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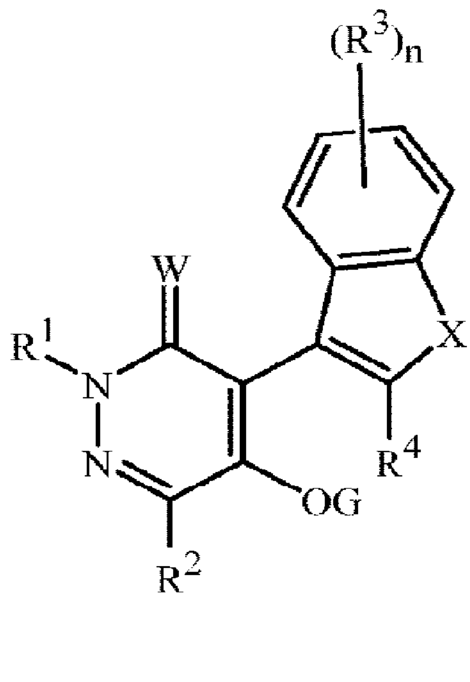

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(57) Abrégé/Abstract:
Disclosed are compounds of Formula 1, including all stereoisomers, N-oxides, and salts thereof, wherein X is O, S or NR^5; or X is $C(R^6)=C(R^7)$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula 1; and R^1, R^2, R^3, R^4, R^5, R^6, R^7, G and W 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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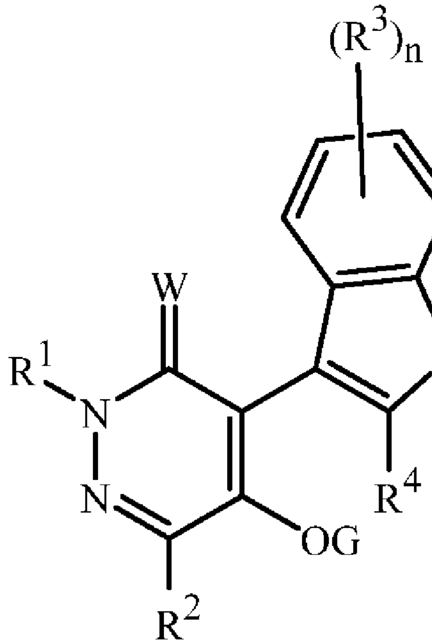
(54) **Title**: PYRIDAZINONE HERBICIDES



(I)

(57) Abstract: Disclosed are compounds of Formula 1, including all stereoisomers, *N*-oxides, and salts thereof, wherein X is O, S or NR^5; or X is $C(R^6)=C(R^7)$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula 1; and R^1, R^2, R^3, R^4, R^5, R^6, R^7, G and W 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

PYRIDAZINONE HERBICIDES

FIELD OF THE INVENTION

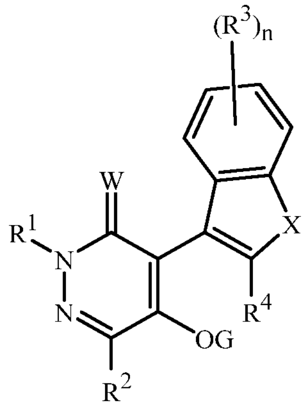
This invention relates to certain pyridazinones, their *N*-oxides, salts and compositions, and methods of their use for controlling undesirable vegetation.

BACKGROUND OF THE INVENTION

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

SUMMARY OF THE INVENTION

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



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wherein

W is O or S;

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl,

C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_1–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

X is O, S or NR^5; or

X is $-C(R^6)=C(R^7)-$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **1**;

each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^4, R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl;

G is G^1 or W^1G^1;

G^1 is H, $-C(=O)R^8$, $-C(=S)R^8$, $-CO_2R^9$, $-C(=O)SR^9$, $-S(O)_2R^8$, $-CONR^{10}R^{11}$, $-S(O)_2NR^{10}R^{11}$, or $P(=O)R^{12}$; or C_1–C_4 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_1–C_4 haloalkyl, C_2–C_4 haloalkenyl, C_2–C_4 haloalkynyl, C_1–C_4 alkoxyalkyl, C_3–C_6 cycloalkyl or C_4–C_7 cycloalkylalkyl; or a 5- or 6-membered heterocyclic ring;

W^1 is C_1–C_4 alkanediyl or C_2–C_4 alkenediyl;

R^8 and R^{10} are independently C_1–C_7 alkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_4–C_7 cycloalkylalkyl; or phenyl, benzyl, or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

R^9 is C_1–C_7 alkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_2–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_4–C_7 cycloalkylalkyl; or phenyl, benzyl or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocycling ring optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

R^{11} is H, C_1–C_7 alkyl, C_2–C_7 alkenyl, C_2–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_1–C_7 haloalkyl or C_2–C_7 alkoxyalkyl;

R^{12} is C_1–C_7 alkyl or C_1–C_7 alkoxy; and

n is 0, 1, 2, 3 or 4;

provided that when R^4 is H, then X is -C(R^6)=C(R^7)-.

More particularly, this invention pertains to a compound of Formula **1** (including all stereoisomers), an *N*-oxide or a salt thereof. This invention also relates to a herbicidal composition comprising a compound of the invention (i.e. in a herbicidally effective amount) and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents. This invention further relates to a method for controlling the growth of undesired vegetation comprising contacting the vegetation or its environment with a herbicidally effective amount of a compound of the invention (e.g., as a composition described herein).

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

DETAILS OF THE INVENTION

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

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

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

Where applicants have defined an invention or a portion thereof with an open-ended term such as "comprising," it should be readily understood that (unless otherwise stated) the description should be interpreted to also describe such an invention using the terms "consisting essentially of" or "consisting of."

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

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

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

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

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

In the above recitations, the term "alkyl", used either alone or in compound words such as "alkylthio" or "haloalkyl" includes straight-chain or branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, or the different butyl, pentyl or hexyl isomers. "Alkenyl" includes straight-chain or branched alkenes such as ethenyl, 1-propenyl, 2-propenyl, and the different butenyl, pentenyl and hexenyl isomers. "Alkenyl" also includes polyenes such as 1,2-propadienyl and 2,4-hexadienyl. "Alkynyl" includes straight-chain or branched alkynes such as ethynyl, 1-propynyl, 2-propynyl and the different butynyl, pentynyl and hexynyl isomers. “Alkynyl” can also include moieties comprised of multiple triple bonds such as 2,5-hexadiynyl.

“Alkoxy” includes, for example, methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy, pentoxy and hexyloxy isomers. “Alkoxyalkyl” denotes alkoxy substitution on alkyl. Examples of “alkoxyalkyl” include CH_3OCH_2, $CH_3OCH_2CH_2$, $CH_3CH_2OCH_2$, $CH_3CH_2CH_2CH_2OCH_2$ and $CH_3CH_2OCH_2CH_2$. “Alkoxyalkoxy” denotes alkoxy substitution on alkoxy. “Alkylthio” includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. “Alkylthioalkyl” denotes alkylthio substitution on alkyl. Examples of “alkylthioalkyl” include CH_3SCH_2, $CH_3SCH_2CH_2$, $CH_3CH_2SCH_2$, $CH_3CH_2CH_2CH_2SCH_2$ and $CH_3CH_2SCH_2CH_2$. “Cyanoalkyl” denotes an alkyl group substituted with one cyano group. Examples of “cyanoalkyl” include $NCCH_2$ and $NCCH_2CH_2$ (alternatively identified as CH_2CH_2CN).

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

The term “halogen”, either alone or in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” includes fluorine, chlorine, bromine or iodine. Further, when used in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of “haloalkyl” or “alkyl substituted with halogen” include F_3C, $ClCH_2$, CF_3CH_2 and CF_3CCl_2. The terms “haloalkoxy”, “haloalkylthio”, “haloalkenyl”, “haloalkynyl”, and the like, areis 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 “haloalkenyl” include $(Cl)_2C{=}CHCH_2$- and $CF_3CH_2CH{=}CHCH_2$-. Examples of “haloalkynyl” include $HC{\equiv}CCHCl$-, $CF_3C{\equiv}C$-, $CCl_3C{\equiv}C$- and $FCH_2C{\equiv}CCH_2$-.

“Alkoxycarbonyl” denotes a straight-chain or branched alkoxy moieties bonded to a C(=O) moiety. Examples of “alkoxycarbonyl” include $CH_3OC(=O)$-, $CH_3CH_2OC(=O)$-, $CH_3CH_2CH_2OC(=O)$-, $(CH_3)_2CHOC(=O)$- and the different butoxy- or pentoxycarbonyl isomers.

The total number of carbon atoms in a substituent group is indicated by the “C_i–C_j” prefix where i and j are numbers from 1 to 7. For example, C_1–C_4 alkylsulfonyl designates methylsulfonyl through butylsulfonyl; C_2 alkoxyalkyl designates CH_3OCH_2-; C_3 alkoxyalkyl designates, for example, $CH_3CH(OCH_3)$-, $CH_3OCH_2CH_2$- or $CH_3CH_2OCH_2$-; and C_4 alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including $CH_3CH_2CH_2OCH_2$- and $CH_3CH_2OCH_2CH_2$-.

When a compound is substituted with a substituent bearing a subscript that indicates the number of said substituents can exceed 1, said substituents (when they exceed 1) are independently selected from the group of defined substituents, e.g., $(R^3)_n$, wherein n is 1, 2, 3 or 4. When a group contains a substituent which can be hydrogen, for example R^2 or R^4, then when this substituent is taken as hydrogen, it is recognized that this is equivalent to said group being unsubstituted. When a variable group is shown to be optionally attached to a position, for example $(R^3)_n$ wherein n may be 0, then hydrogen may be at the position even if not recited in the variable group definition. When one or more positions on a group are said to be “not substituted” or “unsubstituted”, then hydrogen atoms are attached to take up any free valency.

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

Compounds of this invention can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. Stereoisomers are isomers of identical constitution but differing in the arrangement of their atoms in space and include enantiomers, diastereomers, cis-trans isomers (also known as geometric isomers) and atropisomers. Atropisomers result from restricted rotation about single bonds where the rotational barrier is high enough to permit isolation of the isomeric species. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. The compounds of the invention may be present as a mixture of stereoisomers, individual stereoisomers or as an optically active form.

Compounds of Formula **1** typically exist in more than one form, and Formula **1** thus include all crystalline and non-crystalline forms of the compounds they represent. Non-crystalline forms include embodiments which are solids such as waxes and gums as well as embodiments which are liquids such as solutions and melts. Crystalline forms include embodiments which represent essentially a single crystal type and embodiments which represent a mixture of polymorphs (i.e. different crystalline types). The term "polymorph" refers to a particular crystalline form of a chemical compound that can crystallize in different crystalline forms, these forms having different arrangements and/or conformations of the molecules in the crystal lattice. Although polymorphs can have the same chemical composition, they can also differ in composition due the presence or absence of co-crystallized water or other molecules, which can be weakly or strongly bound in the lattice. Polymorphs can differ in such chemical, physical and biological properties as crystal shape, density, hardness, color, chemical stability, melting point, hygroscopicity, suspensibility, dissolution rate and biological availability. One skilled in the art will appreciate that a polymorph of a compound of Formula **1** can exhibit beneficial effects (e.g., suitability for preparation of useful formulations, improved biological performance) relative to another polymorph or a mixture of polymorphs of the same compound of Formula **1**. Preparation and isolation of a particular polymorph of a compound of Formula **1** can be achieved by methods known to those skilled in the art including, for example, crystallization using selected solvents and temperatures. For a comprehensive discussion of polymorphism see R. Hilfiker, Ed., *Polymorphism in the Pharmaceutical Industry*, Wiley-VCH, Weinheim, 2006.

One skilled in the art will appreciate that not all nitrogen-containing heterocycles can form *N*-oxides since the nitrogen requires an available lone pair for oxidation to the oxide; one skilled in the art will recognize those nitrogen-containing heterocycles which can form *N*-oxides. One skilled in the art will also recognize that tertiary amines can form *N*-oxides. Synthetic methods for the preparation of *N*-oxides of heterocycles and tertiary amines are very well known by one skilled in the art including the oxidation of heterocycles and tertiary amines with peroxy acids such as peracetic and *m*-chloroperbenzoic acid (MCPBA), hydrogen peroxide, alkyl hydroperoxides such as *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethyldioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example: T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748–750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18–20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and

B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149–161, A. R. Katritzky, Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285–291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390–392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

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

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

Embodiment 1. A compound of Formula **1** wherein W is O.

Embodiment 2. A compound of Formula **1** or Embodiment 1 wherein X is O, S or -C(R^6)=C(R^7)-.

Embodiment 3. A compound of Embodiment 2 wherein X is O or S.

Embodiment 4. A compound of Embodiment 3 wherein X is O.

Embodiment 5. A compound of Embodiment 3 wherein X is S.

Embodiment 6. A compound of Embodiment 2 wherein X is -C(R^6)=C(R^7)-.

Embodiment 7. A compound of Formula **1** or Embodiment 1 wherein X is NR^5.

Embodiment 7a. A compound of Embodiment 2 wherein X is O, S, -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or -CH=C(CH_3)-.

Embodiment 7b. A compound of Embodiment 2 wherein X is -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or –CH=C(CH_3)-

Embodiment 7c. A compound of Embodiment 2 wherein X is -CH=CH-, -CH=CF-, -CH=CCl- or –CH=C(CH_3)-.

Embodiment 7d. A compound of Formula **1** or any one of Embodiments 1 through 7a wherein R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl.

Embodiment 7e. A compound of Formula **1** or any one of Embodiments 1 through 7a wherein R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy or benzyl.

Embodiment 8. A compound of Formula **1** or any one of Embodiments 1 through 7 wherein R^1 is C_1–C_4 alkyl, C_3–C_4 alkenyl, C_3–C_4 alkynyl, C_3–C_4 cycloalkyl, C_2–C_3 cyanoalkyl, C_1–C_3 haloalkyl or C_2–C_4 alkoxyalkyl.

Embodiment 9. A compound of Embodiment 8 wherein R^1 is C_1–C_3 alkyl, allyl, propargyl, CH_2CH_2CN, C_1–C_2 haloalkyl or 2-methoxyethyl.

Embodiment 10. A compound of Embodiment 9 wherein R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl.

Embodiment 11. A compound of Embodiment 10 wherein R^1 is methyl or ethyl.

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

Embodiment 12a. A compound of Formula **1** wherein R^1 is other than H.

Embodiment 12b. A compound of Formula **1** wherein R^1 is other than phenyl.

Embodiment 12c. A compound of Formula **1** wherein R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_1–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy or C_1–C_5 alkylthio.

Embodiment 12d. A compound of Formula **1** wherein R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_1–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl or C_1–C_7 alkoxy.

Embodiment 13. A compound of Formula **1** or any one of Embodiments 1 through 12 wherein R^2 is H, halogen, -CN, C_1–C_4 alkyl, C_3–C_5 cycloalkyl, C_1–C_3 haloalkyl, C_2–C_4 alkoxyalkyl or C_1–C_3 alkoxy.

Embodiment 14. A compound of Embodiment 13 wherein R^2 is H, halogen, C_1–C_3 alkyl, cyclopropyl, C_1–C_2 haloalkyl, methoxy or ethoxy.

Embodiment 15. A compound of Embodiment 14 wherein R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy.

Embodiment 16. A compound of Embodiment 15 wherein R^2 is methyl or ethyl.

Embodiment 17. A compound of Embodiment 16 wherein R^2 is methyl.

Embodiment 17a. A compound of Formula **1** wherein R^2 is other than phenyl.

Embodiment 18. A compound of Formula **1** or any one of Embodiments 1 through 17 wherein each R^3 is independently halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio.

Embodiment 19. A compound of Embodiment 18 wherein each R^3 is independently halogen, -CN, C_1–C_2 alkyl, $-CH=CH_2$, $-C{\equiv}CH$, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

Embodiment 20. A compound of Embodiment 19 wherein each R^3 is independently halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C{\equiv}CH$, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment 21. A compound of Embodiment 20 wherein each R^3 is independently halogen, -CN, methyl, ethyl, methoxy or ethoxy.

Embodiment 22. A compound of Embodiment 21 wherein each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy.

Embodiment 23. A compound of Formula **1** or any one of Embodiments 1 through 22 wherein R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio.

Embodiment 24. A compound of Embodiment 23 wherein R^4 is halogen, -CN, C_1–C_2 alkyl, $-CH=CH_2$, $-C{\equiv}CH$, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

Embodiment 25. A compound of Embodiment 24 wherein R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C{\equiv}CH$, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment 26. A compound of Embodiment 25 wherein R^4 is methyl or ethyl.

Embodiment 27. A compound of Embodiment 26 wherein R^4 is methyl.

Embodiment 28. A compound of Formula **1** or any one of Embodiments 1 through 27 wherein R^5 is C_1–C_2 alkyl.

Embodiment 29. A compound of Embodiment 28 wherein R^5 is methyl.

Embodiment 30. A compound of Formula **1** or any one of Embodiments 1 through 29 wherein independently, R^6 and R^7 are H, halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio.

Embodiment 31. A compound of Formula **1** or any one of Embodiments 1 through 30 wherein independently, R^6 and R^7 are H, halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

Embodiment 32. A compound of Formula **1** or any one of Embodiments 1 through 31 wherein independently, R^6 and R^7 are H, halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment 34a. A compound of Formula **1** or any one of Embodiments 1 through 32 wherein independently, R^6 and R^7 are H, halogen or C_1–C_2 alkyl.

Embodiment 34b. A compound of Formula **1** or any one of Embodiments 1 through 32 wherein independently, R^6 and R^7 are H or halogen.

Embodiment 34c. A compound of Formula **1** or any one of Embodiments 1 through 32 wherein R^6 is H and R^7 is halogen.

Embodiment 34d. A compound of Formula **1** or any one of Embodiments 1 through 32 wherein R^6 is halogen and R^7 is H.

Embodiment 33. A compound of Formula **1** or any one of Embodiments 1 through 32 wherein independently, R^6 and R^7 are H or C_1–C_2 alkyl.

Embodiment 34. A compound of Formula **1** or any one of Embodiments 1 through 33 wherein R^6 is H or methyl (i.e. CH_3).

Embodiment 35. A compound of Formula **1** or any one of Embodiments 1 through 34 wherein R^7 is H or methyl (i.e. CH_3).

Embodiment 36. A compound of Embodiment 34 or 35 wherein R^6 is H and R^7 is H, or R^6 is H and R^7 is CH_3, or R^6 is CH_3 and R^7 is H.

Embodiment 37. A compound of Embodiment 36 wherein R^6 is H and R^7 is H.

Embodiment 37a. A compound of Formula **1** or any one of Embodiments 1 through 37 wherein G is G^1.

Embodiment 37b. A compound of Formula 1 or any one of Embodiments 1 through 37a whereins G^1 is H, -C(=O)R^8, -C(=S)R^8, -CO_2R^9, -C(=O)SR^9, -S(O)$_2R^8$, -CON$R^{10}R^{11}$, -S(O)$_2$N$R^{10}R^{11}$ or P(=O)R^{12}; or C_3–C_6 cycloalkyl or C_4–C_7 cycloalkylalkyl.

Embodiment 37b. A compound of Formula 1 or any one of Embodiments 1 through 37a wherein G^1 is H, $-C(=O)R^8$, $-C(=S)R^8$, $-CO_2R^9$, $-C(=O)SR^9$, $-S(O)_2R^8$, $-CONR^{10}R^{11}$, $-S(O)_2NR^{10}R^{11}$ or $P(=O)R^{12}$; or $C_4–C_7$ cycloalkylalkyl.

Embodiment 38. A compound of Formula **1** or any one of Embodiments 1 through 37 wherein G^1 is H, $-C(=O)R^8$, $-CO_2R^9$, $-S(O)_2R^8$, $-CONR^{10}R^{11}$, $-S(O)_2NR^{10}R^{11}$ or $P(=O)R^{12}$.

Embodiment 39. A compound of Embodiment 38 wherein G^1 is H, $-C(=O)R^8$, $-CO_2R^9$, $-S(O)_2R^8$ or $P(=O)R^{12}$.

Embodiment 39a. A compound of Embodiment 39 wherein G^1 is H.

Embodiment 39b. A compound of Embodiment 39 wherein G^1 is $-C(=O)R^8$.

Embodiment 39c. A compound of Embodiment 39 wherein G^1 is $-CO_2R^9$.

Embodiment 39d. A compound of Embodiment 39 wherein G^1 $-S(O)_2R^8$.

Embodiment 39e. A compound of Embodiment 39 or $P(=O)R^{12}$

Embodiment 40. A compound of Formula **1** or any one of Embodiments 1 through 39e wherein R^8 and R^{10} are independently H, $C_1–C_7$ alkyl, $C_3–C_7$ cycloalkyl, $C_1–C_3$ haloalkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 41. A compound of Embodiment 40 wherein R^8 and R^{10} are independently H, $C_1–C_7$ alkyl, $C_3–C_7$ cycloalkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 42. A compound of Embodiment 41 wherein R^8 and R^{10} are independently $C_1–C_7$ alkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 42a. A compound of any one of Embodiments 1 through 40 wherein R^8 is $C_1–C_7$ alkyl, $C_3–C_7$ cycloalkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 42b. A compound of Embodiment 41 wherein R^8 is independently $C_1–C_3$ alkyl or $C_2–C_4$ alkoxyalkyl.

Embodiment 42c. A compound of Formula **1** or any one of Embodiments 1 through 37 wherein G is WG^1.

Embodiment 42d. A compound of Formula 1 or any one of Embodiments 1 through 42a wherein W^1 is $C_1–C_2$ alkanediyl or $C_2–C_3$ alkenediyl.

Embodiment 42e. A compound of Embodiment 42b wherein W^1 is $–CH_2–$ or $–CH=CH-$.

Embodiment 42f. A compound of Embodiment 42c wherein W^1 is $–CH_2–$.

Embodiment 43. A compound of Formula **1** or any one of Embodiments 1 through 42 wherein R^9 is H, $C_1–C_7$ alkyl, $C_3–C_7$ cycloalkyl, $C_2–C_3$ haloalkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 44. A compound of Embodiment 43 wherein R^9 is H, $C_1–C_7$ alkyl, $C_3–C_7$ cycloalkyl or $C_2–C_7$ alkoxyalkyl.

Embodiment 45. A compound of Embodiment 44 wherein R^9 is C_1–C_7 alkyl or C_2–C_7 alkoxyalkyl.

Embodiment 46. A compound of Formula **1** or any one of Embodiments 1 through 45 wherein R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment 47. A compound of Embodiment 46 wherein R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment 48. A compound of any one of Embodiments 1 through 47 wherein R^{12} is C_1–C_3 alkyl or C_1–C_3 alkoxy.

Embodiment 49. A compound of Embodiment 48 wherein R^{12} is CH_3 or OCH_3.

Embodiment 48. A compound of Formula **1** or any one of Embodiments 1 through 47 wherein n is 0, 1, 2 or 3.

Embodiment 49. A compound of Embodiment 48 wherein n is 0, 1 or 2.

Embodiment 50. A compound of Embodiment 48 wherein n is 1, 2 or 3.

Embodiment 51. A compound of Embodiment 49 or 50 wherein n is 1 or 2.

Embodiments of this invention, including Embodiments 1–51 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 1–51 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 1–51 are illustrated by:

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

W is O;

X is O, S, -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or -CH=C(CH_3)-;

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_1–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7

haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy or C_1–C_5 alkylthio;

each R^3 is independently halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

G is G^1;

G^1 is H, -C(=O)R^8, -C(=S)R^8, -CO_2R^9, -C(=O)SR^9, -$S(O)_2R^8$, -CON$R^{10}R^{11}$, -$S(O)_2NR^{10}R^{11}$ or P(=O)R^{12}; or C_3–C_6 cycloalkyl or C_4–C_7 cycloalkylalkyl;

R^8 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl;

R^9 is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_2–C_3 haloalkyl or C_2–C_7 alkoxyalkyl;

R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl;

R^{12} is C_1–C_3 alkyl or C_1–C_3 alkoxy;

and

n is 0, 1, 2 or 3.

Embodiment B. A compound of Embodiment A wherein

X is -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or –CH=C(CH_3)-;

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy or benzyl;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_1–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl or C_1–C_7 alkoxy;

each R^3 is independently halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy;

R^4 is halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy;

G^1 is H, -C(=O)R^8, -CO_2R^9, -$S(O)_2R^8$, -CON$R^{10}R^{11}$, -$S(O)_2NR^{10}R^{11}$ or P(=O)R^{12};

R^8, R^9 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl;

R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl; and

R^{12} is CH_3 or OCH_3.

Embodiment C. A compound of Embodiment B wherein

X is -CH=CH-, -CH=CF-, -CH=CCl- or –CH=C(CH_3)-

R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;

R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy;

each R^3 is independently halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

R^4 is halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

G^1 is H, -C(=O)R^8, -CO_2R^9, -$S(O)_2R^8$ or P(=O)R^{12};

R^8 and R^9 are independently C_1–C_7 alkyl or C_2–C_7 alkoxyalkyl; and

n is 1 or 2.

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

4-(2,5-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 1),

5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethylbenzo[b]thien-3-yl)-3(2*H*)-pyridazinone (Compound 2),

5-hydroxy-2,6-dimethyl-4-(2,4,6-trimethylbenzo[b]thien-3-yl)-3(2*H*)-pyridazinone (Compound 3),

5-hydroxy-2,6-dimethyl-4-(2-methyl-3-benzofuranyl)-3(2*H*)-pyridazinone (Compound 4),

5-hydroxy-4-(5-methoxy-3-benzofuranyl)-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 5),

4-(5-chloro-2-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 6),

4-(2,5-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 7),

4-(2,4-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 8),

4-(2,7-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 9), 4-(2-ethyl-5-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 10),

5-hydroxy-2,6-dimethyl-4-(1-naphthalenyl)-3(2*H*)-pyridazinone (Compound 11),

5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2*H*)-pyridazinone (Compound 12),

4-(5-ethyl-2-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 13),

5-(acetyloxy)-4-(2,5-dimethyl-3-benzofuranyl)-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 14),

5-(acetyloxy)-4-(2,7-dimethyl-3-benzofuranyl)-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 15),

5-(acetyloxy)-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2*H*)-pyridazinone (Compound 16),

5-(2,5-dimethyl-3-benzofuranyl)-1,6-dihydro-1,3-dimethyl-6-oxo-4-pyridazinyl 2,2-dimethylpropanoate (Compound 17),

1,6-dihydro-1,3-dimethyl-6-oxo-5-(2,5,7-trimethyl-3-benzofuranyl)-4-pyridazinyl 2,2-dimethylpropanoate (Compound 18), and

4-(2-ethyl-4,6-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 19).

Specific embodiments also include compounds of Formula **1** selected from the group consisting of: compound numbers 1, 3, 11, 23, 25, 27, 28, 29, 32, 42, 47, 57, 59 and 60. Compound numbers refer to compounds in Index Table A.

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

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

Embodiment P1. A compound of Formula **1** wherein W is O.

Embodiment P2. A compound of Formula **1** or Embodiment P1 wherein X is O, S or $-C(R^6)=C(R^7)-$.

Embodiment P3. A compound of Embodiment P2 wherein X is O or S.

Embodiment P4. A compound of Embodiment P3 wherein X is O.

Embodiment P5. A compound of Embodiment P3 wherein X is S.

Embodiment P6. A compound of Embodiment P2 wherein X is $-C(R^6)=C(R^7)-$.

Embodiment P7. A compound of Formula **1** or Embodiment P1 wherein X is NR^5.

Embodiment P8. A compound of Formula **1** or any one of Embodiments P1 through P7 wherein R^1 is $C_1–C_4$ alkyl, $C_3–C_4$ alkenyl, $C_3–C_4$ alkynyl, $C_3–C_4$ cycloalkyl, $C_2–C_3$ cyanoalkyl, $C_1–C_3$ haloalkyl or $C_2–C_4$ alkoxyalkyl.

Embodiment P9. A compound of Embodiment P8 wherein R^1 is $C_1–C_3$ alkyl, allyl, propargyl, CH_2CH_2CN, $C_1–C_2$ haloalkyl or 2-methoxyethyl.

Embodiment P10. A compound of Embodiment P9 wherein R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl.

Embodiment P11. A compound of Embodiment P10 wherein R^1 is methyl or ethyl.

Embodiment P12. A compound of Embodiment P11 wherein R^1 is methyl.

Embodiment P13. A compound of Formula **1** or any one of Embodiments P1 through P12 wherein R^2 is H, halogen, -CN, $C_1–C_4$ alkyl, $C_3–C_5$ cycloalkyl, $C_1–C_3$ haloalkyl, $C_2–C_4$ alkoxyalkyl or $C_1–C_3$ alkoxy.

Embodiment P14. A compound of Embodiment P13 wherein R^2 is H, halogen, $C_1–C_3$ alkyl, cyclopropyl, $C_1–C_2$ haloalkyl, methoxy or ethoxy.

Embodiment P15. A compound of Embodiment P14 wherein R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy.

Embodiment P16. A compound of Embodiment P15 wherein R^2 is methyl or ethyl.

Embodiment P17. A compound of Embodiment P16 wherein R^2 is methyl.

Embodiment P18. A compound of Formula **1** or any one of Embodiments P1 through P17 wherein each R^3 is independently halogen, -CN, $C_1–C_3$ alkyl, $C_2–C_4$ alkenyl, $C_2–C_4$ alkynyl, $C_3–C_4$ cycloalkyl, $C_1–C_3$ haloalkyl, $C_1–C_3$ alkoxy, $C_1–C_2$ haloalkoxy, $C_1–C_2$ alkylthio or $C_1–C_2$ haloalkylthio.

Embodiment P19. A compound of Embodiment P18 wherein each R^3 is independently halogen, -CN, $C_1–C_2$ alkyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, $C_1–C_2$ haloalkyl or $C_1–C_2$ alkoxy.

Embodiment P20. A compound of Embodiment P19 wherein each R^3 is independently halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment P21. A compound of Embodiment P20 wherein each R^3 is independently halogen, -CN, methyl, ethyl, methoxy or ethoxy.

Embodiment P22. A compound of Embodiment P21 wherein each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy.

Embodiment P23. A compound of Formula **1** or any one of Embodiments P1 through P22 wherein R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio.

Embodiment P24. A compound of Embodiment P23 wherein R^4 is halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

Embodiment P25. A compound of Embodiment P24 wherein R^4 is halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment P26. A compound of Embodiment P25 wherein R^4 is methyl or ethyl.

Embodiment P27. A compound of Embodiment P26 wherein R^4 is methyl.

Embodiment P28. A compound of Formula **1** or any one of Embodiments P1 through P27 wherein R^5 is C_1–C_2 alkyl.

Embodiment P29. A compound of Embodiment P28 wherein R^5 is methyl.

Embodiment P30. A compound of Formula **1** or any one of Embodiments P1 through P29 wherein independently, R^6 and R^7 are H, halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio.

Embodiment P31. A compound of Formula **1** or any one of Embodiments P1 through P30 wherein independently, R^6 and R^7 are H, halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

Embodiment P32. A compound of Formula **1** or any one of Embodiments P1 through P31 wherein independently, R^6 and R^7 are H, halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy.

Embodiment P33. A compound of Formula **1** or any one of Embodiments P1 through P32 wherein independently, R^6 and R^7 are H or C_1–C_2 alkyl.

Embodiment P34. A compound of Formula **1** or any one of Embodiments P1 through P33 wherein R^6 is H or methyl (i.e. CH_3).

Embodiment P35. A compound of Formula **1** or any one of Embodiments P1 through P34 wherein R^7 is H or methyl (i.e. CH_3).

Embodiment P36. A compound of Embodiment P34 or 35 wherein R^6 is H and R^7 is H, or R^6 is H and R^7 is CH_3, or R^6 is CH_3 and R^7 is H.

Embodiment P37. A compound of Embodiment P36 wherein R^6 is H and R^7 is H.

Embodiment P38. A compound of Formula **1** or any one of Embodiments P1 through P37 wherein G is H, -C(=O)R^8, -CO_2R^9, -S(O)$_2R^8$, -CON$R^{10}R^{11}$ or -S(O)$_2$N$R^{10}R^{11}$.

Embodiment P39. A compound of Embodiment P38 wherein G is H, -C(=O)R^8, -CO_2R^9 or -S(O)$_2R^8$.

Embodiment P40. A compound of Formula **1** or any one of Embodiments P1 through P39 wherein R^8 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P41. A compound of Embodiment P40 wherein R^8 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P42. A compound of Embodiment P41 wherein R^8 and R^{10} are independently C_1–C_7 alkyl or C_2–C_7 alkoxyalkyl.

Embodiment P43. A compound of Formula **1** or any one of Embodiments 1 through 42 wherein R^9 is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_2–C_3 haloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P44. A compound of Embodiment P43 wherein R^9 is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P45. A compound of Embodiment P44 wherein R^9 is C_1–C_7 alkyl or C_2–C_7 alkoxyalkyl.

Embodiment P46. A compound of Formula **1** or any one of Embodiments P1 through P45 wherein R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P47. A compound of Embodiment P46 wherein R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment P48. A compound of Formula **1** or any one of Embodiments P1 through P47 wherein n is 0, 1, 2 or 3.

Embodiment P49. A compound of Embodiment P48 wherein n is 0, 1 or 2.

Embodiment P50. A compound of Embodiment P48 wherein n is 1, 2 or 3.

Embodiment P51. A compound of Embodiment P49 or P50 wherein n is 1 or 2.

Embodiments of this invention, including Embodiments P1–P51 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 P1–P51 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 P1–P51 are illustrated by:

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

W is O;

X is O, S, -CH=CH-, -C(CH_3)=CH- or –CH=C(CH_3)-;

R^1 is C_1–C_4 alkyl, C_3–C_4 alkenyl, C_3–C_4 alkynyl, C_3–C_4 cycloalkyl, C_2–C_3 cyanoalkyl, C_1–C_3 haloalkyl or C_2–C_4 alkoxyalkyl;

R^2 is H, halogen, -CN, C_1–C_4 alkyl, C_3–C_5 cycloalkyl, C_1–C_3 haloalkyl, C_2–C_4 alkoxyalkyl or C_1–C_3 alkoxy;

each R^3 is independently halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

G is H, -C(=O)R^8, -CO_2R^9, -$S(O)_2R^8$, -CONR^{10}R^{11} or -$S(O)_2NR^{10}R^{11}$;

R^8 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl;

R^9 is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_2–C_3 haloalkyl or C_2–C_7 alkoxyalkyl;

R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl, C_1–C_3 haloalkyl or C_2–C_7 alkoxyalkyl; and

n is 0, 1, 2 or 3.

Embodiment PB. A compound of Embodiment PA wherein

R^1 is C_1–C_3 alkyl, allyl, propargyl, CH_2CH_2CN, C_1–C_2 haloalkyl or 2-methoxyethyl;

R^2 is H, halogen, C_1–C_3 alkyl, cyclopropyl, C_1–C_2 haloalkyl, methoxy or ethoxy;

each R^3 is independently halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy;

R^4 is halogen, -CN, C_1–C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy;

R^8, R^9 and R^{10} are independently H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl; and

R^{11} is H, C_1–C_7 alkyl, C_3–C_7 cycloalkyl or C_2–C_7 alkoxyalkyl.

Embodiment PC. A compound of Embodiment PB wherein

R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;

R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy;

each R^3 is independently halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, CF_3, methoxy or ethoxy;

R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, CF_3, methoxy or ethoxy;

G is H, $-C(=O)R^8$, $-CO_2R^9$ or $-S(O)_2R^8$;

R^8 and R^9 are independently C_1–C_7 alkyl or C_2–C_7 alkoxyalkyl; and

n is 1 or 2.

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

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

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

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

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

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

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

“Photosystem I electron diverters” (b6) are chemical compounds that accept electrons from Photosystem I, and after several cycles, generate hydroxyl radicals. These radicals are extremely reactive and readily destroy unsaturated lipids, including membrane fatty acids and chlorophyll. This destroys cell membrane integrity, so that cells and organelles “leak”, leading to rapid leaf wilting and desiccation, and eventually to plant death. Examples of this second type of photosynthesis inhibitor include diquat and paraquat.

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

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

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

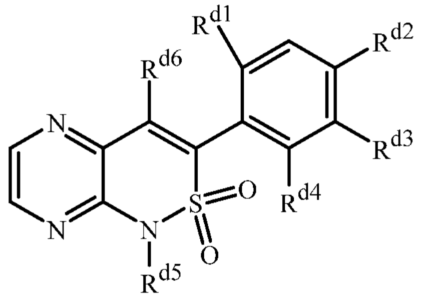
"Auxin transport inhibitors" (b10) are chemical substances that inhibit auxin transport in plants, such as by binding with an auxin-carrier protein. Examples of auxin transport inhibitors include diflufenzopyr, naptalam (also known as *N*-(1-naphthyl)phthalamic acid and 2-[(1-naphthalenylamino)carbonyl]benzoic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

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

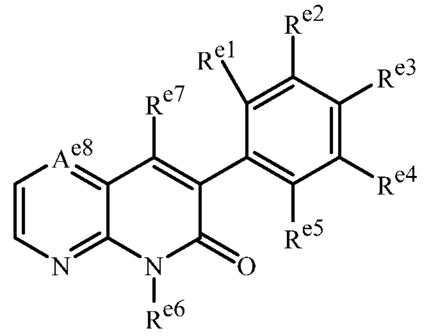
"HPPD inhibitors" (b12) are chemical substances that inhibit the biosynthesis of synthesis of 4-hydroxyphenyl-pyruvate dioxygenase. Examples of HPPD inhibitors include benzobicyclon, benzofenap, bicyclopyrone (4-hydroxy-3-[[2-[(2-methoxyethoxy)methyl]-6-(trifluoromethyl)-3-pyridinyl]carbonyl]bicyclo[3.2.1]oct-3-en-2-one), fenquinotrione (2-[[8-chloro-3,4-dihydro-4-(4-methoxyphenyl)-3-oxo-2-quinoxalinyl]carbonyl]-1,3-cyclohexanedione), isoxachlortole, isoxaflutole, mesotrione, pyrasulfotole, pyrazolynate, pyrazoxyfen, sulcotrione, tefuryltrione, tembotrione, topramezone, 5-chloro-3-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-1-(4-methoxyphenyl)-2(1*H*)-quinoxalinone, 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5(2*H*,4*H*)-dione, 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-(3-methoxyphenyl)-3-(3-methoxypropyl)-4(3*H*)-pyrimidinone, 2-methyl-*N*-(4-methyl-1,2,5-oxadiazol-3-yl)-3-(methylsulfinyl)-4-(trifluoromethyl)benzamide and 2-methyl-3-(methylsulfonyl)-*N*-(1-methyl-1*H*-tetrazol-5-yl)-4-(trifluoromethyl)benzamide. Of note is a mixture of a compound of the invention with mesotrione, isoxaflutole, tembotrione, bicyclopyrone, topramazone or pyrasulfotole. Also of note is a compound of the invention mixed with mesotrione or pyrasulfatole.

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

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



A



B

wherein R^{d1} is H, Cl or CF_3; R^{d2} is H, Cl or Br; R^{d3} is H or Cl; R^{d4} is H, Cl or CF_3; R^{d5} is CH_3, CH_2CH_3 or CH_2CHF_2; and R^{d6} is OH, or -OC(=O)-*i*-Pr; and R^{e1} is H, F, Cl, CH_3 or CH_2CH_3; R^{e2} is H or CF_3; R^{e3} is H, CH_3 or CH_2CH_3; R^{e4} is H, F or Br; R^{e5} is Cl, CH_3, CF_3, OCF_3 or CH_2CH_3; R^{e6} is H, CH_3, CH_2CHF_2 or C≡CH; R^{e7} is OH, -OC(=O)Et, -OC(=O)-*i*-Pr or -OC(=O)-*t*-Bu; and A^{e8} is N or CH.

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

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

“Herbicide safeners” (b16) are substances added to a herbicide formulation to eliminate or reduce phytotoxic effects of the herbicide to certain crops. These compounds protect crops from injury by herbicides but typically do not prevent the herbicide from controlling undesired vegetation. Examples of herbicide safeners include but are not limited to benoxacor, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfamide, daimuron, dichlormid, dicyclonon, dimepiperate, fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone, naphthalic anhydride, oxabetrinil, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide and *N*-(aminocarbonyl)-2-fluorobenzenesulfonamide, 1-bromo-4-[(chloromethyl)sulfonyl]benzene, 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), 4-(dichloroacetyl)-1-oxa-4-azospiro-[4.5]decane (MON 4660).

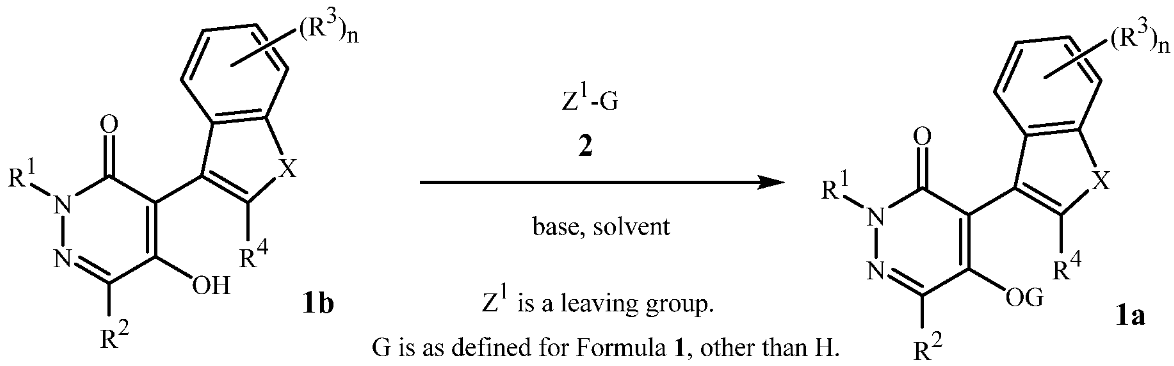
The compounds of Formula **1** can be prepared by general methods known in the art of synthetic organic chemistry. A wide variety of synthetic methods are known in the art to enable preparation of aromatic and nonaromatic heterocyclic rings and ring systems; for extensive reviews see the eight volume 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.

One or more of the following methods and variations as described in Schemes 1–22 can be used to prepare compounds of Formula **1**. The definitions of groups R^1, R^2, R^3, R^4, W, X and G in the compounds of Formulae **1**–**35** are as defined above in the Summary of the Invention unless otherwise noted. Formulae **1a, 1b** and **1c** are subsets of compounds of Formula **1**, and all substituents for Formulae **1a**–**1c** are as defined above for Formula **1** unless otherwise noted. Formulae **6a**, **6b** and **6c** are subsets of compounds of Formula **6**, and all substituents for Formulae **6a**–**6c** are as defined for Formula **6** unless otherwise noted.

As shown in Scheme 1, pyridazinones of Formula **1a** (a subset of compounds of Formula **1** where W is O, and G is as defined above, but other than hydrogen) can be made by reacting substituted 5-hydroxy-3(2*H*)-pyridazinones of Formula **1b** (i.e. Formula **1** wherein W is O and G is H) with a suitable electrophilic reagent of Formula **2** (i.e. Z^1-G where Z^1 is a leaving group, alternatively known as a nucleofuge, such as a halogen) in the presence of base in an appropriate solvent. Some examples of reagent classes representing Formula **2** wherein Z^1 is Cl include acid chlorides (G is -(C=O)R^8), chloroformates (G is -CO_2R^9), carbamoyl chlorides (G is -$CONR^{10}R^{11}$), sulfonyl chlorides (G is -$S(O)_2R^8$) and chlorosulfonamides (G is -$S(O)_2NR^{10}R^{11}$). Examples of suitable bases for this reaction include, but are not limited to, potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride or potassium *tert*-butoxide and, depending on the specific base used, appropriate solvents can be protic or aprotic and used anhydrous or as aqueous mixtures. Preferred solvents for this reaction include acetonitrile, methanol, ethanol, tetrahydrofuran, diethyl ether, 1,2-dimethoxyethane, dioxane, dichloromethane or

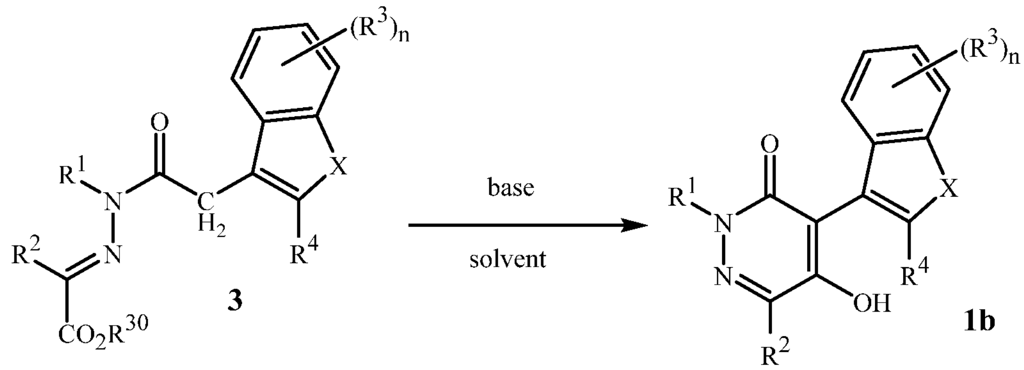
N,*N*-dimethylformamide. The reaction can be run under a range of temperatures, with temperatures typically ranging from 0 °C to the reflux temperature of the solvent.

Scheme 1



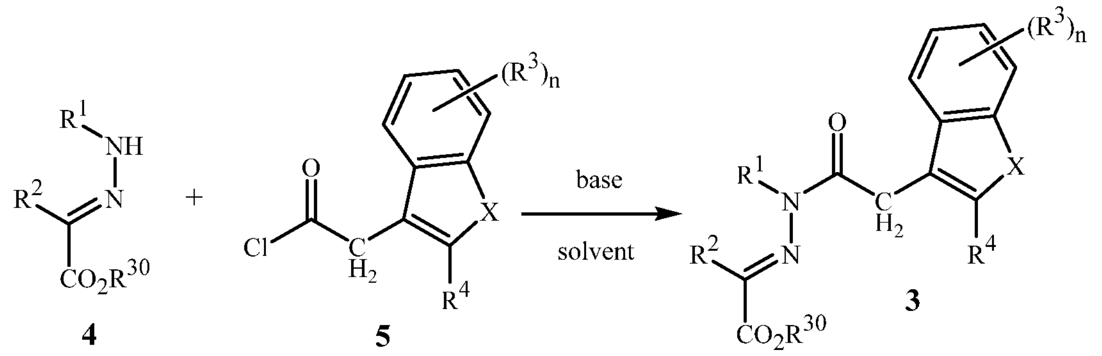
Substituted 5-hydroxy-3(2*H*)-pyridazinones of Formula **1b** can be prepared as outlined in Scheme 2 by cyclization of hydrazide esters of Formula **3** (where R^{30} is alkyl, typically methyl or ethyl) in the presence of base and solvent. Suitable bases for this reaction include but are not limited to potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride, potassium *t*-butoxide or 1,8-diazabicyclo[5.4.0]undec-7-ene. Depending on the specific base used, appropriate solvents can be protic or aprotic and used anhydrous or as aqueous mixtures. Solvents for this cyclization include acetonitrile, methanol, ethanol, tetrahydrofuran, diethyl ether, dioxane, 1,2-dimethoxyethane, dichloromethane or *N*,*N*-dimethylformamide. Temperatures for this cyclization generally range from 0 °C to the reflux temperature of the solvent. Literature methods for cyclizing hydrazide ester intermediates of formula $CH_3(CO_2C_2H_5)C{=}NNCH_3C({=}O)CH_2Ar$ (where Ar is a substituted phenyl instead of the bicyclic ring system shown in Formula **3**) to the corresponding 4-aryl-5-hydroxy-pyridazinones are disclosed in U.S. Patents 8541414 and 8470738. The same conditions reported in these patents are applicable to cyclizing hydrazone esters of Formula **3** to pyridazinones of Formula **1b**. The method of Scheme 2 is illustrated by Step F of Synthesis Example 1, Step H of Synthesis Example 2 and Step H of Synthesis Example 3.

Scheme 2



Substituted hydrazide esters of Formula **3** can be prepared as outlined in Scheme 3 by coupling a hydrazone ester of Formula **4** (where R^{30} is alkyl, typically methyl or ethyl) with an acid chloride of Formula **5** in the presence of base and solvent. Preferred bases for this reaction are usually tertiary amines such as triethylamine or Hunig's base, but other bases can also be used, including *N*,*N*-dimethylaminopyridine, potassium carbonate, sodium hydroxide, potassium hydroxide, sodium hydride or potassium *t*-butoxide. Depending on the specific base used, appropriate solvents can be protic or aprotic where the reaction takes place under anhydrous conditions or as aqueous mixtures under Schotten-Baumann conditions. Solvents that are used for this acylation on nitrogen include acetonitrile, tetrahydrofuran, diethyl ether, dioxane, toluene, 1,2-dimethoxyethane, dichloromethane or *N*,*N*-dimethylformamide. Temperatures for this reaction can range from 0 °C to the reflux temperature of the solvent. Methods to make related hydrazide ester intermediates of formula $CH_3(CO_2C_2H_5)C{=}NNCH_3C({=}O)Ar$ (where Ar is a substituted phenyl) have been published in the patent literature, see U.S. Patents 8541414 and 8470738, and U.S. Patent Application Publication 2010/0267561. The procedures disclosed in these patent publications are directly applicable to making intermediates useful for preparing the present compounds as depicted in Scheme 3. The method of Scheme 3 is illustrated by Step E of Synthesis Example 1, Step G of Synthesis Example 2 and Step G of Synthesis Example 3.

Scheme 3

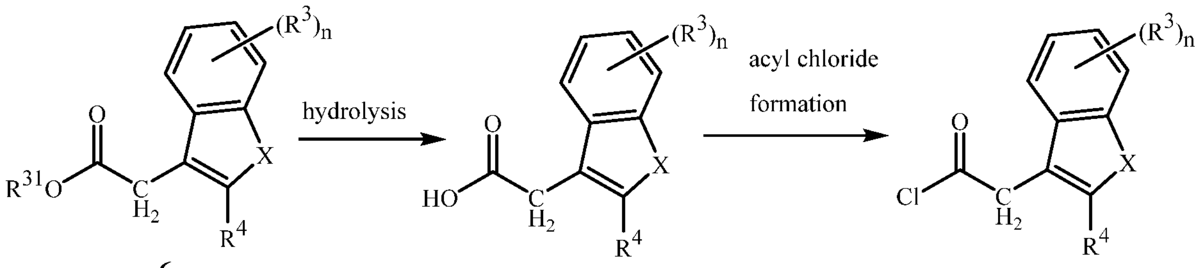


4 5 3

Hydrazone esters of Formula **4** are readily accessible by reaction of an appropriately substituted hydrazine of formula R^1NHNH_2 with a ketone or aldehyde ester of formula $R^2(C{=}O)CO_2R^{30}$ (where R^{30} is typically methyl or ethyl) in a suitable solvent such as ethanol, methanol, acetonitrile or dioxane or dichloromethane at temperatures generally ranging from 0 to 80 °C. U.S. Patent Application Publications 2007/0112038 and 2005/0256123 disclose procedures for forming the hydrazone from methylhydrazine and the keto ester $CH_3(C{=}O)CO_2C_2H_5$. Preparation of hydrazone esters of Formula **4** is illustrated by Step D of Synthesis Example 1.

As shown in Scheme 4, bicyclic acetyl chlorides of Formula **5** can be prepared from the corresponding bicyclic acetic acid esters of Formula **6** wherein R^{31} is typically methyl or ethyl via ester hydrolysis and acid chloride formation. Standard methods for this transformation are known in the literature. For example, ester hydrolysis can be achieved by heating an alcoholic solution of an ester of Formula **6** with an aqueous solution of an alkali metal hydroxide, following by acidification with a mineral acid. The carboxylic acid of Formula **7** formed can then be converted to the corresponding acyl chloride of Formula **5** by treatment with oxalyl chloride and a catalytic amount of *N,N*-dimethylformamide in an inert solvent such as dichloromethane. *J. Heterocyclic Chem.* **1983**, *20*(6), 1697–1703; *J. Med. Chem.* **2007**, *50*(1), 40–64; and PCT Patent Publications WO 2005/012291, WO 98/49141 and WO 98/49158 disclose hydrolysis of benzofuran- and benzothiophene-acetate esters to the corresponding acetic acids. *Monatshefte für Chemie* **1968**, *99*(2) 715–720 and patent publications WO 2004046122, WO 2009/038974 and JP09077767 disclose conversion of benzofuran- and benzothiophene-acetic acids to the corresponding acid chlorides. The hydrolysis step of Scheme 4 is illustrated by Step C of Synthesis Example 1, Step F of Synthesis Example 2 and Step F of Synthesis Example 3. The acyl chloride formation step of Scheme 4 is illustrated by Step E of Synthesis Example 1, Step G of Synthesis Example 2 and Step G of Synthesis Example 3.

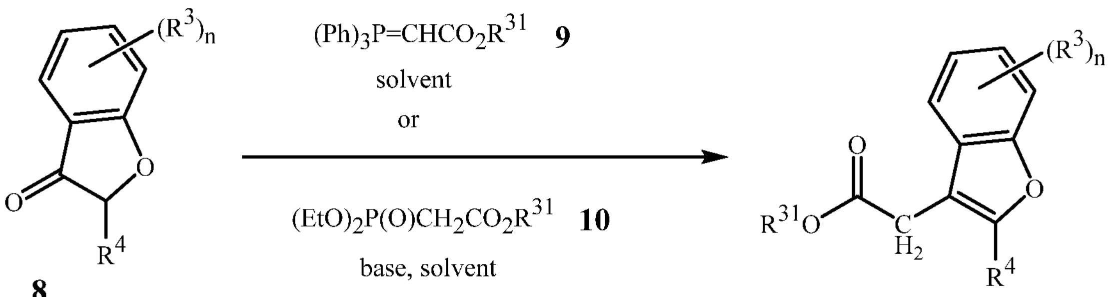
Scheme 4



6 7 5

As shown in Scheme 5, benzofuran acetates of Formula **6a** (i.e. Formula **6** wherein X is O) can be made from benzofuran-3-ones of Formula **8** via either a Wittig reaction with a (triphenylphosphoranylidine)acetate of Formula **9** wherein R^{31} is typically methyl or ethyl in an inert solvent such as tetrahydrofuran or toluene or by a Wadsworth-Emmons reaction using a phosphonate acetate of Formula **10** wherein R^{31} is typically methyl or ethyl in the presence of a base such as sodium hydride or potassium *tert*-butoxide in a suitable solvent that is generally anhydrous tetrahydrofuran or dioxane. This reaction involves migration of an initially formed exocyclic double bond (formation of a dihydrobenzofuran substituted unsaturated ester) to inside the benzofuran ring system, thereby giving rise to a benzofuran acetate of Formula **6a**. Experimental conditions for a Wittig transformation are provided in PCT Patent Publication WO 2008/074752. Temperatures typically range from 0 °C to the reflux temperature of the solvent. In some cases, longer heating is required to drive migration of the exocyclic double bond in conjugation with the ester to the endocyclic position within the fully benzofuran ring system. The method of Scheme 5 is illustrated by Step E of Synthesis Example 2 and Step E of Synthesis Example 3.

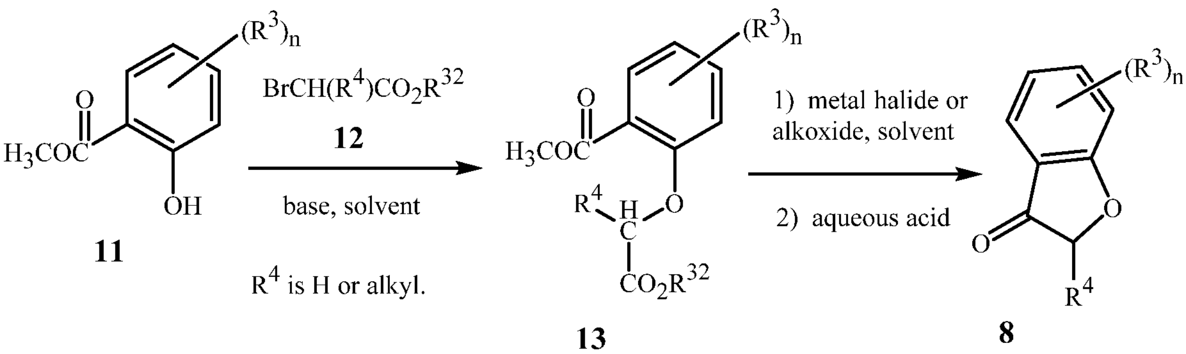
Scheme 5



8 6a

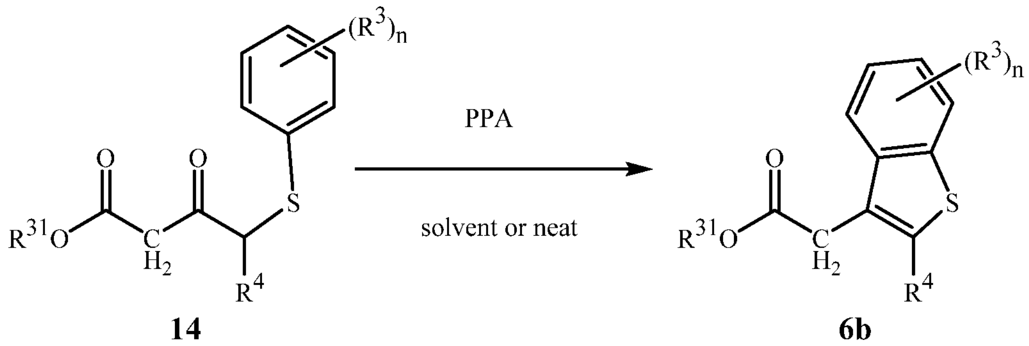
As shown in Scheme 6, substituted benzofuran-3-ones of Formula **8** where R^4 is hydrogen or alkyl can be made by first alkylating a salicylate of Formula **11** with an α-bromo ester of Formula **12** (wherein R^{32} is typically methyl or ethyl) in the presence of a base such as potassium carbonate or sodium hydride in an appropriate solvent, e.g., acetonitrile, methanol, ethanol, tetrahydrofuran, diethyl ether, 1,2-dimethoxyethane, dioxane or *N*,*N*-dimethylformamide, at temperatures ranging from 0 °C to the reflux temperature of the solvent. Next, the bis-ester of Formula **13** is treated with a metal halide or alkoxide, e.g., sodium hydride or potassium *tert*-butoxide, in an inert solvent such as tetrahydrofuran, dioxane, 1,2-dimethoxyethane or *N*,*N*-dimethylformamide to form the corresponding benzofuran-3-one of Formula **8**. An alternative more stepwise process for converting diesters of Formula **13** to benzofuran-3-ones of Formula **8** has been reported in PCT Patent Publication WO 2008/074752 whereas the method in Scheme 5 allows for cyclization of diesters of Formula **13** followed by ester hydrolysis and decarboxylation to provide benzofuran-3-ones of Formula **8** in one convenient step. The first step of the method of Scheme 6 is illustrated by Step A of Synthesis Example 2.

Scheme 6



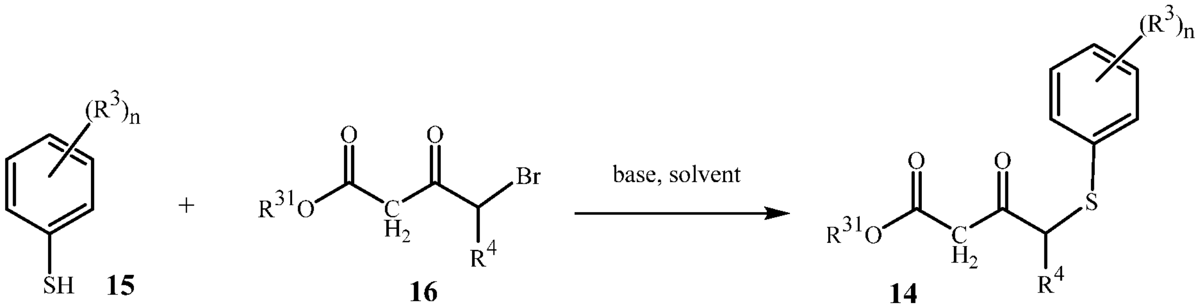
As illustrated in Scheme 7, substituted benzothiophenes of Formula **6b** (i.e. Formula **6** wherein X is S) where R^4 is hydrogen or alkyl are readily accessible by cyclization of appropriately substituted phenylthio ketoesters of Formula **14**, generally under acidic conditions and preferably with polyphosphoric acid (PPA) neat or in an inert generally high boiling solvent, e.g., chlorobenzene, xylene or toluene. Chlorobenzene is usually the solvent of choice and for a literature example of this cyclization using PPA in chlorobenzene, see *J. Heterocyclic Chem.* **1988**, *25*, 1271–1272. Also see U.S. Patent 5376677 for published experimental detail for making benzothiophene acetates using this PPA-mediated cyclization. The method of Scheme 7 is illustrated by Step B of Synthesis Example 1.

Scheme 7



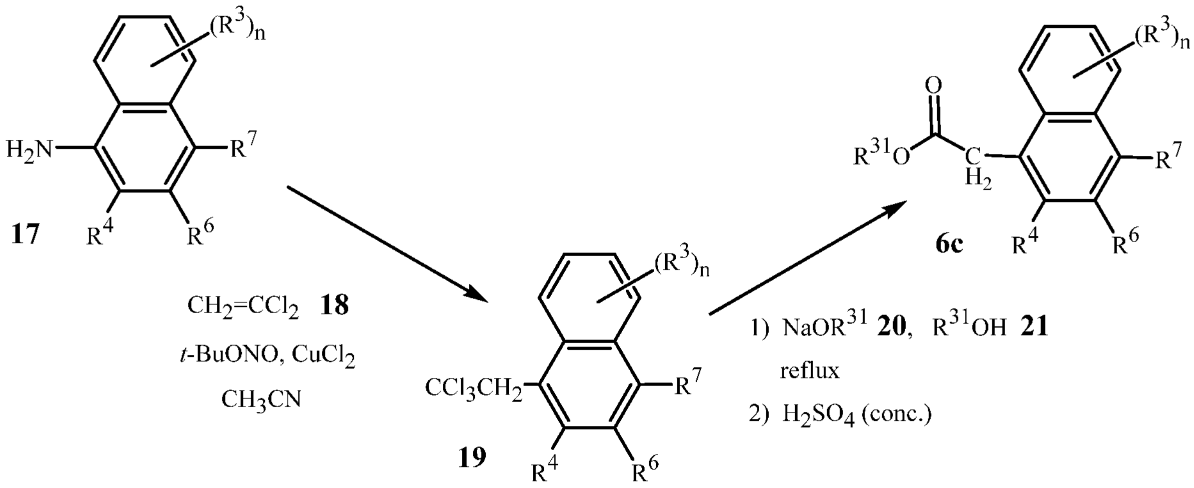
As shown in Scheme 8, by methods also taught in *J. Heterocyclic Chem.* **1988**, *25*, 1271–1272 and U.S. Patent 5376677, substituted 4-phenylthio-1,3-ketoesters of Formula **14**, can be readily made by alkylation of thiophenols of Formula **15** with 4-bromo-1,3-ketoesters of Formula **16** (i.e. $R^4CHBr(C{=}O)CH_2CO_2R$ where R is generally methyl or ethyl) in the presence of base in solvent. Alkylation with an alkali or alkaline carbonate such as potassium carbonate in a polar aprotic solvent such as acetonitrile or *N*,*N*-dimethylformamide is generally preferred. The method of Scheme 8 is illustrated by Step A of Synthesis Example 1.

Scheme 8



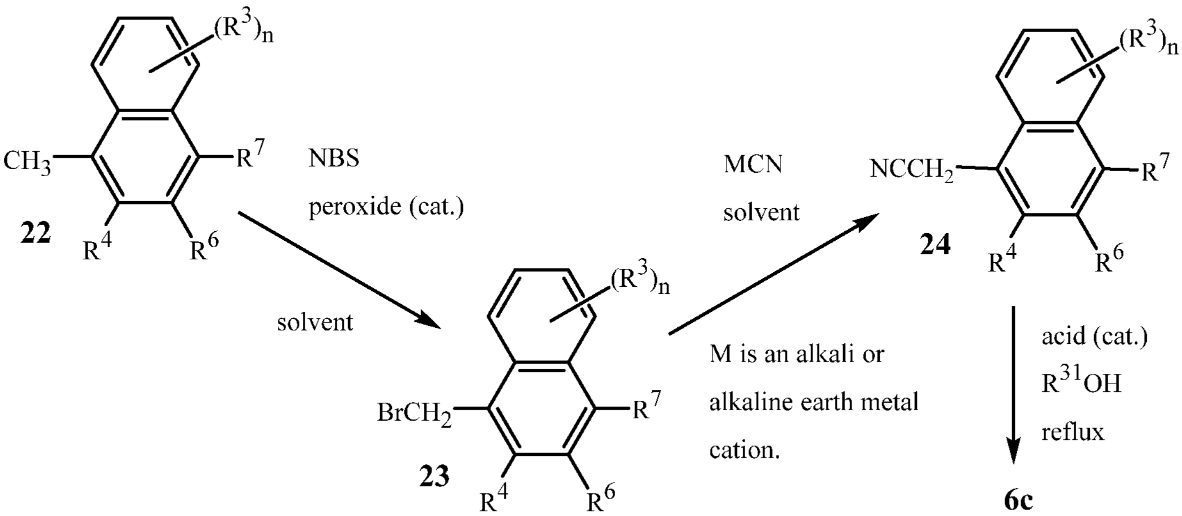
As shown in Scheme 9, naphthalene acetic acid esters of Formula **6c** (i.e. Formula **6** wherein X is -C(R^6)=C(R^7)-) can be prepared from appropriately substituted naphthalene amines of Formula **17**. According to this method, amines of Formula **17** are diazotized (preferably with *t*-butyl nitrite in the presence of cupric chloride in acetonitrile) in the presence of 1,1-dichloroethene (**18**) to give the corresponding trichloroethylnaphthalenes of Formula **19**. The trichloroethylnaphthalenes of Formula **19** are then heated with an appropriate alkali or alkaline earth alkoxide such as a sodium alkoxide of Formula **20**, in a suitable solvent such as an alcohol of Formula **21**, followed by acidification such as with concentrated sulfuric acid to provide the naphthalene acetic acid esters of Formula **6c**. This method is taught in *Pest. Manag. Sci.* **2011**, *67*, 1499–1521 and U.S. Patent 5376677.

Scheme 9



An alternative method for making naphthalene acetic acid esters of Formula **6c** is outlined in Scheme 10. As taught by the method in *Pest. Manag. Sci.* **2011**, *67*, 1499–1521, methyl naphthalenes of Formula **22** can be brominated with *N*-bromosuccinimide (NBS) under free radical conditions (e.g., benzoyl peroxide as catalyst) in an inert solvent such as dichloromethane, dichloromethane or tetrachloromethane to give naphthalene methyl bromides of Formula **23**. Displacement of the bromine with cyanide by reacting compounds of Formula **23** with an alkali or alkaline cyanide (e.g., potassium cyanide) affords the naphthalene acetonitriles of Formula **24** that can be hydrolyzed with esterification to the acetates of Formula **6c** by heating in acidic alcohol (e.g., HCl in methanol or ethanol), generally at reflux.

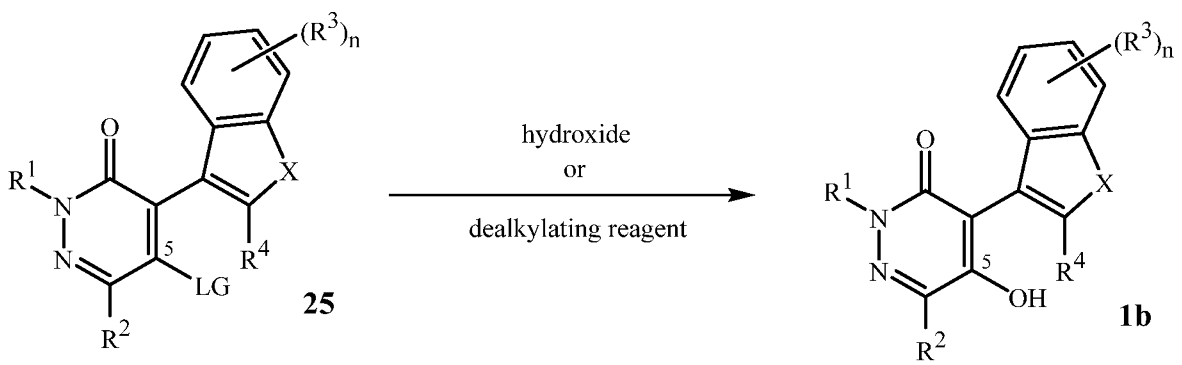
Scheme 10



22 23 24 6c

Hydrolysis of leaving groups at the 5-position of the pyridazinone ring can be accomplished as shown in Scheme 11. When the LG group is lower alkoxy, lower alkylsulfide (sulfoxide or sulfone), halide or *N*-linked azole, it can be removed by hydrolysis with basic reagents such as tetrabutylammonium hydroxide in solvents such as tetrahydrofuran, dimethoxyethane or dioxane at temperatures from 0 to 120 °C. Other hydroxide reagents useful for this hydrolysis include potassium, lithium and sodium hydroxide (see, for example, WO 2009/086041). When the LG group is lower alkoxy, hydrolysis of the LG group can also be accomplished with dealkylation reagents such as boron tribromide or morpholine (see, for example, WO 2009/086041, WO 2013/160126 and WO 2013/050421).

