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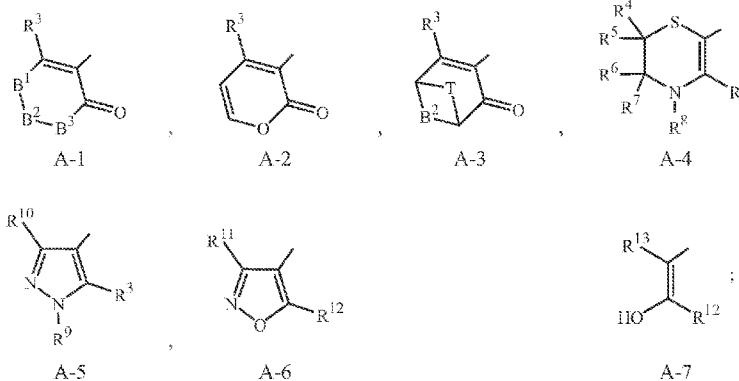
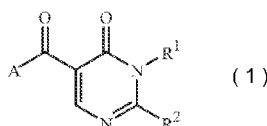
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(54) Title: HERBICIDAL BIS-NITROGEN-CONTAINING OXO HETEROCYCLES



(57) Abstract: Disclosed are compounds of Formula 1, including all stereoisomers, *N* oxides, and salts thereof, A is a radical selected from the group consisting of, and B¹, B², B³, T, R¹, R², R³, 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.



TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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TITLE

HERBICIDAL BIS-NITROGEN-CONTAINING OXO HETEROCYCLES

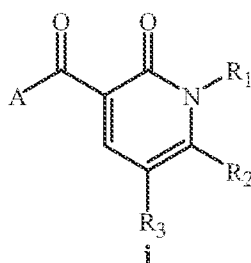
FIELD OF THE INVENTION

5 This invention relates to certain bis-nitrogen oxo heterocycles, their salts and compositions, and methods of their use for controlling undesirable vegetation. This invention also relates to certain intermediates and a method useful for preparing these bis-nitrogen heterocycles and their salts.

BACKGROUND OF THE INVENTION

10 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
15 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.

International patent application publication WO 2007/088876 discloses pyridone compounds of Formula i

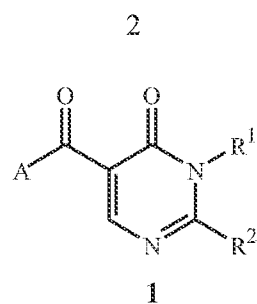


20 wherein *inter alia* R₁ is C₁-C₆ alkyl; R₂ and R₃ are each independently hydrogen, cyano, or nitro; and A is a A-1 through A-5 as defined therein as herbicides.

The bis-nitrogen containing oxo heterocycles of the present invention are not disclosed in this publication.

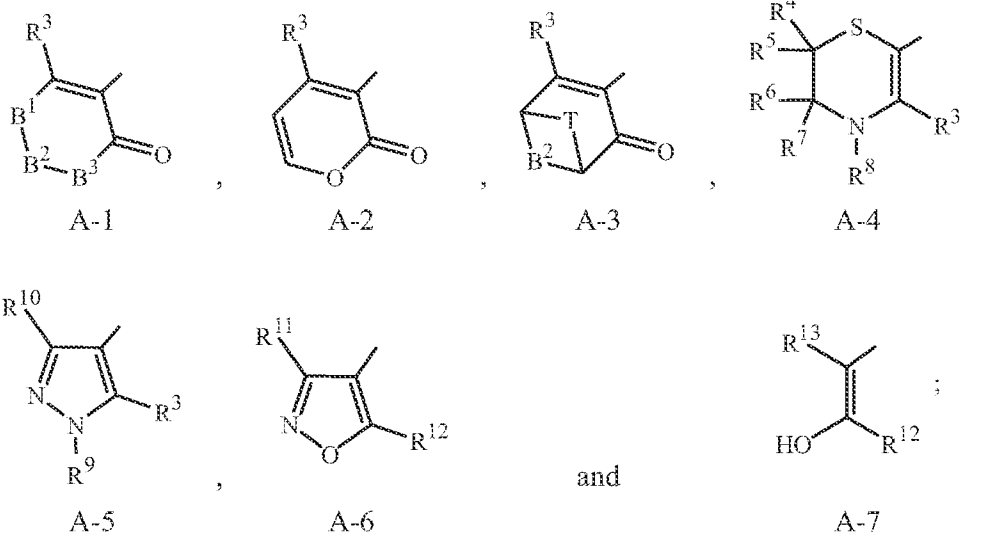
SUMMARY OF THE INVENTION

25 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:

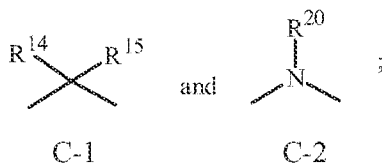


wherein

A is a radical selected from the group consisting of

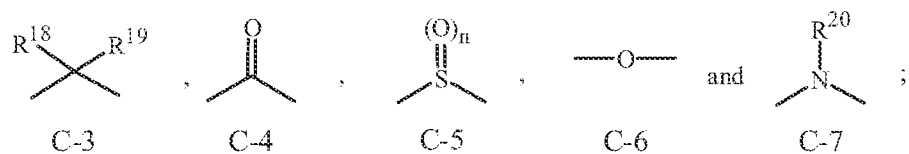


B¹ and B³ are each independently a radical selected from the group consisting of

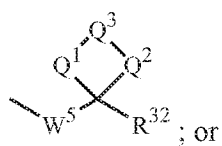


5

B² is a radical selected from the group consisting of



R¹ is

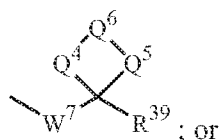


- R^1 is $-W^1C(=E^1)R^{24}$, $-W^1LC(=E^2)R^{25}$, $-W^1C(=E^3)LR^{26}$, $-W^1S(O)_xNR^{28}C(=O)R^{27}$,
 $-W^1S(O)_xNR^{28}C(=O)LR^{27}$, $-W^1S(O)_xNR^{28}SO_2LR^{27}$ or $-W^1CN$; or
 R^1 is $N(R^{40})R^{41}$; or
 R^1 is $-G^A$ or $-W^2G^A$;
- 5 each G^A is a 4- to 7-membered carbocyclic ring including ring members selected from
 $C(=O)$, $C(=S)$, $C(=NR^{29})$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$; or a 6- to 12-membered
 saturated or partially saturated carbospirocyclic or heterospirocyclic ring system
 optionally including ring members selected from $C(=O)$, $C(=S)$, $C(=NR^{29})$,
 $C(=N-OR^{30})$, or $C=NN(R^{29})_2$, each ring or ring system optionally substituted
 10 with up to five substituents selected from R^{21} on carbon ring members and R^{22}
 on nitrogen ring members; or
 each G^A is a 9-membered partially saturated fused ring system containing carbon ring
 members and 2 nitrogen ring members, the ring optionally substituted with up to
 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen
 15 ring members;
- each E^1 , E^2 , and E^3 is independently O, S, NR^{28} , NOR^{28} , $NN(R^{28})_2$, N-CN or N- NO_2 ;
 each L is independently O, $N(R^{31})$ or S;
 provided when E^3 is O, L is other than O;
- each R^{24} , R^{25} , R^{26} and R^{27} is independently hydrogen; or C_1 - C_6 alkyl, C_2 - C_6 alkenyl,
 20 C_2 - C_6 alkynyl or C_3 - C_6 cycloalkyl each optionally substituted with one or more
 substituents selected from the group consisting of halogen, CN, NO_2 , hydroxy,
 C_1 - C_4 alkoxy, C_1 - C_4 alkylsulfinyl, C_1 - C_4 alkylsulfonyl, C_1 - C_4 alkylamino,
 C_2 - C_8 dialkylamino, C_3 - C_6 cycloalkylamino and $(C_1$ - C_4 alkyl) C_3 - C_6
 cycloalkylamino;
- 25 each R^{28} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;
 each R^{29} is independently H, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkylcarbonyl,
 C_1 - C_6 alkylsulfonyl or C_1 - C_6 haloalkylsulfonyl;
 each Q^1 and Q^2 is independently O, S or $N(R^{31})$;
 Q^3 is C_1 - C_4 alkylene optionally substituted with up to 4 substituents selected from
 30 C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl and C_3 - C_6 cycloalkyl;
 R^{30} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;
 R^{31} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;
 R^{32} is H or C_1 - C_6 alkyl;
- each x is 0, 1 or 2;
- 35 W^5 is C_1 - C_6 alkylene;
 W^1 is C_1 - C_6 alkylene, C_2 - C_6 alkenylene or C_2 - C_6 alkynylene; or $-(CH_2)_2OCH_2-$ or
 $-(CH_2)_3OCH_2-$;

W² is C₁-C₆ alkylene;

R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W⁴G; 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-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, C₃-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



- 5 R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴, -W⁶C(=E⁶)L¹R³⁵, -W⁶S(O)_yNR³⁷C(=O)R³⁶ or -W⁶S(O)_yNR³⁷C(=O)L¹R³⁶;
 each E⁴, E⁵, and E⁶ is independently O, S, NR³⁷, NOR³⁷, NN(R³⁷)₂, N-CN or N-NO₂;
 each L¹ is independently O, N(R³⁸) or S;
 each R³³, R³⁴, R³⁵ and R³⁶ is independently hydrogen; or C₁-C₆ alkyl, C₂-C₆ alkenyl,
 C₂-C₆ alkynyl or C₃-C₆ cycloalkyl each optionally substituted with one or more
 10 substituents selected from the group consisting of halogen, CN, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino and (C₁-C₄ alkyl)C₃-C₆ cycloalkylamino;
 each R³⁷ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;
 15 each Q⁴ and Q⁵ is independently O, S or N(R³⁸);
 Q⁶ is C₁-C₄ alkylene optionally substituted with up to 4 substituents selected from C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl and C₃-C₆ cycloalkyl;
 R³⁸ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;
 R³⁹ is H or C₁-C₆ alkyl;
 20 each y is 0, 1 or 2;
 W⁷ is C₁-C₆ alkylene;
 W⁶ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene; or -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;
 W³ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene;
 25 W⁴ is C₁-C₆ alkylene;
 R³ 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, C₃-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 or C₂-C₈ alkylthioalkyl;

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;

each R^{22} is independently 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 or C_2 - C_8 alkoxyalkyl;

R^{40} is C_1 - C_6 alkyl; and

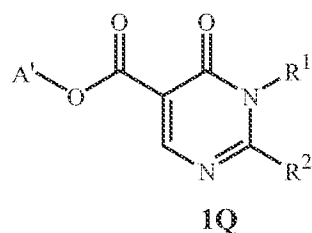
R^{41} is C_1 - C_6 alkyl; or

5 R^{40} and R^{41} are taken together as $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$.

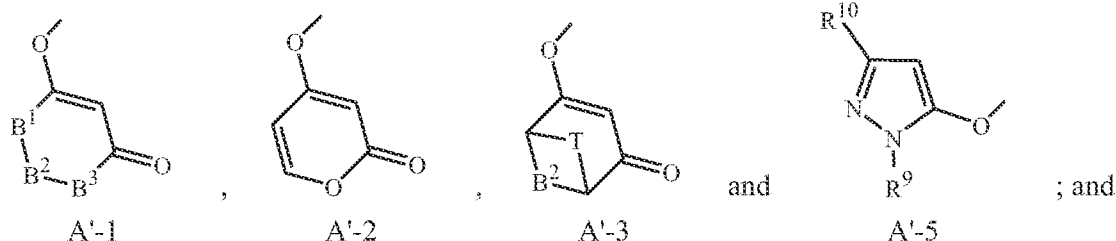
This invention pertains to a compound of Formula 1 (including all stereoisomers), an *N*-oxide, or a salt thereof. This invention also relates to a herbicidal composition comprising a compound of the invention (i.e. in a herbicidally effective amount) and at least one
10 component selected from the group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

This invention also relates to a herbicidal mixture of (a) a compound of Formula 1 and
15 (b) at least one additional active ingredient.

This invention is also directed to an intermediate compound of Formula 1Q (including all stereoisomers), *N*-oxides, and salts thereof:



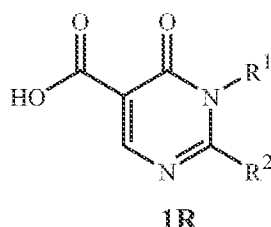
wherein A' is a radical selected from the group consisting of



20 R^1 , R^2 , B^1 , B^2 , B^3 , T , R^9 and R^{10} are as defined above for a compound of Formula 1 which is useful for preparing a compound of Formula 1.

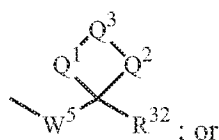
This invention is also directed to a compound of Formula 1R (including all stereoisomers), *N*-oxides, and salts thereof:

9



wherein

R^1 is



5 R^1 is $-W^1C(=E^1)R^{24}$, $-W^1LC(=E^2)R^{25}$ or $-W^1C(=E^3)LR^{26}$; or

R^1 is $N(R^{40})R^{41}$; or

R^1 is G^A ;

each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from
 10 $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$; or a 9- to 11-membered saturated or
 partially saturated carbospirocyclic or heterospirocyclic ring system optionally
 including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$,
 each ring or ring system optionally substituted with up to three substituents
 selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members; or

each G^A is a 9-membered partially saturated fused ring system containing carbon ring
 15 members and 2 nitrogen ring members, the ring optionally substituted with up to
 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen
 ring members;

each E^1 , E^2 and E^3 is independently O, NOR^{28} or $NN(R^{28})_2$;

L is independently O or $N(R^{31})$;

20 each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_4 alkyl or C_3 - C_5 cycloalkyl
 each optionally substituted with one or more substituents selected from the group
 consisting of halogen, CN, hydroxy, C_1 - C_2 alkoxy, C_1 - C_2 alkylsulfinyl and
 C_1 - C_4 alkylsulfonyl;

each R^{28} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

25 each R^{29} is independently H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkylcarbonyl,
 C_1 - C_3 alkylsulfonyl or C_1 - C_3 haloalkylsulfonyl;

each Q^1 and Q^2 is independently O or $N(R^{31})$;

Q^3 is C_2 - C_3 alkylene optionally substituted with up to 2 substituents selected from
 C_1 - C_4 alkyl;

30 R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

R³¹ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

R³² is H or C₁-C₃ alkyl;

W⁵ is C₁-C₄ alkylene;

W¹ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;

5 R² is phenyl or -W³(phenyl), each substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl;

W³ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene;

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;

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

30 R⁴⁰ is C₁-C₆ alkyl; and

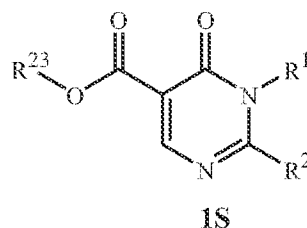
R⁴¹ is C₁-C₆ alkyl; or

R⁴⁰ and R⁴¹ are taken together as -(CH₂)₄-, -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

which is useful for preparing a compound of Formula 1.

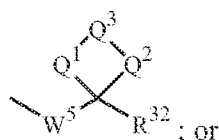
35 This invention is also directed to a compound of Formula 1S (including all stereoisomers), N-oxides, and salts thereof:

11



wherein

R¹ is



- 5 R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶; or
 R¹ is N(R⁴⁰)R⁴¹; or
 R¹ is G^A;
 each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from
 C(=O), C(=N-OR³⁰) or C=NN(R²⁹)₂; or a 9- to 11-membered saturated or
 10 partially saturated carbospirocyclic or heterospirocyclic ring system optionally
 including ring members selected from C(=O), C(=N-OR³⁰) or C=NN(R²⁹)₂,
 each ring or ring system optionally substituted with up to three substituents
 selected from R²¹ on carbon ring members and R²² on nitrogen ring members; or
 each G^A is a 9-membered partially saturated fused ring system containing carbon ring
 15 members and 2 nitrogen ring members, the ring optionally substituted with up to
 2 substituents selected from R²¹ on carbon ring members and R²² on nitrogen
 ring members;
 each E¹, E² and E³ is independently O, NOR²⁸ or NN(R²⁸)₂;
 L is independently O or N(R³¹);
 20 each R²⁴, R²⁵ and R²⁶ is independently hydrogen; or C₁-C₄ alkyl or C₃-C₅ cycloalkyl
 each optionally substituted with one or more substituents selected from the group
 consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl and
 C₁-C₄ alkylsulfonyl;
 each R²⁸ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
 25 each R²⁹ is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkylcarbonyl,
 C₁-C₃ alkylsulfonyl or C₁-C₃ haloalkylsulfonyl;
 each Q¹ and Q² is independently O or N(R³¹);
 Q³ is C₂-C₃ alkylene optionally substituted with up to 2 substituents selected from
 C₁-C₄ alkyl;
 30 R³⁰ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

- R^{31} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;
 R^{32} is H or C_1 - C_3 alkyl;
 W^5 is C_1 - C_4 alkylene;
 W^1 is C_2 - C_4 alkylene, $-(CH_2)_2OCH_2-$ or $-(CH_2)_3OCH_2-$;
 R^2 is phenyl or $-W^3(\text{phenyl})$, each substituted on ring members with up to two
substituents selected from R^{21} ; or $-G$; or C_1 - C_6 alkyl or C_3 - C_8 cycloalkyl;
 W^3 is C_1 - C_6 alkylene, C_2 - C_6 alkenylene or C_2 - C_6 alkynylene;
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 R^{21} on carbon ring
members and R^{22} on nitrogen ring members;
each R^{21} is independently halogen, cyano, hydroxy, amino, nitro, $-CHO$, $-C(=O)OH$,
 $-C(=O)NH_2$, $-C(=S)NH_2$, $-C(=O)NHCN$, $-C(=O)NHOH$, $-SH$, $-SO_2NH_2$,
 $-SO_2NHCN$, $-SO_2NHOH$, $-OCN$, $-SCN$, $-SF_5$, 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 alkylsulfinylalkyl, 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,
 C_1 - C_6 alkylsulfinyl, C_1 - C_6 haloalkylsulfinyl, C_1 - C_6 alkylsulfonyl, C_1 - C_6
haloalkylsulfonyl, C_3 - C_8 cycloalkylsulfonyl, C_1 - C_6 alkylamino, C_2 - C_8
dialkylamino, C_1 - C_6 haloalkylamino, C_2 - C_8 halodialkylamino or C_3 - C_8
cycloalkylamino;
each R^{22} is independently 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 or C_2 - C_8 alkoxyalkyl; and
 R^{23} is an optionally substituted carbon moiety;
 R^{40} is C_1 - C_6 alkyl;
 R^{41} is C_1 - C_6 alkyl; or
 R^{40} and R^{41} are taken together as $-(CH_2)_4-$, $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or
 $-(CH_2)_2O(CH_2)_2-$
which is useful for preparing a compound of Formula 1.

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.

5 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
10 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
15 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”.

20 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
25 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
30 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.

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

As used herein, the term “alkylating agent” refers to a chemical compound in which a carbon-containing radical is bound through a carbon atom to a leaving group such as halide or sulfonate, which is displaceable by bonding of a nucleophile to said carbon atom. Unless otherwise indicated, the term “alkylating” does not limit the carbon-containing radical to alkyl; the carbon-containing radicals in alkylating agents include the variety of carbon-bound substituent radicals specified for R¹, R² and R³. The term “de-alkylating agent” refers to a reagent that cleaves a carbon-carbon or carbon-oxygen bond.

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. When examples are provided for two variables being “taken together as a C₂-C₆ alkenylene”, these examples are not limiting as to the point of attachment. For example when R¹⁴ and R¹⁸ are taken together as -CH=CHCH₂- the attachment point of this exemplary group is interpreted to be attached to either or the R¹⁴ or R¹⁸ variable (i.e. is equivalent to -CH₂CH=CH-). “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.

“Alkoxy” includes, for example, methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy, pentoxy and hexyloxy isomers. “Alkoxyalkyl” denotes alkoxy substitution on alkyl. Examples of “alkoxyalkyl” include CH₃OCH₂, CH₃OCH₂CH₂, CH₃CH₂OCH₂, CH₃CH₂CH₂CH₂OCH₂ and CH₃CH₂OCH₂CH₂. “Alkoxyalkoxy” denotes alkoxy substitution on alkoxy. “Alkenyloxy” includes straight-chain or branched alkenyloxy moieties. Examples of “alkenyloxy” include H₂C=CHCH₂O, (CH₃)₂C=CHCH₂O, (CH₃)CH=CHCH₂O, (CH₃)CH=C(CH₃)CH₂O and CH₂=CHCH₂CH₂O. “Alkynyloxy” includes straight-chain or branched alkynyloxy moieties. Examples of “alkynyloxy” include HC≡CCH₂O, CH₃C≡CCH₂O and CH₃C≡CCH₂CH₂O. “Alkoxyalkenyl” includes straight-chain or branched alkenyl substituted by an alkoxy group. Examples of “alkoxyalkenyl” include CH₃OCH=CH, CH₃C(OCH₃)=CH and CH₃CH₂OCH=CHCH₂.

“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 $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$. “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 $\text{CH}_3\text{S(O)-}$, $\text{CH}_3\text{CH}_2\text{S(O)-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S(O)-}$, $(\text{CH}_3)_2\text{CHS(O)-}$ and the different butylsulfinyl, pentylsulfinyl and hexylsulfinyl isomers. Examples of “alkylsulfonyl” include $\text{CH}_3\text{S(O)}_2\text{-}$, $\text{CH}_3\text{CH}_2\text{S(O)}_2\text{-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S(O)}_2\text{-}$, $(\text{CH}_3)_2\text{CHS(O)}_2\text{-}$, 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 , $\text{CH}_3\text{SCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{SCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{SCH}_2$ and $\text{CH}_3\text{CH}_2\text{SCH}_2\text{CH}_2$; “alkylsulfinylalkyl” and “alkylsulfonylalkyl” include the corresponding sulfoxides and sulfones, respectively. “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 C(=O)NH moiety. Examples of “alkylcarbonylamino” include $\text{CH}_3\text{CH}_2\text{C(=O)NH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{C(=O)NH}$.

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

“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 $\text{CH}_3\text{CH}(\text{CN})\text{CH}_2$.

“Cycloalkyl” includes, for example, cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl. The term “alkylcycloalkyl” denotes alkyl substitution on a cycloalkyl moiety and includes, for example, ethylcyclopropyl, *i*-propylcyclobutyl, 3-methylcyclopentyl and 4-methylcyclohexyl. The term “cycloalkylalkyl” denotes cycloalkyl substitution on an alkyl moiety. Examples of “cycloalkylalkyl” include cyclopropylmethyl, cyclopentylethyl, and other cycloalkyl moieties bonded to straight-chain or branched alkyl groups. The term “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. The term “alkoxycycloalkyl” denotes alkoxy substitution on a cycloalkyl moiety. Examples of “alkoxycycloalkyl” include methoxycyclopropyl, ethoxycyclopentyl and other straight-chain or branched alkoxy groups bonded to a 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. Examples of “cyanocycloalkyl” include 4-cyanocyclohexyl and 3-cyanocyclopentyl. “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 $\text{F}_3\text{C}-$, ClCH_2- , CF_3CH_2- and CF_3CCl_2- . The terms “halocycloalkyl”, “haloalkoxy”, “haloalkylthio”, haloalkylsulfinyl, haloalkylsulfonyl, “haloalkenyloxy”, “haloalkynyloxy”, “haloalkenyl”, “haloalkynyl”, “haloalkoxyalkyl”, “haloalkoxyalkoxy”, “haloalkoxyhaloalkoxy”, “haloalkoxyhaloalkyl”, “haloalkylamino”, “haloalkylaminoalkyl”, “halocycloalkoxy”, “halocycloalkoxyalkyl”, “halocycloalkylalkyl”, “halocycloalkenyl”, “halocycloalkenyloxy”, “halocycloalkenyloxy”, “halocycloalkenyloxyalkyl”, “alkoxyhaloalkoxy”, alkoxyhaloalkyl, haloalkylcarbonyloxy, and the like, are defined analogously to the term “haloalkyl”. Examples of “haloalkoxy” include $\text{CF}_3\text{O}-$, $\text{CCl}_3\text{CH}_2\text{O}-$, $\text{HCF}_2\text{CH}_2\text{CH}_2\text{O}-$ and $\text{CF}_3\text{CH}_2\text{O}-$. Examples of “haloalkylthio” include $\text{CCl}_3\text{S}-$, $\text{CF}_3\text{S}-$, $\text{CCl}_3\text{CH}_2\text{S}-$ and $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{S}-$. Examples of “haloalkylsulfinyl” include $\text{CF}_3\text{S}(\text{O})-$, $\text{CCl}_3\text{S}(\text{O})-$, $\text{CF}_3\text{CH}_2\text{S}(\text{O})-$ and $\text{CF}_3\text{CF}_2\text{S}(\text{O})-$.

Examples of "haloalkylsulfonyl" include $\text{CF}_3\text{S(O)}_2^-$, $\text{CCl}_3\text{S(O)}_2^-$, $\text{CF}_3\text{CH}_2\text{S(O)}_2^-$ and $\text{CF}_3\text{CF}_2\text{S(O)}_2^-$. Examples of "haloalkenyl" include $(\text{Cl})_2\text{C}=\text{CHCH}_2^-$ and $\text{CF}_3\text{CH}_2\text{CH}=\text{CHCH}_2^-$. Examples of "haloalkynyl" include $\text{HC}\equiv\text{CCHCl}-$, $\text{CF}_3\text{C}\equiv\text{C}-$, $\text{CCl}_3\text{C}\equiv\text{C}-$ and $\text{FCH}_2\text{C}\equiv\text{CCH}_2^-$. Examples of "haloalkoxyalkoxy" include $\text{CF}_3\text{OCH}_2\text{O}-$, $\text{ClCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{O}-$, $\text{Cl}_3\text{CCH}_2\text{OCH}_2\text{O}-$ as well as branched alkyl derivatives. Examples of "haloalkylamino" include $\text{CF}_3(\text{CH}_3)\text{CHNH}$, $(\text{CF}_3)_2\text{CHNH}$ and $\text{CH}_2\text{ClCH}_2\text{NH}$. 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 $(\text{BrCH}_2\text{CH}_2)_2\text{N}$ and $\text{BrCH}_2\text{CH}_2(\text{ClCH}_2\text{CH}_2)\text{N}$.

"Alkylcarbonyl" denotes a straight-chain or branched alkyl moieties bonded to a C(=O) moiety. Examples of "alkylcarbonyl" include $\text{CH}_3\text{C(=O)-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C(=O)-}$ and $(\text{CH}_3)_2\text{CHC(=O)-}$. Examples of "alkoxycarbonyl" include $\text{CH}_3\text{OC(=O)-}$, $\text{CH}_3\text{CH}_2\text{OC(=O)-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC(=O)-}$, $(\text{CH}_3)_2\text{CHOC(=O)-}$ and the different butoxy- or pentoxycarbonyl isomers. 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 $\text{CH}_3\text{OC(=O)NH-}$ and $\text{CH}_3\text{CH}_2\text{OC(=O)NH-}$. Examples of "alkylaminocarbonyl" include $\text{CH}_3\text{NHC(=O)-}$, $\text{CH}_3\text{CH}_2\text{NHC(=O)-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NHC(=O)-}$, $(\text{CH}_3)_2\text{CHNHC(=O)-}$ and the different butylamino- or pentylaminocarbonyl isomers. Examples of "dialkylaminocarbonyl" include $(\text{CH}_3)_2\text{NC(=O)-}$, $(\text{CH}_3\text{CH}_2)_2\text{NC(=O)-}$, $\text{CH}_3\text{CH}_2(\text{CH}_3)\text{NC(=O)-}$, $(\text{CH}_3)_2\text{CH}(\text{CH}_3)\text{NC(=O)-}$ and $\text{CH}_3\text{CH}_2\text{CH}_2(\text{CH}_3)\text{NC(=O)-}$. The term "alkylcarbonyloxy" denotes straight-chain or branched alkyl bonded to a C(=O)O moiety. Examples of "alkylcarbonyloxy" include $\text{CH}_3\text{CH}_2\text{C(=O)O}$ and $(\text{CH}_3)_2\text{CHC(=O)O}$. The term "alkylcarbonylalkoxy" denotes alkylcarbonyl bonded to an alkoxy moiety. Examples of "alkylcarbonylalkoxy" include $\text{CH}_3\text{C(=O)CH}_2\text{CH}_2\text{O}$ and $\text{CH}_3\text{CH}_2\text{C(=O)CH}_2\text{O}$. Examples of "alkoxycarbonyloxy" include $\text{CH}_3\text{CH}_2\text{CH}_2\text{OC(=O)O}$ and $(\text{CH}_3)_2\text{CHOC(=O)O}$. 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 $\text{CH}_3\text{CH}_2\text{S(=O)}_2\text{NH-}$ and $(\text{CH}_3)_2\text{CHS(=O)}_2\text{NH-}$. The term "alkylsulfonyloxy" denotes an alkylsulfonyl group bonded to an oxygen atom. Examples of "alkylsulfonyloxy" include $\text{CH}_3\text{S(=O)}_2\text{O-}$, $\text{CH}_3\text{CH}_2\text{S(=O)}_2\text{O-}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S(=O)}_2\text{O-}$,

$(\text{CH}_3)_2\text{CHS}(=\text{O})_2\text{O}-$, 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 "cycloalkoxyalkoxyalkyl" denotes a cycloalkoxy moiety attached to the alkoxy moiety of an alkoxyalkyl group. Examples of the term "cycloalkoxyalkoxyalkyl" include (cyclopropyl) $\text{OCH}_2\text{OCH}_2-$, (cyclobutyl) $\text{OCH}_2\text{CH}_2\text{OCH}_2-$ or (cyclohexyl) $\text{OCH}_2\text{OCH}_2\text{CH}_2-$. 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 $(\text{CH}_3\text{O})_2\text{CH}-$ 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.

