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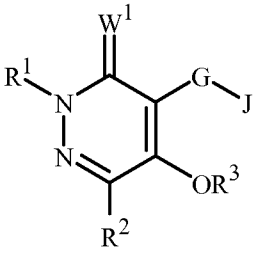
(54) **Title:** HERBICIDAL PYRIDAZINONE DERIVATIVES

(57) **Abstract:** Disclosed are compounds of Formula (1), *N*-oxides, and salts thereof, wherein W^1 is O or S, and R^1, R^2, R^3, G and J are as defined in the disclosure. Also disclosed are compositions containing the compounds of Formula (1) and methods for controlling undesired vegetation comprising contacting the undesired vegetation or its environment with an effective amount of a compound or a composition of the invention.



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TITLE

HERBICIDAL PYRIDAZINONE DERIVATIVES

FIELD OF THE INVENTION

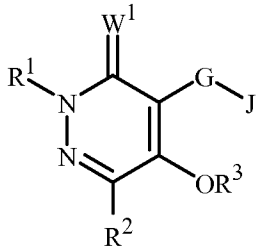
This invention relates to certain pyridazinone derivatives, their *N*-oxides, salts and compositions, and methods of their use for controlling undesirable vegetation.

BACKGROUND OF THE INVENTION

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

SUMMARY OF THE INVENTION

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



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wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, tetrahydropyranyl, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$, $-P(=W^4)R^7R^8$ or $-C(=W^5)NR^9R^{10}$;

R^2 is H, halogen, cyano, -C(=O)OH, -C(=O)NH_2, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_4–C_{10} cycloalkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, nitro, C_3–C_6 cycloalkoxy or C_4–C_8 cycloalkylalkoxy;

R^3 is H, -C(=W^6)R^4, -C(=W^2)W^3R^5, -S(=O)$_2R^6$, -P(=W^4)R^7R^8 or -C(=W^5)NR^9R^{10};

G is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with R^x on nitrogen ring members and optionally substituted with up to 4 substituents selected from R^w on carbon ring members;

J is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u;

each R^4 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl or C_4–C_{10} cycloalkylaminoalkyl, naphthalenyl or -$(CR^{11}R^{12})_nG^A$;

each R^5 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_{10} cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl, C_4–C_{10} cycloalkylaminoalkyl, naphthalenyl or -$(CR^{11}R^{12})_nG^A$;

each R^6 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8

alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl, C_4–C_{10} cycloalkylaminoalkyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_6 haloalkylamino, C_2–C_8 halodialkylamino, C_3–C_8 cycloalkylamino, C_2–C_8 alkylcarbonylamino, C_2–C_8 haloalkylcarbonylamino, C_1–C_6 alkylsulfonylamino, C_1–C_6 haloalkylsulfonylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^7 and R^8 is independently C_1–C_6 alkyl, C_1–C_6 alkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_6 haloalkylamino, C_2–C_8 halodialkylamino, C_3–C_8 cycloalkylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^9 is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_4–C_{10} dialkylaminoalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^{10} is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl or C_4–C_{10} cycloalkylalkyl; or

R^9 and R^{10} are taken together with the nitrogen to which they are attached to form a 3- to 7-membered heterocyclic ring containing, in addition to the linking nitrogen, ring members selected from carbon and optionally O, S and NR^{13}, the carbon ring members optionally in the form of C(=O), and the ring optionally substituted on carbon ring members with up to 4 substituents independently selected from the group consisting of halogen, -CN, C_1–C_3 alkyl and C_1–C_3 alkoxy;

each R^{11} and R^{12} is independently H or C_1–C_3 alkyl;

each R^{13} is independently H or C_1–C_3 alkyl;

each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u; or a naphthalenyl ring system optionally substituted with up to 5 substituents independently selected from R^u;

each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, $-C(=O)NH_2$, $-SO_2NH_2$, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8

alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfinyl, C_1–C_6 haloalkylsulfinyl, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_3–C_{10} trialkylsilyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl;

each R^W is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH_2, -SO_2NH_2, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfinyl, C_1–C_6 haloalkylsulfinyl, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_3–C_{10} trialkylsilyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, naphthalenyl, -$O(CR^{11}R^{12})_nG^A$ or -$(CR^{11}R^{12})_nG^A$;

each R^X is independently H, C_1–C_3 alkyl or C_3–C_7 cycloalkyl;

each W^1, W^2, W^3, W^4, W^5 and W^6 is independently O or S; and

each n is independently an integer selected from 0 through 3.

More particularly, this invention pertains to a compound of Formula **1** (including all geometric and stereoisomers), an *N*-oxide or a salt thereof. This invention also relates to a herbicidal composition comprising a herbicidally effective amount of a compound of Formula **1** 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 Formula **1** (e.g., as a composition described herein).

DETAILS OF THE INVENTION

As used herein, the terms "comprises", "comprising", "includes", "including", "has", "having", "contains" or "containing" or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a composition, process, method, article, or apparatus that comprises a list of elements is not necessarily limited to only those elements but may

include other elements not expressly listed or inherent to such composition, process, method, article, or apparatus. 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 "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.

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. "Alkoxyalkoxyalkyl" denotes at least one straight-chain or branched alkoxy moieties bonded to a straight-chain or branched alkoxy moieties of alkoxyalkyl moiety. Examples of "alkoxyalkoxyalkyl" include $CH_3OCH_2OCH_2$-, $CH_3CH_2O(CH_3)CHOCH_2$- and $(CH_3O)_2CHOCH_2$-. "Alkylthio" includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. "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. "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 $CH_3CH_2SCH_2CH_2$. "Alkylamino", "dialkylamino", and the like, are defined analogously to the above examples.

"Cycloalkyl" includes, for example, cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl. The term "alkylcycloalkyl" denotes alkyl substitution on a cycloalkyl moiety and includes, for example, ethylcyclopropyl, *i*-propylcyclobutyl, 3-methylcyclopentyl and 4-methylcyclohexyl. 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 "cycloalkylcycloalkyl" denotes a cycloalkyl group substituted with other cycloalkyl group. Examples of "cycloalkylcycloalkyl" include 2-cyclopropylcyclopropyl and 3-cyclopropylcyclopentyl. The term "halocycloalkylalkyl" denotes halogen substitution on the cycloalkyl moiety, alkyl moiety or both of the cycloalkylalkyl moieties. Examples of "halocycloalkylalkyl" include 2-chlorocyclopropylmethyl, cyclopentyl-1-chloroethyl, and 3-chlorocyclopentyl-1-chloroethyl. The term "cycloalkoxy" denotes cycloalkyl linked through an oxygen atom such as cyclopentyloxy and cyclohexyloxy. "Cycloalkylalkoxy" denotes cycloalkylalkyl linked through an oxygen atom attached to the alkyl chain. Examples of "cycloalkylalkoxy" include cyclopropylmethoxy, cyclopentylethoxy, and other cycloalkyl moieties bonded to straight-chain or branched alkoxy groups. "Cycloalkenyl" includes groups such as cyclopentenyl and cyclohexenyl as well as groups with more than one double bond such as 1,3- and 1,4-cyclohexadienyl.

The term "tetrahydropyran" denotes a six-membered ring with ring members consisting of 5 carbon atoms and one oxygen atom. The point of attachment of the tetrahydropyran ring to the remainder of the compound of Formula **1** is at any one of the 5 carbon atoms. The term "thien" refers to a 5-membered aromatic ring containing one sulfur atom and four carbon atoms.

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 "halocycloalkyl", "haloalkoxy", "haloalkylthio", "haloalkenyl", "haloalkynyl", and the like, are 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 "haloalkylthio" include CCl_3S-, CF_3S-, CCl_3CH_2S- and $ClCH_2CH_2CH_2S$-. Examples of "haloalkylsulfinyl" include $CF_3S(O)$-, $CCl_3S(O)$-, $CF_3CH_2S(O)$- and $CF_3CF_2S(O)$-. Examples of "haloalkylsulfonyl" include $CF_3S(O)_2$-, $CCl_3S(O)_2$-, $CF_3CH_2S(O)_2$- and $CF_3CF_2S(O)_2$-. Examples of "haloalkenyl" include $(Cl)_2C{=}CHCH_2$- and

$CF_3CH_2CH=CHCH_2$-. Examples of "haloalkynyl" include HC≡CCHCl-, $CF_3C≡C$-, $CCl_3C≡C$- and $FCH_2C≡CCH_2$-. Examples of "haloalkoxyalkoxy" include CF_3OCH_2O-, $ClCH_2CH_2OCH_2CH_2O$-, $Cl_3CCH_2OCH_2O$- as well as branched alkyl derivatives. "Haloalkylaminoalkyl" denotes a halogen group substituted with an alkylaminoalkyl group. "Haloalkylaminoalkyl" includes a halogen group attached to any alkyl groups as well as nitrogen. Examples of "haloalkylaminoalkyl" include CH_3NHCH_2CHCl-, $(CH_3)CHClCH(CH_3)NHCH_2$- and $CH_3NClCH(CH_3)$-. The term "halodialkylamino" denotes at least one halogen group substituted on any alkyl moiety of the dialkylamino group. Examples of "halodialkylamino" include $CF_3(CH_3)N$-, $(CF_3)_2N$- and $CH_2Cl(CH_3)N$-. "Cycloalkylamino" means the amino nitrogen atom is attached to a cycloalkyl radical and a hydrogen atom and includes groups such as cyclopropylamino, cyclobutylamino, cyclopentylamino and cyclohexylamino.

"Alkylcarbonyl" denotes a straight-chain or branched alkyl moieties bonded to a C(=O) moiety. Examples of "alkylcarbonyl" include $CH_3C(=O)$-, $CH_3CH_2CH_2C(=O)$- and $(CH_3)_2CHC(=O)$-. 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. The term "cycloalkylalkoxycarbonyl" denotes a cycloalkylalkyl moiety bonded to an oxygen atom of an oxycarbonyl moiety. Examples of "cycloalkylalkoxycarbonyl" include cyclopropyl-$CH_2OC(=O)$-, cyclopropyl-$CH(CH_3)OC(=O)$- and cyclopentyl-$CH_2OC(=O)$-.

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 14. For example, C_1–C_4 alkylsulfonyl designates methylsulfonyl through butylsulfonyl; 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 $CH_3CH_2OCH_2CH_2$-.

The term "optionally substituted" means unsubstituted or substituted. Therefore an optionally substituted group (i.e. radical) is unsubstituted or has at least 1 non-hydrogen substituent. When an optionally substituted group is defined without specifying the optional substituents, the group is unsubstituted or has at least one non-hydrogen substituent that does not extinguish the biological activity possessed by the unsubstituted analog. When a list of possible substituents is specified, the optional substituents are independently selected from the list. Unless a particular limit is recited, a group can be substituted with as many optional substituents as can be accommodated by replacing a hydrogen atom with a non-hydrogen substituent on any available carbon or nitrogen atom in the group. Furthermore, each substitution is independent of the other. When the term "optionally substituted" is accompanied by a limit such as for the groups listed for J, the number of optional

substituents cannot exceed the limit even if further positions for substitution are available. Therefore, for example, the phrase "optionally substituted with up to 5 substituents" means no substituent may be present, 1 substituent may be present, or up to 5 substituents may be present if accommodated by the number of positions available for substitution.

When the subscript indicates a range, e.g. $(R)_{i-j}$, then the number of substituents may be selected from the integers between i and j inclusive. When a group contains a substituent which can be hydrogen, for example R^1, R^2, R^3, R^9, R^{10}, R^{11}, R^{12} or R^{13}, when this substituent is taken as hydrogen, it is recognized that this is equivalent to said group being unsubstituted. When a linking group is shown to be optionally present, for example $(CR^{11}R^{12})_n$ wherein n may be 0, then the linking group may be a direct bond (i.e. when n is 0). 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.

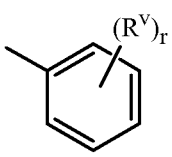
"Aromatic" indicates that each of the ring atoms is essentially in the same plane and has a *p*-orbital perpendicular to the ring plane, and that (4n + 2) π electrons, where n is a positive integer, are associated with the ring to comply with Hückel's rule. When a fully unsaturated carbocyclic ring satisfies Hückel's rule, then said ring is also called an "aromatic ring". When a fully unsaturated heterocyclic ring satisfies Hückel's rule, then said ring is also called a "heteroaromatic ring". Unless otherwise indicated, heterocyclic rings can be attached through any available carbon or nitrogen by replacement of a hydrogen on said carbon or nitrogen.

When J, G, or G^A is a 5- or 6-membered nitrogen-containing heteroaromatic ring, it can be attached to the remainder of Formula **1** through any available carbon or nitrogen ring atom, unless otherwise described. As noted above, each J and G^A can be (among others) independently a phenyl optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of Invention. An example of phenyl optionally substituted with one to five substituents is the ring illustrated as U-1 in Exhibit 1, wherein R^v is R^u as defined in the Summary of the Invention for J and G^A and r is an integer from 0 to 5.

As noted above, J and G^A can be (among others) a 5- or 6-membered heteroaromatic ring, substituted or optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention. Examples of a 5- or 6-membered heteroaromatic ring, substituted or optionally substituted with one or more substituents include the rings U-2 through U-61 illustrated in Exhibit 1 wherein R^v is any substituent as defined in the Summary of the Invention for J and G^A (i.e. R^u) and r is an integer from 0 to 4, limited by the number of available positions on each U group. In U-1 through U-61, the radical $(R^v)_r$ correspond to $(R^u)_p$ in the Summary of the Invention and all Embodiments, Examples, Tables and Schemes. The subscript "r" represents the number of R^v (corresponding to "p" representing the number of R^u) substituents that can be present on

U-1 through U-61. As U-29, U-30, U-36, U-37, U-38, U-39, U-40, U-41, U-42 and U-43 have only one available position, for these U groups r is limited to the integers 0 or 1, and r being 0 means that the U group is unsubstituted and a hydrogen is present at the position indicated by $(R^V)_r$.

Exhibit 1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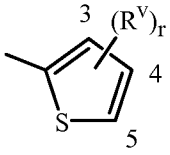
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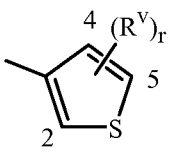
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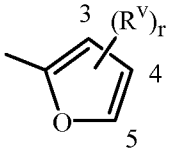
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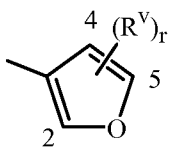
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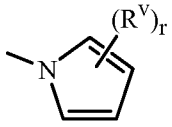
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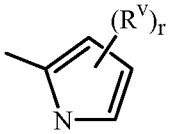
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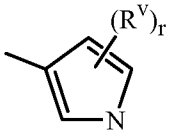
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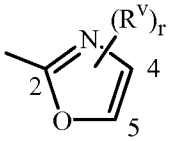
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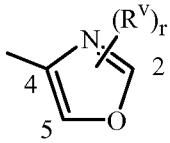
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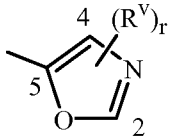
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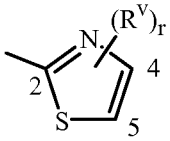
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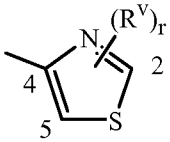
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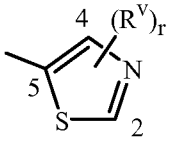
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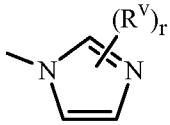
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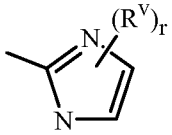
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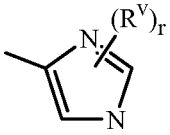
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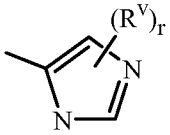
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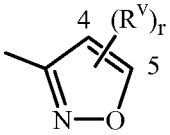
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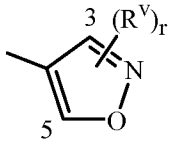
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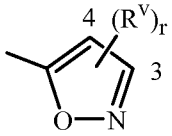
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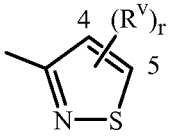
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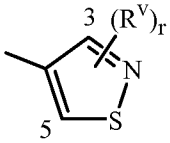
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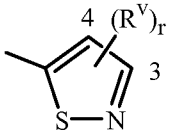
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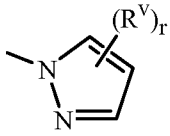
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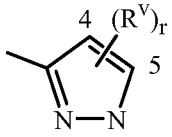
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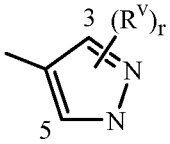
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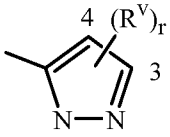
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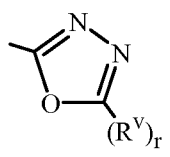
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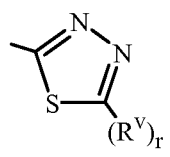
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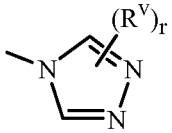
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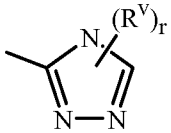
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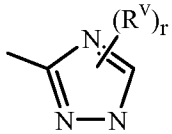
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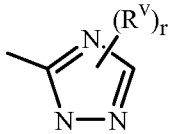
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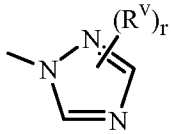
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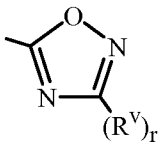
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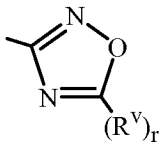
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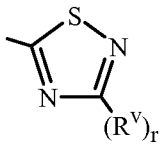
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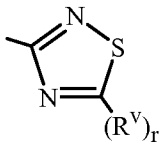
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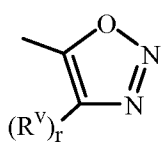
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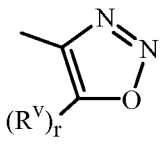
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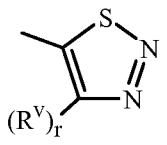
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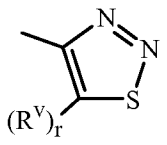
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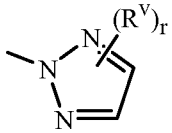
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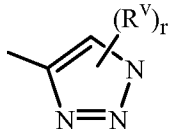
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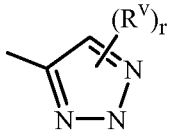
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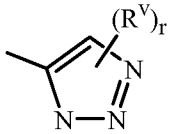
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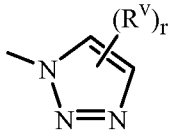
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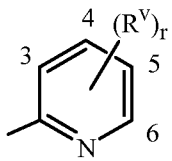
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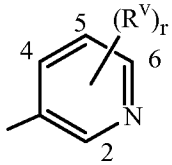
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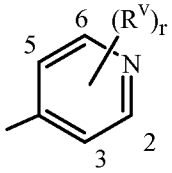
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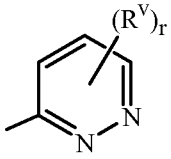
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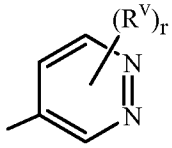
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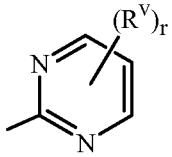
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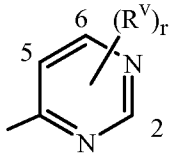
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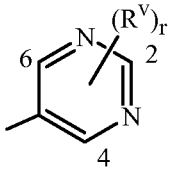
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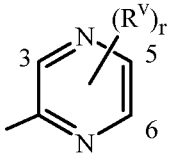
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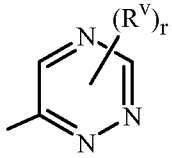
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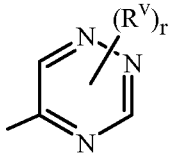
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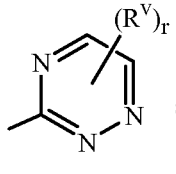
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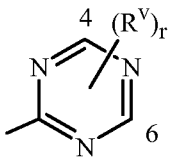

U-61 .

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

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

Compounds of this invention can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. 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.

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 the compounds of Formula **1** are useful for control of undesired vegetation (i.e. are agriculturally suitable). The salts of the compounds of Formula **1** include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. When a compound of Formula **1** contains an acidic moiety such as a carboxylic acid or enol (e.g., when R^3 is H), salts also include those formed with organic or inorganic bases such as pyridine, triethylamine or ammonia, or amides, hydrides, hydroxides or carbonates of sodium, potassium, lithium, calcium, magnesium or barium. Accordingly, the present invention comprises compounds selected from Formula **1**, *N*-oxides and agriculturally suitable salts thereof.

One skilled in the art appreciates compounds of Formula **1**, *N*-oxides and salts thereof typically exist in more than one form, and Formula **1**, *N*-oxides and salts thereof thus include all crystalline and non-crystalline forms of the compounds they represent. Non-crystalline forms include embodiments which are solids such as waxes and gums as well as embodiments which are liquids such as solutions and melts. Crystalline forms include embodiments which represent essentially a single crystal type and embodiments which represent a mixture of polymorphs (i.e. different crystalline types). The term "polymorph" refers to a particular crystalline form of a chemical compound that can crystallize in different crystalline forms, these forms having different arrangements and/or conformations of the molecules in the crystal lattice. Although polymorphs can have the same chemical composition, they can also differ in composition due the presence or absence of co-crystallized water or other molecules, which can be weakly or strongly bound in the lattice. Polymorphs can differ in such chemical, physical and biological properties as crystal shape, density, hardness, color, chemical stability, melting point, hygroscopicity, suspensibility, dissolution rate and biological availability. One skilled in the art will appreciate that a polymorph of a compound of Formula **1** or *N*-oxides or salts thereof 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** or *N*-oxides or salts thereof. Preparation and isolation of a particular polymorph of a compound of Formula **1** or *N*-oxides or salts thereof can be

achieved by methods known to those skilled in the art including, for example, crystallization using selected solvents and temperatures.

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

Embodiment 1. A compound of Formula **1** wherein R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl or C_2–C_8 alkylsulfonylalkyl.

Embodiment 1a. A compound of Embodiment 1 wherein R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl or C_3–C_{10} alkoxyalkoxyalkyl.

Embodiment 2. A compound of Embodiment 1a wherein R^1 is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl.

Embodiment 3. A compound of Embodiment 2 wherein R^1 is H or C_1–C_6 alkyl.

Embodiment 4. A compound of Embodiment 3 wherein R^1 is CH_3.

Embodiment 4a. A compound of Formula **1** wherein R^1 is C_4–C_9 cycloalkylcarbonyl.

Embodiment 4b. A compound of Embodiment 4a wherein R^1 is cyclopropylcarbonyl.

Embodiment 4c. A compound of Formula **1** wherein R^1 is tetrahydropyranyl.

Embodiment 5. A compound of Formula **1** or any one of Embodiments 1 through 4c wherein H, halogen, cyano, -C(=O)OH, -C(=O)NH_2, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10}

dialkylaminocarbonyl, C_4–C_{10} cycloalkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylthio or C_1–C_6 haloalkylthio.

Embodiment 5a. A compound of Embodiment 5 wherein R^2 is H, halogen, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_2–C_8 alkoxycarbonyl, C_1–C_6 alkoxy or C_1–C_6 haloalkoxy.

Embodiment 5b. A compound of Embodiment 5 wherein R^2 is H, halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_2–C_8 alkoxyalkyl or C_1–C_4 alkoxy.

Embodiment 5c. A compound of Embodiment 5b wherein R^2 is H, halogen, C_1–C_6 alkyl or C_1–C_4 alkoxy.

Embodiment 5d. A compound of Embodiment 5c wherein R^2 is H, Cl, CH_3, Et or OMe.

Embodiment 6. A compound of Embodiment 5 wherein R^2 is H, halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl or C_2–C_8 alkoxyalkyl.

Embodiment 7. A compound of Embodiment 6 wherein R^2 is H, halogen or C_1–C_6 alkyl.

Embodiment 8. A compound of Embodiment 7 wherein R^2 is H, Cl, CH_3 or Et (i.e. CH_2CH_3).

Embodiment 9. A compound of Embodiment 5d or 8 wherein R^2 is H.

Embodiment 10. A compound of Embodiment 5d or 8 wherein R^2 is Cl.

Embodiment 11. A compound of Embodiment 5d or 8 wherein R^2 is CH_3.

Embodiment 12. A compound of Formula **1** or any one of Embodiments 1 through 11 wherein R^3 is H, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$ or $-C(=W^5)NR^9R^{10}$.

Embodiment 12a. A compound of Embodiment 12 wherein R^3 is H, $-CO_2$-*i*-Pr (i.e. $-CO_2CH(CH_3)_2$), $-CO_2$-*i*-Bu (i.e. $-CO_2CH_2CH(CH_3)_2$), CO-(2-chlorophenyl) or -CO-*c*-Pr (i.e. -C(O)-cyclopropyl).

Embodiment 12b. A compound of Embodiment 12a wherein R^3 is H, CO_2-*i*-Pr or CO-*t*-Bu.

Embodiment 12c. A compound of Embodiment 12b wherein R^3 is H or CO_2-*i*-Pr.

Embodiment 13. A compound of Embodiment 12 wherein R^3 is H.

Embodiment 14. A compound of Embodiment 12 wherein R^3 is $-C(=W^6)R^4$.

Embodiment 15. A compound of Embodiment 12 wherein R^3 is $-C(=W^2)W^3R^5$.

Embodiment 16. A compound of Embodiment 12 wherein R^3 is $-S(=O)_2R^6$.

Embodiment 17. A compound of Embodiment 12 wherein R^3 is $-C(=W^5)NR^9R^{10}$.

Embodiment 18. A compound of Formula **1** or any one of Embodiments 1 through 17 wherein the compound is in the form of a salt.

Embodiment 18a. A compound of Formula **1** or any one of Embodiments 1 through 18 wherein each W^6 is independently O.

Embodiment 18b. A compound of Formula **1** or any one of Embodiments 1 through 18 wherein each W^6 is independently S.

Embodiment 19. A compound of Formula **1** or any one of Embodiments 1 through 18b wherein each R^4 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 20. A compound of Embodiment 19 wherein each R^4 is independently C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 21. A compound of Embodiment 20 wherein each R^4 is independently C_1–C_6 alkyl.

Embodiment 22. A compound of Embodiment 21 wherein each R^4 is *t*-Bu (i.e. $C(CH_3)_3$).

Embodiment 23. A compound of Formula **1** or any one of Embodiments 1 through 22 wherein each W^2 is O.

Embodiment 24. A compound of Formula **1** or any one of Embodiments 1 through 22 wherein each W^2 is S.

Embodiment 25. A compound of Formula **1** or any one of Embodiments 1 through 24 wherein each W^3 is O.

Embodiment 26. A compound of Formula **1** or any one of Embodiments 1 through 24 wherein each W^3 is S.

Embodiment 27. A compound of Formula **1** or any one of Embodiments 1 through 26 wherein each R^5 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 28. A compound of Embodiment 27 wherein each R^5 is independently C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 29. A compound of Embodiment 28 wherein each R^5 is independently C_1–C_6 alkyl.

Embodiment 30. A compound of Embodiment 29 wherein each R^5 is independently CH_3 or *i*-Pr (i.e. $CH(CH_3)_2$.

Embodiment 31. A compound of Formula **1** or any one of Embodiments 1 through 30 wherein each R^6 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_6 haloalkylamino, C_2–C_8 halodialkylamino, C_3–C_8 cycloalkylamino, C_2–C_8 alkylcarbonylamino, C_2–C_8 haloalkylcarbonylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 32. A compound of Embodiment 31 wherein each R^6 is independently C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 33. A compound of Embodiment 32 wherein each R^6 is independently C_1–C_6 alkyl.

Embodiment 34. A compound of Embodiment 33 wherein each R^6 is CH_3.

Embodiment 35. A compound of Formula **1** or any one of Embodiments 1 through 34 wherein each W^5 is O.

Embodiment 36. A compound of Formula **1** or any one of Embodiments 1 through 34 wherein each W^5 is S.

Embodiment 37. A compound of Formula **1** or any one of Embodiments 1 through 36 wherein each R^9 is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkoxyalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 38. A compound of Embodiment 37 wherein each R^9 is independently H, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkoxyalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$.

Embodiment 39. A compound of Embodiment 38 wherein each R^9 is independently H or C_1–C_6 alkyl.

Embodiment 40. A compound of Embodiment 39 wherein each R^9 is independently H or CH_3.

Embodiment 41. A compound of Embodiment 40 wherein each R^9 is H.

Embodiment 42. A compound of Embodiment 41 wherein each R^9 is CH_3.

Embodiment 43. A compound of Formula **1** or any one of Embodiments 1 through 42 wherein each R^{10} is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl.

Embodiment 44. A compound of Embodiment 43 wherein each R^{10} is independently H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl.

Embodiment 45. A compound of Embodiment 44 wherein each R^{10} is independently H or C_1–C_6 alkyl.

Embodiment 46. A compound of Embodiment 45 wherein each R^{10} is independently H or CH_3.

Embodiment 47. A compound of Embodiment 46 wherein each R^{10} is H.

Embodiment 48. A compound of Formula **1** or any one of Embodiments 1 through 36 wherein when R^9 and R^{10} are taken together with the nitrogen to which they are attached to form a heterocyclic ring, the ring is 5- to 6-membered and contains, in addition to the linking nitrogen, ring members selected from carbon and optionally O, S and NR^{13}, the carbon ring members optionally in the form of C(=O), and the ring optionally substituted on carbon ring members with up to 4 substituents independently selected from the group consisting of halogen, -CN, C_1–C_3 alkyl and C_1–C_3 alkoxy.

Embodiment 49. A compound of Embodiment 48 wherein when R^9 and R^{10} are taken together with the nitrogen to which they are attached to form a heterocyclic ring, the ring is 5- to 6-membered and contains, in addition to the linking nitrogen, ring members selected from carbon and optionally O and S, the carbon ring members optionally in the form of C(=O), and the ring optionally substituted on carbon ring members with up to 3 substituents independently selected from the group consisting of halogen, C_1–C_3 alkyl and C_1–C_3 alkoxy.

Embodiment 50. A compound of Embodiment 49 wherein when R^9 and R^{10} are taken together with the nitrogen to which they are attached to form a heterocyclic ring, the ring is 5- to 6-membered and contains, in addition to the linking nitrogen, ring members selected from carbon and optionally O, and the ring optionally substituted on carbon ring members with up to 3 substituents independently selected from the group consisting of halogen and C_1–C_3 alkyl.

Embodiment 51. A compound of Formula **1** or any one of Embodiments 1 through 50 wherein the compound is in the form of a metal salt.

Embodiment 52. A compound of Formula **1** or any one of Embodiments 1 through 50 wherein the compound is in the form of an ammonium salt.

Embodiment 53. A compound of Embodiment 51 wherein the metal salt is an alkali metal salt.

Embodiment 54. A compound of Embodiment 53 wherein the metal salt is a sodium or potassium salt.

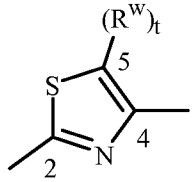
Embodiment 54a. A compound of Formula **1** or any one of Embodiments 1 through 54 wherein G is other than phenyl.

Embodiment 55. A compound of Formula **1** or any one of Embodiments 1 through 54 wherein G is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with R^x on nitrogen ring members and optionally substituted with up to 2 substituents selected from R^W on carbon ring members.

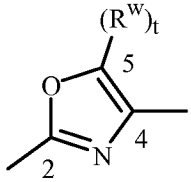
Embodiment 55a. A compound of Formula **1** or any one of Embodiments 1 through 55 wherein each R^x is independently H or C_1–C_3 alkyl.

Embodiment 56. A compound of Formula **1** or any one of Embodiments 1 through 55a wherein G is one of G-1 through G-72 depicted in Exhibit 2;

Exhibit 2



G-1



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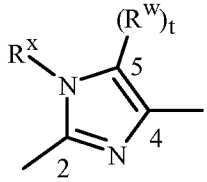

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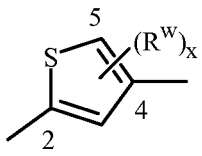

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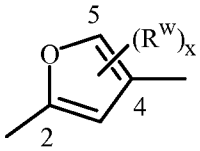

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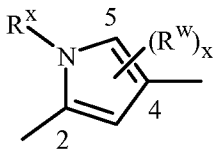

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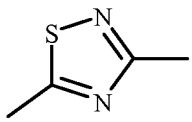

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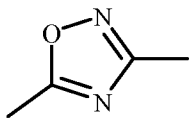

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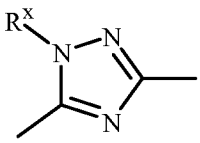

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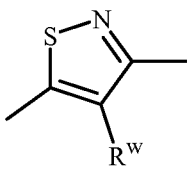

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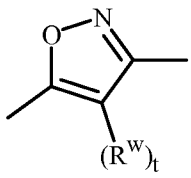

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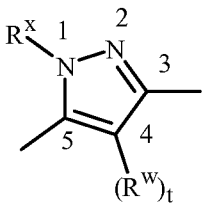

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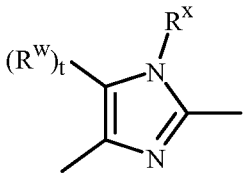

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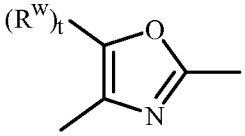

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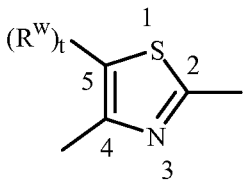

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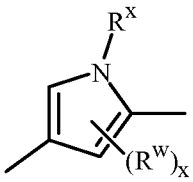

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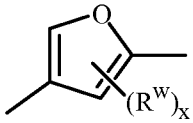

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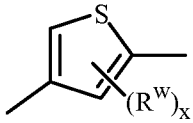

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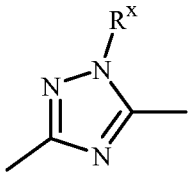

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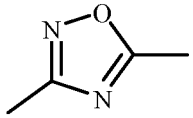

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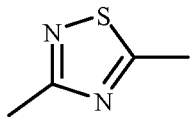

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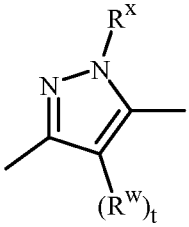

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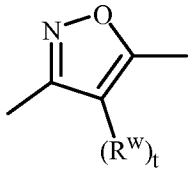

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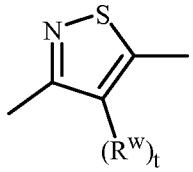

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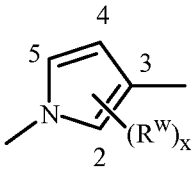

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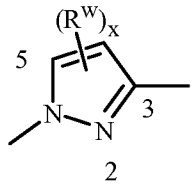

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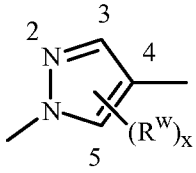

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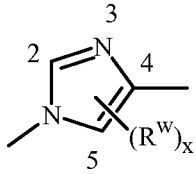

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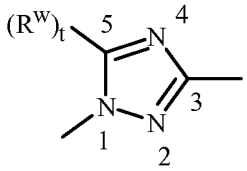

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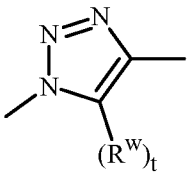

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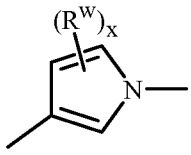

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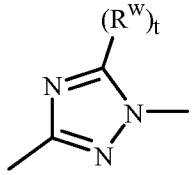

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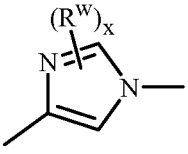

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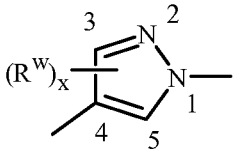

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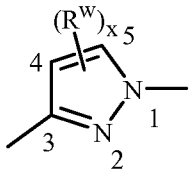

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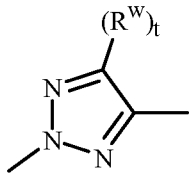

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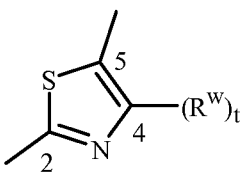

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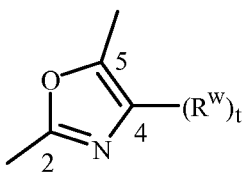

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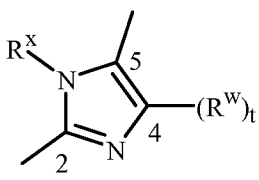

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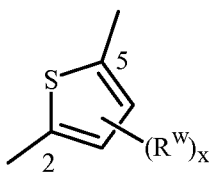

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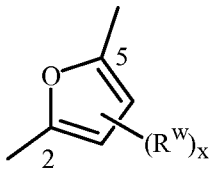
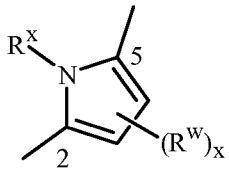
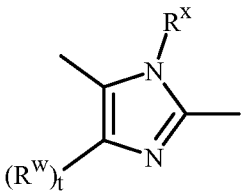


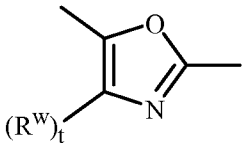
G-41



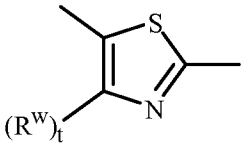
G-42



G-43



G-44



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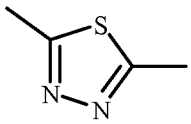

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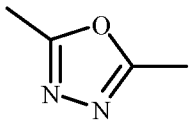

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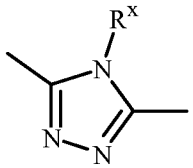
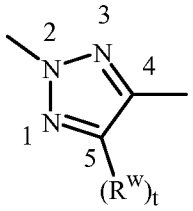


G-48



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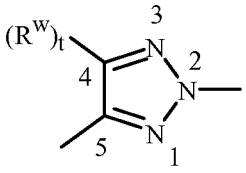
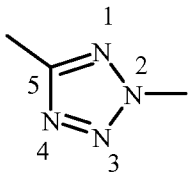
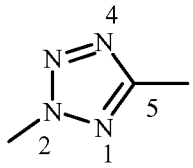


G-50



G-51



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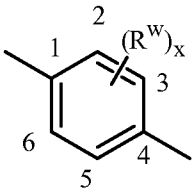

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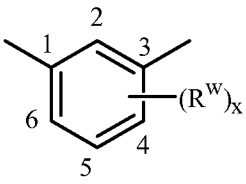
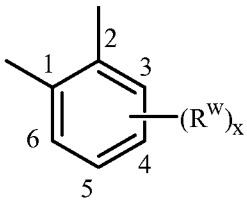


G-54



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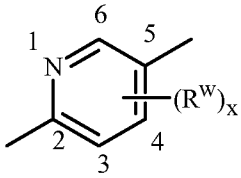

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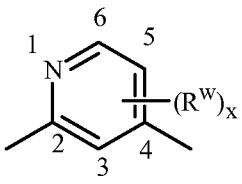

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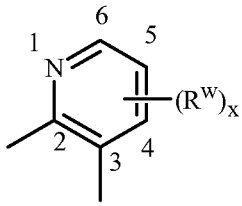
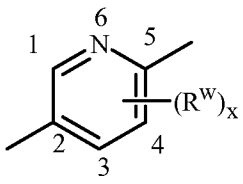


G-58



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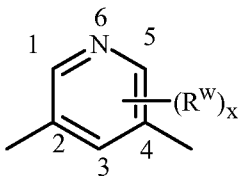

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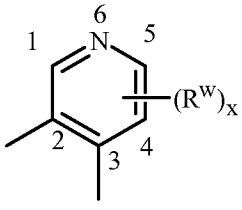

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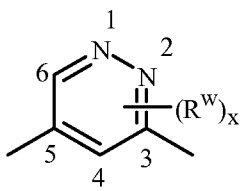

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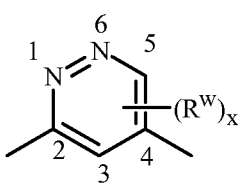

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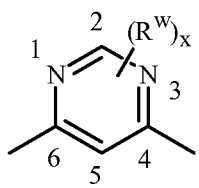
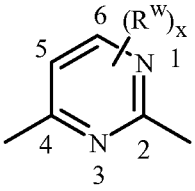


G-64



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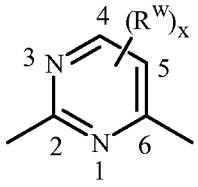

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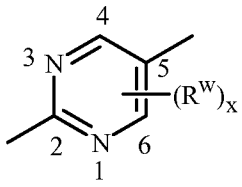

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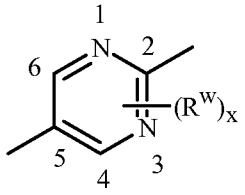

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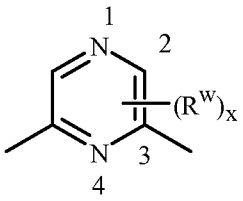
G-65 G-66 G-67 G-68



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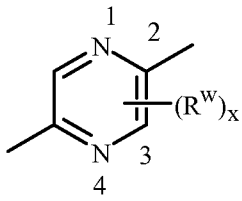

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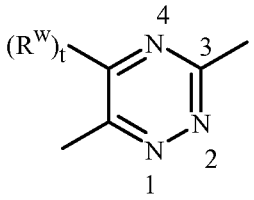
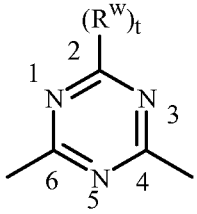


or



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G-69 G-70 G-71 G-72

wherein the bond projecting to the left is bonded to the pyridazinone ring of Formula **1**, and the bond projecting to the right is bonded to J; and x is an integer selected from 0 through 2.

Embodiment 57. A compound of Embodiment 56 wherein G is bonded to J other than at the 2-position of G.

Embodiment 57a. A compound of Embodiment 56 wherein G is bonded to J at the 3- or 4-position of G.

Embodiment 57b. A compound of any one of Embodiments 56 through 57a wherein G is selected from G-3 through G-6, G-9 through G-18, G-22 through G-31, G-33 through G-35, G-39 through G-45, G-48, G-50, G-53 through G-60, G-62 through G-65 and G-68 through G-71.

Embodiment 58. A compound of Embodiment 57b wherein G is selected from G-12 through G-15, G-26 through G-29, G-34, G-35, G-54 and G-65.

Embodiment 59. A compound of Embodiment 58 wherein G is selected from G-12, G-15, G-26, G-28, G-29, G-34, G-35, G-54 and G-65.

Embodiment 60. A compound of any one of Embodiments 56 through 59 wherein x is 1.

Embodiment 61. A compound of any one of Embodiments 56 through 59 wherein x is 2.

Embodiment 62. A compound of any one of Embodiments 56 through 59 wherein at least one R^W is positioned vicinal to the connection of the G group to the pyridazinone ring.

Embodiment 63. A compound of any one of Embodiments 56 through 60 wherein G is G-26.

Embodiment 64. A compound of any one of Embodiments 56 through 59 or 63 wherein x is 1 and R^W is positioned at the 5-position of G-26.

Embodiment 65. A compound of any one of Embodiments 56 through 59 or 63 wherein x is 2 and R^W is positioned at the 4- and 5-positions of G-26.

Embodiment 66. A compound of any one of Embodiments 56 through 59 wherein G is G-15.

Embodiment 67. A compound of any one of Embodiments 56 through 59 wherein G is G-29.

Embodiment 68. A compound of any one of Embodiments 56 through 59 wherein G is G-28, x is 1, and R^W is positioned at the 2-position of G-28.

Embodiment 69. A compound of any one of Embodiments 56 through 59 wherein G is G-28, x is 2, and R^W is positioned at the 2- and 5-positions of G-28.

Embodiment 69a. A compound of any one of Embodiments 56 through 57b wherein G is G-45.

Embodiment 70. A compound of any one of Embodiments 56 through 59 wherein G is G-54, x is 1, and R^W is positioned at the 6-position of G-54.

Embodiment 71. A compound of any one of Embodiments 56 through 59 wherein G is G-54, x is 2, and R^W is positioned at the 2- and 6-position of G-54.

Embodiment 72. A compound of any one of Embodiments 56 through 59 wherein G is G-65, x is 1, and R^W is positioned at the 5-position of G-65.

Embodiment 73. A compound of any one of Embodiments 56 through 59 wherein G is G-35, x is 1, and R^W is positioned at the 4-position of G-35.

Embodiment 74. A compound of any one of Embodiments 56 through 59 wherein G is G-34, x is 1, and R^W is positioned at the 3-position of G-34.

Embodiment 75. A compound of any one of Embodiments 56 through 59 wherein G is G-12.

Embodiment 76. A compound of Formula **1** or any one of Embodiments 1 through 75 wherein each R^W is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, naphthalenyl, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$.

Embodiment 77. A compound of Embodiment 76 wherein each R^W is independently halogen, hydroxy, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$.

Embodiment 77a. A compound of Embodiment 77 wherein each R^W is independently halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$.

Embodiment 78. A compound of Embodiment 77a wherein each R^W is independently halogen, C_1–C_6 alkyl or $-O(CR^{11}R^{12})_nG^A$.

Embodiment 79. A compound of Embodiment 63 wherein each R^W is independently halogen or C_1–C_6 alkyl.

Embodiment 79a. A compound of Embodiment 79 wherein each R^W is independently halogen, CH_3, Et, or *n*-Pr (i.e. $-(CH_2)_2CH_3$).

Embodiment 80. A compound of Embodiment 79a wherein each R^W is independently halogen, CH_3 or Et (i.e. CH_2CH_3).

Embodiment 81. A compound of Embodiment 80 wherein each R^W is independently CH_3 or Et.

Embodiment 82. A compound of Formula **1** or any one of Embodiments 1 through 81 wherein each n is independently an integer selected from 0 through 1.

Embodiment 83. A compound of Embodiment 82 wherein each n is 0.

Embodiment 84. A compound of Formula **1** or any one of Embodiments 1 through 83 wherein J is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 3 substituents independently selected from R^u.

Embodiment 85. A compound of Embodiment 84 wherein J is a phenyl ring or a 6-membered heteroaromatic ring, each ring optionally substituted with up to 3 substituents independently selected from R^u.

Embodiment 86. A compound of Embodiment 85 wherein J is a phenyl ring optionally substituted with up to 3 substituents independently selected from R^u.

Embodiment 87. A compound of Embodiment 86 wherein J is a phenyl ring substituted with a substituent selected from R^u.

Embodiment 88. A compound of Embodiment 87 wherein J is a phenyl ring substituted at the para position with a substituent selected from R^u.

Embodiment 88a. A compound of Formula **1** or any one of Embodiments 1 through 83 wherein J is phenyl substituted at the 3-, 4- or 5-position with halogen or C_1–C_6 haloalkyl.

Embodiment 89. A compound of Formula **1** wherein each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u.

Embodiment 89a. A compound of Embodiment 89 wherein each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 3 substituents independently selected from R^u.

Embodiment 90. A compound of Embodiment 89 wherein each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 1 substituent independently selected from R^u.

Embodiment 91. A compound of Formula **1** or any one of Embodiments 1 through 90 wherein each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH_2, -SO_2NH_2, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl.

Embodiment 92. A compound of Embodiment 91 wherein each R^u is independently halogen, cyano, nitro, -CHO, -C(=O)OH, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino or phenyl.

Embodiment 93. A compound of Embodiment 92 wherein each R^u is independently halogen, cyano, nitro, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy or C_1–C_6 haloalkoxy.

Embodiment 94. A compound of Embodiment 93 wherein each R^u is independently halogen, C_1–C_6 alkyl or C_1–C_6 haloalkyl.

Embodiment 95. A compound of Embodiment 94 wherein each R^u is independently halogen, C_1–C_3 alkyl or C_1–C_3 haloalkyl.

Embodiment 96. A compound of Embodiment 95 wherein each R^u is independently Cl, Br or CF_3.

Embodiment 97. A compound of Formula **1** or any one of Embodiments 1 through 96 wherein W^1 is O.

Embodiment 98. A compound of Formula **1** or any one of Embodiments 1 through 96 wherein W^1 is S.

Embodiments of this invention, including Embodiments 1–98 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 1–98 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 1–98 are illustrated by:

Embodiment A1. A compound of Formula **1** wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl or C_3–C_{10} alkoxyalkoxyalkyl;

R^2 is H, halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl or C_2–C_8 alkoxyalkyl;

R^3 is H, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$ or $-C(W^5)NR^9R^{10}$;

each R^x is independently H or C_1–C_3 alkyl;

J is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 3 substituents independently selected from R^u; and

each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO, $-C(=O)OH$, $-C(=O)NH_2$, $-SO_2NH_2$, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl.

Embodiment A2. A compound of Embodiment A1 wherein

R^1 is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl;

R^2 is H, halogen or C_1–C_6 alkyl;

G is selected from G-3 through G-6, G-9 through G-18, G-22 through G-31, G-33 through G-35, G-39 through G-45, G-48, G-50, G-53 through G-60, G-62 through G-65 and G-68 through G-71 (wherein the bond projecting to the left is bonded to the pyridazinone ring of Formula **1**, and the bond projecting to the right is bonded to J); and x is an integer selected from 0 through 2;

each R^w is independently halogen, hydroxy, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$;

J is a phenyl ring optionally substituted with up to 3 substituents independently selected from R^u;

each R^u is independently is halogen, cyano, nitro, -CHO, -C(=O)OH, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino or phenyl; and

W^1 is O.

Embodiment A3. A compound of Embodiment A2 wherein

R^1 is H or C_1–C_6 alkyl;

R^2 is H, Cl, CH_3 or Et;

R^3 is H or CO_2-*i*-Pr;

G is selected from G-12 through G-15, G-26 through G-29, G-34, G-35, G-54 and G-65;

each R^w is independently halogen, C_1–C_6 alkyl or $-O(CR^{11}R^{12})_nG^A$;

J is a phenyl ring substituted with a substituent selected from R^u; and

each R^u is independently halogen, C_1–C_6 alkyl or C_1–C_6 haloalkyl.

