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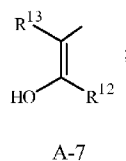
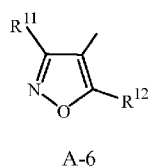
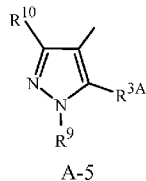
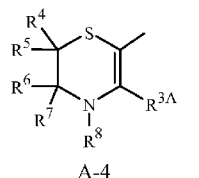
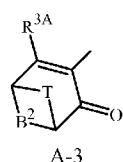
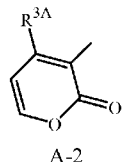
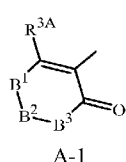
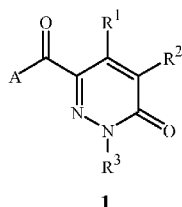
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(54) Title: HERBICIDAL PYRIDAZINONES



(57) Abstract: Disclosed are compounds of Formula 1, including all stereoisomers, N-oxides, and salts thereof, INSERT FORMULA 1 HERE wherein A is a radical selected from the group consisting of INSERT FORMULA A-1, A-2, A-3, A-4, A-5, A-6 AND A-7 HERE and B¹, B², B³, T, R¹, R², R³, R^{3A}, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, R¹² and R¹³ 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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KM, ML, MR, NE, SN, TD, TG).

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TITLE

HERBICIDAL PYRIDAZINONES

FIELD OF THE INVENTION

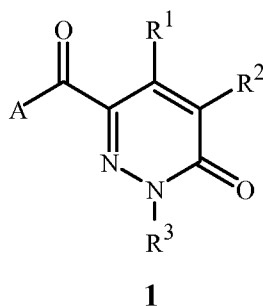
This invention relates to certain pyridazinones, their salts and compositions, and methods of their use for controlling undesirable vegetation.

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.

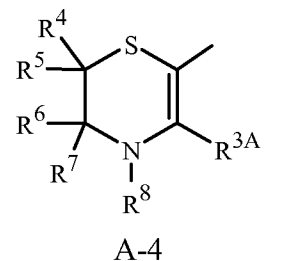
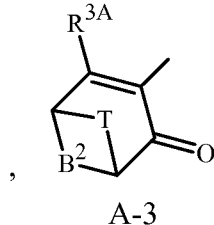
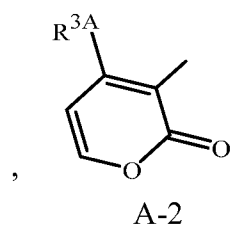
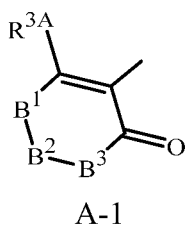
SUMMARY OF THE INVENTION

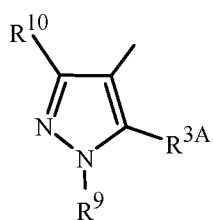
This invention is directed to compounds of Formula 1 (including all stereoisomers), *N*-oxides, and salts thereof, agricultural compositions containing them and their use as herbicides:



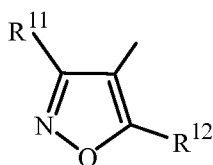
wherein

A is a radical selected from the group consisting of

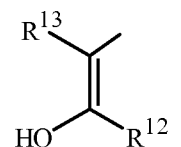




A-5

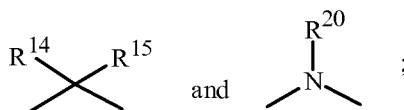


A-6



A-7

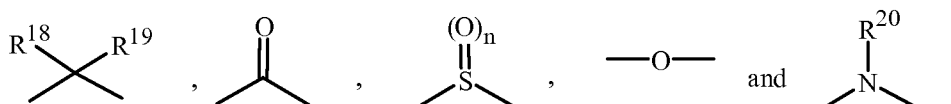
B¹ and B³ are each independently a radical selected from the group consisting of



C-1

C-2

B² is a radical selected from the group consisting of



C-3

C-4

C-5

C-6

C-7

- 5 R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₂-C₆ alkenyloxy, C₃-C₈ haloalkenyloxy, C₃-C₇ alkynyloxy, C₂-C₆ alkoxyalkoxy, C₂-C₆ cyanoalkoxy, C₂-C₆ alkylthioalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio, C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, (R^A)(R^B)N-, (R^A)(R^B)NSO₂-, R^CSO₂N(R^D)-, nitro, cyano,
- 10 C₂-C₆ alkoxyalkyl, C₂-C₆ haloalkoxyalkyl, C₂-C₆ alkylthioalkyl, C₂-C₆ alkylsulfinylalkyl, C₂-C₆ alkylsulfonylalkyl, C₂-C₆ cyanoalkyl, C₂-C₆ alkenyloxyalkyl, C₂-C₆ alkynyloxyalkyl, C₃-C₁₂ alkoxyalkoxyalkyl, C₃-C₁₂ haloalkoxyalkoxyalkyl, C₄-C₁₂ alkoxyalkoxyalkoxyalkyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₃-C₁₀ cycloalkylalkyl or C₃-C₁₀ alkylcycloalkyl;
- 15 each R^A is independently C₁-C₄ alkyl or C₂-C₄ haloalkyl;
each R^B is independently C₁-C₄ alkyl or C₂-C₄ haloalkyl; or
R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 5- or 6-membered ring including ring members selected from -CH₂-, -O- and -N-;
- 20 R^C is C₁-C₄ alkyl or C₂-C₄ haloalkyl;
R^D is C₁-C₃ alkylene;
R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or H, cyano, hydroxy,

amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN,
 -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -SF₅, -NHCHO,
 -NHNH₂, -NHOH, -NHCN, -NHC(=O)NH₂, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆
 alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈
 5 cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀
 cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl,
 C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl,
 C₂-C₈ alkoxyalkyl, C₃-C₁₀ alkoxyalkenyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀
 alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₆ alkylthioalkoxy, C₂-C₈
 10 alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylaminoalkyl, C₃-C₁₀
 dialkylaminoalkyl, C₂-C₈ haloalkylaminoalkyl, C₄-C₁₀ cycloalkylaminoalkyl,
 C₂-C₈ alkylcarbonyl, C₂-C₈ haloalkylcarbonyl, C₄-C₁₀ cycloalkylcarbonyl,
 C₂-C₈ alkoxycarbonyl, C₄-C₁₀ cycloalkoxycarbonyl, C₅-C₁₂
 cycloalkylalkoxycarbonyl, C₂-C₈ alkylaminocarbonyl, C₃-C₁₀
 15 dialkylaminocarbonyl, C₄-C₁₀ cycloalkylaminocarbonyl, C₂-C₅ cyanoalkyl,
 C₁-C₆ hydroxyalkyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈
 alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl,
 C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀
 dialkoxyalkyl, C₃-C₁₀ alkoxyalkylcarbonyl, C₃-C₁₀ alkoxycarbonylalkyl, C₂-C₈
 20 haloalkoxycarbonyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy,
 C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆
 haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy, C₂-C₈ alkoxyalkoxy,
 C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀
 cycloalkylcarbonyloxy, C₃-C₁₀ alkylcarbonylalkoxy, C₁-C₆ alkylthio, C₁-C₆
 25 haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆
 haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈
 cycloalkylsulfonyl, C₃-C₈ trialkylsilyl, C₃-C₈ cycloalkenyloxy, C₃-C₈
 halocycloalkenyloxy, C₂-C₈ haloalkoxyalkoxy, C₂-C₈ alkoxyhaloalkoxy, C₂-C₈
 haloalkoxyhaloalkoxy, C₃-C₁₀ alkoxycarbonylalkoxy, C₂-C₈
 30 alkyl(thiocarbonyl)oxy, C₂-C₈ alkylcarbonylthio, C₂-C₈ alkyl(thiocarbonyl)thio,
 C₃-C₈ cycloalkylsulfinyl, C₁-C₆ alkylaminosulfonyl, C₂-C₈
 dialkylaminosulfonyl, C₃-C₁₀ halotrialkylsilyl, C₁-C₆ alkylamino, C₂-C₈
 dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino, C₃-C₈
 cycloalkylamino, C₂-C₈ alkylcarbonylamino, C₂-C₈ haloalkylcarbonylamino,
 35 C₁-C₆ alkylsulfonylamino, C₁-C₆ haloalkylsulfonylamino or C₄-C₁₀
 cycloalkyl(alkyl)amino; or

R¹ and R² are taken together with the atoms to which they are attached to form a 5-, 6-
 or 7-membered partially unsaturated or fully unsaturated ring along with ring
 members consisting of carbon atoms and up to 2 oxygen atoms, 2 nitrogen atoms

and 2 sulfur atoms or up to two -S(O)-, -S(O)₂- and -C(O)- groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl and C₂-C₈ alkoxyalkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy; the ring optionally substituted on nitrogen ring members selected from H and C₁-C₆ alkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy;

W¹ is C₁-C₆ alkylene, C₂-C₆ alkenylene, C₂-C₆ alkynylene or C₁-C₅ alkyleneoxy;

W² is C₁-C₆ alkylene or C₁-C₅ alkyleneoxy;

R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ halocycloalkyl, C₁-C₄ cyanoalkyl, C₂-C₆ alkoxyalkyl, C₃-C₆ alkoxycarbonylalkyl or C₃-C₆ alkylcarbonylalkyl;

R^{3A} is H, halogen, cyano, hydroxy, -O-M⁺, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, -NHNH₂, -NHOH, -N=C=O, -N=C=S, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀ cycloalkylcarbonyloxy, C₃-C₁₀ alkylcarbonylalkoxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈ cycloalkylsulfonyl, C₁-C₆ alkylsulfonyloxy, C₁-C₆ alkylamino, C₂-C₈ dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino, C₃-C₈ cycloalkylamino, C₂-C₈ alkylcarbonylamino, C₂-C₈ haloalkylcarbonylamino, C₁-C₆ alkylsulfonylamino or C₁-C₆ haloalkylsulfonylamino; or benzyloxy, phenyloxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy, benzylsulfonyloxy, phenylthio, benzylthio, phenylsulfinyl, benzylsulfinyl, phenylsulfonyl or benzylsulfonyl, each optionally substituted on ring members with up to five substituents selected from R²¹;

M⁺ is an alkali metal cation or an ammonium cation;

R⁴, R⁵, R⁶ and R⁷ are each independently H, halogen, hydroxy, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy or C₃-C₈ halocycloalkoxy; or phenyl or benzyl, each optionally substituted on ring members with up to five substituents selected from R²¹;

R⁸ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl or C₃-C₈ halocycloalkyl; or benzyl optionally substituted on ring members with up to five substituents selected from R²¹;

R⁹ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl or C₂-C₈ alkylthioalkyl;

R¹⁰ is H, halogen, cyano, hydroxy, amino, nitro, SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, -NHCHO, -NHNH₂, -N₃, -NHOH, -NHCN, -NHC(=O)NH₂, -N=C=O, -N=C=S, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl or C₂-C₈ alkylthioalkyl;

R¹¹ is H, halogen, cyano, hydroxy, amino, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl or C₂-C₈ alkylsulfonylalkyl; or phenyl optionally substituted with up to five substituents selected from R²¹;

R¹² is H, halogen, cyano, hydroxy, amino, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl or C₂-C₈ alkoxycarbonylamino;

R¹³ is H, halogen, cyano, hydroxy, amino, nitro or C₂-C₈ alkoxycarbonyl;

n is 0, 1, or 2;

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is independently H, halogen, cyano, hydroxy or C₁-C₆ alkyl; or

a pair of R¹⁴ and R¹⁸ is taken together as C₂-C₆ alkylene or C₂-C₆ alkenylene;

R²⁰ is H, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₈ cycloalkyl;

T is C₁-C₆ alkylene or C₂-C₆ alkenylene;

each G is independently a 5- or 6-membered heterocyclic ring or an 8-, 9- or 10-membered fused bicyclic ring system, each ring or ring system optionally substituted with up to five substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members;

each R²¹ is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈ cycloalkylsulfonyl, C₁-C₆ alkylamino, C₂-C₈ dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino or C₃-C₈ cycloalkylamino; and

each R²² is independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl or C₂-C₈ alkoxyalkyl.

More particularly this invention relates to a compound selected from Formula 1, an *N*-oxide, or a salt thereof.

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.

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. “Alkylene” denotes a straight-chain or branched alkanediyl. Examples of “alkylene” include CH₂, CH₂CH₂, CH(CH₃), CH₂CH₂CH₂, CH₂CH(CH₃) and the different butylene isomers. “Alkenylene” denotes a straight-chain or branched alkenediyl containing one olefinic bond. Examples of “alkenylene” include CH=CH, CH₂CH=CH, CH=C(CH₃) and the different butenylene isomers. “Alkynylene” denotes a straight-chain or branched alkynediyl containing one triple bond. Examples of “alkynylene” include C≡C, CH₂C≡C, C≡CCH₂ and the different butynylene isomers. The term “alkyleneoxy” denotes a straight-

chain or branched alkylene bonded through oxygen. Examples of alkyleneoxy include $-\text{CH}_2\text{CH}_2\text{O}-$, $-\text{CH}(\text{CH}_3)\text{CH}_2\text{O}-$ and $-\text{CH}_2\text{O}-$ where the oxygen is bonded to the compound of Formula 1, and the carbon is bonded to alkylene is bonded to the phenyl (i.e. when R^2 is $\text{W}^1(\text{phenyl})$) or G (i.e. when R^2 is W^2G).

“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 , $\text{CH}_3\text{OCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2$. “Alkoxyalkoxy” denotes alkoxy substitution on alkoxy. “Alkenyloxy” includes straight-chain or branched alkenyloxy moieties. Examples of “alkenyloxy” include $\text{H}_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{O}$ and $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{O}$. “Alkenyloxyalkyl” denotes alkenyloxy substitution on alkyl. Examples of “alkenyloxyalkyl” include $\text{H}_2\text{C}=\text{CHCH}_2\text{OCH}_2$ and $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{OCH}_2$. “Alkynyloxy” includes straight-chain or branched alkynyloxy moieties. Examples of “alkynyloxy” include $\text{HC}\equiv\text{CCH}_2\text{O}$, $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{O}$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CH}_2\text{O}$. “Alkynyloxyalkyl” denotes alkynyloxy substitution on alkyl. Examples of “alkynyloxyalkyl” include $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{OCH}_2$ and $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CH}_2\text{OCH}_2$. “Alkoxyalkenyl” includes straight-chain or branched alkenyl substituted by an alkoxy group. Examples of “alkoxyalkenyl” include $\text{CH}_3\text{OCH}=\text{CH}$, $\text{CH}_3\text{C}(\text{OCH}_3)=\text{CH}$ and $\text{CH}_3\text{CH}_2\text{OCH}=\text{CHCH}_2$. “Alkoxyalkoxyalkyl” denotes alkoxyalkoxy substitution on alkyl. Examples of “alkoxyalkoxyalkyl” include $\text{CH}_3\text{OCH}_2\text{OCH}_2$, $\text{CH}_3\text{OCH}_2\text{OCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OCH}_2\text{OCH}_2$ and $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$. “Alkoxyalkoxyalkoxyalkyl” denotes alkoxyalkoxyalkoxy substitution on alkyl. Examples of “alkoxyalkoxyalkoxyalkyl” include $\text{CH}_3\text{OCH}_2\text{OCH}_2\text{OCH}_2$ and $\text{CH}_3\text{OCH}_2\text{OCH}_2\text{CH}_2\text{OCH}_2$. “Alkylthio” includes branched or straight-chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. “Alkylsulfinyl” includes both enantiomers of an alkylsulfinyl group. Examples of “alkylsulfinyl” include $\text{CH}_3\text{S}(\text{O})-$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})-$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})-$, $(\text{CH}_3)_2\text{CHS}(\text{O})-$ and the different butylsulfinyl, pentylsulfinyl and hexylsulfinyl isomers. Examples of “alkylsulfonyl” include $\text{CH}_3\text{S}(\text{O})_2-$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2-$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})_2-$, $(\text{CH}_3)_2\text{CHS}(\text{O})_2-$, and the different butylsulfonyl, pentylsulfonyl and hexylsulfonyl isomers. The terms “cycloalkylsulfinyl” and “cycloalkylsulfonyl” are defined analogously to the terms “alkylsulfinyl” and “alkylsulfonyl” above.

“Alkylthioalkyl” denotes alkylthio substitution on alkyl. Examples of “alkylthioalkyl” include CH_3SCH_2 , $\text{CH}_3\text{SCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{SCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{SCH}_2$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2$; “alkylsulfinylalkyl” and “alkylsulfonylalkyl” include the corresponding sulfoxides and sulfones, respectively. “Alkylthioalkoxy” denotes alkylthio substitution on alkoxy. Examples of “alkylthioalkoxy” include $\text{CH}_3\text{SCH}_2\text{CH}_2\text{O}$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{O}$. “Alkylamino” includes an NH radical substituted with straight-chain or branched alkyl. Examples of “alkylamino” include $\text{CH}_3\text{CH}_2\text{NH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}$, and $(\text{CH}_3)_2\text{CHCH}_2\text{NH}$.

Examples of “dialkylamino” include $(\text{CH}_3)_2\text{N}$, $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{N}$ and $\text{CH}_3\text{CH}_2(\text{CH}_3)\text{N}$. “Alkylaminoalkyl” denotes alkylamino substitution on alkyl. Examples of “alkylaminoalkyl” include CH_3NHCH_2 , $\text{CH}_3\text{NHCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{NHCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NHCH}_2$ and $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_2$. Examples of “dialkylaminoalkyl” include $((\text{CH}_3)_2\text{CH})_2\text{NCH}_2$, $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{NCH}_2$ and $\text{CH}_3\text{CH}_2(\text{CH}_3)\text{NCH}_2\text{CH}_2$. The term “alkylcarbonylamino” denotes alkyl bonded to a $\text{C}(=\text{O})\text{NH}$ moiety. Examples of “alkylcarbonylamino” include $\text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{NH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{NH}$.

“Alkylcarbonylthio” denotes a straight-chain or branched alkylcarbonyl attached to and linked through a sulfur atom. Examples of “alkylcarbonylthio” include $\text{CH}_3\text{C}(=\text{O})\text{S}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})\text{S}$ and $(\text{CH}_3)_2\text{CHC}(=\text{O})\text{S}$. The term “alkyl(thiocarbonyl)oxy” denotes an alkyl group bonded to a thiocarbonyl moiety attached to and linked through an oxygen atom. Examples of “alkyl(thiocarbonyl)oxy”, include $\text{CH}_3\text{CH}_2\text{C}(=\text{S})\text{O}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{S})\text{O}$. The term “alkyl(thiocarbonyl)thio” refers to an alkyl group bonded to a thiocarbonyl moiety attached to and linked through a sulfur atom. Examples “alkyl(thiocarbonyl)thio” include $\text{CH}_3\text{CH}_2\text{C}(=\text{S})\text{S}$.

“Trialkylsilyl” includes 3 branched and/or straight-chain alkyl radicals attached to and linked through a silicon atom, such as trimethylsilyl, triethylsilyl and *tert*-butyldimethylsilyl. Examples of “halotrialkylsilyl” include $\text{CF}_3(\text{CH}_3)_2\text{Si-}$, $(\text{CF}_3)_3\text{Si-}$, and $\text{CH}_2\text{Cl}(\text{CH}_3)_2\text{Si-}$. “Hydroxyalkyl” denotes an alkyl group substituted with one hydroxy group. Examples of “hydroxyalkyl” include HOCH_2CH_2 , $\text{CH}_3\text{CH}_2(\text{OH})\text{CH}$ and $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_2$. “Cyanoalkyl” denotes an alkyl group substituted with one cyano group. Examples of “cyanoalkyl” include NCCH_2 , NCCH_2CH_2 and $\text{CH}_3\text{CH}(\text{CN})\text{CH}_2$. “Cyanoalkoxy” denotes an alkoxy group substituted by one cyano group. Examples of “cyanoalkoxy” include $\text{NCCH}_2\text{CH}_2\text{O}$ and $\text{CH}_3\text{CH}(\text{CN})\text{CH}_2\text{O}$.

“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 “cycloalkoxy” denotes cycloalkyl linked through an oxygen atom such as cyclopentyloxy and cyclohexyloxy. The term “alkylcycloalkyl” denotes alkyl substitution on a cycloalkyl moiety. Examples of “alkylcycloalkyl” include methylcyclopropyl, ethylcyclopentyl and other straight-chain or branched alkyl groups bonded to cycloalkyl moiety. “Cycloalkylalkoxy” denotes cycloalkylalkyl linked through an oxygen atom attached to the alkyl chain. Examples of “cycloalkylalkoxy” include cyclopropylmethoxy, cyclopentylethoxy and other cycloalkyl moieties bonded to straight-chain or branched alkoxy groups. “Cycloalkenyl” includes groups such as cyclopentenyl and cyclohexenyl as well as groups with more than one double bond such as 1,3- and 1,4-cyclohexadienyl.

The term “halogen”, either alone or in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” includes fluorine, chlorine,

bromine or iodine. Further, when used in compound words such as “haloalkyl”, or when used in descriptions such as “alkyl substituted with halogen” said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of “haloalkyl” or “alkyl substituted with halogen” include F_3C- , $ClCH_2-$, CF_3CH_2- and CF_3CCl_2- . The terms “halocycloalkyl”, “haloalkoxy”, “haloalkylthio”, “haloalkylsulfinyl”, “haloalkylsulfonyl”, “haloalkenyloxy”, “haloalkynyloxy”, “haloalkenyl”, “haloalkynyl”, “haloalkoxyalkyl”, “haloalkoxyalkoxy”, “haloalkoxyalkoxyalkyl”, “haloalkoxyhaloalkoxy”, “haloalkoxyhaloalkyl”, “haloalkylamino”, “haloalkylaminoalkyl”, “halocycloalkoxy”, “halocycloalkoxyalkyl”, “halocycloalkylalkyl”, “halocycloalkenyl”, “halocycloalkenyloxy”, “halocycloalkenyloxyalkyl”, “alkoxyhaloalkoxy”, “alkoxyhaloalkyl”, “haloalkylcarbonyloxy”, “haloalkylcarbonylamino” and the like, are defined analogously to the term “haloalkyl”. Examples of “haloalkoxy” include CF_3O- , CCl_3CH_2O- , $HCF_2CH_2CH_2O-$ and CF_3CH_2O- . Examples of “haloalkylthio” include CCl_3S- , CF_3S- , CCl_3CH_2S- and $ClCH_2CH_2CH_2S-$. Examples of “haloalkylsulfinyl” include $CF_3S(O)-$, $CCl_3S(O)-$, $CF_3CH_2S(O)-$ and $CF_3CF_2S(O)-$. Examples of “haloalkylsulfonyl” include $CF_3S(O)_2-$, $CCl_3S(O)_2-$, $CF_3CH_2S(O)_2-$ and $CF_3CF_2S(O)_2-$. Examples of “haloalkylsulfonylamino” include $CF_3S(O)_2N$, and $CF_3CH_2S(O)_2N$. 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 $FCH_2C\equiv CCH_2-$. Examples of “haloalkoxyalkoxy” include CF_3OCH_2O- , $ClCH_2CH_2OCH_2CH_2O-$, $Cl_3CCH_2OCH_2O-$ as well as branched alkyl derivatives. Examples of “haloalkylamino” include $CF_3(CH_3)CHNH$, $(CF_3)_2CHNH$ and CH_2ClCH_2NH . The term “halodialkyl”, either alone or in compound words such as “halodialkylamino”, means at least one of the two alkyl groups is substituted with at least one halogen atom, and independently each halogenated alkyl group may be partially or fully substituted with halogen atoms which may be the same or different. Examples of “halodialkylamino” include $(BrCH_2CH_2)_2N$ and $BrCH_2CH_2(ClCH_2CH_2)N$.

“Alkylcarbonyl” denotes a straight-chain or branched alkyl moieties bonded to a $C(=O)$ moiety. Examples of “alkylcarbonyl” include $CH_3C(=O)-$, $CH_3CH_2CH_2C(=O)-$ and $(CH_3)_2CHC(=O)-$. “Alkylcarbonylalkyl” denotes alkylcarbonyl substitution on alkyl. Examples of “alkylcarbonylalkyl” include $CH_3C(=O)CH_2$ and $CH_3CH_2CH_2C(=O)CH_2$. Examples of “alkoxycarbonyl” include $CH_3OC(=O)-$, $CH_3CH_2OC(=O)-$, $CH_3CH_2CH_2OC(=O)-$, $(CH_3)_2CHOC(=O)-$ and the different butoxy- or pentoxycarbonyl isomers. The term “alkoxycarbonylalkyl” denotes alkoxycarbonyl substitution of alkyl. Examples of “alkoxycarbonylalkyl” include $CH_3OC(=O)CH_2$ and $CH_3CH_2CH_2OC(=O)CH_2$. The term “alkoxycarbonylalkoxy” denotes alkoxycarbonyl substitution of alkoxy. Examples of “alkoxycarbonylalkoxy” include $CH_3OC(=O)CH_2O$ and $CH_3CH_2CH_2OC(=O)CH_2O$. The terms “haloalkylcarbonyl” “haloalkoxycarbonyl”,

“alkoxyalkylcarbonyl”, “cycloalkoxycarbonyl”, “cycloalkylalkoxycarbonyl” and “cycloalkylaminocarbonyl” are defined analogously.

The term “alkoxycarbonylamino” denotes a straight-chain or branched alkoxy moieties bonded to a C(=O) moiety of carbonylamino group. Examples of “alkoxycarbonylamino” include CH₃OC(=O)NH- and CH₃CH₂OC(=O)NH-. Examples of “alkylaminocarbonyl” include CH₃NHC(=O), CH₃CH₂NHC(=O), CH₃CH₂CH₂NHC(=O), (CH₃)₂CHNHC(=O) and the different butylamino- or pentylaminocarbonyl isomers. Examples of “dialkylaminocarbonyl” include (CH₃)₂NC(=O), (CH₃CH₂)₂NC(=O), CH₃CH₂(CH₃)NC(=O), (CH₃)₂CH(CH₃)NC(=O) and CH₃CH₂CH₂(CH₃)NC(=O). The term “alkylcarbonyloxy” denotes straight-chain or branched alkyl bonded to a C(=O)O moiety. Examples of “alkylcarbonyloxy” include CH₃CH₂C(=O)O and (CH₃)₂CHC(=O)O. The term “alkylcarbonylalkoxy” denotes alkylcarbonyl bonded to an alkoxy moiety. Examples of “alkylcarbonylalkoxy” include CH₃C(=O)CH₂CH₂O and CH₃CH₂C(=O)CH₂O. Examples of “alkoxycarbonyloxy” include CH₃CH₂CH₂OC(=O)O and (CH₃)₂CHOC(=O)O. The term “cycloalkylcarbonyloxy” denotes a cycloalkylcarbonyl group bonded to oxygen. Examples of “cycloalkylcarbonyloxy” include cyclopropyl-C(O)O- and cyclohexyl-C(O)O-.

“Alkylsulfonylamino” denotes an NH radical substituted with alkylsulfonyl. Examples of “alkylsulfonylamino” include CH₃CH₂S(=O)₂NH- and (CH₃)₂CHS(=O)₂NH-. The term “alkylsulfonyloxy” denotes an alkylsulfonyl group bonded to an oxygen atom. Examples of “alkylsulfonyloxy” include CH₃S(=O)₂O-, CH₃CH₂S(=O)₂O-, CH₃CH₂CH₂S(=O)₂O-, (CH₃)₂CHS(=O)₂O-, and the different butylsulfonyloxy, pentylsulfonyloxy and hexylsulfonyloxy isomers.

The term “cycloalkoxyalkyl” denotes cycloalkoxy substitution on an alkyl moiety. Examples of “cycloalkoxyalkyl” include cyclopropyloxymethyl, cyclopentyloxyethyl and other cycloalkoxy moieties bonded to straight-chain or branched alkyl groups. The term “cycloalkylthio” denotes cycloalkyl attached to and linked through a sulfur atom such as cyclopropylthio and cyclopentylthio; “cycloalkylsulfonyl” includes the corresponding sulfones. “Alkylcycloalkylalkyl” denotes an alkyl group substituted with alkylcycloalkyl. Examples of “alkylcycloalkylalkyl” include 1-, 2-, 3- or 4-methyl or -ethyl cyclohexylmethyl. The term “cycloalkylcycloalkyl” denotes cycloalkyl substitution on another cycloalkyl ring, wherein each cycloalkyl ring independently has from 3 to 7 carbon atom ring members. Examples of cycloalkylcycloalkyl include cyclopropylcyclopropyl (such as 1,1'-bicyclopropyl-1-yl, 1,1'-bicyclopropyl-2-yl), cyclohexylcyclopentyl (such as 4-cyclopentylcyclohexyl) and cyclohexylcyclohexyl (such as 1,1'-bicyclohexyl-1-yl), and the different *cis*- and *trans*-cycloalkylcycloalkyl isomers, (such as (1*R*,2*S*)-1,1'-bicyclopropyl-2-yl and (1*R*,2*R*)-1,1'-bicyclopropyl-2-yl).

“Dialkoxyalkyl” denotes two independent alkoxy groups substituted on same carbon of the alkyl group. Examples of “dialkoxyalkyl” include (CH₃O)₂CH- and

$\text{CH}_3\text{CH}_2\text{O}(\text{CH}_3\text{O})\text{CH}-$. “Cycloalkylamino” denotes an NH radical substituted with cycloalkyl. Examples of “cycloalkylamino” include cyclopropylamino and cyclohexylamino. “Cycloalkyl(alkyl)amino” means a cycloalkylamino group where the hydrogen atom is replaced by an alkyl radical. Examples of “cycloalkyl(alkyl)amino” include groups such as cyclopropyl(methyl)amino, cyclobutyl(butyl)amino, cyclopentyl(propyl)amino, cyclohexyl(methyl)amino and the like. The term “cycloalkylaminoalkyl” denotes cycloalkylamino substitution on an alkyl group. Examples of “cycloalkylaminoalkyl” include cyclopropylaminomethyl, cyclopentylaminoethyl, and other cycloalkylamino moieties bonded to straight-chain or branched alkyl groups.

“Cycloalkylcarbonyl” denotes cycloalkyl bonded to a $\text{C}(=\text{O})$ group including, for example, cyclopropylcarbonyl and cyclopentylcarbonyl. The term “cycloalkoxycarbonyl” means cycloalkoxy bonded to a $\text{C}(=\text{O})$ group, for example, cyclopropyloxycarbonyl and cyclopentyloxycarbonyl. “Cycloalkylaminocarbonyl” denotes cycloalkylamino bonded to a $\text{C}(=\text{O})$ group, for example, cyclopentylaminocarbonyl and cyclohexylaminocarbonyl. “Cycloalkylalkoxycarbonyl” denotes cycloalkylalkoxy bonded to a $\text{C}(=\text{O})$ group. Examples of “cycloalkylalkoxycarbonyl” include cyclopropylethoxycarbonyl and cyclopentylmethoxycarbonyl. “Cycloalkylcarbonyloxy” denotes cycloalkylcarbonyl attached to and linked through an oxygen atom. Examples of “cycloalkylcarbonyloxy” include cyclohexylcarbonyloxy and cyclopentylcarbonyloxy.

The term “cycloalkenylalkyl” denotes cycloalkenyl substitution on an alkyl moiety. Examples of “cycloalkenylalkyl” include cyclobutenylmethyl, cyclopentenylethyl, and other cycloalkenyl moieties bonded to straight-chain or branched alkyl groups. The term “cycloalkenyloxy” denotes cycloalkenyl linked through an oxygen atom such as cyclopentenyoxy and cyclohexenyloxy. The term “cycloalkenyloxyalkyl” denotes cycloalkenyloxy substitution on an alkyl moiety. Examples of “cycloalkenyloxyalkyl” include cyclobutenyloxymethyl, cyclopentenyoxyethyl, and other cycloalkenyloxy moieties bonded to straight-chain or branched alkyl groups.

The term “alkylaminosulfonyl” denotes a straight-chain or branched alkylamino moiety bonded to a sulfonyl group. Examples of an “alkylaminosulfonyl” group include $\text{CH}_3\text{NHS}(\text{O})_2-$ or $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHS}(\text{O})_2-$. The term “dialkylaminosulfonyl” denotes a straight-chain or branched dialkylamino moiety bonded to a sulfonyl group. Examples of a “dialkylaminosulfonyl” group include $(\text{CH}_3)_2\text{NS}(\text{O})_2-$ or $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{NS}(\text{O})_2-$.

The total number of carbon atoms in a substituent group is indicated by the “ C_i-C_j ” prefix where i and j are numbers from 1 to 14. For example, C_1-C_4 alkylsulfonyl designates methylsulfonyl through butylsulfonyl; C_2 alkoxyalkyl designates CH_3OCH_2- ; C_3 alkoxyalkyl designates, for example, $\text{CH}_3\text{CH}(\text{OCH}_3)-$, $\text{CH}_3\text{OCH}_2\text{CH}_2-$ or $\text{CH}_3\text{CH}_2\text{OCH}_2-$; and C_4 alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_2-$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2-$.

When a 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., $(R^V)_r$, r is 1, 2, 3, 4 or 5 in U-1 of Exhibit 2. When a group contains a substituent which can be hydrogen, for example R^2 , R^3 , R^{3A} , R^4 , R^5 , R^6 , R^7 , R^8 , R^9 , R^{10} , R^{11} , R^{12} , R^{13} , R^{14} , R^{15} , R^{18} , R^{19} or R^{20} , 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 $(R^V)_r$ in Q-29 of Exhibit 1 then hydrogen may be at the position (i.e. when r is 0) 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.

Unless otherwise indicated, a “ring” or “ring system” as a component of Formula 1 (e.g., substituent G) is carbocyclic or heterocyclic. The term “ring system” denotes two or more fused rings. The terms “bicyclic ring system” and “fused bicyclic ring system” denote a ring system consisting of two fused rings, in which either ring can be saturated, partially unsaturated or fully unsaturated unless otherwise indicated. The term “ring member” refers to an atom or other moiety (e.g., $C(=O)$, $C(=S)$, $S(O)$ or $S(O)_2$) forming the backbone of a ring or ring system.

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

The terms “heterocyclic ring”, “heterocycle” or “heterocyclic ring system” denote a ring or ring system in which at least one atom forming the ring backbone is not carbon, e.g., nitrogen, oxygen or sulfur. Typically a heterocyclic ring contains no more than 4 nitrogen atoms, no more than 2 oxygen atoms and no more than 2 sulfur atoms. Unless otherwise indicated, a heterocyclic ring can be a saturated, partially unsaturated or fully unsaturated ring. When a fully unsaturated heterocyclic ring satisfies Hückel’s rule, then said ring is also called a “heteroaromatic ring” or “aromatic heterocyclic ring”. Unless otherwise indicated, heterocyclic rings and ring systems can be attached through any available carbon or nitrogen by replacement of a hydrogen on said carbon or nitrogen.

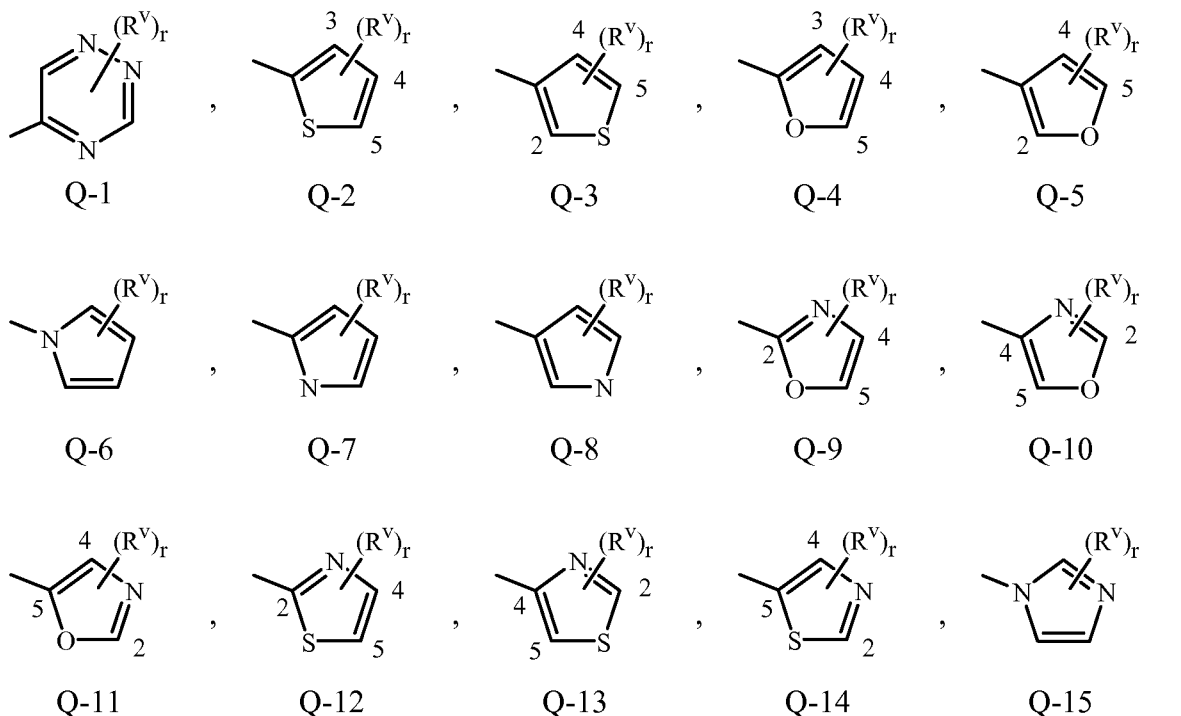
“Aromatic” indicates that each of the ring atoms is essentially in the same plane and has a p -orbital perpendicular to the ring plane, and that $(4n + 2) \pi$ electrons, where n is a positive integer, are associated with the ring to comply with Hückel’s rule. The term “aromatic ring system” denotes a carbocyclic or heterocyclic ring system in which at least one ring of the ring system is aromatic.

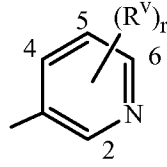
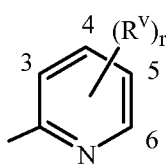
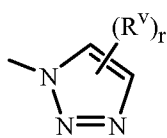
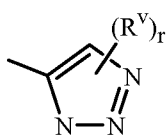
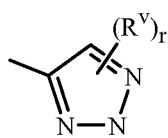
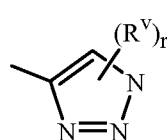
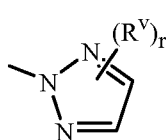
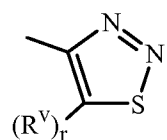
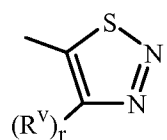
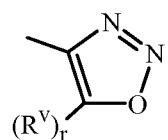
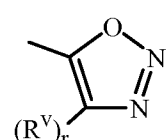
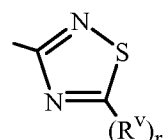
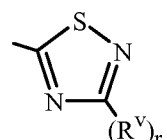
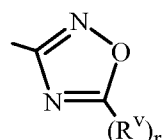
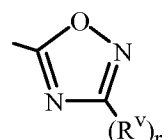
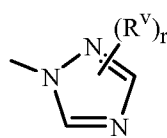
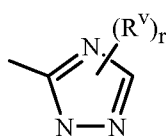
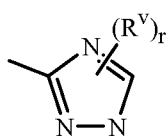
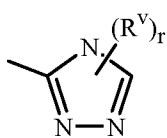
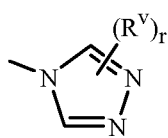
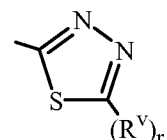
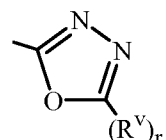
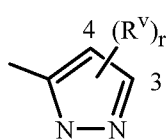
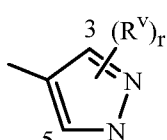
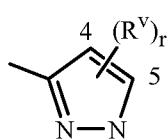
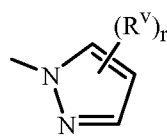
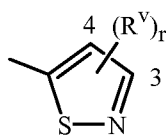
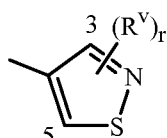
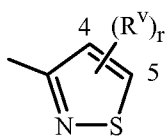
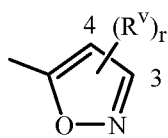
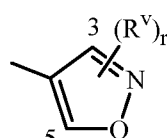
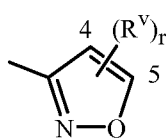
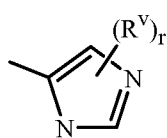
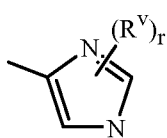
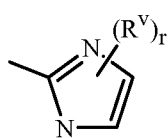
As used herein, the following definitions shall apply unless otherwise indicated. The term “optionally substituted” is used interchangeably with the phrase “substituted or unsubstituted”. Unless otherwise indicated, an optionally substituted group may have a substituent at each substitutable position of the group, and each substitution is independent of the other.