5 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
10 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
15 $\text{CH}_3\text{NHS}(\text{O})_2-$ 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 “ $\text{C}_i\text{-C}_j$ ” prefix where i and j are numbers from 1 to 14. For example, $\text{C}_1\text{-C}_4$ alkylsulfonyl designates
20 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 $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2-$.

25 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., $(\text{R}^v)_r$, r is 1, 2, 3, 4 or 5 in U-1 of Exhibit 3. When a group contains a substituent which can be hydrogen, for example $\text{R}^2, \text{R}^3, \text{R}^4, \text{R}^5, \text{R}^6, \text{R}^7, \text{R}^8, \text{R}^9, \text{R}^{10}, \text{R}^{11}, \text{R}^{12}, \text{R}^{13}, \text{R}^{14}, \text{R}^{15}, \text{R}^{18}, \text{R}^{19}$ or R^{20} , then
30 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 $(\text{R}^v)_r$ in Q-29 of Exhibit 2 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
35 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^A) 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 “spirocyclic ring system” denotes two rings fused at a single atom, and can be either carbospirocyclic or
5 heterospirocyclic. 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
10 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.

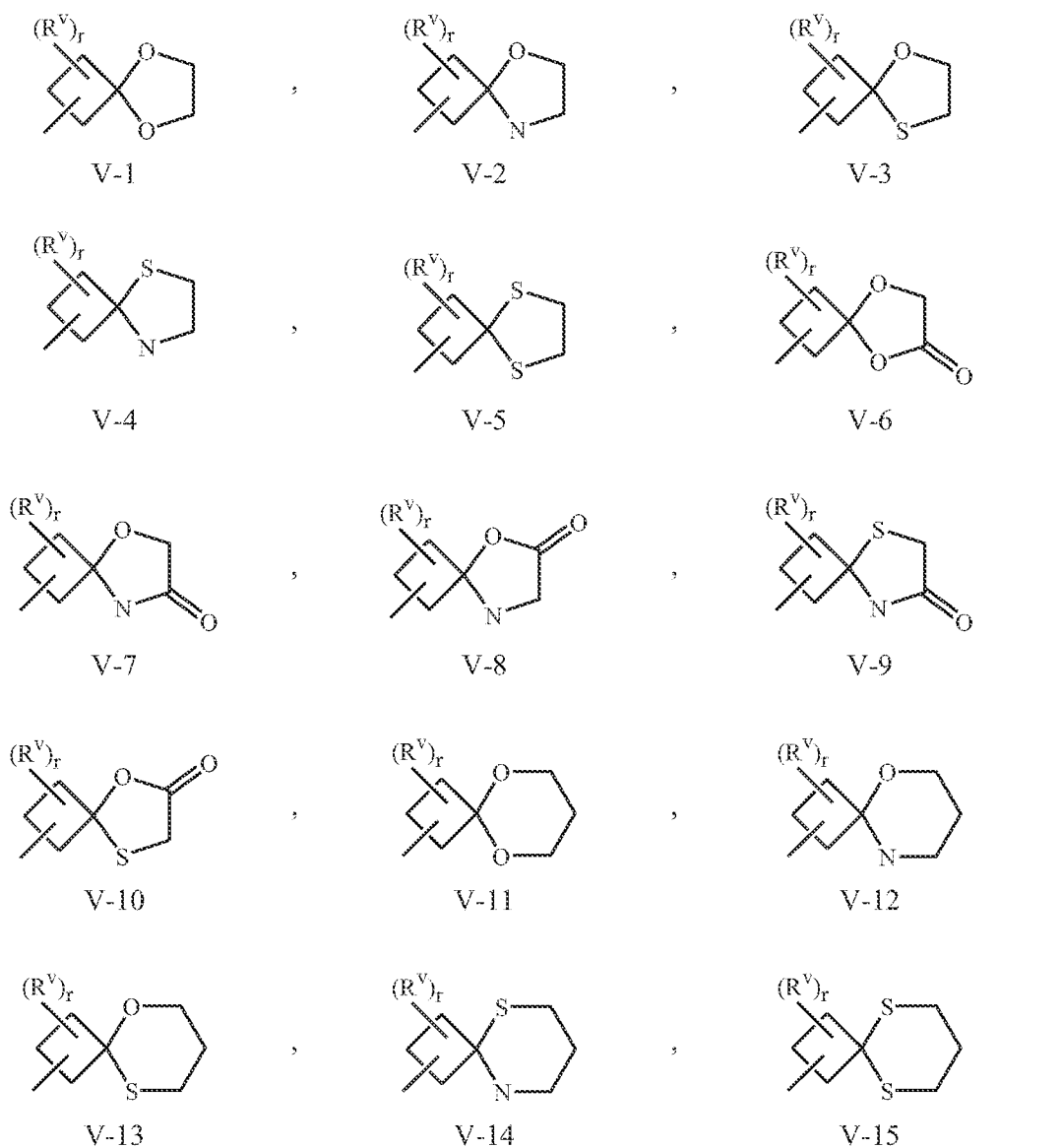
The terms “heterocyclic ring”, “heterocycle” or “heterocyclic ring system” denote a
15 ring or ring system in which at least one atom forming the ring backbone is not carbon, e.g., nitrogen, oxygen or sulfur. Typically a heterocyclic ring contains no more than 4 nitrogen atoms, no more than 2 oxygen 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
20 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
25 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.

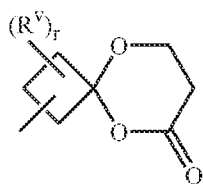
As used herein, the following definitions shall apply unless otherwise indicated. The term “optionally substituted” is used interchangeably with the phrase “substituted or
30 unsubstituted”. Unless otherwise indicated, an optionally substituted group may have a substituent at each substitutable position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

As noted above, G^A can be (among others) a 6- to 12-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring
35 members, each ring or ring system optionally substituted with up to five substituents as defined in the Summary of the Invention (i.e. R²¹ or R²²). Examples of 6- to 12-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring systems optionally

- including ring members selected from C(=O), C(=S), C(=NR²⁹), C(=N-OR³⁰), or C=NN(R²⁹)₂ and optionally substituted with up to five substituents include the rings V-1 through V-104 illustrated in Exhibit 1 wherein R^v is any substituent as defined in the Summary of the Invention for G^A (i.e. R²¹ or R²²), and r is typically an integer from 0 to 4.
- 5 Note that when the attachment point on the V group is illustrated as floating, the V group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the V group by replacement of a hydrogen atom.

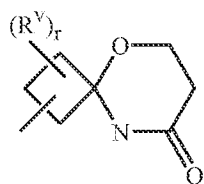
Exhibit 1

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V-16

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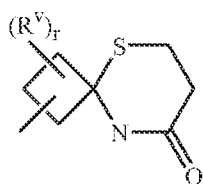
V-17

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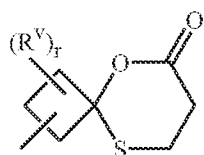
V-18

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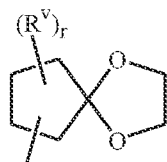
V-19

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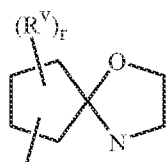
V-20

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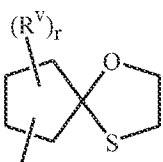
V-21

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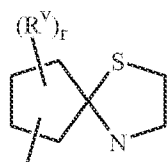
V-22

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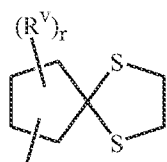
V-23

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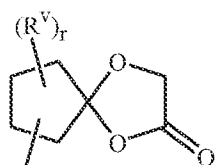
V-24

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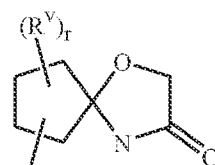
V-25

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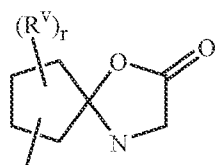
V-26

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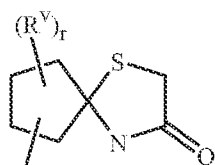
V-27

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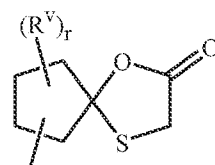
V-28

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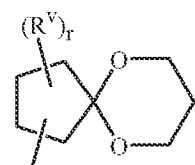
V-29

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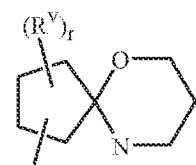
V-30

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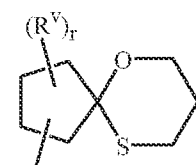
V-31

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V-32

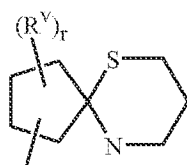
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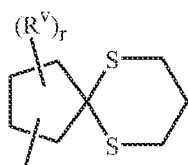
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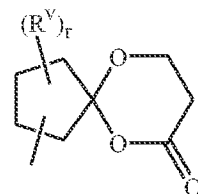
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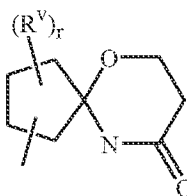
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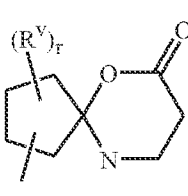
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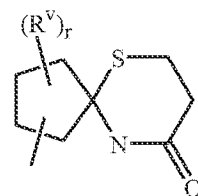
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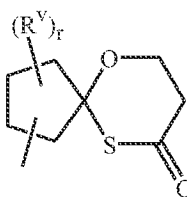
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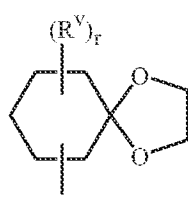
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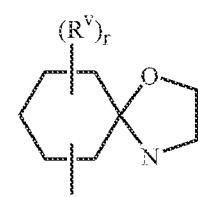
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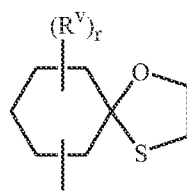
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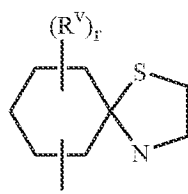
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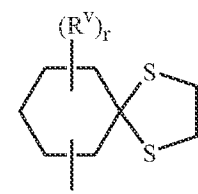
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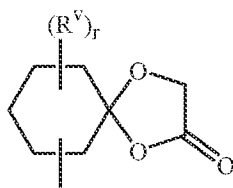
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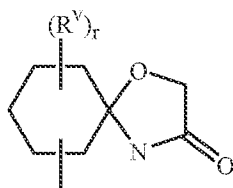
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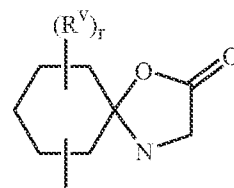
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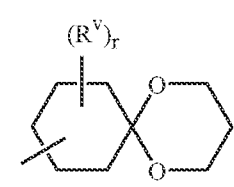
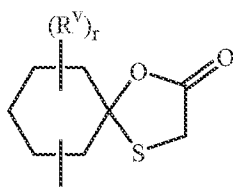
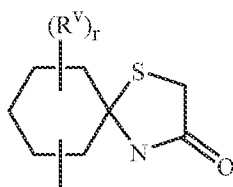
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V-47

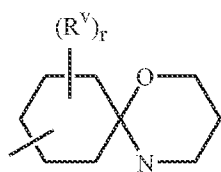


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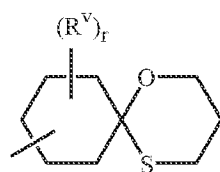
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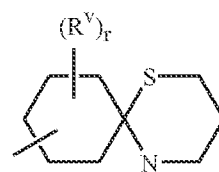
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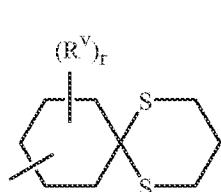


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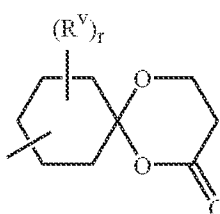
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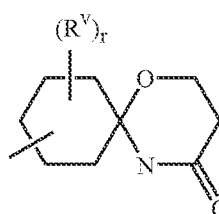
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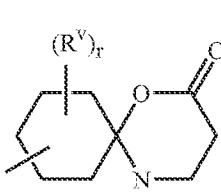
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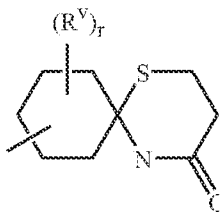
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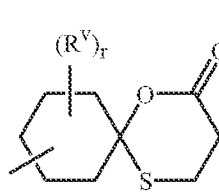
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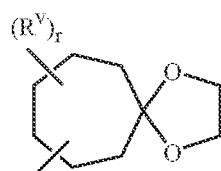
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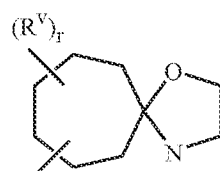
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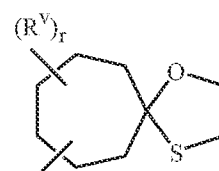
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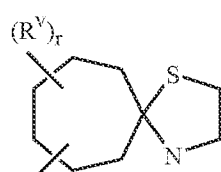
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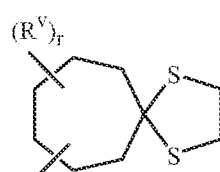
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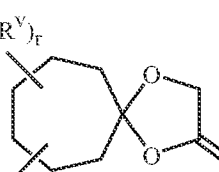
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V-64

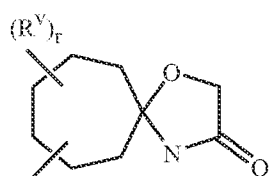


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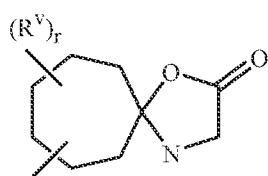


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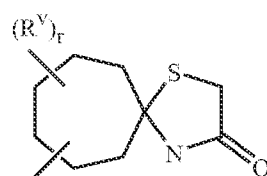
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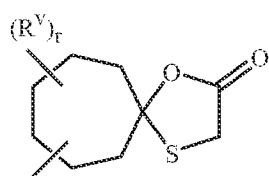
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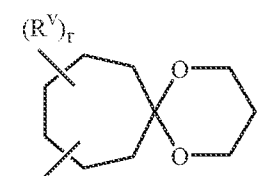
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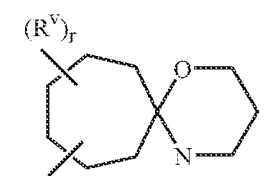
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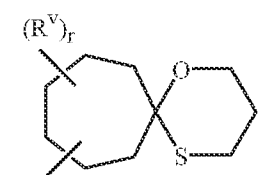
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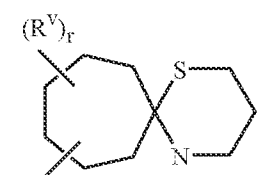
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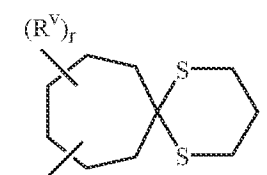
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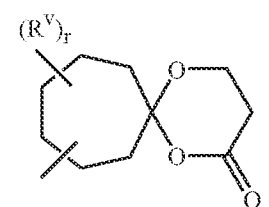
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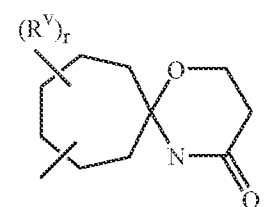
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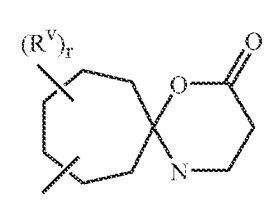
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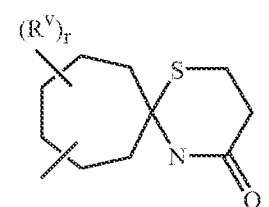
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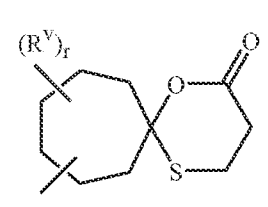
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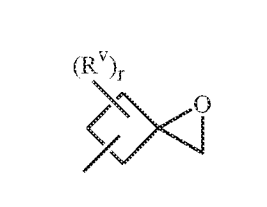
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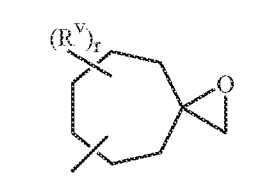
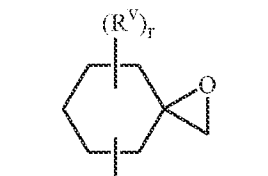
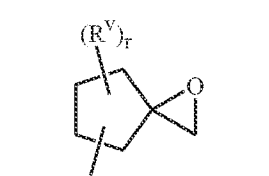
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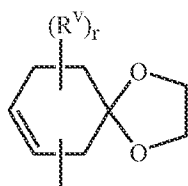
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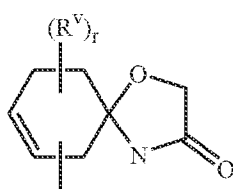
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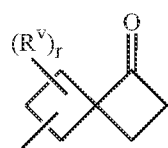
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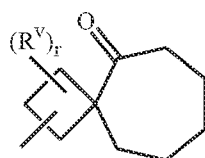
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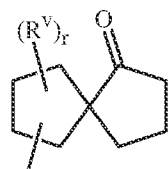
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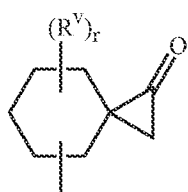
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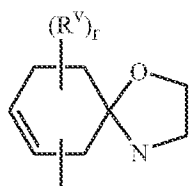
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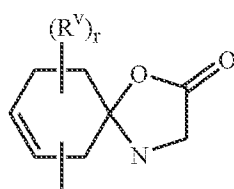
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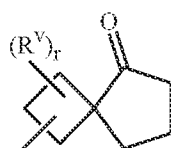
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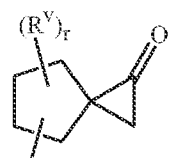
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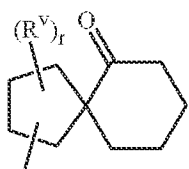
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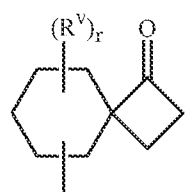
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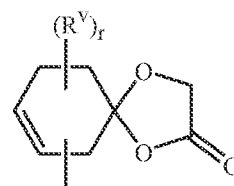
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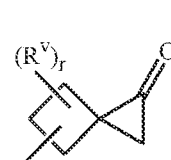
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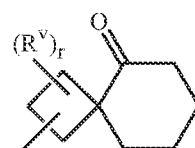
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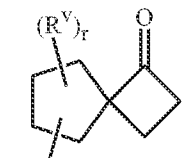
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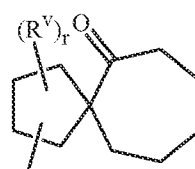
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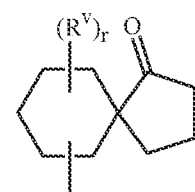
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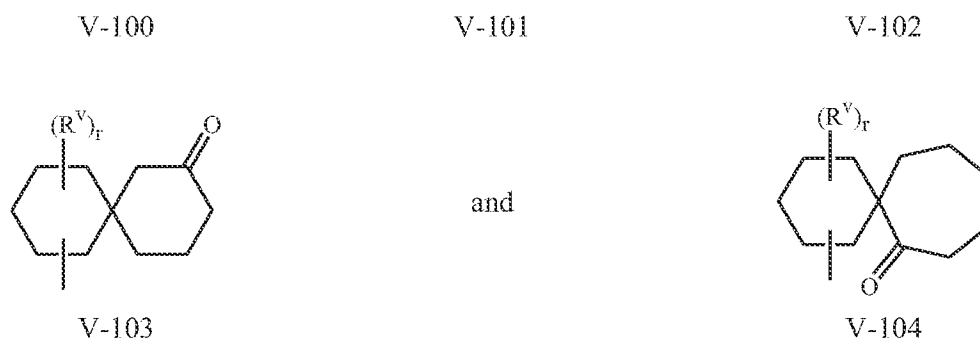


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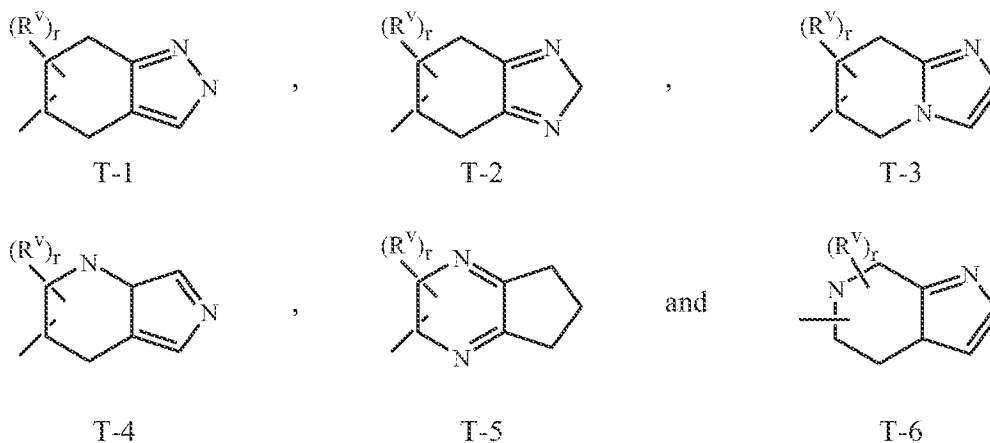


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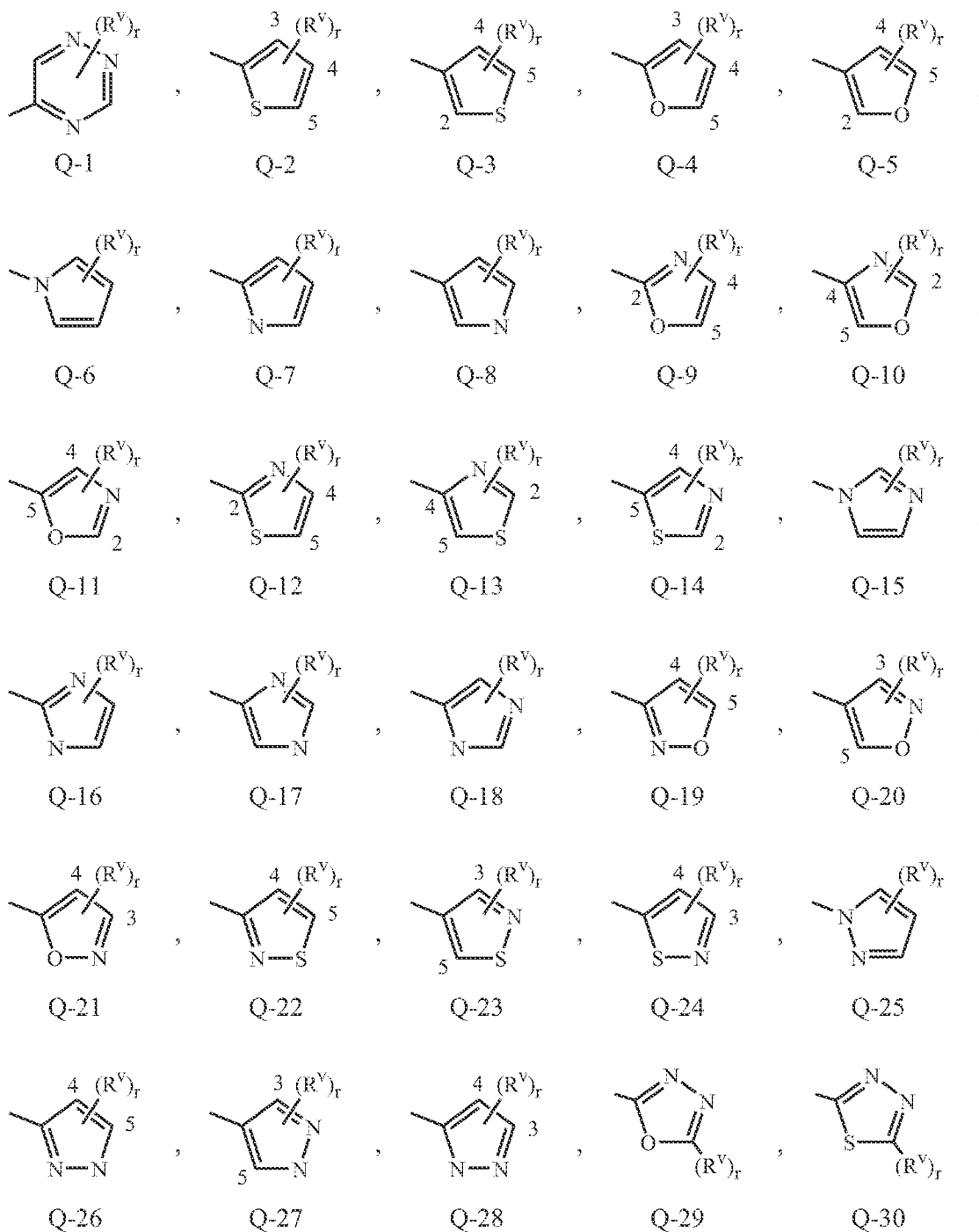


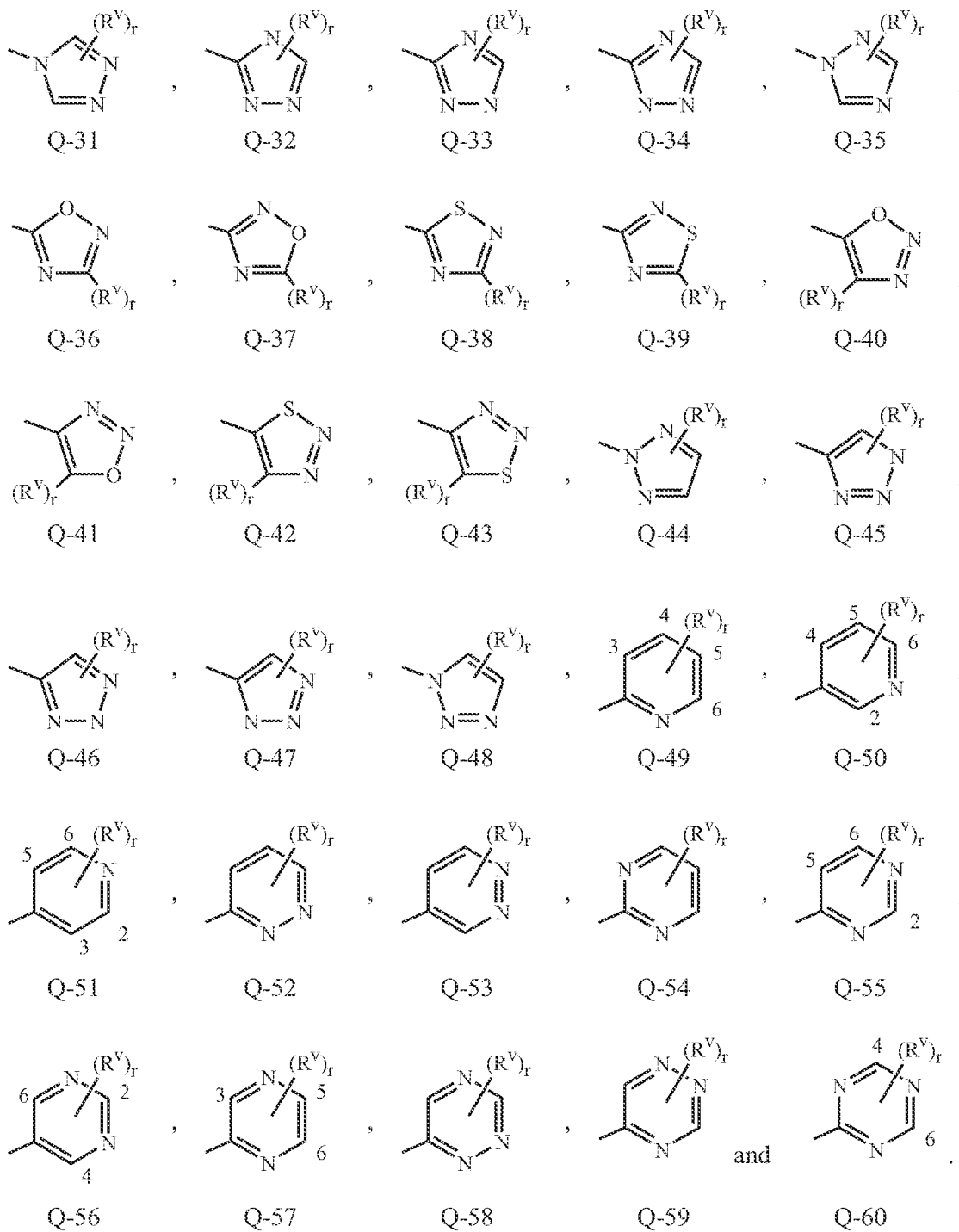
When G^A is a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring can be optionally substituted with up to 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members. Exhibit 1A shows examples of examples of 9-membered partially saturated fused ring systems containing carbon ring members and 2 nitrogen ring members and are optionally substituted by R^V (i.e. R^{21} or R^{22}). Note that when the attachment point on the T group is illustrated as floating, the T group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the T group by replacement of a hydrogen atom.



