoxyethylene sorbitol hexoleate	20.0%
C_6–C_{10} fatty acid methyl ester	70.0%

Example F

Microemulsion

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

Example G

Suspension 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 H

Emulsion 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 I

Oil 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", "Compound 10", "Compound 11", "Compound 12", "Compound 13", "Compound 14", "Compound 15" or "Compound 16".

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 inention 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, alloxydim, ametryn, amicarbazone, amidosulfuron, aminocyclopyrachlor and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)-2-Pyridinecarboxylic 2-propyn-1-yl ester (CAS No. 2251111-17-6), 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)- 2-Pyridinecarboxylic cyanomethyl ester (CAS No.

2251111-18-7), aminopyralid, amitrole, ammonium sulfamate, 2,5-anhydro-3,4-dideoxy-4-[[[(5S)-3-(3,5-difluorophenyl)-5-ethenyl-4,5-dihydro-5-isoxazolyl]carbonyl]amino]-threo-Pentonic methyl ester (CAS No. 27499989-21-6), anilofos, anisiflupurin, asulam, atrazine, azimsulfuron, bixlozone, beflubutamid, beflubutamid-M, benazolin, benazolin-ethyl, bencarbazone, benfluralin, benfuresate, benquitrione, 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, bipyrazone, cafenstrole, carbetamide, 1-(2-carboxyethyl)-4-(2-pyrimidinyl)pyridazinium (CAS No. 2285384-11-2) and salts thereof, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, 3-[2-chloro-5-[3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-1(2H)-pyrimidinyl]-4-fluorophenyl]-4,5-dihydro-5-methyl-5-Isoxazolecarboxylic ethyl ester (CAS No. 1949837-17-5), 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, isoctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, cyprafluone, 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, dimesulfazet, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethylarsinic acid and its sodium salt, dinitramine, dinoterb, dioxopyritrione, diphenamid, diquat dibromide, dithiopyr, diuron, DNOC, endothal, EPTC, epyrifenacil, esprocarb, ethalfluralin, ethametsulfuron-methyl, ethiozin, ethofumesate, ethoxyfen, ethoxysulfuron, etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fenoxasulfone, fenpyrazone, fenquinotrione, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, fluchloraminopyr, flufenacet, flufenoximacil, flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, flusulfinam, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium, glufosinate-P, glyphosate and its salts such as ammonium, isopropylammonium, potassium, 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, 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, mesotrione, metam-sodium, metamifop, metamitron, metazachlor, metazosulfuron, methabenzthiazuron, methylarsonic acid and its calcium, monoammonium, monosodium and disodium salts, methyldymron, metobenzuron, metobromuron, metolachlor, S-metolachlor, metosulam, metoxuron, metribuzin, metsulfuron-methyl, molinate, monolinuron, naproanilide, napropamide, napropamide-M, naptalam, neburon, nicosulfuron, norflurazon, 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, prodiamine, profoxydim, prometon, prometryn, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyrisulfuron, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriflubenzoxim, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyrithiobac, pyrithiobac-sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinoclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimisoxafen, rimsulfuron, saflufenacil, sethoxydim, siduron, simazine, simetryn, sulcotrione, sulfentrazone, sulfometuron-methyl, sulfosulfuron, 2,3,6-TBA, TCA, TCA-sodium, tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxydim, terbacil, terbumeton, terbuthylazine, terbutryn, tetflupyrolimet, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron-methyl, thiobencarb, tiafenacil, tiocarbazil, tolpyralate, topramezone, tralkoxydim, tri-allate, triafamone, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifludimoxazin, trifluralin, triflusulfuron-methyl, tripyrasulfone, tritosulfuron, vernolate, 3-(2-chloro-3,6-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-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-*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 gloeosporiodes* (Penz.) Penz. & Sacc., *Drechsiera monoceras* (MTB-951), *Myrothecium verrucaria* (Albertini & Schweinitz) Ditmar: Fries, *Phytophthora palmivora* (Butl.) Butl. and *Puccinia thlaspeos* Schub.