Scheme 11

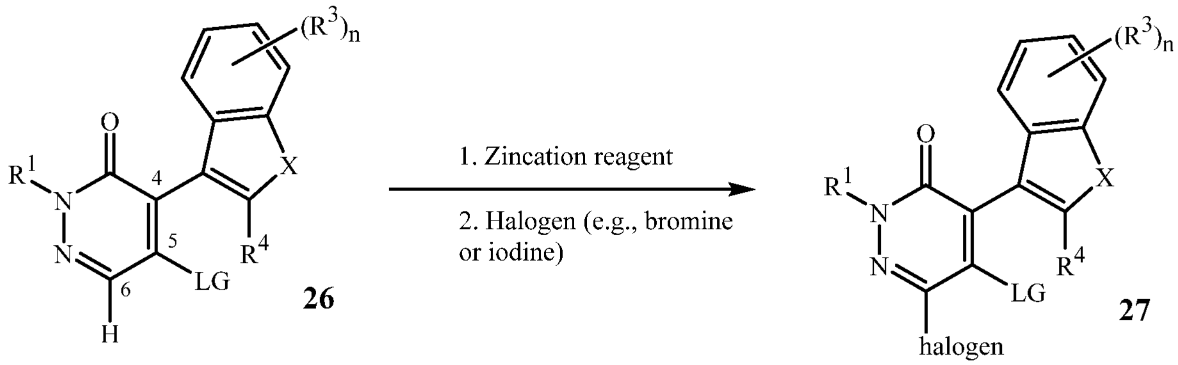


25 1b

Introduction of a halogen at the 6-position of the pyridazinone can be accomplished by zincation followed by halogenation. For conditions, reagents and examples of zincation of pyridazinones, see Verhelst, T., Ph.D. thesis, University of Antwerp, 2012. Typically the pyridazinone of Formula **26** is treated in tetrahydrofuran with a solution of Zn(TMP)-LiCl or

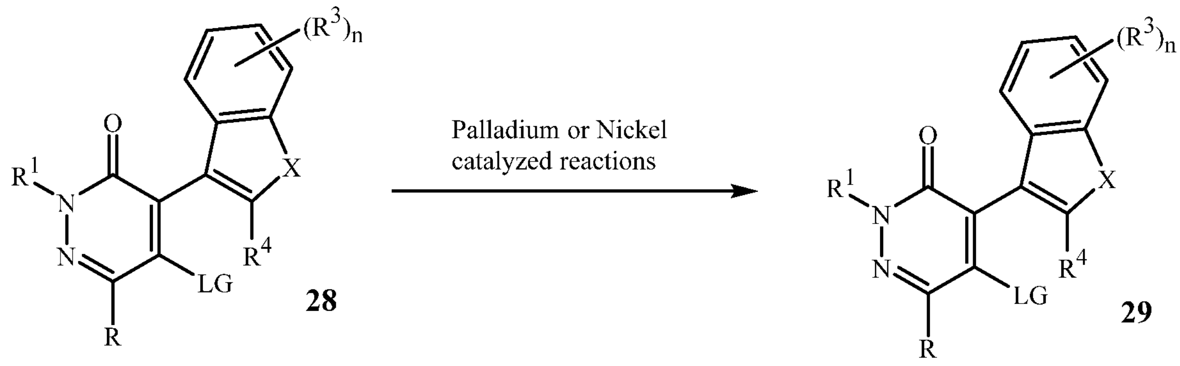
$Zn(TMP)_2$-$MgCl_2$-LiCl (commercially available) at –20 to 30 °C to form a zinc reagent. Subsequent addition of bromine or iodine provides compounds of Formula **27** (wherein R^2 is Br or I, respectively). This method is shown in Scheme 12. For preparation of a variety of appropriate zincation reagents, see Wunderlich, S. Ph.D. thesis, University of Munich, 2010 and references cited therein, as well as WO 2008/138946 and WO 2010/092096. Zincation at the 6-position of the pyridazinone ring can be accomplished in the presence of aromatic/heteroaromatic substituents, alkoxy substituents or halogen at the 4-position of the pyridazinone ring, or in the presence of halogen or alkoxy substituents at the 5-position of the pyridazinone ring.

Scheme 12



The R^2 subsitutent of compounds of Formula **28** (wherein R^2 is halogen or sulfonate) can be further transformed into other functional groups. Compounds wherein R^2 is alkyl, cycloalkyl or substituted alkyl can be prepared by transition metal catalyzed reactions of compounds of Formula **28** as shown in Scheme 13. For reviews of these types of reactions, see: E. Negishi, *Handbook of Organopalladium Chemistry for Organic Synthesis*, John Wiley and Sons, Inc., New York, **2002**, N. Miyaura, *Cross-Coupling Reactions: A Practical Guide*, Springer, New York, **2002**, H. C. Brown et al., *Organic Synthesis via Boranes*, Aldrich Chemical Co., Milwaukee, Vol. 3, **2002**, Suzuki et al., *Chemical Reviews* **1995**, *95*, 2457-2483 and Molander et al., *Accounts of Chemical Research* **2007**, *40*, 275-286. Also see Gribble and Li editors *Palladium in Heterocyclic Chemistry Volume 1*, Pergamon Press, Amsterdam, 2000 and Gribble and Li editors *Palladium in Heterocyclic Chemistry Volume 2*, Pergamon Press, Amsterdam, 2007. For a review of Buchwald-Hartwig chemistry see Yudin and Hartwig, *Catalyzed Carbon-Heteroatom Bond Formation,* 2010, Wiley, New York.

Scheme 13



28

29

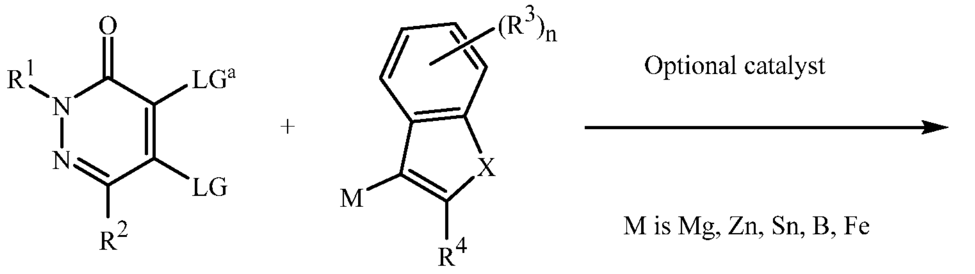
R is halogen or sulfonate

R is alkyl, cycloalkyl, substituted alkyl

Related synthetic methods for the introduction of other functional groups at the R-position of Formula **29** are known in the art. Copper catalyzed reactions are useful for introducing the CF_3 group. For a comprehensive recent review of reagents for this reaction see Wu, Neumann and Beller in *Chemistry: An Asian Journal*, 2012, ASAP, and references cited therein. For introduction of a sulfur containing substituent at this position, see methods disclosed in WO 2013/160126. For introduction of a cyano group, see WO 2014/031971. For introduction of a nitro group, see *J. Am. Chem. Soc.*, 2009, 12898. For introduction of a fluoro substituent, see *J. Am. Chem. Soc.,* 2014, 3792.

Compounds of Formula **28** can be prepared by reaction of organometallic reagents with pyridazinones of Formula **29** with a reactive group at the 4-position, as shown in Scheme 14. Depending upon the leaving group a transition metal catalyst may be desirable. When the leaving group is lower alkoxy, *N*-linked azole (such as pyrazole or triazole) or sulfonate, no catalyst is required, and reaction directly with a magnesium reagent can take place at the 4-position. This reaction can be done in a variety of solvents which do not react with organomagnesium reagents. Typical reaction conditions include tetrahydrofuran as the solvent, a reaction temperature of –20 to 65 °C, and an excess of the organomagnesium reagent. When the reactive group at the 4-position is halogen, a transition metal catalyst and ligand are helpful. A variety of different coupling partners can be used, including boron (Suzuki Reaction), tin (Stille Reaction), and zinc (Negishi reaction); these reactions can be catalyzed by palladium and nickel catalysts with a wide variety of ligands. Conditions for these reactions are known in the art; see, for example, *Palladium-Catalyzed Coupling Reactions: Practical Aspects and Future Development* Edited by Arpad Molnar, Wiley, 2013 and references cited within. The organomagnesium reagents used in the non-catalyzed process can be prepared by direct insertion of magnesium into a carbon-halogen bond (optionally in the presence of a lithium halide), by a Grignard exchange reaction with an *i*-propylmagnesium halide (optionally in the presence of a lithium halide), or by transformation of an organolithium reagent by reaction with a magnesium salt such as magnesium bromide etherate. A variety of groups which are inert toward the organomagnesium reagents can be present at R^2 and at the 5-position of the pyridazinone in these reactions.

Scheme 14

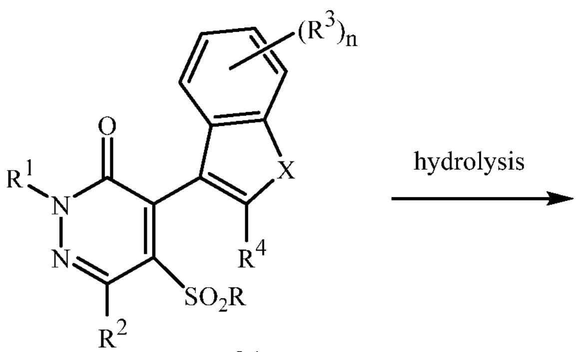


29 **30** **28**

Compounds of Formula **29** are known in the art or can be prepared by methods described by Maes and Lemiere in *Comprehensive Heterocyclic Chemistry III Volume 8*, Katritsky, Ramsden, Scriven and Taylor editors and references cited therein. See also Verhelst, Ph.D. thesis University of Antwerp and references cited therein. Functional group transformations on pyridazinones are also described in Stevenson et. al. *J. Heterocyclic Chem.* **2005**, *42*, 427; U.S. Pat. No. 6,077,953; WO 2009/086041 and references cited therein; U.S. Pat. No. 2,782,195; WO 2013/160126; and WO 2013/050421.

Compounds of Formula **1b** can also be prepared by hydrolysis of sulfonates of Formula **31** in aqueous base. Suitable bases include sodium, potassium or tetrabutylammonium hydroxide. Typical reaction temperatures range from 0 to 80 °C, and typical reaction times are 1–12 hours. This method is shown in Scheme 15.

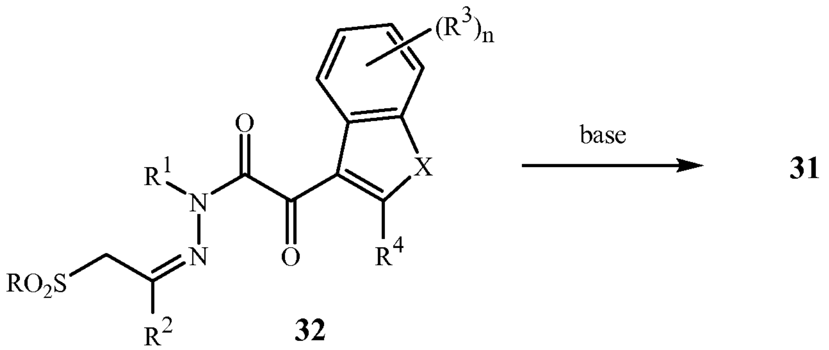
Scheme 15



31 **1b**

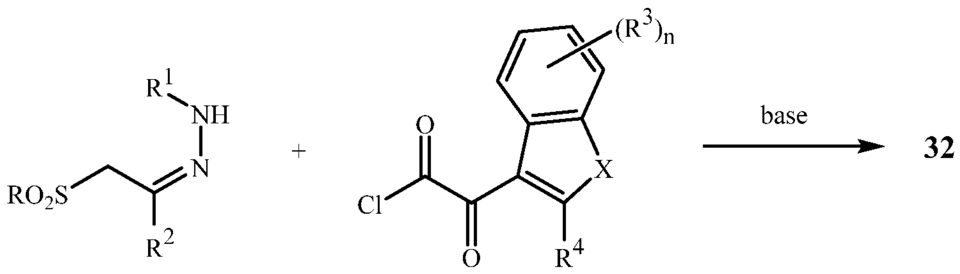
Compounds of Formula **31** can be prepared by the cyclization of compounds of Formula **32** by treatment with base. Typical bases useful in this method include potassium, sodium or cesium carbonate. Typical solvents include acetonitrile, tetrahydrofuran or *N*,*N*-dimethylformamide. This method is shown in Scheme 16.

Scheme 16



Compounds of Formula **32** can be prepared by the method shown in Scheme 17. In this method, compounds of Formula **33** are coupled with compounds of Formula **34** in the presence of a base. Bases useful in this method include triethylamine, sodium or potassium carbonate, pyridine or diisopropylethylamine.

Scheme 17

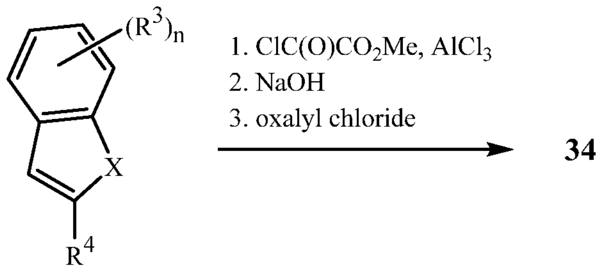


33 **34**

Compounds of Formula **33** can be prepared by methods known in the art.

Compounds of Formula **34** can be prepared by several methods. In one method shown in Scheme 18, compounds of Formula **35** are first treated with $ClC(O)CO_2Me$ in the presence of aluminum trichloride. Subsequent hydrolysis to the carboxylic acid, followed by treatment with oxalyl chloride, provides the acyl chlorides of Formula **34**.

Scheme 18

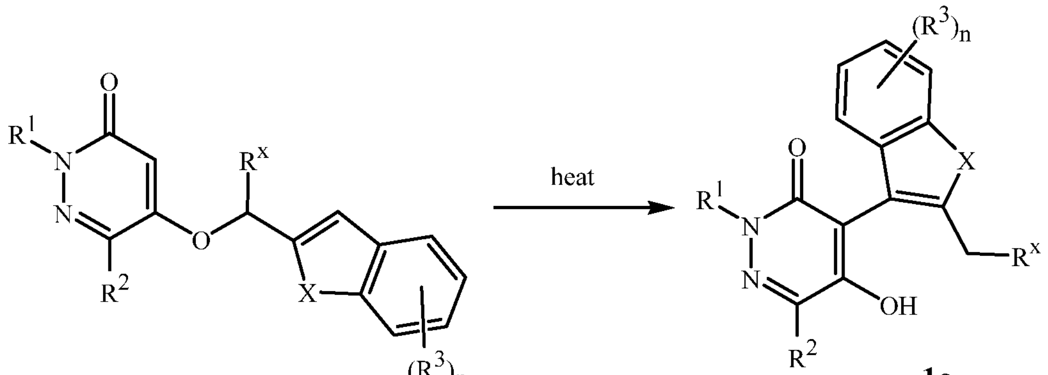


35

Compounds of Formula **35** are commercially available or can be prepared by methods known in the art.

As shown in Scheme 20 compounds of formula 1c can be made by rearrangement of compounds of Formula **30**. This rearrangement may be carried out at temperatures between 110 and 300 °C. Suitable solvents include, but are not limited to, aromatic hydrocarbons such as xylenes, diethylbenzene, and mesitylene as well as halogenated aromatics such as dichlorobenzene. Other high boiling solvents such as Dowtherm A and diglyme may be successfully employed. Many other solvents with lower boiling points can be used in conjunction with microwave heating especially when ionic liquids are added to the medium.

Scheme 20

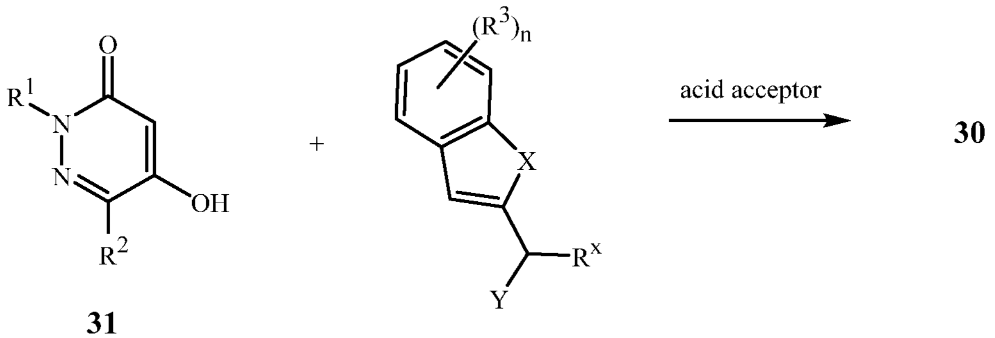


30 **1c**

R^X = H or alkyl

Compounds of Formula **30** can be prepared as shown in Scheme 21 by alkylation of pyridazinones of Formula **31** with alkyl halides of Formula **32**. The reaction can be carried out in a variety of solvents such as acetone, 2-butanone, acetonitrile, dimethylacetamide, N-methylpyrrolidinone, dimethylsulfoxide and dimethylformamide. The presence of an acid acceptor such as, but not limited to, cesium carbonate, potassium carbonate, sodium carbonate, potassium hydroxide or sodium hydroxide is preferred. The leaving group Y can be halogen or sulfonate.

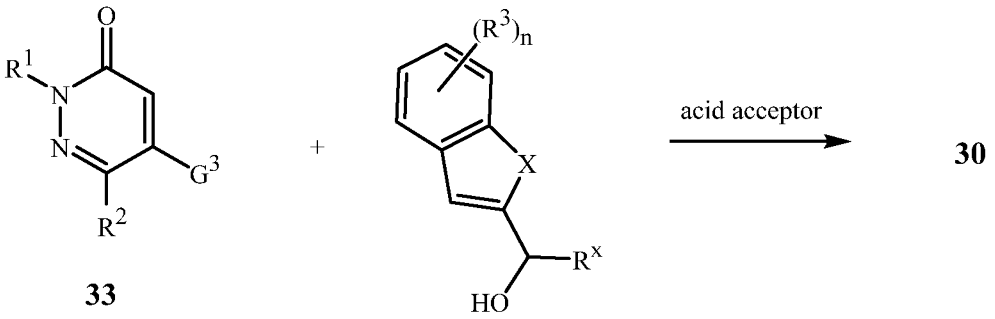
Scheme 21



31

Compounds of Formula **30** may also be prepared as shown in Scheme 22 by the nucleophilic displacement reaction of pyridazinones of Formula **33** with alcohols of Formula **33**. Suitable solvents include dioxanes, dimethoxyethane, tetrahydrofuran, dimethylacetamide, N-methylpyrrolidinone, dimethylsulfoxide and dimethylformamide. Suitable acid acceptors include, but are not limited to, sodium hydride, potassium hydride, potassium *t*-butoxide, sodium hexamethyldisilazide, potassium hexamethyldisilazide, and lithium hexamethyldisilazide.

Scheme 22

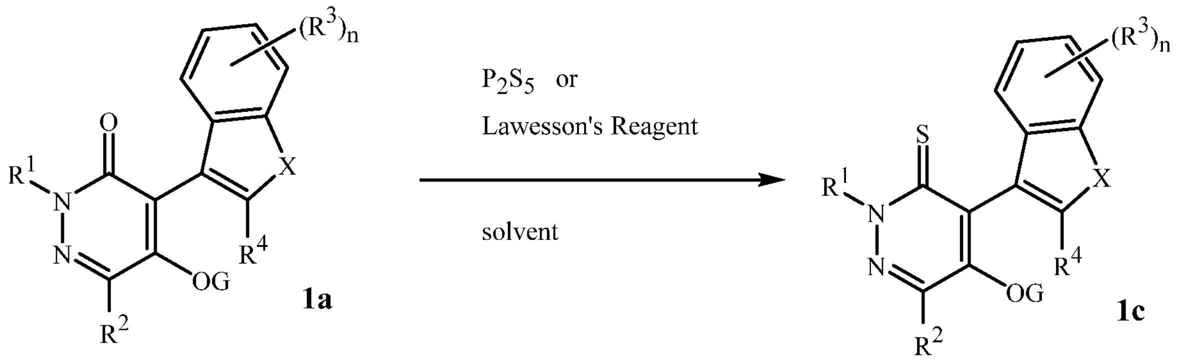


33

G^3= halogen, SO2(C1-C6 alkyl), or SO2(optionally substituted phenyl or optionally substitued 5- or 6-membered ring)

As shown in Scheme 23, pyridazinones of Formula **1a** (a subset of compounds of Formula **1** where W is O) can be thionated to give the corresponding thiones of Formula **1c** (i.e. Formula **1** wherein W is S) with a thionation reagent that is generally phosphorus pentasulfide in pyridine or Lawesson's reagent (2,4-bis-(4-methoxyphenyl)-1,3-dithia-2,4-diphosphetane 2,4-disulfide) in an appropriate solvent (e.g., toluene, tetrahydrofuran or dioxane) at temperatures generally ranging 0 °C to room temperature.

Scheme 23

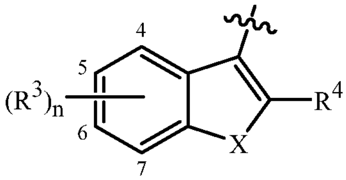


It is recognized by one skilled in the art that various functional groups can be converted into others to provide different compounds of Formula **1**. For a valuable resource that illustrates the interconversion of functional groups in a simple and straightforward fashion, see Larock, R. C., *Comprehensive Organic Transformations: A Guide to Functional Group Preparations, 2nd Ed.*, Wiley-VCH, New York, 1999.

It is recognized that some reagents and reaction conditions described above for preparing compounds of Formula **1** may not be compatible with certain functionalities present in the intermediates. In these instances, the incorporation of protection/deprotection sequences or functional group interconversions into the synthesis will aid in obtaining the desired products. The use and choice of the protecting groups will be apparent to one skilled in chemical synthesis (see, for example, Greene, T. W.; Wuts, P. G. M. *Protective Groups in Organic Synthesis*, 2nd ed.; Wiley: New York, 1991). One skilled in the art will recognize that, in some cases, after the introduction of a given reagent as depicted in any individual scheme, it may be necessary to perform additional routine synthetic steps not described in detail to complete the synthesis of compounds of Formula **1**. One skilled in the art will also recognize that it may be necessary to perform a combination of the steps illustrated in the above schemes in an order other than that implied by the particular presented to prepare the compounds of Formula **1**.

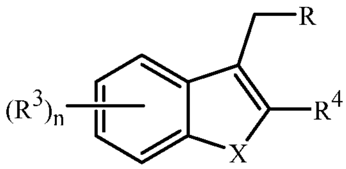
One skilled in the art will also recognize that compounds of Formula **1** and the intermediates described herein can be subjected to various electrophilic, nucleophilic, radical, organometallic, oxidation, and reduction reactions to add substituents or modify existing substituents.

Examples of intermediates useful in the preparation of compounds of this invention are shown in Tables I-1a through I-3d. The position(s) of the R^3 group(s) in Tables I-1a through I-3d is(are) based on the locant numbering shown below.



The following abbreviations are used in the Tables which follow: Me means methyl, Et means ethyl, Pr means propyl, and Ph means phenyl.

TABLE I-1a



X is S, and R is CO_2Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is CO_2Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is CO_2H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is C(O)Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is CO_2Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is CO_2Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is CO_2H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is C(O)Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CF-, and R is CO_2Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CF-, and R is CO_2Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

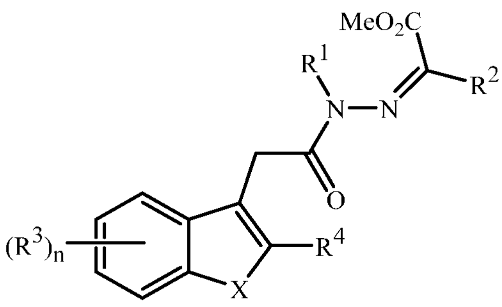
X is -CH=CF-, and R is CO_2H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CF-, and R is C(O)Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

TABLE I-1b



X is S, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CCl-, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CCl-, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CCl-, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CCl-, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

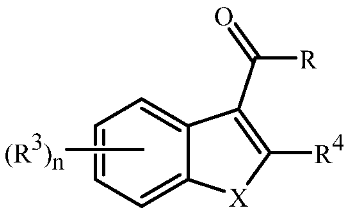
X is -CH=CCl-, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CCl-, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

TABLE I-2a



X is S, and R is CO_2Na.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is CO_2K.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is CO_2H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, and R is C(O)Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is CO_2Na.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is CO_2K.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

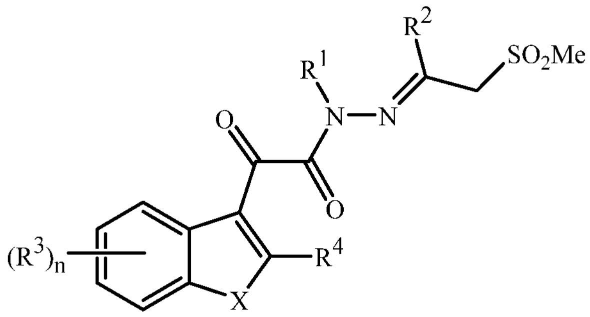
X is -CH=CH-, and R is CO_2H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, and R is C(O)Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

TABLE I-2b



X is S, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

TABLE I-2c

Table I-2c is identical to Table I-2b, except that R^1 is $-SO_2Ph$.

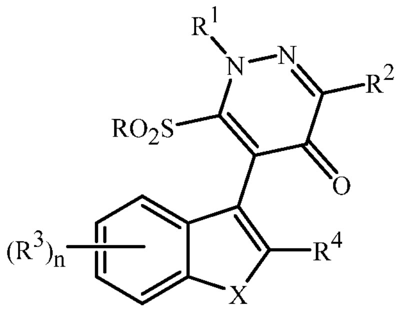
TABLE I-2d

Table I-2d is identical to Table I-2b, except that R^1 is $-SO_2$(4-methylphenyl).

TABLE I-2e

Table I-2e is identical to Table I-2b, except that R^1 is $-SO_2$(4-chlorophenyl).

TABLE I-3a



X is S, R is Me, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is S, R is Me, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Me, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is Me.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is Et.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is Br.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is I.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is Cl.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

X is -CH=CH-, R is Me, R^1 is Et, and R^2 is OMe.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
5-Me	H	5-Me	Me	5-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et

TABLE I-3b

Table I-3b is identical to Table I-3a, except that R is phenyl.

TABLE I-3c

Table I-3c is identical to Table I-3a, except that R is 4-methylphenyl.

TABLE I-3d

Table I-3d is identical to Table I-3a, except that R is 4-chlorophenyl.

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following non-limiting Examples are illustrative of the invention. Steps in the following Examples illustrate a procedure for each step in an overall synthetic transformation, and the starting material for each step may not have necessarily been prepared by a particular preparative run whose procedure is described in other Examples or Steps. Percentages are by weight except for chromatographic solvent mixtures or where otherwise indicated. Parts and percentages for chromatographic solvent mixtures are by volume unless otherwise indicated. ^{1}H NMR spectra are reported in ppm downfield from tetramethylsilane in $CDCl_3$ solution unless indicated otherwise; “s” means singlet, “d” means doublet, “t” means triplet, “q” means quartet, “m” means multiplet, and “br s” means broad singlet.

SYNTHESIS EXAMPLE 1

Preparation of 4-(2,5-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 1)

Step A: Preparation of ethyl 4-[(4-methylphenyl)thio]-3-oxopentanoate

To a mixture of potassium carbonate (1.11 g, 8.03 mmol) in *N*,*N*-dimethylformamide (DMF) (27 mL) at room temperature under nitrogen (i.e. under a nitrogen atmosphere) was added 4-methylbenzenethiol (0.626 g, 5.04 mmol). The mixture was cooled to 0 °C, and then ethyl 4-bromo-3-oxopentanoate (1.25 g, 5.04 mmol) was added dropwise by syringe over 10 minutes. The mixture was allowed to warm to room temperature while being stirred for 16 h. Then the mixture was poured into aqueous hydrochloric acid (0.2 M, 80 mL) and extracted with diethyl ether (3 × 50 mL). The combined extracts were dried ($MgSO_4$) and concentrated. The crude residue was purified by flash chromatography (gradient of 0 to 10 % of ethyl acetate in hexanes) to yield the title product as a yellow oil (0.82 g).

^{1}H NMR δ 7.27–7.31 (m, 2H), 7.12 (m, 2H), 4.18 (m, 2H), 3.82 (q, 1H), 3.64–3.77 (m, 2H), 2.33 (s, 3H), 1.38 (d, 3H), 1.24–1.30 (m, 3H).

Step B: Preparation of ethyl 2,5-dimethylbenzo[b]thiophene-3-acetate

Polyphosphoric acid (1 mL) was added to chlorobenzene (anhydrous, 20 mL), and the mixture was heated to reflux under nitrogen. To the mixture was added ethyl 4-[(4-methylphenyl)thio]-3-oxopentanoate (i.e. the product of Step A) (0.82 g, 3.08 mmol) dropwise via syringe over about 30 minutes. The mixture was held at reflux for 16 h. The mixture was then cooled to room temperature, and the upper, chlorobenzene layer was decanted to a separate flask and concentrated. The crude residue was purified by flash chromatography (gradient of 0 to 10 % ethyl acetate in hexanes) to yield the title product as a white solid (0.33 g).

^{1}H NMR δ 7.61 (d, 1H), 7.46 (s, 1H), 7.10–7.12 (m, 1H), 4.10–4.17 (m, 2H), 3.74 (s, 2H), 2.53 (s, 3H), 2.46 (s, 3H), 1.22–1.25 (m, 3H).

Step C: Preparation of 2,5-dimethylbenzo[b]thiophene-3-acetic acid

Ethyl 2,5-dimethylbenzo[b]thiophene-3-acetate (i.e. the product of Step B) (0.33 g, 1.33 mmol) was dissolved in methanol (50 mL), and aqueous sodium hydroxide (2 M, 5 mL, 10 mmol) was added. The mixture was heated to reflux for 3 h. The mixture was then cooled, and the solvent was removed by rotary evaporation. To the residue was added water (50 mL), and the pH was brought to ~1 by the careful addition of concentrated hydrochloric acid. The mixture was then extracted with dichloromethane (3 × 50 mL), and the combined organic extracts were dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield the title product as a white solid (0.26 g).

^{1}H NMR δ 7.62 (d, 1H), 7.43 (s, 1H), 7.11 (m, 1H), 3.78 (s, 2H), 2.53 (s, 3H), 2.46 (s, 3H).

Step D: Preparation of methyl 2-(2-methylhydrazinylidene)propanoate

To a suspension of methyl 2-oxopropanoate (17.0 mL, 169 mmol) and magnesium sulfate (20.46 g, 170 mmol) in trichloromethane (250 mL) chilled to 0 °C was added a solution of methylhydrazine (9.0 mL, 166 mmol) in trichloromethane (50 mL). The reaction mixture was then warmed to room temperature. After stirring for 24 h at room temperature, the reaction mixture was filtered. The filtrate was concentrated under reduced pressure to give the title product as a yellow solid (21.16 g) that was used directly in the next step without further purification. A portion of this sample was later purified by flash chromatography to provide an off-white solid.

^{1}H NMR δ 5.63 (br s, 1H), 3.82 (s, 3H), 3.22–3.24 (m, 3H), 1.93 (s, 3H).

Step E: Preparation of methyl 2-[2-[2-(2,5-dimethylbenzo[b]thien-3yl)acetyl]-2-methylhydrazinylidene]propanoate

To a solution of 2,5-dimethylbenzo[b]thiophene-3-acetic acid (i.e. the product of Step C) (0.26 g, 1.2 mmol) in dichloromethane (40 mL) was added oxalyl chloride (0.25 mL, 3.0 mmol) followed by a catalytic amount of DMF (3 drops). This mixture is allowed to stir for 2 h under nitrogen and then concentrated by rotary evaporation. The residue, comprising the acid chloride, was dissolved in acetonitrile (25 mL) and added dropwise over 15 min. to a mixture of methyl 2-(2-methylhydrazinylidene)propanoate (i.e. the product of Step D) (0.20 g, 1.5 mmol) and potassium carbonate (0.28 g, 2.0 mmol) in acetonitrile (20 mL) cooled to 0 °C under nitrogen. The reaction mixture was then allowed to warm to room temperature and stirred for 64 h. The solvent was removed by rotary evaporation, and water (50 mL) was added to the residue. The aqueous phase was extracted with ethyl acetate (3 × 50 mL), and the combined organic extracts were washed with brine (i.e. saturated aqueous sodium chloride) (50 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation. The residue was purified by flash chromatography (gradient of 10 to 50 % ethyl acetate in hexanes) to yield a white solid (0.23 g).

^{1}H NMR δ 7.55–7.61 (m, 1H), 7.45–7.46 (m, 1H), 7.04–7.09 (m, 1H), 4.08–4.17 (m, 2H), 3.88 (s, 3H), 3.34 (s, 3H), 2.51 (s, 3H), 2.42 (s, 3H), 2.20 (s, 3H).

Step F: Preparation of 4-(2,5-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone

A solution of methyl 2-[2-[2-(2,5-dimethylbenzo[b]thien-3yl)acetyl]-2-methyl-hydrazinylidene]propanoate (i.e. the product of Step E) (0.23 g, 0.69 mmol) in DMF (anhydrous, 3 mL) was added via syringe pump over a period of 30 minutes to a tetrahydrofuran solution of potassium *tert*-butoxide (3.0 mL, 3 mmol) cooled to 0 °C under nitrogen. The reaction mixture was then allowed to warm to room temperature while being stirred for 1 h. The reaction mixture was poured into aqueous hydrochloric acid (0.5 M, 100 mL) and extracted with ethyl acetate (3 × 50 mL). The combined organic extracts were washed with brine (50 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield a crude residue (0.40 g), which was purified by flash chromatography (gradient of 0 to 40 % ethyl acetate in hexanes) to yield the title product, a compound of the present invention, as a white solid (118 mg).

^{1}H NMR δ 7.60 (d, 1H), 7.09 (m, 1H), 7.02 (s, 1H), 6.91 (br s, 1H), 3.52 (s, 3H), 2.39 (s, 3H), 2.21 (s, 3H), 2.17 (s, 3H).

SYNTHESIS EXAMPLE 2

Preparation of 4-(2,5-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone (Compound 7)

Step A: Preparation of methyl 2-(2-methoxy-1-methyl-2-oxoethoxy)-5-methylbenzoate

A mixture of methyl 2-hydroxy-5-methylbenzoate (11.89 g, 71.5 mmol), methyl 2-bromopropanoate (13.03 g, 78.0 mmol) and potassium carbonate (29.71 g, 215 mmol) in acetone (300 mL) was heated under reflux for 18 h. The reaction mixture was then filtered, and the filtrate was concentrated by rotary evaporation to yield the title product as a white solid (18.9 g).

^{1}H NMR δ 7.61 (s, 1H), 7.15–7.24 (m, 1H), 6.70–6.84 (m, 1H), 4.73 (m, 1H), 3.89 (s, 3H), 3.74 (s, 3H), 2.30 (s, 3H), 1.63–1.65 (d, 3H).

Step B: Preparation of 2-(1-carboxyethoxy)-5-methylbenzoic acid

A solution of methyl 2-(2-methoxy-1-methyl-2-oxoethoxy)-5-methylbenzoate (i.e. the product of Step A) (18.9 g, 71.5 mmol) in a mixture of tetrahydrofuran (100 mL), methanol (100 mL) and aqueous NaOH solution (6 M, 100 mL) was heated to reflux for 16 h. Then the reaction mixture was cooled and concentrated by rotary evaporation. The residue was dissolved in water (150 mL) and acidified with aqueous concentrated hydrochloric acid to pH < 2. The aqueous phase was extracted with ethyl acetate (2 × 125 mL). The combined organic extracts were washed with brine, dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield the title product as a yellow solid (16.31 g), which was used in Step C without further purification.

^{1}H NMR δ 7.91 (d, 1H), 7.36 (m, 1H), 6.90 (d, 1H), 4.99 (m, 1H), 2.34 (s, 3H), 1.75–1.80 (m, 3H).

Step C: Preparation of 2,5-dimethyl-3-benzofuranyl acetate

A mixture of 2-(1-carboxyethoxy)-5-methylbenzoic acid (i.e. the product of Step B) (16.3 g, 71 mmol), acetic anhydride (145 mL) and sodium acetate (11.93 g, 145 mmol) was heated at reflux for 3 h. After cooling, the mixture was added to water (300 mL) and extracted with dichloromethane (2 × 150 mL). The organic extracts were dried ($MgSO_4$) and filtered, and the filtrate was concentrated by rotary evaporation to yield the title product as a light brown oil (14.43 g), which was used in Step D without further purification.

^{1}H NMR δ 7.22–7.25 (m, 1H), 7.07–7.11 (m, 1H), 7.01–7.04 (m, 1H), 2.41 (s, 3H), 2.37 (s, 3H), 2.34 (s, 3H).

Step D: Preparation of 2,5-dimethyl-3(2*H*)-benzofuranone

A mixture of 2,5-dimethyl-3-benzofuranyl acetate (i.e. the product of Step C) (14.40 g, 70.5 mmol), methanol (150 mL) and aqueous hydrochloric acid (1.0 M, 40 mL, 40 mmol) was heated at reflux under nitrogen. The reaction mixture was then concentrated by rotary evaporation. The residue was diluted with water and extracted with diethyl ether (2 × 100 mL). The combined organic extracts were washed with water and brine, dried ($MgSO_4$), filtered and concentrated. The residue was purified by flash chromatography (gradient of 0 to 15 % ethyl acetate in hexanes) to yield the title product as a white solid (7.47 g).

^{1}H NMR δ 7.41–7.46 (m, 2H), 6.99–7.02 (m, 1H), 4.60–4.64 (q, 1H), 2.35 (s, 3H), 1.50–1.54 (d, 3H).

Step E: Preparation of methyl 2,5-dimethyl-3-benzofuranacetate

A mixture of 2,5-dimethyl-3(2*H*)-benzofuranone (i.e. the product of Step D) (7.45 g, 45.9 mmol), methyl 2-(triphenylphosphoranylidine)acetate (20.43 g, 61.1 mmol) and toluene (300 mL) were heated at reflux for 66 h. The reaction mixture was then concentrated by rotary evaporation, and diethyl ether (200 mL) was added to the crude residue. This mixture was filtered to remove solids, and the filtrate was concentrated by rotary evaporation to leave an oily mixture (18 g). To this residue were added methanol (40 mL) and a methanolic hydrogen chloride solution (0.5 M, 60 mL, 30 mmol), and the mixture is heated to reflux for 16 h. Then the reaction mixture was cooled and concentrated by rotary evaporation. The residue was purified by flash chromatography (gradient of 0 to 10 % ethyl acetate in hexanes) to provide the title product as a yellow oil (6.75 g).

^{1}H NMR δ 7.19–7.27 (m, 2H), 6.98–7.05 (m, 1H), 3.693 (s, 3H), 3.584 (s, 2H), 2.40–2.45 (m, 6H).

Step F: Preparation of 2,5-dimethyl-3-benzofuranacetic acid

Aqueous sodium hydroxide (5 M, 33 mL, 165 mmol) was added to a solution of methyl 2,5-dimethyl-3-benzofuranacetate (i.e. the product of Step E) (6.75 g, 30.9 mmol) in methanol (120 mL). The mixture was heated to reflux for 16 h and then cooled. The solvent was removed by rotary evaporation. To the residue was added diethyl ether (100 mL), and the resultant mixture was extracted with aqueous sodium hydroxide (1 N, 2 × 100 mL). The ether layer is discarded, and the combined aqueous extracts were acidified with concentrated aqueous hydrochloric acid to pH 1. The acidic aqueous mixture obtained was extracted with dichloromethane (2 × 125 mL). The combined organic extracts were washed with brine (100 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield the title product as a yellow solid (4.93 g), which was used in Step G without further purification.

^{1}H NMR δ 7.22–7.28 (m, 2H), 6.99–7.05 (m, 1H), 3.61 (s, 2H), 2.42 (s, 3H), 2.41 (s, 3H).

Step G: Preparation of methyl 2-[2-[2-(2,5-dimethyl-3-benzofuranyl)acetyl]-2-methylhydrazinylidene]propanoate

To a solution of 2,5-dimethyl-3-benzofuranacetic acid (i.e. the product of Step F) (4.14 g, 20.2 mmol) in dichloromethane (120 mL) was added oxalyl chloride (2.56 mL, 30.0 mmol) followed by a catalytic amount of DMF (5 drops). The resultant mixture was allowed to stir for 2 h under nitrogen and was then concentrated by rotary evaporation to leave a residue comprising the acid chloride. The residue was dissolved in acetonitrile (50 mL) and added dropwise over 25 min from an addition funnel to a mixture of methyl 2-(2-methylhydrazinylidene)propanoate (2.81 g, 21.6 mmol) and potassium carbonate (3.18 g, 23.0 mmol) in acetonitrile (30 mL) cooled to 0 °C under nitrogen. The reaction mixture was then allowed to warm to room temperature and stirred for 64 h. The solvent was removed by rotary evaporation, and water (150 mL) was added to the residue. The resultant mixture was extracted with ethyl acetate (3 × 80 mL), and the combined organic extracts were washed with brine (50 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation. The residue was purified by flash chromatography (gradient of 10 to 100 % ethyl acetate in hexanes) to yield the title product as a white solid (3.08 g).

^{1}H NMR δ 7.32 (m, 1H), 7.22–7.24 (m, 1H), 6.98–6.99 (m, 1H), 3.96 (s, 2H), 3.90 (s, 3H), 3.35 (s, 3H), 2.40 (m, 6H), 2.20 (s, 3H).

Step H: Preparation of 4-(2,5-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone

A solution of methyl 2-[2-[2-(2,5-dimethyl-3-benzofuranyl)acetyl]-2-methylhydrazinylidene]propanoate (i.e. the product of Step G) (2.97 g, 9.39 mmol) anhydrous DMF (25 mL) was added over 30 min from an addition funnel to a tetrahydrofuran solution of potassium *tert*-butoxide (25.0 mL, 25.0 mmol) cooled to 0 °C under nitrogen. The reaction mixture was then allowed to warm to room temperature and stirred for 1 h. The reaction mixture was poured into aqueous hydrochloric acid (0.5 M, 150 mL) and extracted with ethyl acetate (3 × 90 mL). The combined organic extracts were washed with brine (100 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation. The residue was purified by flash chromatography (gradient of 10 to 75 % ethyl acetate in hexanes) to yield the title product, a compound of the present invention, as a white solid (790 mg).

^{1}H NMR (DMSO-d_6) δ 10.29 (s, 1H), 7.39 (m, 1H), 7.04 (m, 1H), 6.95–7.01 (m, 1H), 3.60 (s, 3H), 2.32 (s, 3H), 2.25 (m, 6H).

SYNTHESIS EXAMPLE 3

Preparation of 5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2*H*)-pyridazinone (Compound 12)

Step A: Preparation of 2,4-dimethylphenyl propanoate

Propanoyl chloride (2.44 g, 26.4 mmol) was added dropwise to a mixture of 2,4-dimethylphenol (3.26 g, 24 mmol) and triethylamine (3.51 mL, 25 mmol) in dichloromethane (35 mL) cooled to 0 °C under nitrogen. The mixture was stirred for 16 h, and then aqueous hydrochloric acid (0.2 M, 50 mL) was added. The organic phase was separated, and the aqueous phase was extracted with dichloromethane (50 mL). The combined organic phases were washed with brine, dried ($MgSO_4$), filtered and concentrated to yield the title product as a yellow oil (3.91 g), which was used directly in the next step without further purification.

^{1}H NMR δ 7.03 (s, 1H), 6.99 (d, 1H), 6.87 (d, 1H), 2.56–2.62 (m, 2H), 2.30 (s, 3H), 2.14 (s, 3H), 1.26–1.31 (m, 3H).

Step B: Preparation of 1-(2-hydroxy-3,5-dimethylphenyl)-1-propanone

Aluminum chloride (3.10 g, 23.2 mmol) was added to 2,4-dimethylphenyl propanoate (i.e. the product of Step A) (3.91 g, 21.9 mmol), and the mixture formed was heated to 130 °C for 2 h. The mixture was then cooled to room temperature, and aqueous hydrochloric acid (1.0 M, 100 mL) was added, followed by diethyl ether (100 mL). The organic phase was separated, and the aqueous phase was extracted with diethyl ether (50 mL). The combined organic extracts were dried ($MgSO_4$), filtered and concentrated to yield the title product as a yellow crystalline solid (3.71 g), which was used directly in the next step without further purification.

^{1}H NMR δ 12.49 (s, 1H), 7.40 (s, 1H), 7.16 (s, 1H), 3.03 (m, 2H), 2.29 (s, 3H), 2.23 (s, 3H), 1.22–1.25 (m, 3H).

Step C: Preparation of 2-bromo-1-(2-hydroxy-3,5-methylphenyl)-1-propanone

To mixture of copper(II) bromide (9.30 g, 41.6 mmol) in ethyl acetate (30 mL) was added dropwise from an addition funnel a solution of 1-(2-hydroxy-3,5-dimethylphenyl)-1-propanone (i.e. the product of Step B) (3.71 g, 20.8 mmol) dissolved in trichloromethane (24 mL). The resultant mixture was heated to reflux for 16 h, then cooled to room temperature and filtered through a filter funnel packed with Celite® diatomaceous filter aid.

The filtrate was concentrated, and the residue was diluted with diethyl ether (100 mL) and washed with saturated aqueous ethylenediaminetetraacetic acid disodium salt solution (100 mL). The organic phase was dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield the title product as a brown oil (5.33 g), which was used directly in the next step without further purification.

^{1}H NMR δ 12.09 (s, 1H), 7.39–7.44 (m, 1H), 7.18–7.23 (m, 1H), 5.31–5.40 (m, 1H), 2.29 (s, 3H), 2.24 (s, 3H), 1.90 (d, 3H).

Step D: Preparation of 2,5,7-trimethyl-3(2*H*)-benzofuranone

N,*N*-dimethylformamide (25 mL) and potassium carbonate (4.15 g, 30 mmol) were added to 2-bromo-1-(2-hydroxy-3,5-methylphenyl)-1-propanone (i.e. the product of Step C) (5.33 g, 20.7 mmol), and the resultant mixture was stirred at room temperature for 18 h. Then water (150 mL) was added, and the mixture was extracted with diethyl ether (3 × 80 mL). The combined organic extracts were washed with water, followed by brine, dried ($MgSO_4$), filtered and concentrated. The residue was purified by flash chromatography (eluted with gradient of 0 to 10 % ethyl acetate in hexanes) to yield the title product as a yellow oil (2.13 g).

^{1}H NMR δ 7.26–7.28 (m, 1H), 7.24–7.26 (m, 1H), 4.59–4.64 (m, 1H), 2.32 (s, 3H), 2.29 (s, 3H), 1.52 (d, 3H).

Step E: Preparation of methyl 2,5,7-trimethyl-3-benzofuranacetate

A mixture of 2,5,7-trimethyl-3(2*H*)-benzofuranone (i.e. the product of Step D) (2.07 g, 11.7 mmol), methyl 2-(triphenylphosphoranylidene)acetate (5.89 g, 17.6 mmol) and toluene (120 mL) were heated at reflux for 66 h. The reaction mixture was then concentrated by rotary evaporation, and to the residue was added diethyl ether (150 mL). The resultant mixture was filtered to remove solids, and the filtrate was concentrated by rotary evaporation to leave an oily mixture (6 g). To this residue were added methanol (100 mL) and a methanol solution of hydrogen chloride (0.5 M, 30 mL, 15 mmol). The resultant mixture was heated to reflux for 16 h and then cooled. The mixture was concentrated by rotary evaporation to leave a residue which was purified by flash chromatography (gradient of 0 to 5 % ethyl acetate in hexanes) to yield the title product as a yellow oil (0.59 g), with was used without further purification in the next step.

^{1}H NMR δ 7.06 (s, 1H), 6.83 (s, 1H), 3.68 (s, 3H), 3.57 (s, 2H), 2.44 (s, 3H), 2.42 (s, 3H), 2.39 (s, 3H).

Step F: Preparation of 2,5,7-trimethyl-3-benzofuranacetic acid

To a solution of methyl 2,5,7-trimethyl-3-benzofuranacetate (i.e. the product of Step E) (0.55 g, 2.37 mmol) in methanol (50 mL) was added aqueous sodium hydroxide (5 M, 2 mL, 10 mmol). The resultant mixture was heated to reflux for 16 h and then cooled. The solvent was removed by rotary evaporation. To the residue was added diethyl ether (100 mL), and the resultant mixture was extracted with aqueous sodium hydroxide (1 N, 2 × 100 mL). The ether layer was discarded, and the combined basic extracts were acidified with concentrated aqueous hydrochloric acid to a pH of 1. The acidic aqueous mixture was then extracted with dichloromethane (2 × 125 mL). The combined organic extracts were dried ($MgSO_4$), filtered and concentrated by rotary evaporation to yield the title product as a yellow solid (0.52 g), which was used in the next step without further purification.

^{1}H NMR δ 7.05 (s, 1H), 6.84 (s, 1H), 3.60 (s, 2H), 2.43 (s, 3H), 2.41 (s, 3H), 2.38 (s, 3H).

Step G: Preparation of 2,5,7-trimethyl-3-benzofuranacetic acid 2-(2-methoxy-1-methyl-2-oxoethylidene)-1-methylhydrazide

To a solution of 2,5,7-trimethyl-3-benzofuranacetic acid (i.e. the product of Step F) (0.52 g, 2.38 mmol) in dichloromethane (80 mL) was added oxalyl chloride (0.5 mL, 6.0 mmol), followed by a catalytic amount of DMF (3 drops). The resultant mixture was allowed to stir for 2 h under nitrogen and then was concentrated by rotary evaporation. The residue, which contained 2,5,7-trimethyl-3-benzofuranacetyl chloride, was dissolved in acetonitrile (50 mL) and added dropwise over 25 min from an addition funnel to a mixture of methyl 2-(2-methylhydrazinylidene)propanoate (0.35 g, 2.7 mmol) and potassium carbonate (0.69 g, 5.0 mmol) in acetonitrile (30 mL) cooled to 0 °C under nitrogen. Then the reaction mixture was allowed to warm to room temperature and stir for 18 h. The solvent was removed by rotary evaporation, and to the residue was added water (90 mL). The resultant mixture was extracted with ethyl acetate (3 × 50 mL), and the combined organic extracts were washed with brine (50 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation. The residue was purified by flash chromatography (gradient of 5 to 50 % ethyl acetate in hexanes) to yield the title product as a yellow solid (0.32 g).

^{1}H NMR δ 7.14 (s, 1H), 6.80 (s, 1H), 3.95 (s, 2H), 3.90 (s, 3H), 3.35 (s, 3H), 2.42 (s, 3H), 2.41 (s, 3H), 2.36 (s, 3H), 2.19 (s, 3H).

Step H: Preparation of 5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2*H*)-pyridazinone

A solution of 2,5,7-trimethyl-3-benzofuranacetic acid 2-(2-methoxy-1-methyl-2-oxoethylidene)-1-methylhydrazide (i.e. the product of Step G) (0.31 g, 1.0 mmol) in *N*,*N*-dimethylformamide (anhydrous, 5 mL) was added by syringe pump over 1 h to a tetrahydrofuran solution of potassium *tert*-butoxide (1 M, 5.0 mL, 5.0 mmol) cooled to 0 °C under nitrogen. The reaction mixture was allowed to warm to room temperature and stirred for 1 h. The mixture was then poured into aqueous hydrochloric acid (0.5 M, 60 mL) and extracted with ethyl acetate (3 × 50 mL). The combined organic extracts were washed with brine (60 mL), dried ($MgSO_4$), filtered and concentrated by rotary evaporation. The resultant residue was purified by flash chromatography (gradient of 5 to 100 % ethyl acetate in hexanes) to yield the title product, a compound of the present invention, as a white solid (72.3 mg).

^{1}H NMR δ 6.88 (s, 1H), 6.84 (s, 1H), 5.86 (br s, 1H), 3.74 (s, 3H), 2.48 (s, 3H), 2.38 (s, 3H), 2.36 (s, 3H), 2.34 (s, 3H).

SYNTHESIS EXAMPLE 4

Preparation of 4-(2,3-dimethyl-1-naphthalenyl)-5-hydroxy-6-methoxy-2-methyl-3(2*H*)-pyridazinone (Compound 46)

Step A: Preparation of 5-chloro-4,6-dimethoxy-2-methyl-3(2*H*)-pyridazinone

4,5-Dichloro-6-methoxy-2-methyl-3(2*H*)-pyridazinone (2.00 g, 9.57 mmol) and sodium methoxide (2.00 mL of a 25 wt% solution in MeOH) were combined in 1, 4-dioxane (20 mL) and stirred at room temperature overnight. The solution was then concentrated to 50% volume and partitioned between water (100 mL) and ethyl acetate (100 mL). The aqueous layer was extracted with ethyl acetate (3 × 100 mL). The organic layers were combined, washed with brine, dried over $MgSO_4$ and concentrated. The resulting residue was absorbed onto silica gel (1 g) and purified by MPLC with a 0-100% ethyl acetate/hexane gradient through a pre-packed 40 g silica gel column. The fractions containing pure desired product were concentrated in vacuo to yield 1.78 g of the title compound as a white solid.

Step B: Preparation of 5-chloro-4-(2,3-dimethyl-1-naphthalenyl)-6-methoxy-2-methyl-3(2*H*)-pyridazinone

In a 2-neck 100 mL RB flask flushed with nitrogen fitted with a thermometer, 1-bromo-2,3-dimethylnaphthalene (1.41 g, 6.01 mmol) was dissolved in anhydrous tetrahydrofuran (15 mL) and cooled over a dry ice/acetone bath to –78 °C. *N*-Butyllithium (2.4 mL of a 2.5M solution in hexane) was added dropwise over 15 minutes, and the reaction mixture was stirred at –78 °C for 5 minutes. The cooling bath was then removed and the solution was allowed to warm to –50 °C. Magnesium bromide etherate (1.55 g, 6.01 mmol) was then added in one portion, and the reaction mixture was stirred and warmed to –20 °C. The product of Step A (0.700 g, 4.00 mmol) was then added in one portion, and the reaction mixture was stirred and warmed to room temperature. After 1 h, the resulting green colored solution was poured into saturated aqueous NH_4Cl (100 mL) and extracted into ethyl acetate (4 × 50 mL). The organic layers were combined, dried over $MgSO_4$ and concentrated in vacuo. The resulting residue was dissolved in dichloromethane, absorbed onto silica gel (1 g) and purified by MPLC with a gradient of 0-100% ethyl acetate/hexane through a 40 g silica gel column. The fractions containing pure desired product were combined and concentrated in vacuo to yield 0.290 g of the title compound.

Step C: Preparation of 4-(2,3-dimethyl-1-naphthalenyl)-5-hydroxy-6-methoxy-2-methyl-3(2*H*)-pyridazinone

The product of Step B (0.200 g, 0.608 mmol) was dissolved in 1,4-dioxane (10 mL) and treated with tetrabutylammonium hydroxide (0.800 mL of a 40 wt% solution in water). The resulting solution was heated to reflux and stirred for 2 h. The reaction mixture was then cooled to room temperature and poured into 1N HCl (50 mL) and extracted into ethyl acetate (4 × 20 mL). The organic layers were combined, dried over $MgSO_4$ and concentrated under reduced pressure. The crude solid was dissolved in dichloromethane and absorbed onto silica gel (1 g). Purification was performed by MPLC with a 40 to 100% ethyl actetate/hexane gradient through a 40 g silica gel column. The fractions containing desired product were combined and concentrated in vacuo to yield 0.130 g of the title compound, a compound of the invention, as a white solid.

SYNTHESIS EXAMPLE 5

Preparation of 6-chloro-4-(5-chloro-2-methylbenzo[b]thiene-2-yl)-5-hydroxy-2-methylpyridazin-3(2*H*)-one (Compound 91)

Step A: Preparation of 6-chloro-5-[(5-chlorobenzo[b]thien-2-yl)methoxy]-2-methylpyridazin-3(2*H*)-one

A slurry of *N*,*N*-dimethylformamide (20 mL) and sodium hydride (0.335 g, 8.37 mmol) was cooled over ice for 15 min under nitrogen. 5-Chloro-[*b*]thiophene-2-methanol (1.33 g, 6.7 mmol) was added portionwise under a blanket of nitrogen and stirred over ice for 15 min. 5,6-Dichloro-2-methyl-3(2H)-pyridazinone (1.00 g, 5.58 mol) was then added under a blanket of nitrogen. The ice bath was removed and the reaction mixture was allowed to stir at room temperature overnight. The resulting reaction mixture was then poured into a solution of saturated ammonium chloride and ice (200 mL) and extracted into diethyl ether (3x 40 mL). The resulting organic layers were combined, dried over $MgSO_4$ and absorbed onto silica gel (4 g). Chromatography using a 40 g silica gel column eluting with a gradient of 0 to 100% ethyl acetate in hexanes gradient afforded the title compound as as a yellow solid. (1.00 g, 53% yield).

^{1}H NMR (500MHz) δ 7.78–7.71 (m, 2H), 7.37–7.32 (m, 2H), 5.35 (s, 2H), 3.74 (s, 3H).

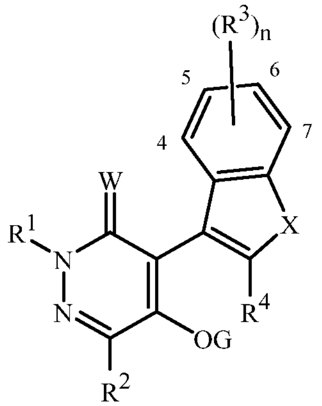
Step B: Preparation 6-chloro-4-(5-chloro-2-methylbenzo[b]thiene-2--yl)-5-hydroxy-2-methylpyridazin-3(2*H*)-one

6-Chloro-5-[(5-chlorobenzo[b]thien-2-yl)methoxy]-2-methylpyridazin-3(2*H*)-one (i.e. the product obtained in Step A above, 0.250 g, 0.700 mmol) was dissolved in 5 mL xylenes in a 40 mL scintillation vial and stirred at 175 °C overnight. The reaction mixture was then cooled to room temperature and 40 mL of hexane was added. The resulting precipitate was filtered, washed with hexane and dried to give the desired product as an orange solid (0.100 g).

^{1}H NMR (500MHz) δ 7.71–7.69 (m, 1H), 7.30–7.27 (m, 1H), 7.26–7.24 (m, 1H), 3.80 (s, 3H), 2.43 (s, 3H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to 619 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, Me means methyl, Et means ethyl, Pr means propyl, Bu means butyl, Bu means butyl, OMe means methoxy, CN means cyano, $S(O)_2Me$ means methylsulfonyl, and "–" means no substitution with R^3.

TABLE 1



W is O, X is S, R^1 is Me, R^2 is Me, and G is H.

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
–	H	–	Me	–	Et
4-Me	H	4-Me	Me	4-Me	Et
5-Me	H	5-Me	Me	5-Me	Et
6-Me	H	6-Me	Me	6-Me	Et
7-Me	H	7-Me	Me	7-Me	Et
4-Et	H	4-Et	Me	4-Et	Et
5-Et	H	5-Et	Me	5-Et	Et
6-Et	H	6-Et	Me	6-Et	Et
7-Et	H	7-Et	Me	7-Et	Et
4-Pr	H	4-Pr	Me	4-Pr	Et
5-Pr	H	5-Pr	Me	5-Pr	Et

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
6-Pr	H	6-Pr	Me	6-Pr	Et
7-Pr	H	7-Pr	Me	7-Pr	Et
4-OMe	H	4-OMe	Me	4-OMe	Et
5-OMe	H	5-OMe	Me	5-OMe	Et
6-OMe	H	6-OMe	Me	6-OMe	Et
7-OMe	H	7-OMe	Me	7-OMe	Et
4-CN	H	4-CN	Me	4-CN	Et
5-CN	H	5-CN	Me	5-CN	Et
6-CN	H	6-CN	Me	6-CN	Et
7-CN	H	7-CN	Me	7-CN	Et
4-CF_3	H	4-CF_3	Me	4-CF_3	Et
5-CF_3	H	5-CF_3	Me	5-CF_3	Et
6-CF_3	H	6-CF_3	Me	6-CF_3	Et
7-CF_3	H	7-CF_3	Me	7-CF_3	Et
4-F	H	4-F	Me	4-F	Et
5-F	H	5-F	Me	5-F	Et
6-F	H	6-F	Me	6-F	Et
7-F	H	7-F	Me	7-F	Et
4-Cl	H	4-Cl	Me	4-Cl	Et
5-Cl	H	5-Cl	Me	5-Cl	Et
6-Cl	H	6-Cl	Me	6-Cl	Et
7-Cl	H	7-Cl	Me	7-Cl	Et
4-Br	H	4-Br	Me	4-Br	Et
5-Br	H	5-Br	Me	5-Br	Et
6-Br	H	6-Br	Me	6-Br	Et
7-Br	H	7-Br	Me	7-Br	Et
4-$OCHF_2$	H	4-$OCHF_2$	Me	4-$OCHF_2$	Et
5$OCHF_2$	H	5$OCHF_2$	Me	5$OCHF_2$	Et
6-$OCHF_2$	H	6-$OCHF_2$	Me	6-$OCHF_2$	Et
7-$OCHF_2$	H	7-$OCHF_2$	Me	7-$OCHF_2$	Et
4-(C≡CH)	H	4-(C≡CH)	Me	4-(C≡CH)	Et
5-(C≡CH)	H	5-(C≡CH)	Me	5-(C≡CH)	Et
6-(C≡CH)	H	6-(C≡CH)	Me	6-(C≡CH)	Et
7-(C≡CH)	H	7-(C≡CH)	Me	7-(C≡CH)	Et

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
4,5-di-Me	H	4,5-di-Me	Me	4,5-di-Me	Et
4,6-di-Me	H	4,6-di-Me	Me	4,6-di-Me	Et
4,7-di-Me	H	4,7-di-Me	Me	4,7-di-Me	Et
5,6-di-Me	H	5,6-di-Me	Me	5,6-di-Me	Et
5,7-di-Me	H	5,7-di-Me	Me	5,7-di-Me	Et
5-Cl, 7-Me	H	5-Cl, 7-Me	Me	5-Cl, 7-Me	Et
5-Cl, 7-OMe	H	5-Cl, 7-OMe	Me	5-Cl, 7-OMe	Et
5-F, 7-Me	H	5-F, 7-Me	Me	5-F, 7-Me	Et
5-Me, 7-F	H	5-Me, 7-F	Me	5-Me, 7-F	Et
5-Me, 7-Cl	H	5-Me, 7-Cl	Me	5-Me, 7-Cl	Et
5-Me, 7-CN	H	5-Me, 7-CN	Me	5-Me, 7-CN	Et
5-Me, 7-OMe	H	5-Me, 7-OMe	Me	5-Me, 7-OMe	Et
5-(C≡CH), 7-Me	H	5-(C≡CH), 7-Me	Me	5-(C≡CH), 7-Me	Et
5,7-di-F	H	5,7-di-F	Me	5,7-di-F	Et
5,7-di-Cl	H	5,7-di-Cl	Me	5,7-di-Cl	Et
5,7-di-Br	H	5,7-di-Br	Me	5,7-di-Br	Et
–	Pr	–	F	–	Cl
4-Me	Pr	4-Me	F	4-Me	Cl
5-Me	Pr	5-Me	F	5-Me	Cl
6-Me	Pr	6-Me	F	6-Me	Cl
7-Me	Pr	7-Me	F	7-Me	Cl
4-Et	Pr	4-Et	F	4-Et	Cl
5-Et	Pr	5-Et	F	5-Et	Cl
6-Et	Pr	6-Et	F	6-Et	Cl
7-Et	Pr	7-Et	F	7-Et	Cl
4-Pr	Pr	4-Pr	F	4-Pr	Cl
5-Pr	Pr	5-Pr	F	5-Pr	Cl
6-Pr	Pr	6-Pr	F	6-Pr	Cl
7-Pr	Pr	7-Pr	F	7-Pr	Cl
4-OMe	Pr	4-OMe	F	4-OMe	Cl
5-OMe	Pr	5-OMe	F	5-OMe	Cl
6-OMe	Pr	6-OMe	F	6-OMe	Cl
7-OMe	Pr	7-OMe	F	7-OMe	Cl

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
4-CN	Pr	4-CN	F	4-CN	Cl
5-CN	Pr	5-CN	F	5-CN	Cl
6-CN	Pr	6-CN	F	6-CN	Cl
7-CN	Pr	7-CN	F	7-CN	Cl
4-CF_3	Pr	4-CF_3	F	4-CF_3	Cl
5-CF_3	Pr	5-CF_3	F	5-CF_3	Cl
6-CF_3	Pr	6-CF_3	F	6-CF_3	Cl
7-CF_3	Pr	7-CF_3	F	7-CF_3	Cl
4-F	Pr	4-F	F	4-F	Cl
5-F	Pr	5-F	F	5-F	Cl
6-F	Pr	6-F	F	6-F	Cl
7-F	Pr	7-F	F	7-F	Cl
4-Cl	Pr	4-Cl	F	4-Cl	Cl
5-Cl	Pr	5-Cl	F	5-Cl	Cl
6-Cl	Pr	6-Cl	F	6-Cl	Cl
7-Cl	Pr	7-Cl	F	7-Cl	Cl
4-Br	Pr	4-Br	F	4-Br	Cl
5-Br	Pr	5-Br	F	5-Br	Cl
6-Br	Pr	6-Br	F	6-Br	Cl
7-Br	Pr	7-Br	F	7-Br	Cl
4-$OCHF_2$	Pr	4-$OCHF_2$	F	4-$OCHF_2$	Cl
5$OCHF_2$	Pr	5$OCHF_2$	F	5$OCHF_2$	Cl
6-$OCHF_2$	Pr	6-$OCHF_2$	F	6-$OCHF_2$	Cl
7-$OCHF_2$	Pr	7-$OCHF_2$	F	7-$OCHF_2$	Cl
4-(C≡CH)	Pr	4-(C≡CH)	F	4-(C≡CH)	Cl
5-(C≡CH)	Pr	5-(C≡CH)	F	5-(C≡CH)	Cl
6-(C≡CH)	Pr	6-(C≡CH)	F	6-(C≡CH)	Cl
7-(C≡CH)	Pr	7-(C≡CH)	F	7-(C≡CH)	Cl
4,5-di-Me	Pr	4,5-di-Me	F	4,5-di-Me	Cl
4,6-di-Me	Pr	4,6-di-Me	F	4,6-di-Me	Cl
4,7-di-Me	Pr	4,7-di-Me	F	4,7-di-Me	Cl
5,6-di-Me	Pr	5,6-di-Me	F	5,6-di-Me	Cl
5,7-di-Me	Pr	5,7-di-Me	F	5,7-di-Me	Cl
5-Cl, 7-Me	Pr	5-Cl, 7-Me	F	5-Cl, 7-Me	Cl

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
5-Cl, 7-OMe	Pr	5-Cl, 7-OMe	F	5-Cl, 7-OMe	Cl
5-F, 7-Me	Pr	5-F, 7-Me	F	5-F, 7-Me	Cl
5-Me, 7-F	Pr	5-Me, 7-F	F	5-Me, 7-F	Cl
5-Me, 7-Cl	Pr	5-Me, 7-Cl	F	5-Me, 7-Cl	Cl
5-Me, 7-CN	Pr	5-Me, 7-CN	F	5-Me, 7-CN	Cl
5-Me, 7-OMe	Pr	5-Me, 7-OMe	F	5-Me, 7-OMe	Cl
5-(C≡CH), 7-Me	Pr	5-(C≡CH), 7-Me	F	5-(C≡CH), 7-Me	Cl
5,7-di-F	Pr	5,7-di-F	F	5,7-di-F	Cl
5,7-di-Cl	Pr	5,7-di-Cl	F	5,7-di-Cl	Cl
5,7-di-Br	Pr	5,7-di-Br	F	5,7-di-Br	Cl
–	Br	–	CN	–	C≡CH
4-Me	Br	4-Me	CN	4-Me	C≡CH
5-Me	Br	5-Me	CN	5-Me	C≡CH
6-Me	Br	6-Me	CN	6-Me	C≡CH
7-Me	Br	7-Me	CN	7-Me	C≡CH
4-Et	Br	4-Et	CN	4-Et	C≡CH
5-Et	Br	5-Et	CN	5-Et	C≡CH
6-Et	Br	6-Et	CN	6-Et	C≡CH
7-Et	Br	7-Et	CN	7-Et	C≡CH
4-Pr	Br	4-Pr	CN	4-Pr	C≡CH
5-Pr	Br	5-Pr	CN	5-Pr	C≡CH
6-Pr	Br	6-Pr	CN	6-Pr	C≡CH
7-Pr	Br	7-Pr	CN	7-Pr	C≡CH
4-OMe	Br	4-OMe	CN	4-OMe	C≡CH
5-OMe	Br	5-OMe	CN	5-OMe	C≡CH
6-OMe	Br	6-OMe	CN	6-OMe	C≡CH
7-OMe	Br	7-OMe	CN	7-OMe	C≡CH
4-CN	Br	4-CN	CN	4-CN	C≡CH
5-CN	Br	5-CN	CN	5-CN	C≡CH
6-CN	Br	6-CN	CN	6-CN	C≡CH
7-CN	Br	7-CN	CN	7-CN	C≡CH
4-CF_3	Br	4-CF_3	CN	4-CF_3	C≡CH
5-CF_3	Br	5-CF_3	CN	5-CF_3	C≡CH