When G is a 5- or 6-membered heterocyclic ring, it may be attached to the remainder of Formula 1 through any available carbon or nitrogen ring atom, unless otherwise described. When G is (among others) a 5- or 6-membered heterocyclic ring it may be saturated or unsaturated, optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention. Examples of a 5- or 6-membered heterocyclic ring optionally substituted with from one or more substituents include the rings Q-1 through Q-60 illustrated in Exhibit 2 wherein R^V is the optional substituent and 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 4, 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 2

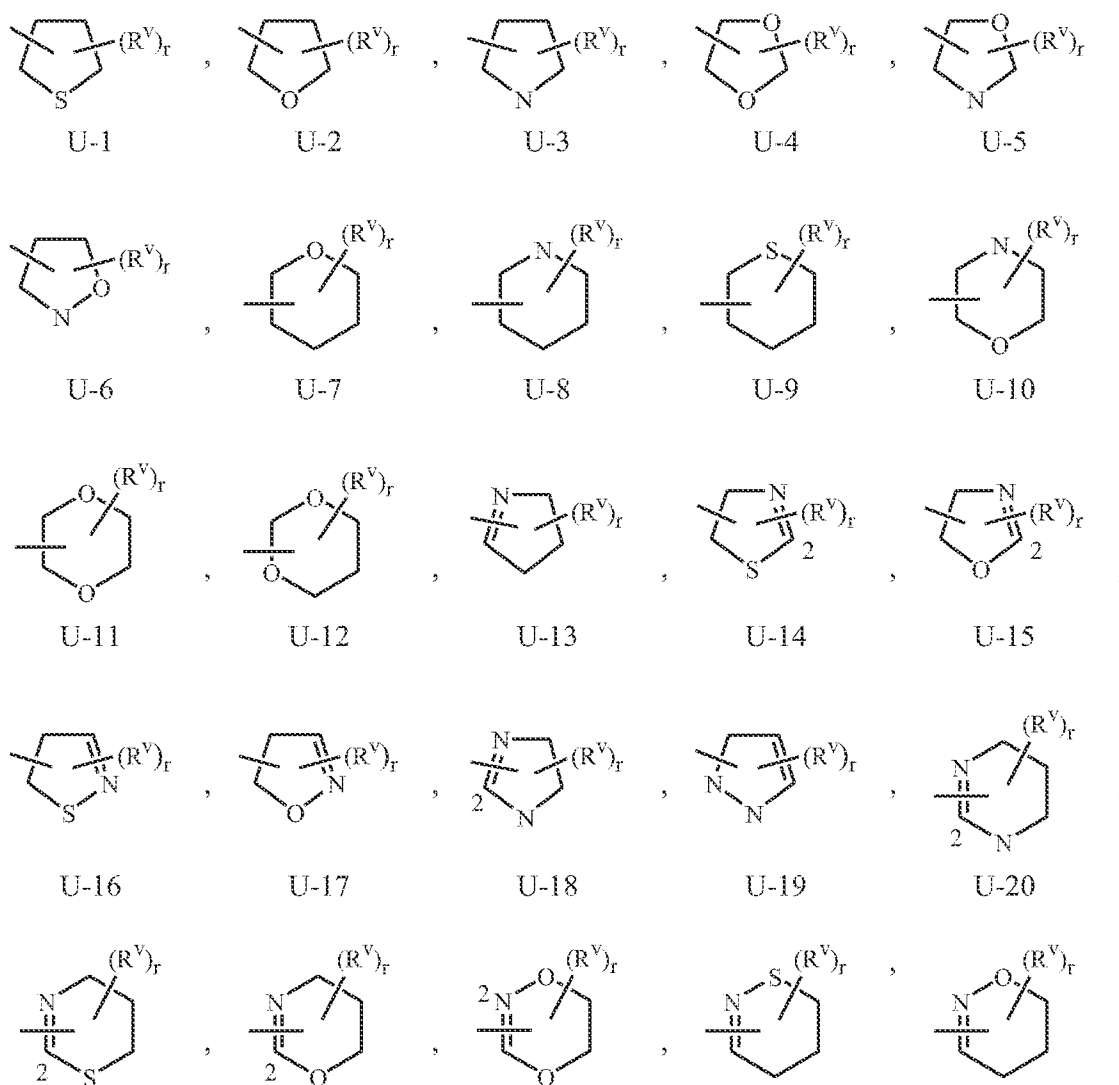


Note that when G is a 5- or 6-membered heterocyclic ring optionally substituted with one or more substituents selected from the group of substituents as defined in the Summary of the Invention for R²¹ one or two carbon ring members of the heterocycle can optionally be in the oxidized form of a carbonyl moiety.

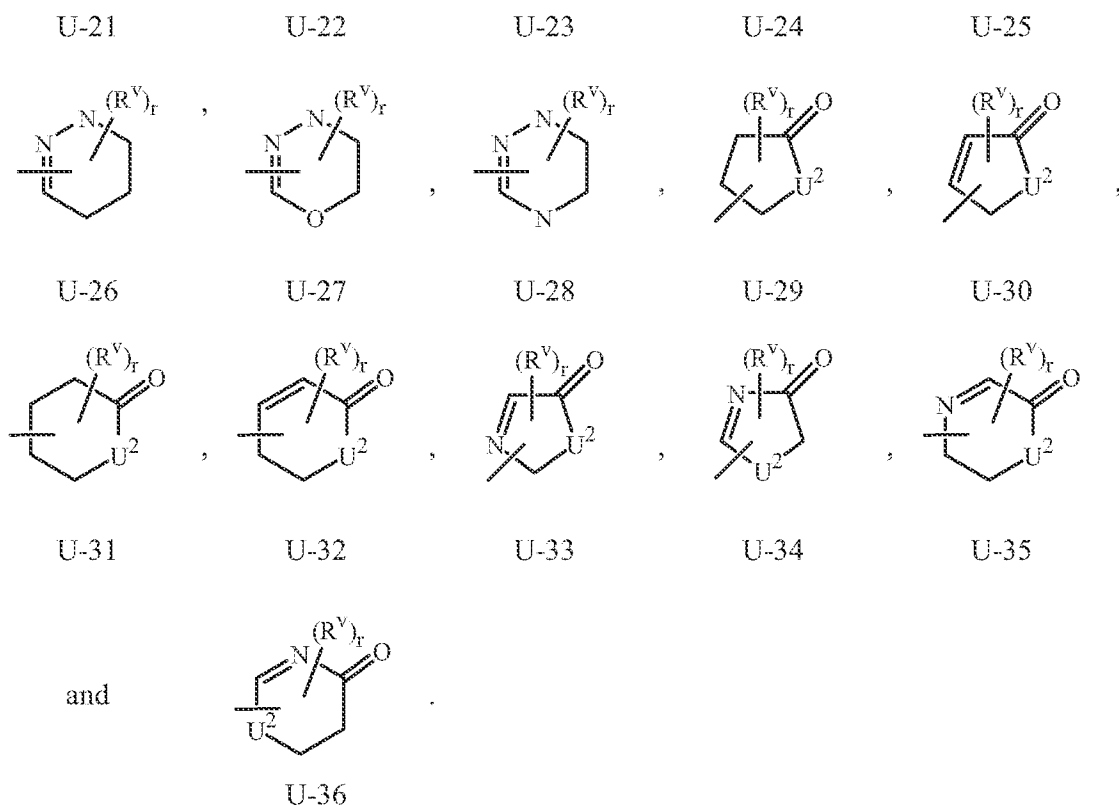
Examples of a 5- or 6-membered heterocyclic ring include the rings U-1 through U-36 as illustrated in Exhibit 3. Note that when the attachment point on the U group is illustrated as floating, the U group can be attached to the remainder of Formula 1 through any available carbon or nitrogen of the U group 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 typically an integer from 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^{22}).

Exhibit 3

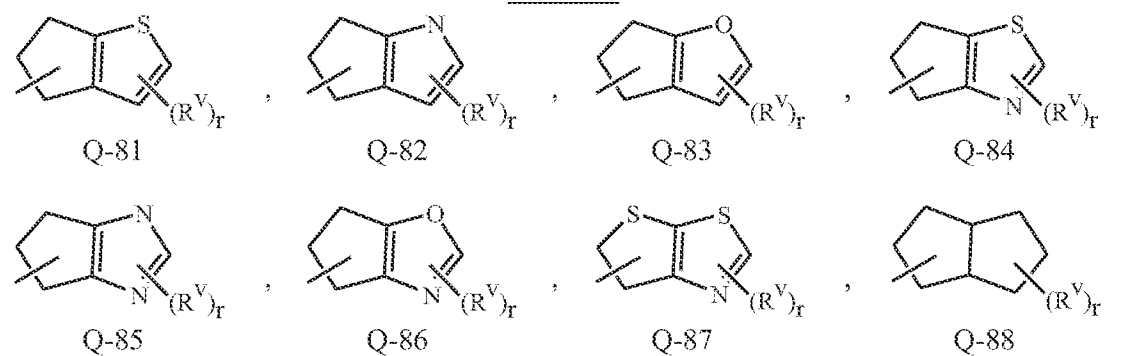


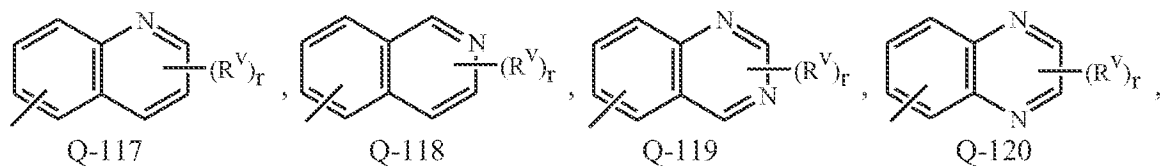
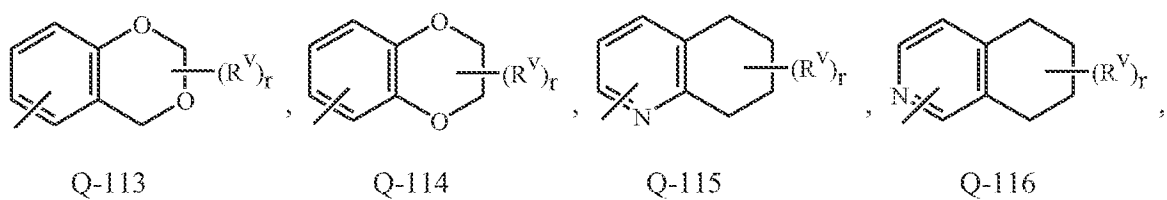
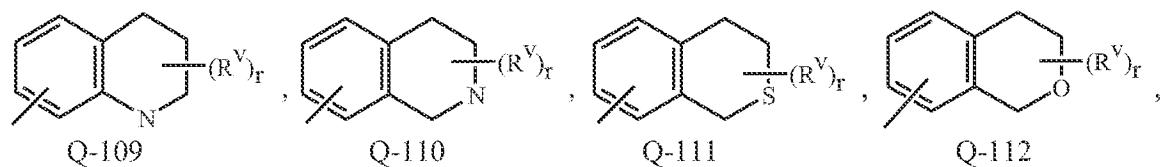
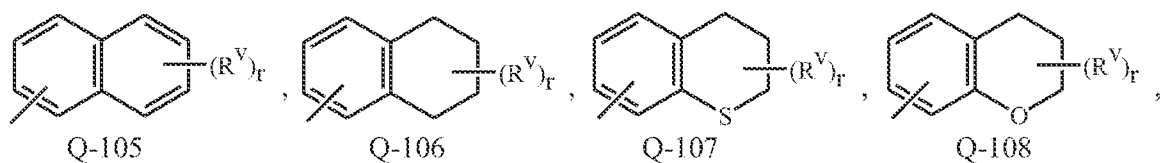
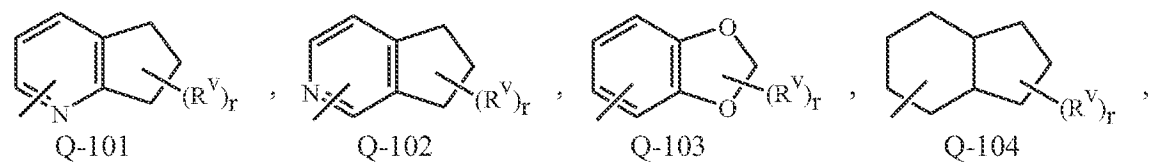
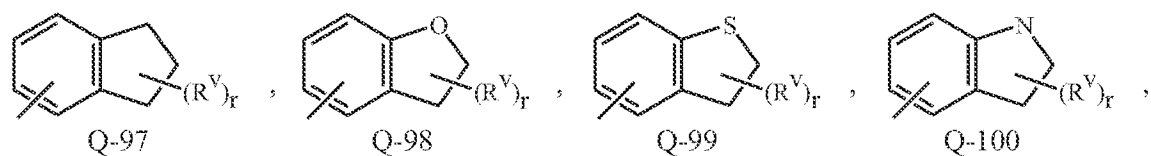
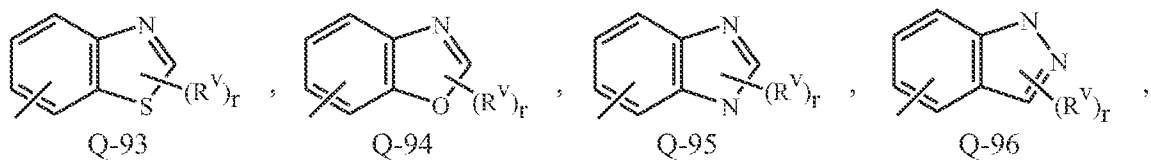
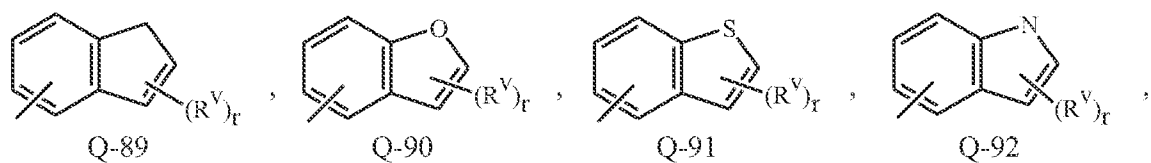
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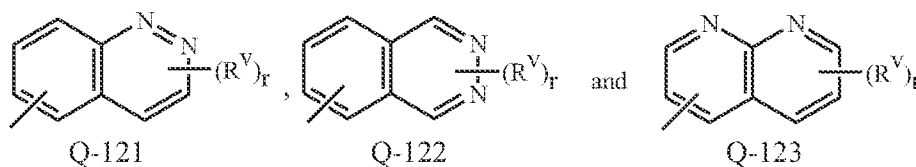


As noted above, G can be (among others) an 8-, 9- or 10-membered fused bicyclic ring system optionally substituted with one or more substituents selected from a group of substituents as defined in the Summary of the Invention (i.e. R²¹ or R²²). Examples of 8-, 9- or 10-membered fused bicyclic ring system optionally substituted with from one or more substituents include the rings Q-81 through Q-123 illustrated in Exhibit 4 wherein R^V is any substituent as defined in the Summary of the Invention for G (i.e. R²¹ or R²²), and r is typically an integer from 0 to 4.

Exhibit 4







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,

5 $(R^V)_r$ 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

10 Q-60).

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*

15 *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

20 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 compound 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^3 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.

30 Likewise, when a compound of Formula 1 is identified by A being A-1, A-2 or A-3, and the R^3 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. As a further example, a compound of Formula 1Q wherein A' is A'-1, A'-2 or A'-3

can be present as a “di-ketone” tautomer or two possible “keto enol” tautomers, 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 *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethyldioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example:

T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748-750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18-20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149-161, A. R. Katritzky, Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285-291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390-392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

One skilled in the art recognizes that because in the environment and under physiological conditions salts of chemical compounds are in equilibrium with their corresponding nonsalt forms, salts share the biological utility of the nonsalt forms. Thus a wide variety of salts of a compound of Formula 1 are useful for control of undesired vegetation (i.e. are agriculturally suitable). The salts of a compound of Formula 1 include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. When a compound of Formula 1 contains an acidic moiety such as 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.

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

- Embodiment 1. A compound of Formula 1 as described in the Summary of the Invention wherein A is A-1, A-3, A-4, A-5 or A-6.
- 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.
- Embodiment 6. A compound of Embodiment 4 wherein A is A-3.
- Embodiment 7. A compound of Formula 1 or any one of Embodiments 1 through 4 wherein A is other than A-1.
- Embodiment 8. A compound of Formula 1 or any one of Embodiments 1 through 7 wherein B¹ is C-1.
- Embodiment 9. A compound of Formula 1 or any one of Embodiments 1 through 7 wherein B¹ is C-2.

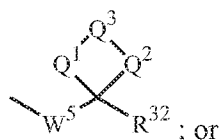
Embodiment 10. A compound of Formula 1 or any one of Embodiments 1 through 9 wherein B² is C-3.

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

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

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

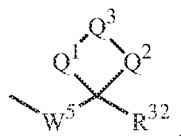
10 Embodiment 14. A compound of Formula 1 or any one of Embodiments 1 through 13 wherein R¹ is



R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶; or

R¹ is -G^A or -W²G^A.

15 Embodiment 15. A compound of Formula 1 or any one of Embodiments 1 through 14 wherein R¹ is



Embodiment 16. A compound of Embodiment 15 wherein each Q¹ and Q² is independently O or N(R³¹).

Embodiment 17. A compound of Embodiment 16 wherein each Q¹ and Q² is O.

20 Embodiment 18. A compound of Formula 1 or any one of Embodiments 1 through 17 wherein Q³ is C₂-C₃ alkylene optionally substituted with up to 4 substituents selected from C₁-C₄ alkyl.

Embodiment 19. A compound of Embodiment 18 wherein Q³ is C₂-C₃ alkylene optionally substituted with up to 2 substituents selected from C₁-C₂ alkyl.

25 Embodiment 20. A compound of Embodiment 19 wherein Q³ is C₂-alkylene optionally substituted with up to 2 substituents selected from C₁-C₂ alkyl.

Embodiment 21. A compound of Embodiment 20 wherein Q³ is C₂-alkylene optionally substituted with up to 2 substituents selected from methyl.

30 Embodiment 22. A compound of Formula 1 or any one of Embodiments 1 through 21 wherein W⁵ is C₁-C₄ alkylene.

Embodiment 22A. A compound of Formula 1 or any one of Embodiments 1 through 22 wherein W⁵ is C₂-C₃ alkylene.

- Embodiment 22B. A compound of Embodiment 22 wherein W^5 is C_2 alkylene or C_3 alkylene.
- Embodiment 23. A compound of Formula 1 or any one of Embodiments 1 through 22 wherein R^{32} is H or C_1 - C_3 alkyl.
- 5 Embodiment 23A. A compound of Embodiment 23 wherein R^{32} is H or methyl.
- Embodiment 24. A compound of Embodiment 23 wherein R^{32} is H.
- Embodiment 25. A compound of Embodiment 23 wherein R^{32} is C_1 - C_3 alkyl.
- Embodiment 26. A compound of Embodiment 25 wherein R^{32} is methyl.
- Embodiment 26A. A compound of Formula 1 or any one of Embodiments 1 through 10 14 wherein R^1 is $-W^1C(=E^1)R^{24}$, $-W^1LC(=E^2)R^{25}$ or $-W^1C(=E^3)LR^{26}$.
- Embodiment 27. A compound of Embodiment 26A wherein R^1 is $-W^1C(=E^1)R^{24}$.
- Embodiment 28. A compound of Embodiment 26A wherein R^1 is $-W^1LC(=E^2)R^{25}$.
- Embodiment 29. A compound of Embodiment 26A wherein R^1 is $-W^1C(=E^3)LR^{26}$.
- Embodiment 29A. A compound of Formula 1 or any one of Embodiments 1 through 15 13 wherein R^1 is other than $-N(R^{40})R^{41}$.
- Embodiment 30. A compound of Formula 1 or any one of Embodiments 1 through 14 or 26A through 29 wherein each E^1 , E^2 , and E^3 is independently O, NOR^{28} or $NN(R^{28})_2$.
- Embodiment 31. A compound of Embodiment 27 wherein E^1 is O.
- 20 Embodiment 32. A compound of Embodiment 27 wherein E^1 is NOR^{28} .
- Embodiment 33. A compound of Embodiment 27 wherein E^1 is $NN(R^{28})_2$.
- Embodiment 34. A compound of Embodiment 28 wherein E^2 is O.
- Embodiment 35. A compound of Embodiment 28 wherein E^2 is NOR^{28} .
- Embodiment 36. A compound of Embodiment 28 wherein E^2 is $NN(R^{28})_2$.
- 25 Embodiment 37. A compound of Embodiment 29 wherein E^3 is O.
- Embodiment 38. A compound of Embodiment 29 wherein E^3 is NOR^{28} .
- Embodiment 39. A compound of Embodiment 29 wherein E^3 is $NN(R^{28})_2$.
- Embodiment 39A. A compound of Formula 1 or any of Embodiments 1 through 39 wherein each R^{28} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.
- 30 Embodiment 40. A compound of Formula 1 or any one of Embodiments 26A, 28, 29 or 34 through 39 wherein each L is independently O or $N(R^{31})$; provided when E^3 is O, L is other than O.
- Embodiment 41. A compound of Embodiment 40 wherein L is O.
- Embodiment 42. A compound of Embodiment 40 wherein L is $N(R^{31})$.
- 35 Embodiment 42A. A compound of Embodiment 40 or 42 wherein R^{31} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.

Embodiment 42B. A compound of Formula 1 or any one of Embodiments 1 through 42 wherein W^1 is C_2 - C_4 alkylene, $-(CH_2)_2OCH_2-$ or $-(CH_2)_3OCH_2-$.

Embodiment 43. A compound Embodiments 42B wherein W^1 is C_1 - C_4 alkylene.

5 Embodiment 43B. A compound of Formula 1 or any one of Embodiments 1 through 42 wherein W^2 is C_1 - C_3 alkylene.

Embodiment 44. A compound of Formula 1 or any one of Embodiments 1 through 14 or 27 through 39 wherein each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_4 alkyl or C_3 - C_5 cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy, C_1 - C_2 alkoxy, C_1 - C_2 alkylsulfinyl and C_1 - C_4 alkylsulfonyl.

Embodiment 45. A compound of Embodiment 44 wherein each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_2 alkyl or C_3 - C_4 cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy and C_1 - C_2 alkoxy.

15 Embodiment 46. A compound of Formula 1 or any one of Embodiments 1 through 14 wherein R^1 is $-G^A$.

Embodiment 47. A compound of Formula 1 or any one of Embodiments 1 through 14 wherein R^1 is $-W^2G^A$.

Embodiment 47A. A compound of any one of Embodiments 46 or 47 wherein each G^A is a 4- to 7-membered carbocyclic ring including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$; or a 6- to 12-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$, each ring or ring system optionally substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

Embodiment 47B. A compound of any one of Embodiments 46 or 47 wherein each G^A is a 4- to 6-membered carbocyclic ring including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$; or a 9- to 11-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$, each ring or ring system optionally substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

Embodiment 48. A compound of Embodiment 47A wherein G^A is a 4- to 7-membered carbocyclic ring including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$, each ring optionally substituted with up to three substituents selected from R^{21} .

Embodiment 49. A compound of Embodiment 48 wherein G^A is a 5- or 6-membered carbocyclic ring including ring members selected from $C=O$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$ each ring optionally substituted with up to three substituents selected from R^{21} .

5 Embodiment 49A. A compound of any one of Embodiments 47A through 49 wherein each R^{29} is independently H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkylcarbonyl, C_1 - C_3 alkylsulfonyl or C_1 - C_3 haloalkylsulfonyl.

Embodiment 49B. A compound of Embodiment 49A wherein each R^{29} is independently C_1 - C_6 alkyl, C_1 - C_6 haloalkyl or C_1 - C_6 alkylcarbonyl.

10 Embodiment 49C. A compound of any one of Embodiments 47A through 49 wherein R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.

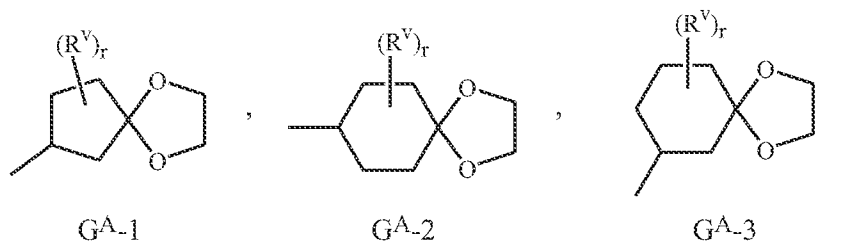
Embodiment 50. A compound of Formula 1 or Embodiment 47A wherein G^A is a 6- to 12-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})$, each ring or ring system optionally substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

Embodiment 50A. A compound of Embodiment 50 wherein G^A is a 9- to 11-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})$, each ring or ring system optionally substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

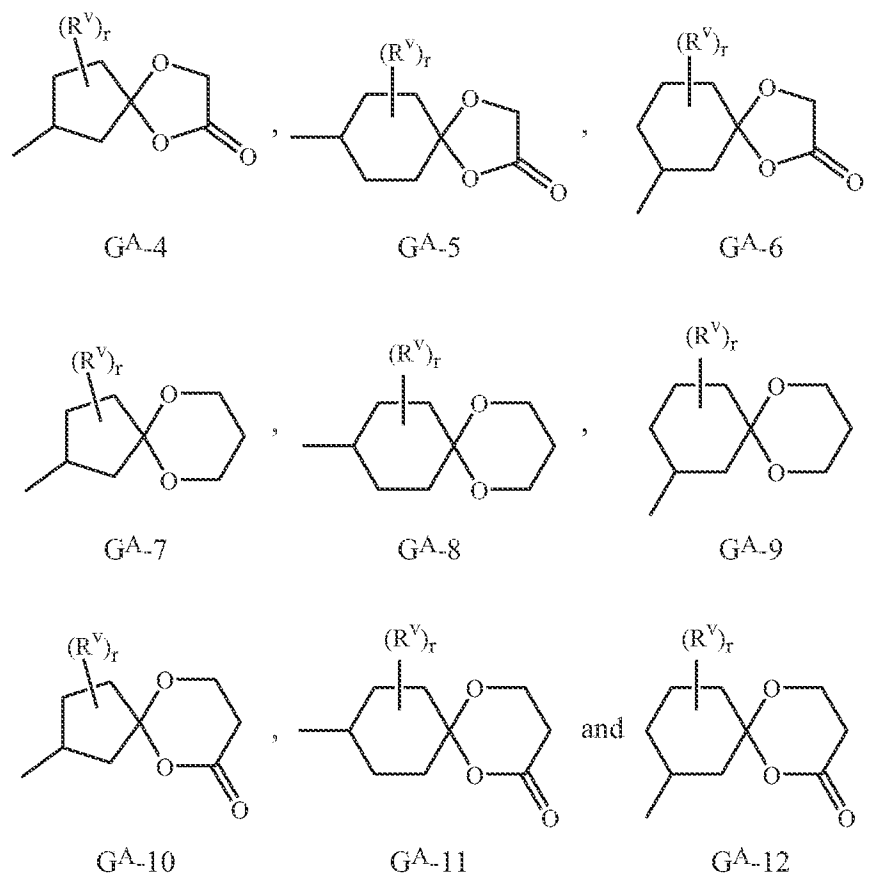
Embodiment 50B. A compound of Embodiment 50 wherein R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.

Embodiment 50C. A compound of Embodiment 50 wherein each R^{29} is C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkylcarbonyl.

Embodiment 51. A compound of Embodiment 50A wherein G^A is selected from



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wherein r is 0 to 3; and R^V is selected from R^{21} .

Embodiment 52. A compound of Embodiment 51 wherein G^A is selected from G^A -1, G^A -2, G^A -3, G^A -7, G^A -8 and G^A -9.

Embodiment 53. A compound of Embodiment 52 wherein G^A is selected from G^A -2 and G^A -3.

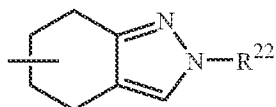
Embodiment 53A. A compound of Embodiment 53 wherein G^A is G^A -2.

Embodiment 53B. A compound of Formula 1 or any one of Embodiments 1 through 53A wherein each G^A is other than a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring optionally substituted with up to 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

Embodiment 53C. A compound of Formula 1 or any one of Embodiments 1 through 47 wherein each G^A is a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring substituted with 1 substituent selected from R^{22} on one nitrogen ring member.

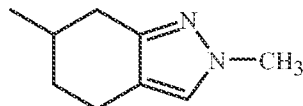
Embodiment 53D. A compound of Embodiment 53C wherein each G^A is

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wherein the bond projecting to the left represents the point of attachment to the remainder of the compound of Formula 1.

Embodiment 53E. A compound of Embodiment 53D wherein each G^A is



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Embodiment 54. A compound of Formula 1 or any one of Embodiments 1 through 53E

wherein R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G; or 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, C₄-C₁₀ cycloalkoxylalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylcarbonyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₃-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 alkoxyalkoxyalkoxy, C₂-C₈ alkyl(thiocarbonyl)oxy, C₃-C₈ cycloalkylsulfinyl or C₃-C₁₀ halotrialkylsilyl; or R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴ or -W⁶C(=E⁶)L¹R³⁵.

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Embodiment 54A. A compound of Embodiment 54 wherein R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl.