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*-beflubutamid, benzisothiazolinone, carfentrazone-ethyl, chlorimuron-ethyl, chlorsulfuron-methyl, 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, 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.

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 A_4 and A_7, 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, fenclorim, 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.

Table A1 lists specific combinations of a Component (a) with Component (b) illustrative of the mixtures, compositions and methods of the present invention. Compound No. (Compound Number) (i.e. Compound 1) in the Component (a) column is identified in Index Table A. The second column of Table A1 lists the specific Component (b) compound (e.g., “2,4-D” in the first line). The third, fourth and fifth columns of Table A1 lists ranges of weight ratios for rates at which the Component (a) compound is typically applied to a field-grown crop relative to Component (b) (i.e. (a):(b)). Thus, for example, the first line of Table A1 specifically discloses the combination of Component (a) (i.e. Compound 1 in Index Table A) with 2,4-D is typically applied in a weight ratio between 1:384 – 6:1. The remaining lines of Table A1 are to be construed similarly.

TABLE A1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	2,4-D	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Acetochlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Acifluorfen	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Aclonifen	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Alachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Ametryn	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Amicarbazone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Amidosulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Aminocyclopyrachlor	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Aminopyralid	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Amitrole	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Anilofos	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Asulam	1:1920 – 2:1	1:640 – 1:3	1:60 – 1:7
1	Atrazine	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Azimsulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Beflubutamid	1:685 – 4:1	1:228 – 2:1	1:21 – 1:3
1	Benfuresate	1:1234 – 2:1	1:411 – 1:2	1:38 – 1:5
1	Bensulfuron-methyl	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Bentazone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Benzobicyclon	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Benzofenap	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Bicyclopyrone	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Bifenox	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Bispyribac-sodium	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Bromacil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Bromobutide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Bromoxynil	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Butachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Butafenacil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Butylate	1:3085 – 1:2	1:1028 – 1:5	1:96 – 1:11
1	Carfenstrole	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Carfentrazone-ethyl	1:257 – 9:1	1:85 – 3:1	1:8 – 2:1
1	Chlorimuron-ethyl	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Chlorotoluron	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Chlorsulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Cincosulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Cinidon-ethyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cinmethylin	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Clacyfos	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Clethodim	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Clodinafop-propargyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Clomazone	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Clomeprop	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2
1	Clopyralid	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Cloransulam-methyl	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Cumyluron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cyanazine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cyclopyrimorate	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Cyclosulfamuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Cycloxydim	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Cyhalofop	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Daimuron	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Desmedipham	1:644 – 4:1	1:214 – 2:1	1:20 – 1:3
1	Dicamba	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Dichlobenil	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Dichlorprop	1:1851 – 2:1	1:617 – 1:3	1:57 – 1:7
1	Diclofop-methyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Diclosulam	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Difenzoquat	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Diflufenican	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Diflufenzopyr	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Dimethachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Dimethametryn	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Dimethenamid-P	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Dithiopyr	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Diuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	EPTC	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Esprocarb	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Ethalfluralin	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Ethametsulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Ethoxyfen	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Ethoxysulfuron	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Etobenzanid	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Fenoxaprop-ethyl	1:240 – 10:1	1:80 – 4:1	1:7 – 2:1
1	Fenoxasulfone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Fenquinotrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Fentrazamide	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Flazasulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Florasulam	1:5 – 420:1	1:1 – 140:1	5:1 – 53:1
1	Florpyrauxifen-benzyl	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Fluazifop-butyl	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Flucarbazone	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Flucetosulfuron	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Flufenacet	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Flumetsulam	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Flumiclorac-pentyl	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Flumioxazin	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Fluometuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Flupyrsulfuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Fluridone	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Fluroxypyr	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Flurtamone	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Fluthiacet-methyl	1:96 – 42:1	1:32 – 14:1	1:1 – 6:1
1	Fomesafen	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Foramsulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Glufosinate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Glyphosate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Halosulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Halauxifen	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Halauxifen methyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Haloxyfop-methyl	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Hexazinone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Imazamox	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Imazapic	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Imazapyr	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Imazaquin	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Imazethabenz-methyl	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2
1	Imazethapyr	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Imazosulfuron	1:54 – 42:1	1:18 – 14:1	1:1 – 6:1
1	Indanofan	1:685 – 4:1	1:228 – 2:1	1:21 – 1:3
1	Indaziflam	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Iodosulfuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Ioxynil	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Ipfencarbazone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Isoproturon	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Isoxaben	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Isoxaflutole	1:120 – 20:1	1:40 – 7:1	1:3 – 3:1
1	Lactofen	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Lenacil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Linuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	MCPA	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	MCPB	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Mecoprop	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Mefenacet	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Mefluidide	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Mesosulfuron-methyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Mesotrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Metamifop	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Metazachlor	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Metazosulfuron	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Methabenzthiazuron	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Metolachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Metosulam	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Metribuzin	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Metsulfuron-methyl	1:4 – 560:1	1:1 – 187:1	7:1 – 70:1
1	Molinate	1:2057 – 2:1	1:685 – 1:3	1:64 – 1:8
1	Napropamide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Napropamide-M	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Naptalam	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Nicosulfuron	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Norflurazon	1:2304 – 1:1	1:768 – 1:3	1:72 – 1:8