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
6-CF_3	Br	6-CF_3	CN	6-CF_3	C≡CH
7-CF_3	Br	7-CF_3	CN	7-CF_3	C≡CH
4-F	Br	4-F	CN	4-F	C≡CH
5-F	Br	5-F	CN	5-F	C≡CH
6-F	Br	6-F	CN	6-F	C≡CH
7-F	Br	7-F	CN	7-F	C≡CH
4-Cl	Br	4-Cl	CN	4-Cl	C≡CH
5-Cl	Br	5-Cl	CN	5-Cl	C≡CH
6-Cl	Br	6-Cl	CN	6-Cl	C≡CH
7-Cl	Br	7-Cl	CN	7-Cl	C≡CH
4-Br	Br	4-Br	CN	4-Br	C≡CH
5-Br	Br	5-Br	CN	5-Br	C≡CH
6-Br	Br	6-Br	CN	6-Br	C≡CH
7-Br	Br	7-Br	CN	7-Br	C≡CH
4-$OCHF_2$	Br	4-$OCHF_2$	CN	4-$OCHF_2$	C≡CH
5$OCHF_2$	Br	5$OCHF_2$	CN	5$OCHF_2$	C≡CH
6-$OCHF_2$	Br	6-$OCHF_2$	CN	6-$OCHF_2$	C≡CH
7-$OCHF_2$	Br	7-$OCHF_2$	CN	7-$OCHF_2$	C≡CH
4-(C≡CH)	Br	4-(C≡CH)	CN	4-(C≡CH)	C≡CH
5-(C≡CH)	Br	5-(C≡CH)	CN	5-(C≡CH)	C≡CH
6-(C≡CH)	Br	6-(C≡CH)	CN	6-(C≡CH)	C≡CH
7-(C≡CH)	Br	7-(C≡CH)	CN	7-(C≡CH)	C≡CH
4,5-di-Me	Br	4,5-di-Me	CN	4,5-di-Me	C≡CH
4,6-di-Me	Br	4,6-di-Me	CN	4,6-di-Me	C≡CH
4,7-di-Me	Br	4,7-di-Me	CN	4,7-di-Me	C≡CH
5,6-di-Me	Br	5,6-di-Me	CN	5,6-di-Me	C≡CH
5,7-di-Me	Br	5,7-di-Me	CN	5,7-di-Me	C≡CH
5-Cl, 7-Me	Br	5-Cl, 7-Me	CN	5-Cl, 7-Me	C≡CH
5-Cl, 7-OMe	Br	5-Cl, 7-OMe	CN	5-Cl, 7-OMe	C≡CH
5-F, 7-Me	Br	5-F, 7-Me	CN	5-F, 7-Me	C≡CH
5-Me, 7-F	Br	5-Me, 7-F	CN	5-Me, 7-F	C≡CH
5-Me, 7-Cl	Br	5-Me, 7-Cl	CN	5-Me, 7-Cl	C≡CH
5-Me, 7-CN	Br	5-Me, 7-CN	CN	5-Me, 7-CN	C≡CH
5-Me, 7-OMe	Br	5-Me, 7-OMe	CN	5-Me, 7-OMe	C≡CH

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
5-(C≡CH), 7-Me	Br	5-(C≡CH), 7-Me	CN	5-(C≡CH), 7-Me	C≡CH
5,7-di-F	Br	5,7-di-F	CN	5,7-di-F	C≡CH
5,7-di-Cl	Br	5,7-di-Cl	CN	5,7-di-Cl	C≡CH
5,7-di-Br	Br	5,7-di-Br	CN	5,7-di-Br	C≡CH
–	OMe	–	$OCHF_2$	–	SMe
4-Me	OMe	4-Me	$OCHF_2$	4-Me	SMe
5-Me	OMe	5-Me	$OCHF_2$	5-Me	SMe
6-Me	OMe	6-Me	$OCHF_2$	6-Me	SMe
7-Me	OMe	7-Me	$OCHF_2$	7-Me	SMe
4-Et	OMe	4-Et	$OCHF_2$	4-Et	SMe
5-Et	OMe	5-Et	$OCHF_2$	5-Et	SMe
6-Et	OMe	6-Et	$OCHF_2$	6-Et	SMe
7-Et	OMe	7-Et	$OCHF_2$	7-Et	SMe
4-Pr	OMe	4-Pr	$OCHF_2$	4-Pr	SMe
5-Pr	OMe	5-Pr	$OCHF_2$	5-Pr	SMe
6-Pr	OMe	6-Pr	$OCHF_2$	6-Pr	SMe
7-Pr	OMe	7-Pr	$OCHF_2$	7-Pr	SMe
4-OMe	OMe	4-OMe	$OCHF_2$	4-OMe	SMe
5-OMe	OMe	5-OMe	$OCHF_2$	5-OMe	SMe
6-OMe	OMe	6-OMe	$OCHF_2$	6-OMe	SMe
7-OMe	OMe	7-OMe	$OCHF_2$	7-OMe	SMe
4-CN	OMe	4-CN	$OCHF_2$	4-CN	SMe
5-CN	OMe	5-CN	$OCHF_2$	5-CN	SMe
6-CN	OMe	6-CN	$OCHF_2$	6-CN	SMe
7-CN	OMe	7-CN	$OCHF_2$	7-CN	SMe
$4-CF_3$	OMe	$4-CF_3$	$OCHF_2$	$4-CF_3$	SMe
$5-CF_3$	OMe	$5-CF_3$	$OCHF_2$	$5-CF_3$	SMe
$6-CF_3$	OMe	$6-CF_3$	$OCHF_2$	$6-CF_3$	SMe
$7-CF_3$	OMe	$7-CF_3$	$OCHF_2$	$7-CF_3$	SMe
4-F	OMe	4-F	$OCHF_2$	4-F	SMe
5-F	OMe	5-F	$OCHF_2$	5-F	SMe
6-F	OMe	6-F	$OCHF_2$	6-F	SMe
7-F	OMe	7-F	$OCHF_2$	7-F	SMe

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
4-Cl	OMe	4-Cl	$OCHF_2$	4-Cl	SMe
5-Cl	OMe	5-Cl	$OCHF_2$	5-Cl	SMe
6-Cl	OMe	6-Cl	$OCHF_2$	6-Cl	SMe
7-Cl	OMe	7-Cl	$OCHF_2$	7-Cl	SMe
4-Br	OMe	4-Br	$OCHF_2$	4-Br	SMe
5-Br	OMe	5-Br	$OCHF_2$	5-Br	SMe
6-Br	OMe	6-Br	$OCHF_2$	6-Br	SMe
7-Br	OMe	7-Br	$OCHF_2$	7-Br	SMe
4-$OCHF_2$	OMe	4-$OCHF_2$	$OCHF_2$	4-$OCHF_2$	SMe
5$OCHF_2$	OMe	5$OCHF_2$	$OCHF_2$	5$OCHF_2$	SMe
6-$OCHF_2$	OMe	6-$OCHF_2$	$OCHF_2$	6-$OCHF_2$	SMe
7-$OCHF_2$	OMe	7-$OCHF_2$	$OCHF_2$	7-$OCHF_2$	SMe
4-(C≡CH)	OMe	4-(C≡CH)	$OCHF_2$	4-(C≡CH)	SMe
5-(C≡CH)	OMe	5-(C≡CH)	$OCHF_2$	5-(C≡CH)	SMe
6-(C≡CH)	OMe	6-(C≡CH)	$OCHF_2$	6-(C≡CH)	SMe
7-(C≡CH)	OMe	7-(C≡CH)	$OCHF_2$	7-(C≡CH)	SMe
4,5-di-Me	OMe	4,5-di-Me	$OCHF_2$	4,5-di-Me	SMe
4,6-di-Me	OMe	4,6-di-Me	$OCHF_2$	4,6-di-Me	SMe
4,7-di-Me	OMe	4,7-di-Me	$OCHF_2$	4,7-di-Me	SMe
5,6-di-Me	OMe	5,6-di-Me	$OCHF_2$	5,6-di-Me	SMe
5,7-di-Me	OMe	5,7-di-Me	$OCHF_2$	5,7-di-Me	SMe
5-Cl, 7-Me	OMe	5-Cl, 7-Me	$OCHF_2$	5-Cl, 7-Me	SMe
5-Cl, 7-OMe	OMe	5-Cl, 7-OMe	$OCHF_2$	5-Cl, 7-OMe	SMe
5-F, 7-Me	OMe	5-F, 7-Me	$OCHF_2$	5-F, 7-Me	SMe
5-Me, 7-F	OMe	5-Me, 7-F	$OCHF_2$	5-Me, 7-F	SMe
5-Me, 7-Cl	OMe	5-Me, 7-Cl	$OCHF_2$	5-Me, 7-Cl	SMe
5-Me, 7-CN	OMe	5-Me, 7-CN	$OCHF_2$	5-Me, 7-CN	SMe
5-Me, 7-OMe	OMe	5-Me, 7-OMe	$OCHF_2$	5-Me, 7-OMe	SMe
5-(C≡CH), 7-Me	OMe	5-(C≡CH), 7-Me	$OCHF_2$	5-(C≡CH), 7-Me	SMe
5,7-di-F	OMe	5,7-di-F	$OCHF_2$	5,7-di-F	SMe
5,7-di-Cl	OMe	5,7-di-Cl	$OCHF_2$	5,7-di-Cl	SMe
5,7-di-Br	OMe	5,7-di-Br	$OCHF_2$	5,7-di-Br	SMe
–	$SCHF_2$	–	SCF_3		

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
4-Me	$SCHF_2$	4-Me	SCF_3		
5-Me	$SCHF_2$	5-Me	SCF_3		
6-Me	$SCHF_2$	6-Me	SCF_3		
7-Me	$SCHF_2$	7-Me	SCF_3		
4-Et	$SCHF_2$	4-Et	SCF_3		
5-Et	$SCHF_2$	5-Et	SCF_3		
6-Et	$SCHF_2$	6-Et	SCF_3		
7-Et	$SCHF_2$	7-Et	SCF_3		
4-Pr	$SCHF_2$	4-Pr	SCF_3		
5-Pr	$SCHF_2$	5-Pr	SCF_3		
6-Pr	$SCHF_2$	6-Pr	SCF_3		
7-Pr	$SCHF_2$	7-Pr	SCF_3		
4-OMe	$SCHF_2$	4-OMe	SCF_3		
5-OMe	$SCHF_2$	5-OMe	SCF_3		
6-OMe	$SCHF_2$	6-OMe	SCF_3		
7-OMe	$SCHF_2$	7-OMe	SCF_3		
4-CN	$SCHF_2$	4-CN	SCF_3		
5-CN	$SCHF_2$	5-CN	SCF_3		
6-CN	$SCHF_2$	6-CN	SCF_3		
7-CN	$SCHF_2$	7-CN	SCF_3		
4-CF_3	$SCHF_2$	4-CF_3	SCF_3		
5-CF_3	$SCHF_2$	5-CF_3	SCF_3		
6-CF_3	$SCHF_2$	6-CF_3	SCF_3		
7-CF_3	$SCHF_2$	7-CF_3	SCF_3		
4-F	$SCHF_2$	4-F	SCF_3		
5-F	$SCHF_2$	5-F	SCF_3		
6-F	$SCHF_2$	6-F	SCF_3		
7-F	$SCHF_2$	7-F	SCF_3		
4-Cl	$SCHF_2$	4-Cl	SCF_3		
5-Cl	$SCHF_2$	5-Cl	SCF_3		
6-Cl	$SCHF_2$	6-Cl	SCF_3		
7-Cl	$SCHF_2$	7-Cl	SCF_3		
4-Br	$SCHF_2$	4-Br	SCF_3		
5-Br	$SCHF_2$	5-Br	SCF_3		

$(R^3)_n$	R^4	$(R^3)_n$	R^4	$(R^3)_n$	R^4
6-Br	$SCHF_2$	6-Br	SCF_3		
7-Br	$SCHF_2$	7-Br	SCF_3		
4-$OCHF_2$	$SCHF_2$	4-$OCHF_2$	SCF_3		
5$OCHF_2$	$SCHF_2$	5$OCHF_2$	SCF_3		
6-$OCHF_2$	$SCHF_2$	6-$OCHF_2$	SCF_3		
7-$OCHF_2$	$SCHF_2$	7-$OCHF_2$	SCF_3		
4-(C≡CH)	$SCHF_2$	4-(C≡CH)	SCF_3		
5-(C≡CH)	$SCHF_2$	5-(C≡CH)	SCF_3		
6-(C≡CH)	$SCHF_2$	6-(C≡CH)	SCF_3		
7-(C≡CH)	$SCHF_2$	7-(C≡CH)	SCF_3		
4,5-di-Me	$SCHF_2$	4,5-di-Me	SCF_3		
4,6-di-Me	$SCHF_2$	4,6-di-Me	SCF_3		
4,7-di-Me	$SCHF_2$	4,7-di-Me	SCF_3		
5,6-di-Me	$SCHF_2$	5,6-di-Me	SCF_3		
5,7-di-Me	$SCHF_2$	5,7-di-Me	SCF_3		
5-Cl, 7-Me	$SCHF_2$	5-Cl, 7-Me	SCF_3		
5-Cl, 7-OMe	$SCHF_2$	5-Cl, 7-OMe	SCF_3		
5-F, 7-Me	$SCHF_2$	5-F, 7-Me	SCF_3		
5-Me, 7-F	$SCHF_2$	5-Me, 7-F	SCF_3		
5-Me, 7-Cl	$SCHF_2$	5-Me, 7-Cl	SCF_3		
5-Me, 7-CN	$SCHF_2$	5-Me, 7-CN	SCF_3		
5-Me, 7-OMe	$SCHF_2$	5-Me, 7-OMe	SCF_3		
5-(C≡CH), 7-Me	$SCHF_2$	5-(C≡CH), 7-Me	SCF_3		
5,7-di-F	$SCHF_2$	5,7-di-F	SCF_3		
5,7-di-Cl	$SCHF_2$	5,7-di-Cl	SCF_3		
5,7-di-Br	$SCHF_2$	5,7-di-Br	SCF_3		

Table 2 is constructed in the same manner except that the Row Heading "W is O, X is S, R^1 is Me, R^2 is Me, and G is H." is replaced with the Row Heading listed for Table 2 below (i.e. "W is O, X is S, R^1 is Me, R^2 is Me, and G is C(O)Me."). Therefore the first entry in Table 2 is a compound of Formula **1** wherein W is O, X is S, R^1 is Me, R^2 is Me, $(R^3)_n$ is "–" (i.e. n is 0; no substitution with R^3), R^4 is H, and G is C(O)Me. Tables 3 through 627 are constructed similarly.

Table	Row Heading
2	W is O, X is S, R^1 is Me, R^2 is Me, and G is C(O)Me.
3	W is O, X is S, R^1 is Me, R^2 is Me, and G is C(O)Et.
4	W is O, X is S, R^1 is Me, R^2 is Me, and G is C(O)-*i*-Pr.
5	W is O, X is S, R^1 is Me, R^2 is Me, and G is C(O)-*t*-Bu.
6	W is O, X is S, R^1 is Me, R^2 is Me, and G is CO_2Me.
7	W is O, X is S, R^1 is Me, R^2 is Me, and G is CO_2Et.
8	W is O, X is S, R^1 is Me, R^2 is Me, and G is CO_2-*i*-Pr.
9	W is O, X is S, R^1 is Me, R^2 is Me, and G is CO_2-*t*-Bu.
10	W is O, X is S, R^1 is Me, R^2 is Me, and G is SO_2Me.
11	W is O, X is S, R^1 is Me, R^2 is H, and G is C(O)Me.
12	W is O, X is S, R^1 is Me, R^2 is H, and G is C(O)Et.
13	W is O, X is S, R^1 is Me, R^2 is H, and G is C(O)-*i*-Pr.
14	W is O, X is S, R^1 is Me, R^2 is H, and G is C(O)-*t*-Bu.
15	W is O, X is S, R^1 is Me, R^2 is H, and G is CO_2Me.
16	W is O, X is S, R^1 is Me, R^2 is H, and G is CO_2Et.
17	W is O, X is S, R^1 is Me, R^2 is H, and G is CO_2-*i*-Pr.
18	W is O, X is S, R^1 is Me, R^2 is H, and G is CO_2-*t*-Bu.
19	W is O, X is S, R^1 is Me, R^2 is H, and G is SO_2Me.
20	W is O, X is S, R^1 is Me, R^2 is Et, and G is C(O)Me.
21	W is O, X is S, R^1 is Me, R^2 is Et, and G is C(O)Et.
22	W is O, X is S, R^1 is Me, R^2 is Et, and G is C(O)-*i*-Pr.
23	W is O, X is S, R^1 is Me, R^2 is Et, and G is C(O)-*t*-Bu.
24	W is O, X is S, R^1 is Me, R^2 is Et, and G is CO_2Me.
25	W is O, X is S, R^1 is Me, R^2 is Et, and G is CO_2Et.
26	W is O, X is S, R^1 is Me, R^2 is Et, and G is CO_2-*i*-Pr.
27	W is O, X is S, R^1 is Me, R^2 is Et, and G is CO_2-*t*-Bu.
28	W is O, X is S, R^1 is Me, R^2 is Et, and G is SO_2Me.
29	W is O, X is S, R^1 is Me, R^2 is Pr, and G is C(O)Me.
30	W is O, X is S, R^1 is Me, R^2 is Pr, and G is C(O)Et.
31	W is O, X is S, R^1 is Me, R^2 is Pr, and G is C(O)-*i*-Pr.
32	W is O, X is S, R^1 is Me, R^2 is Pr, and G is C(O)-*t*-Bu.
33	W is O, X is S, R^1 is Me, R^2 is Pr, and G is CO_2Me.
34	W is O, X is S, R^1 is Me, R^2 is Pr, and G is CO_2Et.
35	W is O, X is S, R^1 is Me, R^2 is Pr, and G is CO_2-*i*-Pr.

36	W is O, X is S, R^1 is Me, R^2 is Pr, and G is CO_2-*t*-Bu.
37	W is O, X is S, R^1 is Me, R^2 is Pr, and G is SO_2Me.
38	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is C(O)Me.
39	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is C(O)Et.
40	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is C(O)-*i*-Pr.
41	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is C(O)-*t*-Bu.
42	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is CO_2Me.
43	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is CO_2Et.
44	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is CO_2-*i*-Pr.
45	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is CO_2-*t*-Bu.
46	W is O, X is S, R^1 is Me, R^2 is CF_3, and G is SO_2Me.
47	W is O, X is S, R^1 is Me, R^2 is Cl, and G is C(O)Me.
48	W is O, X is S, R^1 is Me, R^2 is Cl, and G is C(O)Et.
49	W is O, X is S, R^1 is Me, R^2 is Cl, and G is C(O)-*i*-Pr.
50	W is O, X is S, R^1 is Me, R^2 is Cl, and G is C(O)-*t*-Bu.
51	W is O, X is S, R^1 is Me, R^2 is Cl, and G is CO_2Me.
52	W is O, X is S, R^1 is Me, R^2 is Cl, and G is CO_2Et.
53	W is O, X is S, R^1 is Me, R^2 is Cl, and G is CO_2-*i*-Pr.
54	W is O, X is S, R^1 is Me, R^2 is Cl, and G is CO_2-*t*-Bu.
55	W is O, X is S, R^1 is Me, R^2 is Cl, and G is SO_2Me.
56	W is O, X is S, R^1 is Me, R^2 is Br, and G is C(O)Me.
57	W is O, X is S, R^1 is Me, R^2 is Br, and G is C(O)Et.
58	W is O, X is S, R^1 is Me, R^2 is Br, and G is C(O)-*i*-Pr.
59	W is O, X is S, R^1 is Me, R^2 is Br, and G is C(O)-*t*-Bu.
60	W is O, X is S, R^1 is Me, R^2 is Br, and G is CO_2Me.
61	W is O, X is S, R^1 is Me, R^2 is Br, and G is CO_2Et.
62	W is O, X is S, R^1 is Me, R^2 is Br, and G is CO_2-*i*-Pr.
63	W is O, X is S, R^1 is Me, R^2 is Br, and G is CO_2-*t*-Bu.
64	W is O, X is S, R^1 is Me, R^2 is Br, and G is SO_2Me.
65	W is O, X is S, R^1 is Me, R^2 is I, and G is C(O)Me.
66	W is O, X is S, R^1 is Me, R^2 is I, and G is C(O)Et.
67	W is O, X is S, R^1 is Me, R^2 is I, and G is C(O)-*i*-Pr.
68	W is O, X is S, R^1 is Me, R^2 is I, and G is C(O)-*t*-Bu.
69	W is O, X is S, R^1 is Me, R^2 is I, and G is CO_2Me.
70	W is O, X is S, R^1 is Me, R^2 is I, and G is CO_2Et.

71	W is O, X is S, R^1 is Me, R^2 is I, and G is CO_2-*i*-Pr.
72	W is O, X is S, R^1 is Me, R^2 is I, and G is CO_2-*t*-Bu.
73	W is O, X is S, R^1 is Me, R^2 is I, and G is SO_2Me.
74	W is O, X is S, R^1 is Me, R^2 is OMe, and G is C(O)Me.
75	W is O, X is S, R^1 is Me, R^2 is OMe, and G is C(O)Et.
76	W is O, X is S, R^1 is Me, R^2 is OMe, and G is C(O)-*i*-Pr.
77	W is O, X is S, R^1 is Me, R^2 is OMe, and G is C(O)-*t*-Bu.
78	W is O, X is S, R^1 is Me, R^2 is OMe, and G is CO_2Me.
79	W is O, X is S, R^1 is Me, R^2 is OMe, and G is CO_2Et.
80	W is O, X is S, R^1 is Me, R^2 is OMe, and G is CO_2-*i*-Pr.
81	W is O, X is S, R^1 is Me, R^2 is OMe, and G is CO_2-*t*-Bu.
82	W is O, X is S, R^1 is Me, R^2 is OMe, and G is SO_2Me.
83	W is O, X is S, R^1 is Me, R^2 is OEt, and G is C(O)Me.
84	W is O, X is S, R^1 is Me, R^2 is OEt, and G is C(O)Et.
85	W is O, X is S, R^1 is Me, R^2 is OEt, and G is C(O)-*i*-Pr.
86	W is O, X is S, R^1 is Me, R^2 is OEt, and G is C(O)-*t*-Bu.
87	W is O, X is S, R^1 is Me, R^2 is OEt, and G is CO_2Me.
88	W is O, X is S, R^1 is Me, R^2 is OEt, and G is CO_2Et.
89	W is O, X is S, R^1 is Me, R^2 is OEt, and G is CO_2-*i*-Pr.
90	W is O, X is S, R^1 is Me, R^2 is OEt, and G is CO_2-*t*-Bu.
91	W is O, X is S, R^1 is Me, R^2 is OEt, and G is SO_2Me.
92	W is O, X is S, R^1 is Et, R^2 is Me, and G is C(O)Me.
93	W is O, X is S, R^1 is Et, R^2 is Me, and G is C(O)Et.
94	W is O, X is S, R^1 is Et, R^2 is Me, and G is C(O)-*i*-Pr.
95	W is O, X is S, R^1 is Et, R^2 is Me, and G is C(O)-*t*-Bu.
96	W is O, X is S, R^1 is Et, R^2 is Me, and G is CO_2Me.
97	W is O, X is S, R^1 is Et, R^2 is Me, and G is CO_2Et.
98	W is O, X is S, R^1 is Et, R^2 is Me, and G is CO_2-*i*-Pr.
99	W is O, X is S, R^1 is Et, R^2 is Me, and G is CO_2-*t*-Bu.
100	W is O, X is S, R^1 is Et, R^2 is Me, and G is SO_2Me.
101	W is O, X is S, R^1 is Et, R^2 is H, and G is C(O)Me.
102	W is O, X is S, R^1 is Et, R^2 is H, and G is C(O)Et.
103	W is O, X is S, R^1 is Et, R^2 is H, and G is C(O)-*i*-Pr.
104	W is O, X is S, R^1 is Et, R^2 is H, and G is C(O)-*t*-Bu.

105	W is O, X is S, R^1 is Et, R^2 is H, and G is CO_2Me.
106	W is O, X is S, R^1 is Et, R^2 is H, and G is CO_2Et.
107	W is O, X is S, R^1 is Et, R^2 is H, and G is CO_2-*i*-Pr.
108	W is O, X is S, R^1 is Et, R^2 is H, and G is CO_2-*t*-Bu.
109	W is O, X is S, R^1 is Et, R^2 is H, and G is SO_2Me.
110	W is O, X is S, R^1 is Et, R^2 is Et, and G is C(O)Me.
111	W is O, X is S, R^1 is Et, R^2 is Et, and G is C(O)Et.
112	W is O, X is S, R^1 is Et, R^2 is Et, and G is C(O)-*i*-Pr.
113	W is O, X is S, R^1 is Et, R^2 is Et, and G is C(O)-*t*-Bu.
114	W is O, X is S, R^1 is Et, R^2 is Et, and G is CO_2Me.
115	W is O, X is S, R^1 is Et, R^2 is Et, and G is CO_2Et.
116	W is O, X is S, R^1 is Et, R^2 is Et, and G is CO_2-*i*-Pr.
117	W is O, X is S, R^1 is Et, R^2 is Et, and G is CO_2-*t*-Bu.
118	W is O, X is S, R^1 is Et, R^2 is Et, and G is SO_2Me.
119	W is O, X is S, R^1 is Et, R^2 is Pr, and G is C(O)Me.
120	W is O, X is S, R^1 is Et, R^2 is Pr, and G is C(O)Et.
121	W is O, X is S, R^1 is Et, R^2 is Pr, and G is C(O)-*i*-Pr.
122	W is O, X is S, R^1 is Et, R^2 is Pr, and G is C(O)-*t*-Bu.
123	W is O, X is S, R^1 is Et, R^2 is Pr, and G is CO_2Me.
124	W is O, X is S, R^1 is Et, R^2 is Pr, and G is CO_2Et.
125	W is O, X is S, R^1 is Et, R^2 is Pr, and G is CO_2-*i*-Pr.
126	W is O, X is S, R^1 is Et, R^2 is Pr, and G is CO_2-*t*-Bu.
127	W is O, X is S, R^1 is Et, R^2 is Pr, and G is SO_2Me.
128	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is C(O)Me.
129	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is C(O)Et.
130	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is C(O)-*i*-Pr.
131	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is C(O)-*t*-Bu.
132	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is CO_2Me.
133	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is CO_2Et.
134	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is CO_2-*i*-Pr.
135	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is CO_2-*t*-Bu.
136	W is O, X is S, R^1 is Et, R^2 is CF_3, and G is SO_2Me.
137	W is O, X is S, R^1 is Et, R^2 is Cl, and G is C(O)Me.
138	W is O, X is S, R^1 is Et, R^2 is Cl, and G is C(O)Et.
139	W is O, X is S, R^1 is Et, R^2 is Cl, and G is C(O)-*i*-Pr.

140	W is O, X is S, R^1 is Et, R^2 is Cl, and G is C(O)-*t*-Bu.
141	W is O, X is S, R^1 is Et, R^2 is Cl, and G is CO_2Me.
142	W is O, X is S, R^1 is Et, R^2 is Cl, and G is CO_2Et.
143	W is O, X is S, R^1 is Et, R^2 is Cl, and G is CO_2-*i*-Pr.
144	W is O, X is S, R^1 is Et, R^2 is Cl, and G is CO_2-*t*-Bu.
145	W is O, X is S, R^1 is Et, R^2 is Cl, and G is SO_2Me.
146	W is O, X is S, R^1 is Et, R^2 is Br, and G is C(O)Me.
147	W is O, X is S, R^1 is Et, R^2 is Br, and G is C(O)Et.
148	W is O, X is S, R^1 is Et, R^2 is Br, and G is C(O)-*i*-Pr.
149	W is O, X is S, R^1 is Et, R^2 is Br, and G is C(O)-*t*-Bu.
150	W is O, X is S, R^1 is Et, R^2 is Br, and G is CO_2Me.
151	W is O, X is S, R^1 is Et, R^2 is Br, and G is CO_2Et.
152	W is O, X is S, R^1 is Et, R^2 is Br, and G is CO_2-*i*-Pr.
153	W is O, X is S, R^1 is Et, R^2 is Br, and G is CO_2-*t*-Bu.
154	W is O, X is S, R^1 is Et, R^2 is Br, and G is SO_2Me.
155	W is O, X is S, R^1 is Et, R^2 is I, and G is C(O)Me.
156	W is O, X is S, R^1 is Et, R^2 is I, and G is C(O)Et.
157	W is O, X is S, R^1 is Et, R^2 is I, and G is C(O)-*i*-Pr.
158	W is O, X is S, R^1 is Et, R^2 is I, and G is C(O)-*t*-Bu.
159	W is O, X is S, R^1 is Et, R^2 is I, and G is CO_2Me.
160	W is O, X is S, R^1 is Et, R^2 is I, and G is CO_2Et.
161	W is O, X is S, R^1 is Et, R^2 is I, and G is CO_2-*i*-Pr.
162	W is O, X is S, R^1 is Et, R^2 is I, and G is CO_2-*t*-Bu.
163	W is O, X is S, R^1 is Et, R^2 is I, and G is SO_2Me.
164	W is O, X is S, R^1 is Et, R^2 is OMe, and G is C(O)Me.
165	W is O, X is S, R^1 is Et, R^2 is OMe, and G is C(O)Et.
166	W is O, X is S, R^1 is Et, R^2 is OMe, and G is C(O)-*i*-Pr.
167	W is O, X is S, R^1 is Et, R^2 is OMe, and G is C(O)-*t*-Bu.
168	W is O, X is S, R^1 is Et, R^2 is OMe, and G is CO_2Me.
169	W is O, X is S, R^1 is Et, R^2 is OMe, and G is CO_2Et.
170	W is O, X is S, R^1 is Et, R^2 is OMe, and G is CO_2-*i*-Pr.
171	W is O, X is S, R^1 is Et, R^2 is OMe, and G is CO_2-*t*-Bu.
172	W is O, X is S, R^1 is Et, R^2 is OMe, and G is SO_2Me.
173	W is O, X is S, R^1 is Et, R^2 is OEt, and G is C(O)Me.
174	W is O, X is S, R^1 is Et, R^2 is OEt, and G is C(O)Et.

175	W is O, X is S, R^1 is Et, R^2 is OEt, and G is C(O)-*i*-Pr.
176	W is O, X is S, R^1 is Et, R^2 is OEt, and G is C(O)-*t*-Bu.
177	W is O, X is S, R^1 is Et, R^2 is OEt, and G is CO_2Me.
178	W is O, X is S, R^1 is Et, R^2 is OEt, and G is CO_2Et.
179	W is O, X is S, R^1 is Et, R^2 is OEt, and G is CO_2-*i*-Pr.
180	W is O, X is S, R^1 is Et, R^2 is OEt, and G is CO_2-*t*-Bu.
181	W is O, X is S, R^1 is Et, R^2 is OEt, and G is SO_2Me.
182	W is O, X is S, R^1 is Pr, R^2 is Me, and G is C(O)Me.
183	W is O, X is S, R^1 is Pr, R^2 is Me, and G is C(O)Et.
184	W is O, X is S, R^1 is Pr, R^2 is Me, and G is C(O)-*i*-Pr.
185	W is O, X is S, R^1 is Pr, R^2 is Me, and G is C(O)-*t*-Bu.
186	W is O, X is S, R^1 is Pr, R^2 is Me, and G is CO_2Me.
187	W is O, X is S, R^1 is Pr, R^2 is Me, and G is CO_2Et.
188	W is O, X is S, R^1 is Pr, R^2 is Me, and G is CO_2-*i*-Pr.
189	W is O, X is S, R^1 is Pr, R^2 is Me, and G is CO_2-*t*-Bu.
190	W is O, X is S, R^1 is Pr, R^2 is Me, and G is SO_2Me.
191	W is O, X is S, R^1 is Pr, R^2 is H, and G is C(O)Me.
192	W is O, X is S, R^1 is Pr, R^2 is H, and G is C(O)Et.
193	W is O, X is S, R^1 is Pr, R^2 is H, and G is C(O)-*i*-Pr.
194	W is O, X is S, R^1 is Pr, R^2 is H, and G is C(O)-*t*-Bu.
195	W is O, X is S, R^1 is Pr, R^2 is H, and G is CO_2Me.
196	W is O, X is S, R^1 is Pr, R^2 is H, and G is CO_2Et.
197	W is O, X is S, R^1 is Pr, R^2 is H, and G is CO_2-*i*-Pr.
198	W is O, X is S, R^1 is Pr, R^2 is H, and G is CO_2-*t*-Bu.
199	W is O, X is S, R^1 is Pr, R^2 is H, and G is SO_2Me.
200	W is O, X is S, R^1 is Pr, R^2 is Et, and G is C(O)Me.
201	W is O, X is S, R^1 is Pr, R^2 is Et, and G is C(O)Et.
202	W is O, X is S, R^1 is Pr, R^2 is Et, and G is C(O)-*i*-Pr.
203	W is O, X is S, R^1 is Pr, R^2 is Et, and G is C(O)-*t*-Bu.
204	W is O, X is S, R^1 is Pr, R^2 is Et, and G is CO_2Me.
205	W is O, X is S, R^1 is Pr, R^2 is Et, and G is CO_2Et.
206	W is O, X is S, R^1 is Pr, R^2 is Et, and G is CO_2-*i*-Pr.
207	W is O, X is S, R^1 is Pr, R^2 is Et, and G is CO_2-*t*-Bu.
208	W is O, X is S, R^1 is Pr, R^2 is Et, and G is SO_2Me.

209	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is C(O)Me.
210	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is C(O)Et.
211	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is C(O)-*i*-Pr.
212	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is C(O)-*t*-Bu.
213	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is CO_2Me.
214	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is CO_2Et.
215	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is CO_2-*i*-Pr.
216	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is CO_2-*t*-Bu.
217	W is O, X is S, R^1 is Pr, R^2 is Pr, and G is SO_2Me.
218	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is C(O)Me.
219	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is C(O)Et.
220	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is C(O)-*i*-Pr.
221	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is C(O)-*t*-Bu.
222	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is CO_2Me.
223	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is CO_2Et.
224	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is CO_2-*i*-Pr.
225	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is CO_2-*t*-Bu.
226	W is O, X is S, R^1 is Pr, R^2 is CF_3, and G is SO_2Me.
227	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is C(O)Me.
228	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is C(O)Et.
229	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is C(O)-*i*-Pr.
230	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is C(O)-*t*-Bu.
231	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is CO_2Me.
232	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is CO_2Et.
233	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is CO_2-*i*-Pr.
234	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is CO_2-*t*-Bu.
235	W is O, X is S, R^1 is Pr, R^2 is Cl, and G is SO_2Me.
236	W is O, X is S, R^1 is Pr, R^2 is Br, and G is C(O)Me.
237	W is O, X is S, R^1 is Pr, R^2 is Br, and G is C(O)Et.
238	W is O, X is S, R^1 is Pr, R^2 is Br, and G is C(O)-*i*-Pr.
239	W is O, X is S, R^1 is Pr, R^2 is Br, and G is C(O)-*t*-Bu.
240	W is O, X is S, R^1 is Pr, R^2 is Br, and G is CO_2Me.
241	W is O, X is S, R^1 is Pr, R^2 is Br, and G is CO_2Et.
242	W is O, X is S, R^1 is Pr, R^2 is Br, and G is CO_2-*i*-Pr.
243	W is O, X is S, R^1 is Pr, R^2 is Br, and G is CO_2-*t*-Bu.

244	W is O, X is S, R^1 is Pr, R^2 is Br, and G is SO_2Me.
245	W is O, X is S, R^1 is Pr, R^2 is I, and G is C(O)Me.
246	W is O, X is S, R^1 is Pr, R^2 is I, and G is C(O)Et.
247	W is O, X is S, R^1 is Pr, R^2 is I, and G is C(O)-*i*-Pr.
248	W is O, X is S, R^1 is Pr, R^2 is I, and G is C(O)-*t*-Bu.
249	W is O, X is S, R^1 is Pr, R^2 is I, and G is CO_2Me.
250	W is O, X is S, R^1 is Pr, R^2 is I, and G is CO_2Et.
251	W is O, X is S, R^1 is Pr, R^2 is I, and G is CO_2-*i*-Pr.
252	W is O, X is S, R^1 is Pr, R^2 is I, and G is CO_2-*t*-Bu.
253	W is O, X is S, R^1 is Pr, R^2 is I, and G is SO_2Me.
254	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is C(O)Me.
255	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is C(O)Et.
256	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is C(O)-*i*-Pr.
257	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is C(O)-*t*-Bu.
258	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is CO_2Me.
259	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is CO_2Et.
260	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is CO_2-*i*-Pr.
261	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is CO_2-*t*-Bu.
262	W is O, X is S, R^1 is Pr, R^2 is OMe, and G is SO_2Me.
263	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is C(O)Me.
264	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is C(O)Et.
265	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is C(O)-*i*-Pr.
266	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is C(O)-*t*-Bu.
267	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is CO_2Me.
268	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is CO_2Et.
269	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is CO_2-*i*-Pr.
270	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is CO_2-*t*-Bu.
271	W is O, X is S, R^1 is Pr, R^2 is OEt, and G is SO_2Me.
272	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is C(O)Me.
273	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is C(O)Et.
274	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is C(O)-*i*-Pr.
275	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is C(O)-*t*-Bu.
276	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is CO_2Me.
277	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is CO_2Et.

278	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is CO_2-*i*-Pr.
279	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is CO_2-*t*-Bu.
280	W is O, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is SO_2Me.
281	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is C(O)Me.
282	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is C(O)Et.
283	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is C(O)-*i*-Pr.
284	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is C(O)-*t*-Bu.
285	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is CO_2Me.
286	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is CO_2Et.
287	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is CO_2-*i*-Pr.
288	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is CO_2-*t*-Bu.
289	W is O, X is -CH=CH-, R^1 is Me, R^2 is H, and G is SO_2Me.
290	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is C(O)Me.
291	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is C(O)Et.
292	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is C(O)-*i*-Pr.
293	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is C(O)-*t*-Bu.
294	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is CO_2Me.
295	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is CO_2Et.
296	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is CO_2-*i*-Pr.
297	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is CO_2-*t*-Bu.
298	W is O, X is -CH=CH-, R^1 is Me, R^2 is Et, and G is SO_2Me.
299	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is C(O)Me.
300	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is C(O)Et.
301	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is C(O)-*i*-Pr.
302	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is C(O)-*t*-Bu.
303	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is CO_2Me.
304	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is CO_2Et.
305	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is CO_2-*i*-Pr.
306	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is CO_2-*t*-Bu.
307	W is O, X is -CH=CH-, R^1 is Me, R^2 is Pr, and G is SO_2Me.
308	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is C(O)Me.
309	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is C(O)Et.
310	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is C(O)-*i*-Pr.
311	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is C(O)-*t*-Bu.
312	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is CO_2Me.

313	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is CO_2Et.
314	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is CO_2-*i*-Pr.
315	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is CO_2-*t*-Bu.
316	W is O, X is -CH=CH-, R^1 is Me, R^2 is CF_3, and G is SO_2Me.
317	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is C(O)Me.
318	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is C(O)Et.
319	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is C(O)-*i*-Pr.
320	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is C(O)-*t*-Bu.
321	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is CO_2Me.
322	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is CO_2Et.
323	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is CO_2-*i*-Pr.
324	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is CO_2-*t*-Bu.
325	W is O, X is -CH=CH-, R^1 is Me, R^2 is Cl, and G is SO_2Me.
326	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is C(O)Me.
327	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is C(O)Et.
328	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is C(O)-*i*-Pr.
329	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is C(O)-*t*-Bu.
330	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is CO_2Me.
331	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is CO_2Et.
332	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is CO_2-*i*-Pr.
333	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is CO_2-*t*-Bu.
334	W is O, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is SO_2Me.
335	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is C(O)Me.
336	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is C(O)Et.
337	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is C(O)-*i*-Pr.
338	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is C(O)-*t*-Bu.
339	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is CO_2Me.
340	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is CO_2Et.
341	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is CO_2-*i*-Pr.
342	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is CO_2-*t*-Bu.
343	W is O, X is -CH=CH-, R^1 is Me, R^2 is I, and G is SO_2Me.
344	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is C(O)Me.
345	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is C(O)Et.
346	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is C(O)-*i*-Pr.
347	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is C(O)-*t*-Bu.

348	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is CO_2Me.
349	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is CO_2Et.
350	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is CO_2-*i*-Pr.
351	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is CO_2-*t*-Bu.
352	W is O, X is -CH=CH-, R^1 is Me, R^2 is OMe, and G is SO_2Me.
353	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is C(O)Me.
354	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is C(O)Et.
355	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is C(O)-*i*-Pr.
356	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is C(O)-*t*-Bu.
357	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is CO_2Me.
358	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is CO_2Et.
359	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is CO_2-*i*-Pr.
360	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is CO_2-*t*-Bu.
361	W is O, X is -CH=CH-, R^1 is Me, R^2 is OEt, and G is SO_2Me.
362	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is C(O)Me.
363	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is C(O)Et.
364	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is C(O)-*i*-Pr.
365	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is C(O)-*t*-Bu.
366	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is CO_2Me.
367	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is CO_2Et.
368	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is CO_2-*i*-Pr.
369	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is CO_2-*t*-Bu.
370	W is O, X is -CH=CH-, R^1 is Et, R^2 is Me, and G is SO_2Me.
371	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is C(O)Me.
372	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is C(O)Et.
373	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is C(O)-*i*-Pr.
374	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is C(O)-*t*-Bu.
375	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is CO_2Me.
376	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is CO_2Et.
377	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is CO_2-*i*-Pr.
378	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is CO_2-*t*-Bu.
379	W is O, X is -CH=CH-, R^1 is Et, R^2 is H, and G is SO_2Me.
380	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is C(O)Me.
381	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is C(O)Et.

382	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is C(O)-*i*-Pr.
383	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is C(O)-*t*-Bu.
384	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is CO_2Me.
385	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is CO_2Et.
386	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is CO_2-*i*-Pr.
387	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is CO_2-*t*-Bu.
388	W is O, X is -CH=CH-, R^1 is Et, R^2 is Et, and G is SO_2Me.
389	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is C(O)Me.
390	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is C(O)Et.
391	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is C(O)-*i*-Pr.
392	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is C(O)-*t*-Bu.
393	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is CO_2Me.
394	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is CO_2Et.
395	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is CO_2-*i*-Pr.
396	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is CO_2-*t*-Bu.
397	W is O, X is -CH=CH-, R^1 is Et, R^2 is Pr, and G is SO_2Me.
398	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is C(O)Me.
399	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is C(O)Et.
400	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is C(O)-*i*-Pr.
401	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is C(O)-*t*-Bu.
402	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is CO_2Me.
403	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is CO_2Et.
404	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is CO_2-*i*-Pr.
405	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is CO_2-*t*-Bu.
406	W is O, X is -CH=CH-, R^1 is Et, R^2 is CF_3, and G is SO_2Me.
407	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is C(O)Me.
408	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is C(O)Et.
409	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is C(O)-*i*-Pr.
410	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is C(O)-*t*-Bu.
411	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is CO_2Me.
412	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is CO_2Et.
413	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is CO_2-*i*-Pr.
414	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is CO_2-*t*-Bu.
415	W is O, X is -CH=CH-, R^1 is Et, R^2 is Cl, and G is SO_2Me.
416	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is C(O)Me.

417	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is C(O)Et.
418	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is C(O)-*i*-Pr.
419	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is C(O)-*t*-Bu.
420	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is CO_2Me.
421	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is CO_2Et.
422	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is CO_2-*i*-Pr.
423	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is CO_2-*t*-Bu.
424	W is O, X is -CH=CH-, R^1 is Et, R^2 is Br, and G is SO_2Me.
425	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is C(O)Me.
426	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is C(O)Et.
427	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is C(O)-*i*-Pr.
428	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is C(O)-*t*-Bu.
429	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is CO_2Me.
430	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is CO_2Et.
431	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is CO_2-*i*-Pr.
432	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is CO_2-*t*-Bu.
433	W is O, X is -CH=CH-, R^1 is Et, R^2 is I, and G is SO_2Me.
434	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is C(O)Me.
435	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is C(O)Et.
436	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is C(O)-*i*-Pr.
437	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is C(O)-*t*-Bu.
438	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is CO_2Me.
439	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is CO_2Et.
440	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is CO_2-*i*-Pr.
441	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is CO_2-*t*-Bu.
442	W is O, X is -CH=CH-, R^1 is Et, R^2 is OMe, and G is SO_2Me.
443	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is C(O)Me.
444	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is C(O)Et.
445	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is C(O)-*i*-Pr.
446	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is C(O)-*t*-Bu.
447	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is CO_2Me.
448	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is CO_2Et.
449	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is CO_2-*i*-Pr.
450	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is CO_2-*t*-Bu.
451	W is O, X is -CH=CH-, R^1 is Et, R^2 is OEt, and G is SO_2Me.

452	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is C(O)Me.
453	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is C(O)Et.
454	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is C(O)-*i*-Pr.
455	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is C(O)-*t*-Bu.
456	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is CO_2Me.
457	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is CO_2Et.
458	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is CO_2-*i*-Pr.
459	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is CO_2-*t*-Bu.
460	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Me, and G is SO_2Me.
461	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is C(O)Me.
462	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is C(O)Et.
463	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is C(O)-*i*-Pr.
464	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is C(O)-*t*-Bu.
465	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is CO_2Me.
466	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is CO_2Et.
467	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is CO_2-*i*-Pr.
468	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is CO_2-*t*-Bu.
469	W is O, X is -CH=CH-, R^1 is Pr, R^2 is H, and G is SO_2Me.
470	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is C(O)Me.
471	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is C(O)Et.
472	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is C(O)-*i*-Pr.
473	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is C(O)-*t*-Bu.
474	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is CO_2Me.
475	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is CO_2Et.
476	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is CO_2-*i*-Pr.
477	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is CO_2-*t*-Bu.
478	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Et, and G is SO_2Me.
479	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is C(O)Me.
480	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is C(O)Et.
481	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is C(O)-*i*-Pr.
482	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is C(O)-*t*-Bu.
483	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is CO_2Me.
484	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is CO_2Et.
485	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is CO_2-*i*-Pr.

486	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is CO_2-*t*-Bu.
487	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Pr, and G is SO_2Me.
488	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is C(O)Me.
489	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is C(O)Et.
490	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is C(O)-*i*-Pr.
491	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is C(O)-*t*-Bu.
492	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is CO_2Me.
493	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is CO_2Et.
494	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is CO_2-*i*-Pr.
495	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is CO_2-*t*-Bu.
496	W is O, X is -CH=CH-, R^1 is Pr, R^2 is CF_3, and G is SO_2Me.
497	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is C(O)Me.
498	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is C(O)Et.
499	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is C(O)-*i*-Pr.
500	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is C(O)-*t*-Bu.
501	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is CO_2Me.
502	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is CO_2Et.
503	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is CO_2-*i*-Pr.
504	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is CO_2-*t*-Bu.
505	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Cl, and G is SO_2Me.
506	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is C(O)Me.
507	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is C(O)Et.
508	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is C(O)-*i*-Pr.
509	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is C(O)-*t*-Bu.
510	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is CO_2Me.
511	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is CO_2Et.
512	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is CO_2-*i*-Pr.
513	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is CO_2-*t*-Bu.
514	W is O, X is -CH=CH-, R^1 is Pr, R^2 is Br, and G is SO_2Me.
515	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is C(O)Me.
516	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is C(O)Et.
517	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is C(O)-*i*-Pr.
518	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is C(O)-*t*-Bu.
519	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is CO_2Me.
520	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is CO_2Et.

521	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is CO_2-*i*-Pr.
522	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is CO_2-*t*-Bu.
523	W is O, X is -CH=CH-, R^1 is Pr, R^2 is I, and G is SO_2Me.
524	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is C(O)Me.
525	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is C(O)Et.
526	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is C(O)-*i*-Pr.
527	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is C(O)-*t*-Bu.
528	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is CO_2Me.
529	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is CO_2Et.
530	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is CO_2-*i*-Pr.
531	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is CO_2-*t*-Bu.
532	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OMe, and G is SO_2Me.
533	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is C(O)Me.
534	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is C(O)Et.
535	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is C(O)-*i*-Pr.
536	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is C(O)-*t*-Bu.
537	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is CO_2Me.
538	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is CO_2Et.
539	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is CO_2-*i*-Pr.
540	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is CO_2-*t*-Bu.
541	W is O, X is -CH=CH-, R^1 is Pr, R^2 is OEt, and G is SO_2Me.
542	W is O, X is S, R^1 is CH_2CF_3, R^2 is Me, and G is H.
543	W is O, X is S, R^1 is CH_2CF_3, R^2 is Me, and G is C(O)Me.
544	W is O, X is S, R^1 is CH_2CF_3, R^2 is Me, and G is CO_2Me.
545	W is O, X is S, R^1 is CH_2CF_3, R^2 is Br, and G is H.
546	W is O, X is S, R^1 is CH_2CF_3, R^2 is Br, and G is C(O)Me.
547	W is O, X is S, R^1 is CH_2CF_3, R^2 is Br, and G is CO_2Me.
548	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Me, and G is H.
549	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Me, and G is C(O)Me.
550	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Me, and G is CO_2Me.
551	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Br, and G is H.
552	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Br, and G is C(O)Me.
553	W is O, X is S, R^1 is CH_2CH_2CN, R^2 is Br, and G is CO_2Me.

554	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Me, and G is H.
555	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Me, and G is C(O)Me.
556	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Me, and G is CO_2Me.
557	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Br, and G is H.
558	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Br, and G is C(O)Me.
559	W is O, X is -CH=CH-, R^1 is CH_2CF_3, R^2 is Br, and G is CO_2Me.
560	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Me, and G is H.
561	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Me, and G is C(O)Me.
562	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Me, and G is CO_2Me.
563	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Br, and G is H.
564	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Br, and G is C(O)Me.
565	W is O, X is -CH=CH-, R^1 is CH_2CH_2CN, R^2 is Br, and G is CO_2Me.
566	W is O, X is O, R^1 is Me, R^2 is Me, and G is H.
567	W is O, X is O, R^1 is Me, R^2 is Me, and G is C(O)Me.
568	W is O, X is O, R^1 is Me, R^2 is Me, and G is CO_2Me.
569	W is O, X is O, R^1 is Me, R^2 is Br, and G is H.
570	W is O, X is O, R^1 is Me, R^2 is Br, and G is C(O)Me.
571	W is O, X is O, R^1 is Me, R^2 is Br, and G is CO_2Me.
572	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Me, and G is H.
573	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Me, and G is C(O)Me.
574	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Me, and G is CO_2Me.
575	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Br, and G is H.
576	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Br, and G is C(O)Me.
577	W is O, X is -CH=C(Me)-, R^1 is Me, R^2 is Br, and G is CO_2Me.
578	W is O, X is N(Me), R^1 is Me, R^2 is Me, and G is H.
579	W is O, X is N(Me), R^1 is Me, R^2 is Me, and G is C(O)Me.
580	W is O, X is N(Me), R^1 is Me, R^2 is Me, and G is CO_2Me.
581	W is O, X is N(Me), R^1 is Me, R^2 is Br, and G is H.
582	W is O, X is N(Me), R^1 is Me, R^2 is Br, and G is C(O)Me.
583	W is O, X is N(Me), R^1 is Me, R^2 is Br, and G is CO_2Me.
584	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Me, and G is H.
585	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Me, and G is C(O)Me.
586	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Me, and G is CO_2Me.
587	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Br, and G is H.

588	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Br, and G is C(O)Me.
589	W is O, X is -CH=C(F)-, R^1 is Me, R^2 is Br, and G is CO_2Me.
590	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Me, and G is H.
591	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Me, and G is C(O)Me.
592	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Me, and G is CO_2Me.
593	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Br, and G is H.
594	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Br, and G is C(O)Me.
595	W is O, X is -CH=C(Cl)-, R^1 is Me, R^2 is Br, and G is CO_2Me.
596	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Me, and G is H.
597	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Me, and G is C(O)Me.
598	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Me, and G is CO_2Me.
599	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Br, and G is H.
600	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Br, and G is C(O)Me.
601	W is O, X is -CH=C(OMe)-, R^1 is Me, R^2 is Br, and G is CO_2Me.
602	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Me, and G is H.
603	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Me, and G is C(O)Me.
604	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Me, and G is CO_2Me.
605	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Br, and G is H.
606	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Br, and G is C(O)Me.
607	W is O, X is -CH=C(CN)-, R^1 is Me, R^2 is Br, and G is CO_2Me.
608	W is S, X is S, R^1 is Me, R^2 is Me, and G is H.
609	W is S, X is S, R^1 is Me, R^2 is Me, and G is C(O)Me.
610	W is S, X is S, R^1 is Me, R^2 is Me, and G is CO_2Me.
611	W is S, X is S, R^1 is Me, R^2 is Br, and G is H.
612	W is S, X is S, R^1 is Me, R^2 is Br, and G is C(O)Me.
613	W is S, X is S, R^1 is Me, R^2 is Br, and G is CO_2Me.
614	W is S, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is H.
615	W is S, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is C(O)Me.
616	W is S, X is -CH=CH-, R^1 is Me, R^2 is Me, and G is CO_2Me.
617	W is S, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is H.
618	W is S, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is C(O)Me.
619	W is S, X is -CH=CH-, R^1 is Me, R^2 is Br, and G is CO_2Me.
620	W is O, X is -CH=CH-, R^1 is CH_3, R^2 is Me, and G is H.

621	W is S, X is -CH=CH-, R^1 is CH_3, R^2 is Me, and G is H.
622	W is O, X is -CH=CH-, R^1 is CH_2CH_3, R^2 is Me, and G is H.
623	W is S, X is -CH=CH-, R^1 is CH_2CH_3, R^2 is Me, and G is H.
624	W is O, X is -CH=CH-, R^1 is CH_3, R^2 is Et, and G is H.
625	W is S, X is -CH=CH-, R^1 is CH_3, R^2 is Et, and G is H.
626	W is O, X is -CH=CH-, R^1 is CH_2CH_3, R^2 is Et, and G is H.
627	W is S, X is -CH=CH-, R^1 is CH_2CH_3, R^2 is Et, and G is H.

Formulation/Utility

A compound of this invention will generally be used as a herbicidal active ingredient in a composition, i.e. formulation, with at least one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents, which serves as a carrier. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature.

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

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

Sprayable formulations are typically extended in a suitable medium before spraying. Such liquid and solid formulations are formulated to be readily diluted in the spray medium, usually water, but occasionally another suitable medium like an aromatic or paraffinic hydrocarbon or vegetable oil. Spray volumes can range from about from about one to several thousand liters per hectare, but more typically are in the range from about ten to several hundred liters per hectare. Sprayable formulations can be tank mixed with water or another suitable medium for foliar treatment by aerial or ground application, or for application to the growing medium of the plant. Liquid and dry formulations can be metered directly into drip irrigation systems or metered into the furrow during planting.

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

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

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

Liquid diluents include, for example, water, *N*,*N*-dimethylalkanamides (e.g., *N*,*N*-dimethylformamide), limonene, dimethyl sulfoxide, *N*-alkylpyrrolidones (e.g., *N*-methylpyrrolidinone), alkyl phosphates (e.g., triethyl phosphate), ethylene glycol, triethylene glycol, propylene glycol, dipropylene glycol, polypropylene glycol, propylene carbonate, butylene carbonate, paraffins (e.g., white mineral oils, normal paraffins, isoparaffins), alkylbenzenes, alkylnaphthalenes, glycerine, glycerol triacetate, sorbitol, aromatic hydrocarbons, dearomatized aliphatics, alkylbenzenes, alkylnaphthalenes, ketones such as cyclohexanone, 2-heptanone, isophorone and 4-hydroxy-4-methyl-2-pentanone, acetates such as isoamyl acetate, hexyl acetate, heptyl acetate, octyl acetate, nonyl acetate, tridecyl acetate and isobornyl acetate, other esters such as alkylated lactate esters, dibasic esters, alkyl and aryl benzoates and γ-butyrolactone, and alcohols, which can be linear, branched, saturated or unsaturated, such as methanol, ethanol, *n*-propanol, isopropyl alcohol, *n*-butanol, isobutyl alcohol, *n*-hexanol, 2-ethylhexanol, *n*-octanol, decanol, isodecyl alcohol, isooctadecanol, cetyl alcohol, lauryl alcohol, tridecyl alcohol, oleyl alcohol, cyclohexanol, tetrahydrofurfuryl alcohol, diacetone alcohol, cresol and benzyl alcohol. Liquid diluents also include glycerol esters of saturated and unsaturated fatty acids (typically C_6–C_{22}), such as plant seed and fruit oils (e.g., oils of olive, castor, linseed, sesame, corn (maize), peanut, sunflower, grapeseed, safflower, cottonseed, soybean, rapeseed, coconut and palm kernel), animal-sourced fats (e.g., beef tallow, pork tallow, lard, cod liver oil, fish oil), and mixtures thereof. Liquid diluents also include alkylated fatty acids (e.g., methylated, ethylated, butylated) wherein the fatty acids may be obtained by hydrolysis of glycerol esters from plant and animal sources, and can be purified by distillation. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950.

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

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

Useful anionic surfactants include, but are not limited to: alkylaryl sulfonic acids and their salts; carboxylated alcohol or alkylphenol ethoxylates; diphenyl sulfonate derivatives; lignin and lignin derivatives such as lignosulfonates; maleic or succinic acids or their anhydrides; olefin sulfonates; phosphate esters such as phosphate esters of alcohol alkoxylates, phosphate esters of alkylphenol alkoxylates and phosphate esters of styryl phenol ethoxylates; protein-based surfactants; sarcosine derivatives; styryl phenol ether sulfate; sulfates and sulfonates of oils and fatty acids; sulfates and sulfonates of ethoxylated alkylphenols; sulfates of alcohols; sulfates of ethoxylated alcohols; sulfonates of amines and amides such as *N*,*N*-alkyltaurates; sulfonates of benzene, cumene, toluene, xylene, and dodecyl and tridecylbenzenes; sulfonates of condensed naphthalenes; sulfonates of naphthalene and alkyl naphthalene; sulfonates of fractionated petroleum; sulfosuccinamates; and sulfosuccinates and their derivatives such as dialkyl sulfosuccinate salts.

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

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

Compositions of this invention may also contain formulation auxiliaries and additives, known to those skilled in the art as formulation aids (some of which may be considered to also function as solid diluents, liquid diluents or surfactants). Such formulation auxiliaries and additives may control: pH (buffers), foaming during processing (antifoams such polyorganosiloxanes), sedimentation of active ingredients (suspending agents), viscosity (thixotropic thickeners), in-container microbial growth (antimicrobials), product freezing (antifreezes), color (dyes/pigment dispersions), wash-off (film formers or stickers), evaporation (evaporation retardants), and other formulation attributes. Film formers include, for example, polyvinyl acetates, polyvinyl acetate copolymers, polyvinylpyrrolidone-vinyl acetate copolymer, polyvinyl alcohols, polyvinyl alcohol copolymers and waxes. Examples of formulation auxiliaries and additives include those listed in *McCutcheon's Volume 2: Functional Materials*, annual International and North American editions published by McCutcheon's Division, The Manufacturing Confectioner Publishing Co.; and PCT Publication WO 03/024222.

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

For further information regarding the art of formulation, see T. S. Woods, "The Formulator's Toolbox – Product Forms for Modern Agriculture" in *Pesticide Chemistry and Bioscience, The Food–Environment Challenge*, T. Brooks and T. R. Roberts, Eds., Proceedings of the 9th International Congress on Pesticide Chemistry, The Royal Society of Chemistry, Cambridge, 1999, pp. 120–133. See also U.S. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10–41; U.S. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138–140, 162–164, 166, 167 and 169–182; U.S. 2,891,855, Col. 3, line 66 through Col. 5, line 17 and Examples 1–4; Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81–96; Hance et al., *Weed Control Handbook*, 8th Ed., Blackwell Scientific Publications, Oxford, 1989; and *Developments in formulation technology*, PJB Publications, Richmond, UK, 2000.

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways. Compound numbers refer to compounds in Index Table A. Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following non-limiting Examples are illustrative of the invention. Percentages are by weight except where otherwise indicated.

Example A

High Strength Concentrate

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

Example B

Wettable Powder

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

Example C

Granule

Compound 1	10.0%
attapulgite granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25–50 sieves)	90.0%

Example D

Extruded Pellet

Compound 1	25.0%
anhydrous sodium sulfate	10.0%
crude calcium ligninsulfonate	5.0%
sodium alkylnaphthalenesulfonate	1.0%
calcium/magnesium bentonite	59.0%

Example E

Emulsifiable Concentrate

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

Example F

Microemulsion

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

Example G

Suspension Concentrate

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

Example H

Emulsion in Water

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

<u>Example I</u>

<u>Oil Dispersion</u>

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

The present disclosure also includes Examples A through I above except the "Compound 1" is replaced with "Compound 2", "Compound 3", "Compound 4", "Compound 5", "Compound 6", "Compound 7", "Compound 8", "Compound 9", "Compound 10", "Compound 11", "Compound 12", "Compound 13", "Compound 14", "Compound 15", "Compound 16", "Compound 17", "Compound 18", "Compound 19", "Compound 20", "Compound 21", "Compound 22", "Compound 23", "Compound 24", "Compound 25", "Compound 26", "Compound 27", "Compound 28", "Compound 29", "Compound 30", "Compound 31", "Compound 32", "Compound 33", "Compound 34", "Compound 35", "Compound 36", "Compound 37", "Compound 38", "Compound 39", "Compound 40", "Compound 41", "Compound 42", "Compound 43", "Compound 44", "Compound 45", "Compound 46", "Compound 47", "Compound 48", "Compound 49", "Compound 50", "Compound 51", "Compound 52", "Compound 53", "Compound 54", "Compound 55", "Compound 56", "Compound 57", "Compound 58", "Compound 59", "Compound 60", "Compound 61", "Compound 62", "Compound 63", "Compound 64", "Compound 65", "Compound 66", "Compound 67", "Compound 68", "Compound 69", "Compound 70", "Compound 71", "Compound 72", "Compound 73", "Compound 74", "Compound 75", "Compound 76", "Compound 77", "Compound 78", "Compound 79", "Compound 80", "Compound 81", "Compound 82", "Compound 83", "Compound 84", "Compound 85", "Compound 86", "Compound 87", "Compound 88", "Compound 89", "Compound 90", "Compound 91", "Compound 92", "Compound 93", "Compound 94", "Compound 95", "Compound 96", "Compound 97", "Compound 98", "Compound 99", "Compound 100", "Compound 101", "Compound 102", "Compound 103", "Compound 104", "Compound 105", "Compound 106", "Compound 107", "Compound 108", "Compound 109", "Compound 110", "Compound 111", "Compound 112", "Compound 113", "Compound 114", "Compound 115", "Compound 116", "Compound 117", "Compound 118", "Compound 119", "Compound 120", "Compound 121", "Compound 122", "Compound 123", "Compound 124", "Compound 125", "Compound 126", "Compound 127", "Compound 128", "Compound 129", "Compound 130", "Compound 131", "Compound 132", "Compound 133", "Compound 134", "Compound 135", "Compound 136", "Compound 137", "Compound 138", "Compound 139", "Compound

140”, “Compound 141”, “Compound 142”, “Compound 143”, “Compound 144”, “Compound 145”, “Compound 146”, “Compound 147”, “Compound 148”, “Compound 149”, “Compound 150”, “Compound 151”, “Compound 152”, “Compound 153”, “Compound 154”, “Compound 155”, “Compound 156”, “Compound 157”, “Compound 158”, “Compound 159”, “Compound 160”, “Compound 161”, “Compound 162”, “Compound 163”, “Compound 164”, “Compound 165”, “Compound 166”, “Compound 167”, “Compound 168”, “Compound 169”, “Compound 170”, “Compound 171”, “Compound 172”, “Compound 173”, “Compound 174”, “Compound 175”, “Compound 176”, “Compound 177”, “Compound 178”, “Compound 179”, “Compound 180”, “Compound 181”, “Compound 182”, “Compound 183”, “Compound 184”, “Compound 185”, “Compound 186”, “Compound 187” or “Compound 188”.

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

Those skilled in the art will appreciate that not all compounds are equally effective against all weeds. Alternatively, the subject compounds are useful to modify plant growth.

As the compounds of the invention have both preemergent and postemergent herbicidal activity, to control undesired vegetation by killing or injuring the vegetation or reducing its growth, the compounds can be usefully applied by a variety of methods involving contacting a herbicidally effective amount of a compound of the invention, or a composition comprising said compound and at least one of a surfactant, a solid diluent or a liquid diluent, to the foliage or other part of the undesired vegetation or to the environment of the undesired vegetation such as the soil or water in which the undesired vegetation is growing or which surrounds the seed or other propagule of the undesired vegetation.

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

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

Plant varieties and cultivars of the desired vegetation in the locus treated with a compound of the invention can be obtained by conventional propagation and breeding methods or by genetic engineering methods. Genetically modified plants (transgenic plants) are those in which a heterologous gene (transgene) has been stably integrated into the plant's genome. A transgene that is defined by its particular location in the plant genome is called a transformation or transgenic event.

Genetically modified plant cultivars in the locus which can be treated according to the invention include those that are resistant against one or more biotic stresses (pests such as nematodes, insects, mites, fungi, etc.) or abiotic stresses (drought, cold temperature, soil salinity, etc.), or that contain other desirable characteristics. Plants can be genetically modified to exhibit traits of, for example, herbicide tolerance, insect-resistance, modified oil profiles or drought tolerance. Useful genetically modified plants containing single gene transformation events or combinations of transformation events are listed in Exhibit C. Additional information for the genetic modifications listed in Exhibit C can be obtained from publicly available databases maintained, for example, by the U.S. Department of Agriculture.

The following abbreviations, T1 through T37, are used in Exhibit C for traits. “tol.” means “tolerance”. A hyphen “-” means the entry is not available.