- Embodiment 55. A compound of Embodiment 54 wherein R^2 is $-W^6C(=E^4)R^{24}$,
 $-W^6L^1C(=E^5)R^{25}$ or $-W^6C(=E^6)L^1R^{26}$.
- Embodiment 56. A compound of Embodiment 55 wherein R^2 is $-W^6C(=E^4)R^{24}$.
- Embodiment 57. A compound of Embodiment 55 wherein R^2 is $-W^6L^1C(=E^5)R^{25}$.
- 5 Embodiment 58. A compound of Embodiments 55 wherein R^2 is $-W^6C(=E^6)L^1R^{26}$.
- Embodiment 59. A compound of Formula 1 or any one of Embodiments 1 through 58
wherein each E^4 , E^5 and E^6 is independently O, NOR^{37} or $NN(R^{37})_2$.
- Embodiment 60. A compound of Formula 1 or any one of Embodiments 1 through 56
wherein E^4 is O.
- 10 Embodiment 61. A compound of Formula 1 or any one of Embodiments 1 through 56
wherein E^4 is NOR^{37} .
- Embodiment 62. A compound of Embodiment Formula 1 or any one of Embodiments
1 through 56 wherein E^4 is $NN(R^{37})_2$.
- Embodiment 63. A compound of Formula 1 or any one of Embodiments 1 through 55
15 or 57 wherein E^5 is O.
- Embodiment 64. A compound of Formula 1 or any one of Embodiments 1 through 55
or 57 wherein E^5 is NOR^{37} .
- Embodiment 65. A compound of Formula 1 or any one of Embodiments 1 through 55
or 57 wherein E^5 is $NN(R^{37})_2$.
- 20 Embodiment 66. A compound of Formula 1 or any one of Embodiments 1 through 55
or 58 wherein E^6 is O.
- Embodiment 67. A compound of Formula 1 or any one of Embodiments 1 through 55
or 58 wherein E^6 is NOR^{37} .
- Embodiment 68. A compound of Formula 1 or any one of Embodiments 1 through 55
25 or 58 wherein E^6 is $NN(R^{37})_2$.
- Embodiment 68A. A compound of Formula 1 or any one of Embodiments 1 through 68
wherein W^6 is C_2 - C_4 alkylene, $-(CH_2)_2OCH_2-$ or $-(CH_2)_3OCH_2-$.
- Embodiment 69. A compound of Formula 1 or any one of Embodiments 1 through 68
wherein W^6 is C_2 - C_4 alkylene.
- 30 Embodiment 70. A compound of Formula 1 or any one of Embodiments 1 through 55
or 57 through 59 or 63 through 69 wherein each L^1 is independently O or
 $N(R^{38})$.
- Embodiment 70A. A compound of any one of Embodiments 59, 61, 64 through 65 or
68 wherein each R^{37} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl.
- 35 Embodiment 71. A compound of Formula 1 or any one of Embodiments 1 through 70
wherein each R^{33} , R^{34} and R^{35} is independently hydrogen; or C_1 - C_6 alkyl or
 C_3 - C_6 cycloalkyl each optionally substituted with one or more substituents

selected from the group consisting of halogen, CN, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylsulfinyl and C₁-C₄ alkylsulfonyl.

5 Embodiment 71B. A compound of Embodiment 71 wherein each R³³, R³⁴ and R³⁵ is independently hydrogen; or C₁-C₄ alkyl, C₃-C₅ cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl and C₁-C₂ alkylsulfonyl.

10 Embodiment 72. A compound of Embodiment 71B wherein each R³³, R³⁴ and R³⁵ is independently hydrogen; or C₁-C₂ alkyl or C₃-C₄ cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy and C₁-C₂ alkoxy.

15 Embodiment 73. A compound of Formula 1 or any one of Embodiments 1 through 72 wherein R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl.

Embodiment 74. A compound of Embodiment 73 wherein R² is phenyl optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl.

20 Embodiment 74A. A compound of Embodiment 73 wherein R² is phenyl; or -G; or C₃-C₈ cycloalkyl.

Embodiment 74B. A compound of Embodiment 74A wherein R² is phenyl, 2-thienyl, 5-chloro-2-pyridinyl or cyclopropyl.

Embodiment 74C. A compound of Embodiment 74A wherein R² is phenyl, 3-thienyl or cyclopropyl.

25 Embodiment 75. A compound of Embodiment 74 wherein R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

Embodiment 76. A compound of Embodiment 74 wherein R² is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

30 Embodiment 76A. A compound of Embodiment 74A wherein R² is 5-chloro-2-pyridinyl.

Embodiment 77. A compound of Embodiment 74 wherein R² is phenyl.

Embodiment 78. A compound of Formula 1 or any one of Embodiments 1 through 76 wherein R² is other than phenyl.

35 Embodiment 79. A compound of Embodiment 74 wherein R² is 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 79A. A compound of Embodiment 79 wherein R² is 2-thienyl.

- Embodiment 80. A compound of Embodiment 79 wherein R^2 is 3-pyridinyl.
- Embodiment 81. A compound of Embodiment 76 wherein R^2 is *n*-propyl, *n*-butyl or cyclopropyl.
- Embodiment 81A. A compound of Embodiment 81 wherein R^2 is cyclopropyl.
- 5 Embodiment 82. A compound of Formula 1 or any one of Embodiments 1 through 75 wherein W^3 is $-CH_2-$.
- Embodiment 83. A compound of Formula 1 or any one of Embodiments 1 through 75 wherein W^4 is $-CH_2-$.
- 10 Embodiment 84. A compound of Formula 1 or any one of Embodiments 1 through 83 wherein R^3 is 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 benzylsulfonyloxy, each optionally substituted on ring members with up to two substituents selected from R^{21} .
- 15 Embodiment 85. A compound of Embodiment 84 wherein R^3 is hydroxy, $-O-M^+$ or C_2-C_8 alkylcarbonyloxy; or phenylsulfonyloxy optionally substituted with up to two substituents selected from R^{21} .
- Embodiment 86. A compound of Embodiment 85 wherein M^+ is a sodium or potassium metal cation.
- 20 Embodiment 87. A compound of Embodiment 86 wherein R^3 is hydroxy or C_2-C_8 alkylcarbonyloxy.
- Embodiment 88. A compound of Embodiment 87 wherein R^3 is hydroxy or $-OC(=O)CH_2CH(CH_3)_2$.
- 25 Embodiment 89. A compound of Formula 1 or any one of Embodiments 1, 7 and 14 through 88 wherein R^4 , R^5 , R^6 and R^7 are each independently H or C_1-C_6 alkyl.
- Embodiment 90. A compound of Formula 1 or any one of Embodiments 1 or 7 wherein R^8 is C_1-C_6 alkyl or C_3-C_8 cycloalkyl.
- Embodiment 91. A compound of Embodiment 90 wherein R^8 is CH_3 , CH_2CH_3 or cyclopropyl.
- 30 Embodiment 92. A compound of Formula 1 or any one of Embodiments 1 through 3 or 14 through 91 wherein R^9 is C_1-C_6 alkyl.
- Embodiment 93. A compound of Embodiment 92 wherein R^9 is CH_2CH_3 .
- Embodiment 94. A compound of Formula 1 or any one of Embodiments 1 through 3 or 14 through 93 wherein R^{10} is H, halogen or C_1-C_6 alkyl.
- 35 Embodiment 95. A compound of Embodiment 94 wherein R^{10} is H or CH_3 .
- Embodiment 96. A compound of Formula 1 or any one of Embodiments 1, 2 or 14 through 95 wherein R^{11} is H or C_1-C_6 alkyl.

Embodiment 97. A compound of Embodiment 96 wherein R^{11} is H.

Embodiment 98. A compound of Formula 1 or any one of Embodiments 1, 2 or 14 through 97 wherein R^{12} is H, halogen, cyano, hydroxy, amino or C_1 - C_6 alkyl.

5 Embodiment 99. A compound of Embodiment 98 wherein R^{12} is H, halogen, cyano, C_1 - C_6 alkyl or C_3 - C_8 cycloalkyl.

Embodiment 100. A compound of Embodiment 99 wherein R^{12} is CH_3 , CH_2CH_3 or cyclopropyl.

Embodiment 101. A compound of Formula 1 or any one of Embodiments 1 or 14 through 100 wherein R^{13} is H, halogen, cyano or nitro.

10 Embodiment 102. A compound of Embodiment 101 wherein R^{13} is cyano or nitro.

Embodiment 103. A compound of Formula 1 or any one of Embodiments 1 through 102 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.

15 Embodiment 104. A compound of Embodiment 103 wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of R^{14} and R^{18} are H or CH_3 .

Embodiment 105. A compound of Embodiment 104 wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of R^{14} and R^{18} are H.

20 Embodiment 106. A compound of Formula 1 or any one of Embodiments 1 through 105 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 $-CH_2CH_2CH_2-$ or $-CH=CHCH_2-$.

Embodiment 107. A compound of Formula 1 or any one of Embodiments 1 through 105 wherein all instances of R^{14} and R^{18} are taken alone.

25 Embodiment 108. A compound of Formula 1 or any one of Embodiments 1 through 106 wherein independently each R^{15} and R^{19} is H or C_1 - C_6 alkyl.

Embodiment 109. A compound of Embodiment 108 wherein independently each R^{15} and R^{19} is H or CH_3 .

30 Embodiment 110. A compound of Embodiment 109 wherein independently each R^{15} and R^{19} is H.

Embodiment 110A. A compound of any one of Embodiments 104 and 109 wherein each R^{14} , R^{15} , R^{18} and R^{19} is H or CH_3 .

Embodiment 110B. A compound of Embodiment 110A wherein each R^{14} , R^{15} , R^{18} and R^{19} is H.

35 Embodiment 111. A compound of Formula 1 or any one of Embodiments 1 through 110B wherein R^{20} is H, C_1 - C_6 alkyl, C_2 - C_6 alkenyl or C_3 - C_8 cycloalkyl.

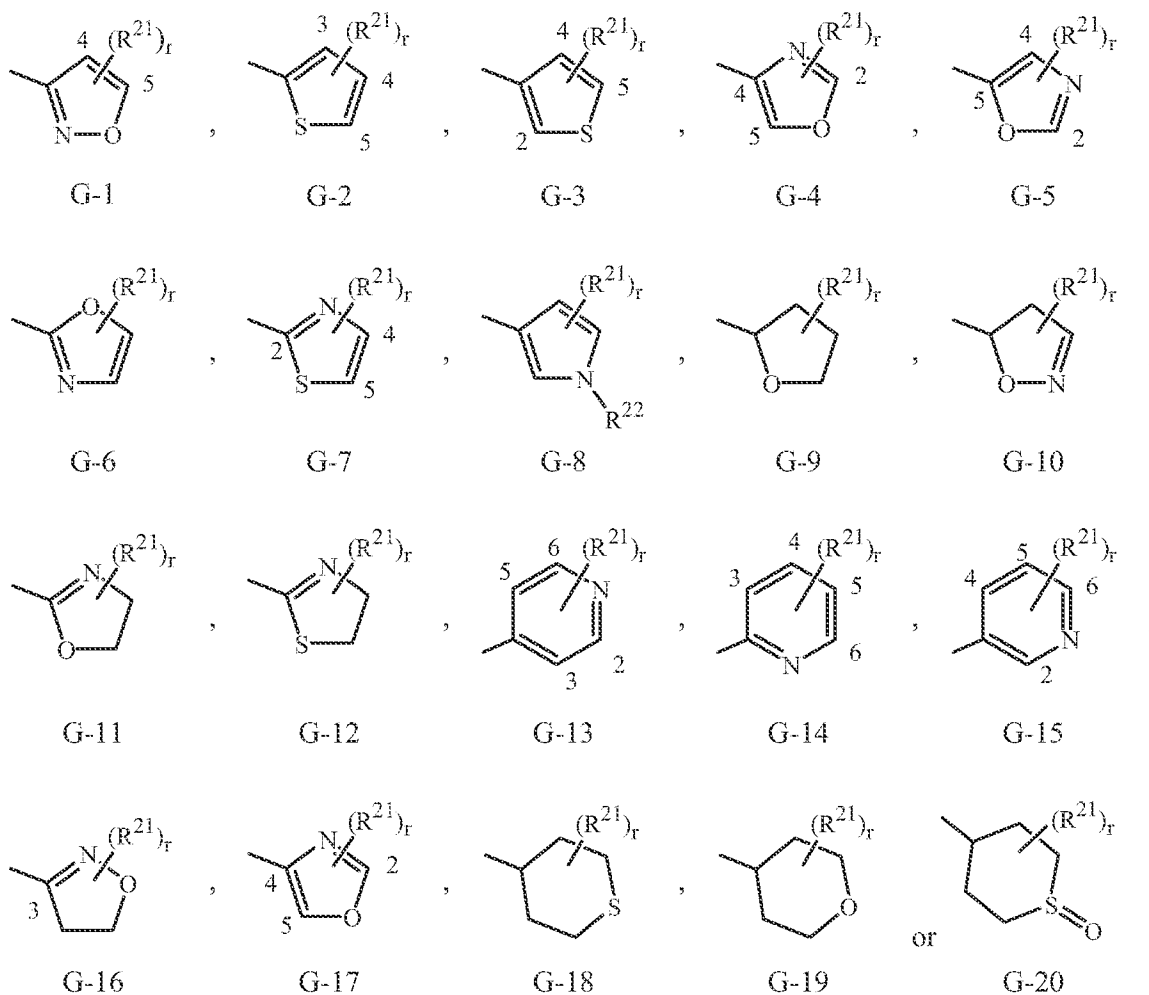
Embodiment 112. A compound of Embodiment 111 wherein R^{20} is H or CH_3 .

Embodiment 113. A compound of Formula 1 or any one of Embodiments 1 through 4, 6, 10, 11 and 14 through 51 wherein T is $-\text{CH}_2\text{CH}_2-$ or $-\text{CH}=\text{CH}-$.

Embodiment 114. A compound of Embodiment 113 wherein T is $-\text{CH}_2\text{CH}_2-$.

Embodiment 115. A compound of Formula 1 or any one of Embodiments 1 through 54, 75 or 84 through 114 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 116. A compound of Embodiment 115 wherein G is



wherein r is 0, 1, 2 or 3.

Embodiment 117. A compound of Embodiment 116 wherein G is G-2, G-3 or G-15.

Embodiment 118. A compound of Embodiment 117 wherein G is G-2 or G-3.

Embodiment 119. A compound of Embodiment 118 wherein G is G-2.

Embodiment 120. A compound of Embodiment 118 wherein G is G-3.

Embodiment 120A. A compound of Embodiment 116 wherein G is G-15.

Embodiment 121. A compound of Formula 1 or any one of Embodiments 1 through

120 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 alkylsulfinylalkyl, 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, C_1 - C_6 alkylsulfinyl, C_1 - C_6 haloalkylsulfinyl, C_1 - C_6 alkylsulfonyl, C_1 - C_6 haloalkylsulfonyl or C_3 - C_8 cycloalkylsulfonyl.

Embodiment 121A. A compound of Embodiment 121 wherein each R^{21} is

15 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.

Embodiment 122. A compound of Embodiment 121A wherein each R^{21} is

independently fluorine, chlorine, bromine, CH_3 , CF_3 , OCH_3 , OCF_3 or SCH_3 .

Embodiment 123. A compound of Formula 1 or any one of Embodiments 1 through

20 122 wherein each R^{22} is independently C_1 - C_6 alkyl or C_1 - C_6 haloalkyl.

Embodiment 124. A compound of Embodiment 123 wherein each R^{22} is

independently CH_3 or CH_2CF_3 .

Embodiment 124A. A compound of Embodiment 124 wherein R^{22} is CH_3 .

Embodiment 124B. A compound of Formula 1 or any one of Embodiments 1 through

25 124A wherein R^{40} is ethyl or *i*-propyl.

Embodiment 124C. A compound of Formula 1 or any one of Embodiments 1 through

124A wherein R^{41} is ethyl or *i*-propyl.

Embodiment 124D. A compound of Formula 1 or any one of Embodiments 1 through

30 124A wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$.

Embodiment 124E. A compound of Embodiment 124D wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$ or $-(CH_2)_2O(CH_2)_2-$.

Embodiment 124F. A compound of Embodiment 124E wherein R^{40} and R^{41} are taken together as $-(CH_2)_2O(CH_2)_2-$.

35 This invention also includes a herbicidal mixture comprising (a) a compound selected from Formula 1, *N*-oxides, and salts thereof, and (b) at least one additional active ingredient selected from (b1) photosystem II inhibitors, (b2) acetohydroxy acid synthase (AHAS)

inhibitors, (b3) acetyl-CoA carboxylase (ACCase) inhibitors, (b4) auxin mimics, (b5) 5-enol-pyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, (b6) photosystem I electron diverters, (b7) protoporphyrinogen oxidase (PPO) inhibitors, (b8) glutamine synthetase (GS) inhibitors, (b9) very long chain fatty acid (VLCFA) elongase inhibitors, 5 (b10) auxin transport inhibitors, (b11) phytoene desaturase (PDS) inhibitors, (b12) 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, (b13) homogentisate solanesyltransferase (HST) inhibitors, (b14) other herbicides including mitotic disruptors, organic arsenicals, asulam, difenzoquat, bromobutide, flurenol, cinmethylin, cumyluron, dazomet, dymron, methyldymron, etobenzanid, fosamine, fosamine-ammonium, metam, 10 oxaziclomefone, oleic acid, pelargonic acid and pyributicarb, and (b15) herbicide safeners; and salts of compounds of (b1) through (b15).

Embodiment 125. A herbicidal mixture comprising (a) a compound of Formula 1 or any one of Embodiments 1 through 125E, and (b) at least one additional active ingredient selected from (b1), (b2), (b3), (b12), (b13) and (b15).

15 Embodiment 126. A herbicidal mixture of Embodiment 125 wherein component (b) comprises at least one additional active ingredient selected from (b1), (b12), (b13) and (b15).

Embodiment 127. A herbicidal mixture of Embodiment 126 wherein component (b) comprises at least one additional active ingredient selected from (b1).

20 Embodiment 128. A herbicidal mixture of Embodiment 127 wherein component (b) comprises bromoxynil.

Embodiment 129. A herbicidal mixture of Embodiment 127 wherein component (b) comprises dimethametryn.

25 Embodiment 130. A herbicidal mixture of Embodiment 126 wherein component (b) comprises at least one additional active ingredient selected from (b13).

Embodiment 131. A herbicidal mixture of Embodiment 130 wherein component (b) comprises haloxydine.

Embodiment 132. A herbicidal mixture of Embodiment 126 wherein component (b) comprises at least one additional active ingredient selected from (b15).

30 Embodiment 133. A herbicidal mixture of Embodiment 132 wherein component (b) comprises at least one additional active ingredient selected from allidochlor, benoxacor, 1-bromo-4-[(chloromethyl)sulfonyl]benzene, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfamide, daimuron, dichlormid, dicyclonon, 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 35 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), dimepiperate, fenchlorazole-ethyl, fencloirim, flurazole, fluxofenim, furilazole,

isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone, naphthalic anhydride and oxabetrinil.

Embodiment 134. A herbicidal mixture of Embodiment 133 wherein component (b) comprises at least one additional active ingredient selected from benoxacor, cloquintocet-mexyl, cyprosulfamide, diamuron, fenchlorazole-ethyl, mefenpyr-diethyl, mephenate and oxabetrinil.

Embodiment 135. A herbicidal mixture of Embodiment 134 wherein component (b) comprises at least one additional active ingredient selected from cloquintocet-mexyl, mefenpyr-diethyl and oxabetrinil.

Embodiment 136. A herbicidal mixture of Embodiment 135 wherein component (b) comprises at least one additional active ingredient selected from cloquintocet-mexyl.

Embodiment 137. A herbicidal mixture of Embodiment 135 wherein component (b) comprises at least one additional active ingredient selected from oxabetrinil.

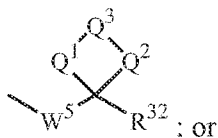
Embodiments of this invention, including Embodiments 1–124F above as well as any other embodiments described herein, can be combined in any manner, and the descriptions of variables in the embodiments pertain not only to the compounds of Formula 1 but also to the starting compounds and intermediate compounds, including compounds of Formulae 1Q, 1R and 1S, useful for preparing the compounds of Formula 1. In addition, embodiments of this invention, including Embodiments 1–124E or 125–137 above as well as any other embodiments described herein, and any combination thereof, pertain to the compositions and methods of the present invention.

Combinations of Embodiments 1-124F are illustrated by:

Embodiment A. A compound of Formula 1 wherein

A is A-1, A-3, A-4, A-5 or A-6;

R¹ is



R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶; or

R¹ is N(R⁴⁰)R⁴¹; or

R¹ is G^A or -W²G^A;

G^A is a 9- to 11-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from C(=O), C(=N-OR³⁰) or C=NN(R²⁹), each ring or ring system optionally

- substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members; or
- each G^A is a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring substituted with 1 substituent
- 5 selected from R^{22} on one nitrogen ring member;
- each E^1 , E^2 and E^3 is independently O, NOR^{28} or $NN(R^{28})_2$;
- L is independently O or $N(R^{31})$;
- each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_4 alkyl or C_3 - C_5 cycloalkyl
- each optionally substituted with one or more substituents selected from the group
- 10 consisting of halogen, CN, hydroxy, C_1 - C_2 alkoxy, C_1 - C_2 alkylsulfinyl and C_1 - C_4 alkylsulfonyl;
- each R^{28} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;
- each R^{29} is independently H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkylcarbonyl, C_1 - C_3 alkylsulfonyl or C_1 - C_3 haloalkylsulfonyl;
- 15 each Q^1 and Q^2 is independently O or $N(R^{31})$;
- Q^3 is C_2 - C_3 alkylene optionally substituted with up to 2 substituents selected from C_1 - C_4 alkyl;
- R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;
- R^{31} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;
- 20 R^{32} is H or C_1 - C_3 alkyl;
- W^1 is C_2 - C_4 alkylene, $-(CH_2)_2OCH_2-$ or $-(CH_2)_3OCH_2-$;
- W^2 is C_1 - C_3 alkylene;
- W^5 is C_1 - C_4 alkylene;
- R^2 is phenyl or $-W^3(\text{phenyl})$, each optionally substituted on ring members with up to
- 25 five substituents selected from R^{21} ; or $-G$; or C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl, C_1 - C_6 haloalkyl, C_2 - C_6 haloalkenyl, C_2 - C_6 haloalkynyl, C_3 - C_8 cycloalkyl, C_3 - C_8 halocycloalkyl, C_4 - C_{10} alkylcycloalkyl, C_4 - C_{10} cycloalkylalkyl, C_6 - C_{14} cycloalkylcycloalkyl, C_4 - C_{10} halocycloalkylalkyl, C_5 - C_{12} alkylcycloalkylalkyl, C_3 - C_8 cycloalkenyl, C_3 - C_8 halocycloalkenyl,
- 30 C_2 - C_8 alkoxyalkyl, C_3 - C_{10} alkoxyalkenyl, C_4 - C_{10} cycloalkoxyalkyl, C_4 - C_{10} cycloalkoxyalkoxyalkyl, C_3 - C_{10} alkoxyalkoxyalkyl, C_2 - C_8 alkylthioalkyl, C_2 - C_8 alkylsulfinylalkyl, C_2 - C_8 alkylsulfonylalkyl, C_2 - C_8 alkylcarbonyl, C_4 - C_{10} cycloalkenylalkyl, C_2 - C_8 haloalkoxyalkyl, C_2 - C_8 alkoxyhaloalkyl, C_2 - C_8 haloalkoxyhaloalkyl, C_4 - C_{10} halocycloalkoxyalkyl, C_4 - C_{10} cycloalkenyloxyalkyl, C_4 - C_{10} halocycloalkenyloxyalkyl, C_3 - C_{10} dialkoxyalkyl,
- 35 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_3 - C_6

- 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 alkoxyalkoxy, C₂-C₈ alkyl(thiocarbonyl)oxy, C₃-C₈ cycloalkylsulfinyl or C₃-C₁₀ halotrialkylsilyl; or
- R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴ or -W⁶C(=E⁶)L¹R³⁵;
 each E⁴, E⁵, and E⁶ is independently O, NOR³⁷ or NN(R³⁷)₂;
 each L¹ is independently O or N(R³⁸);
 each R³³, R³⁴ and R³⁵ is independently hydrogen; or C₁-C₄ alkyl, C₃-C₅ cycloalkyl
 each optionally substituted with one or more substituents selected from the group
 consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl and
 C₁-C₂ alkylsulfonyl;
 each R³⁷ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
 R³⁸ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
 W³ is -CH₂-;
- W⁶ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;
 R³ is 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;
- R¹² is H, halogen, cyano, hydroxy, amino or C₁-C₆ alkyl;
 each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃;
 R²⁰ is H or CH₃;
 T is -CH₂CH₂- or -CH=CH-;
- each G is G-1 through G-20 (as depicted in Embodiment 116);
 r is 0, 1, 2 or 3;
 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;

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

R⁴⁰ is ethyl or *i*-propyl; and

R⁴¹ is ethyl or *i*-propyl; or

R⁴⁰ and R⁴¹ are taken together as -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

15 Embodiment B. A compound of Embodiment A wherein

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

B¹ is C-1;

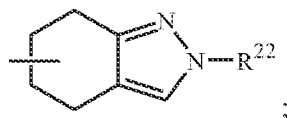
B² is C-3;

B³ is C-1;

20 R¹ is -G^A;

each G^A is selected from G^A-1, G^A-2, G^A-3, G^A-7, G^A-8 and G^A-9; or

each G^A is



25 R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl;

R³ is hydroxy or C₂-C₈ alkylcarbonyloxy;

R⁹ is CH₂CH₃;

R¹⁰ is H or CH₃;

T is -CH₂CH₂-;

30 G is G-2, G-3 or G-15; and

R²¹ is independently halogen, nitro, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy,

C₁-C₆ haloalkoxy or C₁-C₆ alkylthio;

each R²² is independently CH₃ or CH₂CF₃; and

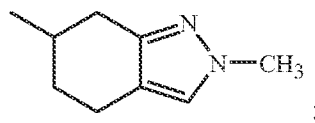
R⁴⁰ and R⁴¹ are taken together as -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

35 Embodiment C. A compound of Embodiment B wherein

A is A-1 or A-3;

each G^A is selected from G^A -2 and G^A -3; or

each G^A is



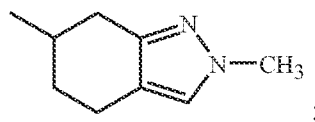
5 R^2 is phenyl; or -G; or C_3 - C_8 cycloalkyl; and

R^{40} and R^{41} are taken together as $-(CH_2)_5-$ or $-(CH_2)_2O(CH_2)_2-$.

Embodiment D. A compound of Embodiment C wherein

A is A-1;

each G^A is



10

R^2 is phenyl;

R^{30} is H or methyl;

R^{21} halogen or C_1 - C_3 alkyl; and

R^{22} is CH_3 .

15 Embodiment E. A compound of Embodiment B wherein

A is A-1;

G^A is G^A -2;

R^2 is phenyl, 2-thienyl, 5-chloro-2-pyridinyl or cyclopropyl;

R^3 is hydroxy; and

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

Embodiment F. A compound of Embodiment B wherein

A is A-3;

G^A is G^A -2;

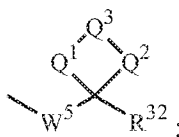
R^2 is phenyl, 2-thienyl 5-chloro-2-pyridinyl or cyclopropyl; and

25 R^3 is hydroxy.

Embodiment G. A compound of Embodiment A wherein

A is A-1;

R^1 is



30 each Q^1 and Q^2 is O;

Q³ is C₂-alkylene;

R³² is H or methyl;

W⁵ is C₂-C₃ alkylene;

R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl,
5 4-chlorophenyl, 3-fluorophenyl 3,5-difluorophenyl, 3-thienyl or 2-thienyl;

R³ is hydroxy or -OC(=O)CH₂CH(CH₃)₂; and

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃.

Embodiment H. A compound of Embodiment G wherein

W⁵ is C₂ alkylene or C₃ alkylene;

10 R² is phenyl, 3-thienyl cyclopropyl; and

R³ is hydroxy.

Specific embodiments include a compound of Formula 1 selected from:

3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-
phenyl-4(3*H*)-pyrimidinone (Compound 1),

15 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-6-oxo-2-phenyl-
1(6*H*)-pyrimidineacetaldehyde 1-(*O*-methyloxime) (Compound 2),

2-(5-chloro-3-pyridinyl)-3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-
cyclohexen-1-yl)carbonyl]-4(3*H*)-pyrimidinone (Compound 7),

2-cyclopropyl-3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-
20 yl)carbonyl]-4(3*H*)-pyrimidinone (Compound 10),

3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-4-oxobicyclo[3.2.1]oct-2-en-3-
yl)carbonyl]-2-(2-thienyl)-4(3*H*)-pyrimidinone (Compound 15) and

5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-phenyl-3-(4,5,6,7-tetrahydro-2-
methyl-2*H*-indazol-5-yl)-4(3*H*)-pyrimidinone (Compound 19).

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

Embodiment 1Q. A compound of Formula 1Q wherein A' is A'-1, A'-3 or A'-5.

Embodiment 2Q. A compound of Embodiment 1Q wherein A' is A'-1 or A'-3.

30 Embodiment 3Q. A compound of Embodiment 2Q wherein A' is A'-1.

Embodiment 4Q. A compound of Embodiment 2Q wherein A' is A'-3.

Embodiment 5Q. A compound of Formula 1Q or any one of Embodiments 1Q through
4Q wherein B¹ is C-1.

Embodiment 6Q. A compound of Formula 1Q or any one of Embodiments 1Q through
35 4Q wherein B¹ is C-2.

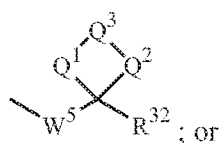
Embodiment 7Q. A compound of Formula 1Q or any one of Embodiments 1Q through
6Q wherein B² is C-3.

Embodiment 8Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 6Q wherein B² is C-4.

Embodiment 9Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 8Q wherein B³ is C-1.

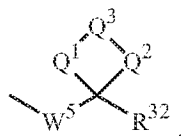
5 Embodiment 10Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 8Q wherein B³ is C-2.

Embodiment 11Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 10Q wherein R¹ is



10 R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶; or
R¹ is -G^A or -W²G^A.

Embodiment 12Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q wherein R¹ is



15 Embodiment 13Q. A compound of Embodiment 12Q wherein each Q¹ and Q² is O.

Embodiment 14Q. A compound of Embodiment 12Q wherein Q³ is C₂-alkylene optionally substituted with up to 2 substituents selected from C₁-C₂ alkyl.

Embodiment 15Q. A compound of Embodiment 14Q wherein Q³ is C₂-alkylene optionally substituted with up to 2 substituents selected from methyl.

20 Embodiment 16Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 15Q wherein W⁵ is C₁-C₄ alkylene.

Embodiment 17Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 16Q wherein R³² is H or C₁-C₃ alkyl.