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Orbencarb	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Orthosulfamuron	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Oryzalin	1:1028 – 3:1	1:342 – 1:2	1:32 – 1:4
1	Oxadiargyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Oxadiazon	1:1097 – 3:1	1:365 – 1:2	1:34 – 1:4
1	Oxasulfuron	1:54 – 42:1	1:18 – 14:1	1:1 – 6:1
1	Oxaziclomefone	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Oxyfluorfen	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Paraquat	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Pendimethalin	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Penoxsulam	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Penthoxamid	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Pentoxazone	1:205 – 12:1	1:68 – 4:1	1:6 – 2:1
1	Phenmedipham	1:205 – 12:1	1:68 – 4:1	1:6 – 2:1
1	Picloram	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Picolinafen	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Pinoxaden	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Pretilachlor	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Primisulfuron-methyl	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Prodiamine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Profoxydim	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Prometryn	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Propachlor	1:2304 – 1:1	1:768 – 1:3	1:72 – 1:8
1	Propanil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Propaquizafop	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Propoxycarbazone	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Propyrisulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Propyzamide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Prosulfocarb	1:2400 – 1:2	1:800 – 1:4	1:75 – 1:9
1	Prosulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Pyraclonil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Pyraflufen-ethyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Pyrasulfotole	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Pyrazolynate	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Pyrazosulfuron-ethyl	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Pyrazoxyfen	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Pyribenzoxim	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Pyributicarb	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Pyridate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Pyriftalid	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Pyriminobac-methyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Pyrimisulfan	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Pyrithiobac	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Pyroxasulfone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Pyroxsulam	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Quinclorac	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Quizalofop-ethyl	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Rimsulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Saflufenacil	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Sethoxydim	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Simazine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Sulcotrione	1:240 – 10:1	1:80 – 4:1	1:7 – 2:1
1	Sulfentrazone	1:294 – 8:1	1:98 – 3:1	1:9 – 1:2
1	Sulfometuron-methyl	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Sulfosulfuron	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Tebuthiuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Tefuryltrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Tembotrione	1:63 – 37:1	1:21 – 13:1	1:1 – 5:1
1	Tepraloxydim	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Terbacil	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Terbuthylazine	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Terbutryn	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Thenylchlor	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Thiazopyr	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Thiencarbazone	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Thifensulfuron-methyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Tiafenacil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Thiobencarb	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Topramezone	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Tralkoxydim	1:137 – 17:1	1:45 – 6:1	1:4 – 3:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Triallate	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Triasulfuron	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Triaziflam	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2
1	Tribenuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Triclopyr	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Trifloxysulfuron	1:5 – 420:1	1:1 – 140:1	5:1 – 53:1
1	Trifluralin	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Triflusulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Tritosulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1