Embodiment A4. A compound of Formula **1** wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl or C_3–C_{10} alkoxyalkoxyalkyl;

R^2 is H, halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_2–C_8 alkoxyalkyl or C_1–C_4 alkoxy;

R^3 is H, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$ or $-C(W^5)NR^9R^{10}$;

G is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with R^x on nitrogen ring members and optionally substituted with up to 2 substituents selected from R^w on carbon ring members;

each R^x is independently H or C_1–C_3 alkyl;

J is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 3 substituents independently selected from R^u; and

each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO,

-C(=O)OH, -C(=O)NH_2, -SO_2NH_2, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl.

Embodiment A5. A compound of Embodiment A4 wherein

R^1 is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl;

R^2 is H, halogen, C_1–C_6 alkyl or C_1–C_4 alkoxy;

G is selected from G-3 through G-6, G-9 through G-18, G-22 through G-31, G-33 through G-35, G-39 through G-45, G-48, G-50, G-53 through G-60, G-62 through G-65 and G-68 through G-71 (wherein the bond projecting to the left is bonded to the pyridazinone ring of Formula **1**, and the bond projecting to the right is bonded to J); and x is an integer selected from 0 through 2;

each R^w is independently halogen, hydroxy, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, -$O(CR^{11}R^{12})_nG^A$ or -$(CR^{11}R^{12})_nG^A$;

J is a phenyl ring optionally substituted with up to 3 substituents independently selected from R^u;

each R^u is independently is halogen, cyano, nitro, -CHO, -C(=O)OH, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino or phenyl; and

W^1 is O.

Embodiment A6. A compound of Embodiment A5 wherein

R^1 is H or C_1–C_6 alkyl;

R^2 is H, Cl, CH_3, Et or OMe;

R^3 is H, CO_2-*i*-Pr or CO-*t*-Bu;

G is selected from G-12 through G-15, G-26 through G-29, G-34, G-35, G-54 and G-65;

each R^w is independently halogen, C_1–C_6 alkyl or -$O(CR^{11}R^{12})_nG^A$;

J is a phenyl ring substituted with a substituent selected from R^u; and

each R^u is independently halogen, C_1–C_6 alkyl or C_1–C_6 haloalkyl.

Embodiment A7. A compound of Embodiment A3 or A6 wherein

R^1 is CH_3;

R^2 is H;

G is selected from G-12, G-15, G-26, G-28, G-29, G-34, G-35, G-54 and G-65;

each R^w is independently CH_3 or Et;

J is a phenyl ring substituted at the para position with a substituent selected from R^u; and

each R^u is independently halogen, C_1–C_3 alkyl or C_1–C_3 haloalkyl.

Embodiment A8. A compound of Embodiment A7 wherein

G is G-26;

x is 1;

R^w is positioned at the 5-position of G-26; and

each R^u is independently Cl, Br or CF_3.

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

5-hydroxy-2-methyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone (Compound 1),

4-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 3),

5-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-1-yl]-1,6-dihydro-1-methyl-6-oxo-4-pyridazinyl-1-methylethyl carbonate (Compound 7),

and also include compounds of Formula **1** selected from the group consisting of:

4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-3(2*H*)-pyridazinone (Compound 78),

4-[5-ethyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 11) and

4-[3-(4-chlorophenyl)-5-ethyl-4-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 26).

Of note is a compound of Formula **1** wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl or C_2–C_8 alkylsulfonylalkyl;

R^2 is H, halogen, cyano, -C(=O)OH, -C(=O)NH_2, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_4–C_{10} cycloalkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylthio or C_1–C_6 haloalkylthio;

R^3 is H, -C(=O)R^4, -C(=W^2)W^3R^5, -S(=O)$_2R^6$, -P(=W^4)R^7R^8 or -C(=W^5)NR^9R^{10}; and

each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u.

Of also note are the above embodiments, including Embodiments 1 through 98 and A1 through A8, wherein Formula **1** does not include *N*-oxides thereof, does not include salts thereof, or does not include *N*-oxides and salts thereof.

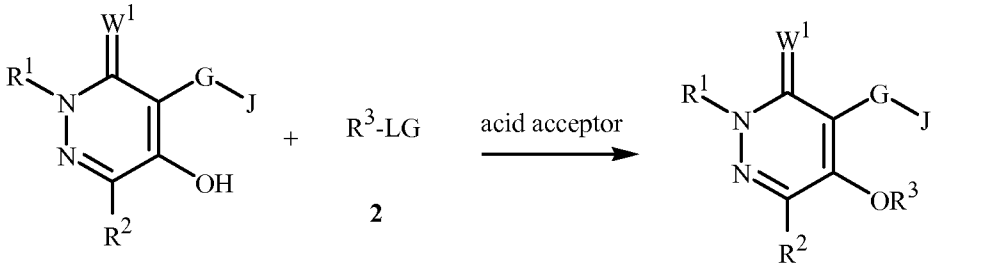
This invention also relates to a method for controlling undesired vegetation comprising applying to the locus of the vegetation herbicidally effective amounts of the compounds of the invention (e.g., as a composition described herein). Of note as embodiments relating to methods of use are those involving the compounds of embodiments described above. Also noteworthy as embodiments are herbicidal compositions of the present invention comprising the compounds of embodiments described above.

One or more of the following methods and variations as described in Schemes 1–12 can be used to prepare the compounds of Formula **1**. The definitions of R^1, R^2, R^3, W^1, G and J in the compounds of Formulae **1**–**17** below are as defined above in the Summary of the Invention unless otherwise noted. Formulae **1a**–**1b** and Formulae **3a**–**3d** are various subsets of Formulae **1** and **3** respectively.

As shown in Scheme 1, compounds of Formula **1** wherein R^3 is other than H can be prepared by reaction of compounds of Formula **1a** (Formula **1** wherein R^3 is H) with acylation, sulfonylation or phosphorylation agents of Formula **2** in the presence of acid acceptors. Suitable acid acceptors for the reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydrides, alkoxides, carbonates, phosphates and hydroxides, and organic bases such as triethylamine, *N*,*N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. Preferred acid acceptors are trialkylamines and potassium hydroxide. A wide variety of solvents are suitable for the

reaction including, for example but are not limited to, tetrahydrofuran, dichloromethane, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, *N*-methylpyrrolidinone, acetonitrile and acetone as well as mixtures of these solvents. Typical examples of compounds of Formula **2** wherein LG is a leaving group such as halogen, sulfonate and carboxylate include carboxylic acid halides, carboxylic acid anhydrides, chloroformates, carbamoyl halides, sulfonyl halides, sulfonyl anhydrides, sulfamoyl halides, halophosphates and halophosphonates, which can be prepared by methods well known in the art. Many are commercially available. This reaction can be conducted between about -20 and 200 °C, and more typically between about 0 and 50 °C.

Scheme 1

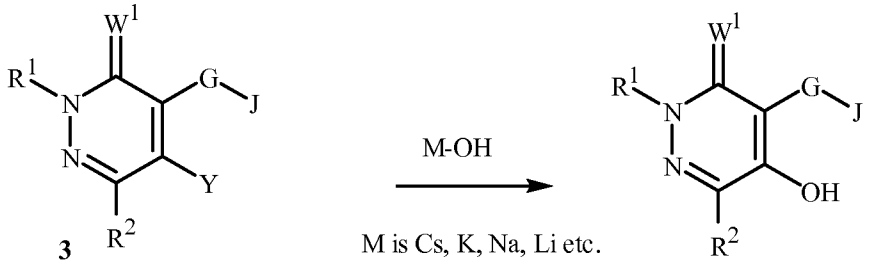


1a **1** R^3 is other than H

LG is a leaving group such as halogen, sulfonate and carboxylate

As shown in Scheme 2, compounds of Formula **1a** (Formula **1** wherein R^3 is H) can be prepared by the reaction of compounds of Formula **3** with an alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydroxide. The reaction is typically carried out in an organic solvent or a mixture of water with an organic solvent such as ethanol or other lower alkyl alcohols, tetrahydrofuran, dioxane, 1,2-dimethoxyethane and *N*,*N*-dimethylformamide. The reaction can be carried out at temperatures ranging from 0 to 150 °C and preferably from 50 to 120 °C. The hydroxide is generally present in excess ranging from 1.5 to 40-fold with respect to the compound of Formula **3**.

Scheme 2



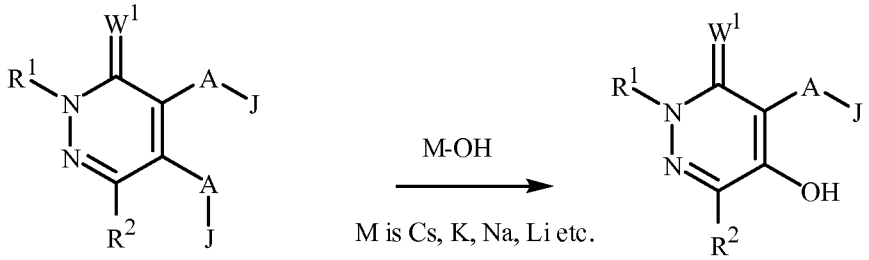
3 M is Cs, K, Na, Li etc. **1a**

Y is OAlkyl or halogen

As shown in Scheme 3, compounds of Formula **1b** wherein A is an azole such as pyrazole, imidazole, pyrrole and triazole bonded through N to the pyridazinone ring can be made by the reaction of compounds of Formula **4** with an alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydroxide. The reaction is typically carried out in

an organic solvent or a mixture of water with an organic solvent such as ethanol and other lower alkyl alcohols, tetrahydrofuran, dioxane, 1,2-dimethoxyethane and *N,N*-dimethylformamide. The reaction can be carried out at temperatures ranging from 0 to 150 °C and more typically from 50 to 120 °C. The hydroxide is generally present in excess ranging from 1.5 to 40-fold with respect to the compound of Formula **4**.

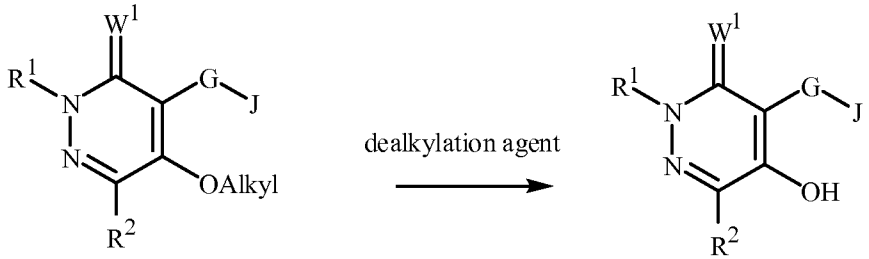
Scheme 3



4 **1b**

Scheme 4 shows the synthesis of compounds of Formula **1a** by the dealkylation of compounds of Formula **3a** (Formula **3** wherein Y is OAlkyl). Many dealkylation reagents which dealkylate ethers (such as compounds of Formula **3a**), including aluminum trichloride, hydrogen bromide, iodotrimethylsilane and boron tribromide, are known in the art. Boron tribromide is preferred for the dealkylation. The alkoxy compound of Formula **3a** is treated with boron tribromide in a solvent such as a chlorinated hydrocarbon (e.g., dichloromethane and chloroform). The reaction is typically carried out at 0 to 30 °C, but can also be carried out at more elevated temperatures such as between about 50 and 120 °C. Other conditions and reagents for dealkylation are described by Larock, "Comprehensive Organic Transformations", VCH Publishing, New York, 1989, pp 501–504.

Scheme 4

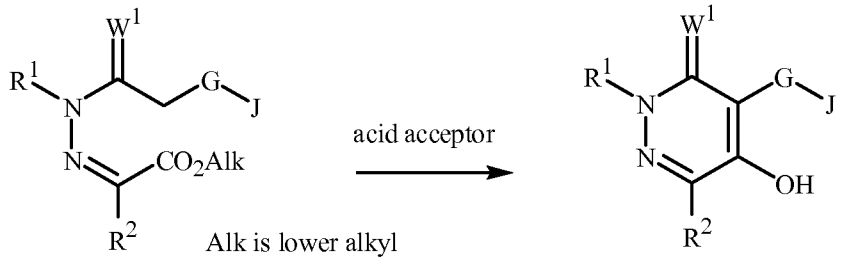


3a **1a**

Scheme 5 shows the synthesis of compounds of Formula **1a** by the cyclization of hydrazono esters of Formula **5** in the presence of an acid acceptor. Suitable acid acceptors for this reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydrides and alkoxides or organic bases such as triethylamine, *N,N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. A wide variety of solvents are suitable for the reaction including, for example but not limited to, aromatic hydrocarbons (e.g., toluene and xylenes), tetrahydrofuran, dioxane, 1,2-dimethoxyethane, *N,N*-dimethylformamide, *N,N*-dimethylacetamide, *N*-methylpyrrolidinone,

and acetonitrile, as well as mixtures of these solvents. This reaction can be conducted between about -20 and 200 °C and more typically between about 20 and 120 °C.

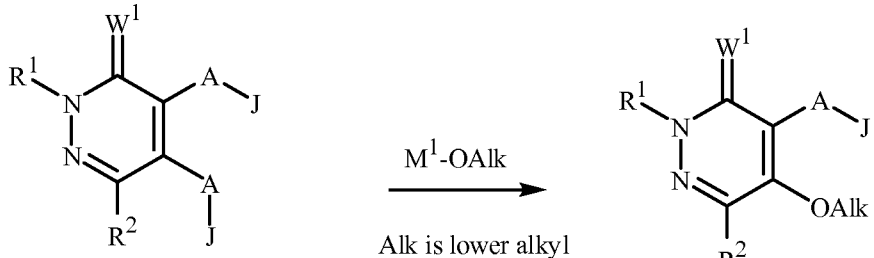
Scheme 5



5 **1a**

As shown in Scheme 6, compounds of Formula **3b** wherein A is an azole ring such as pyrazole, imidazole, pyrrole and triazole bonded through N to the pyridazinone ring can be prepared by reacting compounds of Formula **4** with alcohols in the presence of an acid acceptor. The reaction is typically carried out in the alcohol as solvent or co-solvent in the presence of the acid acceptor. Suitable acid acceptors for the reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydrides and alkoxides or organic bases such as triethylamine, *N*,*N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. This reaction can be conducted between about -20 and 200 °C, and more typically between about 20 and 120 °C. A particularly useful solvent and alcohol combination is sodium methoxide in methanol solvent, for which reaction temperatures ranging from 0 to 70 °C are suitable.

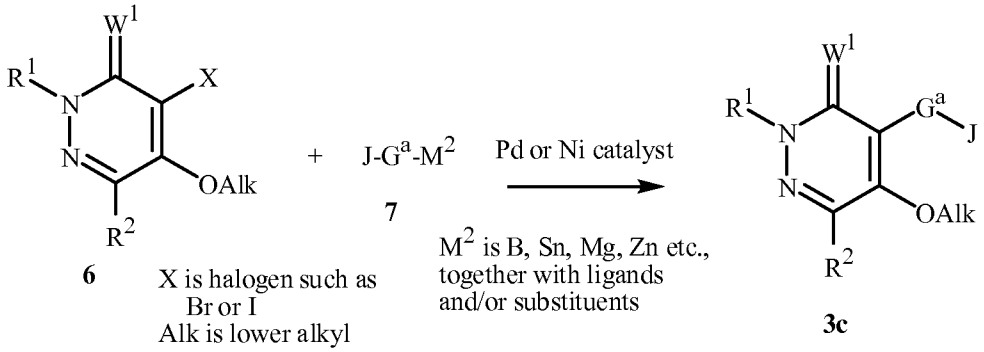
Scheme 6



4 **3b**

The synthesis of compounds of Formula **3c,** in which G^a is a phenyl group or a heterocycle bonded through C to the pyridazinone ring, by means of a transition metal-catalyzed reaction of a halopyridazinone of Formula **6** with an organometallic species represented by Formula **7** is shown in Scheme 7. A variety of metals, catalysts and ligands can be used in this process. For synthesis of organometallic heterocycles of Formula **7** suitable for use in this reaction see Li and Gribble, "Palladium in Heterocyclic Chemistry", first edition, Pergamon Press, Amsterdam, 2000 and 2nd edition, Elsevier, Amsterdam, 2007. This book also describes a wide variety of catalysts and reaction conditions suitable for carrying out the cross-coupling reactions described in Scheme 7.

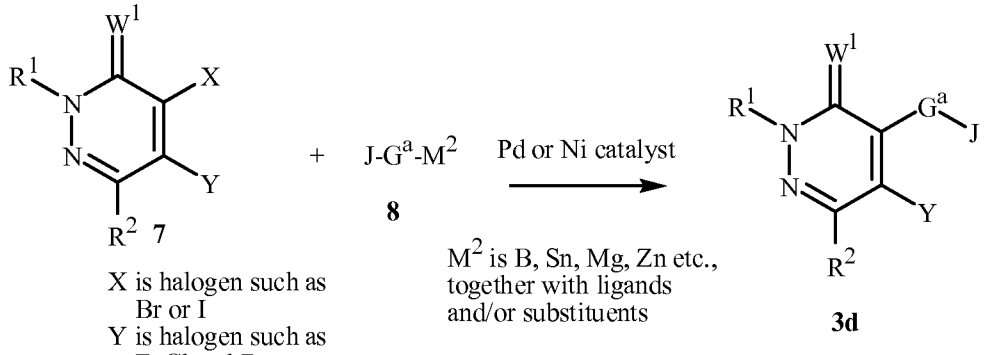
Scheme 7



X is halogen such as Br or I
Alk is lower alkyl

The synthesis of compounds of Formula **3d,** in which G^a is a phenyl group or a heterocycle bonded through C to the pyridazinone ring, by means of a transition metal-catalyzed reaction of a differentially substituted (X and Y of Formula **7** are different halogens) halopyridazinone of Formula **7** with an organometallic species represented by Formula **8** is shown in Scheme 8. A variety of metals, catalysts and ligands may be used in this process. Synthesis of pyridazinones of Formula **7** with differentially substituted halogens on the ring can be found in T. M. Stevenson et al. *J. Heterocyclic Chem.*, **2005**, *42*, 427-435 and Zhang et al. *Tetrahedron Lett.*, **2006**, *47*, 8733-8735. An alternative approach to position-selective palladium-catalyzed cross-coupling reactions on pyridazinones is found in U.S. Patent 6,307,047.

Scheme 8

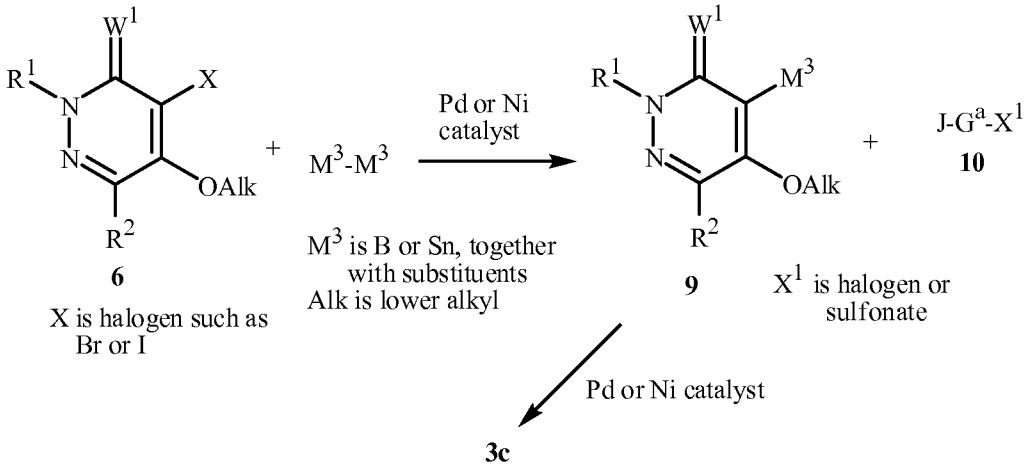


X is halogen such as Br or I
Y is halogen such as F, Cl and Br

Alternatively compounds of Formula **3c** in which G^a is a phenyl group or a heterocycle bonded through C to the pyridazinone ring can be made from organometallic derivatives of pyridazinones of Formula **9** as shown in Scheme 9. Most preferably the organometallic reagent of Formula **9** is made by the reaction of a bimetallic reagent such as hexamethylditin with halopyridazinone compounds of Formula **6** under palladium catalysis. The resulting tin compound of Formula **9** can be transformed to compounds of Formula **3c** by palladium-catalyzed coupling reaction with haloheterocycles of Formula **10**. Conditions and catalysts for reactions of tin pyridazinones with aromatic and heteroaromatic halides as well as conditions for the synthesis of compounds of Formula **9** are described in T. M. Stevenson et

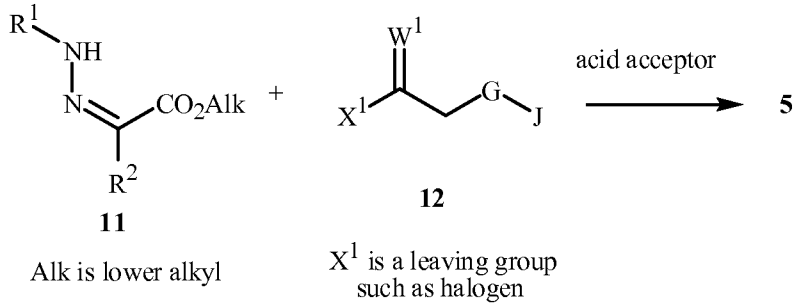
al., *J. Heterocyclic Chem.*, **2005**, *42*, 427-435. Other reagents such as bis-(pinacolato)diboron can also be used for this synthesis.

Scheme 9



Compounds of Formula **5** can be synthesized by the reaction of an activated acid derivative of Formula **12** with a hydrazone of Formula **11** in the presence of an acid acceptor as shown in Scheme 10. Suitable acid acceptors for the reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydrides, alkoxides, carbonates, phosphates and hydroxides, and organic bases such as triethylamine, *N*,*N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. Particularly useful acid acceptors are trialkylamines and potassium hydroxide. A wide variety of solvents are suitable for this reaction including, for example but not limited to, tetrahydrofuran, dichloromethane, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, *N*-methylpyrrolidinone, acetonitrile and acetone, as well as mixtures of these solvents. This reaction can be conducted between about -20 and 100 °C, and more typically between about 0 and 50 °C. Activated acid derivatives include, for example but not limited to, acid chlorides, acid bromides, acylimidazoles, mixed anhydrides and acylcyanides.

Scheme 10

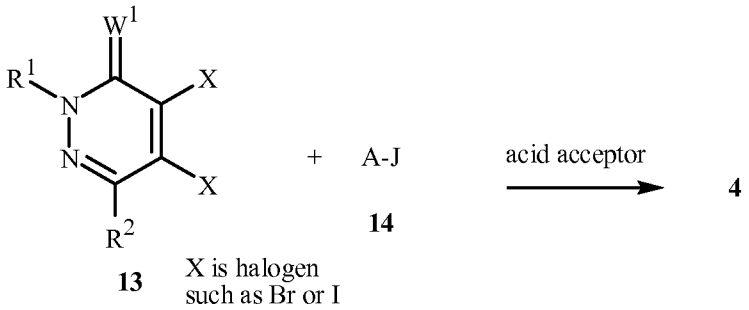


Hydrazones of Formula **11** can be synthesized as described in Li et al., *Synthesis*, **2007**, 3301-3308 and references cited therein. Procedures for the synthesis of hydrazone intermediates and their cyclization are found in US Patent Application 2008/0090814, *Bioorg. Med. Chem. Lett.*, **2008**, 1413, *Bioorg. Med. Chem Lett.*, **2008**, 1419, *Bioorg. Med.*

Chem. Lett., **2008**, 3421, *Bioorg. Med. Chem. Lett.*, **2008**, 4628, *Bioorg. Med. Chem. Lett.*, **2008**, 3446, *Synthesis,* **2008**, 610-616, and *Tet. Lett.,* **2008**, *49*, 811.

Compounds of Formula **4** wherein A is an azole ring such as pyrazole, imidazole, pyrrole and triazole bonded through N to the pyridazinone ring can be made by the reaction of corresponding azoles of Formula **14** with dihalopyridazinones of Formula **13** in the presence of an acid acceptor as shown in Scheme 11. Suitable acid acceptors for the reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) hydrides, alkoxides, carbonates, phosphates and hydroxides. A variety of solvents are suitable for the reaction including, for example but not limited to, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, *N*-methylpyrrolidinone, acetonitrile and acetone. Particularly useful reaction conditions include using potassium carbonate as acid acceptor and *N*,*N*-dimethylacetamide as solvent at temperatures between 80 and 180 °C. To enable complete conversion, the acid acceptor and azole of Formula **14** are charged in a molar ratio of at least 2 compared to the compound of Formula **13**.

Scheme 11

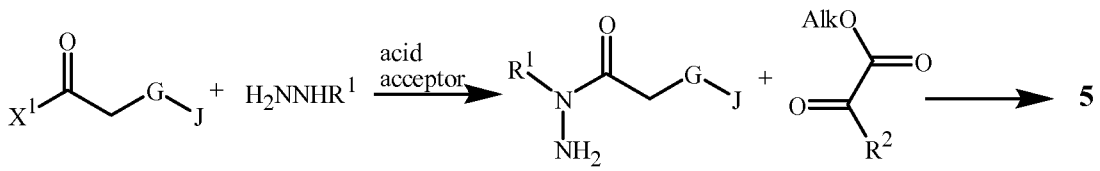


Pyridazinones of Formulae **6** and **13** can be prepared as described in T. M. Stevenson et al., *J. Heterocyclic Chem.*, **2005**, *42*, 427-435 and references cited therein. Other pyridazinones are found in U.S. Patent 2,782,195 and Maes and Lemiere in Katritsky editor, *Comprehensive Heterocyclic Chemistry III,* Volume 8, 1-117; Elsevier, Oxford. Azoles of Formula **14** can be prepared using chemistry disclosed in U.S. Patent 7,230,116 and references cited therein.

As shown in Scheme 12 compounds of Formula **5** can be prepared by a two-step route. In the first step compounds of Formula **16** can be prepared by condensing activated acids of Formula **12** with a substituted hydrazine of Formula **15** in the presence of an acid acceptor to give hydrazides of Formula **16**. Suitable acid acceptors for the reaction include inorganic bases such as alkali or alkaline earth metal (e.g., lithium, sodium, potassium and cesium) carbonates, phosphates and hydroxides, and organic bases such as triethylamine, *N*,*N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. Particularly useful acid acceptors are trialkylamines and potassium hydroxide. A wide variety of solvents are suitable for this reaction including, for example but not limited to, tetrahydrofuran,

dichloromethane, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, *N*-methylpyrrolidinone, acetonitrile and acetone, as well as mixtures of these solvents. This reaction can be conducted between about -20 and 100 °C, and more typically between about 0 and 50 °C. Compounds of Formula **12** include, for example but not limited to, acid chlorides, acid bromides, acylimidazoles, mixed anhydrides and acylcyanides. Further treatment of compounds of Formula **16** with ketoesters of Formula **17** gives compounds of Formula **5**. A wide variety of solvents are suitable for this reaction including, for example but not limited to, lower aliphatic alcohols, tetrahydrofuran, dichloromethane, dioxane, chloroform, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, *N*-methylpyrrolidinone, acetonitrile and acetone, as well as mixtures of these solvents. The reaction can also be carried out without the presence of a solvent. This reaction can be conducted between about -20 and 200 °C, and more typically between about 0 and 100 °C.

Scheme 12



12 **15** **16** **17**

Alk is lower alkyl

Acid precursors to compounds of Formula **12** can be prepared using methods described in U.S. Patents 6,767,864 and 7,230,116 and PCT Patent Publications WO 2007/014290, WO 2005/005428 and WO2007/119434.

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 it is 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 those implied by the particular sequence 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 Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Steps in the following Examples illustrate a procedure for each step in an overall synthetic transformation, and the starting material for each step may not have necessarily been prepared by a particular preparative run whose procedure is described in other Examples or Steps. 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. ^{1}H NMR spectra are reported in ppm downfield from tetramethylsilane at 400 MHz ; "s" means singlet, "m" means multiplet, d means doublet and bs means broad singlet. For melting points "dec." means "decomposition". Mass spectra are reported as the molecular weight of the highest isotopic abundance parent ion (M+1) formed by addition of H^+ (molecular weight of 1) to the molecule, observed by mass spectrometry using atmospheric pressure chemical ionization (AP^+).

EXAMPLE 1

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

Step A: Preparation of 2-methyl-4,5-bis[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone

A solution of 3-methyl-5-(4-trifluoromethylphenyl)pyrazole (2 g, 8.9 mmol; prepared as described in U.S. Patent 7,230,116) and 4,5-dichloro-2-methyl-(2*H*)-pyridazinone (Aldrich, 0.85 g, 4.7 mmol) in *N,N*-dimethylformamide (15 mL) was treated with potassium carbonate (powdered, 1.9 g, 13.8 mmol). The reaction mixture was heated at 100 °C for 11 h and then poured onto ice water. The resulting solid was filtered and washed with water. The solid was dissolved in dichloromethane (50 mL) and dried over magnesium sulfate. The residue after filtration and evaporation was subjected to chromatography on a 20 g silica gel column using a gradient of 6:1 to 4:1 hexanes/ethyl acetate as eluent to give 0.75 g of the title compound as a yellow oil.

^{1}H NMR ($CDCl_3$) δ 8.17 (s, 1H), 7.85 (m, 2H), 7.70 (m, 2H), 7.65 (m, 2H), 6.45 (s, 1H), 6.40 (s, 1H), 3.96 (s, 3H), 2.26 (s, 3H), 2.05 (s, 3H).

Step B: Preparation of 5-methoxy-2-methyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone

A solution of 2-methyl-4,5-bis[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone (i.e. the product of Step A) (0.74 g, 1.3 mmol) in methanol (20 mL) was treated with sodium methoxide (4.5 N solution in methanol, 0.8 mL, 3.6 mmol).

The reaction mixture was heated to reflux to dissolve suspended solids and then stirred at 25 °C for 6 h. The resulting mixture was quenched with saturated aqueous ammonium chloride solution (20 mL) and diluted with ethyl acetate (30 mL). The ethyl acetate layer was dried with magnesium sulfate, filtered and evaporated. The residue was subjected to chromatography on a 10 g silica gel cartridge using a gradient of 3:1 to 1:1 hexanes/ethyl acetate as eluent to give 0.4 g of the title compound as an oil which solidified on addition of diethyl ether.

^{1}H NMR ($CDCl_3$) δ 7.90 (m, 2H), 7.85 (s, 1H), 7.63 (m, 2H), 6.57 (s, 1H), 3.83 (m, 6H), 2.25 (s, 3H).

Step C: Preparation of 5-hydroxy-2-methyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone

To a solution of 5-methoxy-2-methyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone (i.e. the product of Step B) (0.25 g, 0.69 mmol) in dichloromethane (5 mL) was added a solution of boron tribromide (1.0 M solution in dichloromethane, 0.82 mL, 0.82 mmol). The reaction mixture was stirred at room temperature for 2 h and then treated with 1 N aqueous sodium hydroxide solution (4 mL). After stirring for 15 min, the reaction mixture was adjusted to pH 4 with 1 N aqueous hydrochloric acid (4 mL). The reaction mixture was then dried with magnesium sulfate, and purified by pouring onto a Varian Chem Elut® tube and eluting with dichloromethane. The eluted solution was concentrated in vacuo to give 210 mg of the title product, a compound of the present invention.

^{1}H NMR ($CDCl_3$) δ 7.89 (s, 3H), 7.86 (m, 2H), 7.68 (m, 2H), 6.60 (s, 1H), 3.81 (s, 3H), 2.35 (s, 3H).

EXAMPLE 2

Preparation of 4-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 3)

Step A: Preparation of 4,5-bis[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-1-yl]-2-methyl-3(2*H*)-pyridazinone

A solution of 3-methyl-5-(4-chlorophenyl)pyrazole (2.6 g, 13.5 mmol; prepared as described in U.S. Patent 7,230,116) and *N*-methyl-4,5-dichloropyridazinone (Aldrich, 1.07 g, 5.9 mmol) in *N,N*-dimethylacetamide (10 mL) was treated with potassium carbonate (powdered, 3.2 g, 23.2 mmol). The reaction mixture was heated at 120-130 °C for 4 h and then poured onto ice water. The solid that separated was filtered and washed with water. The solid was dissolved in dichloromethane (50 mL) and dried over magnesium sulfate. The solution was filtered and concentrated in vacuo. The resulting residue was subjected to chromatography on a 20 g silica gel cartridge using dichloromethane as eluent to give 1.6 g of the title compound as a yellow solid.

^{1}H NMR ($CDCl_3$) δ 8.16 (s, 1H), 7.65 (m, 2H), 7.50 (m, 2H), 7.35 (m, 2H), 7.20 (m, 2H), 6.40 (2 x s, 2H), 3.94 (s, 3H), 2.21(s, 3H), 1.98 (s, 3H).

Step B: Preparation of 4-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone

4,5-Bis[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-1-yl]-2-methyl-3(2*H*)-pyridazinone (i.e. the product of Step A) (1.35 g, 2.7 mmol) and aqueous sodium hydroxide (50 %, 3 mL) were dissolved in a mixture of methanol (40 mL) and water (10 mL). The heterogeneous reaction mixture was heated at reflux for 2 h during which time it became homogeneous. The reaction mixture was evaporated under reduced pressure, and the residue was acidified with 6 N aqueous hydrochloric acid. The resulting gum was separated, washed with water and then dissolved in hot ethyl acetate (150 mL). The reaction solution was dried over magnesium sulfate, filtered and evaporated. The resulting residue was subjected to chromatography on a 20 g silica gel cartridge using dichloromethane followed by a gradient mixture of dichloromethane/ethyl acetate from 90:10 to 0:100 as eluent to give 460 mg of the title product, a compound of the present invention, as an off-white solid.

^{1}H NMR ($CDCl_3$) δ 7.77 (s, 1H), 7.66 (m, 2H), 7.40 (m, 2H), 6.46 (s, 1H), 3.80 (s, 3H), 2.27 (s, 3H).

EXAMPLE 3

Preparation of 5-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-1-yl]-1,6-dihydro-1-methyl-6-oxo-4-pyridazinyl-1-methylethyl carbonate (Compound 7)

A solution of 4-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (i.e. the product of Example 2, Step B) (0.175 g, 0.54 mmol) in dichloromethane (15 mL) was treated with triethylamine (0.6 mL, 4.2 mmol) followed by isopropyl chloroformate (1 M solution in toluene, 1.0 mL, 1 mmol). The reaction mixture was stirred at 25 °C for 2 h. It was then quenched with 1 N aqueous hydrochloric acid (10 mL) and diluted with dichloromethane (10 mL). The organic layer was washed with saturated aqueous sodium bicarbonate solution (20 mL). The organic layer was separated, dried over magnesium sulfate, and filtered. The resulting filtrate was evaporated under reduced pressure, and the resulting residue was subjected to chromatography on a 10 g silica gel cartridge using a gradient of 1-chlorobutane (100 %) to 1-chlorobutane/ethyl acetate (90:10) as eluent to give 200 mg of the title product, a compound of the present invention, as an off-white solid.

^{1}H NMR ($CDCl_3$) δ 7.89 (s, 1H), 7.69 (m, 2H), 7.35 (m, 2H), 6.45 (s, 1H), 4.75 (m, 1H), 3.88 (s, 3H), 2.33 (s, 3H), 1.12 (m, 6H).

EXAMPLE 4

Preparation of 4-[2-(4-chlorophenyl)-5-methyl-4-thiazolyl]-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 79)

Step A Preparation of 2-(4-chlorophenyl)-5-methyl-4-thiazoleacetic acid 2-(2-ethoxy-1-methyl-2-oxoethylidine)-1-methylhydrazide

A suspension of 2-(4-chlorophenyl)-5-methylthiazole-4-acetic acid (1.2 g, 4.2 mmol) in dichloromethane (10 mL) at 23 °C was treated with methanesulfonyl chloride (0.35 mL). The purple-tinged mixture was stirred for 10 min and then treated with methyl hydrazine (0.35 g). After stirring for 30 min the mixture was treated with ethyl acetate (40 mL) and saturated aqueous sodium bicarbonate solution (30 mL). The organic layer was dried over magnesium sulfate and concentrated to a foam. The residue was suspended in ethanol (15 mL), treated with ethyl pyruvate (0.35 g, 3.0 mmol) and heated to reflux. After 30 min the solvent was evaporated, and the residue was subjected to silica gel chromatography (20 g silica) using a gradient of ethyl acetate/hexanes (6:1 to 3:1). Appropriate fractions were combined and evaporated to give 0.53 g of a thick oil containing the title compound with with a small amount of ethyl acetate.

Step B Preparation of 4-[2-(4-chlorophenyl)-5-methyl-4-thiazolyl]-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone

A solution of 2-(4-chlorophenyl)-5-methyl-4-thiazoleacetic acid 2-(2-ethoxy-1-methyl-2-oxoethylidine)-1-methylhydrazide (i.e. the product of Step A) (0.52 g) in tetrahydrofuran (15 mL) at 23 °C was treated dropwise with potassium *tert*-butoxide (1 M in THF, 4 mL). The red-colored mixture was stirred for 30 min and then quenched with hydrochloric acid (1 N, 20 mL). The mixture was extracted with ethyl acetate (2 x 50 mL), dried over magnesium sulfate and evaporated. The residue was subjected to silica gel chromatography (20 g silica) using a gradient of dichloromethane/ethyl acetate (100:1 to 20:1 to 10:1), and appropriate fractions were combined and evaporated to yield 70 mg of the title product, a compound of the present invention.

^{1}H NMR ($CDCl_3$) δ 7.79 (m, 2H), 7.43 (m, 2H), 3.78 (s, 3H), 2.66 (s, 3H), 2.35 (s, 3H).

EXAMPLE 5

Preparation of 5-hydroxy-2,6-dimethyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone (Compound 75)

Step A Preparation of 6-bromo-4,5-dichloro-3(2*H*)-pyridazinone

A mixture of 4,5-dichloropyridazinone (5.0 g, 30 mmol) and water (30 mL) was heated with bromine (1.9 mL, 36 mmol) at 180 °C for 30 min in a microwave oven. Upon cooling the mixture was diluted with water (50 mL) and the solid was collected by filtration and washed with water (10 mL) to give the title compound as an off-white solid (6.75 g) after drying.

Step B Prepartion of 6-bromo-4,5-dichloro-2-methyl-3(2*H*)-pyridazinone

6-Bromo-4,5-dichloro-3(2*H*)-pyridazinone (i.e. the product of step A) (6.6 g, 27 mmol) was dissolved in *N*,*N*-dimethylformamide (30 mL) and treated with potassium

carbonate (11 g, 81 mmol) and iodomethane (1.7 mL, 27 mmol). The mixture was stirred for 18 h at 23 °C, diluted with water (50 mL) and extracted with ethyl acetate (3 x 20 mL). The combined extract was washed with brine (50 mL) and dried over magnesium sulfate. After concentration the residue was subjected to silica gel chromatography (40 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 100:0), and appropriate fractions were combined and evaporated to give 4.88 g of the title compound.

^{1}H NMR ($CDCl_3$) δ.3.82 (s, 3H).

Step C Preparation of 4,5-dichloro-2,6-dimethyl-3(2*H*)-pyridazinone

6-Bromo-4,5-dichloro-2-methyl-3(2*H*)-pyridazinone (i.e. the product of Step B) (3.3 g, 13 mmol), dichloro[1,1'-bis(diphenylphosphino)ferrocene]palladium(II) dichloromethane adduct (1:1) (also known as $PdCl_2$(dppf)) (0.94 g, 1.3 mmol), cesium carbonate (6.9 g, 21 mmol) and trimethylboroxine (1.3 mL, 9.3 mmol) were combined with dioxane (30 mL) and heated at reflux for 18 h. Additional trimethylboroxine (1.0 mL) was added, and reflux was continued for an additional 4 h. The mixture was diluted with water (20 mL), saturated aqueous ethylenediaminetetraacetic acid sodium salt solution (40 mL) and dichloromethane (40 mL). The aqueous layer was extracted with dichloromethane (2 x 20 mL), and the combined organic layers were dried over magnesium sulfate. The residue after evaporation was subjected to silica gel chromatography (40 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 100:0), and appropriate fractions were combined and evaporated to give 1.7 g of the title compound as a white solid.

^{1}H NMR ($CDCl_3$) δ 3.82 (s, 3H), 2.43 (s, 3H).

Step D Preparation of 5-methoxy-2,6-dimethyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone

4,5-Dichloro-2,6-dimethyl-3(2*H*)-pyridazinone (i.e. the product of Step C) (0.62 g, 3.2 mmol), potassium carbonate (2.9 g, 21 mmol) and 3-(4-trifluoromethylphenyl)-5-methylpyrazole (1.46 g, 6.4 mmol) were mixed with *N,N*-dimethylacetamide (10 mL) and heated at 140 °C for 3 h. The mixture was then poured into ice-water (100 mL) extracted with dichloromethane (3 x 20 mL) and concentrated to a brown oil (1.33 g), which was dissolved in methanol (20 mL) and treated with sodium methoxide solution (25% in methanol, 2.5 mL, 11 mmol). The dark mixture was heated at reflux for 3.5 h. The mixture was then diluted with aqueous hydrochloric acid (30 mL) and extracted with ethyl acetate (3 x 30 mL). The combined extract was washed with brine (20 mL) and dried over magnesium sulfate. The residue after evaporation was subjected to silica gel chromatography (40 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 100:0), and appropriate fractions were combined and evaporated to give 0.35 g of the title compound.

^{1}H NMR ($CDCl_3$) δ 7.91 (m, 2H), 7.63 (m, 2H), 6.58 (s, 1H), 3.74 (s, 3H), 3.52 (s, 3H), 2.30 (s, 6H).

Step E Preparation of 5-hydroxy-2,6-dimethyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone

5-Methoxy-2,6-dimethyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone (i.e. the product of Step D) (0.35 g, 0.9 mmol) was dissolved in dioxane (20 mL) and treated with aqueous sodium hydroxide solution (50%, 10 mL, excess). The mixture was heated at reflux for 18 h. The mixture was then diluted with water and extracted with ethyl acetate (30 mL). The aqueous layer was acidified with aqueous 6 N hydrochloric acid and extracted with ethyl acetate (2 x 30 mL). The combined organic extracts from the extraction after acidification were dried with magnesium sulfate and evaporated to provide 0.12 g of the title compound as a solid, a compound of the present invention, melting at 191-194 °C.

^{1}H NMR ($CDCl_3$) δ 7.87 (m, 2H), 7.67 (m, 2H), 6.58 (s, 1H), 3.79 (s, 3H), 2.40 (s, 3H), 2.36 (s, 3H).

EXAMPLE 6

Preparation of 4-[4-bromo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 87)

Step A Preparation of 3-iodo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazole

A mixture of 3-iodopyrazole (prepared as described in WO2007/035309) (1.0 g, 5.1 mmol), 4-fluorobenzotrifluoride (0.72 mL, 5.7 mmol) and potassium carbonate (0.93g, 6.7 mmol) was stirred in *N,N*-dimethylformamide (10 mL) at 100 °C for 2 h. The mixture was diluted with water (60 mL) and extracted with ethyl acetate (2 x 30 mL). The organic layers were combined, dried over magnesium sulfate and concentrated. The residue after evaporation was subjected to silica gel chromatography (40 g silica) using a gradient of ethyl acetate/chlorobutane (0:100 to 50:50), and appropriate fractions were combined and evaporated to give the title compound (1.27 g).

^{1}H NMR ($CDCl_3$) δ 7.79 (m, 3H), 7.71 (m, 2H), 6.67 (d, 1H).

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

3-Iodo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazole (i.e. the product of Step A) (1.3 g, 2.6 mmol), 5-methoxy-2-methyl-4-trimethylstannyl-2*H*-pyridazin-3-one (prepared as described in *J. Heterocyclic Chem.*, **2005**, *42*, 427) (0.95 g, 3.1 mmol), bis(triphenylphosphine)palladium(II) dichloride (0.36 g, 0.52 mmol) and copper(I) iodide (50 mg, 0.26 mmol) were mixed in dioxane (15 mL) and heated at reflux for 2 h. The reaction mixture was filtered through Celite® diatomaceous filter aid, and the Celite® was washed with ethyl acetate (20 mL). The organics were evaporated and the residue was subjected to silica gel chromatography (40 g silica) using a gradient of ethyl acetate/hexanes

(0:100 to 80:20). The appropriate fractions were combined and evaporated to give the title compound (0.51 g) as a solid.

^{1}H NMR ($CDCl_3$) δ 8.04 (m, 1H), 7.90 (s, 1H), 7.88 (m, 2H), 7.71 (m, 2H), 7.13 (m, 1H), 4.04 (s, 3H), 3.84 (s, 3H).

Step C Preparation of 4-[4-bromo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-5-methoxy-2-methyl-3(2*H*)-pyridazinone

5-Methoxy-2-methyl-4-[1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-3(2*H*)-pyridazinone (i.e. the product of Step B) (0.15 g, 0.43 mmol) and *N*-bromosuccinimide (0.076 g, 0.43 mmol) were dissolved in *N*,*N*-dimethylformamide (5 m L) and stirred at 80 °C for 4 h. *N*-bromosuccinimide (30 mg) was added, and heating was continued for an additional 16 h. The reaction mixture was then diluted with water (40 mL) and extracted with ethyl acetate (3 x 20 mL). The organic extracts were dried over magnesium sulfate and evaporated. The residue was subjected to silica gel chromatography (12 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 80:20). The appropriate fractions were combined and evaporated to give the title compound as a white solid (0.13 g).

^{1}H NMR ($CDCl_3$) δ 8.10 (s, 1H), 7.87 (s, 1H), 7.83-7.68 (m, 4H), 3.94 (s, 3H), 3.84 (s, 3H).

Step D Preparation of 4-[4-bromo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone

4-[4-Bromo-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-5-methoxy-2-methyl-3(2*H*)-pyridazinone (i.e. the product of Step C) (0.13 g, 0.31 mmol) was mixed with dioxane (10 mL), aqueous sodium hydroxide (50 %, 5 mL) and methanol (1 mL). The reaction mixture was heated at 90 °C for 16 h. The reaction mixture was then diluted with water (20 mL) and extracted with ethyl acetate (15 mL). The aqueous layer was then acidified with 6 M hydrochloric acid and extracted with ethyl acetate (3 x 20 mL). The combined organic extracts from the extraction after acidification were dried over magnesium sulfate and evaporated. The residue was subjected to silica gel chromatography (12 g silica) using a gradient of ethyl acetate/hexanes (20:80 to 100:0), and appropriate fractions were combined and evaporated to give the title product, a compound of the present invention, as a solid (0.07 g) melting at 237-241 °C.

^{1}H NMR ($CDCl_3$) δ 8.19 (s, 1H), 7.80 -7.73 (m, 5H), 3.83 (s, 3H).

EXAMPLE 7

Preparation of 5-hydroxy-2-methyl-4-[4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-3(2*H*)-pyridazinone (Compound 85)

Step A Preparation of 3-iodo-4-methyl-1*H*-pyrazole

A solution of 4-methylpyrazole (10.0 g, 122 mmol) in *N*,*N*-dimethylformamide (100 mL) at 23 °C was treated with *N*-iodosuccinimide (27.4 g, 122 mmol) for 18 h. The reaction mixture was diluted with water (100 mL) and then filtered. The filtrate was extracted with

ethyl acetate (3 x 50 mL). The combined organic extracts were washed with brine (100 mL) and dried over magnesium sulfate. The residue after evaporation was subjected to silica gel chromatography (80 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 80:20) and appropriate fractions were combined and evaporated to give 5.39 g of the title compound as a solid.

^{1}H NMR ($CDCl_3$) δ 7.35 (s, 1H), 2.04 (s, 3H).

Step B Preparation of 3-iodo-4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazole

3-Iodo-4-methyl-1*H*-pyrazole (i.e. the product of Step A) (0.50 g, 2.4 mmol), 4-fluorobenzotrifluoride (0.34 mL, 2.6 mmol) and potassium carbonate (0.43 g, 3.1 mmol) were combined with *N*,*N*-dimethylformamide (20 mL) and heated at 100 °C for 2 h. The reaction mixture was diluted with water (50 mL) and extracted with ethyl acetate (2 x 30 mL). The organic layers were combined, dried over magnesium sulfate and concentrated. The residue after evaporation was subjected to silica gel chromatography (12 g silica) using a gradient of ethyl acetate/hexanes (0:100 to 80:20), and appropriate fractions were combined and evaporated to give the title compound (0.32 g).

^{1}H NMR ($CDCl_3$) δ 7.75 (m, 2H), 7.68 (m, 2H), 7.61 (s, 1H), 2.07 (s, 3H).

Step C Preparation of 5-methoxy-2-methyl-4-[4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-3(2*H*)-pyridazinone

3-Iodo-4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazole (i.e. the product of Step B) (0.32 g, 0.76 mmol), 5-methoxy-2-methyl-4-trimethylstannyl-2*H*-pyridazin-3-one (prepared as described in *J. Heterocyclic Chem.*, **2005**, *42*, 427) (0.23 g, 0.9 mmol), bis(triphenylphosphine)palladium(II) dichloride (0.10 g, 0.15 mmol) and copper iodide (10 mg, 0.076 mmol) were mixed in dioxane (10 mL) and heated at reflux for 2 h. The reaction mixture was filtered through Celite®, and the Celite® was washed with ethyl acetate (20 mL). The filtrate was evaporated, and the residue was subjected to silica gel chromatography (12 g silica) using a gradient of ethyl acetate/chlorobutane (0:100 to 100:0), and appropriate fractions combined and evaporated to give the title compound (0.11 g) as a solid.

^{1}H NMR ($CDCl_3$) δ 7.85 (m, 2H), 7.80 (m, 2H), 7.68 (m, 2H), 3.90 (s, 3H), 3.82 (s, 3H), 2.07 (s, 3H).

Step D Preparation of 5-hydroxy-2-methyl-4-[4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-3(2*H*)-pyridazinone

5-Methoxy-2-methyl-4-[4-methyl-1-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-3-yl]-3(2*H*)-pyridazinone (i.e. the product of Step C) (0.10 g, 0.24 mmol) was mixed with dioxane (10 mL), aqueous sodium hydroxide (50%, 4 mL) and methanol (1 mL). The mixture was heated at 90 °C for 31 h. The reaction was diluted with water (20 mL) and extracted with ethyl acetate (15 mL). The aqueous layer was acidified with hydrochloric acid and extracted with ethyl acetate (3 x 20 mL). The combined organic extracts from the extraction after

acidification were dried over magnesium sulfate and evaporated. The residue was subjected to silica gel chromatography (12 g silica) using a gradient of ethyl acetate/hexanes (20:80 to 100:0), and appropriate fractions were combined and evaporated to give the title product, a compound of the present invention, as a solid (0.09 g) melting at 150-154 °C.