Trait	Description	Trait	Description	Trait	Description
T1	Glyphosate tolerance	T15	Cold tolerance	T27	High tryptophan
T2	High lauric acid oil	T16	Imidazolinone herbicide tol.	T28	Erect leaves semidwarf
T3	Glufosinate tolerance	T17	Modified alpha-amylase	T29	Semidwarf
T4	Phytate breakdown	T18	Pollination control	T30	Low iron tolerance
T5	Oxynil tolerance	T19	2,4-D tolerance	T31	Modified oil/fatty acid
T6	Disease resistance	T20	Increased lysine	T32	HPPD tolerance
T7	Insect resistance	T21	Drought tolerance	T33	High oil
T9	Modified flower color	T22	Delayed ripening/senescence	T34	Aryloxyalkanoate tol.
T11	ALS herbicide tol.	T23	Modified product quality	T35	Mesotrione tolerance
T12	Dicamba tolerance	T24	High cellulose	T36	Reduced nicotine
T13	Anti-allergy	T25	Modified starch/carbohydrate	T37	Modified product
T14	Salt tolerance	T26	Insect & disease resistance		

<u>Exhibit C</u>

Crop	Event Name	Event Code	Trait(s)	Gene(s)
Alfalfa	J101	MON-00101-8	T1	cp4 epsps (aroA:CP4)
Alfalfa	J163	MON-ØØ163-7	T1	cp4 epsps (aroA:CP4)
Canola*	23-18-17 (Event 18)	CGN-89465-2	T2	te
Canola*	23-198 (Event 23)	CGN-89465-2	T2	te
Canola*	61061	DP-Ø61Ø61-7	T1	gat4621
Canola*	73496	DP-Ø73496-4	T1	gat4621
Canola*	GT200 (RT200)	MON-89249-2	T1	cp4 epsps (aroA:CP4); goxv247
Canola*	GT73 (RT73)	MON-ØØØ73-7	T1	cp4 epsps (aroA:CP4); goxv247
Canola*	HCN10 (Topas 19/2)	-	T3	bar
Canola*	HCN28 (T45)	ACS-BNØØ8-2	T3	pat (syn)
Canola*	HCN92 (Topas 19/2)	ACS-BNØØ7-1	T3	bar
Canola*	MON88302	MON-883Ø2-9	T1	cp4 epsps (aroA:CP4)
Canola*	MPS961	-	T4	phyA
Canola*	MPS962	-	T4	phyA
Canola*	MPS963	-	T4	phyA
Canola*	MPS964	-	T4	phyA
Canola*	MPS965	-	T4	phyA

Canola*	MS1 (B91-4)	ACS-BNØØ4-7	T3	bar
Canola*	MS8	ACS-BNØØ5-8	T3	bar
Canola*	OXY-235	ACS-BNØ11-5	T5	bxn
Canola*	PHY14	-	T3	bar
Canola*	PHY23	-	T3	bar
Canola*	PHY35	-	T3	bar
Canola*	PHY36	-	T3	bar
Canola*	RF1 (B93-101)	ACS-BNØØ1-4	T3	bar
Canola*	RF2 (B94-2)	ACS-BNØØ2-5	T3	bar
Canola*	RF3	ACS-BNØØ3-6	T3	bar
Bean	EMBRAPA 5.1	EMB-PV051-1	T6	ac1 (sense and antisense)
Brinjal #	EE-1	-	T7	cry1Ac
Cotton	19-51a	DD-Ø1951A-7	T11	S4-HrA
Cotton	281-24-236	DAS-24236-5	T3,T7	pat (syn); cry1F
Cotton	3006-210-23	DAS-21Ø23-5	T3,T7	pat (syn); cry1Ac
Cotton	31707	-	T5,T7	bxn; cry1Ac
Cotton	31803	-	T5,T7	bxn; cry1Ac
Cotton	31807	-	T5,T7	bxn; cry1Ac
Cotton	31808	-	T5,T7	bxn; cry1Ac
Cotton	42317	-	T5,T7	bxn; cry1Ac
Cotton	BNLA-601	-	T7	cry1Ac
Cotton	BXN10211	BXN10211-9	T5	bxn; cry1Ac
Cotton	BXN10215	BXN10215-4	T5	bxn; cry1Ac
Cotton	BXN10222	BXN10222-2	T5	bxn; cry1Ac
Cotton	BXN10224	BXN10224-4	T5	bxn; cry1Ac
Cotton	COT102	SYN-IR102-7	T7	vip3A(a)
Cotton	COT67B	SYN-IR67B-1	T7	cry1Ab
Cotton	COT202	-	T7	vip3A
Cotton	Event 1	-	T7	cry1Ac
Cotton	GMF Cry1A	GTL-GMF311-7	T7	cry1Ab-Ac
Cotton	GHB119	BCS-GH005-8	T7	cry2Ae
Cotton	GHB614	BCS-GH002-5	T1	2mepsps
Cotton	GK12	-	T7	cry1Ab-Ac
Cotton	LLCotton25	ACS-GH001-3	T3	bar
Cotton	MLS 9124	-	T7	cry1C
Cotton	MON1076	MON-89924-2	T7	cry1Ac

Cotton	MON1445	MON-01445-2	T1	cp4 epsps (aroA:CP4)
Cotton	MON15985	MON-15985-7	T7	cry1Ac; cry2Ab2
Cotton	MON1698	MON-89383-1	T7	cp4 epsps (aroA:CP4)
Cotton	MON531	MON-00531-6	T7	cry1Ac
Cotton	MON757	MON-00757-7	T7	cry1Ac
Cotton	MON88913	MON-88913-8	T1	cp4 epsps (aroA:CP4)
Cotton	Nqwe Chi 6 Bt	-	T7	-
Cotton	SKG321	-	T7	cry1A; CpTI
Cotton	T303-3	BCS-GH003-6	T3,T7	cry1Ab; bar
Cotton	T304-40	BCS-GH004-7	T3,T7	cry1Ab; bar
Cotton	CE43-67B	-	T7	cry1Ab
Cotton	CE46-02A	-	T7	cry1Ab
Cotton	CE44-69D	-	T7	cry1Ab
Cotton	1143-14A	-	T7	cry1Ab
Cotton	1143-51B	-	T7	cry1Ab
Cotton	T342-142	-	T7	cry1Ab
Cotton	PV-GHGT07 (1445)	-	T1	cp4 epsps (aroA:CP4)
Cotton	EE-GH3	-	T1	mepsps
Cotton	EE-GH5	-	T7	cry1Ab
Cotton	MON88701	MON-88701-3	T3,T12	Modified dmo; bar
Cotton	OsCr11	-	T13	Modified Cry j
Flax	FP967	CDC-FL001-2	T11	als
Lentil	RH44	-	T16	als
Maize	3272	SYN-E3272-5	T17	amy797E
Maize	5307	SYN-05307-1	T7	ecry3.1Ab
Maize	59122	DAS-59122-7	T3,T7	cry34Ab1; cry35Ab1; pat
Maize	676	PH-000676-7	T3,T18	pat; dam
Maize	678	PH-000678-9	T3,T18	pat; dam
Maize	680	PH-000680-2	T3,T18	pat; dam
Maize	98140	DP-098140-6	T1,T11	gat4621; zm-hra
Maize	Bt10	-	T3,T7	cry1Ab; pat
Maize	Bt176 (176)	SYN-EV176-9	T3,T7	cry1Ab; bar
Maize	BVLA430101	-	T4	phyA2
Maize	CBH-351	ACS-ZM004-3	T3,T7	cry9C; bar
Maize	DAS40278-9	DAS40278-9	T19	aad-1
Maize	DBT418	DKB-89614-9	T3,T7	cry1Ac; pinII; bar
Maize	DLL25 (B16)	DKB-89790-5	T3	bar
Maize	GA21	MON-00021-9	T1	mepsps
Maize	GG25	-	T1	mepsps

Maize	GJ11	-	T1	mepsps
Maize	Fl117	-	T1	mepsps
Maize	GAT-ZM1	-	T3	pat
Maize	LY038	REN-00038-3	T20	cordapA
Maize	MIR162	SYN-IR162-4	T7	vip3Aa20
Maize	MIR604	SYN-IR604-5	T7	mcry3A
Maize	MON801 (MON80100)	MON801	T1,T7	cry1Ab; cp4 epsps (aroA:CP4); goxv247
Maize	MON802	MON-80200-7	T1,T7	cry1Ab; cp4 epsps (aroA:CP4); goxv247
Maize	MON809	PH-MON-809-2	T1,T7	cry1Ab; cp4 epsps (aroA:CP4); goxv247
Maize	MON810	MON-00810-6	T1,T7	cry1Ab; cp4 epsps (aroA:CP4); goxv247
Maize	MON832	-	T1	cp4 epsps (aroA:CP4); goxv247
Maize	MON863	MON-00863-5	T7	cry3Bb1
Maize	MON87427	MON-87427-7	T1	cp4 epsps (aroA:CP4)
Maize	MON87460	MON-87460-4	T21	cspB
Maize	MON88017	MON-88017-3	T1,T7	cry3Bb1; cp4 epsps (aroA:CP4)
Maize	MON89034	MON-89034-3	T7	cry2Ab2; cry1A.105
Maize	MS3	ACS-ZM001-9	T3,T18	bar; barnase
Maize	MS6	ACS-ZM005-4	T3,T18	bar; barnase
Maize	NK603	MON-00603-6	T1	cp4 epsps (aroA:CP4)
Maize	T14	ACS-ZM002-1	T3	pat (syn)
Maize	T25	ACS-ZM003-2	T3	pat (syn)
Maize	TC1507	DAS-01507-1	T3,T7	cry1Fa2; pat
Maize	TC6275	DAS-06275-8	T3,T7	mocry1F; bar
Maize	VIP1034	-	T3,T7	vip3A; pat
Maize	43A47	DP-043A47-3	T3,T7	cry1F; cry34Ab1; cry35Ab1; pat
Maize	40416	DP-040416-8	T3,T7	cry1F; cry34Ab1; cry35Ab1; pat
Maize	32316	DP-032316-8	T3,T7	cry1F; cry34Ab1; cry35Ab1; pat
Maize	4114	DP-004114-3	T3,T7	cry1F; cry34Ab1; cry35Ab1; pat
Melon	Melon A	-	T22	sam-k
Melon	Melon B	-	T22	sam-k
Papaya	55-1	CUH-CP551-8	T6	prsv cp
Papaya	63-1	CUH-CP631-7	T6	prsv cp
Papaya	Huanong No. 1	-	T6	prsv rep
Papaya	X17-2	UFL-X17CP-6	T6	prsv cp
Plum	C-5	ARS-PLMC5-6	T6	ppv cp
Canola**	ZSR500	-	T1	cp4 epsps (aroA:CP4); goxv247
Canola**	ZSR502	-	T1	cp4 epsps (aroA:CP4); goxv247

Canola**	ZSR503	-	T1	cp4 epsps (aroA:CP4); goxv247
Rice	7Crp#242-95-7	-	T13	7crp
Rice	7Crp#10	-	T13	7crp
Rice	GM Shanyou 63	-	T7	cry1Ab; cry1Ac
Rice	Huahui-1/TT51-1	-	T7	cry1Ab; cry1Ac
Rice	LLRICE06	ACS-OS001-4	T3	bar
Rice	LLRICE601	BCS-OS003-7	T3	bar
Rice	LLRICE62	ACS-OS002-5	T3	bar
Rice	Tarom molaii + cry1Ab	-	T7	cry1Ab (truncated)
Rice	GAT-OS2	-	T3	bar
Rice	GAT-OS3	-	T3	bar
Rice	PE-7	-	T7	Cry1Ac
Rice	7Crp#10	-	T13	7crp
Rice	KPD627-8	-	T27	OASA1D
Rice	KPD722-4	-	T27	OASA1D
Rice	KA317	-	T27	OASA1D
Rice	HW5	-	T27	OASA1D
Rice	HW1	-	T27	OASA1D
Rice	B-4-1-18	-	T28	Δ OsBRI1
Rice	G-3-3-22	-	T29	OSGA2ox1
Rice	AD77	-	T6	DEF
Rice	AD51	-	T6	DEF
Rice	AD48	-	T6	DEF
Rice	AD41	-	T6	DEF
Rice	13pNasNa800725atAprt1	-	T30	HvNAS1; HvNAAT-A; APRT
Rice	13pAprt1	-	T30	APRT
Rice	gHvNAS1-gHvNAAT-1	-	T30	HvNAS1; HvNAAT-A; HvNAAT-B
Rice	gHvIDS3-1	-	T30	HvIDS3
Rice	gHvNAAT1	-	T30	HvNAAT-A; HvNAAT-B
Rice	gHvNAS1-1	-	T30	HvNAS1
Rice	NIA-OS006-4	-	T6	WRKY45
Rice	NIA-OS005-3	-	T6	WRKY45
Rice	NIA-OS004-2	-	T6	WRKY45
Rice	NIA-OS003-1	-	T6	WRKY45
Rice	NIA-OS002-9	-	T6	WRKY45
Rice	NIA-OS001-8	-	T6	WRKY45
Rice	OsCr11	-	T13	Modified Cry j
Rice	17053	-	T1	cp4 epsps (aroA:CP4)
Rice	17314	-	T1	cp4 epsps (aroA:CP4)

Rose	WKS82 / 130-4-1	IFD-52401-4	T9	5AT; bp40 (f3'5'h)
Rose	WKS92 / 130-9-1	IFD-52901-9	T9	5AT; bp40 (f3'5'h)
Soybean	260-05 (G94-1, G94-19, G168)	-	T9	gm-fad2-1 (silencing locus)
Soybean	A2704-12	ACS-GM005-3	T3	pat
Soybean	A2704-21	ACS-GM004-2	T3	pat
Soybean	A5547-127	ACS-GM006-4	T3	pat
Soybean	A5547-35	ACS-GM008-6	T3	pat
Soybean	CV127	BPS-CV127-9	T16	csr1-2
Soybean	DAS68416-4	DAS68416-4	T3	pat
Soybean	DP305423	DP-305423-1	T11,T31	gm-fad2-1 (silencing locus); gm-hra
Soybean	DP356043	DP-356043-5	T1,T31	gm-fad2-1 (silencing locus); gat4601
Soybean	FG72	MST-FG072-3	T32,T1	2mepsps; hppdPF W336
Soybean	GTS 40-3-2 (40-3-2)	MON-04032-6	T1	cp4 epsps (aroA:CP4)
Soybean	GU262	ACS-GM003-1	T3	pat
Soybean	MON87701	MON-87701-2	T7	cry1Ac
Soybean	MON87705	MON-87705-6	T1,T31	fatb1-A (sense & antisense); fad2-1A (sense & antisense); cp4 epsps (aroA:CP4)
Soybean	MON87708	MON-87708-9	T1,T12	dmo; cp4 epsps (aroA:CP4)
Soybean	MON87769	MON-87769-7	T1,T31	Pj.D6D; Nc.Fad3; cp4 epsps (aroA:CP4)
Soybean	MON89788	MON-89788-1	T1	cp4 epsps (aroA:CP4)
Soybean	W62	ACS-GM002-9	T3	bar
Soybean	W98	ACS-GM001-8	T3	bar
Soybean	MON87754	MON-87754-1	T33	dgat2A
Soybean	DAS21606	DAS-21606	T34,T3	Modified aad-12; pat
Soybean	DAS44406	DAS-44406-6	T1,T3,T34	Modified aad-12; 2mepsps; pat
Soybean	SYHT04R	SYN-0004R-8	T35	Modified avhppd
Soybean	9582.814.19.1	-	T3,T7	cry1Ac, cry1F, PAT
Squash	CZW3	SEM-ØCZW3-2	T6	cmv cp, zymv cp, wmv cp
Squash	ZW20	SEM-0ZW20-7	T6	zymv cp, wmv cp
Sugar Beet	GTSB77 (T9100152)	SY-GTSB77-8	T1	cp4 epsps (aroA:CP4); goxv247
Sugar Beet	H7-1	KM-000H71-4	T1	cp4 epsps (aroA:CP4)
Sugar Beet	T120-7	ACS-BV001-3	T3	pat
Sugar Beet	T227-1	-	T1	cp4 epsps (aroA:CP4)
Sugarcane	NXI-1T	-	T21	EcbetA

Sunflower	X81359	-	T16	als
Pepper	PK-SP01	-	T6	cmv cp
Tobacco	C/F/93/08-02	-	T5	bxn
Tobacco	Vector 21-41	-	T36	NtQPT1 (antisense)
Sunflower	X81359	-	T16	als
Wheat	MON71800	MON-718ØØ-3	T1	cp4 epsps (aroA:CP4)

* Argentine (*Brassica napus*), ** Polish (*B. rapa*), # Eggplant

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

Compounds of this invention can also be mixed with one or more other biologically active compounds or agents including herbicides, herbicide safeners, fungicides, insecticides, nematocides, bactericides, acaricides, growth regulators such as insect molting inhibitors and rooting stimulants, chemosterilants, semiochemicals, repellents, attractants, pheromones, feeding stimulants, plant nutrients, other biologically active compounds or entomopathogenic bacteria, virus or fungi to form a multi-component pesticide giving an even broader spectrum of agricultural protection. Mixtures of the compounds of the invention with other herbicides can broaden the spectrum of activity against additional weed species, and suppress the proliferation of any resistant biotypes. Thus the present invention also pertains to a composition comprising a compound of Formula **1** (in a herbicidally effective amount) and at least one additional biologically active compound or agent (in a biologically effective amount) and can further comprise at least one of a surfactant, a solid diluent or a liquid diluent. The other biologically active compounds or agents can be formulated in compositions comprising at least one of a surfactant, solid or liquid diluent. For mixtures of the present invention, one or more other biologically active compounds or agents can be formulated together with a compound of Formula **1**, to form a premix, or one or more other biologically active compounds or agents can be formulated separately from the compound of Formula **1**, and the formulations combined together before application (e.g., in a spray tank) or, alternatively, applied in succession.

A mixture of one or more of the following herbicides with a compound of this invention may be particularly useful for weed control: acetochlor, acifluorfen and its sodium salt, aclonifen, acrolein (2-propenal), alachlor, alloxydim, ametryn, amicarbazone, amidosulfuron, aminocyclopyrachlor and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), aminopyralid, amitrole, ammonium sulfamate, anilofos, asulam, atrazine, azimsulfuron, beflubutamid, benazolin, benazolin-ethyl, bencarbazone, benfluralin, benfuresate, bensulfuron-methyl, bensulide, bentazone, benzobicyclon, benzofenap, bicyclopyrone, bifenox, bilanafos, bispyribac and its sodium salt, bromacil, bromobutide, bromofenoxim, bromoxynil, bromoxynil octanoate, butachlor, butafenacil, butamifos, butralin, butroxydim, butylate, cafenstrole, carbetamide, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, chlorotoluron, chlorpropham, chlorsulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, clacyfos, clefoxydim, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclopyrimorate, cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, 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, fenoxasulfone, fenquinotrione, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, flufenacet, flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium, glufosinate-P, glyphosate and its salts such as ammonium, isopropylammonium, potassium, sodium (including sesquisodium) and trimesium (alternatively named sulfosate), halauxifen, halauxifen-methyl, halosulfuron-methyl, haloxyfop-etotyl, haloxyfop-methyl, hexazinone, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, indaziflam, iofensulfuron, iodosulfuron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium, ipfencarbazone, isoproturon, isouron, isoxaben, isoxaflutole, isoxachlortole, lactofen, lenacil, linuron, maleic hydrazide, MCPA and its salts (e.g., MCPA-dimethylammonium, MCPA-potassium and MCPA-sodium, esters (e.g., MCPA-2-ethylhexyl, MCPA-butotyl) and thioesters (e.g., MCPA-thioethyl), MCPB and its salts (e.g., MCPB-sodium) and esters (e.g., MCPB-ethyl), mecoprop, mecoprop-P, mefenacet, mefluidide, mesosulfuron-methyl, mesotrione, metam-sodium, metamifop, metamitron, metazachlor, metazosulfuron, methabenzthiazuron, methylarsonic acid and its calcium, monoammonium, monosodium and disodium salts, methyldymron, metobenzuron, metobromuron, metolachlor, S-metolachlor, metosulam, metoxuron, metribuzin, metsulfuron-methyl, molinate, monolinuron, naproanilide, napropamide, napropamide-M, naptalam, neburon, nicosulfuron, norflurazon, orbencarb, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxasulfuron, oxaziclomefone, oxyfluorfen, paraquat dichloride, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentanochlor, pentoxazone, perfluidone, pethoxamid, pethoxyamid, phenmedipham, picloram, picloram-potassium, picolinafen, pinoxaden, piperophos, pretilachlor, primisulfuron-methyl, prodiamine, profoxydim, prometon, prometryn, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyrisulfuron, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyrithiobac, pyrithiobac-sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinoclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimsulfuron, saflufenacil, sethoxydim, siduron, simazine, simetryn, sulcotrione, sulfentrazone, sulfometuron-methyl, sulfosulfuron, 2,3,6-TBA, TCA, TCA-sodium, tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxydim, terbacil, terbumeton, terbuthylazine, terbutryn, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron-methyl, thiobencarb, tiafenacil, tiocarbazil, topramezone, tralkoxydim, tri-allate, triafamone, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron-methyl, tritosulfuron, vernolate, 3-(2-chloro-3,6-difluorophenyl)-4-hydroxy-1-methyl-1,5-naphthyridin-2(1*H*)-one, 5-chloro-3-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-1-(4-methoxyphenyl)-2(1*H*)-quinoxalinone, 2-chloro-*N*-(1-methyl-1*H*-tetrazol-5-yl)-6-(trifluoromethyl)-3-pyridinecarboxamide, 7-(3,5-dichloro-4-pyridinyl)-5-(2,2-difluoroethyl)-8-hydroxypyrido[2,3-*b*]pyrazin-6(5*H*)-one), 4-(2,6-diethyl-4-methylphenyl)-5-hydroxy-2,6-dimethyl-3(2*H*)-pyridazinone), 5-[[(2,6-difluorophenyl)methoxy]methyl]-4,5-dihydro-5-methyl-3-(3-methyl-2-thienyl)isoxazole (previously methioxolin), 3-[7-fluoro-3,4-dihydro-3-oxo-4-(2-propyn-1-yl)-2*H*-1,4-benzoxazin-6-yl]dihydro-1,5-dimethyl-6-thioxo-1,3,5-triazine-2,4(1*H*,3*H*)-dione, 4-(4-fluorophenyl)-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-1,2,4-triazine-3,5(2*H*,4*H*)-dione, methyl 4-amino-3-chloro-6-(4-

chloro-2-fluoro-3-methoxyphenyl)-5-fluoro-2-pyridinecarboxylate, 2-methyl-3-(methylsulfonyl)-*N*-(1-methyl-1*H*-tetrazol-5-yl)-4-(trifluoromethyl)benzamide and 2-methyl-*N*-(4-methyl-1,2,5-oxadiazol-3-yl)-3-(methylsulfinyl)-4-(trifluoromethyl)benzamide. Other herbicides also include bioherbicides such as *Alternaria destruens* Simmons, *Colletotrichum gloeosporiodes* (Penz.) Penz. & Sacc., *Drechsiera monoceras* (MTB-951), *Myrothecium verrucaria* (Albertini & Schweinitz) Ditmar: Fries, *Phytophthora palmivora* (Butl.) Butl. and *Puccinia thlaspeos* Schub.

Compounds of this invention can also be used in combination with plant growth regulators such as aviglycine, *N*-(phenylmethyl)-1*H*-purin-6-amine, epocholeone, gibberellic acid, gibberellin A_4 and A_7, harpin protein, mepiquat chloride, prohexadione calcium, prohydrojasmon, sodium nitrophenolate and trinexapac-methyl, and plant growth modifying organisms such as *Bacillus cereus* strain BP01.

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

For embodiments where one or more of these various mixing partners are used, the mixing partners are typically used in the amounts similar to amounts customary when the mixture partners are used alone. More particularly in mixtures, active ingredients are often applied at an application rate between one-half and the full application rate specified on product labels for use of active ingredient alone. These amounts are listed in references such as *The Pesticide Manual* and *The BioPesticide Manual*. The weight ratio of these various mixing partners (in total) to the compound of Formula **1** is generally between about 1:3000 and about 3000:1. Of note are weight ratios between about 1:300 and about 300:1 (for example ratios between about 1:30 and about 30:1). One skilled in the art can easily determine through simple experimentation the biologically effective amounts of active ingredients necessary for the desired spectrum of biological activity. It will be evident that including these additional components may expand the spectrum of weeds controlled beyond the spectrum controlled by the compound of Formula **1** alone.

In certain instances, combinations of a compound of this invention with other biologically active (particularly herbicidal) compounds or agents (i.e. active ingredients) can result in a greater-than-additive (i.e. 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 the invention with at least one other herbicidal active ingredient. Of particular note is such a combination where the other herbicidal active ingredient has different site of action from the compound of the invention. In certain instances, a combination with at least one other herbicidal active ingredient having a similar spectrum of control but a different site of action will be particularly advantageous for resistance management. Thus, a composition of the present invention can further comprise (in a herbicidally effective amount) at least one additional herbicidal active ingredient having a similar spectrum of control but a different site of action.

Compounds of this invention can also be used in combination with herbicide safeners such as allidochlor, benoxacor, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfonamide, daimuron, dichlormid, dicyclonon, dietholate, dimepiperate, fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone naphthalic anhydride (1,8-naphthalic anhydride), oxabetrinil, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide, *N*-(aminocarbonyl)-2-fluorobenzenesulfonamide, 1-bromo-4-[(chloromethyl)sulfonyl]benzene (BCS), 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), ethyl 1,6-dihydro-1-(2-methoxyphenyl)-6-oxo-2-phenyl-5-pyrimidinecarboxylate, 2-hydroxy-*N*,*N*-dimethyl-6-(trifluoromethyl)pyridine-3-carboxamide, and 3-oxo-1-cyclohexen-l-yl 1-(3,4-dimethylphenyl)-l,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylate 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.

Of note is a composition comprising a compound of the invention (in a herbicidally effective amount), at least one additional active ingredient selected from the group consisting of other herbicides and herbicide safeners (in an effective amount), and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.

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

TABLE A1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	2,4-D	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Acetochlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Acifluorfen	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Aclonifen	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Alachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Ametryn	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Amicarbazone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Amidosulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Aminocyclopyrachlor	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Aminopyralid	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Amitrole	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Anilofos	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Asulam	1:1920 – 2:1	1:640 – 1:3	1:60 – 1:7
1	Atrazine	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Azimsulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Beflubutamid	1:685 – 4:1	1:228 – 2:1	1:21 – 1:3
1	Benfuresate	1:1234 – 2:1	1:411 – 1:2	1:38 – 1:5
1	Bensulfuron-methyl	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Bentazone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Benzobicyclon	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Benzofenap	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Bicyclopyrone	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Bifenox	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Bispyribac-sodium	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Bromacil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Bromobutide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Bromoxynil	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Butachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Butafenacil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Butylate	1:3085 – 1:2	1:1028 – 1:5	1:96 – 1:11
1	Carfenstrole	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Carfentrazone-ethyl	1:257 – 9:1	1:85 – 3:1	1:8 – 2:1
1	Chlorimuron-ethyl	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Chlorotoluron	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Chlorsulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Cincosulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Cinidon-ethyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cinmethylin	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Clacyfos	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Clethodim	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Clodinafop-propargyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Clomazone	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Clomeprop	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2
1	Clopyralid	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Cloransulam-methyl	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Cumyluron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cyanazine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Cyclopyrimorate	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Cyclosulfamuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Cycloxydim	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Cyhalofop	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Daimuron	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Desmedipham	1:644 – 4:1	1:214 – 2:1	1:20 – 1:3
1	Dicamba	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Dichlobenil	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Dichlorprop	1:1851 – 2:1	1:617 – 1:3	1:57 – 1:7
1	Diclofop-methyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Diclosulam	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Difenzoquat	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Diflufenican	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Diflufenzopyr	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Dimethachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Dimethametryn	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Dimethenamid-P	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Dithiopyr	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Diuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	EPTC	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Esprocarb	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Ethalfluralin	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Ethametsulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Ethoxyfen	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Ethoxysulfuron	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Etobenzanid	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Fenoxaprop-ethyl	1:240 – 10:1	1:80 – 4:1	1:7 – 2:1
1	Fenoxasulfone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Fenquinotrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Fentrazamide	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Flazasulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Florasulam	1:5 – 420:1	1:1 – 140:1	5:1 – 53:1
1	Fluazifop-butyl	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Flucarbazone	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Flucetosulfuron	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Flufenacet	1:514 – 5:1	1:171 – 2:1	1:16 – 1:2
1	Flumetsulam	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Flumiclorac-pentyl	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Flumioxazin	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Fluometuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Flupyrsulfuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Fluridone	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Fluroxypyr	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Flurtamone	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Fluthiacet-methyl	1:96 – 42:1	1:32 – 14:1	1:1 – 6:1
1	Fomesafen	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Foramsulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Glufosinate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Glyphosate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Halosulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Halauxifen	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Halauxifen methyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Haloxyfop-methyl	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Hexazinone	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Imazamox	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Imazapic	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Imazapyr	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Imazaquin	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Imazethabenz-methyl	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2
1	Imazethapyr	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Imazosulfuron	1:54 – 42:1	1:18 – 14:1	1:1 – 6:1
1	Indanofan	1:685 – 4:1	1:228 – 2:1	1:21 – 1:3
1	Indaziflam	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Iodosulfuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Ioxynil	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Ipfencarbazone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Isoproturon	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Isoxaben	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Isoxaflutole	1:120 – 20:1	1:40 – 7:1	1:3 – 3:1
1	Lactofen	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Lenacil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Linuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	MCPA	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	MCPB	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Mecoprop	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Mefenacet	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Mefluidide	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Mesosulfuron-methyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Mesotrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Metamifop	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Metazachlor	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Metazosulfuron	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Methabenzthiazuron	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Metolachlor	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Metosulam	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Metribuzin	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Metsulfuron-methyl	1:4 – 560:1	1:1 – 187:1	7:1 – 70:1
1	Molinate	1:2057 – 2:1	1:685 – 1:3	1:64 – 1:8
1	Napropamide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Napropamide-M	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Naptalam	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Nicosulfuron	1:24 – 96:1	1:8 – 32:1	1:1 – 12:1
1	Norflurazon	1:2304 – 1:1	1:768 – 1:3	1:72 – 1:8
1	Orbencarb	1:2742 – 1:2	1:914 – 1:4	1:85 – 1:10
1	Orthosulfamuron	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Oryzalin	1:1028 – 3:1	1:342 – 1:2	1:32 – 1:4
1	Oxadiargyl	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Oxadiazon	1:1097 – 3:1	1:365 – 1:2	1:34 – 1:4
1	Oxasulfuron	1:54 – 42:1	1:18 – 14:1	1:1 – 6:1
1	Oxaziclomefone	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Oxyfluorfen	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Paraquat	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Pendimethalin	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Penoxsulam	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Penthoxamid	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Pentoxazone	1:205 – 12:1	1:68 – 4:1	1:6 – 2:1
1	Phenmedipham	1:205 – 12:1	1:68 – 4:1	1:6 – 2:1
1	Picloram	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Picolinafen	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Pinoxaden	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Pretilachlor	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Primisulfuron-methyl	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Prodiamine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Profoxydim	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Prometryn	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Propachlor	1:2304 – 1:1	1:768 – 1:3	1:72 – 1:8
1	Propanil	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Propaquizafop	1:96 – 24:1	1:32 – 8:1	1:3 – 3:1
1	Propoxycarbazone	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Propyrisulfuron	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Propyzamide	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Prosulfocarb	1:2400 – 1:2	1:800 – 1:4	1:75 – 1:9
1	Prosulfuron	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Pyraclonil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Pyraflufen-ethyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Pyrasulfotole	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Pyrazolynate	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Pyrazosulfuron-ethyl	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Pyrazoxyfen	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Pyribenzoxim	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1
1	Pyributicarb	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Pyridate	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Pyriftalid	1:20 – 112:1	1:6 – 38:1	1:1 – 14:1

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Pyriminobac-methyl	1:41 – 56:1	1:13 – 19:1	1:1 – 7:1
1	Pyrimisulfan	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Pyrithiobac	1:48 – 48:1	1:16 – 16:1	1:1 – 6:1
1	Pyroxasulfone	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Pyroxsulam	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Quinclorac	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Quizalofop-ethyl	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Rimsulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1
1	Saflufenacil	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Sethoxydim	1:192 – 12:1	1:64 – 4:1	1:6 – 2:1
1	Simazine	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Sulcotrione	1:240 – 10:1	1:80 – 4:1	1:7 – 2:1
1	Sulfentrazone	1:294 – 8:1	1:98 – 3:1	1:9 – 1:2
1	Sulfometuron-methyl	1:68 – 34:1	1:22 – 12:1	1:2 – 5:1
1	Sulfosulfuron	1:17 – 135:1	1:5 – 45:1	1:1 – 17:1
1	Tebuthiuron	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Tefuryltrione	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Tembotrione	1:63 – 37:1	1:21 – 13:1	1:1 – 5:1
1	Tepraloxydim	1:51 – 45:1	1:17 – 15:1	1:1 – 6:1
1	Terbacil	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Terbuthylazine	1:1714 – 2:1	1:571 – 1:3	1:53 – 1:6
1	Terbutryn	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Thenylchlor	1:171 – 14:1	1:57 – 5:1	1:5 – 2:1
1	Thiazopyr	1:768 – 3:1	1:256 – 1:1	1:24 – 1:3
1	Thiencarbazone	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Thifensulfuron-methyl	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Tiafenacil	1:85 – 27:1	1:28 – 9:1	1:2 – 4:1
1	Thiobencarb	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Topramezone	1:13 – 168:1	1:4 – 56:1	2:1 – 21:1
1	Tralkoxydim	1:137 – 17:1	1:45 – 6:1	1:4 – 3:1
1	Triallate	1:1536 – 2:1	1:512 – 1:2	1:48 – 1:6
1	Triasulfuron	1:10 – 224:1	1:3 – 75:1	3:1 – 28:1
1	Triaziflam	1:342 – 7:1	1:114 – 3:1	1:10 – 1:2

Component (a) (Compound No.)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
1	Tribenuron-methyl	1:6 – 336:1	1:2 – 112:1	4:1 – 42:1
1	Triclopyr	1:384 – 6:1	1:128 – 2:1	1:12 – 1:2
1	Trifloxysulfuron	1:5 – 420:1	1:1 – 140:1	5:1 – 53:1
1	Trifluralin	1:576 – 4:1	1:192 – 2:1	1:18 – 1:2
1	Triflusulfuron-methyl	1:34 – 68:1	1:11 – 23:1	1:1 – 9:1
1	Tritosulfuron	1:27 – 84:1	1:9 – 28:1	1:1 – 11:1

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

Table Number	Component (a) Column Entries	Table Number	Component (a) Column Entries	Table Number	Component (a) Column Entries
A2	Compound 2	A20	Compound 20	A38	Compound 38
A3	Compound 3	A21	Compound 21	A39	Compound 39
A4	Compound 4	A22	Compound 22	A40	Compound 40
A5	Compound 5	A23	Compound 23	A41	Compound 41
A6	Compound 6	A24	Compound 24	A42	Compound 42
A7	Compound 7	A25	Compound 25	A43	Compound 43
A8	Compound 8	A26	Compound 26	A44	Compound 44
A9	Compound 9	A27	Compound 27	A45	Compound 45
A10	Compound 10	A28	Compound 28	A46	Compound 46
A11	Compound 11	A29	Compound 29	A47	Compound 47
A12	Compound 12	A30	Compound 30	A48	Compound 48
A13	Compound 13	A31	Compound 31	A49	Compound 49
A14	Compound 14	A32	Compound 32	A50	Compound 50
A15	Compound 15	A33	Compound 33	A51	Compound 51
A16	Compound 16	A34	Compound 34	A52	Compound 52
A17	Compound 17	A35	Compound 35	A53	Compound 53
A18	Compound 18	A36	Compound 36	A54	Compound 54
A19	Compound 19	A37	Compound 37	A55	Compound 55

Table Number	Component (a) Column Entries
A56	Compound 56
A57	Compound 57
A58	Compound 58
A59	Compound 59
A60	Compound 60
A61	Compound 61
A62	Compound 62
A63	Compound 63
A64	Compound 64
A65	Compound 65
A66	Compound 66
A67	Compound 67
A68	Compound 68
A69	Compound 69
A70	Compound 70
A71	Compound 71
A72	Compound 72
A73	Compound 73
A74	Compound 74
A75	Compound 75
A76	Compound 76
A77	Compound 77
A78	Compound 78
A79	Compound 79
A80	Compound 80
A81	Compound 81
A82	Compound 82
A83	Compound 83
A84	Compound 84
A85	Compound 85
A86	Compound 86
A87	Compound 87
A88	Compound 88

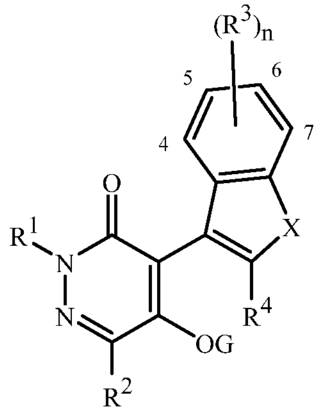
Table Number	Component (a) Column Entries
A89	Compound 89
A90	Compound 90
A91	Compound 91
A92	Compound 92
A93	Compound 93
A94	Compound 94
A95	Compound 95
A96	Compound 96
A97	Compound 97
A98	Compound 98
A99	Compound 99
A100	Compound 100
A101	Compound 101
A102	Compound 102
A103	Compound 103
A104	Compound 104
A105	Compound 105
A106	Compound 106
A107	Compound 107
A108	Compound 108
A109	Compound 109
A110	Compound 110
A111	Compound 111
A112	Compound 112
A113	Compound 113
A114	Compound 114
A115	Compound 115
A116	Compound 116
A117	Compound 117
A118	Compound 118
A119	Compound 119
A120	Compound 120
A121	Compound 121

Table Number	Component (a) Column Entries
A122	Compound 122
A123	Compound 123
A124	Compound 124
A125	Compound 125
A126	Compound 126
A127	Compound 127
A128	Compound 128
A129	Compound 129
A130	Compound 130
A131	Compound 131
A132	Compound 132
A133	Compound 133
A134	Compound 134
A135	Compound 135
A136	Compound 136
A137	Compound 137
A138	Compound 138
A139	Compound 139
A140	Compound 140
A141	Compound 141
A142	Compound 142
A143	Compound 143
A144	Compound 144
A145	Compound 145
A146	Compound 146
A147	Compound 147
A148	Compound 148
A149	Compound 149
A150	Compound 150
A151	Compound 151
A152	Compound 152
A153	Compound 153
A154	Compound 154

Table Number	Component (a) Column Entries
A155	Compound 155
A156	Compound 156
A157	Compound 157
A158	Compound 158
A159	Compound 159
A160	Compound 160
A161	Compound 161
A162	Compound 162
A163	Compound 163
A164	Compound 164
A165	Compound 165
A166	Compound 166
A167	Compound 167
A168	Compound 168
A169	Compound 169
A170	Compound 170
A171	Compound 171
A172	Compound 172
A173	Compound 173
A174	Compound 174
A175	Compound 175
A176	Compound 176
A177	Compound 177
A178	Compound 178
A179	Compound 179
A180	Compound 180
A181	Compound 181
A182	Compound 182
A183	Compound 183
A184	Compound 184
A185	Compound 185
A186	Compound 186
A187	Compound 187
A188	Compound 188

The following Tests demonstrate the control efficacy of the compounds of this invention against specific weeds. The weed control afforded by the compounds is not limited, however, to these species. See Index Table A for compound descriptions. The following abbreviations are used in the Index Table which follows: *t* is tertiary, Me is methyl, morph is morpholinyl, Bn is benzyl and Bu is butyl. The abbreviation "Cmpd. No." stands for "Compound Number". The abbreviation "Ex." stands for "Example" and is followed by a number indicating in which example the compound is prepared. Mass spectra are reported with an estimated precision within ±0.5 Da 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 using atmospheric pressure chemical ionization (AP+).

INDEX TABLE A



Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
1 (Ex. 1)	Me	Me	S	5-Me	Me	H		301.5	**
2	Me	Me	S	5,7-di-Me	Me	H			*
3	Me	Me	S	4,6-di-Me	Me	H	224–227	315.5	*
4	Me	Me	O	–	Me	H	238–240	271.5	*
5	Me	Me	O	5-OMe	Me	H		301.5	*
6	Me	Me	O	5-Cl	Me	H			*
7 (Ex. 2)	Me	Me	O	5-Me	Me	H			**
8	Me	Me	O	4-Me	Me	H			*
9	Me	Me	O	7-Me	Me	H		285.5	*
10	Me	Me	O	5-Me	Et	H		299.5	*
11	Me	Me	-CH=CH-	–	H	H		267	*
12 (Ex. 3)	Me	Me	O	5,7-di-Me	Me	H			**
13	Me	Me	O	5-Et	Me	H			*
14	Me	Me	O	5-Me	Me	-C(=O)Me			*
15	Me	Me	O	7-Me	Me	-C(=O)Me			*
16	Me	Me	O	5,7-di-Me	Me	-C(=O)Me		341.0	*
17	Me	Me	O	5-Me	Me	-C(=O)-*t*-Bu		369.0	*
18	Me	Me	O	5,7-di-Me	Me	-C(=O)-*t*-Bu		383.0	*
19	Me	Me	S	4,6-di-Me	Et	H			*
20	Me	Br	-CH=CH-	–	H	H		332	
21	Me	Me	-CH=C(Me)-	–	Me	H			*
22	Me	Me	S	5-Br	Me	H		367	
23	Me	Br	-CH=CH-	–	Me	H		343	
24	Me	H	-CH=CF-	–	H	H			*
25	Me	Me	S	5-Me	Me	-C(=O)Me			*
26	Me	Me	S	5-Me	Me	-C(=O)-*t*-Bu		385.4	

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
27	Me	Me	S	5,7-di-Me	Me	-C(=O)Me	140–145		
28	Me	Me	S	5,7-di-Me	Me	-C(=O)Et	134–137		
29	Me	I	-CH=CH-	–	Me	H		393	
30	Me	OMe	-CH=CH-	5-Me	Me	H		311	
31	Me	Me	N(Me)	5-Me	Me	H	94–98		
32	Me	Me	-CH=CH-	–	Et	H	226–229		
33	Me	OMe	S	–	Me	H		303	
34	Me	Me	-C(Me)=CH-	–	Me	H		295	
35	Me	Me	S	5-Cl, 7-Me	Me	H		335	
36	Me	OMe	-CH=CH-	–	Me	-C(=O)O-*i*-Pr			*
37	Me	Me	-CH=CH-	–	Et	-C(=O)OEt		367.6	
38	Me	Me	-CH=CH-	–	Et	-C(=O)-*c*-Pr		363.6	
39	Me	Me	-CH=CH-	–	Et	-C(=O)O-*i*-Pr	112–116		
40	Me	Me	-CH=CH-	–	OMe	H		297	
41	Me	Me	-CH=CF-	–	H	H			*
42	Me	Me	S	5-Me	Me	-C(=O)Et	125–130		
43	Me	Me	S	5,7-di-Me	Me	-C(=O)-*t*-Bu		399.4	
44	Me	Me	S	4,6-di-Me	Me	-C(=O)Me		357	
45	Me	Me	S	4,6-di-Me	Me	-C(=O)-*t*-Bu		399	
46 (Ex. 4)	Me	OMe	-C(Me)=CH-	–	Me	H		311	
47	Me	Me	S	5-Me	Et	H	203–205		
48	Me	H	S	–	Me	H		273	
49	Me	H	-CH=CH-	–	H	H		251.5#	

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
50	Me	H	-CH=C(Me)-	–	H	H		267	
51	Me	H	-CH=C(Me)-	–	Me	H			*
52	Me	Br	-CH=C(Me)-	–	H	H		347.4	
53	Me	Me	S	5-OMe	Me	H	187–189		
54	Me	OMe	-CH=CH-	–	Me	H		297	
55	Me	OMe	-CH=CH-	–	H	H		283	
56	Me	H	-CH=CH-	–	Me	H	249–251		
57	Me	Me	S	5,7-di-Me	Et	H	200–202		
58	Me	Me	-CH=C(OMe)-	–	H	H		297	
59	Me	Me	-CH=CH-	–	Me	H	269–273		
60	Me	Me	-CH=CH-	5-Me	Me	H	230–233		
61	Me	Ph	O	5-Me	Me	H	259–263		
62	Me	Me	-CH=C(Cl)-	–	H	-C(=O)Et			*
63	Me	Me	-CH=C(Cl)-	–	H	-C(=O)OMe		359	
64	Et	Et	O	5-Me	Me	H	215–219		
65	Me	Me	S	–	Me	H	225–228		
66	Me	Me	S	5-Me	Me	-C(=O)O-*i*-Pr	128–129		
67	Me	Me	S	5,7-di-Me	Me	-C(=O)O-*i*-Pr	123–125		
68	Me	Me	O	5-OEt	Et	H	170–174		

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
69	Me	Me	-CH=CH-	5-Me	H	H		282	
70	Me	Me	-CH=CH-	5-I	H	H		393	
71	Me	Me	-CH=CH-	5-*c*-Pr	H	H		307	
72	Me	Me	-CH=CH-	–	Me	-C(=O)O-*i*-Pr	230–235		
73	Me	Me	-CH=CH-	–	Me	-C(=O)OEt	146–150		
74	Me	Me	N(Me)	5-Cl	Me	H	314–318		
75	Me	Me	-CH=C(Br)-	–	H	H	285–289		
76	Me	Me	-CH=CH-	–	Me	-C(=O)-*c*-Pr		349	
77	Me	Et	O	5-Cl	Me	H	242–248		
78	Me	Me	-CH=CH-	–	Me	-C(=O)Et			*
79	Me	Me	S	5-Me	Br	H		367.2	
80	Me	Me	S	5-Me	Me	-C(=O)OMe		359.5	
81	Me	Me	S	5,7-di-Me	Me	-C(=O)OMe		373.5	
82	Me	Me	S	5-Me	Me	-C(=O)OEt		373.5	
83	Me	Me	S	5,7-di-Me	Me	-C(=O)OEt		387.5	
84	Me	Me	S	5-Me	Me	-C(=O)OCH$_2$CH$_2$Cl		407.4	
85	Me	Me	S	5,7-di-Me	Me	-C(=O)OCH$_2$CH$_2$Cl		421.4	
86	Me	OMe	-CH=CH-	–	CF$_2$H	H		331#	
87	Me	Me	S	5-Me	Me	-C(=O)OCH$_2$C≡CH		383.3	
88	Me	Me	S	5,7-di-Me	Me	-C(=O)OCH$_2$C≡CH		397.3	
89	Me	Cl	S	–	Me	H		307	
90	Me	Me	-CH=CF-	–	H	-C(=O)Me			*

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
91 (Ex. 5)	Me	Cl	S	5-Cl	Me	H			**
92	Me	Me	-CH=CH-	5-OEt	H	H		309	
93	Me	Me	-CH=CH-	5-OCF_2H	H	H		333	
94	Me	Cl	S	–	Me	-C(=O)O-*i*-Pr			*
95	Me	Me	NMe	–	Cl	H	237–239		
96	Me	Me	-CH=CH-	5-OEt	H	H		297	
97	Me	H	S	–	Me	-C(=O)OMe		331	
98	Me	CN	-CH=CH-	–	Me	-C(=O)Me			*
99	Me	Me	-CH=CMe-	–	Me	-C(=O)Me			*
100	Me	OMe	S	5-Cl	Me	H		337	
101	Me	Cl	S	5-Cl	Me	-C(=O)OMe			*
102	Me	CF_3	-CH=CH-	–	Me	H		335	
103	Me	Me	-CH=CH-	5-Me	Et	H	186-189		
104	Me	Me	S	5-Cl	Me	H	254–257		
105	Me	Me	S	5-Me	Me	-C(=O)-*n*-Pr	115–117		
106	Me	Me	S	5,7-di-Me	Me	-C(=O)-*n*-Pr	113–115		
107	Me	Me	S	5-Me	Et	-C(=O)-*n*-Pr	80–82		
108	Me	Me	S	5-Cl	Me	-C(=O)Me	203–206		
109	Me	Me	S	5-Cl	Me	-C(=O)Et	125–127		
110	Me	Me	-CH=CH-	6-Me	Me	H		295	
111	Me	Cl	S	5-Cl	Me	-C(=O)Et			*
112	Me	OMe	S	5-Cl	Me	-C(=O)OMe		395	
113	Me	Me	-CH=CF-	–	H	-C(=O)Et-			*

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
114	Me	Cl	S	5-Cl	Me	$-SO_2Me$			*
115	Me	Me	-CF=CH-	–	H	$-SO_2Me$		363	
116	Me	Cl	S	5-Cl	Me	-C(=O)Me			*
117	Me	Et	O	–	Me	H	210–215		
118	Me	Et	O	5-Me	Me	H	334–338		
119	Me	*i*-Pr	O	5-Me	Me	H	245–250		
120	Me	H	S	–	Me	-C(=O)Me			*
121	Me	Me	S	$5-CF_3$	Me	H		355	
122	Me	OMe	S	5-Cl	Me	-C(=O)Me			*
123	Me	Me	-CH=CF-	–	H	$-C(=O)CH_2CF_3$			*
124	Me	Me	-CH=CH-	5-OC(=O)Me	H	-C(=O)Me			*
125	Me	Cl	-CH=CH-	–	Me	H		301	
126	Me	Me	-CH=CH-	5-Br	H	H		347	
127	Me	Me	-CH=CH-	5-CN	H	H		292	
128	Me	CN	-CH=CH-	–	Me	-C(=O)-*t*-Bu			*
129	Me	Br	-CH=CH-	–	Me	-C(=O)Me			*
130	Me	Me	-CH=CF-	–	H	-C(=O)OMe			*
131	Me	OMe	S	5-Cl	Me	-C(=O)Et			*
132	Me	Me	S	$5-CF_3$	Me	-C(=O)Me			*
133	Me	Me	-CH=CBr-	–	H	-C(=O)OEt	117–120		
134	Me	Me	-CH=CBr-	–	H	-C(=O)Et	120–124		
135	Me	OMe	S	5-Cl	Me	$-SO_2Me$		415	
136	Me	OMe	-CH=CH-	–	Me	-C(=O)OMe		355	
137	Me	Br	-CH=CH-	–	Me	-C(=O)OMe			*

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
138	Me	OMe	-CH=CH-	–	Me	-C(=O)Me			*
139	Me	Me	-CH=CCl-	–	H	H		301	
140	Me	Cl	S	5-CF_3	Me	H		375	
141	Me	OMe	S	–	Me	-C(=O)Me			*
142	Me	H	-CH=CH-	–	Me	-SO_2Me		345	
143	Me	H	-CH=CH-	–	Me	-C(=O)OMe		325	
144	Me	Me	-CH=CH-	5-Cl	Me	H	280–284		
145	Me	Me	-CH=CBr-	–	H	-C(=O)OMe		403	
146	Me	Me	-CH=CH-	–	CF_3	-C(=O)OEt	115–118		
147	Me	Me	-CH=CH-	–	CF_3	-C(=O)Et	132–135		
148	Me	Me	-CH=CH-	–	CF_3	-C(=O)Me	181–184		
149	Me	Me	-CH=CH-	–	CF_3	-C(=O)OMe	130–133		
150	Me	Me	-CH=CH-	5-C≡CH	H	H		291	
151	Me	Me	-CH=CH-	5-F,7-Me	Me	H		319.1	
152	Me	Cl	S	5-CF_3	Me	-C(=O)Me			*
153	Me	Me	-CH=CMe-	–	Me	-C(=O)Me			*
154	Me	Me	-CH=CMe-	–	Me	-SO_2Me		373	
155	Me	Br	-CH=CH-	–	Me	-SO_2Me			*
156	Me	Br	-CH=CH-	–	Me	-C(=O)Et			*
157	Me	Me	-CH=CCl-	–	H	-C(=O)Me		343	
158	Me	Me	-CH=CCl-	–	H	-SO_2CF_3	?	433	
159	Me	Me	-CH=CCl-	–	H	-C(=O)CF_3			*
160	Me	Me	S	5-Me	Me	-CH_2CN		340	
161	Me	Me	-CH=CH-	5-NO_2	Me	H		312	

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
162	Me	Me	-CH=CH-	–	NO_2	-C(=O)OMe	162–166		
163	Me	Me	-CH=CH-	–	NO_2	-C(=O)-*t*-Bu	239–243		
164	Me	Me	-CH=CH-	–	NO_2	-C(=O)Me	189–193		
165	Me	Me	-CH=CH-	–	NO_2	H	264–268		
166	Me	Me	-CH=CH-	–	NO_2	-C(=O)OEt	147–150		
167	Me	Me	-CH=CH-	–	NO_2	-C(=O)-*c*-Pr	165–170		
168	Bn	Me	-CH=CH-	–	H	H		343	
169	H	Me	-CH=CH-	–	H	H		253	
170	Me	Me	S	–	Me	-C(=O)-N-morph	168–171		
171	Me	Me	-CH=CH-	–	H	-C(=O)CH_2SMe			*
172	CH_2CO_2Me	Me	-CH=CH-	–	H	H		325	
173	H	Me	-CH=CH-	–	H	-CH_2CF_2H		317	
174	Me	Me	S	5,7-di-Me	Me	-C(=O)-N-morph		428	
175	H	Me	-CH=CH-	–	H	-CF_2H		303	
176	Me	Br	-CH=CH-	–	Me	-C(=O)-N-morph			*
177	Me	NO_2	-CH=CH-	–	Me	H		312	
178	Me	Me	-CH=CH-	–	H	-CH_2C(=O)Me		323	
179	Me	Me	-CH=CH-	–	H	-CH_2C≡CH		305	
180	Me	Me	-CH=CH-	–	H	-CH_2CH=CHPh		383	
181	Me	Me	-CH=CH-	–	H	-CH_2C(=O)-*c*-Pr		349	
182	Me	Me	-CH=CH-	–	H	-CH_2C(=O)OMe		339	
183	Me	Me	-CH=CH-	–	H	-C(=O)CH=CHPh		397	
184	Me	Me	-CH=CH-	–	H	-CH_2C(=O)Ph		385	

Cmpd. No.	R^1	R^2	X	$(R^3)_n$	R^4	G	m.p. (°C)	M+1	NMR
185	Me	Me	-CH=CCl-	–	H	$-SO_2N(Me)_2$		408	
186	Me	Me	-CH=CCl-	–	H	$-P(=O)(OMe)_2$		410	
187	Me	Me	-CH=CCl-	–	H	$-P(=O)(Me)_2$		377	
188	Me	Me	S	5,7-di-Me	Me	$-CH_2CN$		354	

* See Index Table B for ^{1}H NMR data.

** See Synthesis Example for ^{1}H NMR data.

\# M-1 peak.

INDEX TABLE B

Cmpd. No.	^{1}H NMR Data ($CDCl_3$ solution unless indicated otherwise)[a]
2	δ 6.93 (s, 1H), 6.90 (s, 1H), 6.41 (br s, 1H), 3.60 (s, 3H), 2.47 (s, 3H), 2.36 (s, 3H), 2.25–2.29 (m, 6H)
3	δ 7.40 (s, 1H), 6.83 (s, 1H), 6.10 (br s, 1H), 3.66 (s, 3H), 2.38 (s, 3H), 2.28 (s, 3H), 2.21 (s, 3H), 2.13 (s, 3H).
4	(DMSO-d_6) δ 10.33 (s, 1H), 7.52 (d, 1H), 7.14–7.27 (m, 3H), 3.60 (s, 3H), 2.28 (s, 3H), 2.25 (s, 3H).
5	δ 7.34 (d, 1H), 6.84–6.87 (m, 1H), 6.65–6.66 (d, 1H), 3.79 (s, 3H), 3.75 (s, 3H), 2.36 (s, 3H), 2.35 (s, 3H).
6	δ 7.35–7.39 (m, 1H), 7.20–7.24 (m, 2H), 6.08 (br s, 1H), 3.72 (s, 3H), 2.36 (s, 3H), 2.32 (s, 3H).
8	δ 7.28–7.30 (d, 1H), 7.13-7.16 (m, 1H), 6.93–6.96 (m, 1H), 5.65–5.80 (br s, 1H), 3.77 (s, 3H), 2.35 (s, 3H), 2.31 (s, 3H), 2.23 (s, 3H).
9	(DMSO-d_6) δ 10.26 (s, 1H), 6.99–7.07 (m, 3H), 3.60 (s, 3H), 2.48 (s, 3H), 2.28 (s, 3H), 2.25 (s, 3H).
10	(DMSO-d_6) δ 10.28–10.30 (br s, 1H), 7.39–7.42 (m, 1H), 7.03–7.07 (m, 1H), 6.96–6.98 (m, 1H), 3.60 (s, 3H), 2.55–2.62 (m, 2H), 2.34 (s, 3H), 2.25 (s, 3H), 1.18–1.23 (m, 3H).
11	(DMSO-d_6) δ 10.11 (br s, 1H), 8.10–7.93 (m, 2H), 7.58–7.40 (m, 4H), 7.35–7.31 (m, 1H), 3.60 (s, 3H), 2.27 (s, 3H).
13	δ 7.35 (d, 1H), 7.08–7.13 (m, 1H), 7.00–7.05 (m, 1H), 5.99–6.03 (m, 1H), 3.72 (s, 3H), 2.70 (m, 2H), 2.35 (s, 3H), 2.32 (s, 3H), 1.17–1.29 (m, 3H).
14	δ 7.27–7.29 (m, 1H), 7.06–7.07 (m, 1H), 7.01 (m, 1H), 3.83 (s, 3H), 2.38–2.40 (m, 6H), 2.29 (s, 3H), 1.89 (s, 3H).
15	δ 7.07–7.11 (m, 2H), 7.00–7.02 (m, 1H), 3.84 (s, 3H), 2.50 (s, 3H), 2.42 (s, 3H), 2.29 (s, 3H), 1.89 (s, 3H).

16	δ 6.88 (s, 1H), 6.83 (s, 1H), 3.84 (s, 3H), 2.45 (s, 3H), 2.39 (s, 3H), 2.35 (s, 3H), 2.29 (s, 3H), 1.91 (s, 3H).
17	δ 7.26 (d, 1H), 7.02 (d, 1H), 7.00 (d, 1H), 3.84 (s, 3H), 2.37 (d, 6H), 2.26 (s, 3H) 0.93 (br s, 9H).
18	δ 6.83 (s, 1H), 6.81 (s, 1H), 3.83 (s, 3H), 2.44 (s, 3H), 2.37 (s, 3H), 2.34 (s, 3H), 2.25 (s, 3H), 0.94 (br s, 9H).
19	δ 7.45 (s, 1H), 6.86 (s, 1H), 5.62 (s, 1H), 3.74 (s, 3H), 2.55–2.71 (m, 2H), 2.39 (s, 3H), 2.32 (s, 3H), 2.18 (s, 3H), 1.20–1.29 (m, 3H).
21	δ 8.03 (m, 1H), 7.61–7.49 (m, 3H), 7.32 (s, 1H), 5.23 (br s, 1H), 3.79 (s, 1H), 2.71 (s, 1H), 2.36 (s, 3H), 2.26 (s, 3H).
24	δ 8.17 (m, 1H), 7.75 (s, 1H), 7.62–7.52 (m, 3H), 7.38 (m, 1H), 7.25 (m, 1H), 5.69 (br s, 1H), 3.81 (s, 3H).
25	δ 8.17 (m, 1H), 7.62–7.52 (m, 3H), 7.37 (m, 1H), 7.26 (m, 1H) 5.49 (s, 1H), 3.77 (s, 3H), 2.36 (s, 3H).
36	δ 7.82–7.78 (m, 2H), 7.45–7.35 (m, 4H), 4.72–4.64 (m, 1H), 3.97 (s, 3H), 3.78 (s, 3H), 2.30 (s, 3H), 1.10 (m, 3H), 1.03 (m, 3H).
41	δ 8.18 (m, 1H), 7.62–7.54 (m, 3H), 7.36 (m, 1H), 7.25 (m, 2H), 5.48 (s, 1H), 3.77 (s, 3H), 2.36 (s, 3H).
51	δ 8.04 (m, 2H), 7.73 (s, 1H), 7.53–7.45 (m, 2H), 7.31 (s, 1H), 5.60 (br s, 1H) 3.83 (s, 3H), 2.70 (s, 3H), 2.26 (s, 3H).
62	δ 8.28–8.35 (m, 1H), 7.57–7.65 (m, 2H), 7.47–7.56 (m, 2H), 7.20–7.29 (m, 1H), 3.85 (s, 3H), 2.29 (s, 3H), 1.96–2.19 (m, 2H), 0.62–0.85 (m, 3H).
78	(500MHz) δ 7.88 (s, 1H), 7.81 (s, 1H), 7.79 (s, 1H), 7.44–7.33 (m, 4H), 3.91–3.88 (m, 3H), 2.29 (s, 3H), 2.02 (m, 2H), 0.76 (s, 1H), 0.64 (m, 3H).
90	(500MHz) δ 8.15–8.14 (m, 1H), 7.65–7.51 (m, 4H), 7.29–7.27 (m, 1H), 7.20–7.16 (m, 1H), 3.85 (s, 3H), 2.31 (s, 3H), 1.84 (s, 3H).
95	(500MHz) δ 7.75–7.72 (m, 1H), 7.33–7.26 (m, 3H), 4.66–4.63 (m, 1H), 3.87 (s, 3H), 2.43 (s, 3H), 1.07–1.00 (m, 6H).
99	δ 7.81–7.87 (m, 2H), 7.38–7.45 (m, 3H), 7.30–7.34 (m, 1H), 3.96 (s, 3H), 2.28 (s, 3H), 1.85 (s, 3H).
100	(500MHz) δ 7.78–7.76 (m, 1H), 7.71 (s, 1H), 7.42–7.31 (m, 2H), 7.23–7.22 (m, 1H), 3.84 (s, 3H), 2.52 (s, 3H), 2.48 (s, 3H), 2.18 (s, 3H).
102	(500MHz) δ 7.67–7.66 (m, 1H), 7.27–7.24 (m, 2H), 3.88 (s, 3H), 3.69 (s, 3H), 2.43 (s, 3H).
112	(500MHz) δ 7.67–7.65 (m, 1H), 7.46–7.27 (m, 2H), 3.87 (s, 3H), 2.42 (s, 3H), 2.35–2.13 (m, 2H), 0.86–0.83 (m, 3H).

114	(500MHz) δ 8.15–8.13 (m, 1H), 7.60–7.49 (m, 3H), 7.33–7.27 (m, 1H), 7.21–7.16 (m, 1H), 3.85 (s, 3H), 2.29 (s, 3H), 2.13–2.02 (m, 2H), 0.78–0.75 (m, 3H).
115	(500MHz) δ 7.69–7.68 (m, 1H), 7.31–7.27 (m, 2H), 3.88 (s, 3H), 2.58 (s, 3H), 2.48 (s, 3H).
117	(500MHz) δ 7.67–7.65 (m, 1H), 7.26–7.24 (m, 2H), 3.87 (s, 3H), 2.42 (s, 3H), 1.96 (s, 3H).
121	(500MHz) δ 7.84 (s, 1H), 7.79–7.69 (m, 1H), 7.30–7.26 (m, 3H), 3.88 (s, 3H), 2.43 (s, 3H), 1.90 (s, 3H).
123	(500MHz) δ 7.65–7.64 (m, 1H), 7.28–7.27 (m, 1H), 7.24–7.22 (m, 1H), 3.93 (s, 3H), 3.77 (s, 3H), 2.42 (s, 3H), 1.98 (s, 3H).
124	(500MHz) δ 8.16–8.15 (m, 1H), 7.60–7.45 (m, 3H), 7.29–7.26 (m, 2H), 7.20–7.17 (m, 1H), 3.87 (s, 3H), 3.00–2.82 (m, 2H), 2.31 (s, 3H).
125	δ 7.84–7.94 (m, 2H), 7.46–7.55 (m, 1H), 7.33–7.40 (m, 1H), 7.23–7.30 (m, 1H), 7.16–7.21 (m, 1H), 3.85 (s, 3H), 2.31 (s, 3H), 2.29 (s, 3H), 1.82 (s, 3H).
129	δ 7.78–7.85 (m, 2H), 7.36–7.45 (m, 3H), 7.29–7.35 (m, 1H), 3.98 (s, 3H), 2.29 (s, 3H), 0.72 (s, 9H).
130	δ 7.82, (m, 2H), 7.29 (m, 4H), 3.88 (s, 1H), 2.30 (s, 3H) 1.80 (s, 3H).
131	(500MHz) δ 8.24–8.13 (m, 1H), 7.60–7.52 (m, 3H), 7.34–7.30 (m, 1H), 7.26–7.18 (m, 1H), 3.88 (s, 3H), 3.61 (s, 3H), 2.37 (s, 3H).
132	(500MHz) δ 7.65–7.63 (m, 1H), 7.35–7.27 (m, 1H), 7.26–7.19 (m, 1H), 3.93 (s, 3H), 3.77 (s, 3H), 2.42 (s, 3H), 2.29–2.19 (m, 2H), 0.89–0.86 (m, 3H).
133	(500MHz) δ 7.89–7.83 (m, 1H), 7.54–7.48 (m, 2H), 3.86 (s, 3H), 2.45 (s, 3H), 2.32 (s, 3H), 1.81 (s, 3H).
138	(500MHz) δ 7.84–7.82 (m, 2H), 7.45–7.35 (m, 4H), 3.90 (s, 3H), 3.58 (s, 3H), 2.30 (s, 3H).
139	(500MHz) δ 7.81–7.79 (m, 2H), 7.44–7.36 (m, 4H), 3.95 (s, 3H), 3.78 (s, 3H), 2.30 (s, 3H), 1.85 (s, 3H).
142	(500MHz) δ 7.75–7.73 (m, 1H), 7.29–7.23 (m, 3H), 3.93 (s, 3H), 3.76 (s, 3H), 2.42 (s, 3H), 1.94 (s, 3H).
153	(500MHz) δ 7.93–7.83 (m, 1H), 7.53–7.52 (m, 2H), 3.88 (s, 3H), 2.46 (s, 3H), 1.93 (s, 3H).
154	(500MHz) δ 7.97–7.95 (m, 1H), 7.48–7.34 (m, 3H), 7.29–7.26 (m, 1H), 3.85 (s, 3H), 2.74 (s, 3H), 2.30 (s, 3H), 2.24 (s, 3H), 1.71 (s, 3H).
156	(500MHz) δ 7.89–7.87 (m, 2H), 7.48–7.38 (m, 4H), 3.90 (s, 3H), 2.37 (s, 3H), 2.07 (s, 3H).
157	(500MHz) δ 7.86–7.76 (m, 2H), 7.44–7.35 (m, 4H), 3.90 (s, 3H), 2.30 (s, 3H), 2.09–2.03 (m, 2H), 0.65–0.62 (m, 3H).
160	δ 8.31–8.37 (m, 1H), 7.59–7.68 (m, 2H), 7.49–7.56 (m, 1H), 7.42–7.48 (m, 1H), 7.19–7.25 (m, 1H), 3.93 (s, 3H), 2.37 (s, 3H).

175	(500MHz) δ 8.17–8.10 (m, 1H), 7.59–7.45 (m, 3H), 7.31–7.27 (m, 1H), 7.23–7.14 (m, 1H), 3.86 (s, 3H), 2.95–2.88 (m, 2H), 2.33 (s, 3H), 1.67 (s, 3H).
180	(500MHz) δ 7.89–7.77 (m, 2H), 7.50–7.33 (m, 4H), 3.90 (s, 3H), 3.26–2.86 (m, 6H), 2.33 (s, 3H).