Table A2 is constructed the same as Table A1 above except that entries below the "Component (a)" column heading are replaced with the respective Component (a) Column Entry shown below. Compound No. in the Component (a) column is identified in Index Table A. Thus, for example, in Table A2 the entries below the "Component (a)" column heading all recite "Compound 2" (i.e. Compound 2 identified in Index Table A), and the first line below the column headings in Table A2 specifically discloses a mixture of Compound 2 with 2,4-D. Tables A3 through A60 are constructed similarly.

Table Number	Component (a) Column Entries
A2	Compound 2
A3	Compound 3
A4	Compound 4
A5	Compound 5
A6	Compound 6

Table Number	Component (a) Column Entries
A7	Compound 7
A8	Compound 8
A9	Compound 9
A10	Compound 10
A11	Compound 11

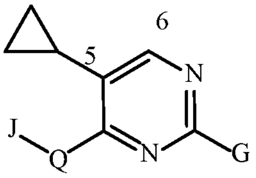
Table Number	Component (a) Column Entries
A12	Compound 12
A13	Compound 13
A14	Compound 14
A15	Compound 15
A16	Compound 16

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, flupyrsulfuron-methyl, tribenuron, pyroxasulfone, pinoxaden, tembotrione, pyroxsulam, metolachlor and *S*-metolachlor.

The following TESTS demonstrate the control efficacy of compounds of this invention on specific pathogens. The pathogen control protection afforded by the compounds is not limited, however, to these species. See Index Tables A and B below for compound descriptions. The abbreviation "Cmpd." stands for "Compound", and the abbreviation "Ex."

stands for “Example” and is followed by a number indicating in which example the compound is prepared. The numerical value reported in the column “MS” is the molecular weight of the highest isotopic abundance positively charged parent ion (M+1) formed by addition of H+ (molecular weight of 1) to the molecule having the highest isotopic abundance, or the highest isotopic abundance negatively charged ion (M–1) formed by loss of H+ (molecular weight of 1). “Pyr” means “Pyridine”. “Przl” means “Pyrazol”. “Thzl” means “Thiazole”. “Imdzl” mean “Imidazol”. The presence of molecular ions containing one or more higher atomic weight isotopes of lower abundance (e.g., 37Cl, 81Br) is not reported. The reported MS peaks were observed by mass spectrometry using electrospray ionization (ESI) or atmospheric pressure chemical ionization (APCI).

INDEX TABLE A



Cmpd. No.	G	Q	J	MS (M+1)
1	3-CF_3-Przl-1-yl	O	3-CF_3-Ph	415
2	4-CF_3-Przl-1-yl	O	3-CF_3-Ph	415
3	4-F-Ph	O	3-CF_3-Ph	375
4	4-Cl-Ph	O	3-CF_3-Ph	391
5	4-CF_3-Ph	O	3-CF_3-Ph	425
6	4-F-Przl-1-yl	O	3-CF_3-Ph	365
7	3-CF_3-Przl-1-yl	CH_2	3-CF_3-Ph	413
8	3-CF_3-Przl-1-yl	O	6-CF_3-Pyr-2-yl	416
9	3-CF_3-Przl-1-yl	O	2-CF_3-Pyr-4-yl	416
10	3-CF_3-Przl-1-yl	O	3-OCF_3-Ph	431
11	3-CF_3-Przl-1-yl	O	1-Me-5-CF_3-1*H*-przl-3-yl	419
12	3-CF_3-Przl-1-yl	O	1-Me-3-CF_3-1*H*-przl-5-yl	419
13	6-CF_3-Pyr-3-yl	O	3-CF_3-Ph	426
14	4-CF_3-Thzl-2-yl	O	3-CF_3-Ph	432
15	3-CF_3-Przl-1-yl	O	2-CF_3-pyrimidin-4-yl	417
16	3-CF_3-Przl-1-yl	O	5-CF_3-pyr-3-yl	416