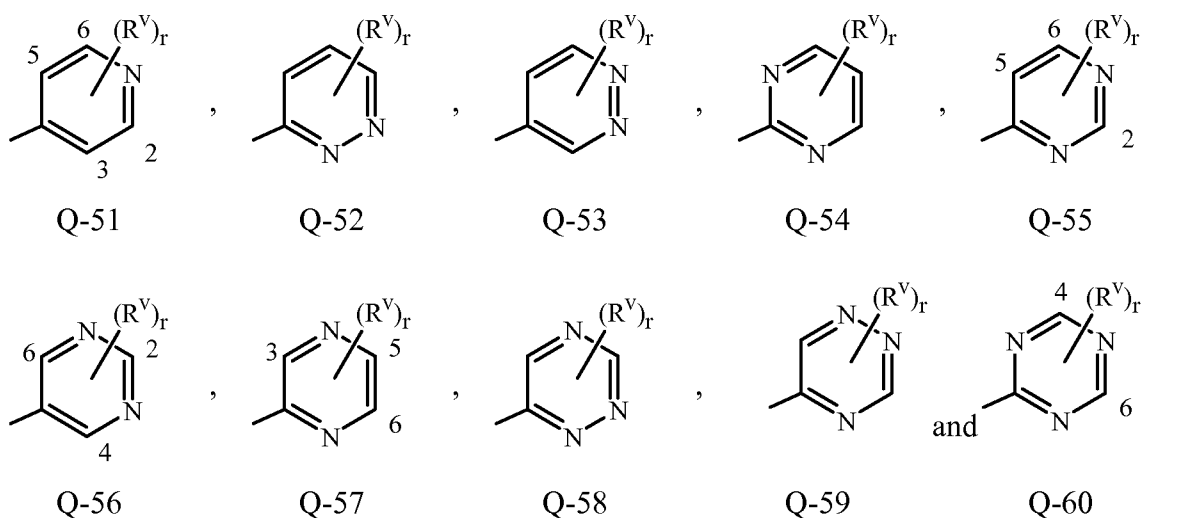
G may be attached to the remainder of Formula 1 through any available carbon or nitrogen ring atom, unless otherwise described. The ring or ring system of G may be saturated, partially saturated or fully unsaturated and is optionally substituted with up to 5 substituents selected from a group of substituents as defined in the Summary of the Invention.

Examples of a 5- or 6-membered unsaturated aromatic heterocyclic ring optionally substituted with from up to 5 substituents include the rings Q-1 through Q-60 illustrated in Exhibit 1 wherein R^V is any substituent as defined in the Summary of the Invention for R^{21} on carbon ring members or R^{22} on nitrogen ring members, and r is an integer from 0 to 5, limited by the number of available positions on each Q group. As Q-29, Q-30, Q-36, Q-37, Q-38, Q-39, Q-40, Q-41, Q-42 and Q-43 have only one available position, for these Q groups r is limited to the integers 0 or 1, and r being 0 means that the Q group is unsubstituted and a hydrogen is present at the position indicated by $(R^V)_r$.

Exhibit 1







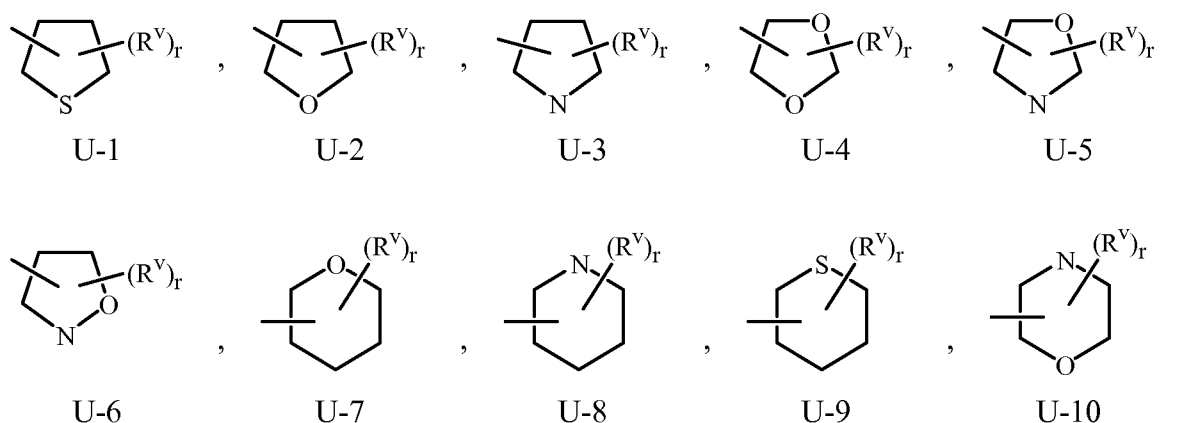
Note that when G is an optionally substituted 5- or 6-membered non-aromatic heterocyclic ring, one or two carbon ring members of the heterocycle can optionally be in the oxidized form of a carbonyl moiety.

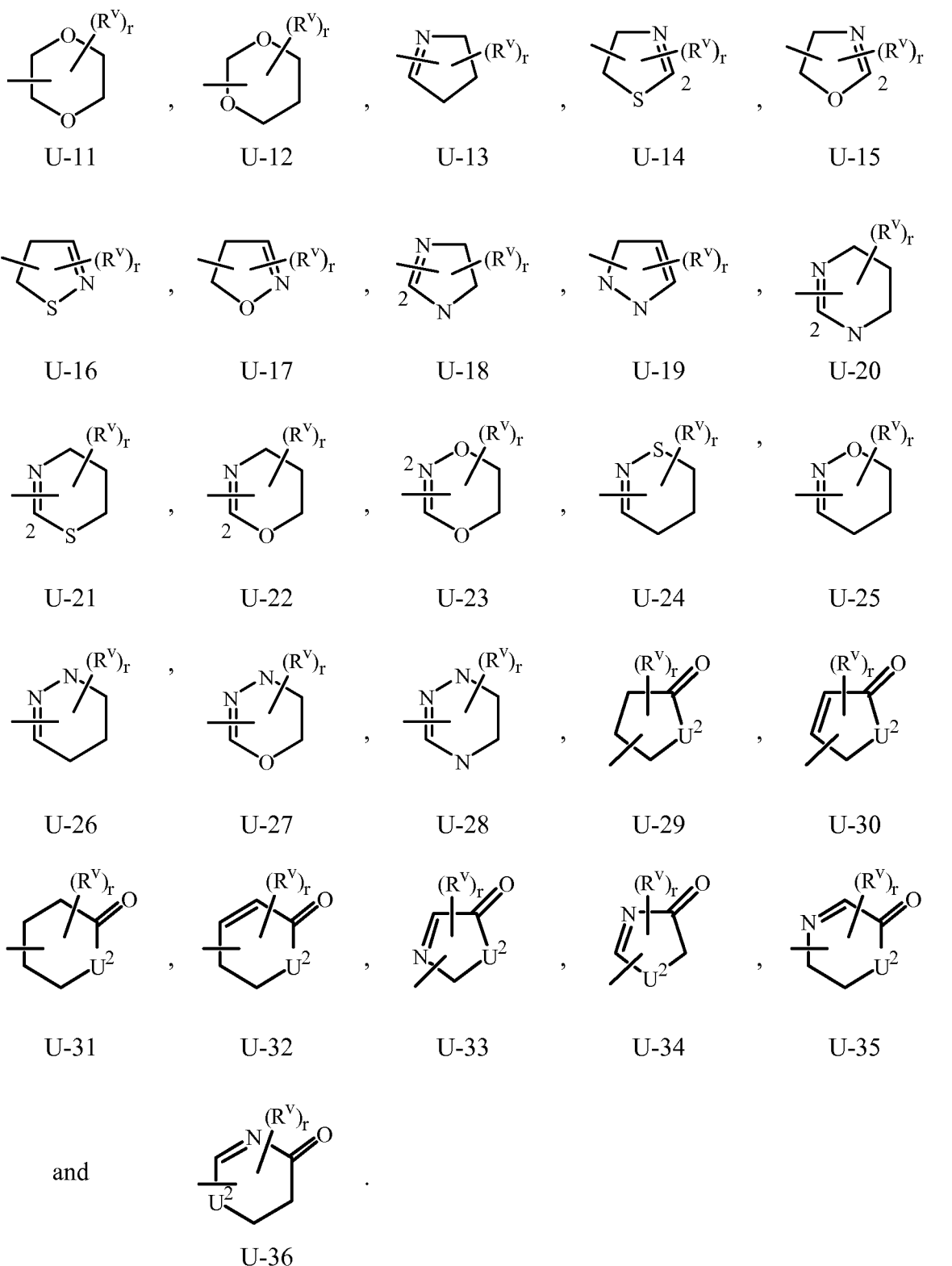
Examples of a 5- or 6-membered non-aromatic heterocyclic ring include the rings U-1 through U-36 as illustrated in Exhibit 2. Note that when the attachment point on the U group is illustrated as floating, the U group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the U group by replacement of a hydrogen atom. The optional substituents corresponding to R^V can be attached to any available carbon or nitrogen by replacing a hydrogen atom. For these U rings, r is an integer from 0 to 5, more typically 0 to 4, limited by the number of available positions on each U group.

Note that when G comprises a ring selected from U-29 through U-36, U^2 is selected from O, S or N. Note that when U^2 is N, the nitrogen atom can complete its valence by substitution with either H or the substituents corresponding to R^V as defined in the Summary of the Invention for U (i.e. R^{21} or R^{22}).

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Exhibit 2

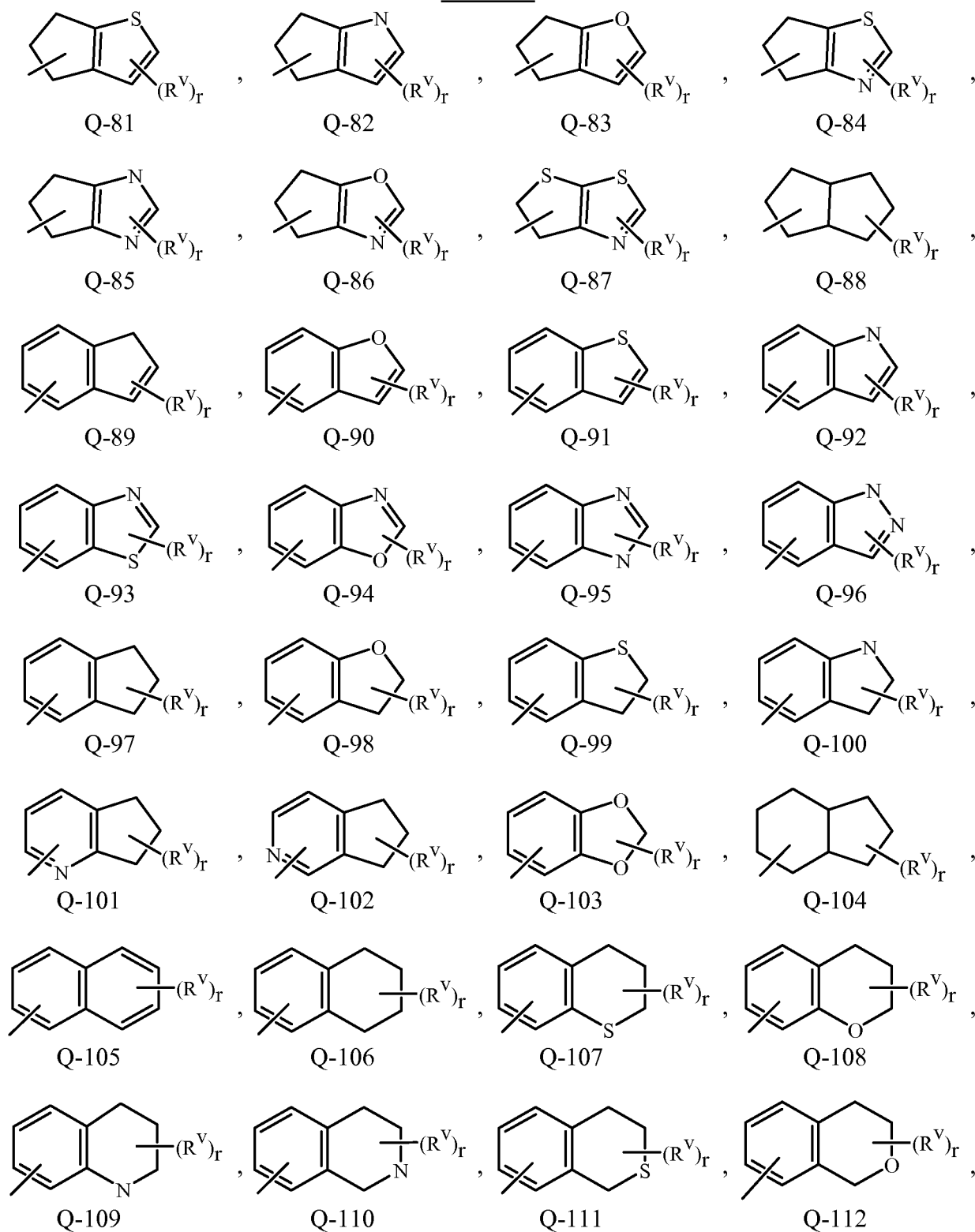


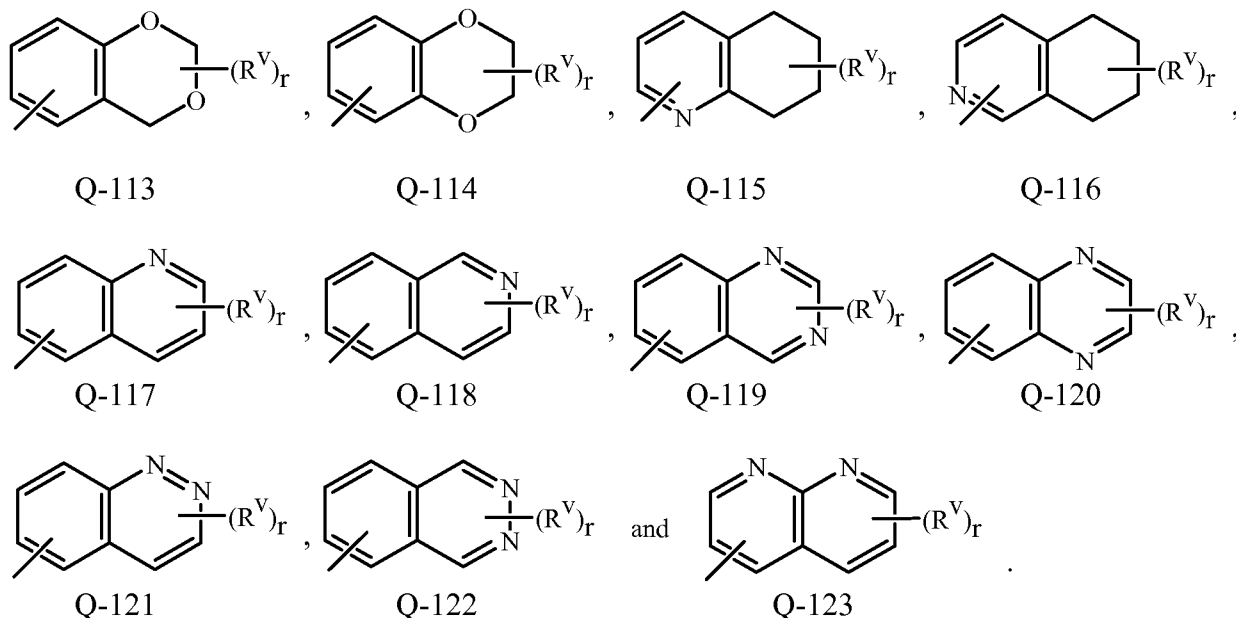


As noted above, G can be (among others) an 8-, 9- or 10-membered fused bicyclic ring system optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention (i.e. R^{21} or R^{22}). Examples of an 8-, 9- or 10-membered fused bicyclic ring system optionally substituted with from one or more substituents include the rings Q-81 through Q-123 illustrated in Exhibit 3 wherein R^v

is any substituent as defined in the Summary of the Invention for G (i.e. R²¹ or R²²), and r is an integer from 0 to 5, more typically 0 to 4.

Exhibit 3





Although R^V groups are shown in the structures Q-1 through Q-60 and Q-81 through Q-123, it is noted that they do not need to be present since they are optional substituents. The nitrogen atoms that require substitution to fill their valence are substituted with H or R^V . Note that when the attachment point between $(R^V)_r$ and the Q group is illustrated as floating, $(R^V)_r$ can be attached to any available carbon atom or nitrogen atom of the Q group. Note that when the attachment point on the Q group is illustrated as floating, the Q group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the Q group by replacement of a hydrogen atom. Note that some Q groups can only be substituted with less than 4 R^V groups (e.g., Q-1 through Q-5, Q-7 through Q-48, and Q-52 through Q-60).

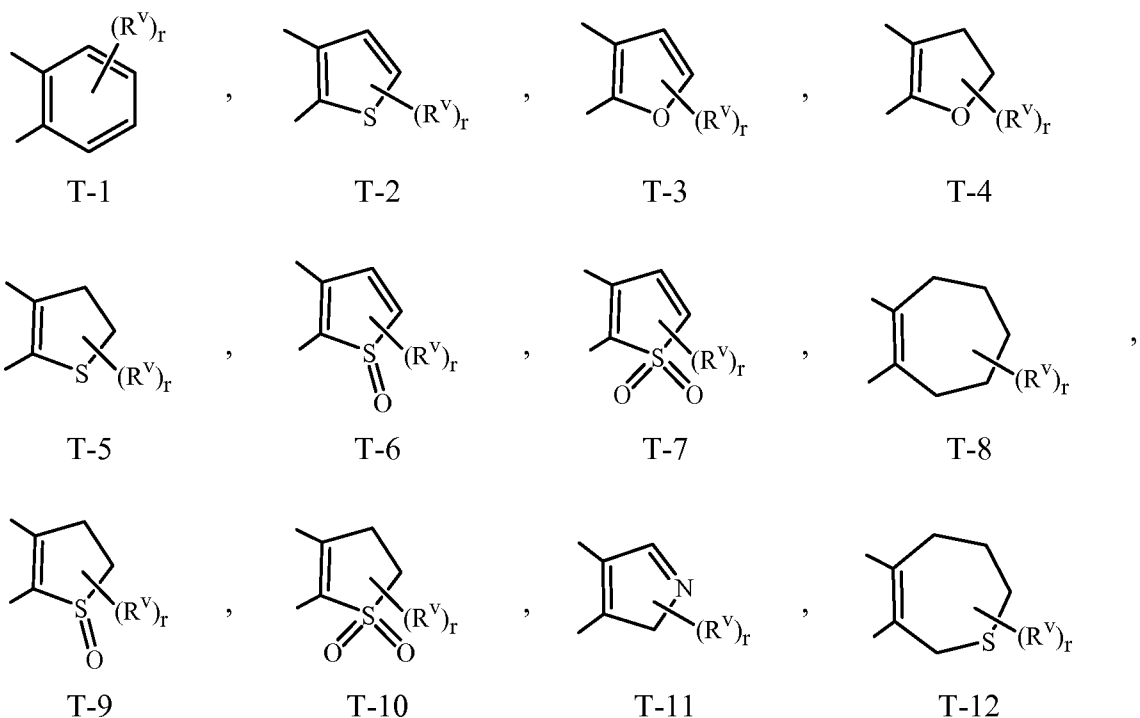
As noted in the Summary of the Invention, besides the possibility of R^1 and R^2 being separate substituents, they may also be taken together along with the atoms to which they are attached to form a 5-, 6- or 7-membered partially unsaturated or fully unsaturated ring fused to the pyridazinone ring. The fused ring includes as ring members the two atoms shared with the pyridazinone ring to which the R^1 and R^2 substituents are attached. The other 3, 4 or 5 ring members of the fused ring are provided by the R^1 and R^2 substituents taken together. These other ring members, up to 5 allowed by ring size, include carbon atoms and optionally up to 2 nitrogen atoms, up to 2 oxygen atoms and up to 2 sulfur atoms; or up to 2 ring members are selected from $C(=O)$ -, $-S(=O)$ - and $-S(=O)_2$ -. The fused ring is optionally substituted on carbon atom ring members and on nitrogen atom ring members with groups as defined in the Summary of the Invention. Typically the total number of said substituents selected does not exceed 3.

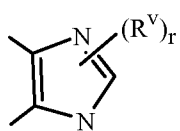
Exhibit 4 provides, as illustrative examples, fused rings formed by R^1 and R^2 taken together. As these rings are fused with the pyridazinone ring of Formula 1, a portion of the pyridazinone ring is shown and the truncated lines represent the ring bonds of the

pyridazinone ring. The rings depicted are fused to the two adjacent carbon atoms of the pyridazinone ring. The optional substituents $(R^V)_r$ on carbon atom ring members (e.g. selected from halogen, cyano, C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_1 - C_6 haloalkyl, C_3 - C_8 cycloalkyl and C_2 - C_8 alkoxyalkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C_1 - C_6 alkyl, C_1 - C_6 alkoxy and C_1 - C_6 haloalkoxy) and on nitrogen atom ring members (H and C_1 - C_6 alkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C_1 - C_6 alkyl, C_1 - C_6 alkoxy and C_1 - C_6 haloalkoxy) are selected from groups as defined in the Summary of the Invention. Substituents are limited by the number of available positions on each T-ring.

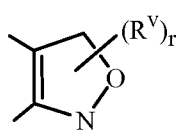
When the attachment point between $(R^V)_r$ and the T-ring is illustrated as floating, R^V may be bonded to any available T-ring carbon or nitrogen atom. One skilled in the art recognizes that while r is nominally an integer from 0 to 3, some of the rings shown in Exhibit 4 have less than 3 available positions, and for these groups r is limited to the number of available positions. When “ r ” is 0 this means the ring is unsubstituted and hydrogen atoms are present at all available positions. If r is 0 and $(R^V)_r$ is shown attached to a particular atom, then hydrogen is attached to that atom. The nitrogen atoms that require substitution to fill their valence are substituted with H or R^V . Furthermore, one skilled in the art recognizes that some of the rings shown in Exhibit 4 can form tautomers, and the particular tautomer depicted is representative of all the possible tautomers.

Exhibit 4

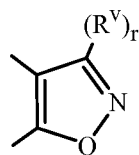




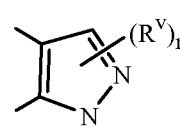
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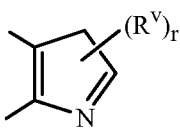
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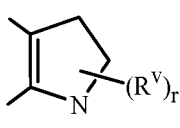
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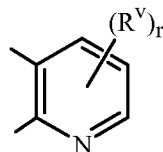
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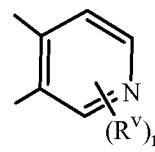
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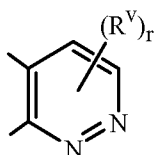
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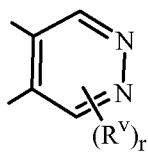
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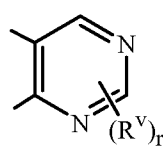
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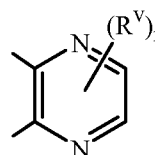
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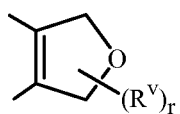
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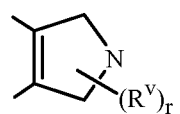
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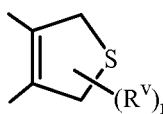
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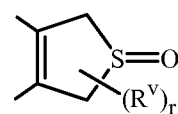
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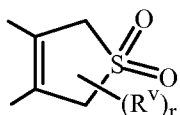
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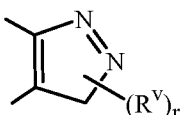
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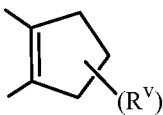
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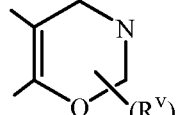
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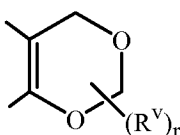
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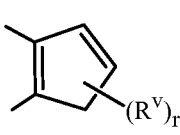
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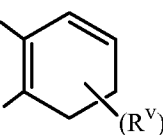
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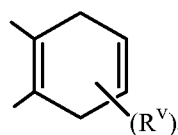
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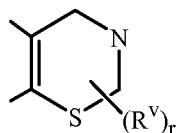
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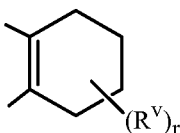
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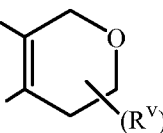
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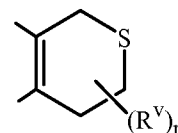
T-37



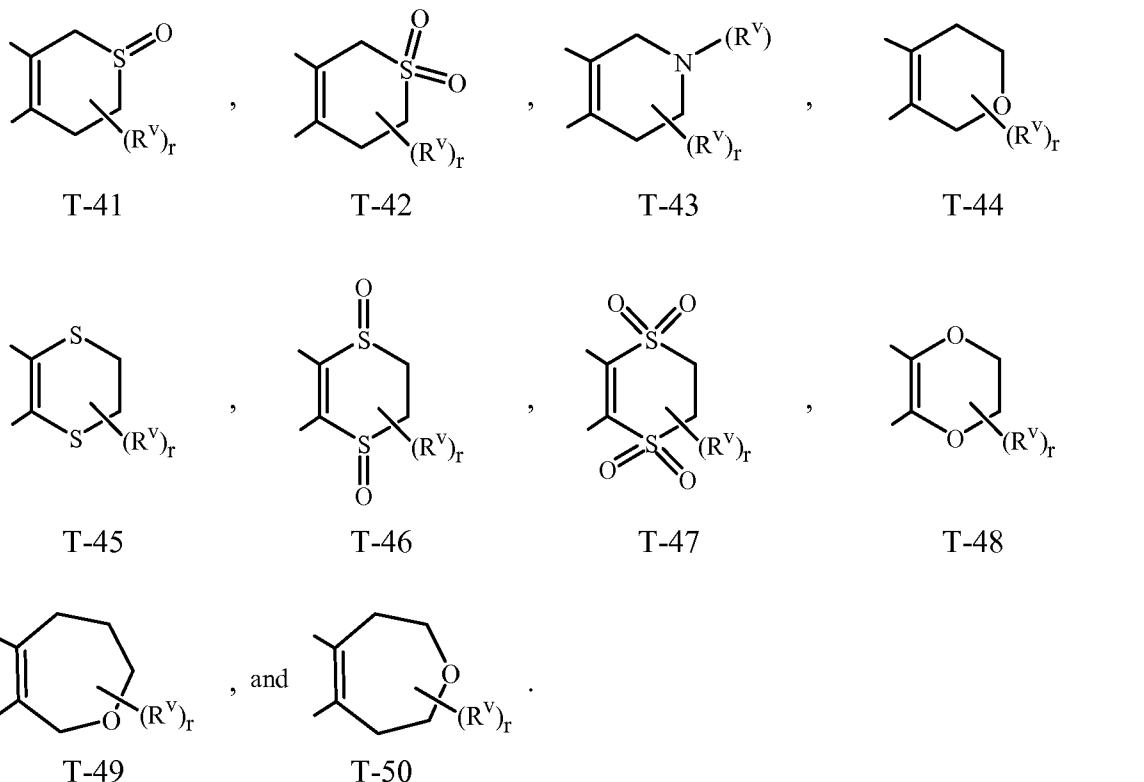
T-38



T-39



T-40



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

Compounds of this invention can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. The compounds of the invention may be present as a mixture of stereoisomers, individual stereoisomers or as an optically active form.

One skilled in the art will recognize that many of the compounds of the invention as well as intermediate compounds for their preparation can exist in the form of multiple tautomers. For example, when a compound of Formula 1 is identified by A being A-1, A-2 or A-3, and the R^{3A} variable being hydroxy or O^-M^+ , then said compound of Formula 1 can exist as a “triketone” tautomer or a “di-keto enol” tautomer, or a combination thereof. Likewise, when a compound of Formula 1 is identified by A being A-1, A-2 or A-3, and the R^{3A} variable being -SH, then said compound of Formula 1 can exist as a “di-keto thioketo”

tautomer, a “di-keto thioenol” tautomer or a “keto thioketo enol” tautomer, or a combination thereof. Furthermore, acyclic enols (e.g., the fragment A-7 in the definition of the variable A) can exist as tautomers having *E* and *Z* configurations. In the context of the present invention, tautomers represent functionally equivalent species, and identification of a compound by one tautomer is to be considered reference to all possible tautomers of the compound unless otherwise indicated.

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

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 *tert*-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
5 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
10 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
15 contains an acidic moiety such as a carboxylic acid or phenol, salts also include those formed with organic or inorganic bases such as pyridine, triethylamine or ammonia, or amides, hydrides, hydroxides or carbonates of sodium, potassium, lithium, calcium, magnesium or barium. Accordingly, the present invention comprises compounds selected from Formula 1, *N*-oxides and agriculturally suitable salts thereof.

20 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 (including all stereoisomers), *N*-oxides, and salts thereof, agricultural compositions containing them and their use as
25 herbicides as described in the Summary of the Invention.

Embodiment 2. A compound of Embodiment 1 wherein A is A-1, A-3, A-5 or A-6.

Embodiment 3. A compound of Embodiment 2 wherein A is A-1, A-3 or A-5.

Embodiment 4. A compound of Embodiment 3 wherein A is A-1 or A-3.

Embodiment 5. A compound of Embodiment 4 wherein A is A-1.

30 Embodiment 6. A compound of Embodiment 4 wherein A is A-3.

Embodiment 7. A compound of any one of Embodiments 1 through 5 wherein A is other than A-1.

Embodiment 8. A compound of any one of Embodiments 1 through 7 wherein B¹ is C-1.

35 Embodiment 9. A compound of any one of Embodiments 1 through 7 wherein B¹ is C-2.

Embodiment 10. A compound of any one of Embodiments 1 through 9 wherein B² is C-3.

Embodiment 11. A compound of any one of Embodiments 1 through 9 wherein B² is C-4.

Embodiment 12. A compound of any one of Embodiments 1 through 11 wherein B³ is C-1.

5 Embodiment 13. A compound of any one of Embodiments 1 through 11 wherein B³ is C-2.

Embodiment 14. A compound of any one of Embodiments 1 through 13 wherein R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₂-C₆ alkenyloxy, C₃-C₈ haloalkenyloxy, C₃-C₇ alkynyloxy, C₂-C₆ alkoxyalkoxy, C₂-C₆ cyanoalkoxy, C₂-C₆ alkylthioalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio, C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, (R^A)(R^B)N-, (R^A)(R^B)NSO₂-, R^CSO₂N(R^D)-, nitro or cyano.

10 Embodiment 15. A compound of Embodiment 14 wherein R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₆ alkenyloxy.

Embodiment 16. A compound of Embodiment 15 wherein R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy or C₁-C₆ haloalkoxy.

20 Embodiment 17. A compound of Embodiment 16 wherein R¹ is chloro, methyl, methoxy or trifluoromethyl.

Embodiment 18. A compound of Embodiment 17 wherein R¹ is methyl.

Embodiment 18A. A compound of Embodiment 17 wherein R¹ is chloro or methyl.

Embodiment 19. A compound of any one of Embodiments 1 through 14 wherein each R^A is independently C₁-C₄ alkyl.

25 Embodiment 20. A compound of any one of Embodiments 1 through 14 wherein each R^B is independently C₁-C₄ alkyl.

Embodiment 21. A compound of any one of Embodiments 1 through 14 wherein R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 6-membered ring including ring members selected from -CH₂- and -O-.

30 Embodiment 22. A compound of Embodiment 21 wherein R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 6-membered ring including ring members selected from 4 -CH₂- and 1 -O- (i.e. a morpholine moiety).

35 Embodiment 23. A compound of Embodiment 21 wherein R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 6-membered ring including ring members selected from 5 -CH₂- (i.e. a piperidine ring).

Embodiment 24. A compound of any one of Embodiments 1 through 14 wherein R^C is C₁-C₄ alkyl.

Embodiment 25. A compound of any one of Embodiments 1 through 14 wherein R^D is C₁ alkylene (i.e. -CH₂-).

Embodiment 26. A compound of any one of Embodiments 1 through 25 wherein R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or H, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -SF₅, -NHCHO, -NHNH₂, -NHOH, -NHCN, -NHC(=O)NH₂, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₃-C₁₀ alkoxyalkenyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₆ alkylthioalkoxy, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylaminoalkyl, C₃-C₁₀ dialkylaminoalkyl, C₂-C₈ haloalkylaminoalkyl, C₄-C₁₀ cycloalkylaminoalkyl, C₂-C₈ alkylcarbonyl, C₂-C₈ haloalkylcarbonyl, C₄-C₁₀ cycloalkylcarbonyl, C₂-C₈ alkoxycarbonyl, C₄-C₁₀ cycloalkoxycarbonyl, C₅-C₁₂ cycloalkylalkoxycarbonyl, C₂-C₈ alkylaminocarbonyl, C₃-C₁₀ dialkylaminocarbonyl, C₄-C₁₀ cycloalkylaminocarbonyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, C₃-C₁₀ alkoxyalkylcarbonyl, C₃-C₁₀ alkoxycarbonylalkyl, C₂-C₈ haloalkoxycarbonyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy or C₂-C₈ alkoxyalkoxy.

Embodiment 27. A compound of Embodiment 26 wherein R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₈ alkoxyalkoxy.

Embodiment 28. A compound of Embodiment 27 wherein R² is phenyl optionally substituted with up to five substituents selected from R²¹; or C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₈ alkoxyalkoxy.

Embodiment 28A. A compound of Embodiment 27 wherein R² is C₁-C₆ alkyl, C₃-C₈ cycloalkyl or C₁-C₆ haloalkoxy.

Embodiment 28B. A compound of Embodiment 28A wherein R² is *n*-propyl, *c*-hexyl or -OCH₂CH₂CF₃.

Embodiment 28C. A compound of Embodiment 28B wherein R² is *c*-hexyl.

Embodiment 29. A compound of Embodiment 28 wherein R² is phenyl; or C₁-C₆ alkyl.

Embodiment 30. A compound of Embodiment 29 wherein R² is phenyl; or *n*-propyl.

Embodiment 31. A compound of any one of Embodiments 1 through 13 wherein R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and up to 2 oxygen atoms, 2 sulfur atoms or up to two -S(O)₂- groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl and C₂-C₈ alkoxyalkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy.

Embodiment 32. A compound of Embodiment 31 wherein R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and 2 oxygen atoms, 2 sulfur atoms or two -S(O)₂- groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano and C₁-C₆ alkyl.

Embodiment 33. A compound of Embodiment 32 wherein R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and two -S(O)₂- groups, the ring optionally substituted on carbon atom ring members selected from halogen and C₁-C₆ alkyl.

Embodiment 34. A compound of any one of Embodiments 1 through 33 wherein W¹ is -CH₂-, -CH=CH- or -CH₂O-.

Embodiment 35. A compound of Embodiment 34 wherein W¹ is -CH₂-.

Embodiment 36. A compound of any one of Embodiments 1 through 33 wherein W² is -CH₂- or -CH₂O-.

Embodiment 37. A compound of any one of Embodiments 1 through 36 wherein R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ halocycloalkyl, C₁-C₄ cyanoalkyl, C₂-C₆ alkoxyalkyl or C₃-C₆ alkoxycarbonylalkyl.

Embodiment 38. A compound of Embodiment 37 wherein R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl or C₃-C₆ alkoxycarbonylalkyl.

Embodiment 39. A compound of Embodiment 38 wherein R^3 is C_1 - C_4 alkyl or C_3 - C_8 cycloalkyl.

Embodiment 40. A compound of Embodiment 39 wherein R^3 is methyl or cyclopropyl.

5 Embodiment 41. A compound of Embodiment 40 wherein R^3 is methyl.

Embodiment 42. A compound of any one of Embodiments 1 through 41 wherein R^{3A} is H, hydroxy, $-O-M^+$, C_2 - C_8 alkylcarbonyloxy, C_2 - C_8 haloalkylcarbonyloxy, C_4 - C_{10} cycloalkylcarbonyloxy or C_3 - C_{10} alkylcarbonylalkoxy; or benzyloxy, phenyloxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy or

10 benzylsulfonyloxy, each optionally substituted on ring members with up to two substituents selected from R^{21} .

Embodiment 43. A compound of Embodiment 42 wherein R^{3A} is hydroxy, $-O-M^+$ or C_2 - C_8 alkylcarbonyloxy; or phenylsulfonyloxy optionally substituted with up to two substituents selected from R^{21} .

15 Embodiment 44. A compound of Embodiment 43 wherein R^{3A} is hydroxy or C_2 - C_8 alkylcarbonyloxy.

Embodiment 45. A compound of Embodiment 44 wherein R^{3A} is hydroxy or $-OC(=O)CH_2CH(CH_3)_2$.

20 Embodiment 46. A compound of Embodiment 43 wherein M^+ is a sodium or potassium metal cation.

Embodiment 47. A compound of any one of Embodiments 1, 2, 3, 7 and 14 through 46 wherein R^9 is C_1 - C_6 alkyl.

Embodiment 48. A compound of Embodiment 47 wherein R^9 is ethyl.

25 Embodiment 49. A compound of any one of Embodiments 1, 2, 3 7 and 14 through 48 wherein R^{10} is H, halogen or C_1 - C_6 alkyl.

Embodiment 50. A compound of Embodiment 49 wherein R^{10} is H or methyl.

Embodiment 51. A compound of Embodiment 50 wherein R^{10} is methyl.

Embodiment 52. A compound any one of Embodiments 1, 2 and 14 through 46 wherein R^{11} is H or C_1 - C_6 alkyl.

30 Embodiment 53. A compound of any one of Embodiments 1 through 52 wherein when instances of R^{14} and R^{18} are taken alone (i.e. R^{14} and R^{18} are not taken together as alkylene or alkenylene), then independently said instances of R^{14} and R^{18} are H or C_1 - C_6 alkyl.

35 Embodiment 54. A compound of Embodiment 53 wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of each R^{14} and R^{18} are H or methyl.

Embodiment 55. A compound of Embodiment 54 wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of R^{14} and R^{18} are H.

Embodiment 56. A compound any one of Embodiments 1 through 55 wherein when instances of R^{14} and R^{18} are taken together, then said instances of R^{14} and R^{18} are taken together as $-\text{CH}_2\text{CH}_2\text{CH}_2-$ or $-\text{CH}=\text{CHCH}_2-$.

Embodiment 57. A compound of any one of Embodiments 1 through 55 wherein all instances of R^{14} and R^{18} are taken alone.

Embodiment 58. A compound of any one of Embodiments 1 through 55 wherein independently each R^{15} and R^{19} is H or $\text{C}_1\text{-C}_6$ alkyl.

Embodiment 59. A compound of Embodiment 58 wherein independently each R^{15} and R^{19} is H or methyl.

Embodiment 60. A compound of Embodiment 59 wherein independently each R^{15} and R^{19} is H.

Embodiment 61. A compound of Embodiment 57 and 59 wherein each R^{14} , R^{15} , R^{18} and R^{19} is H or methyl.

Embodiment 62. A compound of Embodiment 61 wherein each R^{14} , R^{15} , R^{18} and R^{19} is H.

Embodiment 63. A compound of any one of Embodiments 1 through 62 wherein R^{20} is H, $\text{C}_1\text{-C}_6$ alkyl, $\text{C}_2\text{-C}_6$ alkenyl or $\text{C}_3\text{-C}_8$ cycloalkyl.

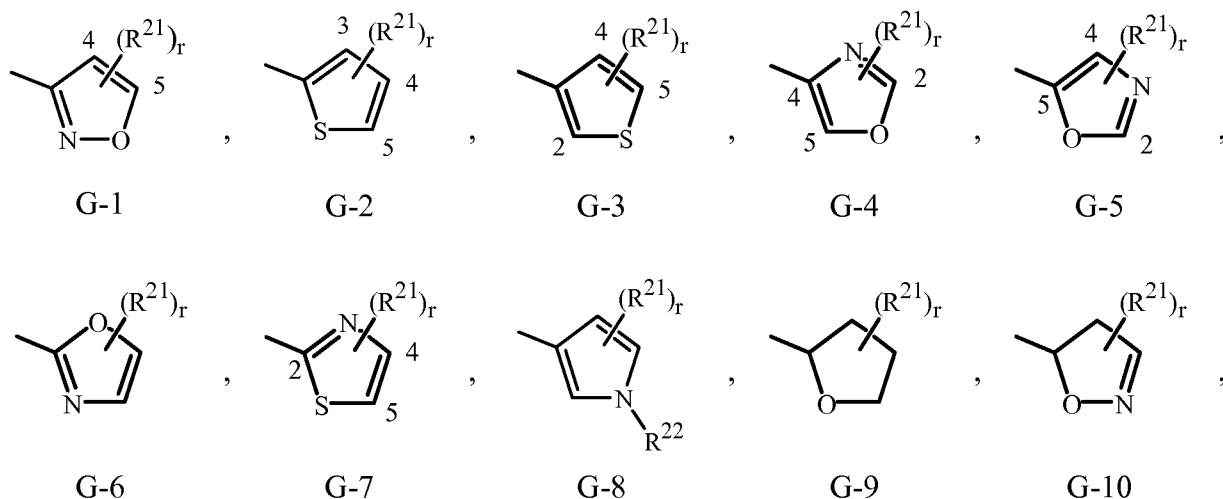
Embodiment 64. A compound of Embodiment 63 wherein R^{20} is H or CH_3 .