Embodiment 17QA. A compound of Embodiment 17Q wherein R³² is H or methyl.

25 Embodiment 18Q. A compound of Embodiments 17Q wherein R³² is methyl.

Embodiment 19Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q wherein R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶.

30 Embodiment 12QA. A compound of Formula **1Q** or any one of Embodiments 1Q through 19Q wherein W¹ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-.

Embodiment 20Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q or 19Q wherein each E^1 , E^2 , and E^3 is independently O, NOR^{28} or $NN(R^{28})_2$.

5 Embodiment 20QA. A compound of Formula **1Q** or any of Embodiments 1Q through 20Q wherein each R^{28} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl

Embodiment 20QB. A compound of Formula **1Q** or any one of Embodiments 1Q through 10Q wherein R^1 is other than $-N(R^{40})(R^{41})$.

10 Embodiment 21Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q or 19Q wherein each L is independently O or $N(R^{31})$; provided when E^3 is O, L is other than O;

Embodiment 22Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 21Q wherein W^1 is C_1 - C_4 alkylene.

15 Embodiment 23Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q or 19Q wherein each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_2 alkyl or C_3 - C_4 cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxyl and C_1 - C_2 alkoxy.

Embodiment 24Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 11Q wherein R^1 is $-G^A$.

20 Embodiment 25Q. A compound of Embodiment 24Q wherein G^A is a 5- or 6-membered carbocyclic ring including ring members selected from $C=O$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$, each ring optionally substituted with up to two substituents selected from R^{21} .

25 Embodiment 26Q. A compound of Embodiment 25Q wherein R^{29} is independently H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl or C_1 - C_3 alkylcarbonyl.

Embodiment 26QA. A compound of Embodiment 25Q wherein R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl

30 Embodiment 27Q. A compound of Embodiment 24Q wherein G^A is a 9- to 10-membered saturated heterospirocyclic ring system optionally including ring members selected from $C(=O)$ or $C(=N-OR^{30})$, each ring or ring system optionally substituted with up to two substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members;

Embodiment 28Q. A compound of Embodiment 27Q wherein R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

35 Embodiment 29Q. A compound of Embodiment 27Q or 28Q wherein G^A is selected from G^A -1, G^A -2, G^A -3, G^A -7, G^A -8 and G^A -9 (as described in Embodiment 51).

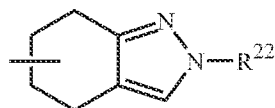
Embodiment 30Q. A compound of Embodiment 29Q wherein G^A is selected from G^A -2 and G^A -3.

Embodiment 30QA. A compound of Embodiment 30Q wherein G^A is G^A -2.

Embodiment 30QB. A compound of Formula 1Q or any one of Embodiments 1Q through 30QA wherein each G^A is other than a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring optionally substituted with up to 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members.

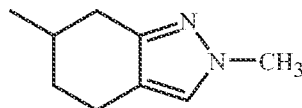
Embodiment 30QC. A compound of Formula 1 or any one of Embodiments 1Q through 24Q wherein each G^A is a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring substituted with 1 substituent selected from R^{22} on one nitrogen ring member.

Embodiment 30QD. A compound of Embodiment 30QC wherein each G^A is



wherein the bond projecting to the left represents the point of attachment to the remainder of the compound of Formula 1.

Embodiment 30QE. A compound of Embodiment 30QD wherein each G^A is



Embodiment 31Q. A compound of Formula 1Q or any one of Embodiments 1Q through 30Q wherein R^2 is phenyl or $-W^3$ (phenyl), each optionally substituted on ring members with up to two substituents selected from R^{21} ; or $-G$ or; or C_1 - C_6 alkyl or C_3 - C_8 cycloalkyl.

Embodiment 32Q. A compound of Embodiment 31Q wherein R^2 is phenyl optionally substituted on ring members with up to two substituents selected from R^{21} ; or $-G$; or C_1 - C_6 alkyl, C_3 - C_8 cycloalkyl.

Embodiment 32QA. A compound of Embodiment 32Q wherein R^2 is phenyl; or $-G$; or C_3 - C_8 cycloalkyl.

Embodiment 32QB. A compound of Embodiment 32QA wherein R^2 is phenyl, 2-thienyl 5-chloro-2-pyridinyl or cyclopropyl.

Embodiment 32QC. A compound of Embodiment 32QA wherein R^2 is phenyl, 3-thienyl or cyclopropyl.

Embodiment 33Q. A compound of Embodiment 32Q wherein R^2 is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

5 Embodiment 33QA. A compound of Embodiment 32Q wherein R^2 is phenyl, 3-thienyl or cyclopropyl.

Embodiment 34Q. A compound of Embodiment 33Q wherein R^2 is phenyl.

Embodiment 35Q. A compound of Formula 1Q or any one of Embodiments 1Q through 31Q wherein R^2 is other than phenyl.

10 Embodiment 36Q. A compound of Embodiment 35Q wherein R^2 is 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 36Qa. A compound of Embodiment 36Q wherein R^2 is 3-pyridinyl.

Embodiment 37Q. A compound of Formula 1Q or any one of Embodiments 1Q through 36Q wherein W^3 is $-CH_2-$.

15 Embodiment 38Q. A compound of Formula 1Q or any one of Embodiments 1Q through 3Q, 7Q and 11Q through 37Q wherein R^9 is C_1-C_6 alkyl.

Embodiment 39Q. A compound of Embodiments 38Q wherein R^9 is CH_2CH_3 .

Embodiment 40Q. A compound of Formula 1Q or any one of Embodiments 1Q or 11Q through 39Q wherein R^{10} is H, halogen or C_1-C_6 alkyl.

Embodiment 41Q. A compound of Embodiment 40Q wherein R^{10} is H or CH_3 .

20 Embodiment 42Q. A compound of Formula 1Q or any one of Embodiments 1Q through 41Q 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.

25 Embodiment 43Q. A compound of Embodiment 42Q wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of R^{14} and R^{18} are H or CH_3 .

Embodiment 44Q. A compound of Embodiment 43Q wherein when instances of R^{14} and R^{18} are taken alone, then independently said instances of R^{14} and R^{18} are H.

30 Embodiment 45Q. A compound of Formula 1Q or any one of Embodiments 1Q through 44Q wherein independently each R^{15} and R^{19} is H or CH_3 .

Embodiment 46Q. A compound of Embodiment 45Q wherein independently each R^{15} and R^{19} is H.

Embodiment 47Q. A compound of Formula 1Q or any one of Embodiments 1Q through 46Q wherein R^{20} is H, C_1-C_6 alkyl, C_2-C_6 alkenyl or C_3-C_8 cycloalkyl.

35 Embodiment 48Q. A compound of Embodiment 47Q wherein R^{20} is H or CH_3 .

Embodiment 49Q. A compound of Formula 1Q or any one of Embodiments 1Q, 2Q, 4Q, 7Q, 8Q and 11Q through 48Q wherein T is $-CH_2CH_2-$ or $-CH=CH-$.

Embodiment 50Q. A compound of Embodiment 49Q wherein T is $-\text{CH}_2\text{CH}_2-$.

Embodiment 51Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 50Q wherein G is G-2, G-3 or G-15 (as depicted in Embodiment 51).

Embodiment 52Q. A compound of Embodiment 51Q wherein G is G-2 (as depicted in Embodiment 51).

Embodiment 53Q. A compound of Embodiment 51Q wherein G is G-3 (as depicted in Embodiment 51).

Embodiment 54Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 54Q wherein 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.

Embodiment 55Q. A compound of Embodiment 54Q wherein each R^{21} is independently fluorine, chlorine, bromine, CH_3 , CF_3 , OCH_3 , OCF_3 or SCH_3 .

Embodiment 56Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 55Q wherein each R^{22} is independently C_1 - C_6 alkyl or C_1 - C_6 haloalkyl.

Embodiment 57Q. A compound of Embodiment 56Q wherein each R^{22} is independently CH_3 or CH_2CF_3 .

Embodiment 58Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 57Q wherein R^{40} is ethyl or *i*-propyl.

Embodiment 59Q. A compound of Formula **1Q** or any one of Embodiments 1Q through 58Q wherein R^{41} is ethyl or *i*-propyl.

Embodiment 60Q. A compound of Formula **1Q** or any one of Embodiments 1 through 57Q wherein R^{40} and R^{41} are taken together as $-(\text{CH}_2)_5-$, $-\text{CH}_2\text{CH}=\text{CHCH}_2-$ or $-(\text{CH}_2)_2\text{O}(\text{CH}_2)_2-$.

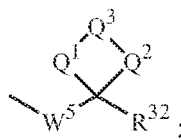
Embodiment 61Q. A compound of Embodiment 60Q wherein R^{40} and R^{41} are taken together as $-(\text{CH}_2)_5-$ or $-(\text{CH}_2)_2\text{O}(\text{CH}_2)_2-$.

Embodiment 62Q. A compound of Embodiment 61Q wherein R^{40} and R^{41} are taken together as $-(\text{CH}_2)_2\text{O}(\text{CH}_2)_2-$.

Embodiments of the present invention as described in the Summary of the Invention also include (where Formula **1R** from the Summary of the Invention as used in the following

Embodiments include *N*-oxides and salts thereof):

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



each Q^1 and Q^2 is O;

Q^3 is C_2 -alkylene;

R^{32} is H or methyl;

W⁵ is C₂-C₃ alkylene;

R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl, 3,5-difluorophenyl, 3-thienyl, 2-thienyl or 3-pyridinyl; and

5 each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H.

Embodiment 1RA. A compound of Formula **1R** or Embodiment 1 wherein R¹ is other than -N(R⁴⁰)(R⁴¹).

Embodiment 1RB. A compound of Formula **1R** wherein R² is phenyl; or -G; or C₃-C₈ cycloalkyl.

10 Embodiment 1RC. A compound of Embodiment 1RB wherein R² is phenyl, 2-thienyl, 5-chloro-2-pyridinyl or cyclopropyl.

Embodiment 1RD. A compound of Embodiment 1RB wherein R² is phenyl, 3-thienyl or cyclopropyl.

15 Embodiment 2R. A compound of Embodiment 1R wherein R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

Embodiment 3R. A compound of Embodiment 1R wherein R² is phenyl, 3-thienyl or cyclopropyl.

20 Embodiment 3RA. A compound of Embodiment 1R wherein R² is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

Embodiment 4R. A compound of Embodiment 1R wherein R² is 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 5R. A compound of Embodiment 1R wherein R² is phenyl.

Embodiment 6R. A compound of Formula **1R** wherein

25 R¹ is -W¹C(=E¹)R²⁴;

E¹ is NOR²⁸;

R²⁸ is H or methyl; and

30 R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl, 3,5-difluorophenyl, 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 7R. A compound of Embodiment 6R wherein R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

35 Embodiment 8R. A compound of Embodiment 6R wherein R² is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

Embodiment 9R. A compound of Embodiment 6R wherein R² is 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 10R. A compound of Embodiment 6R wherein R^2 is phenyl.

Embodiment 11R. A compound of Formula **1R** wherein

R^1 is $-G^A$;

5 each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from $C(=O)$ or $C(=N-OR^{30})$; or a 9- to 10-membered saturated heterospirocyclic ring system optionally including ring members selected from $C(=O)$ or $C(=N-OR^{30})$, each ring or ring system optionally substituted with up to two substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members;

10 R^{30} is H or methyl;

R^{21} halogen or C_1 - C_3 alkyl;

R^{22} is C_1 - C_3 alkyl.

Embodiment 12R. A compound of Embodiment 11R wherein G^A is selected from

G^A -1, G^A -2, G^A -3, G^A -7, G^A -8 and G^A -9 (as depicted in Embodiment 51), and

15 R^2 is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl 3,5-difluorophenyl, 3-thienyl 2-thienyl or 3-pyridinyl;

Embodiment 13R. A compound of Embodiment 11R wherein R^2 is phenyl,

2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or

20 3,5-difluorophenyl.

Embodiment 14R. A compound of Embodiment 11R wherein R^2 is phenyl,

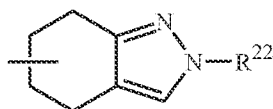
3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

Embodiment 15R. A compound of Embodiment 11R wherein R^2 is 3-thienyl, 2-thienyl

or 3-pyridinyl.

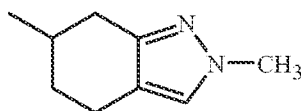
25 Embodiment 16R. A compound of Embodiment 11R wherein R^2 phenyl.

Embodiment 16RA. A compound of Formula **1R** wherein each G^A is



wherein the bond projecting to the left represents the point of attachment to the remainder of the compound of Formula **1R**.

30 Embodiment 16RB. A compound of Embodiment 16RA wherein each G^A is



wherein the bond projecting to the left represents the point of attachment to the remainder of a compound of Formula **1**.

Embodiment 17R. A compound of Formula **1R** or any one of Embodiments 1R through 16R wherein R^{40} is ethyl or *i*-propyl.

Embodiment 18R. A compound of Formula **1R** or any one of Embodiments 1R through 16R wherein R^{41} is ethyl or *i*-propyl.

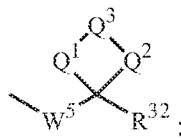
5 Embodiment 19R. A compound of Formula **1R** or any one of Embodiments 1R through 16R wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$.

Embodiment 20R. A compound of Embodiment 19R wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$ or $-(CH_2)_2O(CH_2)_2-$.

10 Embodiment 21R. A compound of Embodiment 20R wherein R^{40} and R^{41} are taken together as $-(CH_2)_2O(CH_2)_2-$.

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

15 Embodiment 1S. A compound of Formula **1S** wherein R^1 is



each Q^1 and Q^2 is O;

Q^3 is C_2 -alkylene;

20 R^{32} is H or methyl;

W^5 is C_2 - C_3 alkylene;

R^2 is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl, 3,5-difluorophenyl, 3-thienyl, 2-thienyl or 3-pyridinyl;

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

R^{23} is methyl or ethyl.

Embodiment 1SA. A compound of Formula **1S** or Embodiment 1S wherein R^1 is other than $-N(R^{40})(R^{41})$.

Embodiment 1SB. A compound of Formula **1S** or Embodiment 1S wherein R^2 is phenyl; or -G; or C_3 - C_8 cycloalkyl.

30 Embodiment 1SC. A compound of Embodiment 1SB wherein R^2 is phenyl, 2-thienyl 5-chloro-2-pyridinyl or cyclopropyl.

Embodiment 1SD. A compound of Embodiment 1SB wherein R^2 is phenyl, 3-thienyl or cyclopropyl.

Embodiment 2S. A compound of Embodiment 1S wherein R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

5 Embodiment 2SA. A compound of Embodiment 1S wherein R² is phenyl, 3-thienyl or cyclopropenyl.

Embodiment 3S. A compound of Embodiment 1S wherein R² is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

Embodiment 4S. A compound of Embodiment 1S wherein R² is 3-thienyl, 2-thienyl or 3-pyridinyl.

10 Embodiment 5S. A compound of Embodiment 1S wherein R² is phenyl.

Embodiment 6S. A compound of Formula 1S wherein

R¹ is -W¹C(=E¹)R²⁴;

E¹ is NOR²⁸;

R²⁸ is H or methyl; and

15 R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl, 3,5-difluorophenyl, 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 7S. A compound of Embodiment 6S wherein R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 20 3,5-difluorophenyl.

Embodiment 8S. A compound of Embodiment 6S wherein R² is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

Embodiment 9S. A compound of Embodiment 6S wherein R² is 3-thienyl, 2-thienyl or 3-pyridinyl.

25 Embodiment 9SA. A compound of Embodiment 6S wherein R² is 2-thienyl.

Embodiment 10S. A compound of Embodiment 6S wherein R² is phenyl.

Embodiment 11S. A compound of Formula 1S wherein

R¹ is -G^A;

30 each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from C(=O) or C(=N-OR³⁰); or a 9- to 10-membered saturated heterospirocyclic ring system optionally including ring members selected from C(=O) or C(=N-OR³⁰), each ring or ring system optionally substituted with up to two substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members; or

35 R³⁰ is H or methyl;

R²¹ halogen or C₁-C₃ alkyl;

R²² is C₁-C₃ alkyl.

Embodiment 12S. A compound of Embodiment 11S wherein G^A is selected from G^A -1, G^A -2, G^A -3, G^A -7, G^A -8 and G^A -9; and

R^2 is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl, 4-chlorophenyl, 3-fluorophenyl, 3,5-difluorophenyl, 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 12SA. A compound of Embodiment 12S wherein G^A is selected from G^A -2; and

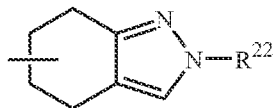
R^2 is phenyl or 2-thienyl.

Embodiment 13S. A compound of Embodiment 11S wherein R^2 is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl.

Embodiment 14S. A compound of Embodiment 11S wherein R^2 is phenyl, 3-bromophenyl, 3-chlorophenyl or 2-methylphenyl.

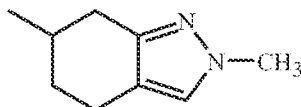
Embodiment 15S. A compound of Embodiment 11S wherein R^2 is 3-thienyl, 2-thienyl or 3-pyridinyl.

Embodiment 16S. A compound of Formula 1S wherein each G^A is



wherein the bond projecting to the left represents the point of attachment to the remainder of the compound of Formula 1S.

Embodiment 17S. A compound of Embodiment 16S wherein each G^A is



wherein the bond projecting to the left represents the point of attachment to the remainder of a compound of Formula 1.

Embodiment 17SA. A compound of Formula 1S or any one of Embodiments 1S through 16S wherein R^{40} is ethyl or *i*-propyl.

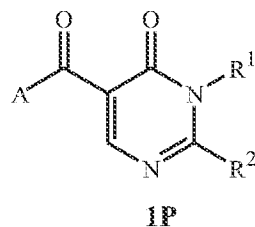
Embodiment 18S. A compound of Formula 1S or any one of Embodiments 1S through 16S wherein R^{41} is ethyl or *i*-propyl.

Embodiment 19S. A compound of Formula 1S or any one of Embodiments 1S through 16S wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$, $-CH_2CH=CHCH_2-$ or $-(CH_2)_2O(CH_2)_2-$.

Embodiment 20S. A compound of Embodiment 19S wherein R^{40} and R^{41} are taken together as $-(CH_2)_5-$ or $-(CH_2)_2O(CH_2)_2-$.

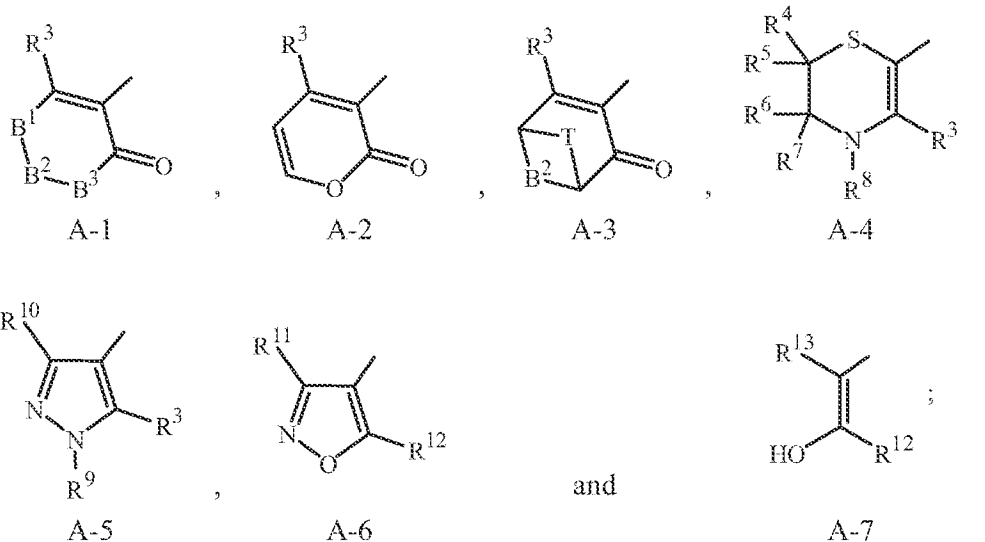
Embodiment 21S. A compound of Embodiment 20S wherein R⁴⁰ and R⁴¹ are taken together as -(CH₂)₂O(CH₂)₂-.

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

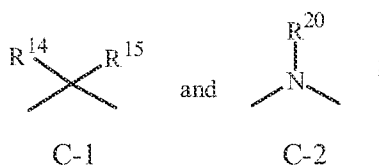


wherein

A is a radical selected from the group consisting of

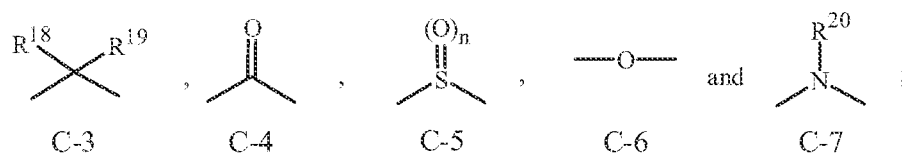


B¹ and B³ are each independently a radical selected from the group consisting of



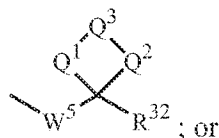
10

B² is a radical selected from the group consisting of



66

R¹ is



R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵, -W¹C(=E³)LR²⁶, -W¹S(O)_xNR²⁸C(=O)R²⁷,
-W¹S(O)_xNR²⁸C(=O)LR²⁷, -W¹S(O)_xNR²⁸SO₂LR²⁷ or -W¹CN; or

5 R¹ is -G^A or -W²G^A;

each G^A is a 4- to 7-membered carbocyclic ring including ring members selected from
C(=O), C(=S), C(=NR²⁹), C(=N-OR³⁰) or C=NN(R²⁹)₂; or a 6- to 12-membered
saturated or partially saturated carbospirocyclic or heterospirocyclic ring system
optionally including ring members selected from C(=O), C(=S), C(=NR²⁹),
10 C(=N-OR³⁰), or C=NN(R²⁹)₂, 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 E¹, E², and E³ is independently O, S, NR²⁸, NOR²⁸, NN(R²⁸)₂, N-CN or N-NO₂;

each L is independently O, NR³¹ or S;

15 provided when E³ is O, L is other than O;

each R²⁴, R²⁵, R²⁶ and R²⁷ is independently hydrogen; or C₁-C₆ alkyl, C₂-C₆ alkenyl,
C₂-C₆ alkynyl or C₃-C₆ cycloalkyl each optionally substituted with one or more
substituents selected from the group consisting of halogen, CN, NO₂, hydroxy,
C₁-C₄ alkoxy, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino,
20 C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino and (C₁-C₄ alkyl)C₃-C₆
cycloalkylamino;

each R²⁸ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;

R²⁹ is independently H, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkylcarbonyl, C₁-C₆
alkylsulfonyl, or C₁-C₆ haloalkylsulfonyl;

25 each Q¹ and Q² is independently O, S or -NR³¹;

Q³ is C₁-C₄ alkylene optionally substituted with up to 4 substituents selected from
C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl and C₃-C₆ cycloalkyl;

R³⁰ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;

R³¹ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;

30 R³² is H or C₁-C₆ alkyl;

each x is 0, 1 or 2;

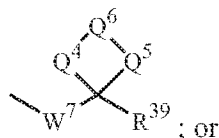
W⁵ is C₁-C₆ alkylene;

W¹ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene; or -(CH₂)₂OCH₂- or
-(CH₂)₃OCH₂-;

35 W² is C₁-C₆ alkylene;

- R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W⁴G; 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-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



- 5 R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴, -W⁶C(=E⁶)L¹R³⁵, -W⁶S(O)_xNR³⁷C(=O)R³⁶
or -W⁶S(O)_xNR³⁷C(=O)L¹R³⁶;
each E⁴, E⁵, and E⁶ is independently O, S, NR³⁷, NOR³⁷, NN(R³⁷)₂, N-CN or N-NO₂;
each L¹ is independently O, NR³⁸ or S;
each R³³, R³⁴, R³⁵ and R³⁶ is independently hydrogen; or C₁-C₆ alkyl, C₂-C₆ alkenyl,
C₂-C₆ alkynyl or C₃-C₆ cycloalkyl each optionally substituted with one or more
10 substituents selected from the group consisting of halogen, CN, NO₂, hydroxy,
C₁-C₄ alkoxy, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino,
C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino and (C₁-C₄ alkyl)C₃-C₆
cycloalkylamino;
each R³⁷ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;
15 each Q⁴ and Q⁵ is independently O, S or NR³⁸;
Q⁶ is C₁-C₄ alkylene optionally substituted with up to 4 substituents selected from
C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl and C₃-C₆ cycloalkyl;
R³⁸ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;
R³⁹ is H or C₁-C₆ alkyl;
20 each x is 0, 1 or 2;
W⁷ is C₁-C₆ alkylene;
W⁶ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene; or -(CH₂)₂OCH₂- or
-(CH₂)₃OCH₂-;
W³ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene;
25 W⁴ is C₁-C₆ alkylene;
R³ 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
30 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
35 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 or C₂-C₈ alkylthioalkyl;

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;

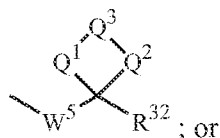
each R²¹ is independently halogen, cyano, hydroxy, amino, nitro, -CHO, -C(=O)OH, -C(=O)NH₂, -C(=S)NH₂, -C(=O)NHCN, -C(=O)NHOH, -SH, -SO₂NH₂, -SO₂NHCN, -SO₂NHOH, -OCN, -SCN, -SF₅, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₈ cycloalkyl, C₃-C₈ 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 R^{22} is independently 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 or C_2 - C_8 alkoxyalkyl.

Embodiments of a compound of Formula **1P** include:

Embodiment PA is A-1, A-3, A-4, A-5 or A-6;

5 R^1 is



R^1 is $-W^1C(=E^1)R^{24}$, $-W^1LC(=E^2)R^{25}$ or $-W^1C(=E^3)LR^{26}$; or

R^1 is G^A or $-W^2G^A$;

10 each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$; or a 9- to 11-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from $C(=O)$, $C(=N-OR^{30})$ or $C=NN(R^{29})_2$, each ring or ring system optionally substituted with up to three substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen ring members;

15 each E^1 , E^2 and E^3 is independently O, NOR^{28} or $NN(R^{28})_2$;

L is independently O or NR^{31} ;

20 each R^{24} , R^{25} and R^{26} is independently hydrogen; or C_1 - C_4 alkyl or C_3 - C_5 cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy, C_1 - C_2 alkoxy, C_1 - C_2 alkylsulfinyl and C_1 - C_4 alkylsulfonyl;

each R^{28} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

R^{29} is independently H, C_1 - C_3 alkyl, C_1 - C_3 haloalkyl, C_1 - C_3 alkylcarbonyl, C_1 - C_3 alkylsulfonyl or C_1 - C_3 haloalkylsulfonyl;

each Q^1 and Q^2 is independently O or $N(R^{31})$;

25 Q^3 is C_2 - C_3 alkylene optionally substituted with up to 2 substituents selected from C_1 - C_4 alkyl;

R^{30} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

R^{31} is independently H, C_1 - C_3 alkyl or C_1 - C_3 haloalkyl;

R^{32} is H or C_1 - C_3 alkyl;

30 W^1 is C_2 - C_4 alkylene, $-(CH_2)_2OCH_2-$ or $-(CH_2)_3OCH_2-$;

W^2 is C_1 - C_3 alkylene

W^5 is C_1 - C_4 alkylene;

35 R^2 is phenyl or $-W^3(\text{phenyl})$, each optionally substituted on ring members with up to five substituents selected from R^{21} ; or $-G$; or 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, 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, C₄-C₁₀ cycloalkoxylalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylcarbonyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, 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 alkoxyalkoxy, C₂-C₈ alkyl(thiocarbonyl)oxy, C₃-C₈ cycloalkylsulfinyl or C₃-C₁₀ halotrialkylsilyl; or
- R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴ or -W⁶C(=E⁶)L¹R³⁵;
 each E⁴, E⁵, and E⁶ is independently O, NOR³⁷ or NN(R³⁷)₂;
 each L¹ is independently O or NR³⁸;
 each R³³, R³⁴ and R³⁵ is independently hydrogen; or C₁-C₄ alkyl, C₃-C₅ cycloalkyl
- each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl, or C₁-C₂ alkylsulfonyl;
- each R³⁷ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
 R³⁸ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- W³ is -CH₂-;
- W⁶ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;
- R³ is 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;

R¹² is H, halogen, cyano, hydroxy, amino or C₁-C₆ alkyl;

5 each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃;

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

R²⁰ is H or CH₃;

T is -CH₂CH₂- or -CH=CH-;

each G is G-1 through G-20 (as depicted in Embodiment 116);

10 r is 0, 1, 2 or 3;

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.

Embodiment PB. A compound of Embodiment PA wherein

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

B¹ is C-1;

B² is C-3;

B³ is C-1;

30 R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl;

R³ is hydroxy or C₂-C₈ alkylcarbonyloxy;

R⁹ is CH₂CH₃;

R¹⁰ is H or CH₃;

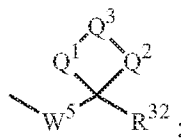
G is G-2, G-3 or G-15; and

35 R²¹ is independently halogen, nitro, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₁-C₆ alkylthio.

Embodiment PC. A compound of Embodiment PB wherein

A is A-1;

R¹ is



each Q¹ and Q² is O;

5 Q³ is C₂-alkylene;

R³² is H or methyl;

W⁵ is C₃-C₄ alkylene;

R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl,
4-chlorophenyl, 3-fluorophenyl 3,5-difluorophenyl, 3-thienyl or 2-thienyl;

10 R³ is hydroxy or -OC(=O)CH₂CH(CH₃)₂;

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃.

Embodiment PD. A compound of Embodiment B wherein

A is A-1;

R¹ is -W¹C(=E¹)R²⁴;

15 E¹ is NOR²⁸;

R²⁸ is H or methyl;

R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl,
4-chlorophenyl, 3-fluorophenyl 3,5-difluorophenyl, 3-thienyl 2-thienyl or
2-pyridinyl;

20 R³ is hydroxy or -OC(=O)CH₂CH(CH₃)₂; and

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H.