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

Seeds of plant species selected from blackgrass (*Alopecurus myosuroides*), corn (*Zea mays*), foxtail, giant (giant foxtail, *Setaria faberi*), goosegrass (*Eleusine indica*), kochia (*Bassia scoparia*), oat, wild (wild oat, *Avena fatua*), pigweed, palmer (palmer amaranth, palmer pigweed, *Amaranthus palmeri*), ragweed (common ragweed, *Ambrosia artemisiifolia*), ryegrass, Italian (italian ryegrass, *Lolium multiflorum*), soybean (*Glycine max*) and wheat (*Triticum aestivum*) were planted into a blend of loam soil and sand and treated 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 crop and weed species and also galium (catchweed bedstraw, *Galium aparine*) and horseweed (*Erigeron canadensis*) 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 10 days, 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	4	5	6	7	8	9	10	11	12	13	14
Preemergence														
Blackgrass	90	40	40	30	80	30	90	70	90	70	0	10	90	80
Corn	30	0	0	0	0	0	20	60	40	10	0	10	10	10
Foxtail, Giant	100	100	100	90	100	30	100	100	100	100	10	80	100	100
Goosegrass	90	90	90	90	90	50	100	100	100	100	0	70	100	100
Kochia	100	60	30	40	70	10	100	100	100	100	0	50	100	90
Oat, Wild	80	30	10	20	70	0	50	90	80	70	0	20	50	50
Pigweed, Palmer	100	100	90	90	100	80	100	100	100	100	80	100	100	100
Ragweed	90	60	10	10	80	0	40	90	60	100	0	10	80	50
Ryegrass, Italian	100	70	60	90	100	20	90	100	100	100	0	50	100	100
Soybean	30	10	0	0	10	0	50	50	0	50	0	0	20	30
Wheat	70	20	10	10	30	0	20	40	30	50	0	10	30	20

Table A	Compounds	
125 g ai/ha	15	16
Preemergence		
Blackgrass	70	90

Corn	40	80
Foxtail, Giant	100	100
Goosegrass	100	100
Kochia	80	100
Oat, Wild	30	80
Pigweed, Palmer	100	0
Ragweed	100	70
Ryegrass, Italian	30	80
Soybean	10	60
Wheat	20	80

Table A	Compounds													
31 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Preemergence														
Blackgrass	90	30	0	0	0	0	30	50	20	10	0	0	40	20
Corn	0	0	0	0	0	0	0	30	0	0	0	0	0	0
Foxtail, Giant	100	90	30	20	70	0	100	100	100	90	0	20	90	90
Goosegrass	90	80	40	30	90	10	80	100	90	100	0	10	90	80
Kochia	60	60	10	10	30	0	80	100	100	80	0	10	10	90
Oat, Wild	30	10	0	0	30	0	20	30	30	30	0	0	20	30
Pigweed, Palmer	100	90	80	60	90	40	100	100	100	100	10	50	100	100
Ragweed	30	20	10	0	20	0	20	10	10	40	0	0	40	10
Ryegrass, Italian	80	50	10	20	40	0	90	60	40	100	0	0	80	100
Soybean	10	0	0	0	0	0	0	10	0	30	0	0	10	10
Wheat	20	10	0	0	10	0	10	20	20	10	0	0	10	10

Table A	Compounds	
31 g ai/ha	15	16
Preemergence		
Blackgrass	20	20
Corn	0	30
Foxtail, Giant	90	100
Goosegrass	90	90
Kochia	70	90
Oat, Wild	10	30
Pigweed, Palmer	60	0
Ragweed	50	0
Ryegrass, Italian	10	80
Soybean	0	10
Wheat	0	20