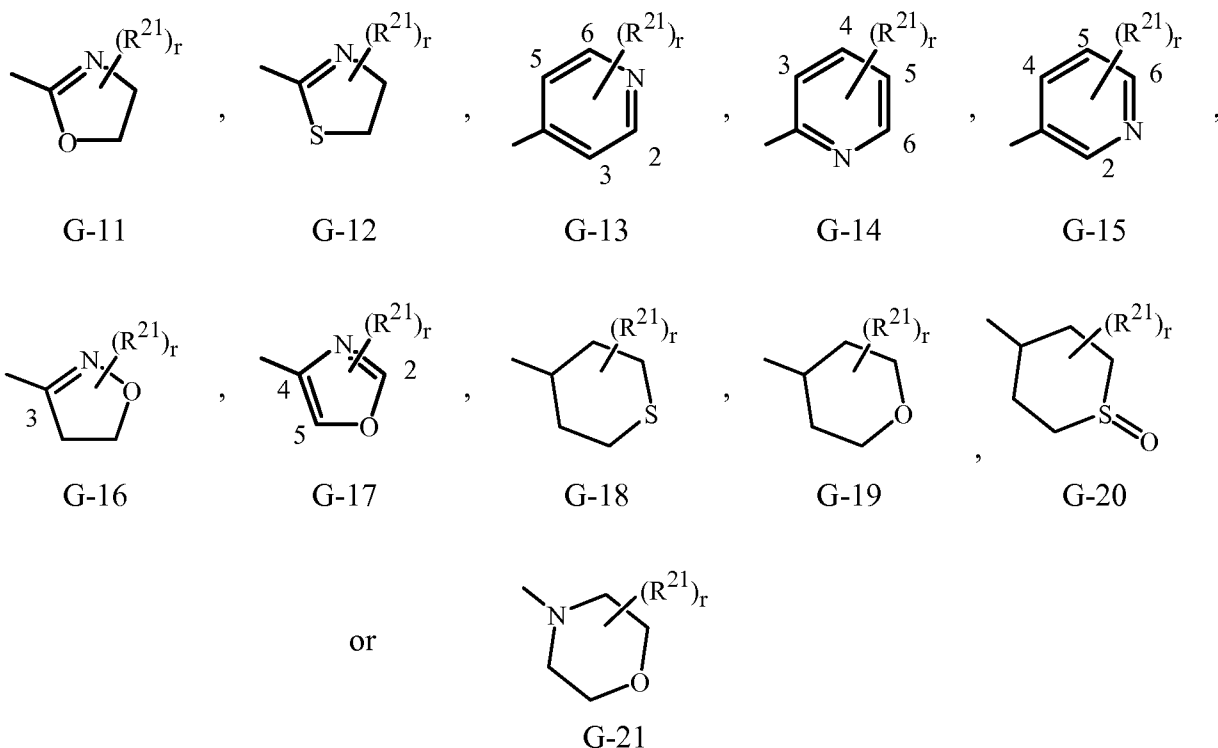
Embodiment 65. A compound of any one of Embodiments 1, 2, 3, 4, 6, 10, 11 and 14 through 64 wherein T is $-\text{CH}_2\text{CH}_2-$ or $-\text{CH}=\text{CH}-$.

Embodiment 66. A compound of Embodiment 65 wherein T is $-\text{CH}_2\text{CH}_2-$.

Embodiment 67. A compound of any one of Embodiments 1 through 27 and 31 through 66 wherein each G is independently a 5- or 6-membered heterocyclic ring optionally substituted with up to five substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

Embodiment 68. A compound of Embodiment 67 wherein G is





r is 0, 1, 2 or 3.

Embodiment 69. A compound of Embodiment 68 wherein G is G-2, G-3, G-9 or G-15.

Embodiment 70. A compound of Embodiment 69 wherein G is G-2, G-3 or G-15.

Embodiment 71. A compound of Embodiment 70 wherein G is G-2 or G-3.

Embodiment 72. A compound of Embodiment 71 wherein G is G-2.

Embodiment 73. A compound of Embodiment 70 wherein G is G-3.

Embodiment 73A. A compound of Embodiment 68 wherein G is G-21.

Embodiment 73B. A compound of Embodiment 68 wherein G is other than G-21.

Embodiment 74. A compound of any one of Embodiments 68 through 73 wherein r is 0, 1 or 2.

Embodiment 75. A compound Embodiment 74 wherein r is 0 or 1.

Embodiment 76. A compound any one of Embodiments 1 through 75 wherein each

R^{21} is independently halogen, cyano, hydroxy, nitro, -CHO, -SH, C_1 - C_6 alkyl,

C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_1 - C_6 haloalkyl, C_2 - C_6 haloalkenyl, C_2 - C_6

haloalkynyl, C_3 - C_8 cycloalkyl, C_3 - C_8 halocycloalkyl, C_4 - C_{10} alkylcycloalkyl,

C_4 - C_{10} cycloalkylalkyl, C_3 - C_8 cycloalkenyl, C_3 - C_8 halocycloalkenyl, C_2 - C_8

alkoxyalkyl, C_4 - C_{10} cycloalkoxyalkyl, C_3 - C_{10} alkoxyalkoxyalkyl, C_2 - C_8

alkylthioalkyl, C_2 - C_8 alkylsulfanylalkyl, C_2 - C_8 alkoxyhaloalkyl, C_2 - C_5

cyanoalkyl, C_1 - C_6 hydroxyalkyl, C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy, C_3 - C_8

cycloalkoxy, C_3 - C_8 halocycloalkoxy, C_4 - C_{10} cycloalkylalkoxy, C_2 - C_6

alkenyloxy, C_2 - C_6 haloalkenyloxy, C_2 - C_8 alkoxyalkoxy, C_2 - C_8

alkylcarbonyloxy, C_1 - C_6 alkylthio, C_1 - C_6 haloalkylthio, C_3 - C_8 cycloalkylthio,

C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl or C₃-C₈ cycloalkylsulfonyl.

Embodiment 77. A compound of Embodiment 76 wherein each R²¹ is independently halogen, nitro, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₁-C₆ alkylthio.

Embodiment 78. A compound of Embodiment 77 wherein each R²¹ is independently fluorine, chlorine, bromine, methyl, trifluoromethyl, methoxy, trifluoromethoxy or thiomethoxy.

Embodiment 79. A compound of Embodiments 1 through 78 wherein each R²² is independently C₁-C₆ alkyl or C₁-C₆ haloalkyl.

Embodiment 80. A compound of Embodiment 79 wherein each R²² is independently methyl or -CH₂CF₃.

Embodiments of the present invention as described in the Summary of the Invention and any of Embodiments 1 through 80 can be combined in any way, 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. Combined Embodiments from above can be illustrated as:

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

A is A-1, A-3, A-5 or A-6;

R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₂-C₆ alkenyloxy, C₃-C₈ haloalkenyloxy, C₃-C₇ alkynyloxy, C₂-C₆ alkoxyalkoxy, C₂-C₆ cyanoalkoxy, C₂-C₆ alkylthioalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio, C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, (R^A)(R^B)N-, (R^A)(R^B)NSO₂-, R^CSO₂N(R^D)-, nitro or cyano;

each R^A is independently C₁-C₄ alkyl;

each R^B is independently C₁-C₄ alkyl;

R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 6-membered ring including ring members selected from -CH₂- and -O-;

R^C is C₁-C₄ alkyl;

R^D is C₁ alkylene;

R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or H, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -SF₅, -NHCHO, -NHNH₂, -NHOH, -NHCN, -NHC(=O)NH₂, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆

alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈
 cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀
 cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl,
 C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl,
 C₂-C₈ alkoxyalkyl, C₃-C₁₀ alkoxyalkenyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀
 alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₆ alkylthioalkoxy, C₂-C₈
 alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylaminoalkyl, C₃-C₁₀
 dialkylaminoalkyl, C₂-C₈ haloalkylaminoalkyl, C₄-C₁₀ cycloalkylaminoalkyl,
 C₂-C₈ alkylcarbonyl, C₂-C₈ haloalkylcarbonyl, C₄-C₁₀ cycloalkylcarbonyl,
 C₂-C₈ alkoxycarbonyl, C₄-C₁₀ cycloalkoxycarbonyl, C₅-C₁₂
 cycloalkylalkoxycarbonyl, C₂-C₈ alkylaminocarbonyl, C₃-C₁₀
 dialkylaminocarbonyl, C₄-C₁₀ cycloalkylaminocarbonyl, C₂-C₅ cyanoalkyl,
 C₁-C₆ hydroxyalkyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈
 alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl,
 C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀
 dialkoxyalkyl, C₃-C₁₀ alkoxyalkylcarbonyl, C₃-C₁₀ alkoxycarbonylalkyl, C₂-C₈
 haloalkoxycarbonyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy,
 C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆
 haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy or C₂-C₈
 alkoxyalkoxy; or

R¹ and R² are taken together with the atoms to which they are attached to form a
 6-membered partially unsaturated ring along with ring members consisting of
 carbon atoms and up to 2 oxygen atoms, 2 sulfur atoms or up to two -S(O)₂-
 groups, the ring optionally substituted on carbon atom ring members selected
 from halogen, cyano, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆
 haloalkyl, C₃-C₈ cycloalkyl and C₂-C₈ alkoxyalkyl; and phenyl optionally
 substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆
 alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy;

W¹ is -CH₂- -CH=CH- or -CH₂O-;

W² is -CH₂- or -CH₂O-;

R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₈
 cycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ halocycloalkyl, C₁-C₄ cyanoalkyl,
 C₂-C₆ alkoxyalkyl or C₃-C₆ alkoxycarbonylalkyl;

R^{3A} is H, hydroxy, -O-M⁺, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy,
 C₄-C₁₀ cycloalkylcarbonyloxy or C₃-C₁₀ alkylcarbonylalkoxy; or benzyloxy,
 phenyloxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy or
 benzylsulfonyloxy, each optionally substituted on ring members with up to two
 substituents selected from R²¹;

M⁺ is a sodium or potassium metal cation;

R⁹ is C₁-C₆ alkyl;

R¹⁰ is H, halogen or C₁-C₆ alkyl;

R¹¹ is H or C₁-C₆ alkyl;

R¹⁴ and R¹⁸ are H or C₁-C₆ alkyl; or

5 R¹⁴ and R¹⁸ are taken together as -CH₂CH₂CH₂- or -CH=CHCH₂-;

each R¹⁵ and R¹⁹ is H or C₁-C₆ alkyl;

R²⁰ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl or C₃-C₈ cycloalkyl;

T is -CH₂CH₂- or -CH=CH-;

10 G is independently a 5- or 6-membered heterocyclic ring optionally substituted with up to five substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members;

each R²¹ is independently halogen, cyano, hydroxy, nitro, -CHO, -SH, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, 15 C₄-C₁₀ cycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl or C₃-C₈ cycloalkylsulfonyl; and

each R²² is independently C₁-C₆ alkyl or C₁-C₆ haloalkyl.

25 Embodiment B. A compound of Embodiment A wherein

A is A-1, A-3 or A-5;

B¹ is C-1;

B² is C-3;

B³ is C-1;

30 R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₆ alkenyloxy;

R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₈ alkoxyalkoxy; or

35 R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and 2 oxygen atoms, 2 sulfur atoms or two -S(O)₂- groups, the ring

optionally substituted on carbon atom ring members selected from halogen,
cyano and C₁-C₆ alkyl;

W¹ is -CH₂-;

R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl or
C₃-C₆ alkoxy carbonylalkyl;

R^{3A} is hydroxy, -O-M⁺ or C₂-C₈ alkylcarbonyloxy; or phenylsulfonyloxy optionally
substituted with up to two substituents selected from R²¹;

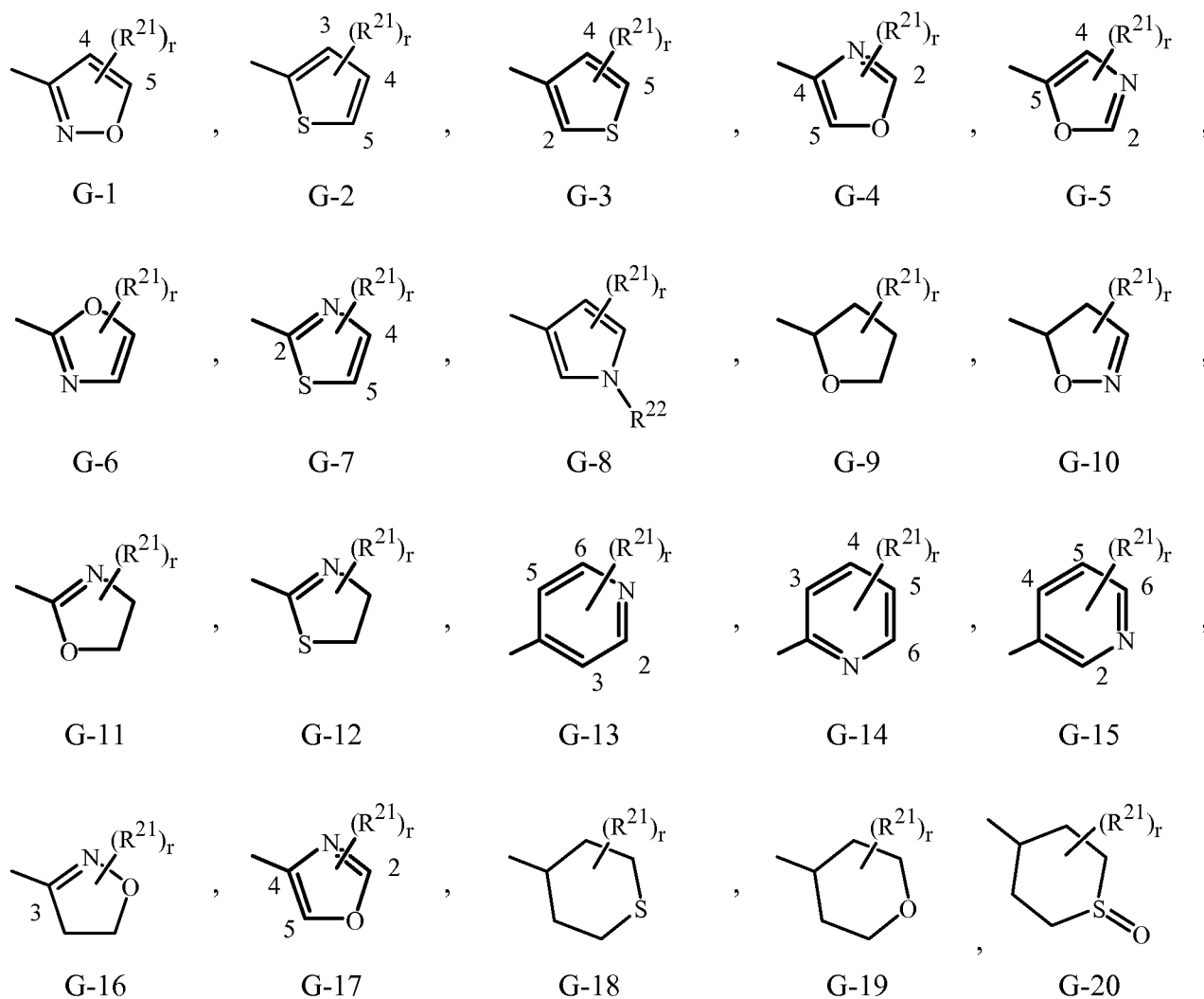
R⁹ is ethyl;

R¹⁰ is H or methyl;

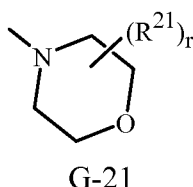
each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or methyl;

T is -CH₂CH₂-;

G is



or



r is 0, 1, 2 or 3;

each R^{21} is independently halogen, nitro, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy or C_1 - C_6 alkylthio; and

each R^{22} is independently methyl or $-CH_2CF_3$.

5 Embodiment C. A compound of Embodiment B wherein

A is A-1 or A-3;

R^1 is halogen, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkoxy or C_1 - C_6 haloalkoxy;

R^2 is phenyl optionally substituted with up to five substituents selected from R^{21} ; or

10 C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_3 - C_8 cycloalkyl, C_2 - C_8 alkoxyalkyl, C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy or C_2 - C_8 alkoxyalkoxy; or

R^1 and R^2 are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and two $-S(O)_2-$ groups, the ring optionally substituted on carbon atom ring members selected from halogen and C_1 - C_6 alkyl;

15 R^3 is C_1 - C_4 alkyl or C_3 - C_8 cycloalkyl;

R^{3A} is hydroxy or C_2 - C_8 alkylcarbonyloxy;

R^{10} is methyl;

each R^{14} , R^{15} , R^{18} and R^{19} is H; and

20 each R^{21} is independently fluorine, chlorine, bromine, methyl, trifluoromethyl, methoxy, trifluoromethoxy or thiomethoxy.

Embodiment D. A compound of Embodiment C wherein

A is A-1;

R^1 is chloro, methyl, methoxy or trifluoromethyl;

R^2 is phenyl; or C_1 - C_6 alkyl;

25 R^3 is methyl or cyclopropyl; and

R^{3A} is hydroxy or $-OC(=O)CH_2CH(CH_3)_2$.

Embodiment E. A compound of Embodiment D wherein

R^1 is methyl;

R^2 is phenyl; or n -propyl; and

30 R^3 is methyl.

Embodiment F. A compound of Embodiment C wherein

A is A-1;

R^1 is chloro or methyl;

R² is *n*-propyl, *c*-hexyl or -OCH₂CH₂CF₃;

R³ is methyl; and

R^{3A} is hydroxy or -OC(=O)CH₂CH(CH₃)₂.

Specific embodiments of the present invention include:

- 5 5-chloro-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-3(2*H*)-pyridazinone (Compound 1),
- 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-propyl-3(2*H*)-pyridazinone (Compound 2),
- 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-5-methoxy-2-methyl-4-phenyl-3(2*H*)-pyridazinone (Compound 3),
- 10 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-phenyl-3(2*H*)-pyridazinone (Compound 4) and
- 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-5-(trifluoromethyl)-3(2*H*)-pyridazinone (Compound 5).

- 15 Specific embodiments of the present invention also include a compound of Formula 1 wherein:

- A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is Cl; R² is *c*-hexyl; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H (Compound 22);
- A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is Cl; R² is *c*-propyl; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H (Compound 25); and
- 20 A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is CH₃; R² is -OCH₂CH₂CF₃; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H (Compound 37).

- This invention also relates to a method for controlling undesired vegetation comprising
- 25 applying to the locus of the vegetation a herbicidally effective amount of a compound 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.

- 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
- 30 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,
- 35 (b10) auxin transport inhibitors, (b11) phytoene desaturase (PDS) inhibitors, (b12) 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, (b13) homogentisate solanesyltransferase (HST) inhibitors, (b14) cellulose biosynthesis inhibitors, (b15) other herbicides including mitotic disruptors, organic arsenicals, asulam, difenzoquat, bromobutide, flurenol, cinmethylin, cumyluron, dazomet, dymron, methyl dymron,

etobenzanid, fosamine, fosamine-ammonium, metam, oxaziclomefone, oleic acid, 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, atrazine, cyanazine, desmetryne, dimethametryn, prometon, prometryne, propazine, simazine, simetryn, terbutometon, terbuthylazine, terbutryne, trietazine, hexazinone, metamitron, metribuzin, amicarbazone, bromacil, lenacil, terbacil, chloridazon, desmedipham, phenmedipham, chlorobromuron, chlorotoluron, chloroxuron, dimefuron, diuron, ethidimuron, fenuron, fluometuron, isoproturon, isouron, linuron, methabenzthiazuron, metobromuron, metoxuron, monolinuron, neburon, siduron, tebuthiuron, propanil, pentanochlor, bromofenoxim, bromoxynil, ioxynil, bentazon, pyridate and pyridafol.

“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 DNA synthesis and cell growth. Examples of AHAS inhibitors include amidosulfuron, azimsulfuron, bensulfuron-methyl, chlorimuron-ethyl, chlorsulfuron, cinosulfuron, cyclosulfamuron, ethametsulfuron-methyl, ethoxysulfuron, flazasulfuron, flupyrsulfuron-methyl (including sodium salt), foramsulfuron, halosulfuron-methyl, imazosulfuron, iodosulfuron-methyl (including sodium salt), mesosulfuron-methyl, metazosulfuron, metsulfuron-methyl, nicosulfuron, oxasulfuron, primisulfuron-methyl, propyrisulfuron, prosulfuron, pyrazosulfuron-ethyl, rimsulfuron, sulfometuron-methyl, sulfosulfuron, thifensulfuron-methyl, triasulfuron, tribenuron-methyl, trifloxysulfuron (including sodium salt), triflusulfuron-methyl, tritosulfuron, imazapic, imazamethabenz-methyl, imazamox, imazapyr, imazaquin, imazethapyr, cloransulam-methyl, diclosulam, florasulam, flumetsulam, metosulam, penoxsulam, bispyribac-sodium, pyribenzoxim, pyriftalid, pyriithiobac-sodium, pyriminobac-methyl, thienencarbazone, flucarbazone-sodium and propoxycarbazone-sodium.

“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

5 clodinafop, cyhalofop, diclofop, fenoxaprop, fluazifop, haloxyfop, propaquizafop, quizalofop, alloxydim, butroxydim, clethodim, cyclopyrimorate (6-chloro-3-(2-cyclopropyl-6-methylphenoxy)-4-pyridazinyl 4-morpholinecarboxylate), cycloxydim, pinoxaden, profoxydim, sethoxydim, tepraloxym and tralkoxydim, including resolved forms such as fenoxaprop-P, fluazifop-P, haloxyfop-P and quizalofop-P and ester forms such as

10 clodinafop-propargyl, cyhalofop-butyl, diclofop-methyl and fenoxaprop-P-ethyl.

Auxin is a plant hormone that regulates growth in many plant tissues. "Auxin mimics" (b4) are chemical compounds mimicking the plant growth hormone auxin, thus causing uncontrolled and disorganized growth leading to plant death in susceptible species. Examples of auxin mimics include aminocyclopyrachlor and its esters (e.g., methyl, ethyl)

15 and salts (e.g., sodium, potassium), aminopyralid benazolin-ethyl, chloramben, 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) and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), mecoprop, MCPA, MCPB, 2,3,6-TBA, picloram, triclopyr, quinclorac, quinmerac and amino-3-chloro-6-(4-chloro-2-fluoro-3-

20 methoxyphenyl)-2-pyridinecarboxylic acid.

"EPSP (5-enol-pyruvylshikimate-3-phosphate) 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

25 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 paraquat and diquat.

35 "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, bifenox, chlormethoxyfen, fluoroglycofen-ethyl, fomesafen, halosafen, lactofen, oxyfluorfen, fluazolate, pyraflufen-ethyl, cinidon-ethyl,

flumioxazin, flumiclorac-pentyl, fluthiacet-methyl, 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), thidiazimin, oxadiazon, oxadiargyl, saflufencil, azafenidin, carfentrazone carfentrazone-ethyl, sulfentrazone, pentoxazone, benzfendizone, butafenacil, pyraclonil, profluazol and flufenpyr-ethyl.

“GS (glutamine synthase) 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 and bilanaphos.

“VLCFA (very long chain fatty acid) 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, butachlor, dimethachlor, dimethanamid, metazachlor, metolachlor, pethoxamid, pretilachlor, propachlor, propisochlor, pyroxasulfone, thenylchlor, diphenamid, napropamide, naproanilide, fenoxasulfone, flufenacet, indanofan, mefenacet, fentrazamide, anilofos, cafenstrole, piperophos including resolved forms such as S-metolachlor and chloroacetamides and oxyacetamides.

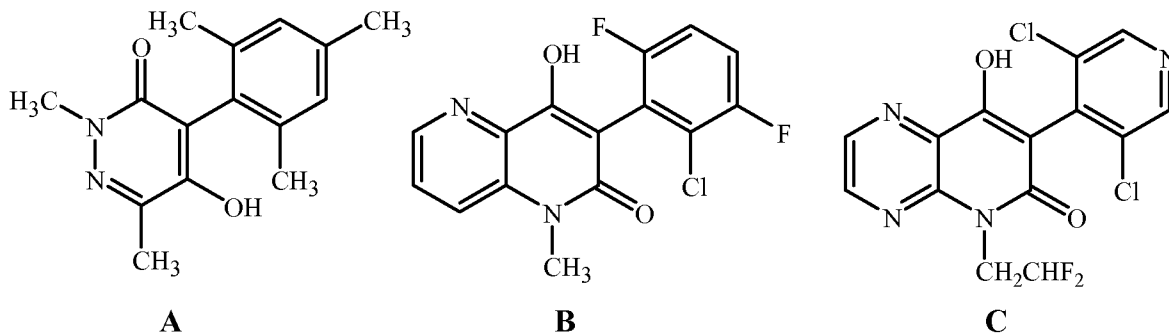
“Auxin transport inhibitors” (b10) are chemical substances that inhibit auxin transport in plants, such as by binding with an auxin-carrier protein. Examples of auxin transport inhibitors include naptalam (also known as *N*-(1-naphthyl)phthalamic acid and 2-[(1-naphthalenylamino)carbonyl]benzoic acid)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

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

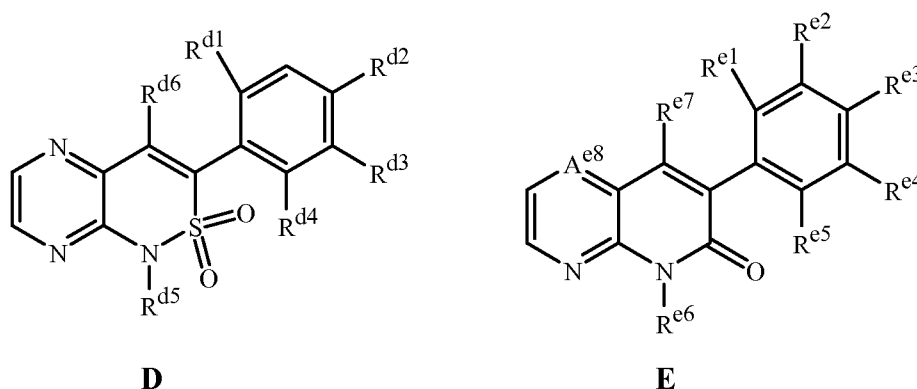
“HPPD (4-hydroxyphenyl-pyruvate dioxygenase) inhibitors” (b12) are chemical substances that inhibit the biosynthesis of synthesis of 4-hydroxyphenyl-pyruvate dioxygenase. Examples of HPPD inhibitors include fenquinotriene (2-[[8-chloro-3,4-dihydro-4-(4-methoxyphenyl)-3-oxo-2-quinoxaliny]carbonyl]-1,3-cyclohexanedione), mesotriene, sulcotriene, topramezone, tembotriene, tefuryltrione, isoxachlortole, isoxaflutole, benzofenap, pyrasulfatole, pyrazolynate, pyrazoxyfen, bicyclopyrone and benzobicyclon.

HST (homogentisate solanesyltransferase) inhibitors (b13) disrupt a plant's ability to convert homogentisate to 2-methyl-6-solanyl-1,4-benzoquinone, thereby disrupting

carotenoid biosynthesis. Examples of HST inhibitors include haloxydine, pyriclor and the compounds of Formulae **A**, **B** and **C**.



HST inhibitors also include compounds of Formulae **D** and **E**.



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

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Cellulose biosynthesis inhibitors (b14) inhibit the biosynthesis of cellulose in certain plants. They are most effective when using a pre-application or early post-application on young or rapidly growing plants. Examples of cellulose biosynthesis inhibitors include chlorthiamid, diclobenil, flupoxam, indaziflam, isoxaben and triaziflam.

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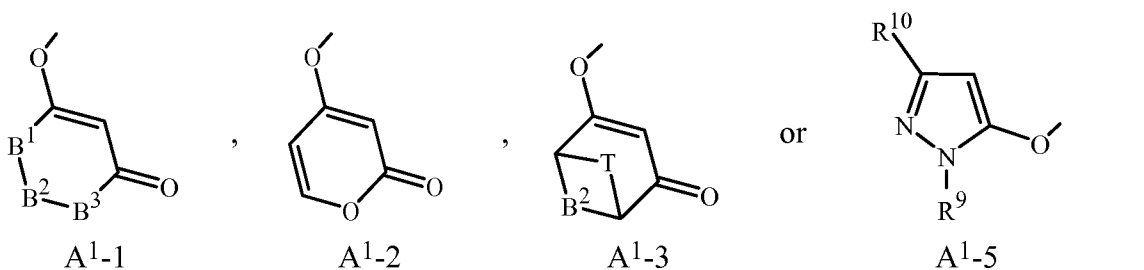
Other herbicides (b15) include herbicides that act through a variety of different modes of action such as mitotic disruptors (e.g., flumetrol-M-methyl and flumetrol-M-isopropyl) organic arsenicals (e.g., DSMA, and MSMA), 7,8-dihydropteroate synthase inhibitors, chloroplast isoprenoid synthesis inhibitors 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 acifluorfen, asulam, amitrole, clomezone, fluometuron, difenzoquat, bromobutide, flurenol, cinmethylin, cumyluron, dazomet, dymron, methyldymron, methiozolon, ipfencarbazone, etobenzanid, fosamine, fosamine-ammonium, metam, oxaziclomefone, oleic acid, pelargonic acid and pyributicarb.

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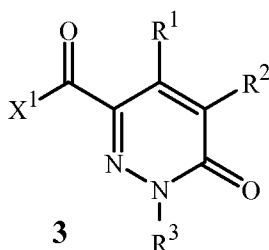
“Herbicide safeners” (b16) are substances added to a herbicide formulation to eliminate or reduce phytotoxic effects of the herbicide to certain crops. These compounds protect crops from injury by herbicides but typically do not prevent the herbicide from controlling undesired vegetation. Examples of herbicide safeners include but are not limited to allidochlor, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide, benoxacor, BCS (1-bromo-4-[(chloromethyl)sulfonyl]benzene), cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfamide, daimuron, dichlormid, 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), dicyclonon, dietholate, dimepiperate, ethyl 1,6-dihydro-1-(2-methoxyphenyl)-6-oxo-2-phenyl-5-pyrimidinecarboxylate, fenchlorazole-ethyl, fencloirim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone, naphthalic anhydride (1,8-naphthalic anhydride), oxabetrinil and 3-oxo-1-cyclohexen-1-yl 1-(3,4-dimethylphenyl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylate.

One or more of the following methods and variations as described in Schemes 1a–21 can be used to prepare the compounds of Formula 1. The definitions of A, B¹, B², B³, T, R¹, R², R³, R^{3A}, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, R¹² and R¹³ in the compounds of Formulae 1–21 below are as defined above in the Summary of the Invention unless otherwise noted. Formulae 1a–1g, 2a–2d, 3a, 4a–4d, and 13a–13e are various subsets of Formulae 1, 2, 3, 4 and 13, respectively. All substituents for Formulae 1a–1g are as defined above for Formula 1 unless otherwise noted.

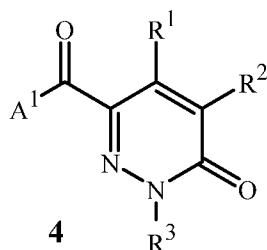
As described in further detail below, compounds of Formula 1 wherein A is A-1, A-2, A-3 or A-5 can be prepared by reacting a compound of Formula 2 which is A¹–H wherein A¹ is



with a compound of Formula 3



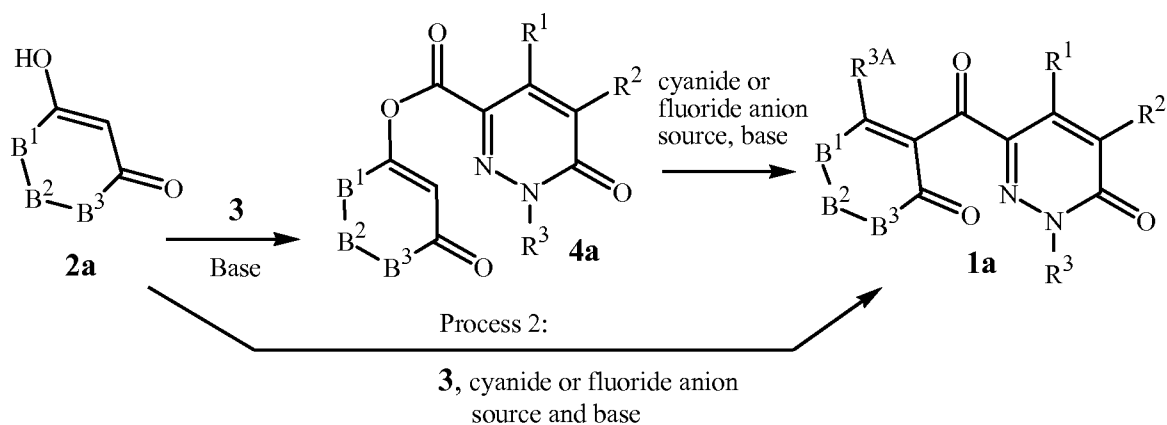
wherein X^1 is a nucleophilic reaction leaving group (i.e. nucleofuge), for example, a halogen, alkylcarbonyloxy, haloalkyloxy, haloalkoxycarbonyloxy, 1-pyridinyl or 1-imidazolyl group; in the presence of a base to form a compound of Formula 4,



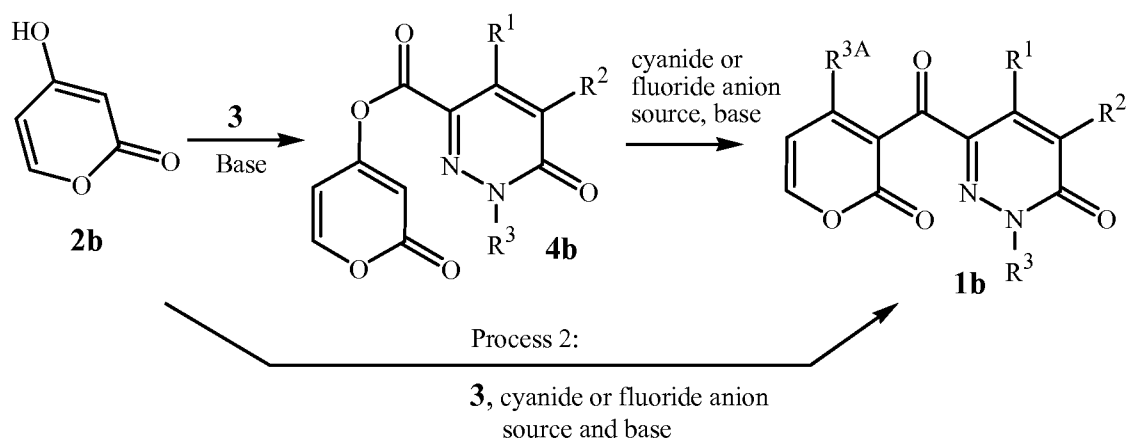
5 which, in the presence of a cyanide or fluoride ion source and base is rearranged to form the corresponding compound of Formula 1.

Thus compounds of Formula **1a**, **1b**, **1c** or **1d** (i.e. Formula 1 in which A is A-1, A-2, A-3 or A-5, respectively) wherein R^{3A} is hydroxy can be prepared via the two-step process shown in Schemes 1a, 1b, 1c and 1d, respectively. Intermediate compounds of Formula **4a**, **4b**, **4c** or **4d** (i.e. Formula 4 wherein A1 is A-1, A-2, A-3 or A-5, respectively) are prepared by reacting a compound of Formula **2a**, **2b**, **2c** or **2d** with a compound of Formula 3 in the presence of a base such as triethylamine. In the presence of an appropriate source of cyanide ion (e.g., acetone cyanohydrin, potassium cyanide, sodium cyanide) and a base such as triethylamine or pyridine, the intermediate compound of Formula **4a**, **4b**, **4c** or **4d** is then rearranged to the corresponding compound of Formula **1a**, **1b**, **1c** or **1d**. Alternatively a fluoride anion source such as potassium fluoride or cesium fluoride, optionally in the presence of a phase transfer catalyst (e.g., tetrabutyl ammonium bromide), can be used to cause this rearrangement. Typically the reaction is conducted in a solvent such as dimethylsulfoxide, *N,N*-dimethylformamide, acetonitrile or dichloromethane at temperatures ranging from ambient temperature to the reflux temperature of the solvent. Alternatively, compounds of Formula **1a**, **1b**, **1c** or **1d** can be prepared by Process 2 (in Schemes 1a, 1b, 1c and 1d respectively) by reacting a compound of Formula **2a**, **2b**, **2c** or **2d** with a compound of Formula 3 in the presence of a cyanide or fluoride anion source along with a base. For reaction conditions for this general coupling methodology, see Edmunds, A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapters 4.3 and 4.4, and references cited therein.

Scheme 1a

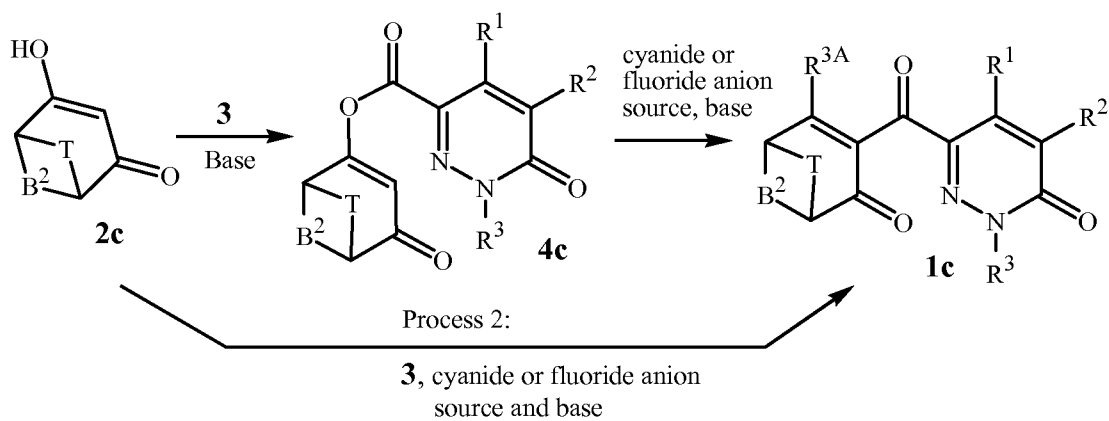


Scheme 1b

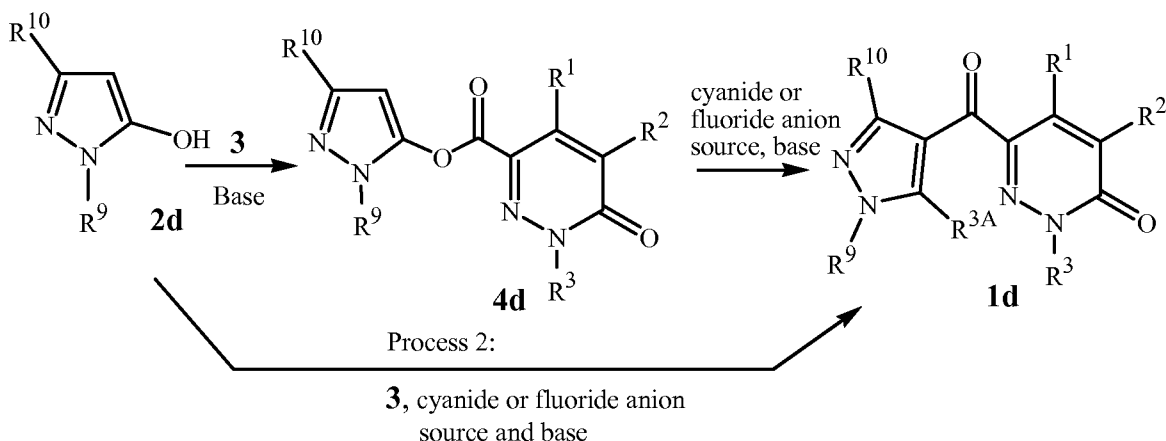


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Scheme 1c

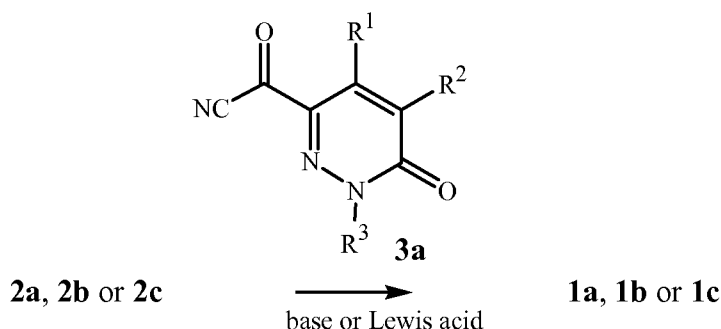


Scheme 1d



Compounds of Formula **1a**, **1b** or **1c** can also be prepared as shown in Scheme 2, by reacting dione **2a**, **2b** or **2c** with intermediate **3a** (i.e. Formula **3** in which X^1 is $-CN$) in the presence of a base or Lewis acid. For reaction conditions for this general coupling methodology, see Edmunds, A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.3 and references cited therein.