^{1}H NMR ($CDCl_3$) δ 7.91 (s, 1H), 7.75 (m, 5H), 3.81 (s, 3H), 2.38 (s, 3H).

EXAMPLE 8

Preparation of 4-[1-(4-chlorophenyl)-4-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone (Compound 30)

Step A Preparation of 5-chloro-2-methyl-4-(1-propyn-1-yl)-3(2*H*)-pyridazinone

A mixture of 1-methyl-4-iodo-5-chloro-2*H*-pyridazin-3-one (prepared as described in *J. Heterocyclic Chem.*, **2005**, *42*, 427) (2.5 g, 9.3 mmol), bis(triphenylphosphine)palladium(II) dichloride (0.13 g) and tributyl(1-propynyl)tin (3.3 g, 10 mmol) in dioxane (12 mL) was heated at reflux for 3 h. The residue after evaporation was subjected to silica gel chromatography (20 g silica) using gradient of ethyl acetate/chlorobutane (0:100 to 10:90), and appropriate fractions were combined and evaporated and then triturated with a mixture of hexanes/diethyl ether (10:1) to give the title compound (1.1 g) as a solid.

^{1}H NMR ($CDCl_3$) δ 7.71 (s, 1H), 3.76 (s, 3H), 2.22 (s, 3H).

Step B Preparation of 4-[1-(4-chlorophenyl)-4-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone

5-Chloro-2-methyl-4-(1-propyn-1-yl)-3(2*H*)-pyridazinone (i.e. the product of Step A) (0.46 g, 2.5 mmol) and 4-chlorophenylsydnone (as prepared as described in *J. Org. Chem.*, **1974**, *39*, 3676) (0.50 g, 2.5 mmol) were mixed in mesitylene (5 mL) and heated at 140 °C for 18 h. The mesitylene was distilled off, and the residue was subjected to silica gel chromatography (20 g silica) using a gradient of ethyl acetate/dichloromethane (5:95 to 30:70), and appropriate fractions were combined and evaporated to give the chloropyridazinone intermediate (0.10 g). The residue was dissolved in a mixture of dioxane (10 mL), aqueous sodium hydroxide (50%, 4 mL) and methanol (1 mL) and then heated at 90 °C for 31 h. The reaction mixture was diluted with water (20 mL) and extracted with ethyl acetate (15 mL). The aqueous layer was then acidified with hydrochloric acid to give a solid, which was collected by filtration. The solid was dissolved in ethyl acetate (20 mL), dried over magnesium sulfate and evaporated to provide 0.061 g of the title product, a compound of the present invention, melting at 147-151 °C.

^{1}H NMR ($CDCl_3$) δ 7.81 (s, 1H), 7.75 (s, 1H), 7.56 (m, 2H), 7.45 (m, 2H), 3.81 (s, 3H), 2.37 (s, 3H).

EXAMPLE 9

Preparation of 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone (Compound 77)

Step A Preparation of 4,5-bis[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone

4,5-Dichloro-2-(tetrahydro-2H-pyran-2-yl)-3(2*H*)-pyridazinone, (0.525 g, 2.11 mmol; prepared as described in *J. Heterocyclic Chem.,* **1995**, *32,* 1473-1476) was added to a mixture of 3-(4-bromophenyl)-5-methyl-1*H*-pyrazole (1.0 g, 4.2 mmol) and potassium carbonate (1.5 g, 11 mmol) in *N*,*N*-dimethylacetamide (7 mL) and heated to 140° C for 16 h. The reaction mixture was then diluted with water and extracted with ethyl acetate. The combined organic extracts were dried over magnesium sulfate, filtered and concentrated to yield 1.38 g of crude product, which was used without purification.

Step B Preparation of 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-methoxy-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone

To a solution of the crude product from Step A (i.e, 4,5-bis[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone) (1.38 g, 2.12 mmol) dissolved in methanol (9 mL) was added 1 mL of a 25 % w/w solution of sodium methoxide in methanol. The mixture was heated at reflux for 1 h and then quenched with 10 mL 1 N hydrochloric acid. The mixture was extracted with ethyl acetate, and the combined organic extracts were dried over magenesium sulfate, filtered and concentrated. The crude residue was purified by silica gel chromatography (0 to 100 % gradient of ethyl acetate in hexanes as eluant) to yield 0.31 g of the title compound as a solid.

^{1}H NMR ($CDCl_3$) δ 7.91 (s, 1H) 7.66 (d, 2H) 7.49 (m, 2H) 6.48 (s, 1H) 6.04 (d, 1H) 4.13 (m, 1H) 3.79 (s, 3H) 3.70 (m, 1H) 2.23 (s, 3H) 2.13 (m, 1H) 2.03 (bs., 1H) 1.67 (m, 4H).

Step C 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone

4-[3-(4-Bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-methoxy-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone (i.e. the product of Step B) (0.29 g, 0.65 mmol) was added to a solution of potassium hydroxide (0.37 g, 6.5 mmol) in dioxane (8 mL) and water (8 mL), which was then heated at reflux for 2 h. The reaction mixture was neutralized with 10 mL 1 N hydrochloric acid and extracted with ethyl acetate yielding (0.28 g) of the title product, a compound of the present invention. $AP^+ = 432$.

EXAMPLE 10

Preparation of 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-3(2*H*)-pyridazinone (Compound 78)

To a solution of 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-2-(tetrahydro-2*H*-pyran-2-yl)-3(2*H*)-pyridazinone (i.e. the product of Example 9, Step C) (0.22

g, 0.52 mmol) in methanol (4.0 mL) was added 0.42 mL of 6 M hydrochloric acid. The reaction mixture was heated at reflux for 2 h and then an additional 0.42 mL of 6 M hydrochloric acid was added, and heating was continued for an additional 3 h. The reaction mixture was cooled and then filtered through a sintered glass frit to provide the title product, a compound of the present invention, as a white solid (0.08 g) melting at 325-335° C (dec.). ^{1}H NMR (DMSO-d_6) δ 13.06 (s, 1H) 12.07 (bs, 1H) 7.87 (s, 1H) 7.72 (d, 2H) 7.59 (d, 2H) 6.68 (s, 1H) 2.10 (s, 3H).

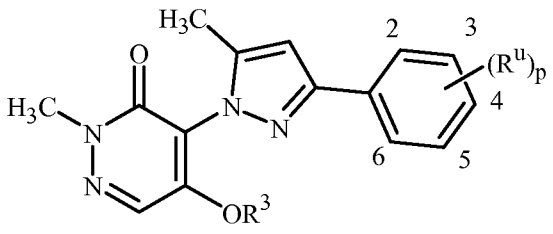
EXAMPLE 11

Preparation of 5-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-1-(cyclopropylcarbonyl)-1,6-dihydro-6-oxo-4-pyridazinyl cyclopropanecarboxylate (Compound 80)

To a solution of 4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-3(2*H*)-pyridazinone (i.e. the product of Example 10) (0.017 g, 0.049 mmol) in dichloromethane (2 mL) was added cyclopropylcarbonyl chloride (0.016 g, 0.16 mmol) and triethylamine (0.022 g, 0.22 mmol). The mixture was stirred for 18 h at room temperature, washed two times with saturated aqueous sodium carbonate solution, dried over magnesium sulfate and concentrated to yield the title compound (0.021 g), a compound of the present invention. ^{1}H NMR ($CDCl_3$) δ 7.96 (s, 1H) 7.66 (m, 2H) 7.51 (m, 2H) 6.48 (s, 1H) 2.88 (m, 1H) 2.71 (m, 1H) 2.32 (s, 3H) 1.69 (m, 2H) 1.19 (m, 4H) 1.03 (m, 2H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1A to 11 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, *i*-Pr means isopropyl, Bu means butyl, Ph means phenyl, CS means thiocarbonyl (C(S)), CO means carbonyl (C(O)), CO_2 means carbonyloxy (C(O)O), SO means sulfinyl (S(O)), SO_2 means sulfonyl ($S(O)_2$), NO_2 means nitro, OMe means methoxy, OEt means ethoxy, SMe means methylthio, CN and -CN mean cyano, Ph means phenyl, Py means pyridinyl, TMS means trimethylsilyl, S(O)Me means methylsulfinyl, thien means thiophene, and $S(O)_2$Me means methylsulfonyl. In the Tables, "$(R^u)_p$" denotes up to 5 instances of the substituent R^u as listed in the Tables.

TABLE 1A



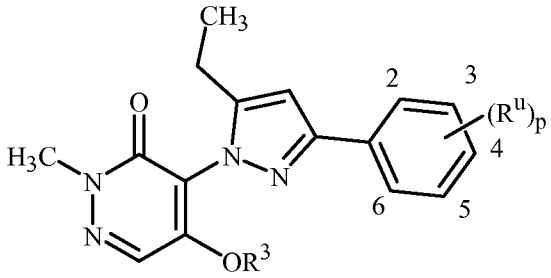
R^3 is H.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^3 is CO_2-*i*-Pr.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

TABLE 1B



R^3 is H.

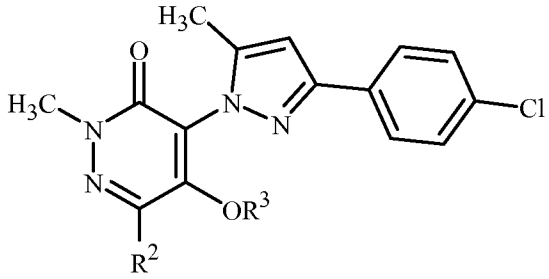
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^3 is CO_2-*i*-Pr.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-CHO	4-OCOMe	4-$SiMe_3$
4-Cl	4-CF_2H	4-SMe	4-NH_2
4-Br	4-Me	4-SCF_3	4-NMe_2
4-I	4-Et	4-SCF_2H	4-NHCOMe
4-CF_3	4-CH=CH_2	4-SOMe	4-NHCOOMe
4-CN	4-C≡ CH	4-SO_2Me	4-$NHSO_2$Me
4-NO_2	4-COMe	4-$SOCF_3$	4-Ph
4-OH	4-$COCF_3$	4-$SOCF_2H$	4-Pyridin-2-yl
4-OMe	4-COOMe	4-SO_2CF_3	4-Pyridin-3-yl
4-OCF_3	4-$CONH_2$	4-SO_2CF_2H	4-Pyridin-4-yl
4-OCF_2H	4-CONHMe	4-SO_2NH_2	4-Thien-2-yl
4-OCF_2CF_2H	4-$CONMe_2$	4-SO_2NMe_2	4-SF_5

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
2-Cl	2-F	2,4-di-Cl	3,4-di-F
3-Cl	3-F	3,4-di-Cl	

TABLE 1C



R^2 is H.

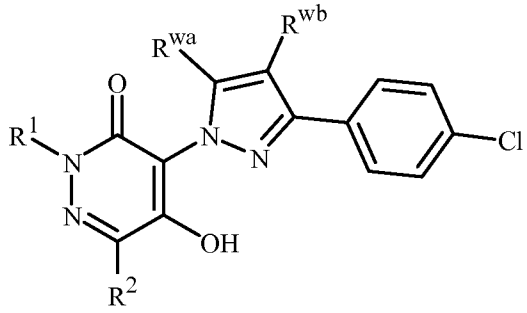
R^3	R^3	R^3	R^3
COMe	COO-*i*-Pr	$SO_2CH=CF_2$	PO(Et)OEt
$COCH=CH_2$	COO-*t*-Bu	SO_2-*c*-Pentyl	$PS(OEt)_2$
$COC\equiv CH$	COO-*i*-Bu	SO_2-*c*-Pr	PS(Me)OEt
$COCF_3$	CSSMe	SO_2-(2,2-di-Cl-*c*-Pr)	PS(Me)SMe
$COCH_2CH=CF_2$	COSMe	SO_2-(1-Me-*c*-Pr)	PO(Me)SMe
CO-*c*-Pentyl	CSOMe	SO_2-*c*-(3-hexen-1-yl)	$PO(OMe)_2$
CO-*c*-Pr	$COOCH_2CH=CH_2$	$SO_2CH_2CH_2OMe$	$PS(OMe)_2$
CO-(2,2-di-Cl-*c*-Pr)	$COOCH_2C\equiv CH$	$SO_2CH_2CH_2SMe$	$PO(NMe_2)_2$
CO-(1-Me-*c*-Pr)	$COCH_2CF_3$	$SO_2CH_2CH_2SOMe$	$PS(NMe_2)_2$
CO-*c*-(3-hexen-1-yl)	$COOCH_2CH=CF_2$	$SO_2CH_2CH_2SO_2Me$	CO-2-Cl-Ph
$COCH_2CH_2OMe$	COO-*c*-Pentyl	$SO_2CH_2CH_2NMe_2$	CO-3-Cl-Ph
$COCH_2CH_2SMe$	$COOCH_2$-*c*-Pr	SO_2Et	CO-4-Cl-Ph
$COCH_2CH_2SOMe$	$COCH_2$-(2,2-di-Cl-*c*-Pr)	SO_2-*n*-Pr	CO-2-F-Ph
$COCH_2CH_2SO_2Me$		SO_2-*i*-Pr	CO-3-F-Ph
$COCH_2CH_2NMe_2$	$COCH_2$-(1-Me-*c*-Pr)	SO_2-*t*-Bu	CO-4-F-Ph
COEt	COO-*c*-(3-hexen-1-yl)	SO_2-*i*-Bu	CO-2-CF_3-Ph
CO-*n*-Pr	$COOCH_2CH_2OMe$	$SO_2CH_2C(CH_3)_3$	CO-3-CF_3-Ph
CO-*i*-Pr	$COOCH_2CH_2SMe$	SO_2Ph	CO-4-CF_3-Ph
CO-*t*-Bu	$COOCH_2CH_2SOMe$	SO_2CH_2Ph	SO_2-2-Cl-Ph
CO-*i*-Bu	$COOCH_2CH_2SO_2Me$	SO_2NHMe	SO_2-3-Cl-Ph
$COCH_2C(CH_3)_3$	$COOCH_2CH_2NMe_2$	$SO_2NHCH_2CF_3$	SO_2-4-Cl-Ph
COPh	SO_2Me	SO_2NMe_2	SO_2-2-F-Ph
$COCH_2Ph$	$SO_2CH=CH_2$	SO_2NH-*c*-Pr	SO_2-3-F-Ph
COOMe	$SO_2C\equiv CH$	$PO(OEt)_2$	SO_2-4-F-Ph
COOEt	SO_2CF_3	PO(Me)OEt	SO_2-2-CF_3-Ph

R^3	R^3	R^3
SO_2-3-CF_3-Ph	CO-2-OMe-Ph	CO-4-OMe-Ph
SO_2-4-CF_3-Ph	CO-3-OMe-Ph	

R^2 is CH_3.

R^3	R^3	R^3	R^3
COMe	COO-*i*-Bu	SO_2-(1-Me-*c*-Pr)	$PS(OMe)_2$
$COCH=CH_2$	CSSMe	SO_2-*c*-(3-hexen-1-yl)	$PO(NMe_2)_2$
$COC\equiv CH$	COSMe	$SO_2CH_2CH_2OMe$	$PS(NMe_2)_2$
$COCF_3$	CSOMe	$SO_2CH_2CH_2SMe$	CO-2-Cl-Ph
$COCH_2CH=CF_2$	$COOCH_2CH=CH_2$	$SO_2CH_2CH_2SOMe$	CO-3-Cl-Ph
CO-*c*-Pentyl	$COOCH_2C\equiv CH$	$SO_2CH_2CH_2SO_2Me$	CO-4-Cl-Ph
CO-*c*-Pr	$COCH_2CF_3$	$SO_2CH_2CH_2NMe_2$	CO-2-F-Ph
CO-(2,2-di-Cl-*c*-Pr)	$COOCH_2CH=CF_2$	SO_2Et	CO-3-F-Ph
CO-(1-Me-*c*-Pr)	COO-*c*-Pentyl	SO_2-*n*-Pr	CO-4-F-Ph
CO-*c*-(3-hexen-1-yl)	$COOCH_2$-*c*-Pr	SO_2-*i*-Pr	CO-2-CF_3-Ph
$COCH_2CH_2OMe$	$COCH_2$-(2,2-di-Cl-*c*-Pr)	SO_2-*t*-Bu	CO-3-CF_3-Ph
$COCH_2CH_2SMe$		SO_2-*i*-Bu	CO-4-CF_3-Ph
$COCH_2CH_2SOMe$	$COCH_2$-(1-Me-*c*-Pr)	$SO_2CH_2C(CH_3)_3$	SO_2-2-Cl-Ph
$COCH_2CH_2SO_2Me$	COO-*c*-(3-hexen-1-yl)	SO_2Ph	SO_2-3-Cl-Ph
$COCH_2CH_2NMe_2$	$COOCH_2CH_2OMe$	SO_2CH_2Ph	SO_2-4-Cl-Ph
COEt	$COOCH_2CH_2SMe$	SO_2NHMe	SO_2-2-F-Ph
CO-*n*-Pr	$COOCH_2CH_2SOMe$	$SO_2NHCH_2CF_3$	SO_2-3-F-Ph
CO-*i*-Pr	$COOCH_2CH_2SO_2Me$	SO_2NMe_2	SO_2-4-F-Ph
CO-*t*-Bu	$COOCH_2CH_2NMe_2$	SO_2NH-*c*-Pr	SO_2-2-CF_3-Ph
CO-*i*-Bu	SO_2Me	$PO(OEt)_2$	SO_2-3-CF_3-Ph
$COCH_2C(CH_3)_3$	$SO_2CH=CH_2$	PO(Me)OEt	SO_2-4-CF_3-Ph
COPh	$SO_2C\equiv CH$	PO(Et)OEt	CO-2-OMe-Ph
$COCH_2Ph$	SO_2CF_3	$PS(OEt)_2$	CO-3-OMe-Ph
COOMe	$SO_2CH=CF_2$	PS(Me)OEt	CO-4-OMe-Ph
COOEt	SO_2-*c*-Pentyl	PS(Me)SMe	
COO-*i*-Pr	SO_2-*c*-Pr	PO(Me)SMe	
COO-*t*-Bu	SO_2-(2,2-di-Cl-*c*-Pr)	$PO(OMe)_2$	

TABLE 1D



R^1	R^2	R^{wa}	R^{wb}	R^1	R^2	R^{wa}	R^{wb}
Me	Et	Me	H	$CH_2C\equiv CH$	H	Me	H
Me	*n*-Pr	Me	H	CH_2CF_3	H	Me	H
Me	*i*-Pr	Me	H	*c*-Pr	H	Me	H
Me	*i*-Bu	Me	H	CH_2-*c*-Pr	H	Me	H
Me	*t*-Bu	Me	H	*c*-(3-hexen-1-yl)	H	Me	H
Me	*n*-Bu	Me	H	CH_2CH_2OMe	H	Me	H
Me	*c*-Pr	Me	H	CH_2OMe	H	Me	H
Me	$CH_2CH=CH_2$	Me	H	CH_2CH_2SMe	H	Me	H
Me	$C\equiv CH$	Me	H	CH_2CH_2SOMe	H	Me	H
Me	F	Me	H	$CH_2CH_2SO_2Me$	H	Me	H
Me	Cl	Me	H	Me	H	Me	Me
Me	Br	Me	H	Me	H	Me	Cl
Me	CN	Me	H	Me	H	Me	Br
Me	$CONH_2$	Me	H	Me	H	Me	F
Me	COOMe	Me	H	Me	H	Me	CF_3
Me	CH_2OMe	Me	H	Me	H	Me	H
Me	CH_2SMe	Me	H	Me	H	Me	CN
Me	CH_2SOMe	Me	H	Me	H	Me	NO_2
Me	CH_2SO_2Me	Me	H	Me	H	Me	SMe
Me	OMe	Me	H	Me	H	Me	SCF_3
Me	OEt	Me	H	Me	H	H	H
Me	OCF_2H	Me	H	Me	H	Et	H
Me	SMe	Me	H	Me	H	*n*-Pr	H
Me	SCH_2CF_3	Me	H	Me	H	*c*-Pr	H
H	H	Me	H	Me	H	*i*-Pr	H
Et	H	Me	H	Me	H	F	H
n-Pr	H	Me	H	Me	H	Cl	H
$CH_2CH=CH_2$	H	Me	H	Me	H	Br	H

R^1	R^2	R^{wa}	R^{wb}
Me	H	CN	H
Me	H	SMe	H
Me	H	CF_3	H
Me	H	Et	Me
Me	H	*n*-Pr	Me
Me	H	*i*-Pr	Me
Me	H	*i*-Bu	Me
Me	H	*t*-Bu	Me
Me	H	*n*-Bu	Me
Me	H	*c*-Pr	Me
Me	H	F	Me
Me	H	Cl	Me
Me	H	Br	Me
Me	H	CN	Me
Me	H	SMe	Me
Me	H	CF_3	Me
Me	H	OMe	Me
Me	H	Et	Cl
Me	H	*n*-Pr	Cl
Me	H	*i*-Pr	Cl
Me	H	*i*-Bu	Cl
Me	H	*t*-Bu	Cl
Me	H	*n*-Bu	Cl
Me	H	*c*-Pr	Cl
Me	H	F	Cl
Me	H	Cl	Cl
Me	H	Br	Cl
Me	H	CN	Cl
Me	H	SMe	Cl
Me	H	CF_3	Cl
Me	H	OMe	Cl
Me	H	Et	F
Me	H	*n*-Pr	F
Me	OMe	Et	H
Me	OMe	*n*-Pr	H
Me	OMe	*c*-Pr	H
Me	OMe	Cl	H
Me	OMe	Br	H
Me	OMe	Et	Me
Me	OMe	Me	Me
Me	OEt	Et	H
Me	OEt	Et	Me
Me	NO_2	Et	H
Me	NO_2	Me	H
Me	F	Et	H
Me	Cl	Et	H
Me	Br	Et	H
Et	H	Et	H
Et	H	*n*-Pr	H
Et	H	*i*-Pr	H
Et	H	*i*-Bu	H
Et	H	*t*-Bu	H
Et	H	*n*-Bu	H
Et	H	*c*-Pr	H
Et	H	F	H
Et	H	Cl	H
Et	H	Br	H
Et	H	Et	Me
H	H	Et	H
H	H	*n*-Pr	H
H	H	*i*-Pr	H
H	H	*i*-Bu	H
H	H	*t*-Bu	H
H	H	*n*-Bu	H
H	H	*c*-Pr	H
H	H	F	H
H	H	Cl	H
H	H	Br	H
H	H	Et	Me

TABLE 1E

Table 1E is constructed the same as Table 1D, except that the chemical structure under the Table 1D heading is replaced with the following structure:

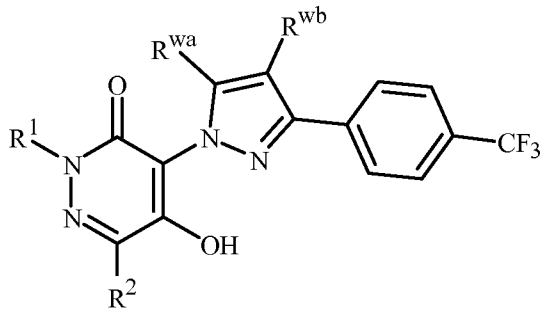


TABLE 1F

Table 1F is constructed the same as Table 1D, except that the chemical structure under the Table 1D heading is replaced with the following structure:

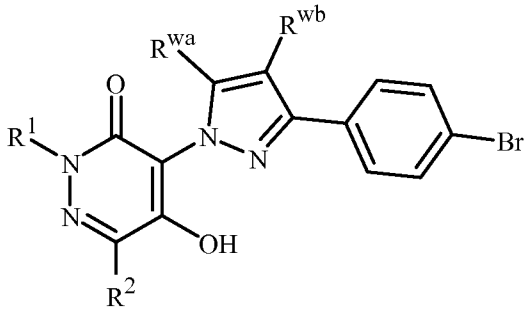
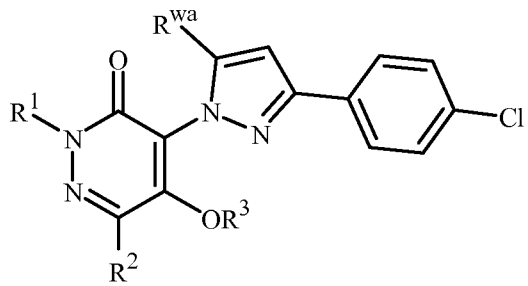


TABLE 1G



R^2 is H.

R^1	R^3	R^{wa}	R^1	R^3	R^{wa}
COEt	COEt	Et	CO-*i*-Bu	CO-*i*-Bu	Et
CO-*n*-Pr	CO-*n*-Pr	Et	$COCH_2C(CH_3)_3$	$COCH_2C(CH_3)_3$	Et
CO-*i*-Pr	CO-*i*-Pr	Et	COPh	COPh	Et
CO-*t*-Bu	CO-*t*-Bu	Et	COOMe	COOMe	Et

R^1	R^3	R^{wa}
COOEt	COOEt	Et
COO-*i*-Pr	COO-*i*-Pr	Et
COO-*t*-Bu	COO-*t*-Bu	Et
COO-*i*-Bu	COO-*i*-Bu	Et
$COCH_2CF_3$	$COCH_2CF_3$	Et
SO_2Me	SO_2Me	Et
SO_2CF_3	SO_2CF_3	Et
SO_2-*c*-Pr	SO_2-*c*-Pr	Et
SO_2Et	SO_2Et	Et
SO_2-*n*-Pr	SO_2-*n*-Pr	Et
SO_2-*i*-Pr	SO_2-*i*-Pr	Et
SO_2-*t*-Bu	SO_2-*t*-Bu	Et
SO_2-*i*-Bu	SO_2-*i*-Bu	Et
$SO_2CH_2C(CH_3)_3$	$SO_2CH_2C(CH_3)_3$	Et
SO_2Ph	SO_2Ph	Et
SO_2NMe_2	SO_2NMe_2	Et
$PO(OEt)_2$	$PO(OEt)_2$	Et
PO(Me)OEt	PO(Me)OEt	Et
$PS(OEt)_2$	$PS(OEt)_2$	Et
$PO(OMe)_2$	$PO(OMe)_2$	Et
H	COEt	Et
H	CO-*n*-Pr	Et
H	CO-*i*-Pr	Et
H	CO-*t*-Bu	Et
H	CO-*i*-Bu	Et
H	$COCH_2C(CH_3)_3$	Et
H	COPh	Et
H	COOMe	Et
H	COOEt	Et
H	COO-*i*-Pr	Et
H	COO-*t*-Bu	Et
H	COO-*i*-Bu	Et
H	$COCH_2CF_3$	Et
H	SO_2Me	Et
H	SO_2CF_3	Et
H	SO_2-*c*-Pr	Et
H	SO_2Et	Et

R^1	R^3	R^{wa}
H	SO_2-*n*-Pr	Et
H	SO_2-*i*-Pr	Et
H	SO_2-*t*-Bu	Et
H	SO_2-*i*-Bu	Et
H	$SO_2CH_2C(CH_3)_3$	Et
H	SO_2Ph	Et
H	SO_2NMe_2	Et
H	$PO(OEt)_2$	Et
H	PO(Me)OEt	Et
H	$PS(OEt)_2$	Et
H	$PO(OMe)_2$	Et
COEt	COEt	Me
CO-*n*-Pr	CO-*n*-Pr	Me
CO-*i*-Pr	CO-*i*-Pr	Me
CO-*t*-Bu	CO-*t*-Bu	Me
CO-*i*-Bu	CO-*i*-Bu	Me
$COCH_2C(CH_3)_3$	$COCH_2C(CH_3)_3$	Me
COPh	COPh	Me
COOMe	COOMe	Me
COOEt	COOEt	Me
COO-*i*-Pr	COO-*i*-Pr	Me
COO-*t*-Bu	COO-*t*-Bu	Me
COO-*i*-Bu	COO-*i*-Bu	Me
$COCH_2CF_3$	$COCH_2CF_3$	Me
SO_2Me	SO_2Me	Me
SO_2CF_3	SO_2CF_3	Me
SO_2-*c*-Pr	SO_2-*c*-Pr	Me
SO_2Et	SO_2Et	Me
SO_2-*n*-Pr	SO_2-*n*-Pr	Me
SO_2-*i*-Pr	SO_2-*i*-Pr	Me
SO_2-*t*-Bu	SO_2-*t*-Bu	Me
SO_2-*i*-Bu	SO_2-*i*-Bu	Me
$SO_2CH_2C(CH_3)_3$	$SO_2CH_2C(CH_3)_3$	Me
SO_2Ph	SO_2Ph	Me
SO_2NMe_2	SO_2NMe_2	Me
$PO(OEt)_2$	$PO(OEt)_2$	Me
PO(Me)OEt	PO(Me)OEt	Me

R^1	R^3	R^{wa}	R^1	R^3	R^{wa}
$PS(OEt)_2$	$PS(OEt)_2$	Me	H	SO_2Me	Me
$PO(OMe)_2$	$PO(OMe)_2$	Me	H	SO_2CF_3	Me
H	COEt	Me	H	SO_2-*c*-Pr	Me
H	CO-*n*-Pr	Me	H	SO_2Et	Me
H	CO-*i*-Pr	Me	H	SO_2-*n*-Pr	Me
H	CO-*t*-Bu	Me	H	SO_2-*i*-Pr	Me
H	CO-*i*-Bu	Me	H	SO_2-*t*-Bu	Me
H	$COCH_2C(CH_3)_3$	Me	H	SO_2-*i*-Bu	Me
H	COPh	Me	H	$SO_2CH_2C(CH_3)_3$	Me
H	COOMe	Me	H	SO_2Ph	Me
H	COOEt	Me	H	SO_2NMe_2	Me
H	COO-*i*-Pr	Me	H	$PO(OEt)_2$	Me
H	COO-*t*-Bu	Me	H	PO(Me)OEt	Me
H	COO-*i*-Bu	Me	H	$PS(OEt)_2$	Me
H	$COCH_2CF_3$	Me	H	$PO(OMe)_2$	Me

TABLE 1GA

Table 1GA is constructed the same as Table 1G, except that "R^2 is H." below the chemical structure under the Table 1G heading is replaced with "R^2 is Me.".

TABLE 1GB

Table 1GB is constructed the same as Table 1G, except that "R^2 is H." below the chemical structure under the Table 1G heading is replaced with "R^2 is OMe.".

TABLE 1H

Table 1H is constructed the same as Table 1G, except that the chemical structure under the Table 1G heading is replaced with the following structure:

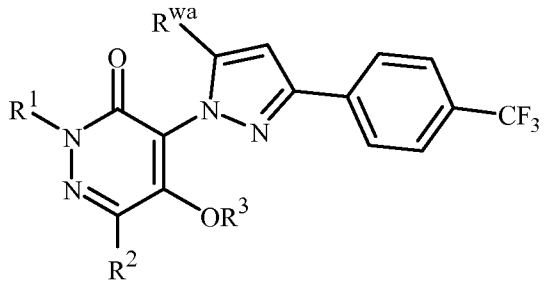


TABLE 1HA

Table 1HA is constructed the same as Table 1H, except that "R^2 is H." is replaced with "R^2 is Me.".

TABLE 1HB

Table 1HB is constructed the same as Table 1H, except that "R^2 is H." is replaced with "R^2 is OMe.".

TABLE 1I

Table 1I is constructed the same as Table 1G, except that the chemical structure under the Table 1G heading is replaced with the following structure:

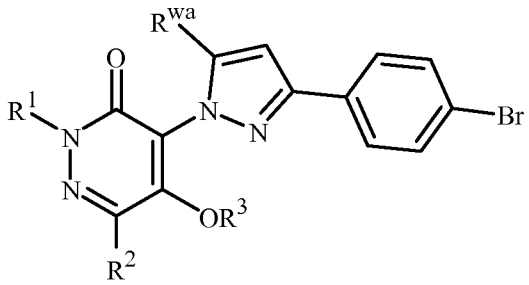


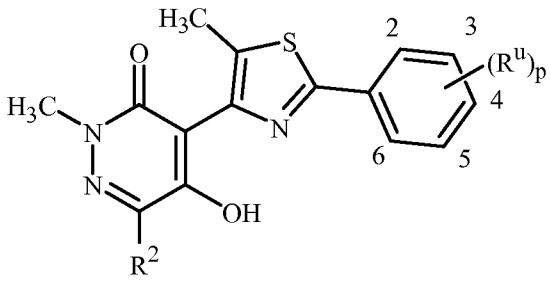
TABLE 1IA

Table 1IA is constructed the same as Table 1I, except that "R^2 is H." is replaced with "R^2 is Me.".

TABLE 1IB

Table 1IB is constructed the same as Table 1I, except that "R^2 is H." is replaced with "R^2 is OMe.".

TABLE 2A



R^2 is H.

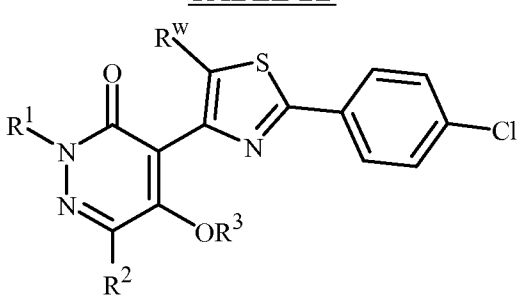
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Br	4-CF_3	4-NO_2
4-Cl	4-I	4-CN	4-OH

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-OMe	4-COOMe	4-SO_2CF_3	4-Pyridin-3-yl
4-OCF_3	4-$CONH_2$	4-SO_2CF_2H	4-Pyridin-4-yl
4-OCF_2H	4-CONHMe	4-SO_2NH_2	4-Thien-2-yl
4-OCF_2CF_2H	4-$CONMe_2$	4-SO_2NMe_2	4-SF_5
4-CHO	4-OCOMe	4-$SiMe_3$	2-Cl
4-CF_2H	4-SMe	4-NH_2	3-Cl
4-Me	4-SCF_3	4-NMe_2	2-F
4-Et	4-SCF_2H	4-NHCOMe	3-F
4-$CH=CH_2$	4-SOMe	4-NHCOOMe	2,4-di-Cl
4-C≡ CH	4-SO_2Me	4-$NHSO_2Me$	3,4-di-Cl
4-COMe	4-$SOCF_3$	4-Ph	3,4-di-F
4-$COCF_3$	4-$SOCF_2H$	4-Pyridin-2-yl	

R^2 is CH_3.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-$CH=CH_2$	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2Me$	

TABLE 2B



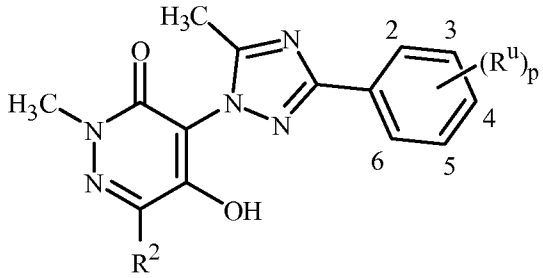
R^1 is Me and R^W is Me.

R^2	R^3	R^2	R^3
H	COMe	*n*-Bu	H
H	$COCH=CH_2$	*c*-Pr	H
H	$COC\equiv CH$	$CH_2CH=CH_2$	H
H	$COCF_3$	$C\equiv CH$	H
H	$COCH_2CH=CF_2$	F	H
H	CO-*c*-Pentyl	Cl	H
H	CO-*c*-Pr	Br	H
H	CO-(2,2-di-Cl-*c*-Pr)	-CN	H
H	CO-(1-Me-*c*-Pr)	$CONH_2$	H
H	CO-*c*-(3-hexen-1-yl)	COOMe	H
H	$COCH_2CH_2OMe$	CH_2OMe	H
H	$COCH_2CH_2SMe$	CH_2SMe	H
H	$COCH_2CH_2SOMe$	CH_2SOMe	H
H	$COCH_2CH_2SO_2Me$	CH_2SO_2Me	H
H	$COCH_2CH_2NMe_2$	OMe	H
Et	H	OEt	H
n-Pr	H	OCF_2H	H
i-Pr	H	SMe	H
i-Bu	H	SCH_2CF_3	H
t-Bu	H		

R^2 is H and R^3 is H.

R^1	R^W	R^1	R^W	R^1	R^W
H	Me	CH_2CH_2OMe	Me	Me	*i*-Pr
Et	Me	CH_2OMe	Me	Me	F
n-Pr	Me	CH_2CH_2SMe	Me	Me	Cl
$CH_2CH=CH_2$	Me	CH_2CH_2SOMe	Me	Me	Br
$CH_2C\equiv CH$	Me	$CH_2CH_2SO_2Me$	Me	Me	-CN
CH_2CF_3	Me	Me	H	Me	SMe
c-Pr	Me	Me	Et	Me	CF_3
CH_2-*c*-Pr	Me	Me	*n*-Pr		
c-(3-hexen-1-yl)	Me	Me	*c*-Pr		

TABLE 3A



R^2 is H.

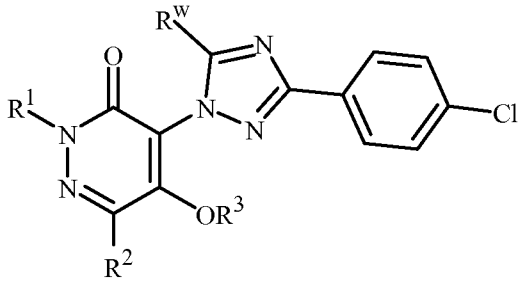
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^2 is CH_3.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-CHO	4-OCOMe	4-$SiMe_3$
4-Cl	4-CF_2H	4-SMe	4-NH_2
4-Br	4-Me	4-SCF_3	4-NMe_2
4-I	4-Et	4-SCF_2H	4-NHCOMe
4-CF_3	4-CH=CH_2	4-SOMe	4-NHCOOMe
4-CN	4-C≡ CH	4-SO_2Me	4-$NHSO_2$Me
4-NO_2	4-COMe	4-$SOCF_3$	4-Ph
4-OH	4-$COCF_3$	4-$SOCF_2H$	4-Pyridin-2-yl
4-OMe	4-COOMe	4-SO_2CF_3	4-Pyridin-3-yl
4-OCF_3	4-$CONH_2$	4-SO_2CF_2H	4-Pyridin-4-yl
4-OCF_2H	4-CONHMe	4-SO_2NH_2	4-Thien-2-yl
4-OCF_2CF_2H	4-$CONMe_2$	4-SO_2NMe_2	4-SF_5

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
2-Cl	2-F	2,4-di-Cl	3,4-di-F
3-Cl	3-F	3,4-di-Cl	

TABLE 3B



R^1 is Me and R^W is Me.

R^1	R^2	R^3	R^W	R^1	R^2	R^3	R^W
Me	H	COMe	Me	Me	*n*-Bu	H	Me
Me	H	$COCH=CH_2$	Me	Me	*c*-Pr	H	Me
Me	H	$COC\equiv CH$	Me	Me	$CH_2CH=CH_2$	H	Me
Me	H	$COCF_3$	Me	Me	$C\equiv CH$	H	Me
Me	H	$COCH_2CH=CF_2$	Me	Me	F	H	Me
Me	H	CO-*c*-Pentyl	Me	Me	Cl	H	Me
Me	H	CO-*c*-Pr	Me	Me	Br	H	Me
Me	H	CO-(2,2-di-Cl-*c*-Pr)	Me	Me	-CN	H	Me
Me	H	CO-(1-Me-*c*-Pr)	Me	Me	$CONH_2$	H	Me
Me	H	CO-*c*-(3-hexen-1-yl)	Me	Me	COOMe	H	Me
Me	H	$COCH_2CH_2OMe$	Me	Me	CH_2OMe	H	Me
Me	H	$COCH_2CH_2SMe$	Me	Me	CH_2SMe	H	Me
Me	H	$COCH_2CH_2SOMe$	Me	Me	CH_2SOMe	H	Me
Me	H	$COCH_2CH_2SO_2Me$	Me	Me	CH_2SO_2Me	H	Me
Me	H	$COCH_2CH_2NMe_2$	Me	Me	OMe	H	Me
Me	Et	H	Me	Me	OEt	H	Me
Me	*n*-Pr	H	Me	Me	OCF_2H	H	Me
Me	*i*-Pr	H	Me	Me	SMe	H	Me
Me	*i*-Bu	H	Me	Me	SCH_2CF_3	H	Me
Me	*t*-Bu	H	Me				

R^2 is H and R^3 is H.

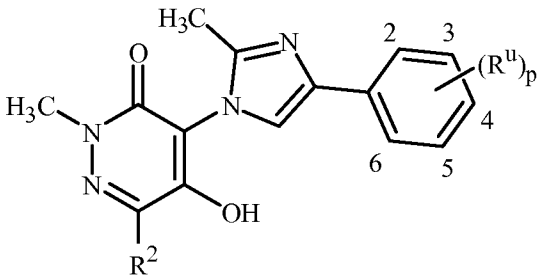
R^1	R^W	R^1	R^W	R^1	R^W
H	Me	*n*-Pr	Me	$CH_2C\equiv CH$	Me
Et	Me	$CH_2CH=CH_2$	Me	CH_2CF_3	Me

R^1	R^W
c-Pr	Me
CH_2-*c*-Pr	Me
c-(3-hexen-1-yl)	Me
CH_2CH_2OMe	Me
CH_2OMe	Me
CH_2CH_2SMe	Me
CH_2CH_2SOMe	Me

R^1	R^W
$CH_2CH_2SO_2Me$	Me
Me	H
Me	Et
Me	*n*-Pr
Me	*c*-Pr
Me	*i*-Pr
Me	F

R^1	R^W
Me	Cl
Me	Br
Me	CN
Me	SMe
Me	CF_3
Et	Me

TABLE 4A



R^2 is H.

$(R^u)_p$
4-F
4-Cl
4-Br
4-I
4-CF_3
4-CN
4-NO_2
4-OH
4-OMe
4-OCF_3
4-OCF_2H
4-OCF_2CF_2H
4-CHO
4-CF_2H

$(R^u)_p$
4-Me
4-Et
4-$CH{=}CH_2$
4-C≡ CH
4-COMe
4-$COCF_3$
4-COOMe
4-$CONH_2$
4-CONHMe
4-$CONMe_2$
4-OCOMe
4-SMe
4-SCF_3
4-SCF_2H

$(R^u)_p$
4-SOMe
4-SO_2Me
4-$SOCF_3$
4-$SOCF_2H$
4-SO_2CF_3
4-SO_2CF_2H
4-SO_2NH_2
4-SO_2NMe_2
4-$SiMe_3$
4-NH_2
4-NMe_2
4-NHCOMe
4-NHCOOMe
4-$NHSO_2Me$

$(R^u)_p$
4-Ph
4-Pyridin-2-yl
4-Pyridin-3-yl
4-Pyridin-4-yl
4-Thien-2-yl
4-SF_5
2-Cl
3-Cl
2-F
3-F
2,4-di-Cl
3,4-di-Cl
3,4-di-F

R^2 is CH_3.

$(R^u)_p$
4-F
4-Cl
4-Br

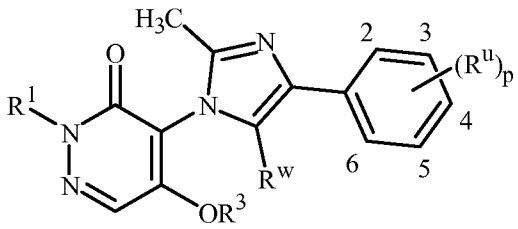
$(R^u)_p$
4-I
4-CF_3
4-CN

$(R^u)_p$
4-NO_2
4-OH
4-OMe

$(R^u)_p$
4-OCF_3
4-OCF_2H
4-OCF_2CF_2H

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-CHO	4-$CONMe_2$	4-SO_2NH_2	4-Pyridin-4-yl
4-CF_2H	4-OCOMe	4-SO_2NMe_2	4-Thien-2-yl
4-Me	4-SMe	4-$SiMe_3$	4-SF_5
4-Et	4-SCF_3	4-NH_2	2-Cl
4-$CH=CH_2$	4-SCF_2H	4-NMe_2	3-Cl
4-C≡ CH	4-SOMe	4-NHCOMe	2-F
4-COMe	4-SO_2Me	4-NHCOOMe	3-F
4-$COCF_3$	4-$SOCF_3$	4-$NHSO_2Me$	2,4-di-Cl
4-COOMe	4-$SOCF_2H$	4-Ph	3,4-di-Cl
4-$CONH_2$	4-SO_2CF_3	4-Pyridin-2-yl	3,4-di-F
4-CONHMe	4-SO_2CF_2H	4-Pyridin-3-yl	

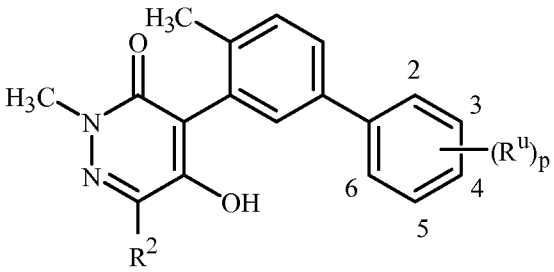
TABLE 4B



R^1	R^3	R^w	$(R^u)_p$	R^1	R^3	R^w	$(R^u)_p$
Me	H	Me	4-Cl	Me	H	Me	2-Cl
Me	H	Me	4-F	Me	H	Me	3-Cl
Me	H	Me	4-Br	Me	H	Me	2-F
Me	H	Me	4-CF_3	Me	H	Me	3-F
Me	H	Me	4-CN	Me	H	Me	2,4-di-Cl
Me	H	Me	4-NO_2	Me	H	Me	3,4-di-Cl
Me	H	Me	4-OMe	Me	H	Me	3,4-di-F
Me	H	Me	4-OCF_3	Me	COEt	H	4-Cl
Me	H	Me	4-OCF_2H	Me	CO-*n*-Pr	H	4-Cl
Me	H	Me	4-OCF_2CF_2H	Me	CO-*i*-Pr	H	4-Cl
Me	H	Me	4-CHO	Me	CO-*t*-Bu	H	4-Cl
Me	H	Me	4-CF_2H	Me	CO-*i*-Bu	H	4-Cl
Me	H	Me	4-Me	Me	$COCH_2C(CH_3)_3$	H	4-Cl
Me	H	Me	4-Et	Me	COPh	H	4-Cl
Me	H	Me	4-SMe	Me	COOMe	H	4-Cl
Me	H	Me	4-SCF_3	Me	COOEt	H	4-Cl
Me	H	Me	4-SCF_2H	Me	COO-*i*-Pr	H	4-Cl

R^1	R^3	R^W	$(R^u)_p$
Me	COO-*t*-Bu	H	4-Cl
Me	COO-*i*-Bu	H	4-Cl
Me	$COCH_2CF_3$	H	4-Cl
Me	SO_2Me	H	4-Cl
Me	SO_2CF_3	H	4-Cl
Me	SO_2-*c*-Pr	H	4-Cl
Me	SO_2Et	H	4-Cl
Me	SO_2-*n*-Pr	H	4-Cl
Me	SO_2-*i*-Pr	H	4-Cl
Me	SO_2-*t*-Bu	H	4-Cl
Me	SO_2-*i*-Bu	H	4-Cl
Me	$SO_2CH_2C(CH_3)_3$	H	4-Cl
Me	SO_2Ph	H	4-Cl
Me	SO_2NMe_2	H	4-Cl
Me	$PO(OEt)_2$	H	4-Cl
Me	PO(Me)OEt	H	4-Cl
Me	$PS(OEt)_2$	H	4-Cl
Me	$PO(OMe)_2$	H	4-Cl
Et	H	H	4-Cl

TABLE 5A



R^2 is H.