Table A	Compounds													
125 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Postemergence														
Blackgrass	90	90	80	80	90	30	60	90	80	80	10	30	90	90
Corn	50	10	10	10	20	10	20	60	50	30	10	10	20	30
Foxtail, Giant	90	80	40	70	60	20	90	90	90	90	10	30	90	60
Galium	90	100	70	70	100	50	70	100	100	100	0	70	100	70
Goosegrass	90	90	80	80	90	30	80	90	90	100	10	30	90	80
Horseweed	70	70	40	50	70	40	60	50	50	80	0	20	100	80
Kochia	90	90	90	90	90	70	90	90	90	90	40	100	90	100
Oat, Wild	70	60	30	60	40	20	50	60	50	70	10	30	50	40
Pigweed, Palmer	100	90	90	100	90	80	100	100	100	100	70	100	100	100
Ragweed	90	70	70	80	90	20	70	70	50	100	0	70	100	70
Ryegrass, Italian	100	70	60	80	100	40	80	100	90	90	0	60	100	90
Soybean	80	60	60	80	90	40	100	90	70	80	10	50	60	60
Wheat	40	30	20	10	40	10	30	40	40	30	10	20	30	30

Table A	Compounds	
125 g ai/ha	15	16
Postemergence		
Blackgrass	80	90
Corn	50	80
Foxtail, Giant	80	90
Galium	100	90
Goosegrass	70	80
Horseweed	90	60
Kochia	30	90
Oat, Wild	70	100
Pigweed, Palmer	50	100
Ragweed	70	70
Ryegrass, Italian	70	70
Soybean	20	80
Wheat	30	50

Table A	Compounds													
31 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Postemergence														
Blackgrass	80	60	30	40	70	30	20	50	40	70	0	20	70	40
Corn	30	10	10	10	10	10	0	40	20	20	0	10	20	20
Foxtail, Giant	50	30	20	20	30	20	40	40	50	70	0	10	30	40

Galium	60	70	50	60	90	60	70	70	70	70	0	50	70	60
Goosegrass	80	60	30	40	70	30	40	40	30	90	0	20	50	40
Horseweed	40	30	20	30	60	40	30	40	30	60	0	10	70	20
Kochia	90	90	90	70	90	60	90	90	60	80	0	60	80	80
Oat, Wild	50	30	20	20	30	20	20	30	20	20	0	20	20	20
Pigweed, Palmer	100	100	90	100	90	90	100	100	90	100	60	90	100	100
Ragweed	70	60	50	40	40	20	40	40	30	80	0	40	60	50
Ryegrass, Italian	60	50	20	30	80	20	50	50	40	80	0	30	30	50
Soybean	60	50	40	40	60	30	80	40	60	60	0	30	50	50
Wheat	30	20	10	10	20	0	10	30	20	20	0	20	20	20

Table A	Compounds	
31 g ai/ha	15	16
Postemergence		
Blackgrass	40	40
Corn	20	40
Foxtail, Giant	60	60
Galium	70	60
Goosegrass	30	30
Horseweed	40	10
Kochia	20	90
Oat, Wild	20	50
Pigweed, Palmer	50	100
Ragweed	60	50
Ryegrass, Italian	30	50
Soybean	0	60
Wheat	20	20

TEST B

Plant species in the flooded paddy test selected from barnyardgrass (*Echinochloa crus-galli*), ducksalad (*Heteranthera limosa*), rice (*Oryza sativa*), and sedge, umbrella (small-flower umbrella sedge, *Cyperus difformis*) were grown to the 2-leaf stage for testing. At 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 that water depth for the duration of the test. Treated plants and controls were maintained in a greenhouse for 13 days, 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.