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

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

Seeds of plant species selected from barnyardgrass (*Echinochloa crus-galli*), kochia (*Kochia scoparia*), ragweed (common ragweed, *Ambrosia elatior*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), crabgrass, large (large crabgrass, *Digitaria sanguinalis*), foxtail, giant (giant foxtail, *Setaria faberii*), morningglory (*Ipomoea* spp.), 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, plants selected from these crop and weed species and also blackgrass (*Alopecurus myosuroides*), and galium (catchweed bedstraw, *Galium aparine*) were planted in pots containing the same blend of loam soil and sand and treated with postemergence applications of test chemicals formulated in the same manner. Plants ranged in height from 2 to 10 cm and were in the one- to two-leaf stage for the postemergence treatment. Treated plants and untreated controls were maintained in a greenhouse for approximately 10 d, after which time all treated plants were compared to untreated controls and visually evaluated for injury. Plant response ratings, summarized in Table A, are based on a 0 to 100 scale where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table A	Compounds													
1000 g ai/ha	1	3	4	5	6	7	10	11	13	32	60	178	179	180
Postemergence														
Barnyardgrass	90	50	70	40	70	90	90	80	80	90	90	0	10	0
Blackgrass	-	-	-	-	-	-	-	-	30	90	90	30	40	30
Corn	40	0	0	0	0	10	20	50	20	50	50	0	10	0
Crabgrass, Large	90	10	50	80	50	50	70	70	-	-	-	-	-	-
Foxtail, Giant	80	10	80	80	70	90	80	90	80	90	90	0	10	0
Galium	-	-	-	-	-	-	-	-	70	100	100	70	90	80
Kochia	-	-	-	-	-	-	-	-	30	100	100	10	10	40

Morningglory	100	90	70	70	40	100	100	90	-	-	-	-	-	-
Pigweed	100	0	50	10	50	100	90	90	20	100	100	70	0	50
Ragweed	-	-	-	-	-	-	-	-	30	100	100	60	40	0
Ryegrass, Italian	-	-	-	-	-	-	-	-	70	100	100	70	70	70
Velvetleaf	100	70	60	-	-	100	100	100	-	-	-	-	-	-
Wheat	0	0	0	0	20	20	0	60	20	100	70	0	0	0

Table A	Compounds			
1000 g ai/ha	181	182	183	184
Postemergence				
Barnyardgrass	0	0	40	20
Blackgrass	20	10	80	30
Corn	0	0	10	0
Crabgrass, Large	-	-	-	-
Foxtail, Giant	0	0	70	20
Galium	80	50	90	90
Kochia	0	0	90	80
Morningglory	-	-	-	-
Pigweed	30	0	90	80
Ragweed	30	30	70	30
Ryegrass, Italian	80	0	100	80
Velvetleaf	-	-	-	-
Wheat	0	0	0	0

Table A						Compounds								
500 g ai/ha	2	8	9	12	14	15	16	17	18	19	20	21	22	23
Postemergence														
Barnyardgrass	80	0	90	40	70	90	90	0	40	80	100	90	50	90
Blackgrass	-	-	-	50	30	50	30	40	20	0	40	90	70	80
Corn	20	0	0	0	20	20	0	0	20	0	30	60	0	50
Crabgrass, Large	70	30	50	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	90	30	90	70	70	90	80	0	20	60	100	100	90	90
Galium	-	-	-	90	90	90	100	60	60	80	100	100	100	100
Kochia	-	-	-	60	90	50	60	0	0	0	100	100	100	100
Morningglory	100	10	80	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	80	0	50	80	0	40	0	0	0	100	100	100	100
Ragweed	-	-	-	70	90	50	70	0	0	0	100	100	100	100

Ryegrass, Italian	-	-	-	70	80	90	80	60	50	0	100	100	100	100
Velvetleaf	100	60	10	-	-	-	-	-	-	-	-	-	-	-
Wheat	20	0	0	0	0	0	0	0	0	0	30	60	0	80

Table A							Compounds							
500 g ai/ha	24	25	26	27	28	29	30	31	33	34	35	36	37	38
Postemergence														
Barnyardgrass	50	90	30	90	90	80	30	10	90	90	90	80	90	40
Blackgrass	50	90	70	90	90	80	60	20	40	90	80	80	100	60
Corn	0	20	0	20	20	40	0	0	10	0	30	40	40	10
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	60	90	60	90	90	90	60	10	90	90	90	90	90	50
Galium	100	100	90	100	100	90	90	70	100	100	100	100	100	100
Kochia	80	100	90	90	90	90	80	0	100	80	100	100	90	80
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	90	100	90	100	90	40	70	90	90	90	100	50
Ragweed	60	100	90	100	100	100	70	20	90	100	80	90	90	70
Ryegrass, Italian	90	100	90	100	100	100	60	0	70	100	100	80	100	50
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	70	0	0	0	0	60	10	0	0	40	40	30	80	20

Table A							Compounds							
500 g ai/ha	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Postemergence														
Barnyardgrass	10	60	90	90	30	0	0	80	80	50	20	0	80	50
Blackgrass	70	80	90	90	80	0	0	70	70	30	30	10	60	30
Corn	0	10	70	20	0	0	0	0	10	0	0	0	0	20
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	60	80	100	100	70	0	0	80	80	60	20	0	80	50
Galium	100	100	100	100	90	70	0	90	100	90	80	80	100	100
Kochia	30	90	100	100	10	0	0	40	90	80	10	20	90	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	80	100	90	100	10	0	0	90	100	70	40	50	90	30
Ragweed	90	90	100	100	0	0	0	90	100	20	10	20	70	100
Ryegrass, Italian	60	90	100	100	60	0	0	80	80	60	50	40	90	80
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	10	50	80	20	0	0	0	20	0	0	0	0	0	0

Table A	Compounds													
500 g ai/ha	53	54	55	56	57	58	59	61	62	63	64	65	66	67
Postemergence														
Barnyardgrass	20	90	90	60	100	0	90	0	90	90	0	90	90	70
Blackgrass	30	40	80	50	60	50	100	0	80	80	0	70	80	80
Corn	0	30	20	10	30	0	60	0	30	40	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	30	90	90	60	90	10	100	0	90	90	0	90	90	90
Galium	80	100	100	100	100	100	100	0	100	100	0	100	90	90
Kochia	80	100	100	100	100	90	100	0	100	100	0	90	90	30
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	100	90	90	100	20	100	0	100	100	0	90	90	20
Ragweed	70	100	100	90	100	60	100	0	100	100	0	90	90	70
Ryegrass, Italian	70	100	100	100	90	80	100	0	100	100	0	100	100	90
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	20	20	0	50	10	20	100	0	50	40	0	0	0	0

Table A	Compounds													
500 g ai/ha	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Postemergence														
Barnyardgrass	80	40	10	20	60	90	10	60	30	0	30	80	80	90
Blackgrass	10	40	30	40	90	90	40	70	10	0	80	80	80	90
Corn	0	0	0	20	40	60	0	20	0	0	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	40	25	20	90	100	20	50	20	0	70	80	80	100
Galium	0	90	90	90	100	100	20	100	80	60	100	90	90	100
Kochia	0	80	60	70	90	100	30	90	40	10	90	90	90	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	90	80	80	90	100	50	50	20	0	90	90	90	100
Ragweed	0	80	70	70	90	100	10	90	20	0	80	90	90	100
Ryegrass, Italian	0	90	80	90	100	100	0	100	80	60	100	90	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	20	70	90	0	20	0	0	60	0	0	0

Table A	Compounds													
500 g ai/ha	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Postemergence														

Barnyardgrass	50	90	40	80	10	80	90	80	100	90	0	20	40	10
Blackgrass	70	100	80	90	30	80	90	60	90	60	20	0	30	10
Corn	0	0	0	0	0	0	0	0	30	30	0	30	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	70	100	80	90	70	80	100	80	100	100	0	10	50	0
Galium	90	100	90	100	100	90	100	90	100	100	30	90	90	60
Kochia	80	100	80	70	80	90	100	90	100	90	70	30	60	10
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	80	100	90	100	90	90	100	90	100	100	30	60	70	0
Ragweed	70	100	90	90	80	90	100	90	100	100	0	50	60	10
Ryegrass, Italian	80	100	80	90	50	80	100	90	100	100	0	90	50	50
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	20	0	0	0	0	0	0	30	30	0	20	20	0

Table A							Compounds							
500 g ai/ha	96	97	98	99	100	101	102	103	104	105	106	107	108	109
Postemergence														
Barnyardgrass	20	90	90	90	30	30	90	90	100	90	90	100	90	90
Blackgrass	20	90	30	80	70	40	70	90	90	90	90	90	90	90
Corn	0	70	20	40	20	20	20	60	20	30	20	30	0	30
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	20	100	100	90	80	50	90	90	100	90	90	90	90	90
Galium	50	100	100	100	100	90	100	100	100	100	100	100	100	100
Kochia	70	100	60	70	100	30	40	90	100	90	90	90	100	90
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	100	100	90	90	70	90	100	90	90	90	90	100	90
Ragweed	50	100	100	100	90	80	100	100	100	100	90	90	100	100
Ryegrass, Italian	60	100	100	100	100	50	80	100	100	100	100	90	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	80	30	30	20	20	20	20	20	20	20	20	20	30

Table A							Compounds							
500 g ai/ha	110	111	112	113	114	115	116	117	118	119	120	121	122	123
Postemergence														
Barnyardgrass	10	90	20	90	90	90	90	40	0	0	10	50	30	70
Blackgrass	60	70	80	90	60	70	70	0	0	0	10	50	40	50
Corn	20	20	30	70	30	20	30	0	0	0	0	20	20	20

Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	100	50	90	90	90	100	20	0	0	10	80	60	60
Galium	90	100	90	100	100	100	100	0	0	0	70	90	70	90
Kochia	70	90	30	100	60	90	60	10	0	0	30	80	70	70
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	30	100	90	90	100	20	0	0	50	90	70	70
Ragweed	100	100	80	100	80	100	100	0	0	0	10	90	60	90
Ryegrass, Italian	90	100	100	100	90	100	100	0	0	0	80	100	70	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	40	30	30	70	40	30	50	0	0	0	0	20	0	20

Table A							Compounds							
500 g ai/ha	124	125	126	127	128	129	130	131	132	133	134	135	136	137
Postemergence														
Barnyardgrass	30	90	60	50	80	100	90	20	30	90	60	0	100	100
Blackgrass	0	80	70	50	20	100	70	50	50	60	70	30	90	100
Corn	0	30	20	10	0	80	30	10	10	50	50	20	30	70
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	90	60	60	70	100	90	80	80	90	80	0	100	100
Galium	30	90	100	100	70	100	100	100	100	100	100	90	100	100
Kochia	0	100	90	80	0	90	100	80	80	100	100	0	100	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	100	100	100	90	100	100	90	90	100	100	20	100	100
Ragweed	0	100	90	80	30	100	100	90	100	100	100	60	100	100
Ryegrass, Italian	0	100	100	90	50	100	100	90	100	100	100	70	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	80	20	20	0	80	30	20	20	30	30	0	30	90

Table A							Compounds							
500 g ai/ha	138	139	140	141	142	143	144	145	146	147	148	149	150	151
Postemergence														
Barnyardgrass	100	100	90	50	20	60	100	90	30	40	30	20	30	90
Blackgrass	90	90	50	50	20	60	100	80	70	90	80	70	50	90
Corn	20	40	30	0	0	20	90	60	30	0	0	30	0	30
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	100	100	90	70	20	60	100	80	70	80	70	80	30	90
Galium	100	100	90	90	80	100	100	100	90	100	90	100	80	100

Kochia	100	100	70	30	20	90	100	100	100	100	90	100	70	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	100	90	30	50	90	100	100	90	90	90	100	80	100
Ragweed	100	100	100	40	20	70	100	100	100	90	90	90	30	90
Ryegrass, Italian	100	100	100	90	90	100	100	100	100	100	90	100	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	20	30	70	0	0	50	100	30	70	80	60	70	20	20

Table A						Compounds								
500 g ai/ha	152	153	154	155	156	157	158	159	160	161	162	163	164	165
Postemergence														
Barnyardgrass	40	90	90	80	90	80	50	80	20	80	50	0	20	30
Blackgrass	30	90	90	70	90	70	60	70	20	90	40	20	40	50
Corn	0	80	40	20	30	40	0	40	0	0	30	0	20	20
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	90	90	90	90	80	60	80	20	80	40	0	30	50
Galium	70	100	100	90	100	100	90	100	90	100	100	60	100	100
Kochia	40	90	50	80	100	100	100	100	60	90	90	20	90	90
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	60	100	90	100	100	100	100	80	90	90	90	20	80	80
Ragweed	90	90	80	100	100	100	100	100	80	90	100	0	100	90
Ryegrass, Italian	90	100	100	90	100	100	100	100	90	100	90	70	90	90
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	50	30	20	50	60	50	0	30	0	20	20	0	0	0

Table A						Compounds								
500 g ai/ha	166	167	168	169	170	171	172	173	174	175	176	177	185	186
Postemergence														
Barnyardgrass	20	20	40	20	10	90	70	0	10	0	10	0	30	100
Blackgrass	30	40	30	20	10	90	30	0	0	20	30	0	20	80
Corn	20	20	20	30	0	40	0	0	0	20	0	0	30	30
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	40	40	40	30	10	90	80	0	10	0	10	0	20	90
Galium	90	90	30	70	80	100	40	0	80	0	100	0	90	100
Kochia	70	70	20	100	70	100	20	0	0	0	70	0	100	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	80	80	40	70	80	100	30	0	60	0	90	0	90	100

Ragweed	70	70	0	80	80	100	0	0	20	0	100	0	50	100
Ryegrass, Italian	90	80	60	100	50	100	60	0	40	30	100	0	80	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	20	0	20	30	0	70	20	0	0	20	0	0	0	40

Table A	Compounds	
500 g ai/ha	187	188
Postemergence		
Barnyardgrass	80	20
Blackgrass	70	60
Corn	30	0
Crabgrass, Large	-	-
Foxtail, Giant	80	80
Galium	100	90
Kochia	100	20
Morningglory	-	-
Pigweed	90	80
Ragweed	100	50
Ryegrass, Italian	100	80
Velvetleaf	-	-
Wheat	30	0

Table A	Compounds													
125 g ai/ha	2	8	9	12	14	15	16	17	18	19	20	21	22	23
Postemergence														
Barnyardgrass	30	0	10	0	10	70	20	0	0	20	30	90	30	80
Blackgrass	-	-	-	20	20	0	10	10	0	0	30	90	50	70
Corn	0	0	0	0	0	0	0	0	0	0	20	50	0	40
Crabgrass, Large	50	0	10	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	80	0	10	10	10	70	20	0	0	20	30	100	60	90
Galium	-	-	-	60	80	70	90	50	40	30	90	100	90	100
Kochia	-	-	-	0	80	50	50	0	0	0	90	100	100	100
Morningglory	100	0	40	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	70	0	30	60	0	30	0	0	0	100	100	100	100
Ragweed	-	-	-	10	70	50	30	0	0	0	80	100	90	90
Ryegrass, Italian	-	-	-	60	60	50	50	50	10	0	100	100	80	100
Velvetleaf	100	60	0	-	-	-	-	-	-	-	-	-	-	-
Wheat	20	0	0	0	0	0	0	0	0	0	20	10	0	50

Table A	Compounds													
125 g ai/ha	24	25	26	27	28	29	30	31	33	34	35	36	37	38
Postemergence														
Barnyardgrass	40	20	10	90	80	70	0	0	40	30	50	50	60	0
Blackgrass	30	60	30	90	90	70	20	0	10	80	70	60	60	50

Corn	0	0	0	0	0	10	0	0	0	0	0	20	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	90	10	90	90	80	0	0	40	30	90	80	80	0
Galium	80	100	70	100	100	90	70	20	90	90	100	100	100	80
Kochia	70	100	80	70	70	80	60	0	90	70	80	90	60	30
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	90	80	90	90	90	90	20	40	90	80	90	100	50
Ragweed	30	100	60	100	80	90	40	0	90	90	50	90	90	40
Ryegrass, Italian	70	100	60	100	90	90	70	0	50	100	80	70	90	0
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	30	0	0	0	0	40	10	0	0	20	20	20	40	10

Table A						Compounds								
125 g ai/ha	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Postemergence														
Barnyardgrass	0	10	30	30	0	0	0	20	40	10	0	0	20	10
Blackgrass	30	60	70	80	30	0	0	20	60	0	10	0	30	20
Corn	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	60	70	90	0	0	0	50	80	50	0	0	50	40
Galium	90	90	80	100	50	30	0	70	90	90	50	60	90	100
Kochia	30	80	100	100	0	0	0	30	90	70	0	0	70	40
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	50	80	60	90	0	0	0	70	100	60	20	20	70	10
Ragweed	50	70	70	100	0	0	0	80	100	0	0	0	70	90
Ryegrass, Italian	90	90	100	100	40	0	0	30	70	50	30	20	60	70
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A						Compounds								
125 g ai/ha	53	54	55	56	57	58	59	61	62	63	64	65	66	67
Postemergence														
Barnyardgrass	0	30	60	10	90	0	80	0	70	60	0	20	20	20
Blackgrass	0	20	70	30	30	20	90	0	70	70	0	20	60	70
Corn	0	20	0	0	20	0	20	0	10	0	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	60	70	20	80	0	90	0	80	70	0	20	70	80

Galium	60	100	100	90	100	70	100	0	100	100	0	90	90	80
Kochia	70	100	90	90	80	20	100	0	100	100	0	90	90	20
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	60	90	70	80	100	0	100	0	100	100	0	80	80	20
Ragweed	60	100	90	70	100	0	90	0	100	100	0	50	70	50
Ryegrass, Italian	40	60	100	90	70	60	100	0	100	100	0	90	90	70
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	20	0	10	0	0	50	0	0	0	0	0	0	0

Table A							Compounds							
125 g ai/ha	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Postemergence														
Barnyardgrass	70	10	0	0	20	40	0	0	0	0	20	50	70	30
Blackgrass	0	30	10	30	70	90	20	50	0	0	30	70	80	90
Corn	0	0	0	0	20	20	0	0	0	0	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	10	30	0	30	90	0	50	0	0	20	70	80	90
Galium	0	80	70	70	90	100	10	90	70	20	80	90	90	100
Kochia	0	60	50	50	60	90	30	80	20	0	50	80	90	60
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	80	80	70	90	100	40	30	10	0	60	90	90	100
Ragweed	0	80	40	70	70	90	0	60	0	0	40	90	80	90
Ryegrass, Italian	0	80	60	30	100	100	0	90	40	20	80	80	80	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	0	20	40	0	0	0	0	0	0	0	0

Table A							Compounds							
125 g ai/ha	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Postemergence														
Barnyardgrass	30	40	20	30	30	40	30	40	80	90	0	0	0	0
Blackgrass	70	90	70	90	10	80	90	30	70	30	0	0	0	0
Corn	0	0	0	0	0	0	0	0	20	20	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	90	50	90	50	70	90	70	80	90	0	0	30	0
Galium	90	100	90	90	90	90	100	90	100	100	10	70	80	20
Kochia	30	70	70	30	70	90	70	80	100	70	60	20	30	0
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pigweed	60	100	80	90	90	80	100	80	100	90	20	30	30	0
Ragweed	70	90	80	90	80	80	90	80	100	100	0	0	10	0
Ryegrass, Italian	70	90	70	90	0	80	100	80	100	90	0	40	30	10
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	0	0	0	0	0	20	20	0	0	0	0

Table A	Compounds													
125 g ai/ha	96	97	98	99	100	101	102	103	104	105	106	107	108	109
Postemergence														
Barnyardgrass	0	30	90	20	30	0	40	40	70	50	70	60	30	30
Blackgrass	0	90	30	60	40	20	20	70	90	80	90	80	80	80
Corn	0	10	20	20	0	0	20	20	0	0	0	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	80	90	40	80	30	70	90	80	70	90	70	60	70
Galium	20	100	100	100	90	70	100	100	100	100	100	100	100	100
Kochia	60	90	30	30	70	20	20	50	90	90	70	80	90	90
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	60	90	100	70	80	30	90	90	90	90	90	90	90	90
Ragweed	0	90	100	100	90	60	100	100	100	90	90	90	70	80
Ryegrass, Italian	20	100	90	100	90	30	20	100	100	100	90	60	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	20	30	20	0	0	20	0	20	0	0	30	0	20

Table A	Compounds													
125 g ai/ha	110	111	112	113	114	115	116	117	118	119	120	121	122	123
Postemergence														
Barnyardgrass	0	40	20	40	20	20	20	0	0	0	0	30	20	40
Blackgrass	20	30	40	90	20	20	30	0	0	0	0	20	30	30
Corn	0	0	0	20	0	0	0	0	0	0	0	20	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	70	20	40	70	20	70	0	0	0	0	60	40	50
Galium	70	90	70	100	90	80	70	0	0	0	40	70	60	80
Kochia	50	40	20	100	30	70	30	0	0	0	0	70	40	70
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	100	20	90	90	70	70	0	0	0	20	90	30	60
Ragweed	60	70	60	90	70	80	70	0	0	0	0	90	50	50
Ryegrass, Italian	70	90	80	100	90	100	90	0	0	0	20	90	50	90

Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	20	20	30	20	20	20	0	0	0	0	0	0	0

Table A	Compounds													
125 g ai/ha	124	125	126	127	128	129	130	131	132	133	134	135	136	137
Postemergence														
Barnyardgrass	20	90	30	10	50	90	60	0	0	20	20	0	20	70
Blackgrass	0	70	60	20	0	60	60	30	30	60	60	0	60	90
Corn	0	20	0	0	0	10	0	0	0	10	20	0	30	30
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	90	20	10	50	90	70	50	60	20	20	0	90	100
Galium	0	90	100	90	40	100	100	70	80	100	100	60	100	100
Kochia	0	100	90	70	0	70	100	60	50	90	100	0	100	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	100	90	90	70	90	100	60	60	90	90	0	90	100
Ragweed	0	90	90	60	10	100	70	100	100	100	100	30	100	100
Ryegrass, Italian	0	100	90	80	20	100	100	90	100	100	100	40	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	50	0	0	0	20	0	0	0	20	30	0	0	50

Table A	Compounds													
125 g ai/ha	138	139	140	141	142	143	144	145	146	147	148	149	150	151
Postemergence														
Barnyardgrass	20	20	50	20	10	20	100	20	0	10	10	20	0	70
Blackgrass	80	60	30	0	10	40	90	40	20	60	60	30	0	90
Corn	0	30	20	0	0	0	60	20	0	0	0	20	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	90	70	40	20	10	20	100	20	10	30	30	40	0	80
Galium	100	100	70	70	70	90	100	100	80	90	90	90	30	100
Kochia	100	100	30	10	0	70	100	100	70	80	80	80	40	70
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	60	70	0	20	90	100	100	90	90	90	90	40	90
Ragweed	100	100	90	60	0	70	100	100	90	90	90	90	0	90
Ryegrass, Italian	90	100	70	70	80	80	100	100	70	90	90	70	40	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	30	20	0	0	0	90	20	0	20	20	20	0	0

Table A	Compounds

125 g ai/ha	152	153	154	155	156	157	158	159	160	161	162	163	164	165
Postemergence														
Barnyardgrass	20	90	90	30	70	50	10	40	10	20	20	0	20	20
Blackgrass	20	90	70	60	60	60	50	70	10	80	20	0	20	20
Corn	0	0	0	0	0	0	0	20	0	0	20	0	0	0
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	30	90	90	80	90	60	30	50	10	80	20	0	20	20
Galium	60	100	100	90	100	100	80	100	70	80	90	30	80	100
Kochia	30	40	20	70	80	100	90	100	30	60	70	0	60	60
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	50	80	90	90	90	90	80	60	80	50	80	0	80	80
Ragweed	70	80	80	100	90	100	90	100	70	80	80	0	70	90
Ryegrass, Italian	30	100	90	90	90	100	90	100	30	100	60	20	70	80
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	30	0	0	30	30	0	0	0	0	0	0	0	0	0

Table A						Compounds								
125 g ai/ha	166	167	168	169	170	171	172	173	174	175	176	177	185	186
Postemergence														
Barnyardgrass	10	20	0	0	0	40	40	0	0	0	0	0	10	70
Blackgrass	10	20	20	10	0	80	20	0	0	0	30	0	0	40
Corn	20	0	0	0	0	20	0	0	0	0	0	0	0	20
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	20	30	0	0	40	40	0	0	0	0	0	0	70
Galium	70	70	0	30	40	90	20	0	30	0	90	0	70	100
Kochia	50	50	20	40	0	100	0	0	0	0	30	0	70	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	40	70	0	20	70	90	0	0	40	0	30	0	50	100
Ragweed	30	60	0	0	40	100	0	0	20	0	40	0	10	100
Ryegrass, Italian	40	70	60	70	0	100	20	0	10	20	30	0	70	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	0	0	30	20	0	0	0	0	0	0	0

Table A	Compounds	
125 g ai/ha	187	188
Postemergence		
Barnyardgrass	30	10

Table A	Compounds			
1000 g ai/ha	181	182	183	184
Preemergence				
Barnyardgrass	0	0	40	10

Blackgrass	40	10
Corn	0	0
Crabgrass, Large	-	-
Foxtail, Giant	50	20
Galium	90	70
Kochia	90	10
Morningglory	-	-
Pigweed	70	50
Ragweed	100	20
Ryegrass, Italian	100	20
Velvetleaf	-	-
Wheat	0	0

Corn	-	-	-	-
Crabgrass, Large	-	-	-	-
Foxtail, Giant	0	0	60	30
Kochia	10	0	70	20
Morningglory	-	-	-	-
Pigweed	30	0	90	90
Ragweed	10	0	80	70
Ryegrass, Italian	60	0	90	90
Velvetleaf	-	-	-	-
Wheat	-	-	-	-

Table A						Compounds								
1000 g ai/ha	1	3	4	5	6	7	10	11	13	32	60	178	179	180
Preemergence														
Barnyardgrass	90	80	100	90	100	100	100	90	60	100	80	0	0	0
Corn	0	0	10	0	30	30	10	20	-	-	-	-	-	-
Crabgrass, Large	90	80	80	90	-	90	90	80	-	-	-	-	-	-
Foxtail, Giant	100	60	80	80	50	90	100	90	50	100	90	0	30	10
Kochia	-	-	-	-	-	-	-	-	20	100	80	0	30	0
Morningglory	90	80	60	0	10	80	90	90	-	-	-	-	-	-
Pigweed	100	0	70	0	-	100	100	100	0	100	100	0	80	40
Ragweed	-	-	-	-	-	-	-	-	0	90	100	0	50	40
Ryegrass, Italian	-	-	-	-	-	-	-	-	60	100	100	60	30	50
Velvetleaf	100	70	40	0	20	80	90	80	-	-	-	-	-	-
Wheat	0	0	0	0	0	0	0	50	-	-	-	-	-	-

Table A						Compounds								
500 g ai/ha	2	8	9	12	14	15	16	17	18	19	20	21	22	23
Preemergence														
Barnyardgrass	80	0	100	80	40	90	70	0	0	90	90	100	70	90
Corn	10	0	0	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	100	60	90	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	100	60	100	90	10	70	30	0	0	0	90	100	90	90
Kochia	-	-	-	10	50	0	30	0	0	0	100	90	100	100
Morningglory	100	0	0	-	-	-	-	-	-	-	-	-	-	-

Pigweed	100	100	0	60	90	0	70	0	0	0	100	100	100	100
Ragweed	-	-	-	30	30	30	0	10	0	20	90	100	90	90
Ryegrass, Italian	-	-	-	50	-	100	80	40	20	0	100	100	100	90
Velvetleaf	90	30	0	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
500 g ai/ha	24	25	26	27	28	29	30	31	33	34	35	36	37	38
Preemergence														
Barnyardgrass	60	90	10	100	90	90	10	0	90	80	90	30	90	10
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	80	90	50	100	100	90	60	0	70	90	100	90	90	40
Kochia	50	100	30	90	90	100	40	0	80	60	70	80	80	40
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	100	100	100	100	90	0	20	100	90	100	100	80
Ragweed	0	100	40	100	90	90	70	30	100	90	80	90	90	70
Ryegrass, Italian	80	100	70	100	100	90	50	0	60	100	90	70	100	70
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
500 g ai/ha	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Preemergence														
Barnyardgrass	10	50	90	100	10	0	0	60	90	0	0	0	90	70
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	60	70	90	100	50	0	0	90	80	10	10	0	90	60
Kochia	0	80	100	100	20	0	0	30	90	10	0	0	30	80
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	80	100	100	100	10	0	0	100	100	30	40	0	100	60
Ragweed	70	80	90	100	10	10	0	80	90	60	10	0	80	80
Ryegrass, Italian	50	100	100	100	70	0	0	50	90	60	30	10	90	80
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
500 g ai/ha	53	54	55	56	57	58	59	61	62	63	64	65	66	67

Preemergence														
Barnyardgrass	20	90	90	50	100	20	100	0	90	90	0	90	70	90
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	100	100	70	100	0	100	0	90	70	0	90	90	100
Kochia	70	100	100	90	100	80	90	0	90	100	0	90	70	20
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	100	100	100	100	20	100	0	100	100	0	100	100	100
Ragweed	50	100	100	90	100	80	100	0	90	90	0	80	90	80
Ryegrass, Italian	50	100	100	100	100	100	100	0	100	100	0	100	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Preemergence														
Barnyardgrass	40	60	30	20	100	100	0	80	30	10	70	70	90	100
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	50	30	50	100	100	0	90	20	10	60	90	90	100
Kochia	0	90	40	20	100	100	0	90	0	0	100	90	90	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	100	100	100	100	100	50	100	50	0	100	100	100	100
Ragweed	20	80	80	20	90	90	0	90	50	0	90	80	90	100
Ryegrass, Italian	0	100	90	70	100	100	0	100	70	40	100	100	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Preemergence														
Barnyardgrass	70	100	60	100	40	80	100	60	100	100	0	0	40	0
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	90	100	90	100	70	100	100	80	100	100	0	0	50	0
Kochia	90	100	80	30	40	90	100	90	100	100	20	30	70	10
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pigweed	100	100	90	100	100	100	100	100	100	100	0	90	90	20
Ragweed	80	100	90	90	90	80	90	90	100	90	0	20	80	20
Ryegrass, Italian	90	100	90	100	40	100	100	90	100	90	0	40	50	60
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	96	97	98	99	100	101	102	103	104	105	106	107	108	109
Preemergence														
Barnyardgrass	0	100	100	90	20	30	60	90	100	100	100	100	100	100
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	100	100	80	90	60	90	100	100	100	100	100	100	100
Kochia	30	100	40	70	70	40	30	40	100	100	90	90	100	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	100	100	100	90	100	100	100	100	100	100	100	100
Ragweed	0	100	90	80	80	40	90	100	100	100	100	100	100	100
Ryegrass, Italian	40	100	90	100	100	100	60	100	100	100	100	100	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	110	111	112	113	114	115	116	117	118	119	120	121	122	123
Preemergence														
Barnyardgrass	20	100	20	100	80	50	100	50	30	0	30	50	30	80
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	40	100	60	100	90	50	100	30	20	0	20	80	70	70
Kochia	100	100	80	100	100	90	100	0	0	0	0	30	70	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	100	100	100	100	100	90	30	10	0	70	100	100	100
Ragweed	40	90	80	90	90	90	90	0	0	0	30	80	80	70
Ryegrass, Italian	80	100	100	100	90	100	100	0	0	0	30	90	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	124	125	126	127	128	129	130	131	132	133	134	135	136	137

Preemergence														
Barnyardgrass	0	90	80	40	90	100	100	40	70	50	90	0	80	100
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	100	70	60	90	100	90	90	90	70	90	30	100	100
Kochia	20	90	90	90	0	90	100	20	90	100	100	0	90	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	100	100	100	100	100	100	100	100	100	100	70	100	100
Ragweed	0	90	80	70	70	90	90	60	90	100	90	60	90	100
Ryegrass, Italian	30	100	100	90	30	100	100	90	90	100	100	60	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
500 g ai/ha	138	139	140	141	142	143	144	145	146	147	148	149	150	151
Preemergence														
Barnyardgrass	100	100	70	90	70	80	100	90	50	60	60	70	10	100
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	100	100	80	70	60	70	100	90	50	40	50	90	30	100
Kochia	100	100	30	60	0	70	100	100	70	80	90	90	20	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	100	100	60	50	100	100	100	100	100	100	100	100	100
Ragweed	100	100	90	60	40	90	100	100	80	90	80	90	30	90
Ryegrass, Italian	100	100	90	80	80	100	100	100	80	100	100	90	70	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
500 g ai/ha	152	153	154	155	156	157	158	159	160	161	162	163	164	165
Preemergence														
Barnyardgrass	40	100	100	80	100	90	60	80	10	60	20	0	20	30
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	90	100	100	90	90	80	40	80	30	70	40	0	40	40
Kochia	70	90	20	90	100	100	40	100	20	30	90	0	100	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pigweed	90	100	100	100	100	100	100	100	100	100	90	70	100	90
Ragweed	100	90	90	90	90	90	80	80	80	90	90	0	90	90
Ryegrass, Italian	100	100	100	90	100	100	80	100	80	100	100	50	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
500 g ai/ha	166	167	168	169	170	171	172	173	174	175	176	177	185	186
Preemergence														
Barnyardgrass	10	20	20	30	0	100	50	0	0	0	10	0	50	80
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	30	20	40	30	0	100	90	0	10	0	10	0	30	70
Kochia	90	100	0	90	0	100	0	0	0	20	20	0	10	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	0	100	100	100	0	0	20	60	90	0	60	100
Ragweed	90	80	0	20	20	90	0	0	0	20	70	0	40	80
Ryegrass, Italian	90	100	40	100	40	100	20	0	0	20	90	0	40	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds	
500 g ai/ha	187	188
Preemergence		
Barnyardgrass	90	30
Corn	-	-
Crabgrass, Large	-	-
Foxtail, Giant	70	90
Kochia	100	20
Morningglory	-	-
Pigweed	100	90
Ragweed	80	30
Ryegrass, Italian	100	80
Velvetleaf	-	-
Wheat	-	-

Table A	Compounds	
125 g ai/ha	187	188
Preemergence		
Barnyardgrass	70	10
Corn	-	-
Crabgrass, Large	-	-
Foxtail, Giant	20	10
Kochia	60	20
Morningglory	-	-
Pigweed	90	60
Ragweed	70	10
Ryegrass, Italian	100	20
Velvetleaf	-	-
Wheat	-	-

Table A	Compounds													
125 g ai/ha	2	8	9	12	14	15	16	17	18	19	20	21	22	23

Preemergence														
Barnyardgrass	50	0	50	20	0	20	10	0	0	30	30	90	10	90
Corn	0	0	0	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	90	10	20	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	100	40	70	20	0	10	0	0	0	0	40	90	70	90
Kochia	-	-	-	0	10	0	0	0	0	0	80	30	70	80
Morningglory	80	0	0	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	70	0	10	70	0	0	0	0	0	80	100	100	100
Ragweed	-	-	-	0	0	0	0	0	0	0	30	100	90	90
Ryegrass, Italian	-	-	-	20	30	50	30	10	0	0	90	100	100	80
Velvetleaf	80	0	0	-	-	-	-	-	-	-	-	-	-	-
Wheat	0	0	0	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	24	25	26	27	28	29	30	31	33	34	35	36	37	38
Preemergence														
Barnyardgrass	30	30	0	90	90	70	0	0	20	20	60	0	30	0
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	60	90	30	90	100	80	0	0	50	40	90	80	70	0
Kochia	30	90	30	40	50	60	0	0	30	30	40	10	30	40
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	70	100	80	100	100	100	80	0	20	90	60	100	100	0
Ragweed	0	90	20	90	90	90	0	0	80	80	70	80	80	0
Ryegrass, Italian	80	100	30	100	100	80	30	0	20	100	90	70	90	40
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Preemergence														
Barnyardgrass	0	10	20	80	0	0	0	20	70	0	0	0	30	50
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	40	70	80	0	0	0	50	70	0	0	0	50	40
Kochia	0	50	90	80	50	0	0	30	10	0	0	0	0	0
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pigweed	80	90	100	100	0	0	0	30	70	30	0	0	70	10
Ragweed	10	30	80	90	0	0	0	50	80	10	0	0	30	20
Ryegrass, Italian	40	60	100	100	10	0	0	30	60	20	0	0	50	80
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
125 g ai/ha	53	54	55	56	57	58	59	61	62	63	64	65	66	67
Preemergence														
Barnyardgrass	0	40	90	10	100	0	80	0	50	80	0	60	20	30
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	50	60	80	30	100	0	90	0	50	40	0	60	60	80
Kochia	50	50	70	40	100	20	90	0	90	100	0	60	60	20
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	50	100	70	60	100	0	100	0	100	100	0	100	100	90
Ragweed	0	90	90	80	90	70	90	0	70	80	0	70	80	80
Ryegrass, Italian	10	30	100	100	90	70	90	0	100	100	0	90	90	90
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
125 g ai/ha	68	69	70	71	72	73	74	75	76	77	78	79	80	81
Preemergence														
Barnyardgrass	10	10	0	0	10	40	0	40	0	0	0	50	70	90
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	10	0	0	70	90	0	50	0	0	20	90	80	100
Kochia	0	20	10	0	50	50	0	80	0	0	20	70	90	30
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	90	60	30	100	100	30	100	20	0	60	100	90	100
Ragweed	0	80	70	0	90	90	0	70	0	0	60	80	80	90
Ryegrass, Italian	0	70	60	0	100	100	0	100	50	10	100	80	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A							Compounds							
125 g ai/ha	82	83	84	85	86	87	88	89	90	91	92	93	94	95

Preemergence														
Barnyardgrass	40	70	20	70	0	50	90	50	60	90	0	0	0	0
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	70	100	70	100	20	80	100	50	50	80	0	0	20	0
Kochia	70	30	70	0	0	80	60	70	70	60	0	0	30	0
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	100	90	100	80	100	100	100	100	100	0	20	70	0
Ragweed	80	90	80	90	40	70	90	80	90	80	0	0	50	0
Ryegrass, Italian	80	100	70	100	0	90	100	80	100	90	0	20	20	10
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	96	97	98	99	100	101	102	103	104	105	106	107	108	109
Preemergence														
Barnyardgrass	0	20	40	60	20	0	40	40	80	20	80	70	20	20
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	60	90	50	70	30	70	80	70	90	100	70	90	90
Kochia	0	80	20	20	30	0	10	20	100	100	20	20	90	100
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	30	100	100	100	100	90	80	100	100	100	100	100	100	100
Ragweed	0	90	60	80	40	40	90	90	90	100	90	90	90	100
Ryegrass, Italian	0	100	20	100	90	60	60	90	100	100	100	80	100	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	110	111	112	113	114	115	116	117	118	119	120	121	122	123
Preemergence														
Barnyardgrass	0	70	10	70	30	10	70	0	0	0	0	20	0	0
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	80	50	70	40	30	80	0	0	0	0	80	30	70
Kochia	0	60	20	90	30	30	30	0	0	0	0	0	30	50
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pigweed	90	90	90	100	100	70	90	0	0	0	0	100	100	100
Ragweed	30	80	40	70	80	40	90	0	0	0	0	60	-	60
Ryegrass, Italian	20	90	90	100	80	100	80	0	0	0	30	80	70	90
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	124	125	126	127	128	129	130	131	132	133	134	135	136	137
Preemergence														
Barnyardgrass	0	70	40	10	50	90	30	0	0	20	20	0	10	90
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	0	90	10	50	80	90	30	80	70	40	50	20	80	90
Kochia	0	60	50	0	0	70	60	0	60	40	70	0	60	30
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	0	100	100	70	90	100	90	80	90	80	100	30	100	100
Ragweed	0	80	70	30	70	90	60	40	80	90	80	30	80	90
Ryegrass, Italian	0	100	90	60	10	100	100	90	90	100	100	20	90	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	138	139	140	141	142	143	144	145	146	147	148	149	150	151
Preemergence														
Barnyardgrass	10	20	50	50	10	20	90	20	0	30	10	0	0	90
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	90	60	50	30	10	20	100	30	0	10	20	30	0	90
Kochia	40	100	0	0	0	10	100	90	20	50	30	40	0	30
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	100	100	50	40	60	80	100	90	100	90	100	100	80	100
Ragweed	90	90	70	60	20	10	90	80	80	80	80	80	0	90
Ryegrass, Italian	100	100	70	70	50	70	100	100	80	70	80	90	20	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	152	153	154	155	156	157	158	159	160	161	162	163	164	165

Preemergence														
Barnyardgrass	40	100	70	50	70	70	10	50	10	10	10	0	10	10
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	40	100	90	60	80	50	10	60	10	10	10	0	10	10
Kochia	30	80	0	20	50	100	30	100	20	0	60	0	60	60
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	90	100	100	100	100	100	10	100	50	100	80	30	80	100
Ragweed	80	80	80	90	90	60	50	80	30	90	50	0	50	50
Ryegrass, Italian	90	100	90	70	90	100	80	100	20	100	40	10	60	40
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A	Compounds													
125 g ai/ha	166	167	168	169	170	171	172	173	174	175	176	177	185	186
Preemergence														
Barnyardgrass	10	10	0	0	0	70	20	0	0	0	0	0	0	40
Corn	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crabgrass, Large	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxtail, Giant	10	10	0	0	0	50	60	0	0	0	0	0	0	50
Kochia	30	60	0	20	0	100	0	0	0	0	0	0	0	80
Morningglory	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pigweed	80	100	0	50	30	90	0	0	0	0	0	0	20	100
Ragweed	70	70	0	0	0	70	0	0	0	0	20	0	0	70
Ryegrass, Italian	40	80	0	80	0	100	0	0	0	20	0	0	0	100
Velvetleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TEST B

Plant species in the flooded paddy test selected from rice (*Oryza sativa*), sedge, umbrella (small-flower umbrella sedge, *Cyperus difformis*), ducksalad (*Heteranthera limosa*), and barnyardgrass (*Echinochloa crus-galli*) were grown to the 2-leaf stage for testing. At 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 d, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table B	Compounds													
250 g ai/ha	1	2	3	4	5	7	8	9	10	11	12	13	14	15
Flood														
Barnyardgrass	0	30	0	0	0	20	30	0	0	0	0	0	0	0
Ducksalad	20	80	20	0	45	60	20	0	30	0	30	0	0	20
Rice	0	35	0	0	0	0	0	0	0	0	0	0	0	0
Sedge, Umbrella	0	85	0	0	75	60	70	0	0	0	0	0	0	0

Table B	Compounds													
250 g ai/ha	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Flood														
Barnyardgrass	0	0	0	0	0	70	0	0	0	30	0	30	60	0
Ducksalad	30	0	30	0	50	0	0	75	0	20	0	30	80	55
Rice	0	0	0	0	0	55	0	0	0	0	0	40	40	0
Sedge, Umbrella	0	0	0	0	50	65	0	95	0	60	0	80	95	60

Table B	Compounds													
250 g ai/ha	31	32	33	34	35	36	41	42	43	44	45	46	47	48
Flood														
Barnyardgrass	0	0	0	0	0	0	30	0	0	0	0	0	0	0
Ducksalad	0	0	0	0	75	30	40	0	0	0	0	0	0	0
Rice	0	0	0	0	0	20	0	0	0	0	0	0	0	0
Sedge, Umbrella	0	0	0	0	65	70	40	0	0	0	0	0	0	0

Table B	Compounds													
250 g ai/ha	49	50	51	53	54	55	56	57	58	59	60	62	63	65
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	35	20	0	0
Ducksalad	0	0	0	0	0	0	0	0	0	0	20	20	30	0
Rice	0	0	0	0	0	0	0	0	0	0	35	0	0	0
Sedge, Umbrella	0	0	0	0	0	0	0	0	0	0	30	75	65	0

Table B	Compounds													
250 g ai/ha	66	67	68	72	73	74	75	79	81	82	83	84	85	86
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	60	0	60	0	50	0

Ducksalad	0	0	0	0	0	0	0	0	70	0	70	0	50	20
Rice	0	0	0	0	0	0	15	0	60	0	30	0	50	15
Sedge, Umbrella	0	0	30	0	0	0	0	0	80	0	90	0	80	60

Table B	Compounds													
250 g ai/ha	87	88	89	91	92	93	94	98	99	100	101	102	103	110
Flood														
Barnyardgrass	0	50	0	0	0	0	0	45	0	0	0	0	30	0
Ducksalad	0	50	65	0	0	0	0	75	0	0	0	0	0	0
Rice	0	40	0	0	0	0	0	30	0	0	0	0	0	0
Sedge, Umbrella	0	80	40	40	40	50	0	60	0	0	0	50	50	0

Table B	Compounds													
250 g ai/ha	111	112	113	114	115	116	117	118	119	121	122	123	124	125
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Ducksalad	75	0	0	50	0	50	0	0	0	0	0	30	0	80
Rice	0	0	0	0	0	0	0	0	0	0	0	15	0	0
Sedge, Umbrella	75	0	0	70	0	70	0	0	0	0	0	70	0	75

Table B	Compounds													
250 g ai/ha	126	127	128	130	131	132	133	134	135	136	137	138	139	143
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	25	0	0	0
Ducksalad	30	0	30	0	0	0	0	0	0	0	40	0	0	0
Rice	0	0	0	0	0	0	20	0	0	0	0	0	0	0
Sedge, Umbrella	0	0	0	0	0	0	0	0	0	0	65	0	0	0

Table B	Compounds													
250 g ai/ha	144	145	146	147	148	149	150	151	152	153	154	155	156	157
Flood														
Barnyardgrass	30	0	0	0	0	0	0	45	0	0	50	0	0	20
Ducksalad	40	0	0	0	0	0	0	40	0	0	60	50	60	0
Rice	30	0	0	0	0	0	0	20	0	0	50	20	0	0
Sedge, Umbrella	0	0	0	0	0	0	0	70	0	0	80	65	75	75

Table B	Compounds													
250 g ai/ha	158	159	160	162	163	164	165	166	167	168	169	170	171	172
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	40	0	0	0	0
Rice	20	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedge, Umbrella	65	50	0	0	0	0	0	0	0	0	0	60	60	0

Table B						Compounds								
250 g ai/ha	173	174	175	176	177	179	180	181	183	184	185	186	187	188
Flood														
Barnyardgrass	0	0	0	0	0	0	0	0	0	0	0	15	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	0	0	0	0	0	20	0
Sedge, Umbrella	0	0	0	0	0	0	0	0	0	0	0	40	0	0

TEST C

Seeds of plant species selected from blackgrass (*Alopecurus myosuroides*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), wheat (winter wheat, *Triticum aestivum*), galium (catchweed bedstraw, *Galium aparine*), corn (*Zea mays*), large crabgrass, large (large crabgrass, *Digitaria sanguinalis*), foxtail, giant (giant foxtail, *Setaria faberii*), johnsongrass (*Sorghum halepense*), lambsquarters (*Chenopodium album*), morningglory (*Ipomoea coccinea*), nutsedge, yellow (yellow nutsedge, *Cyperus esculentus*), pigweed (*Amaranthus retroflexus*), ragweed (common ragweed, *Ambrosia elatior*), soybean (*Glycine max*), barnyardgrass (*Echinochloa crus-galli*), oilseed rape (*Brassica napus*), waterhemp (common waterhemp, *Amaranthus rudis*), and velvetleaf (*Abutilon theophrasti*) were planted into a blend of loam soil and sand 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 chickweed (common chickweed, *Stellaria media*), kochia (*Kochia scoparia*), and oat, wild (wild oat, *Avena fatua*), were planted in pots containing Redi-Earth® planting medium (Scotts Company, 14111 Scottslawn Road, Marysville, Ohio 43041) comprising spaghnum peat moss, vermiculite, wetting agent and starter nutrients and treated with postemergence applications of 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 13 to 15 d, 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

250 g ai/ha	1	2	10	11	14	16	20	21	22	23	25	26	27	28
Postemergence														
Barnyardgrass	5	20	98	15	60	90	45	90	15	85	25	35	50	40
Blackgrass	75	80	15	75	20	40	45	95	20	85	80	75	90	90
Chickweed	100	98	90	90	90	90	100	100	98	100	100	100	100	95
Corn	40	10	5	0	5	0	10	20	5	25	10	5	15	15
Crabgrass, Large	35	10	75	10	35	30	30	55	5	45	20	25	45	45
Foxtail, Giant	90	95	90	30	50	80	80	95	35	90	85	65	95	95
Galium	95	98	85	90	90	80	100	100	95	100	95	95	100	100
Johnsongrass	15	5	25	5	5	5	10	35	5	40	10	5	10	30
Kochia	100	75	95	100	90	25	100	100	95	100	100	100	90	100
Lambsquarters	100	100	98	90	90	20	100	98	90	98	98	98	98	100
Morningglory	100	100	100	98	100	40	100	100	100	100	100	100	100	100
Nutsedge, Yellow	-	98	-	45	-	-	95	90	65	85	90	25	95	90
Oat, Wild	100	85	25	70	45	40	40	100	80	100	95	90	100	100
Oilseed Rape	40	75	0	0	0	0	25	100	75	10	5	5	70	70
Pigweed	100	98	95	95	90	50	100	98	98	98	98	95	90	90
Ragweed	95	98	98	95	98	30	100	95	100	98	95	90	90	90
Ryegrass, Italian	98	90	55	90	85	70	90	95	90	95	95	90	90	95
Soybean	5	5	0	0	5	0	0	20	0	15	10	10	0	5
Velvetleaf	100	100	70	80	40	35	100	90	80	90	98	70	95	90
Waterhemp	100	100	90	95	40	5	90	80	90	98	98	95	90	85
Wheat	15	5	0	5	5	0	0	35	0	30	5	5	5	5

Table C Compounds

250 g ai/ha	29	32	33	34	36	37	41	42	47	51	52	54	56	57
Postemergence														
Barnyardgrass	40	90	80	35	40	90	60	40	90	20	10	20	10	98
Blackgrass	75	80	10	60	20	85	60	70	30	10	30	40	40	25
Chickweed	100	100	95	95	95	95	100	100	98	90	100	100	70	100
Corn	20	40	20	5	5	30	20	5	5	0	0	10	0	10
Crabgrass, Large	40	70	25	25	35	35	35	20	35	10	10	55	20	35
Foxtail, Giant	80	90	70	35	80	85	65	80	85	35	35	90	50	95
Galium	100	100	95	95	95	95	100	95	90	95	100	98	90	100
Johnsongrass	25	35	40	5	5	35	35	25	25	0	15	10	10	10
Kochia	85	95	50	85	90	80	100	100	98	75	70	95	100	95

Lambsquarters	90	100	100	100	100	100	98	98	85	-	98	100	85	90
Morningglory	100	100	98	98	100	98	98	100	100	75	100	100	50	100
Nutsedge, Yellow	75	85	65	85	65	60	80	95	90	90	95	70	60	90
Oat, Wild	95	100	45	90	85	90	95	95	50	10	0	85	40	60
Oilseed Rape	0	90	50	20	90	50	0	0	10	5	0	70	0	5
Pigweed	98	95	80	98	100	95	95	98	98	85	55	100	90	100
Ragweed	95	98	98	95	95	98	100	100	100	25	98	98	60	95
Ryegrass, Italian	95	95	75	90	80	90	90	95	30	70	60	80	90	60
Soybean	25	35	0	5	15	25	15	15	15	0	0	10	0	5
Velvetleaf	90	85	85	90	95	90	90	95	95	70	100	100	70	100
Waterhemp	98	98	75	98	98	98	85	95	100	-	55	95	90	100
Wheat	10	40	0	0	5	35	5	0	0	0	0	0	5	5

Table C	Compounds													
250 g ai/ha	59	60	65	66	67	69	72	73	75	78	79	80	81	82
Postemergence														
Barnyardgrass	70	65	50	35	45	55	65	60	20	25	40	35	60	30
Blackgrass	90	90	40	60	80	70	90	90	35	30	50	50	90	40
Chickweed	98	98	90	95	95	100	90	95	95	80	90	98	95	98
Corn	50	35	5	25	20	10	25	60	10	0	35	5	0	5
Crabgrass, Large	60	65	25	45	40	30	60	75	20	10	35	35	55	30
Foxtail, Giant	90	90	60	80	85	25	85	85	10	25	90	90	90	80
Galium	98	100	90	95	90	98	95	95	90	95	95	95	95	95
Johnsongrass	35	45	5	15	10	15	45	50	10	5	10	15	70	10
Kochia	90	100	100	98	80	98	90	100	95	90	90	90	80	90
Lambsquarters	98	100	100	100	100	98	95	98	100	100	100	100	100	100
Morningglory	100	100	95	100	100	98	100	95	75	65	98	98	98	100
Nutsedge, Yellow	95	95	65	85	85	65	85	90	70	60	85	95	90	85
Oat, Wild	98	95	70	90	100	85	95	95	35	60	90	95	95	90
Oilseed Rape	55	80	5	0	75	0	85	85	80	5	80	80	45	75
Pigweed	98	98	100	100	85	95	98	98	98	80	98	95	90	90
Ragweed	98	100	90	100	95	98	90	90	100	75	98	98	85	95
Ryegrass, Italian	95	95	85	85	85	95	90	90	85	90	85	85	90	85
Soybean	25	50	10	5	10	35	30	45	10	20	5	20	0	10
Velvetleaf	95	95	75	95	98	98	95	90	85	60	90	90	90	90
Waterhemp	100	98	85	100	70	100	85	100	100	90	95	95	80	98
Wheat	15	15	0	0	0	0	35	40	0	10	0	15	0	5

Table C	Compounds													
250 g ai/ha	83	84	85	87	88	89	90	91	97	98	99	100	102	104
Postemergence														
Barnyardgrass	45	40	50	45	60	40	70	65	35	98	35	40	40	55
Blackgrass	90	60	90	65	90	5	40	30	0	70	65	25	10	55
Chickweed	100	100	100	98	100	100	98	100	60	100	90	95	98	100
Corn	10	10	5	5	15	5	25	20	5	15	10	10	10	30
Crabgrass, Large	55	30	45	35	55	10	75	40	25	70	50	15	15	55
Foxtail, Giant	90	85	90	85	90	30	75	80	5	100	50	90	75	85
Galium	100	95	100	98	100	95	95	98	90	98	98	95	95	98
Johnsongrass	10	20	25	10	5	5	20	10	5	10	5	10	10	5
Kochia	80	95	70	95	85	100	100	98	85	80	95	95	50	100
Lambsquarters	98	98	100	100	98	100	100	100	60	100	98	98	100	100
Morningglory	98	100	100	100	98	98	100	100	30	100	100	100	100	100
Nutsedge, Yellow	90	90	90	85	85	75	85	85	5	60	85	50	75	75
Oat, Wild	95	90	90	90	100	40	95	90	10	100	95	95	25	90
Oilseed Rape	70	50	15	20	80	0	5	90	35	25	55	90	30	98
Pigweed	90	100	90	98	90	95	100	100	75	100	95	100	100	100
Ragweed	85	95	90	100	90	98	100	100	35	100	100	98	100	100
Ryegrass, Italian	95	85	95	85	90	80	90	95	55	85	95	95	30	90
Soybean	10	5	15	5	25	0	70	20	5	25	5	5	10	10
Velvetleaf	90	98	95	90	90	80	98	100	30	100	100	65	100	90
Waterhemp	80	90	85	90	90	50	100	80	10	100	98	98	85	95
Wheat	0	0	0	0	0	0	30	5	0	30	10	5	5	10

Table C	Compounds													
250 g ai/ha	105	106	107	108	109	111	113	114	115	121	123	125	126	127
Postemergence														
Barnyardgrass	20	40	90	60	65	40	45	40	45	30	70	70	50	25
Blackgrass	60	75	30	55	80	35	60	15	35	50	45	80	40	35
Chickweed	100	98	98	98	100	98	100	98	90	98	98	95	100	95
Corn	30	10	15	30	50	10	15	0	15	5	20	5	25	10
Crabgrass, Large	30	30	65	40	60	25	70	25	25	40	75	60	30	25
Foxtail, Giant	85	95	75	85	85	85	70	85	35	85	80	98	25	40
Galium	100	100	98	95	100	95	95	95	95	95	95	95	98	90
Johnsongrass	0	10	20	5	5	10	20	15	20	5	25	20	25	15
Kochia	100	80	90	100	100	95	100	95	90	95	98	90	95	90

Lambsquarters	100	98	98	98	100	100	100	100	98	100	100	100	95	98
Morningglory	100	98	100	100	100	100	100	100	100	98	100	100	98	98
Nutsedge, Yellow	90	80	85	75	80	75	95	35	80	75	90	90	85	70
Oat, Wild	90	90	35	90	90	98	90	85	90	90	95	95	85	60
Oilseed Rape	75	95	45	95	95	100	0	80	0	55	5	10	85	100
Pigweed	98	90	98	98	100	98	98	95	90	98	98	98	95	95
Ragweed	100	98	98	100	100	100	100	100	98	98	98	98	95	90
Ryegrass, Italian	80	35	90	90	90	95	95	95	95	90	95	95	90	90
Soybean	40	10	10	15	25	10	55	5	65	0	65	10	35	35
Velvetleaf	100	100	100	100	100	90	98	85	65	80	95	98	95	55
Waterhemp	98	80	90	98	100	70	100	45	90	70	100	100	100	95
Wheat	5	5	0	10	35	25	15	15	5	0	20	35	5	30

Table C	Compounds													
250 g ai/ha	129	130	132	133	134	136	137	138	139	145	153	154	161	162
Postemergence														
Barnyardgrass	85	55	25	35	55	40	65	40	60	70	90	95	55	25
Blackgrass	80	60	45	30	98	45	0	80	10	90	90	85	65	40
Chickweed	100	100	95	-	-	-	-	-	-	-	98	95	80	95
Corn	30	15	10	5	15	10	20	15	15	10	10	5	40	0
Crabgrass, Large	60	60	25	20	40	35	35	25	40	20	75	75	20	10
Foxtail, Giant	95	70	75	55	45	90	95	80	60	55	95	95	35	40
Galium	100	98	95	100	100	95	95	95	100	100	98	95	95	98
Johnsongrass	25	20	10	10	25	5	15	20	25	20	15	20	25	10
Kochia	95	100	95	100	100	100	100	100	100	100	85	80	90	90
Lambsquarters	98	100	100	100	100	100	100	98	100	100	95	95	85	95
Morningglory	100	100	98	95	100	100	100	100	100	100	100	100	98	90
Nutsedge, Yellow	95	85	85	98	90	85	90	80	85	95	90	80	50	30
Oat, Wild	98	95	90	95	95	90	90	90	90	100	95	90	90	70
Oilseed Rape	5	0	40	98	100	98	98	98	95	90	90	95	90	0
Pigweed	98	90	65	95	100	98	100	98	98	100	85	85	98	90
Ragweed	95	98	98	5	30	5	40	5	0	25	90	90	85	90
Ryegrass, Italian	95	95	95	5	40	35	60	70	60	40	95	95	90	80
Soybean	25	50	20	40	85	15	20	25	60	70	5	25	40	0
Velvetleaf	100	98	75	100	100	98	95	98	100	100	95	90	100	70
Waterhemp	98	98	75	100	100	100	90	100	100	100	90	70	95	65
Wheat	55	15	0	80	90	90	95	90	90	90	10	5	15	10

Table C	Compounds			
250 g ai/ha	164	165	171	176
Postemergence				
Barnyardgrass	35	25	60	20
Blackgrass	45	25	55	0
Chickweed	98	98	95	-
Corn	5	5	20	5
Crabgrass, Large	10	20	55	30
Foxtail, Giant	30	25	75	40
Galium	100	100	95	60
Johnsongrass	10	15	20	10
Kochia	95	90	98	100
Lambsquarters	98	98	100	90
Morningglory	90	95	100	100
Nutsedge, Yellow	40	35	-	5
Oat, Wild	80	70	95	35
Oilseed Rape	0	5	30	95
Pigweed	85	85	100	75
Ragweed	90	85	100	0
Ryegrass, Italian	85	70	95	10
Soybean	5	15	50	10
Velvetleaf	70	50	100	80
Waterhemp	75	75	100	55
Wheat	20	15	20	40

Table C	Compounds													
125 g ai/ha	1	2	10	11	14	16	20	21	22	23	25	26	27	28
Postemergence														
Barnyardgrass	5	15	90	5	55	70	30	75	10	75	20	30	25	35
Blackgrass	60	85	10	30	5	5	10	90	20	70	60	60	85	80
Chickweed	98	95	90	85	90	90	100	100	95	100	100	100	100	98
Corn	5	5	5	0	0	0	5	20	5	10	5	5	0	5
Crabgrass, Large	25	15	65	0	30	20	10	40	5	35	20	20	30	40
Foxtail, Giant	60	90	50	10	50	70	45	90	40	85	70	40	90	85
Galium	95	98	70	90	80	85	100	100	95	100	100	95	100	100
Johnsongrass	0	5	5	5	0	0	10	20	5	10	5	5	-	-
Kochia	95	65	95	100	90	20	90	95	95	100	100	90	90	95
Lambsquarters	100	98	65	90	80	40	100	95	90	95	98	90	90	100
Morningglory	100	100	100	90	100	60	100	100	100	100	100	100	100	100
Nutsedge, Yellow	-	98	-	30	-	-	85	90	65	85	90	20	-	85
Oat, Wild	85	90	5	60	40	10	25	98	80	100	90	95	95	100
Oilseed Rape	5	70	0	0	0	10	5	100	90	45	20	5	80	5
Pigweed	98	90	70	90	70	30	98	95	90	98	95	98	85	90
Ragweed	95	95	70	95	50	0	95	90	90	95	95	85	85	85
Ryegrass, Italian	95	85	20	90	65	60	80	95	90	95	90	90	90	90
Soybean	5	50	0	0	5	0	35	10	0	10	10	10	0	0

Velvetleaf	95	100	40	45	40	20	85	85	80	85	85	60	90	85
Waterhemp	100	85	50	95	50	5	60	85	75	85	95	85	10	85
Wheat	10	5	0	5	5	0	0	35	5	35	0	0	5	0

Table C	Compounds													
125 g ai/ha	29	32	33	34	36	37	40	41	42	47	51	52	54	56
Postemergence														
Barnyardgrass	40	65	50	35	35	60	25	40	30	85	10	5	55	5
Blackgrass	60	80	5	35	5	80	45	50	60	30	0	30	60	5
Chickweed	100	100	90	90	95	90	90	90	100	98	70	98	95	55
Corn	30	30	5	5	5	20	20	10	5	10	0	0	5	0
Crabgrass, Large	50	75	20	20	25	25	10	25	20	40	10	5	35	5
Foxtail, Giant	60	80	60	25	70	60	20	30	35	75	15	10	75	0
Galium	100	100	95	95	95	95	90	100	100	90	90	100	98	90
Johnsongrass	-	15	5	5	5	5	5	10	-	20	0	10	10	5
Kochia	75	90	40	60	55	5	0	100	100	95	50	5	90	90
Lambsquarters	85	98	98	95	98	95	80	95	100	98	65	75	100	85
Morningglory	100	100	95	95	98	98	80	100	100	100	75	100	98	50
Nutsedge, Yellow	-	80	45	85	55	65	20	65	-	80	85	90	55	50
Oat, Wild	85	100	40	90	65	90	60	90	90	30	5	0	60	20
Oilseed Rape	5	60	30	50	50	40	5	5	10	5	5	0	40	0
Pigweed	98	90	65	80	95	95	85	75	98	98	70	10	98	85
Ragweed	95	98	90	95	95	98	85	95	98	98	5	80	95	60
Ryegrass, Italian	85	90	70	90	60	90	80	90	90	25	60	45	85	65
Soybean	20	30	0	15	5	15	30	20	10	10	0	0	10	0
Velvetleaf	85	85	75	100	95	85	20	85	85	95	50	55	98	15
Waterhemp	80	85	65	90	95	80	80	90	98	100	80	10	95	95
Wheat	30	25	0	10	0	30	10	30	0	0	0	0	0	5

Table C	Compounds													
125 g ai/ha	57	59	60	65	66	67	69	72	73	75	78	79	80	81
Postemergence														
Barnyardgrass	95	55	35	35	30	35	35	50	55	15	30	30	35	35
Blackgrass	5	85	85	10	40	65	30	80	90	20	5	35	40	90
Chickweed	95	98	95	90	95	95	95	90	95	95	70	90	95	95
Corn	5	65	30	5	5	10	5	20	20	10	10	25	5	10
Crabgrass, Large	30	25	50	20	35	35	25	35	60	5	10	30	30	40

Foxtail, Giant	85	85	70	35	65	80	10	75	75	5	20	75	70	90
Galium	95	98	100	90	95	95	98	95	95	90	80	95	95	95
Johnsongrass	5	25	55	5	5	5	10	5	40	5	5	10	5	5
Kochia	70	85	100	90	90	35	95	90	90	95	85	90	90	80
Lambsquarters	95	98	95	95	100	90	100	90	95	100	75	98	98	98
Morningglory	100	100	100	95	100	100	95	95	95	100	65	100	100	100
Nutsedge, Yellow	90	95	90	60	85	80	70	70	80	50	35	80	85	90
Oat, Wild	45	90	95	50	90	90	80	90	95	40	60	85	90	95
Oilseed Rape	0	40	85	0	10	75	50	20	70	90	0	70	60	85
Pigweed	85	95	95	98	100	80	90	95	95	100	75	98	95	85
Ragweed	85	95	98	80	90	98	95	95	90	100	60	98	98	70
Ryegrass, Italian	50	90	95	85	85	85	95	90	90	85	85	85	85	90
Soybean	0	10	40	5	10	5	20	15	25	35	5	5	5	5
Velvetleaf	100	90	90	65	85	85	85	85	85	85	35	90	55	90
Waterhemp	85	98	98	75	90	75	95	85	85	100	80	80	85	85
Wheat	0	10	30	0	0	0	0	5	35	0	5	0	10	0

Table C						Compounds								
125 g ai/ha	82	83	84	85	87	88	89	90	91	97	98	99	100	102
Postemergence														
Barnyardgrass	25	30	25	40	35	40	20	50	45	15	98	35	30	35
Blackgrass	35	90	55	90	60	90	0	25	10	0	50	50	5	5
Chickweed	90	95	95	95	95	100	100	95	100	15	100	90	95	95
Corn	10	10	30	0	30	20	10	10	10	0	15	10	5	10
Crabgrass, Large	20	40	20	40	25	55	5	35	25	10	45	30	25	20
Foxtail, Giant	60	85	65	90	75	90	20	55	75	5	98	30	75	60
Galium	95	100	95	100	95	100	95	95	98	85	98	98	95	95
Johnsongrass	10	5	10	50	5	5	0	10	5	0	10	10	5	0
Kochia	90	65	90	60	90	100	90	100	90	70	60	90	95	20
Lambsquarters	98	85	98	100	98	95	100	98	100	50	100	85	98	70
Morningglory	100	100	98	100	100	98	98	100	100	30	100	100	100	100
Nutsedge, Yellow	85	85	85	95	80	80	70	90	45	0	50	75	20	60
Oat, Wild	90	90	90	95	85	100	30	90	90	5	95	90	85	10
Oilseed Rape	50	45	50	10	50	60	0	0	95	0	10	60	10	5
Pigweed	90	90	95	85	90	90	80	95	100	60	100	98	100	95
Ragweed	95	90	98	85	95	85	90	95	95	25	98	95	95	100
Ryegrass, Italian	85	90	85	90	85	90	75	90	95	50	65	95	90	25

Soybean	5	0	10	0	10	5	0	55	10	5	25	5	5	10
Velvetleaf	95	90	85	85	90	85	75	98	98	10	75	98	40	100
Waterhemp	90	60	95	85	90	85	50	100	75	5	100	95	95	80
Wheat	5	0	5	0	0	0	0	10	10	0	15	10	0	5

Table C	Compounds													
125 g ai/ha	104	105	106	107	108	109	111	113	114	115	121	123	125	126
Postemergence														
Barnyardgrass	45	25	20	40	40	55	45	35	40	35	25	40	80	35
Blackgrass	50	50	60	5	35	50	20	45	5	20	15	45	60	10
Chickweed	100	98	95	95	95	95	100	98	98	90	90	90	95	95
Corn	50	30	10	20	25	35	15	10	0	5	5	20	5	20
Crabgrass, Large	35	20	30	35	25	60	25	25	20	20	20	30	40	30
Foxtail, Giant	75	75	90	70	75	80	70	30	50	20	70	35	95	15
Galium	98	95	95	100	95	100	95	95	95	95	95	95	95	98
Johnsongrass	5	0	10	0	5	5	15	10	5	10	5	20	20	15
Kochia	95	95	80	90	95	100	90	95	90	90	95	95	90	95
Lambsquarters	100	100	95	90	98	100	100	100	100	90	98	100	98	95
Morningglory	100	100	100	98	98	100	100	100	100	95	100	98	100	98
Nutsedge, Yellow	60	75	90	75	70	80	65	85	25	65	85	85	85	70
Oat, Wild	90	90	90	40	90	90	90	90	65	80	80	90	95	90
Oilseed Rape	95	60	85	80	85	95	95	0	40	0	85	0	5	60
Pigweed	100	100	90	98	98	100	90	95	95	70	90	80	98	95
Ragweed	98	98	75	98	98	100	98	98	98	95	95	95	98	95
Ryegrass, Italian	90	90	90	60	90	90	95	95	80	95	90	90	95	90
Soybean	10	10	0	20	15	30	5	40	0	20	0	20	10	20
Velvetleaf	98	90	90	95	100	98	98	90	55	70	75	85	95	98
Waterhemp	100	100	75	95	90	90	55	90	55	90	75	100	98	95
Wheat	5	5	0	0	5	10	15	5	5	0	25	15	30	0

Table C	Compounds													
125 g ai/ha	127	129	130	132	133	134	136	137	138	139	143	145	153	154
Postemergence														
Barnyardgrass	25	70	35	25	45	40	35	50	30	40	30	30	70	90
Blackgrass	5	60	55	25	70	50	30	0	50	60	20	30	90	60
Chickweed	90	100	98	95	-	-	-	-	-	-	80	-	98	90
Corn	5	30	5	5	5	10	10	10	15	15	5	5	25	5

Crabgrass, Large	10	35	15	10	5	15	25	35	20	30	30	10	50	70
Foxtail, Giant	25	85	40	60	40	35	70	80	65	30	20	25	90	95
Galium	85	100	95	95	98	100	90	90	95	100	90	98	98	95
Johnsongrass	10	15	5	5	20	5	5	15	20	15	20	20	10	20
Kochia	95	90	100	95	100	100	100	100	100	100	60	100	80	60
Lambsquarters	85	95	100	100	100	100	95	98	95	100	75	100	95	90
Morningglory	85	100	85	95	100	100	100	100	98	100	70	100	98	98
Nutsedge, Yellow	60	85	80	75	95	95	75	85	75	70	35	85	95	85
Oat, Wild	55	100	85	70	95	95	85	90	80	90	60	95	95	90
Oilseed Rape	25	5	0	5	98	100	98	98	98	98	5	95	90	98
Pigweed	90	98	90	70	100	100	85	98	90	98	75	75	85	90
Ragweed	60	95	98	95	5	5	0	30	5	0	70	5	95	85
Ryegrass, Italian	80	95	95	95	35	20	30	30	10	35	90	30	95	90
Soybean	30	20	25	0	75	70	10	15	10	65	20	55	10	20
Velvetleaf	25	95	98	65	100	100	90	90	95	95	50	98	90	85
Waterhemp	85	85	80	80	100	100	95	85	98	100	90	100	90	85
Wheat	5	40	10	0	55	65	45	90	80	60	15	85	10	10

Table C	Compounds					
125 g ai/ha	161	162	164	165	171	176
Postemergence						
Barnyardgrass	45	25	30	25	40	10
Blackgrass	60	30	40	20	40	0
Chickweed	70	95	95	95	90	-
Corn	15	0	5	0	10	0
Crabgrass, Large	5	10	10	20	40	20
Foxtail, Giant	10	15	15	15	50	35
Galium	95	95	100	98	95	60
Johnsongrass	20	5	5	10	15	5
Kochia	80	90	90	85	98	95
Lambsquarters	80	90	85	85	98	80
Morningglory	95	85	90	85	100	98
Nutsedge, Yellow	20	30	25	25	75	5
Oat, Wild	80	70	70	65	90	10
Oilseed Rape	95	0	0	0	0	95
Pigweed	90	85	85	75	90	50
Ragweed	95	75	85	75	100	0

Ryegrass, Italian	90	70	80	55	95	0
Soybean	40	0	10	15	60	15
Velvetleaf	90	30	25	20	100	75
Waterhemp	85	70	70	75	98	60
Wheat	10	5	10	10	30	10

Table C						Compounds								
62 g ai/ha	1	2	10	11	14	16	20	21	22	23	25	26	27	28
Postemergence														
Barnyardgrass	5	10	90	0	5	70	10	45	5	60	20	25	20	25
Blackgrass	50	65	0	15	0	5	10	90	0	60	55	55	70	70
Chickweed	95	95	90	65	90	80	98	100	90	100	98	95	100	95
Corn	25	5	0	0	0	0	5	65	5	30	5	10	5	5
Crabgrass, Large	10	15	30	0	5	20	10	35	5	20	15	20	25	20
Foxtail, Giant	15	65	60	5	45	60	25	80	15	65	35	25	75	80
Galium	95	95	50	90	55	80	100	100	90	100	95	95	100	100
Johnsongrass	0	5	0	0	0	0	10	20	5	5	5	5	0	5
Kochia	95	55	85	95	85	0	80	90	95	95	95	70	80	70
Lambsquarters	100	85	80	90	80	60	85	90	85	95	95	85	85	98
Morningglory	100	100	90	80	85	50	100	100	100	100	100	100	100	98
Nutsedge, Yellow	-	95	-	15	-	-	65	90	50	70	75	10	80	85
Oat, Wild	70	80	5	45	30	5	5	98	50	95	70	80	95	95
Oilseed Rape	0	70	0	0	0	0	0	80	15	15	0	0	70	60
Pigweed	95	60	60	90	70	30	90	95	75	98	90	85	80	85
Ragweed	95	80	30	40	90	0	85	90	75	90	85	70	75	75
Ryegrass, Italian	90	75	5	70	60	50	60	95	70	90	85	90	85	85
Soybean	0	0	0	0	0	0	0	0	0	10	0	5	0	0
Velvetleaf	85	100	45	5	20	5	25	85	50	85	80	30	85	85
Waterhemp	95	65	45	80	10	5	40	75	70	55	95	85	60	75
Wheat	0	0	0	0	0	0	0	5	0	30	0	0	0	0

Table C						Compounds								
62 g ai/ha	29	32	33	34	35	36	37	40	41	42	47	51	52	54
Postemergence														
Barnyardgrass	25	30	25	25	20	25	20	15	35	30	55	5	5	30
Blackgrass	50	60	0	10	45	5	40	15	35	35	20	0	10	5
Chickweed	95	95	90	90	95	95	90	60	95	100	90	55	90	95