Embodiment PE. A compound of Embodiment PB wherein

A is A-1;

R¹ is -G^A;

25 each G^A is a 5- to 6-membered carbocyclic ring including ring members selected from
C(=O) or C(=N-OR³⁰); or a 9- to 10-membered saturated heterospirocyclic ring
system optionally including ring members selected from C(=O) or C(=N-OR³⁰),
each ring or ring system optionally substituted with up to two substituents
selected from R²¹ on carbon ring members and R²² on nitrogen ring members;

30 R³⁰ is R³⁰ is H or methyl;

R²¹ halogen or C₁-C₃ alkyl;

R²² is C₁-C₃ alkyl;

Embodiment PF. A compound of Embodiment PE wherein G^A is selected from G^A-1,
G^A-2, G^A-3, G^A-7, G^A-8 and G^A-9.

R² is phenyl, 2-methylphenyl, 3-methylphenyl, 4-chlorophenyl, 3-fluorophenyl or 3,5-difluorophenyl;

R³ is hydroxy; and

each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H.

5 Specific embodiments include a compound of Formula **1P** selected from:

3-(1,4-Dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-phenyl-4(3*H*)-pyrimidinone (Compound 1) and

5-[(2-Hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-6-oxo-2-phenyl-1(6*H*)-pyrimidineacetaldehyde 1-(*O*-methyloxime) (Compound 2).

10 This invention also relates to a method for controlling undesired vegetation comprising 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.

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

“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
30 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,
35 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, metamilon, 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, thiencazone, flucarbazone-sodium and propoxycarbazine-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 clodinafop, cyhalofop, diclofop, fenoxaprop, fluazifop, haloxyfop, propaquizafop, quizalofop, alloxymid, butoxydim, clethodim, cycloxydim, pinoxaden, profoxydim, setoxydim, tepraloxymid and tralkoxydim, including resolved forms such as fenoxaprop-P, fluazifop-P, haloxyfop-P and quizalofop-P and ester forms such as clodinafop-propargyl, cyhalofop-butyl, diclofop-methyl and fenoxaprop-P-ethyl.

Auxin is a plant hormone that regulates growth in many plant tissues. “Auxin mimics” (b4) are chemical compounds mimicking the plant growth hormone auxin, thus causing

uncontrolled and disorganized growth leading to plant death in susceptible species. Examples of auxin mimics include but are not limited to aminocyclopyrachlor, aminopyralid benazolin-ethyl, chloramben, clomeprop, clopyralid, dicamba, 2,4-D, 2,4-DB, dichlorprop, fluroxypyr, mecoprop, MCPA, MCPB, 2,3,6-TBA, picloram, triclopyr, quinclorac and quinmerac.

“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 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.

“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, chlomethoxyfen, fluoroglycofen-ethyl, fomesafen, halosafen, lactofen, oxyfluorfen, fluazolate, pyraflufen-ethyl, cinidon-ethyl, flumioxazin, flumiclorac-pentyl, fluthiacet-methyl, thidiazimin, oxadiazon, oxadiargyl, saflufencil, azafenidin, carfentrazone, carfentrazone-ethyl, sulfentrazone, pentoxazone, benzfendizone, butafenacil, pyraclonil, proflumazone 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

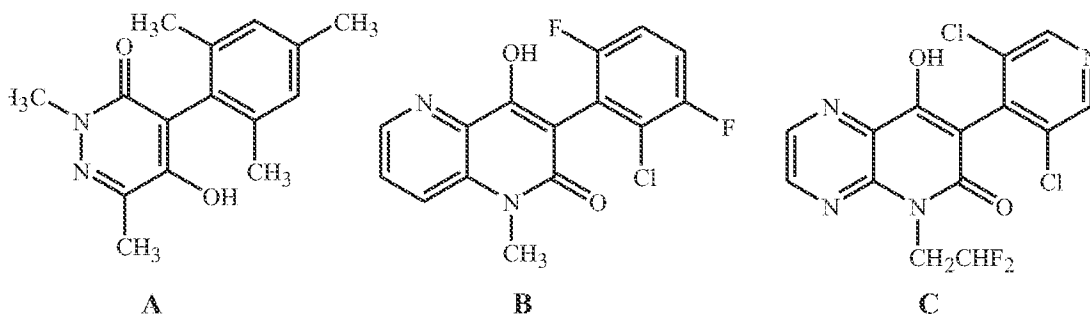
plants, very-long-chain fatty acids are the main constituents of hydrophobic polymers that prevent desiccation at the leaf surface and provide stability to pollen grains. Such herbicides include acetochlor, alachlor, butachlor, dimethachlor, dimethanamid, metazachlor, metolachlor, pethoxamid, pretilachlor, propachlor, propisochlor, pyroxasulfone, thenylchlor, 5 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 10 inhibitors include but are not limited to naptalam (also known as *N*-(1-naphthyl)phthalamic acid and 2-[(1-naphthalenylamino)carbonyl]benzoic acid) and diflufenzopyr.

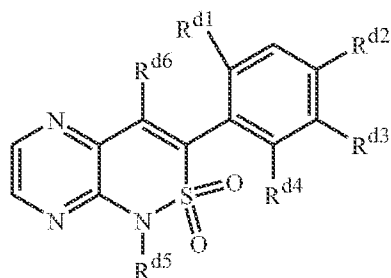
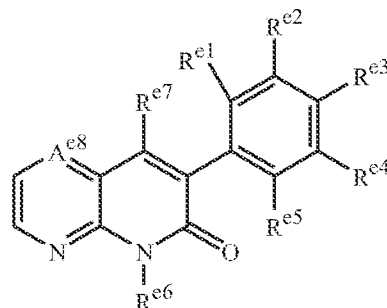
“PDS (phytoene desaturase inhibitors) (b11) are chemical compounds that inhibit carotenoid biosynthesis pathway at the phytoene desaturase step. Examples of PDS 15 inhibitors include norflurzon, diflufenican, picolinafen, beflubutamide, fluridone, flurochloridone and flurtamone.

“HPPD (4-hydroxyphenyl-pyruvate-dioxygenase) inhibitors” (b12) are chemical substances that inhibit the biosynthesis of synthesis of 4-hydroxy-phenyl-pyruvate-dioxygenase. Examples of HPPD inhibitors include, but are not limited to 20 mesotrione, sulcotrione, topramezone, tefuryltrione, tembotrione, isoxachlortole, isoxaflutole, benzofenap, pyrasulfatole, pyrazolynate, pyrazoxyfen, bicyclopyrone and benzobicyclon.

“HST” (homogentisate solenesyltransferase) inhibitors (b13) disrupt a plant’s ability to convert homogentisate to 2-methyl-6-solanil-1,4-benzoquinone, thereby disrupting 25 carotenoid biosynthesis. Examples of HST inhibitors include haloxydine, pyriclor and the compounds of Formulae A, B and C



HST inhibitors also include the compounds of Formulae D and E

**D****E**

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 $-OC(=O)-i\text{-Pr}$; 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, $-OC(=O)Et$, $-OC(=O)-i\text{-Pr}$ or $-OC(=O)-t\text{-Bu}$; and A^{e8} is N or CH.

Other herbicides (b14) 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 (b12) 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.

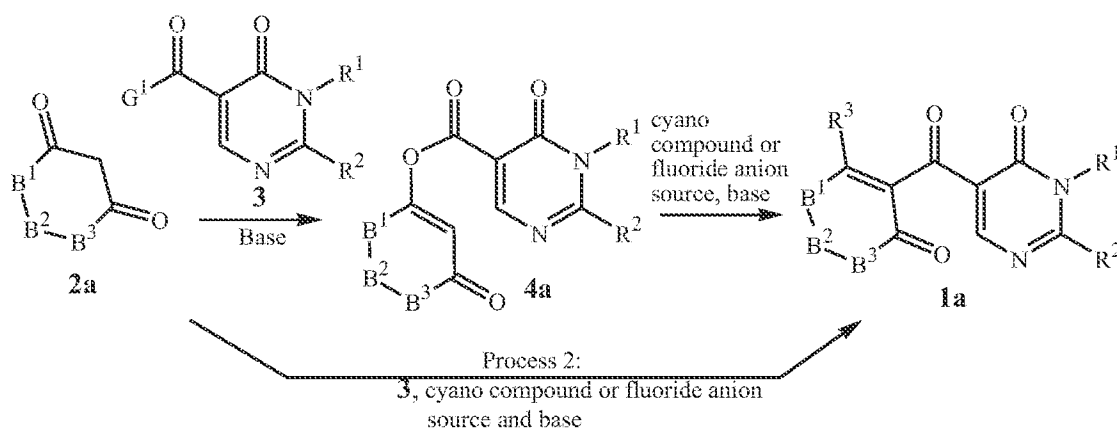
"Herbicide safeners" (b15) are substances added to a herbicide formulation to eliminate or reduce phytotoxic effects of the herbicide to certain crops. These compounds protect crops from injury by herbicides but typically do not prevent the herbicide from controlling undesired vegetation. Examples of herbicide safeners include but are not limited to allidochlor, benoxacor, 1-bromo-4-[(chloromethyl)sulfonyl]benzene, cloquintocet-mexyl, cumyluron, cyometrinil, cyprosulfamide, daimuron, dichlormid, dicyclonon, 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), dimepiperate, fenclorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone, naphthalic anhydride and oxabetrinil.

One or more of the following methods and variations as described in Schemes 1-18 can be used to prepare the compounds of Formula 1. The definitions of A, B¹, B², B³, R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹² and R¹³ in the compounds of Formulae 1-34 below are as defined above in the Summary of the Invention unless otherwise noted. Compounds

of Formulae **1a-1h** are various subsets of the compounds of Formula **1**, and all substituents for Formulae **1a-1h** are as defined above for Formula **1**.

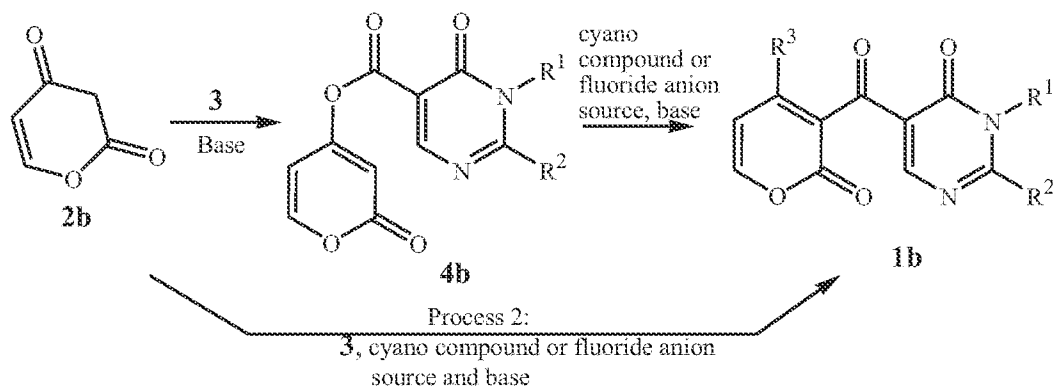
Compounds of Formula **1a**, **1b** or **1c** (where R^3 is hydroxy) can be prepared via the two-step process shown in Schemes 1a, 1b and 1c respectively. Intermediate **4a**, **4b** or **4c** can be prepared by reacting dione **2** with intermediate **3** where G^1 is a nucleophilic reaction leaving group (e.g., G^1 is a halogen, alkoxy, haloalkyl, haloalkoxy, pyridinyl or imidazolyl group). Reaction of intermediate **4a**, **4b** or **4c** with the appropriate cyano compound (e.g., acetone cyanohydrin, potassium cyanide, sodium cyanide) in the presence of a base such as triethylamine or pyridine leads to a compound of Formula **1a**, **1b** or **1c**. Alternatively a fluoride anion source such as potassium fluoride or cesium fluoride and optionally in the presence of a phase transfer catalyst (e.g. tetrabutyl ammonium bromide, etc.) can be used in this transformation. A solvent such as dimethylsulfoxide, *N,N*-dimethylformamide, acetonitrile or dichloromethane at ambient temperature to the reflux temperature of the solvent can lead to a compound of Formula **1a**, **1b** or **1c**. (Formula **1a** is Formula **1** wherein A is A-1; Formula **1b** is Formula **1** wherein A is A-2; Formula **1c** is Formula **1** wherein A is A-3.) Alternatively, compounds of Formula **1a**, **1b** or **1c** can be prepared by Process 2 (in Schemes 1a, 1b and 1c respectively) by reacting dione **2a**, **2b** or **2c** with intermediate **3** in the presence of a cyano compound or a fluoride anion source along with a base. For additional 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 1a

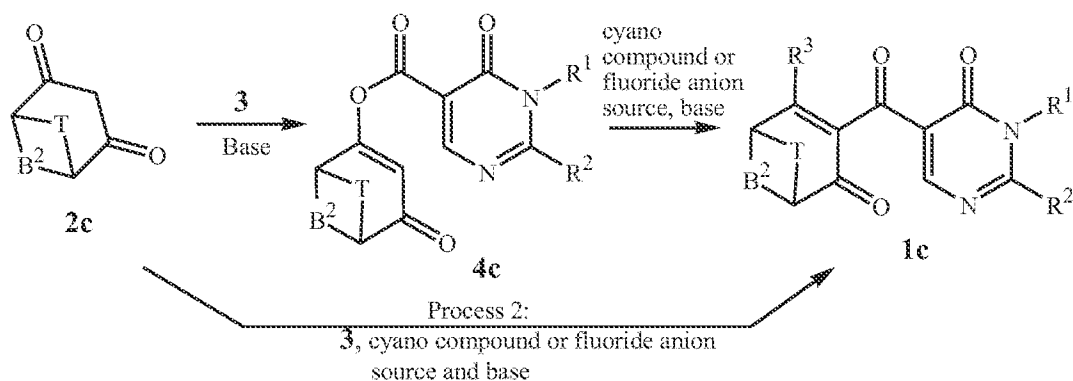


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Scheme 1b



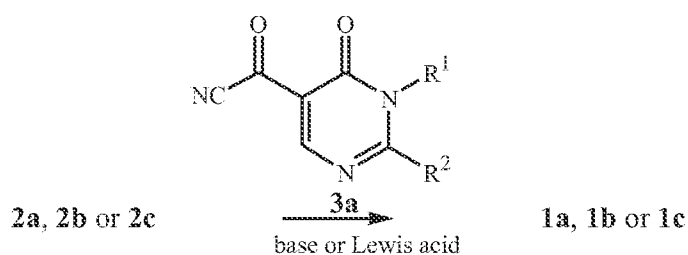
Scheme 1c



5 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** 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.

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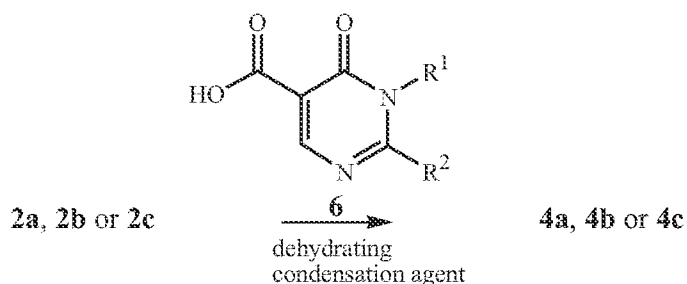
Scheme 2



As shown in Scheme 3, intermediate **4a**, **4b** or **4c** can also be prepared by allowing dione **2a**, **2b** or **2c** to react with acid **6** in the presence of a dehydrating condensation agent such as 2-chloro-1-pyridinium iodide (known as the Mukaiyama coupling agent),
 15 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.

Scheme 3

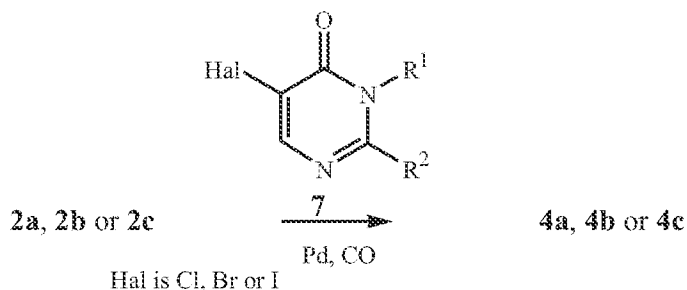


5

Intermediate **4a**, **4b** or **4c** can also be made by the palladium-catalyzed carbonylation reaction of a compound of Formula **7** in the presence of dione **2a**, **2b** or **2c** (Scheme 4). 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.

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Scheme 4

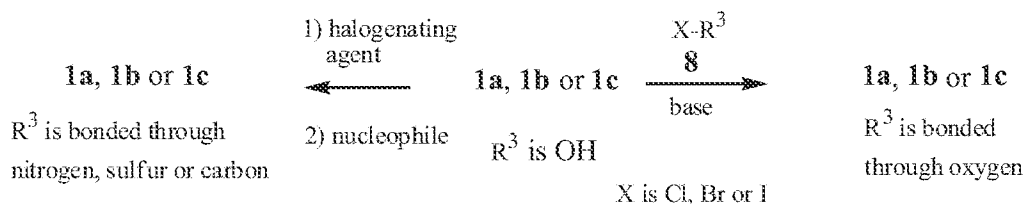


Compounds of Formula **1a**, **1b** or **1c** (where R^3 is bonded through oxygen) are prepared by reacting compounds of Formula **1a**, **1b** or **1c** with intermediate **8** where X is a nucleophilic reaction leaving group, also known as a nucleofuge in the presence of a base as shown in Scheme 5. Alternatively, compounds of Formula **1a**, **1b** and **1c** (where R^3 is bonded through nitrogen, sulfur or carbon) can be prepared using the appropriate halogenating agent followed by nucleophilic addition. For reaction conditions for this general functionalization method, see Edmunds, A. or Almisick A. V. 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.

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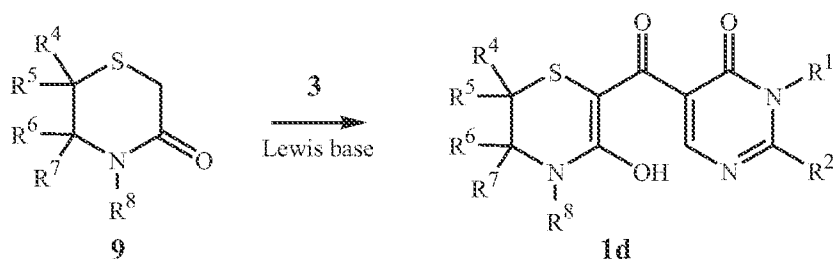
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Scheme 5



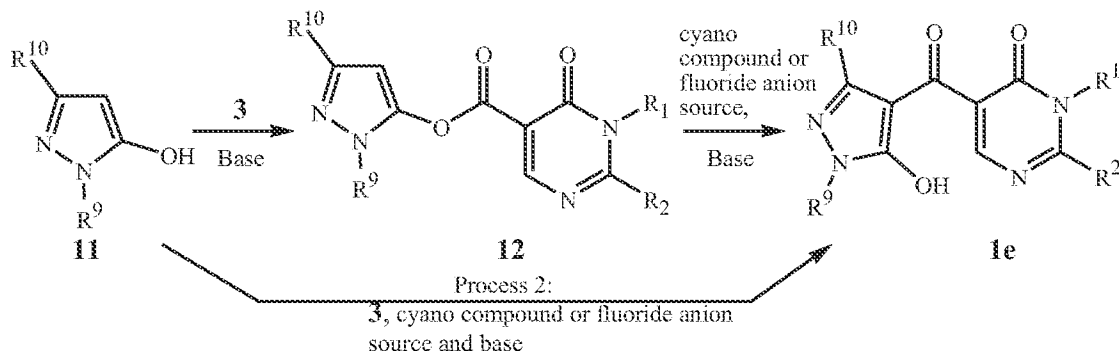
As shown in Scheme 6, compounds of Formula **1d** (i.e. Formula **1** wherein A is A-4 and R³ is OH) can be prepared by the reaction of intermediate **9** with intermediate **3** in the presence of a Lewis base, for example *n*-butyllithium or lithium diisopropylamide in an appropriate solvent such as tetrahydrofuran or diethyl ether. For reaction conditions for this type of transformation, see JP 2003327580.

Scheme 6



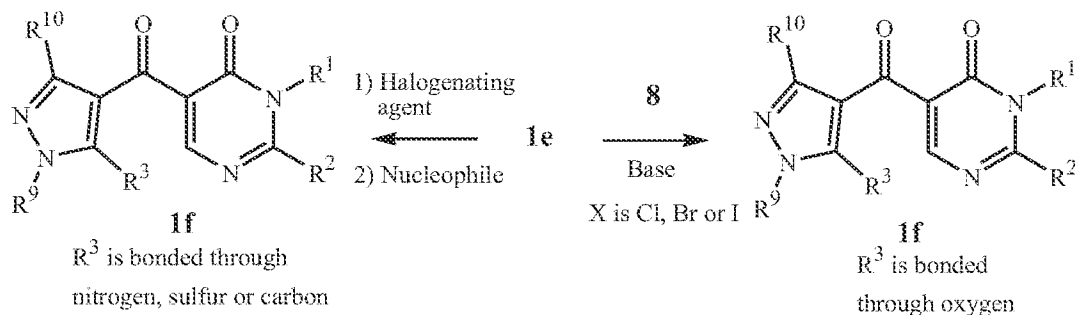
Compounds of Formula **1e** (i.e. Formula **1** wherein A is A-5 and R³ is OH) can be prepared via a two-step process as shown in Scheme 7. Intermediate **12** can be prepared by reacting pyrazole **11** with intermediate **3** where G¹ is a nucleophilic reaction leaving group (i.e. G¹ is a halogen atom, alkoxy carbonyl, haloalkylcarbonyloxy, benzoyloxy, pyridinyl or imidazolyl group). Reaction of intermediate **12** with the appropriate cyano compound in the presence of a base leads to a compound of Formula **1e**. Alternatively, a compound of Formula **1e** can be prepared directly by reacting intermediate **11** with intermediate **3** (Process 2, Scheme 7) in the presence of a cyano compound or a fluoride anion source with a base. For reaction conditions for this general coupling methodology, see Almisick A. V. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

Scheme 7



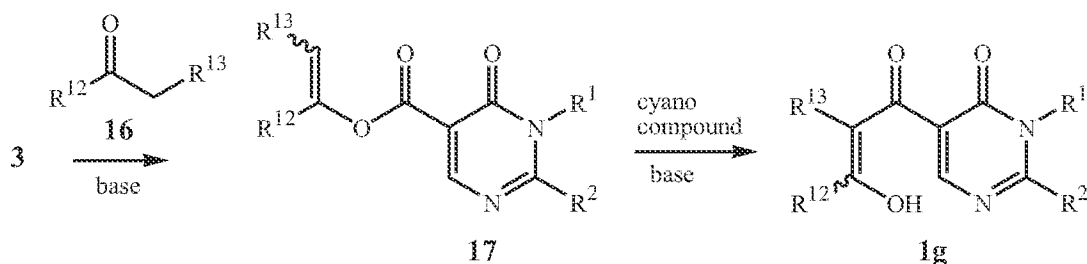
Compounds of Formula 1f (i.e. Formula 1 wherein A is A-5) wherein R³ is bonded through oxygen can be prepared by reacting a compound of Formula 1e with intermediate 8 (where X is a nucleophilic reaction leaving group, also known as a nucleofuge) in the presence of a base as shown in Scheme 8. Alternatively compounds of Formula 1f wherein R³ is bonded through nitrogen, sulfur or carbon can be prepared using the appropriate halogenating agent followed by nucleophilic displacement. For reaction conditions for these general functionalization methods, see Almisick A. V. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

Scheme 8



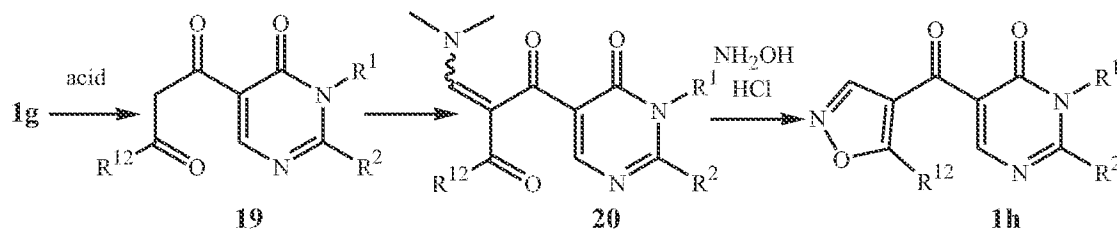
Compounds of Formula 17 can be prepared by reacting intermediate 3 with a compound Formula 16 in an appropriate solvent in the presence of a base. Thereafter intermediate 17 can be rearranged into the compound of Formula 1g (i.e. Formula 1 wherein A is A-7) in the presence of a cyano compound and a base as shown in Scheme 9. For reaction conditions for this general coupling methodology, see Almisick A. V. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

Scheme 9



Compounds of Formula **19** can be prepared from corresponding compounds of Formula **1g** wherein R^{13} is an alkoxy carbonyl in the presence of an acid such as hydrogen chloride, sulfuric or acetic acid and optionally in the presence of a solvent such as tetrahydrofuran, diethyl ether or dichloromethane as shown in Scheme 10. Intermediate **19** is then reacted with an orthoformate ester or *N,N*-dimethylformamide dimethylacetal (DMF-DMA) in the presence of an acid to obtain intermediate **20**. Reaction of intermediate **20** with hydroxylamine hydrochloride salt in a solvent such as ethanol, acetonitrile, water or acetic acid provides isoxazole compounds of Formula **1h** (i.e. Formula **1** wherein A is A-6 and R^{11} is H). For reaction conditions for this general cyclization methodology, see Almisick A. V. in *Modern Crop Protection Compounds*; Kramer, W. and Schirmer, U., Eds.; Wiley, Weinheim, 2007; Chapter 4.4, and references cited therein.

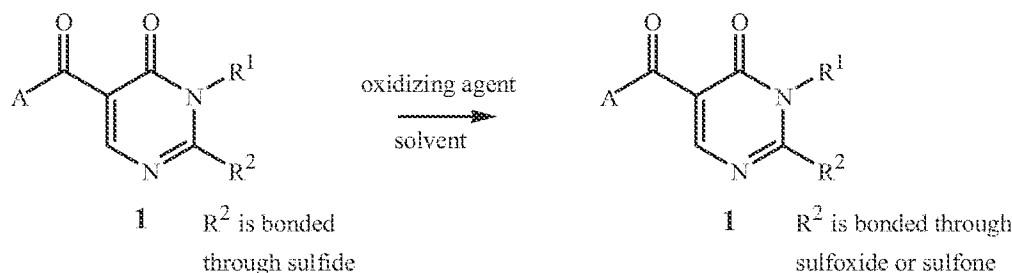
Scheme 10



As illustrated in Scheme 11, sulfoxides and sulfones of Formula **1** wherein R^2 is a substituent bonded through a sulfoxide or sulfone radical can be prepared by oxidation of the compounds of Formula **1** wherein R^2 is a substituent bonded through a sulfide radical. In a typical procedure, an oxidizing agent in an amount from 1 to 4 equivalents depending on the oxidation state of the product desired is added to a solution of the compound of Formula **1** in a solvent. Useful oxidizing agents include Oxone[®] (potassium peroxymonosulfate), hydrogen peroxide, sodium periodate, peracetic acid and 3-chloroperbenzoic acid. The solvent is selected with regard to the oxidizing agent employed. Aqueous ethanol or aqueous acetone is preferably used with potassium peroxymonosulfate, and dichloromethane is generally preferable with 3-chloroperbenzoic acid. Useful reaction temperatures typically range from 0 to 90 °C. Particular procedures useful for oxidizing sulfides to sulfoxides and

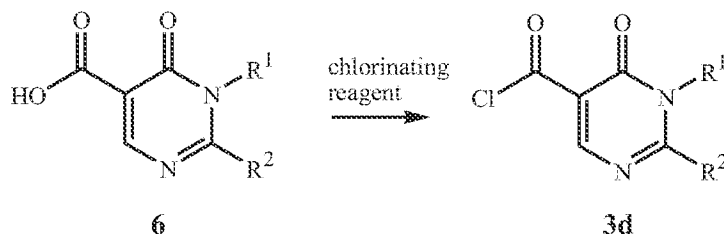
sulfones are described by Brand et al., *J. Agric. Food Chem.* **1984**, 32, 221-226 and references cited therein.

Scheme 11



One skilled in the art will realize that acid chlorides of Formula 3d (i.e. Formula 3 wherein G¹ is Cl) are easily prepared from the acid of Formula 6 (Scheme 12) by numerous well-known methods. For example reacting the acid with a chlorinating reagent such as oxalyl chloride or thionyl chloride in a solvent such as dichloromethane or toluene and optionally in the presence of a catalytic amount of *N,N*-dimethylformamide can provide the corresponding acid chloride of Formula 3d.

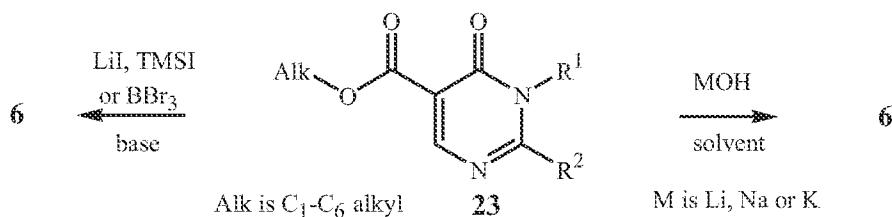
Scheme 12



Compounds of Formula 6 can be prepared from esters of Formula 23 by numerous well-known methods, for example standard saponification procedures using aqueous bases such as LiOH, NaOH or KOH in a solvent such methanol or ethanol as described in Scheme 13. 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. Additional reaction procedures for deesterification can be found in PCT Patent Publication WO 2006/133242. Boron tribromide (BBr₃) can alternatively be used to to prepare a compound of Formula 6 from a compound of Formula 23 in a solovent such as dichloromethane. Procedures using boron tribromide can be found in *Bioorg. & Med. Chem. Lett.* **2009**, 19(16), 4733-4739.