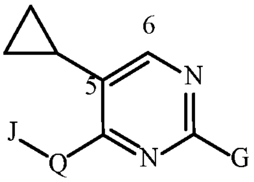
Table B	Compounds													
250 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flood														
Barnyardgrass	60	0	25	45	45	0	50	30	55	50	0	0	40	35
Ducksalad	75	30	25	40	85	0	45	20	30	40	0	15	20	25
Rice	65	0	0	25	30	0	10	15	35	20	0	0	20	10
Sedge, Umbrella	75	45	75	55	75	0	40	85	85	55	0	65	90	95

Table B	Compounds	
250 g ai/ha	15	16
Flood		
Barnyardgrass	10	25
Ducksalad	55	70
Rice	35	15
Sedge, Umbrella	50	85

CLAIMS

What is claimed is:

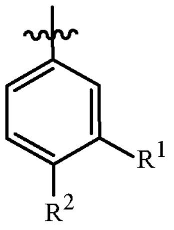
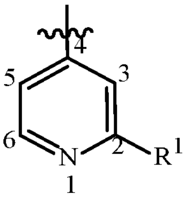
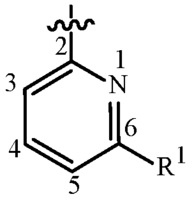
1. A compound of Formula **1**, all stereoisomers, N-oxides, and salts thereof



1

wherein

J is selected from the group consisting of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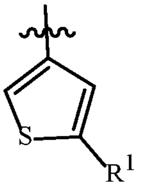		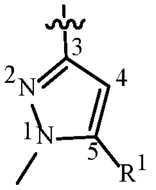		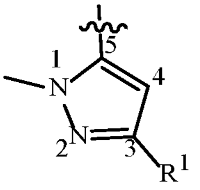	and
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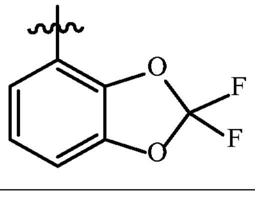
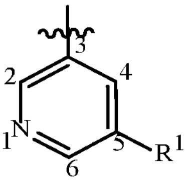
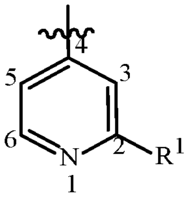
			and		
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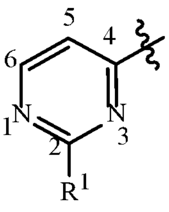					
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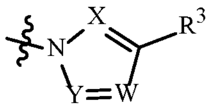		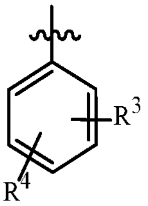		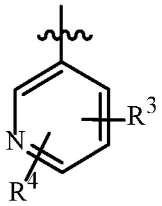	
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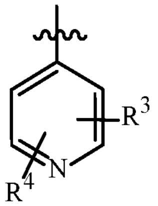		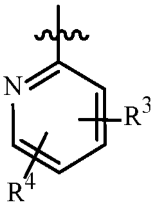		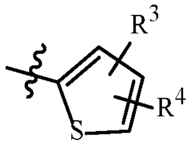	
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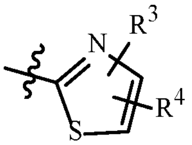	;				
G-7					

R^1 is halogen, C_1–C_4 haloalkyl, C_1–C_4 haloalkoxy, C_1–C_4 alkoxy, C_1–C_4 haloalkenyl, C_1–C_4 haloalkynyl, C_1–C_4 haloalkenyloxy, C_1–C_4 haloalkynyloxy, C_1–C_4 haloalkylthio, C_1–C_4 alkylthio or -CN;

R^2 is H or halogen;

W, X, and Y are independently N or CR^5;

R^3 is C_1–C_5 alkyl, halogen, -CN, C_3–C_5 alkenyl, C_3–C_5 alkynyl, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy or C_1–C_5 alkylthio;

R^4 is H, C_1–C_5 alkyl, halogen, -CN, C_1–C_5 haloalkyl, C_1–C_5 alkoxy or C_1–C_5 alkylthio;

Q is O, S, -CH_2- or –(C=O)-; and

R^5 is H, C_1–C_5 alkyl, halogen, -CN, C_3–C_5 alkenyl, C_3–C_5 alkynyl, C_3–C_7 cycloalkyl, C_1–C_5 haloalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy or C_1–C_5 alkylthio.