Corn	10	20	5	5	5	0	10	0	5	5	5	0	0	0
Crabgrass, Large	20	30	20	10	20	30	20	5	10	15	30	5	0	25
Foxtail, Giant	35	50	40	20	75	55	35	15	15	30	65	5	5	55
Galium	95	100	90	95	95	95	95	85	100	90	90	90	100	98
Johnsongrass	5	25	5	5	20	5	5	5	10	5	10	0	10	5
Kochia	60	50	5	45	40	55	0	80	100	100	90	15	0	90
Lambsquarters	85	90	95	90	70	98	90	70	95	95	85	50	60	95
Morningglory	100	100	95	98	100	98	95	65	95	100	100	55	100	98
Nutsedge, Yellow	35	80	15	60	85	40	40	15	65	75	70	70	80	35
Oat, Wild	55	90	30	85	60	60	80	50	90	90	10	5	0	50
Oilseed Rape	0	60	55	30	10	40	20	30	0	5	0	5	0	80
Pigweed	95	90	50	85	55	85	100	65	75	95	90	65	5	95
Ragweed	90	90	95	98	40	90	95	75	85	85	98	5	65	95
Ryegrass, Italian	80	90	45	80	55	60	85	65	90	90	10	50	40	80
Soybean	10	25	0	5	5	0	5	60	15	5	10	0	0	5
Velvetleaf	80	70	60	80	100	85	70	10	65	85	90	20	25	90
Waterhemp	80	80	30	85	45	95	80	65	75	85	75	50	10	90
Wheat	5	15	0	5	5	0	0	10	0	0	0	0	0	50

Table C						Compounds								
62 g ai/ha	56	57	59	60	65	66	67	69	72	73	75	78	79	80
Postemergence														
Barnyardgrass	5	95	30	25	15	20	35	35	40	40	25	25	25	30
Blackgrass	5	5	80	60	5	15	60	20	70	85	5	5	10	35
Chickweed	10	95	98	95	90	95	95	90	90	90	90	60	90	95
Corn	0	5	45	25	5	0	5	0	10	20	5	0	0	5
Crabgrass, Large	5	20	20	35	20	30	35	25	25	35	10	5	25	25
Foxtail, Giant	0	70	60	60	20	55	75	10	70	65	5	5	60	55
Galium	85	95	98	100	85	95	95	95	95	90	90	80	95	95
Johnsongrass	0	5	5	35	5	5	5	10	5	5	5	5	5	5
Kochia	90	65	85	90	90	90	30	90	85	90	85	70	90	90
Lambsquarters	50	70	95	90	95	100	95	90	85	95	100	70	95	95
Morningglory	50	100	100	98	85	95	95	95	90	90	100	40	100	100
Nutsedge, Yellow	5	90	85	85	50	70	70	65	60	80	20	25	80	80
Oat, Wild	10	35	75	95	35	80	85	60	95	90	35	50	60	90
Oilseed Rape	0	0	50	5	0	10	50	10	35	70	70	0	25	50
Pigweed	75	80	95	85	90	98	85	85	90	85	95	60	98	90

Ragweed	0	90	95	90	85	85	75	90	90	90	85	20	95	90
Ryegrass, Italian	60	30	90	90	80	80	80	90	90	90	80	65	60	85
Soybean	0	0	15	20	5	10	5	25	15	15	35	0	0	15
Velvetleaf	0	95	85	85	20	75	85	80	85	85	50	10	85	90
Waterhemp	75	65	90	90	75	90	70	90	65	75	100	90	90	80
Wheat	0	0	20	5	0	0	0	0	30	30	0	5	0	5

Table C						Compounds								
62 g ai/ha	81	82	83	84	85	87	88	89	90	91	97	98	99	100
Postemergence														
Barnyardgrass	35	25	25	20	45	25	40	15	35	30	5	85	25	25
Blackgrass	85	35	80	35	80	35	80	0	15	5	0	30	30	5
Chickweed	90	90	95	90	95	90	100	95	90	98	0	100	90	90
Corn	5	30	5	20	0	5	0	5	10	0	0	0	5	10
Crabgrass, Large	35	20	25	10	30	10	20	5	15	20	5	25	20	15
Foxtail, Giant	85	25	85	55	85	55	85	10	25	45	5	95	15	45
Galium	95	95	90	95	100	95	100	95	95	90	80	95	95	95
Johnsongrass	5	5	5	5	15	5	5	0	10	5	0	5	10	0
Kochia	75	90	60	90	70	90	50	90	100	90	0	20	85	90
Lambsquarters	95	98	85	90	98	98	85	90	98	100	20	100	75	90
Morningglory	100	100	90	98	98	98	100	95	100	100	40	100	95	100
Nutsedge, Yellow	85	80	80	85	85	80	85	60	80	40	0	15	55	25
Oat, Wild	90	85	90	90	90	90	95	10	70	70	5	80	70	70
Oilseed Rape	65	40	0	45	10	50	5	0	0	90	0	0	5	60
Pigweed	85	90	85	90	85	90	85	75	80	90	50	100	75	85
Ragweed	75	98	85	90	85	95	85	90	85	98	10	98	90	95
Ryegrass, Italian	85	85	90	80	90	80	90	75	90	80	30	45	90	90
Soybean	0	10	0	5	0	0	0	0	50	5	0	10	5	5
Velvetleaf	85	80	90	90	85	85	85	75	75	75	20	70	85	50
Waterhemp	60	98	85	85	65	80	85	40	100	50	5	100	75	90
Wheat	0	0	0	0	0	0	0	0	10	5	0	10	0	0

Table C						Compounds								
62 g ai/ha	102	104	105	106	107	108	109	111	113	114	115	121	123	125
Postemergence														
Barnyardgrass	20	35	25	15	50	35	30	30	35	35	20	20	25	40
Blackgrass	5	35	40	50	5	35	25	5	25	0	10	15	35	45

Chickweed	95	98	95	98	90	90	95	98	90	95	75	90	90	95
Corn	0	80	15	10	10	40	15	10	10	0	5	5	15	0
Crabgrass, Large	10	30	30	40	20	10	40	20	15	20	20	5	35	35
Foxtail, Giant	35	70	50	75	55	40	50	45	25	20	15	50	20	90
Galium	95	95	98	95	95	98	100	95	95	95	90	90	95	95
Johnsongrass	0	5	0	10	0	0	5	10	10	5	10	5	10	5
Kochia	0	95	95	85	85	95	95	85	98	90	90	90	95	90
Lambsquarters	70	98	85	90	90	95	100	100	98	95	90	95	98	98
Morningglory	100	100	98	98	98	100	98	100	100	100	85	98	90	95
Nutsedge, Yellow	55	45	70	85	80	60	50	40	70	10	60	40	75	85
Oat, Wild	5	90	60	90	20	90	80	70	90	60	60	90	85	90
Oilseed Rape	0	70	30	80	55	90	90	10	0	85	0	60	0	0
Pigweed	80	98	98	80	95	95	95	90	75	85	70	85	80	95
Ragweed	95	90	95	85	90	95	95	90	95	90	85	90	90	98
Ryegrass, Italian	5	90	90	90	50	90	90	90	95	70	90	90	90	90
Soybean	10	0	0	0	5	5	15	5	30	0	20	0	10	5
Velvetleaf	75	85	85	85	98	85	80	80	95	55	25	35	75	90
Waterhemp	60	90	100	80	85	85	85	45	90	55	75	65	90	95
Wheat	0	5	0	0	0	5	5	10	15	5	5	5	5	15

Table C						Compounds								
62 g ai/ha	126	127	129	130	132	133	134	136	137	138	139	143	145	151
Postemergence														
Barnyardgrass	30	20	65	30	30	30	20	25	40	25	20	25	15	50
Blackgrass	5	5	40	35	5	35	45	5	0	5	50	5	0	35
Chickweed	90	90	98	95	90	-	-	-	-	-	-	70	-	98
Corn	10	0	20	5	5	5	10	5	15	0	0	0	5	25
Crabgrass, Large	20	5	30	15	15	5	10	20	30	20	10	10	10	40
Foxtail, Giant	15	5	75	20	40	25	25	45	60	60	30	5	25	75
Galium	95	80	100	95	95	95	95	90	90	90	95	90	95	95
Johnsongrass	10	5	15	5	5	10	10	5	10	10	5	25	10	20
Kochia	90	85	60	95	90	100	100	95	100	95	100	60	98	30
Lambsquarters	95	80	95	98	90	98	98	90	90	90	95	60	98	98
Morningglory	95	75	100	80	80	100	100	98	98	100	100	65	98	98
Nutsedge, Yellow	60	35	75	75	55	90	80	55	85	65	75	40	90	85
Oat, Wild	80	20	90	80	60	90	90	75	70	80	90	55	95	90
Oilseed Rape	80	0	0	0	10	98	100	98	98	98	95	0	98	20

Pigweed	90	85	95	70	55	98	100	80	98	85	95	65	100	70
Ragweed	90	55	90	90	95	0	5	0	20	0	0	30	0	85
Ryegrass, Italian	85	75	90	90	85	10	15	10	30	5	10	60	15	85
Soybean	10	10	10	15	0	40	70	10	10	10	55	15	40	25
Velvetleaf	85	30	95	70	40	90	90	95	90	90	80	25	90	65
Waterhemp	90	85	70	85	60	100	100	80	65	95	100	55	100	75
Wheat	0	5	35	5	0	35	50	45	90	40	55	35	50	0

Table C	Compounds							
62 g ai/ha	153	154	161	162	164	165	171	176
Postemergence								
Barnyardgrass	60	85	35	20	25	15	35	5
Blackgrass	85	65	40	15	15	15	30	0
Chickweed	95	90	70	90	90	90	90	-
Corn	35	5	5	0	0	0	0	10
Crabgrass, Large	50	70	5	5	5	5	20	5
Foxtail, Giant	85	90	5	15	10	5	25	15
Galium	95	95	80	90	95	85	95	5
Johnsongrass	5	5	5	5	5	5	5	5
Kochia	70	50	70	80	85	40	95	90
Lambsquarters	90	85	90	95	85	75	95	80
Morningglory	100	98	90	85	85	70	100	85
Nutsedge, Yellow	90	60	10	25	20	30	75	5
Oat, Wild	95	80	50	60	45	45	90	5
Oilseed Rape	90	90	70	0	0	0	0	95
Pigweed	75	85	80	80	80	70	80	30
Ragweed	90	75	80	85	80	55	100	0
Ryegrass, Italian	95	90	80	70	60	50	95	0
Soybean	10	20	30	0	0	10	30	10
Velvetleaf	85	85	65	15	60	25	70	25
Waterhemp	65	80	90	65	70	70	95	40
Wheat	20	5	0	10	5	5	15	5

Table C							Compounds							
31 g ai/ha	1	2	10	11	14	16	20	21	22	23	25	26	27	28
Postemergence														
Barnyardgrass	0	10	35	0	5	5	5	35	5	40	15	20	15	20

Blackgrass	20	45	0	5	0	0	5	80	0	50	30	50	50	50
Chickweed	95	95	90	60	90	75	90	95	90	100	90	95	95	95
Corn	0	0	0	0	0	0	5	5	0	10	5	0	0	5
Crabgrass, Large	20	10	10	0	5	5	5	30	0	5	5	5	5	25
Foxtail, Giant	35	20	70	5	20	55	0	55	10	30	35	15	60	60
Galium	90	95	5	75	50	60	98	98	90	95	90	90	100	100
Johnsongrass	0	5	0	0	0	0	5	10	5	5	0	5	10	5
Kochia	95	50	60	85	85	0	50	80	90	95	95	80	75	70
Lambsquarters	85	85	50	80	80	10	80	85	70	85	90	75	85	85
Morningglory	100	100	55	70	65	45	100	85	100	100	100	98	100	95
Nutsedge, Yellow	-	80	-	5	-	-	45	85	35	60	65	5	85	75
Oat, Wild	50	75	5	40	10	5	0	90	40	85	60	60	85	95
Oilseed Rape	0	65	0	0	0	0	0	65	5	5	0	0	5	5
Pigweed	95	80	55	50	55	40	75	70	85	90	90	75	55	60
Ragweed	90	80	5	0	15	0	80	85	70	85	90	15	70	65
Ryegrass, Italian	80	60	5	70	40	10	55	90	60	85	70	85	80	80
Soybean	0	0	0	0	0	0	0	0	0	5	0	5	0	0
Velvetleaf	80	100	40	0	10	5	25	75	20	70	70	5	80	70
Waterhemp	95	65	40	80	5	5	70	40	75	80	75	75	65	60
Wheat	0	0	0	0	0	0	0	0	0	10	0	0	0	0

Table C							Compounds							
31 g ai/ha	29	32	33	34	35	36	37	40	41	42	47	51	52	54
Postemergence														
Barnyardgrass	15	10	25	20	20	15	25	5	25	20	15	5	5	15
Blackgrass	40	30	0	10	15	5	35	5	30	30	0	0	0	15
Chickweed	95	90	85	90	95	80	90	55	95	90	90	50	95	95
Corn	0	0	0	0	5	0	0	0	5	0	0	0	0	0
Crabgrass, Large	10	10	10	5	20	25	10	5	5	10	20	0	0	20
Foxtail, Giant	30	15	20	10	50	30	25	5	15	25	50	5	0	20
Galium	90	90	90	90	90	90	90	80	100	95	80	85	90	95
Johnsongrass	0	5	0	5	20	0	0	0	5	5	10	0	5	5
Kochia	60	50	20	10	30	50	0	70	100	90	75	0	0	50
Lambsquarters	80	85	90	90	80	90	90	70	90	85	85	5	55	95
Morningglory	85	90	85	85	100	90	90	55	95	75	100	5	98	95
Nutsedge, Yellow	25	55	5	45	75	20	20	0	65	65	40	35	60	10
Oat, Wild	60	70	35	80	40	50	60	35	55	75	5	0	0	45

Oilseed Rape	0	10	40	30	-	40	40	5	0	0	0	0	0	70
Pigweed	95	75	30	90	60	70	85	35	65	85	90	60	30	85
Ragweed	80	85	85	85	25	90	90	45	70	90	80	10	55	90
Ryegrass, Italian	70	85	30	80	35	55	80	50	80	65	0	35	10	50
Soybean	0	15	0	5	0	0	10	5	15	0	0	0	0	5
Velvetleaf	35	10	10	50	100	65	20	5	30	45	70	5	5	45
Waterhemp	70	70	25	85	25	85	85	65	75	75	90	30	10	85
Wheat	5	5	0	5	0	0	30	10	10	0	0	0	0	0

Table C	Compounds													
31 g ai/ha	56	57	59	60	65	66	67	69	72	73	75	78	79	80
Postemergence														
Barnyardgrass	0	90	20	20	10	15	25	25	35	25	25	15	20	25
Blackgrass	0	5	65	50	5	10	40	15	60	40	5	0	5	15
Chickweed	5	90	90	90	55	90	90	90	90	90	95	30	90	90
Corn	0	0	5	10	5	0	5	0	5	5	5	0	0	0
Crabgrass, Large	0	10	15	15	5	25	35	5	10	30	5	5	20	10
Foxtail, Giant	0	70	45	45	10	40	70	5	50	40	5	15	35	25
Galium	80	95	95	100	85	90	90	90	80	90	90	70	95	90
Johnsongrass	0	5	5	5	5	5	5	5	5	5	5	5	5	5
Kochia	70	50	95	90	90	90	0	90	60	90	90	45	50	90
Lambsquarters	0	70	90	85	90	90	85	85	85	90	100	40	85	95
Morningglory	35	95	95	90	75	90	95	90	80	75	98	20	100	100
Nutsedge, Yellow	0	90	65	85	25	65	65	40	30	80	25	0	85	65
Oat, Wild	5	20	80	85	25	55	80	45	85	75	40	35	50	90
Oilseed Rape	0	0	5	5	0	0	40	40	40	10	70	0	20	5
Pigweed	80	60	90	85	90	95	100	70	85	80	85	50	90	85
Ragweed	0	60	90	85	55	85	70	70	80	85	95	10	90	98
Ryegrass, Italian	40	25	85	90	65	60	80	85	85	85	80	55	50	80
Soybean	0	0	0	15	5	0	5	10	10	0	20	0	0	0
Velvetleaf	0	90	80	40	10	55	70	40	45	40	70	0	75	70
Waterhemp	55	50	85	65	60	98	60	85	70	75	100	75	85	85
Wheat	0	0	0	5	0	0	0	0	30	10	0	0	0	0

Table C	Compounds													
31 g ai/ha	81	82	83	84	85	87	88	89	90	91	97	98	99	100
Postemergence														

Barnyardgrass	25	20	25	10	25	25	35	5	30	25	0	60	25	10
Blackgrass	60	10	40	10	70	10	40	0	10	0	0	5	20	5
Chickweed	90	90	90	90	90	90	95	90	90	95	0	95	90	90
Corn	0	35	5	0	0	5	0	5	5	0	0	5	0	5
Crabgrass, Large	25	10	20	5	35	5	25	0	5	15	0	10	20	5
Foxtail, Giant	80	35	75	40	75	35	80	5	20	10	5	90	5	20
Galium	90	90	90	90	95	90	95	90	90	90	45	95	90	90
Johnsongrass	5	5	5	0	5	0	5	0	5	0	0	0	5	0
Kochia	40	90	40	85	30	90	30	85	95	75	0	0	20	80
Lambsquarters	95	90	95	90	85	95	85	85	95	98	0	98	75	80
Morningglory	95	100	98	90	98	98	95	90	100	100	10	100	75	100
Nutsedge, Yellow	70	65	85	80	75	70	65	40	70	20	0	10	30	5
Oat, Wild	85	55	90	85	90	85	90	5	70	50	5	70	60	50
Oilseed Rape	45	35	50	5	5	10	20	0	0	60	0	0	0	30
Pigweed	80	85	80	85	85	75	65	80	75	98	20	100	75	75
Ragweed	70	90	70	85	75	90	80	80	85	75	0	100	70	98
Ryegrass, Italian	85	80	80	80	85	80	80	45	85	60	10	40	85	65
Soybean	0	10	0	0	0	0	0	0	40	0	0	5	0	0
Velvetleaf	75	70	85	60	75	75	75	25	35	50	0	55	35	20
Waterhemp	60	85	85	80	85	85	60	30	85	50	5	98	75	85
Wheat	0	0	0	0	0	0	0	0	5	0	0	10	0	0

Table C	Compounds													
31 g ai/ha	102	104	105	106	107	108	109	111	113	114	115	121	123	125
Postemergence														
Barnyardgrass	20	20	10	15	35	20	25	10	25	30	10	20	20	35
Blackgrass	0	15	15	45	0	15	20	0	15	0	0	0	15	20
Chickweed	95	90	90	95	90	90	80	95	90	90	80	90	90	95
Corn	0	5	10	0	5	5	0	5	5	0	5	0	10	5
Crabgrass, Large	5	20	20	25	15	5	35	10	5	10	10	10	10	25
Foxtail, Giant	20	50	40	70	15	30	45	15	20	10	5	20	20	70
Galium	90	95	95	95	95	90	98	95	95	95	85	90	95	95
Johnsongrass	0	10	5	5	0	0	0	10	0	5	5	0	5	5
Kochia	0	95	95	70	70	90	95	80	95	30	70	90	95	85
Lambsquarters	75	90	85	85	85	90	95	90	98	95	70	90	95	90
Morningglory	100	98	100	100	95	98	95	100	98	95	55	98	95	95
Nutsedge, Yellow	20	55	55	65	80	30	45	35	70	10	40	45	55	35

Oat, Wild	5	80	60	50	20	80	80	55	90	40	55	65	70	85
Oilseed Rape	0	85	5	60	25	80	70	80	0	15	0	70	0	0
Pigweed	75	95	85	70	85	90	95	85	65	80	30	75	65	95
Ragweed	95	85	90	80	85	90	80	98	90	90	60	75	75	95
Ryegrass, Italian	0	90	85	85	40	90	90	85	90	60	90	85	90	85
Soybean	0	0	5	0	0	10	0	0	15	0	10	0	10	0
Velvetleaf	30	50	75	80	75	70	75	40	70	25	15	10	65	85
Waterhemp	25	70	80	65	75	85	80	40	85	25	65	60	80	85
Wheat	0	0	0	0	0	0	0	10	5	0	0	5	5	0

Table C	Compounds													
31 g ai/ha	126	127	129	130	132	133	134	136	137	138	139	143	144	145
Postemergence														
Barnyardgrass	25	10	50	30	15	15	10	15	25	25	25	20	65	20
Blackgrass	5	0	35	30	5	45	50	10	0	5	20	5	35	5
Chickweed	90	50	98	90	90	-	-	-	-	-	-	45	-	-
Corn	10	0	0	5	0	5	5	0	5	0	5	5	30	10
Crabgrass, Large	10	0	20	10	15	0	5	10	30	15	20	10	30	15
Foxtail, Giant	5	5	60	20	30	25	15	35	45	35	20	5	70	20
Galium	90	75	95	95	90	90	95	90	85	90	95	65	95	90
Johnsongrass	10	5	10	5	0	5	10	5	10	10	5	10	10	10
Kochia	90	40	50	95	85	98	95	95	100	90	95	30	98	95
Lambsquarters	80	70	95	90	90	95	100	90	90	90	98	50	90	98
Morningglory	95	65	98	75	65	100	98	98	100	98	98	50	98	95
Nutsedge, Yellow	35	10	60	55	30	75	75	15	65	45	55	10	75	70
Oat, Wild	60	10	85	60	40	90	90	50	70	50	90	40	90	95
Oilseed Rape	60	0	0	0	5	95	95	95	95	95	95	0	95	98
Pigweed	85	70	95	50	50	80	80	75	90	80	80	50	90	70
Ragweed	85	10	90	85	65	0	0	0	10	0	0	0	35	0
Ryegrass, Italian	80	50	70	90	80	5	5	5	10	5	5	55	70	5
Soybean	5	0	0	10	0	55	75	5	10	10	45	0	25	40
Velvetleaf	30	20	85	75	30	85	80	75	85	85	70	20	85	85
Waterhemp	75	70	75	70	40	95	98	80	85	90	98	40	95	95
Wheat	0	0	10	0	0	25	30	35	75	60	45	5	95	40

Table C	Compounds								
31 g ai/ha	151	153	154	161	162	164	165	171	176

Postemergence									
Barnyardgrass	40	40	70	20	10	10	10	15	5
Blackgrass	45	80	60	10	10	5	5	5	0
Chickweed	95	90	90	65	90	80	70	90	-
Corn	20	20	15	0	0	0	0	0	0
Crabgrass, Large	35	55	65	0	0	0	0	5	10
Foxtail, Giant	60	80	85	0	5	5	0	10	5
Galium	95	95	95	80	90	90	85	95	0
Johnsongrass	10	10	5	10	5	5	0	5	5
Kochia	60	40	50	70	70	60	45	95	90
Lambsquarters	95	85	90	80	85	70	70	90	60
Morningglory	98	98	95	90	60	80	75	90	85
Nutsedge, Yellow	80	85	70	5	20	20	20	50	5
Oat, Wild	70	90	55	60	50	35	40	65	0
Oilseed Rape	65	90	75	50	0	0	0	0	95
Pigweed	75	85	65	80	75	70	75	60	20
Ragweed	60	70	70	70	70	70	40	75	0
Ryegrass, Italian	60	90	80	70	60	50	40	90	0
Soybean	5	5	10	15	0	0	10	10	5
Velvetleaf	60	85	70	45	5	25	20	35	0
Waterhemp	55	70	75	85	45	60	65	75	20
Wheat	0	15	0	0	0	5	5	0	0

Table C	Compounds				
16 g ai/ha	35	40	143	144	151
Postemergence					
Barnyardgrass	10	5	15	35	30
Blackgrass	5	5	0	20	40
Chickweed	90	50	30	-	95
Corn	0	0	0	5	25
Crabgrass, Large	5	5	5	25	30
Foxtail, Giant	35	5	5	60	40
Galium	90	30	60	90	95
Johnsongrass	15	0	10	10	5
Kochia	30	20	0	98	10
Lambsquarters	75	50	10	90	80
Morningglory	100	5	30	98	98

Table C	Compounds		
8 g ai/ha	35	144	151
Postemergence			
Barnyardgrass	10	25	25
Blackgrass	0	30	10
Chickweed	90	-	90
Corn	0	0	20
Crabgrass, Large	5	20	5
Foxtail, Giant	25	50	20
Galium	90	90	95
Johnsongrass	10	10	5
Kochia	-	90	0
Lambsquarters	35	90	80
Morningglory	100	95	95

Nutsedge, Yellow	60	0	10	60	55
Oat, Wild	30	5	30	90	50
Oilseed Rape	0	0	60	95	50
Pigweed	25	15	50	85	55
Ragweed	0	25	0	35	35
Ryegrass, Italian	30	10	45	45	40
Soybean	0	35	0	25	5
Velvetleaf	75	5	30	90	60
Waterhemp	30	20	25	90	55
Wheat	0	0	0	95	0

Nutsedge, Yellow	45	60	55
Oat, Wild	10	90	35
Oilseed Rape	0	95	30
Pigweed	35	85	65
Ragweed	0	10	10
Ryegrass, Italian	10	35	40
Soybean	0	40	0
Velvetleaf	60	70	15
Waterhemp	0	90	30
Wheat	0	90	0

Table C	Compound
4 g ai/ha	144
Postemergence	
Barnyardgrass	15
Blackgrass	30
Corn	0
Crabgrass, Large	20
Foxtail, Giant	45
Galium	80
Johnsongrass	20
Kochia	90
Lambsquarters	80
Morningglory	90
Nutsedge, Yellow	10
Oat, Wild	80
Oilseed Rape	85
Pigweed	80
Ragweed	10
Ryegrass, Italian	20
Soybean	45
Velvetleaf	50
Waterhemp	90
Wheat	90

Table C	Compounds													
250 g ai/ha	1	2	10	11	20	21	22	23	25	27	28	29	32	34
Preemergence														
Barnyardgrass	90	98	5	80	85	100	60	85	85	90	95	90	100	75
Blackgrass	90	95	0	85	80	90	45	90	90	90	90	85	90	90
Corn	5	10	5	0	35	65	35	65	10	0	15	45	35	0
Crabgrass, Large	100	95	0	40	60	100	35	95	90	98	85	90	100	30
Foxtail, Giant	100	100	0	90	85	100	85	100	100	100	100	95	85	70
Galium	100	100	45	95	95	100	95	100	98	95	95	98	98	100
Johnsongrass	5	5	0	0	10	50	0	35	20	25	10	20	45	20
Lambsquarters	100	100	30	100	90	100	90	95	95	98	90	90	90	75

Morningglory	100	100	55	100	100	100	100	98	100	100	100	98	98	95
Nutsedge, Yellow	75	95	0	30	95	85	70	90	80	95	70	85	60	65
Oilseed Rape	20	65	0	0	20	100	80	100	35	98	90	70	100	90
Pigweed	100	100	30	100	100	100	100	100	100	100	100	100	100	100
Ragweed	98	98	5	90	75	100	100	90	95	95	90	90	98	95
Ryegrass, Italian	100	98	80	100	95	95	95	95	95	95	95	90	95	95
Soybean	0	0	0	0	30	20	5	55	5	0	50	0	55	5
Velvetleaf	98	100	50	90	100	98	98	100	98	98	95	100	90	98
Waterhemp	100	100	90	100	100	100	100	100	100	100	100	100	100	100
Wheat	20	10	0	10	30	40	0	90	5	10	10	50	70	25

Table C							Compounds							
250 g ai/ha	36	37	41	42	47	54	57	59	60	66	67	69	72	73
Preemergence														
Barnyardgrass	70	80	95	80	100	85	100	95	90	70	80	75	80	85
Blackgrass	30	90	90	90	90	80	80	98	90	30	60	35	90	90
Corn	0	20	40	35	5	0	35	65	45	0	0	5	20	25
Crabgrass, Large	65	25	70	85	95	60	100	100	95	85	65	10	85	75
Foxtail, Giant	85	85	85	100	100	90	100	100	100	85	100	60	85	95
Galium	100	100	98	98	98	100	98	98	100	98	90	98	95	98
Johnsongrass	5	0	35	30	0	10	0	65	60	65	30	35	85	55
Lambsquarters	80	90	90	90	100	80	100	95	90	98	85	95	90	90
Morningglory	95	98	98	98	95	98	100	100	100	90	90	90	90	95
Nutsedge, Yellow	65	60	80	80	85	70	95	90	85	65	70	90	70	95
Oilseed Rape	95	90	100	20	10	100	60	95	90	5	20	40	80	85
Pigweed	100	100	100	100	100	100	100	100	100	100	100	85	100	98
Ragweed	95	98	100	100	100	100	100	100	95	95	98	95	95	98
Ryegrass, Italian	85	95	95	90	50	90	85	100	95	90	90	90	90	90
Soybean	20	65	55	5	30	20	0	25	75	0	0	5	0	0
Velvetleaf	90	90	98	98	100	95	100	100	98	85	75	90	85	85
Waterhemp	100	100	100	100	100	100	100	100	100	100	85	95	90	95
Wheat	0	45	65	5	0	0	5	85	70	40	0	5	40	60

Table C							Compounds							
250 g ai/ha	75	79	80	81	82	83	84	85	87	88	89	90	91	97
Preemergence														
Barnyardgrass	85	85	85	98	90	90	85	90	85	100	65	95	95	35

Blackgrass	30	85	90	90	80	90	85	90	90	90	45	55	60	5
Corn	10	5	25	30	25	10	0	10	10	20	0	30	25	0
Crabgrass, Large	50	30	75	98	80	85	85	85	85	80	75	85	85	60
Foxtail, Giant	75	95	98	100	100	100	100	100	95	100	75	95	98	55
Galium	98	98	95	95	95	95	98	95	98	98	98	-	98	90
Johnsongrass	10	30	35	98	40	70	30	40	40	60	5	65	25	0
Lambsquarters	90	100	98	95	98	100	100	100	100	90	90	100	100	25
Morningglory	100	98	98	95	95	98	95	98	95	100	90	98	98	30
Nutsedge, Yellow	75	90	80	95	90	95	80	80	80	95	90	90	90	0
Oilseed Rape	98	30	0	95	85	50	80	90	80	30	90	90	100	0
Pigweed	100	100	100	100	100	100	100	100	100	95	100	100	100	65
Ragweed	100	100	100	98	95	95	98	98	90	98	90	95	100	10
Ryegrass, Italian	90	90	90	90	90	90	95	90	90	90	90	95	95	30
Soybean	55	0	0	0	0	0	0	0	0	100	5	100	20	20
Velvetleaf	98	95	95	98	90	90	90	90	90	85	85	95	100	30
Waterhemp	100	100	100	100	100	100	100	100	100	98	75	100	85	20
Wheat	5	0	0	0	0	0	0	5	0	10	0	40	40	0

Table C							Compounds							
250 g ai/ha	99	102	104	105	106	107	108	109	111	113	114	116	121	125
Preemergence														
Barnyardgrass	85	85	80	90	95	98	85	80	85	95	95	95	60	98
Blackgrass	90	70	60	90	85	10	85	90	20	60	10	35	60	90
Corn	30	30	10	25	20	15	15	0	15	35	5	25	5	55
Crabgrass, Large	80	55	60	80	80	85	70	80	80	90	80	90	35	98
Foxtail, Giant	90	90	100	100	100	98	95	90	-	-	-	-	95	100
Galium	98	95	98	98	95	95	95	90	100	98	100	100	100	100
Johnsongrass	20	0	30	60	15	20	20	65	20	30	0	10	10	70
Lambsquarters	95	100	95	95	100	95	100	100	95	100	95	95	100	100
Morningglory	95	98	98	95	98	98	98	98	98	100	90	98	90	98
Nutsedge, Yellow	90	75	85	85	90	90	80	80	90	85	95	95	50	90
Oilseed Rape	98	35	95	10	90	80	90	90	100	90	100	100	85	100
Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Ragweed	95	100	100	100	95	100	98	100	98	95	98	100	98	100
Ryegrass, Italian	100	70	95	95	90	30	95	95	95	95	95	90	100	95
Soybean	20	5	0	0	0	15	0	0	0	80	-	5	0	35
Velvetleaf	95	100	90	95	90	90	90	90	100	100	100	100	95	100

Waterhemp	100	85	100	100	90	98	100	100	85	98	80	100	100	100
Wheat	65	25	0	5	0	5	10	15	40	50	35	15	15	90

Table C	Compounds													
250 g ai/ha	129	131	132	133	134	136	137	138	139	145	152	153	154	161
Preemergence														
Barnyardgrass	90	35	45	95	90	95	100	98	95	95	70	100	95	30
Blackgrass	80	90	50	50	75	90	90	90	90	60	35	95	90	45
Corn	40	15	10	10	5	5	55	15	15	15	15	65	5	5
Crabgrass, Large	85	80	40	65	60	95	80	80	50	55	10	100	100	40
Foxtail, Giant	98	98	98	90	80	98	100	100	95	95	90	100	100	80
Galium	98	95	98	100	98	100	100	98	100	98	100	100	100	95
Johnsongrass	25	20	25	40	5	10	20	20	25	5	5	70	75	10
Lambsquarters	90	95	100	95	100	100	95	100	98	100	98	98	95	80
Morningglory	98	95	90	95	100	98	98	98	98	100	90	98	90	85
Nutsedge, Yellow	95	75	75	95	90	80	95	90	90	90	85	95	85	60
Oilseed Rape	90	80	90	90	98	100	90	100	100	98	100	100	98	90
Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Ragweed	95	98	100	98	98	100	100	95	100	90	90	100	95	85
Ryegrass, Italian	95	95	95	100	100	90	100	95	100	100	90	95	90	85
Soybean	20	0	0	80	75	20	30	15	80	80	10	45	20	100
Velvetleaf	98	95	95	100	100	100	100	100	100	100	75	90	85	80
Waterhemp	100	100	98	100	100	100	98	100	100	100	75	100	100	95
Wheat	85	20	50	40	40	45	90	5	10	5	85	50	30	0

Table C	Compound
250 g ai/ha	171
Preemergence	
Barnyardgrass	95
Blackgrass	90
Corn	40
Crabgrass, Large	80
Foxtail, Giant	-
Galium	100
Johnsongrass	35
Lambsquarters	100
Morningglory	98

Table C	Compound
250 g ai/ha	171
Preemergence	
Nutsedge, Yellow	90
Oilseed Rape	90
Pigweed	100
Ragweed	98
Ryegrass, Italian	95
Soybean	70
Velvetleaf	100
Waterhemp	100
Wheat	70

Table C	Compounds													
125 g ai/ha	1	2	10	11	20	21	22	23	25	27	28	29	32	34
Preemergence														
Barnyardgrass	25	95	5	10	60	100	5	85	70	90	90	80	85	65
Blackgrass	90	95	0	50	40	90	40	90	90	90	90	85	90	85
Corn	0	0	0	0	5	40	0	30	0	5	30	0	0	10
Crabgrass, Large	80	98	0	40	15	85	0	75	95	95	80	55	70	25
Foxtail, Giant	100	98	0	50	65	100	55	85	90	100	100	90	85	75
Galium	95	100	5	90	95	98	95	100	95	95	95	98	100	90
Johnsongrass	5	5	0	0	0	35	0	35	5	5	5	25	10	0
Lambsquarters	100	100	-	100	85	98	90	95	85	95	85	80	85	80
Morningglory	100	98	25	100	98	100	100	95	95	100	98	95	98	85
Nutsedge, Yellow	70	70	0	10	95	85	70	85	70	90	85	85	45	35
Oilseed Rape	-	65	0	0	0	100	5	90	5	98	85	5	90	90
Pigweed	100	100	10	100	100	100	100	100	100	98	100	100	100	100
Ragweed	100	100	0	80	70	100	90	95	98	100	95	85	95	90
Ryegrass, Italian	100	98	25	100	95	90	95	95	95	90	95	90	95	85
Soybean	0	0	0	0	30	0	0	5	0	10	0	0	40	0
Velvetleaf	100	100	10	90	100	98	75	100	90	85	90	100	85	85
Waterhemp	100	100	100	100	100	100	100	100	100	100	85	100	100	100
Wheat	5	0	0	0	35	30	0	90	0	0	0	45	50	5

Table C	Compounds													
125 g ai/ha	36	37	41	42	47	54	57	59	60	66	67	69	72	73
Preemergence														
Barnyardgrass	65	70	85	60	85	65	100	90	85	40	40	20	55	70
Blackgrass	20	90	85	90	40	55	70	90	90	35	40	60	70	85
Corn	0	0	5	10	0	10	0	50	30	0	0	0	0	5
Crabgrass, Large	20	20	65	80	60	75	98	85	85	75	10	10	65	75
Foxtail, Giant	85	85	85	90	85	75	90	98	100	80	98	25	85	85
Galium	100	95	98	95	98	100	95	98	98	95	90	90	95	95
Johnsongrass	5	5	35	5	0	5	0	45	40	55	10	30	80	35
Lambsquarters	85	85	100	85	100	80	100	95	95	85	85	90	85	80
Morningglory	90	90	95	98	100	95	100	100	98	80	80	85	90	90
Nutsedge, Yellow	20	40	75	40	75	25	90	85	85	30	55	25	60	50
Oilseed Rape	60	60	40	5	0	90	30	95	90	0	0	0	80	90
Pigweed	100	100	100	100	100	100	100	100	100	100	95	100	98	100

Ragweed	95	95	95	95	98	95	100	100	95	90	100	90	100	95
Ryegrass, Italian	35	90	95	90	45	80	70	100	95	80	85	90	90	90
Soybean	30	20	50	0	10	0	0	15	65	0	0	5	0	0
Velvetleaf	85	85	95	90	100	90	95	98	95	70	60	75	80	85
Waterhemp	100	95	100	100	100	100	100	100	100	100	65	100	90	90
Wheat	0	5	50	0	0	0	0	75	45	0	0	0	30	35

Table C							Compounds							
125 g ai/ha	75	79	80	81	82	83	84	85	87	88	89	90	91	97
Preemergence														
Barnyardgrass	50	65	75	80	70	85	60	80	65	85	25	75	20	0
Blackgrass	30	60	80	90	65	80	90	90	85	90	40	50	60	0
Corn	0	5	10	20	20	0	0	0	0	0	0	5	10	0
Crabgrass, Large	25	20	40	90	70	70	70	80	80	80	25	75	50	0
Foxtail, Giant	70	85	85	98	90	100	90	100	90	98	65	90	90	5
Galium	90	95	95	95	90	95	95	95	98	98	98	-	98	0
Johnsongrass	20	40	30	45	60	60	5	65	40	60	0	60	0	0
Lambsquarters	85	100	90	85	98	95	100	90	85	90	98	85	80	20
Morningglory	95	98	90	90	95	95	95	95	95	95	85	98	90	20
Nutsedge, Yellow	65	90	80	80	60	85	70	75	85	95	80	85	80	0
Oilseed Rape	90	30	50	40	0	50	80	40	85	10	30	50	100	0
Pigweed	100	100	100	95	100	100	100	100	100	95	100	100	100	65
Ragweed	90	98	95	95	90	95	95	98	95	95	80	85	90	0
Ryegrass, Italian	90	90	90	90	85	90	85	90	90	90	90	95	95	30
Soybean	45	5	0	0	0	0	0	0	100	0	0	10	10	10
Velvetleaf	90	95	90	85	85	85	85	85	90	85	90	95	85	20
Waterhemp	100	100	100	90	100	100	100	90	100	95	40	100	65	10
Wheat	10	0	0	0	0	0	0	0	0	0	0	35	30	0

Table C							Compounds							
125 g ai/ha	99	102	104	105	106	107	108	109	111	113	114	116	121	125
Preemergence														
Barnyardgrass	55	30	40	60	85	80	35	70	55	65	60	70	55	90
Blackgrass	90	45	30	55	90	10	60	85	5	55	5	30	45	55
Corn	10	20	15	5	10	10	5	0	0	20	5	60	0	20
Crabgrass, Large	60	30	55	75	75	75	65	70	85	75	75	50	10	75
Foxtail, Giant	65	85	75	90	100	85	85	85	-	-	-	-	90	98

Galium	98	95	90	95	95	90	95	90	100	98	100	100	98	100
Johnsongrass	0	0	20	20	5	10	30	40	0	20	0	0	0	60
Lambsquarters	100	85	95	90	100	95	90	90	90	90	90	90	98	100
Morningglory	90	85	100	100	98	95	98	90	95	98	75	85	85	95
Nutsedge, Yellow	60	75	75	40	80	70	70	90	75	85	65	85	20	95
Oilseed Rape	90	10	85	10	30	20	90	85	100	60	100	95	30	85
Pigweed	100	98	100	100	100	100	100	100	98	100	100	100	90	100
Ragweed	95	90	95	98	95	85	98	95	90	85	95	95	98	98
Ryegrass, Italian	100	50	90	90	85	35	90	90	85	90	90	70	95	95
Soybean	5	5	0	0	0	0	0	0	0	65	20	0	0	30
Velvetleaf	90	85	90	90	85	85	85	80	95	98	85	100	85	100
Waterhemp	98	75	100	100	80	95	100	100	75	98	65	80	85	100
Wheat	30	-	5	10	0	0	15	10	20	35	5	5	10	90

Table C	Compounds													
125 g ai/ha	129	131	132	133	134	136	137	138	139	145	152	153	154	161
Preemergence														
Barnyardgrass	100	10	35	50	70	90	90	90	75	75	30	100	90	10
Blackgrass	70	40	40	50	40	70	30	40	60	60	30	95	85	5
Corn	15	5	0	10	10	0	10	5	10	0	10	40	5	5
Crabgrass, Large	75	60	10	35	40	60	70	70	20	55	10	98	90	20
Foxtail, Giant	95	90	85	75	70	100	95	100	85	75	65	100	100	25
Galium	100	95	90	100	98	100	98	98	100	100	95	100	98	95
Johnsongrass	10	0	55	30	5	20	20	30	35	5	0	65	50	0
Lambsquarters	85	85	85	95	100	100	100	100	95	100	90	100	85	65
Morningglory	90	85	95	90	95	98	90	98	95	98	75	98	85	75
Nutsedge, Yellow	90	65	45	70	95	70	90	95	85	95	55	80	70	55
Oilseed Rape	90	85	30	90	90	90	50	90	98	90	95	98	98	90
Pigweed	98	100	100	100	100	100	100	100	100	100	100	100	100	98
Ragweed	95	98	95	95	95	100	95	98	95	85	75	98	90	30
Ryegrass, Italian	95	95	95	100	100	85	100	90	100	100	90	90	90	85
Soybean	5	0	0	65	65	10	40	20	60	75	5	20	5	0
Velvetleaf	98	85	90	90	90	100	100	98	100	95	65	95	85	50
Waterhemp	100	98	95	95	98	98	95	98	100	98	85	95	95	75
Wheat	55	20	20	10	15	45	90	5	15	0	25	30	0	0

Table C Compound Table C Compound

125 g ai/ha	171
Preemergence	
Barnyardgrass	75
Blackgrass	45
Corn	0
Crabgrass, Large	60
Foxtail, Giant	-
Galium	98
Johnsongrass	10
Lambsquarters	95
Morningglory	95
Nutsedge, Yellow	70
Oilseed Rape	50
Pigweed	100
Ragweed	95
Ryegrass, Italian	95
Soybean	55
Velvetleaf	95
Waterhemp	100
Wheat	45

Table C	Compounds													
62 g ai/ha	1	2	10	11	20	21	22	23	25	27	28	29	32	34
Preemergence														
Barnyardgrass	5	70	5	0	30	100	5	85	30	80	75	35	65	55
Blackgrass	90	90	0	40	5	90	20	85	85	90	90	50	90	50
Corn	0	0	0	0	0	15	0	0	0	0	0	0	0	0
Crabgrass, Large	40	55	0	0	15	85	0	45	75	80	60	5	35	10
Foxtail, Giant	75	100	0	35	30	100	15	85	85	100	100	75	80	65
Galium	100	100	5	90	100	98	90	100	95	95	95	95	95	95
Johnsongrass	5	0	0	0	0	10	0	5	0	5	0	5	0	0
Lambsquarters	95	100	0	100	85	98	45	85	85	95	85	80	70	90
Morningglory	100	100	0	100	98	98	85	90	95	98	98	95	90	80
Nutsedge, Yellow	35	45	0	5	85	85	45	90	30	90	75	80	45	25
Oilseed Rape	5	20	0	0	0	100	5	90	0	95	20	0	90	25
Pigweed	100	100	0	100	100	100	100	100	100	100	100	100	100	100
Ragweed	80	100	0	50	45	100	75	85	95	100	90	85	90	80
Ryegrass, Italian	100	98	0	95	95	90	90	90	95	90	90	90	90	85
Soybean	0	0	0	0	20	0	0	0	0	0	25	0	10	10
Velvetleaf	90	95	0	10	90	90	60	90	85	85	85	90	85	80
Waterhemp	100	100	0	100	100	95	80	100	100	85	75	100	100	100
Wheat	0	0	0	0	0	5	0	85	0	0	0	5	45	0

Table C	Compounds													
62 g ai/ha	35	36	37	41	42	47	54	57	59	60	66	67	69	72
Preemergence														

Barnyardgrass	25	25	30	40	30	20	35	90	70	40	20	20	5	20
Blackgrass	55	30	30	80	85	30	55	60	90	90	30	30	30	50
Corn	0	0	0	0	0	0	10	-	20	10	0	0	0	0
Crabgrass, Large	5	20	5	35	70	30	40	35	70	75	65	70	5	80
Foxtail, Giant	85	75	75	80	80	50	80	80	95	85	75	80	5	70
Galium	95	100	90	100	90	95	95	90	95	95	90	90	90	90
Johnsongrass	10	5	0	50	0	0	0	0	25	20	25	20	10	25
Lambsquarters	100	80	60	90	80	100	85	100	90	85	85	80	100	65
Morningglory	98	80	80	95	98	100	90	100	100	98	85	80	85	85
Nutsedge, Yellow	40	20	20	75	60	45	5	30	80	45	35	20	35	10
Oilseed Rape	90	60	40	50	0	0	90	0	80	85	0	0	0	35
Pigweed	80	100	98	100	100	100	100	100	100	100	100	90	100	98
Ragweed	40	90	90	85	90	85	90	95	95	90	85	85	70	90
Ryegrass, Italian	70	30	85	95	90	20	50	65	100	95	50	40	90	90
Soybean	0	0	30	20	0	0	90	0	0	45	0	0	0	0
Velvetleaf	85	80	80	90	90	90	85	80	90	85	60	35	55	45
Waterhemp	50	100	95	95	98	98	100	98	100	100	90	80	95	90
Wheat	5	0	0	5	0	0	0	0	60	40	0	0	0	0

Table C						Compounds								
62 g ai/ha	73	75	79	80	81	82	83	84	85	87	88	89	90	91
Preemergence														
Barnyardgrass	25	25	15	65	70	55	70	25	60	35	40	15	65	15
Blackgrass	80	30	50	80	80	60	80	60	85	30	90	40	40	30
Corn	0	5	0	10	10	0	0	0	10	10	0	0	0	10
Crabgrass, Large	30	10	25	15	75	20	65	10	85	65	80	0	70	20
Foxtail, Giant	70	45	85	85	98	85	100	75	98	80	90	60	75	65
Galium	98	90	95	95	95	90	90	95	90	95	98	98	-	98
Johnsongrass	10	20	35	5	5	65	75	5	30	25	70	75	55	0
Lambsquarters	70	100	95	90	90	90	85	85	90	80	85	85	80	25
Morningglory	90	85	95	90	85	90	90	90	90	90	90	85	85	85
Nutsedge, Yellow	35	40	45	25	70	60	90	40	85	35	75	75	45	45
Oilseed Rape	85	70	35	30	5	0	0	0	85	30	20	0	35	98
Pigweed	100	100	100	100	95	100	100	100	100	100	100	100	100	98
Ragweed	95	85	95	95	95	90	100	95	90	90	85	80	90	75
Ryegrass, Italian	90	90	90	70	90	85	90	85	85	90	90	80	95	70
Soybean	0	20	0	0	100	100	0	0	0	0	10	0	0	10

Velvetleaf	80	85	85	85	65	80	70	65	80	85	70	80	90	70
Waterhemp	90	100	100	100	85	100	90	100	80	100	100	50	90	60
Wheat	20	0	0	0	0	0	0	0	0	0	0	0	0	5

Table C							Compounds							
62 g ai/ha	97	99	102	104	105	106	107	108	109	111	113	114	116	121
Preemergence														
Barnyardgrass	0	15	10	25	30	45	45	35	35	20	35	10	30	10
Blackgrass	0	70	50	15	50	50	5	0	30	5	50	5	5	45
Corn	0	20	10	0	0	0	0	10	0	0	0	5	0	0
Crabgrass, Large	0	35	5	55	50	70	30	70	65	5	35	5	20	10
Foxtail, Giant	5	35	75	85	80	95	80	85	85	-	-	-	-	55
Galium	0	-	-	85	90	90	90	90	90	80	90	98	85	90
Johnsongrass	0	0	0	20	20	5	0	5	30	0	10	0	0	0
Lambsquarters	0	80	85	85	85	90	100	90	90	95	85	98	98	80
Morningglory	30	85	75	95	90	90	85	90	85	70	95	55	80	55
Nutsedge, Yellow	0	70	70	45	45	70	50	80	70	20	70	40	35	25
Oilseed Rape	0	40	10	30	5	0	0	90	85	98	0	98	80	85
Pigweed	35	100	85	100	100	98	100	100	100	90	75	90	100	98
Ragweed	0	90	75	90	90	90	90	90	90	75	95	75	90	95
Ryegrass, Italian	5	90	25	85	90	70	35	85	90	90	95	85	30	90
Soybean	10	0	5	0	0	0	0	0	0	-	45	0	0	0
Velvetleaf	0	75	85	80	85	60	60	75	75	70	95	60	85	75
Waterhemp	10	100	65	90	95	75	75	90	90	65	100	75	70	95
Wheat	0	0	5	5	10	0	0	10	10	5	30	0	0	0

Table C							Compounds							
62 g ai/ha	125	129	131	132	133	134	136	137	138	139	145	151	152	153
Preemergence														
Barnyardgrass	70	70	0	5	40	40	50	85	55	55	35	85	5	100
Blackgrass	55	30	40	45	60	40	80	40	55	55	30	65	5	90
Corn	0	5	0	0	5	0	5	10	5	0	0	10	10	0
Crabgrass, Large	45	25	20	0	30	30	5	20	40	30	50	70	0	100
Foxtail, Giant	100	90	85	70	65	75	85	85	85	65	60	98	35	100
Galium	100	98	90	90	95	98	98	98	98	90	98	95	45	98
Johnsongrass	55	5	0	10	35	5	5	5	15	35	5	25	0	50
Lambsquarters	100	80	70	60	90	90	90	100	95	90	90	85	75	100

Morningglory	95	90	55	65	85	90	95	85	90	90	80	98	40	90
Nutsedge, Yellow	95	85	35	35	55	45	35	85	60	60	85	95	20	85
Oilseed Rape	0	50	40	85	85	90	30	90	90	98	90	98	85	100
Pigweed	100	98	100	100	100	100	100	100	98	98	98	100	100	100
Ragweed	100	85	95	85	75	95	98	95	100	90	65	85	40	95
Ryegrass, Italian	95	90	80	90	95	100	55	95	90	100	100	90	50	95
Soybean	5	0	0	0	55	45	10	20	0	35	55	10	5	10
Velvetleaf	100	85	55	60	90	90	95	100	90	85	85	75	40	90
Waterhemp	100	95	98	85	100	98	100	98	100	100	98	45	85	95
Wheat	45	50	0	40	0	0	10	80	35	10	0	0	10	10

Table C	Compounds		
62 g ai/ha	154	161	171
Preemergence			
Barnyardgrass	80	0	35
Blackgrass	50	0	40
Corn	5	5	0
Crabgrass, Large	85	30	45
Foxtail, Giant	95	25	-
Galium	95	70	90
Johnsongrass	45	0	5
Lambsquarters	60	40	95
Morningglory	85	40	90
Nutsedge, Yellow	20	20	55
Oilseed Rape	85	20	5
Pigweed	95	98	60
Ragweed	95	15	80
Ryegrass, Italian	55	40	95
Soybean	5	0	0
Velvetleaf	60	40	90
Waterhemp	85	70	95
Wheat	0	0	5

Table C						Compounds								
31 g ai/ha	1	2	10	11	20	21	22	23	25	27	28	29	32	34
Preemergence														
Barnyardgrass	5	35	0	0	5	80	5	10	0	55	45	10	20	60
Blackgrass	60	85	0	35	0	90	5	45	85	85	85	50	70	5
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Large	35	55	0	0	10	35	0	5	70	55	25	5	0	0
Foxtail, Giant	55	80	0	0	5	100	5	30	75	100	85	75	55	0
Galium	90	95	0	85	90	98	90	98	90	90	95	95	90	95
Johnsongrass	0	0	0	0	0	10	0	5	0	0	0	10	0	0
Lambsquarters	80	100	0	70	80	90	25	85	80	70	65	75	80	80
Morningglory	95	98	0	100	85	95	30	85	85	85	80	80	80	70
Nutsedge, Yellow	40	30	0	0	80	75	55	40	40	70	50	15	25	25
Oilseed Rape	0	0	0	0	0	90	0	50	0	5	0	0	25	10

Pigweed	100	100	0	0	100	100	60	100	100	98	100	100	100	100
Ragweed	90	65	0	15	35	95	30	85	80	80	70	80	85	80
Ryegrass, Italian	95	95	0	90	75	90	90	85	90	85	85	90	85	45
Soybean	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Velvetleaf	70	75	0	0	60	85	10	85	80	70	55	85	75	70
Waterhemp	100	75	10	90	90	90	75	100	100	80	70	100	98	85
Wheat	0	0	0	0	0	0	0	75	0	0	0	0	15	0

Table C							Compounds							
31 g ai/ha	35	36	37	41	42	47	54	57	59	60	66	67	69	72
Preemergence														
Barnyardgrass	5	10	10	10	0	5	15	5	30	10	0	5	0	10
Blackgrass	50	0	10	70	40	0	50	30	85	90	10	60	30	40
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Large	5	70	5	30	55	0	40	0	25	20	75	10	0	60
Foxtail, Giant	60	75	65	45	75	15	70	45	80	75	70	75	0	60
Galium	90	100	100	90	90	90	95	80	98	90	90	70	50	90
Johnsongrass	10	0	0	0	0	0	0	0	5	5	10	10	20	0
Lambsquarters	20	70	85	75	85	100	80	100	70	80	80	80	10	60
Morningglory	25	80	70	85	85	90	80	100	98	85	80	70	70	75
Nutsedge, Yellow	20	10	0	60	55	35	5	10	80	45	35	10	5	10
Oilseed Rape	90	50	0	5	0	0	70	0	65	30	0	0	0	30
Pigweed	75	90	98	75	100	100	100	100	100	100	100	75	100	90
Ragweed	5	85	85	85	90	50	90	70	90	80	75	60	60	85
Ryegrass, Italian	65	30	50	95	85	0	55	45	100	90	55	30	85	90
Soybean	0	100	0	0	35	0	0	0	0	0	0	0	0	80
Velvetleaf	40	55	25	85	85	65	80	50	85	75	15	10	35	30
Waterhemp	40	100	90	85	80	100	98	90	95	100	85	70	85	75
Wheat	0	0	0	0	0	0	0	0	60	10	0	0	0	0

Table C							Compounds							
31 g ai/ha	73	75	79	80	81	82	83	84	85	87	88	89	90	91
Preemergence														
Barnyardgrass	10	5	10	10	30	10	50	5	35	5	35	5	35	0
Blackgrass	50	20	20	70	60	50	70	60	50	40	55	5	25	0
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Large	0	75	25	10	90	25	75	10	80	10	55	20	35	0
Foxtail, Giant	55	5	65	70	80	60	85	70	90	70	85	10	75	5

Galium	90	90	95	90	90	90	90	90	90	95	90	95	–	95
Johnsongrass	0	0	10	5	25	45	65	5	40	5	50	0	50	0
Lambsquarters	75	65	100	90	75	85	80	60	85	55	60	40	75	10
Morningglory	85	70	90	85	80	85	85	85	85	85	85	80	85	25
Nutsedge, Yellow	0	15	25	20	60	35	85	15	70	10	40	60	55	10
Oilseed Rape	90	30	0	0	0	0	0	0	5	30	20	0	30	80
Pigweed	95	85	100	100	98	95	100	100	100	75	90	95	100	70
Ragweed	85	80	90	90	85	85	85	85	80	90	90	30	80	35
Ryegrass, Italian	75	90	20	35	80	80	90	80	85	35	85	20	90	30
Soybean	0	0	0	0	0	0	30	0	0	0	0	0	0	0
Velvetleaf	25	35	80	55	35	65	35	40	50	55	10	70	85	55
Waterhemp	85	100	100	100	85	100	60	100	60	100	100	75	75	25
Wheat	0	0	0	0	0	0	0	0	0	0	0	0	5	0

Table C							Compounds							
31 g ai/ha	97	99	102	104	105	106	107	108	109	111	113	114	116	121
Preemergence														
Barnyardgrass	0	5	5	10	0	25	15	5	10	10	10	5	5	5
Blackgrass	0	50	0	5	20	10	0	10	35	0	10	0	0	10
Corn	5	5	5	5	0	0	0	5	5	0	0	0	0	0
Crabgrass, Large	0	30	0	40	20	70	30	5	40	5	0	0	0	0
Foxtail, Giant	0	40	30	75	60	85	60	65	65	–	–	–	–	20
Galium	0	–	–	90	85	90	90	90	90	80	100	98	60	90
Johnsongrass	0	0	0	10	10	5	0	0	0	0	0	0	0	0
Lambsquarters	0	25	70	85	95	90	90	85	80	90	90	90	65	60
Morningglory	25	80	45	80	85	85	80	80	85	50	85	25	55	25
Nutsedge, Yellow	0	20	15	30	40	60	30	35	40	0	55	10	0	10
Oilseed Rape	0	0	0	5	0	0	0	5	5	0	0	30	85	0
Pigweed	5	95	75	100	98	98	100	100	100	98	70	98	95	100
Ragweed	0	70	70	85	90	85	75	75	95	60	65	55	85	35
Ryegrass, Italian	5	90	15	55	40	50	15	60	70	10	95	40	5	75
Soybean	15	0	0	0	0	0	75	0	0	–	0	0	–	0
Velvetleaf	0	60	65	40	60	40	30	50	60	65	60	45	70	60
Waterhemp	0	85	75	75	90	70	75	75	80	50	85	50	55	70
Wheat	0	0	0	5	0	15	0	0	0	0	0	0	0	0

Table C							Compounds							

31 g ai/ha	125	129	131	132	133	134	136	137	138	139	144	145	151	152
Preemergence														
Barnyardgrass	55	15	0	0	0	5	25	35	30	20	35	10	70	5
Blackgrass	50	5	0	20	30	20	70	30	45	50	90	10	60	5
Corn	0	0	0	0	5	0	0	0	5	0	0	0	10	15
Crabgrass, Large	40	5	0	0	0	5	0	20	0	5	60	5	30	0
Foxtail, Giant	95	85	35	40	30	25	75	65	80	35	90	35	85	0
Galium	100	95	85	90	95	100	90	98	95	90	100	90	95	50
Johnsongrass	40	5	0	15	5	0	5	0	10	5	60	10	0	0
Lambsquarters	90	85	60	50	90	75	95	90	95	100	100	90	80	50
Morningglory	90	85	35	40	45	75	80	70	80	85	90	75	90	10
Nutsedge, Yellow	65	55	10	10	20	30	5	55	5	65	40	35	70	5
Oilseed Rape	85	5	20	70	5	55	10	0	85	20	70	5	98	50
Pigweed	100	100	60	100	100	75	100	100	100	70	100	70	100	80
Ragweed	95	70	65	70	70	70	95	80	95	75	98	55	90	85
Ryegrass, Italian	85	90	10	45	90	98	50	85	55	95	100	100	90	10
Soybean	0	0	0	0	5	40	10	30	0	25	5	0	20	0
Velvetleaf	95	70	0	60	55	75	75	80	85	60	90	40	60	15
Waterhemp	98	90	95	90	80	90	98	85	95	100	100	85	35	20
Wheat	40	35	0	25	0	0	0	15	0	0	90	0	0	0

Table C	Compounds			
31 g ai/ha	153	154	161	171
Preemergence				
Barnyardgrass	85	65	0	5
Blackgrass	90	5	5	30
Corn	0	5	0	0
Crabgrass, Large	80	70	30	0
Foxtail, Giant	98	85	10	-
Galium	95	98	80	90
Johnsongrass	25	10	0	0
Lambsquarters	95	15	0	98
Morningglory	95	45	10	85
Nutsedge, Yellow	80	0	0	45
Oilseed Rape	95	80	10	0
Pigweed	100	55	75	70
Ragweed	95	80	40	65

Table C	Compounds		
16 g ai/ha	35	144	151
Preemergence			
Barnyardgrass	5	5	20
Blackgrass	40	70	60
Corn	0	0	30
Crabgrass, Large	0	25	10
Foxtail, Giant	25	75	75
Galium	90	95	95
Johnsongrass	0	25	0
Lambsquarters	5	65	80
Morningglory	25	80	90
Nutsedge, Yellow	20	25	30
Oilseed Rape	5	5	85
Pigweed	75	100	95
Ragweed	0	95	85

Ryegrass, Italian	90	40	5	90	Ryegrass, Italian	50	100	50
Soybean	20	0	0	-	Soybean	0	0	0
Velvetleaf	85	40	0	70	Velvetleaf	0	85	55
Waterhemp	80	30	20	85	Waterhemp	40	100	10
Wheat	0	0	0	0	Wheat	0	70	0

Table C	Compounds		
8 g ai/ha	35	144	151
Preemergence			
Barnyardgrass	0	0	5
Blackgrass	5	55	30
Corn	0	0	20
Crabgrass, Large	0	5	0
Foxtail, Giant	5	60	40
Galium	90	95	98
Johnsongrass	0	25	0
Lambsquarters	5	35	60
Morningglory	10	60	80
Nutsedge, Yellow	0	5	40
Oilseed Rape	0	0	85
Pigweed	40	100	70
Ragweed	0	90	55
Ryegrass, Italian	40	95	15
Soybean	0	0	0
Velvetleaf	0	70	40
Waterhemp	-	100	5
Wheat	0	55	0

Table C	Compound
4 g ai/ha	144
Preemergence	
Barnyardgrass	0
Blackgrass	30
Corn	0
Crabgrass, Large	0
Foxtail, Giant	30
Galium	90
Johnsongrass	0
Lambsquarters	25
Morningglory	25
Nutsedge, Yellow	5
Oilseed Rape	0
Pigweed	75
Ragweed	70
Ryegrass, Italian	80
Soybean	10
Velvetleaf	25
Waterhemp	80
Wheat	0

TEST D

Seeds of plant species selected from bluegrass (annual bluegrass, *Poa annua*), blackgrass (*Alopecurus myosuroides*), Canada thistle (*Cirsium arvense*), canarygrass (*Phalaris minor*), chickweed (common chickweed, *Stellaria media*), geranium, cutleaf (cutleaf geranium, *Geranium dissectum*), galium (catchweed bedstraw, *Galium aparine*), bromegrass, downy (downy bromegrass, *Bromus tectorum*), field poppy (*Papaver rhoeas*), field violet (*Viola arvensis*), foxtail, green (green foxtail, *Setaria viridis*), deadnettle (henbit deadnettle, *Lamium amplexicaule*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), kochia (*Kochia scoparia*), lambsquarters (*Chenopodium album*), oilseed rape (*Brassica napus*), pigweed (*Amaranthus retroflexus*), chamomile (scentless chamomile, *Matricaria inodora*), Russian thistle (*Salsola kali*), speedwell (bird's-eye speedwell, *Veronica persica*), barley, spring (spring barley, *Hordeum vulgare*), wheat, spring (spring wheat, *Triticum aestivum*), buckwheat, wild (wild buckwheat, *Polygonum convolvulus*), mustard, wild (wild mustard, *Sinapis arvensis*), oat, wild (wild oat, *Avena fatua*), radish, wild (wild radish, *Raphanus raphanistrum*), windgrass (*Apera spica-venti*), barley, winter (winter barley, *Hordeum vulgare*), and wheat, winter (winter wheat, *Triticum aestivum*) were planted into a silt loam soil and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, these species were planted in pots containing Redi-Earth® planting medium (Scotts Company, 14111 Scottslawn Road, Marysville, Ohio 43041) comprising spaghnum peat moss, vermiculite, wetting agent and starter nutrients and 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). Treated plants and controls were maintained in a controlled growth environment for 14 to 21 d after which time all species were compared to controls and visually evaluated. 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	1	2	11	20	21	22	23	25	27	28	34	35	36	41
Postemergence														
Barley, Spring	10	5	10	0	30	15	30	10	10	10	5	15	10	20
Barley, Winter	10	10	40	0	40	5	30	10	5	5	20	15	10	35
Blackgrass	80	90	70	60	90	70	80	80	90	85	75	85	70	75
Bluegrass	5	15	15	40	50	25	40	40	40	50	20	40	35	35
Bromegrass, Downy	20	20	50	15	80	25	75	65	70	70	70	30	65	45
Buckwheat, Wild	100	100	95	100	100	100	100	100	100	100	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	70	75	55	55	95	65	90	85	90	85	85	80	80	80
Chamomile	100	100	90	100	100	100	100	100	100	95	100	100	100	100
Chickweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Deadnettle	70	60	100	65	100	70	85	45	60	70	100	80	100	100
Field Poppy	95	100	100	100	100	100	100	100	100	100	100	100	100	95
Field Violet	95	80	90	45	100	95	75	95	85	90	95	98	90	100
Foxtail, Green	85	100	70	70	95	75	90	75	80	90	70	95	90	65

Galium	100	100	90	100	100	98	100	100	100	100	100	100	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	100	70	100	100	85	100	80	100	75	75	95	70	100	100
Lambsquarters	100	100	85	95	95	98	80	95	85	90	100	98	100	85
Mustard, Wild	65	55	95	100	100	100	100	85	75	70	100	100	100	100
Oat, Wild	95	100	98	75	100	100	95	90	98	95	95	98	95	85
Oilseed Rape	60	70	55	5	100	100	85	60	85	85	90	100	100	55
Pigweed	100	95	100	100	98	100	100	100	95	90	100	98	100	85
Radish, Wild	60	60	85	65	100	85	100	75	90	95	95	100	100	95
Russian Thistle	-	-	-	98	85	85	80	90	70	85	85	95	90	75
Ryegrass, Italian	85	90	90	90	80	90	85	90	85	85	95	90	90	90
Speedwell	70	90	100	100	100	100	95	80	100	100	100	100	100	100
Wheat, Spring	15	25	25	20	50	15	60	20	20	20	45	30	10	40
Wheat, Winter	5	10	25	25	40	15	70	20	10	15	25	20	15	35
Windgrass	70	70	20	40	85	55	85	85	90	85	75	85	75	75

Table D							Compounds							
250 g ai/ha	42	47	52	54	57	59	60	66	67	69	72	73	75	79
Postemergence														
Barley, Spring	10	0	0	10	10	60	50	15	20	5	15	40	0	10
Barley, Winter	10	15	0	30	25	60	50	5	10	5	35	35	5	5
Blackgrass	85	65	40	75	75	85	90	75	95	65	80	90	70	50
Bluegrass	35	15	30	35	15	75	60	35	30	25	55	65	15	15
Bromegrass, Downy	70	5	10	75	35	85	80	70	70	40	75	85	30	20
Buckwheat, Wild	100	100	100	100	100	100	100	100	100	98	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	-	98	-	-	-	-
Canarygrass	80	0	0	75	25	90	90	85	95	75	85	90	50	45
Chamomile	100	-	100	100	100	100	100	100	100	80	100	100	100	100
Chickweed	100	100	100	100	100	100	100	100	100	98	100	100	100	100
Deadnettle	55	30	35	100	100	100	95	40	60	80	100	100	100	40
Field Poppy	100	100	100	100	100	100	100	95	100	80	100	100	100	98
Field Violet	90	-	75	90	85	95	85	95	95	98	95	90	100	95
Foxtail, Green	80	80	40	80	90	85	75	98	100	15	75	80	60	80
Galium	100	80	100	100	98	100	100	100	100	100	100	100	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	65	-	-	-	-
Kochia	100	100	65	100	75	100	95	100	50	98	100	100	100	95
Lambsquarters	90	70	90	100	85	95	80	100	100	100	100	100	100	100

Mustard, Wild	80	25	100	100	40	100	100	70	65	80	100	100	100	50
Oat, Wild	95	40	15	90	85	98	100	100	100	85	98	100	80	85
Oilseed Rape	70	70	80	100	65	90	80	75	90	20	90	95	100	30
Pigweed	100	100	80	100	100	100	100	100	100	100	100	100	100	100
Radish, Wild	65	20	85	100	90	100	95	45	95	75	95	100	100	65
Russian Thistle	90	-	55	100	-	85	85	80	85	70	85	85	85	65
Ryegrass, Italian	85	45	80	95	85	90	95	98	100	85	100	98	98	90
Speedwell	45	50	100	100	100	100	100	75	100	100	80	100	100	65
Wheat, Spring	20	15	5	25	10	80	55	5	5	0	70	85	15	5
Wheat, Winter	15	5	15	30	15	80	40	0	0	0	60	75	0	0
Windgrass	98	15	5	75	15	85	98	100	90	55	85	85	65	65