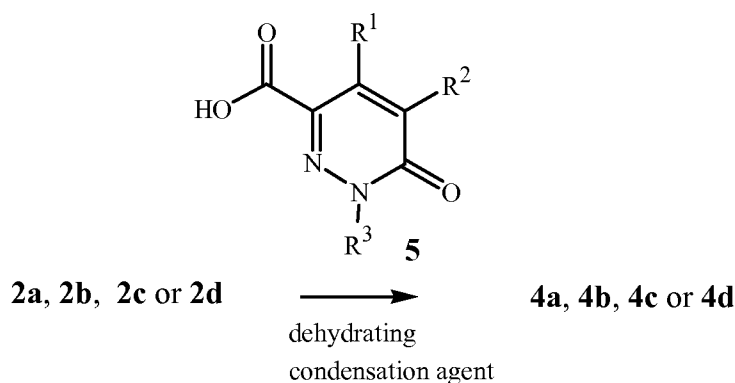
Scheme 2



As shown in Scheme 3, a compound of Formulae **4a**, **4b**, **4c** or **4d** is useful as an intermediate in the method of Schemes 1a–1d and can also be prepared by reacting a compound of Formula **2a**, **2b**, **2c** or **2d**, respectively, with a carboxylic acid of Formula **5** in the presence of a dehydrating condensation agent such as 2-chloro-1-pyridinium iodide (known as the Mukaiyama coupling agent), dicyclohexyl carbodiimide (DCC) or the like and optionally in the presence of a base. For additional reaction conditions for this general enol ester coupling methodology, see Edmunds, A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.3 and references cited therein.

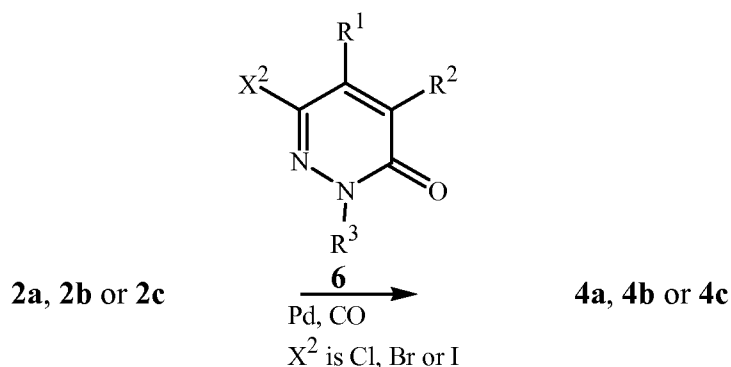
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Scheme 3



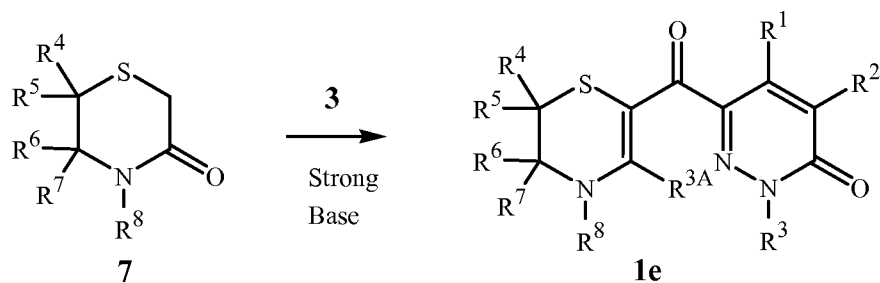
As shown in Scheme 4, an intermediate compound of Formula **4a, 4b** or **4c** can also be made by the palladium-catalyzed carbonylation reaction of a halo compound of Formula **6** in the presence of a compound of Formula **2a, 2b** or **2c**, respectively. For reaction conditions for this general enol ester forming methodology, see Edmunds, A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.3 and references cited therein.

Scheme 4



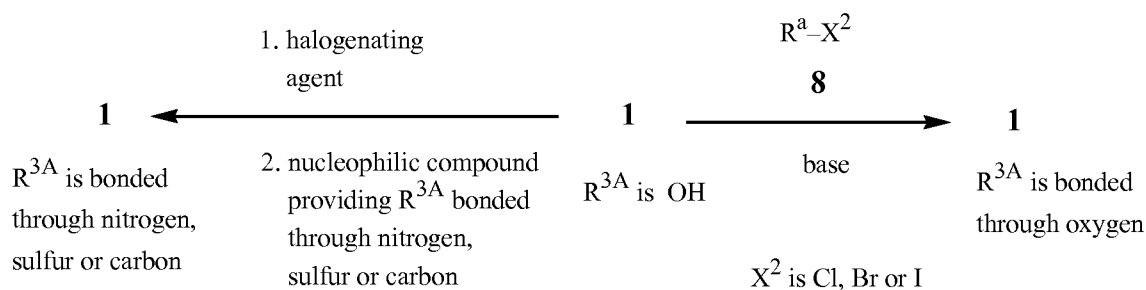
As shown in Scheme 5, a compound of Formula **1e** (i.e. Formula **1** in which A is A-4) wherein R^{3A} is hydroxy can be prepared by reacting a compound of Formula **7** with a compound of Formula **3** in the presence of a strong base such as *n*-butyllithium or lithium diisopropylamide in an appropriate solvent such as tetrahydrofuran or diethyl ether. For reaction conditions for this type of transformation, see JP 2003327580.

Scheme 5



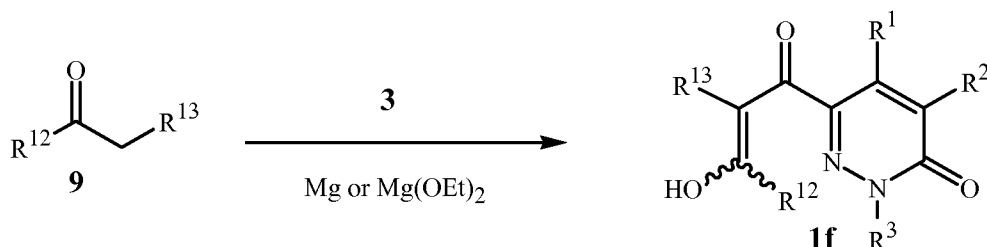
As shown in Scheme 6, compounds of Formula **1** wherein A is A-1, A-2, A-3, A-4 or A-5 (i.e. Formula **1a**, **1b**, **1c**, **1d** or **1e**) and R^{3A} is a substituent group bonded to the remainder of Formula **1** through an oxygen atom are prepared by reacting corresponding compounds of Formula **1** wherein R^{3A} is hydroxy with a compound of formula R^a-X² (Formula **8**) wherein R^a is the part of R^{3A} not including the oxygen atom and X² is nucleophilic leaving group such as Cl, Br or I in the presence of a base. Alternatively, a compound of Formula **1** wherein A is A-1, A-2, A-3, A-4 or A-5 and R^{3A} is bonded to the remainder of Formula **1** through a nitrogen, sulfur or carbon atom can be prepared by reacting a compound of Formula **1** wherein R^{3A} is hydroxy with an appropriate halogenating agent to prepare a corresponding halo compound of Formula **1** wherein R^{3A} is halogen, followed by reacting the halo compound with an appropriate nucleophilic compound to replace the halogen with R^{3A} through displacement. For reaction conditions for this general functionalization method, see Edmunds, A. or Van Almsick A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.3 or Chapter 4.4, and references cited therein.

Scheme 6



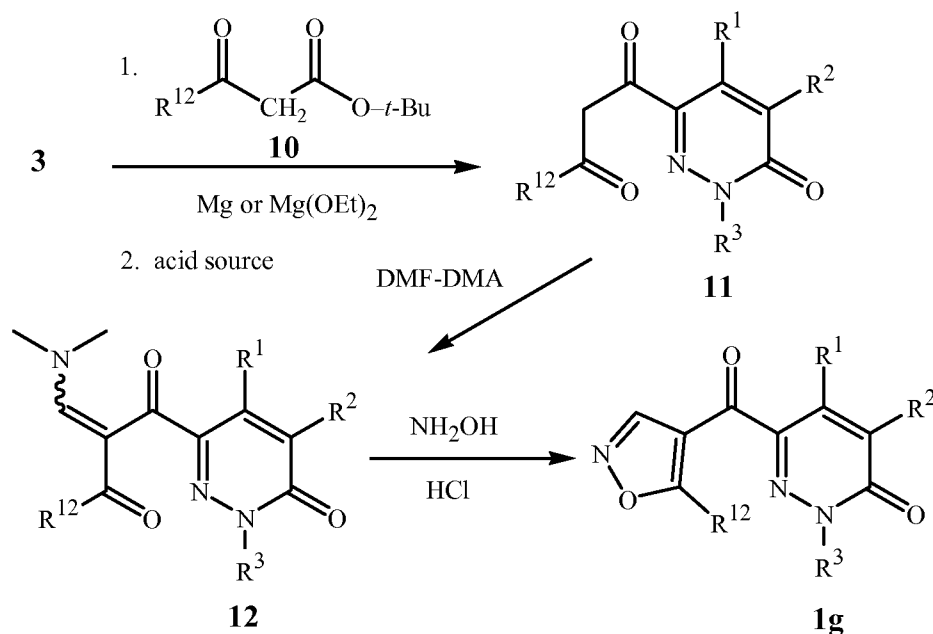
As shown in Scheme 7, compounds of Formula **1f** (i.e. Formula **1** wherein A is A-7) can be prepared from corresponding compounds of Formulae **3** and **9**. In this method, a compound of Formula **3** is reacted with a compound Formula **9** in the presence of a base that promotes carbon-centered acylation. Magnesium enolates, which can be formed by reaction of the compound of Formula **9** with magnesium metal or magnesium alcoholates such as magnesium ethoxide, are preferred for carbon-centered acylation. This type of acylation is well known in the literature and typical conditions which result in acylation on carbon can be found in U.S. Patents 4741769 and 4781750, and Van Almsick A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

Scheme 7



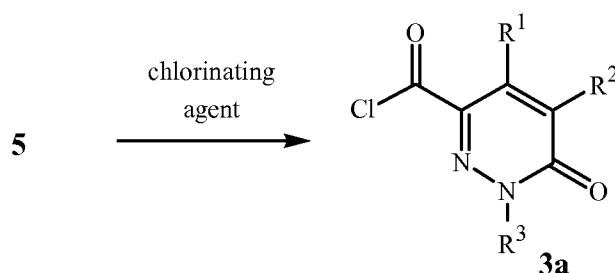
As shown in Scheme 8, compounds of Formula **1g** (i.e. Formula **1** in which A is A-6 and R^{11} is H) can be prepared from diketones of Formula **11**. Compounds of Formula **11** can be prepared by acylation of compounds of Formula **10** with a compound of Formula **3**. Acylation on carbon can be achieved by using a magnesium enolate of the compound of Formula **10** produced using conditions previously described in Scheme 7. Removal of the ester can be conveniently carried out by heating the reaction product with a source of acid which cleaves the *tert*-butyl group and results in decarboxylation producing the compound of Formula **11**. Acid sources such as hydrochloric acid, hydrobromic acid, sulfuric acid, trifluoroacetic acid and *p*-toluenesulfonic acid as well as many others may be employed. The compound of Formula **11** is then reacted with an orthoformate ester or *N,N*-dimethylformamide dimethylacetal (DMF-DMA) to provide an intermediate compound of Formula **12**. Reaction of the compound of Formula **12** with hydroxylamine hydrochloride salt in a solvent such as ethanol, acetonitrile, water or acetic acid provides the isoxazole compound of Formula **1g**. For reaction conditions for synthesis of 4-acyl isoxazoles, see European Patent Application EP 527036 and World Patent Application WO 99/02489 as well as Van Almsick A. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

Scheme 8



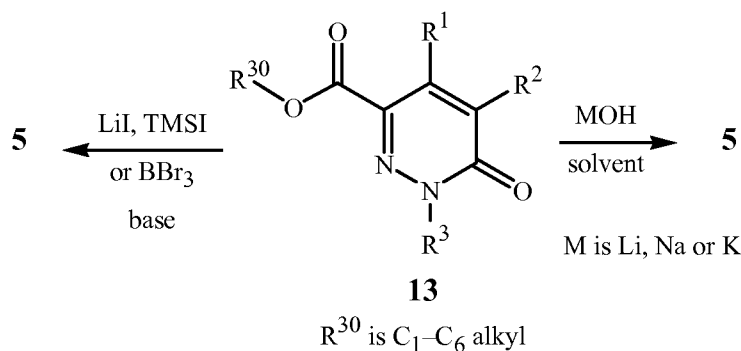
Compounds of Formula **3** can be prepared by a wide variety of methods known in the art of synthetic organic chemistry. As shown in Scheme 9, acid chlorides of Formula **3a** (i.e. Formula **3** wherein X¹ is Cl) are easily prepared from corresponding carboxylic acids of Formula **5** by numerous well-known methods. For example, reacting a carboxylic acid of Formula **5** with a chlorinating reagent such as oxalyl chloride or thionyl chloride in a solvent such as dichloromethane or toluene, optionally in the presence of a catalytic amount of *N,N*-dimethylformamide, provides the corresponding acid chloride of Formula **3a**.

Scheme 9



As shown in Scheme 10, carboxylic acids of Formula **5** can be prepared by de-esterification of esters of Formula **13**. The de-esterification can be accomplished by many well-known methods, for example, saponification procedures using alkali hydroxides such as LiOH, NaOH or KOH in a lower alkanol such methanol or ethanol or in mixtures of alkanols and water. Alternatively, a dealkylating agent such as lithium iodide or trimethylsilyl iodide can be used in the presence of a base in a solvent such as pyridine or ethyl acetate. Alternatively, boron tribromide (BBr₃) can be used to prepare a compound of Formula **5** from a compound of Formula **13** in a solvent such as dichloromethane, hexanes or toluene. A typical procedure using boron tribromide is disclosed in *Bioorg. & Med. Chem. Lett.* **2009**, 19(16), 4733–4739. Additional reaction procedures for de-esterification can be found in PCT Patent Publication WO 2006/133242.

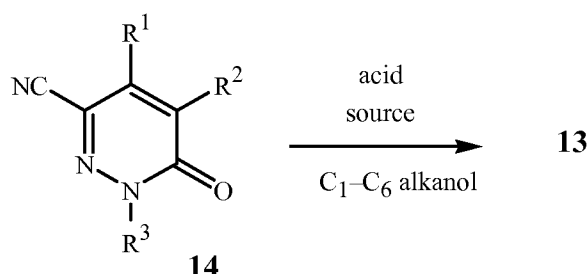
Scheme 10



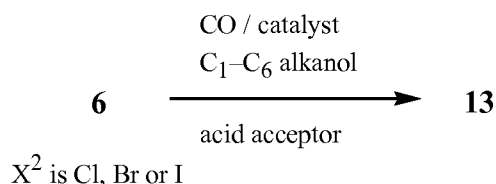
As shown in Scheme 11, esters of Formula **13** can be prepared from the corresponding nitriles of Formula **14**. As is well known in the art, in the presence of an acid and an alkanol, a nitrile is converted into the ester of the alkanol. Suitable acids include, for example,

hydrochloric, hydrobromic acid and sulfuric acid. To prepare an ester of Formula **13** wherein R³⁰ is C₁-C₆ alkyl, the corresponding C₁-C₆ alkanol is used. Lower (i.e. C₁-C₄) alkanols are preferred, and methanol is especially preferred for this method. In a typical reaction, the nitrile of Formula **14** is reacted with hydrochloric acid in the presence of methanol as a solvent. The reaction temperature can be from about 0 to 200 °C depending upon the alcohol used and whether the pressure is increased above ambient atmospheric pressure. An especially useful procedure to perform the reaction involves generating the hydrochloric acid by addition of thionyl chloride, trimethylsilyl chloride or acetyl chloride to methanol in the presence of the compound of Formula **14**.

Scheme 11

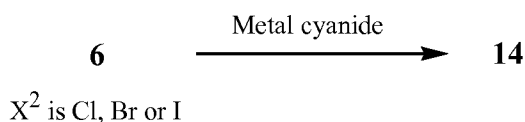


As shown in Scheme 12, esters of Formula **13** can also be prepared from corresponding halo compounds of Formula **6**. In this method the compound of Formula **6** is reacted with carbon monoxide and the appropriate C₁-C₆ alkanol in the presence of an acid acceptor and a transition metal catalyst. Typically lower alkanols such as methanol and ethanol are preferred in this transformation. Carbon monoxide can be present at pressures ranging from about 100 to 10000 kPa. Examples of suitable acid acceptors include tertiary amines such as triethylamine, alkali metal carbonates such as potassium carbonate, alkali metal phosphates, alkali metal acetates and alkali metal hydrogencarbonates. Tertiary amines are most preferred. Palladium catalysts are most preferred for use in this carbonylation reaction. A wide variety of commercially available ligands and palladium sources can be employed. Among the most useful catalysts are those generated from 1,3-bis(diphenylphosphino)propane (dppp) and 1,1'-bis(diphenylphosphino)ferrocene (dppf). These reactions can be performed at temperatures between about 0 and 200 °C; temperatures between about 50 and 100 °C are most commonly employed. Suitable solvents include polar aprotic solvents such as *N,N*-dimethylformamide, dimethylsulfoxide, *N*-methylpyrrolidinone and *N,N*-dimethylacetamide as well as ethers such as dioxane and tetrahydrofuran. For examples of carbonylation of pyridazinones see Stevenson et al., *J. Heterocyclic Chem.* **2005**, 42, 427. A useful carbonylation of halides without the need for carbon monoxide is described by Manabe and co-workers in *Org. Lett.* **2012**, 14, 3100-3103.

Scheme 12

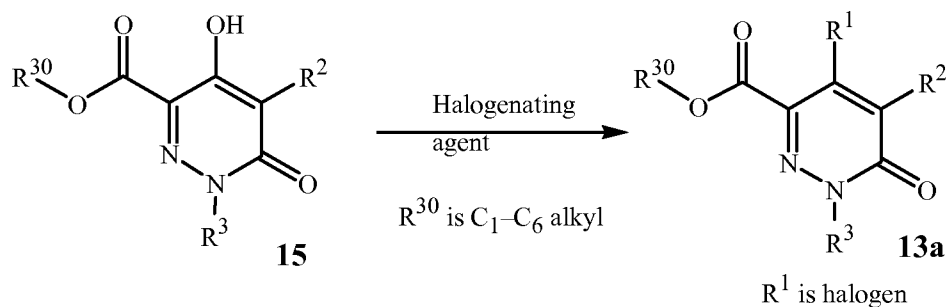
As shown in Scheme 13, nitriles of Formula **14** can be prepared by cyanation of corresponding halo compounds of Formula **6**. Cyanation reactions are well known in the art.

A particularly useful cyanide source for this reaction is copper (I) cyanide. Heating a halide of Formula **6** with an excess of copper(I) cyanide in an aprotic polar solvent such as *N,N*-dimethylacetamide, *N,N*-dimethylformamide or *N*-methylpyrrolidinone forms the compound of Formula **14**. The reaction can be performed at temperatures ranging from about 0 to 250 °C, but preferably at temperatures between 100 °C and 150 °C. This reaction may also be performed with the aid of a transition metal catalyst. For reagents, conditions and procedures for cyanation of activated heterocyclic halides see PCT Patent Publications WO 2008/070158, WO 2009/061991 and WO 2009/085816, and the references cited therein. Starting halides of Formula **6** can be prepared by methods disclosed in PCT Patent Publication WO 2009/086041 and Verhelst, T., Ph.D. thesis, University of Antwerp, 2012.

Scheme 13

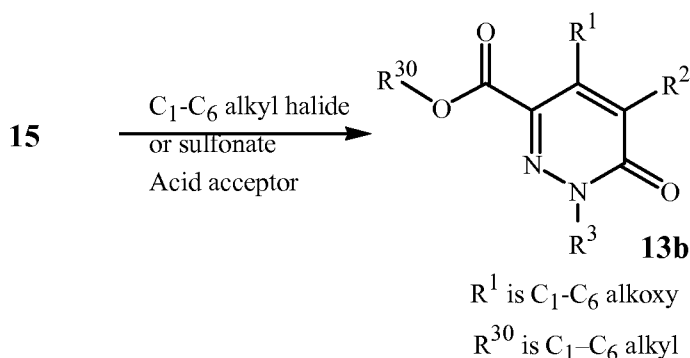
Esters of Formula **13a** (i.e. compounds of Formula **13** wherein R¹ is halogen) can be prepared by reaction of hydroxypyridazinones of Formula **15** with halogenating agents as shown in Scheme 14. Many types of halogenating reagents such as, but not limited to, POCl₃, PCl₅, SOCl₂, SOBr₂, PBr₃ and POBr₃ will accomplish this conversion. This reaction can be carried out in aprotic solvents which are compatible with the reagents for example, dichloromethane, chlorobenzene, toluene, dichloroethane and chloroform. Temperatures from 0 to 180 °C can be employed. In some cases the addition of a tertiary amine base can be helpful. Preferred amines for this purpose are *N,N*-dimethylaniline and *N,N*-diethylaniline. In addition the halogens may be interconverted by reaction of alkali halides in solvents such as *N,N*-dimethylformamide, *N,N*-dimethylacetamide, acetonitrile or *N*-methylpyrrolidinone at temperatures from 80 to 200 °C.

Scheme 14



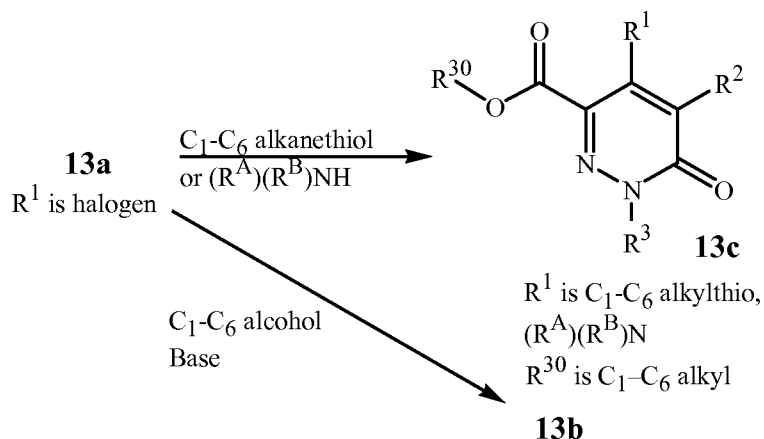
Compounds of Formula **13b** (i.e. compounds of Formula **13** wherein R^1 is C_1 - C_6 alkoxy) may be obtained by alkylation of compounds of Formula **15** with C_1 - C_6 alkyl halides or sulfonates in the presence of an acid acceptor as shown in Scheme 15. The reaction may be conducted at temperatures between -20 and 150 °C. Useful solvents include, but are not limited to *N,N*-dimethylformamide, *N,N*-dimethylacetamide, acetonitrile, *N*-methylpyrrolidinone, dioxane, tetrahydrofuran or dimethylsulfoxide. Suitable acid acceptors include but are not limited to alkali carbonates, hydroxides, alkoxides and hydrides as well as cesium carbonate and alkali hexamethyldisilazides. A preferred set of conditions utilizes *N,N*-dimethylformamide as solvent with sodium hydride as acid acceptor.

Scheme 15



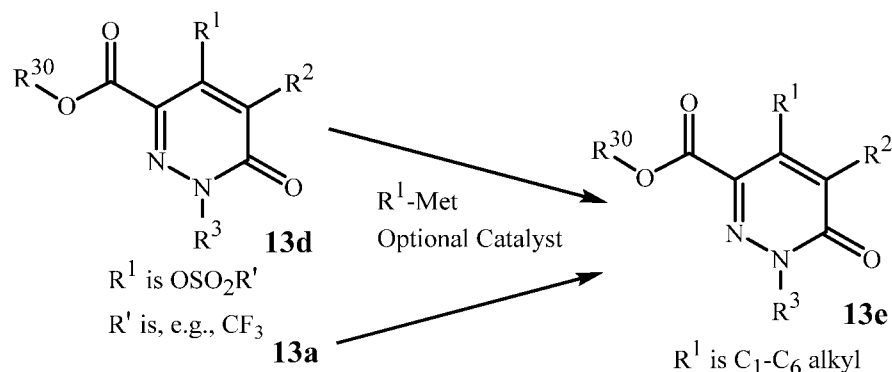
As shown in Scheme 16 compounds of Formula **13c** (, compounds of Formula **13** wherein R^1 is C_1 - C_6 alkylthio or $(R^A)(R^B)N$ can be prepared by nucleophilic displacement reactions of compounds of Formula **13a** with C_1 - C_6 alkanethiols or amines $(R^A)(R^B)NH$. Useful solvents include, but are not limited to *N,N*-dimethylformamide, *N,N*-dimethylacetamide, *N*-methylpyrrolidinone, dioxane, tetrahydrofuran or dimethylsulfoxide. The reaction may be conducted at temperatures between -20 and 150 °C. As also shown in Scheme 16, compounds of Formula **13b** can be prepared in similar fashion by reaction of compounds of Formula **13a** with C_1 - C_6 alcohols in the presence of a base.

Scheme 16



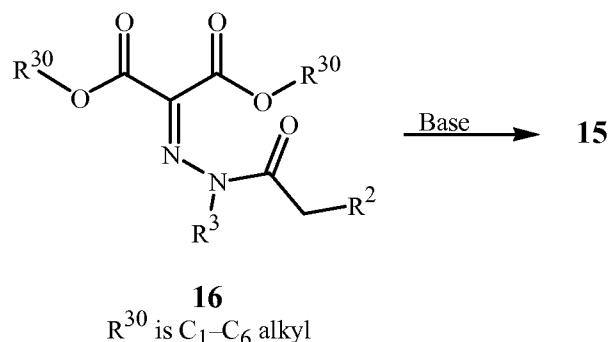
As shown in Scheme 17, compounds of Formula **13e** (i.e. compounds of Formula **13** wherein R¹ is C₁-C₆ alkyl) can be prepared by transition metal catalyzed reactions of compounds of Formula **13d** (i.e. compounds of Formula **13** wherein R¹ is a sulfonate such as trifluoromethanesulfonate), or with compounds of Formula **13a**. Various palladium catalyzed reactions are known to introduce functional groups in this way. For reviews of this type of reaction 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 Eds., *Palladium in Heterocyclic Chemistry Volume 1*, Pergamon Press, Amsterdam, 2000 and Gribble and Li, Eds., *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. Copper catalyzed reactions are useful for introducing the CF₃ group. For a comprehensive recent review of reagents for this reaction see Wu, Neumann and Beller in *Chemistry: An Asian Journal* **2012**, ASAP, available at <http://onlinelibrary.wiley.com/doi/10.1002/asia.201200211/pdf> and references cited therein. Sulfonate precursors of formula **13d** can be made from the hydroxyl precursors of Formula **15** by the well known sulfonylation reaction outlined by Maes and Lemiere in *Comprehensive Heterocyclic Chemistry III, Volume 8*, Katritzky, Ramsden, Scriven and Taylor editors, and references cited therein.

Scheme 17



Scheme 18 shows the synthesis of compounds of Formula **15** by the cyclization of
 hydrazone esters of formula **16** in the presence of an acid acceptor. Suitable acid acceptors
 for the reaction include inorganic bases, such as alkali or alkaline earth metal (such as
 lithium, sodium, potassium and cesium) hydrides and alkoxides or organic bases, such as
 triethylamine, *N,N*-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. A wide
 variety of solvents are suitable for the reaction, including, for example but are not limited to
 aromatic hydrocarbons (such as toluene and xylenes), tetrahydrofuran, dioxane,
 dimethoxyethane, *N,N*-dimethylformamide, *N,N*-dimethylacetamide, *N*-methylpyrrolidinone,
 and acetonitrile as well as mixtures of these solvents. This reaction can be conducted
 between about -20 and 200 $^{\circ}\text{C}$, and preferably between about 20 and 120 $^{\circ}\text{C}$.

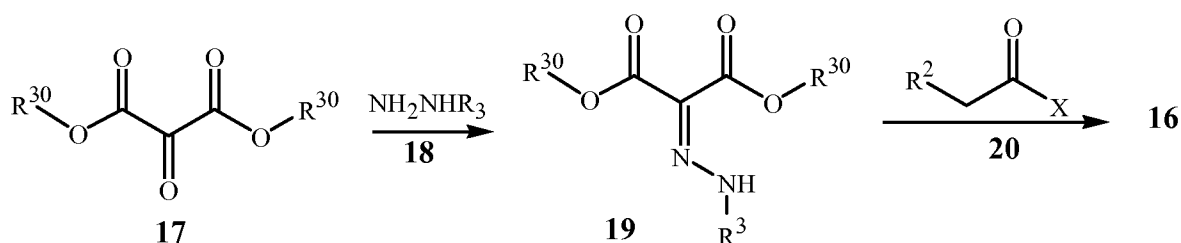
Scheme 18



Compounds of Formula **16** can be synthesized by the reaction of an activated acid
 derivative of Formula **20** with a hydrazone of Formula **19** in the presence of an acid acceptor
 as shown in Scheme 19. Suitable acid acceptors for the reaction include inorganic bases,
 such as alkali or alkaline earth metal (such as lithium, sodium, potassium, cesium) hydrides,
 alkoxides, carbonates, phosphates and hydroxides, and organic bases, such as triethylamine,
N,N-diisopropylethylamine and 1,8-diazabicyclo[5.4.0]undec-7-ene. Preferred acid
 acceptors are trialkylamines and potassium hydroxide. A wide variety of solvents are
 suitable for the reaction, including, for example but are not limited to tetrahydrofuran,
 dichloromethane, *N,N*-dimethylformamide, *N,N*-dimethylacetamide, *N*-methylpyrrolidinone,
 acetonitrile and acetone, as well as mixtures of these solvents. This reaction can be

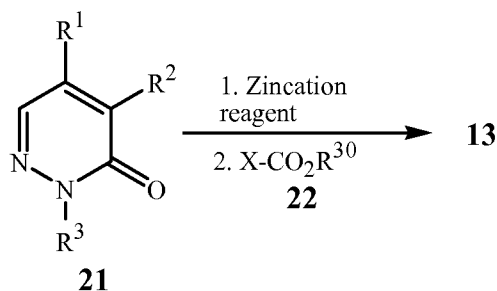
conducted between about -20 and 100 $^{\circ}\text{C}$, and preferably between about 0 and 50 $^{\circ}\text{C}$. Activated acid derivatives include, for example, but are not limited to acid chlorides, acid bromides, acylimidazoles, mixed anhydrides and acylecyanides. Examples of related chemistry can be found in U.S. Pat. No. 7,517,994. Hydrazones of Formula **19** can be prepared as shown in Scheme 19 by reaction of ketomalonates of Formula **17** with hydrazines of Formula **18**. This reaction can be performed by methods disclosed in U.S. Pat. No. 7,517,994.

Scheme 19



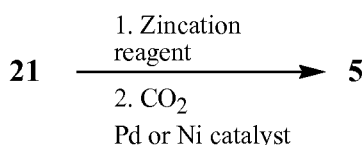
Compounds of Formula **13** can be prepared by zincation of pyridazinones of Formula **21** and quenching with haloformates of Formula **22** as shown in Scheme 20. Reaction of a CH containing pyridazinone with a zincation reagent such as zinc chloro 2,2,6,6-tetramethylpiperidide lithium chloride complex ($\text{Zn}(\text{TMP})\text{-LiCl}$, where TMP is 2,2,6,6-tetramethylpiperidine), produces a zincated intermediate which can be reacted with a haloformate of Formula **22** in the presence of a transition metal catalyst to produce compounds of Formula **13**. The preferred metal for this process is palladium and the preferred catalysts contain phosphine ligands such as triphenylphosphine. Preferred catalysts include palladium tetrakis-(triphenylphosphine) and bis-(triphenylphosphine) palladium dichloride. The zincation reaction may be carried out at temperatures from -20 to 150 $^{\circ}\text{C}$ and the coupling reaction from 0 to 120 $^{\circ}\text{C}$. Etheral solvents such as dioxane and tetrahydrofuran are preferred for this reaction, but other solvents which do not react with the zinc reagent may also be employed. Alternatively the transition metal can be a copper (I) salt such as CuCl , CuI , CuBr or CuCN or a soluble version in which lithium chloride is used to increase the solubility of the salt. For conditions, reagents and examples for zincation of pyridazinones, see Verhelst, T., Ph.D. thesis, University of Antwerp, 2012. 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 PCT Patent Publications WO 2008/138946 and WO 2010/092096.

Scheme 20



As shown in Scheme 21, compounds of Formula 5 can be prepared by the reaction of zincated heterocycles with carbon dioxide in the presence of a transition metal catalyst. Pyridazinones of Formula 21 can be zincated as indicated in Scheme 21 and treated with carbon dioxide in the presence of palladium or nickel catalysts. Conditions and catalysts which are suitable for this transformation are disclosed in *J. Am. Chem. Soc.* **2008**, *130*, 7826-7827. Preferred conditions are from -10 to 30 °C using a catalyst prepared from Pd(OAc)₂ and tricyclohexylphosphine in tetrahydrofuran as solvent.

Scheme 21



Compounds of Formula 21 are known in the literature or can be prepared by methods outlined by Maes and Lemiére in *Comprehensive Heterocyclic Chemistry III Volume 8*, Katritzky, Ramsden, Scriven and Taylor editors and references cited therein. See also Verhelst, Ph.D. thesis, University of Antwerp and references cited therein. Other methods of functional group transformations on pyridazinones which can be used to synthesize compounds of Formula 21 may be found in *J. Heterocyclic Chem.* **2005** *42*, 427. Chemistry leading to other pyridazinones can be found in U.S. Pat. No. 6,077,953. See also PCT Patent Publication WO 2009/086041 and references cited therein.

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

art will also recognize that it may be necessary to perform a combination of the steps illustrated in the above schemes in an order other than that implied by the particular sequence presented to prepare the compounds of Formula 1.

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

Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Synthesis Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Steps in the following Synthesis 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. ^1H NMR spectra are reported in ppm downfield from tetramethylsilane in CDCl_3 at 400 MHz unless otherwise noted; “s” means singlet, “m” means multiplet, “br s” means broad singlet. Mass spectra (MS) are reported as the molecular weight of the highest isotopic abundance parent ion ($\text{M}+1$) formed by addition of H^+ (molecular weight of 1) to the molecule, observed by mass spectrometry using atmospheric pressure chemical ionization (AP^+) where “amu” stands for atomic mass units. The presence of molecular ions containing one or more higher atomic weight isotopes of lower abundance (e.g., ^{37}Cl , ^{81}Br) is not reported.

SYNTHESIS EXAMPLE 1

Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-phenyl-3(2*H*)-pyridazinone (Compound 4)

Step A: Preparation of 1,3-diethyl-2-(2-methylhydrazinylidene)propanedioate (2-propanone 2-methylhydrazone-1,3-diethyl ester)

To a stirred solution of diethyl ketomalonate (2.00 g, 11.5 mmol) in ethanol (20 mL) was added methylhydrazine (0.580 g, 12.6 mmol). The reaction mixture was stirred at 60 °C for 6 h, then cooled to room temperature and concentrated under reduced pressure. The crude residue was purified by chromatography on silica gel eluting with 5 to 10% ethyl acetate in hexanes to afford the title compound (1.01 g) as a yellow oil.

^1H NMR δ 1.36–1.31 (m, 6H), 3.40 (d, $J = 3.9$ Hz, 3H), 4.31–4.25 (m, 4H), 11.30 (br s, 1H).

MS: 203 amu (AP^+).

Step B: Preparation of ethyl 1,6-dihydro-4-hydroxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

To a stirred solution of 1,3-diethyl-2-(2-propanone 2-methylhydrazone)propanedioate (i.e. the product of Step A, (2-propanone 2-methylhydrazone-1,3-diethyl ester), 3.0 g, 14.9 mmol) in tetrahydrofuran (30 mL) was added lithium hexamethyldisilazide (1M solution in tetrahydrofuran, 32.7 mL, 32.7 mmol) at 0 °C over a period of 40 min. The mixture was stirred for an additional 40 min and subsequently treated dropwise with phenylacetyl chloride (2.75 g, 17.82 mmol). The reaction mixture was stirred at room temperature for 6 h, then cooled to 0 °C and the pH adjusted to approximately 2 by slow addition of 1N hydrochloric acid (40 mL). The mixture was then extracted with ethyl acetate (3 X 30 mL), and the combined organic extracts were washed with water and brine, dried (Na₂SO₄) and concentrated under reduced pressure. The crude residue was purified by chromatography on silica gel eluting with 20% ethyl acetate in hexanes to afford the title compound (1.57 g) as an off-white solid.

¹H NMR δ 10.81 (s, 1H), 7.60–7.58, (m, 2H), 7.47–7.41 (m, 3H), 4.52 (q, *J* = 7.1 Hz, 2H), 3.91 (s, 3H), 1.47 (t, *J* = 7.1, 3H). MS: 275 amu (AP⁺).

Step C: Preparation of ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

Ethyl 1,6-dihydro-4-hydroxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Step B, 80 mg, 0.29 mmol) was treated with phosphorous oxychloride (2.0 mL, 21.4 mmol) and heated to 85 °C for 16 h. The reaction mixture was concentrated under reduced pressure and quenched with crushed ice. The pH was adjusted to approximately 7 by addition of saturated aqueous sodium bicarbonate (20 mL) and extracted with ethyl acetate (10 mL). The organic layer was dried (Na₂SO₄) and concentrated under reduced pressure. The crude residue was purified by chromatography on silica gel eluting with 10% ethyl acetate in hexanes to afford the title compound (36 mg) as a light brown oil.

¹H NMR δ 7.49–7.43 (m, 3H), 7.41–7.38 (m, 2H), 4.45 (q, *J* = 7.1 Hz, 2H), 3.85 (s, 3H), 1.44 (t, *J* = 7.1 Hz, 3H). MS: 293 amu (AP⁺).

Step D: Preparation of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

To a degassed solution of ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Step C, 100 mg, 0.34 mmol) in toluene (2 mL) was added tetrakis(triphenylphosphine)palladium(0) (19.6 mg, 0.017 mmol) and 2M trimethylaluminum in toluene (0.18 mL, 0.376 mmol). The mixture was heated at reflux for 2 h, cooled to room temperature, diluted with water (10 mL) and extracted with ethyl acetate (10 mL). The organic layers were dried (Na₂SO₄) and concentrated under reduced pressure. The crude material was purified by chromatography on silica gel eluting with 5 to 15% ethyl acetate in hexanes to afford the title compound (81 mg, 87%) as a colorless gum.

¹H NMR δ 7.47–7.38 (m, 3H), 7.23 (t, *J* = 1.2 Hz, 1H), 4.42 (q, *J* = 7.1 Hz, 2H), 3.86 (s, 3H), 2.22 (s, 3H), 1.42 (t, *J* = 7.1 Hz, 3H). MS: 273 amu (AP⁺).

Step E: Preparation of 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid

To a solution of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Step D, 1 equiv) in 1,4-dioxane/water (8:2), was added lithium hydroxide monohydrate (3.0 equiv.) and the mixture was stirred at room temperature for 4 h. The reaction mixture was concentrated and diluted with water. The pH was adjusted to approximately 2 by slow addition of 1N hydrochloric acid and extracted with ethyl acetate. The combined organic extracts were washed with water and brine, dried (Na_2SO_4) and concentrated under reduced pressure to afford the title compound (79%) as an off-white solid.

^1H NMR δ 7.49–7.42 (m, 3H), 7.25–7.22 (m, 2H), 3.89 (s, 3H), 2.42 (s, 3H). MS: 245 amu (AP^+).

Step F: Preparation of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

To a stirred solution of 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid (i.e. the product of Step E, 1.0 equiv), *N,N*-diisopropylethylamine (3.0 equiv) in tetrahydrofuran was added cyclohexane-1,3-dione (1.1 equiv) at room temperature. The mixture was stirred for 30 min, 2-chloro-1-methylpyridinium iodide (1.5 equiv) was added and stirring was continued for 16 h. The reaction mixture was diluted with water, acidified by slow addition of aqueous 1N hydrochloric acid, and extracted with ethyl acetate. The organic layers were dried (Na_2SO_4) and concentrated under reduced pressure. The crude material was purified by chromatography on silica gel eluting with 1 to 3% methanol in dichloromethane to provide the title compound (30%) as a light brown gum.

^1H NMR δ 7.49–7.41 (m, 3H), 7.23 (t, $J = 1.4$ Hz, 1H), 6.03 (t, $J = 1.0$ Hz, 1H), 3.90 (s, 3H), 2.68 (t, $J = 6.2$ Hz, 2H), 2.47 (t, $J = 7.1$ Hz, 2H), 2.28 (s, 3H), 2.18–2.10 (m, 2H).

Step G: Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-phenyl-3(2*H*)-pyridazinone

To a stirred solution of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Step F, 1.0 equiv) and triethylamine (1.0 equiv) in acetonitrile, was added potassium cyanide (1.0 equiv) at room temperature. The mixture was stirred for 3–4 h, concentrated under reduced pressure, diluted with water and the pH was adjusted to approximately 2 by slow addition of 1N hydrochloric and extracted with ethyl acetate. The combined organic extracts were washed with water and brine, dried (Na_2SO_4) and concentrated under reduced pressure. Purification of the crude material by reverse phase (C18) column chromatography eluting with acetonitrile/water (3:2 to 4:1) afforded the title compound (15%) as an off-white solid.