2. The compound of Claim 1 wherein

J is J-1, J-2, J-3, J-5, J-6, J-8, J-9 or J-10; and

G is G-1, G-2, G-3 or G-7.

3. The compound of Claim 1 wherein

R^1 is C_1–C_4 haloalkyl or C_1–C_4 haloalkoxy;

R^3 is halogen or C_1–C_5 haloalkyl;

R^4 is H; and
Q is O or -CH_2-.

4. The compound of Claim 3 wherein
Q is O.

5. The compound of Claim 1 wherein
J is J-1, J-2 or J-3;
R^1 is CF_3 or OCF_3; and
R^3 is F, Cl or CF_3.

6. The compound of Claim 5 wherein
J is J-1; and
R^2 is H or halogen.

7. The compound of Claim 6 wherein
R^2 is H.

8. The compound of Claim 5 wherein
J is J-2; and
R^1 is CF_3.

9. The compound of Claim 5 wherein
J is J-3; and
R^1 is CF_3.

10. The compound of Claim 1 wherein
G is G-1, G-2 or G-3.

11. The compound of Claim 10 wherein
G is G-1;
X is N;
Y is CH;
W is CH; and
R^5 is CF_3.

12. The compound of Claim 10 wherein
G is G-2; and
R^3 is CF_3.

13. The compound of Claim 10 wherein
G is G-3; and
R^3 is CF_3.

14. The compound of Claim 1 wherein
J is J-5, J-6 or J-8;
R^1 is CF_3 or OCF_3; and
R^3 is F, Cl or CF_3.

15. The compound of Claim 14 wherein
J is J-5.

16. The compound of Claim 14 wherein
J is J-6.

17. The compound of Claim 1 wherein
Q is O.

18. The compound of Claim 1 selected from the group consisting of
5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine; (Compound 1)
5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[4-(trifluoromethyl)phenyl]pyrimidine; (Compound 5)
5-cyclopropyl-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]-4-[[2-(trifluoromethyl)-4-pyridinyl]oxy]pyrimidine; (Compound 9)
5-cyclopropyl-4-[3-(trifluoromethoxy)phenoxy]-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]pyrimidine; (Compound 10)
5-cyclopropyl-2-[3-(trifluoromethyl)-1*H*-pyrazol-1-yl]-4-[[6-(trifluoromethyl)-2-pyridinyl]oxy]pyrimidine; (Compound 8) and
5-cyclopropyl-4-[3-(trifluoromethyl)phenoxy]-2-[6-(trifluoromethyl)-3-pyridinyl]pyrimidine. (Compound 13)

19. 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.

20. 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.

21. 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, (b16) herbicide safeners, and salts of compounds of (b1) through (b16).

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2022/053915

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D239/34 C07D401/14 C07D403/04 C07D403/14 C07D417/04
A01N43/54

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 A01N

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2020/087694 A1 (QINGDAO KINGAGROOT CHEMICAL COMPOUND CO LTD [CN]) 7 May 2020 (2020-05-07)	1,2, 5-16, 19-22
A	page 19; compound I page 37; compound 238 -----	3,4,17, 18
Y	WO 2016/149315 A1 (DU PONT [US]) 22 September 2016 (2016-09-22)	1,2, 5-16, 19-22
A	page 43; table 1 page 89; table Index table A -----	3,4,17, 18

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

☒ See patent family annex.

* Special categories of cited documents :

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"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 10 March 2023	Date of mailing of the international search report 17/03/2023
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Lewis, Sara

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2022/053915

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2020087694 A1	07-05-2020	CN 109293640 A	01-02-2019
		WO 2020087694 A1	07-05-2020
WO 2016149315 A1	22-09-2016	AR 103965 A1	14-06-2017
		AU 2016233348 A1	15-06-2017
		BR 112017012197 A2	16-01-2018
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		CN 107250134 A	13-10-2017
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		RU 2017134351 A	04-04-2019
		US 2018020664 A1	25-01-2018
		WO 2016149315 A1	22-09-2016