Table D						Compounds								
250 g ai/ha	80	81	82	83	84	85	87	88	90	104	105	108	109	126
Postemergence														
Barley, Spring	25	10	5	10	10	20	5	15	40	15	15	20	25	10
Barley, Winter	15	10	0	15	0	10	5	10	35	15	15	15	20	0
Blackgrass	90	85	80	80	85	90	90	95	65	70	65	75	75	45
Bluegrass	45	40	35	25	35	40	45	35	30	30	25	35	45	15
Bromegrass, Downy	75	75	60	70	75	60	65	65	55	65	65	65	75	25
Buckwheat, Wild	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	98	-	-	-	-	100
Canarygrass	90	100	85	90	80	90	90	95	75	85	80	80	90	75
Chamomile	100	100	100	100	100	85	100	95	100	100	100	100	100	100
Chickweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Deadnettle	50	60	35	60	40	45	60	45	100	85	30	90	95	85
Field Poppy	100	100	100	100	100	95	100	100	90	80	80	75	85	85
Field Violet	100	100	100	100	100	90	100	80	100	98	100	100	100	100
Foxtail, Green	95	100	90	100	95	85	90	80	75	90	80	95	85	25
Galium	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	95	-	-	-	-	90
Kochia	100	95	100	90	100	75	95	70	100	100	100	100	100	100
Lambsquarters	100	100	100	100	100	95	100	90	100	100	95	100	100	100
Mustard, Wild	100	80	70	70	75	80	60	75	100	90	75	100	100	100
Oat, Wild	100	98	95	95	100	100	100	100	100	100	100	100	100	90
Oilseed Rape	75	85	80	95	75	80	75	80	70	95	60	100	85	85
Pigweed	100	100	100	100	100	85	100	90	100	100	100	100	100	98

Radish, Wild	65	100	60	100	45	80	60	85	95	95	70	90	100	95
Russian Thistle	80	90	85	85	85	90	75	85	90	85	50	90	90	85
Ryegrass, Italian	100	95	90	90	100	90	98	95	100	95	95	100	100	90
Speedwell	80	100	85	100	80	100	80	100	100	70	75	80	100	100
Wheat, Spring	30	20	5	20	10	20	10	35	50	30	25	30	30	5
Wheat, Winter	15	5	0	10	0	10	5	5	40	25	20	20	35	0
Windgrass	98	95	85	95	85	85	100	85	90	85	85	85	90	55

Table D	Compounds	
250 g ai/ha	129	153
Postemergence		
Barley, Spring	30	30
Barley, Winter	35	25
Blackgrass	75	80
Bluegrass	30	40
Bromegrass, Downy	80	70
Buckwheat, Wild	100	100
Canada Thistle	100	100
Canarygrass	80	85
Chamomile	100	100
Chickweed	100	100
Deadnettle	95	90
Field Poppy	98	100
Field Violet	75	100
Foxtail, Green	95	85
Galium	100	100
Geranium, Cutleaf	75	98
Kochia	85	35
Lambsquarters	100	75
Mustard, Wild	100	100
Oat, Wild	100	98
Oilseed Rape	70	98
Pigweed	100	85
Radish, Wild	98	100
Russian Thistle	90	55
Ryegrass, Italian	90	90
Speedwell	75	100
Wheat, Spring	70	50
Wheat, Winter	55	35
Windgrass	90	75

Table D	Compounds													
125 g ai/ha	1	2	11	20	21	22	23	25	27	28	34	35	36	41
Postemergence														
Barley, Spring	5	5	10	0	10	15	25	0	5	5	0	10	0	10
Barley, Winter	5	15	25	0	30	0	25	0	5	5	0	0	5	5
Blackgrass	70	80	70	50	85	45	75	80	90	85	70	75	45	70
Bluegrass	5	5	5	30	35	25	35	30	30	35	15	35	40	25
Bromegrass, Downy	10	10	25	10	75	25	60	50	55	40	40	25	55	35
Buckwheat, Wild	100	100	60	100	100	100	100	100	100	100	100	100	100	95
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Canarygrass	50	55	30	45	85	40	85	80	85	80	75	70	55	80
Chamomile	85	90	75	100	100	85	85	100	95	90	100	100	100	80
Chickweed	90	100	80	100	100	98	100	100	100	100	100	100	100	95
Deadnettle	35	60	100	55	95	45	75	20	30	35	100	20	100	80
Field Poppy	100	100	80	100	100	100	100	100	100	100	100	100	90	75
Field Violet	90	75	75	25	100	75	75	85	75	85	95	75	90	90
Foxtail, Green	75	95	65	40	85	70	80	70	80	85	55	95	80	50
Galium	95	100	90	100	100	98	100	100	100	100	100	95	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	95	65	85	85	75	100	75	100	55	50	85	65	100	85
Lambsquarters	90	95	80	90	90	95	75	90	85	90	100	98	100	75
Mustard, Wild	40	40	75	100	100	100	100	70	30	70	100	100	100	100
Oat, Wild	80	90	85	60	85	85	95	90	90	90	95	85	85	85
Oilseed Rape	35	55	20	5	100	95	65	45	70	65	75	100	95	25
Pigweed	100	85	95	100	90	98	85	95	95	100	100	85	100	80
Radish, Wild	30	65	60	70	100	100	100	65	85	85	90	100	100	90
Russian Thistle	-	-	-	80	80	75	75	80	70	80	80	85	85	75
Ryegrass, Italian	85	85	85	80	85	85	85	85	85	80	95	80	90	85
Speedwell	60	80	100	100	100	65	75	25	100	100	100	80	100	100
Wheat, Spring	10	10	25	15	40	10	60	15	10	10	15	25	0	30
Wheat, Winter	0	5	15	15	35	15	55	5	5	5	15	15	5	25
Windgrass	50	55	15	30	85	35	75	85	80	85	65	70	70	60

Table D						Compounds								
125 g ai/ha	42	47	52	54	57	59	60	66	67	69	72	73	75	79
Postemergence														
Barley, Spring	5	0	5	0	10	40	40	5	10	0	10	30	0	5
Barley, Winter	0	15	0	5	25	45	40	0	5	5	30	20	0	0
Blackgrass	80	35	15	70	55	85	85	75	85	35	75	80	65	40
Bluegrass	20	10	30	25	15	55	35	30	20	15	40	55	15	10
Bromegrass, Downy	40	5	0	55	25	70	65	65	65	20	65	70	15	10
Buckwheat, Wild	100	90	100	100	85	100	100	100	100	95	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	-	100	-	-	-	-
Canarygrass	80	0	0	65	15	90	85	70	85	70	80	80	30	40
Chamomile	100	-	100	100	100	85	100	100	100	80	85	90	85	100
Chickweed	100	95	90	100	100	100	100	100	100	90	100	100	100	100
Deadnettle	35	30	35	100	85	90	95	35	40	75	100	100	95	20

Field Poppy	100	100	90	100	100	95	85	95	100	70	100	100	100	95
Field Violet	90	-	75	95	75	95	100	95	90	85	95	90	95	85
Foxtail, Green	65	70	10	70	75	75	65	90	100	15	70	75	55	75
Galium	100	75	98	100	90	100	100	100	100	90	100	100	95	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	55	-	-	-	-
Kochia	95	95	55	100	65	95	90	100	40	95	100	100	100	85
Lambsquarters	85	70	75	95	75	90	80	100	100	95	90	100	100	90
Mustard, Wild	70	15	90	100	30	100	98	55	40	80	100	100	100	40
Oat, Wild	85	20	5	90	65	95	95	100	100	80	95	95	85	80
Oilseed Rape	60	55	65	100	65	85	75	65	85	10	80	75	95	20
Pigweed	90	100	75	100	100	100	100	100	85	98	100	100	100	100
Radish, Wild	20	5	80	100	100	100	95	30	70	60	90	100	100	0
Russian Thistle	85	-	45	90	-	85	80	75	75	50	80	80	85	55
Ryegrass, Italian	85	30	75	90	75	90	90	95	98	80	95	95	95	85
Speedwell	45	40	100	100	25	100	90	70	75	100	100	100	100	35
Wheat, Spring	15	15	0	15	10	70	40	0	0	0	60	70	5	0
Wheat, Winter	10	10	15	25	10	55	35	0	0	0	50	65	0	0
Windgrass	90	15	5	70	10	80	90	85	90	35	80	75	40	35

Table D							Compounds							
125 g ai/ha	80	81	82	83	84	85	87	88	90	104	105	108	109	126
Postemergence														
Barley, Spring	15	0	0	5	5	15	0	5	35	10	10	15	10	10
Barley, Winter	5	0	0	0	5	5	5	5	25	10	10	10	5	0
Blackgrass	90	80	75	75	85	90	85	90	55	65	65	65	65	30
Bluegrass	35	30	30	15	30	25	45	30	25	20	20	25	25	15
Bromegrass, Downy	70	65	60	50	65	35	65	35	40	55	25	40	60	20
Buckwheat, Wild	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	100	-	-	-	-	98
Canarygrass	85	95	75	80	80	85	85	85	75	80	75	80	80	45
Chamomile	100	100	100	100	100	90	100	95	98	95	100	95	95	98
Chickweed	100	100	95	100	90	100	100	100	98	100	100	100	100	100
Deadnettle	35	35	25	55	20	40	35	35	100	70	20	75	70	80
Field Poppy	100	100	95	100	90	80	85	100	75	75	80	65	75	75
Field Violet	95	100	100	100	100	75	100	80	100	95	95	100	100	90
Foxtail, Green	90	95	85	90	85	85	80	80	70	85	75	75	75	25
Galium	95	100	100	100	100	100	100	100	100	100	95	100	100	100

Geranium, Cutleaf	-	-	-	-	-	-	-	-	75	-	-	-	-	80
Kochia	100	90	100	80	100	70	90	60	100	100	95	100	100	95
Lambsquarters	100	100	95	100	95	95	100	90	100	100	90	100	95	100
Mustard, Wild	70	60	40	65	70	30	25	25	100	85	40	95	90	90
Oat, Wild	100	95	95	90	98	95	98	100	98	95	95	100	95	80
Oilseed Rape	65	75	60	75	70	70	65	75	15	90	25	75	75	75
Pigweed	100	100	100	100	95	85	100	75	95	100	100	100	100	98
Radish, Wild	50	95	50	100	55	75	30	85	75	90	20	85	90	75
Russian Thistle	80	90	75	80	75	80	65	80	75	65	50	75	75	80
Ryegrass, Italian	98	95	90	90	98	85	95	90	95	95	90	95	95	90
Speedwell	85	95	85	75	75	80	75	85	100	55	65	70	75	100
Wheat, Spring	15	0	0	5	0	15	5	5	40	20	20	20	25	0
Wheat, Winter	5	5	0	5	0	0	0	5	40	20	10	20	25	0
Windgrass	95	90	80	90	80	80	85	85	70	85	80	75	80	30

Table D	Compounds	
125 g ai/ha	129	153
Postemergence		
Barley, Spring	30	15
Barley, Winter	30	10
Blackgrass	60	75
Bluegrass	20	30
Bromegrass, Downy	65	65
Buckwheat, Wild	100	100
Canada Thistle	100	100
Canarygrass	75	80
Chamomile	100	100
Chickweed	100	85
Deadnettle	70	80
Field Poppy	80	100
Field Violet	70	95
Foxtail, Green	85	85
Galium	100	100

Table D	Compounds	
125 g ai/ha	129	153
Postemergence		
Geranium, Cutleaf	75	90
Kochia	80	30
Lambsquarters	95	65
Mustard, Wild	98	100
Oat, Wild	95	90
Oilseed Rape	15	85
Pigweed	100	80
Radish, Wild	80	100
Russian Thistle	85	45
Ryegrass, Italian	90	90
Speedwell	65	90
Wheat, Spring	50	40
Wheat, Winter	40	25
Windgrass	55	65

Table D	Compounds													
62 g ai/ha	1	2	11	20	21	22	23	25	27	28	34	35	36	41
Postemergence														

Barley, Spring	5	0	0	0	5	0	15	0	0	5	0	0	0	5
Barley, Winter	5	10	20	0	10	0	15	0	0	0	0	0	0	5
Blackgrass	50	70	40	40	85	20	70	75	80	80	40	65	35	65
Bluegrass	5	10	5	25	30	15	35	20	25	30	15	25	15	30
Bromegrass, Downy	10	10	15	10	60	10	45	25	25	25	30	25	20	20
Buckwheat, Wild	75	95	45	100	100	98	100	100	100	100	100	100	100	90
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	35	40	20	30	80	35	75	80	80	75	65	30	40	70
Chamomile	75	80	65	95	95	80	85	95	90	90	80	100	95	75
Chickweed	80	95	90	100	100	95	100	98	100	100	100	100	100	98
Deadnettle	35	60	100	35	100	10	65	10	5	35	100	20	100	100
Field Poppy	95	95	85	60	100	85	100	80	100	90	100	100	70	80
Field Violet	75	85	65	15	95	70	45	75	70	75	100	75	85	90
Foxtail, Green	65	80	25	35	80	45	75	65	80	75	45	90	45	55
Galium	90	100	85	75	100	90	100	100	100	100	100	98	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	85	60	75	65	45	95	75	95	55	40	85	20	95	95
Lambsquarters	90	90	80	85	85	85	75	90	85	85	95	100	95	65
Mustard, Wild	30	35	70	100	100	95	95	40	40	45	85	100	100	100
Oat, Wild	70	80	75	25	85	85	75	80	85	85	85	90	80	80
Oilseed Rape	15	45	15	0	100	30	60	30	65	65	70	98	85	5
Pigweed	90	80	65	100	85	95	75	100	85	90	100	80	100	80
Radish, Wild	20	55	30	40	100	75	75	35	75	100	85	100	90	80
Russian Thistle	-	-	-	75	75	70	75	75	75	75	80	75	85	70
Ryegrass, Italian	75	80	85	70	80	80	80	85	85	80	95	75	80	85
Speedwell	55	65	100	15	100	60	100	15	70	85	75	75	90	100
Wheat, Spring	0	0	15	15	30	10	50	0	5	5	10	20	0	20
Wheat, Winter	0	0	15	10	25	5	40	0	5	5	25	15	0	20
Windgrass	25	25	10	30	80	20	70	75	75	80	50	65	50	55

Table D						Compounds								
62 g ai/ha	42	47	52	54	57	59	60	66	67	69	72	73	75	79
Postemergence														
Barley, Spring	0	0	0	0	10	30	25	0	5	0	5	25	0	5
Barley, Winter	0	10	0	0	30	30	25	0	0	0	20	15	0	0
Blackgrass	75	25	15	40	45	80	80	70	75	30	70	70	20	20
Bluegrass	20	10	5	15	15	40	25	25	15	15	35	30	10	10

Bromegrass, Downy	20	0	0	55	20	70	55	60	60	15	55	55	0	5
Buckwheat, Wild	95	75	100	100	85	100	95	100	100	70	100	100	100	100
Canada Thistle	-	-	-	-	-	-	-	-	-	100	-	-	-	-
Canarygrass	75	0	0	55	5	80	80	65	85	25	50	70	15	20
Chamomile	70	-	100	100	100	80	80	90	100	70	80	85	90	95
Chickweed	100	95	100	100	100	98	100	85	100	80	100	95	100	95
Deadnettle	25	20	25	100	90	80	75	15	30	65	90	90	90	15
Field Poppy	85	100	80	100	100	75	75	85	100	70	90	100	100	85
Field Violet	80	-	65	75	70	80	95	95	80	80	95	95	100	75
Foxtail, Green	50	60	5	65	75	70	40	80	90	10	65	70	25	70
Galium	100	75	95	100	90	100	100	100	100	85	100	100	95	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	30	-	-	-	-
Kochia	90	70	20	95	55	95	85	95	35	85	95	80	100	80
Lambsquarters	85	50	75	95	75	85	80	95	100	95	95	95	100	80
Mustard, Wild	70	0	75	100	30	100	75	40	35	35	100	100	100	20
Oat, Wild	85	15	5	85	25	90	90	95	98	75	85	95	70	70
Oilseed Rape	50	20	5	95	25	70	70	20	80	10	70	70	95	5
Pigweed	90	75	40	100	85	85	95	100	80	80	100	100	100	100
Radish, Wild	10	10	65	100	100	95	75	25	65	20	80	95	100	0
Russian Thistle	75	-	35	80	-	80	80	80	60	20	75	80	80	55
Ryegrass, Italian	80	10	50	85	50	90	90	95	90	75	95	85	95	75
Speedwell	50	10	85	100	15	100	80	70	75	85	75	100	100	30
Wheat, Spring	10	10	0	0	10	45	35	0	0	0	50	55	0	0
Wheat, Winter	5	5	10	5	10	40	30	0	0	0	35	35	0	0
Windgrass	75	10	5	45	10	80	85	80	85	15	75	70	15	20

Table D						Compounds								
62 g ai/ha	80	81	82	83	84	85	87	88	90	104	105	108	109	126
Postemergence														
Barley, Spring	10	0	5	5	0	0	0	0	25	10	5	10	5	0
Barley, Winter	0	0	0	0	0	0	0	0	15	10	10	5	0	5
Blackgrass	80	75	70	70	75	80	75	85	35	40	25	45	30	20
Bluegrass	35	20	20	10	20	20	25	25	15	10	10	10	15	10
Bromegrass, Downy	65	35	45	35	65	30	65	25	30	30	20	30	30	10
Buckwheat, Wild	100	100	100	100	80	100	100	85	90	95	95	100	95	100
Canada Thistle	-	-	-	-	-	-	-	-	100	-	-	-	-	100
Canarygrass	80	85	55	75	65	85	80	80	45	65	50	50	55	35

Chamomile	95	100	100	100	98	75	100	100	75	85	85	85	85	95
Chickweed	100	100	90	100	90	100	90	95	90	100	90	100	100	98
Deadnettle	25	35	10	25	10	15	15	15	80	50	10	50	50	70
Field Poppy	80	100	85	100	80	90	85	85	70	65	75	55	50	55
Field Violet	85	85	100	80	100	65	85	75	98	90	90	95	95	85
Foxtail, Green	90	95	80	90	80	80	75	75	55	70	70	70	65	10
Galium	95	100	100	100	100	95	100	100	100	90	95	95	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	65	-	-	-	-	40
Kochia	100	85	95	75	95	65	90	55	100	95	95	100	100	80
Lambsquarters	100	100	95	100	90	85	100	80	90	100	95	95	95	98
Mustard, Wild	50	60	35	25	50	25	35	20	95	75	25	75	85	80
Oat, Wild	98	90	90	85	95	85	95	95	90	90	85	95	95	70
Oilseed Rape	55	70	45	70	45	70	40	65	5	75	15	70	70	65
Pigweed	100	100	100	100	95	80	100	75	90	100	100	100	85	100
Radish, Wild	50	90	20	90	40	65	20	60	75	75	15	75	75	70
Russian Thistle	70	85	75	80	70	75	65	75	75	60	45	70	75	40
Ryegrass, Italian	95	90	85	85	95	85	95	90	90	95	85	90	85	90
Speedwell	75	80	75	70	70	70	75	65	100	35	50	65	60	65
Wheat, Spring	10	0	0	0	0	0	0	0	35	15	10	20	15	0
Wheat, Winter	0	0	0	0	0	0	0	10	35	15	5	15	15	0
Windgrass	90	80	75	85	75	70	85	80	50	75	70	70	65	20

Table D	Compounds	
62 g ai/ha	129	153
Postemergence		
Barley, Spring	25	5
Barley, Winter	20	5
Blackgrass	45	70
Bluegrass	15	15
Bromegrass, Downy	40	35
Buckwheat, Wild	100	95
Canada Thistle	100	98
Canarygrass	55	75
Chamomile	98	95
Chickweed	100	85
Deadnettle	40	75
Field Poppy	75	95

Table D	Compounds	
62 g ai/ha	129	153
Postemergence		
Geranium, Cutleaf	70	90
Kochia	70	15
Lambsquarters	90	65
Mustard, Wild	80	98
Oat, Wild	90	85
Oilseed Rape	5	85
Pigweed	98	75
Radish, Wild	75	85
Russian Thistle	80	20
Ryegrass, Italian	85	90
Speedwell	60	75
Wheat, Spring	35	30

Field Violet	70	90	Wheat, Winter	35	15
Foxtail, Green	80	80	Windgrass	35	30
Galium	100	100			

Table D	Compounds													
31 g ai/ha	1	2	11	20	21	22	25	27	28	34	35	36	41	42
Postemergence														
Barley, Spring	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Barley, Winter	5	10	20	0	0	0	0	0	0	0	0	0	0	0
Blackgrass	40	65	25	15	80	15	65	75	75	25	30	25	55	75
Bluegrass	0	5	5	10	20	10	10	15	20	10	35	10	15	15
Bromegrass, Downy	0	10	15	0	45	10	5	15	15	20	5	10	10	0
Buckwheat, Wild	70	85	45	80	100	90	80	100	100	100	95	100	80	80
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	20	25	10	10	80	20	70	75	75	30	20	15	55	50
Chamomile	65	70	40	70	90	80	75	80	85	75	100	95	75	75
Chickweed	80	85	45	90	90	85	98	95	100	95	90	100	98	95
Deadnettle	35	60	75	25	90	10	5	5	10	95	15	80	85	5
Field Poppy	95	75	35	30	85	75	70	85	80	100	100	60	55	65
Field Violet	85	60	65	5	95	70	65	75	80	75	65	70	100	70
Foxtail, Green	50	70	5	15	70	15	60	70	65	40	75	35	45	35
Galium	80	85	85	70	100	90	100	100	100	95	98	100	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	70	50	60	35	35	80	90	45	35	60	25	85	85	70
Lambsquarters	75	90	60	85	80	80	90	80	80	90	75	95	70	80
Mustard, Wild	25	25	65	75	100	90	20	15	35	80	98	100	90	25
Oat, Wild	40	55	40	20	80	65	75	75	75	75	85	35	70	75
Oilseed Rape	0	20	0	0	80	30	5	55	65	65	95	75	0	10
Pigweed	80	70	35	80	80	85	80	75	75	100	80	100	75	85
Radish, Wild	10	25	50	50	95	85	15	65	85	65	85	80	90	5
Russian Thistle	-	-	-	70	70	65	70	65	70	70	70	80	70	70
Ryegrass, Italian	65	70	80	55	80	75	75	80	75	90	65	75	80	75
Speedwell	25	50	0	5	100	60	10	35	60	65	70	60	100	10
Wheat, Spring	0	0	15	0	20	5	0	0	0	0	15	0	15	0
Wheat, Winter	0	0	10	0	20	5	0	0	5	5	10	0	10	0
Windgrass	10	10	10	25	70	15	70	75	70	40	25	40	40	70

Table D	Compounds													
31 g ai/ha	47	52	54	57	59	60	66	67	69	72	73	75	79	80
Postemergence														
Barley, Spring	0	0	0	10	25	15	0	0	0	5	10	0	0	0
Barley, Winter	10	0	0	20	20	10	0	0	0	10	15	0	0	0
Blackgrass	25	10	25	15	70	75	65	70	20	40	65	15	10	75
Bluegrass	5	5	10	5	25	15	0	5	0	20	15	10	5	15
Bromegrass, Downy	5	0	10	15	35	30	50	60	0	45	25	0	5	55
Buckwheat, Wild	60	100	100	80	65	90	95	100	60	95	95	100	70	100
Canada Thistle	-	-	-	-	-	-	-	-	85	-	-	-	-	-
Canarygrass	0	0	35	5	75	80	55	75	25	40	60	15	5	55
Chamomile	-	85	90	100	80	75	85	95	65	75	70	80	85	80
Chickweed	90	90	100	100	100	85	75	85	75	98	90	100	95	90
Deadnettle	20	35	100	70	80	70	15	40	20	85	75	75	5	35
Field Poppy	80	85	70	100	70	60	70	80	65	80	75	100	75	60
Field Violet	-	35	85	80	75	80	85	80	75	90	90	95	75	90
Foxtail, Green	50	5	55	75	65	35	75	80	10	60	65	0	20	70
Galium	65	90	100	90	100	100	85	90	75	95	95	90	95	90
Geranium, Cutleaf	-	-	-	-	-	-	-	-	15	-	-	-	-	-
Kochia	45	0	15	40	95	70	85	10	60	80	100	95	70	100
Lambsquarters	45	75	95	75	90	80	95	90	75	80	95	100	85	95
Mustard, Wild	0	20	100	30	90	75	10	25	20	85	85	100	20	35
Oat, Wild	10	5	75	15	80	85	85	95	70	85	85	50	70	95
Oilseed Rape	20	0	75	20	60	65	0	70	0	65	65	70	0	15
Pigweed	75	35	100	85	80	75	95	75	80	95	100	100	100	100
Radish, Wild	5	35	80	40	95	65	5	55	0	75	75	95	0	10
Russian Thistle	-	20	80	-	80	80	75	55	15	70	75	80	50	70
Ryegrass, Italian	10	40	80	25	80	80	85	85	75	95	70	90	70	85
Speedwell	10	70	75	100	65	85	55	70	70	75	70	80	25	65
Wheat, Spring	10	0	0	0	40	30	0	0	0	40	45	0	0	0
Wheat, Winter	5	0	0	5	35	25	0	0	0	25	25	0	0	0
Windgrass	10	0	35	10	75	80	75	85	15	65	70	10	15	75

Table D	Compounds													
31 g ai/ha	81	82	83	84	85	87	88	90	104	105	108	109	126	129
Postemergence														
Barley, Spring	0	0	0	0	0	0	0	10	0	0	0	0	0	20

Barley, Winter	0	0	0	0	0	0	0	0	0	0	5	5	0	10
Blackgrass	65	45	65	65	75	65	75	15	35	15	20	20	15	35
Bluegrass	5	10	0	20	10	25	10	5	10	10	5	5	0	10
Bromegrass, Downy	15	55	25	40	30	45	15	20	20	10	25	30	5	25
Buckwheat, Wild	100	85	100	85	95	85	80	80	90	65	90	95	70	100
Canada Thistle	-	-	-	-	-	-	-	98	-	-	-	-	98	100
Canarygrass	75	50	50	50	75	55	65	25	45	40	40	40	20	30
Chamomile	100	90	95	95	75	90	85	70	80	80	75	80	70	100
Chickweed	100	80	100	85	90	85	85	80	95	90	90	100	80	100
Deadnettle	15	10	15	5	10	10	5	70	45	10	35	20	40	35
Field Poppy	100	70	100	70	70	70	70	65	15	70	20	45	25	70
Field Violet	75	95	90	85	65	80	75	90	85	85	90	90	85	65
Foxtail, Green	80	75	75	75	75	70	70	25	30	70	65	55	10	80
Galium	100	90	100	90	85	85	100	98	85	85	90	100	90	90
Geranium, Cutleaf	-	-	-	-	-	-	-	45	-	-	-	-	30	60
Kochia	60	90	70	85	40	85	45	85	95	85	90	95	75	60
Lambsquarters	95	95	95	90	80	95	80	90	95	85	90	90	90	75
Mustard, Wild	50	25	25	25	10	10	10	80	70	5	70	60	80	80
Oat, Wild	85	90	80	85	75	85	80	75	85	80	85	95	60	90
Oilseed Rape	70	25	65	10	65	15	65	0	70	0	45	65	60	5
Pigweed	100	90	100	95	75	95	75	80	100	85	95	85	98	98
Radish, Wild	75	25	75	20	60	15	35	65	70	5	75	75	40	60
Russian Thistle	75	65	75	70	65	60	75	30	55	40	65	60	30	70
Ryegrass, Italian	85	85	80	80	80	90	80	75	90	75	90	85	85	80
Speedwell	75	70	65	70	35	70	25	100	30	45	60	50	60	35
Wheat, Spring	0	0	0	0	0	0	0	25	10	0	15	5	0	25
Wheat, Winter	0	0	0	0	0	0	0	20	5	0	10	10	0	30
Windgrass	70	70	75	75	60	80	65	30	55	60	65	60	0	20

Table D	Compound
31 g ai/ha	153
Postemergence	
Barley, Spring	5
Barley, Winter	0
Blackgrass	65
Bluegrass	15
Bromegrass, Downy	25

Table D	Compound
31 g ai/ha	153
Postemergence	
Geranium, Cutleaf	75
Kochia	20
Lambsquarters	75
Mustard, Wild	98
Oat, Wild	85

Buckwheat, Wild	95	Oilseed Rape	70
Canada Thistle	98	Pigweed	80
Canarygrass	75	Radish, Wild	80
Chamomile	70	Russian Thistle	25
Chickweed	80	Ryegrass, Italian	80
Deadnettle	70	Speedwell	75
Field Poppy	75	Wheat, Spring	20
Field Violet	85	Wheat, Winter	10
Foxtail, Green	80	Windgrass	25
Galium	100		

Table D	Compounds													
250 g ai/ha	1	2	11	20	22	25	27	28	34	35	36	41	42	47
Preemergence														
Barley, Spring	15	0	15	0	0	0	0	0	20	0	0	60	5	15
Barley, Winter	0	0	20	0	0	20	15	15	65	0	0	30	15	10
Blackgrass	90	90	75	75	75	95	100	95	65	95	50	80	100	50
Bluegrass	50	50	55	35	40	75	80	75	60	45	15	90	80	20
Bromegrass, Downy	70	70	55	45	80	85	85	85	80	65	35	80	90	15
Buckwheat, Wild	100	100	25	100	95	25	80	100	0	35	10	75	60	85
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	90	90	90	80	90	100	100	95	95	98	65	95	100	5
Chamomile	90	100	-	-	100	95	100	100	-	100	-	-	100	85
Chickweed	100	100	100	95	100	100	100	100	100	100	100	95	100	90
Deadnettle	60	55	100	20	-	50	80	5	95	80	85	100	15	65
Field Poppy	95	100	100	100	100	100	100	100	100	100	100	95	100	100
Field Violet	100	100	100	75	100	100	95	100	95	100	95	100	100	100
Foxtail, Green	100	100	65	85	20	100	100	100	75	100	75	100	100	100
Galium	100	100	100	85	85	100	100	100	85	100	85	100	100	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	75	20	95	90	75	100	60	65	50	25	60	100	100	40
Lambsquarters	100	100	100	100	100	100	100	100	95	100	95	100	100	100
Mustard, Wild	25	40	100	100	95	60	65	55	100	100	90	95	25	65
Oat, Wild	100	100	85	95	95	100	95	100	90	95	85	95	95	40
Oilseed Rape	20	40	5	0	75	35	35	25	85	100	65	15	0	15
Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Radish, Wild	100	100	25	65	80	0	95	30	60	100	70	100	60	85

Russian Thistle	-	-	-	70	20	90	75	35	15	25	15	70	75	-
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	70	100	100	70
Speedwell	95	100	100	90	100	100	100	100	100	100	100	100	100	100
Wheat, Spring	10	10	35	45	25	25	25	25	60	30	30	85	20	15
Wheat, Winter	5	5	30	25	5	20	5	0	40	10	0	75	15	10
Windgrass	100	100	75	60	80	100	100	100	70	100	65	95	100	75

Table D						Compounds								
250 g ai/ha	52	54	57	59	60	66	67	69	72	73	75	79	80	81
Preemergence														
Barley, Spring	0	5	10	60	60	10	0	0	60	60	0	0	0	5
Barley, Winter	0	0	5	45	65	10	0	0	75	75	0	10	45	45
Blackgrass	65	75	80	100	100	80	80	75	75	85	55	60	85	85
Bluegrass	35	25	65	80	80	30	50	65	50	30	35	35	75	60
Bromegrass, Downy	20	40	30	95	98	85	70	65	60	90	25	60	85	75
Buckwheat, Wild	100	80	100	95	60	0	0	15	10	30	50	100	20	15
Canada Thistle	-	-	-	-	-	-	-	95	-	-	-	-	-	-
Canarygrass	35	90	65	100	100	95	95	95	95	100	75	85	100	100
Chamomile	100	-	-	100	100	100	100	100	-	-	-	-	100	-
Chickweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Deadnettle	25	95	45	100	100	55	60	98	70	100	100	90	75	55
Field Poppy	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Field Violet	85	95	100	100	100	98	100	95	95	95	100	100	95	95
Foxtail, Green	35	100	100	100	100	70	85	55	85	100	100	95	100	100
Galium	95	100	100	100	100	75	70	90	85	90	80	100	90	95
Geranium, Cutleaf	-	-	-	-	-	-	-	10	-	-	-	-	-	-
Kochia	90	45	100	100	75	85	0	5	40	95	100	95	100	15
Lambsquarters	100	95	100	100	100	100	100	100	95	100	100	100	100	95
Mustard, Wild	98	100	30	100	90	0	0	80	80	100	95	10	0	50
Oat, Wild	30	95	60	100	100	90	90	95	95	100	85	90	95	95
Oilseed Rape	55	100	25	80	80	35	25	15	25	70	100	35	40	100
Pigweed	90	100	100	100	100	100	100	100	100	100	100	100	100	100
Radish, Wild	75	100	100	100	90	70	95	20	50	90	100	55	100	-
Russian Thistle	0	35	-	90	70	90	25	10	25	75	35	100	100	35
Ryegrass, Italian	98	100	95	100	100	95	90	100	90	100	0	100	100	100
Speedwell	100	100	100	100	100	100	100	100	100	100	100	-	100	100
Wheat, Spring	5	45	10	85	75	20	10	10	80	85	45	0	35	40

Wheat, Winter	0	35	10	80	55	0	5	0	45	75	15	0	20	5
Windgrass	10	95	80	100	100	85	95	95	90	95	85	80	98	100

Table D							Compounds							
250 g ai/ha	82	83	84	85	87	88	90	104	105	108	109	126	129	153
Preemergence														
Barley, Spring	10	5	5	5	5	0	35	15	20	0	5	0	20	40
Barley, Winter	25	40	35	15	25	25	30	20	25	20	10	5	10	40
Blackgrass	80	85	90	85	80	90	60	75	75	80	80	65	75	95
Bluegrass	80	35	80	75	70	80	65	75	75	75	60	40	60	75
Bromegrass, Downy	85	40	85	80	80	75	95	85	75	75	65	30	80	95
Buckwheat, Wild	0	25	20	100	60	80	80	95	25	35	75	25	85	85
Canada Thistle	-	-	-	-	-	-	100	-	-	-	-	95	100	100
Canarygrass	95	100	95	95	95	90	95	100	98	95	98	90	90	100
Chamomile	100	-	100	-	100	-	100	-	-	-	-	100	100	100
Chickweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Deadnettle	70	100	75	35	70	85	98	100	65	100	95	80	95	100
Field Poppy	100	100	100	95	100	90	100	100	100	100	100	95	100	100
Field Violet	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Foxtail, Green	85	100	100	100	95	100	95	100	100	100	95	45	95	100
Galium	85	85	90	100	80	100	95	100	100	100	100	98	95	98
Geranium, Cutleaf	-	-	-	-	-	-	90	-	-	-	-	15	95	90
Kochia	100	50	95	45	100	55	80	100	100	100	100	95	100	70
Lambsquarters	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mustard, Wild	15	25	20	40	25	70	90	95	20	85	100	98	100	100
Oat, Wild	95	90	95	90	95	95	98	100	100	95	90	90	100	98
Oilseed Rape	60	10	35	30	45	25	0	55	50	40	85	90	100	100
Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	98	100
Radish, Wild	100	90	65	100	95	-	95	100	55	90	95	90	100	100
Russian Thistle	65	0	95	75	100	25	60	75	90	100	50	15	100	100
Ryegrass, Italian	95	100	100	90	98	90	100	100	98	100	100	100	100	100
Speedwell	100	100	95	100	100	100	100	-	-	-	-	100	100	100
Wheat, Spring	40	35	-	40	20	30	70	45	40	40	40	0	75	85
Wheat, Winter	10	25	5	15	15	15	50	15	5	30	20	0	60	50
Windgrass	100	95	100	100	100	95	98	100	95	95	100	85	80	95

Table D Compounds

125 g ai/ha	1	2	11	20	22	25	27	28	34	35	36	41	42	47
Preemergence														
Barley, Spring	10	0	10	0	0	0	0	0	0	0	0	30	0	15
Barley, Winter	0	0	5	0	0	5	10	15	0	0	0	25	5	5
Blackgrass	85	85	55	60	55	90	95	85	40	85	35	80	95	30
Bluegrass	35	30	30	25	30	40	70	65	50	35	10	80	65	20
Bromegrass, Downy	70	65	20	40	25	80	85	70	50	55	10	70	70	15
Buckwheat, Wild	65	100	15	100	85	20	45	20	0	20	10	65	80	70
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	85	85	90	70	85	95	100	95	90	95	40	90	100	0
Chamomile	95	95	-	-	100	100	100	100	-	100	-	-	100	85
Chickweed	100	100	100	95	100	100	100	100	100	100	100	95	100	100
Deadnettle	0	0	50	10	15	0	55	5	50	55	50	100	25	10
Field Poppy	95	95	100	95	100	100	100	95	100	100	70	-	100	100
Field Violet	100	100	100	25	80	100	95	100	75	85	70	100	100	100
Foxtail, Green	75	100	15	75	0	95	100	100	60	65	70	100	100	60
Galium	100	100	100	75	75	95	85	85	80	95	75	95	95	100
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	35	0	75	70	50	40	30	30	15	20	45	80	75	35
Lambsquarters	100	100	100	100	100	98	100	100	95	100	75	100	100	100
Mustard, Wild	10	5	75	100	85	20	45	30	75	100	85	95	20	40
Oat, Wild	95	95	80	85	70	95	90	90	85	85	75	90	95	35
Oilseed Rape	5	20	5	0	0	0	0	10	50	65	55	25	0	10
Pigweed	100	65	98	100	98	100	100	100	100	100	100	100	100	100
Radish, Wild	15	15	20	50	70	0	60	35	60	100	50	95	15	100
Russian Thistle	-	-	-	40	0	40	65	15	10	0	10	40	65	-
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	70	100	100	60
Speedwell	-	90	85	70	50	95	100	95	100	100	100	100	70	80
Wheat, Spring	0	5	25	25	10	10	5	5	25	5	0	70	0	15
Wheat, Winter	5	0	20	15	0	0	0	0	25	0	0	45	5	10
Windgrass	85	95	55	50	70	100	100	90	55	100	5	80	85	20

Table D							Compounds							
125 g ai/ha	52	54	57	59	60	66	67	69	72	73	75	79	80	81
Preemergence														
Barley, Spring	0	0	10	40	45	-	0	0	0	0	0	0	5	0
Barley, Winter	0	0	5	40	50	0	0	0	50	60	0	0	15	45

Blackgrass	65	50	70	95	100	75	75	70	55	80	40	55	80	70
Bluegrass	25	15	25	75	65	25	20	35	25	35	10	25	75	20
Bromegrass, Downy	15	15	25	90	95	80	35	35	35	50	10	50	75	15
Buckwheat, Wild	55	70	10	100	50	0	0	5	15	60	0	25	20	0
Canada Thistle	-	-	-	-	-	-	-	95	-	-	-	-	-	-
Canarygrass	25	80	55	95	95	85	90	95	85	90	70	75	90	95
Chamomile	100	-	-	100	100	100	100	100	-	-	-	-	100	-
Chickweed	100	95	100	100	100	100	100	100	100	100	95	100	100	100
Deadnettle	10	70	25	90	85	55	55	75	65	70	90	100	70	5
Field Poppy	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Field Violet	75	70	100	95	100	95	100	95	75	80	100	98	100	100
Foxtail, Green	15	65	100	85	95	65	85	50	60	50	55	65	100	100
Galium	90	85	100	100	95	65	35	90	70	80	60	100	80	85
Geranium, Cutleaf	-	-	-	-	-	-	-	0	-	-	-	-	-	-
Kochia	40	30	35	95	60	75	0	70	10	85	80	100	100	25
Lambsquarters	100	95	100	100	100	100	100	100	95	95	100	100	100	70
Mustard, Wild	90	100	25	100	85	0	0	40	60	100	100	5	0	0
Oat, Wild	25	85	50	95	100	85	80	90	85	85	80	85	90	85
Oilseed Rape	0	85	0	50	40	35	25	15	15	0	100	40	35	50
Pigweed	65	100	98	100	100	100	100	100	95	100	100	100	100	100
Radish, Wild	55	100	25	95	95	75	75	20	50	100	100	45	100	-
Russian Thistle	0	25	-	80	35	60	0	0	15	40	25	75	95	15
Ryegrass, Italian	100	100	80	100	100	90	85	98	100	100	100	90	95	85
Speedwell	95	100	100	100	100	100	100	100	-	100	100	-	95	100
Wheat, Spring	0	0	5	80	65	5	0	0	65	70	35	0	25	0
Wheat, Winter	0	15	5	70	55	0	0	0	25	50	20	0	0	5
Windgrass	10	70	65	100	100	85	80	75	80	90	50	50	95	90

Table D							Compounds							
125 g ai/ha	82	83	84	85	87	88	90	104	105	108	109	126	129	153
Preemergence														
Barley, Spring	0	0	0	0	0	0	20	5	0	0	5	0	0	25
Barley, Winter	5	0	5	0	10	0	15	10	10	10	0	0	0	25
Blackgrass	75	70	80	85	80	85	45	65	60	50	75	55	55	85
Bluegrass	65	35	65	65	45	75	65	70	60	35	30	30	25	75
Bromegrass, Downy	80	60	75	55	75	65	55	65	70	70	65	20	65	85
Buckwheat, Wild	15	0	25	80	0	50	40	55	5	20	30	10	85	85

Canada Thistle	-	-	-	-	-	-	100	-	-	-	-	95	100	100
Canarygrass	90	90	90	90	90	90	85	95	95	90	90	80	60	95
Chamomile	100	-	100	-	100	-	100	-	-	-	-	100	100	100
Chickweed	100	100	100	100	100	100	100	95	100	100	100	100	98	100
Deadnettle	25	15	65	10	65	65	90	80	15	95	80	70	75	100
Field Poppy	100	100	100	-	100	90	100	100	100	100	100	90	100	100
Field Violet	95	95	100	95	95	100	100	95	100	100	100	100	85	100
Foxtail, Green	90	100	75	100	95	100	70	100	65	100	75	25	80	100
Galium	80	40	75	75	60	75	85	100	85	95	100	85	90	95
Geranium, Cutleaf	-	-	-	-	-	-	65	-	-	-	-	0	70	85
Kochia	75	30	75	10	100	15	90	95	95	80	80	75	85	25
Lambsquarters	100	100	95	100	100	100	85	100	100	100	100	75	100	100
Mustard, Wild	25	35	5	35	0	65	100	75	0	95	100	70	100	100
Oat, Wild	95	90	95	85	90	90	85	80	85	80	90	80	90	98
Oilseed Rape	35	10	35	20	30	0	0	55	50	75	75	15	55	90
Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Radish, Wild	60	90	35	100	75	-	90	95	35	100	90	75	100	98
Russian Thistle	65	15	95	25	85	15	35	55	70	70	35	5	100	60
Ryegrass, Italian	90	90	100	85	98	85	100	100	95	100	100	98	98	100
Speedwell	100	100	90	100	90	100	100	-	-	-	-	100	100	100
Wheat, Spring	15	10	15	15	15	25	60	35	0	25	20	0	60	70
Wheat, Winter	0	5	0	5	0	10	25	5	5	10	5	0	45	45
Windgrass	100	90	90	95	85	85	80	80	80	75	80	75	75	80

Table D	Compounds													
62 g ai/ha	1	2	11	20	22	25	27	28	34	35	36	41	42	47
Preemergence														
Barley, Spring	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Barley, Winter	0	0	5	0	0	0	0	0	0	0	0	20	0	0
Blackgrass	70	75	30	40	45	90	90	85	20	85	30	75	80	20
Bluegrass	15	15	15	15	30	35	35	45	25	25	15	75	45	20
Bromegrass, Downy	25	50	5	35	5	65	55	55	50	30	0	55	55	10
Buckwheat, Wild	10	10	15	20	20	0	30	0	10	20	0	55	25	60
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	60	60	55	35	35	80	95	85	50	85	45	90	95	0
Chamomile	95	100	-	-	100	100	100	95	-	100	-	-	100	80
Chickweed	90	100	100	95	100	100	100	100	95	95	95	95	100	95

Deadnettle	0	0	15	0	0	0	0	0	40	15	0	90	0	10
Field Poppy	95	95	75	70	0	100	100	95	100	85	50	95	100	100
Field Violet	100	100	100	15	65	100	90	85	25	75	10	90	95	100
Foxtail, Green	15	100	10	60	0	90	95	80	60	45	25	80	65	25
Galium	95	85	80	30	65	90	70	60	35	85	20	85	85	95
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	0	0	40	25	35	10	20	20	10	0	25	75	60	10
Lambsquarters	100	60	35	90	100	95	100	100	60	98	95	100	100	100
Mustard, Wild	0	0	20	35	65	0	40	15	25	100	85	90	15	20
Oat, Wild	70	90	70	65	55	90	85	85	75	80	45	90	90	20
Oilseed Rape	0	0	0	0	0	0	0	0	55	10	0	5	0	0
Pigweed	100	50	0	40	98	100	100	100	95	95	75	75	100	100
Radish, Wild	0	5	15	0	25	0	50	0	0	100	0	85	-	25
Russian Thistle	-	-	-	30	0	25	10	0	0	0	15	20	15	-
Ryegrass, Italian	100	95	90	100	90	100	100	95	95	85	65	100	100	30
Speedwell	50	-	15	70	0	80	100	95	100	75	100	95	75	25
Wheat, Spring	0	0	15	15	0	0	0	0	0	0	0	55	0	5
Wheat, Winter	0	0	0	0	0	0	0	0	0	0	0	20	0	5
Windgrass	60	75	35	40	20	85	85	75	25	95	5	75	85	5

Table D							Compounds							
62 g ai/ha	52	54	57	59	60	66	67	69	72	73	75	79	80	81
Preemergence														
Barley, Spring	0	0	10	25	10	0	0	0	0	10	0	0	0	0
Barley, Winter	0	0	0	25	30	0	0	0	25	40	0	0	0	0
Blackgrass	20	30	35	90	95	70	75	25	30	60	30	45	75	60
Bluegrass	10	10	20	50	45	15	0	0	25	35	15	10	55	10
Bromegrass, Downy	0	15	5	85	90	60	35	20	0	40	0	35	35	45
Buckwheat, Wild	20	5	10	65	25	0	0	0	0	0	0	90	25	15
Canada Thistle	-	-	-	-	-	-	-	90	-	-	-	-	-	-
Canarygrass	25	55	10	90	95	80	85	80	80	85	55	60	90	65
Chamomile	100	-	-	95	100	100	95	100	-	-	-	-	100	-
Chickweed	98	90	100	100	100	100	100	100	100	90	100	100	100	100
Deadnettle	0	60	20	90	90	40	30	55	15	0	55	10	65	0
Field Poppy	0	55	100	100	100	100	100	90	100	100	95	100	100	100
Field Violet	10	35	100	90	100	85	98	90	75	75	100	85	95	80
Foxtail, Green	0	60	70	75	80	35	80	50	30	20	35	60	80	65

Galium	100	45	100	95	85	20	10	70	60	80	50	90	40	65
Geranium, Cutleaf	-	-	-	-	-	-	-	0	-	-	-	-	-	-
Kochia	35	60	10	60	20	15	0	20	15	30	80	55	75	0
Lambsquarters	90	65	100	100	100	100	100	100	100	95	95	100	100	95
Mustard, Wild	100	100	25	95	70	0	0	30	25	80	35	15	0	0
Oat, Wild	25	75	30	90	95	85	75	75	75	90	65	80	90	85
Oilseed Rape	0	50	0	30	15	35	20	15	15	5	75	35	35	0
Pigweed	55	100	75	100	100	100	95	100	85	100	100	100	100	100
Radish, Wild	15	100	10	85	90	70	60	0	0	75	70	25	75	50
Russian Thistle	0	0	-	50	20	20	0	0	10	25	0	70	95	0
Ryegrass, Italian	85	90	75	100	100	85	80	95	75	100	100	85	90	65
Speedwell	100	95	90	100	100	100	75	100	70	100	100	-	95	60
Wheat, Spring	0	0	5	65	55	0	0	0	35	55	25	0	0	0
Wheat, Winter	0	0	5	35	35	0	0	0	10	40	0	0	0	0
Windgrass	10	50	35	85	90	75	75	55	65	65	15	40	90	75

Table D	Compounds													
62 g ai/ha	82	83	84	85	87	88	90	104	105	108	109	126	129	153
Preemergence														
Barley, Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barley, Winter	0	0	0	0	0	0	0	0	10	0	0	0	0	10
Blackgrass	75	60	75	80	75	85	35	60	50	35	25	45	15	80
Bluegrass	45	15	30	60	35	60	40	35	30	15	20	5	10	75
Bromegrass, Downy	65	30	55	35	65	45	20	65	65	25	30	0	15	75
Buckwheat, Wild	0	0	15	65	0	45	-	60	5	0	20	0	30	60
Canada Thistle	-	-	-	-	-	-	95	-	-	-	-	15	100	100
Canarygrass	85	85	85	90	90	90	75	85	95	80	75	50	15	90
Chamomile	100	-	100	-	95	-	100	-	-	-	-	100	100	100
Chickweed	100	100	100	100	100	100	198	100	100	100	100	98	100	100
Deadnettle	25	0	20	0	35	0	70	80	10	25	60	45	75	100
Field Poppy	100	100	95	-	100	95	100	100	100	10	100	45	98	100
Field Violet	90	80	100	70	85	95	95	100	100	100	100	85	85	100
Foxtail, Green	75	50	35	55	55	100	45	70	55	90	65	20	70	75
Galium	60	25	60	70	40	70	75	95	95	70	75	70	90	95
Geranium, Cutleaf	-	-	-	-	-	-	60	-	-	-	-	0	0	75
Kochia	15	0	15	10	55	10	65	75	50	95	70	20	55	50
Lambsquarters	95	65	95	100	100	100	98	100	100	100	100	100	75	85

Mustard, Wild	0	0	0	25	0	55	98	70	0	60	75	70	100	100
Oat, Wild	85	85	90	75	85	85	80	80	80	80	80	70	75	95
Oilseed Rape	35	5	20	0	30	0	0	20	60	45	40	0	15	85
Pigweed	100	100	100	100	100	100	35	100	100	100	100	100	100	100
Radish, Wild	60	70	35	25	65	0	65	100	15	100	75	15	100	98
Russian Thistle	15	0	5	10	15	0	15	10	60	15	20	0	50	15
Ryegrass, Italian	80	75	90	80	95	85	100	100	90	98	95	90	80	100
Speedwell	75	75	75	90	85	100	100	-	-	-	-	100	100	100
Wheat, Spring	0	0	5	0	0	10	35	15	0	20	5	0	50	45
Wheat, Winter	0	0	0	0	0	0	10	0	0	0	0	0	35	20
Windgrass	80	75	80	70	80	75	65	75	80	50	60	35	45	80

Table D						Compounds								
31 g ai/ha	1	2	11	20	22	25	27	28	34	35	36	41	42	47
Preemergence														
Barley, Spring	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Barley, Winter	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Blackgrass	35	65	5	20	45	85	85	85	15	75	15	70	80	5
Bluegrass	5	0	10	10	0	25	25	30	0	25	0	70	35	0
Bromegrass, Downy	20	10	5	15	0	40	35	45	0	20	0	50	45	5
Buckwheat, Wild	5	-	20	15	20	0	25	0	0	15	0	35	20	70
Canada Thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canarygrass	40	40	45	25	25	80	85	85	20	75	0	90	90	0
Chamomile	95	80	-	-	95	100	100	100	-	100	-	-	95	80
Chickweed	100	90	20	85	95	95	100	100	85	95	95	90	100	90
Deadnettle	0	0	10	0	0	0	0	0	0	0	0	35	0	0
Field Poppy	95	95	75	70	0	95	100	100	-	75	-	95	100	60
Field Violet	95	95	85	0	20	90	80	75	15	15	15	95	85	95
Foxtail, Green	10	65	10	25	0	35	95	70	55	50	45	45	30	0
Galium	75	100	70	10	10	70	60	15	0	80	0	75	70	85
Geranium, Cutleaf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kochia	0	0	10	0	35	0	0	20	25	0	0	80	20	10
Lambsquarters	20	15	25	75	100	80	100	100	60	70	75	25	98	100
Mustard, Wild	0	0	0	25	5	0	40	10	15	85	45	70	15	10
Oat, Wild	75	80	15	35	30	85	85	85	70	75	35	85	90	10
Oilseed Rape	0	0	5	0	0	0	0	0	10	0	0	0	0	0
Pigweed	70	25	0	30	100	100	100	90	50	25	55	25	90	70

Radish, Wild	0	0	10	0	0	0	0	0	0	35	0	25	0	20
Russian Thistle	-	-	-	0	0	10	0	0	0	0	0	25	10	-
Ryegrass, Italian	100	85	85	90	85	95	90	90	75	75	20	95	95	20
Speedwell	70	55	0	70	0	35	75	95	100	0	95	100	70	25
Wheat, Spring	0	0	5	0	0	0	0	0	0	0	0	40	0	5
Wheat, Winter	0	0	0	0	0	0	0	0	0	0	0	10	0	5
Windgrass	15	60	25	35	0	75	75	70	15	25	0	70	70	5

Table D						Compounds								
31 g ai/ha	52	54	57	59	60	66	67	69	72	73	75	79	80	81
Preemergence														
Barley, Spring	0	0	5	5	5	0	0	0	0	0	0	0	0	0
Barley, Winter	0	0	0	15	15	0	0	0	5	5	0	0	0	0
Blackgrass	20	15	25	85	90	25	75	15	15	50	15	20	70	55
Bluegrass	0	0	0	30	35	10	0	5	10	15	15	10	20	0
Bromegrass, Downy	0	0	0	75	60	15	25	20	0	20	0	35	30	20
Buckwheat, Wild	20	0	0	20	0	0	0	0	0	0	0	0	0	15
Canada Thistle	-	-	-	-	-	-	-	30	-	-	-	-	-	-
Canarygrass	20	15	0	80	90	25	40	30	0	80	20	45	85	75
Chamomile	60	-	-	100	95	90	95	100	-	-	-	-	95	-
Chickweed	98	85	100	100	95	90	100	95	70	95	90	100	100	95
Deadnettle	0	0	0	50	35	15	15	15	5	0	30	0	55	0
Field Poppy	0	90	100	100	75	100	100	85	100	70	0	100	90	100
Field Violet	0	25	95	80	95	60	85	85	10	35	95	80	55	75
Foxtail, Green	0	50	10	55	70	15	15	50	20	15	15	55	20	75
Galium	70	0	85	95	75	0	0	45	20	40	15	80	25	25
Geranium, Cutleaf	-	-	-	-	-	-	-	0	-	-	-	-	-	-
Kochia	15	25	10	20	15	0	0	0	10	30	65	60	35	0
Lambsquarters	35	65	100	95	100	55	95	85	35	95	95	100	100	55
Mustard, Wild	85	50	0	95	45	0	0	0	0	65	55	0	0	0
Oat, Wild	25	75	15	90	90	75	70	60	65	75	55	80	85	85
Oilseed Rape	0	15	0	20	0	35	10	10	5	0	50	25	35	0
Pigweed	60	80	70	95	100	30	35	50	35	70	85	45	100	95
Radish, Wild	0	25	0	-	55	30	25	0	0	30	40	25	20	0
Russian Thistle	0	0	-	40	15	0	0	0	0	10	0	0	10	0
Ryegrass, Italian	85	35	55	100	100	80	75	90	55	95	95	80	90	55
Speedwell	50	100	25	100	100	75	80	98	5	100	95	-	65	55

Wheat, Spring	0	0	5	35	35	0	0	0	0	15	0	0	0	0
Wheat, Winter	0	0	5	10	10	0	0	0	5	15	0	0	0	0
Windgrass	10	0	20	85	85	70	30	35	25	40	0	25	75	60

Table D							Compounds							
31 g ai/ha	82	83	84	85	87	88	90	104	105	108	109	126	129	153
Preemergence														
Barley, Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barley, Winter	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Blackgrass	70	20	70	75	70	80	25	25	35	15	25	25	10	75
Bluegrass	15	15	15	40	25	35	0	35	25	10	10	5	0	70
Bromegrass, Downy	45	20	35	15	25	20	15	0	35	25	0	0	15	75
Buckwheat, Wild	35	0	10	20	0	0	15	0	15	0	0	0	0	40
Canada Thistle	-	-	-	-	-	-	50	-	-	-	-	0	80	100
Canarygrass	75	65	85	80	85	85	50	65	85	45	35	15	5	85
Chamomile	100	-	80	-	95	-	100	-	-	-	-	85	100	100
Chickweed	100	100	100	100	100	100	100	100	100	100	100	70	98	98
Deadnettle	10	0	25	0	25	5	15	65	-	0	0	0	60	98
Field Poppy	95	100	90	-	100	-	15	0	100	10	100	30	90	100
Field Violet	100	75	65	65	80	70	95	100	100	90	85	85	85	100
Foxtail, Green	35	15	30	25	10	30	25	20	45	30	0	20	35	75
Galium	60	0	20	30	15	25	75	65	80	60	40	50	75	85
Geranium, Cutleaf	-	-	-	-	-	-	0	-	-	-	-	0	0	35
Kochia	0	0	10	5	0	10	75	30	10	60	20	10	5	20
Lambsquarters	75	95	95	25	70	100	90	75	95	100	95	100	100	70
Mustard, Wild	0	0	0	25	0	20	35	10	10	5	5	60	75	100
Oat, Wild	80	80	90	75	80	80	75	75	80	80	75	65	75	80
Oilseed Rape	30	5	25	0	15	0	0	15	55	20	15	0	0	75
Pigweed	100	100	95	95	50	75	25	60	100	100	100	98	100	100
Radish, Wild	65	30	-	0	45	5	0	95	-	45	25	5	80	80
Russian Thistle	10	0	5	5	5	0	10	0	0	0	0	0	10	0
Ryegrass, Italian	75	40	80	55	90	75	100	100	85	80	80	75	70	100
Speedwell	75	70	70	50	80	95	100	-	-	-	-	70	90	100
Wheat, Spring	0	0	0	0	0	0	20	0	0	0	0	0	25	25
Wheat, Winter	0	0	0	0	0	0	0	0	0	0	0	0	10	5
Windgrass	75	15	75	55	80	60	50	70	75	25	55	25	35	75

TEST E

Seeds of plant species selected from corn (*Zea mays*), soybean (*Glycine max*), velvetleaf (*Abutilon theophrasti*), lambsquarters (*Chenopodium album*), wild poinsettia (*Euphorbia heterophylla*), pigweed, palmer (palmer pigweed, *Amaranthus palmeri*), waterhemp (common waterhemp, *Amaranthus rudis*), surinam grass (*Brachiaria decumbens*), crabgrass, large (large crabgrass, *Digitaria sanguinalis*), crabgrass, Brazilian (Brazilian crabgrass, *Digitaria horizontalis*), panicum, fall (fall panicum, *Panicum dichotomiflorum*), foxtail, giant (giant foxtail, Setaria faberii), foxtail, green (green foxtail, *Setaria viridis*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), ragweed (common ragweed, *Ambrosia elatior*), barnyardgrass (*Echinochloa crus-galli*), sandbur (southern sandbur, *Cenchrus echinatus*), arrowleaf sida (*Sida rhombifolia*), Italian ryegrass (*Lolium multiflorum*), dayflower (Virginia (VA) dayflower, *Commelina virginica*), field bindweed (*Convolvulus arvensis*), morningglory (*Ipomoea coccinea*), nightshade (eastern black nightshade, *Solanum ptycanthum*), kochia (*Kochia scoparia*), nutsedge, yellow (yellow nutsedge, *Cyperus esculentus*), horseweed (*Conyza canadensis*), and beggarticks (hairy beggarticks, *Bidens pilosa*), were planted into a silt loam soil and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants from these crop and weed species and also waterhemp_RES1, (ALS & Triazine resistant common waterhemp, *Amaranthus rudis*), and waterhemp_RES2, (ALS & HPPD resistant common waterhemp, *Amaranthus rudis*) were planted in pots containing Redi-Earth® planting medium (Scotts Company, 14111 Scottslawn Road, Marysville, Ohio 43041) comprising spaghnum peat moss, vermiculite, wetting agent and starter nutrients were treated with postemergence applications of test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm for postemergence treatments (1- to 4-leaf stage). Treated plants and controls were maintained in a greenhouse for 14 to 21 d, 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													
250 g ai/ha	1	2	20	25	28	34	41	42	47	57	69	72	75	79
Postemergence														
Arrowleaf Sida	80	40	80	85	60	75	90	80	60	45	80	90	80	70
Barnyardgrass	35	35	80	50	60	40	60	35	60	90	30	50	30	20
Beggarticks	100	100	100	100	100	100	100	100	98	100	100	98	100	100
Corn	5	5	15	15	5	5	5	20	20	15	5	30	0	0
Crabgrass, Brazil	35	15	50	50	60	50	50	50	40	30	30	70	50	40

Dayflower, VA	50	65	50	65	80	90	90	70	10	30	80	80	65	65
Field Bindweed	95	80	95	90	80	95	95	90	90	95	90	90	85	95
Horseweed	-	-	85	-	80	90	70	85	75	80	90	70	50	90
Kochia	-	-	90	98	90	85	95	98	85	75	95	90	100	98
Panicum, Fall	85	90	50	90	90	60	50	95	70	80	50	85	60	75
Pigweed, Palmer	98	35	70	85	50	75	95	95	70	60	60	75	100	75
Poinsettia, Wild	35	15	30	60	40	-	-	-	30	20	0	75	-	10
Ragweed	-	-	80	95	75	100	95	90	95	95	95	95	90	100
Ryegrass, Italian	90	75	80	90	75	90	90	90	10	50	85	90	90	80
Sandbur	30	30	40	75	80	90	75	60	35	70	10	80	30	65
Soybean	20	0	30	75	60	60	75	50	30	10	20	50	75	10
Waterhemp	100	90	85	90	75	90	85	90	100	75	90	90	95	80
Waterhemp_RES1	100	100	80	95	80	95	95	98	95	60	85	90	90	75
Waterhemp_RES2	75	60	60	75	50	70	85	80	70	50	65	65	75	55

Table E					Compounds					
250 g ai/ha	81	82	83	84	85	88	100	126	153	171
Postemergence										
Arrowleaf Sida	60	90	60	80	50	60	75	85	40	95
Barnyardgrass	50	50	50	40	30	25	50	30	80	50
Beggarticks	100	98	100	100	100	100	100	100	100	100
Corn	5	0	10	0	5	5	0	5	0	0
Crabgrass, Brazil	50	50	50	20	50	50	50	50	50	60
Dayflower, VA	80	65	70	30	80	80	0	50	95	90
Field Bindweed	85	85	75	80	90	75	95	100	95	100
Horseweed	85	80	90	85	90	90	80	80	85	60
Kochia	75	98	65	100	80	90	100	100	70	100
Panicum, Fall	90	75	90	90	95	85	80	35	90	75
Pigweed, Palmer	50	65	60	70	80	50	50	80	40	70
Poinsettia, Wild	50	50	-	40	-	-	35	50	75	80
Ragweed	80	90	75	95	85	80	90	100	90	98
Ryegrass, Italian	80	80	85	85	80	85	85	90	95	90
Sandbur	75	75	70	65	70	70	50	40	70	60
Soybean	10	35	15	35	15	10	0	30	25	70
Waterhemp	75	90	60	95	90	70	90	90	75	90
Waterhemp_RES1	65	95	70	95	80	85	90	100	60	90
Waterhemp_RES2	50	60	50	70	50	50	70	85	50	60

Table E	Compounds													
125 g ai/ha	1	2	20	25	28	34	41	42	47	57	66	69	72	75
Postemergence														
Arrowleaf Sida	70	35	70	80	60	70	95	70	60	40	70	70	80	80
Barnyardgrass	25	30	60	50	50	40	50	30	40	90	20	20	40	25
Beggarticks	100	100	98	100	100	98	95	100	98	100	100	100	98	100
Corn	5	5	0	20	5	0	0	15	5	15	15	0	20	0
Crabgrass, Brazil	20	10	20	50	50	50	30	40	25	20	40	30	60	50
Dayflower, VA	30	65	50	50	70	90	85	60	0	35	50	65	80	50
Field Bindweed	85	75	90	95	60	80	85	90	85	98	80	80	95	80
Horseweed	-	-	70	-	80	80	80	75	60	75	90	85	75	60
Kochia	-	-	75	100	75	85	95	95	80	60	95	80	90	100
Panicum, Fall	80	85	30	80	70	70	30	80	55	70	80	30	80	50
Pigweed, Palmer	75	5	55	100	50	65	90	60	30	30	80	40	60	100
Poinsettia, Wild	15	15	30	35	50	-	-	-	25	30	-	5	65	-
Ragweed	-	-	85	90	70	90	90	95	95	95	90	90	90	60
Ryegrass, Italian	65	65	70	85	75	85	85	85	0	20	50	90	85	85
Sandbur	30	20	30	70	60	85	70	60	25	65	60	5	75	20
Soybean	15	0	40	30	50	70	60	30	20	15	20	25	30	70
Waterhemp	98	75	80	85	70	85	90	100	85	30	80	80	80	90
Waterhemp_RES1	98	70	80	85	60	90	90	70	80	40	80	85	80	95
Waterhemp_RES2	70	5	50	70	50	-	80	70	60	20	50	50	50	60

Table E	Compounds													
125 g ai/ha	79	81	82	83	84	85	88	90	99	100	105	109	126	153
Postemergence														
Arrowleaf Sida	60	30	80	60	70	50	50	90	60	70	70	80	100	40
Barnyardgrass	20	30	50	40	40	20	20	50	50	30	30	40	40	50
Beggarticks	100	100	98	100	95	100	100	100	95	90	100	100	100	100
Corn	0	5	0	0	0	0	5	0	0	0	20	20	5	0
Crabgrass, Brazil	25	50	50	50	15	50	30	70	20	40	50	50	40	40
Dayflower, VA	60	80	60	75	10	60	70	90	75	0	60	60	50	90
Field Bindweed	95	75	95	70	100	60	60	100	80	90	95	90	95	100
Horseweed	95	65	75	85	85	85	90	70	75	75	-	85	85	85
Kochia	90	70	95	75	100	80	80	100	70	80	100	100	100	55
Panicum, Fall	60	85	75	80	85	80	85	70	70	70	80	80	30	90
Pigweed, Palmer	40	-	75	50	80	80	50	60	50	40	70	100	50	30

Poinsettia, Wild	20	40	40	-	30	-	-	60	50	10	30	50	50	50
Ragweed	95	85	90	70	98	60	70	90	90	90	95	95	100	80
Ryegrass, Italian	70	75	75	80	75	75	80	85	80	70	80	85	85	90
Sandbur	50	70	70	65	60	70	70	50	40	40	50	70	40	60
Soybean	15	0	40	0	10	5	0	60	30	0	25	20	40	10
Waterhemp	70	60	85	40	90	65	60	90	75	-	90	90	90	50
Waterhemp_RES1	70	60	85	80	80	75	65	80	75	85	100	90	90	50
Waterhemp_RES2	15	50	60	40	70	40	50	70	60	65	70	60	70	30

Table E	Compound
125 g ai/ha	171
Postemergence	
Arrowleaf Sida	90
Barnyardgrass	50
Beggarticks	100
Corn	0
Crabgrass, Brazil	50
Dayflower, VA	70
Field Bindweed	100
Horseweed	70
Kochia	100
Panicum, Fall	60

Table E	Compound
125 g ai/ha	171
Postemergence	
Pigweed, Palmer	60
Poinsettia, Wild	40
Ragweed	90
Ryegrass, Italian	85
Sandbur	50
Soybean	50
Waterhemp	85
Waterhemp_RES1	75
Waterhemp_RES2	40

Table E	Compounds													
62 g ai/ha	1	2	20	25	34	41	42	47	57	66	69	72	75	79
Postemergence														
Arrowleaf Sida	70	30	60	75	60	90	60	50	20	60	60	75	70	50
Barnyardgrass	20	25	50	50	40	35	30	30	85	25	25	40	30	15
Beggarticks	98	100	95	100	100	95	95	100	100	90	85	100	95	100
Corn	5	0	0	20	0	0	15	5	10	10	0	10	0	0
Crabgrass, Brazil	15	0	20	40	40	20	35	20	20	30	20	40	40	20
Dayflower, VA	0	15	10	40	80	40	50	5	15	60	50	65	50	50
Field Bindweed	70	65	85	95	80	90	85	75	95	80	85	80	90	95
Horseweed	-	-	80	-	75	80	75	40	75	90	75	60	50	95
Kochia	-	-	65	95	98	95	85	70	70	90	80	98	98	80
Panicum, Fall	75	70	15	50	65	25	50	55	60	70	20	80	40	60
Pigweed, Palmer	90	5	35	80	80	60	75	35	20	60	20	50	70	35

Poinsettia, Wild	15	0	20	30	-	-	-	15	10	-	0	40	-	10
Ragweed	-	-	75	90	85	-	85	90	60	80	80	90	70	98
Ryegrass, Italian	50	50	50	80	80	85	70	0	0	40	70	80	80	40
Sandbur	30	15	20	60	80	50	50	20	60	50	0	70	20	30
Soybean	10	0	20	20	40	40	20	25	0	20	10	30	70	10
Waterhemp	95	75	75	80	85	85	80	80	50	75	85	65	90	60
Waterhemp_RES1	90	70	70	80	90	75	75	70	50	75	70	80	90	60
Waterhemp_RES2	70	5	50	60	80	80	65	50	10	40	40	40	60	15