^1H NMR δ 7.85 (br s, 2H), 7.46–7.36 (m, 3H), 3.67 (br s, 3H), 2.36–2.32 (m, 4H), 2.00–1.84 (m, 5H).

SYNTHESIS EXAMPLE 2

Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-5-(trifluoromethyl)-3(2*H*)-pyridazinone (Compound 5)

Step A: Preparation of ethyl 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylate

To a degassed suspension of ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Example 1, Step C, 100 mg, 0.34 mmol), methyl difluoro(fluorosulfonyl)acetate (FSO₂CF₂COOMe, 657 mg, 3.42 mmol), cuprous iodide (325 mg, 1.71 mmol) and triphenylarsine (41.8 mg, 0.40 mmol) in *N,N*-dimethylformamide (4.0 mL) was added tris(dibenzylideneacetone)dipalladium(0) (313 mg, 0.342 mmol) and the reaction mixture was heated at 90 °C for 24 h. The reaction mixture was cooled to room temperature, partitioned between water and ethyl acetate (1:1, 30 mL) and filtered. The layers were separated, and the aqueous layer was extracted with ethyl acetate (15 mL). The combined organic extracts were washed with water and brine, dried (Na₂SO₄) and concentrated under reduced pressure. The crude material was purified by chromatography on silica gel eluting with 10 to 15% ethyl acetate in hexanes to afford the title compound (71 mg) as a light brown oil.

¹H NMR δ 7.48–7.44 (m, 3H), 7.33–7.31 (m, 2H), 4.43 (q, *J* = 7.1 Hz, 2H), 3.87 (s, 3H), 1.40 (t, *J* = 7.1 Hz, 2H). MS: 327 amu (AP⁺).

Step B: Preparation of 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylic acid

Using the method of Example 1, Step E, ethyl 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylate (i.e. the product of Step A) afforded the title compound (92%) as a light brown solid.

¹H NMR δ 7.49–7.45 (m, 3H), 7.38–7.30 (m, 2H), 3.90 (s, 3H).

Step C: Preparation of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylate

Using the method of Example 1, Step F, 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylic acid (i.e. the product of Step B) afforded the title compound (88%) as a light brown gum.

¹H NMR δ 7.50–7.45 (m, 3H), 7.34–7.32 (m, 2H), 6.08 (t, *J* = 1.2 Hz, 1H), 3.91 (s, 3H), 2.68 (t, *J* = 6.2 Hz, 2H), 2.47 (t, *J* = 7.2 Hz, 2H), 2.17–2.11 (m, 2H). MS: 393 amu (AP⁺).

Step D: Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-4-(trifluoromethyl)-3(2*H*)-pyridazinone

Using the method of Example 1, Step G, 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1-methyl-6-oxo-5-phenyl-4-(trifluoromethyl)-3-pyridazinecarboxylate (i.e. the product of Step C) afforded the title compound (17%) as an off-white solid. MP 201–203 °C.

¹H NMR (CD₃OD) δ 7.45–7.44 (m, 3H), 7.34 (br s, 2H), 3.78 (s, 3H), 2.80 (t, *J* = 6.3 Hz, 2H), 2.48 (t, *J* = 6.5 Hz, 2H), 2.13–2.06 (m, 2H).

SYNTHESIS EXAMPLE 3

Preparation of 5-chloro-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-3(2*H*)-pyridazinone (Compound 1)

Step A: Preparation of 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid

Using the method of Example 1, Step E, ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Example 1, Step C) afforded the title compound (88%) as an off-white solid.

¹H NMR δ 7.51–7.45 (m, 3H), 7.40–7.37 (m, 2H), 3.90 (s, 3H). MS: 265 amu (AP⁺).

Step B: Preparation of 3-oxo-1-cyclohexen-1-yl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

Using the method of Example 1, Step F, 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid (i.e. the product of Step A) afforded the title compound (72%) as a clear gum.

¹H NMR δ 7.51–7.45 (m, 3H), 7.41–7.39 (m, 2H), 3.89 (s, 3H), 2.69 (t, *J* = 2.6 Hz, 2H), 2.47 (t, *J* = 7.1 Hz, 2H), 2.17–2.11 (m, 2H). MS: 359 amu (AP⁺).

Step C: Preparation of 5-chloro-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-3(2*H*)-pyridazinone

Using the method of Example 1, Step G, 3-oxo-1-cyclohexen-1-yl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (the product of Step B) afforded the title compound (34%) as a light brown solid. MP 176–178 °C.

¹H NMR δ 7.46–7.41 (m, 5H), 3.78 (s, 3H), 2.81 (t, *J* = 6.3 Hz, 2H), 2.49 (t, *J* = 6.2 Hz, 2H), 2.12–2.05 (m, 2H).

SYNTHESIS EXAMPLE 4

Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-5-methoxy-2-methyl-4-phenyl-3(2*H*)-pyridazinone (Compound 3)

Step A: Preparation of 1,6-dihydro-4-methoxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid

(Prepared as described in *Heterocycles* **2012**, 57(11), 2115-2158.) To a stirred solution of ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Example 1, Step C, 50 mg, 0.171 mmol) in 1,4-dioxane (2.0 mL) was added 4M methanolic sodium methoxide (0.11 mL, 1.88 mmol) and the reaction mixture was stirred at room temperature for 1 h, then concentrated under reduced pressure and diluted with water (3 mL). The pH was adjusted to approximately 2 by slow addition of 1N hydrochloric acid (10 mL) and extracted with ethyl acetate (3 X 10 mL). The combined organic extracts were

washed with water and brine, dried (Na₂SO₄) and concentrated under reduced pressure to obtain the title compound (31 mg) as a white solid.

¹H NMR δ 7.52–7.42 (m, 5H), 3.90 (s, 3H), 3.55 (s, 3H). MS: 259 amu (AP⁺).

Step B: Preparation of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-4-methoxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate

Using the method of Example 1, Step F, 1,6-dihydro-4-methoxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylic acid (i.e. the product of Step A) afforded the title compound (88%) as a clear gum.

¹H NMR δ 7.52–7.41 (m, 5H), 6.05 (t, *J* = 1.2 Hz, 1H), 3.87 (s, 3H), 3.48 (s, 3H), 2.69 (t, *J* = 6.3 Hz, 2H), 2.47 (t, *J* = 7.2 Hz, 2H), 2.17–2.10 (m, 2H). MS: 355 amu (AP⁺).

Step C: Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-5-methoxy-2-methyl-4-phenyl-3(2*H*)-pyridazinone

Using the method of Example 1, Step G, 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-4-methoxy-1-methyl-6-oxo-5-phenyl-3-pyridazinecarboxylate (i.e. the product of Step B) afforded the title compound (18%) as a light brown solid. MP 205–207 °C.

¹H NMR (DMSO-*d*₆ at 340 °K) δ 7.38 (s, 5H), 3.55 (s, 3H), 3.32 (br s, 3H), 2.34 (br s, 4H), 1.88–1.76 (m, 2H).

SYNTHESIS EXAMPLE 5

Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-propyl-3(2*H*)-pyridazinone (Compound 2)

Step A: Preparation of pentanoic acid 1-methyl-2-(1-methylethylidene)hydrazide

To a stirred solution of 2-propanone 2-methylhydrazone (i.e. the product of Example 1, Step A, 200 mg, 0.99 mmol) in tetrahydrofuran (3.0 mL) at 0 °C was added 1M lithium hexamethyldisilazide in tetrahydrofuran (1.28 mL, 1.28 mmol) slowly over a period of 1 h. Stirring was continued at 0 °C for an additional 40 min and valeroyl chloride (0.14 mL, 1.19 mmol) was added dropwise at 0 °C. The reaction mixture was stirred for 6 h and warmed to room temperature during this time, then water (10 mL) was added and the mixture was extracted with ethyl acetate (3 X 30 mL). The combined organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. The crude material was purified by chromatography on silica gel eluting with 10 to 15% ethyl acetate in hexanes to obtain the title compound (154 mg) as a light brown oil.

¹H NMR δ 4.38 (q, *J* = 7.2 Hz, 2H), 4.31 (q, *J* = 7.0 Hz, 2H), 3.32 (s, 3H), 2.83 (t, *J* = 7.7 Hz, 2H), 1.68–1.61 (m, 2H), 1.42–1.29 (m, 6H), 0.93 (t, *J* = 7.3 Hz, 3H). MS: 287 amu (AP⁺).

Step B: Preparation of ethyl 1,6-dihydro-4-hydroxy-1-methyl-6-oxo-5-propyl-3-pyridazinecarboxylate

To a stirred solution of 1M lithium hexamethyldisilazide in tetrahydrofuran (59 mL, 59.0 mmol) at -78°C was added dropwise a solution of pentanoic acid 1-methyl-2-(1-methylethylidene)hydrazide (i.e. the product of Step A, 2.98 g, 14.8 mmol) in tetrahydrofuran (20 mL). The reaction mixture was warmed to -40°C and stirred for 1.5 h.

The reaction mixture was quenched with 1N hydrochloric acid and extracted with ethyl acetate (3 X 30 mL). The combined organic extracts were dried (Na_2SO_4) and concentrated under reduced pressure. The crude material was purified by chromatography on silica gel eluting with 5 to 10% ethyl acetate in hexanes to afford the title compound (1.85 g) as a light brown oil.

^1H NMR δ 10.42 (s, 1H), 4.49 (q, $J = 7.1$ Hz, 2H), 3.85 (s, 3H), 2.62–2.56 (m, 2H), 1.66–1.52 (m, 2H), 1.45 (t, $J = 7.1$ Hz, 3H), 0.96 (t, $J = 7.3$ Hz, 3H).

Step C: Preparation of ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-propyl-3-pyridazinecarboxylate

Using the method of Example 1, Step C, ethyl 1,6-dihydro-4-hydroxy-1-methyl-6-oxo-5-propyl-3-pyridazinecarboxylate (, the product of Step B) afforded the title compound (76%) as a light-brown oil.

^1H NMR δ 4.43 (q, $J = 7.1$ Hz, 2H), 3.80 (s, 3H), 2.77–2.74 (m, 2H), 1.65–1.57 (m, 2H), 1.41 (t, $J = 7.1$ Hz, 3H), 1.01 (t, $J = 7.4$ Hz, 3H). MS: 259 amu (AP^+).

Step D: Preparation of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylate

Using the method of Example 1, Step 1, ethyl 4-chloro-1,6-dihydro-1-methyl-6-oxo-5-propyl-3-pyridazinecarboxylate (i.e. the product of Step C) afforded the title compound (62%) as a clear gum.

^1H NMR δ 4.40 (q, $J = 7.1$ Hz, 2H), 3.81 (s, 3H), 2.66–2.62 (m, 2H), 2.32 (s, 3H), 1.55–1.50 (m, 2H), 1.40 (t, $J = 7.1$ Hz, 3H), 0.99 (t, $J = 7.3$ Hz, 3H). MS: 239 amu (AP^+).

Step E: Preparation of 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylic acid

Using the method of Example 1, Step E, ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylate (i.e. the product of Step D) afforded the title compound (86%) as an off-white solid.

^1H NMR δ 3.84 (s, 3H), 2.69–2.66 (m, 2H), 2.55 (s, 3H), 1.57–1.48 (m, 2H), 1.00 (t, $J = 7.3$ Hz, 3H). MS: 211 amu (AP^+).

Step F: Preparation of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylate

Using the method of Example 1, Step F, 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylic acid (i.e. the product of Step E) afforded the title compound (77%) as a light brown gum.

¹H NMR δ 6.01 (t, J = 1.1 Hz, 1H), 3.84 (s, 3H), 2.68–2.64 (m, 4H), 2.48–2.42 (m, 2H), 2.39 (s, 3H), 2.16–2.09 (m, 2H), 1.54–1.50 (m, 2H), 1.00 (t, J = 7.0 Hz, 3H). MS: 305 amu (AP⁺).

Step G: Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-propyl-3(2H)-pyridazinone

Using the method of Example 1, Step G, 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-6-oxo-5-propyl-3-pyridazinecarboxylate (i.e. the product of Step F) afforded the title compound (56%) as an orange yellow oil.

¹H NMR δ 3.70 (s, 3H), 2.78 (t, J = 6.3 Hz, 2H), 2.64–2.60 (m, 2H), 2.46 (t, J = 6.4 Hz, 2H), 2.10–2.04 (m, 2H), 2.04 (s, 3H), 1.62–1.53 (m, 2H), 1.00 (t, J = 7.3 Hz).

SYNTHESIS EXAMPLE 6

Preparation of 5-chloro-6[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-4-(2-methoxyethoxy)-2-methyl-3(2H)-pyridazinone (Compound 6)

Step A: Preparation of 5-chloro-4-(2-methoxyethoxy)-2-methyl-3(2H)-pyridazinone

4,5-Dichloro-2-methyl-3(2H)-pyridazinone (2.0 g, 11 mmol), 2-methoxyethanol (1.06 mL, 13.4 mmol) and sodium hydride (0.672 g, 16.8 mmol) were combined in 30 mL of dioxane and stirred at ambient temperature overnight. The reaction mixture was then poured over 100 mL of an ice/water mixture and extracted into ethyl acetate. The organic layer was washed with brine, dried (MgSO₄) and absorbed onto silica gel. Chromatography through silica gel eluting with a gradient of 0 to 100% ethyl acetate in hexanes provided 1.76 g of the title product as a white solid.

¹H NMR (500 MHz) δ 7.69 (s, 1H), 4.71–4.77 (m, 2H), 3.75 (s, 3H), 3.69–3.72 (m, 2H), 3.39 (s, 3H).

Step B: Preparation of 5-chloro-6-iodo-4-(2-methoxyethoxy)-2-methyl-3(2H)-pyridazinone

5-Chloro-4-(2-methoxyethoxy)-2-methyl-3(2H)-pyridazinone (i.e. the product of Step A) (5.32g, 24.3 mmol) and zinc chloro 2,2,6,6-tetramethylpiperidide lithium chloride complex (1135881-09-9) (0.67M solution in tetrahydrofuran, 54.4 mL, 36.5 mmol) was allowed to stir in 150 mL of anhydrous tetrahydrofuran at ambient temperature under a blanket of nitrogen for 6 min. Iodine (9.26 g, 36.5 mmol) was then added and stirring under nitrogen continued for 30 min. Sodium bisulfite (20 g) dissolved in 100 mL of water was then added and the resulting mixture was extracted with ethyl acetate. The organic layer was dried (MgSO₄) and concentrated to give 8.6 g of the title compound as a tan solid.

¹H NMR (500 MHz) δ 4.73–4.81 (m, 2H), 3.75 (s, 3H), 3.66–3.73 (m, 2H), 3.38 (s, 3H).

Step C: Preparation of 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarbonitrile

5-Chloro-6-iodo-4-(2-methoxyethoxy)-2-methyl-3(2H)-pyridazinone (i.e. the product obtained in Step B) (5.06 g, 14.7 mmol) and copper cyanide (1.45 g, 16.2 mmol) were

combined in dimethylacetamide and stirred at 120 °C for 3 h. After this time, the reaction mixture was cooled to room temperature and diluted with ethyl acetate and filtered. The filtrate was washed with water followed by brine. The organic layer was dried (MgSO₄) and absorbed onto silica gel. Chromatography through silica gel eluting with a gradient of 20 to 100% ethyl acetate in hexanes provided 2.7 g of the title product as a yellow solid.

¹H NMR (500 MHz) δ 4.80–4.83 (m, 2H), 3.82 (s, 3H), 3.64–3.75 (m, 2H), 3.37 (s, 3H).

Step D: Preparation of methyl 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylate

4-Chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarbonitrile (i.e. the product of Step C) (2.7 g, 11.1 mmol) was dissolved in methanol and treated with the dropwise addition of thionyl chloride (3.0 mL, 41.1 mmol) and stirred at reflux for 2 h. The reaction was 50% complete by TLC, so an additional 6 mL of thionyl chloride was added and continued to stir at reflux overnight. The reaction mixture was then concentrated and the resulting residue was dissolved in ethyl acetate and washed with water then saturated NaCl solution. Chromatography through silica gel using a gradient of 10 to 30% ethyl acetate in hexanes provided 1.38 g of the title compound.

¹H NMR (500 MHz) δ 4.75–4.78 (m, 2H), 3.96 (s, 3H), 3.81 (s, 3H), 3.68–3.73 (m, 2H), 3.38 (s, 3H).

Step E: Preparation of 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylic acid

Methyl 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylate (i.e. the product of Step D) (1.38 g, 4.9 mmol) was dissolved in a dioxane/water solution (8:2). Lithium hydroxide (0.627 g, 14.9 mmol) was added in one portion and the reaction mixture was allowed to stir at room temperature for 2 h, then concentrated. The resulting residue was treated with water and adjusted to pH 2 with the dropwise addition of 1N HCl. The aqueous layer was then extracted with ethyl acetate and concentrated to give 1.22 g of the title compound.

¹H NMR (500 MHz) δ 4.77–4.81 (m, 2H), 3.84 (s, 3H), 3.66–3.76 (m, 2H), 3.39 (s, 3H).

Step F: Preparation of 3-oxo-1-cyclohexen-1-yl 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylate

4-Chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylic acid (i.e. the product of Step E) (1.22 g, 5.34 mmol) was dissolved in a minimum amount of methylene chloride and treated with a drop of *N,N*-dimethylformamide followed by the addition of oxalyl chloride (0.688 mL, 8.02 mmol). This was allowed to stir at room temperature for one hour then concentrated. The residue was redissolved in methylene chloride and added to a stirred solution of cyclohexanedione (0.598 g, 5.34 mmol) and triethylamine (1.12 mL, 8.02 mmol) in dichloromethane and stirred at room temperature

overnight. Purification by silica gel chromatography using a gradient of 30 to 100% ethyl acetate in hexanes afforded 1.14 g of the title compound as a yellow oil.

¹H NMR (500 MHz) δ 6.06 (s, 1H), 4.76–4.82 (m, 2H), 3.84 (s, 3H), 3.69–3.75 (m, 2H), 3.39 (s, 3H), 2.65–2.71 (m, 2H), 2.44–2.50 (m, 1H), 2.10–2.18 (m, 2H).

5 Step G: Preparation of 5-chloro-6[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-4-(2-methoxyethoxy)-2-methyl-3(2*H*)-pyridazinone

3-Oxo-1-cyclohexen-1-yl 4-chloro-1,6-dihydro-5-(2-methoxyethoxy)-1-methyl-6-oxo-3-pyridazinecarboxylate (i.e. the product obtained in Step F) (1.14 g, 3.19 mmol) was dissolved in 15 mL of anhydrous acetonitrile and treated with 4 drops of acetone cyanohydrin. The solution was stirred at room temperature overnight. TLC showed very little product formed, so the reaction mixture was concentrated and re-dissolved in a minimum amount of anhydrous acetonitrile. Cesium fluoride (1.14 g, freshly milled) was added and the mixture was allowed to stir at ambient temperature overnight. The reaction mixture was filtered and washed with acetonitrile. The resulting filtrate was concentrated and absorbed onto silica gel. Chromatography through silica gel eluting with a gradient of 0–50% methanol in dichloromethane afforded 0.050 g of title compound as a yellow solid.

¹H NMR (DMSO-*d*₆) δ 4.53–4.63 (m, 2H), 3.58–3.62 (m, 2H), 3.57 (s, 3H), 3.27 (s, 3H), 2.48–2.52 (m, 2H), 2.33–2.39 (m, 2H), 1.77–1.87 (m, 2H).

SYNTHESIS EXAMPLE 7

20 Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-(2-propen-1-yloxy)-3(2*H*)-pyridazinone (Compound 30)

Step A: Preparation of 1,3-diethyl 2-[2-(2-methoxyacetyl)-2-methylhydrazinylidene]propanedioate

25 An ice-cold solution of 1,3-diethyl-2-(2-methylhydrazinylidene)propanedioate (15.0 g, 75.3 mmol) in tetrahydrofuran (300 mL) was treated with a solution of lithium hexamethyldisilazide (97 mL of a 1.0 M soln in THF, 97.0 mmol), dropwise over 0.5 h. The mixture was maintained at 0 °C for 1 h, and methoxyacetylchloride (8.2 mL, 90.4 mmol) was added in one portion and the mixture allowed to warm to ambient temperature over 16 h. The reaction was quenched with saturated aqueous ammonium chloride solution (100 mL), extracted with ethyl acetate (3 × 100 mL) and the combined organic extracts were washed with water (100 mL), brine (100 mL) then dried (Na₂SO₄), filtered and concentrated to give the title compound as a brown oil (12.3 g):

¹H NMR δ 4.60 (s, 1H), 4.39 (q, 2H, *J* = 7.1 Hz), 4.32 (q, 2H, *J* = 7.1 Hz), 3.49 (s, 3H), 3.35 (s, 3H), 1.37 (t, 3H, *J* = 7.1 Hz), 1.34 (t, 3H, *J* = 7.1 Hz). MS (ESI⁺) 275 (M+H).

35 Step B: Preparation of ethyl 1,6-dihydro-4-hydroxy-5-methoxy-1-methyl-6-oxo-3-pyridazinecarboxylate

Lithium hexamethyldisilazide (73.6 mL of a 1M solution in tetrahydrofuran, 73.6 mmol) was cooled to –78 °C and treated with a solution of 1,3-diethyl 2-[2-(2-

methoxyacetyl)-2-methylhydrazinylidene]propanedioate (i.e. the product obtained in Step A) (12.6 g, 45.9 mmol) in tetrahydrofuran (50 mL), dropwise, over 1 h. The mixture was warmed to -45°C and maintained at this temperature ($\pm 5^{\circ}\text{C}$) for 1.5 h. The reaction was quenched with a previously prepared aqueous HCl solution (100 mL of a 2M solution in MeOH/water: prepared by diluting concentrated aqueous HCl (12N) with methanol), diluted with ethyl acetate (200 mL) and the precipitate was dissolved with water (100 mL). The separated aqueous layer was extracted with ethyl acetate (3×100 mL) and the combined organic extracts washed with water (100 mL), brine (100 mL), then dried (Na_2SO_4), filtered and concentrated. The residue was chromatographed through 120 g silica gel eluting with a gradient of 0% to 100% ethyl acetate in hexanes to give the title compound as a light tan oil (6.62 g).

^1H NMR δ 10.21 (s, 1H), 4.51 (q, 2H, $J = 7.1$ Hz), 4.13 (s, 3H), 3.86 (s, 3H), 1.46 (t, 3H, $J = 7.1$ Hz). MS (ESI+) 229 (M+H).

Step C: Preparation of ethyl 1,6-dihydro-5-methoxy-1-methyl-6-oxo-4-
[[trifluoromethyl)sulfonyl]oxy]-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-4-hydroxy-5-methoxy-1-methyl-6-oxo-3-pyridazinecarboxylate (i.e. the product obtained in Step B) (6.62 g, 29.0 mmol) in dichloromethane (100 mL) was cooled to 0°C and treated with *N,N*-diisopropylethylamine (12.0 mL, 34.8 mmol) and trifluoromethanesulfonic anhydride (6.3 mL, 37.7 mmol). The mixture was allowed to gradually warm to ambient temperature over 16 h, concentrated and chromatographed through 120 g silica gel eluting with, 20% ethyl acetate in hexanes to provide the title compound as a light brown oil (8.48 g).

^1H NMR δ 4.44 (q, 2H, $J = 7.1$ Hz), 4.35 (s, 3H), 3.86 (s, 3H), 1.41 (t, 3H, $J = 7.1$ Hz). MS (ESI+) 361 (M+H).

Step D: Preparation of ethyl 1,6-dihydro-5-methoxy-1,4-dimethyl-6-oxo-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-5-methoxy-1-methyl-6-oxo-4-[[trifluoromethyl)sulfonyl]oxy]-3-pyridazinecarboxylate (i.e. the product obtained in the Step C) (8.48 g, 23.6 mmol) in toluene (50 mL) was treated with tetrakis(triphenyl)phosphine (1.32 g, 1.15 mmol) and dimethyl zinc (26 mL of a 1.0 M solution in tetrahydrofuran, 26.0 mmol) and heated at 80°C for 1 h. The mixture was washed with saturated aqueous sodium bicarbonate solution (50 mL), extracted with ethyl acetate (3×100 mL) and the combined organic extracts were combined and washed with water (100 mL), brine (100 mL), dried (Na_2SO_4), filtered and concentrated. The residue was chromatographed through 80 g silica gel eluting with a gradient of 0% to 40% ethyl acetate in hexanes to provide the title compound as a brown oil (4.7 g).

^1H NMR δ 4.40 (q, 2H, $J = 7.1$ Hz), 4.13 (s, 3H), 3.82 (s, 3H), 2.28 (s, 3H), 1.40 (t, 3H, $J = 7.1$ Hz). MS (ESI+) 227 (M+H).

Step E: Preparation of ethyl 1,6-dihydro-5-hydroxy-1,4-dimethyl-6-oxo-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-5-methoxy-1,4-dimethyl-6-oxo-3-pyridazinecarboxylate (i.e. the product obtained in the Step D) (134 mg, 0.593 mmol) in dichloromethane (6 mL) was cooled to 0 °C and treated dropwise with boron tribromide (0.712 mL of a 1.0 M solution in dichloromethane, 0.712 mmol). The mixture was maintained at 0 °C for 1 h, quenched with saturated aqueous sodium bicarbonate (10 mL) and extracted with dichloromethane (3 × 50 mL). The combined organic fractions were dried (Na₂SO₄), filtered, concentrated and the resulting residue chromatographed through 12 g silica gel eluting with 0% to 100% ethyl acetate in hexanes to provide the title compound as an off-white solid (68.7 mg).

¹H NMR δ 4.41 (q, 2H, *J* = 7.1 Hz), 3.87 (s, 3H), 2.31 (s, 3H), 1.41 (t, 3H, *J* = 7.1 Hz). MS (ESI+) 213 (M+H).

Step F: Preparation of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-(2-propen-1-yloxy)-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-5-hydroxy-1,4-dimethyl-6-oxo-3-pyridazinecarboxylate (i.e. the product obtained in the Step E) (68.7 mg, 0.324 mmol) in acetone (10 mL) was treated with potassium carbonate (134 mg, 0.972 mmol) and allyl bromide (56 µL, 0.648 mmol). The mixture was heated to reflux for 3 h, cooled to ambient temperature, diluted with dichloromethane (50 mL) and water (50 mL). The separated organic fraction was washed with water (50 mL), dried (Na₂SO₄), filtered and concentrated to give the title compound as a light brown oil (68.7 mg).

¹H NMR δ 6.06–5.96 (m, 1H), 5.38–5.33 (m, 1H), 5.26–5.22 (m, 1H), 4.98–4.96 (m, 1H), 4.39 (q, 2H, *J* = 7.1 Hz), 3.82 (s, 3H), 2.30 (s, 3H), 1.40 (t, 3H, *J* = 7.1 Hz). MS (ESI+) 253 (M+H).

Step G: Preparation of 6-[(2-Hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-(2-propen-1-yloxy)-3(2*H*)-pyridazinone

A solution of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-(2-propen-1-yloxy)-3-pyridazinecarboxylate (i.e. the product obtained in the Step F) (278 mg, 1.10 mmol) in tetrahydrofuran (2.2 mL) was diluted with methanol (2.2 mL) and treated with sodium hydroxide (2.2 mL of a 1N aqueous solution). The mixture was stirred at ambient temperature for 1 h, diluted with water (50 mL) and washed with ethyl acetate (10 mL). The aqueous fraction was acidified with HCl (5 mL of a 1N aq. soln), extracted with dichloromethane/methanol (3 × 50 mL of a 4:1 v/v solution), dried (Na₂SO₄), filtered and concentrated to give 1,6-dihydro-1,4-dimethyl-6-oxo-5-(2-propen-1-yloxy)-3-pyridazinecarboxylic acid as a white solid (204 mg). MS (ESI+) 225 (M+H).

The carboxylic acid (204 mg, 0.911 mmol) obtained above was dissolved in tetrahydrofuran (5 mL), treated with 2-chloro-1-methylpyridin-1-ium iodide (349 mg, 1.37

mmol), 1,3-cyclohexanedione (112 mg, 1.00 mmol) and *N,N*-diisopropylethylamine (464 μ L, 2.73 mmol). The mixture was heated at 50 °C for 16 h, cooled to ambient temperature, diluted with water (10 mL) and extracted with ethyl acetate (3 $\times$ 50 mL). The combined organic extracts were washed with water (50 mL), brine (50 mL), dried (Na_2SO_4), filtered and concentrated to give a residue which was chromatographed through 12 g silica-gel eluting with 0% to 50% ethyl acetate in hexanes to give 215 mg of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-6-oxo-5-(2-propen-1-yloxy)-3-pyridazinecarboxylate as a yellow oil.

^1H NMR δ 6.07–5.96 (m, 2H), 5.40–5.34 (m, 1H), 5.28–5.24 (m, 1H), 5.00 (d, 2H, J = 15.7 Hz), 3.86 (s, 3H), 2.69–2.63 (m, 2H), 2.48–2.44 (m, 2H), 2.36 (s, 3H), 2.17–2.09 (m, 2H). MS (ESI+) 319 (M+H).

The enol ester (215 mg, 0.676 mmol) thus obtained was dissolved in acetonitrile (5 mL) and treated with potassium cyanide (44 mg, 0.676 mmol), triethylamine (94 μ L) and acetone (2 drops). The mixture was stirred at ambient temperature for 2 h and the precipitated solids dissolved in methanol (1 mL). The resulting solution was concentrated onto silica-gel and chromatographed through 12 g silica gel eluting with 0% to 20% methanol in dichloromethane to give a residue which was further purified by C18 chromatography to obtain the title compound, a compound of the present invention as a yellow gum (101 mg).

^1H NMR δ 6.09 (m, 1H), 5.41–5.34 (m, 1H), 5.26–5.22 (m, 1H), 5.02–4.96 (m, 2H), 3.71 (s, 3H), 2.61 (br s, 4H), 2.11 (m, 2H), 2.02 (s, 3H). MS (ESI+) 319 (M+H).

SYNTHESIS EXAMPLE 8

Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-(4-morpholinyl)-3(2*H*)-pyridazinone (Compound 42)

Step A: Preparation of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-[[[(trifluoromethyl)sulfonyl]oxy]-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-5-hydroxy-1,4-dimethyl-6-oxo-3-pyridazinecarboxylate (i.e. the product obtained in Step E in Synthesis Example 7 above) (800 mg, 3.77 mmol) in dichloromethane (20 mL) was cooled to 0 °C and treated with trifluoromethanesulfonic anhydride (824 μ L, 4.91 mmol) and *N,N*-diisopropylethylamine (1.6 mL, 4.52 mmol). The mixture was maintained at 0 °C for 4 h, concentrated and chromatographed through 40 g silica gel eluting with 20% ethyl acetate in hexanes to give the title compound as a brown oil (1.05 g).

^1H NMR δ 4.30 (q, 2H, J = 7.1 Hz), 3.92 (s, 3H), 2.47 (s, 3H), 1.42 (t, 3H, J = 7.1 Hz). MS (AP+) 345 (M+H).

Step B: Preparation of ethyl 1,6-dihydro-1,4-dimethyl-5-(4-morpholinyl)-6-oxo-3-pyridazinecarboxylate

A solution of ethyl 1,6-dihydro-1,4-dimethyl-6-oxo-5-[[[(trifluoromethyl)sulfonyl]oxy]-3-pyridazinecarboxylate (939 mg, 2.73 mmol) in toluene (10 mL) was treated with morpholine (476 μ L, 5.52 mmol), palladium acetate (60 mg, 0.27 mmol) and 2-dicyclohexylphosphino-2',4',6'-triisopropylbiphenyl (X-Phos) (258 mg, 0.54 mmol). The mixture was heated at 66 °C for 16 h and cooled to ambient temperature. The mixture was washed with saturated aqueous sodium bicarbonate solution (5 mL), water (5 mL) and brine (5 mL) then dried (Na_2SO_4), filtered and concentrated. The residue was chromatographed through 80 g silica-gel eluting with 0% to 50% ethyl acetate in hexanes to give the title compound as a brown oil (382 mg).

^1H NMR δ 4.40 (q, 2H, $J = 7.1$ Hz), 3.81–3.77 (m, 4H), 3.78 (s, 3H), 3.31 (t, 4H, $J = 4.7$ Hz), 2.29 (s, 3H), 1.40 (t, 3H, $J = 7.1$ Hz). MS (ESI+) 282 (M+H).

Step C: Preparation of 6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-(4-morpholinyl)-3(2H)-pyridazinone

The title compound was prepared using the procedure described in Step G in Synthesis Example 7 through intermediate 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1,4-dimethyl-5-(4-morpholinyl)-6-oxo-3-pyridazinecarboxylate to isolate the title compound, a compound of the present invention.

^1H NMR δ 3.79 (t, 4H, $J = 4.5$ Hz), 3.68 (s, 3H), 3.32 (t, 4H, $J = 4.5$ Hz), 2.81–2.76 (m, 2H), 2.49–2.43 (m, 2H), 2.11–2.04 (m, 2H), 2.02 (s, 3H). MS (ESI+) 348 (M+H).

By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to 140 can be prepared. The following abbreviations are used in the Tables which follow: Me means methyl, Et means ethyl, *n*-Pr means normal propyl, *i*-Pr means isopropyl, *n*-Bu means normal butyl, *i*-Bu means isobutyl, *s*-Bu means secondary butyl, *t*-Bu means tertiary butyl, Ph means phenyl, OMe means methoxy, OEt means ethoxy, SMe means methylthio, SEt means ethylthio, thp means tetrahydropyran, thtp means tetrahydrothiopyran, thf means tetrahydrofuran, -CN means cyano, -NO₂ means nitro, SO₂ means sulfonyl and SO₂Me means methylsulfonyl. The structures of individual "A" substituents in the Tables are depicted in Exhibit 5.

Exhibit 5

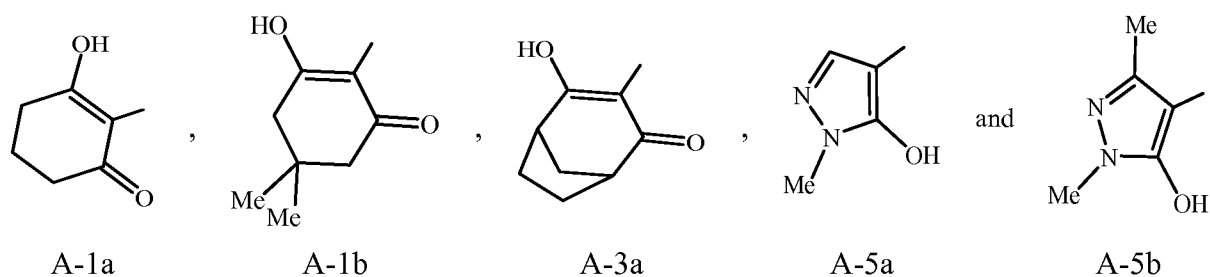
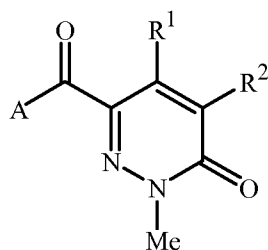


TABLE 1



A is A-1a and R¹ is Me.

R ²	R ²	R ²
Me	CH ₂ OCH ₂ CH ₃	Ph(2,4-di-F)
Et	CH ₂ CH ₂ OCH ₃	Ph(2,5-di-F)
<i>n</i> -Pr	CH ₂ SO ₂ CH ₃	Ph(2,6-di-F)
<i>i</i> -Pr	CH ₂ SCH ₂ CH ₃	CH ₂ CH ₂ CF ₃
cyclopropyl	Ph(2,3-di-OMe)	CH ₂ C≡CH
<i>n</i> -Bu	CH ₂ SO ₂ - <i>n</i> -Pr	Ph(2,3-di-Cl)
<i>i</i> -Bu	CH ₂ CH ₂ SO ₂ Et	Ph(3,5-di-F)
<i>s</i> -Bu	Ph(2,4-di-OMe)	isoxazolin-2-yl
cyclobutyl	Ph(2,5-di-OMe)	Ph(2-Cl)
<i>t</i> -Bu	Ph(2,6-di-OMe)	Ph(3-Cl)
<i>n</i> -pentyl	Ph(3,5-di-OMe)	Ph(4-Cl)
cyclopentyl	CH ₂ Ph(2-OMe)	Ph(2-Me)
<i>n</i> -hexyl	CH ₂ Ph(3-OMe)	Ph(3-Me)
cyclohexyl	CH ₂ Ph(4-OMe)	CH ₂ OCH ₃
Ph	CH ₂ CH ₂ SMe	CH ₂ CH=CH ₂
CH ₂ -cyclopropyl	CH ₂ SCH ₂ Ph	Ph(2-OMe)
CH ₂ -cyclobutyl	CH ₂ SO ₂ Ph	Ph(3-OMe)
CH ₂ SPh	CH ₂ CH ₂ SEt	Ph(4-OMe)
CH ₂ SCH ₃	Ph(2,4-di-Cl)	Ph(2-CN)
CH ₂ CF ₃	Ph(2,5-di-Cl)	Ph(3-CN)
CH ₂ Ph	Ph(2,6-di-Cl)	Ph(4-CN)
Ph(4-Me)	Ph(3,5-di-Cl)	Ph(2-F)
CH ₂ CHC(CH ₃) ₂	Ph(2,3-di-Me)	Ph(3-F)
CH ₂ CH ₂ C≡CH	Ph(2,4-di-Me)	Ph(4-F)
CH ₂ CH=CCl ₂	Ph(2,5-di-Me)	CH ₂ S- <i>n</i> -Pr
CH ₂ CH=CF ₂	Ph(2,6-di-Me)	CH ₂ -cyclopentyl
CH ₂ CF=CF ₂	Ph(3,5-di-Me)	oxazolin-2-yl
CH ₂ CCl=CCl ₂	CH ₂ -cyclohexyl	2-pyridinyl
CH ₂ C≡CCH ₃	Ph(2,3-di-F)	3-pyridinyl

R ²	R ²	R ²
4-pyridinyl	CH ₂ (3-methylisoxazol-5-yl)	Ph(3-OCF ₃)
Ph(2-NO ₂)	5-methylisoxazol-3-yl	Ph(4-OCF ₃)
Ph(3-NO ₂)	4-methyloxazol-2-yl	Ph(2-Me-3-F)
Ph(4-NO ₂)	4-methylthiazol-2-yl	Ph(2-Me-4-F)
Ph(2-CF ₃)	CH ₂ CH ₂ CH=CH ₂	Ph(2-Me-5-F)
Ph(3-CF ₃)	CH ₂ SO ₂ CH ₂ CH ₃	Ph(2-F-3-Me)
Ph(4-CF ₃)	CH ₂ CH ₂ SO ₂ Me	Ph(2-F-4-Me)
Ph(2-Br)	CH ₂ OCH ₂ OCH ₃	Ph(2-F-5-Me)
Ph(3-Br)	3-methylthiazol-2-yl	Ph(3-F-4-Me)
Ph(4-Br)	5-chloropyridin-2-yl	Ph(3-F-5-Me)
CH ₂ Ph(2-Me)	5-methylpyridin-2-yl	Ph(3-Me-4-F)
CH ₂ Ph(3-Me)	5-methoxypyridin-2-yl	CH ₂ CH ₂ CH ₂ OCH ₃
CH ₂ Ph(4-Me)	6-methylpyridin-2-yl	CH ₂ CH ₂ CH ₂ OCH ₂ CH ₃
Cl	6-methylpyridin-3-yl	CH ₂ (thp-2-yl)
CN	3-methoxypyridin-4-yl	CH ₂ (thp-4-yl)
CHO	3-methylpyridin-4-yl	CH ₂ CH ₂ CH=CH ₂
OEt	3-chloropyridin-4-yl	CH ₂ C≡CH
O- <i>i</i> -Pr	CH ₂ OCH ₂ CH ₂ OCH ₃	CH ₂ CH ₂ SCH ₃
O- <i>n</i> -Bu	CH ₂ C(CH ₃)=C(CH ₃) ₂	CH ₂ CH ₂ SOCH ₃
O- <i>n</i> -Pr	<i>n</i> -heptyl	CH ₂ CH ₂ SO ₂ CH ₃
O- <i>t</i> -Bu	cycloheptyl	CH ₂ CH ₂ CH ₂ SCH ₃
O- <i>c</i> -pentyl	thp-4-yl	CH ₂ CH ₂ CH ₂ SOCH ₃
O- <i>c</i> -hexyl	thtp-4-yl	CH ₂ CH ₂ CH ₂ SO ₂ CH ₃
1-piperidinyl	Ph(2,3-di-OMe)	cyclohexyl(3-OCH ₃)
OCH ₂ CF ₃	Ph(3,4-di-OMe)	cyclohexyl(4-OCH ₃)
CH ₂ Ph(2-Cl)	Ph(3,4-di-Me)	cyclohexyl(3,4-di-OCH ₃)
CH ₂ Ph(3-Cl)	Ph(3,4-di-F)	cyclohexyl(3,5-di-OCH ₃)
CH ₂ Ph(4-Cl)	Ph(3,4,5-tri-OMe)	OCH ₂ CH ₂ OCH ₃
thiazol-3-yl	Ph(2-I)	Ph(3-OEt)
thiazol-2-yl	Ph(3-I)	Ph(4-OEt)
thiazolin-2-yl	Ph(4-I)	Ph(3,4-di-OEt)
oxazol-2-yl	Ph(2-Et)	Ph(3,5-di-OEt)
CH ₂ CF ₂ CF ₃	Ph(3-Et)	Ph(3,4,5-tri-OEt)
CH=CH ₂	Ph(4-Et)	Ph(3-OCH ₂ CH=CH ₂)
CH ₂ (thf-2-yl)	CH ₂ CH ₂ OCH ₂ CH ₃	Ph(4-OCH ₂ CH=CH ₂)
CH ₂ (3-methylisoxazolin-5-yl)	CH(CH ₃)CH ₂ OCH ₃	cyclohexyl(3-OEt)
isoxazolin-4-yl	Ph(2-OCF ₃)	cyclohexyl(4-OEt)

R ²	R ²	R ²
cyclohexyl(3-Me)	CH(CH ₃)Ph	O- <i>c</i> -Pr
cyclohexyl(4-Me)	4,6-dimethoxypyrimidin-2-yl	O- <i>i</i> -Bu
cyclohexyl(4,4-di-Me)	4,6-dimethoxytriazin-2-yl	O- <i>c</i> -Bu
-CH ₂ CH(OCH ₃)CH ₂ OCH ₃	4,6-diethoxypyrimidin-2-yl	O- <i>n</i> -pentyl
-CH(CH ₂ OCH ₃) ₂	4,6-diethoxytriazine-2-yl	O- <i>n</i> -hexyl
-CH ₂ CH(OCH ₂ CH ₃)CH ₂ OEt	Br	1-morpholino
-CH(CH ₃)CH ₂ OCH ₃	NO ₂	1-pyrrolidinyl
-CH(CH ₂ OCH ₂ CH ₃)	OMe	
-CH ₂ CH ₂ OCH ₂ CH ₂ OCH ₃	O- <i>n</i> -Pr	

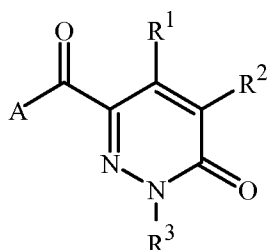
The present disclosure also includes Tables 2 through 100, each of which is constructed the same as Table 1 above except that the row heading in Table 1 (i.e. “A is A-1a and R¹ is Me.”) is replaced with the respective row headings shown below. For example, in Table 2 the row heading is “A is A-1a and R¹ is Cl.”, and R² is as defined in Table 1 above. Thus, the first entry in Table 2 specifically discloses 5-chloro-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,4-dimethyl-3(2*H*)-pyridazinone.