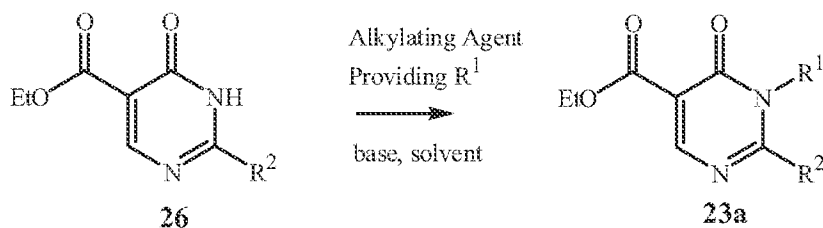
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Scheme 13



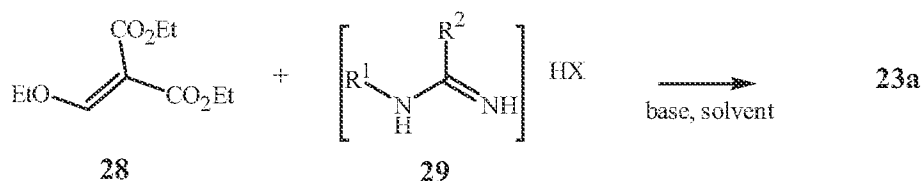
Pyrimidinone esters of Formula **23a** (i.e. Formula **23** wherein Alk is ethyl, X is CH and Y is C(O)) are prepared as illustrated in Scheme 14 by *N*-alkylation of pyridones of Formula **26** with agents such as alkyl halides in the presence of a base such as sodium hydride or potassium carbonate in a solvent such as *N,N*-dimethylformamide, tetrahydrofuran or diethyl ether.

Scheme 14



Pyrimidinone esters of Formula **23a** can be made by the method of Scheme 15. In this method an methylene malonate of Formula **28** is cyclized with an amidine salt of Formula **29** wherein X is a halogen or sulfonate counter ion in the presence of excess base such as sodium alkoxide or potassium carbonate in an appropriate solvent such as ethanol (generally at the reflux temperature of the solvent) to give the corresponding pyrimidinone of Formula **3f**. Examples of this synthetic method are reported in PCT Patent Publication WO 2006/133242 and *Tetrahedron* **2001**, 57, 2689.

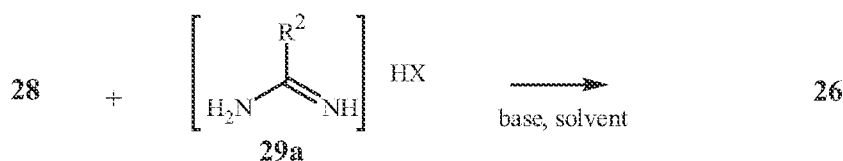
Scheme 15



Pyrimidinone esters of Formula **26** can be prepared by the method of Scheme 16. In this method, an ethylene malonate of Formula **28** is cyclized with an amidine salt Formula **29a** wherein X is a halogen or sulfonate counter ion in the presence of excess base such as sodium alkoxide or potassium carbonate in an appropriate solvent such as methanol

(generally at the reflux temperature of the solvent) to give the corresponding pyrimidinone of Formula **26**. Examples of this synthetic procedure are reported in PCT Patent Publication WO 2006/133242 and *Tetrahedron* **2001**, 57, 2689.

Scheme 16



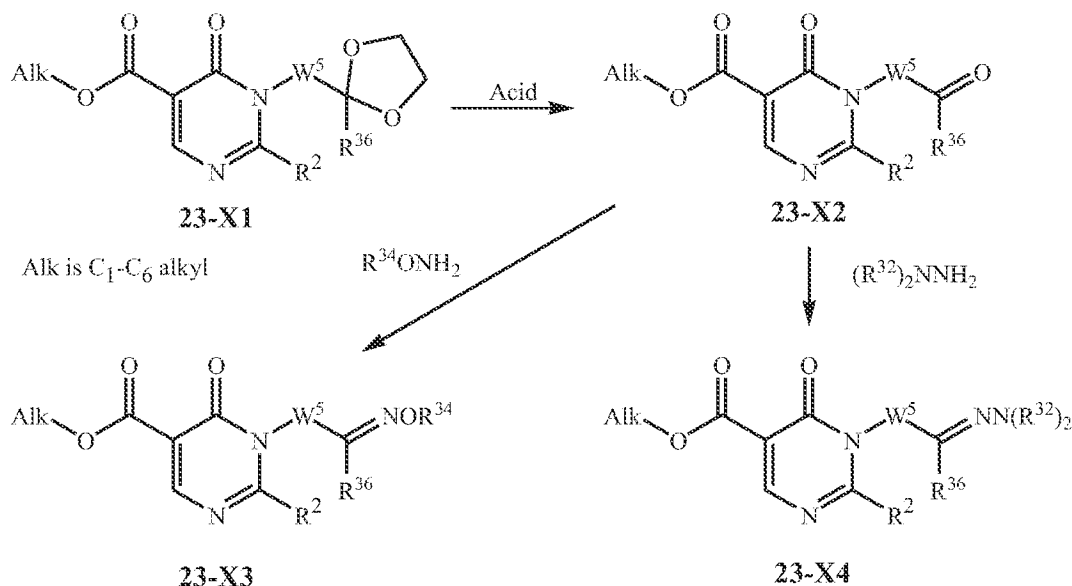
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Pyrimidinone esters of Formula **23-X1** can be transformed to pyrimidinone esters of Formula **23-X3** and **23-X4** by the method of Scheme 17. In this method **23-X1** is contacted with an acid such as HCl or H₂SO₄ in an aprotic solvent such as dioxane, or a protic solvent such as methanol or ethanol at a temperature between 0° C and the boiling point of that solvent to yield aldehydes or ketones of Formula **23-X2**. Subsequently, or concurrently, aldehydes or ketones of Formula **23-X2** can be reacted with substituted hydroxylamines or hydrazines in the presence of an acid catalyst such as HCl or H₂SO₄ in an aprotic solvent such as dioxane, or a protic solvent such as methanol or ethanol at a temperature between 0° C and the boiling point of that solvent to yield compounds of Formula **23-X3** and **23-X4** which can be further reacted by methods described in Schemes 1 - 16. One skilled in the art will recognize that aldehydes and ketones of Figure **23-X2** can be further converted to many other functionalities by a myriad of methods known in the chemical literature.

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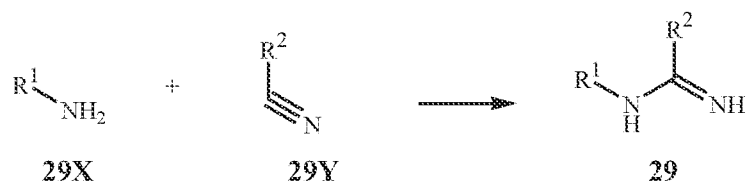
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Scheme 17



Amidines of Formula **29** can be prepared from amines of Formula **29X** and nitriles of Formula **29Y** according to many methods, including, but not limited to, those described in: European Patent Application EP 80592; *J. Org. Chem.* **2010**, 75, 945-947; *Chemistry - A European Journal* **2009**, 15, 7292-7296; *Organic Process Research & Development* **2008**, 12, 1201-1208; *Org. Lett.*, **2008**, 10, 445-448.

Scheme 18



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 Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Steps in the following Examples illustrate a procedure for each step in an overall synthetic transformation, and the starting material for each step may not have necessarily been prepared by a particular preparative run whose procedure is described in other Examples or Steps. Percentages are by weight except for chromatographic solvent mixtures or where otherwise indicated. Parts and percentages for chromatographic solvent mixtures are by volume unless otherwise indicated. ¹H NMR spectra are reported in CDCl₃

in ppm downfield from tetramethylsilane at 400 MHz unless otherwise noted; "s" means singlet, "m" means multiplet, "br s" means broad singlet, "d" means doublet, "dd" means doublet of doublets, "t" means triplet, "td" means triplet of doublets, "dt" means doublet of triplets and "q" means quartet.

EXAMPLE 1

Preparation of

3-(1,4-Dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-phenyl-4
(3*H*)-pyrimidinone (Compound 1)

Step A: Preparation of
1-(1,4-dioxaspiro[4.5]dec-8-yl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid methyl ester

To ethylbenzimidate hydrochloride (1.1 g, 5.9 mmol) dissolved in 15 ml of methanol was added 1,4-dioxaspiro[4.5]dec-8-ylamine (1.0 g, 6.8 mmol). The mixture was stirred at ambient temperature for 16 h, after which time a 25% w/w solution of sodium methoxide (1.3 g, 6.1 mmol) was then added, and stirring was continued for 20 minutes. The mixture was concentrated to dryness, and the residual *N*-1,4-dioxaspiro[4.5]dec-8-ylbenzenecarboximidamide hydrochloride was suspended in 20 ml acetonitrile and treated with dimethyl methoxymethylenemalonate (1.13 g, 6.5 mmol), followed by DBU (0.9 g, 5.9 mmol). The reaction mixture was refluxed for 16 h and then concentrated under reduced pressure, and purified by medium pressure liquid chromatography on silica gel eluting with 30%-100% ethyl acetate in hexanes to provide 1.2 g of the title compound as an oil.

¹H NMR (CDCl₃) δ 8.61 (d, 1H), 7.49–7.61 (m, 3 H), 7.42–7.48 (m, 2H), 3.98–4.08 (m, 1H), 3.86–3.94 (m, 7H), 3.09 (m, 2H), 1.76 (d, 2H), 1.64 (d, 2H), 1.27–1.34 (m, 2H).

Step B: Preparation of 1-(1,4-Dioxaspiro[4.5]dec-8-yl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid

To a solution of 1-(1,4-dioxaspiro[4.5]dec-8-yl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid methyl ester (the product of Example 1, Step A) (0.40 g, 1.1 mmol) in 10 ml of ethyl acetate was added lithium iodide (0.43 g, 3.2 mmol). The reaction mixture was refluxed for 16 h and then cooled to ambient temperature and diluted with water. The mixture was made acidic with 1N HCl and extracted three times with ethyl acetate. The combined organic layers were then extracted with 1N NaOH. The resulting aqueous layer was made acidic with concentrated HCl and extracted three times with dichloromethane. The combined organic layers were then dried with MgSO₄, filtered and concentrated under reduced pressure to yield 0.39 g of the title compound as a solid.

¹H NMR (CDCl₃) δ 8.95 (s, 1H), 7.59 (m, 3H), 7.51 (s, 2H), 4.19 (m, 1H), 3.99 (s, 2H), 3.92 (s, 2H), 3.06 (m, 2H), 1.82 (d, 2H), 1.73 (d, 2H), 1.34 (m, 2H).

Step C: Preparation of 3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[2-hydroxy-6-oxo-1-cyclohexen-1-yl]carbonyl]-2-phenyl-4(3H)-pyrimidinone (Compound 1)

A solution of 1-(1,4-Dioxaspiro[4.5]dec-8-yl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid (the product of Example 1, Step B) (0.39 g, 1.1 mmol) in 10 ml dichloromethane was treated with oxalyl chloride (196 μ l, 2.3 mmol) and 1 drop of *N,N*-dimethylformamide. The reaction was stirred for 1 h then concentrated and redissolved in 10 ml dichloromethane. 1,3-cyclohexanedione (0.14 g, 1.2 mmol) and triethylamine (310 μ l, 2.2 mmol) were added and the reaction mixture was stirred at ambient temperature for 20 min and then treated with additional triethylamine (310 μ l, 2.2 mmol) followed by 2 drops acetone cyanohydrin. The reaction mixture was stirred at ambient temperature for 16 h and then concentrated under reduced pressure and purified by medium pressure liquid chromatography on silica gel eluting with 0% - 3% methanol in chloroform to yield 0.060 g of the title compound, a compound of the present invention.

^1H NMR (CDCl_3) δ 16.58 (s, 1H), 7.98 (s, 1H), 7.50 (m, 5H), 3.99 (s, 1H), 3.89 (m, 4H), 2.95 (d, 2H), 2.72 (t, 2H), 2.50 (m, 2H), 2.08 (m, 2H), 1.72 (m, 4H), 1.29 (m, 2H).

EXAMPLE 2

Preparation of 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-6-oxo-2-phenyl-1(6H)-pyrimidineacetaldehyde 1-(*O*-methyloxime) (Compound 2)

Step A: Preparation of *N*-(2,2-dimethoxyethyl)benzenecarboximidamide

Sodium methoxide (0.75 g, 14.56 mmol) was added portionwise to a stirred solution of benzonitrile (15.0 g, 145.6 mmol) in MeOH (150 mL) under nitrogen atmosphere at room temperature and stirred for 12 h. Acetic acid (0.5 mL) was added, the resulting mixture stirred for 20 minutes, followed by the addition of 2,2-dimethoxyethylamine (18.34 g, 174.75 mmol). The reaction mixture was stirred overnight, concentrated under reduced pressure, the residue dissolved in methylene chloride and washed with water. The organic layer was dried and concentrated under reduced pressure to afford the title compound as a white solid (15.5 g).

^1H NMR (CDCl_3) δ 7.49–7.61 (m, 5H), 4.64 (m, 1H), 3.55 (m, 2H), 3.44 (s, 6H).

Step B: Preparation of Methyl 1-(2,2-dimethoxyethyl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylate

To a stirred solution of *N*-(2,2-Dimethoxyethyl)benzenecarboximidamide (15 g, 72.1 mmol) in acetonitrile (150 mL) was added dimethyl methoxymethylenemalonate (13.8 g, 79.3 mmol) followed by DBU (3.28 g, 21.6 mmol). The reaction mixture heated it at 120 °C for 6 h, cooled to room temperature and concentrated under reduced pressure. The residue was purified by column chromatography (60% ethyl acetate in hexane) to afford the title product (6 g).

^1H NMR (CDCl_3) δ 8.73 (s, 1H), 7.49–7.57 (m, 5H), 4.87 (m, 1H), 4.16 (m, 2H), 3.94 (s, 3H), 3.31 (s, 6H).

Step C: Preparation of 1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid methyl ester

5 To a stirred solution of methyl 1-(2,2-dimethoxyethyl)-1,6-dihydro-6-oxo-2-phenyl-5-pyrimidinecarboxylate (3.5 g, 11.0 mmol) in ethanol (10 mL), added catalytic amount of *p*-toluenesulfonic acid and *O*-methylhydroxylamine hydrochloride (2.0 g, 24.2 mmol). The reaction mixture was warmed to reflux for 4 h then concentrated under reduced pressure. The residue was dissolved in dichloromethane (100 mL) and washed with

10 saturated sodium bicarbonate solution (20 mL). The organic layer was dried (MgSO_4) and concentrated under reduced pressure and the residue was purified by column chromatography (100% of ethyl acetate in hexane to afford the title product (1.0 g)

^1H NMR (CDCl_3) δ 8.65 (s, 1H), 7.40–7.51 (m, 5H), 6.72 (m, 1H), 4.73 (m, 1H), 4.61 (m, 1H), 3.86 (s, 3H), 3.72 (s, 3H).

15 Step D: Preparation of 1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid

To a stirred solution of 1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid methyl ester (0.8 g, 2.6 mmol) in ethyl acetate (10 mL) was added lithium iodide (0.88 g, 6.6 mmol). The reaction mixture was warmed to

20 reflux and stirred for 4 h. The reaction mixture was concentrated and the residue was dissolved in water and added 1N hydrochloric acid until the pH = 4 then extracted with dichloromethane (100 mL). The organic layer was dried (MgSO_4) and concentrated under reduced pressure to afford the title compound as a white solid (0.7 g).

^1H NMR (CDCl_3) δ 8.93 (s, 1H), 7.45–7.55 (m, 5H), 6.72 (m, 1H), 4.84 (m, 1H), 4.22 (m, 25 1H), 3.68 (s, 3H).

Step E: Preparation of 3-oxo-1-cyclohexen-1-yl
1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-
2-phenyl-5-pyrimidinecarboxylate

To a stirred solution of 1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-2-phenyl-5-pyrimidinecarboxylic acid (0.25 g, 0.87 mmol) in dichloromethane (10 mL) was

30 added *N*-methyl 2-chloropyridinium iodide (0.33 g, 1.3 mmol) and the resulting mixture stirred for 15 min. at room temperature. Cyclohexanedione (0.14 g, 1.3 mmol) followed by triethylamine (0.21 g, 2.17 mmol) were added and the reaction mixture stirred for 12 h at room temperature. The reaction mixture was diluted with dichloromethane (30 mL) and

35 washed with ice water (20 mL), dichloromethane layer was separated and washed with brine (20 mL), dried over (MgSO_4) and concentrated under reduced pressure and the residue was

purified by column chromatography (75% ethyl acetate in hexane) to afford the title compound (0.2 g). LCMS: 382 (M+1).

Step F: Preparation 5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-6-oxo-2-phenyl-1(6*H*)-pyrimidineacetaldehyde 1-(*O*-methyloxime)

5 To a stirred solution of 3-oxo-1-cyclohexen-1-yl 1,6-dihydro-1-[2-(methoxyimino)ethyl]-6-oxo-2-phenyl-5-pyrimidinecarboxylate (0.2 g, 0.52 mmol) in acetonitrile (5 mL) added triethylamine (0.07 g, 0.78 mmol), followed by acetone cyanohydrin (3 drops, cat) and stirred for 6 h at room temperature. Reaction mixture was concentrated under reduced pressure and the residue diluted with methylene chloride (30 mL) and washed with water (20 mL). The dichloromethane layer was dried over (MgSO₄) and concentrated under reduced pressure and the residue was purified by column chromatography (100% of ethyl acetate in hexanes to afford the title compound (20 mg)).
 10 ¹H NMR (CDCl₃) δ 8.93 (s, 1H), 7.45–7.59 (m, 5H), 6.68 (m, 1H), 4.70 (m, 1H), 4.57 (m, 1H), 3.68 (s, 3H), 2.96 (m, 2H), 2.49 (m, 2H), 0.94 (m, 2H).

15 EXAMPLE 3

Preparation of 2-cyclopropyl-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-3-(4-morpholinyl)-4(3*H*)-pyrimidinone (Compound 22)

Step A: Preparation of methyl 2-cyclopropyl-1,6-dihydro-1-(4-morpholinyl)-6-oxo-5-pyrimidinecarboxylate

20 *N*-aminomorpholine (1.37 g, 13.4 mmol) was added to a solution of ethyl cyclopropylimidate hydrochloride salt (2.0 g, 13.4 mmol) in methanol (19 mL), which was then stirred at room temperature for 16 h. Sodium methoxide solution (25% w/w in methanol, 3.18 g, 14.7 mmol) was added and the solution was stirred for 30 min. The solution was concentrated *in vacuo* and dissolved in acetonitrile (20 mL). Dimethyl methoxymethylenemalonate (2.56 g, 14.7 mmol) and 1,8-diazabicyclo[5.4.0]undec-7-ene (0.83 g, 5.3 mmol) were added and the mixture was heated to reflux for 4 h before being concentrated under reduced pressure and purified by medium pressure liquid chromatography on silica gel eluting with 0 to 100% ethyl acetate in hexanes to provide 1.14 g of the title compound as a yellow oil.

30 ¹H NMR (500 MHz) δ ppm 8.46 (s, 1H), 4.31 (td, 2H), 3.97 (m, 2H), 3.89 (s, 3H), 3.71 (td, 2H), 2.97 (m, 1H), 2.83 (m, 2H), 1.25 (s, 2H), 1.17 (m, 2H).

Step B: Preparation of 2-cyclopropyl-1,6-dihydro-1-(4-morpholinyl)-6-oxo-5-pyrimidinecarboxylic acid

35 2-Cyclopropyl-1,6-dihydro-1-(4-morpholinyl)-6-oxo-5-pyrimidinecarboxylate (i.e. the product from Step A) (1.14 g, 4.1 mmol) was dissolved in acetonitrile (2% water by volume) and treated with lithium bromide (powder, 1.77 g, 20.4 mmol) and triethylamine (0.63 g, 6.1 mmol) and stirred at room temperature for 16 h. The crude reaction mixture was diluted

with aqueous hydrochloric acid (1 N, 20 mL) and the aqueous layer was extracted with dichloromethane (2 x 40 mL). The organic layers were combined, dried (Na₂SO₄), filtered and concentrated under reduced pressure resulting in 0.942 g of title compound as a white solid.

- 5 ¹H NMR (500 MHz) δ ppm 12.68 (br s, 1H), 8.71 (s, 1H), 4.25 (td, 2H), 4.02 (m, 2H), 3.74 (d, 2H), 3.02 (m, 1H), 2.91 (m, 2H), 1.34 (d, 2H), 1.27 (d, 2H).

Step C: Preparation of 2-cyclopropyl-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-3-(4-morpholinyl)-4(3*H*)-pyrimidinone (Compound 22)

- To 2-cyclopropyl-1,6-dihydro-1-(4-morpholinyl)-6-oxo-5-pyrimidinecarboxylic acid
10 (i.e. the product from Step B) (0.5 g, 1.9 mmol) in 6 mL of dichloromethane was added 2-chloro-1-methylpyridinium iodide (0.72 g, 2.8 mmol) and cyclohexanedione (0.32 g, 2.8 mmol). Triethylamine (0.48 g, 4.7 mmol) was added dropwise and the solution was stirred for 16 h under an atmosphere of N₂. The solution was then diluted with dichloromethane (50 mL) and washed with distilled water and brine. The organic layer was dried (Na₂SO₄),
15 filtered and concentrated *in vacuo*. The crude material was filtered through a plug of silica gel eluting with ethyl acetate. The organic layer was concentrated *in vacuo*. The crude material was taken up in acetonitrile (10 mL) and 2-hydroxy-2-methyl-propanenitrile (0.015 g, 0.15 mmol) and triethylamine (0.48 g, 4.7 mmol) were added. The solution was stirred at ambient temperature for 16 h. The reaction mixture was then concentrated under reduced
20 pressure and purified by medium pressure liquid chromatography on silica gel eluting with 0 to 5% methanol in dichloromethane to provide 0.95 g of the title compound as a solid.

¹H NMR (500 MHz) δ ppm 16.47 (s, 1H), 7.88 (s, 1H), 4.19 (m, 2H), 3.95 (dd, 2H), 3.71 (m, 2H), 2.94 (m, 1H), 2.87 (d, 2H), 2.69 (t, 2H), 2.48 (t, 2H), 2.06 (m, 2H), 1.22 (m, 2H), 1.12 (m, 2H).

25 EXAMPLE 4

Preparation of 2-cyclopropyl-5-[(2-hydroxy-4-oxobicyclo[3.2.1]oct-2-en-3-yl)carbonyl]-3-(4-morpholinyl)-4(3*H*)-pyrimidinone (Compound 23)

Step A: Preparation of 2-cyclopropyl-5-[(2-hydroxy-4-oxobicyclo[3.2.1]oct-2-en-3-yl)carbonyl]-3-(4-morpholinyl)-4(3*H*)-pyrimidinone (Compound 23)

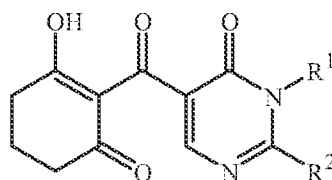
- To 2-cyclopropyl-1,6-dihydro-1-(4-morpholinyl)-6-oxo-5-pyrimidinecarboxylic acid
30 (i.e. the product from Example 3, Step B) (0.5 g, 1.9 mmol) in 6 mL of dichloromethane was added 2-chloro-1-methylpyridinium iodide (0.72 g, 2.8 mmol) and bicyclo[3.2.1]octane-2,4-dione (0.39 g, 2.8 mmol). Triethylamine (0.48 g, 4.7 mmol) was added dropwise and the solution was stirred for 16 h under an atmosphere of nitrogen. The solution was then diluted
35 with dichloromethane (50 mL) and washed with distilled water and brine. The organic layer was dried (Na₂SO₄), filtered and concentrated *in vacuo*. The crude material was filtered through a plug of silica gel eluting with ethyl acetate. The organic layer was concentrated *in*

vacuo. The crude material was taken up in acetonitrile (10 mL) and 2-hydroxy-2-methylpropanenitrile (0.015 g, 0.15 mmol) and triethylamine (0.481 g, 4.7 mmol) were added. The solution was stirred at ambient temperature for 16 h. The reaction mixture was then concentrated under reduced pressure and purified by medium pressure liquid chromatography on silica gel eluting with 0 to 5% methanol in dichloromethane to provide 0.199 g of the title compound as a solid.

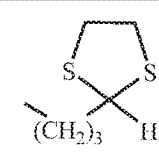
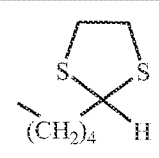
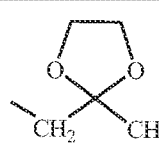
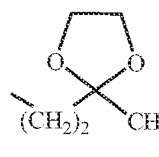
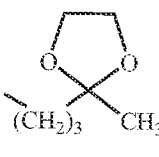
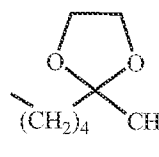
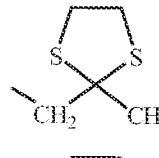
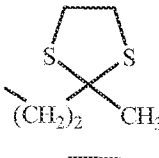
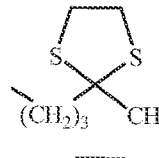
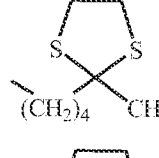
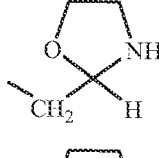
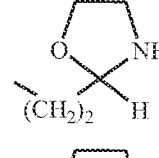
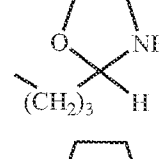
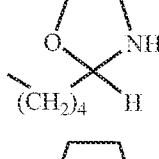
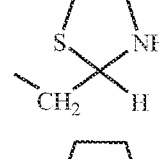
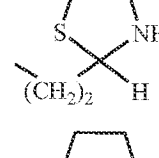
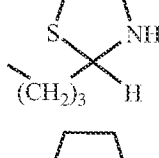
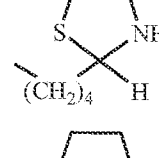
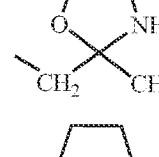
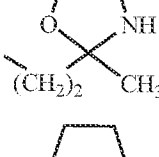
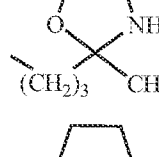
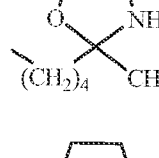
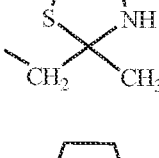
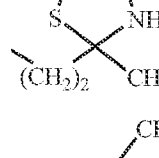
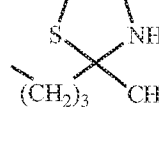
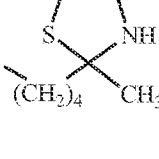
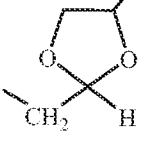
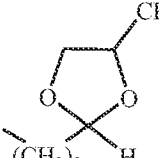
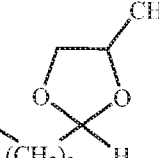
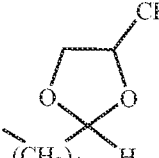
¹H NMR (500 MHz) δ ppm 16.64 (s, 1H), 7.82 (s, 1H), 4.21 (m, 2H), 3.96 (dd, 2H), 3.71 (m, 2H), 3.07 (m, 1H), 2.93 (m, 2H), 2.88 (d, 2H), 2.22 (d, 1H), 2.13 (m, 2H), 2.00 (m, 1H), 1.85 (m, 1H), 1.71 (m, 1H), 1.20 (m, 2H), 1.11 (m, 2H).