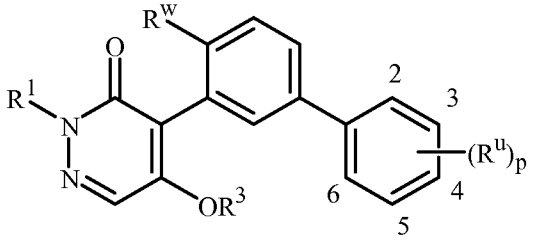
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	$4-SO_2Me$	4-Pyridin-2-yl
4-Br	$4-CH=CH_2$	$4-SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡CH	$4-SOCF_2H$	4-Pyridin-4-yl
$4-CF_3$	4-COMe	$4-SO_2CF_3$	4-Thien-2-yl
4-CN	$4-COCF_3$	$4-SO_2CF_2H$	$4-SF_5$
$4-NO_2$	4-COOMe	$4-SO_2NH_2$	2-Cl
4-OH	$4-CONH_2$	$4-SO_2NMe_2$	3-Cl
4-OMe	4-CONHMe	$4-SiMe_3$	2-F
$4-OCF_3$	$4-CONMe_2$	$4-NH_2$	3-F
$4-OCF_2H$	4-OCOMe	$4-NMe_2$	2,4-di-Cl
$4-OCF_2CF_2H$	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	$4-SCF_3$	4-NHCOOMe	3,4-di-F
$4-CF_2H$	$4-SCF_2H$	$4-NHSO_2Me$	

R^2 is CH_3.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

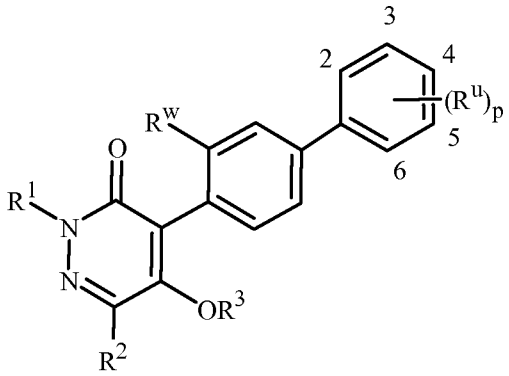
TABLE 5B



R^1	R^3	R^W	$(R^u)_p$	R^1	R^3	R^W	$(R^u)_p$
Me	COEt	Me	4-Cl	Me	SO_2Me	Me	4-Cl
Me	CO-*n*-Pr	Me	4-Cl	Me	SO_2CF_3	Me	4-Cl
Me	CO-*i*-Pr	Me	4-Cl	Me	SO_2-*c*-Pr	Me	4-Cl
Me	CO-*t*-Bu	Me	4-Cl	Me	SO_2Et	Me	4-Cl
Me	CO-*i*-Bu	Me	4-Cl	Me	SO_2-*n*-Pr	Me	4-Cl
Me	$COCH_2C(CH_3)_3$	Me	4-Cl	Me	SO_2-*i*-Pr	Me	4-Cl
Me	COPh	Me	4-Cl	Me	SO_2-*t*-Bu	Me	4-Cl
Me	COOMe	Me	4-Cl	Me	SO_2-*i*-Bu	Me	4-Cl
Me	COOEt	Me	4-Cl	Me	$SO_2CH_2C(CH_3)_3$	Me	4-Cl
Me	COO-*i*-Pr	Me	4-Cl	Me	SO_2Ph	Me	4-Cl
Me	COO-*t*-Bu	Me	4-Cl	Me	SO_2NMe_2	Me	4-Cl
Me	COO-*i*-Bu	Me	4-Cl	Me	$PO(OEt)_2$	Me	4-Cl
Me	$COCH_2CF_3$	Me	4-Cl	Me	PO(Me)OEt	Me	4-Cl

R^1	R^3	R^W	$(R^u)_p$
Me	$PS(OEt)_2$	Me	4-Cl
Me	$PO(OMe)_2$	Me	4-Cl
Me	H	Cl	4-Cl
Me	H	Cl	4-F
Me	H	Cl	4-Br
Me	H	Cl	$4\text{-}CF_3$
Me	H	Cl	4-CN
Me	H	Cl	$4\text{-}NO_2$
Me	H	Cl	4-OMe
Me	H	Cl	$4\text{-}OCF_3$
Me	H	Cl	$4\text{-}OCF_2H$
Me	H	Cl	$4\text{-}OCF_2CF_2H$
Me	H	Cl	4-CHO
Me	H	Cl	$4\text{-}CF_2H$
Me	H	Cl	4-Me
Me	H	Cl	4-Et
Me	H	Cl	4-SMe
Me	H	Cl	$4\text{-}SCF_3$
Me	H	Cl	$4\text{-}SCF_2H$
Me	H	Cl	2-Cl
Me	H	Cl	3-Cl
Me	H	Cl	2-F
Me	H	Cl	3-F
Me	H	Cl	2,4-di-Cl
Me	H	Cl	3,4-di-Cl
Me	H	Cl	3,4-di-F
Me	H	Et	4-Cl
Me	H	Et	4-F
Me	H	Et	4-Br
Me	H	Et	$4\text{-}CF_3$
Me	H	Et	4-CN
Me	H	Et	$4\text{-}NO_2$
Me	H	Et	4-OMe
Me	H	Et	$4\text{-}OCF_3$
Me	H	Et	$4\text{-}OCF_2H$
Me	H	Et	$4\text{-}OCF_2CF_2H$
Me	H	Et	4-CHO
Me	H	Et	$4\text{-}CF_2H$
Me	H	Et	4-Me
Me	H	Et	4-Et
Me	H	Et	4-SMe
Me	H	Et	$4\text{-}SCF_3$
Me	H	Et	$4\text{-}SCF_2H$
Me	H	Et	2-Cl
Me	H	Et	3-Cl
Me	H	Et	2-F
Me	H	Et	3-F
Me	H	Et	2,4-di-Cl
Me	H	Et	3,4-di-Cl
Me	H	Et	3,4-di-F
Et	H	Me	4-Cl

TABLE 5C



R^2 is H.

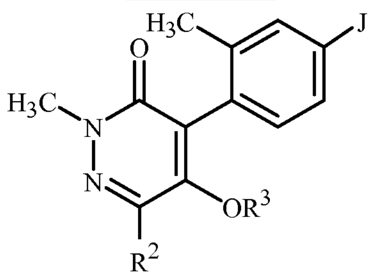
R^1	R^3	R^W	$(R^u)_p$
Me	COEt	Me	4-Cl
Me	CO-*n*-Pr	Me	4-Cl
Me	CO-*i*-Pr	Me	4-Cl
Me	CO-*t*-Bu	Me	4-Cl
Me	CO-*i*-Bu	Me	4-Cl
Me	$COCH_2C(CH_3)_3$	Me	4-Cl
Me	COPh	Me	4-Cl
Me	COOMe	Me	4-Cl
Me	COOEt	Me	4-Cl
Me	COO-*i*-Pr	Me	4-Cl
Me	COO-*t*-Bu	Me	4-Cl
Me	COO-*i*-Bu	Me	4-Cl
Me	$COCH_2CF_3$	Me	4-Cl
Me	SO_2Me	Me	4-Cl
Me	SO_2CF_3	Me	4-Cl
Me	SO_2-*c*-Pr	Me	4-Cl
Me	SO_2Et	Me	4-Cl
Me	SO_2-*n*-Pr	Me	4-Cl
Me	SO_2-*i*-Pr	Me	4-Cl
Me	SO_2-*t*-Bu	Me	4-Cl
Me	SO_2-*i*-Bu	Me	4-Cl
Me	$SO_2CH_2C(CH_3)_3$	Me	4-Cl
Me	SO_2Ph	Me	4-Cl
Me	SO_2NMe_2	Me	4-Cl
Me	$PO(OEt)_2$	Me	4-Cl
Me	PO(Me)OEt	Me	4-Cl
Me	$PS(OEt)_2$	Me	4-Cl
Me	$PO(OMe)_2$	Me	4-Cl
Me	H	Cl	4-Cl
Me	H	Cl	4-F
Me	H	Cl	4-Br
Me	H	Cl	4-CF_3
Me	H	Cl	4-CN
Me	H	Cl	4-NO_2
Me	H	Cl	4-OMe
Me	H	Cl	4-OCF_3
Me	H	Cl	4-OCF_2H
Me	H	Cl	4-OCF_2CF_2H
Me	H	Cl	4-CHO
Me	H	Cl	4-CF_2H
Me	H	Cl	4-Me
Me	H	Cl	4-Et
Me	H	Cl	4-SMe
Me	H	Cl	4-SCF_3
Me	H	Cl	4-SCF_2H
Me	H	Cl	2-Cl
Me	H	Cl	3-Cl
Me	H	Cl	2-F
Me	H	Cl	3-F
Me	H	Cl	2,4-di-Cl
Me	H	Cl	3,4-di-Cl
Me	H	Cl	3,4-di-F
Me	H	Et	4-Cl
Me	H	Et	4-F
Me	H	Et	4-Br
Me	H	Et	4-CF_3
Me	H	Et	4-CN
Me	H	Et	4-NO_2
Me	H	Et	4-OMe
Me	H	Et	4-OCF_3
Me	H	Et	4-OCF_2H
Me	H	Et	4-OCF_2CF_2H
Me	H	Et	4-CHO
Me	H	Et	4-CF_2H
Me	H	Et	4-Me
Me	H	Et	4-Et
Me	H	Et	4-SMe
Me	H	Et	4-SCF_3
Me	H	Et	4-SCF_2H
Me	H	Et	2-Cl
Me	H	Et	3-Cl
Me	H	Et	2-F
Me	H	Et	3-F
Me	H	Et	2,4-di-Cl

R^1	R^3	R^W	$(R^u)_p$	R^1	R^3	R^W	$(R^u)_p$
Me	H	Et	3,4-di-Cl	Me	H	Me	4-Cl
Me	H	Et	3,4-di-F	Me	H	Me	4-Cl
Et	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl	Me	H	Me	4-Cl
Me	H	Me	4-Cl				

TABLE 5CA

Table 5CA is constructed the same as Table 5C, except that "R^2 is H." below the chemical structure under the Table 5C heading is replaced with "R^2 is Me.".

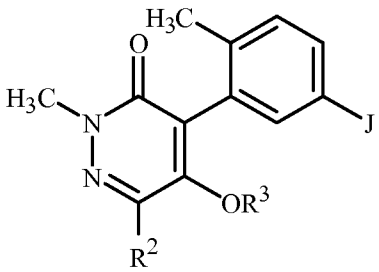
TABLE 5D



R^2	R^3	J	R^2	R^3	J
H	H	3-CF_3-1*H*-pyrazol-1-yl	H	H	4-Cl-1*H*-pyrazol-1-yl
H	H	3-Br-1*H*-pyrazol-1-yl	H	H	4-CN-1*H*-pyrazol-1-yl
H	H	3-Me-1*H*-pyrazol-1-yl	H	H	3-Me-1*H*-1,2,4-triazol-1-yl
H	H	3-Cl-1*H*-pyrazol-1-yl	H	H	3-Br-1*H*-1,2,4-triazol-1-yl
H	H	4-CF_3-1*H*-pyrazol-1-yl	H	H	3-CF_3-1*H*-1,2,4-triazol-1-yl
H	H	4-Br-1*H*-pyrazol-1-yl	H	H	4-CF_3-1*H*-imidazol-1-yl
H	H	4-Me-1*H*-pyrazol-1-yl	H	H	4-Me-1*H*-imidazol-1-yl

R^2	R^3	J
H	H	4-Cl-1*H*-imidazol-1-yl
H	H	5-CF_3-pyridin-2-yl
H	H	5-Cl-pyridin-2-yl
H	H	2-Cl-pyridin-5-yl
H	H	5-Cl-thien-2-yl
Me	H	3-CF_3-1*H*-pyrazol-1-yl
Me	H	3-Br-1*H*-pyrazol-1-yl
Me	H	3-Me-1*H*-pyrazol-1-yl
Me	H	3-Cl-1*H*-pyrazol-1-yl
Me	H	4-CF_3-1*H*-pyrazol-1-yl
Me	H	4-Br-1*H*-pyrazol-1-yl
Me	H	4-Me-1*H*-pyrazol-1-yl
Me	H	4-Cl-1*H*-pyrazol-1-yl
Me	H	4-CN-1*H*-pyrazol-1-yl
Me	H	3-Me-1*H*-1,2,4-triazol-1-yl
Me	H	3-Br-1*H*-1,2,4-triazol-1-yl
Me	H	3-CF_3-1*H*-1,2,4-triazol-1-yl
Me	H	4-CF_3-1*H*-imidazol-1-yl
Me	H	4-Me-1*H*-imidazol-1-yl
Me	H	4-Cl-1*H*-imidazol-1-yl
Me	H	5-CF_3-pyridin-2-yl
Me	H	5-Cl-pyridin-2-yl
Me	H	2-Cl-pyridin-5-yl
Me	H	5-Cl-thien-2-yl
H	COO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Me	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Ph	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*t*-Bu	3-CF_3-1*H*-pyrazol-1-yl

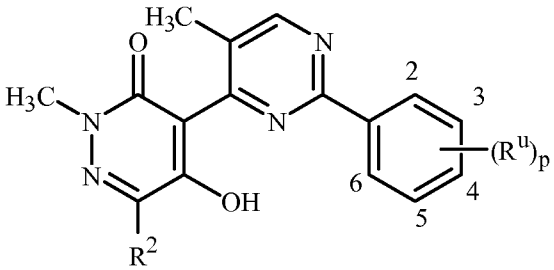
TABLE 5E



R^2	R^3	J
H	H	3-CF_3-1*H*-pyrazol-1-yl
H	H	3-Br-1*H*-pyrazol-1-yl
H	H	3-Me-1*H*-pyrazol-1-yl
H	H	3-Cl-1*H*-pyrazol-1-yl
H	H	4-CF_3-1*H*-pyrazol-1-yl
H	H	4-Br-1*H*-pyrazol-1-yl
H	H	4-Me-1*H*-pyrazol-1-yl
H	H	4-Cl-1*H*-pyrazol-1-yl
H	H	4-CN-1*H*-pyrazol-1-yl
H	H	3-Me-1*H*-1,2,4-triazol-1-yl
H	H	3-Br-1*H*-1,2,4-triazol-1-yl
H	H	3-CF_3-1*H*-1,2,4-triazol-1-yl
H	H	4-CF_3-1*H*-imidazol-1-yl
H	H	4-Me-1*H*-imidazol-1-yl
H	H	4-Cl-1*H*-imidazol-1-yl
H	H	5-CF_3-pyridin-2-yl
H	H	5-Cl-pyridin-2-yl
H	H	2-Cl-pyridin-5-yl
H	H	5-Cl-thien-2-yl
Me	H	3-CF_3-1*H*-pyrazol-1-yl
Me	H	3-Br-1*H*-pyrazol-1-yl
Me	H	3-Me-1*H*-pyrazol-1-yl
Me	H	3-Cl-1*H*-pyrazol-1-yl
Me	H	4-CF_3-1*H*-pyrazol-1-yl

R^2	R^3	J
Me	H	4-Br-1*H*-pyrazol-1-yl
Me	H	4-Me-1*H*-pyrazol-1-yl
Me	H	4-Cl-1*H*-pyrazol-1-yl
Me	H	4-CN-1*H*-pyrazol-1-yl
Me	H	3-Me-1*H*-1,2,4-triazol-1-yl
Me	H	3-Br-1*H*-1,2,4-triazol-1-yl
Me	H	3-CF_3-1*H*-1,2,4-triazol-1-yl
Me	H	4-CF_3-1*H*-imidazol-1-yl
Me	H	4-Me-1*H*-imidazol-1-yl
Me	H	4-Cl-1*H*-imidazol-1-yl
Me	H	5-CF_3-pyridin-2-yl
Me	H	5-Cl-pyridin-2-yl
Me	H	2-Cl-pyridin-5-yl
Me	H	5-Cl-thien-2-yl
H	COO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Me	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Ph	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*t*-Bu	3-CF_3-1*H*-pyrazol-1-yl

TABLE 6A



R^2 is H.

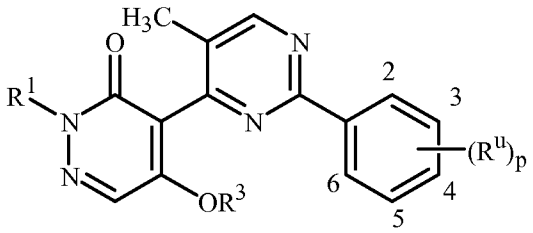
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-$CH=CH_2$	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^2 is CH_3.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$

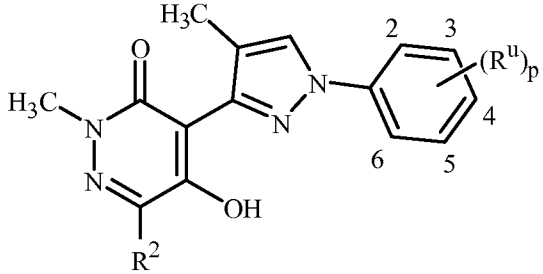
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

TABLE 6B



R^1	R^3	$(R^u)_p$	R^1	R^3	$(R^u)_p$
Me	COO-*i*-Pr	4-Cl	Me	COO-*i*-Pr	4-OCF_3
Me	COO-*i*-Pr	4-Br	Me	COO-*i*-Pr	4-Me
Me	COO-*i*-Pr	4-F	Et	H	4-Cl
Me	COO-*i*-Pr	4-CF_3			

TABLE 7A



R^2 is H.

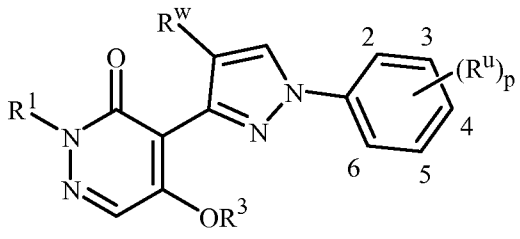
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^2 is CH_3.

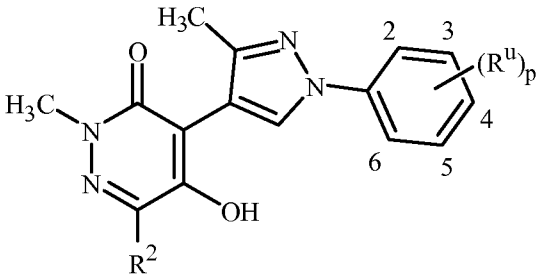
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

TABLE 7B



R^1	R^3	R^W	$(R^u)_p$	R^1	R^3	R^W	$(R^u)_p$
Me	H	Cl	4-Cl	Me	H	Cl	4-OCF_2CF_2H
Me	H	Br	4-Cl	Me	H	Cl	4-CHO
Me	H	Cl	4-F	Me	H	Cl	4-CF_2H
Me	H	Cl	4-Br	Me	H	Cl	4-Me
Me	H	Cl	4-CF_3	Me	COO-*i*-Pr	Me	4-Cl
Me	H	Br	4-CF_3	Me	COO-*i*-Pr	Me	4-Br
Me	H	Cl	4-CN	Me	COO-*i*-Pr	Me	4-F
Me	H	Cl	4-NO_2	Me	COO-*i*-Pr	Me	4-CF_3
Me	H	Cl	4-OMe	Me	COO-*i*-Pr	Me	4-OCF_3
Me	H	Cl	4-OCF_3	Me	COO-*i*-Pr	Me	4-Me
Me	H	Cl	4-OCF_2H	Et	H	Me	4-Cl

TABLE 8A



R^2 is H.

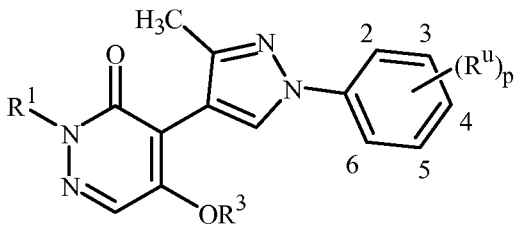
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-OCF_3	4-COMe	4-SCF_2H
4-Cl	4-OCF_2H	4-$COCF_3$	4-SOMe
4-Br	4-OCF_2CF_2H	4-COOMe	4-SO_2Me
4-I	4-CHO	4-$CONH_2$	4-$SOCF_3$
4-CF_3	4-CF_2H	4-CONHMe	4-$SOCF_2H$
4-CN	4-Me	4-$CONMe_2$	4-SO_2CF_3
4-NO_2	4-Et	4-OCOMe	4-SO_2CF_2H
4-OH	4-$CH=CH_2$	4-SMe	4-SO_2NH_2
4-OMe	4-C≡ CH	4-SCF_3	4-SO_2NMe_2

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-$SiMe_3$	4-$NHSO_2Me$	4-Thien-2-yl	3-F
4-NH_2	4-Ph	4-SF_5	2,4-di-Cl
4-NMe_2	4-Pyridin-2-yl	2-Cl	3,4-di-Cl
4-NHCOMe	4-Pyridin-3-yl	3-Cl	3,4-di-F
4-NHCOOMe	4-Pyridin-4-yl	2-F	

R^2 is CH_3.

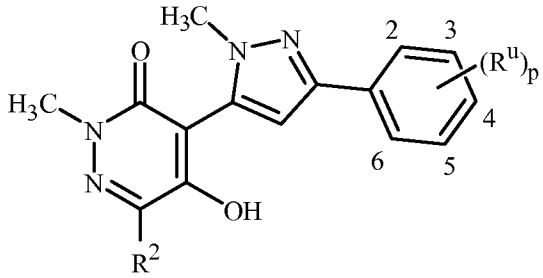
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-$CH=CH_2$	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2Me$	

TABLE 8B



R^1	R^3	$(R^u)_p$	R^1	R^3	$(R^u)_p$
Me	COO-*i*-Pr	4-Cl	Me	COO-*i*-Pr	4-OCF_3
Me	COO-*i*-Pr	4-Br	Me	COO-*i*-Pr	4-Me
Me	COO-*i*-Pr	4-F	Et	H	4-Cl
Me	COO-*i*-Pr	4-CF_3			

TABLE 9A



R^2 is H.

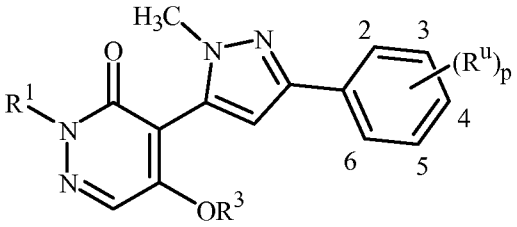
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-Me	4-SOMe	4-Ph
4-Cl	4-Et	4-SO_2Me	4-Pyridin-2-yl
4-Br	4-CH=CH_2	4-$SOCF_3$	4-Pyridin-3-yl
4-I	4-C≡ CH	4-$SOCF_2H$	4-Pyridin-4-yl
4-CF_3	4-COMe	4-SO_2CF_3	4-Thien-2-yl
4-CN	4-$COCF_3$	4-SO_2CF_2H	4-SF_5
4-NO_2	4-COOMe	4-SO_2NH_2	2-Cl
4-OH	4-$CONH_2$	4-SO_2NMe_2	3-Cl
4-OMe	4-CONHMe	4-$SiMe_3$	2-F
4-OCF_3	4-$CONMe_2$	4-NH_2	3-F
4-OCF_2H	4-OCOMe	4-NMe_2	2,4-di-Cl
4-OCF_2CF_2H	4-SMe	4-NHCOMe	3,4-di-Cl
4-CHO	4-SCF_3	4-NHCOOMe	3,4-di-F
4-CF_2H	4-SCF_2H	4-$NHSO_2$Me	

R^2 is CH_3.

$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
4-F	4-CHO	4-OCOMe	4-$SiMe_3$
4-Cl	4-CF_2H	4-SMe	4-NH_2
4-Br	4-Me	4-SCF_3	4-NMe_2
4-I	4-Et	4-SCF_2H	4-NHCOMe
4-CF_3	4-CH=CH_2	4-SOMe	4-NHCOOMe
4-CN	4-C≡ CH	4-SO_2Me	4-$NHSO_2$Me
4-NO_2	4-COMe	4-$SOCF_3$	4-Ph
4-OH	4-$COCF_3$	4-$SOCF_2H$	4-Pyridin-2-yl
4-OMe	4-COOMe	4-SO_2CF_3	4-Pyridin-3-yl
4-OCF_3	4-$CONH_2$	4-SO_2CF_2H	4-Pyridin-4-yl
4-OCF_2H	4-CONHMe	4-SO_2NH_2	4-Thien-2-yl
4-OCF_2CF_2H	4-$CONMe_2$	4-SO_2NMe_2	4-SF_5

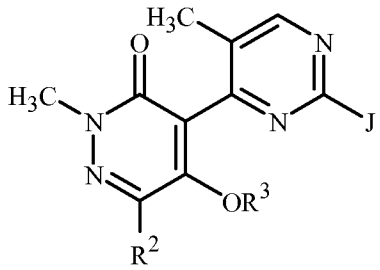
$(R^u)_p$	$(R^u)_p$	$(R^u)_p$	$(R^u)_p$
2-Cl	2-F	2,4-di-Cl	3,4-di-F
3-Cl	3-F	3,4-di-Cl	

TABLE 9B



R^1	R^3	$(R^u)_p$	R^1	R^3	$(R^u)_p$
Me	COO-*i*-Pr	4-Cl	Me	COO-*i*-Pr	4-OCF_3
Me	COO-*i*-Pr	4-Br	Me	COO-*i*-Pr	4-Me
Me	COO-*i*-Pr	4-F	Et	H	4-Cl
Me	COO-*i*-Pr	4-CF_3			

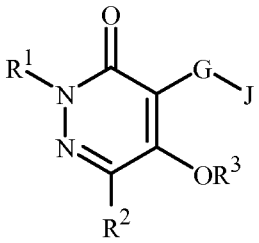
TABLE 10



R^2	R^3	J	R^2	R^3	J
H	H	3-CF_3-1*H*-pyrazol-1-yl	H	H	4-CF_3-1*H*-imidazol-1-yl
H	H	3-Br-1*H*-pyrazol-1-yl	H	H	4-Me-1*H*-imidazol-1-yl
H	H	3-Me-1*H*-pyrazol-1-yl	H	H	4-Cl-1*H*-imidazol-1-yl
H	H	3-Cl-1*H*-pyrazol-1-yl	H	H	5-CF_3-pyridin-2-yl
H	H	4-CF_3-1*H*-pyrazol-1-yl	H	H	5-Cl-pyridin-2-yl
H	H	4-Br-1*H*-pyrazol-1-yl	H	H	2-Cl-pyridin-5-yl
H	H	4-Me-1*H*-pyrazol-1-yl	H	H	5-Cl-thien-2-yl
H	H	4-Cl-1*H*-pyrazol-1-yl	Me	H	3-CF_3-1*H*-pyrazol-1-yl
H	H	4-CN-1*H*-pyrazol-1-yl	Me	H	3-Br-1*H*-pyrazol-1-yl
H	H	3-Me-1*H*-1,2,4-triazol-1-yl	Me	H	3-Me-1*H*-pyrazol-1-yl
H	H	3-Br-1*H*-1,2,4-triazol-1-yl	Me	H	3-Cl-1*H*-pyrazol-1-yl
H	H	3-CF_3-1*H*-1,2,4-triazol-1-yl	Me	H	4-CF_3-1*H*-pyrazol-1-yl

R^2	R^3	J
Me	H	4-Br-1*H*-pyrazol-1-yl
Me	H	4-Me-1*H*-pyrazol-1-yl
Me	H	4-Cl-1*H*-pyrazol-1-yl
Me	H	4-CN-1*H*-pyrazol-1-yl
Me	H	3-Me-1*H*-1,2,4-triazol-1-yl
Me	H	3-Br-1*H*-1,2,4-triazol-1-yl
Me	H	3-CF_3-1*H*-1,2,4-triazol-1-yl
Me	H	4-CF_3-1*H*-imidazol-1-yl
Me	H	4-Me-1*H*-imidazol-1-yl
Me	H	4-Cl-1*H*-imidazol-1-yl
Me	H	5-CF_3-pyridin-2-yl
Me	H	5-Cl-pyridin-2-yl
Me	H	2-Cl-pyridin-5-yl
Me	H	5-Cl-thien-2-yl
H	COO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*i*-Pr	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Me	3-CF_3-1*H*-pyrazol-1-yl
H	SO_2Ph	3-CF_3-1*H*-pyrazol-1-yl
H	CO-*t*-Bu	3-CF_3-1*H*-pyrazol-1-yl

TABLE 11



R^1	R^2	R^3	G	J
Me	H	H	1,2,4-thiadiazol-5-yl	3-(4-chlorophenyl)
Me	H	H	1,2,4-oxadiazol-5-yl	3-(4-chlorophenyl)
Me	H	H	isoxazol-5-yl	3-(4-chlorophenyl)
Me	H	H	isoxazol-3-yl	5-(4-chlorophenyl)
Me	H	H	isothiazol-5-yl	3-(4-chlorophenyl)
Me	H	H	isothiazol-3-yl	5-(4-chlorophenyl)
Me	H	H	5-Me-2*H*-1,2,3-triazol-4-yl	2-(4-chlorophenyl)
Me	H	H	1,3,4-thiadiazol-2-yl	5-(4-chlorophenyl)
Me	H	H	1,3,4-thiadiazol-5-yl	2-(4-chlorophenyl)
Me	H	H	1,3,5-thiadiazol-2-yl	4-(4-chlorophenyl)
Me	H	H	1,3,5-thiadiazol-4-yl	2-(4-chlorophenyl)
Me	H	H	1,3,4-oxadiazol-2-yl	5-(4-chlorophenyl)
Me	H	H	1,3,4-oxadiazol-5-yl	2-(4-chlorophenyl)
Me	H	H	1,3,5-oxadiazol-2-yl	4-(4-chlorophenyl)
Me	H	H	1,3,5-oxadiazol-4-yl	2-(4-chlorophenyl)
Me	H	H	thiazol-2-yl	5-(4-chlorophenyl)
Me	H	H	thiazol-2-yl	4-(4-chlorophenyl)
Me	H	H	5-Me-thiazol-4-yl	2-(4-chlorophenyl)

R^1	R^2	R^3	G	J
Me	H	H	oxazol-2-yl	5-(4-chlorophenyl)
Me	H	H	oxazol-2-yl	4-(4-chlorophenyl)
Me	H	H	5-Me-oxazol-4-yl	2-(4-chlorophenyl)
Me	H	H	4-Me-oxazol-5-yl	2-(4-chlorophenyl)
Me	H	H	1,2,4-triazin-3-yl	5-(4-chlorophenyl)
Me	H	H	6-Me-1,2,4-triazin-5-yl	3-(4-chlorophenyl)
Me	H	H	1,3,5-triazin-2-yl	4-(4-chlorophenyl)
Me	H	H	3-Me-pyridin-2-yl	6-(4-chlorophenyl)
Me	H	H	2-Me-pyridin-3-yl	5-(4-chlorophenyl)
Me	H	H	3-Cl-pyridin-2-yl	4-(4-chlorophenyl)
Me	H	H	5-Me-pyridin-4-yl	2-(4-chlorophenyl)
Me	H	H	2-Me-pyrazin-3-yl	5-(4-chlorophenyl)
Me	H	H	3-Me-pyridazin-4-yl	6-(4-chlorophenyl)
Me	H	H	3-Cl-pyridazin-4-yl	6-(4-chlorophenyl)
Me	H	H	Pyrimidin-2-yl	4-(4-chlorophenyl)
Me	H	H	3-Me-thien-2-yl	5-(4-chlorophenyl)
Me	H	H	2-Me-thien-3-yl	5-(4-chlorophenyl)
Me	H	H	3-Me-furan-2-yl	5-(4-chlorophenyl)
Me	H	H	2-Me-furan-3-yl	5-(4-chlorophenyl)
Me	Me	H	5-Me-2*H*-1,2,3-triazol-4-yl	2-(4-chlorophenyl)
Me	H	COO-*i*-Pr	5-Me-2*H*-1,2,3-triazol-4-yl	2-(4-chlorophenyl)
Me	Me	H	6-Me-1,2,4-triazin-5-yl	3-(4-chlorophenyl)
Me	H	SO_2Me	6-Me-1,2,4-triazin-5-yl	3-(4-chlorophenyl)
Me	Me	H	5-Me-oxazol-4-yl	2-(4-chlorophenyl)
Me	H	CO-*t*-Bu	5-Me-oxazol-4-yl	2-(4-chlorophenyl)
Et	H	H	5-Me-2*H*-1,2,3-triazol-4-yl	2-(4-chlorophenyl)

Formulation/Utility

A compound Formula **1** 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 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 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. 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), 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, triacetin, 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 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 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 Tables A–B. 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 2	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
montmorillonite (calcined)	23.0%

Example C

Granule	
Compound 3	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 4	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 5	10.0%
polyoxyethylene sorbitol hexoleate	20.0%
C_6–C_{10} fatty acid methyl ester	70.0%

Example F

Microemulsion

Compound 6	5.0%
polyvinylpyrrolidone-vinyl acetate copolymer	30.0%
alkylpolyglycoside	30.0%
glyceryl monooleate	15.0%
water	20.0%

Test results indicate that the compounds of the present invention are highly active preemergent and/or postemergent herbicides and/or plant growth regulants. 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 highways 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 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 the present invention are particularly useful for selective weed control in crops of corn, rice (both upland and paddy), soybeans and wheat. 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.

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 0.0001 to 20 kg/ha with a preferred range of about 0.001 to 5 kg/ha and a more preferred range of about 0.004 to 3 kg/ha. One skilled in the art can easily determine the herbicidally effective amount necessary for the desired level of weed control.

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 herbicidally effective amount of a compound of Formula **1** and a biologically effective amount of at least one additional biologically active compound or agent 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), aminopyralid, amitrole, ammonium sulfamate, anilofos, asulam, atrazine, azimsulfuron, beflubutamid, benazolin, benazolin-ethyl, bencarbazone, benfluralin, benfuresate, bensulfuron-methyl, bensulide, bentazone, benzobicyclon, benzofenap, bifenox, bilanafos, bispyribac and its sodium salt, bromacil, bromobutide, bromofenoxim, bromoxynil, bromoxynil octanoate, butachlor, butafenacil, butamifos, butralin, butroxydim, butylate, cafenstrole, carbetamide, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, chlorotoluron, chlorpropham, chlorsulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, clefoxydim, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, isoctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, daimuron, dalapon, dalapon-sodium, dazomet, 2,4-DB and its dimethylammonium, potassium and sodium salts, desmedipham, desmetryn, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium salts, dichlobenil, dichlorprop, diclofop-methyl, diclosulam, difenzoquat metilsulfate, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethylarsinic acid and its sodium salt, dinitramine, dinoterb, diphenamid, diquat dibromide, dithiopyr, diuron, DNOC, endothal, EPTC, esprocarb, ethalfluralin, ethametsulfuron-methyl, ethiozin, ethofumesate, ethoxyfen, ethoxysulfuron, etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, flucarbazone, flucetosulfuron, fluchloralin, flufenacet, flufenpyr, flufenpyr-ethyl, fluazolate, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium, glyphosate and its salts such as ammonium, isopropylammonium, potassium, sodium (including sesquisodium) and trimesium (alternatively named sulfosate), halosulfuron-methyl, haloxyfop-etotyl,

haloxyfop-methyl, hexazinone, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, iodosulfuron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium, isoproturon, isouron, isoxaben, isoxaflutole, isoxachlortole, lactofen, lenacil, linuron, maleic hydrazide, MCPA and its dimethylammonium, potassium and sodium salts, MCPA-isoctyl, MCPA-thioethyl, MCPB and its sodium salt, MCPB-ethyl, mecoprop, mecoprop-P, mefenacet, mefluidide, mesosulfuron-methyl, mesotrione, metam-sodium, metamifop, metamitron, metazachlor, 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, 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, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyrithiobac, pyrithiobac-sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinoclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimsulfuron, 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, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron-methyl, thiobencarb, tiocarbazil, topramezone, tralkoxydim, tri-allate, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron-methyl, tritosulfuron and vernolate. 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. 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. synergistic) 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 synergism of herbicidal 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 Formula **1** with at least one other herbicidal active ingredient. Of particular note is such a combination where the other herbicidal active ingredient has a different site of action from the compound of Formula **1**. 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 a biologically effective amount of at least one additional herbicidal active ingredient having a similar spectrum of control but a different site of action. Herbicidally effective amounts of compounds of the invention as well as herbicidally effective amounts of other herbicides can be easily determined by one skilled in the art through simple experimentation.

Preferred for better control of undesired vegetation (e.g., lower use rate, 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 2,4-D, aminocyclopyrachlor, atrazine, chlorimuron-ethyl, chlorsulfuron, clomazone, diflufenican, dimethenamid, flufenacet, flumetsulam, flumioxazin, flupyrsulfuron-methyl, flupyrsulfuron-methyl-sodium, glyphosate (particularly glyphosate-isopropylammonium, glyphosate-sodium, glyphosate-potassium, glyphosate-trimesium), imazamethabenz-methyl, imazaquin, imazethapyr, iodosulfuron-methyl, isoproturon, lactofen, mesosulfuron-methyl, mesotrione, metribuzin, metsulfuron-methyl, nicosulfuron, rimsulfuron, S-metolachlor, sulfentrazone, thifensulfuron-methyl, and tribenuron-methyl. Specifically preferred mixtures (compound numbers refer to compounds in Index Table A) are selected from the group: compound 1 and 2,4-D; compound 2 and 2,4-D; compound 3 and 2,4-D; compound 4 and 2,4-D; compound 5 and 2,4-D; compound 6 and 2,4-D; compound 7 and 2,4-D; compound 1 and aminocyclopyrachlor; compound 2 and aminocyclopyrachlor; compound 3 and aminocyclopyrachlor; compound 4 and aminocyclopyrachlor; compound 5 and aminocyclopyrachlor; compound 6 and aminocyclopyrachlor; compound 7 and aminocyclopyrachlor; compound 1 and atrazine; compound 2 and atrazine; compound 3 and atrazine; compound 4 and atrazine; compound 5 and atrazine; compound 6 and atrazine; compound 7 and atrazine; compound 1 and chlorimuron-ethyl; compound 2 and chlorimuron-ethyl; compound 3 and chlorimuron-ethyl; compound 4 and chlorimuron-ethyl; compound 5 and chlorimuron-ethyl; compound 6 and chlorimuron-ethyl; compound 7 and chlorimuron-ethyl; compound 1 and chlorsulfuron;

compound 2 and chlorsulfuron; compound 3 and chlorsulfuron; compound 4 and chlorsulfuron; compound 5 and chlorsulfuron; compound 6 and chlorsulfuron; compound 7 and chlorsulfuron; compound 1 and clomazone; compound 2 and clomazone; compound 3 and clomazone; compound 4 and clomazone; compound 5 and clomazone; compound 6 and clomazone; compound 7 and clomazone; compound 1 and diflufenican; compound 2 and diflufenican; compound 3 and diflufenican; compound 4 and diflufenican; compound 5 and diflufenican; compound 6 and diflufenican; compound 7 and diflufenican; compound 1 and dimethenamid; compound 2 and dimethenamid; compound 3 and dimethenamid; compound 4 and dimethenamid; compound 5 and dimethenamid; compound 6 and dimethenamid; compound 7 and dimethenamid; compound 1 and flufenacet; compound 2 and flufenacet; compound 3 and flufenacet; compound 4 and flufenacet; compound 5 and flufenacet; compound 6 and flufenacet; compound 7 and flufenacet; compound 1 and flumetsulam; compound 2 and flumetsulam; compound 3 and flumetsulam; compound 4 and flumetsulam; compound 5 and flumetsulam; compound 6 and flumetsulam; compound 7 and flumetsulam; compound 1 and flumioxazin; compound 2 and flumioxazin; compound 3 and flumioxazin; compound 4 and flumioxazin; compound 5 and flumioxazin; compound 6 and flumioxazin; compound 7 and flumioxazin; compound 1 and flupyrsulfuron-methyl; compound 2 and flupyrsulfuron-methyl; compound 3 and flupyrsulfuron-methyl; compound 4 and flupyrsulfuron-methyl; compound 5 and flupyrsulfuron-methyl; compound 6 and flupyrsulfuron-methyl; compound 7 and flupyrsulfuron-methyl; compound 1 and flupyrsulfuron-methyl-sodium; compound 2 and flupyrsulfuron-methyl-sodium; compound 3 and flupyrsulfuron-methyl-sodium; compound 4 and flupyrsulfuron-methyl-sodium; compound 5 and flupyrsulfuron-methyl-sodium; compound 6 and flupyrsulfuron-methyl-sodium; compound 7 and flupyrsulfuron-methyl-sodium; compound 1 and glyphosate; compound 2 and glyphosate; compound 3 and glyphosate; compound 4 and glyphosate; compound 5 and glyphosate; compound 6 and glyphosate; compound 7 and glyphosate; compound 1 and imazamethabenz-methyl; compound 2 and imazamethabenz-methyl; compound 3 and imazamethabenz-methyl; compound 4 and imazamethabenz-methyl; compound 5 and imazamethabenz-methyl; compound 6 and imazamethabenz-methyl; compound 7 and imazamethabenz-methyl; compound 1 and imazaquin; compound 2 and imazaquin; compound 3 and imazaquin; compound 4 and imazaquin; compound 5 and imazaquin; compound 6 and imazaquin; compound 7 and imazaquin; compound 1 and imazethapyr; compound 2 and imazethapyr; compound 3 and imazethapyr; compound 4 and imazethapyr; compound 5 and imazethapyr; compound 6 and imazethapyr; compound 7 and imazethapyr; compound 1 and iodosulfuron-methyl; compound 2 and iodosulfuron-methyl; compound 3 and iodosulfuron-methyl; compound 4 and iodosulfuron-methyl; compound 5 and iodosulfuron-methyl; compound 6 and iodosulfuron-methyl; compound 7 and iodosulfuron-methyl; compound 1 and isoproturon; compound 2 and isoproturon; compound

3 and isoproturon; compound 4 and isoproturon; compound 5 and isoproturon; compound 6 and isoproturon; compound 7 and isoproturon; compound 1 and lactofen; compound 2 and lactofen; compound 3 and lactofen; compound 4 and lactofen; compound 5 and lactofen; compound 6 and lactofen; compound 7 and lactofen; compound 1 and mesosulfuron-methyl; compound 2 and mesosulfuron-methyl; compound 3 and mesosulfuron-methyl; compound 4 and mesosulfuron-methyl; compound 5 and mesosulfuron-methyl; compound 6 and mesosulfuron-methyl; compound 7 and mesosulfuron-methyl; compound 1 and mesotrione; compound 2 and mesotrione; compound 3 and mesotrione; compound 4 and mesotrione; compound 5 and mesotrione; compound 6 and mesotrione; compound 7 and mesotrione; compound 1 and metribuzin; compound 2 and metribuzin; compound 3 and metribuzin; compound 4 and metribuzin; compound 5 and metribuzin; compound 6 and metribuzin; compound 7 and metribuzin; compound 1 and metsulfuron-methyl; compound 2 and metsulfuron-methyl; compound 3 and metsulfuron-methyl; compound 4 and metsulfuron-methyl; compound 5 and metsulfuron-methyl; compound 6 and metsulfuron-methyl; compound 7 and metsulfuron-methyl; compound 1 and nicosulfuron; compound 2 and nicosulfuron; compound 3 and nicosulfuron; compound 4 and nicosulfuron; compound 5 and nicosulfuron; compound 6 and nicosulfuron; compound 7 and nicosulfuron; compound 1 and rimsulfuron; compound 2 and rimsulfuron; compound 3 and rimsulfuron; compound 4 and rimsulfuron; compound 5 and rimsulfuron; compound 6 and rimsulfuron; compound 7 and rimsulfuron; compound 1 and S-metolachlor; compound 2 and S-metolachlor; compound 3 and S-metolachlor; compound 4 and S-metolachlor; compound 5 and S-metolachlor; compound 6 and S-metolachlor; compound 7 and S-metolachlor; compound 1 and sulfentrazone; compound 2 and sulfentrazone; compound 3 and sulfentrazone; compound 4 and sulfentrazone; compound 5 and sulfentrazone; compound 6 and sulfentrazone; compound 7 and sulfentrazone; compound 1 and thifensulfuron-methyl; compound 2 and thifensulfuron-methyl; compound 3 and thifensulfuron-methyl; compound 4 and thifensulfuron-methyl; compound 5 and thifensulfuron-methyl; compound 6 and thifensulfuron-methyl; compound 7 and thifensulfuron-methyl; compound 1 and tribenuron-methyl; compound 2 and tribenuron-methyl; compound 3 and tribenuron-methyl; compound 4 and tribenuron-methyl; compound 5 and tribenuron-methyl; compound 6 and tribenuron-methyl; compound 7 and tribenuron-methyl.

Also specifically preferred mixtures (compound numbers refer to compounds in Index Table A) are selected from the group: compound 11 and 2,4-D; compound 12 and 2,4-D; compound 21 and 2,4-D; compound 26 and 2,4-D; compound 31 and 2,4-D; compound 35 and 2,4-D; compound 37 and 2,4-D; compound 38 and 2,4-D; compound 57 and 2,4-D; compound 61 and 2,4-D; compound 66 and 2,4-D; compound 72 and 2,4-D; compound 74 and 2,4-D; compound 78 and 2,4-D; compound 82 and 2,4-D; compound 11 and aminocyclopyrachlor; compound 12 and aminocyclopyrachlor, compound 21 and

aminocyclopyrachlor, compound 26 and aminocyclopyrachlor, compound 31 and aminocyclopyrachlor, compound 35 and aminocyclopyrachlor, compound 37 and aminocyclopyrachlor, compound 38 and aminocyclopyrachlor, compound 57 and aminocyclopyrachlor, compound 61 and aminocyclopyrachlor, compound 66 and aminocyclopyrachlor, compound 72 and aminocyclopyrachlor, compound 74 and aminocyclopyrachlor, compound 78 and aminocyclopyrachlor, compound 82 and aminocyclopyrachlor, compound 12 and atrazine; compound 21 and atrazine; compound 26 and atrazine; compound 31 and atrazine; compound 35 and atrazine; compound 37 and atrazine; compound 38 and atrazine; compound 57 and atrazine; compound 61 and atrazine; compound 66 and atrazine; compound 72 and atrazine; compound 74 and atrazine; compound 78 and atrazine; compound 82 and atrazine; compound 11 and bromoxynil; compound 12 and bromoxynil; compound 21 and bromoxynil; compound 26 and bromoxynil; compound 31 and bromoxynil; compound 35 and bromoxynil; compound 37 and bromoxynil; compound 38 and bromoxynil; compound 57 and bromoxynil; compound 61 and bromoxynil; compound 66 and bromoxynil; compound 72 and bromoxynil; compound 74 and bromoxynil; compound 78 and bromoxynil; compound 82 and bromoxynil; compound 11 and bromoxynil octanoate; compound 12 and bromoxynil octanoate; compound 21 and bromoxynil octanoate; compound 26 and bromoxynil octanoate; compound 31 and bromoxynil octanoate; compound 35 and bromoxynil octanoate; compound 37 and bromoxynil octanoate; compound 38 and bromoxynil octanoate; compound 57 and bromoxynil octanoate; compound 61 and bromoxynil octanoate; compound 66 and bromoxynil octanoate; compound 72 and bromoxynil octanoate; compound 74 and bromoxynil octanoate; compound 78 and bromoxynil octanoate; compound 82 and bromoxynil octanoate; compound 11 and carfentrazone-ethyl; compound 12 and carfentrazone-ethyl; compound 21 and carfentrazone-ethyl; compound 26 and carfentrazone-ethyl; compound 31 and carfentrazone-ethyl; compound 35 and carfentrazone-ethyl; compound 37 and carfentrazone-ethyl; compound 38 and carfentrazone-ethyl; compound 57 and carfentrazone-ethyl; compound 61 and carfentrazone-ethyl; compound 66 and carfentrazone-ethyl; compound 72 and carfentrazone-ethyl; compound 74 and carfentrazone-ethyl; compound 78 and carfentrazone-ethyl; compound 82 and carfentrazone-ethyl; compound 11 and chlorimuron-ethyl; compound 12 and chlorimuron-ethyl; compound 21 and chlorimuron-ethyl; compound 26 and chlorimuron-ethyl; compound 31 and chlorimuron-ethyl; compound 35 and chlorimuron-ethyl; compound 37 and chlorimuron-ethyl; compound 38 and chlorimuron-ethyl; compound 57 and chlorimuron-ethyl; compound 61 and chlorimuron-ethyl; compound 66 and chlorimuron-ethyl; compound 72 and chlorimuron-ethyl; compound 74 and chlorimuron-ethyl; compound 78 and chlorimuron-ethyl; compound 82 and chlorimuron-ethyl; compound 11 and chlorsulfuron; compound 12 and chlorsulfuron; compound 21 and chlorsulfuron; compound 26 and

chlorsulfuron; compound 31 and chlorsulfuron; compound 35 and chlorsulfuron; compound 37 and chlorsulfuron; compound 38 and chlorsulfuron; compound 57 and chlorsulfuron; compound 61 and chlorsulfuron; compound 66 and chlorsulfuron; compound 72 and chlorsulfuron; compound 74 and chlorsulfuron; compound 78 and chlorsulfuron; compound 82 and chlorsulfuron; compound 11 and clomazone; compound 12 and clomazone; compound 21 and clomazone; compound 26 and clomazone; compound 31 and clomazone; compound 35 and clomazone; compound 37 and clomazone; compound 38 and clomazone; compound 57 and clomazone; compound 61 and clomazone; compound 66 and clomazone; compound 72 and clomazone; compound 74 and clomazone; compound 78 and clomazone; compound 82 and clomazone; compound 11 and clopyralid; compound 12 and clopyralid; compound 21 and clopyralid; compound 26 and clopyralid; compound 31 and clopyralid; compound 35 and clopyralid; compound 37 and clopyralid; compound 38 and clopyralid; compound 57 and clopyralid; compound 61 and clopyralid; compound 66 and clopyralid; compound 72 and clopyralid; compound 74 and clopyralid; compound 78 and clopyralid; compound 82 and clopyralid; compound 11 and dicamba; compound 12 and dicamba; compound 21 and dicamba; compound 26 and dicamba; compound 31 and dicamba; compound 35 and dicamba; compound 37 and dicamba; compound 38 and dicamba; compound 57 and dicamba; compound 61 and dicamba; compound 66 and dicamba; compound 72 and dicamba; compound 74 and dicamba; compound 78 and dicamba; compound 82 and dicamba; compound 11 and diflufenican; compound 12 and diflufenican; compound 21 and diflufenican; compound 26 and diflufenican; compound 31 and diflufenican; compound 35 and diflufenican; compound 37 and diflufenican; compound 38 and diflufenican; compound 57 and diflufenican; compound 61 and diflufenican; compound 66 and diflufenican; compound 72 and diflufenican; compound 74 and diflufenican; compound 78 and diflufenican; compound 82 and diflufenican; compound 11 and dimethenamid; compound 12 and dimethenamid; compound 21 and dimethenamid; compound 26 and dimethenamid; compound 31 and dimethenamid; compound 35 and dimethenamid; compound 37 and dimethenamid; compound 38 and dimethenamid; compound 57 and dimethenamid; compound 61 and dimethenamid; compound 66 and dimethenamid; compound 72 and dimethenamid; compound 74 and dimethenamid; compound 78 and dimethenamid; compound 82 and dimethenamid; compound 11 and florasulam; compound 12 and florasulam; compound 21 and florasulam; compound 26 and florasulam; compound 31 and florasulam; compound 35 and florasulam; compound 37 and florasulam; compound 38 and florasulam; compound 57 and florasulam; compound 61 and florasulam; compound 66 and florasulam; compound 72 and florasulam; compound 74 and florasulam; compound 78 and florasulam; compound 82 and florasulam; compound 11 and flufenacet; compound 12 and flufenacet; compound 21 and flufenacet; compound 26 and flufenacet; compound 31 and flufenacet; compound 35 and flufenacet; compound 37 and

flufenacet; compound 38 and flufenacet; compound 57 and flufenacet; compound 61 and flufenacet; compound 66 and flufenacet; compound 72 and flufenacet; compound 74 and flufenacet; compound 78 and flufenacet; compound 82 and flufenacet; compound 11 and flumetsulam; compound 12 and flumetsulam; compound 21 and flumetsulam; compound 26 and flumetsulam; compound 31 and flumetsulam; compound 35 and flumetsulam; compound 37 and flumetsulam; compound 38 and flumetsulam; compound 57 and flumetsulam; compound 61 and flumetsulam; compound 66 and flumetsulam; compound 72 and flumetsulam; compound 74 and flumetsulam; compound 78 and flumetsulam; compound 82 and flumetsulam; compound 11 and flumioxazin; compound 12 and flumioxazin; compound 21 and flumioxazin; compound 26 and flumioxazin; compound 31 and flumioxazin; compound 35 and flumioxazin; compound 37 and flumioxazin; compound 38 and flumioxazin; compound 57 and flumioxazin; compound 61 and flumioxazin; compound 66 and flumioxazin; compound 72 and flumioxazin; compound 74 and flumioxazin; compound 78 and flumioxazin; compound 82 and flumioxazin; compound 11 and flupyrsulfuron-methyl; compound 12 and flupyrsulfuron-methyl; compound 21 and flupyrsulfuron-methyl; compound 26 and flupyrsulfuron-methyl; compound 31 and flupyrsulfuron-methyl; compound 35 and flupyrsulfuron-methyl; compound 37 and flupyrsulfuron-methyl; compound 38 and flupyrsulfuron-methyl; compound 57 and flupyrsulfuron-methyl; compound 61 and flupyrsulfuron-methyl; compound 66 and flupyrsulfuron-methyl; compound 72 and flupyrsulfuron-methyl; compound 74 and flupyrsulfuron-methyl; compound 78 and flupyrsulfuron-methyl; compound 82 and flupyrsulfuron-methyl; compound 11 and flupyrsulfuron-methyl-sodium; compound 12 and flupyrsulfuron-methyl-sodium; compound 21 and flupyrsulfuron-methyl-sodium; compound 26 and flupyrsulfuron-methyl-sodium; compound 31 and flupyrsulfuron-methyl-sodium; compound 35 and flupyrsulfuron-methyl-sodium; compound 37 and flupyrsulfuron-methyl-sodium; compound 38 and flupyrsulfuron-methyl-sodium; compound 57 and flupyrsulfuron-methyl-sodium; compound 61 and flupyrsulfuron-methyl-sodium; compound 66 and flupyrsulfuron-methyl-sodium; compound 72 and flupyrsulfuron-methyl-sodium; compound 74 and flupyrsulfuron-methyl-sodium; compound 78 and flupyrsulfuron-methyl-sodium; compound 82 and flupyrsulfuron-methyl-sodium; compound 11 and fluroxypyr; compound 12 and fluroxypyr; compound 21 and fluroxypyr; compound 26 and fluroxypyr; compound 31 and fluroxypyr; compound 35 and fluroxypyr; compound 37 and fluroxypyr; compound 38 and fluroxypyr; compound 57 and fluroxypyr; compound 61 and fluroxypyr; compound 66 and fluroxypyr; compound 72 and fluroxypyr; compound 74 and fluroxypyr; compound 78 and fluroxypyr; compound 82 and fluroxypyr; compound 11 and glyphosate; compound 12 and glyphosate; compound 21 and glyphosate; compound 26 and glyphosate; compound 31 and glyphosate; compound 35 and glyphosate; compound 37 and glyphosate; compound 38 and glyphosate; compound 57 and glyphosate; compound 61 and glyphosate; compound