TABLES 2–100

Table	Row Heading	Table	Row Heading
2	A is A-1a, R ¹ is Cl.	52	A is A-3a, R ¹ is SMe.
3	A is A-1a, R ¹ is Br.	53	A is A-3a, R ¹ is SCH ₂ CF ₃ .
4	A is A-1a, R ¹ is F.	54	A is A-3a, R ¹ is SCHF ₂ .
5	A is A-1a, R ¹ is Et.	55	A is A-3a, R ¹ is SMe.
6	A is A-1a, R ¹ is CF ₃ .	56	A is A-3a, R ¹ is SO ₂ Me.
7	A is A-1a, R ¹ is OMe.	57	A is A-3a, R ¹ is CH ₂ OCH ₂ CH ₂ OMe.
8	A is A-1a, R ¹ is OCH ₂ CF ₃ .	58	A is A-3a, R ¹ is <i>c</i> -Pr.
9	A is A-1a, R ¹ is O-allyl.	59	A is A-3a, R ¹ is NMe ₂ .
10	A is A-1a, R ¹ is OCH ₂ CH ₂ OMe.	60	A is A-3a, R ¹ is NO ₂ .
11	A is A-1a, R ¹ is OCH ₂ CN.	61	A is A-5a, R ¹ is Me.
12	A is A-1a, R ¹ is SMe.	62	A is A-5a, R ¹ is Cl.
13	A is A-1a, R ¹ is SCH ₂ CF ₃ .	63	A is A-5a, R ¹ is Br.
14	A is A-1a, R ¹ is SCHF ₂ .	64	A is A-5a, R ¹ is F.
15	A is A-1a, R ¹ is SMe.	65	A is A-5a, R ¹ is Et.
16	A is A-1a, R ¹ is SO ₂ Me.	66	A is A-5a, R ¹ is CF ₃ .
17	A is A-1a, R ¹ is CH ₂ OCH ₂ CH ₂ OMe.	67	A is A-5a, R ¹ is OMe.
18	A is A-1a, R ¹ is <i>c</i> -Pr.	68	A is A-5a, R ¹ is OCH ₂ CF ₃ .
19	A is A-1a, R ¹ is NMe ₂ .	69	A is A-5a, R ¹ is O-allyl.
20	A is A-1a, R ¹ is NO ₂ .	70	A is A-5a, R ¹ is OCH ₂ CH ₂ OMe.

21	A is A-1b, R ¹ is Cl.	71	A is A-5a, R ¹ is OCH ₂ CN.
22	A is A-1b, R ¹ is Br.	72	A is A-5a, R ¹ is SMe.
23	A is A-1b, R ¹ is F.	73	A is A-5a, R ¹ is SCH ₂ CF ₃ .
24	A is A-1b, R ¹ is Et.	74	A is A-5a, R ¹ is SCHF ₂ .
25	A is A-1b, R ¹ is CF ₃ .	75	A is A-5a, R ¹ is SMe.
26	A is A-1b, R ¹ is OMe.	76	A is A-5a, R ¹ is SO ₂ Me.
27	A is A-1b, R ¹ is OCH ₂ CF ₃ .	77	A is A-5a, R ¹ is CH ₂ OCH ₂ CH ₂ OMe.
28	A is A-1b, R ¹ is O-allyl.	78	A is A-5a, R ¹ is <i>c</i> -Pr.
29	A is A-1b, R ¹ is OCH ₂ CH ₂ OMe.	79	A is A-5a, R ¹ is NMe ₂ .
30	A is A-1b, R ¹ is OCH ₂ CN.	80	A is A-5a, R ¹ is NO ₂ .
31	A is A-1b, R ¹ is SMe.	81	A is A-5b, R ¹ is Me.
32	A is A-1b, R ¹ is SCH ₂ CF ₃ .	82	A is A-5b, R ¹ is Cl.
33	A is A-1b, R ¹ is SCHF ₂ .	83	A is A-5b, R ¹ is Br.
34	A is A-1b, R ¹ is SMe.	84	A is A-5b, R ¹ is F.
35	A is A-1b, R ¹ is SO ₂ Me.	85	A is A-5b, R ¹ is Et.
36	A is A-1b, R ¹ is CH ₂ OCH ₂ CH ₂ OMe.	86	A is A-5b, R ¹ is CF ₃ .
37	A is A-1b, R ¹ is <i>c</i> -Pr.	87	A is A-5b, R ¹ is OMe.
38	A is A-1b, R ¹ is NMe ₂ .	88	A is A-5b, R ¹ is OCH ₂ CF ₃ .
39	A is A-1b, R ¹ is NO ₂ .	89	A is A-5b, R ¹ is O-allyl.
40	A is A-1b, R ¹ is Me.	90	A is A-5b, R ¹ is OCH ₂ CH ₂ OMe.
41	A is A-3a, R ¹ is Me.	91	A is A-5b, R ¹ is OCH ₂ CN.
42	A is A-3a, R ¹ is Cl.	92	A is A-5b, R ¹ is SMe.
43	A is A-3a, R ¹ is Br.	93	A is A-5b, R ¹ is SCH ₂ CF ₃ .
44	A is A-3a, R ¹ is F.	94	A is A-5b, R ¹ is SCHF ₂ .
45	A is A-3a, R ¹ is Et.	95	A is A-5b, R ¹ is SMe.
46	A is A-3a, R ¹ is CF ₃ .	96	A is A-5b, R ¹ is SO ₂ Me.
47	A is A-3a, R ¹ is OMe.	97	A is A-5b, R ¹ is CH ₂ OCH ₂ CH ₂ OMe.
48	A is A-3a, R ¹ is OCH ₂ CF ₃ .	98	A is A-5b, R ¹ is <i>c</i> -Pr.
49	A is A-3a, R ¹ is O-allyl.	99	A is A-5b, R ¹ is NMe ₂ .
50	A is A-3a, R ¹ is OCH ₂ CH ₂ OMe.	100	A is A-5b, R ¹ is NO ₂ .
51	A is A-3a, R ¹ is OCH ₂ CN.		

TABLE 101



A is A-1a, R¹ is Me and R³ is Et.

R ²	R ²	R ²
Me	Ph(2,4-di-OMe)	CH ₂ CH=CH ₂
Et	Ph(2,5-di-OMe)	Ph(2-OMe)
<i>n</i> -Pr	Ph(2,6-di-OMe)	Ph(3-OMe)
<i>i</i> -Pr	Ph(3,5-di-OMe)	Ph(4-OMe)
cyclopropyl	CH ₂ Ph(2-OMe)	Ph(2-CN)
<i>n</i> -Bu	CH ₂ Ph(3-OMe)	Ph(3-CN)
<i>i</i> -Bu	CH ₂ Ph(4-OMe)	Ph(4-CN)
<i>s</i> -Bu	CH ₂ CH ₂ SMe	Ph(2-F)
cyclobutyl	CH ₂ SCH ₂ Ph	Ph(3-F)
<i>t</i> -Bu	CH ₂ SO ₂ Ph	Ph(4-F)
<i>n</i> -pentyl	CH ₂ CH ₂ SEt	CH ₂ S- <i>n</i> -Pr
cyclopentyl	Ph(2,4-di-Cl)	CH ₂ -cyclopentyl
<i>n</i> -hexyl	Ph(2,5-di-Cl)	oxazolin-2-yl
cyclohexyl	Ph(2,6-di-Cl)	2-pyridinyl
Ph	Ph(3,5-di-Cl)	3-pyridinyl
CH ₂ -cyclopropyl	Ph(2,3-di-Me)	4-pyridinyl
CH ₂ -cyclobutyl	Ph(2,4-di-Me)	Ph(2-NO ₂)
CH ₂ SPh	Ph(2,5-di-Me)	Ph(3-NO ₂)
CH ₂ SCH ₃	Ph(2,6-di-Me)	Ph(4-NO ₂)
CH ₂ CF ₃	Ph(3,5-di-Me)	Ph(2-CF ₃)
CH ₂ Ph	CH ₂ -cyclohexyl	Ph(3-CF ₃)
Ph(4-Me)	Ph(2,3-di-F)	Ph(4-CF ₃)
CH ₂ CHC(CH ₃) ₂	Ph(2,4-di-F)	Ph(2-Br)
CH ₂ CH ₂ C≡CH	Ph(2,5-di-F)	Ph(3-Br)
CH ₂ CH=CCl ₂	Ph(2,6-di-F)	Ph(4-Br)
CH ₂ CH=CF ₂	CH ₂ CH ₂ CF ₃	CH ₂ Ph(2-Me)
CH ₂ CF=CF ₂	CH ₂ C≡CH	CH ₂ Ph(3-Me)
CH ₂ CCl=CCl ₂	Ph(2,3-di-Cl)	CH ₂ Ph(4-Me)
CH ₂ C≡CCH ₃	Ph(3,5-di-F)	Cl
CH ₂ OCH ₂ CH ₃	isoxazolin-2-yl	CN
CH ₂ CH ₂ OCH ₃	Ph(2-Cl)	CHO
CH ₂ SO ₂ CH ₃	Ph(3-Cl)	OEt
CH ₂ SCH ₂ CH ₃	Ph(4-Cl)	O- <i>i</i> -Pr
Ph(2,3-di-OMe)	Ph(2-Me)	O- <i>n</i> -Bu
CH ₂ SO ₂ - <i>n</i> -Pr	Ph(3-Me)	O- <i>n</i> -Pr
CH ₂ CH ₂ SO ₂ Et	CH ₂ OCH ₃	O- <i>t</i> -Bu

R ²	R ²	R ²
O- <i>c</i> -pentyl	thp-4-yl	CH ₂ CH ₂ CH ₂ SOCH ₃
O- <i>c</i> -hexyl	thtp-4-yl	CH ₂ CH ₂ CH ₂ SO ₂ CH ₃
1-piperidiny	Ph(2,3-di-OMe)	cyclohexyl(3-OCH ₃)
OCH ₂ CF ₃	Ph(3,4-di-OMe)	cyclohexyl(4-OCH ₃)
CH ₂ Ph(2-Cl)	Ph(3,4-di-Me)	cyclohexyl(3,4-di-OCH ₃)
CH ₂ Ph(3-Cl)	Ph(3,4-di-F)	cyclohexyl(3,5-di-OCH ₃)
CH ₂ Ph(4-Cl)	Ph(3,4,5-tri-OMe)	OCH ₂ CH ₂ OCH ₃
thiazol-3-yl	Ph(2-I)	Ph(3-OEt)
thiazol-2-yl	Ph(3-I)	Ph(4-OEt)
thiazolin-2-yl	Ph(4-I)	Ph(3,4-di-OEt)
oxazol-2-yl	Ph(2-Et)	Ph(3,5-di-OEt)
CH ₂ CF ₂ CF ₃	Ph(3-Et)	Ph(3,4,5-tri-OEt)
CH=CH ₂	Ph(4-Et)	Ph(3-OCH ₂ CH=CH ₂)
CH ₂ (thf-2-yl)	CH ₂ CH ₂ OCH ₂ CH ₃	Ph(4-OCH ₂ CH=CH ₂)
CH ₂ (3-methylisoxazolin-5-yl)	CH(CH ₃)CH ₂ OCH ₃	cyclohexyl(3-OEt)
isoxazolin-4-yl	Ph(2-OCF ₃)	cyclohexyl(4-OEt)
CH ₂ (3-methylisoxazol-5-yl)	Ph(3-OCF ₃)	cyclohexyl(3-Me)
5-methylisoxazol-3-yl	Ph(4-OCF ₃)	cyclohexyl(4-Me)
4-methyloxazol-2-yl	Ph(2-Me-3-F)	cyclohexyl(4,4-di-Me)
4-methylthiazol-2-yl	Ph(2-Me-4-F)	-CH ₂ CH(OCH ₃)CH ₂ OCH ₃
CH ₂ CH ₂ CH=CH ₂	Ph(2-Me-5-F)	-CH(CH ₂ OCH ₃) ₂
CH ₂ SO ₂ CH ₂ CH ₃	Ph(2-F-3-Me)	-CH ₂ CH(OCH ₂ CH ₃)CH ₂ OEt
CH ₂ CH ₂ SO ₂ Me	Ph(2-F-4-Me)	-CH(CH ₃)CH ₂ OCH ₃
CH ₂ OCH ₂ OCH ₃	Ph(2-F-5-Me)	-CH(CH ₂ OCH ₂ CH ₃)
3-methylthiazol-2-yl	Ph(3-F-4-Me)	-CH ₂ CH ₂ OCH ₂ CH ₂ OCH ₃
5-chloropyridin-2-yl	Ph(3-F-5-Me)	CH(CH ₃)Ph
5-methylpyridin-2-yl	Ph(3-Me-4-F)	4,6-dimethoxypyrimidin-2-yl
5-methoxypyridin-2-yl	CH ₂ CH ₂ CH ₂ OCH ₃	4,6-dimethoxytriazin-2-yl
6-methylpyridin-2-yl	CH ₂ CH ₂ CH ₂ OCH ₂ CH ₃	4,6-diethoxypyrimidin-2-yl
6-methylpyridin-3-yl	CH ₂ (thp-2-yl)	4,6-diethoxytriazine-2-yl
3-methoxypyridin-4-yl	CH ₂ (thp-4-yl)	Br
3-methylpyridin-4-yl	CH ₂ CH ₂ CH=CH ₂	NO ₂
3-chloropyridin-4-yl	CH ₂ C≡CH	OMe
CH ₂ OCH ₂ CH ₂ OCH ₃	CH ₂ CH ₂ SCH ₃	O- <i>n</i> -Pr
CH ₂ C(CH ₃)=C(CH ₃) ₂	CH ₂ CH ₂ SOCH ₃	O- <i>c</i> -Pr
<i>n</i> -heptyl	CH ₂ CH ₂ SO ₂ CH ₃	O- <i>i</i> -Bu
cycloheptyl	CH ₂ CH ₂ CH ₂ SCH ₃	O- <i>c</i> -Bu

R ²	R ²
O- <i>n</i> -pentyl	1-pyrrolidinyl
O- <i>n</i> -hexyl	
1-morpholino	

The present disclosure also includes Tables 102 through 140, each of which is constructed the same as Table 101 above except that the row heading in Table 1 (i.e. “A is A-1a, R¹ is Me and R³ is Et.”) is replaced with the respective row headings shown below. For example, in Table 102 the row heading is “A is A-1a, R¹ is Me and R³ is *n*-Pr.”, and R² is as defined in Table 1 above. Thus, the first entry in Table 102 specifically discloses 6-[(2-

5

Table	Row Heading	Table	Row Heading
102	A is A-1a, R ¹ is Me, R ³ is <i>n</i> -Pr.	122	A is A-1a, R ¹ is Cl, R ³ is <i>n</i> -Pr.
103	A is A-1a, R ¹ is Me, R ³ is <i>n</i> -Bu.	123	A is A-1a, R ¹ is Cl, R ³ is <i>n</i> -Bu.
104	A is A-1a, R ¹ is Me, R ³ is <i>c</i> -Pr.	124	A is A-1a, R ¹ is Cl, R ³ is <i>c</i> -Pr.
105	A is A-1a, R ¹ is Me, R ³ is <i>c</i> -hexyl.	125	A is A-1a, R ¹ is Cl, R ³ is <i>c</i> -hexyl.
106	A is A-1a, R ¹ is Me, R ³ is CH ₂ CF ₃ .	126	A is A-1a, R ¹ is Cl, R ³ is CH ₂ CF ₃ .
107	A is A-1a, R ¹ is Me, R ³ is CH ₂ CH ₂ OMe.	127	A is A-1a, R ¹ is Cl, R ³ is CH ₂ CH ₂ OMe.
108	A is A-1a, R ¹ is Me, R ³ is allyl.	128	A is A-1a, R ¹ is Cl, R ³ is allyl.
109	A is A-1a, R ¹ is Me, R ³ is propargyl.	129	A is A-1a, R ¹ is Cl, R ³ is propargyl.
110	A is A-1a, R ¹ is Me, R ³ is <i>i</i> -Pr.	130	A is A-1a, R ¹ is Cl, R ³ is <i>i</i> -Pr.
111	A is A-1a, R ¹ is CF ₃ , R ³ is Et.	131	A is A-1a, R ¹ is OMe, R ³ is Et.
112	A is A-1a, R ¹ is CF ₃ , R ³ is <i>n</i> -Pr.	132	A is A-1a, R ¹ is OMe, R ³ is <i>n</i> -Pr.
113	A is A-1a, R ¹ is CF ₃ , R ³ is <i>n</i> -Bu.	133	A is A-1a, R ¹ is OMe, R ³ is <i>n</i> -Bu.
114	A is A-1a, R ¹ is CF ₃ , R ³ is <i>c</i> -Pr.	134	A is A-1a, R ¹ is OMe, R ³ is <i>c</i> -Pr.
115	A is A-1a, R ¹ is CF ₃ , R ³ is <i>c</i> -hexyl.	135	A is A-1a, R ¹ is OMe, R ³ is <i>c</i> -hexyl.
116	A is A-1a, R ¹ is CF ₃ , R ³ is CH ₂ CF ₃ .	136	A is A-1a, R ¹ is OMe, R ³ is CH ₂ CF ₃ .
117	A is A-1a, R ¹ is CF ₃ , R ³ is CH ₂ CH ₂ OMe.	137	A is A-1a, R ¹ is OMe, R ³ is CH ₂ CH ₂ OMe.
118	A is A-1a, R ¹ is CF ₃ , R ³ is allyl.	138	A is A-1a, R ¹ is OMe, R ³ is allyl.
119	A is A-1a, R ¹ is CF ₃ , R ³ is propargyl.	139	A is A-1a, R ¹ is OMe, R ³ is propargyl.
120	A is A-1a, R ¹ is CF ₃ , R ³ is <i>i</i> -Pr.	140	A is A-1a, R ¹ is OMe, R ³ is <i>i</i> -Pr.
121	A is A-1a, R ¹ is Cl, R ³ is Et.		

Formulation/Utility

A compound of Formula 1 of this invention (including *N*-oxides and salts thereof) 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 serve as a carrier. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature.

10

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

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

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

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

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

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

Liquid diluents include, for example, water, *N,N*-dimethylalkanamides (e.g., *N,N*-dimethylformamide), limonene, dimethyl sulfoxide, *N*-alkylpyrrolidones (e.g., *N*-methylpyrrolidinone), 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 and γ -butyrolactone, and alcohols, which can be linear, branched, saturated or unsaturated, such as methanol, ethanol, *n*-propanol, isopropyl alcohol, *n*-butanol, isobutyl alcohol, *n*-hexanol, 2-ethylhexanol, *n*-octanol, decanol, isodecyl alcohol, isooctadecanol, cetyl alcohol, lauryl alcohol, tridecyl alcohol, oleyl alcohol, cyclohexanol, tetrahydrofurfuryl alcohol, diacetone alcohol and benzyl alcohol. Liquid diluents also include glycerol esters of saturated and unsaturated fatty acids (typically C₆–C₂₂), such as plant seed and fruit oils (e.g., oils of olive, castor, linseed, sesame, corn (maize), peanut, sunflower, grapeseed, safflower, cottonseed, soybean, rapeseed, coconut and palm kernel), animal-sourced fats (e.g., beef tallow, pork tallow, lard, cod liver oil, fish oil), and mixtures thereof. Liquid diluents also include alkylated fatty acids (e.g., methylated, ethylated, butylated) wherein the fatty acids may be obtained by hydrolysis of glycerol esters from plant and animal sources, and can be purified by distillation. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950.

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

Surfactants can be classified as nonionic, anionic or cationic. Nonionic surfactants useful for the present compositions include, but are not limited to: alcohol alkoxylates such as alcohol alkoxylates based on natural and synthetic alcohols (which may be branched or linear) and prepared from the alcohols and ethylene oxide, propylene oxide, butylene oxide or mixtures thereof; amine ethoxylates, alkanolamides and ethoxylated alkanolamides;

alkoxylated triglycerides such as ethoxylated soybean, castor and rapeseed oils; alkylphenol alkoxylates such as octylphenol ethoxylates, nonylphenol ethoxylates, dinonyl phenol ethoxylates and dodecyl phenol ethoxylates (prepared from the phenols and ethylene oxide, propylene oxide, butylene oxide or mixtures thereof); block polymers prepared from ethylene oxide or propylene oxide and reverse block polymers where the terminal blocks are prepared from propylene oxide; ethoxylated fatty acids; ethoxylated fatty esters and oils; ethoxylated methyl esters; ethoxylated tristyrylphenol (including those prepared from ethylene oxide, propylene oxide, butylene oxide or mixtures thereof); fatty acid esters, glycerol esters, lanolin-based derivatives, polyethoxylate esters such as polyethoxylated sorbitan fatty acid esters, polyethoxylated sorbitol fatty acid esters and polyethoxylated glycerol fatty acid esters; other sorbitan derivatives such as sorbitan esters; polymeric surfactants such as random copolymers, block copolymers, 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 alkyl dimethylamine oxides and bis-(2-hydroxyethyl)-alkylamine oxides.

Also useful for the present compositions are mixtures of nonionic and anionic surfactants or mixtures of nonionic and cationic surfactants. Nonionic, anionic and cationic surfactants and their recommended uses are disclosed in a variety of published references including *McCutcheon's Emulsifiers and Detergents*, annual American and International

Editions published by McCutcheon's Division, The Manufacturing Confectioner Publishing Co.; Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964; and A. S. Davidson and B. Milwidsky, *Synthetic Detergents*, Seventh Edition, John Wiley and Sons, New York, 1987.

5 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
10 (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
15 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
20 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,
25 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
30 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,
35 and WO 91/13546. Pellets can be prepared as described in U.S. 4,172,714. Water-dispersible and water-soluble granules can be prepared as taught in U.S. 4,144,050, U.S. 3,920,442 and DE 3,246,493. Tablets can be prepared as taught in U.S. 5,180,587, U.S. 5,232,701 and U.S. 5,208,030. Films can be prepared as taught in GB 2,095,558 and U.S. 3,299,566.

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

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways. Compound numbers refer to compounds in Index Table A. Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Percentages are by weight except where otherwise indicated.

Example A: High Strength Concentrate

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

Example B: Wettable Powder

Compound 2	65.0%
dodecylphenol polyethylene glycol ether	2.0%
sodium ligninsulfonate	4.0%
sodium silicoaluminate	6.0%
montmorillonite (calcined)	23.0%

Example C: Granule

Compound 3	10.0%
attapulgit granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25–50 sieves)	90.0%

Example D: Extruded Pellet

Compound 4	25.0%
anhydrous sodium sulfate	10.0%
crude calcium ligninsulfonate	5.0%
sodium alkyl naphthalenesulfonate	1.0%
calcium/magnesium bentonite	59.0%

Example E: Emulsifiable Concentrate

Compound 5	10.0%
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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%

These compounds generally show highest activity for early postemergence weed control (i.e. applied when the emerged weed seedlings are still young) 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 not limited to, alfalfa, barley, cotton, wheat, rape, sugar beets, corn (maize), sorghum, soybeans, rice, oats, peanuts, vegetables, tomato, potato, perennial plantation crops including coffee, cocoa, oil palm, rubber, sugarcane, citrus, grapes, fruit trees, nut trees, banana, plantain, pineapple, hops, tea and forests such as eucalyptus and conifers (e.g., loblolly pine), and turf species (e.g., Kentucky bluegrass, St. Augustine grass, Kentucky fescue and Bermuda grass). Compounds of the invention are particularly useful for selective control of weeds in wheat, barley, and particularly maize, soybean, cotton and perennial plantation crops such as sugarcane and citrus. 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 postemergent and preemergent 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 a compound of this invention is about 0.001 to 20 kg/ha with a typical 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.

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

A mixture of one or more of the following herbicides with a compound of this invention may be particularly useful for weed control: acetochlor, acifluorfen and its sodium salt, aclonifen, acrolein (2-propenal), alachlor, alloxymid, ametryn, amicarbazone, amidosulfuron, aminocyclopyrachlor and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridine-carboxylic acid and its esters (e.g., methyl) 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,
 5 chlorotoluron, chlorpropham, chloresulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, clacifyos (1-(dimethoxyphosphinyl)ethyl 2-(2,4-dichlorophenoxy)acetate), clefoxydim, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclopyrimorate (6-chloro-3-(2-cyclopropyl-6-methylphenoxy)-4-pyridazinyl 4-
 10 morpholinecarboxylate), cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, isooctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, daimuron, dalapon, dalapon-sodium, dazomet, 2,4-DB and its dimethylammonium, potassium and sodium salts, desmedipham, desmetryn, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium salts, dichlobenil,
 15 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,
 20 etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fenoxasulfone, fenquinotrine (2-[[8-chloro-3,4-dihydro-4-(4-methoxyphenyl)-3-oxo-2-quinoxaliny]carbonyl]-1,3-cyclohexanedione), fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl, fluazifop-P-butyl, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, flufenacet,
 25 flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyr-sulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium, glyphosate and its salts such as ammonium, isopropylammonium, potassium, sodium
 30 (including sesquisodium) and trimesium (alternatively named sulfosate), halauxifen (4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid) and its esters (e.g., methyl, ethyl) and salts (e.g., sodium, potassium), halosulfuron-methyl, haloxyfop-etotyl, haloxyfop-methyl, hexazinone, 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-(3-methoxyphenyl)-3-(3-methoxypropyl)-4(3*H*)-pyrimidinone,
 35 imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan, iodofluron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium, 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, naptalam, neburon, nicosulfuron, norflurazon, orbencarb, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxasulfuron, oxaziclomefone, oxyfluorfen, paraquat dichloride, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentanochlor, pentoxazone, perfluidone, pethoxamid, pethoxyamid, phenmedipham, picloram, picloram-potassium, picolinafen, pinoxaden, piperophos, pretilachlor, primisulfuron-methyl, prodiamine, profoxydim, prometon, prometryn, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, pyriftalid, pyriminobac-methyl, pyrimisulfan, pyriithiobac, pyriithiobac-sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinclamine, quizalofop-ethyl, quizalofop-P-ethyl, quizalofop-P-tefuryl, rimsulfuron, saflufenacil, sethoxydim, siduron, simazine, simetryn, sulcotrione, sulfentrazone, sulfometuron-methyl, sulfosulfuron, 2,3,6-TBA, TCA, TCA-sodium, tebutam, tebuthiuron, tefuryltrione, tembotrione, tepraloxym, terbacil, terbutylazine, terbutryn, thenylchlor, thiazopyr, thienecarbazone, thifensulfuron-methyl, thiobencarb, 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), tiocarbazil, topramezone, tralkoxydim, tri-allate, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron-methyl, tritosulfuron and vernolate. Other herbicides also include bioherbicides such as *Alternaria destruens* Simmons, *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc., *Drechslera 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 A₄ and A₇, harpin protein, mepiquat chloride, prohexadione calcium, prohydrojasmon, sodium nitrophenolate and trinexapac-methyl, and plant growth modifying organisms such as *Bacillus cereus* strain BP01.

General references for agricultural protectants (i.e. herbicides, herbicide safeners, insecticides, fungicides, nematocides, acaricides and biological agents) include *The Pesticide Manual, 13th Edition*, C. D. S. Tomlin, Ed., British Crop Protection Council, Farnham,

Surrey, U.K., 2003 and *The BioPesticide Manual, 2nd Edition*, L. G. Copping, Ed., British Crop Protection Council, Farnham, Surrey, U.K., 2001.

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

In certain instances, combinations of a compound of this invention with other biologically active (particularly herbicidal) compounds or agents (i.e. active ingredients) can result in a greater-than-additive (i.e. 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, *N*-(aminocarbonyl)-2-methylbenzenesulfonamide, benoxacor, BCS (1-bromo-4-[(chloromethyl)sulfonyl]benzene), cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfonamide, daimuron, dichlormid, 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), dicyclonon, dietholate, dimepiperate, ethyl 1,6-dihydro-1-(2-methoxyphenyl)-6-oxo-2-phenyl-5-pyrimidinecarboxylate, fenchlorazole-ethyl, fencloirim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone ((4-methoxy-3-methylphenyl)(3-methylphenyl)methanone), naphthalic anhydride (1,8-naphthalic

anhydride), oxabetrinil and 3-oxo-1-cyclohexen-1-yl 1-(3,4-dimethylphenyl)-1,6-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.

Preferred for better control of undesired vegetation (e.g., lower use rate such as from synergism, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group consisting of 2,4-D, ametryne, aminocyclopyrachlor, aminopyralid, atrazine, bromacil, bromoxynil, bromoxynil octanoate, carfentrazone-ethyl, chlorimuron-ethyl, chlorsulfuron, clopyralid, clopyralid-olamine, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium salts, diflufenican, dimethenamid, dimethenamid-P, diuron, florasulam, flufenacet, flumetsulam, flumioxazin, flupyrsulfuron-methyl, flupyrsulfuron-methyl-sodium, fluroxypyr, glyphosate (particularly glyphosate-isopropylammonium, glyphosate-sodium, glyphosate-potassium, glyphosate-trimesium), hexazinone, imazamethabenz-methyl, imazaquin, imazethapyr, iodosulfuron-methyl, lactofen, lenacil, linuron, MCPA and its dimethylammonium, potassium and sodium salts, MCPA-isooctyl, MCPA-thioethyl, mesosulfuron-methyl, S-metolachlor, metribuzin, metsulfuron-methyl, nicosulfuron, oxyfluorfen, pendimethalin, pinoxaden, pronamide, prosulfuron, pyroxasulfone, pyroxsulam, quinclorac, rimsulfuron, saflufenacil, sulfentrazone, thifensulfuron-methyl, triasulfuron, tribenuron-methyl, triclopyr, triclopyr-butotyl, and triclopyr-triethylammonium.

Table A1 lists specific combinations of a Component (a) with Component (b) illustrative of the mixtures, compositions and methods of the present invention. 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 (b) compound is typically applied to a field-grown crop relative to Component (a). Thus, for example, the first line of Table A1 specifically discloses the combination of Component (a) with 2,4-D is typically applied in a weight ratio between 1:192 to 6:1. The remaining lines of Table A1 are to be construed similarly.

TABLE A1

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	2,4-D	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid (halauxifen)	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid methyl ester (halauxifen methyl)	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Acetochlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Acifluorfen	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Aclonifen	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Alachlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Ametryn	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Amicarbazone	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Amidosulfuron	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1
Compound 1	Aminocyclopyrachlor	1:48 to 24:1	1:16 to 8:1	1:6 to 2:1
Compound 1	Aminopyralid	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Amitrole	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Anilofos	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Asulam	1:960 to 2:1	1:320 to 1:3	1:120 to 1:14
Compound 1	Atrazine	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Azimsulfuron	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1
Compound 1	Beflubutamid	1:342 to 4:1	1:114 to 2:1	1:42 to 1:5
Compound 1	Benfuresate	1:617 to 2:1	1:205 to 1:2	1:77 to 1:9
Compound 1	Bensulfuron-methyl	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Bentazon	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Benzobicyclon	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Benzofenap	1:257 to 5:1	1:85 to 2:1	1:32 to 1:4
Compound 1	Bicyclopyrone	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Bifenox	1:257 to 5:1	1:85 to 2:1	1:32 to 1:4
Compound 1	Bispyribac-sodium	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Bromacil	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Bromobutide	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Bromoxynil	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Butachlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Butafenacil	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Butylate	1:1542 to 1:2	1:514 to 1:5	1:192 to 1:22
Compound 1	Carfenstrole	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Carfentrazone-ethyl	1:128 to 9:1	1:42 to 3:1	1:16 to 1:2
Compound 1	Chlorimuron-ethyl	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Chlorotoluron	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Chlorsulfuron	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1
Compound 1	Cincosulfuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Cinidon-ethyl	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Cinmethylin	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Clacyfos	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Clethodim	1:48 to 24:1	1:16 to 8:1	1:6 to 2:1
Compound 1	Clodinafop-propargyl	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Clomazone	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Clomeprop	1:171 to 7:1	1:57 to 3:1	1:21 to 1:3
Compound 1	Clopyralid	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Cloransulam	1:12 to 96:1	1:4 to 32:1	1:1 to 6:1
Compound 1	Cumyluron	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Cyanazine	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Cyclopyrimorate	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Cyclosulfamuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Cycloxydim	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Cyhalofop	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Daimuron	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Desmedipham	1:322 to 4:1	1:107 to 2:1	1:40 to 1:5
Compound 1	Dicamba	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Dichlobenil	1:1371 to 1:2	1:457 to 1:4	1:171 to 1:20

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Dichlorprop	1:925 to 2:1	1:308 to 1:3	1:115 to 1:13
Compound 1	Diclofop-methyl	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Diclosulam	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Difenzoquat	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Di flufenican	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Di flufenzopyr	1:12 to 96:1	1:4 to 32:1	1:1 to 6:1
Compound 1	Dimethachlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Dimethametryn	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Dimethenamid-P	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Dithiopyr	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Diuron	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	EPTC	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Esprocarb	1:1371 to 1:2	1:457 to 1:4	1:171 to 1:20
Compound 1	Ethalfuralin	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Ethametsulfuron-methyl	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Ethoxyfen	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Ethoxysulfuron	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Etobenzanid	1:257 to 5:1	1:85 to 2:1	1:32 to 1:4
Compound 1	Fenoxaprop-ethyl	1:120 to 10:1	1:40 to 4:1	1:15 to 1:2
Compound 1	Fenoxasulfone	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2
Compound 1	Fenquinotrine	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Fentrazamide	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Flazasulfuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Florasulam	1:2 to 420:1	1:1 to 140:1	2:1 to 27:1
Compound 1	Fluazifop-butyl	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Flucarbazone	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Flucetosulfuron	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Flufenacet	1:257 to 5:1	1:85 to 2:1	1:32 to 1:4
Compound 1	Flumetsulam	1:24 to 48:1	1:8 to 16:1	1:3 to 3:1
Compound 1	Flumiclorac-pentyl	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Flumioxazin	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Fluometuron	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Flupyrsulfuron-methyl	1:3 to 336:1	1:1 to 112:1	2:1 to 21:1
Compound 1	Fluridone	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Fluroxypyr	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Flurtamone	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Fluthiacet-methyl	1:48 to 42:1	1:16 to 14:1	1:3 to 3:1
Compound 1	Fomesafen	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Foramsulfuron	1:13 to 84:1	1:4 to 28:1	1:1 to 6:1
Compound 1	Glufosinate	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Glyphosate	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Halosulfuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Haloxypop-methyl	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Hexazinone	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Imazamox	1:13 to 84:1	1:4 to 28:1	1:1 to 6:1
Compound 1	Imazapic	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Imazapyr	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2
Compound 1	Imazaquin	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Imazethabenz	1:171 to 7:1	1:57 to 3:1	1:21 to 1:3
Compound 1	Imazethapyr	1:24 to 48:1	1:8 to 16:1	1:3 to 3:1
Compound 1	Imazosulfuron	1:27 to 42:1	1:9 to 14:1	1:3 to 3:1
Compound 1	Indanofan	1:342 to 4:1	1:114 to 2:1	1:42 to 1:5
Compound 1	Indaziflam	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Iodosulfuron-methyl	1:3 to 336:1	1:1 to 112:1	2:1 to 21:1
Compound 1	Ioxynil	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Ipfencarbazone	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2
Compound 1	Isoproturon	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Isoxaben	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Isoxaflutole	1:60 to 20:1	1:20 to 7:1	1:7 to 2:1
Compound 1	Lactofen	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Lenacil	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Linuron	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	MCPA	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	MCPB	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Mecoprop	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Mefenacet	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Mefluidide	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Mesosulfuron-methyl	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Mesotrione	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Metamifop	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Metazachlor	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Metazosulfuron	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Methabenzthiazuron	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Metolachlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	S-Metolachlor	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Metosulam	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Metribuzin	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Metsulfuron-methyl	1:2 to 560:1	1:1 to 187:1	3:1 to 35:1
Compound 1	Molinate	1:1028 to 2:1	1:342 to 1:3	1:128 to 1:15
Compound 1	Napropamide	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Naptalam	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Nicosulfuron	1:12 to 96:1	1:4 to 32:1	1:1 to 6:1
Compound 1	Norflurazon	1:1152 to 1:1	1:384 to 1:3	1:144 to 1:16
Compound 1	Orbencarb	1:1371 to 1:2	1:457 to 1:4	1:171 to 1:20
Compound 1	Orthosulfamuron	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Oryzalin	1:514 to 3:1	1:171 to 1:2	1:64 to 1:8
Compound 1	Oxadiargyl	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Oxadiazon	1:548 to 3:1	1:182 to 1:2	1:68 to 1:8
Compound 1	Oxasulfuron	1:27 to 42:1	1:9 to 14:1	1:3 to 3:1
Compound 1	Oxaziclomefone	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Oxyfluorfen	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Paraquat	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Pendimethalin	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Penoxsulam	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Pentoxamid	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Pentoxazone	1:102 to 12:1	1:34 to 4:1	1:12 to 1:2
Compound 1	Phenmedipham	1:102 to 12:1	1:34 to 4:1	1:12 to 1:2
Compound 1	Picloram	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Picolinafen	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Pinoxaden	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Pretilachlor	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Primisulfuron-methyl	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Prodiamine	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Profoxydim	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Prometryn	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Propachlor	1:1152 to 1:1	1:384 to 1:3	1:144 to 1:16
Compound 1	Propanil	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Propaquizafop	1:48 to 24:1	1:16 to 8:1	1:6 to 2:1
Compound 1	Propoxycarbazone	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Propyrisulfuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Propyzamide	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Prosulfocarb	1:1200 to 1:2	1:400 to 1:4	1:150 to 1:17
Compound 1	Prosulfuron	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1
Compound 1	Pyraclonil	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Pyraflufen-ethyl	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Pyrasulfotole	1:13 to 84:1	1:4 to 28:1	1:1 to 6:1
Compound 1	Pyrazolynate	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Pyrazosulfuron-ethyl	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Pyrazoxyfen	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Pyribenzoxim	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Pyributicarb	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Pyridate	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Pyriftalid	1:10 to 112:1	1:3 to 38:1	1:1 to 7:1
Compound 1	Pyriminobac-methyl	1:20 to 56:1	1:6 to 19:1	1:2 to 4:1
Compound 1	Pyrimisulfan	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Pyrithiobac	1:24 to 48:1	1:8 to 16:1	1:3 to 3:1
Compound 1	Pyroxasulfone	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2
Compound 1	Pyroxsulam	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Quinclorac	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Quizalofop-ethyl	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1
Compound 1	Rimsulfuron	1:13 to 84:1	1:4 to 28:1	1:1 to 6:1
Compound 1	Saflufenacil	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Sethoxydim	1:96 to 12:1	1:32 to 4:1	1:12 to 1:2
Compound 1	Simazine	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Sulcotrione	1:120 to 10:1	1:40 to 4:1	1:15 to 1:2
Compound 1	Sulfentrazone	1:147 to 8:1	1:49 to 3:1	1:18 to 1:3
Compound 1	Sulfometuron-methyl	1:34 to 34:1	1:11 to 12:1	1:4 to 3:1
Compound 1	Sulfosulfuron	1:8 to 135:1	1:2 to 45:1	1:1 to 9:1
Compound 1	Tebuthiuron	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Tefuryltrione	1:42 to 27:1	1:14 to 9:1	1:5 to 2:1

<u>Component (a)</u>	<u>Component (b)</u>	<u>Typical Weight Ratio</u>	<u>More Typical Weight Ratio</u>	<u>Most Typical Weight Ratio</u>
Compound 1	Tembotrione	1:31 to 37:1	1:10 to 13:1	1:3 to 3:1
Compound 1	Tepraloxydim	1:25 to 45:1	1:8 to 15:1	1:3 to 3:1
Compound 1	Terbacil	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Terbuthylatrazine	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Terbutryn	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Thenylchlor	1:85 to 14:1	1:28 to 5:1	1:10 to 1:2
Compound 1	Thiazopyr	1:384 to 3:1	1:128 to 1:1	1:48 to 1:6
Compound 1	Thiencarbazone	1:3 to 336:1	1:1 to 112:1	2:1 to 21:1
Compound 1	Thifensulfuron-methyl	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Thiobencarb	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Tiafenacil	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Topramazone	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1
Compound 1	Tralkoxydim	1:68 to 17:1	1:22 to 6:1	1:8 to 2:1
Compound 1	Triallate	1:768 to 2:1	1:256 to 1:2	1:96 to 1:11
Compound 1	Triasulfuron	1:5 to 224:1	1:1 to 75:1	1:1 to 14:1
Compound 1	Triaziflam	1:171 to 7:1	1:57 to 3:1	1:21 to 1:3
Compound 1	Tribenuron-methyl	1:3 to 336:1	1:1 to 112:1	2:1 to 21:1
Compound 1	Triclopyr	1:192 to 6:1	1:64 to 2:1	1:24 to 1:3
Compound 1	Trifloxysulfuron	1:2 to 420:1	1:1 to 140:1	2:1 to 27:1
Compound 1	Trifluralin	1:288 to 4:1	1:96 to 2:1	1:36 to 1:4
Compound 1	Triflusulfuron-methyl	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1
Compound 1	Tritosulfuron	1:13 to 84:1	1:4 to 28:1	1:1 to 6:1

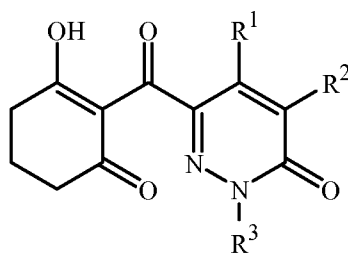
The present disclosure also includes Tables A2 through A5 which are each constructed the same as Table A1 above except that entries below the “Component (a)” column heading are replaced with the respective Component (a) Column Entry shown below. Compound numbers refer to compounds in Index Table A. Thus, for example, in Table A2 the entries below the “Component (a)” column heading all recite “Compound 2”, 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 A5 are constructed similarly.