Table E	Compounds													
62 g ai/ha	81	82	83	84	85	88	90	99	100	105	109	126	153	171
Postemergence														
Arrowleaf Sida	40	70	50	60	50	50	90	50	60	60	60	80	50	80
Barnyardgrass	20	40	50	30	30	30	40	40	40	30	30	50	40	45
Beggarticks	100	90	100	100	100	100	98	100	80	100	85	100	100	95
Corn	0	0	0	0	0	0	5	0	5	15	10	10	0	0
Crabgrass, Brazil	40	30	40	10	30	15	50	10	50	40	30	25	30	50
Dayflower, VA	70	50	60	0	60	60	80	70	0	50	50	20	90	50
Field Bindweed	65	80	70	100	50	60	90	70	80	75	95	90	90	85
Horseweed	75	70	80	75	85	95	75	60	70	85	90	75	80	60
Kochia	70	98	60	98	70	70	95	60	80	90	95	100	50	95
Panicum, Fall	80	65	70	70	75	80	60	50	50	70	65	35	90	50
Pigweed, Palmer	20	60	40	75	80	55	50	30	30	70	65	50	20	50
Poinsettia, Wild	40	30	-	30	-	-	50	40	0	25	45	20	30	30
Ragweed	60	90	50	95	50	50	80	80	85	90	90	80	70	75
Ryegrass, Italian	70	70	60	65	60	65	85	70	60	70	90	80	90	75
Sandbur	60	60	50	50	60	60	50	40	40	45	60	30	85	50
Soybean	0	25	0	15	0	0	40	10	0	15	20	30	15	40
Waterhemp	60	80	50	85	50	60	80	60	75	80	80	90	40	80
Waterhemp_RES1	60	75	65	85	75	70	50	70	80	75	90	95	30	70
Waterhemp_RES2	20	50	40	65	50	50	60	40	60	60	50	70	40	30

Table E	Compounds													
31 g ai/ha	1	2	20	25	34	41	42	47	57	66	69	72	75	79
Postemergence														
Arrowleaf Sida	50	25	40	60	65	85	20	40	10	40	50	70	70	50
Barnyardgrass	15	20	30	40	30	20	20	10	80	15	20	30	20	15

Beggarticks	85	95	85	100	90	100	95	85	100	80	80	90	100	100
Corn	5	0	0	10	0	0	10	0	15	0	0	0	0	0
Crabgrass, Brazil	15	10	10	30	40	10	20	20	15	20	10	50	40	20
Dayflower, VA	0	20	0	10	60	50	30	0	10	25	20	60	30	50
Field Bindweed	65	60	75	90	70	80	90	70	85	60	70	70	85	80
Horseweed	-	-	70	-	85	75	75	40	60	80	70	60	40	90
Kochia	-	-	60	90	70	90	75	60	50	95	75	70	90	70
Panicum, Fall	75	70	0	50	50	15	60	40	40	70	20	75	50	55
Pigweed, Palmer	20	50	40	75	50	50	70	35	10	70	10	50	70	40
Poinsettia, Wild	10	0	0	35	-	-	-	10	10	-	5	30	-	10
Ragweed	-	-	65	90	90	80	90	80	50	80	70	85	55	90
Ryegrass, Italian	35	30	40	75	65	80	50	0	0	30	65	80	75	30
Sandbur	10	10	15	50	70	60	35	20	50	40	0	60	10	20
Soybean	0	0	20	0	35	30	10	20	10	0	5	25	70	0
Waterhemp	85	70	70	80	70	75	75	75	50	65	65	65	80	50
Waterhemp_RES1	80	70	60	75	90	75	75	60	40	80	65	60	90	50
Waterhemp_RES2	75	0	50	70	40	20	60	15	20	40	50	35	60	20

Table E	Compounds													
31 g ai/ha	81	82	83	84	85	88	90	99	100	105	109	126	153	171
Postemergence														
Arrowleaf Sida	40	65	50	50	40	60	80	30	50	60	65	75	40	80
Barnyardgrass	20	30	40	30	20	20	30	30	30	20	30	40	25	40
Beggarticks	90	90	98	95	90	100	90	80	75	90	90	100	100	80
Corn	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Crabgrass, Brazil	40	20	30	10	15	15	55	10	25	20	40	10	20	40
Dayflower, VA	60	40	50	5	50	50	60	60	0	30	30	0	85	40
Field Bindweed	60	85	60	70	50	50	80	60	75	80	80	85	80	70
Horseweed	50	60	75	60	60	75	70	50	35	85	80	70	85	50
Kochia	60	90	40	80	60	60	90	50	60	80	95	100	50	90
Panicum, Fall	85	70	70	60	75	75	60	30	30	60	60	10	85	40
Pigweed, Palmer	30	50	40	70	65	50	65	10	20	70	50	40	20	50
Poinsettia, Wild	30	40	-	20	-	-	35	30	0	30	25	30	20	25
Ragweed	60	85	60	85	50	50	75	75	75	-	85	70	75	60
Ryegrass, Italian	50	50	60	60	50	50	80	50	50	50	75	70	85	65
Sandbur	60	50	40	50	40	40	40	30	20	40	40	0	50	30
Soybean	0	10	0	10	0	0	30	0	0	10	0	10	0	40

Waterhemp	50	70	40	70	50	70	70	45	80	70	75	75	50	80
Waterhemp_RES1	50	60	70	60	80	60	50	50	80	80	70	75	50	50
Waterhemp_RES2	10	50	30	55	40	40	50	50	50	50	50	55	10	15

Table E	Compounds						
16 g ai/ha	1	2	66	90	99	105	109
Postemergence							
Arrowleaf Sida	30	0	30	70	10	50	50
Barnyardgrass	10	20	20	30	40	15	25
Beggarticks	70	85	75	85	70	80	80
Corn	0	0	0	5	0	0	0
Crabgrass, Brazil	0	0	10	50	5	5	10
Dayflower, VA	0	0	0	40	40	30	30
Field Bindweed	65	60	70	60	50	75	75
Horseweed	-	-	60	50	40	80	60
Kochia	-	-	90	90	55	80	80
Panicum, Fall	70	60	30	40	20	40	50
Pigweed, Palmer	70	0	50	40	5	75	60
Poinsettia, Wild	5	0	-	20	35	30	0
Ragweed	-	-	75	50	50	70	80
Ryegrass, Italian	20	20	20	75	40	30	50
Sandbur	0	5	25	40	20	30	60
Soybean	0	0	0	20	0	0	0
Waterhemp	70	70	70	50	65	60	60
Waterhemp_RES1	75	65	70	50	50	80	60
Waterhemp_RES2	0	0	40	50	50	40	-

Table E	Compounds													
250 g ai/ha	1	2	20	25	27	28	29	34	37	41	47	57	59	69
Preemergence														
Arrowleaf Sida	80	5	95	95	35	70	98	80	98	100	90	40	98	80
Barnyardgrass	20	70	30	90	95	90	90	65	30	65	95	100	90	10
Beggarticks	100	100	98	100	100	100	100	100	100	100	100	100	100	100
Corn	0	0	0	0	0	0	0	0	0	25	0	0	20	10
Crabgrass, Brazil	100	100	90	95	95	90	90	80	95	80	60	70	100	60
Crabgrass, Large	65	60	30	85	90	90	65	20	90	60	35	0	95	20
Dayflower, VA	25	90	0	30	65	70	60	90	60	80	80	80	80	70

Field Bindweed	100	70	95	98	70	75	98	60	100	90	100	100	95	85
Foxtail, Giant	98	98	90	100	100	100	98	65	90	90	80	95	100	60
Foxtail, Green	90	98	70	100	100	100	100	65	80	75	70	100	100	30
Goosegrass	25	25	85	90	85	90	90	10	80	60	0	5	98	50
Horseweed	-	-	100	100	100	98	100	-	100	100	-	-	100	-
Johnsongrass	40	50	0	90	70	90	100	0	100	25	20	35	80	20
Kochia	85	40	100	100	100	100	70	85	65	100	100	100	100	95
Lambsquarters	100	100	100	100	100	98	98	98	100	100	100	100	100	90
Morningglory	100	100	95	100	100	100	95	90	65	95	100	100	100	85
Nightshade	100	100	-	98	98	100	90	95	98	98	100	98	-	90
Nutsedge, Yellow	70	70	95	65	80	95	70	80	70	85	35	70	70	60
Panicum, Fall	100	100	98	100	100	100	98	95	100	98	95	100	100	70
Pigweed, Palmer	100	100	70	100	85	98	100	90	100	85	65	60	100	70
Poinsettia, Wild	35	50	-	-	-	-	-	-	-	65	20	50	-	20
Ragweed	100	98	98	100	100	98	98	100	98	100	100	100	100	100
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	50	80	100	100
Sandbur	70	75	75	85	90	85	90	70	65	80	70	80	90	60
Soybean	75	40	-	70	0	0	50	0	0	65	40	20	70	20
Surinam Grass	75	95	90	95	100	98	100	80	90	95	35	95	100	50
Velvetleaf	98	90	100	100	100	100	100	100	100	100	100	100	98	90
Waterhemp	100	98	100	100	95	100	100	100	100	100	100	80	100	100

Table E					Compounds						
250 g ai/ha	72	75	79	81	82	83	84	85	87	88	153
Preemergence											
Arrowleaf Sida	65	98	75	70	95	65	100	70	80	50	75
Barnyardgrass	50	65	50	75	40	75	20	35	35	70	90
Beggarticks	100	100	100	100	100	100	100	100	100	100	100
Corn	0	35	20	0	5	0	15	0	15	0	20
Crabgrass, Brazil	98	90	100	100	100	80	100	90	100	90	100
Crabgrass, Large	90	30	30	98	90	20	75	25	65	20	80
Dayflower, VA	50	75	70	65	35	65	50	75	35	70	90
Field Bindweed	90	98	100	100	95	100	98	95	100	100	100
Foxtail, Giant	80	75	90	100	95	100	90	100	95	100	100
Foxtail, Green	70	90	90	100	90	70	100	100	80	100	95
Goosegrass	80	5	65	80	90	25	35	20	75	0	75
Horseweed	100	-	100	100	100	-	100	-	-	-	100

Johnsongrass	35	15	65	100	50	20	0	0	75	0	60
Kochia	98	100	100	100	100	75	100	98	100	98	90
Lambsquarters	100	100	100	100	100	100	100	100	100	100	100
Morningglory	95	100	100	100	100	100	95	100	90	100	100
Nightshade	100	100	100	98	100	100	100	100	98	100	100
Nutsedge, Yellow	35	65	75	90	65	75	40	65	60	65	95
Panicum, Fall	98	90	90	100	100	98	100	100	98	100	100
Pigweed, Palmer	90	100	75	100	100	80	100	90	90	100	95
Poinsettia, Wild	20	-	55	60	20	-	30	-	20	-	75
Ragweed	100	100	100	100	100	98	100	98	100	100	100
Ryegrass, Italian	100	100	100	100	100	100	100	100	100	100	100
Sandbur	70	70	75	90	75	80	75	90	85	85	90
Soybean	15	70	50	0	-	0	0	0	0	0	-
Surinam Grass	90	90	80	95	90	95	95	90	75	95	100
Velvetleaf	90	98	100	95	98	100	90	95	95	100	100
Waterhemp	100	100	100	90	100	75	100	85	100	100	100

Table E	Compounds													
125 g ai/ha	1	2	20	21	25	27	28	29	34	37	41	47	57	59
Preemergence														
Arrowleaf Sida	75	0	85	50	90	75	50	98	65	90	98	75	50	98
Barnyardgrass	0	25	10	90	60	80	65	65	35	0	40	50	75	60
Beggarticks	100	100	95	100	100	100	100	100	100	98	100	100	100	100
Corn	0	0	0	30	0	0	0	0	0	0	0	0	0	0
Crabgrass, Brazil	100	50	70	100	95	95	80	70	80	90	100	0	40	100
Crabgrass, Large	35	30	35	100	80	50	90	40	50	80	80	0	0	80
Dayflower, VA	15	25	0	80	15	30	65	10	70	40	70	0	30	80
Field Bindweed	95	35	85	98	60	70	90	95	40	85	75	90	98	95
Foxtail, Giant	95	98	75	100	98	100	100	95	40	80	70	40	95	98
Foxtail, Green	90	95	65	100	98	100	100	90	25	65	50	30	90	95
Goosegrass	35	25	50	95	80	80	75	50	10	75	50	0	5	98
Horseweed	-	-	100	100	100	100	100	100	-	100	100	-	-	100
Johnsongrass	30	35	-	60	80	75	80	65	0	100	0	0	30	80
Kochia	35	0	98	65	98	80	60	25	5	0	100	75	75	100
Lambsquarters	100	98	95	100	100	100	100	100	100	98	100	100	100	100
Morningglory	90	100	90	100	95	90	95	80	35	50	90	100	100	98
Nightshade	100	98	-	-	95	95	98	85	98	98	98	100	98	-

Nutsedge, Yellow	50	65	75	80	20	98	70	30	40	65	75	30	60	75
Panicum, Fall	95	98	65	100	100	100	98	98	90	100	95	80	100	100
Pigweed, Palmer	100	90	5	98	100	85	95	100	90	100	75	25	40	100
Poinsettia, Wild	30	30	-	-	-	-	-	-	-	-	40	0	25	-
Ragweed	100	98	70	100	98	100	95	70	100	95	90	98	100	100
Ryegrass, Italian	100	100	98	100	98	100	95	95	100	100	100	30	65	100
Sandbur	70	70	65	90	80	90	80	90	65	50	75	10	30	90
Soybean	40	15	20	35	0	0	0	70	15	-	20	0	0	30
Surinam Grass	80	90	85	100	90	100	100	95	95	75	75	35	85	100
Velvetleaf	90	80	80	90	98	95	70	100	100	70	95	75	95	95
Waterhemp	100	85	85	100	100	85	98	98	100	98	100	90	40	100

Table E	Compounds													
125 g ai/ha	66	69	72	75	79	80	81	82	83	84	85	87	88	105
Preemergence														
Arrowleaf Sida	65	50	85	90	75	25	70	85	35	80	50	70	0	50
Barnyardgrass	15	15	50	35	40	20	35	30	35	10	30	10	30	35
Beggarticks	100	100	98	100	100	100	100	100	100	100	100	100	100	100
Corn	20	0	0	0	0	0	0	0	0	0	0	20	0	0
Crabgrass, Brazil	65	50	90	90	80	100	90	100	50	90	80	90	25	75
Crabgrass, Large	15	0	30	0	20	35	90	80	40	15	0	65	20	75
Dayflower, VA	20	70	50	60	65	10	35	5	25	35	30	10	10	10
Field Bindweed	40	95	65	100	100	100	75	100	35	100	20	95	65	70
Foxtail, Giant	90	50	70	35	85	85	98	50	100	85	95	70	100	75
Foxtail, Green	70	0	65	0	80	65	95	75	95	75	15	60	100	40
Goosegrass	10	30	60	0	60	20	70	70	5	30	5	60	5	10
Horseweed	-	-	100	-	100	100	100	100	-	100	-	-	-	100
Johnsongrass	0	0	35	10	-	80	65	35	0	0	0	70	0	20
Kochia	90	50	60	100	100	100	35	100	0	100	0	100	25	100
Lambsquarters	100	-	100	100	100	100	100	100	100	100	100	100	100	100
Morningglory	40	50	80	60	90	75	100	90	95	90	50	50	100	60
Nightshade	100	90	100	90	100	98	100	98	100	50	100	98	15	98
Nutsedge, Yellow	50	30	30	70	65	35	80	40	70	60	35	65	50	40
Panicum, Fall	98	75	90	80	80	98	100	98	100	95	98	100	100	98
Pigweed, Palmer	100	60	95	50	70	70	75	100	50	90	50	75	70	90
Poinsettia, Wild	-	20	10	-	60	40	30	0	-	10	-	15	-	10
Ragweed	100	95	90	80	100	100	100	100	95	100	90	98	100	98

Ryegrass, Italian	100	100	100	100	100	98	90	100	98	98	95	98	100	100
Sandbur	70	50	60	40	80	75	70	60	75	60	80	75	80	75
Soybean	0	10	0	40	40	0	0	0	0	0	0	0	0	75
Surinam Grass	50	20	75	60	60	75	95	85	85	90	70	80	90	70
Velvetleaf	80	60	80	100	95	90	90	95	70	70	70	90	70	95
Waterhemp	90	100	100	100	100	100	90	100	75	90	70	90	75	100

Table E	Compounds	
125 g ai/ha	109	153
Preemergence		
Arrowleaf Sida	35	60
Barnyardgrass	25	70
Beggarticks	100	100
Corn	0	10
Crabgrass, Brazil	70	100
Crabgrass, Large	35	75
Dayflower, VA	25	90
Field Bindweed	80	100
Foxtail, Giant	80	95
Foxtail, Green	60	90
Goosegrass	50	60
Horseweed	100	100
Johnsongrass	40	-
Kochia	100	50

Table E	Compounds	
125 g ai/ha	109	153
Preemergence		
Lambsquarters	98	100
Morningglory	65	90
Nightshade	98	95
Nutsedge, Yellow	40	80
Panicum, Fall	95	100
Pigweed, Palmer	85	60
Poinsettia, Wild	30	60
Ragweed	100	95
Ryegrass, Italian	98	100
Sandbur	75	85
Soybean	0	30
Surinam Grass	40	90
Velvetleaf	65	90
Waterhemp	98	85

Table E	Compounds													
62 g ai/ha	1	2	20	21	25	27	28	29	34	37	41	47	57	59
Preemergence														
Arrowleaf Sida	65	0	70	0	80	65	0	90	20	85	50	0	0	95
Barnyardgrass	0	0	0	70	60	50	20	25	0	0	25	0	0	25
Beggarticks	100	100	85	100	100	100	100	98	100	98	98	100	100	100
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Brazil	80	60	60	98	90	70	70	75	10	85	65	0	0	90
Crabgrass, Large	20	0	35	85	15	50	35	25	0	75	70	0	0	50
Dayflower, VA	20	20	0	60	5	10	10	0	35	5	40	0	25	40
Field Bindweed	80	15	65	95	98	40	0	90	50	90	70	50	95	75
Foxtail, Giant	35	95	20	98	95	98	100	80	40	70	65	0	35	95

Foxtail, Green	70	95	40	100	98	100	98	75	0	60	25	20	20	90
Goosegrass	5	5	10	95	65	75	60	20	5	35	0	0	0	95
Horseweed	-	-	100	100	100	100	100	100	-	100	100	-	-	100
Johnsongrass	0	20	-	20	60	75	80	70	0	0	0	0	30	25
Kochia	5	0	90	0	80	25	0	0	5	0	90	85	65	90
Lambsquarters	98	98	95	100	100	100	100	100	100	100	100	100	100	100
Morningglory	98	90	75	98	70	85	90	65	25	40	50	75	40	95
Nightshade	95	98	-	-	80	100	98	70	25	80	80	98	98	-
Nutsedge, Yellow	15	35	50	75	20	15	20	0	80	0	65	-	30	35
Panicum, Fall	90	95	35	100	100	100	95	95	80	100	90	50	98	98
Pigweed, Palmer	100	50	0	70	90	60	65	70	0	90	85	0	35	98
Poinsettia, Wild	30	30	-	-	-	-	-	-	-	-	40	0	20	-
Ragweed	75	75	65	98	95	95	90	85	75	90	70	95	100	95
Ryegrass, Italian	100	98	95	100	95	95	80	75	100	95	100	30	35	100
Sandbur	20	15	0	80	65	40	65	75	40	35	70	0	0	70
Soybean	15	0	0	35	-	0	0	50	35	0	35	0	0	30
Surinam Grass	50	75	65	100	80	95	98	95	75	75	75	0	70	90
Velvetleaf	75	60	65	90	100	80	35	95	90	50	85	-	65	95
Waterhemp	100	80	65	95	100	90	80	90	100	75	98	90	75	100

Table E							Compounds							
62 g ai/ha	66	69	72	75	79	80	81	82	83	84	85	87	88	105
Preemergence														
Arrowleaf Sida	40	60	35	75	80	35	60	70	25	0	0	60	0	40
Barnyardgrass	20	10	30	20	30	20	25	15	30	0	0	0	0	20
Beggarticks	95	95	80	80	100	100	100	100	100	100	100	100	100	100
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Brazil	25	20	60	20	30	90	95	100	10	85	50	80	40	35
Crabgrass, Large	0	0	0	0	0	35	75	70	5	10	0	0	5	50
Dayflower, VA	0	60	15	10	70	0	15	5	10	20	0	0	5	0
Field Bindweed	50	40	0	5	90	70	0	50	5	90	5	98	5	50
Foxtail, Giant	40	50	65	5	70	80	98	65	98	35	65	65	98	35
Foxtail, Green	35	0	35	0	70	50	70	70	40	50	25	20	75	30
Goosegrass	10	10	40	0	60	30	40	25	0	30	5	0	0	0
Horseweed	-	-	100	-	100	100	100	100	-	100	-	-	-	100
Johnsongrass	0	0	0	0	-	80	90	-	0	0	0	65	0	20
Kochia	60	-	35	100	70	100	20	90	0	75	0	100	0	35

Lambsquarters	100	-	80	100	100	98	100	75	98	100	100	100	100	100
Morningglory	30	30	30	30	85	70	85	80	20	70	30	35	30	70
Nightshade	15	80	80	0	100	100	90	98	50	100	95	90	5	98
Nutsedge, Yellow	65	0	20	10	60	40	30	10	65	0	35	60	50	10
Panicum, Fall	95	20	80	50	70	95	100	95	95	90	85	90	98	90
Pigweed, Palmer	65	60	75	85	70	70	75	90	20	100	30	65	50	98
Poinsettia, Wild	-	25	15	-	60	0	5	0	-	0	-	15	-	10
Ragweed	90	85	90	65	100	100	100	80	75	98	80	95	85	95
Ryegrass, Italian	90	90	90	100	80	98	95	95	95	95	80	95	98	95
Sandbur	10	40	35	10	70	70	40	35	70	30	50	65	65	70
Soybean	0	15	0	35	50	0	0	0	0	0	0	0	0	0
Surinam Grass	5	5	40	35	50	20	90	65	60	65	70	15	75	10
Velvetleaf	20	20	40	85	80	70	70	75	35	70	30	60	65	70
Waterhemp	80	100	100	60	100	100	90	90	65	90	80	90	90	90

Table E	Compounds	
62 g ai/ha	109	153
Preemergence		
Arrowleaf Sida	30	70
Barnyardgrass	10	50
Beggarticks	100	100
Corn	0	0
Crabgrass, Brazil	40	70
Crabgrass, Large	40	70
Dayflower, VA	25	85
Field Bindweed	40	100
Foxtail, Giant	40	95
Foxtail, Green	40	75
Goosegrass	25	40
Horseweed	100	100
Johnsongrass	0	0
Kochia	85	30
Lambsquarters	100	100
Morningglory	20	90
Nightshade	65	85
Nutsedge, Yellow	40	70
Panicum, Fall	90	100
Pigweed, Palmer	100	60
Poinsettia, Wild	25	50
Ragweed	100	100
Ryegrass, Italian	98	100
Sandbur	65	85
Soybean	-	50
Surinam Grass	60	80
Velvetleaf	25	90
Waterhemp	70	70

Table E	Compounds													
31 g ai/ha	1	2	20	21	25	27	28	29	34	37	41	47	57	59
Preemergence														
Arrowleaf Sida	0	0	0	0	40	40	-	70	0	70	20	0	0	80

Barnyardgrass	0	0	0	40	20	15	20	0	0	0	10	0	0	0
Beggarticks	100	100	20	100	100	90	100	80	90	80	65	100	100	100
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Brazil	10	35	40	90	75	70	70	30	0	70	80	0	0	60
Crabgrass, Large	0	0	30	65	-	35	-	0	0	50	65	0	0	0
Dayflower, VA	0	15	0	80	0	0	5	0	35	0	15	0	0	10
Field Bindweed	20	0	35	35	80	0	0	80	5	75	30	50	70	65
Foxtail, Giant	50	75	5	95	80	95	85	70	5	65	30	0	5	85
Foxtail, Green	15	35	0	95	65	75	65	65	0	0	20	0	0	65
Goosegrass	15	0	20	90	20	35	35	0	5	35	0	0	10	90
Horseweed	-	-	100	100	100	100	100	100	-	100	100	-	-	100
Johnsongrass	0	35	0	-	75	70	70	70	0	0	0	0	0	0
Kochia	0	0	0	0	20	0	0	0	0	0	90	0	20	80
Lambsquarters	65	100	70	100	98	100	100	100	10	100	35	100	100	100
Morningglory	60	75	20	90	65	85	50	35	0	15	30	25	85	75
Nightshade	90	75	-	-	90	90	80	5	0	90	25	80	90	-
Nutsedge, Yellow	10	0	0	0	0	10	20	0	0	0	25	0	0	50
Panicum, Fall	75	85	0	100	95	100	90	85	70	90	80	50	95	95
Pigweed, Palmer	90	20	0	65	65	-	0	90	0	0	15	0	35	95
Poinsettia, Wild	30	25	-	-	-	-	-	-	-	-	15	0	0	-
Ragweed	70	35	30	95	75	95	95	90	70	50	5	80	90	100
Ryegrass, Italian	95	95	90	100	95	80	70	65	90	85	98	5	10	100
Sandbur	10	15	0	80	35	30	15	75	0	20	50	0	0	70
Soybean	0	0	0	35	0	0	0	70	0	0	0	0	0	35
Surinam Grass	25	35	10	95	65	85	85	75	5	50	10	0	5	85
Velvetleaf	75	30	0	80	60	50	0	70	20	30	20	0	30	90
Waterhemp	90	65	0	95	100	95	65	80	100	0	75	50	80	75

Table E						Compounds								
31 g ai/ha	66	69	72	75	79	80	81	82	83	84	85	87	88	105
Preemergence														
Arrowleaf Sida	0	20	20	50	75	0	40	20	15	0	0	0	0	0
Barnyardgrass	15	10	0	20	30	0	0	0	0	0	0	0	0	-
Beggarticks	70	90	70	35	100	85	80	100	100	90	90	90	85	80
Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crabgrass, Brazil	25	0	50	0	-	75	65	75	0	80	10	60	15	0
Crabgrass, Large	0	0	0	0	0	0	50	-	0	0	0	0	0	0

Dayflower, VA	0	50	0	10	50	0	10	0	0	10	0	0	0	0
Field Bindweed	5	0	0	0	60	25	0	65	0	60	-	40	0	20
Foxtail, Giant	5	40	35	0	60	50	75	30	95	5	15	25	95	0
Foxtail, Green	0	0	30	0	55	15	20	20	0	10	0	20	50	0
Goosegrass	5	0	20	0	50	0	20	20	0	20	5	0	0	0
Horseweed	-	-	0	-	100	100	90	90	-	100	-	-	-	0
Johnsongrass	0	0	0	0	70	0	70	0	0	0	0	-	0	0
Kochia	0	0	25	98	50	90	0	20	0	0	0	65	0	0
Lambsquarters	90	10	90	100	100	100	98	98	100	15	70	100	100	0
Morningglory	0	20	20	0	60	65	60	70	25	20	25	20	25	20
Nightshade	0	70	0	0	80	75	80	90	35	80	95	50	0	50
Nutsedge, Yellow	5	0	-	0	50	10	35	0	65	0	-	0	10	0
Panicum, Fall	60	20	75	10	80	90	98	90	90	85	95	95	90	65
Pigweed, Palmer	0	40	35	30	75	35	35	90	0	75	25	0	65	0
Poinsettia, Wild	-	0	0	-	50	0	0	0	-	0	-	0	-	10
Ragweed	65	40	0	35	100	70	90	85	70	90	60	98	20	65
Ryegrass, Italian	65	80	90	100	75	70	75	75	80	80	80	75	95	90
Sandbur	0	50	0	0	60	65	10	0	20	0	0	25	10	15
Soybean	0	0	0	0	40	0	0	0	0	0	0	0	0	0
Surinam Grass	20	0	5	5	40	10	70	35	65	0	60	10	25	0
Velvetleaf	0	30	50	35	70	20	10	0	0	25	0	0	15	50
Waterhemp	65	50	90	50	75	70	60	85	65	85	35	75	60	80

Table E	Compounds	
31 g ai/ha	109	153
Preemergence		
Arrowleaf Sida	35	50
Barnyardgrass	0	20
Beggarticks	75	100
Corn	0	0
Crabgrass, Brazil	60	90
Crabgrass, Large	0	70
Dayflower, VA	25	80
Field Bindweed	0	90
Foxtail, Giant	35	75
Foxtail, Green	0	50
Goosegrass	20	40

Table E	Compounds	
31 g ai/ha	109	153
Preemergence		
Lambsquarters	95	100
Morningglory	0	85
Nightshade	65	70
Nutsedge, Yellow	0	50
Panicum, Fall	80	100
Pigweed, Palmer	20	50
Poinsettia, Wild	10	40
Ragweed	5	100
Ryegrass, Italian	75	100
Sandbur	40	80
Soybean	0	30

Horseweed	100	90	Surinam Grass	30	50
Johnsongrass	0	0	Velvetleaf	0	85
Kochia	10	40	Waterhemp	0	60

Table E	Compounds					
16 g ai/ha	1	2	66	80	105	109
Preemergence						
Arrowleaf Sida	0	0	0	0	0	40
Barnyardgrass	0	0	0	0	20	0
Beggarticks	100	90	65	100	90	20
Corn	0	0	0	0	0	0
Crabgrass, Brazil	0	0	0	65	-	70
Crabgrass, Large	0	0	0	0	0	0
Dayflower, VA	0	0	0	0	0	0
Field Bindweed	5	0	0	20	20	0
Foxtail, Giant	0	40	0	0	0	0
Foxtail, Green	0	0	0	0	0	0
Goosegrass	0	0	5	0	0	0
Horseweed	-	-	-	100	0	0
Johnsongrass	0	0	0	-	0	0
Kochia	0	0	0	25	0	0
Lambsquarters	65	50	5	65	0	0
Morningglory	20	0	0	0	40	0
Nightshade	80	35	0	75	0	25
Nutsedge, Yellow	0	0	0	5	0	0
Panicum, Fall	65	75	10	80	25	75
Pigweed, Palmer	20	0	0	20	0	0
Poinsettia, Wild	20	0	-	0	0	10
Ragweed	35	20	25	70	50	0
Ryegrass, Italian	70	50	40	50	75	60
Sandbur	0	0	0	0	0	0
Soybean	0	0	0	0	0	0
Surinam Grass	0	5	5	0	0	0
Velvetleaf	35	0	0	0	0	0
Waterhemp	35	65	0	0	70	0

Test F

This test evaluated the effect of mixtures of Compuond 1 or Compound 2 with various commercial herbicides on multiple plant species. Seeds of multiple plant species selected were planted into Sandy Loam soil and treated either Post-emergence or Pre-emergence with test chemicals formulated in a non-phytotoxic solvent mixture. Plants were grown in a greenhouse using supplemental lighting to maintain a photoperiod of approximately 16 h; daytime and nighttime temperatures were approximately 24–30 and 19–21 °C, respectively. Balanced fertilizer was applied through the watering system. Treated plants and controls were maintained in a greenhouse for 20 d, after which time all species were compared to controls and visually evaluated. Plant response ratings summarized in Tables F1 through F4 and 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. Application rates (i.e. "Rate") are expressed in grams of active ingredient per hectare (g a.i./ha). In the following tables KCHSC is kochia (*Kochia scoparia*), LOLMU in Italian Ryegrass (*Lolium multiflorum*), AMBEL is common ragweed (*Ambrosia elatior*), ECHCG is barnyardgrass (*Echinochloa crus-galli*), SETVI is giant foxtail (*Setaria faberii*), AMARE is redroot pigweed (*Amaranthus retroflexus*), ALOMY is blackgrass (*Alopecurus myosuroides*) and GALAP is galium (*Galium aparine*). "Obsd." is observed effect. "Exp." is expected effect calculated from Colby's Equation.

Colby's Equation was used to determine the herbicidal effects expected from the mixtures. Colby's Equation (Colby, S. R. "Calculating Synergistic and Antagonistic Responses of Herbicide Combinations," Weeds, 15(1), pp 20–22 (1967)) calculates the expected additive effect of herbicidal mixtures, and for two active ingredients is of the form:

$$P_{a+b} = P_a + P_b - (P_a P_b / 100)$$

wherein P_{a+b} is the percentage effect of the mixture expected from additive contribution of the individual components:

P_a is the observed percentage effect of the first active ingredient at the same use rate as in the mixture, and

P_b is the observed percentage effect of the second active ingredient at the same use rate as in the mixture.

The results and additive effects expected from Colby's Equation are listed in Tables F1 through F4.

Table F1: Observed and Expected Results from Compound 1 Alone and in Combination with Mesotrione when applied Post-emergence.

Treatment	Rate	KCHSC		LOLMU		AMBEL		ECHCG	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.

1	16	60.0		65.0		95.0		0.0	
1	62	100.0		100.0		100.0		0.0	
mesotrione	4	0.0		0.0		0.0		0.0	
mesotrione	16	90.0		0.0		75.0		20.0	
1 + mesotrione	16 + 4	100.0	60.0	65.0	65.0	75.0	95.0	20.0	0.0
1 + mesotrione	16+16	100.0	96.0	95.0	65.0	100.0	98.8	75.0	20.0
1 + mesotrione	62+4	100.0	100.0	100.0	100.0	100.0	100.0	60.0	0.0
1 + mesotrione	62+16	100.0	100.0	100.0	100.0	100.0	100.0	100.0	20.0

Treatment	Rate	SETVI		AMARE		ALOMY		GALAP	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
1	16	0.0		30.0		0.0		65.0	
1	62	40.0		100.0		35.0		100.0	
mesotrione	4	0.0		0.0		0.0		0.0	
mesotrione	16	0.0		30.0		0.0		35.0	
1 + mesotrione	16+4	0.0	0.0	100.0	30.0	0.0	0.0	100.0	65.0
1 + mesotrione	16+16	20.0	0.0	100.0	51.0	50.0	0.0	100.0	77.3
1 + mesotrione	62+4	70.0	40.0	100.0	100.0	65.0	35.0	100.0	100.0
1 + mesotrione	62+16	95.0	40.0	100.0	100.0	75.0	35.0	100.0	100.0

As can be seen from the results listed in Table F1, most of the observed results for weed species were greater/equal than expected, thereby showing highly synergistic effect of Compound 1 and mesotrione on all above weed species in Post emergence herbicidal application.

Table F2: Observed and Expected Results from Compound 1 Alone and in Combination with Mesotrione when applied Pre-emergence.

Treatment	Rate	KCHSC		LOLMU		AMBEL	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
1	16	0		65		65	
1	62	25		100		90	
mesotrione	4	0		0		0	
mesotrione	16	50		0		30	
1 + mesotrione	16+4	50	0	65	65	85	65
1 + mesotrione	16+ 6	100	25	100	100	100	90
1 + mesotrione	62+4	50	50	80	65	100	76

1 + mesotrione	62+16	100	63	100	100	100	93

Treatment	Rate	ECHCG		SETVI		AMARE	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
1	16	0		0		20	
1	62	20		60		90	
mesotrione	4	0		0		0	
mesotrione	16	0		0		20	
1 + mesotrione	16 + 4	0	0	0	0	98	20
1 + mesotrione	16 + 16	10	20	50	60	100	90
1 + mesotrione	62 + 4	20	0	0	0	100	36
1 + mesotrione	62 + 16	45	20	90	60	100	92

As can be seen from the results listed in Table F2, most of the observed results for weed species were greater/equal than expected, thereby showing highly synergistic effect of Compound 1 and mesotrione on all above weed species in Pre-emergence herbicidal application.

Table F3: Observed and Expected Results from Compoune 2 Alone and in Combination with Atrazine when applied Post-emergence

Treatment	Rate	KCHSC		LOLMU		AMBEL		ECHCG	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
2	16	16	50		75		40		5
2	62	62	75		95		80		20
atrazine	62	62	100		15		10		20
2 + atrazine	16 + 62	100	100	100	100	79	75	46	50
2 + atrazine	62 + 62	100	100	100	100	96	100	82	100

Treatment	Rate	SETVI		AMARE		ALOMY		GALAP	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
2	16		15		25		20		100
2	62		80		80		60		100
atrazine	62		5		75		60		50
2 + atrazine	16 + 62	24	85	19	100	81	100	68	100
2 + atrazine	62 + 62	36	95	81	100	95	100	84	100

As can be seen from the results listed in Table F3, most of the observed results for weed species were greater/equal than expected, thereby showing highly synergistic effect of Compound 2 and atrazine on all above weed species in Post emergence herbicidal application.

Table F4: Observed and Expected Results from Compound 2 Alone and in Combination with Atrazine when applied Pre-emergence

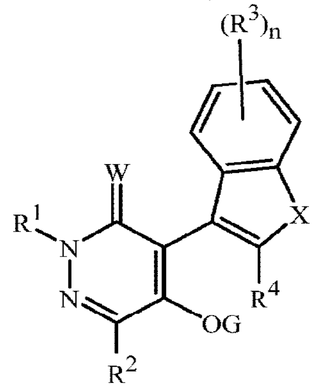
Treatment	Rate	KCHSC		LOLMU		AMBEL	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
2	16	16	0		0		30
2	62	62	0		50		95
atrazine	62	62	100		100		10
2 + atrazine	16 + 62	100	100	100	65	100	100
2 + atrazine	62 + 62	100	100	100	100	100	100

Treatment	Rate	ECHCG		SETVI		AMARE	
		Obsd.	Exp.	Obsd.	Exp.	Obsd.	Exp.
2	16		0		60		25
2	62		25		98		75
atrazine	62		0		5		85
2 +atrazine	16 + 62	37	25	0	70	62	100
2+atrazine	62 + 62	96	50	25	100	98	100

As can be seen from the results listed in Table F4, most of the observed results for weed species were greater/equal than expected, thereby showing synergistic/additive effect of Compound 2 and atrazine on all above weed species in Pre-emergence herbicidal application.

What is claimed:

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



1

wherein

W is O or S;

R^1 is H, C_1-C_7 alkyl, C_3-C_8 alkylcarbonylalkyl, C_3-C_8 alkoxycarbonylalkyl, C_4-C_7 alkylcycloalkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_3-C_7 alkylthioalkyl, C_1-C_7 alkoxy or benzyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1-C_7 alkyl, C_3-C_8 alkylcarbonylalkyl, C_3-C_8 alkoxycarbonylalkyl, C_2-C_4 alkylcarbonyl, C_2-C_7 alkylcarbonyloxy, C_4-C_7 alkylcycloalkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_1-C_4 alkylsulfinyl, C_1-C_4 alkylsulfonyl, C_1-C_4 alkylamino, C_2-C_8 dialkylamino, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_1-C_7 alkoxy, C_1-C_5 alkylthio, C_2-C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1-C_4 alkyl or C_1-C_4 haloalkyl;

X is O, S or NR^5; or

X is $-C(R^6)=C(R^7)-$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **1**;

each R^3 is independently halogen, -CN, nitro, C_1-C_5 alkyl, C_2-C_5 alkenyl, C_2-C_5 alkynyl, C_3-C_5 cycloalkyl, C_4-C_5 cycloalkylalkyl, C_1-C_5 haloalkyl, C_3-C_5 haloalkenyl, C_3-C_5 haloalkynyl, C_2-C_5 alkoxyalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy, C_1-C_5 alkylthio, C_1-C_5 haloalkylthio or C_2-C_5 alkoxycarbonyl;

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R^4, R^6 and R^7 are independently H, halogen, nitro, -CN, C_1-C_5 alkyl, C_2-C_5 alkenyl, C_2-C_5 alkynyl, C_3-C_5 cycloalkyl, C_4-C_5 cycloalkylalkyl, C_1-C_5 haloalkyl, C_3-C_5 haloalkenyl, C_3-C_5 haloalkynyl, C_2-C_5 alkoxyalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy, C_1-C_5 alkylthio, C_1-C_4 alkylsulfinyl, C_1-C_4 alkylsulfonyl, C_1-C_5 haloalkylthio or C_2-C_5 alkoxycarbonyl;

R^5 is H, C_1-C_3 alkyl or C_1-C_3 haloalkyl;

G is G^l or W^lG^l;

G^l is H, -C(=O)R^8, -C(=S)R^8, -CO_2R^9, -C(=O)SR^9, -S(O)$_2R^8$, -CON$R^{10}R^{ll}$, -S(O)$_2$N$R^{10}R^{ll}$, or P(=O)(R^{l2})$_2$; or C_1-C_4 alkyl, C_2- C_4 alkenyl, C_2-C_4 alkynyl, C_1-C_4 haloalkyl, C_2-C_4 haloalkenyl, C_2-C_4 haloalkynyl, C_1-C_4 alkoxyalkyl, C_3-C_6 cycloalkyl or C_4-C_7 cycloalkylalkyl; or a 5- or 6- membered heterocyclic ring;

W^l is C_1-C_4 alkanediyl or C_2-C_4 alkenediyl;

R^8 and R^{10} are independently C_1-C_7 alkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_4-C_7 cycloalkylalkyl; or phenyl, benzyl or a 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C_1-C_4 alkyl or C_1-C_4 haloalkyl;

R^9 is C_1-C_7 alkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_2-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_4-C_7 cycloalkylalkyl; or phenyl, benzyl, or 5- to 6-membered heterocyclic ring, each phenyl, benzyl or heterocyclic ring optionally substituted by halogen, C_1-C_4 alkyl or C_1-C_4 haloalkyl;

R^{11} is H, C_1-C_7 alkyl, C_2-C_7 alkenyl, C_2-C_7 alkynyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_1-C_7 haloalkyl or C_2-C_7 alkoxyalkyl;

R^{l2} is C_1-C_7 alkyl or C_1-C_7 alkoxy; and

n is 0, 1, 2, 3 or 4;

provided that when R4 is H, then X is -C(R^6)=C(R^7)-.

2. A compound of Claim 1 wherein

W is O;

X is O, S, -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or -CH=C(CH_3)-;

R^1 is H, C_1-C_7 alkyl, C_3-C_8 alkylcarbonylalkyl, C_3-C_8 alkoxycarbonylalkyl, C_4-C_7 alkylcycloalkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_3-C_7 alkylthioalkyl, C_1-C_7 alkoxy or benzyl;

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R^2 is H, halogen, -CN, -CHO, C_1-C_7 alkyl, C_3-C_8 alkylcarbonylalkyl, C_3-C_8 alkoxycarbonylalkyl, C_2-C_4 alkylcarbonyl, C_2-C_7 alkylcarbonyloxy, C_4-C_7 alkylcycloalkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_1-C_4 alkylsulfinyl, C_1-C_4 alkylsulfonyl, C_1-C_4 alkylamino, C_2-C_8 dialkylamino, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_1-C_7 alkoxy or C_1-C_5 alkylthio;

each R^3 is independently halogen, -CN, C_1-C_3 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, C_3-C_4 cycloalkyl, C_1-C_3 haloalkyl, C_1-C_3 alkoxy, C_1-C_2 haloalkoxy, C_1-C_2 alkylthio, or C_1-C_2 haloalkylthio;

R4 is halogen, -CN, C_1-C_3 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, C_3-C_4 cycloalkyl, C_1-C_3 haloalkyl, C_1-C_3 alkoxy, C_1-C_2 haloalkoxy, C_1-C_2 alkylthio or C_1-C_2 haloalkylthio;

G is G^l;

G^l is H, $-C(=O)R^8$, $-C(=S)R^8$, $-CO_2R^9$, $-C(=O)SR^9$, $-S(O)_2R^8$, $-CONR^{10}R^{ll}$, $-S(O)_2NR^{10}R^{ll}$, or $P(=O)(R^{l2})_2$; or C_3-C_6 cycloalkyl or C_4-C_7 cycloalkylalkyl;

R^8 and R^{l0} are independently C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_1-C_3 haloalkyl or C_2-C_7 alkoxyalkyl;

R^9 is C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_2-C_3 haloalkyl or C_2-C_7 alkoxyalkyl;

R^{ll} is H, C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_1-C_3 haloalkyl or C_2-C_7 alkoxyalkyl;

R^{l2} is C_1-C_3 alkyl or C_1-C_3 alkoxy; and

n is 0, 1, 2 or 3.

3. A compound of Claim 2 wherein

X is -CH=CH-, $-C(CH_3)=CH-$, -CH=CF-, -CH=CCl- or $-CH=C(CH_3)-$;

R^1 is H, C_1-C_7 alkyl, C_3-C_8 alkoxycarbonylalkyl, C_4-C_7 alkylcycloalkyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_2-C_7 alkoxyalkyl, C_3-C_7 alkylthioalkyl, C_1-C_7 alkoxy or benzyl;

R^2 is H, halogen, -CN, -CHO, C_1-C_7 alkyl, C_2-C_4 alkylcarbonyl, C_2-C_7 alkylcarbonyloxy, C_4-C_7 alkylcycloalkyl, C_1-C_4 alkylsulfinyl, C_1-C_4 alkylsulfonyl, C_1-C_4 alkylamino, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_4 nitroalkyl, C_2-C_7 haloalkoxyalkyl, C_1-C_7 haloalkyl, C_2-C_7 alkoxyalkyl or C_1-C_7 alkoxy;

each R^3 is independently halogen, -CN, C_1-C_2 alkyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl,

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C_1-C_2 haloalkyl or C_1-C_2 alkoxy;

R^4 is halogen, -CN, C_1-C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1-C_2 haloalkyl or C_1-C_2 alkoxy;

G^1 is H, -C(=O)R^8, -CO_2R^9, -$S(O)_2R^8$, -$CONR^{10}R^{11}$, -$S(O)_2NR^{10}R^{11}$ or $P(=O)(R^{12})_2$;

R^8, R^9 and R^{10} are independently C_1-C_7 alkyl, C_3-C_7 cycloalkyl or C_2-C_7 alkoxyalkyl;

R^{11} is H, C_1-C_7 alkyl, C_3-C_7 cycloalkyl or C_2-C_7 alkoxyalkyl; and

R^{12} is CH_3 or OCH_3.

4. A compound of Claim 3 wherein

X is -CH=CH-, -CH=CF-, -CH=CCl- or-CH=C(CH_3)-;

R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;

R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy;

each R^3 is independently halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

R^4 is halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

G^1 is H, -C(=O)R^8, -CO_2R^9, -$S(O)_2R^8$, or $P(=O)(R^{12})_2$;

R^8 and R^9 are independently C_1-C_7 alkyl or C_2-C_7 alkoxyalkyl;

and n is 1 or 2.

5. A compound of Claim 1 wherein

W is O or S;

R^1 is C_1-C_7 alkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_2-C_3 cyanoalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_3-C_7 alkylthioalkyl or C_1-C_7 alkoxy;

R^2 is H, halogen, -CN, C_1-C_7 alkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_2-C_3 cyanoalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_1-C_7 alkoxy, C_1-C_5 alkylthio, C_2-C_3 alkoxycarbonyl or phenyl;

X is O, S or NR5; or

X is -C(R^6)=C(R^7)-, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **1**;

each R^3 is independently halogen, -CN, C_1-C_5 alkyl, C_2-C_5 alkenyl, C_2-C_5 alkynyl, C_3-C_5 cycloalkyl, C_4-C_5 cycloalkylalkyl, C_1-C_5 haloalkyl, C_3-C_5 haloalkenyl,

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C_3-C_5 haloalkynyl, C_2-C_5 alkoxyalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy, C_1-C_5 alkylthio, C_1-C_5 haloalkylthio or C_2-C_5 alkoxycarbonyl;

R^4, R^6 and R^7 are independently H, halogen, -CN, C_1-C_5 alkyl, C_2-C_5 alkenyl, C_2-C_5 alkynyl, C_3-C_5 cycloalkyl, C_4-C_5 cycloalkylalkyl, C_1-C_5 haloalkyl, C_3-C_5 haloalkenyl, C_3-C_5 haloalkynyl, C_2-C_5 alkoxyalkyl, C_1-C_5 alkoxy, C_1-C_5 haloalkoxy, C_1-C_5 alkylthio, C_1-C_5 haloalkylthio or C_2-C_5 alkoxycarbonyl;

R^5 is C_1-C_3 alkyl or C_1-C_3 haloalkyl;

G is G^1;

G^1 is H, $-C(=O)R^8$, $-C(=S)R^8$, $-CO_2R^9$, $-C(=O)SR^9$, $-S(O)_2R^8$, $-CONR^{10}R^{11}$ or $-S(O)_2NR^{10}R^{11}$;

R^8 and R^{10} are independently C_1-C_7 alkyl, C_3-C_7 alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_1-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_4-C_7 cycloalkylalkyl, phenyl or benzyl;

R^9 is C_1-C_7 alkyl, C_3-C_7alkenyl, C_3-C_7 alkynyl, C_3-C_7 cycloalkyl, C_2-C_7 haloalkyl, C_3-C_7 haloalkenyl, C_2-C_7 alkoxyalkyl, C_4- C_7 cycloalkylalkyl, phenyl or benzyl;

R^{11} is H, C_1-C_7 alkyl, C_2-C_7 alkenyl, C_2-C_7 alkynyl, C_3-C_7 cycloalkyl, C_4-C_7 cycloalkylalkyl, C_1-C_7 haloalkyl or C_2-C_7 alkoxyalkyl; and

n is 0, 1, 2, 3 or 4;

provided that when R^4 is H, then X is $-C(R^6)=C(R^7)-$.

6. A compound of Claim 5 wherein

W is O;

X is O, S, -CH=CH-, $-C(CH_3)=CH-$ or $-CH=C(CH_3)-$;

R^1 is C_1-C_4 alkyl, C_3-C_4 alkenyl, C_3-C_4 alkynyl, C_3-C_4 cycloalkyl, C_2-C_3 cyanoalkyl, C_1-C_3 haloalkyl or C_2-C_4 alkoxyalkyl

R^2 is H, halogen, -CN, C_1-C_4 alkyl, C_3-C_5 cycloalkyl, C_1-C_3 haloalkyl, C_2-C_4 alkoxyalkyl or C_1-C_3 alkoxy;

each R^3 is independently halogen, -CN, C_1-C_3 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, C_3-C_4 cycloalkyl, C_1-C_3 haloalkyl, C_1-C_3 alkoxy, C_1-C_2 haloalkoxy, C_1-C_2 alkylthio or C_1-C_2 haloalkylthio;

R^4 is halogen, -CN, C_1-C_3 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, C_3-C_4 cycloalkyl, C_1-C_3 haloalkyl, C_1-C_3 alkoxy, C_1-C_2 haloalkoxy, C_1-C_2 alkylthio or C_1-C_2 haloalkylthio;

G^1 is H, $-C(=O)R^8$, $-CO_2R^9$, $-S(O)_2R^8$, $-CONR^{10}R^{11}$ or $-S(O)_2NR^{10}R^{11}$;

R^8 and R^{10} are independently C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_1-C_3 haloalkyl or

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C_2-C_7 alkoxyalkyl;
R^9 is C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_2-C_3 haloalkyl or C_2-C_7 alkoxyalkyl;
R^{11} is H, C_1-C_7 alkyl, C_3-C_7 cycloalkyl, C_1-C_3 haloalkyl or C_2-C_7 alkoxyalkyl; and
n is 0, 1, 2 or 3.

7. A compound of Claim 6 wherein
R^1 is C_1-C_3 alkyl, allyl, propargyl, CH_2CH_2CN, C_1-C_2 haloalkyl or 2-methoxyethyl;
R^2 is H, halogen, C_1-C_3 alkyl, cyclopropyl, C_1-C_2 haloalkyl, methoxy or ethoxy;
each R^3 is independently halogen, -CN, C_1-C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1-C_2 haloalkyl or C_1-C_2 alkoxy;
R^4 is halogen, -CN, C_1-C_2 alkyl, -CH=CH_2, -C≡CH, cyclopropyl, C_1-C_2 haloalkyl or C_1-C_2 alkoxy;
R^8, R^9 and R^{10} are independently C_1-C_7 alkyl, C_3-C_7 cycloalkyl or C_2-C_7 alkoxyalkyl; and
R^{11} is H, C_1-C_7 alkyl, C_3-C_7 cycloalkyl or C_2-C_7 alkoxyalkyl.

8. A compound of Claim 7 wherein
R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;
R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy;
each R^3 is independently halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;
R^4 is halogen, -CN, methyl, ethyl, -CH=CH_2, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;
G^1 is H, -C(=O)R^8, -CO_2R^9 or -S(O)$_2R^8$;
R^8 and R^9 are independently C_1-C_7 alkyl or C_2-C_7 alkoxyalkyl;
and n is 1 or 2.

9. A compound of Claim 1 selected from the group consisting of 4-(2,5-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethylbenzo[b]thien-3-yl)-3(2H)-pyridazinone,
5-hydroxy-2,6-dimethyl-4-(2,4,6-trimethylbenzo[b]thien-3-yl)-3(2H)-pyridazinone,
5-hydroxy-2,6-dimethyl-4-(2-methyl-3-benzofuranyl)-3(2H)-pyridazinone,
5-hydroxy-4-(5-methoxy-3-benzofuranyl)-2,6-dimethyl-3(2H)-pyridazinone,

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4-(5-chloro-2-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
4-(2,5-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
4-(2,4-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
4-(2,7-dimethyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
4-(2-ethyl-5-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
5-hydroxy-2,6-dimethyl-4-(1-naphthalenyl)-3(2H)-pyridazinone,
5-hydroxy-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2H)-pyridazinone,
4-(5-ethyl-2-methyl-3-benzofuranyl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone,
5-(acetyloxy)-4-(2,5-dimethyl-3-benzofuranyl)-2,6-dimethyl-3(2H)-pyridazinone,
5-(acetyloxy)-4-(2,7-dimethyl-3-benzofuranyl)-2,6-dimethyl-3(2H)-pyridazinone,
5-(acetyloxy)-2,6-dimethyl-4-(2,5,7-trimethyl-3-benzofuranyl)-3(2H)-pyridazinone,
5-(2,5-dimethyl-3-benzofuranyl)-l,6-dihydro-l,3-dimethyl-6-oxo-4-pyridazinyl 2,2-dimethyl propanoate,
l,6-dihydro-l,3-dimethyl-6-oxo-5-(2,5,7-trimethyl-3-benzofuranyl)-4-pyridazinyl 2,2-dimethylpropanoate, and
4-(2-ethyl-4,6-dimethylbenzo[b]thien-3-yl)-5-hydroxy-2,6-dimethyl-3(2H)-pyridazinone.

10. A compound of Claim 1 selected from a compound of Formula **1** wherein
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^4 is $OCHF_2$; G is G^1; G^1 is H; and n is 0;
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^3 is 5-F; R^4 is Cl; G is G^1; G^1 is H; and n is 1;
W is O; R1 is CH3; R^2 is Cl; X is -CH=CH-; R^4 is Me; G is G^1; G^1 is H; and n is 0;
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^4 is Cl; G is G^1; G^1 is H; and n is 0;
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^3 is 5-Me; R^4 is $OCHF_2$; G is G^1; G^1 is H; and n is 1;
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^3 is 5-Br; R^4 is $OCHF_2$; G is G^1; G^1 is H; and n is 1;
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^3 is 5-Cl; R^4 is Cl; G is G^1; G^1 is H; and n is 1; and
W is O; R^1 is CH_3; R^2 is Me; X is -CH=CH-; R^4 is OCHF2; G is G^1; G^1 is C(O)Me; and n is 0.

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

12. A herbicidal composition comprising a compound of Claim 1, at least one additional active ingredient selected from the group consisting of other herbicides and herbicide safeners, and at least one component selected from the group consisting of surfactants, solid diluents and liquid diluents.

13. A herbicidal mixture comprising (a) a compound of Claim 1, and (b) at least one additional active ingredient selected from (bl) photosystem II inhibitors, (b2) acetohydroxy acid synthase (AHAS) inhibitors, (b3) acetyl-CoA carboxylase (ACCase) inhibitors, (b4) auxin mimics and (b5) 5-enol-pyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, (b6) photosystem I electron diverters, (b7) protoporphyrinogen oxidase (PPO) inhibitors, (b8) glutamine synthetase (GS) inhibitors, (b9) very long chain fatty acid (VLCFA) elongase inhibitors, (b I0) auxin transport inhibitors, (b11) phytoene desaturase (PDS) inhibitors, (b12) 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, (b13) homogentisate solenesyltransererase (HST) inhibitors, (b14) cellulose biosynthesis inhibitors, (b15) other herbicides including mitotic disruptors, organic arsenicals, asulam, bromobutide, cinmethylin, cumyluron, dazomet, difenzoquat, dymron, etobenzanid, flurenol, fosamine, fosamine-ammonium, metam, methyldymron, oleic acid, oxaziclomefone, pelargonic acid and pyributicarb, and (b16) herbicide safeners; and salts of compounds of (b1) through (b16).

14. 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.

15. A herbicidal mixture comprising a compound of Claim 1, and at least one additional active ingredient selected from amidosulfuron, azimsulfuron, bensulfuron-methyl, bispyribac-sodium, cloransulam-methyl, chlorimuron-ethyl, chlorsulfuron, cinosulfuron, cyclosulfamuron, diclosulam, ethametsulfuron-methyl, ethoxysulfuron, flazasulfuron, florasulam, flucarbazone-sodium, flumetsulam, flupyrsulfuron-methyl, flupyrsulfuron-sodium, foramsulfuron, halosulfuron-methyl, imazamethabenz-methyl, imazamox,

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imazapic, imazapyr, imazaquin, imazethapyr, imazosulfuron, iodosulfuron-methyl (including sodium salt), iofensulfuron (2-iodo-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide), mesosulfuron-methyl, metazosulfuron (3-chloro-4-(5,6-dihydro-5-methyl-l,4,2-dioxazin-3-yl)-N-[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-l-methyl-lH-pyrazole-5-sulfonamide), metosulam, metsulfuron-methyl, nicosulfuron, oxasulfuron, penoxsulam, primisulfuron-methyl, propoxycarbazone-sodium, propyrisulfuron (2-chloro-N-[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-6-propylimidazo[l,*2-b*]pyridazine-3-sulfonamide), prosulfuron, pyrazosulfuron-ethyl, pyribenzoxim, pyriftalid, pyriminobac-methyl, pyrithiobac-sodium, rimsulfuron, sulfometuron-methyl, sulfosulfuron, thiencarbazone, thifensulfuron-methyl, triafamone (N-[2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)carbonyl]-6-fluorophenyl]-1,1-difluoro-N-methylmethanesulfonamide), triasulfuron, tribenuron-methyl, trifloxysulfuron (including sodium salt), triflusulfuron-methyl and tritosulfuron.

16. A herbicidal mixture comprising a compound of Claim 1 mixed with rimsulfuron, thifensulfuron-methyl, tribenuron, nicosulfuron, metsulfuron-methyl, flupyrsulfuron-methyl, cloransulam-methyl, pyroxsulam or florasulam.

17. A herbicidal mixture comprising a compound of Claim 1 mixed with rimsulfuron.

18. A herbicidal mixture comprising a compound of Claim 1 mixed with thifensulfuron-methyl.

19. A herbicidal mixture comprising a compound of Claim 1 mixed with tribenuron-methyl.

20. A herbicidal mixture comprising a compound of Claim 1 mixed with ethametsulfuron-methyl.

21. A herbicidal mixture comprising a compound of Claim 1 mixed with nicosulfuron.

22. A compound selected from Formula **3**, *N*-oxides and salts thereof,

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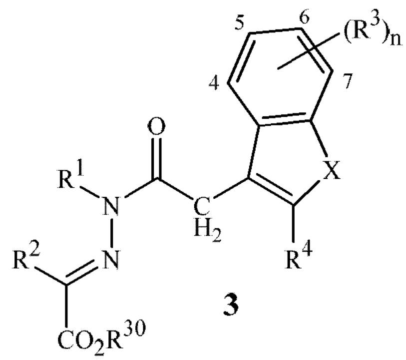

3

wherein

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

X is O, S or NR^5; or

X is -$C(R^6)$=$C(R^7)$-, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **3**;

each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio:

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R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl;

n is 0, 1, 2, 3 or 4; and

R^{30} is alkyl.

23. The compound of Claim 22 wherein

X is O, S, -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or -CH=C(CH_3)-;

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy or C_1–C_5 alkylthio;

each R^3 is independently halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

and

n is 0, 1, 2 or 3.

24. The compound of Claim 23 wherein

X is -CH=CH-, -C(CH_3)=CH-, -CH=CF-, -CH=CCl- or –CH=C(CH_3)-;

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy or benzyl;

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R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_2–C_7 alkoxyalkyl or C_1–C_7 alkoxy;

each R^3 is independently halogen, -CN, C_1–C_2 alkyl, $-CH=CH_2$, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy;

R^4 is halogen, -CN, C_1–C_2 alkyl, $-CH=CH_2$, -C≡CH, cyclopropyl, C_1–C_2 haloalkyl or C_1–C_2 alkoxy.

25. The compound of Claim 24 wherein

X is -CH=CH-, -CH=CF-, -CH=CCl- or $–CH=C(CH_3)$-;

R^1 is methyl, ethyl, *n*-propyl or 2-methoxyethyl;

R^2 is H, methyl, ethyl, *n*-propyl, CF_3 or methoxy;

each R^3 is independently halogen, -CN, methyl, ethyl, $-CH=CH_2$, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

n is 1 or 2; and

R^{30} is methyl or ethyl.

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26. The compound of claim 22 wherein

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^4 is Me, and n is 0;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 5-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 4,6-di-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 5,7-di-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^4 is Et, n is 0;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 5-Me, and R^4 is Et;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 4,6-di-Me, and R^4 is Et;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Me, R^3 is 5,7-di-Me, and R^4 is Et;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^4 is Me, and n is 0;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 5-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 4,6-di-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 5,7-di-Me, and R^4 is Me;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^4 is Et, n is 0;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 5-Me, and R^4 is Et;

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 4,6-di-Me, and R^4 is Et; or

R^{30} is Me, X is -CH=CH-, R^1 is Me, R^2 is Et, R^3 is 5,7-di-Me, and R^4 is Et.

27. A compound of Formula **3** as defined in Claim 22 which is

methyl 2-[2-[2-(2,5-dimethylbenzo[b]thien-3yl)acetyl]-2-methylhydrazinylidene]propanoate; methyl 2-[2-[2-(2,5-dimethyl-3-benzofuranyl)acetyl]-2-methylhydrazinylidene]propanoate; or 2,5,7-trimethyl-3-benzofuranacetic acid 2-(2-methoxy-1-methyl-2-oxoethylidene)-1-methylhydrazide.

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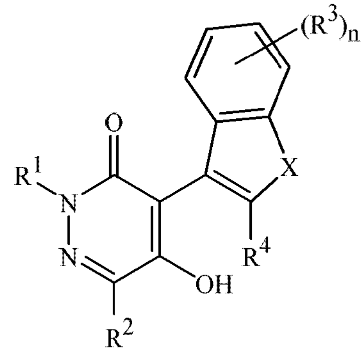
28. A method for preparing a compound of Formula **1b**



1b

wherein

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

X is O, S or NR^5; or

X is -C(R^6)=C(R^7)-, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **1b**;

each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

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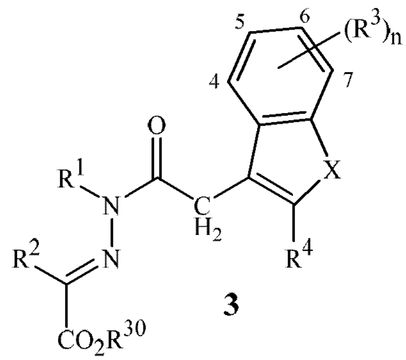
R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl; and

n is 0, 1, 2, 3 or 4

comprising cyclizing the compound of Formula **3** in the presence of solvent and base



3

wherein

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

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X is O, S or NR^5; or

X is $-C(R^6)=C(R^7)-$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **3**;

each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl;

n is 0, 1, 2, 3 or 4; and

R^{30} is alkyl.

29. The method of Claim 28 for preparing a compound of Formula **1b** wherein

R^1 is methyl or ethyl;

R^2 is methyl or ethyl;

X is $-C(R^6)=C(R^7)-$;

each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy;

R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C{\equiv}CH$, cyclopropyl, CF_3, methoxy or ethoxy;

R^6 and R^7 are H or halogen; and

n is 0, 1 or 2

comprising cyclizing the compound of Formula **3** in the presence of solvent and base wherein

R^1 is methyl or ethyl;

R^2 is methyl or ethyl;

X is $-C(R^6)=C(R^7)-$;

each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy;

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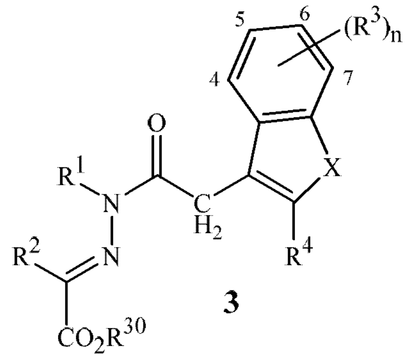
R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, -C≡CH, cyclopropyl, CF_3, methoxy or ethoxy;

R^6 and R^7 are H or halogen;

n is 0, 1 or 2; and

R^{30} is methyl or ethyl.

30. A method for preparing a compound of Formula **3**



3

wherein

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl;

X is O, S or NR^5; or

X is $-C(R^6)=C(R^7)-$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **3**;

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each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

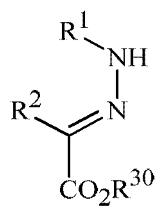
R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl;

n is 0, 1, 2, 3 or 4; and

R^{30} is alkyl;

comprising reacting a hydrazine ester of Formula **4**



4

wherein

R^1 is H, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_3–C_7 alkylthioalkyl, C_1–C_7 alkoxy, benzyl or phenyl; or a 5-, or 6-membered saturated or partially saturated heterocyclic ring containing ring members selected from carbon and up to 1 O and 1 S;

R^2 is H, halogen, -CN, -CHO, C_1–C_7 alkyl, C_3–C_8 alkylcarbonylalkyl, C_3–C_8 alkoxycarbonylalkyl, C_2–C_4 alkylcarbonyl, C_2–C_7 alkylcarbonyloxy, C_4–C_7 alkylcycloalkyl, C_3–C_7 alkenyl, C_3–C_7 alkynyl, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_4 alkylamino, C_2–C_8 dialkylamino, C_3–C_7 cycloalkyl, C_4–C_7 cycloalkylalkyl, C_2–C_3 cyanoalkyl, C_1–C_4 nitroalkyl, C_2–C_7 haloalkoxyalkyl, C_1–

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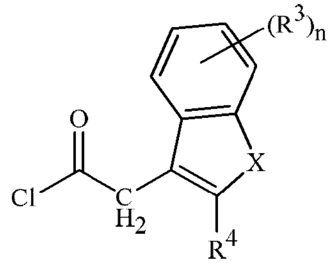
C_7 haloalkyl, C_3–C_7 haloalkenyl, C_2–C_7 alkoxyalkyl, C_1–C_7 alkoxy, C_1–C_5 alkylthio, C_2–C_3 alkoxycarbonyl; or phenyl optionally substituted by halogen, C_1–C_4 alkyl or C_1–C_4 haloalkyl; and

R^{30} is alkyl;

with an acid chloride of Formula **5**



5

wherein

X is O, S or NR^5; or

X is $-C(R^6)=C(R^7)-$, wherein the carbon atom bonded to R^6 is also bonded to the carbon atom bonded to R^4, and the carbon atom bonded to R^7 is also bonded to the phenyl ring moiety in Formula **5**;

each R^3 is independently halogen, -CN, nitro, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^4 is halogen, -CN, C_1–C_3 alkyl, C_2–C_4 alkenyl, C_2–C_4 alkynyl, C_3–C_4 cycloalkyl, C_1–C_3 haloalkyl, C_1–C_3 alkoxy, C_1–C_2 haloalkoxy, C_1–C_2 alkylthio or C_1–C_2 haloalkylthio;

R^6 and R^7 are independently H, halogen, nitro, -CN, C_1–C_5 alkyl, C_2–C_5 alkenyl, C_2–C_5 alkynyl, C_3–C_5 cycloalkyl, C_4–C_5 cycloalkylalkyl, C_1–C_5 haloalkyl, C_3–C_5 haloalkenyl, C_3–C_5 haloalkynyl, C_2–C_5 alkoxyalkyl, C_1–C_5 alkoxy, C_1–C_5 haloalkoxy, C_1–C_5 alkylthio, C_1–C_4 alkylsulfinyl, C_1–C_4 alkylsulfonyl, C_1–C_5 haloalkylthio or C_2–C_5 alkoxycarbonyl;

R^5 is H, C_1–C_3 alkyl or C_1–C_3 haloalkyl; and

n is 0, 1, 2, 3 or 4

in the presence of solvent and base.

31. The method of Claim 30 for preparing a compound of Formula **3** wherein

R^1 is methyl or ethyl;

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R^2 is methyl or ethyl;

X is $-C(R^6)=C(R^7)-$;

each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy;

R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, CF_3, methoxy or ethoxy;

R^6 and R^7 are H or halogen;

n is 0, 1 or 2; and

R^{30} is methyl or ethyl

comprising reacting a hydrazine ester of Formula **4** wherein

R^1 is methyl or ethyl;

R^2 is methyl or ethyl; and

R^{30} is methyl or ethyl

with an acid chloride of Formula **5** wherein

X is $-C(R^6)=C(R^7)-$;

each R^3 is independently F, Cl, Br, methyl, ethyl or methoxy;

R^4 is halogen, -CN, methyl, ethyl, $-CH=CH_2$, $-C\equiv CH$, cyclopropyl, CF_3, methoxy or ethoxy;

R^6 and R^7 are H or halogen; and

n is 0, 1 or 2

in the presence of solvent and base.

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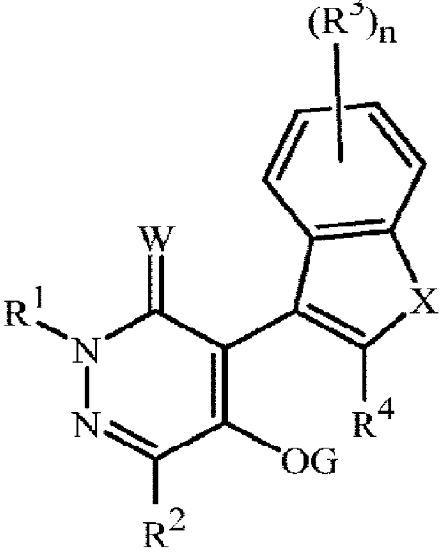

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