66 and glyphosate; compound 72 and glyphosate; compound 74 and glyphosate; compound 78 and glyphosate; compound 82 and glyphosate; compound 11 and imazamethabenz-methyl; compound 12 and imazamethabenz-methyl; compound 21 and imazamethabenz-methyl; compound 26 and imazamethabenz-methyl; compound 31 and imazamethabenz-methyl; compound 35 and imazamethabenz-methyl; compound 37 and imazamethabenz-methyl; compound 38 and imazamethabenz-methyl; compound 57 and imazamethabenz-methyl; compound 61 and imazamethabenz-methyl; compound 66 and imazamethabenz-methyl; compound 72 and imazamethabenz-methyl; compound 74 and imazamethabenz-methyl; compound 78 and imazamethabenz-methyl; compound 82 and imazamethabenz-methyl; compound 11 and imazaquin; compound 12 and imazaquin; compound 21 and imazaquin; compound 26 and imazaquin; compound 31 and imazaquin; compound 35 and imazaquin; compound 37 and imazaquin; compound 38 and imazaquin; compound 57 and imazaquin; compound 61 and imazaquin; compound 66 and imazaquin; compound 72 and imazaquin; compound 74 and imazaquin; compound 78 and imazaquin; compound 82 and imazaquin; compound 11 and imazethapyr; compound 12 and imazethapyr; compound 21 and imazethapyr; compound 26 and imazethapyr; compound 31 and imazethapyr; compound 35 and imazethapyr; compound 37 and imazethapyr; compound 38 and imazethapyr; compound 57 and imazethapyr; compound 61 and imazethapyr; compound 66 and imazethapyr; compound 72 and imazethapyr; compound 74 and imazethapyr; compound 78 and imazethapyr; compound 82 and imazethapyr; compound 11 and iodosulfuron-methyl; compound 12 and iodosulfuron-methyl; compound 21 and iodosulfuron-methyl; compound 26 and iodosulfuron-methyl; compound 31 and iodosulfuron-methyl; compound 35 and iodosulfuron-methyl; compound 37 and iodosulfuron-methyl; compound 38 and iodosulfuron-methyl; compound 57 and iodosulfuron-methyl; compound 61 and iodosulfuron-methyl; compound 66 and iodosulfuron-methyl; compound 72 and iodosulfuron-methyl; compound 74 and iodosulfuron-methyl; compound 78 and iodosulfuron-methyl; compound 82 and iodosulfuron-methyl; compound 11 and isoproturon; compound 12 and isoproturon; compound 21 and isoproturon; compound 26 and isoproturon; compound 31 and isoproturon; compound 35 and isoproturon; compound 37 and isoproturon; compound 38 and isoproturon; compound 57 and isoproturon; compound 61 and isoproturon; compound 66 and isoproturon; compound 72 and isoproturon; compound 74 and isoproturon; compound 78 and isoproturon; compound 82 and isoproturon; compound 11 and lactofen; compound 12 and lactofen; compound 21 and lactofen; compound 26 and lactofen; compound 31 and lactofen; compound 35 and lactofen; compound 37 and lactofen; compound 38 and lactofen; compound 57 and lactofen; compound 61 and lactofen; compound 66 and lactofen; compound 72 and lactofen; compound 74 and lactofen; compound 78 and lactofen; compound 82 and lactofen; compound 11 and MCPA; compound 12 and MCPA; compound 21 and MCPA; compound

26 and MCPA; compound 31 and MCPA; compound 35 and MCPA; compound 37 and MCPA; compound 38 and MCPA; compound 57 and MCPA; compound 61 and MCPA; compound 66 and MCPA; compound 72 and MCPA; compound 74 and MCPA; compound 78 and MCPA; compound 82 and MCPA; compound 11 and MCPA-isoctyl; compound 12 and MCPA-isoctyl; compound 21 and MCPA-isoctyl; compound 26 and MCPA-isoctyl; compound 31 and MCPA-isoctyl; compound 35 and MCPA-isoctyl; compound 37 and MCPA-isoctyl; compound 38 and MCPA-isoctyl; compound 57 and MCPA-isoctyl; compound 61 and MCPA-isoctyl; compound 66 and MCPA-isoctyl; compound 72 and MCPA-isoctyl; compound 74 and MCPA-isoctyl; compound 78 and MCPA-isoctyl; compound 82 and MCPA-isoctyl; compound 11 and MCPA-thioethyl; compound 12 and MCPA-thioethyl; compound 21 and MCPA-thioethyl; compound 26 and MCPA-thioethyl; compound 31 and MCPA-thioethyl; compound 35 and MCPA-thioethyl; compound 37 and MCPA-thioethyl; compound 38 and MCPA-thioethyl; compound 57 and MCPA-thioethyl; compound 61 and MCPA-thioethyl; compound 66 and MCPA-thioethyl; compound 72 and MCPA-thioethyl; compound 74 and MCPA-thioethyl; compound 78 and MCPA-thioethyl; compound 82 and MCPA-thioethyl; compound 11 and mesosulfuron-methyl; compound 12 and mesosulfuron-methyl; compound 21 and mesosulfuron-methyl; compound 26 and mesosulfuron-methyl; compound 31 and mesosulfuron-methyl; compound 35 and mesosulfuron-methyl; compound 37 and mesosulfuron-methyl; compound 38 and mesosulfuron-methyl; compound 57 and mesosulfuron-methyl; compound 61 and mesosulfuron-methyl; compound 66 and mesosulfuron-methyl; compound 72 and mesosulfuron-methyl; compound 74 and mesosulfuron-methyl; compound 78 and mesosulfuron-methyl; compound 82 and mesosulfuron-methyl; compound 11 and mesotrione; compound 12 and mesotrione; compound 21 and mesotrione; compound 26 and mesotrione; compound 31 and mesotrione; compound 35 and mesotrione; compound 37 and mesotrione; compound 38 and mesotrione; compound 57 and mesotrione; compound 61 and mesotrione; compound 66 and mesotrione; compound 72 and mesotrione; compound 74 and mesotrione; compound 78 and mesotrione; compound 82 and mesotrione; compound 11 and metribuzin; compound 12 and metribuzin; compound 21 and metribuzin; compound 26 and metribuzin; compound 31 and metribuzin; compound 35 and metribuzin; compound 37 and metribuzin; compound 38 and metribuzin; compound 57 and metribuzin; compound 61 and metribuzin; compound 66 and metribuzin; compound 72 and metribuzin; compound 74 and metribuzin; compound 78 and metribuzin; compound 82 and metribuzin; compound 11 and metsulfuron-methyl; compound 12 and metsulfuron-methyl; compound 21 and metsulfuron-methyl; compound 26 and metsulfuron-methyl; compound 31 and metsulfuron-methyl; compound 35 and metsulfuron-methyl; compound 37 and metsulfuron-methyl; compound 38 and metsulfuron-methyl; compound 57 and metsulfuron-methyl; compound 61 and metsulfuron-methyl; compound 66 and metsulfuron-methyl; compound 72 and metsulfuron-

methyl; compound 74 and metsulfuron-methyl; compound 78 and metsulfuron-methyl; compound 82 and metsulfuron-methyl; compound 11 and nicosulfuron; compound 12 and nicosulfuron; compound 21 and nicosulfuron; compound 26 and nicosulfuron; compound 31 and nicosulfuron; compound 35 and nicosulfuron; compound 37 and nicosulfuron; compound 38 and nicosulfuron; compound 57 and nicosulfuron; compound 61 and nicosulfuron; compound 66 and nicosulfuron; compound 72 and nicosulfuron; compound 74 and nicosulfuron; compound 78 and nicosulfuron; compound 82 and nicosulfuron; compound 11 and oxyfluorfen; compound 12 and oxyfluorfen; compound 21 and oxyfluorfen; compound 26 and oxyfluorfen; compound 31 and oxyfluorfen; compound 35 and oxyfluorfen; compound 37 and oxyfluorfen; compound 38 and oxyfluorfen; compound 57 and oxyfluorfen; compound 61 and oxyfluorfen; compound 66 and oxyfluorfen; compound 72 and oxyfluorfen; compound 74 and oxyfluorfen; compound 78 and oxyfluorfen; compound 82 and oxyfluorfen; compound 11 and pendimethalin; compound 12 and pendimethalin; compound 21 and pendimethalin; compound 26 and pendimethalin; compound 31 and pendimethalin; compound 35 and pendimethalin; compound 37 and pendimethalin; compound 38 and pendimethalin; compound 57 and pendimethalin; compound 61 and pendimethalin; compound 66 and pendimethalin; compound 72 and pendimethalin; compound 74 and pendimethalin; compound 78 and pendimethalin; compound 82 and pendimethalin; compound 11 and pronamide; compound 12 and pronamide; compound 21 and pronamide; compound 26 and pronamide; compound 31 and pronamide; compound 35 and pronamide; compound 37 and pronamide; compound 38 and pronamide; compound 57 and pronamide; compound 61 and pronamide; compound 66 and pronamide; compound 72 and pronamide; compound 74 and pronamide; compound 78 and pronamide; compound 82 and pronamide; compound 11 and prosulfuron; compound 12 and prosulfuron; compound 21 and prosulfuron; compound 26 and prosulfuron; compound 31 and prosulfuron; compound 35 and prosulfuron; compound 37 and prosulfuron; compound 38 and prosulfuron; compound 57 and prosulfuron; compound 61 and prosulfuron; compound 66 and prosulfuron; compound 72 and prosulfuron; compound 74 and prosulfuron; compound 78 and prosulfuron; compound 82 and prosulfuron; compound 11 and pyrasulfotole; compound 12 and pyrasulfotole; compound 21 and pyrasulfotole; compound 26 and pyrasulfotole; compound 31 and pyrasulfotole; compound 35 and pyrasulfotole; compound 37 and pyrasulfotole; compound 38 and pyrasulfotole; compound 57 and pyrasulfotole; compound 61 and pyrasulfotole; compound 66 and pyrasulfotole; compound 72 and pyrasulfotole; compound 74 and pyrasulfotole; compound 78 and pyrasulfotole; compound 82 and pyrasulfotole; compound 11 and pyroxsulam; compound 12 and pyroxsulam; compound 21 and pyroxsulam; compound 26 and pyroxsulam; compound 31 and pyroxsulam; compound 35 and pyroxsulam; compound 37 and pyroxsulam; compound 38 and pyroxsulam; compound 57 and pyroxsulam; compound 61 and

pyroxsulam; compound 66 and pyroxsulam; compound 72 and pyroxsulam; compound 74 and pyroxsulam; compound 78 and pyroxsulam; compound 82 and pyroxsulam; compound 11 and quinclorac; compound 12 and quinclorac; compound 21 and quinclorac; compound 26 and quinclorac; compound 31 and quinclorac; compound 35 and quinclorac; compound 37 and quinclorac; compound 38 and quinclorac; compound 57 and quinclorac; compound 61 and quinclorac; compound 66 and quinclorac; compound 72 and quinclorac; compound 74 and quinclorac; compound 78 and quinclorac; compound 82 and quinclorac; compound 11 and rimsulfuron; compound 12 and rimsulfuron; compound 21 and rimsulfuron; compound 26 and rimsulfuron; compound 31 and rimsulfuron; compound 35 and rimsulfuron; compound 37 and rimsulfuron; compound 38 and rimsulfuron; compound 57 and rimsulfuron; compound 61 and rimsulfuron; compound 66 and rimsulfuron; compound 72 and rimsulfuron; compound 74 and rimsulfuron; compound 78 and rimsulfuron; compound 82 and rimsulfuron; compound 11 and S-metolachlor; compound 12 and S-metolachlor; compound 21 and S-metolachlor; compound 26 and S-metolachlor; compound 31 and S-metolachlor; compound 35 and S-metolachlor; compound 37 and S-metolachlor; compound 38 and S-metolachlor; compound 57 and S-metolachlor; compound 61 and S-metolachlor; compound 66 and S-metolachlor; compound 72 and S-metolachlor; compound 74 and S-metolachlor; compound 78 and S-metolachlor; compound 82 and S-metolachlor; compound 11 and sulfentrazone; compound 12 and sulfentrazone; compound 21 and sulfentrazone; compound 26 and sulfentrazone; compound 31 and sulfentrazone; compound 35 and sulfentrazone; compound 37 and sulfentrazone; compound 38 and sulfentrazone; compound 57 and sulfentrazone; compound 61 and sulfentrazone; compound 66 and sulfentrazone; compound 72 and sulfentrazone; compound 74 and sulfentrazone; compound 78 and sulfentrazone; compound 82 and sulfentrazone; compound 11 and thifensulfuron-methyl; compound 12 and thifensulfuron-methyl; compound 21 and thifensulfuron-methyl; compound 26 and thifensulfuron-methyl; compound 31 and thifensulfuron-methyl; compound 35 and thifensulfuron-methyl; compound 37 and thifensulfuron-methyl; compound 38 and thifensulfuron-methyl; compound 57 and thifensulfuron-methyl; compound 61 and thifensulfuron-methyl; compound 66 and thifensulfuron-methyl; compound 72 and thifensulfuron-methyl; compound 74 and thifensulfuron-methyl; compound 78 and thifensulfuron-methyl; compound 82 and thifensulfuron-methyl; compound 11 and triasulfuron; compound 12 and triasulfuron; compound 21 and triasulfuron; compound 26 and triasulfuron; compound 31 and triasulfuron; compound 35 and triasulfuron; compound 37 and triasulfuron; compound 38 and triasulfuron; compound 57 and triasulfuron; compound 61 and triasulfuron; compound 66 and triasulfuron; compound 72 and triasulfuron; compound 74 and triasulfuron; compound 78 and triasulfuron; compound 82 and triasulfuron; compound 11 and tribenuron-methyl; compound 12 and tribenuron-methyl; compound 21 and tribenuron-methyl; compound 26 and

tribenuron-methyl; compound 31 and tribenuron-methyl; compound 35 and tribenuron-methyl; compound 37 and tribenuron-methyl; compound 38 and tribenuron-methyl; compound 57 and tribenuron-methyl; compound 61 and tribenuron-methyl; compound 66 and tribenuron-methyl; compound 72 and tribenuron-methyl; compound 74 and tribenuron-methyl; compound 78 and tribenuron-methyl; compound 82 and tribenuron-methyl; compound 11 and triclopyr; compound 12 and triclopyr; compound 21 and triclopyr; compound 26 and triclopyr; compound 31 and triclopyr; compound 35 and triclopyr; compound 37 and triclopyr; compound 38 and triclopyr; compound 57 and triclopyr; compound 61 and triclopyr; compound 66 and triclopyr; compound 72 and triclopyr; compound 74 and triclopyr; compound 78 and triclopyr; compound 82 and triclopyr; compound 11 and triclopyr-butotyl; compound 12 and triclopyr-butotyl; compound 21 and triclopyr-butotyl; compound 26 and triclopyr-butotyl; compound 31 and triclopyr-butotyl; compound 35 and triclopyr-butotyl; compound 37 and triclopyr-butotyl; compound 38 and triclopyr-butotyl; compound 57 and triclopyr-butotyl; compound 61 and triclopyr-butotyl; compound 66 and triclopyr-butotyl; compound 72 and triclopyr-butotyl; compound 74 and triclopyr-butotyl; compound 78 and triclopyr-butotyl; compound 82 and triclopyr-butotyl; compound 11 and triclopyr-triethylammonium; compound 12 and triclopyr-triethylammonium; compound 21 and triclopyr-triethylammonium; compound 26 and triclopyr-triethylammonium; compound 31 and triclopyr-triethylammonium; compound 35 and triclopyr-triethylammonium; compound 37 and triclopyr-triethylammonium; compound 38 and triclopyr-triethylammonium; compound 57 and triclopyr-triethylammonium; compound 61 and triclopyr-triethylammonium; compound 66 and triclopyr-triethylammonium; compound 72 and triclopyr-triethylammonium; compound 74 and triclopyr-triethylammonium; compound 78 and triclopyr-triethylammonium; compound 82 and triclopyr-triethylammonium;

Compounds of this invention can also be used in combination with herbicide safeners such as benoxacor, BCS (1-bromo-4-[(chloromethyl)sulfonyl]benzene), cloquintocet-mexyl, cyometrinil, cyprosulfamide, dichlormid, dicyclonon, dietholate, 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone ((4-methoxy-3-methylphenyl)(3-methylphenyl)methanone), naphthalic anhydride (1,8-naphthalic anhydride) and oxabetrinil 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.

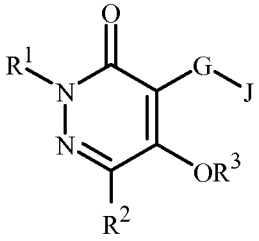
Compounds of this invention can also be used in combination with plant growth regulators such as aviglycine, *N*-(phenylmethyl)-1*H*-purin-6-amine, epocholeone, gibberellic acid, gibberellin A_4 and A_7, harpin protein, mepiquat chloride, prohexadione calcium, prohydrojasmon, sodium nitrophenolate and 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 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.

The following Tests demonstrate the control efficacy of the compounds of this invention against specific weeds. The weed control afforded by the compounds is not limited, however, to these species. See Index Table A for compound descriptions. The following abbreviations are used in the Index Tables which follow: *t* is tertiary, *i* is iso, *c* is cyclo, Me is methyl, CH_3O or OMe is methoxy, Pr is propyl, *i*-Pr is isopropyl, *c*-Pr is cyclopropyl, *t*-Bu is *tert*-butyl SO_2 means sulfonyl ($S(O)_2$), and naphthyl means naphthalenyl, CF_3 is trifluoromethyl, CF_3O is trifluoromethoxy, THP means tetrahydropyranyl, Ph means phenyl, NO_2 is nitro, Cl is chloro, F is fluoro and Br is bromo. The abbreviation "Ex." stands for "Example" and is followed by a number indicating in which example the compound is prepared.

INDEX TABLE A



Cmpd. No.	R^1	R^2	R^3	G	J	M.P. (°C)
1 (Ex 1)	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
2	Me	H	CO-*t*-Bu	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
3 (Ex 2)	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
4	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
5	Me	H	CO-*c*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
6	Me	H	CO_2-*i*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
7 (Ex 3)	Me	H	CO_2-*i*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
8	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-[3-(CF_3)-Ph]	*
9	Me	H	CO_2-*i*-Pr	2-Me-1*H*-imidazol-1-yl	4-(4-Cl-Ph)	*
10	Me	H	H	2-Me-1*H*-imidazol-1-yl	4-(4-Cl-Ph)	*
11	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	202-204
12	Me	H	CO_2-*i*-Pr	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	179-182
13	Me	H	CO_2-*i*-Pr	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3O)-Ph]	*
14	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3O)-Ph]	*
15	Me	Me	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
16	Me	Me	H	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
17	Me	H	H	5-Me-1*H*-triazol-1-yl	3-(4-Cl-Ph)	*
18	Me	H	CO-*t*-Bu	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
19	Me	H	SO_2Me	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
20	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-(3,4-di-Cl-Ph)	*
21	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
22	Me	H	CO_2-*i*-Pr	5-Et-1*H*-pyrazol-1-yl	3-(3,4-di-Cl-Ph)	*
23	Me	H	H	5-SMe-1*H*-pyrazol-1-yl	3-(4-F-Ph)	*
24	Me	H	H	4-Me-thiazol-5-yl	2-[4-(CF_3)-Ph]	209-213
25	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-(4-F-Ph)	*

Cmpd. No.	R^1	R^2	R^3	G	J	M.P. (°C)
26	Me	H	H	4-Me-5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	227-229
27	Me	*i*-Pr	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
28	Me	H	H	4-Cl-1*H*-pyrazol-3-yl	1-(4-Cl-Ph)	235-240
29	Me	H	H	3-Me-1*H*-pyrazol-4-yl	1-(4-Cl-Ph)	243-247
30	Me	H	H	4-Me-1*H*-pyrazol-3-yl	1-(4-Cl-Ph)	147-151
31	Me	H	H	4-Br-1*H*-pyrazol-3-yl	1-(4-Cl-Ph)	189-191
32	Me	H	CO-(3-Cl-Ph)	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	170-175
33	Me	H	CO_2Me	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	149-151
34	Me	H	CO-*i*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	107-110
35	Me	H	SO_2Ph	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	136-139
36	Me	H	SO_2Me	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	122-125
37	Me	H	CO-*i*-Bu	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	125-129
38	Me	H	CO-(2-Cl-Ph)	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	103-106
39	Me	H	SO_2Me	5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
40	Me	H	CO-*t*-Bu	5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
41	Me	H	CO_2-*i*-Pr	5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
42	Me	CF_3	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
43	Me	H	H	5-*n*-Pr-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
44	Me	CF_3	H	5-Me-1*H*-pyrazol-1-yl	3-[3-F-4-(CF_3)-Ph]	*
45	Me	H	H	5-*c*-Pr-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
46	Me	H	H	2-Me-Ph	5-(4-Cl-Ph)	235-238
47	Me	H	SO_2-1-Naphthyl	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	156-160
48	Me	H	CO-Ph	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	165-168
49	Me	H	SO_2-*c*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	152-155
50	Me	H	SO_2-*i*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	130-134
51	Me	H	SO_2-(2-NO_2-Ph)	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	186-189
52	Me	H	CO-2-Thienyl	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	150-153
53	Me	H	CO_2Et	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	131-135
54	Me	H	CO_2Ph	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	169-173
55	Me	H	SO_2-(2-Cl-thien-5-yl)	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	128-131
56	Me	H	CO-*n*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	109-114
57	Me	H	CO_2-*i*-Bu	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	171-174
58	Me	H	$CO_2CH_2C\equiv CH$	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	190-192
59	Me	Me	H	5-Cl-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*

Cmpd. No.	R^1	R^2	R^3	G	J	M.P. (°C)
60	Me	H	H	2-Me-Ph	4-(4-Cl-1*H*-pyrazol-1-yl)	*
61	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
62	Me	H	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CH_3O)-Ph]	*
63	Me	H	H	5-Et-1*H*-pyrazol-1-yl	3-(2-Cl-thien-5-yl)	*
64	Me	H	$CONMe_2$	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	191-194
65	Et	H	H	3-Me-1*H*-pyrazol-4-yl	1-(4-Cl-Ph)	160-165
66	Me	OMe	H	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
67	Et	H	H	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
68	Me	H	H	5-CH_2OMe-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	117-120
69	Me	H	$CSNMe_2$	5-Me-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	119-123
70	Me	H	H	4-Br-5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
71	Me	H	H	4-Br-1*H*-pyrazol-3-yl	1-[5-(CF_3)-pyridin-2-yl]	*
72	Me	H	H	5-*n*-Pr-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
73	$CHCF_3$	H	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
74	Me	Me	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	203-205
75	Me	Me	H	5-Me-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	191-194
76	Me	H	H	5-*n*-Pr-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	194-198
77 (Ex 9)	2-THP	H	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
78 (Ex 10)	H	H	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	325-335
79 (Ex 4)	Me	Me	H	5-Me-thiazol-4-yl	2-(4-Cl-Ph)	*
80 (Ex 11)	CO-*c*-Pr	H	CO-*c*-Pr	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	**
81	Me	Me	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	200-204
82	Me	OMe	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	222-225
83	Me	H	H	4-Me-5-Et-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	*
84	Me	H	H	4-Me-1*H*-pyrazol-3-yl	1-(5-Cl-pyridin-2-yl)	238-241
85	Me	H	H	4-Me-1*H*-pyrazol-3-yl	1-[4-(CF_3)-Ph]	150-154

Cmpd. No.	R^1	R^2	R^3	G	J	M.P. (°C)
(Ex 7)						
86	Me	Me	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
87	Me	H	H	4-Br-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	237-241
(Ex 6)						
88	Me	H	H	4-Cl-1*H*-pyrazol-3-yl	1-[4-(CF_3)-Ph]	176-179
89	Me	OMe	H	5-Et-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	214-216
90	Me	H	H	5-Me-Pyrimdin-4-yl	3-[4-(CF_3)-Ph]	142-145
91	Me	H	H	5-*n*-Bu-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
92	Me	H	H	5-*i*-Bu-1*H*-pyrazol-1-yl	3-(4-Cl-Ph)	*
93	Me	OMe	H	5-Me-1*H*-pyrazol-1-yl	3-(4-Br-Ph)	208-211
94	Me	H	CO-(6-Cl-pyridin-3-yl)	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
95	Me	H	CO-*c*-hexyl	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
96	Me	H	$SO_2N(Me)_2$	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*
97	Me	H	CO-4-Morpholinyl	5-Et-1*H*-pyrazol-1-yl	3-[4-(CF_3)-Ph]	*

* See Index Table B for ^{1}H NMR or mass spectra data.
** See synthesis example for ^{1}H NMR data.
Cmpd. No. means Compound Number.

INDEX TABLE B

Cmpd. No.	^{1}H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a] or mass spectra data[b]
1	δ 7.89 (s, 3H), 7.86 (m, 2H), 7.68 (m, 2H), 6.60 (s, 1H), 3.81 (s, 3H), 2.35 (s, 3H)
2	δ 7.87 (s, 1H), 7.82 (m, 2H), 7.62 (m, 2H), 6.54 (s, 1H), 3.89 (s, 3H), 1.09 (s, 9H)
3	δ 7.77 (s, 1H), 7.66 (m, 2H), 7.40 (m, 2H), 6.46 (s, 1H), 3.80 (s, 3H), 2.27 (s, 3H)
4	δ 7.77 (s, 1H), 7.55 (m, 4H), 6.45 (s, 1H), 3.80 (s, 3H), 2.26 (s, 3H)
5	δ 7.84 (s, 1H), 7.67 (m, 2H), 7.52 (m, 2H), 6.46 (s, 1H), 3.87 (s, 3H), 2.30 (s, 3H), 1.65 (m, 1H), 0.92 (m, 2H), 0.86 (m, 2H)
6	δ 7.89 (s, 1H), 7.64 (m, 2H), 7.52 (m, 2H), 6.48 (s, 1H), 4.73 (m, 1H), 3.88 (s, 3H), 2.33 (s, 3H), 1.12 (m, 6H)
7	δ 7.89 (s, 1H), 7.69 (m, 2H), 7.35 (m, 2H), 6.45 (s, 1H), 4.75 (m, 1H), 3.88 (s, 3H), 2.33 (s, 3H), 1.12 (m, 6H)
8	δ 7.92 (s, 1H), 7.79 (s, 1H), 7.61 (m, 1H), 7.55 (m, 1H), 6.54 (s, 1H), 3.81 (s, 3H), 2.30 (s, 3H)
9	δ 7.93 (s, 1H), 7.68 (d, 2H), 7.32 (d, 2H), 7.26 (s, 1H), 4.64 - 4.94 (m, 1H), 3.90 (s, 3H), 2.36 (s, 3H), 1.08 - 1.34 (m, 6H)
10	DMSO-d_6 δ 7.76 (d, 2H), 7.68 (s, 1H), 7.62 (s, 1H), 7.46 (d, 2H), 3.58 (s, 3H), 2.23 (s, 3H)

Cmpd. No.	^{1}H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a] or mass spectra data[b]
13	δ 7.89 (s, 1H), 7.77 (m, 2H), 7.18 (m, 2H), 6.50 (s, 1H), 4.71 (m, 1H), 3.88 (s, 3H), 2.34 (s, 3H), 1.10 (m, 6H)
14	δ 7.77 (s, 1H), 7.73 (m, 2H), 7.26 (m, 2H), 6.42 (s, 1H), 3.79 (s, 3H), 2.18 (s, 3H)
15	δ 7.67 (d, 2H), 7.39 (d, 2H), 6.49 (s, 1H), 3.78 (s, 3H), 2.36 (s, 6H)
16	δ 7.89 (d, 2H), 7.67 (d, 2H), 6.62 (s, 1H), 3.78 (s, 3H), 2.80 (d, 2H), 2.37 (s, 3H), 1.28 (t, 3H)
17	δ 7.89 (d, 2H), 7.81 (s, 1H), 7.37 (d, 2H), 3.80 (s, 3H), 2.52 (s, 3H)
18	δ 7.89 (s, 1H), 7.84 (m, 2H), 7.62 (m, 2H), 6.56 (s, 1H), 3.88 (s, 3H), 2.70 (m, 1H), 2.49 (m, 1H), 1.30 (m, 3H), 1.09 (s, 9H)
19	δ 8.09 (s, 1H), 7.90 (m, 2H), 7.65 (m, 2H), 6.62 (s, 1H), 3.90 (s, 3H), 3.04 (s, 3H), 2.70 (br, 1H), 2.50 (br, 1H), 1.32 (m, 3H)
20	δ 7.85 (s, 1H), 7.79 (s, 1H), 7.59 (m, 1H), 7.50 (m, 1H), 6.52 (s, 1H), 3.82 (s, 3H), 2.73 (m, 2H), 1.25 (m, 3H)
21	δ 7.89 (s, 1H), 7.69 (m, 2H), 7.39 (m, 2H), 6.50 (s, 1H), 3.81 (s, 3H), 2.69 (m, 1H), 1.22 (m, 3H)
22	δ 7.91 (s, 1H), 7.88 (s, 1H), 7.61 (m, 1H), 7.45 (m, 1H), 6.50 (s, 1H), 4.78 (m, 1H) 3.87 (s, 3H), 2.64 (br, 2H), 1.25 (m, 3H), 1.16 (br, 6H)
23	δ 7.79 (s, 1H), 7.73 (m, 2H), 7.13 (m, 2H), 6.57 (s, 1H), 3.83 (s, 3H), 2.47 (s, 3H)
24	Acetone-d_6 δ 8.19 (m, 2H), 7.84 (m, 2H), 7.81 (s, 1H), 3.69 (s, 3H), 2.35 (s, 3H)
25	δ 7.74 (s, 1H), 7.71 (m, 2H), 7.11 (m, 2H), 6.45 (s, 1H), 3.79 (s, 3H), 2.63 (m, 2H), 1.20 (m, 3H)
27	δ 7.78 (d, 2H), 7.66 (d, 2H), 6.36 (s, 1H), 3.75 (s, 3H), 3.23 (m, 1H), 2.07 (s, 3H), 1.24 (d, 6H)
32	δ 8.01 (s, 1H), 7.92 (m, 1H), 7.79 (m, 1H), 7.45 (m, 3H), 7.22 (m, 3H), 6.40 (s, 1H), 3.92 (s, 3H), 2.36 (m, 2H)
33	δ 7.91 (s, 1H), 7.73 (m, 2H), 7.34 (m, 2H), 6.46 (s, 1H), 3.88 (m, 3H), 3.71 (m, 3H), 2.33 (s, 3H)
39	δ 8.07 (s, 1H), 7.70 (m, 2H), 7.37 (m, 2H), 6.56 (s, 1H), 3.88 (s, 3H), 3.02 (s, 3H), 2.67 (br, 1H), 2.48 (br, 1H), 1.30 (m, 3H)
40	δ 7.82 (s, 1H), 7.71 (m, 2H), 7.34 (m, 2H), 6.48 (s, 1H), 3.87 (s, 3H), 2.73 m, 1H), 2.46 (m, 1H), 1.29 (m, 3H), 1.09 (s, 9H)
41	δ 7.90 (s, 1H), 7.71 (m, 2H), 7.34 (m, 2H), 6.49 (s, 1H), 4.74 (m, 2H), 3.87 (s, 3H), 2.64 (br, 2H), 1.30 (m, 3H), 1.14 (m, 6H)
42	δ 7.84 (d, 2H) 7.69 (d, 2H) 6.60 (s, 1H) 3.86 (s, 3H) 2.38 (s, 3H)
43	δ 7.75 (s, 1H), 7.67 (m, 2H), 7.39 (m, 2H),), 6.47 (s, 1H), 3.79 (s, 3H), 2.59 (m, 2H), 1.60 (m, 2H), 0.95 (m, 3H)
44	δ 7.79 (s, 1H), 7.62 (m, 3H), 6.56 (s, 1H), 3.82 (s, 3H), 2.70 (m, 2H), 1.24 (m, 3H)
45	δ 7.74 (s, 1H), 7.62 (m, 2H), 7.37 (m, 2H), 6.19 (s, 1H), 3.79 (s, 3H), 1.97 (m, 1H), 0.91 (m, 2H), 0.59 (m, 2H)
59	δ 7.60 (m, 2H), 7.39 (m, 2H), 6.56 (s, 1H), 3.75 (s, 3H), 2.32 (s, 3H)

Cmpd. No.	^{1}H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a] or mass spectra data[b]
60	δ 9.95 (br, 1H), 7.82 (s, 1H), 7.58 (s, 1H), 7.49 (s, 1H), 7.39 (d, 1H), 7.26 (m, 1H), 7.04 (d, 1H), 3.65 (s, 3H), 2.04 (s, 3H)
61	δ 7.75 (s, 1H), 7.60 (m, 2H), 7.55 (m, 2H), 6.49 (s, 1H), 3.80 (s, 3H), 2.67 (m, 2H), 1.22 (m, 3H)
62	δ 7.71 (s, 1H), 7.63 (m, 2H), 6.95 (m, 2H), 6.39 (s, 1H), 3.84 (s, 3H), 3.79 (s, 3H), 2.20 (s, 3H)
63	δ 7.75 (s, 1H), 7.11 (m, 2H), 6.88 (m, 2H), 6.36 (s, 1H), 3.79 (s, 3H), 2.66 (m, 2H), 1.22 (m, 3H)
66	DMSO-d_6. δ 7.96 (m, 2H), 7.71 (m, 2H), 6.62 (s, 1H), 3.71 (s, 3H), 3.31 (s, 3H), 2.34 (m, 2H), 1.13 (m, 3H)
67	δ 7.87 (m, 2H), 7.82 (s, 1H), 7.66 (m, 2H), 6.61 (s, 1H), 4.24 (m, 2H), 2.76 (m, 2H), 1.39 (m, 3H), 1.27 (m, 3H)
70	δ 7.78 (m, 2H), 7.75 (s, 1H), 7.59 (m, 2H), 3.82 (s, 3H), 2.31 (s, 3H)
71	δ 8.82 (s, 1H), 8.74 (s, 1H), 8.11 (m, 1H), 7.97 (m, 1H), 7.77 (s, 1H), 3.83 (s, 3H)
72	Acetone-d_6 δ 8.06 (m, 2H), 7.88 (s, 1H), 7.75 (m, 2H), 6.79 (s, 1H), 3.72 (s, 3H), 2.56 (m, 2H), 1.68 (m, 2H), 0.96 (m, 3H)
73	δ 7.82 (s, 1H), 7.60 (m, 2H), 7.57 (m, 2H), 6.51 (s, 1H), 4.79 (m, 2H), 2.64 (m, 2H), 1.22 (m, 3H)
77	Mass Spec: AP+ = 432
83	δ 7.70 (s, 1H), 7.57 (m, 2H), 7.48 (m, 2H), 3.78 (s, 3H), 2.69 (s, 3H), 2.16 (s, 3H), 1.05 (m, 3H)
86	δ 7.72 (m, 2H), 7.39 (m, 2H), 6.55 (s, 1H), 3.78 (s, 3H), 2.80 (m, 2H), 2.36 (s, 3H), 1.28 (m, 3H)
91	δ 7.74 - 7.80 (m, 1H), 7.68 (d, 2H), 7.39 (d, 2H), 6.51 (s, 1H), 3.80 (s, 3H), 2.66 (q, 2H), 1.52 - 1.63 (m, 2H), 1.30 - 1.43 (m, 2H), 0.92 (t, 3H)
92	DMSO-d_6 δ 7.88 (s, 1H), 7.81 (d, 2H), 7.41 - 7.50 (m, 2H), 6.66 - 6.76 (m, 1H), 3.65 (s, 3H), 2.29 (dd, 2H), 1.76 - 1.93 (m, 1H), 0.87 (d, 6H)
94	8.84 (s, 1H), 8.03 (d, 1H), 8.03 (s, 1H), 7.62 (d, 2H), 7.53 (d, 2H), 7.25 (dd, 1H), 6.51 (s, 1H), 3.93 (s, 3H), 2.70 (m, 2H), 1.33 (t, 3H)
95	7.90 (d, 2H) 7.83 (s, 1H), 7.62 (d, 2H), 6.55 (s, 1H), 3.87 (s, 3H), 2.80 - 2.50 (m, 2H), 2.35 (m,1H), 1.68 (m, 2H), 1.55 (m, 4H), 1.35 (t, 3H), 1.33 (m, 2H), 1.1 (m, 2H)
96	8.18 (s, 1H), 7.90 (d, 2H), 7.59 (d, 2H), 6.60 (s, 1H), 3.89 (s, 3H), 2.72 (s, 6H), 2.71 - 2.50 (m, 2H), 1.30 (t, 3H)
97	8.02 (s, 1H), 7.9 (d, 2H), 7.76 (d, 2H), 6.58 (s, 1H), 3.88 (s, 3H), 3.33 (m, 8H), 2.80 - 2.50 (m, 2H), 1.33 (t, 3H)

Cmpd. No. means Compound number. [a] ^{1}H NMR data are in ppm downfield from tetramethylsilane. Couplings are designated by (s)-singlet, (m)-multiplet, (d)-doublet, (q)-quartet, (dd) doublet of doublets, (br)-broad and (t)-triplet. [b] Mass spectra are reported as the molecular weight of the highest isotopic abundance parent ion (M+1) formed by addition of H^+ (molecular weight of 1) to the molecule, observed by mass spectrometry using atmospheric pressure chemical ionization (AP^+).

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

Seeds of species selected from barnyardgrass (*Echinochloa crus-galli*), large crabgrass (*Digitaria sanguinalis*), giant foxtail (*Setaria faberi*), blackgrass (*Alopecurus myosuroides*), canarygrass (*Phalaris minor*), morningglory (*Ipomoea coccinea*), pigweed (*Amaranthus retroflexus*), velvetleaf (*Abutilon theophrasti*), wheat (*Triticum aestivum*), and corn (*Zea mays*) 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 these species were also treated with postemergence applications of test chemicals formulated in the same manner.

Plants ranged in height from 2 to 10 cm and were in the one- to two-leaf stage for the postemergence treatment. Treated plants and untreated controls were maintained in a greenhouse for approximately 10 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 results.

Table A	Compounds	
1000 g ai/ha	1	2
Postemergence		
Barnyardgrass	100	100
Corn	100	90
Crabgrass, Large	100	80
Foxtail, Giant	100	90

Table A	Compounds	
1000 g ai/ha	1	2
Postemergence		
Morningglory	60	0
Pigweed	30	0
Velvetleaf	60	40
Wheat	100	90

Table A	Compounds													
500 g ai/ha	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Postemergence														
Barnyardgrass	100	100	100	100	100	0	0	0	100	100	90	100	100	100
Corn	100	100	100	100	100	0	0	0	90	90	60	80	90	100
Crabgrass, Large	100	100	100	90	90	0	0	0	100	100	80	90	100	100
Foxtail, Giant	100	100	100	90	90	0	0	0	100	100	80	100	100	100
Morningglory	60	20	0	50	20	50	0	0	0	0	0	0	0	0
Pigweed	10	20	0	30	0	0	0	0	0	0	0	0	0	0
Velvetleaf	50	60	50	50	40	40	0	0	0	0	0	30	0	0
Wheat	90	80	70	70	60	0	0	0	100	90	60	70	60	90

Table A	Compounds													
500 g ai/ha	17	19	20	21	22	23	24	26	27	28	29	30	31	42

Postemergence														
Barnyardgrass	90	100	100	100	90	70	10	100	90	100	50	90	90	0
Corn	40	90	90	90	90	20	20	100	80	90	0	70	70	20
Crabgrass, Large	80	100	100	100	80	20	10	100	80	90	50	90	90	0
Foxtail, Giant	90	100	100	100	80	80	40	100	90	90	80	90	90	10
Morningglory	0	0	0	0	0	0	0	20	0	30	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	20	0	0	0	0	0	0
Wheat	50	90	70	80	60	0	20	60	90	70	20	50	60	10

Table A	Compounds			
500 g ai/ha	60	62	65	77
Postemergence				
Barnyardgrass	90	100	0	100
Blackgrass	-	-	-	100
Canarygrass	-	-	-	100
Corn	90	40	0	100
Crabgrass, Large	60	90	20	100
Foxtail, Giant	80	60	20	100
Morningglory	0	0	0	-
Pigweed	0	0	0	0
Velvetleaf	0	0	0	-
Wheat	50	20	0	90

Table A	Compound
250 g ai/ha	18
Postemergence	
Barnyardgrass	100
Corn	90
Crabgrass, Large	100
Foxtail, Giant	100
Morningglory	0
Pigweed	0
Velvetleaf	0
Wheat	80

Table A	Compounds													
125 g ai/ha	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Postemergence														
Barnyardgrass	100	100	100	90	80	0	0	0	100	90	50	70	100	90
Corn	90	90	100	100	50	0	0	0	90	90	30	40	70	90
Crabgrass, Large	100	100	100	90	80	0	0	0	90	90	20	60	90	90
Foxtail, Giant	100	100	100	90	90	0	0	0	90	80	70	80	90	100
Morningglory	50	0	0	30	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	20	20	40	20	20	0	0	0	0	0	0	0	0
Wheat	70	60	60	50	40	0	0	0	80	70	50	40	50	70

Table A	Compounds													
125 g ai/ha	17	19	20	21	22	23	24	25	26	27	28	29	30	31
Postemergence														
Barnyardgrass	50	100	80	100	50	0	0	100	100	20	60	10	50	60

Corn	0	90	70	80	20	0	0	80	60	50	40	0	0	10
Crabgrass, Large	40	90	80	90	10	0	0	90	80	60	80	0	60	60
Foxtail, Giant	80	100	90	100	60	20	0	100	90	50	90	0	80	90
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	60	50	60	20	0	0	20	0	50	50	0	40	40

Table A Compounds

125 g ai/ha	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Postemergence														
Barnyardgrass	70	100	100	90	100	100	100	100	100	100	0	100	100	100
Corn	50	90	90	60	80	100	90	100	100	90	20	80	90	80
Crabgrass, Large	70	100	100	90	90	90	100	100	100	90	0	90	100	100
Foxtail, Giant	90	100	100	90	90	100	90	100	100	90	0	100	100	100
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	10	0	10	0	10	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	20	70	60	60	60	70	60	80	90	70	0	80	80	90

Table A Compounds

125 g ai/ha	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Postemergence														
Barnyardgrass	50	40	90	0	70	80	100	100	100	30	100	80	80	100
Corn	50	10	60	0	30	60	100	90	90	40	100	60	60	70
Crabgrass, Large	40	50	80	20	40	70	90	100	90	60	100	80	70	90
Foxtail, Giant	60	60	80	20	60	70	90	100	100	70	100	90	90	90
Morningglory	0	0	0	0	0	0	0	20	0	0	0	0	0	0
Pigweed	0	0	30	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	70	0	0	0	20	0	0	0	0	0	0	0
Wheat	30	10	60	0	20	40	60	70	60	30	80	50	60	60

Table A Compounds

125 g ai/ha	60	61	62	63	64	65	66	67	68	69	70	71	72	73
Postemergence														
Barnyardgrass	30	100	40	20	10	0	100	100	100	100	50	90	100	100
Blackgrass	-	-	-	-	-	-	-	-	80	60	10	-	100	90
Canarygrass	-	-	-	-	-	-	-	-	40	80	0	-	100	100
Corn	40	100	0	30	60	0	100	100	50	90	20	40	100	100
Crabgrass, Large	20	100	50	10	40	0	100	100	10	80	0	80	90	100

Foxtail, Giant	50	100	40	60	80	0	100	100	90	100	0	90	100	100
Morningglory	0	0	0	0	0	0	0	0	-	-	-	0	-	-
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Velvetleaf	0	0	0	0	0	0	0	0	-	-	-	0	-	-
Wheat	0	90	0	20	0	0	100	100	0	30	0	80	90	70

Table A	Compounds													
125 g ai/ha	74	75	76	77	78	79	80	81	82	83	84	85	86	87
Postemergence														
Barnyardgrass	100	90	100	50	100	50	100	100	100	100	0	30	100	90
Blackgrass	100	90	100	100	100	100	100	100	100	100	0	40	100	80
Canarygrass	100	80	100	60	70	90	100	100	100	100	0	20	100	70
Corn	100	90	100	80	100	30	100	100	100	100	0	0	90	40
Crabgrass, Large	100	80	100	70	100	50	100	100	100	100	10	40	100	80
Foxtail, Giant	100	80	90	80	100	70	100	100	100	100	10	60	90	80
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	80	70	50	70	90	50	70	70	100	60	0	20	50	50

Table A	Compounds						
125 g ai/ha	88	89	90	92	93	94	95
Postemergence							
Barnyardgrass	90	100	0	80	100	100	100
Blackgrass	70	100	0	50	100	100	100
Canarygrass	70	100	0	30	100	100	100
Corn	50	100	0	20	100	100	100
Crabgrass, Large	90	100	0	10	100	100	100
Foxtail, Giant	90	100	0	60	100	100	100
Pigweed	0	0	0	0	0	0	0
Wheat	60	90	0	30	80	80	80

Table A	Compound
62 g ai/ha	18
Postemergence	
Barnyardgrass	90
Corn	80
Crabgrass, Large	80
Foxtail, Giant	90
Morningglory	0
Pigweed	0
Velvetleaf	0
Wheat	70

Table A	Compounds													
31 g ai/ha	25	32	33	34	35	36	37	38	39	40	41	43	44	45
Postemergence														
Barnyardgrass	80	0	90	90	60	80	90	40	100	100	80	90	100	80
Corn	20	0	60	70	0	50	60	20	70	90	60	50	70	40
Crabgrass, Large	60	10	90	70	40	80	50	40	60	70	20	40	50	40
Foxtail, Giant	90	10	90	90	60	90	80	80	90	100	70	80	90	90
Morningglory	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Wheat	0	0	20	40	0	0	20	0	40	70	60	40	70	70

Table A	Compounds													
31 g ai/ha	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Postemergence														
Barnyardgrass	0	0	20	0	0	20	80	90	80	0	100	0	0	90
Corn	20	0	20	0	0	20	30	80	40	0	90	0	0	30
Crabgrass, Large	0	10	20	0	0	20	60	80	70	10	80	0	0	50
Foxtail, Giant	20	10	30	0	0	20	80	90	90	20	100	0	20	90
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	0	0	0	30	20	30	0	70	0	0	0

Table A	Compounds													
31 g ai/ha	61	63	64	66	67	68	69	70	71	72	73	74	75	76
Postemergence														
Barnyardgrass	100	0	0	100	100	10	90	0	10	50	60	100	10	90
Blackgrass	-	-	-	-	-	0	10	0	-	80	90	100	40	90
Canarygrass	-	-	-	-	-	0	0	0	-	40	20	100	10	40
Corn	100	0	0	100	90	0	60	0	0	80	90	60	0	20
Crabgrass, Large	100	10	0	100	80	10	40	0	20	20	40	60	20	20
Foxtail, Giant	100	0	30	100	100	50	90	0	30	90	50	70	50	70
Morningglory	0	0	0	0	0	-	-	-	0	-	-	-	-	-
Pigweed	0	0	0	0	0	0	0	0	0	0	10	0	0	0
Velvetleaf	0	0	0	0	0	-	-	-	0	-	-	-	-	-
Wheat	80	0	0	90	90	0	0	0	0	60	40	70	10	20

Table A	Compounds													
31 g ai/ha	78	79	80	81	82	83	84	85	86	87	88	89	90	92
Postemergence														
Barnyardgrass	90	0	100	90	100	100	0	0	100	0	10	100	0	0
Blackgrass	90	60	30	100	100	90	0	0	80	30	10	100	0	0
Canarygrass	40	40	40	60	100	70	0	0	-	10	30	100	0	0
Corn	60	0	60	30	80	0	0	0	30	0	0	100	0	0
Crabgrass, Large	80	30	60	90	100	60	0	0	70	10	40	100	0	0
Foxtail, Giant	80	10	90	80	100	90	0	0	70	20	40	100	0	10
Pigweed	0	0	0	0	0	0	0	0	0	0	0	-	0	0
Wheat	70	0	30	0	90	0	0	0	20	20	20	80	0	0