<u>Table Number</u>	<u>Component (a) Column Entries</u>	<u>Table Number</u>	<u>Component (a) Column Entries</u>
A2	Compound 2	A22	Compound 22
A3	Compound 3	A23	Compound 23
A4	Compound 4	A24	Compound 24
A5	Compound 5	A25	Compound 25
A6	Compound 6	A26	Compound 26

A7	Compound 7	A27	Compound 27
A8	Compound 8	A28	Compound 28
A9	Compound 9	A29	Compound 29
A10	Compound 10	A30	Compound 30
A11	Compound 11	A31	Compound 31
A12	Compound 12	A32	Compound 32
A13	Compound 13	A33	Compound 33
A14	Compound 14	A34	Compound 34
A15	Compound 15	A35	Compound 35
A16	Compound 16	A36	Compound 36
A17	Compound 17	A37	Compound 37
A18	Compound 18	A38	Compound 38
A19	Compound 19	A39	Compound 39
A20	Compound 20	A40	Compound 40
A21	Compound 21	A41	Compound 41
		A42	Compound 42

The following abbreviations are used in the Index Table A which follows: “Cmpd” means Compound, Me is methyl ($-\text{CH}_3$), *n*-Pr is *n*-propyl, thf is tetrahydrofuran, Ph is phenyl and OMe is methoxy. The abbreviation “Ex.” stands for “Example” and is followed by a number indicating in which example the compound is prepared. Mass spectra (M.S.) are reported as the molecular weight of the highest isotopic abundance parent ion ($\text{M}+1$) formed by addition of H^+ (molecular weight of 1) to the molecule, observed by mass spectrometry using atmospheric pressure chemical ionization (AP^+). The presence of molecular ions containing one or more higher atomic weight isotopes of lower abundance (e.g., ^{37}Cl , ^{81}Br) is not reported.

INDEX TABLE A



Cmpd	R ¹	R ²	R ³	M.P. (°C)	M.S.
1 (Ex. 3)	Cl	Ph	Me	*	359
2 (Ex. 5)	Me	<i>n</i> -Pr	Me	**	305
3 (Ex. 4)	OMe	Ph	Me	*	355
4 (Ex. 1)	Me	Ph	Me	**	339

Cmpd	R ¹	R ²	R ³	M.P. (°C)	M.S.
5 (Ex. 2)	CF ₃	Ph	Me	*	393
6 (Ex. 6)	Cl	OCH ₂ CH ₂ OMe	Me	**	357
7	OMe	Ph(4-Cl)	Me	77-79	
8	Me	Ph(4-Cl)	Me	84-86	
9	Cl	<i>n</i> -Bu	Me		339
10	OMe	<i>n</i> -Bu	Me		335
11	OMe	Me	Me		293
12	Me	<i>c</i> -hex	Me	169-170	
13	Me	<i>n</i> -Bu	Me		319
14	CF ₃	<i>n</i> -Bu	Me		373
15	Me	OCH ₂ Me	Me		307
16	CF ₃	Ph(4-OMe)	Me	78-80	
17	OMe	Ph(4-OMe)	Me	132-134	
18	Me	Ph(4-OMe)	Me	180-182	
19	Cl	Ph(4-OMe)	Me	181-183	
20	CF ₃	<i>c</i> -hex	Me	144-150	
21	OMe	<i>c</i> -hex	Me		361
22	Cl	<i>c</i> -hex	Me	138-139	
23	OMe	<i>n</i> -Pr	Me		321
24	CF ₃	<i>n</i> -Pr	Me	146-147	
25	Cl	<i>n</i> -Pr	Me		325
26	OMe	Ph(3,4-diOMe)	Me	68-70	
27	CF ₃	Ph(3,4-diOMe)	Me	76-78	
28	Me	Ph(3,4-diOMe)	Me	72-74	
29	Me	OMe	Me		293
30 (Ex. 7)	Me	OCH ₂ CH=CH ₂	Me	**	319
31	OMe	CH ₂ OMe	Me		323
32	Me	OCH ₂ CH ₂ Me	Me		321
33	Me	O(CH ₂) ₃ OMe	Me		351
34	Me	O- <i>n</i> -Bu	Me		335
35	OMe	CH ₂ OCH ₂ CF ₃	Me		391
36	Me	O(CH ₂) ₃ CH(Me) ₂	Me		363
37	Me	OCH ₂ CH ₂ CF ₃	Me	111-112	375
38	Me	OCH ₂ CH ₂ SMe	Me		353
39	Me	OCH ₂ Ph	Me		369
40	Me	OCH ₂ CH ₂ OMe	Me		337
41	Me	OCH ₂ (thf-2-yl)	Me		363

Cmpd	R ¹	R ²	R ³	M.P. (°C)	M.S.
42 (Ex. 8)	Me	<i>N</i> -morpholinyl	Me	164-165**	348

*¹H NMR and melting point data are found in the Synthesis Examples.

**¹H NMR data are found in the Synthesis Examples.

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

5 Seeds of plant species selected from barnyardgrass (*Echinochloa crus-galli*), crabgrass, large (large crabgrass, *Digitaria sanguinalis*), foxtail, giant (giant foxtail, *Setaria faberii*), morningglory (*Ipomoea* spp.), pigweed (redroot pigweed, *Amaranthus retroflexus*), velvetleaf (*Abutilon theophrasti*), wheat (winter wheat, *Triticum aestivum*) and corn (*Zea mays*) were planted into a blend of loam soil and sand and treated preemergence with a
10 directed soil spray using test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. At the same time these species were also treated with postemergence applications of test compounds formulated in the same manner.

15 Plants ranged in height from 2 to 10 cm and were in the one- to two-leaf stage for the postemergence treatment. Treated plants and untreated controls were maintained in a greenhouse for approximately 10 days, after which time all treated plants were visually 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.

Table A	Compounds		
1000 g ai/ha	1	3	4
Postemergence			
Barnyardgrass	100	90	100
Corn	10	0	40
Crabgrass, Large	60	30	90
Foxtail, Giant	90	70	90
Morningglory	100	100	100
Pigweed	70	100	90
Velvetleaf	100	100	100
Wheat	70	0	50

Table A	Compounds		
1000 g ai/ha	1	3	4
Preemergence			
Barnyardgrass	100	90	100
Corn	0	0	0
Crabgrass, Large	60	20	90
Foxtail, Giant	90	60	90
Morningglory	90	90	90
Pigweed	100	100	100
Velvetleaf	100	100	100
Wheat	40	20	40

20	Table A	Compounds													
	500 g ai/ha	2	5	6	7	8	9	10	11	12	13	14	15	16	17
	Postemergence														
	Barnyardgrass	90	100	100	100	100	100	90	90	90	90	90	90	90	90
	Corn	50	0	80	0	60	80	10	0	0	30	10	-	0	0

5	Crabgrass, Large	100	60	90	90	90	90	90	70	90	80	70	90	40	80
	Foxtail, Giant	90	90	90	90	90	90	70	60	90	70	70	90	40	70
	Morningglory	100	100	-	-	-	90	90	90	100	90	90	90	80	90
	Pigweed	100	100	100	100	100	100	100	50	100	90	90	100	90	100
	Velvetleaf	100	100	100	100	100	100	100	100	100	90	90	100	100	90
	Wheat	80	10	90	90	90	60	50	10	60	20	20	70	10	20
	Table A	Compounds													
500 g ai/ha	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
10	Postemergence														
	Barnyardgrass	100	100	90	90	90	90	100	100	100	90	90	90	100	80
	Corn	0	0	0	0	40	20	50	80	20	0	0	20	40	0
	Crabgrass, Large	80	80	70	70	90	80	80	100	80	70	80	90	90	40
	Foxtail, Giant	60	90	80	60	90	50	80	100	70	70	60	80	90	60
	Morningglory	90	90	90	90	90	90	90	100	80	80	70	90	100	70
	Pigweed	90	90	100	90	100	100	100	100	90	90	90	80	100	100
15	Velvetleaf	100	100	90	80	100	90	100	100	90	90	90	100	100	100
	Wheat	50	50	20	0	70	50	70	80	20	20	20	50	60	0
	Table A	Compounds													
	500 g ai/ha	32	33	34	35	36	37	38	41						
	Postemergence														
	Barnyardgrass	100	100	100	90	90	100	90	90						
	Corn	90	60	50	20	0	60	20	30						
20	Crabgrass, Large	100	100	90	90	90	100	90	100						
	Foxtail, Giant	100	70	90	80	30	90	60	60						
	Morningglory	100	100	100	90	100	100	90	100						
	Pigweed	100	90	100	90	90	100	70	90						
	Velvetleaf	100	100	100	100	100	100	100	100						
	Wheat	90	80	90	30	50	90	40	50						
	Table A	Compounds													
25	125 g ai/ha	2	5	6	7	8	9	10	11	12	13	14	15	16	17
	Postemergence														
	Barnyardgrass	90	90	90	90	90	100	90	50	90	80	90	90	80	90
	Corn	0	0	20	0	30	40	0	0	0	0	0	-	0	0
	Crabgrass, Large	90	30	90	30	80	90	60	40	80	70	50	80	20	40
	Foxtail, Giant	70	80	90	40	70	50	50	20	90	50	30	60	20	50
	Morningglory	100	100	-	-	-	90	90	80	90	90	80	90	50	90
30	Pigweed	90	100	90	100	70	100	100	10	90	80	70	100	70	80
	Velvetleaf	100	100	100	100	100	100	100	100	100	90	90	90	80	80
	Wheat	30	0	60	60	30	10	0	0	30	0	0	40	0	0
	Table A	Compounds													
	125 g ai/ha	2	5	6	7	8	9	10	11	12	13	14	15	16	17
	Postemergence														
	Barnyardgrass	90	90	90	90	90	100	90	50	90	80	90	90	80	90
35	Corn	0	0	20	0	30	40	0	0	0	0	0	-	0	0
	Crabgrass, Large	90	30	90	30	80	90	60	40	80	70	50	80	20	40
	Foxtail, Giant	70	80	90	40	70	50	50	20	90	50	30	60	20	50
	Morningglory	100	100	-	-	-	90	90	80	90	90	80	90	50	90
	Pigweed	90	100	90	100	70	100	100	10	90	80	70	100	70	80
	Velvetleaf	100	100	100	100	100	100	100	100	100	90	90	90	80	80
	Wheat	30	0	60	60	30	10	0	0	30	0	0	40	0	0

Table A		Compounds													
125 g ai/ha		18	19	20	21	22	23	24	25	26	27	28	29	30	31
Postemergence															
5	Barnyardgrass	100	100	60	80	90	40	100	100	90	80	90	90	90	0
	Corn	0	0	0	0	0	0	20	20	20	0	0	20	10	0
	Crabgrass, Large	60	40	30	30	90	50	60	100	50	30	60	80	90	0
	Foxtail, Giant	20	40	40	40	90	20	60	90	50	50	20	60	80	0
	Morningglory	90	80	90	90	90	80	90	90	70	60	60	90	90	20
10	Pigweed	60	70	80	50	100	90	90	100	70	90	70	70	100	80
	Velvetleaf	100	100	90	70	100	90	100	100	90	90	90	90	100	100
	Wheat	0	10	0	0	60	20	40	80	20	0	0	0	40	0

Table A		Compounds								
125 g ai/ha		32	33	34	35	36	37	38	40	41
Postemergence										
Barnyardgrass		100	100	90	50	30	100	90	90	90
Corn		30	20	20	0	0	10	0	20	10
Crabgrass, Large		100	100	90	60	70	100	50	90	100
Foxtail, Giant		90	40	50	50	10	80	30	70	50
Morningglory		90	100	100	90	90	100	80	90	90
Pigweed		100	80	90	80	70	90	50	80	70
Velvetleaf		100	100	100	100	100	100	100	100	100
Wheat		80	70	50	0	20	70	0	40	0

Table A	Compound	Table A	Compound
31 g ai/ha	40	31 g ai/ha	40
Postemergence		Preemergence	
Barnyardgrass	90	Barnyardgrass	60
Corn	10	Corn	0
Crabgrass, Large	70	Crabgrass, Large	40
Foxtail, Giant	50	Foxtail, Giant	10
Morningglory	80	Morningglory	10
Pigweed	60	Pigweed	10
Velvetleaf	100	Velvetleaf	50
Wheat	0	Wheat	0

Table A		Compounds													
500 g ai/ha		2	5	6	7	8	9	10	11	12	13	14	15	16	17
Preemergence															
Barnyardgrass		100	100	100	100	100	100	90	70	90	100	100	100	100	100

	Corn	20	10	30	0	20	20	20	0	0	20	0	0	0	20
	Crabgrass, Large	100	70	90	90	100	100	80	80	90	100	100	90	80	90
	Foxtail, Giant	90	80	90	90	90	90	60	40	90	70	50	80	50	70
	Morningglory	90	100	50	50	70	90	70	30	80	80	80	70	70	60
5	Pigweed	100	100	100	100	90	100	100	20	100	100	100	100	100	100
	Velvetleaf	100	100	100	100	100	100	100	100	100	100	100	100	100	90
	Wheat	70	20	80	30	50	40	40	10	0	10	10	30	0	20
	Table A	Compounds													
	500 g ai/ha	18	19	20	21	22	23	24	25	26	27	28	29	30	31
10	Preemergence														
	Barnyardgrass	100	100	100	80	100	60	100	100	80	90	70	90	100	20
	Corn	0	0	0	0	0	20	20	30	0	0	0	10	30	0
	Crabgrass, Large	90	80	100	80	100	90	90	100	90	60	80	100	100	50
	Foxtail, Giant	60	90	90	60	100	50	70	100	60	80	60	80	90	0
15	Morningglory	60	70	70	70	80	60	80	90	40	60	20	60	-	0
	Pigweed	100	90	100	90	100	100	100	100	100	100	90	100	100	20
	Velvetleaf	100	100	100	70	100	90	100	100	0	100	60	100	100	100
	Wheat	10	40	20	0	30	0	20	80	0	0	0	0	50	0
	Table A	Compounds													
20	500 g ai/ha	32	33	34	35	36	37	38	41						
	Preemergence														
	Barnyardgrass	100	100	100	80	80	100	30	100						
	Corn	0	0	40	0	0	30	0	0						
	Crabgrass, Large	100	100	100	100	80	100	70	100						
25	Foxtail, Giant	100	70	80	80	30	90	30	60						
	Morningglory	-	80	100	80	70	90	50	70						
	Pigweed	100	80	100	100	90	100	70	60						
	Velvetleaf	100	100	100	100	90	100	70	100						
	Wheat	80	40	60	50	10	50	0	10						
30	Table A	Compounds													
	125 g ai/ha	2	5	6	7	8	9	10	11	12	13	14	15	16	17
	Preemergence														
	Barnyardgrass	90	80	90	80	90	100	50	0	80	90	90	90	90	70
	Corn	0	0	10	0	10	0	0	0	0	0	0	0	0	0
35	Crabgrass, Large	90	10	90	20	90	100	50	20	90	90	90	80	20	70
	Foxtail, Giant	80	60	60	0	50	50	30	0	80	40	30	40	10	50
	Morningglory	90	90	50	10	30	80	40	0	70	80	70	50	20	20
	Pigweed	100	70	90	80	20	100	80	0	80	100	90	100	90	80
	Velvetleaf	100	100	100	100	100	100	100	70	100	80	100	100	90	80

	Wheat	10	0	20	30	0	0	0	0	0	0	0	10	0	0
	Table A	Compounds													
	125 g ai/ha	18	19	20	21	22	23	24	25	26	27	28	29	30	31
5	Preemergence														
	Barnyardgrass	90	70	80	50	90	10	90	100	50	50	50	80	90	0
	Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Crabgrass, Large	80	60	70	50	100	70	90	100	70	20	60	100	90	0
	Foxtail, Giant	10	50	70	20	100	0	60	100	20	50	10	20	80	0
10	Morningglory	20	10	10	20	70	20	70	60	10	20	0	30	–	0
	Pigweed	50	70	70	60	90	80	100	100	50	100	30	60	90	0
	Velvetleaf	80	90	80	50	90	70	80	60	0	70	50	90	100	20
	Wheat	0	0	0	0	10	0	0	20	0	0	0	0	0	0
	Table A	Compounds													
15	125 g ai/ha	32	33	34	35	36	37	38	40	41					
	Preemergence														
	Barnyardgrass	100	80	90	50	30	80	0	90	90					
	Corn	0	0	0	0	0	0	0	0	0					
	Crabgrass, Large	100	100	100	80	70	100	10	100	100					
20	Foxtail, Giant	80	30	60	50	0	80	0	60	30					
	Morningglory	50	70	80	60	50	80	10	60	50					
	Pigweed	100	40	90	90	70	30	0	50	0					
	Velvetleaf	100	100	100	100	70	100	0	100	90					
	Wheat	30	20	40	10	0	20	0	0	0					

TEST B

- 25 Seeds of plant species selected from blackgrass (*Alopecurus myosuroides*), brome grass, downy (downy brome grass, *Bromus tectorum*), foxtail, green (green foxtail, *Setaria viridis*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), wheat, winter (winter wheat, *Triticum aestivum*), oat, wild (wild oat, *Avena fatua*), galium (catchweed bedstraw, *Galium aparine*), bermudagrass (*Cynodon dactylon*), surinam grass (*Brachiaria decumbens*), cocklebur (common cocklebur, *Xanthium strumarium*), corn (*Zea mays*),
- 30 crabgrass, large (large crabgrass, *Digitaria sanguinalis*), cupgrass, woolly (woolly cupgrass, *Eriochloa villosa*), foxtail, giant (giant foxtail, *Setaria faberii*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), lambsquarters (common lambsquarters, *Chenopodium album*), morningglory (*Ipomoea coccinea*), nightshade (eastern
- 35 black nightshade, *Solanum ptycanthum*), nutsedge, yellow (yellow nutsedge, *Cyperus esculentus*), pigweed (redroot pigweed, *Amaranthus retroflexus*), ragweed (common ragweed, *Ambrosia elatior*), soybean (*Glycine max*), sunflower (common (oilseed)

sunflower, *Helianthus annuus*), Russian thistle (*Salsola kali*), and velvetleaf (*Abutilon theophrasti*).

At the same time, barley, (winter barley, *Hordeum vulgare*), canarygrass (littleseed canarygrass, *Phalaris minor*), chickweed (common chickweed, *Stellaria media*), windgrass (*Apera spica-venti*), and deadnettle (henbit deadnettle, *Lamium amplexicaule*) were planted in pots containing a planting medium comprising sphagnum peat moss, vermiculite, wetting agent and starter nutrients and treated with postemergence applications of the test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Plant species in the flooded paddy test consisted of rice (*Oryza sativa*), sedge, umbrella (small-flower umbrella sedge, *Cyperus difformis*), ducksalad (*Heteranthera limosa*), and barnyardgrass (*Echinochloa crus-galli*) grown to the 2-leaf stage for testing. At time of treatment, test pots were flooded to 3 cm above the soil surface, treated by application of test compounds directly to the paddy water, and then maintained at that water depth for the duration of the test.

Treated plants and controls were maintained in a greenhouse for 13 to 15 days, after which time all species were visually 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				Table B	Compounds			
250 g ai/ha	1	3	29	30	62 g ai/ha	1	3	29	30
Flood					Flood				
Barnyardgrass	40	0	40	75	Barnyardgrass	0	0	0	20
Ducksalad	65	40	45	75	Ducksalad	45	30	0	40
Rice	30	0	15	15	Rice	0	0	15	0
Sedge, Umbrella	75	60	80	90	Sedge, Umbrella	70	20	75	40

Table B	Compounds									
250 g ai/ha	5	6	10	12	13	15	17	20	22	25
Postemergence										
Barley	0	65	55	90	90	60	35	45	85	50
Bermudagrass	90	95	90	98	95	98	80	75	90	90
Blackgrass	60	85	45	60	80	70	55	50	80	70
Bromegrass, Downy	10	98	35	45	50	80	50	10	70	60
Canarygrass	70	95	80	95	95	100	70	70	95	90
Chickweed	98	100	100	100	100	100	100	100	98	100
Cocklebur	98	98	100	95	98	98	95	85	100	95
Corn	35	90	65	50	90	65	5	15	75	80
Crabgrass, Large	65	100	100	100	100	98	50	90	95	100

5	Cupgrass, Woolly	75	98	50	95	85	85	50	55	95	90		
	Deadnettle	100	100	100	100	100	100	100	100	100	100		
	Foxtail, Giant	85	95	75	98	95	95	75	90	95	90		
	Foxtail, Green	98	100	80	100	100	100	98	100	98	100		
	Galium	95	98	90	95	95	95	95	85	95	95		
	Goosegrass	90	80	90	95	98	98	80	85	90	75		
	Johnsongrass	50	70	65	55	55	75	35	0	55	75		
	Kochia	100	100	98	100	100	100	98	90	98	100		
10	Lambsquarters	100	100	100	100	100	100	100	100	98	100		
	Morningglory	100	100	98	100	100	100	98	100	98	98		
	Nutsedge, Yellow	85	60	25	75	55	50	70	40	80	45		
	Oat, Wild	40	85	55	55	55	50	30	10	90	70		
15	Pigweed	98	98	98	100	100	98	85	98	98	98		
	Ragweed	98	100	95	98	98	100	98	98	98	95		
	Ryegrass, Italian	5	80	20	50	75	85	50	5	70	65		
	Soybean	75	100	90	98	98	75	98	80	98	98		
	Surinam Grass	65	98	75	98	85	98	95	35	90	95		
	Velvetleaf	98	98	100	100	100	100	98	90	95	98		
20	Wheat	25	80	45	50	40	70	45	45	70	90		
	Windgrass	80	85	80	100	100	100	60	70	90	80		
25	Table B	Compounds											
	125 g ai/ha	2	5	6	9	10	12	13	15	17	20	22	25
	Postemergence												
	Barley	30	0	45	50	30	60	65	40	10	35	85	45
	Bermudagrass	85	80	85	95	90	95	90	98	80	65	85	85
	Blackgrass	55	35	65	70	45	60	65	70	55	40	60	40
	Bromegrass, Downy	40	5	85	50	30	35	45	55	40	5	60	55
	Canarygrass	80	25	95	100	55	95	95	90	60	50	95	85
	Chickweed	98	98	100	100	100	100	100	100	98	98	98	100
	Cocklebur	98	90	98	100	100	–	98	98	90	70	98	95
	Corn	15	15	75	85	–	50	80	60	0	5	60	75
	Crabgrass, Large	95	40	98	100	95	100	100	85	35	65	95	98
30	Cupgrass, Woolly	75	65	95	50	40	85	75	80	50	50	85	85
	Deadnettle	100	100	100	100	90	100	100	100	95	–	100	100
	Foxtail, Giant	80	80	90	70	65	95	85	85	45	80	95	80
	Foxtail, Green	80	90	95	100	80	98	80	95	80	90	90	98
	Galium	85	90	90	90	90	95	95	95	90	70	95	95
	Goosegrass	75	80	70	95	90	85	85	85	80	70	85	60
	35												

5	Johnsongrass	40	30	50	65	30	45	50	65	20	-	55	55	
	Kochia	100	98	100	100	85	100	100	100	98	80	98	100	
	Lambsquarters	98	100	100	100	100	100	100	100	100	100	98	100	
	Morningglory	100	100	98	100	98	98	100	98	95	98	98	98	
	Nutsedge, Yellow	55	75	55	30	15	75	40	35	70	40	70	35	
	Oat, Wild	60	10	70	40	10	55	55	40	30	10	50	70	
	Pigweed	90	85	98	100	95	100	100	98	85	98	95	95	
	Ragweed	95	95	100	98	95	98	98	100	95	85	98	95	
	Ryegrass, Italian	55	5	60	60	5	50	60	80	40	5	60	50	
10	Soybean	95	70	98	98	90	98	98	70	90	65	95	95	
	Surinam Grass	50	60	90	70	-	70	80	95	85	25	85	85	
	Velvetleaf	98	95	98	100	98	100	100	100	98	90	95	98	
	Wheat	55	25	75	50	40	50	15	50	30	15	60	80	
	Windgrass	80	50	85	100	35	95	90	90	60	60	90	55	
15	Table B	Compounds												
	62 g ai/ha	2	3	5	6	9	10	12	13	15	17	20	22	25
	Postemergence													
20	Barley	10	5	0	35	50	10	45	60	25	5	20	60	35
	Bermudagrass	75	45	75	75	85	80	95	85	90	70	55	85	85
	Blackgrass	35	5	25	55	50	5	45	40	45	45	30	55	35
	Bromegrass, Downy	30	5	0	75	40	10	25	5	50	40	5	5	5
	Canarygrass	70	25	25	85	95	50	85	80	90	50	15	95	80
	Chickweed	98	80	98	98	100	100	98	80	100	95	90	80	100
25	Cocklebur	98	95	90	98	98	98	-	-	98	90	70	98	95
	Corn	15	20	10	55	70	55	25	75	55	0	5	45	65
	Crabgrass, Large	80	20	30	90	100	75	98	100	60	25	35	90	98
	Cupgrass, Woolly	70	20	60	85	40	35	70	50	70	40	50	80	70
	Deadnettle	100	100	100	98	100	90	100	100	100	90	85	-	100
30	Foxtail, Giant	75	35	75	70	55	55	80	65	65	45	55	85	70
	Foxtail, Green	50	5	80	95	90	80	80	80	95	80	50	90	98
	Galium	85	80	85	85	90	90	85	95	95	85	65	90	95
	Goosegrass	55	35	65	50	80	75	85	80	65	40	70	80	50
35	Johnsongrass	20	5	10	25	50	-	5	50	45	5	0	35	25
	Kochia	100	65	98	100	100	80	100	98	98	80	55	98	100
	Lambsquarters	98	95	100	100	100	100	100	100	100	100	98	98	100
	Morningglory	98	98	100	95	98	95	95	95	98	85	98	98	98
	Nutsedge, Yellow	20	55	60	40	25	0	70	20	15	45	15	70	25
	Oat, Wild	30	0	10	40	40	5	25	10	35	25	5	45	35

	Pigweed	75	70	70	60	100	95	98	98	98	-	98	95	90
	Ragweed	95	90	95	98	98	90	95	98	98	95	70	98	95
	Ryegrass, Italian	20	0	5	50	60	5	15	40	60	10	0	20	10
	Soybean	80	75	60	98	98	90	90	98	45	85	55	90	95
5	Surinam Grass	45	30	60	75	60	50	70	55	90	80	15	65	85
	Velvetleaf	98	90	95	98	98	90	100	100	100	65	80	95	98
	Wheat	40	5	5	75	30	30	35	10	35	15	10	25	55
	Windgrass	55	20	5	75	90	10	70	90	70	55	55	70	15
	Table B	Compounds												
10	31 g ai/ha	2	3	5	6	9	10	12	13	15	17	20	22	25
	Postemergence													
	Barley	10	0	0	20	40	0	20	40	5	0	5	45	30
	Bermudagrass	60	35	70	70	80	75	85	85	80	55	10	75	75
	Blackgrass	35	5	5	45	35	5	30	15	35	40	5	50	35
15	Bromegrass, Downy	20	0	0	65	15	0	0	0	30	15	0	0	5
	Canarygrass	45	0	5	75	90	5	85	70	85	35	10	85	70
	Chickweed	95	80	95	98	98	98	98	80	100	85	80	80	98
	Cocklebur	95	95	60	98	98	98	85	-	98	85	10	60	90
	Corn	5	10	5	55	60	0	0	55	55	0	0	45	65
20	Crabgrass, Large	55	20	15	85	95	55	95	100	45	15	20	85	80
	Cupgrass, Woolly	60	20	50	80	25	20	55	15	50	35	40	60	45
	Deadnettle	100	95	98	98	90	80	80	95	100	90	70	100	98
	Foxtail, Giant	50	-	70	60	15	30	65	40	55	20	45	75	55
	Foxtail, Green	45	5	70	85	60	80	80	80	30	80	5	85	30
25	Galium	85	10	60	85	80	70	85	90	80	80	5	85	90
	Goosegrass	25	10	60	50	40	60	60	60	55	20	55	55	10
	Johnsongrass	10	5	10	20	40	5	0	45	25	5	0	20	25
	Kochia	98	55	80	98	90	70	95	98	98	80	50	98	98
	Lambsquarters	98	95	98	98	100	90	100	100	100	98	95	98	100
30	Morningglory	98	95	98	90	98	85	85	85	98	85	95	85	98
	Nutsedge, Yellow	10	50	50	30	0	0	60	10	10	15	15	70	10
	Oat, Wild	15	0	5	25	35	0	5	5	35	10	0	40	15
	Pigweed	75	50	70	55	100	80	85	98	98	75	85	85	85
	Ragweed	90	85	80	98	85	90	95	98	98	85	55	98	95
35	Ryegrass, Italian	15	0	0	30	55	0	10	10	55	5	0	10	0
	Soybean	75	55	40	98	98	75	80	98	40	80	45	90	90
	Surinam Grass	25	20	45	70	25	15	50	45	60	50	10	55	55
	Velvetleaf	98	85	75	90	98	85	98	98	100	65	70	90	98

Wheat	35	0	5	50	5	20	20	0	10	5	5	20	40
Windgrass	35	0	0	40	85	5	5	50	45	50	5	50	15

Table B	Compounds		
16 g ai/ha	2	3	9
Postemergence			
Barley	5	0	25
Bermudagrass	50	20	75
Blackgrass	25	0	5
Bromegrass, Downy	5	0	0
Canarygrass	30	0	80
Chickweed	90	70	98
Cocklebur	85	90	98
Corn	5	5	30
Crabgrass, Large	30	15	85
Cupgrass, Woolly	50	5	25
Deadnettle	90	85	70
Foxtail, Giant	50	15	10
Foxtail, Green	40	5	50
Galium	45	10	80
Goosegrass	25	5	15
Johnsongrass	10	5	0
Kochia	40	40	80
Lambsquarters	98	45	100
Morningglory	95	85	90
Nutsedge, Yellow	10	30	0
Oat, Wild	10	0	10
Pigweed	60	35	98
Ragweed	85	70	85
Ryegrass, Italian	5	0	15
Soybean	65	30	95
Surinam Grass	25	15	5
Velvetleaf	80	65	98
Wheat	30	0	5
Windgrass	25	0	60

Table B	Compound
8 g ai/ha	3
Postemergence	
Barley	0
Bermudagrass	10
Blackgrass	0
Bromegrass, Downy	0
Canarygrass	0
Chickweed	50
Cocklebur	75
Corn	5
Crabgrass, Large	0
Cupgrass, Woolly	5
Deadnettle	70
Foxtail, Giant	10
Foxtail, Green	0
Galium	5
Goosegrass	5
Johnsongrass	0
Kochia	20
Lambsquarters	40
Morningglory	80
Nutsedge, Yellow	15
Oat, Wild	0
Pigweed	25
Ragweed	60
Ryegrass, Italian	0
Soybean	15
Surinam Grass	5
Velvetleaf	55
Wheat	0
Windgrass	0

Table B	Compounds	
125 g ai/ha	29	30
Flood		

Table B	Compounds	
31 g ai/ha	29	30
Flood		

Barnyardgrass	0	50
Ducksalad	0	70
Rice	15	10
Sedge, Umbrella	75	75

Barnyardgrass	0	0
Ducksalad	0	0
Rice	0	0
Sedge, Umbrella	0	0

Table B	Compounds			
250 g ai/ha	12	13	22	25
Preemergence				
Bermudagrass	98	98	98	98
Blackgrass	60	50	75	60
Bromegrass, Downy	5	30	40	45
Cocklebur	85	95	100	95
Corn	15	15	5	-
Crabgrass, Large	100	100	100	98
Cupgrass, Woolly	90	75	95	85
Foxtail, Giant	98	95	100	95
Foxtail, Green	95	95	98	90
Galium	100	100	100	98
Goosegrass	100	100	100	98
Johnsongrass	5	10	35	75
Kochia	85	85	95	98
Lambsquarters	98	98	98	100
Morningglory	98	98	100	98
Nightshade	98	100	95	98
Nutsedge, Yellow	98	85	98	85
Oat, Wild	30	50	30	85
Pigweed	100	98	100	100
Ragweed	85	90	90	90
Russian Thistle	-	-	0	-
Ryegrass, Italian	35	40	55	55
Soybean	60	60	85	80
Sunflower	90	95	95	90
Surinam Grass	95	98	100	100
Velvetleaf	100	100	100	100
Wheat	5	10	45	30

Table B	Compounds				
125 g ai/ha	9	12	13	22	25
Preemergence					
Bermudagrass	100	98	98	98	98
Blackgrass	45	30	25	60	20
Bromegrass, Downy	5	0	30	10	10
Cocklebur	90	80	85	95	95
Corn	55	10	0	0	35
Crabgrass, Large	98	100	98	100	98
Cupgrass, Woolly	65	85	65	85	85
Foxtail, Giant	55	85	60	98	85
Foxtail, Green	95	95	90	95	85
Galium	98	95	95	98	98
Goosegrass	95	98	95	100	95
Johnsongrass	20	5	10	35	70
Kochia	90	75	85	85	85
Lambsquarters	98	98	98	98	95
Morningglory	98	95	95	98	95
Nightshade	98	95	100	95	98
Nutsedge, Yellow	55	95	70	98	65
Oat, Wild	45	0	30	20	30
Pigweed	100	98	98	100	100
Ragweed	90	80	85	85	85
Russian Thistle	90	-	-	-	-
Ryegrass, Italian	45	25	30	40	40
Soybean	85	55	50	70	65
Sunflower	90	85	95	85	85
Surinam Grass	70	95	85	98	98
Velvetleaf	100	100	100	100	100
Wheat	0	0	0	20	20

Table B	Compounds			
62 g ai/ha	9	12	13	22

Table B	Compounds				
31 g ai/ha	9	12	13	22	25

Preemergence						Preemergence					
Bermudagrass	100	98	98	98	98	Bermudagrass	100	98	98	98	98
Blackgrass	35	30	20	5	20	Blackgrass	5	5	5	0	5
Bromegrass, Downy	0	0	0	0	0	Bromegrass, Downy	0	0	0	0	0
Cocklebur	85	55	85	-	90	Cocklebur	85	5	70	95	-
Corn	25	10	0	0	0	Corn	15	0	0	0	0
Crabgrass, Large	95	98	95	100	95	Crabgrass, Large	85	98	95	98	95
Cupgrass, Woolly	60	80	45	80	80	Cupgrass, Woolly	60	40	40	50	65
Foxtail, Giant	50	80	5	85	75	Foxtail, Giant	15	30	5	35	65
Foxtail, Green	80	90	85	95	85	Foxtail, Green	30	50	40	90	75
Galium	95	80	95	98	98	Galium	90	80	80	80	95
Goosegrass	80	80	75	90	90	Goosegrass	80	60	70	85	75
Johnsongrass	10	0	0	20	55	Johnsongrass	0	0	0	5	35
Kochia	80	70	75	75	85	Kochia	75	15	70	50	75
Lambsquarters	95	95	98	98	90	Lambsquarters	95	90	95	98	90
Morningglory	95	85	85	90	95	Morningglory	85	45	60	85	90
Nightshade	98	95	98	95	95	Nightshade	98	85	95	85	90
Nutsedge, Yellow	50	90	40	95	30	Nutsedge, Yellow	30	80	30	80	5
Oat, Wild	25	0	0	5	0	Oat, Wild	0	0	0	0	0
Pigweed	98	98	90	100	100	Pigweed	95	85	90	98	98
Ragweed	85	75	80	85	80	Ragweed	75	65	75	80	80
Ryegrass, Italian	40	20	20	5	25	Russian Thistle	-	-	-	0	-
Soybean	80	35	45	65	55	Ryegrass, Italian	0	0	0	0	5
Sunflower	85	85	85	-	85	Soybean	55	35	40	30	55
Surinam Grass	35	85	75	98	80	Sunflower	85	80	80	80	80
Velvetleaf	100	100	100	100	100	Surinam Grass	10	70	35	55	80
Wheat	0	0	0	5	5	Velvetleaf	100	60	100	100	100
						Wheat	0	0	0	0	0

Table B	Compound
16 g ai/ha	9
Preemergence	
Bermudagrass	90
Blackgrass	5
Bromegrass, Downy	0
Cocklebur	80
Corn	15
Crabgrass, Large	55

Table B	Compound
16 g ai/ha	9
Preemergence	
Morningglory	60
Nightshade	95
Nutsedge, Yellow	30
Oat, Wild	0
Pigweed	90
Ragweed	65

Cupgrass, Woolly	55	Russian Thistle	90
Foxtail, Giant	10	Ryegrass, Italian	0
Foxtail, Green	5	Soybean	40
Galium	80	Sunflower	80
Goosegrass	50	Surinam Grass	0
Johnsongrass	0	Velvetleaf	85
Kochia	65	Wheat	0
Lambsquarters	90		

TEST C

Plant species in the flooded paddy test selected from rice (*Oryza sativa*), small-flower umbrella sedge (*Cyperus difformis*), duck salad (*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 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table C					Compounds									
250 g ai/ha	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Flood														
Barnyardgrass	85	35	80	85	0	0	70	65	60	80	65	65	70	60
Ducksalad	85	20	30	90	0	0	20	80	70	90	75	70	75	75
Rice	70	15	0	85	0	0	50	65	25	60	30	0	30	20
Sedge, Umbrella	85	70	90	90	20	0	90	85	85	90	70	75	85	90

Table C					Compounds									
250 g ai/ha	20	21	22	23	24	25	26	27	28	29	30	31	32	
Flood														
Barnyardgrass	40	20	80	30	75	–	0	20	35	70	100	0	75	
Ducksalad	0	50	85	0	0	80	45	70	70	85	100	0	80	
Rice	15	15	85	15	70	80	0	35	0	10	10	0	60	
Sedge, Umbrella	70	70	85	0	60	65	60	80	90	85	100	0	80	

TEST D

Seeds of plant species selected from bluegrass (annual bluegrass, *Poa annua*), blackgrass (*Alopecurus myosuroides*), canarygrass (*Phalaris minor*), chickweed (common chickweed, *Stellaria media*), brome grass, downy (downy brome grass *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*), Russian thistle (*Salsola iberica*), chamomile (scentless chamomile, *Matricaria inodora*),
 5 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
 10 (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, plants selected from these crop and weed species and also galium (catchweed bedstraw, *Galium aparine*) were planted in pots containing a planting medium comprising sphagnum peat moss, vermiculite, wetting agent and starter
 15 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 days 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
 20 no effect and 100 is complete control. A dash (–) response means no test result.