Table A	Compound		
31 g ai/ha	93	94	95
Postemergence			
Barnyardgrass	100	100	100
Blackgrass	90	80	70
Canarygrass	80	70	90
Corn	80	100	90
Crabgrass, Large	100	90	90
Foxtail, Giant	100	100	100
Pigweed	0	0	0
Wheat	70	50	70

Table A	Compounds	
1000 g ai/ha	1	2
Preemergence		
Barnyardgrass	100	100
Corn	100	80
Crabgrass, Large	90	100
Foxtail, Giant	100	100
Morningglory	0	0
Pigweed	20	0
Velvetleaf	0	60
Wheat	90	90

Table A	Compounds													
500 g ai/ha	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preemergence														
Barnyardgrass	100	100	100	100	100	0	0	0	100	100	100	100	100	100
Corn	90	90	90	90	90	0	0	0	100	90	70	60	90	90
Crabgrass, Large	100	100	100	100	100	0	0	0	100	100	90	90	100	100
Foxtail, Giant	100	100	100	100	100	0	0	0	100	100	100	100	100	100
Morningglory	0	0	0	40	20	0	0	0	30	0	0	0	0	0
Pigweed	0	0	0	40	0	0	0	0	30	0	0	0	0	0
Velvetleaf	10	10	20	50	30	0	0	0	0	0	20	20	0	0
Wheat	90	100	100	90	80	0	0	0	100	100	70	80	80	100

Table A	Compounds													
500 g ai/ha	17	19	20	21	22	23	24	26	27	28	29	30	31	42
Preemergence														
Barnyardgrass	100	100	100	100	100	10	30	100	100	100	70	100	100	0
Corn	40	90	90	100	70	20	0	90	80	90	0	70	70	0
Crabgrass, Large	70	100	100	100	90	0	60	100	100	100	40	100	100	0
Foxtail, Giant	90	100	100	100	100	70	80	100	90	100	100	100	100	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Velvetleaf	0	0	0	0	0	0	0	0	0	20	0	0	0	0
Wheat	50	100	80	100	70	0	0	70	100	100	0	90	90	0

Table A	Compounds			
500 g ai/ha	60	62	65	77
Preemergence				

Table A	Compound
250 g ai/ha	18
Preemergence	

Barnyardgrass	100	90	0	100	Barnyardgrass	100	
Blackgrass	-	-	-	100	Corn	90	
Canarygrass	-	-	-	90	Crabgrass, Large	100	
Corn	90	20	0	80	Foxtail, Giant	100	
Crabgrass, Large	80	60	0	100	Morningglory	0	
Foxtail, Giant	100	30	90	100	Pigweed	0	
Morningglory	0	0	0	-	Velvetleaf	0	
Pigweed	0	0	0	0	Wheat	100	
Velvetleaf	0	0	0	-			
Wheat	50	0	0	80			

Table A	Compounds													
125 g ai/ha	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Preemergence														
Barnyardgrass	90	100	90	90	100	0	0	0	100	100	60	70	100	100
Corn	80	70	80	80	60	0	0	0	90	80	20	0	50	70
Crabgrass, Large	100	100	100	100	100	0	0	0	100	100	60	70	80	90
Foxtail, Giant	100	100	100	100	100	0	0	0	100	100	70	80	90	100
Morningglory	0	0	0	30	20	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	20	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	40	0	0	0	0	0	0	0	0	0	0
Wheat	70	70	90	80	60	0	0	0	100	90	20	10	60	70

Table A	Compounds													
125 g ai/ha	17	19	20	21	22	23	24	25	26	27	28	29	30	31
Preemergence														
Barnyardgrass	40	100	90	100	30	0	0	100	100	80	100	0	100	100
Corn	0	80	60	90	30	0	0	50	50	20	80	0	0	50
Crabgrass, Large	0	100	90	100	50	0	0	90	90	80	90	0	100	100
Foxtail, Giant	40	100	90	100	90	20	0	100	100	80	100	60	100	100
Morningglory	0	0	0	0	0	0	0	0	0	0	-	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	20	90	60	90	40	0	0	50	20	40	70	0	40	60

Table A	Compounds													
125 g ai/ha	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Preemergence														
Barnyardgrass	90	100	100	100	100	100	100	100	100	100	0	100	100	100
Corn	60	90	60	80	80	90	70	90	90	90	0	90	80	60

Crabgrass, Large	90	100	90	100	100	100	100	100	100	100	0	90	100	90
Foxtail, Giant	100	100	100	100	100	100	100	100	100	100	0	100	100	100
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	30	30	0	0	0	-	0	0	0	0	0
Velvetleaf	10	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	60	80	70	80	90	90	60	80	90	80	0	70	80	80

Table A Compounds

125 g ai/ha	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Preemergence														
Barnyardgrass	100	80	100	0	100	100	100	100	100	80	100	100	100	100
Corn	0	40	80	0	20	80	70	70	60	40	80	50	20	60
Crabgrass, Large	90	90	100	40	90	100	100	100	100	80	100	100	90	50
Foxtail, Giant	100	90	100	80	90	100	100	100	100	90	100	100	100	90
Morningglory	0	0	0	0	0	0	20	0	20	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	50	40	80	0	50	80	80	90	60	50	80	70	70	50

Table A Compounds

125 g ai/ha	60	61	62	63	64	65	66	67	68	69	70	71	72	73
Preemergence														
Barnyardgrass	70	100	10	10	0	0	100	100	90	70	0	40	90	10
Blackgrass	-	-	-	-	-	-	-	-	50	40	0	-	100	90
Canarygrass	-	-	-	-	-	-	-	-	20	80	0	-	80	-
Corn	50	90	0	0	30	0	80	80	0	30	0	20	50	20
Crabgrass, Large	20	100	20	0	50	0	70	90	10	90	0	60	60	50
Foxtail, Giant	80	100	0	0	50	0	100	100	100	90	0	100	90	30
Morningglory	0	0	0	0	0	0	0	0	-	-	-	0	-	-
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	-	-	-	0	-	-
Wheat	0	90	0	0	0	0	90	90	-	0	0	50	80	70

Table A Compounds

125 g ai/ha	74	75	76	77	78	79	80	81	82	83	84	85	86	87
Preemergence														
Barnyardgrass	100	80	100	0	100	100	100	100	100	100	0	40	100	50
Blackgrass	100	80	90	80	100	100	100	100	100	100	0	40	90	90
Canarygrass	100	80	70	-	100	100	100	90	100	90	0	70	100	90
Corn	60	0	50	30	90	20	60	50	50	40	0	0	40	20

Crabgrass, Large	90	40	80	10	100	100	100	100	100	70	0	70	90	70
Foxtail, Giant	100	80	100	30	100	100	100	100	100	100	0	100	100	90
Pigweed	0	0	0	0	0	0	0	0	0	30	0	0	0	0
Wheat	60	20	0	0	90	60	80	50	90	30	0	20	40	20

Table A	Compounds						
125 g ai/ha	88	89	90	92	93	94	95
Preemergence							
Barnyardgrass	90	100	0	20	100	100	100
Blackgrass	80	100	0	0	100	100	100
Canarygrass	70	100	0	10	90	90	100
Corn	20	70	0	20	60	90	90
Crabgrass, Large	90	100	0	20	100	100	100
Foxtail, Giant	90	100	0	50	100	100	100
Pigweed	0	0	0	0	0	0	0
Wheat	40	90	0	0	80	90	90

Table A	Compound
62 g ai/ha	18
Preemergence	
Barnyardgrass	100
Corn	90
Crabgrass, Large	100
Foxtail, Giant	100
Morningglory	0
Pigweed	0
Velvetleaf	0
Wheat	90

Table A	Compounds													
31 g ai/ha	25	32	33	34	35	36	37	38	39	40	41	43	44	45
Preemergence														
Barnyardgrass	50	20	100	70	80	90	90	90	100	100	100	100	80	90
Corn	0	0	30	20	0	50	30	0	30	30	30	0	30	0
Crabgrass, Large	20	90	90	80	90	70	80	90	60	70	80	10	20	30
Foxtail, Giant	40	90	100	100	100	100	100	90	90	100	90	90	80	90
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	-	-	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	50	30	20	50	30	20	40	50	50	20	40	50

Table A	Compounds													
31 g ai/ha	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Preemergence														
Barnyardgrass	40	20	60	0	10	80	70	100	70	0	80	60	50	90
Corn	0	0	-	0	0	20	0	0	0	0	40	0	0	0
Crabgrass, Large	10	10	60	0	50	90	30	90	60	20	70	50	60	20
Foxtail, Giant	50	70	90	0	70	90	100	100	90	80	90	90	90	70
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	0	-	0	0	0	0	0	0	0
Wheat	0	0	30	0	0	40	10	50	0	0	20	0	20	0

Table A	Compounds													
31 g ai/ha	61	63	64	66	67	68	69	70	71	72	73	74	75	76
Preemergence														
Barnyardgrass	90	0	0	10	0	0	20	0	0	20	0	100	0	40
Blackgrass	-	-	-	-	-	0	20	0	-	70	60	100	40	-
Canarygrass	-	-	-	-	-	0	-	0	-	50	30	80	10	30
Corn	70	0	0	40	20	0	20	0	0	20	0	-	0	0
Crabgrass, Large	80	0	0	0	20	0	0	0	10	0	0	50	0	20
Foxtail, Giant	100	0	0	90	40	10	20	0	0	70	0	90	20	70
Morningglory	0	0	0	0	0	-	-	-	0	-	-	-	-	-
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Velvetleaf	0	0	0	0	0	-	-	-	0	-	-	-	-	-
Wheat	70	0	0	60	20	0	0	0	0	50	20	20	0	0

Table A	Compounds													
31 g ai/ha	78	79	80	81	82	83	84	85	86	87	88	89	90	92
Preemergence														
Barnyardgrass	0	0	0	70	50	20	0	0	50	0	0	30	0	0
Blackgrass	0	80	70	70	70	20	0	0	50	30	40	90	0	0
Canarygrass	0	0	60	50	20	-	0	40	-	0	0	50	0	0
Corn	0	0	40	30	40	0	0	0	0	0	0	50	0	0
Crabgrass, Large	10	10	10	70	50	0	0	10	10	20	0	70	0	0
Foxtail, Giant	20	10	80	80	90	0	0	0	10	20	40	90	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	20	20	50	0	0	0	0	0	0	40	0	0

Table A	Compound		
31 g ai/ha	93	94	95
Preemergence			
Barnyardgrass	20	50	50
Blackgrass	30	60	90
Canarygrass	10	70	70
Corn	30	-	40

Table A	Compound		
31 g ai/ha	93	94	95
Preemergence			
Crabgrass, Large	20	70	90
Foxtail, Giant	90	90	100
Pigweed	0	0	0
Wheat	50	50	80

TEST B

Seeds of plant species selected from blackgrass (*Alopecurus myosuroides*), downy bromegrass (*Bromus tectorum*), green foxtail (*Setaria viridis*), Italian ryegrass (*Lolium multiflorum*), wheat (*Triticum aestivum*), wild oat (*Avena fatua*), catchweed bedstraw (*Galium aparine*), bermudagrass (*Cynodon dactylon*), surinam grass (*Brachiaria*

decumbens), cocklebur (*Xanthium strumarium*), corn (*Zea mays*), large crabgrass (*Digitaria sanguinalis*), woolly cupgrass (*Eriochloa villosa*), giant foxtail (*Setaria faberii*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), lambsquarters (*Chenopodium album*), morningglory (*Ipomoea coccinea*), eastern black (E.B.) nightshade (*Solanum ptycanthum*), yellow nutsedge (*Cyperus esculentus*), pigweed (*Amaranthus retroflexus*), common ragweed (*Ambrosia elatior*), Russian thistle (*Salsola iberica*), soybean (*Glycine max*), common (oilseed) sunflower (*Helianthus annuus*), and velvetleaf (*Abutilon theophrasti*) were planted and treated preemergence with 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 winter barley (*Hordeum vulgare*), canarygrass (*Phalaris minor*), chickweed (*Stellaria media*) and windgrass (*Apera spica-venti*) were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Plant species in the flooded paddy test consisted of rice (*Oryza sativa*), umbrella sedge (*Cyperus difformis*), ducksalad (*Heteranthera limosa*) and barnyardgrass (*Echinochloa crus-galli*) 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 to 15 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	11	12	13	14	15	16	17
Flood														
Barnyardgrass	60	45	80	75	90	90	85	75	80	0	20	60	60	0
Ducksalad	30	40	40	85	65	70	40	40	50	0	40	100	0	95
Rice	50	45	80	80	80	90	65	70	80	0	20	70	80	40
Sedge, Umbrella	60	-	80	100	80	95	80	40	60	0	60	70	45	70

Table B	Compounds													
250 g ai/ha	19	20	21	22	25	26	27	28	29	30	31	32	33	34
Flood														
Barnyardgrass	75	0	100	0	0	20	30	30	0	0	0	70	100	100
Ducksalad	25	0	65	0	0	70	75	0	0	0	0	40	50	40
Rice	70	0	70	0	0	0	0	60	0	0	0	65	80	80

Sedge, Umbrella	70	0	30	0	0	75	65	0	0	0	0	30	60	0

Table B	Compounds													
250 g ai/ha	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Flood														
Barnyardgrass	0	100	95	85	100	95	0	-	50	65	40	0	30	0
Ducksalad	0	75	40	80	0	70	0	30	70	75	85	0	30	0
Rice	0	90	85	80	80	80	0	20	40	45	35	0	0	0
Sedge, Umbrella	0	60	70	85	0	85	0	0	30	65	75	0	50	0

Table B	Compounds													
250 g ai/ha	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Flood														
Barnyardgrass	0	30	75	40	80	65	60	0	70	50	30	100	0	0
Ducksalad	0	0	0	50	0	75	75	70	45	20	0	70	0	0
Rice	0	0	60	30	80	30	10	15	60	25	30	60	0	0
Sedge, Umbrella	0	70	0	70	0	80	85	80	0	30	0	30	0	0

Table B	Compounds													
250 g ai/ha	64	65	66	67	68	69	72	73	75	76	77	80	81	83
Flood														
Barnyardgrass	0	0	20	50	0	0	70	0	0	0	0	0	0	0
Ducksalad	0	40	0	75	0	0	40	0	0	0	0	0	0	-
Rice	0	15	30	15	0	0	65	0	0	0	0	0	0	0
Sedge, Umbrella	0	80	0	0	0	0	65	0	0	0	0	0	0	0

Table B	Compounds			
250 g ai/ha	84	85	86	87
Flood				
Barnyardgrass	0	0	40	0
Ducksalad	0	0	65	0
Rice	0	0	35	0
Sedge, Umbrella	0	0	55	0

Table B	Compounds													
125 g ai/ha	1	2	3	4	5	6	7	11	12	13	14	15	16	17
Flood														
Barnyardgrass	20	20	70	70	70	80	65	65	60	0	20	40	40	0
Ducksalad	0	0	0	85	50	60	20	0	40	0	40	80	0	40
Rice	0	15	75	70	75	80	45	60	70	0	0	15	45	20
Sedge, Umbrella	40	60	80	90	80	85	80	40	60	0	-	60	30	40

Table B	Compounds													
125 g ai/ha	19	20	21	22	26	27	28	29	30	31	32	33	34	35
Flood														
Barnyardgrass	60	0	80	0	0	0	0	0	0	0	65	85	100	0
Ducksalad	0	0	0	0	-	60	0	0	0	0	40	40	30	0
Rice	60	0	20	0	0	0	0	0	0	0	30	75	70	0
Sedge, Umbrella	60	0	0	0	0	30	0	0	0	0	30	35	0	0

Table B	Compounds													
125 g ai/ha	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Flood														
Barnyardgrass	0	100	95	65	100	80	0	75	30	60	30	0	0	0
Ducksalad	0	70	30	0	0	40	0	0	70	0	45	0	0	-
Rice	0	80	75	50	70	50	0	20	20	45	20	0	0	0
Sedge, Umbrella	0	0	70	0	0	0	0	0	20	0	60	0	0	0

Table B	Compounds													
125 g ai/ha	50	51	53	55	56	57	61	62	63	65	66	67	68	69
Flood														
Barnyardgrass	0	10	0	0	20	0	50	0	0	0	20	35	0	0
Ducksalad	0	0	50	0	40	0	0	0	0	0	0	0	0	0
Rice	0	0	0	0	0	10	15	0	0	0	0	0	0	0
Sedge, Umbrella	0	60	40	75	85	75	0	0	0	0	0	0	0	0

Table B	Compounds					
125 g ai/ha	72	73	77	80	81	83
Flood						
Barnyardgrass	40	0	0	0	0	0
Ducksalad	0	0	0	0	0	0
Rice	45	0	0	0	0	0
Sedge, Umbrella	60	0	0	0	0	0

Table B	Compounds													
62 g ai/ha	1	2	3	4	5	6	7	11	12	13	14	15	16	17
Flood														
Barnyardgrass	0	0	60	60	50	40	45	50	30	0	0	15	20	0
Ducksalad	0	0	0	75	40	50	0	0	0	0	0	0	0	40
Rice	0	15	60	40	60	30	30	30	20	0	0	0	20	15
Sedge, Umbrella	40	50	60	60	70	70	80	30	40	0	60	50	30	40

Table B	Compounds													
62 g ai/ha	19	20	21	22	25	26	27	28	29	30	31	32	33	34
Flood														
Barnyardgrass	30	0	75	0	0	0	0	0	0	0	0	20	60	50
Ducksalad	0	0	0	0	0	50	40	0	0	0	0	30	0	0
Rice	20	0	0	0	0	0	0	0	0	0	0	0	65	40
Sedge, Umbrella	30	0	0	0	0	0	20	0	0	0	0	30	20	0

Table B	Compounds													
62 g ai/ha	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Flood														
Barnyardgrass	0	0	60	95	80	85	75	0	50	0	20	0	0	0
Ducksalad	0	0	70	-	0	0	0	0	0	0	0	30	0	0
Rice	0	0	70	75	0	40	20	0	15	15	0	0	0	0
Sedge, Umbrella	0	0	0	-	0	0	0	0	0	0	0	50	0	0

Table B	Compounds													
62 g ai/ha	49	50	51	52	53	54	55	56	57	58	59	60	61	62
Flood														
Barnyardgrass	0	0	0	15	0	20	0	0	0	30	0	0	0	0
Ducksalad	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice	0	0	0	10	0	15	0	0	0	0	10	0	0	0
Sedge, Umbrella	0	0	40	0	0	0	70	75	65	0	0	0	0	0

Table B	Compounds													
62 g ai/ha	63	64	65	66	67	68	69	72	73	75	76	77	80	81
Flood														
Barnyardgrass	0	0	0	0	25	0	0	20	0	0	0	0	0	0
Ducksalad	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice	0	0	0	0	0	0	0	15	0	0	0	0	0	0
Sedge, Umbrella	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B	Compounds				
62 g ai/ha	83	84	85	86	87
Flood					
Barnyardgrass	0	0	0	0	0
Ducksalad	0	0	0	30	0
Rice	0	0	0	30	0
Sedge, Umbrella	0	0	0	0	0

Table B	Compounds													
31 g ai/ha	1	2	3	4	5	6	7	11	12	13	14	15	16	17
Flood														
Barnyardgrass	0	0	0	0	20	0	20	40	0	0	0	0	15	0
Ducksalad	0	0	0	0	30	40	0	0	0	0	0	0	0	40
Rice	0	0	20	15	15	20	20	0	0	0	0	0	0	0
Sedge, Umbrella	0	0	60	40	70	30	70	30	0	0	0	0	0	30

Table B	Compounds													
31 g ai/ha	19	20	21	22	26	27	28	29	30	31	32	33	34	35
Flood														
Barnyardgrass	0	0	55	0	0	0	0	0	0	0	10	30	40	0
Ducksalad	0	0	0	0	40	0	0	0	0	0	30	0	0	0
Rice	0	0	0	0	0	0	0	0	0	0	0	30	0	0
Sedge, Umbrella	0	0	0	0	0	20	0	0	0	0	20	0	0	0

Table B	Compounds													
31 g ai/ha	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Flood														
Barnyardgrass	0	30	20	0	60	60	0	40	0	20	0	0	0	0
Ducksalad	0	-	40	0	0	0	0	0	-	0	-	0	0	0
Rice	0	0	0	0	35	15	0	0	0	0	0	0	0	0
Sedge, Umbrella	0	-	20	0	0	0	0	0	0	0	40	0	0	0

Table B	Compounds													
31 g ai/ha	50	51	53	55	56	57	61	62	63	65	66	67	68	69
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ducksalad	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Rice	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedge, Umbrella	0	0	0	45	70	45	0	0	0	0	0	0	0	0

Table B	Compounds					
31 g ai/ha	72	73	77	80	81	83
Flood						
Barnyardgrass	0	0	0	0	0	0
Ducksalad	0	0	0	0	0	0
Rice	10	0	0	0	0	0
Sedge, Umbrella	0	0	0	0	0	0

Table B	Compounds							
250 g ai/ha	1	3	4	5	6	7	15	16
Postemergence								
Barley	30	0	95	95	80	0	-	98
Bermudagrass	100	100	100	100	100	100	100	100
Blackgrass	100	100	100	100	100	100	98	100
Bromegrass, Downy	100	5	40	-	10	0	60	100
Canarygrass	40	90	100	100	100	90	-	-
Chickweed	5	0	20	0	0	0	0	0
Cocklebur	0	0	0	20	40	0	0	0
Corn	100	100	100	100	100	90	-	100
Crabgrass, Large	100	100	100	100	100	100	100	100
Cupgrass, Woolly	100	100	100	100	100	100	100	100
Foxtail, Giant	100	100	100	100	100	100	100	100
Foxtail, Green	100	100	100	100	100	100	100	100
Goosegrass	85	100	100	100	100	100	100	80
Johnsongrass	100	-	-	90	-	0	100	100
Kochia	20	70	70	70	20	10	0	100
Lambsquarters	50	20	80	80	70	10	0	0
Morningglory	0	0	0	0	50	0	0	0
Nutsedge, Yellow	0	0	0	-	0	0	0	0
Oat, Wild	100	100	100	100	100	95	100	100
Pigweed	40	25	50	45	40	20	0	0
Ragweed	55	50	80	65	50	0	40	0
Ryegrass, Italian	100	100	100	100	100	100	100	100
Soybean	60	60	90	70	90	-	0	0
Surinam Grass	100	100	100	100	100	100	100	100
Velvetleaf	50	0	45	10	10	0	0	0
Wheat	95	100	100	100	100	-	85	100
Windgrass	100	100	100	100	100	100	100	100

Table B	Compounds									
125 g ai/ha	1	3	4	5	6	7	11	12	15	16
Postemergence										
Barley	0	0	90	95	80	0	100	100	90	95
Bermudagrass	100	100	100	100	100	100	100	100	100	100
Blackgrass	100	100	100	100	100	100	100	100	95	100
Bromegrass, Downy	95	5	20	50	5	0	100	-	45	90
Canarygrass	0	85	100	100	100	90	100	100	85	-

Chickweed	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0
Corn	100	100	100	100	100	90	100	100	95	100
Crabgrass, Large	100	100	100	100	100	100	100	100	98	100
Cupgrass, Woolly	100	100	100	100	100	100	100	100	100	100
Foxtail, Giant	100	100	100	100	100	100	100	100	100	100
Foxtail, Green	100	100	100	100	100	100	100	100	100	100
Goosegrass	50	100	100	100	100	100	100	100	90	75
Johnsongrass	100	-	100	85	-	0	100	100	100	100
Kochia	0	60	60	0	20	0	0	0	0	98
Lambsquarters	40	15	60	80	20	0	0	40	0	0
Morningglory	0	0	0	0	0	0	0	40	0	0
Nutsedge, Yellow	0	0	0	60	0	0	0	0	0	0
Oat, Wild	100	100	100	100	100	95	100	100	98	100
Pigweed	0	10	35	45	0	0	5	50	0	0
Ragweed	50	0	50	60	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100
Soybean	50	40	90	65	75	-	0	0	0	0
Surinam Grass	100	100	100	100	100	100	100	100	100	100
Velvetleaf	0	0	20	0	0	0	0	30	0	0
Wheat	90	100	100	100	100	95	100	100	70	100
Windgrass	100	100	100	100	100	100	100	100	100	100

Table B	Compounds													
62 g ai/ha	1	3	4	5	6	7	11	12	15	16	19	20	21	25
Postemergence														
Barley	0	0	10	90	30	0	100	100	10	90	90	0	100	0
Bermudagrass	100	100	100	100	100	100	100	100	100	100	100	0	100	60
Blackgrass	90	100	100	100	100	90	100	100	95	100	95	60	100	95
Bromegrass, Downy	60	5	5	50	5	0	98	85	15	70	90	50	85	15
Canarygrass	0	85	90	100	95	-	100	100	35	95	100	-	100	10
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	100	100	95	100	95	90	100	100	95	98	95	-	100	-
Crabgrass, Large	90	100	100	100	100	100	100	100	90	95	100	90	100	80
Cupgrass, Woolly	100	100	100	100	100	100	100	100	100	95	100	100	100	100
Foxtail, Giant	100	100	100	100	100	100	100	100	100	98	100	95	100	95
Foxtail, Green	100	100	100	100	100	100	100	100	95	98	100	95	100	98
Goosegrass	30	95	100	95	100	100	100	100	60	65	90	80	100	50

Johnsongrass	90	80	-	0	0	-	100	100	80	100	100	100	100	30
Kochia	0	0	0	0	0	0	0	0	0	65	0	0	0	0
Lambsquarters	0	0	0	20	0	0	0	0	0	0	0	40	0	10
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	20
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	30	0	0	0
Oat, Wild	100	95	100	100	100	95	100	100	98	100	100	90	100	95
Pigweed	0	0	0	0	0	0	0	5	0	0	0	0	0	10
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	100	90	100	95
Soybean	25	40	30	50	60	0	0	0	0	0	0	0	10	0
Surinam Grass	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Velvetleaf	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Wheat	90	90	100	100	100	80	100	95	60	98	98	60	100	0
Windgrass	100	100	100	100	95	85	100	100	90	100	100	90	100	98

Table B	Compounds													
62 g ai/ha	26	28	32	33	34	35	36	37	38	39	40	41	43	44
Postemergence														
Barley	0	-	0	30	15	35	15	15	10	70	70	0	50	20
Bermudagrass	0	100	100	100	100	100	100	100	100	95	98	95	-	100
Blackgrass	80	100	70	95	90	90	80	90	98	100	90	95	100	98
Bromegrass, Downy	60	20	60	80	80	60	50	75	60	80	100	85	65	90
Canarygrass	-	-	30	-	20	45	10	40	30	50	80	0	95	-
Chickweed	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	100	40	0	100	98	100	40	100	100	100	100	95	100	95
Crabgrass, Large	80	98	98	100	100	100	100	100	100	100	100	100	85	98
Cupgrass, Woolly	98	95	100	100	100	100	95	100	100	100	100	100	95	100
Foxtail, Giant	100	100	100	100	100	100	60	100	100	100	100	100	100	100
Foxtail, Green	98	100	95	100	100	95	70	85	98	100	100	100	100	100
Goosegrass	20	90	70	100	80	75	100	100	100	100	100	98	85	90
Johnsongrass	20	98	98	90	100	95	100	100	100	95	100	75	100	100
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	98	95	98	100	95	90	98	100	100	100	100	100	100
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ryegrass, Italian	100	98	95	100	100	98	95	100	98	100	100	100	100	100
Soybean	0	20	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	90	98	100	100	100	100	100	100	100	100	100	100	100
Velvetleaf	0	0	0	5	0	0	0	0	0	0	0	0	0	0
Wheat	5	90	-	98	90	85	85	95	95	98	100	85	100	95
Windgrass	95	85	50	70	80	40	65	85	80	100	100	85	100	100

Table B	Compounds													
62 g ai/ha	45	48	52	53	54	56	57	59	61	66	67	68	69	72
Postemergence														
Barley	5	10	0	0	0	75	40	50	90	-	-	0	0	95
Bermudagrass	98	100	100	100	100	100	100	20	100	100	75	0	98	80
Blackgrass	90	95	95	95	70	98	95	90	100	100	100	85	90	100
Bromegrass, Downy	90	90	70	90	70	0	60	10	98	98	100	0	45	30
Canarygrass	0	-	5	0	0	95	60	70	85	-	-	10	0	95
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	100	98	100	100	95	100	90	100	100	100	95	20	100
Crabgrass, Large	100	100	100	100	98	100	100	60	100	100	100	85	100	100
Cupgrass, Woolly	100	100	100	100	100	100	100	85	100	100	100	60	100	90
Foxtail, Giant	100	100	100	100	100	100	100	95	100	100	100	90	100	100
Foxtail, Green	100	100	100	100	100	100	100	95	100	100	100	95	95	100
Goosegrass	95	95	85	100	98	98	90	0	100	98	90	5	90	35
Johnsongrass	70	100	95	100	100	100	100	80	100	100	100	30	75	100
Kochia	0	0	0	0	0	0	0	0	45	0	0	0	98	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	100	100	98	98	90	98	80	100	100	100	40	90	100
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	100	65	95	85	100	100	100	95	100	100
Soybean	0	0	0	0	0	0	0	0	-	0	15	0	20	0
Surinam Grass	100	100	100	100	100	100	100	100	100	100	100	80	95	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	98	98	85	85	60	90	90	50	100	100	100	0	80	95
Windgrass	65	80	80	60	80	20	70	50	100	100	100	35	40	100

Table B	Compounds									
62 g ai/ha	73	74	75	76	78	79	80	81	82	83
Postemergence										
Barley	70	95	60	25	95	40	98	98	100	45
Bermudagrass	10	98	90	90	100	100	100	100	100	90
Blackgrass	100	100	95	100	100	98	100	100	100	100
Bromegrass, Downy	60	60	50	20	100	50	-	70	100	85
Canarygrass	100	100	50	98	100	95	100	100	100	90
Chickweed	0	0	0	0	0	0	0	0	90	0
Cocklebur	0	0	0	0	0	0	0	0	20	0
Corn	100	100	100	100	100	35	100	100	100	100
Crabgrass, Large	100	100	60	100	100	98	100	100	100	100
Cupgrass, Woolly	100	98	75	90	100	80	100	98	100	100
Foxtail, Giant	100	98	85	98	100	90	100	100	100	100
Foxtail, Green	100	100	95	100	100	98	100	98	100	100
Goosegrass	90	85	75	75	100	90	98	85	90	60
Johnsongrass	100	100	100	98	100	100	100	100	100	100
Kochia	0	0	0	0	-	-	-	-	-	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	55	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	100	98	100	100	98	100	100	100	100
Pigweed	0	0	0	0	0	0	0	0	0	20
Ragweed	0	0	0	0	60	0	0	20	85	0
Ryegrass, Italian	100	100	98	100	100	90	100	100	100	100
Soybean	10	0	0	0	25	15	20	20	70	0
Surinam Grass	100	100	85	100	100	85	100	100	100	100
Velvetleaf	0	0	0	0	0	0	0	0	55	20
Wheat	95	95	85	35	100	85	98	100	100	95
Windgrass	95	100	90	90	80	70	70	95	100	100

Table B	Compounds													
31 g ai/ha	1	3	4	5	6	7	11	12	15	16	19	20	21	25
Postemergence														
Barley	0	0	0	30	30	-	95	95	10	90	5	0	-	0
Bermudagrass	100	100	100	100	100	100	100	100	70	65	100	0	80	60
Blackgrass	20	100	90	95	100	85	100	100	90	98	90	-	100	75
Bromegrass, Downy	30	5	0	5	5	0	90	85	10	60	75	40	80	10
Canarygrass	0	85	80	80	95	90	100	100	35	70	20	50	-	0

Chickweed	0	0	0	0	0	0	0	0	0	0	-	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	10	100	90	90	95	90	100	100	90	98	0	95	100	95
Crabgrass, Large	80	100	100	100	100	100	100	100	90	95	95	85	100	75
Cupgrass, Woolly	95	100	100	95	100	100	100	100	-	80	100	90	100	85
Foxtail, Giant	100	100	100	100	100	98	100	100	95	85	100	95	100	85
Foxtail, Green	95	90	95	95	100	75	100	100	95	95	100	85	100	80
Goosegrass	30	95	95	95	95	95	100	100	45	60	80	65	95	0
Johnsongrass	60	0	80	0	0	-	100	100	70	98	100	100	90	0
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	-	0	0	0	0	0
Oat, Wild	90	90	98	95	100	95	100	100	95	95	100	90	100	70
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	95	95	100	100	100	95	100	100	98	100	100	90	100	85
Soybean	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	100	100	100	100	100	100	100	100	90	100	90	100	95
Velvetleaf	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Wheat	45	80	90	90	90	60	100	95	5	95	85	20	90	0
Windgrass	95	80	90	95	90	80	100	100	90	90	100	85	100	60

Table B	Compounds													
31 g ai/ha	26	28	32	33	34	35	36	37	38	39	40	41	43	44
Postemergence														
Barley	0	50	0	30	0	5	15	5	10	40	70	0	-	20
Bermudagrass	0	100	100	100	100	100	100	100	100	75	65	25	65	95
Blackgrass	80	95	70	80	75	70	50	90	80	95	90	95	95	98
Bromegrass, Downy	30	10	45	70	50	20	40	55	50	45	80	60	60	70
Canarygrass	60	50	10	80	20	5	10	10	10	40	80	0	50	90
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	100	0	0	100	98	100	15	100	100	98	100	95	85	95
Crabgrass, Large	80	80	95	90	95	80	90	85	90	98	98	100	75	90
Cupgrass, Woolly	98	95	100	100	100	100	95	100	100	100	100	100	95	100
Foxtail, Giant	95	95	98	100	100	100	60	85	50	100	100	100	98	100
Foxtail, Green	80	98	90	100	100	95	60	80	80	85	100	100	100	95
Goosegrass	0	80	70	90	70	70	100	100	100	85	80	85	75	75

Johnsongrass	20	75	98	85	98	95	95	95	90	95	98	60	80	98
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	90	95	95	95	95	85	60	95	95	100	100	100	100	100
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	85	55	95	100	95	90	65	98	85	95	100	100	100	100
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	70	85	100	100	100	100	100	100	100	100	100	95	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	5	85	70	85	40	50	40	80	85	80	98	85	80	90
Windgrass	80	50	30	60	60	40	40	65	50	80	90	70	90	100

Table B	Compounds													
31 g ai/ha	45	48	52	53	54	56	57	59	61	66	67	68	69	72
Postemergence														
Barley	5	-	0	0	0	50	0	20	90	100	95	0	0	0
Bermudagrass	98	100	100	100	100	95	98	0	95	100	60	0	95	60
Blackgrass	85	85	95	95	70	95	80	90	100	100	100	50	35	98
Bromegrass, Downy	90	60	40	60	50	0	50	5	98	98	80	0	15	30
Canarygrass	0	90	0	0	0	90	0	55	85	95	95	0	0	30
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	100	98	100	25	95	98	85	100	90	100	30	0	90
Crabgrass, Large	100	90	100	90	98	95	98	55	100	98	100	80	98	100
Cupgrass, Woolly	100	100	95	100	98	100	100	65	100	100	100	30	95	90
Foxtail, Giant	100	100	100	100	100	98	98	90	100	100	100	65	100	100
Foxtail, Green	100	100	98	100	95	90	100	90	100	100	98	60	90	100
Goosegrass	80	75	80	65	70	75	85	0	100	85	85	0	75	35
Johnsongrass	65	100	90	98	80	85	90	60	100	100	100	0	70	-
Kochia	0	0	0	0	0	0	0	0	35	0	0	0	95	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	98	95	95	98	90	95	70	100	100	100	5	90	100
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ryegrass, Italian	100	100	95	100	95	60	95	85	100	100	100	80	98	100
Soybean	0	0	0	0	0	0	0	0	-	0	0	0	0	0
Surinam Grass	98	100	100	100	98	98	100	90	100	100	100	80	80	98
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	85	95	70	85	60	80	90	40	98	100	100	0	40	85
Windgrass	60	60	60	40	20	20	55	10	100	100	100	0	10	100

Table B	Compounds									
31 g ai/ha	73	74	75	76	78	79	80	81	82	83
Postemergence										
Barley	40	95	15	5	95	30	95	70	100	45
Bermudagrass	10	95	85	85	100	100	100	100	100	85
Blackgrass	100	98	65	100	100	90	95	98	100	95
Bromegrass, Downy	30	50	30	0	95	30	90	50	100	75
Canarygrass	90	100	0	90	100	85	100	98	100	90
Chickweed	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0
Corn	100	100	90	100	100	20	100	100	100	98
Crabgrass, Large	100	98	30	95	100	85	100	100	100	100
Cupgrass, Woolly	100	90	65	85	100	75	100	95	95	98
Foxtail, Giant	90	95	80	95	100	85	100	98	100	100
Foxtail, Green	70	98	80	95	80	98	100	95	100	98
Goosegrass	90	75	60	70	90	85	85	80	85	55
Johnsongrass	90	100	98	95	100	100	95	-	100	98
Kochia	0	0	0	0	-	-	-	-	-	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	100	85	100	100	60	100	100	95	100
Pigweed	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	65	0
Ryegrass, Italian	100	100	95	100	100	80	100	100	100	100
Soybean	10	0	0	0	20	15	15	15	55	0
Surinam Grass	90	100	75	100	100	75	100	100	100	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0
Wheat	90	90	70	30	98	60	95	95	100	90
Windgrass	80	100	70	80	60	50	60	85	100	100

Table B	Compounds													
16 g ai/ha	11	12	19	20	21	25	26	28	32	33	34	35	36	37
Postemergence														
Barley	90	80	5	0	60	0	0	0	0	25	0	0	0	0
Bermudagrass	100	100	100	0	60	0	0	80	65	100	100	65	80	85
Blackgrass	100	100	85	50	95	40	50	70	35	70	75	60	50	75
Bromegrass, Downy	85	85	75	0	55	0	10	5	10	50	50	20	5	55
Canarygrass	80	100	20	30	90	0	10	0	10	35	10	0	0	10
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	100	100	0	90	100	50	0	0	0	95	98	90	15	95
Crabgrass, Large	98	100	85	70	100	60	60	75	85	90	80	70	65	70
Cupgrass, Woolly	95	100	90	90	100	80	95	55	85	100	90	95	90	98
Foxtail, Giant	100	100	100	90	100	85	95	80	80	100	90	98	35	70
Foxtail, Green	85	85	100	60	100	70	80	65	60	85	90	75	50	75
Goosegrass	100	100	80	20	80	0	0	75	65	70	55	40	100	100
Johnsongrass	100	100	80	75	90	0	0	65	70	70	95	60	50	55
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	100	98	90	100	55	90	80	85	95	90	70	50	95
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	98	55	100	80	85	55	85	80	85	40	30	90
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	100	100	90	100	60	85	65	70	100	80	95	85	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	90	90	60	20	85	0	0	40	30	70	40	35	5	50
Windgrass	100	100	95	70	98	60	80	35	0	50	10	0	0	60

Table B	Compounds													
16 g ai/ha	38	39	40	41	43	44	45	48	52	53	54	56	57	59
Postemergence														
Barley	0	5	40	0	50	20	5	0	0	0	0	40	0	0
Bermudagrass	85	60	60	0	45	90	95	98	98	100	100	70	85	0
Blackgrass	40	0	90	90	85	90	20	85	70	60	45	65	80	60
Bromegrass, Downy	45	10	60	50	45	60	60	50	30	45	50	0	20	5
Canarygrass	0	0	30	0	50	90	0	0	0	0	0	85	0	40

Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	85	0	85	85	95	90	95	98	100	0	85	0	85
Crabgrass, Large	70	90	98	85	70	65	80	85	85	85	85	85	95	45
Cupgrass, Woolly	98	95	98	100	90	98	95	85	90	100	90	100	90	60
Foxtail, Giant	20	98	100	100	98	98	98	95	98	95	98	98	95	85
Foxtail, Green	75	80	95	100	75	95	95	98	95	95	95	90	95	90
Goosegrass	100	65	75	80	70	60	70	65	65	60	65	65	80	0
Johnsongrass	65	55	0	50	0	95	65	75	80	70	25	65	65	0
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	90	95	100	100	100	95	98	95	90	90	90	85	85	60
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	85	90	100	98	90	95	90	90	80	90	95	40	95	80
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	90	100	100	100	95	100	85	90	85	98	95	75	75	85
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	45	20	70	85	70	90	85	50	50	55	30	65	45	15
Windgrass	0	40	80	60	70	85	35	40	0	20	20	0	50	0

Table B	Compounds													
16 g ai/ha	61	66	67	68	69	72	73	74	75	76	78	79	80	81
Postemergence														
Barley	90	98	85	0	0	0	40	40	0	0	90	10	60	15
Bermudagrass	70	98	0	0	65	50	0	85	80	80	98	80	95	95
Blackgrass	100	100	100	0	35	95	100	95	50	85	95	50	85	90
Bromegrass, Downy	90	95	80	0	0	30	0	40	10	0	85	0	45	45
Canarygrass	85	90	80	0	0	30	90	90	0	60	90	55	98	-
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	100	75	90	0	0	90	100	100	50	85	100	0	100	100
Crabgrass, Large	100	85	98	60	75	100	70	90	0	85	100	80	100	98
Cupgrass, Woolly	100	95	100	0	90	80	98	90	65	65	100	65	95	85
Foxtail, Giant	100	98	95	60	85	100	70	85	70	85	100	80	100	85
Foxtail, Green	100	100	70	50	80	98	70	95	40	85	60	85	60	90
Goosegrass	100	75	70	0	70	30	90	65	50	60	85	80	75	70

Johnsongrass	100	100	98	0	65	75	85	98	80	75	100	90	90	95
Kochia	0	0	0	0	0	0	0	0	0	0	-	-	-	-
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	100	100	0	40	100	95	98	30	95	100	45	100	95
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	10	55	100	70	100	50	98	98	70	98	90
Soybean	-	0	0	0	0	0	0	0	0	0	15	0	0	0
Surinam Grass	100	98	85	35	75	95	90	100	70	90	100	70	100	98
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	95	100	100	0	35	85	60	70	20	30	85	20	85	55
Windgrass	100	100	100	0	0	100	60	90	50	80	50	50	40	80

Table B	Compounds	
16 g ai/ha	82	83
Postemergence		
Barley	98	0
Bermudagrass	100	65
Blackgrass	98	95
Bromegrass, Downy	95	55
Canarygrass	95	-
Chickweed	0	0
Cocklebur	0	0
Corn	100	95
Crabgrass, Large	100	95
Cupgrass, Woolly	90	95
Foxtail, Giant	100	90
Foxtail, Green	100	65
Goosegrass	65	45
Johnsongrass	100	70

Table B	Compounds	
16 g ai/ha	82	83
Postemergence		
Kochia	-	0
Lambsquarters	0	0
Morningglory	0	0
Nutsedge, Yellow	0	0
Oat, Wild	95	100
Pigweed	0	0
Ragweed	40	0
Ryegrass, Italian	98	98
Soybean	45	0
Surinam Grass	95	100
Velvetleaf	0	0
Wheat	98	55
Windgrass	100	98

Table B	Compounds													
8 g ai/ha	19	20	21	25	26	28	32	33	34	35	36	37	38	39
Postemergence														
Barley	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bermudagrass	80	0	40	0	0	65	60	70	65	40	40	80	40	0
Blackgrass	80	30	95	0	0	60	30	70	0	0	0	10	0	0

Bromegrass, Downy	10	0	55	0	0	0	5	5	20	0	0	0	30	5
Canarygrass	0	5	10	0	10	0	0	0	10	0	0	0	0	0
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	0	0	50	0	0	0	0	80	0	40	10	45	90	0
Crabgrass, Large	80	5	95	5	45	60	60	70	70	60	50	70	70	70
Cupgrass, Woolly	90	45	100	60	85	50	75	98	75	80	85	90	70	80
Foxtail, Giant	95	80	98	70	80	65	75	100	80	90	0	30	0	80
Foxtail, Green	60	20	95	55	60	60	60	85	60	0	0	60	30	30
Goosegrass	50	5	65	0	0	65	0	50	50	20	0	100	100	20
Johnsongrass	40	30	60	0	0	20	50	70	75	0	0	0	60	40
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	90	50	98	25	85	45	60	90	70	50	0	85	80	95
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	80	40	98	60	70	40	5	75	70	40	10	60	10	30
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	90	60	100	50	85	65	65	85	70	70	70	95	90	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	50	0	0	20	0	20	0	0	0	15	10	20
Windgrass	90	20	50	40	50	0	0	10	0	0	0	10	0	0

Table B	Compounds													
8 g ai/ha	40	41	43	44	45	48	52	53	54	56	57	59	61	66
Postemergence														
Barley	35	-	20	15	5	0	0	0	0	0	0	0	70	90
Bermudagrass	0	0	20	65	60	65	40	70	100	65	65	0	55	20
Blackgrass	85	85	85	85	0	40	50	30	45	0	40	0	85	90
Bromegrass, Downy	50	30	40	40	30	5	30	10	5	0	0	0	80	80
Canarygrass	20	-	30	50	0	0	0	0	0	50	0	0	80	40
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	0	85	80	85	85	90	85	20	0	75	0	0	75	65
Crabgrass, Large	70	70	65	60	65	70	65	65	65	65	75	20	98	70
Cupgrass, Woolly	98	95	80	98	85	75	75	85	80	95	65	55	98	90
Foxtail, Giant	100	100	85	95	90	85	85	85	85	75	80	80	98	85

Foxtail, Green	85	85	60	75	60	70	80	95	70	50	80	50	95	80
Goosegrass	60	80	60	60	65	15	60	20	55	60	65	0	98	70
Johnsongrass	0	50	0	55	60	65	75	35	0	0	15	0	65	75
Kochia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	95	100	95	90	90	80	50	80	85	5	85	45	100	95
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	80	90	80	90	70	40	70	85	75	0	80	80	100	60
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Surinam Grass	98	100	65	98	75	75	70	75	50	70	65	75	100	95
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	70	80	30	55	60	0	0	5	0	5	30	0	90	95
Windgrass	70	30	50	85	30	0	0	0	0	0	50	0	90	90

Table B	Compounds													
8 g ai/ha	67	68	69	72	73	74	75	76	78	79	80	81	82	83
Postemergence														
Barley	35	0	0	0	0	20	0	0	45	0	30	10	90	0
Bermudagrass	0	0	20	0	0	20	65	70	80	70	85	40	98	40
Blackgrass	85	0	10	80	60	90	10	70	70	50	80	85	98	70
Bromegrass, Downy	55	0	0	20	0	10	0	0	55	0	40	0	85	10
Canarygrass	50	0	0	-	30	80	0	45	80	10	90	65	80	65
Chickweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	75	0	0	50	95	98	0	75	40	0	100	45	40	65
Crabgrass, Large	70	20	55	95	45	80	0	20	98	75	98	50	100	80
Cupgrass, Woolly	90	0	20	55	85	85	20	60	98	60	80	75	85	65
Foxtail, Giant	85	10	60	95	30	80	50	75	98	75	95	80	95	80
Foxtail, Green	65	10	60	98	40	85	0	65	40	75	50	85	85	60
Goosegrass	65	0	60	30	70	60	30	20	70	60	20	65	60	0
Johnsongrass	80	0	60	70	70	98	75	65	75	85	75	75	100	65
Kochia	0	0	0	0	0	0	0	0	-	-	-	-	-	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	0	20	100	70	98	0	80	98	30	85	80	95	98

Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Ryegrass, Italian	100	0	10	80	45	98	30	65	90	55	80	85	98	85
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	70	35	65	95	60	85	60	65	98	65	95	90	75	85
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	95	0	0	85	5	40	0	10	50	0	35	30	85	40
Windgrass	95	0	0	85	50	85	10	30	40	0	30	45	70	90

Table B	Compounds								
250 g ai/ha	1	2	3	4	5	6	7	15	16
Preemergence									
Bermudagrass	100	100	100	100	100	100	100	100	100
Blackgrass	100	100	100	100	100	100	100	100	100
Bromegrass, Downy	95	-	98	100	100	95	60	98	100
Cocklebur	0	0	0	30	-	0	0	10	0
Corn	100	95	98	100	100	100	100	100	100
Crabgrass, Large	100	100	100	100	100	100	100	100	40
Cupgrass, Woolly	100	100	100	100	100	85	100	98	95
Foxtail, Giant	100	100	100	100	100	100	100	100	70
Foxtail, Green	100	100	100	100	100	100	100	100	100
Galium	0	100	85	90	90	70	80	100	0
Goosegrass	100	95	100	100	100	100	100	100	60
Johnsongrass	100	80	100	100	100	100	100	100	100
Kochia	-	50	30	0	60	60	0	-	-
Lambsquarters	0	30	-	90	100	95	100	0	-
Morningglory	0	0	0	30	0	0	0	-	0
Nightshade, E. B.	0	0	100	80	100	90	100	0	0
Nutsedge, Yellow	0	0	0	-	-	0	0	0	20
Oat, Wild	98	60	95	95	95	85	85	85	100
Pigweed	0	70	90	0	100	60	-	0	0
Ragweed	0	0	0	0	10	20	20	0	0
Russian Thistle	-	-	-	-	-	-	-	80	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100
Soybean	0	0	0	20	-	70	0	30	0
Sunflower	60	0	-	70	0	0	0	60	0
Surinam Grass	100	100	100	100	100	100	100	100	100
Velvetleaf	50	10	20	50	0	40	0	0	0
Wheat	95	75	98	100	98	90	95	80	100

Table B	Compounds										
125 g ai/ha	1	2	3	4	5	6	7	11	12	15	16
Preemergence											
Bermudagrass	100	100	100	100	100	100	90	100	100	100	98
Blackgrass	100	100	100	100	100	100	100	100	100	100	100
Bromegrass, Downy	80	70	95	98	98	65	60	100	75	90	100
Cocklebur	0	0	-	0	0	0	0	0	0	0	0
Corn	100	95	95	98	98	98	98	100	95	100	100
Crabgrass, Large	100	100	100	100	100	100	100	100	100	100	20
Cupgrass, Woolly	100	80	90	100	100	85	85	100	100	90	70
Foxtail, Giant	100	100	100	100	100	100	100	100	100	100	40
Foxtail, Green	100	100	100	100	100	100	100	100	100	100	100
Galium	0	-	85	85	80	70	80	0	0	10	0
Goosegrass	100	95	85	100	100	100	100	100	100	90	50
Johnsongrass	100	-	100	100	100	95	100	100	100	98	100
Kochia	20	0	30	0	50	20	0	-	0	-	-
Lambsquarters	0	0	-	85	90	85	90	0	0	0	-
Morningglory	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	100	-	-	90	100	0	85	0	0
Nutsedge, Yellow	-	0	0	0	0	0	0	0	0	-	0
Oat, Wild	90	-	80	85	80	85	80	100	98	80	98
Pigweed	0	70	90	-	80	30	100	-	-	0	0
Ragweed	0	0	0	0	0	20	0	0	0	0	0
Russian Thistle	-	-	-	-	-	-	-	-	-	-	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	100
Soybean	-	0	0	0	0	40	0	0	0	-	-
Sunflower	0	0	-	0	0	0	0	0	0	-	0
Surinam Grass	100	-	100	100	100	100	100	100	100	100	95
Velvetleaf	0	0	0	40	0	0	0	0	0	-	0
Wheat	90	60	95	100	95	90	80	100	95	60	98

Table B	Compounds													
62 g ai/ha	1	2	3	4	5	6	7	11	12	15	16	19	20	21
Preemergence														
Bermudagrass	100	100	100	100	100	100	90	100	100	98	0	100	70	100
Blackgrass	100	80	100	100	100	100	85	100	100	100	100	100	90	100
Bromegrass, Downy	80	20	60	70	85	65	35	98	70	55	100	60	0	100
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	90	95	95	95	98	95	95	95	98	100	98	95	98

Crabgrass, Large	100	100	90	100	100	100	100	100	100	100	0	100	60	100
Cupgrass, Woolly	100	80	50	85	90	85	70	100	98	85	25	100	98	100
Foxtail, Giant	100	100	98	100	100	100	100	100	100	100	0	100	100	100
Foxtail, Green	100	95	100	100	100	100	100	100	100	100	100	100	100	100
Galium	0	100	85	0	-	-	0	0	0	0	0	0	100	90
Goosegrass	50	60	85	100	100	95	90	100	100	90	0	100	70	100
Johnsongrass	95	80	95	30	100	90	98	100	100	95	70	100	95	100
Kochia	0	0	-	-	50	0	0	-	0	0	-	0	0	0
Lambsquarters	0	0	-	85	-	-	30	-	-	0	-	40	100	100
Morningglory	0	0	0	0	0	0	0	0	0	-	0	0	0	0
Nightshade, E. B.	0	0	100	-	0	-	30	0	50	0	0	0	0	-
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	85	50	70	70	70	50	70	98	95	70	95	95	60	95
Pigweed	0	0	90	-	0	0	100	-	-	0	0	0	0	0
Ragweed	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	-	-	-	-	-	-	-	-	-	-	0	-	0	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	100	100	90	100
Soybean	-	0	0	0	0	0	-	0	0	0	-	0	-	-
Sunflower	0	0	40	0	0	0	0	0	0	0	0	0	40	0
Surinam Grass	100	85	100	100	100	98	100	100	100	100	55	100	100	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	45	50	75	95	70	80	65	95	95	60	90	95	0	95

Table B	Compounds													
62 g ai/ha	25	26	27	28	30	31	32	33	34	35	36	37	38	39
Preemergence														
Bermudagrass	100	80	100	100	100	100	0	100	100	100	100	100	100	98
Blackgrass	90	100	100	-	100	100	98	100	100	100	100	100	100	90
Bromegrass, Downy	0	65	50	50	85	85	75	100	80	60	90	80	90	85
Cocklebur	0	10	0	0	0	0	0	-	0	0	0	0	0	0
Corn	75	98	85	90	5	90	95	95	95	90	95	98	95	100
Crabgrass, Large	80	95	0	100	100	100	100	98	100	100	100	100	100	100
Cupgrass, Woolly	80	100	55	98	100	100	85	100	95	100	100	100	100	98
Foxtail, Giant	100	100	20	100	100	100	100	100	100	100	100	100	100	100
Foxtail, Green	98	100	85	100	100	100	100	100	100	100	100	100	100	100
Galium	0	0	-	-	0	50	0	0	0	20	0	0	0	0
Goosegrass	85	95	95	100	100	100	100	98	100	100	100	100	95	100
Johnsongrass	0	50	85	100	98	75	90	100	100	80	100	80	80	95
Kochia	50	-	-	-	0	0	0	0	0	-	-	0	-	0

Lambsquarters	40	0	0	98	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	-	0	0	0	0	10	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	60	85	50	90	80	90	80	90	90	95	95	95	90	95
Pigweed	80	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	0	0	0	80	0	0	80	90	0	0
Ryegrass, Italian	100	100	95	100	100	100	100	98	100	100	100	100	100	100
Soybean	0	0	0	0	0	60	0	0	0	0	0	0	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	30	0	0
Surinam Grass	100	100	75	100	95	100	100	100	100	100	100	100	100	100
Velvetleaf	0	0	0	0	0	0	0	-	0	0	0	0	0	0
Wheat	15	0	45	90	10	80	70	80	40	30	60	70	90	80

Table B	Compounds													
62 g ai/ha	40	41	43	44	45	46	47	48	50	51	52	53	54	55
Preemergence														
Bermudagrass	100	0	95	0	0	100	100	0	100	100	85	0	0	100
Blackgrass	95	100	100	100	100	85	100	100	95	100	100	100	90	100
Bromegrass, Downy	90	80	80	85	90	5	90	80	0	85	80	90	85	60
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	95	100	85	98	0	95	75	90	80	75	60	85	95
Crabgrass, Large	100	20	100	0	0	100	100	0	100	90	0	0	0	100
Cupgrass, Woolly	100	75	100	100	0	98	100	0	100	100	0	0	0	100
Foxtail, Giant	100	98	100	0	45	100	100	0	100	100	98	70	55	100
Foxtail, Green	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Galium	0	100	0	0	0	0	-	-	-	0	0	-	0	0
Goosegrass	100	0	100	0	0	100	100	20	100	90	0	0	0	100
Johnsongrass	98	95	98	95	98	90	95	80	100	80	85	100	90	95
Kochia	0	0	0	100	0	-	-	0	-	-	85	-	-	-
Lambsquarters	0	0	0	0	0	0	65	0	100	0	0	35	0	0
Morningglory	0	0	0	0	0	0	0	0	30	0	100	0	0	0
Nightshade, E. B.	0	0	0	55	0	100	0	20	100	0	0	20	0	100
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	95	95	95	90	95	35	70	85	70	90	90	85	95	70
Pigweed	0	0	0	0	0	100	0	0	0	0	0	0	0	0
Ragweed	0	0	0	20	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	-	0	40	0	0	0	0	0	0	0

Ryegrass, Italian	100	100	90	100	100	100	98	100	100	100	100	100	100	100
Soybean	0	0	0	90	65	0	0	0	100	0	0	65	0	0
Sunflower	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Surinam Grass	100	100	100	20	90	0	100	75	98	100	100	95	85	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	90	100	80	90	95	0	20	60	0	60	50	55	50	5

Table B	Compounds													
62 g ai/ha	56	57	58	61	66	67	69	72	74	75	76	78	79	80
Preemergence														
Bermudagrass	100	100	100	95	100	0	0	100	100	98	100	100	100	100
Blackgrass	98	100	100	100	100	100	70	100	100	90	90	100	100	100
Bromegrass, Downy	75	70	85	95	100	100	0	95	85	80	0	98	80	85
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	95	80	100	100	100	0	100	98	95	85	100	100	100
Crabgrass, Large	100	100	100	100	80	0	0	100	100	55	98	100	100	100
Cupgrass, Woolly	100	100	100	100	98	0	85	100	100	75	98	100	100	100
Foxtail, Giant	100	100	100	100	95	0	0	100	100	95	100	100	100	100
Foxtail, Green	100	100	100	100	100	100	100	100	100	80	90	100	100	100
Galium	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goosegrass	100	100	100	100	70	60	0	100	100	98	100	100	100	100
Johnsongrass	100	100	60	100	100	100	0	100	100	95	85	100	100	100
Kochia	100	0	-	0	-	-	-	-	-	-	-	-	-	-
Lambsquarters	20	65	100	0	-	-	-	40	20	0	0	0	100	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	20	0	0	0	0	0	0	30	65	0	0	55	0	0
Nutsedge, Yellow	0	0	0	0	100	0	0	0	0	0	100	0	0	100
Oat, Wild	90	80	95	100	100	100	40	98	80	50	80	85	95	70
Pigweed	0	0	0	0	95	0	0	50	20	0	0	0	0	55
Ragweed	0	0	0	0	0	0	100	10	0	0	0	0	0	0
Russian Thistle	0	0	60	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	98	95	100	100	100
Soybean	0	0	0	0	0	-	-	0	0	0	0	0	100	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	100	100	100	98	55	35	100	100	98	100	100	100	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	80	50	80	95	95	100	0	90	85	45	0	95	0	95

Table B	Compounds		
62 g ai/ha	81	82	83
Preemergence			
Bermudagrass	100	100	100
Blackgrass	100	100	98
Bromegrass, Downy	85	100	30
Cocklebur	0	35	0
Corn	100	98	95
Crabgrass, Large	100	100	100
Cupgrass, Woolly	98	100	100
Foxtail, Giant	100	100	100
Foxtail, Green	100	100	100
Galium	0	50	0
Goosegrass	100	100	100
Johnsongrass	95	100	98
Kochia	-	-	100
Lambsquarters	0	100	100

Table B	Compounds		
62 g ai/ha	81	82	83
Preemergence			
Morningglory	100	25	0
Nightshade, E. B.	50	0	0
Nutsedge, Yellow	0	45	0
Oat, Wild	85	80	85
Pigweed	55	0	0
Ragweed	0	80	0
Russian Thistle	0	0	-
Ryegrass, Italian	100	100	100
Soybean	0	100	0
Sunflower	20	85	0
Surinam Grass	100	100	100
Velvetleaf	0	75	0
Wheat	85	100	20

Table B	Compounds													
31 g ai/ha	1	2	3	4	5	6	7	11	12	15	16	19	20	21
Preemergence														
Bermudagrass	100	100	30	100	98	100	60	100	100	98	0	98	0	85
Blackgrass	100	60	80	100	100	80	70	100	100	100	100	100	90	100
Bromegrass, Downy	40	0	50	70	40	50	35	95	0	50	90	30	0	60
Cocklebur	0	0	0	0	0	0	0	-	0	0	0	0	0	0
Corn	90	50	95	85	95	95	90	85	75	50	0	95	80	95
Crabgrass, Large	98	98	90	100	100	98	100	90	100	85	0	100	50	80
Cupgrass, Woolly	85	70	50	85	50	85	70	100	85	60	0	98	50	-
Foxtail, Giant	100	100	98	100	98	100	100	90	100	90	0	100	50	100
Foxtail, Green	100	90	100	100	98	100	100	100	100	100	100	100	100	100
Galium	0	100	-	0	-	0	-	0	0	0	0	0	50	0
Goosegrass	50	50	80	85	75	80	85	90	98	0	0	100	-	95
Johnsongrass	90	-	80	0	0	60	75	98	95	70	25	100	75	90
Kochia	-	0	0	0	-	0	0	-	0	-	-	-	0	0
Lambsquarters	0	0	-	-	-	0	30	0	0	0	-	0	100	100
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	90	-	-	0	30	0	0	0	0	-	-	0
Nutsedge, Yellow	0	0	0	0	-	0	0	0	0	0	0	0	0	0

Oat, Wild	60	0	60	65	30	50	0	98	90	10	90	95	50	90
Pigweed	-	0	0	-	0	-	85	-	-	0	-	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Russian Thistle	-	-	-	-	-	-	-	-	-	0	0	0	0	0
Ryegrass, Italian	80	75	98	100	100	90	90	100	95	70	100	100	40	-
Soybean	0	0	0	0	0	0	-	0	0	0	-	-	-	0
Sunflower	0	0	30	0	0	0	0	0	0	0	0	0	30	0
Surinam Grass	100	85	100	100	100	98	98	100	100	100	45	98	50	-
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	35	30	45	60	30	35	0	95	90	0	15	90	0	85

Table B	Compounds													
31 g ai/ha	25	26	27	28	30	31	32	33	34	35	36	37	38	39
Preemergence														
Bermudagrass	80	0	100	100	100	100	0	100	98	100	100	100	100	95
Blackgrass	-	85	50	-	100	98	95	100	100	100	100	100	90	90
Bromegrass, Downy	0	10	50	50	10	65	0	80	55	40	50	60	60	85
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	50	70	75	55	5	60	60	90	85	55	70	95	75	98
Crabgrass, Large	60	70	0	100	100	100	100	95	100	100	100	100	100	100
Cupgrass, Woolly	80	85	30	98	98	100	80	100	95	100	98	50	90	95
Foxtail, Giant	90	100	0	100	100	100	100	100	100	100	100	100	100	100
Foxtail, Green	98	100	60	100	100	100	100	100	100	100	100	100	100	100
Galium	0	0	-	-	0	0	0	0	0	0	0	0	0	0
Goosegrass	75	70	95	100	100	100	98	98	98	100	100	98	95	100
Johnsongrass	0	0	75	98	50	75	85	98	100	80	40	80	70	90
Kochia	-	-	-	-	0	0	0	0	0	0	-	0	-	0
Lambsquarters	0	0	-	95	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	0	85	50	70	50	70	60	80	85	80	90	80	85	90
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	0	0	0	0	0	0	-	0	0	0
Ryegrass, Italian	90	100	70	100	50	90	100	95	100	100	100	98	95	100
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	85	100	0	98	90	100	100	98	100	100	100	98	100	100

Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	15	15	0	0	20	50	30	0	5	5	0	70
Table B						Compounds								
31 g ai/ha	40	41	43	44	45	46	47	48	50	51	52	53	54	55
Preemergence														
Bermudagrass	100	0	65	0	0	85	100	0	100	100	0	0	0	100
Blackgrass	95	100	100	100	100	40	100	90	60	98	100	100	90	100
Bromegrass, Downy	80	75	70	60	80	0	0	70	0	45	35	70	70	30
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	85	85	85	65	65	0	85	70	-	60	70	55	65	80
Crabgrass, Large	100	0	98	0	0	60	100	0	100	75	0	0	0	100
Cupgrass, Woolly	100	0	98	0	-	85	100	0	98	90	0	0	0	100
Foxtail, Giant	100	0	100	0	35	95	100	0	100	100	0	45	20	100
Foxtail, Green	100	100	100	100	100	80	100	100	98	98	100	100	100	100
Galium	0	50	0	-	0	0	0	0	-	0	-	-	-	0
Goosegrass	100	0	98	0	0	100	100	0	98	75	0	0	0	98
Johnsongrass	98	70	80	0	75	85	85	75	98	70	80	75	75	70
Kochia	0	0	0	0	0	-	-	0	-	-	-	0	0	-
Lambsquarters	0	0	0	0	0	0	0	0	100	0	0	0	0	0
Morningglory	0	0	0	-	0	0	0	0	0	0	90	0	0	0
Nightshade, E. B.	0	0	0	0	0	20	0	0	100	0	0	15	0	80
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	90	95	95	85	90	0	0	80	40	80	70	80	75	35
Pigweed	0	0	0	0	0	60	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	95	100	90	90	100	40	90	100	5	100	95	100	90	90
Soybean	0	0	0	70	-	0	0	0	100	0	-	0	0	0
Sunflower	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	55	100	0	40	0	98	65	90	90	25	60	55	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	60	60	15	10	70	0	0	5	0	10	20	0	10	0
Table B						Compounds								
31 g ai/ha	56	57	58	61	66	67	69	72	74	75	76	78	79	80
Preemergence														
Bermudagrass	100	100	100	90	98	0	0	100	100	65	100	100	100	100
Blackgrass	98	100	100	100	100	100	40	95	100	60	80	100	98	100
Bromegrass, Downy	45	65	65	95	100	100	0	50	85	50	0	80	55	85

Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	95	85	55	100	98	100	0	85	90	75	75	100	50	98
Crabgrass, Large	100	98	90	100	60	0	0	80	100	25	55	100	100	100
Cupgrass, Woolly	100	85	100	100	90	0	0	85	98	65	90	100	100	98
Foxtail, Giant	100	100	100	100	95	0	0	100	100	50	90	100	100	100
Foxtail, Green	100	100	100	100	100	100	40	100	100	50	90	100	98	100
Galium	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goosegrass	98	98	95	100	25	0	0	95	100	90	80	100	100	100
Johnsongrass	70	90	40	100	98	100	0	95	90	85	70	95	100	80
Kochia	98	0	-	0	-	-	-	-	-	-	-	-	-	-
Lambsquarters	0	20	95	0	-	-	-	30	0	0	0	0	20	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	100	0	0	0
Oat, Wild	60	70	80	95	95	95	20	95	70	40	5	70	70	60
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	-	-	100	0	0	0	0	0	0	0
Russian Thistle	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	98	95	100	100	100	100	60	100	100	98	95	100	100	40
Soybean	-	0	0	0	0	-	-	0	0	0	0	0	98	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	100	98	100	98	0	15	85	100	80	95	100	100	98
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	35	40	40	90	95	100	0	80	25	20	0	90	0	60

Table B	Compounds		
31 g ai/ha	81	82	83
Preemergence			
Bermudagrass	100	100	100
Blackgrass	100	100	80
Bromegrass, Downy	70	98	20
Cocklebur	0	0	0
Corn	98	98	95
Crabgrass, Large	100	100	85
Cupgrass, Woolly	95	98	100
Foxtail, Giant	100	100	100
Foxtail, Green	100	100	80
Galium	0	50	0
Goosegrass	100	98	95

Table B	Compounds		
31 g ai/ha	81	82	83
Preemergence			
Morningglory	0	0	0
Nightshade, E. B.	0	0	0
Nutsedge, Yellow	0	0	0
Oat, Wild	70	80	80
Pigweed	0	0	0
Ragweed	0	50	0
Russian Thistle	0	0	-
Ryegrass, Italian	100	100	100
Soybean	0	20	0
Sunflower	15	70	0
Surinam Grass	100	95	98

Johnsongrass	95	98	95	Velvetleaf	0	45	0
Kochia	-	-	100	Wheat	50	98	0
Lambsquarters	0	100	100				

Table B	Compounds													
16 g ai/ha	11	12	19	20	21	25	26	27	28	30	31	32	33	34
Preemergence														
Bermudagrass	100	100	90	0	80	70	0	0	100	90	100	0	98	98
Blackgrass	100	98	100	-	100	-	-	20	-	60	90	85	100	85
Bromegrass, Downy	50	0	0	0	50	0	0	0	40	10	0	0	0	55
Cocklebur	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	70	70	85	5	80	5	30	0	0	5	0	45	85	65
Crabgrass, Large	90	100	100	50	80	20	65	0	98	90	90	85	95	100
Cupgrass, Woolly	100	80	85	30	100	40	70	0	30	75	98	70	90	90
Foxtail, Giant	90	100	100	0	100	60	95	0	98	98	90	95	100	100
Foxtail, Green	100	100	100	95	100	98	100	0	100	0	98	100	100	100
Galium	0	0	-	0	0	0	0	-	-	0	0	0	0	0
Goosegrass	85	40	75	0	80	50	50	75	100	80	90	98	98	85
Johnsongrass	90	70	100	50	85	0	0	40	85	50	60	75	95	95
Kochia	-	0	0	0	0	0	-	-	-	0	0	0	-	0
Lambsquarters	0	0	0	20	0	0	0	0	95	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Oat, Wild	80	60	75	0	85	0	80	0	50	50	45	0	80	-
Pigweed	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Russian Thistle	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	90	90	90	35	100	50	90	0	80	10	90	100	95	100
Soybean	0	0	-	-	-	0	0	0	-	0	0	0	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	100	100	80	20	100	85	85	0	65	60	80	75	90	100
Velvetleaf	0	0	0	0	-	0	0	0	0	0	0	0	0	0
Wheat	90	20	10	0	30	0	0	0	5	0	0	0	0	0

Table B	Compounds													
16 g ai/ha	35	36	37	38	39	40	41	43	44	45	46	47	48	50
Preemergence														
Bermudagrass	98	100	90	100	90	90	0	0	0	0	20	100	0	100

Blackgrass	85	80	100	-	90	95	100	95	100	98	30	70	90	0
Bromegrass, Downy	40	50	30	55	70	60	70	0	20	50	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	40	55	40	50	80	75	65	70	55	55	0	20	55	0
Crabgrass, Large	100	98	98	98	100	100	0	65	0	0	0	85	0	98
Cupgrass, Woolly	35	85	50	50	65	100	0	60	0	0	0	100	0	75
Foxtail, Giant	100	100	100	98	100	100	0	100	0	0	15	98	0	98
Foxtail, Green	100	100	98	100	100	100	100	100	98	100	10	80	80	95
Galium	0	0	0	0	0	0	0	0	-	0	0	0	0	0
Goosegrass	100	100	90	85	100	100	0	75	0	0	100	98	0	80
Johnsongrass	80	-	50	-	90	95	65	65	0	20	55	75	60	95
Kochia	0	-	0	0	0	0	0	0	0	0	-	-	0	-
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	-	0	65
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	-	50	65	60	90	85	85	90	80	80	0	0	5	40
Pigweed	0	0	0	0	0	0	0	0	0	0	0	-	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	0	0	-	0	0	0	0	0	0	0
Ryegrass, Italian	100	98	90	80	95	95	85	90	90	90	10	80	85	0
Soybean	0	0	0	0	0	0	0	0	-	0	0	0	0	50
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	90	100	85	90	95	100	40	90	0	20	0	95	40	40
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	0	30	60	15	10	0	30	0	0	0	0

Table B	Compounds													
16 g ai/ha	51	52	53	54	55	56	57	58	61	66	67	69	72	74
Preemergence														
Bermudagrass	100	0	0	0	100	100	100	100	80	85	0	0	100	100
Blackgrass	98	95	100	90	80	60	100	100	100	100	100	0	90	100
Bromegrass, Downy	0	35	50	0	0	20	0	-	90	85	90	0	30	85
Cocklebur	0	0	0	0	-	0	0	0	0	0	0	0	0	0
Corn	-	55	45	0	0	10	60	0	98	70	98	0	80	80
Crabgrass, Large	20	0	0	0	98	60	0	75	95	0	0	0	50	95
Cupgrass, Woolly	80	0	0	0	80	80	20	80	98	80	0	0	-	95
Foxtail, Giant	100	0	20	0	98	100	98	95	100	45	0	0	85	98
Foxtail, Green	90	90	100	95	90	65	100	100	100	100	100	0	100	100

Galium	0	0	-	0	-	0	0	0	-	0	0	0	0	0
Goosegrass	60	0	0	0	90	80	0	85	100	0	0	0	95	98
Johnsongrass	50	65	65	40	15	65	90	0	95	95	90	0	55	85
Kochia	-	0	-	-	-	20	0	-	-	-	-	-	-	-
Lambsquarters	-	0	0	0	0	0	0	0	0	-	-	-	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B,	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	10	30	65	70	0	50	60	80	90	95	95	0	80	70
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	-	98	0	0
Russian Thistle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	95	100	90	70	98	70	100	100	100	100	20	90	98
Soybean	0	0	0	0	0	0	0	0	0	0	-	-	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	75	0	20	0	50	90	98	98	100	80	0	0	85	100
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	0	0	10	15	0	30	90	70	0	35	0

Table B	Compounds							
16 g ai/ha	75	76	78	79	80	81	82	83
Preemergence								
Bermudagrass	0	20	100	100	100	50	100	65
Blackgrass	20	40	90	85	70	85	98	30
Bromegrass, Downy	20	0	60	0	30	70	50	0
Cocklebur	0	0	0	0	0	0	0	0
Corn	0	55	85	0	85	70	95	45
Crabgrass, Large	0	20	95	100	98	98	98	35
Cupgrass, Woolly	0	75	98	65	65	45	80	90
Foxtail, Giant	0	70	100	100	100	100	100	100
Foxtail, Green	30	65	100	60	98	80	100	70
Galium	0	0	0	0	0	0	-	0
Goosegrass	65	75	100	100	20	98	98	80
Johnsongrass	75	0	80	85	65	80	85	85
Kochia	-	-	-	-	-	-	-	100
Lambsquarters	0	0	0	0	0	0	0	100
Morningglory	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	-	0	0	0
Nutsedge, Yellow	0	100	0	0	0	0	0	0

Oat, Wild	0	0	40	0	40	60	60	30
Pigweed	0	0	0	0	0	0	-	0
Ragweed	0	0	0	0	0	0	20	0
Russian Thistle	0	0	0	0	0	0	0	-
Ryegrass, Italian	30	75	98	90	40	100	98	85
Soybean	0	0	0	0	0	0	0	0
Sunflower	0	0	0	0	0	0	60	0
Surinam Grass	50	90	95	85	65	85	85	90
Velvetleaf	0	0	0	0	0	0	0	0
Wheat	0	0	80	0	20	5	65	0

Table B	Compounds													
8 g ai/ha	19	20	21	25	26	27	28	30	31	32	33	34	35	36
Preemergence														
Bermudagrass	0	0	60	0	0	-	0	60	95	0	80	50	98	98
Blackgrass	95	10	95	70	-	-	-	0	80	-	60	0	0	80
Bromegrass, Downy	0	0	0	0	0	0	20	0	0	0	0	0	40	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	70	0	70	0	15	0	0	0	-	0	50	0	5	40
Crabgrass, Large	50	0	0	0	0	0	65	80	80	20	70	100	90	98
Cupgrass, Woolly	50	0	60	0	20	0	0	50	70	55	80	55	35	85
Foxtail, Giant	70	0	85	50	65	0	60	60	90	85	100	98	100	100
Foxtail, Green	85	20	100	50	98	0	30	0	65	70	100	100	30	50
Galium	0	0	0	0	0	-	-	0	0	0	0	0	0	0
Goosegrass	0	0	10	0	50	0	80	80	85	60	85	55	80	80
Johnsongrass	80	0	0	0	0	0	70	0	55	65	60	65	45	0
Kochia	0	-	0	0	0	-	-	0	0	0	0	0	0	-
Lambsquarters	-	0	0	0	0	0	80	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	60	0	65	0	-	0	0	50	-	0	70	40	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	50	30	90	50	50	0	0	0	50	90	85	100	100	20
Soybean	0	-	-	0	0	0	-	0	0	0	0	0	0	0
Sunflower	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	80	0	98	50	75	0	0	10	80	70	75	95	45	70

Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B							Compounds							
8 g ai/ha	37	38	39	40	41	43	44	45	46	47	48	50	51	52
Preemergence														
Bermudagrass	90	60	0	0	0	0	0	0	0	60	0	90	60	0
Blackgrass	95	90	40	95	95	70	90	-	0	70	80	0	50	0
Bromegrass, Downy	0	55	0	0	70	0	0	0	0	0	0	0	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	40	45	65	55	45	0	0	0	0	0	15	0	-	0
Crabgrass, Large	70	45	60	45	0	15	0	0	0	0	0	60	0	0
Cupgrass, Woolly	50	0	20	15	0	0	-	0	0	98	0	20	0	0
Foxtail, Giant	100	45	100	100	0	95	0	0	0	0	0	20	80	0
Foxtail, Green	40	30	80	90	100	100	40	100	0	5	30	0	50	90
Galium	0	0	0	0	0	0	0	0	0	0	-	0	0	0
Goosegrass	75	45	95	98	0	65	0	0	0	70	0	0	0	0
Johnsongrass	50	0	75	90	20	20	0	15	-	0	40	70	-	55
Kochia	0	0	0	0	0	0	0	0	-	-	0	-	-	0
Lambsquarters	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	0	0	70	60	70	70	25	15	0	0	0	20	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Thistle	0	0	0	0	-	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	45	30	90	80	85	90	20	0	0	0	85	0	100	0
Soybean	0	0	0	0	0	0	0	-	0	0	0	0	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	65	90	90	80	0	0	0	0	0	80	0	20	30	0
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	5	10	0	0	0	0	0	0	0	0	0

Table B							Compounds							
8 g ai/ha	53	54	55	56	57	58	61	66	67	69	72	74	75	76
Preemergence														
Bermudagrass	0	0	100	85	100	100	55	0	0	0	40	100	-	0
Blackgrass	95	60	0	40	40	80	40	90	100	0	60	85	0	40

Bromegrass, Downy	10	0	0	0	0	0	0	85	50	0	0	30	0	0
Cocklebur	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	0	0	0	0	0	0	95	0	60	0	70	75	0	0
Crabgrass, Large	0	0	20	0	0	50	50	0	0	0	30	65	0	0
Cupgrass, Woolly	0	0	15	0	0	75	80	0	0	0	70	65	0	55
Foxtail, Giant	0	0	90	95	98	55	75	0	0	0	70	80	0	0
Foxtail, Green	95	55	0	65	70	100	100	98	100	0	25	100	0	40
Galium	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goosegrass	0	0	55	75	0	70	80	0	0	0	95	95	50	20
Johnsongrass	45	0	0	60	65	0	90	70	70	0	50	70	0	0
Kochia	-	-	-	0	0	-	-	-	-	-	-	-	-	-
Lambsquarters	0	0	0	0	0	0	0	-	-	-	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0	-	0	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Oat, Wild	40	40	0	0	0	80	40	90	90	0	60	50	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0	0	0	-	0	0	0	0	0
Russian Thistle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	80	20	60	60	0	0	85	100	100	0	75	60	0	75
Soybean	0	0	0	0	0	0	0	0	-	-	0	0	0	0
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surinam Grass	0	0	15	75	60	95	85	0	0	0	-	100	45	65
Velvetleaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat	0	0	0	0	0	0	20	30	0	0	0	0	0	0

Table B	Compounds					
8 g ai/ha	78	79	80	81	82	83
Preemergence						
Bermudagrass	85	90	50	0	90	55
Blackgrass	70	85	70	80	80	0
Bromegrass, Downy	40	0	0	20	30	0
Cocklebur	0	0	0	0	0	0
Corn	55	0	20	65	95	0
Crabgrass, Large	15	20	0	65	95	0
Cupgrass, Woolly	65	20	0	20	45	65
Foxtail, Giant	98	55	0	80	98	80
Foxtail, Green	100	30	0	40	70	40
Galium	0	0	0	0	-	0

Goosegrass	85	98	0	80	95	55
Johnsongrass	60	65	60	60	70	55
Kochia	-	-	-	-	-	50
Lambsquarters	0	0	0	0	0	100
Morningglory	0	0	0	0	0	0
Nightshade, E. B.	0	0	0	0	0	0
Nutsedge, Yellow	0	0	0	0	0	0
Oat, Wild	30	0	30	45	0	0
Pigweed	0	0	0	0	0	0
Ragweed	0	0	0	0	0	0
Russian Thistle	0	0	0	0	0	-
Ryegrass, Italian	98	0	0	70	40	30
Soybean	0	0	0	0	0	0
Sunflower	0	0	0	0	0	0
Surinam Grass	95	75	0	60	80	55
Velvetleaf	0	0	0	0	0	0
Wheat	0	0	0	0	0	0

TEST C

Seeds of plant species selected from annual bluegrass (*Poa annua*), blackgrass (*Alopecurus myosuroides*), canola (*Brassica rapa*), downy bromegrass (*Bromus tectorum*), green foxtail (*Setaria viridis*), Italian ryegrass (*Lolium multiflorum*), canarygrass (*Phalaris minor*), pigweed (*Amaranthus retroflexus*), spring barley (*Hordeum vulgare*), spring wheat (*Triticum aestivum*), wild mustard (*Sinapis arvensis*), wild oat (*Avena fatua*), windgrass (*Apera spica-venti*), winter barley (*Hordeum vulgare*), and winter wheat (*Triticum aestivum*) were planted and treated preemergence with 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 were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Treated plants and controls were maintained in a controlled growth environment for 15 to 25 days after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table C, 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 C	Compounds										
62 g ai/ha	11	15	19	20	25	26	37	43	44	53	57

Postemergence											
Barley, Spring	98	50	100	50	-	50	100	90	98	100	40
Barley, Winter	100	90	100	20	-	40	95	80	95	95	90
Blackgrass	100	100	100	75	98	95	100	100	100	100	-
Bluegrass	20	50	35	0	15	15	20	15	0	35	35
Bromegrass, Downy	98	30	100	10	20	0	70	75	75	90	70
Canarygrass	100	-	-	95	40	100	100	95	100	-	-
Canola	0	0	0	0	0	0	0	0	0	0	0
Foxtail, Green	100	98	100	98	98	98	100	98	100	100	100
Mustard, Wild	40	20	20	0	0	-	0	25	0	0	0
Oat, Wild	100	90	100	100	95	100	95	100	100	100	100
Pigweed	20	0	0	0	20	20	0	0	0	0	0
Ryegrass, Italian	100	100	100	98	95	100	100	100	100	100	100
Wheat, Spring	98	70	100	60	-	30	95	90	100	98	75
Wheat, Winter	100	25	100	60	-	35	90	65	98	95	50
Windgrass	95	40	100	75	60	65	30	60	100	70	65

Table C	Compounds										
31 g ai/ha	11	15	19	20	25	26	37	43	44	53	57
Postemergence											
Barley, Spring	95	0	100	25	0	35	50	50	95	40	30
Barley, Winter	95	10	100	20	0	10	25	40	90	40	15
Blackgrass	100	98	100	60	90	70	100	100	100	100	98
Bluegrass	15	40	25	0	15	0	20	0	0	0	30
Bromegrass, Downy	98	20	98	0	0	0	50	0	65	30	30
Canarygrass	100	-	-	75	0	75	75	85	90	-	-
Canola	0	0	0	0	0	0	0	0	0	0	0
Foxtail, Green	100	98	100	80	95	95	100	98	98	100	100
Mustard, Wild	25	0	20	0	0	-	0	0	0	0	0
Oat, Wild	100	90	100	100	90	98	90	100	100	100	90
Pigweed	10	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	95	80	95	100	100	100	100	100
Wheat, Spring	98	15	90	25	0	30	75	60	95	80	75
Wheat, Winter	100	0	90	30	0	30	60	40	95	65	30
Windgrass	95	0	100	50	35	20	15	60	95	50	0

Table C	Compounds										
16 g ai/ha	11	15	19	20	25	26	37	43	44	53	57
Postemergence											

Barley, Spring	95	0	90	25	0	0	20	35	95	40	20
Barley, Winter	70	0	50	0	0	0	10	15	75	10	15
Blackgrass	100	95	100	35	35	50	90	98	98	100	75
Bluegrass	15	25	0	0	0	0	20	0	0	0	10
Bromegrass, Downy	80	15	65	0	0	0	30	0	40	20	30
Canarygrass	100	-	-	35	0	75	35	75	80	-	-
Canola	0	0	0	0	0	0	0	0	0	0	0
Foxtail, Green	98	95	100	70	80	95	100	95	95	98	100
Mustard, Wild	25	0	20	0	0	0	0	0	0	0	0
Oat, Wild	100	25	100	98	15	98	80	100	100	90	90
Pigweed	10	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	98	100	100	80	60	85	95	98	98	100	98
Wheat, Spring	90	0	80	25	0	10	50	15	95	50	25
Wheat, Winter	100	0	80	20	0	0	30	25	80	10	30
Windgrass	95	0	100	0	0	0	0	60	90	0	0

Table C	Compounds										
8 g ai/ha	11	15	19	20	25	26	37	43	44	53	57
Postemergence											
Barley, Spring	80	0	20	0	0	0	0	20	60	0	0
Barley, Winter	60	0	20	0	0	0	10	5	20	0	0
Blackgrass	100	75	75	0	5	50	65	90	90	65	35
Bluegrass	0	0	0	0	0	0	0	0	0	0	0
Bromegrass, Downy	50	0	40	0	0	0	20	0	15	0	0
Canarygrass	65	-	-	10	0	25	0	65	75	-	-
Canola	0	0	0	0	0	0	0	0	0	0	0
Foxtail, Green	95	90	95	0	70	90	90	90	50	95	90
Mustard, Wild	0	0	0	0	0	0	0	0	0	0	0
Oat, Wild	100	0	100	10	0	70	25	100	100	25	10
Pigweed	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	98	50	60	65	0	70	75	75	90	75	75
Wheat, Spring	65	0	70	0	0	10	15	0	70	5	0
Wheat, Winter	90	0	20	0	0	0	0	5	75	0	0
Windgrass	95	0	80	0	0	0	0	30	50	0	0

Table C	Compounds													
62 g ai/ha	11	15	19	21	25	26	28	30	32	33	34	35	37	41
Preemergence														
Barley, Spring	100	65	80	75	0	35	25	50	75	25	70	65	40	90

Barley, Winter	95	60	80	75	0	10	40	15	65	20	35	50	40	80
Blackgrass	100	98	100	100	75	75	85	98	98	100	85	75	98	100
Bluegrass	30	90	-	-	40	0	50	0	20	0	35	0	70	-
Bromegrass, Downy	100	70	95	95	35	20	75	0	60	60	60	60	85	80
Canarygrass	100	95	100	100	35	70	90	90	90	90	100	90	95	100
Canola	0	0	0	0	0	0	0	0	-	0	0	-	0	0
Foxtail, Green	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mustard, Wild	0	-	0	0	-	0	0	-	-	-	0	0	0	0
Oat, Wild	100	65	95	100	40	75	75	40	70	75	75	70	80	95
Pigweed	15	0	75	0	0	20	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	75	100	95	75	75	100	100	100	100	100
Wheat, Spring	100	70	75	90	0	25	50	20	98	50	90	65	98	95
Wheat, Winter	100	25	90	95	0	25	60	0	65	40	60	70	90	98
Windgrass	100	95	100	100	-	100	85	35	75	50	60	80	80	100

Table C	Compounds										
62 g ai/ha	43	44	47	48	51	52	53	54	55	57	58
Preemergence											
Barley, Spring	60	75	75	80	70	60	75	70	70	40	75
Barley, Winter	65	75	40	70	40	50	50	75	60	60	75
Blackgrass	100	100	100	98	100	95	98	100	95	95	100
Bluegrass	25	0	50	0	10	10	65	25	15	65	0
Bromegrass, Downy	75	80	35	40	50	80	85	80	40	80	75
Canarygrass	95	85	90	95	90	95	95	95	90	90	95
Canola	0	0	-	-	-	-	0	-	-	0	-
Foxtail, Green	100	100	100	100	100	100	100	100	100	100	100
Mustard, Wild	0	-	0	0	0	0	0	0	0	0	0
Oat, Wild	98	90	80	70	50	60	85	70	65	80	75
Pigweed	20	20	0	0	0	0	0	0	-	0	0
Ryegrass, Italian	98	100	100	100	90	100	100	100	90	100	100
Wheat, Spring	65	75	65	75	75	90	85	98	60	90	90
Wheat, Winter	70	70	65	70	40	65	70	50	60	65	80
Windgrass	100	100	65	80	80	70	90	75	60	75	70

Table C	Compounds													
31 g ai/ha	11	15	19	21	25	26	28	30	32	33	34	35	37	41
Preemergence														
Barley, Spring	70	40	65	60	0	25	15	30	25	10	0	20	15	75
Barley, Winter	75	50	75	50	0	10	0	0	20	0	10	0	20	70

Blackgrass	90	95	100	100	75	-	15	90	75	80	75	75	90	100
Bluegrass	-	75	-	-	40	0	-	0	0	0	0	0	60	-
Bromegrass, Downy	70	35	75	75	20	0	20	0	20	35	10	50	60	50
Canarygrass	98	80	98	90	10	65	10	65	75	65	65	50	80	98
Canola	0	0	0	0	0	0	0	0	-	0	0	-	0	0
Foxtail, Green	100	100	100	100	100	75	100	80	100	100	100	40	100	100
Mustard, Wild	0	0	0	0	0	0	0	0	0	-	0	0	0	0
Oat, Wild	98	50	80	95	40	65	20	30	65	60	70	30	70	95
Pigweed	0	0	50	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	100	100	100	100	60	100	90	60	-	100	100	98	98	100
Wheat, Spring	75	35	60	60	0	25	35	0	60	20	50	50	90	75
Wheat, Winter	100	20	60	60	0	0	30	0	35	15	25	25	25	60
Windgrass	100	75	100	100	-	98	75	-	0	-	20	15	60	100

Table C	Compounds										
31 g ai/ha	43	44	47	48	51	52	53	54	55	57	58
Preemergence											
Barley, Spring	35	60	35	30	20	40	40	25	0	20	10
Barley, Winter	50	75	40	0	0	0	50	15	0	20	0
Blackgrass	98	100	90	65	100	95	98	100	80	95	98
Bluegrass	-	0	50	0	0	10	40	0	0	50	0
Bromegrass, Downy	40	50	35	0	0	15	80	15	0	40	70
Canarygrass	75	75	50	85	80	90	95	80	20	80	90
Canola	0	0	-	-	-	-	-	-	-	-	-
Foxtail, Green	100	100	80	100	100	100	100	100	100	100	100
Mustard, Wild	0	0	0	0	0	0	0	0	0	0	-
Oat, Wild	80	80	75	50	35	60	75	40	0	60	65
Pigweed	0	20	0	0	0	0	0	0	0	0	-
Ryegrass, Italian	98	100	80	90	-	90	100	100	-	100	100
Wheat, Spring	30	70	25	60	60	65	85	65	50	65	60
Wheat, Winter	20	-	35	20	0	40	50	35	0	20	60
Windgrass	80	100	30	35	20	70	75	60	0	50	50

Table C	Compounds													
16 g ai/ha	11	15	19	21	25	26	28	30	32	33	34	35	37	41
Preemergence														
Barley, Spring	30	0	65	35	0	0	15	0	0	0	0	0	0	65
Barley, Winter	40	20	40	40	0	0	0	0	0	0	0	-	0	25
Blackgrass	90	80	100	98	50	50	5	20	-	50	20	30	75	100

Bluegrass	20	60	0	0	35	0	0	0	0	0	0	0	35	0
Bromegrass, Downy	65	20	65	40	20	0	0	0	20	35	0	0	0	50
Canarygrass	75	70	90	75	0	0	0	0	0	10	20	0	60	80
Canola	0	0	0	0	0	-	0	0	-	0	0	-	-	0
Foxtail, Green	100	98	100	100	25	0	20	25	75	95	100	-	90	100
Mustard, Wild	0	0	0	0	0	0	0	-	0	-	0	-	0	-
Oat, Wild	98	-	65	75	15	15	0	0	10	25	0	0	20	75
Pigweed	0	0	30	0	0	0	0	0	0	0	0	-	0	0
Ryegrass, Italian	98	100	100	100	30	75	15	30	20	65	100	35	80	100
Wheat, Spring	60	10	40	40	0	0	0	0	25	0	0	20	0	50
Wheat, Winter	40	0	50	50	0	0	10	0	20	0	10	10	15	40
Windgrass	100	25	100	100	75	30	30	-	0	0	0	-	20	98

Table C	Compounds										
16 g ai/ha	43	44	47	48	51	52	53	54	55	57	58
Preemergence											
Barley, Spring	20	60	20	15	15	0	0	0	0	0	0
Barley, Winter	20	50	20	0	0	0	15	10	0	0	0
Blackgrass	90	25	0	50	35	60	75	70	40	85	65
Bluegrass	0	0	20	0	0	0	20	0	0	30	0
Bromegrass, Downy	25	20	15	0	0	0	20	0	0	20	15
Canarygrass	65	65	0	0	0	65	0	70	0	75	60
Canola	-	0	-	-	-	-	-	-	-	-	-
Foxtail, Green	100	90	15	95	80	100	90	98	40	100	98
Mustard, Wild	0	0	0	-	0	0	-	0	0	0	0
Oat, Wild	70	75	0	0	0	40	0	0	0	15	50
Pigweed	0	20	0	0	0	0	0	0	0	0	-
Ryegrass, Italian	98	100	20	40	90	65	100	20	0	85	65
Wheat, Spring	0	20	15	35	0	0	20	25	0	20	50
Wheat, Winter	0	65	20	0	0	0	0	0	0	15	0
Windgrass	25	100	0	0	10	0	30	0	0	0	20

Table C	Compounds													
8 g ai/ha	11	15	19	21	25	26	28	30	32	33	34	35	37	41
Preemergence														
Barley, Spring	20	0	50	20	0	0	0	0	0	0	0	0	0	0
Barley, Winter	20	0	20	20	0	0	0	0	0	0	0	0	0	10
Blackgrass	85	70	80	95	0	20	0	0	-	0	0	0	35	100
Bluegrass	0	40	-	0	0	0	0	0	0	0	0	0	0	0

Bromegrass, Downy	35	0	30	0	20	0	0	0	0	0	0	0	0	0
Canarygrass	15	20	65	65	0	0	0	0	0	0	0	0	15	50
Canola	0	0	0	0	0	-	0	0	-	0	0	-	0	0
Foxtail, Green	100	60	20	50	15	0	0	10	40	15	30	15	75	98
Mustard, Wild	0	0	0	0	0	0	0	-	0	-	-	-	0	0
Oat, Wild	98	0	65	65	15	0	0	0	0	0	0	0	20	65
Pigweed	0	0	0	0	0	0	0	0	0	-	0	0	0	0
Ryegrass, Italian	85	15	80	98	25	15	0	0	0	10	30	0	0	100
Wheat, Spring	50	0	0	30	0	0	0	0	0	0	0	0	0	0
Wheat, Winter	20	0	10	0	0	0	0	0	0	0	0	0	0	0
Windgrass	100	-	100	100	50	30	20	-	0	0	0	0	0	65

Table C	Compounds										
8 g ai/ha	43	44	47	48	51	52	53	54	55	57	58
Preemergence											
Barley, Spring	0	0	10	0	0	0	0	0	0	0	0
Barley, Winter	0	0	0	0	0	0	0	0	0	0	0
Blackgrass	85	-	0	35	0	40	70	35	-	75	0
Bluegrass	0	0	0	0	0	0	0	0	0	0	0
Bromegrass, Downy	10	0	0	0	0	0	10	0	0	0	0
Canarygrass	50	30	0	0	0	0	0	0	0	0	0
Canola	0	0	-	-	-	-	-	-	-	0	-
Foxtail, Green	75	15	0	35	10	75	90	40	20	40	35
Mustard, Wild	0	0	0	-	-	0	0	-	0	0	0
Oat, Wild	35	50	0	0	0	0	0	0	0	0	0
Pigweed	0	0	0	0	0	0	0	0	0	0	0
Ryegrass, Italian	60	90	0	40	0	0	25	0	0	65	25
Wheat, Spring	0	0	0	0	0	0	0	0	0	20	0
Wheat, Winter	0	40	0	0	0	0	0	0	0	15	0
Windgrass	-	100	0	0	0	0	0	0	0	0	0

TEST D

Three plastic pots (ca. 16-cm diameter) for each application rate were partially filled with sterilized Tama silt loam soil comprising a 35:50:15 ratio of sand, silt and clay and 2.6% organic matter. Separate plantings for each of the three pots were as follows. Seeds from the U.S. of ducksalad (*Heteranthera limosa*), umbrella sedge (*Cyperus difformis*) and purple redstem (*Ammannia coccinea*), were planted into one 16-cm pot for each rate. Seeds from the U.S. of rice flatsedge (*Cyperus iria*), bearded (Brdd.) sprangletop (*Leptochloa*

fascicularis), one stand of 9 or 10 water-seeded rice seedlings (*Oryza sativa* cv. 'Japonica – M202'), and one stand of 6 transplanted rice seedlings (*Oryza sativa* cv. 'Japonica – M202') were planted into one 16-cm pot for each rate. Seeds from the U.S. of barnyardgrass (*Echinochloa crus-galli*), late watergrass (*Echinochloa oryzicola*), early watergrass (*Echinochloa oryzoides*) and junglerice (*Echinochloa colona*) were planted into one 16-cm pot for each rate. Plantings were sequential so that crop and weed species were at the 2.0 to 2.5-leaf stage at time of treatment.

Potted plants were grown in a greenhouse with day/night temperature settings of 30/27 °C, and supplemental balanced lighting was provided to maintain a 16-hour photoperiod. Test pots were maintained in the greenhouse until test completion.