Table D	Compound	Table D	Compound
125 g ai/ha	25	62 g ai/ha	25
Postemergence		Postemergence	
Barley, Spring	15	Barley, Spring	15
Barley, Winter	25	Barley, Winter	15
Blackgrass	25	Blackgrass	15
Bluegrass	5	Bluegrass	5
Bromegrass, Downy	30	Bromegrass, Downy	25
Buckwheat, Wild	100	Buckwheat, Wild	100
Canarygrass	70	Canarygrass	65
Chamomile	100	Chamomile	100
Chickweed	85	Chickweed	95
Deadnettle	100	Deadnettle	95
Field Poppy	55	Field Poppy	15
Field Violet	80	Field Violet	75
Foxtail, Green	75	Foxtail, Green	75
Galium	95	Galium	95
Kochia	85	Kochia	90

Lambsquarters	95
Mustard, Wild	100
Oat, Wild	30
Oilseed Rape	100
Pigweed	95
Russian Thistle	70
Ryegrass, Italian	40
Speedwell	100
Wheat, Spring	35
Wheat, Winter	50
Windgrass	55

Lambsquarters	95
Mustard, Wild	100
Oat, Wild	20
Oilseed Rape	100
Pigweed	80
Russian Thistle	85
Ryegrass, Italian	15
Speedwell	75
Wheat, Spring	25
Wheat, Winter	25
Windgrass	30

Table D	Compound
31 g ai/ha	25
Postemergence	
Barley, Spring	5
Barley, Winter	10
Blackgrass	10
Bluegrass	0
Bromegrass, Downy	15
Buckwheat, Wild	80
Canarygrass	25
Chamomile	95
Chickweed	90
Deadnettle	70
Field Poppy	20
Field Violet	35
Foxtail, Green	55
Galium	90
Kochia	90
Lambsquarters	90
Mustard, Wild	100
Oat, Wild	10
Oilseed Rape	100
Pigweed	75
Russian Thistle	100
Ryegrass, Italian	10
Speedwell	70

Table D	Compound
16 g ai/ha	25
Postemergence	
Barley, Spring	0
Barley, Winter	0
Blackgrass	5
Bluegrass	5
Bromegrass, Downy	10
Buckwheat, Wild	75
Canarygrass	15
Chamomile	85
Chickweed	95
Deadnettle	70
Field Poppy	0
Field Violet	20
Foxtail, Green	30
Galium	80
Kochia	80
Lambsquarters	85
Mustard, Wild	85
Oat, Wild	5
Oilseed Rape	85
Pigweed	50
Russian Thistle	85
Ryegrass, Italian	0
Speedwell	50

Wheat, Spring	15
Wheat, Winter	15
Windgrass	15

Wheat, Spring	10
Wheat, Winter	15
Windgrass	0

Table D	Compound
125 g ai/ha	25
Preemergence	
Barley, Spring	0
Barley, Winter	5
Blackgrass	20
Bluegrass	5
Bromegrass, Downy	15
Buckwheat, Wild	90
Canarygrass	20
Chamomile	100
Chickweed	100
Deadnettle	100
Field Poppy	5
Field Violet	75
Foxtail, Green	35
Kochia	100
Lambsquarters	100
Mustard, Wild	75
Oat, Wild	15
Oilseed Rape	50
Pigweed	75
Radish, Wild	100
Russian Thistle	85
Ryegrass, Italian	10
Speedwell	100
Wheat, Spring	15
Wheat, Winter	5
Windgrass	10

Table D	Compound
62 g ai/ha	25
Preemergence	
Barley, Spring	0
Barley, Winter	0
Blackgrass	0
Bluegrass	0
Bromegrass, Downy	10
Buckwheat, Wild	15
Canarygrass	5
Chamomile	90
Chickweed	45
Deadnettle	60
Field Poppy	15
Field Violet	65
Foxtail, Green	10
Kochia	90
Lambsquarters	100
Mustard, Wild	35
Oat, Wild	20
Oilseed Rape	20
Pigweed	30
Radish, Wild	25
Russian Thistle	35
Ryegrass, Italian	10
Speedwell	80
Wheat, Spring	5
Wheat, Winter	0
Windgrass	5

Table D	Compound
31 g ai/ha	25
Preemergence	
Barley, Spring	0

Table D	Compound
16 g ai/ha	25
Preemergence	
Barley, Spring	0

Barley, Winter	5	Barley, Winter	0
Blackgrass	0	Blackgrass	10
Bluegrass	0	Bluegrass	0
Bromegrass, Downy	5	Bromegrass, Downy	0
Buckwheat, Wild	15	Buckwheat, Wild	20
Canarygrass	0	Canarygrass	0
Chamomile	85	Chamomile	70
Chickweed	20	Chickweed	5
Deadnettle	5	Deadnettle	0
Field Poppy	5	Field Poppy	0
Field Violet	30	Field Violet	20
Foxtail, Green	0	Foxtail, Green	0
Kochia	60	Kochia	10
Lambsquarters	90	Lambsquarters	100
Mustard, Wild	10	Mustard, Wild	5
Oat, Wild	10	Oat, Wild	15
Oilseed Rape	10	Oilseed Rape	5
Pigweed	25	Pigweed	15
Radish, Wild	20	Radish, Wild	10
Russian Thistle	15	Russian Thistle	0
Ryegrass, Italian	0	Ryegrass, Italian	0
Speedwell	30	Speedwell	25
Wheat, Spring	5	Wheat, Spring	0
Wheat, Winter	5	Wheat, Winter	5
Windgrass	0	Windgrass	0

TEST E

- Seeds of plant species selected from corn (*Zea mays*), soybean (*Glycine max*), velvetleaf (*Abutilon theophrasti*), lambsquarters (*Chenopodium album*), poinsettia, wild (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*), foxtail, giant (giant foxtail, *Setaria faberii*), foxtail, green (green foxtail, *Setaria viridis*), goosegrass (*Eleusine indica*), ragweed (common ragweed, *Ambrosia elatior*), barnyardgrass (*Echinochloa crus-galli*), sandbur (southern sandbur, *Cenchrus echinatus*), arrowleaf sida (*Sida rhombifolia*), ryegrass, Italian (Italian ryegrass, *Lolium multiflorum*), dayflower, VA (Virginia dayflower, *Commelina virginica*), field bindweed (*Convolvulus arvensis*), cocklebur (common cocklebur, *Xanthium strumarium*), morningglory (*Ipomoea coccinea*), nightshade (eastern black nightshade, *Solanum ptycanthum*), kochia (*Kochia scoparia*), nutsedge, yellow (yellow

nutsedge, *Cyperus esculentus*) 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 selected from these crop and weed species and also smartweed (ladythumb smartweed, *Polygonum persicaria*), crabgrass, Brazil (Brazilian crabgrass, *Digitaria horizontalis*), fall panicum (*Panicum dichotomiflorum*), waterhemp_RES1 (ALS/Triazine resistant common waterhemp, *Amaranthus rudis*) and waterhemp_RES2 (ALS/HPPD resistant common waterhemp, *Amaranthus rudis*) were planted in pots containing a planting medium comprising sphagnum peat moss, vermiculite, wetting agent and starter nutrients and treated with postemergence applications of some of the 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 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table E, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table E	Compounds					Table E	Compounds				
250 g ai/ha	10	12	13	17	20	250 g ai/ha	10	12	13	17	20
Postemergence						Postemergence					
Arrowleaf Sida	65	80	85	80	50	Pigweed, Palmer	95	100	100	–	–
Barnyardgrass	85	95	98	100	90	Poinsettia, Wild	–	100	100	90	90
Beggarticks	80	–	–	85	70	Ryegrass, Italian	30	50	70	60	30
Corn	50	10	60	–	–	Sandbur	30	60	60	50	50
Crabgrass, Brazil	75	95	98	50	50	Soybean	95	95	95	95	80
Dayflower, VA	70	85	80	70	50	Waterhemp	100	–	–	95	95
Field Bindweed	85	85	90	90	85	Waterhemp_RES2	70	–	–	70	95
Panicum, Fall	100	–	–	95	80						

Table E	Compounds							
125 g ai/ha	5	10	12	13	17	20	22	25
Postemergence								
20 Arrowleaf Sida	55	60	70	80	65	40	75	90
Barnyardgrass	100	75	95	95	100	85	90	100
Beggarticks	90	70	–	–	75	60	85	80
Corn	10	0	0	35	–	–	20	0
Crabgrass, Brazil	50	70	95	95	45	40	95	95
25 Dayflower, VA	60	30	75	60	60	40	85	85
Field Bindweed	85	80	80	90	85	70	90	90
Panicum, Fall	90	90	–	–	95	50	95	95

	Pigweed, Palmer	100	80	80	95	-	-	100	-
	Poinsettia, Wild	90	70	90	95	90	85	-	95
	Ryegrass, Italian	0	10	40	50	50	10	55	60
	Sandbur	20	20	50	50	40	40	50	80
5	Smartweed	90	-	-	-	-	-	-	-
	Soybean	55	80	95	95	95	70	95	98
	Waterhemp	100	90	-	-	85	95	100	98
	Waterhemp_RES1	-	-	-	-	-	-	100	40
	Waterhemp_RES2	80	50	-	-	50	80	100	90
10	Table E	Compounds							
	62 g ai/ha	5	10	12	13	17	22	25	
	Postemergence								
	Arrowleaf Sida	50	10	70	70	60	65	85	
	Barnyardgrass	98	70	95	90	98	90	95	
15	Beggarticks	80	60	-	-	70	75	60	
	Corn	5	0	0	0	-	10	0	
	Crabgrass, Brazil	50	50	90	90	40	95	90	
	Dayflower, VA	40	10	55	50	50	70	75	
	Field Bindweed	80	80	70	85	85	85	90	
20	Panicum, Fall	90	80	-	-	90	95	90	
	Pigweed, Palmer	90	70	80	90	-	100	-	
	Poinsettia, Wild	75	70	85	90	80	100	95	
	Ryegrass, Italian	0	0	30	40	50	35	50	
	Sandbur	20	20	40	50	20	40	60	
25	Smartweed	80	-	-	-	-	-	-	
	Soybean	55	75	95	95	95	95	98	
	Waterhemp	100	75	-	-	75	100	95	
	Waterhemp_RES1	-	-	-	-	-	95	35	
	Waterhemp_RES2	70	40	-	-	30	98	80	
30	Table E	Compounds							
	31 g ai/ha	5	10	12	13	17	22	25	
	Postemergence								
	Arrowleaf Sida	35	0	60	60	35	50	70	
	Barnyardgrass	80	60	90	90	90	90	95	
35	Beggarticks	70	40	-	-	70	75	50	
	Corn	0	0	0	0	-	0	0	
	Crabgrass, Brazil	50	30	75	85	30	90	85	
	Dayflower, VA	40	0	30	30	10	40	60	
	Field Bindweed	70	60	60	80	75	85	90	

	Panicum, Fall	50	80	-	-	90	90	90
	Pigweed, Palmer	90	60	70	85	-	100	-
	Poinsettia, Wild	70	60	85	90	80	80	90
	Ryegrass, Italian	0	0	10	30	20	35	10
5	Sandbur	20	0	30	40	10	30	40
	Smartweed	80	-	-	-	-	-	-
	Soybean	45	70	85	95	90	95	95
	Waterhemp	90	70	-	-	60	95	85
	Waterhemp_RES1	-	-	-	-	-	95	0
10	Waterhemp_RES2	60	-	-	-	20	95	75
	Table E	Compounds						
	16 g ai/ha	5	10	12	13	17	22	25
	Postemergence							
	Arrowleaf Sida	30	0	30	30	30	50	60
15	Barnyardgrass	70	40	90	85	80	80	95
	Beggarticks	60	30	-	-	50	60	50
	Corn	0	0	0	0	-	0	0
	Crabgrass, Brazil	40	0	70	80	10	85	65
	Dayflower, VA	30	0	20	20	0	10	40
20	Field Bindweed	65	50	50	75	60	70	80
	Panicum, Fall	15	60	-	-	50	60	70
	Pigweed, Palmer	75	50	50	75	-	90	-
	Poinsettia, Wild	60	50	80	80	80	50	80
	Ryegrass, Italian	0	0	10	10	0	30	0
25	Sandbur	15	0	15	40	0	25	20
	Smartweed	60	-	-	-	-	-	-
	Soybean	30	50	60	90	85	95	95
	Waterhemp	60	70	-	-	60	90	80
	Waterhemp_RES1	-	-	-	-	-	85	0
30	Waterhemp_RES2	15	0	-	-	10	80	70

Table E Compounds

250 g ai/ha 12 13

Preemergence

Arrowleaf Sida 0 20

Barnyardgrass 100 100

Beggarticks 90 95

Cocklebur 90 -

Corn 0 0

Table E Compounds

125 g ai/ha 12 13

Preemergence

Arrowleaf Sida 0 0

Barnyardgrass 100 75

Beggarticks 90 90

Cocklebur 50 -

Corn 0 0

Crabgrass, Large	98	-
Dayflower, VA	75	75
Field Bindweed	70	98
Foxtail, Giant	65	75
Foxtail, Green	65	75
Goosegrass	98	50
Kochia	80	-
Lambsquarters	98	-
Morningglory	98	95
Nightshade	98	98
Nutsedge, Yellow	95	35
Pigweed, Palmer	100	100
Poinsettia, Wild	95	-
Ragweed	95	98
Sandbur	25	40
Soybean	60	60
Surinam Grass	70	70
Velvetleaf	100	-
Waterhemp	98	98

Crabgrass, Large	90	95
Dayflower, VA	40	50
Field Bindweed	50	95
Foxtail, Giant	-	65
Foxtail, Green	25	65
Goosegrass	30	50
Kochia	80	95
Morningglory	95	95
Nightshade	98	98
Nutsedge, Yellow	85	-
Pigweed, Palmer	100	100
Poinsettia, Wild	-	75
Ragweed	90	98
Ryegrass, Italian	-	40
Sandbur	0	40
Soybean	30	50
Surinam Grass	30	70
Velvetleaf	100	-
Waterhemp	98	98

Table E	Compounds	
62 g ai/ha	12	13
Preemergence		
Arrowleaf Sida	0	0
Barnyardgrass	35	-
Beggarticks	0	0
Corn	0	0
Crabgrass, Large	65	35
Dayflower, VA	0	0
Field Bindweed	0	80
Foxtail, Giant	0	35
Foxtail, Green	20	40
Goosegrass	0	35
Lambsquarters	98	-
Morningglory	90	-
Nightshade	-	98
Nutsedge, Yellow	75	10
Pigweed, Palmer	25	98

Table E	Compounds	
31 g ai/ha	12	13
Preemergence		
Arrowleaf Sida	0	0
Barnyardgrass	0	-
Beggarticks	0	0
Cocklebur	0	0
Corn	0	0
Crabgrass, Large	0	0
Dayflower, VA	0	-
Field Bindweed	0	0
Foxtail, Giant	0	0
Foxtail, Green	0	35
Goosegrass	0	0
Kochia	0	50
Lambsquarters	98	-
Morningglory	65	-
Nightshade	0	98

Ragweed	90	95
Sandbur	0	0
Soybean	20	35
Surinam Grass	20	10
Velvetleaf	80	-
Waterhemp	0	70

Nutsedge, Yellow	25	0
Pigweed, Palmer	25	75
Poinsettia, Wild	0	-
Ragweed	30	70
Ryegrass, Italian	0	-
Sandbur	0	0
Soybean	0	0
Surinam Grass	0	0
Waterhemp	0	30

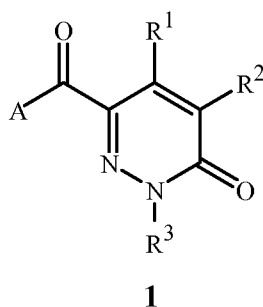
Table E	Compounds	
16 g ai/ha	12	13
Preemergence		
Arrowleaf Sida	0	0
Barnyardgrass	0	0
Beggarticks	0	0
Corn	0	0
Crabgrass, Large	0	0
Dayflower, VA	0	0
Field Bindweed	0	0
Foxtail, Giant	0	0
Foxtail, Green	0	0
Goosegrass	-	0
Kochia	0	0

Table E	Compounds	
16 g ai/ha	12	13
Preemergence		
Morningglory	0	0
Nightshade	0	90
Nutsedge, Yellow	-	0
Pigweed, Palmer	-	40
Poinsettia, Wild	0	20
Ragweed	0	70
Sandbur	0	0
Soybean	0	0
Surinam Grass	0	0
Velvetleaf	0	-
Waterhemp	0	0

CLAIMS

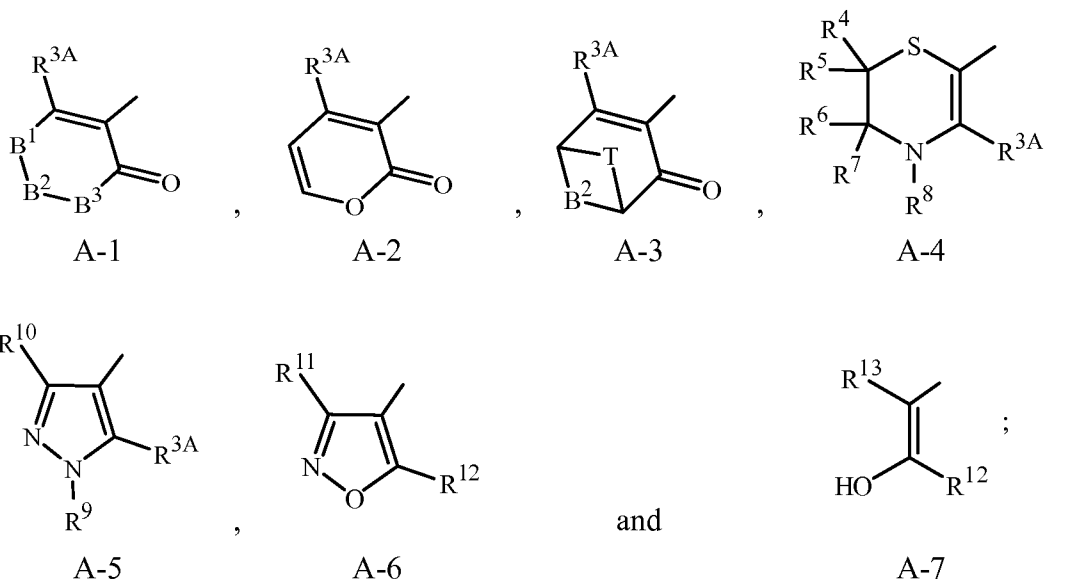
What is claimed is:

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

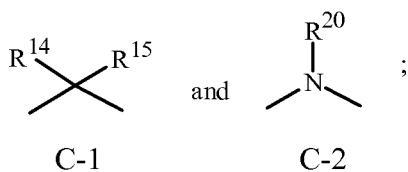


5 wherein

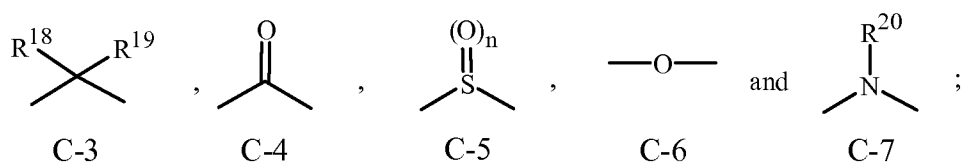
A is a radical selected from the group consisting of



B¹ and B³ are each independently a radical selected from the group consisting of



B² is a radical selected from the group consisting of



R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₂-C₆ alkenyloxy, C₃-C₈ haloalkenyloxy, C₃-C₇ alkynyloxy, C₂-C₆ alkoxyalkoxy, C₂-C₆ cyanoalkoxy, C₂-C₆ alkylthioalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio, C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, (R^A)(R^B)N-, (R^A)(R^B)NSO₂-, R^CSO₂N(R^D)-, nitro, cyano, C₂-C₆ alkoxyalkyl, C₂-C₆ haloalkoxyalkyl, C₂-C₆ alkylthioalkyl, C₂-C₆ alkylsulfinylalkyl, C₂-C₆ alkylsulfonylalkyl, C₂-C₆ cyanoalkyl, C₂-C₆ alkenyloxyalkyl, C₂-C₆ alkynyloxyalkyl, C₃-C₁₂ alkoxyalkoxyalkyl, C₃-C₁₂ haloalkoxyalkoxyalkyl, C₄-C₁₂ alkoxyalkoxyalkoxyalkyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₃-C₁₀ cycloalkylalkyl or C₃-C₁₀ alkylcycloalkyl;

each R^A is independently C₁-C₄ alkyl or C₂-C₄ haloalkyl;

each R^B is independently C₁-C₄ alkyl or C₂-C₄ haloalkyl; or

R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 5- or 6-membered ring including ring members selected from -CH₂-, -O- and -N-;

R^C is C₁-C₄ alkyl or C₂-C₄ haloalkyl;

R^D is C₁-C₃ alkylene;

R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or H, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -SF₅, -NHCHO, -NHNH₂, -NHOH, -NHCN, -NHC(=O)NH₂, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₃-C₁₀ alkoxyalkenyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₆ alkylthioalkoxy, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylaminoalkyl, C₃-C₁₀ dialkylaminoalkyl, C₂-C₈ haloalkylaminoalkyl, C₄-C₁₀ cycloalkylaminoalkyl, C₂-C₈ alkylcarbonyl, C₂-C₈ haloalkylcarbonyl, C₄-C₁₀ cycloalkylcarbonyl, C₂-C₈ alkoxycarbonyl, C₄-C₁₀ cycloalkoxycarbonyl, C₅-C₁₂ cycloalkylalkoxycarbonyl, C₂-C₈ alkylaminocarbonyl, C₃-C₁₀ dialkylaminocarbonyl, C₄-C₁₀ cycloalkylaminocarbonyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, C₃-C₁₀ alkoxyalkylcarbonyl, C₃-C₁₀ alkoxycarbonylalkyl, C₂-C₈

haloalkoxycarbonyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀ cycloalkylcarbonyloxy, C₃-C₁₀ alkylcarbonylalkoxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈ cycloalkylsulfonyl, C₃-C₈ trialkylsilyl, C₃-C₈ cycloalkenyloxy, C₃-C₈ halocycloalkenyloxy, C₂-C₈ haloalkoxyalkoxy, C₂-C₈ alkoxyhaloalkoxy, C₂-C₈ haloalkoxyhaloalkoxy, C₃-C₁₀ alkoxycarbonylalkoxy, C₂-C₈ alkyl(thiocarbonyl)oxy, C₂-C₈ alkylcarbonylthio, C₂-C₈ alkyl(thiocarbonyl)thio, C₃-C₈ cycloalkylsulfinyl, C₁-C₆ alkylaminosulfonyl, C₂-C₈ dialkylaminosulfonyl, C₃-C₁₀ halotrialkylsilyl, C₁-C₆ alkylamino, C₂-C₈ dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino, C₃-C₈ cycloalkylamino, C₂-C₈ alkylcarbonylamino, C₂-C₈ haloalkylcarbonylamino, C₁-C₆ alkylsulfonylamino, C₁-C₆ haloalkylsulfonylamino or C₄-C₁₀ cycloalkyl(alkyl)amino; or

R¹ and R² are taken together with the atoms to which they are attached to form a 5-, 6- or 7-membered partially unsaturated or fully unsaturated ring along with ring members consisting of carbon atoms and up to 2 oxygen atoms, 2 nitrogen atoms and 2 sulfur atoms or up to two -S(O)-, -S(O)₂- and -C(O)- groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl and C₂-C₈ alkoxyalkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy; the ring optionally substituted on nitrogen ring members selected from H and C₁-C₆ alkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy;

W¹ is C₁-C₆ alkylene, C₂-C₆ alkenylene, C₂-C₆ alkynylene or C₁-C₅ alkyleneoxy;

W² is C₁-C₆ alkylene or C₁-C₅ alkyleneoxy;

R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ halocycloalkyl, C₁-C₄ cyanoalkyl, C₂-C₆ alkoxyalkyl, C₃-C₆ alkoxycarbonylalkyl or C₃-C₆ alkylcarbonylalkyl;

R^{3A} is H, halogen, cyano, hydroxy, -O-M⁺, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, -NHNH₂, -NHOH, -N=C=O, -N=C=S, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₆ alkynyloxy,

C₃-C₆ haloalkynyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀ cycloalkylcarbonyloxy, C₃-C₁₀ alkylcarbonylalkoxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈ cycloalkylsulfonyl, C₁-C₆ alkylsulfonyloxy, C₁-C₆ alkylamino, C₂-C₈ dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino, C₃-C₈ cycloalkylamino, C₂-C₈ alkylcarbonylamino, C₂-C₈ haloalkylcarbonylamino, C₁-C₆ alkylsulfonylamino or C₁-C₆ haloalkylsulfonylamino; or benzyloxy, phenoxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy, benzylsulfonyloxy, phenylthio, benzylthio, phenylsulfinyl, benzylsulfinyl, phenylsulfonyl or benzylsulfonyl, each optionally substituted on ring members with up to five substituents selected from R²¹;

M⁺ is an alkali metal cation or an ammonium cation;

R⁴, R⁵, R⁶ and R⁷ are each independently H, halogen, hydroxy, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy or C₃-C₈ halocycloalkoxy; or phenyl or benzyl, each optionally substituted on ring members with up to five substituents selected from R²¹;

R⁸ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl or C₃-C₈ halocycloalkyl; or benzyl optionally substituted on ring members with up to five substituents selected from R²¹;

R⁹ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl or C₂-C₈ alkylthioalkyl;

R¹⁰ is H, halogen, cyano, hydroxy, amino, nitro, SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, -NHCHO, -NHNH₂, -N₃, -NHOH, -NHCN, -NHC(=O)NH₂, -N=C=O, -N=C=S, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl or C₂-C₈ alkylthioalkyl;

R¹¹ is H, halogen, cyano, hydroxy, amino, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl,

C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl or C₂-C₈ alkylsulfonylalkyl; or phenyl optionally substituted with up to five substituents selected from R²¹;

R¹² is H, halogen, cyano, hydroxy, amino, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl or C₂-C₈ alkoxycarbonylamino;

R¹³ is H, halogen, cyano, hydroxy, amino, nitro or C₂-C₈ alkoxycarbonyl;

n is 0, 1, or 2;

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is independently H, halogen, cyano, hydroxy or C₁-C₆ alkyl; or

a pair of R¹⁴ and R¹⁸ is taken together as C₂-C₆ alkylene or C₂-C₆ alkenylene;

R²⁰ is H, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₈ cycloalkyl;

T is C₁-C₆ alkylene or C₂-C₆ alkenylene;

each G is independently a 5- or 6-membered heterocyclic ring or an 8-, 9- or 10-membered fused bicyclic ring system, each ring or ring system optionally substituted with up to five substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members;

each R²¹ is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₃-C₈ cycloalkylsulfonyl, C₁-C₆ alkylamino, C₂-C₈ dialkylamino, C₁-C₆ haloalkylamino, C₂-C₈ halodialkylamino or C₃-C₈ cycloalkylamino; and

each R²² is independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl or C₂-C₈ alkoxyalkyl.

2. A compound of Claim 1 wherein

A is A-1, A-3, A-5 or A-6;

R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₂-C₆ alkenyloxy, C₃-C₈ haloalkenyloxy, C₃-C₇ alkynyloxy, C₂-C₆ alkoxyalkoxy, C₂-C₆ cyanoalkoxy, C₂-C₆ alkylthioalkoxy, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylthio, C₁-C₆ haloalkylsulfinyl, C₁-C₆ haloalkylsulfonyl, (R^A)(R^B)N-, (R^A)(R^B)NSO₂-, R^CSO₂N(R^D)-, nitro or cyano;

each R^A is independently C₁-C₄ alkyl;

each R^B is independently C₁-C₄ alkyl;

R^A and R^B are taken together with the nitrogen atom to which they are both attached to form a 6-membered ring including ring members selected from -CH₂- and -O-;

R^C is C₁-C₄ alkyl;

R^D is C₁ alkylene;

R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or H, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -SF₅, -NHCHO, -NHNH₂, -NHOH, -NHCN, -NHC(=O)NH₂, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₆-C₁₄ cycloalkylcycloalkyl, C₄-C₁₀ halocycloalkylalkyl, C₅-C₁₂ alkylcycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₃-C₁₀ alkoxyalkenyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₆ alkylthioalkoxy, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylaminoalkyl, C₃-C₁₀ dialkylaminoalkyl, C₂-C₈ haloalkylaminoalkyl, C₄-C₁₀ cycloalkylaminoalkyl, C₂-C₈ alkylcarbonyl, C₂-C₈ haloalkylcarbonyl, C₄-C₁₀ cycloalkylcarbonyl, C₂-C₈ alkoxycarbonyl, C₄-C₁₀ cycloalkoxycarbonyl, C₅-C₁₂ cycloalkylalkoxycarbonyl, C₂-C₈ alkylaminocarbonyl, C₃-C₁₀ dialkylaminocarbonyl, C₄-C₁₀ cycloalkylaminocarbonyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, C₃-C₁₀ alkoxyalkylcarbonyl, C₃-C₁₀ alkoxycarbonylalkyl, C₂-C₈

haloalkoxycarbonyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₆ alkynyloxy, C₃-C₆ haloalkynyloxy or C₂-C₈ alkoxyalkoxy; or

- 5 R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and up to 2 oxygen atoms, 2 sulfur atoms or up to two -S(O)₂-groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl and C₂-C₈ alkoxyalkyl; and phenyl optionally substituted with up to 5 substituents selected from cyano, nitro, halogen, C₁-C₆ alkyl, C₁-C₆ alkoxy and C₁-C₆ haloalkoxy;

W¹ is -CH₂-, -CH=CH- or -CH₂O-;

W² is -CH₂- or -CH₂O-;

- 15 R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ halocycloalkyl, C₁-C₄ cyanoalkyl, C₂-C₆ alkoxyalkyl or C₃-C₆ alkoxycarbonylalkyl;
- R^{3A} is H, hydroxy, -O-M⁺, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀ cycloalkylcarbonyloxy or C₃-C₁₀ alkylcarbonylalkoxy; or benzyloxy, phenyloxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy or benzylsulfonyloxy, each optionally substituted on ring members with up to two substituents selected from R²¹;

M⁺ is a sodium or potassium metal cation;

R⁹ is C₁-C₆ alkyl;

- 25 R¹⁰ is H, halogen or C₁-C₆ alkyl;

R¹¹ is H or C₁-C₆ alkyl;

R¹⁴ and R¹⁸ are H or C₁-C₆ alkyl; or

R¹⁴ and R¹⁸ are taken together as -CH₂CH₂CH₂- or -CH=CHCH₂-;

each R¹⁵ and R¹⁹ is H or C₁-C₆ alkyl;

- 30 R²⁰ is H, C₁-C₆ alkyl, C₂-C₆ alkenyl or C₃-C₈ cycloalkyl;

T is -CH₂CH₂- or -CH=CH-;

G is independently a 5- or 6-membered heterocyclic ring optionally substituted with up to five substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members;

- 35 each R²¹ is independently halogen, cyano, hydroxy, nitro, -CHO, -SH, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ halocycloalkyl, C₄-C₁₀ alkylcycloalkyl, C₄-C₁₀ cycloalkylalkyl, C₃-C₈ cycloalkenyl, C₃-C₈ halocycloalkenyl, C₂-C₈ alkoxyalkyl, C₄-C₁₀ cycloalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈

alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₅ cyanoalkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₂-C₈ alkoxyalkoxy, C₂-C₈ alkylcarbonyloxy, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₃-C₈ cycloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl or C₃-C₈ cycloalkylsulfonyl; and each R²² is independently C₁-C₆ alkyl or C₁-C₆ haloalkyl.

3. A compound of Claim 2 wherein

A is A-1, A-3 or A-5;

B¹ is C-1;

B² is C-3;

B³ is C-1;

R¹ is halogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₂-C₆ alkenyl, C₂-C₆ haloalkenyl, C₂-C₆ alkynyl, C₂-C₆ haloalkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₆ alkenyloxy;

R² is phenyl or -W¹(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W²G; or C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₃-C₈ cycloalkyl, C₂-C₈ alkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₂-C₈ alkoxyalkoxy; or

R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and 2 oxygen atoms, 2 sulfur atoms or two -S(O)₂- groups, the ring optionally substituted on carbon atom ring members selected from halogen, cyano and C₁-C₆ alkyl;

W¹ is -CH₂-;

R³ is H, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₃-C₈ cycloalkyl, C₄-C₁₀ cycloalkylalkyl or C₃-C₆ alkoxycarbonylalkyl;

R^{3A} is hydroxy, -O-M⁺ or C₂-C₈ alkylcarbonyloxy; or phenylsulfonyloxy optionally substituted with up to two substituents selected from R²¹;

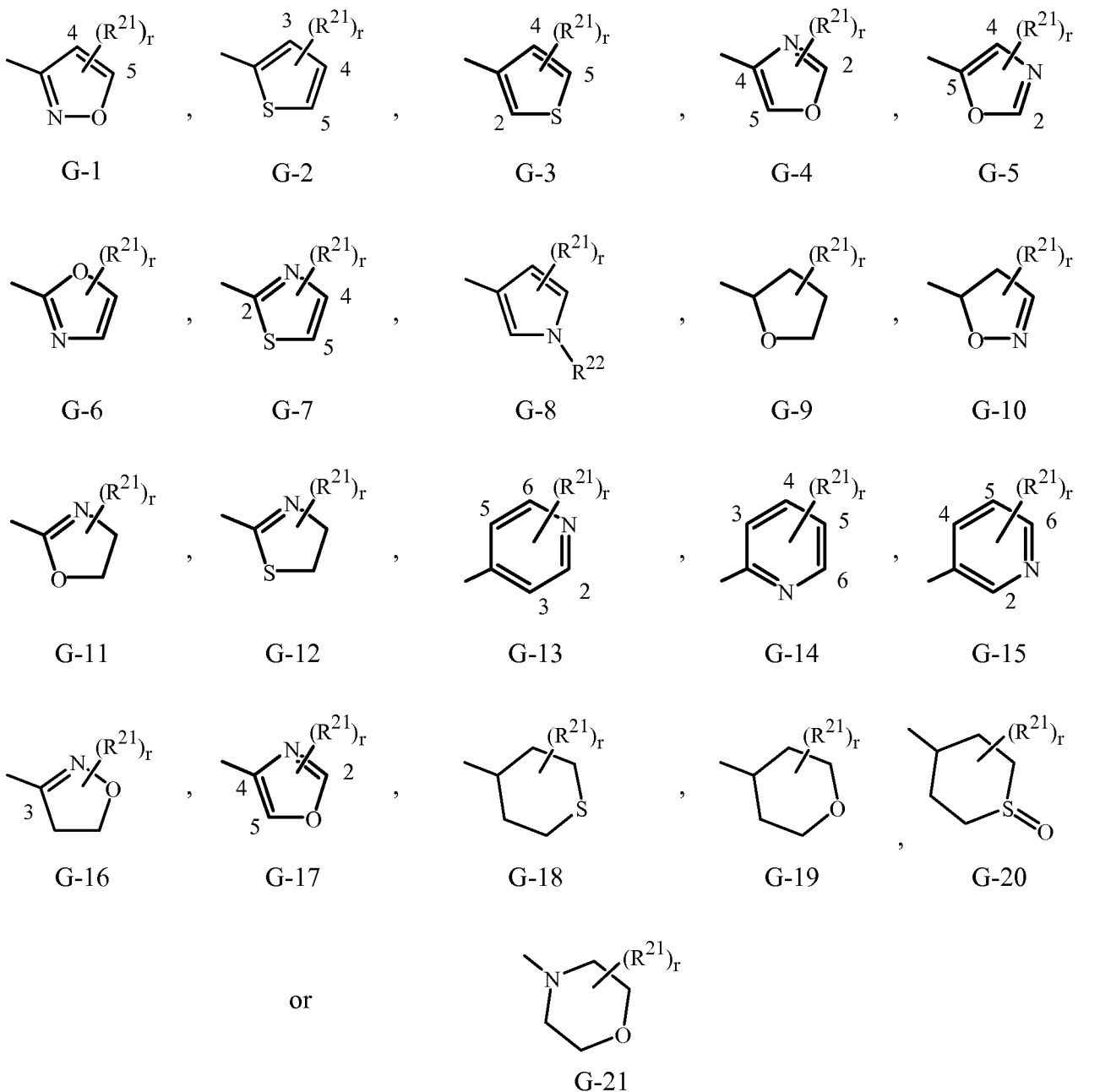
R⁹ is ethyl;

R¹⁰ is H or methyl;

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or methyl;

T is -CH₂CH₂-;

G is



r is 0, 1, 2 or 3;

each R^{21} is independently halogen, nitro, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkoxy,

C_1 - C_6 haloalkoxy or C_1 - C_6 alkylthio; and

each R^{22} is independently methyl or $-CH_2CF_3$.

5

4. A compound of Claim 3 wherein

A is A-1 or A-3;

R^1 is halogen, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkoxy or C_1 - C_6 haloalkoxy;

R^2 is phenyl optionally substituted with up to five substituents selected from R^{21} ; or

C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_3 - C_8 cycloalkyl, C_2 - C_8 alkoxyalkyl, C_1 - C_6

alkoxy, C_1 - C_6 haloalkoxy or C_2 - C_8 alkoxyalkoxy; or

10

R¹ and R² are taken together with the atoms to which they are attached to form a 6-membered partially unsaturated ring along with ring members consisting of carbon atoms and two -S(O)₂- groups, the ring optionally substituted on carbon atom ring members selected from halogen and C₁-C₆ alkyl;

R³ is C₁-C₄ alkyl or C₃-C₈ cycloalkyl;

R^{3A} is hydroxy or C₂-C₈ alkylcarbonyloxy;

R¹⁰ is methyl;

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H; and

each R²¹ is independently fluorine, chlorine, bromine, methyl, trifluoromethyl, methoxy, trifluoromethoxy or thiomethoxy.

5. A compound of Claim 4 wherein

A is A-1;

R¹ is chloro, methyl, methoxy or trifluoromethyl;

R² is phenyl; or C₁-C₆ alkyl;

R³ is methyl or cyclopropyl; and

R^{3A} is hydroxy or -OC(=O)CH₂CH(CH₃)₂.

6. A compound of Claim 5 wherein

R¹ is methyl;

R² is phenyl; or *n*-propyl; and

R³ is methyl.

7. A compound of Claim 1 that is selected from the group:

5-chloro-6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-3(2*H*)-pyridazinone,

6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-propyl-3(2*H*)-pyridazinone,

6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-5-methoxy-2-methyl-4-phenyl-3(2*H*)-pyridazinone,

6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2,5-dimethyl-4-phenyl-3(2*H*)-pyridazinone and

6-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-methyl-4-phenyl-5-(trifluoromethyl)-3(2*H*)-pyridazinone.

8. A compound of Claim 4 wherein

A is A-1;

R¹ is chloro or methyl;

R² is *n*-propyl, *c*-hexyl or -OCH₂CH₂CF₃;

R³ is methyl; and

R^{3A} is hydroxy or -OC(=O)CH₂CH(CH₃)₂.

9. A compound of Claim 1 that is selected from the group:

a compound of Formula 1 wherein A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is Cl; R² is *c*-hexyl; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H;

5 a compound of Formula 1 wherein A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is Cl; R² is *c*-propyl; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H; and

10 a compound of Formula 1 wherein A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; R¹ is CH₃; R² is -OCH₂CH₂CF₃; R³ is CH₃; R^{3A} is hydroxy; each R¹⁴ and R¹⁵ is H; and each R¹⁸ and R¹⁹ is H.

10. 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.

15 11. 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.

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

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2013/056420

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D401/04 A01N43/60 C07D403/04 C07D403/06 C07D237/14
C07D413/04 C07D417/04

ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07D A01N

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

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

EPO-Internal, CHEM ABS Data, WPI Data, BEILSTEIN Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/031658 A1 (DU PONT [US]; KOVACS PATRICK RYAN [US]; PATEL KANU MAGANBHAI [US]; SEL) 17 March 2011 (2011-03-17) pages 173-275; examples -----	1-12
Y	WO 2011/045271 A1 (BAYER CROPSOURCE AG [DE]; BOJACK GUIDO [DE]; LEHR STEFAN [DE]; HAEUSE) 21 April 2011 (2011-04-21) the whole document -----	1-12
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Further documents are listed in the continuation of Box C.



See patent family annex.

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

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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