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. Effects of treatments on rice and weeds were visually evaluated by comparison to untreated controls after 21 days. Plant response ratings, summarized in Table D, 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 D	Compounds	
250 g ai/ha	21	43
Flood		
Barnyardgrass	100	100
Ducksalad	0	0
Flatsedge, Rice	70	0
Junglerice	100	100
Redstem, Purple	0	0
Rice, Transplanted	65	35
Rice, Water Seeded	75	35
Sedge, Umbrella	0	0
Sprangletop, Brdd.	100	20
Watergrass, Early	100	100
Watergrass, Late	100	100

Table D	Compounds	
125 g ai/ha	21	43
Flood		
Barnyardgrass	100	100
Ducksalad	0	0
Flatsedge, Rice	70	0
Junglerice	100	100
Redstem, Purple	0	0
Rice, Transplanted	50	10
Rice, Water Seeded	65	30
Sedge, Umbrella	0	0
Sprangletop, Brdd.	100	0
Watergrass, Early	100	70
Watergrass, Late	100	65

Table D	Compounds	
64 g ai/ha	21	43
Flood		
Barnyardgrass	100	60
Ducksalad	0	0
Flatsedge, Rice	70	0

Table D	Compounds	
32 g ai/ha	21	43
Flood		
Barnyardgrass	60	20
Ducksalad	0	0
Flatsedge, Rice	0	0

Junglerice	100	60
Redstem, Purple	0	0
Rice, Transplanted	0	0
Rice, Water Seeded	35	0
Sedge, Umbrella	0	0
Sprangletop, Brdd.	80	0
Watergrass, Early	65	60
Watergrass, Late	60	30

Junglerice	70	0
Redstem, Purple	0	0
Rice, Transplanted	0	0
Rice, Water Seeded	20	0
Sedge, Umbrella	0	0
Sprangletop, Brdd.	30	0
Watergrass, Early	40	0
Watergrass, Late	30	0

Table D	Compounds	
16 g ai/ha	21	43
Flood		
Barnyardgrass	0	0
Ducksalad	0	0
Flatsedge, Rice	0	0
Junglerice	0	0
Redstem, Purple	0	0
Rice, Transplanted	0	0

Table D	Compounds	
16 g ai/ha	21	43
Flood		
Rice, Water Seeded	0	0
Sedge, Umbrella	0	0
Sprangletop, Brdd.	30	0
Watergrass, Early	0	0
Watergrass, Late	0	0

TEST E

Seeds of plant species selected from bermudagrass (*Cynodon dactylon*), Surinam grass (*Brachiaria decumbens*), large crabgrass (*Digitaria sanguinalis*), green foxtail (*Setaria viridis*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), pitted morningglory (*Ipomoea lacunosa*), purple nutsedge (*Cyperus rotundus*), common ragweed (*Ambrosia elatior*), black mustard (*Brassica nigra*), guineagrass (*Panicum maximum*), dallisgrass (*Paspalum dilatatum*), barnyardgrass (*Echinochloa crus-galli*), southern (S.) sandbur (*Cenchrus echinatus*), common sowthistle (*Sonchus oleraceous*), prickly sida (*Sida spinosa*), Italian ryegrass (*Lolium multiflorum*), common purslane (*Portulaca oleracea*), broadleaf signalgrass (*Brachiaria platyphylla*), common groundsel (*Senecio vulgaris*), common chickweed (*Stellaria media*), Virginia (V.) dayflower (*Commelina virginica*), tropical (T.) spiderwort (*Commelina benghalensis*), annual bluegrass (*Poa annua*), naked crabgrass (*Digitaria nuda*), itchgrass (*Rottboellia cochinchinensis*), quackgrass (*Elytrigia repens*), Canada horseweed (*Conyza canadensis*), field bindweed (*Convolvulus arvensis*), spanishneedles (*Bidens bipinnata*), common mallow (*Malva sylvestris*) and Russian thistle (*Salsola kali*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. At the same time, plants selected from these weed species were treated with postemergence

applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Treated plants and controls were maintained in a greenhouse for 14 to 21 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table E, 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 E	Compounds											
62 g ai/ha	21	31	32	33	34	35	36	39	40	43	53	54
Postemergence												
Barnyardgrass	100	100	100	100	100	100	100	100	100	100	100	100
Bermudagrass	75	95	75	95	95	90	90	65	70	20	98	80
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	15	10	0	5	0	0	0	0	15	0	0	0
Chickweed	-	-	-	-	-	-	-	0	-	-	-	-
Crabgrass, Large	98	80	80	95	100	80	80	98	95	80	100	100
Crabgrass, Naked	100	90	90	98	100	95	98	98	100	100	100	90
Dallisgrass	98	70	40	65	70	60	50	75	95	50	75	80
Dayflower, V.	-	-	0	-	0	-	-	-	-	0	0	0
Foxtail, Green	100	75	90	95	98	75	75	95	98	98	100	98
Goosegrass	98	75	80	75	80	75	75	95	95	90	95	95
Groundsel	0	-	0	0	0	-	-	0	-	0	0	-
Guineagrass	100	90	100	95	100	95	90	95	100	100	100	100
Itchgrass	75	70	90	75	95	70	60	60	80	75	98	100
Johnsongrass	100	100	100	98	100	98	95	95	98	-	100	100
Mallow	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	50	0	30	0	0	0	0	0	30	0
Prickly Sida	-	-	0	-	0	-	-	-	-	0	0	0
Nutsedge, Purple	0	0	0	0	0	0	0	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0	0	0
Quackgrass	80	50	0	70	40	40	35	60	95	75	30	35
Ryegrass, Italian	100	90	98	95	100	95	80	100	100	100	100	100
Sandbur, S.	100	75	80	90	100	75	85	100	100	100	100	95
Signalgrass	100	75	100	100	100	100	100	100	100	98	100	100
Sowthistle	-	-	0	-	0	-	-	-	-	0	0	0
Spiderwort, T.	0	0	-	0	-	0	0	0	0	-	-	-
Surinam Grass	100	75	100	100	100	90	100	100	100	98	100	100

Table E	Compounds													
31 g ai/ha	11	12	19	21	31	32	33	34	35	36	39	40	43	53
Postemergence														
Barnyardgrass	100	100	100	100	75	100	100	100	100	95	100	100	100	100
Bermudagrass	95	95	80	65	90	40	90	80	80	70	50	60	20	80
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	10	0	0	5	0	0	0	0	15	0	0
Chickweed	0	0	-	0	0	-	0	-	0	-	0	0	-	-
Crabgrass, Large	100	95	80	95	75	75	90	100	75	75	95	90	80	95
Crabgrass, Naked	98	95	98	98	75	80	90	-	95	90	80	95	-	98
Dallisgrass	90	85	75	85	60	30	65	20	50	30	75	80	20	30
Dayflower, V.	0	0	0	-	-	0	-	0	-	-	-	-	0	0
Field Bindweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Green	100	100	100	95	70	85	75	95	65	75	75	95	80	90
Goosegrass	85	90	75	90	70	60	75	80	40	40	80	80	75	80
Groundsel	0	0	0	-	-	0	0	0	-	-	0	-	0	0
Guineagrass	98	95	98	100	85	98	90	100	80	90	90	95	100	100
Horseweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Itchgrass	98	95	80	75	65	90	70	95	70	50	40	80	20	95
Johnsongrass	100	95	100	85	75	98	98	98	70	75	75	90	65	100
Kochia	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Mallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	35	0	0	0	0	0	0	0	0
Prickly Sida	0	0	0	-	-	0	-	0	-	-	-	-	0	0
Nutsedge, Purple	-	0	-	0	0	0	0	0	0	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0	0	0	-	0
Quackgrass	95	95	80	40	30	0	60	30	30	30	60	70	20	0
Ragweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Ryegrass, Italian	95	100	100	100	50	95	90	100	60	60	98	100	100	100
Sandbur, S.	100	100	100	95	75	80	80	90	75	80	95	95	98	95
Signalgrass	100	100	98	100	75	95	95	95	75	90	95	95	95	95
Sowthistle	0	0	0	-	-	0	-	0	-	-	-	-	0	0
Spanishneedles	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Spiderwort, T.	-	-	-	0	0	-	-	-	0	0	0	0	-	-
Surinam Grass	100	98	100	100	50	100	100	100	80	80	100	100	98	100

Table E	Compound	Table E	Compound
31 g ai/ha	54	31 g ai/ha	54
Postemergence		Postemergence	

Barnyardgrass	100	Johnsongrass	100
Bermudagrass	40	Kochia	-
Mustard, Black	0	Mallow	0
Bluegrass	0	Morningglory	0
Chickweed	-	Prickly Sida	0
Crabgrass, Large	95	Nutsedge, Purple	0
Crabgrass, Naked	90	Purslane	0
Dallisgrass	40	Quackgrass	0
Dayflower, V.	0	Ragweed	-
Field Bindweed	-	Ryegrass, Italian	100
Foxtail, Green	80	Sandbur, S.	90
Goosegrass	50	Signalgrass	98
Groundsel	0	Sowthistle	0
Guineagrass	95	Spanishneedles	-
Horseweed	-	Spiderwort, T.	-
Itchgrass	95	Surinam Grass	100

Table E Compounds

16 g ai/ha	11	19	21	31	32	33	34	35	36	39	40	43	53	54
Postemergence														
Barnyardgrass	100	100	100	70	98	100	100	75	50	100	100	100	100	98
Bermudagrass	80	35	50	75	20	80	50	65	40	40	50	20	70	20
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chickweed	0	-	-	0	-	0	-	0	0	0	0	-	-	-
Crabgrass, Large	95	60	90	65	75	75	75	60	70	90	85	60	95	80
Crabgrass, Naked	95	90	90	65	-	90	80	50	60	80	75	65	80	85
Dallisgrass	90	60	80	40	20	35	20	30	20	70	75	-	20	30
Dayflower, V.	0	0	-	-	0	-	0	-	-	-	-	0	0	0
Field Bindweed	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Green	98	95	75	60	60	65	75	60	50	70	80	80	80	70
Goosegrass	80	60	80	50	35	35	20	30	35	70	65	75	65	0
Groundsel	0	0	-	0	0	0	0	0	-	-	-	0	0	0
Guineagrass	98	95	98	80	98	80	95	75	75	80	90	100	98	95
Horseweed	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Itchgrass	85	70	65	60	75	65	80	40	40	25	40	-	90	90
Johnsongrass	100	100	65	60	80	75	80	50	50	75	60	25	100	60
Kochia	0	0	-	-	-	-	-	-	-	-	-	-	-	-

Mallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	35	0	0	0	0	0	0	0	0	0
Prickly Sida	0	0	-	-	0	-	0	-	-	-	-	0	0	0
Nutsedge, Purple	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quackgrass	90	75	35	30	0	30	0	10	0	30	50	0	0	0
Ragweed	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Ryegrass, Italian	95	100	98	35	95	75	95	20	35	98	90	80	100	80
Sandbur, S.	100	98	80	70	75	75	75	75	65	85	85	95	80	80
Signalgrass	90	98	90	65	80	75	85	70	50	95	90	80	95	90
Sowthistle	0	0	-	-	0	-	0	-	-	-	-	0	0	0
Spanishneedles	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Spiderwort, T.	-	-	0	0	-	0	-	0	0	0	0	-	-	-
Surinam Grass	100	95	95	50	-	75	98	75	65	100	90	98	90	90

Table E	Compounds													
8 g ai/ha	11	12	19	21	31	32	33	34	35	36	39	40	43	53
Postemergence														
Barnyardgrass	100	100	98	100	35	98	95	95	60	50	100	100	100	100
Bermudagrass	35	70	35	40	65	5	70	20	35	40	35	30	0	50
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chickweed	0	0	-	-	0	-	0	-	0	0	0	0	-	-
Crabgrass, Large	70	65	40	80	60	35	70	60	50	65	65	75	30	35
Crabgrass, Naked	90	90	85	80	30	60	75	40	50	40	65	50	65	30
Dallisgrass	75	75	30	75	35	0	35	10	30	0	60	65	0	0
Dayflower, V.	0	0	0	-	-	0	-	0	-	-	-	-	0	0
Field Bindweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Green	90	90	90	65	50	40	60	50	40	35	60	70	75	70
Goosegrass	35	30	25	75	35	35	35	0	30	0	35	65	20	20
Groundsel	0	0	0	0	0	0	0	0	0	-	-	-	0	0
Guineagrass	95	95	90	95	75	90	80	95	75	35	80	80	100	90
Horseweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Itchgrass	75	50	20	50	50	30	40	70	30	0	20	40	20	70
Johnsongrass	100	95	90	50	40	50	50	10	40	35	35	60	15	50
Kochia	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Mallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prickly Sida	0	0	0	-	-	0	-	0	-	-	-	-	0	0

Nutsedge, Purple	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quackgrass	65	30	15	20	0	0	0	0	0	0	0	30	0	0
Ragweed	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Ryegrass, Italian	90	100	90	80	30	75	35	60	20	0	75	90	50	80
Sandbur, S.	95	98	98	80	0	60	65	75	40	40	75	75	80	65
Signalgrass	90	80	80	80	65	80	75	75	60	10	35	75	80	90
Sowthistle	0	0	0	-	-	0	-	0	-	-	-	-	0	0
Spanishneedles	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Spiderwort, T.	-	-	-	0	0	-	0	-	0	0	0	0	-	-
Surinam Grass	80	90	70	95	20	80	75	90	70	65	95	90	95	90

Table E	Compound
8 g ai/ha	54
Postemergence	
Barnyardgrass	95
Bermudagrass	10
Mustard, Black	0
Bluegrass	0
Chickweed	-
Crabgrass, Large	25
Crabgrass, Naked	10
Dallisgrass	20
Dayflower, V.	0
Field Bindweed	-
Foxtail, Green	40
Goosegrass	0
Groundsel	0
Guineagrass	95
Horseweed	-
Itchgrass	10
Johnsongrass	20
Kochia	-
Mallow	0
Morningglory	0
Prickly Sida	0
Nutsedge, Purple	0
Purslane	0
Quackgrass	0

Table E	Compounds		
4 g ai/ha	11	12	19
Postemergence			
Barnyardgrass	90	90	90
Bermudagrass	10	15	15
Mustard, Black	0	0	0
Bluegrass	0	0	0
Chickweed	0	0	0
Crabgrass, Large	60	0	30
Crabgrass, Naked	25	50	40
Dallisgrass	60	65	0
Dayflower, V.	0	0	0
Field Bindweed	0	0	0
Foxtail, Green	60	30	20
Goosegrass	10	10	0
Groundsel	0	0	0
Guineagrass	90	95	80
Horseweed	0	0	0
Itchgrass	0	0	0
Johnsongrass	95	95	90
Kochia	0	0	0
Mallow	0	0	0
Morningglory	0	0	0
Prickly Sida	0	0	0
Nutsedge, Purple	0	0	0
Purslane	0	0	0
Quackgrass	40	20	0

Ragweed	-		Ragweed	0	0	0
Ryegrass, Italian	80		Ryegrass, Italian	75	75	50
Sandbur, S.	60		Sandbur, S.	90	90	90
Signalgrass	75		Signalgrass	90	65	65
Sowthistle	0		Sowthistle	0	0	0
Spanishneedles	-		Spanishneedles	0	0	0
Spiderwort, T.	-		Surinam Grass	25	35	35
Surinam Grass	90					

Table E Compounds

62 g ai/ha	21	31	33	34	35	36	39	40	43	53
Preemergence										
Barnyardgrass	100	90	100	100	100	100	100	100	100	100
Bermudagrass	100	100	100	100	100	100	100	100	85	98
Mustard, Black	0	0	0	0	0	0	0	0	0	25
Bluegrass	0	0	0	15	0	0	0	95	0	60
Chickweed	-	-	-	-	-	-	-	-	0	0
Crabgrass, Large	100	95	100	100	100	98	100	100	80	100
Crabgrass, Naked	100	100	100	100	100	100	100	100	75	100
Dallisgrass	100	98	100	85	90	98	100	100	90	95
Dayflower, V.	-	-	-	0	-	-	-	-	0	0
Foxtail, Green	100	90	100	100	98	100	100	100	100	100
Goosegrass	100	100	100	100	100	100	100	100	98	100
Groundsel	-	-	-	0	-	-	-	-	0	0
Guineagrass	100	100	100	100	100	100	100	100	100	100
Itchgrass	80	75	80	90	75	90	80	85	85	90
Johnsongrass	95	98	98	90	90	95	98	98	60	95
Kochia	-	-	-	0	-	-	-	-	0	-
Mallow	-	0	0	0	0	0	-	-	0	0
Morningglory	0	0	0	0	0	0	0	0	30	35
Prickly Sida	-	-	-	0	-	-	-	-	0	0
Nutsedge, Purple	0	0	0	35	0	0	-	0	75	98
Purslane	0	0	0	-	0	0	0	0	0	0
Quackgrass	95	65	60	70	50	70	100	90	95	70
Thistle, Russian	-	-	-	0	-	-	-	-	0	0
Ryegrass, Italian	100	100	100	100	100	100	-	100	90	100
Sandbur, S.	100	90	100	100	100	100	100	100	98	100
Signalgrass	100	80	100	100	100	100	100	100	-	98

Sowthistle	-	-	-	0	-	-	-	-	0	0			
Spiderwort, T.	0	0	0	-	0	0	0	0	-	-			
Surinam Grass	100	95	100	100	100	100	100	100	100	100			

Table E	Compounds												
31 g ai/ha	11	12	19	21	31	33	34	35	36	39	40	43	53
Preemergence													
Barnyardgrass	98	95	100	100	75	100	100	95	95	100	100	100	100
Bermudagrass	100	95	100	95	95	98	90	98	100	95	98	70	98
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	0	0	0	0	0	0	0	-	0	0
Chickweed	-	-	-	-	-	-	-	-	-	-	-	0	-
Crabgrass, Large	100	98	100	100	75	100	50	95	98	98	100	70	95
Crabgrass, Naked	100	100	98	100	98	100	100	100	100	98	100	35	100
Dallisgrass	85	100	95	100	75	80	85	90	75	98	100	80	80
Dayflower, V.	0	0	-	-	-	-	0	-	-	-	-	0	0
Field Bindweed	0	0	0	-	-	-	-	-	-	-	-	-	-
Foxtail, Green	98	100	100	100	60	100	75	90	95	98	98	85	65
Goosegrass	90	75	90	100	100	98	95	100	98	100	100	95	100
Groundsel	0	0	0	-	-	-	0	-	-	-	-	0	0
Guineagrass	98	100	100	100	100	100	100	100	100	100	100	100	100
Itchgrass	80	80	80	75	75	80	85	75	75	75	75	50	85
Johnsongrass	95	95	98	90	80	85	90	80	85	80	75	50	90
Kochia	0	0	0	-	-	-	0	-	-	-	-	0	0
Mallow	-	0	0	-	0	0	0	-	0	-	-	0	-
Morningglory	0	0	0	0	0	0	0	0	0	0	0	20	0
Prickly Sida	0	0	0	-	-	-	0	-	-	-	-	0	0
Nutsedge, Purple	0	0	-	0	0	0	20	-	0	0	0	0	35
Purslane	0	0	0	0	0	0	0	0	0	0	0	0	0
Quackgrass	75	80	80	90	20	20	50	40	50	95	80	80	65
Ragweed	0	0	0	-	-	-	-	-	-	-	-	-	-
Thistle, Russian	0	-	0	-	-	-	0	-	-	-	-	0	0
Ryegrass, Italian	100	98	100	100	90	100	100	100	100	100	100	90	100
Sandbur, S.	95	95	95	100	20	90	90	90	100	100	100	75	100
Signalgrass	100	95	80	100	65	98	90	100	100	95	98	100	98
Sowthistle	-	-	-	-	-	-	0	-	-	-	-	0	0
Spanishneedles	0	0	0	-	-	-	-	-	-	-	-	-	-
Spiderwort, T.	-	-	-	0	0	0	-	0	0	0	0	-	-
Surinam Grass	95	95	100	100	95	98	100	100	100	100	100	70	100

Table E	Compounds											
16 g ai/ha	11	19	21	31	33	34	35	36	39	40	43	53
Preemergence												
Barnyardgrass	90	95	100	15	80	80	80	95	90	95	50	95
Bermudagrass	40	95	90	75	90	40	80	100	75	80	30	80
Mustard, Black	0	0	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	0	0	0	0	0	0	90	0	0
Chickweed	-	-	-	-	-	0	-	-	-	-	0	-
Crabgrass, Large	30	95	100	40	75	-	20	95	60	70	0	40
Crabgrass, Naked	95	-	95	50	95	100	98	100	98	90	35	80
Dallisgrass	35	90	100	15	50	50	40	60	98	95	40	65
Dayflower, V.	0	0	-	-	-	0	-	-	-	-	0	0
Field Bindweed	0	0	-	-	-	-	-	-	-	-	-	-
Foxtail, Green	98	65	100	5	65	65	35	60	90	75	25	20
Goosegrass	50	70	100	35	98	65	75	98	80	98	65	80
Groundsel	0	0	-	-	-	0	-	-	-	-	0	0
Guineagrass	98	100	100	90	100	100	100	100	100	100	95	98
Itchgrass	65	65	65	0	60	80	75	65	60	60	35	75
Johnsongrass	90	95	75	25	75	50	75	75	75	75	0	70
Kochia	0	0	-	-	-	0	-	-	-	-	0	0
Mallow	-	0	-	-	0	0	-	0	-	-	0	-
Morningglory	0	0	0	0	0	0	0	0	0	0	0	0
Prickly Sida	0	0	-	-	-	0	-	-	-	-	0	0
Nutsedge, Purple	0	-	0	0	0	0	0	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0	0	0
Quackgrass	60	65	50	0	20	20	20	20	60	60	70	35
Ragweed	0	0	-	-	-	-	-	-	-	-	-	-
Thistle, Russian	-	-	-	-	-	0	-	-	-	-	0	0
Ryegrass, Italian	80	100	100	65	98	80	98	100	100	98	90	90
Sandbur, S.	90	80	98	15	90	75	75	90	90	98	60	30
Signalgrass	90	80	98	15	75	65	80	70	85	95	60	40
Sowthistle	0	-	-	-	-	0	-	-	-	-	0	0
Spanishneedles	0	0	-	-	-	-	-	-	-	-	-	-
Spiderwort, T.	-	-	0	0	0	-	0	0	0	0	-	-
Surinam Grass	95	100	100	20	98	98	95	95	100	100	50	100

Table E	Compounds									
8 g ai/ha	11	12	19	21	31	33	35	36	39	40
Preemergence										

Barnyardgrass	75	70	75	95	0	65	40	80	90	75
Bermudagrass	25	75	60	40	0	90	60	75	20	40
Mustard, Black	0	0	0	0	0	0	0	0	0	0
Bluegrass	0	0	0	0	0	0	0	0	0	60
Crabgrass, Large	0	35	15	65	0	40	20	35	30	50
Crabgrass, Naked	40	95	98	-	0	75	75	90	75	90
Dallisgrass	20	40	40	80	0	25	0	35	35	80
Dayflower, V.	0	0	0	-	-	-	-	-	-	-
Field Bindweed	0	0	0	-	-	-	-	-	-	-
Foxtail, Green	50	60	40	75	0	40	15	15	75	40
Goosegrass	25	65	40	95	20	75	20	30	75	75
Groundsel	0	0	0	-	-	-	-	-	-	-
Guineagrass	0	95	75	100	35	100	90	100	100	100
Itchgrass	35	35	65	40	0	50	0	15	50	35
Johnsongrass	75	90	90	60	15	35	30	60	60	40
Kochia	0	0	0	-	-	-	-	-	-	-
Mallow	0	0	-	-	-	0	0	0	0	-
Morningglory	0	0	0	0	0	0	0	0	0	0
Prickly Sida	0	0	0	-	-	-	-	-	-	-
Nutsedge, Purple	-	-	-	0	-	0	0	0	0	0
Purslane	0	0	0	0	0	0	0	0	0	0
Quackgrass	10	20	30	40	0	0	0	0	50	40
Ragweed	0	0	0	-	-	-	-	-	-	-
Thistle, Russian	0	-	-	-	-	-	-	-	-	-
Ryegrass, Italian	80	80	75	100	0	90	75	80	100	90
Sandbur, S.	35	40	60	90	0	50	30	40	90	50
Signalgrass	60	15	80	80	0	75	60	50	80	60
Spanishneedles	0	0	0	-	-	-	-	-	-	-
Spiderwort, T.	-	-	-	0	0	0	0	0	0	0
Surinam Grass	70	80	100	98	10	90	75	95	100	98

Table E	Compounds		
4 g ai/ha	11	12	19
Preemergence			
Barnyardgrass	0	20	0
Bermudagrass	15	35	25
Mustard, Black	0	0	0
Bluegrass	0	0	0
Crabgrass, Large	0	0	0

Table E	Compounds		
4 g ai/ha	11	12	19
Preemergence			
Kochia	0	0	0
Mallow	-	0	-
Morningglory	0	0	0
Prickly Sida	0	0	0
Nutsedge, Purple	-	-	0

Crabgrass, Naked	-	15	35	Purslane	0	0	0
Dallisgrass	10	0	20	Quackgrass	0	0	0
Dayflower, V.	0	0	0	Ragweed	0	0	0
Field Bindweed	0	0	0	Thistle, Russian	-	0	-
Foxtail, Green	0	0	0	Ryegrass, Italian	20	40	65
Goosegrass	25	25	15	Sandbur, S.	0	0	0
Groundsel	0	0	0	Signalgrass	0	0	40
Guineagrass	0	0	60	Sowthistle	-	0	-
Itchgrass	0	20	10	Spanishneedles	0	-	0
Johnsongrass	75	75	75	Surinam Grass	0	0	50

TEST F

This test evaluated the effect of mixtures of Compound 3, Compound 11, or Compound 12 with the commercial crop safener cloquintocet-mexyl on three plant species. Seeds of test plants consisting of winter wheat (TRZAW, *Triticum aestivum*), winter barley (HORVX, *Hordeum vulgare*), and wild oat (AVEFA, *Avena fatua*) (a weed) 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 that included a surfactant. At the same time, plants selected from these crop and weed species were treated with postemergence applications of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Plants were grown in a greenhouse using supplemental lighting to maintain a photoperiod of about 16 hours; daytime and nighttime temperatures were about 24–30 °C and 19–21 °C, respectively. Balanced fertilizer was applied through the watering system. Treatments consisted of Compound 3, Compound 11, or Compound 12 and the above mentioned safener alone and in combination using a spray volume of 457 L/ha. Each treatment was replicated three times. Treated plants and controls were maintained in a greenhouse for 14 to 21 days, after which time all treated plants were compared to controls and visually evaluated. Plant response ratings were calculated as the means of the three replicates and are summarized in Tables F1 to F6, and are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. Because cloquintocet-mexyl alone caused no injury at the rates tested, the expected effect of a mixture of Compound 3 with cloquintocet-mexyl is the same as the observed effect of Compound 3 applied alone. The observed and expected additive effects are listed in Tables F1 to F6.

Table F1 – Observed and Expected Results from Compound 3 Alone and in Combination with cloquintocet-mexyl*

Preemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 3	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	0	–	10	–	0	–
8	–	33	–	32	–	35	–
16	–	77	–	68	–	60	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	0	0	0	10	0	0
4	8	5	0	3	10	0	0
8	4	17	33	20	32	53	35
8	8	33	33	17	32	40	35
16	4	58	77	75	68	67	60
16	8	75	77	65	68	78	60

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F1, the observed results for TRZAW at three of the six combination treatments and for HORVX at five of the six combination treatments were less than expected, thereby indicating safening at these mixture application rates of Compound 3 and cloquintocet-mexyl.

Table F2 – Observed and Expected Results from Compound 3 Alone and in Combination with cloquintocet-mexyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 3	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	0	–	0	–	27	–
8	–	0	–	0	–	67	–
16	–	22	–	15	–	83	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	0	0	0	0	30	27
4	8	0	0	0	0	28	27
8	4	0	0	3	0	55	67
8	8	0	0	0	0	67	67
16	4	0	22	0	15	85	83
16	8	5	22	0	15	85	83

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F2, the observed results for TRZAW and HORVX at 16 g ai/ha of compound 3 and 4 or 8 g ai/ha of cloquintocet-mexyl were less than expected, thereby indicating safening at these mixture application rates of Compound 3 and cloquintocet-mexyl.

Table F3 – Observed and Expected Results from Compound 11 Alone and in Combination with cloquintocet-mexyl*

Preemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 11	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	32	–	22	–	58	–
8	–	72	–	70	–	77	–
16	–	92	–	92	–	93	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	23	32	38	22	73	58
4	8	60	32	63	22	77	58
8	4	73	72	82	70	90	77
8	8	92	72	85	70	92	77
16	4	95	92	93	92	96	93
16	8	98	92	95	92	96	93

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F3, the observed results for TRZAW at one of the six combination treatments were less than expected, thereby indicating safening at this mixture application rate of Compound 11 and cloquintocet-mexyl.

Table F4 – Observed and Expected Results from Compound 11 Alone and in Combination with cloquintocet-mexyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 11	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	18	–	5	–	75	–
8	–	3	–	55	–	97	–
16	–	32	–	90	–	98	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	18	18	3	5	94	75
4	8	0	18	7	5	91	75
8	4	32	3	32	55	96	97
8	8	28	3	18	55	98	97
16	4	98	32	87	90	99	98
16	8	67	32	90	90	100	98

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F4, the observed results for HORVX at four of the six combination treatments and TRZAW at 4 g ai/ha of compound 11 and 8 g ai/ha of cloquintocet-mexyl were less than expected, thereby indicating safening at these mixture application rates of Compound 11 and cloquintocet-mexyl.

Table F5 – Observed and Expected Results from Compound 12 Alone and in Combination with cloquintocet-mexyl*

Preemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 12	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	0	–	10	–	7	–
8	–	75	–	73	–	92	–
16	–	97	–	80	–	96	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	23	0	35	10	70	7
4	8	30	0	37	10	67	7
8	4	73	75	75	73	85	92
8	8	83	75	80	73	90	92
16	4	93	97	93	80	96	96
16	8	97	97	92	80	93	96

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F5, the observed results for TRZAW show minimal safening at these mixture application rates of Compound 12 and cloquintocet-mexyl.

Table F6 – Observed and Expected Results from Compound 12 Alone and in Combination with cloquintocet-mexyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Compound 12	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
4	–	0	–	0	–	13	–
8	–	18	–	32	–	98	–
16	–	77	–	65	–	100	–
–	4	0	–	0	–	0	–
–	8	0	–	0	–	0	–
4	4	7	0	0	0	75	13
4	8	0	0	0	0	93	13
8	4	37	18	0	32	98	98
8	8	0	18	3	32	96	98
16	4	47	77	67	65	99	100
16	8	7	77	57	65	99	100

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect.

As can be seen from the results listed in Table F6, the observed results for TRZAW and HORVX at three of the six combination treatments were less than expected, thereby indicating safening at these mixture application rates of Compound 12 and cloquintocet-mexyl.

TEST G

This test evaluated the effect of mixtures of Compound 26 with commercial crop safeners cloquintocet-mexyl, mefenpyr-diethyl, and fenchlorazole-ethyl on three plant species. Seeds of winter wheat (TRZAW, *Triticum aestivum*), winter barley (HORVX, *Hordeum vulgare*), and wild oat (AVEFA, *Avena fatua*) (a weed) were planted into a silt loam soil. Plants from these seeds were treated postemergence using test chemicals formulated in a non-phytotoxic solvent mixture that included a surfactant. Plants ranged in height from 6 to 10 cm (2- to 3-leaf stage).

Plants were grown in a greenhouse using supplemental lighting to maintain a photoperiod of about 14 hours; daytime and nighttime temperatures were about 22–26 °C and 15–19 °C, respectively. Balanced fertilizer was applied through the watering system. Treatments consisted of Compound 26 and the above mentioned safeners alone and in combination using a spray volume of 281 L/ha. Each treatment was replicated four times.

Treated plants and controls were maintained in a greenhouse for 15 days, after which time all treated plants were compared to controls and visually evaluated. Plant response ratings were calculated as the means of the four replicates based on a scale of 0 to 100 where 0 is no effect and 100 is complete control and are summarized in Tables G1 to G3. Because the safeners alone caused no injury at the rates tested, the expected effect of a mixture of Compound 26 with a safener is the same as the observed effect of Compound 26 alone. The observed and expected effects are listed in Tables G1 to G3.

The highest application rate of each safener was tested alone to confirm the absence of herbicidal activity on the test species when appled postemergence at 125 g ai/ha. Therefore, an extrapolated result of zero for each safener alone at 16, 31, or 62 g ai/ha was used to calculate the mixture response of Compound 26 and these safener application rates.

Table G1 – Observed and Expected Results from Compound 26 Alone and in Combination with cloquintocet-mexyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Cmpd 26	cloquintocet-mexyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
62	–	10	–	19	–	89	–
125	–	9	–	34	–	97	–
250	–	36	–	45	–	99	–
–	125	0	–	0	–	0	–
62	16	3	10	4	19	97	89
62	31	3	10	15	19	96	89
125	31	8	9	20	34	96	97
125	62	8	9	21	34	99	97
250	62	21	36	25	45	99	99
250	125	18	36	20	45	100	99

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect. Cmpd means Compound.

As can be seen from the results listed in Table G1, the observed results for TRZAW and HORVX were less than expected, thereby indicating safening at these application mixture rates of Compound 26 and cloquintocet-mexyl.

Table G2 – Observed and Expected Results from Compound 26 Alone and in Combination with mefenpyr-diethyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Cmpd 26	mefenpyr-diethyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
62	–	10	–	19	–	89	–
125	–	9	–	34	–	97	–
250	–	36	–	45	–	99	–
–	125	0	–	0	–	0	–
62	16	0	10	8	19	95	89
62	31	0	10	3	19	95	89
125	31	0	9	16	34	100	97
125	62	3	9	14	34	96	97
250	62	14	36	16	45	100	99
250	125	8	36	30	45	99	99

* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect. Cmpd means Compound.

As can be seen from the results listed in Table G2, the observed results for TRZAW and HORVX were less than expected, thereby indicating safening at these application mixture rates of Compound 26 and mefenpyr-diethyl.

Table G3 – Observed and Expected Results from Compound 26 Alone and in Combination with fenchlorazole-ethyl*

Postemergence Application Rate (g a.i./ha)		TRZAW		HORVX		AVEFA	
Cmpd 26	fenchlorazole-ethyl	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
62	–	10	–	19	–	89	–
125	–	9	–	34	–	97	–
250	–	36	–	45	–	99	–
–	125	0	–	0	–	0	–
62	16	0	10	5	19	93	89
62	31	0	10	13	19	95	89
125	31	0	9	14	34	96	97
125	62	0	9	20	34	98	97
250	62	19	36	46	45	100	99
250	125	16	36	44	45	99	99

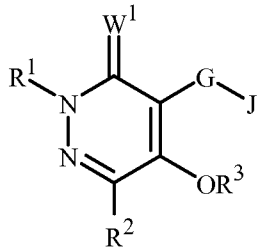
* Application rates are grams of active ingredient per hectare (g a.i./ha). "Obsd." is observed effect. "Exp." is expected effect. Cmpd means Compound.

As can be seen from the results listed in Table G3, the observed results for TRZAW and HORVX at eleven of the twelve combination treatments were less than expected, thereby indicating safening at these application mixture rates of Compound 26 and fenchlorazole-ethyl.

CLAIMS

What is claimed is:

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



1

wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, tetrahydropyranyl, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$, $-P(=W^4)R^7R^8$ or $-C(=W^5)NR^9R^{10}$;

R^2 is H, halogen, cyano, $-C(=O)OH$, $-C(=O)NH_2$, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_3–C_8 halocycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_4–C_{10} cycloalkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, nitro, C_3–C_6 cycloalkoxy or C_4–C_8 cycloalkylalkoxy;

R^3 is H, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$, $-P(=W^4)R^7R^8$ or $-C(=W^5)NR^9R^{10}$;

G is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with R^x on nitrogen ring members and optionally substituted with up to 4 substituents selected from R^w on carbon ring members;

J is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u;

each R^4 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl or C_4–C_{10} cycloalkylaminoalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^5 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_{10} cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl, C_4–C_{10} cycloalkylaminoalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^6 is independently C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_3–C_{10} dialkylaminoalkyl, C_2–C_8 haloalkylaminoalkyl, C_4–C_{10} cycloalkylaminoalkyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_6 haloalkylamino, C_2–C_8 halodialkylamino, C_3–C_8 cycloalkylamino, C_2–C_8 alkylcarbonylamino, C_2–C_8 haloalkylcarbonylamino, C_1–C_6 alkylsulfonylamino, C_1–C_6 haloalkylsulfonylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^7 and R^8 is independently C_1–C_6 alkyl, C_1–C_6 alkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_6 haloalkylamino, C_2–C_8 halodialkylamino, C_3–C_8 cycloalkylamino, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^9 is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_3–C_8 cycloalkenyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl, C_3–C_{10} alkoxyalkoxyalkyl, C_2–C_8 alkylthioalkyl, C_2–C_8 alkylsulfinylalkyl, C_2–C_8 alkylsulfonylalkyl, C_2–C_8 alkylaminoalkyl, C_4–C_{10} dialkylaminoalkyl, naphthalenyl or $-(CR^{11}R^{12})_nG^A$;

each R^{10} is independently H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl or C_4–C_{10} cycloalkylalkyl; or

R^9 and R^{10} are taken together with the nitrogen to which they are attached to form a 3- to 7-membered heterocyclic ring containing, in addition to the linking nitrogen, ring members selected from carbon and optionally O, S and NR^{13}, the carbon ring members optionally in the form of C(=O), and the ring optionally substituted on carbon ring members with up to 4 substituents independently selected from the group consisting of halogen, -CN, C_1–C_3 alkyl and C_1–C_3 alkoxy;

each R^{11} and R^{12} is independently H or C_1–C_3 alkyl;

each R^{13} is independently H or C_1–C_3 alkyl;

each G^A is independently a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with up to 5 substituents independently selected from R^u; or a naphthalenyl ring system optionally substituted with up to 5 substituents independently selected from R^u;

each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH_2, -SO_2NH_2, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfinyl, C_1–C_6 haloalkylsulfinyl, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_3–C_{10} trialkylsilyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl;

each R^w is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH_2, -SO_2NH_2, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_4–C_{10} cycloalkoxycarbonyl, C_5–C_{12} cycloalkylalkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfinyl,

C_1–C_6 haloalkylsulfinyl, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8 dialkylaminosulfonyl, C_3–C_{10} trialkylsilyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, naphthalenyl, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$;

each R^x is independently H, C_1–C_3 alkyl or C_3–C_7 cycloalkyl;

each W^1, W^2, W^3, W^4, W^5 and W^6 is independently O or S; and

each n is independently an integer selected from 0 through 3.

2. A compound of Claim 1 wherein

R^1 is H, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_2–C_6 haloalkenyl, C_2–C_6 haloalkynyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_6–C_{14} cycloalkylcycloalkyl, C_4–C_{10} halocycloalkylalkyl, C_5–C_{12} alkylcycloalkylalkyl, C_2–C_8 alkoxyalkyl, C_4–C_{10} cycloalkoxyalkyl or C_3–C_{10} alkoxyalkoxyalkyl;

R^2 is H, halogen, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_2–C_8 alkoxyalkyl or C_1–C_4 alkoxy;

R^3 is H, $-C(=W^6)R^4$, $-C(=W^2)W^3R^5$, $-S(=O)_2R^6$ or $-C(=W^5)NR^9R^{10}$;

G is a phenyl ring or a 5- or 6-membered heteroaromatic ring, each ring optionally substituted with R^x on nitrogen ring members and optionally substituted with up to 2 substituents selected from R^w on carbon ring members;

each R^w is independently halogen, cyano, hydroxy, amino, nitro, -CHO, $-C(=O)OH$, $-C(=O)NH_2$, $-SO_2NH_2$, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_4–C_{10} alkylcycloalkyl, C_4–C_{10} cycloalkylalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$;

each R^x is independently H or C_1–C_3 alkyl;

J is a phenyl or a 5- or 6-membered heteroaromatic ring, each ring substituted with up to 3 substituents independently selected from R^u; and

each R^u is independently halogen, cyano, hydroxy, amino, nitro, -CHO, $-C(=O)OH$, $-C(=O)NH_2$, $-SO_2NH_2$, SF_5, C_1–C_6 alkyl, C_2–C_6 alkenyl, C_2–C_6 alkynyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_2–C_8 alkylcarbonyl, C_2–C_8 haloalkylcarbonyl, C_2–C_8 alkoxycarbonyl, C_2–C_8 alkylaminocarbonyl, C_3–C_{10} dialkylaminocarbonyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_2–C_8 alkylcarbonyloxy, C_1–C_6 alkylthio, C_1–C_6 haloalkylthio, C_1–C_6 alkylsulfonyl, C_1–C_6 haloalkylsulfonyl, C_1–C_6 alkylaminosulfonyl, C_2–C_8

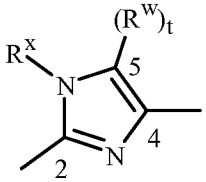
dialkylaminosulfonyl, C_1–C_6 alkylamino, C_2–C_8 dialkylamino, C_2–C_8 alkylcarbonylamino, C_1–C_6 alkylsulfonylamino, phenyl, pyridinyl or thienyl.

3. A compound of Claim 2 wherein

R^1 is H, C_1–C_6 alkyl, C_1–C_6 haloalkyl or C_3–C_8 cycloalkyl;

R^2 is H, halogen, C_1–C_6 alkyl or C_1–C_4 alkoxy;

G is selected from



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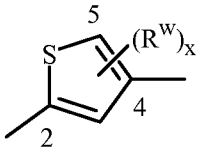

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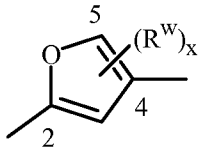

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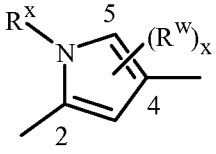

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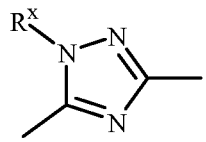

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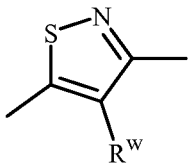

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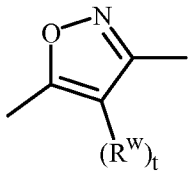

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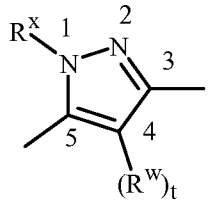

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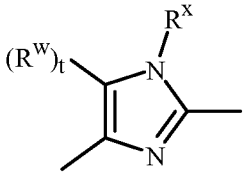

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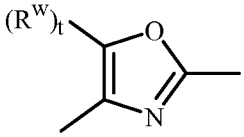

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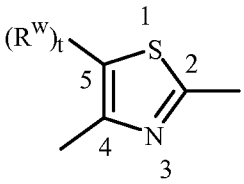

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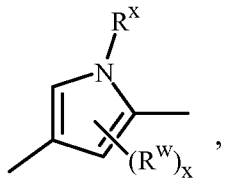

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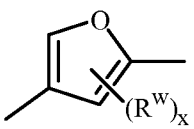

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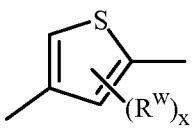

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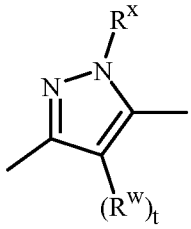

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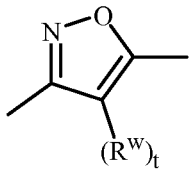

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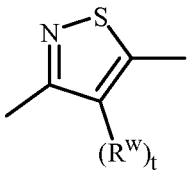

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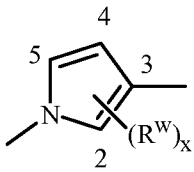

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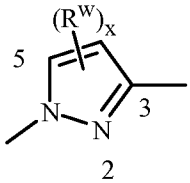

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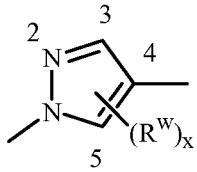

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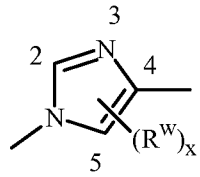

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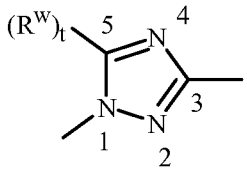

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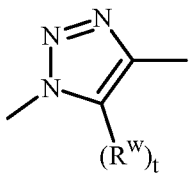

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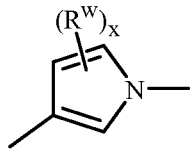

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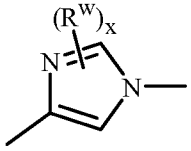

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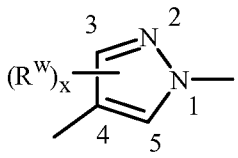

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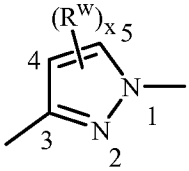

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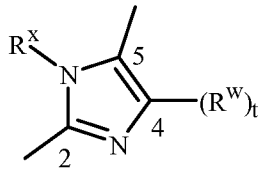

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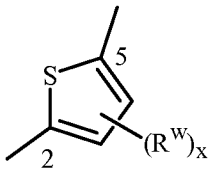

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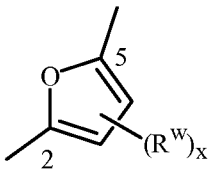

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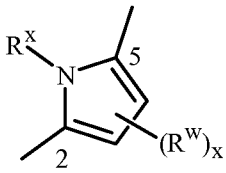

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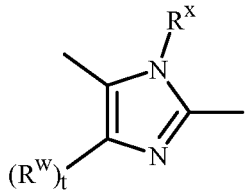

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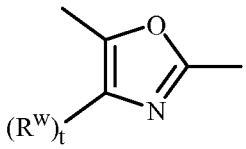

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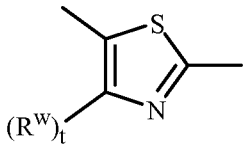

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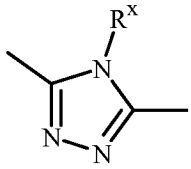

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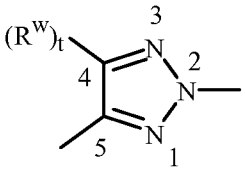

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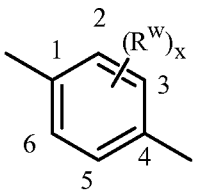

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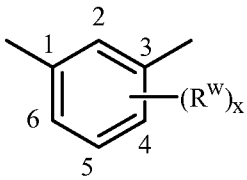

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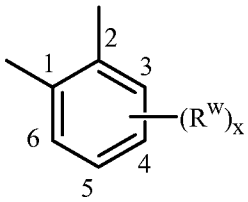

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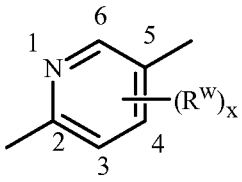

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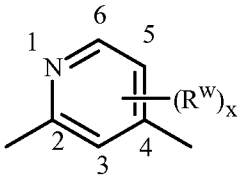

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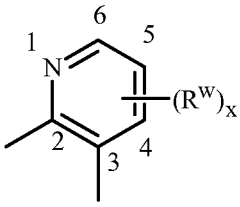

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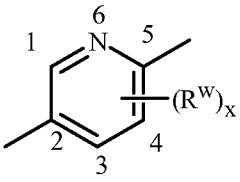

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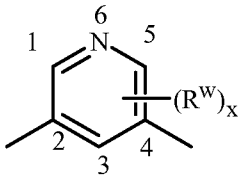

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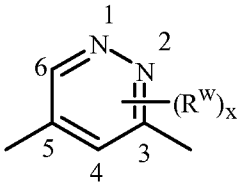
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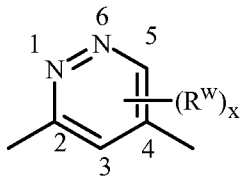
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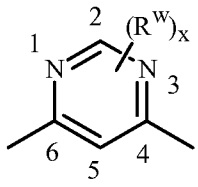
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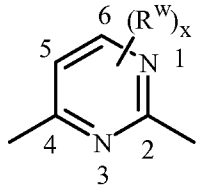
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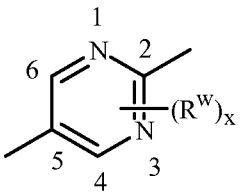
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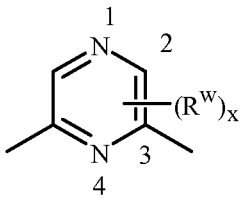
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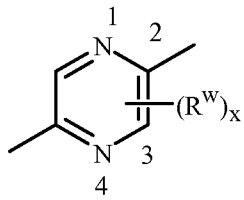
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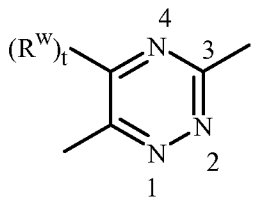
G-71

wherein the bond projecting to the left is bonded to the pyridazinone ring of Formula **1**, and the bond projecting to the right is bonded to J; and x is an integer selected from 0 through 2;

each R^W is independently halogen, hydroxy, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, $-O(CR^{11}R^{12})_nG^A$ or $-(CR^{11}R^{12})_nG^A$;

J is a phenyl ring optionally substituted with up to 3 substituents independently selected from R^u;

each R^u is independently halogen, cyano, nitro, -CHO, -C(=O)OH, C_1–C_6 alkyl, C_1–C_6 haloalkyl, C_3–C_8 cycloalkyl, C_3–C_8 halocycloalkyl, C_1–C_6 alkoxy, C_1–C_6 haloalkoxy, C_1–C_6 alkylamino, C_2–C_8 dialkylamino or phenyl; and

W^1 is O.

4. A compound of Claim 3 wherein

R^1 is H or C_1–C_6 alkyl;

R^2 is H, Cl, CH_3, Et or OMe;

R^3 is H, CO_2-*i*-Pr, or CO-*t*-Bu;

G is selected from G-12 through G-15, G-26 through G-29, G-34, G-35, G-54 and G-65;

each R^W is independently halogen, C_1–C_6 alkyl or $-O(CR^{11}R^{12})_nG^A$;

J is a phenyl substituted with a substituent selected from R^u; and

each R^u is independently halogen, C_1–C_6 alkyl or C_1–C_6 haloalkyl.

5. A compound of Claim 4 wherein

R^1 is CH_3;

R^2 is H;

G is selected from G-12, G-15, G-26, G-28, G-29, G-34, G-35, G-54 and G-65;
each R^W is independently CH_3 or Et;
J is a phenyl substituted at the para position with a substituent selected from R^u; and
each R^u is independently halogen, C_1–C_3 alkyl or C_1–C_3 haloalkyl.

6. A compound of Claim 5 wherein
G is G-26;
x is 1;
R^W is positioned at the 5-position of G-26; and
each R^u is independently Cl, Br or CF_3.

7. A compound of Claim 1 which is selected from the group consisting of
5-hydroxy-2-methyl-4-[5-methyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-3(2*H*)-pyridazinone,
4-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-3-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone,
5-[3-(4-chlorophenyl)-5-methyl-1*H*-pyrazol-1-yl]-1,6-dihydro-1-methyl-6-oxo-4-pyridazinyl-1-methylethyl carbonate,
4-[3-(4-bromophenyl)-5-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-3(2*H*)-pyridazinone,
4-[5-ethyl-3-[4-(trifluoromethyl)phenyl]-1*H*-pyrazol-1-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone and
4-[3-(4-chlorophenyl)-5-ethyl-4-methyl-1*H*-pyrazol-1-yl]-5-hydroxy-2-methyl-3(2*H*)-pyridazinone.

8. A herbicidal composition comprising a herbicidally effective amount of a compound of Claim 1 and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.

9. A herbicidal composition comprising a herbicidally effective amount of a compound of Claim 1, an effective amount of 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.

10. 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/US2008/087577

A. CLASSIFICATION OF SUBJECT MATTER
INV. C07D237/16 C07D401/14 C07D403/04 C07D403/10 C07D405/14
C07D409/14 C07D413/04 C07D417/04 C07D417/14 A61K31/501
A01N43/58

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 A61K 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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007/119434 A (SUMITOMO CHEMICAL CO [JP]; KIJI TOSHIYUKI [JP]; FUSAKA TAKAFUMI [JP]) 25 October 2007 (2007-10-25) the whole document	1-10

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

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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"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	Date of mailing of the international search report
25 March 2009	02/04/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Diederen, Jeroen

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/087577

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007119434 A	25-10-2007	AR 059904 A1	07-05-2008
		AU 2007237660 A1	25-10-2007
		CA 2645272 A1	25-10-2007
		EP 1996557 A1	03-12-2008
		KR 20080105084 A	03-12-2008