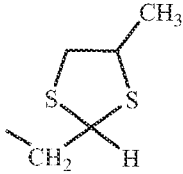
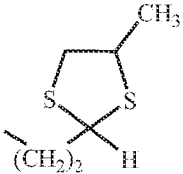
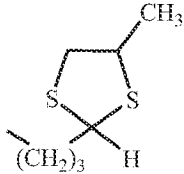
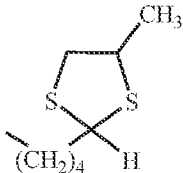
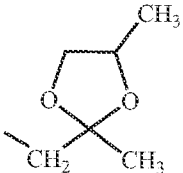
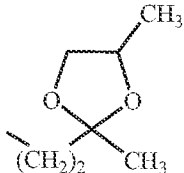
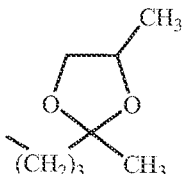
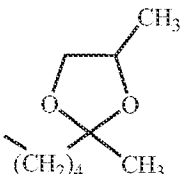
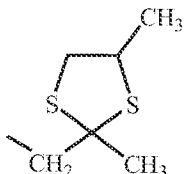
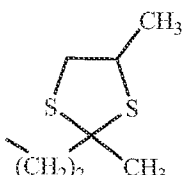
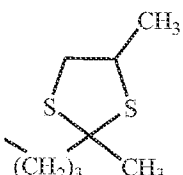
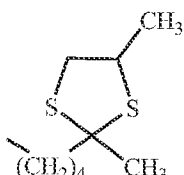
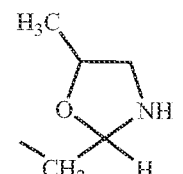
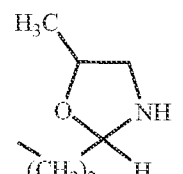
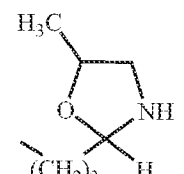
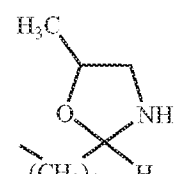
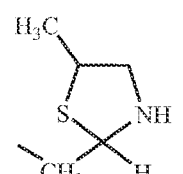
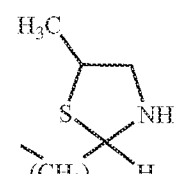
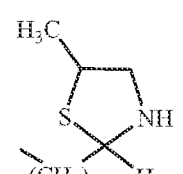
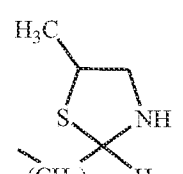
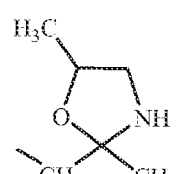
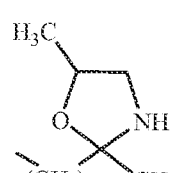
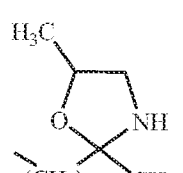
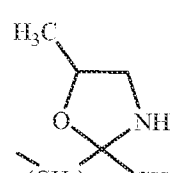
By the procedures described herein together with methods known in the art, the following compounds of Tables 1 to 12 can be prepared. The following abbreviations are used in the Tables which follow: Me means methyl, Et means ethyl, *n*-Pr means normal propyl, *i*-Pr means isopropyl, *c*-Pr means cyclopropyl, *n*-Bu means normal butyl, *i*-Bu means isobutyl, *s*-Bu means secondary butyl, *c*-Bu means cyclobutyl, *t*-Bu means tertiary butyl, *n*-pent means normal pentyl, *c*-Pent means cyclopentyl, *n*-Hex means normal hexyl, hept means heptyl, *c*-Hex means cyclohexyl, 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, S(O)Me means methylsulfinyl, SO₂ means sulfonyl and S(O)₂Me means methylsulfonyl.

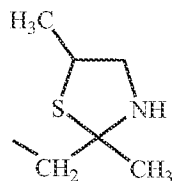
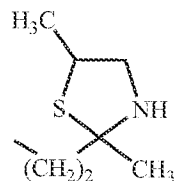
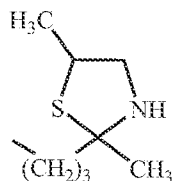
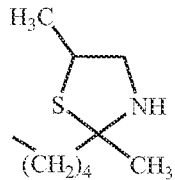
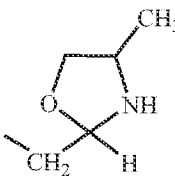
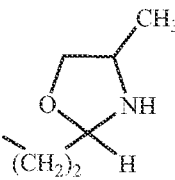
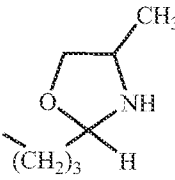
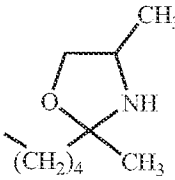
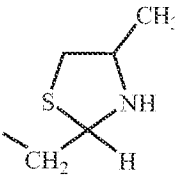
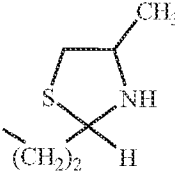
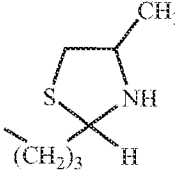
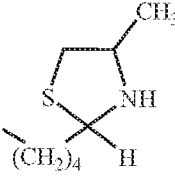
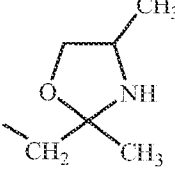
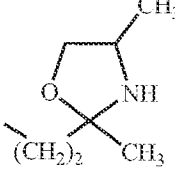
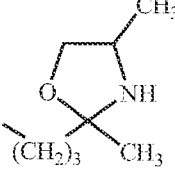
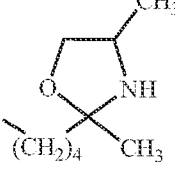
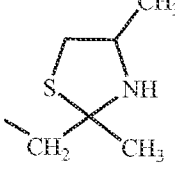
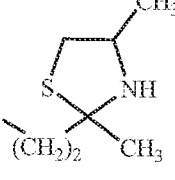
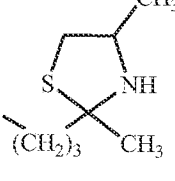
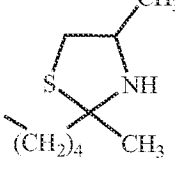
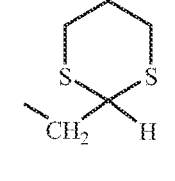
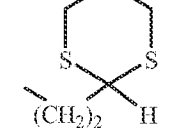
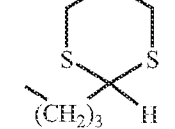
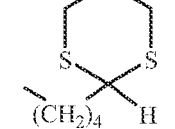
TABLE 1

R² is Ph

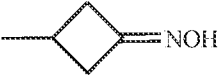
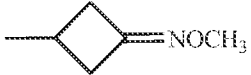
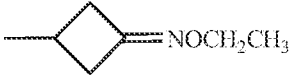
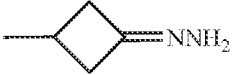
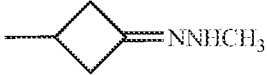
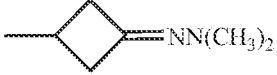
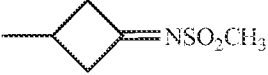
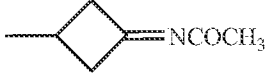
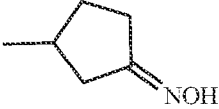
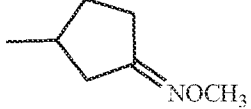
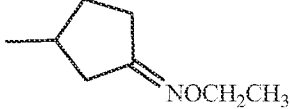
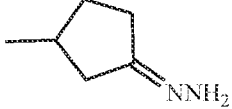
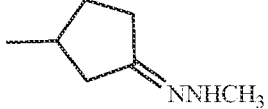
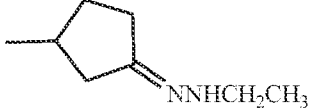
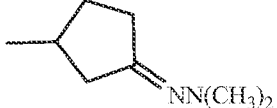
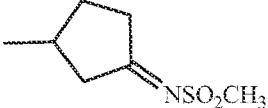
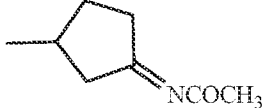
R ¹	R ¹	R ¹

R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		
		
		

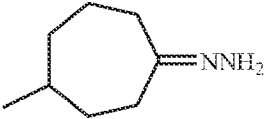
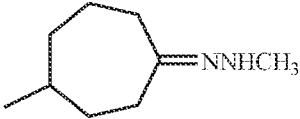
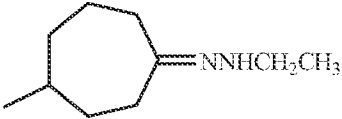
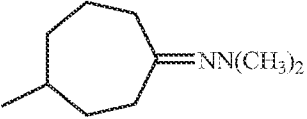
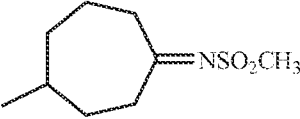
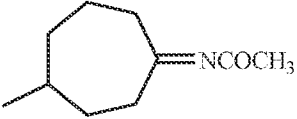
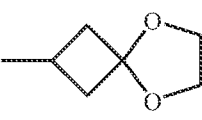
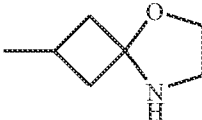
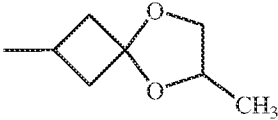
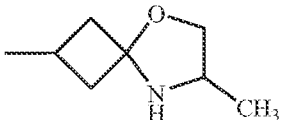
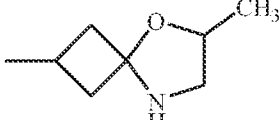
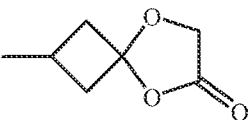
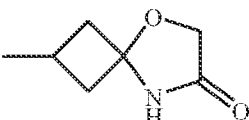
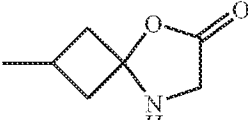
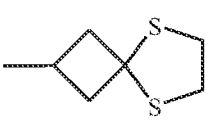
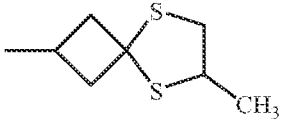
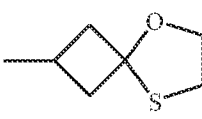
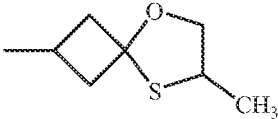
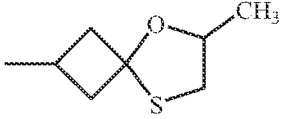
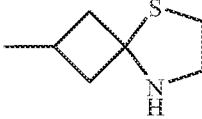
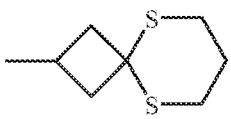
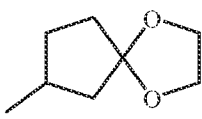
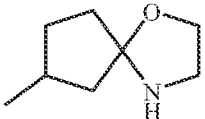
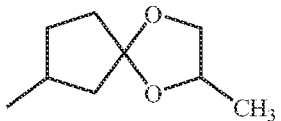
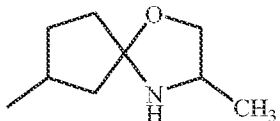
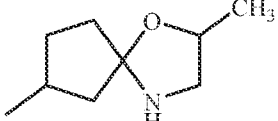
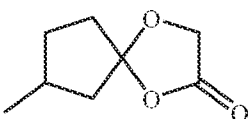
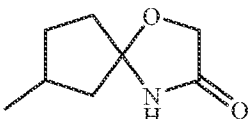
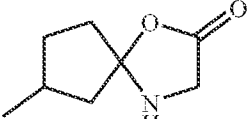
R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		

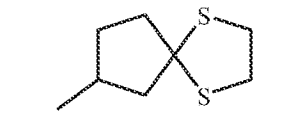
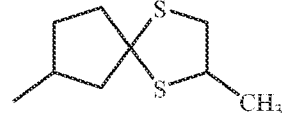
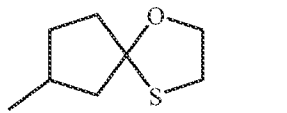
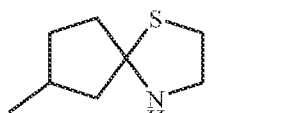
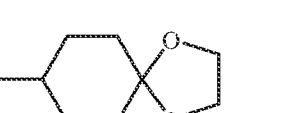
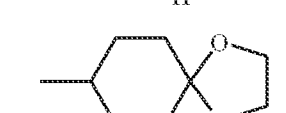
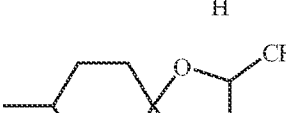
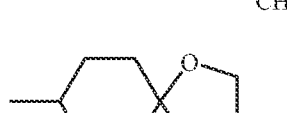
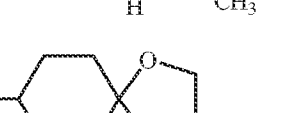
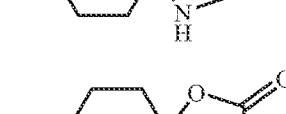
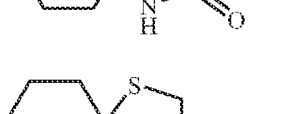
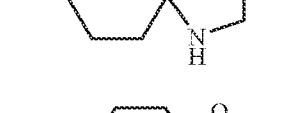
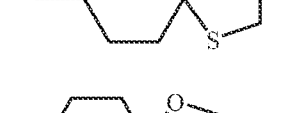
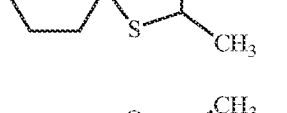
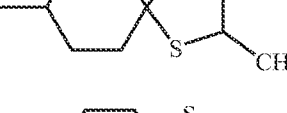
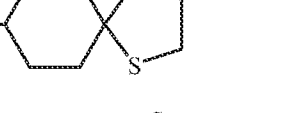
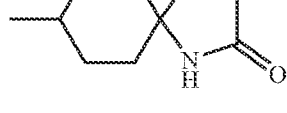
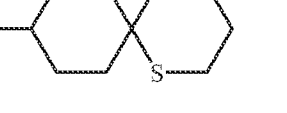
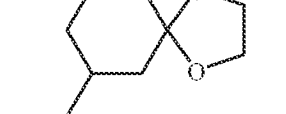
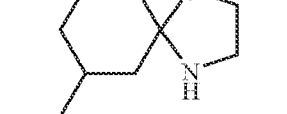
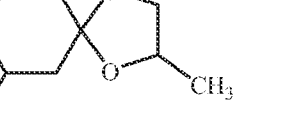
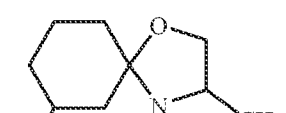
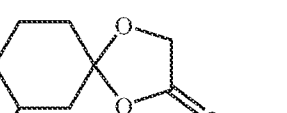
R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		

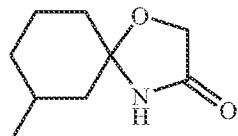
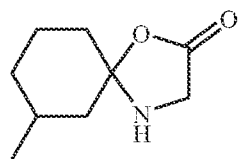
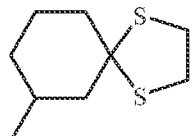
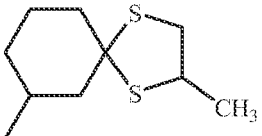
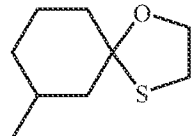
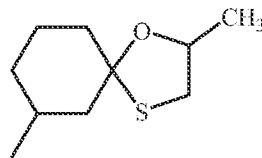
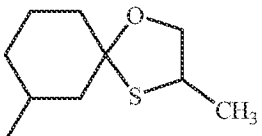
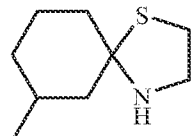
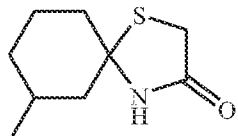
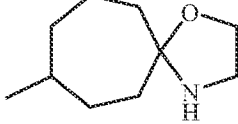
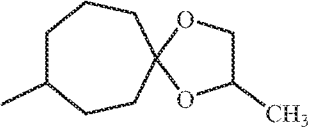
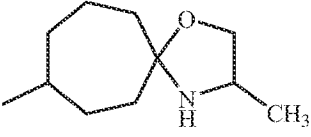
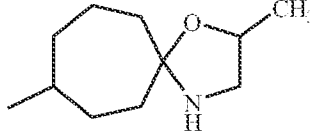
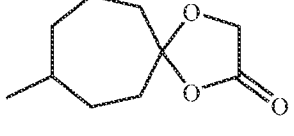
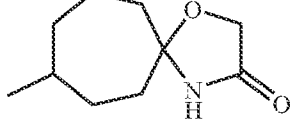
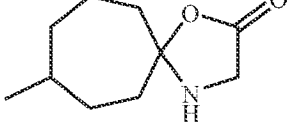
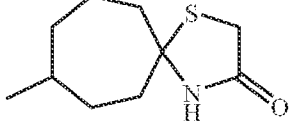
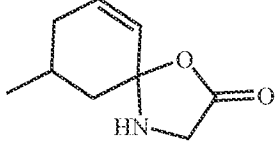
R ¹	R ¹	R ¹
-(CH ₂) ₂ CH=NOH	-(CH ₂) ₃ CH=NOH	-(CH ₂) ₄ CH=NOH
-CH ₂ C(CH ₃)=NOH	-(CH ₂) ₂ C(CH ₃)=NOH	-(CH ₂) ₃ C(CH ₃)=NOH
-(CH ₂) ₄ C(CH ₃)=NOH	-(CH ₂) ₂ CH=NOCH ₃	-(CH ₂) ₃ CH=NOCH ₃
-(CH ₂) ₄ CH=NOCH ₃	-CH ₂ C(CH ₃)=NOCH ₃	-(CH ₂) ₂ C(CH ₃)=NOH
-(CH ₂) ₃ C(CH ₃)=NOH	-(CH ₂) ₄ C(CH ₃)=NOH	-(CH ₂) ₂ CH=NNH ₂
-(CH ₂) ₃ CH=NNH ₂	-(CH ₂) ₄ CH=NNH ₂	-CH ₂ C(CH ₃)=N NH ₂
-(CH ₂) ₂ C(CH ₃)=NNH ₂	-(CH ₂) ₃ C(CH ₃)=NNH ₂	-(CH ₂) ₄ C(CH ₃)=NNH ₂
-(CH ₂) ₂ CH=NNHCH ₃	-(CH ₂) ₃ CH=NNHCH ₃	-(CH ₂) ₄ CH=NNHCH ₃
-CH ₂ C(CH ₃)=NNH ₂	-(CH ₂) ₂ C(CH ₃)=NNH ₂	-(CH ₂) ₃ C(CH ₃)=NNH ₂

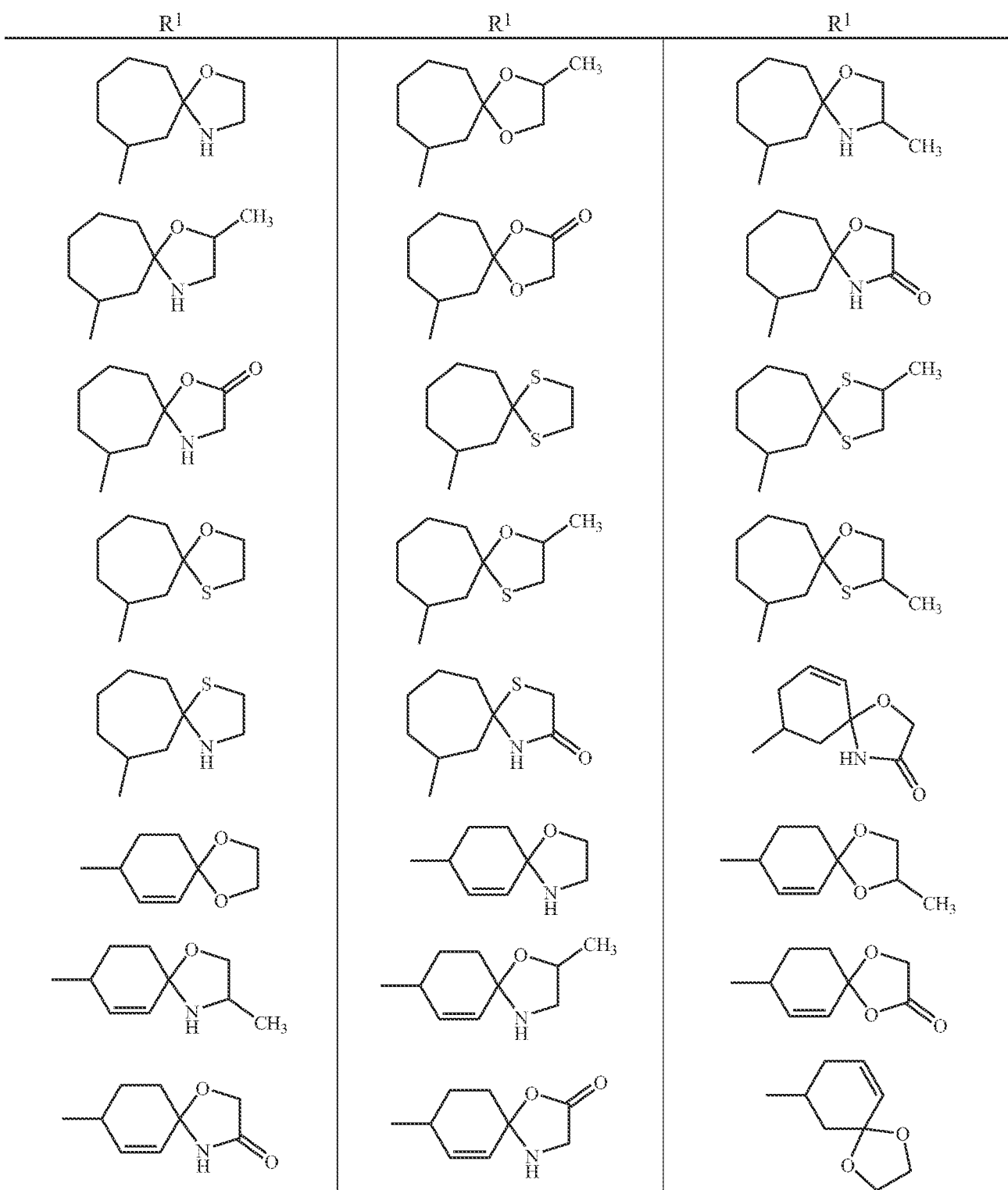
R ¹	R ¹	R ¹
$-(CH_2)_4C(CH_3)=NNH_2$	$-(CH_2)_2CH=NN(CH_3)_2$	$-(CH_2)_3CH=NN(CH_3)_2$
$-(CH_2)_4CH=NN(CH_3)_2$	$-CH_2C(CH_3)=NN(CH_3)_2$	$-(CH_2)_2C(CH_3)=NN(CH_3)_2$
$-(CH_2)_3C(CH_3)=NN(CH_3)_2$	$-(CH_2)_3C(CH_3)=NN(CH_3)_2$	$-(CH_2)_4C(CH_3)=NN(CH_3)_2$
$-(CH_2)_2CH=NSO_2CH_3$	$-(CH_2)_3CH=NSO_2CH_3$	$-(CH_2)_4CH=NSO_2CH_3$
$-CH_2C(CH_3)=NSO_2CH_3$	$-(CH_2)_2C(CH_3)=NSO_2CH_3$	$-(CH_2)_3C(CH_3)=NSO_2CH_3$
$-(CH_2)_4C(CH_3)=NSO_2CH_3$	$-(CH_2)_2CH=NCOCH_3$	$-(CH_2)_3CH=NCOCH_3$
$-(CH_2)_4CH=NCOCH_3$	$-CH_2C(CH_3)=NCOCH_3$	$-(CH_2)_2C(CH_3)=NCOCH_3$
$-(CH_2)_3C(CH_3)=NCOCH_3$	$-(CH_2)_4C(CH_3)=NCOCH_3$	$-CH=CHCH_2CH=NOCH_3$
$-(CH_2)_2CH=CHCH=NOCH_3$	$-CH_2CH=CHC(CH_3)=NOCH_3$	$-(CH_2)_2CH=CHC(CH_3)=NOCH_3$
$-CH_2CONH_2$	$-(CH_2)_2CONH_2$	$-(CH_2)_3CONH_2$
$-CH_2CONHCH_3$	$-(CH_2)_3CONHCH_3$	$-CH_2CON(CH_3)_2$
$-(CH_2)_2CON(CH_3)_2$	$-(CH_2)_3CON(CH_3)_2$	$-CH_2COCH_3$
$-(CH_2)_2COCH_3$	$-(CH_2)_3COCH_3$	$-CH_2COCH_2CH_3$
$-(CH_2)_2COCH_2CH_3$	$-(CH_2)_3COCH_2CH_3$	$-(CH_2)_2OCH_2CN$
$-(CH_2)_3OCH_2CN$	$-(CH_2)_2OCH_2CONH_2$	$-CH_2OCH_2CONH_2$
		
		
		
		
		
		

R ¹	R ¹	R ¹

R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		
		
		

R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		
		
		
		

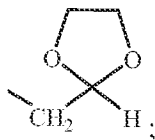
R ¹	R ¹	R ¹
		
		
		
		
		
		
		
		
		



R ¹	R ¹	R ¹

The present disclosure also includes Tables 1A through 101A, each of which is constructed the same as Table 1 above except that the row heading in Table 1 (i.e. “R² is Ph”) is replaced with the respective row headings shown below. For example, in Table 1A the row heading is “R² is Me”, and R¹ is as defined in Table 1 above. Thus, the first entry in Table 1A

5 specifically discloses a compound of Formula 1 wherein R¹ is



R² is Me; R³ is OH; A is A-1; B¹ is C-1; B² is C-3; B³ is C-1; and each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H. Tables 2A through 101A are constructed similarly.

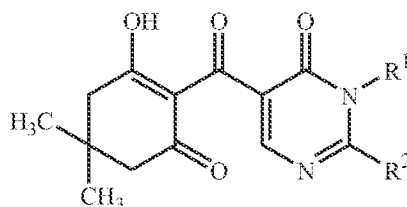
Table	Row Heading	Table	Row Heading
1A	R ² is Me	12A	R ² is Ph(3-Me)
2A	R ² is Et	13A	R ² is Ph(4-Me)
3A	R ² is <i>n</i> -Pr	14A	R ² is Ph(2-OMe)
4A	R ² is <i>c</i> -Pr	15A	R ² is Ph(3-OMe)
5A	R ² is SMe	16A	R ² is Ph(4-OMe)
6A	R ² is SO ₂ Me	17A	R ² is Ph(2-F)
7A	R ² is CF ₃	18A	R ² is Ph(3-F)
8A	R ² is Ph(2-Cl)	19A	R ² is Ph(4-F)
9A	R ² is Ph(3-Cl)	20A	R ² is OMe
10A	R ² is Ph(4-Cl)	21A	R ² is OEt
11A	R ² is Ph(2-Me)	22A	R ² is CH ₂ Ph

Table	Row Heading	Table	Row Heading
23A	R ² is 2-pyridinyl	59A	R ² is i-Bu
24A	R ² is 3-pyridinyl	60A	R ² is 2-thienyl
25A	R ² is 4-pyridinyl	61A	R ² is 3-thienyl
26A	R ² is H	62A	R ² is 2-furanyl
27A	R ² is Ph(3,5-di-F)	63A	R ² is 3-furanyl
28A	R ² is Ph(3,4-di-F)	64A	R ² is 2-isoxazoliny
29A	R ² is Ph(3,4,5-tri-F)	65A	R ² is 2-oxazoliny
30A	R ² is Ph(2,3-di-F)	66A	R ² is 1-Me-3-pyrazolyl
31A	R ² is Ph(3-CF ₃)	67A	R ² is 3-thiazolyl
32A	R ² is Ph(4-CF ₃)	68A	R ² is 2-thiazolyl
33A	R ² is Ph(3,5-di-CF ₃)	69A	R ² is 2-thiazoliny
34A	R ² is <i>n</i> -Bu	70A	R ² is 2-oxazolyl
35A	R ² is CH ₂ OCH ₃ ,	71A	R ² is 4-isoxazoliny
36A	R ² is CH ₂ CH ₂ OCH ₃	72A	R ² is 5-Me-3-pyridinyl
37A	R ² is CH ₂ CH ₂ CF ₃	73A	R ² is 5-Cl-2-pyridinyl
38A	R ² is CH ₂ CF ₃	74A	R ² is Ph(3,4-di-OMe)
39A	R ² is <i>n</i> -pent	75A	R ² is Ph(3,5-di-OMe)
40A	R ² is <i>c</i> -pent	76A	R ² is Ph(3-OEt)
41A	R ² is <i>c</i> -Hex	77A	R ² is Ph(4-OEt)
42A	R ² is <i>n</i> -Hex	78A	R ² is Ph(3,4-di-OEt)
43A	R ² is thp-4-yl	79A	R ² is Ph(3,5-di-OEt)
44A	R ² is Ph(2-CN)	80A	R ² is Ph(3,4-di-Me)
45A	R ² is Ph(3-CN)	81A	R ² is Ph(3,5-di-Me)
46A	R ² is Ph(4-CN)	82A	R ² is Ph(3,4,5-tri-OEt)
47A	R ² is Ph(2-C≡CH)	83A	R ² is Ph(3-OCH ₂ CH=CH ₂)
48A	R ² is Ph(3-C≡CH)	84A	R ² is Ph(4-OCH ₂ CH=CH ₂)
49A	R ² is Ph(4-C≡CH)	85A	R ² is 3,5-(MeO) ₂ -pyrimidinyl
50A	R ² is Ph(3-Me, 2-F)	86A	R ² is 3,5-(EtO) ₂ -pyrimidinyl
51A	R ² is Ph(3-Me, 4-F)	87A	R ² is 3,5-(MeO) ₂ -triazinyl
52A	R ² is Ph(3-Me, 5-F)	88A	R ² is 3,5-(EtO) ₂ -triazinyl
53A	R ² is Ph(3-Me, 6-F)	89A	R ² is -CH ₂ CH=NOCH ₃
54A	R ² is Ph(3-F, 2-Me)	90A	R ² is -(CH ₂) ₂ CH=NOCH ₃
55A	R ² is Ph(3-F, 4-Me)	91A	R ² is -(CH ₂) ₃ CH=NOCH ₃
56A	R ² is Ph(3-F, 5-Me)	92A	R ² is -CH=CHCH ₂ CH=NOCH ₃
57A	R ² is Ph(3-F, 6-Me)	93A	R ² is
58A	R ² is i-Pr		-(CH ₂) ₂ CH=CHCH=NOCH ₃

Table	Row Heading	Table	Row Heading
94A	R^2 is $-\text{CH}_2\text{C}(\text{CH}_3)=\text{NOCH}_3$	98A	R^2 is $-(\text{CH}_2)_3\text{CONHCH}_3$
95A	R^2 is $-(\text{CH}_2)_2\text{C}(\text{CH}_3)=\text{NOCH}_3$	99A	R^2 is $-\text{CH}_2\text{CON}(\text{CH}_3)_2$
96A	R^2 is $-\text{CH}_2\text{CONHCH}_3$	100A	R^2 is $-(\text{CH}_2)_2\text{CON}(\text{CH}_3)_2$
97A	R^2 is $-(\text{CH}_2)_2\text{CONHCH}_3$	101A	R^2 is $-(\text{CH}_2)_3\text{CON}(\text{CH}_3)_2$

TABLE 2

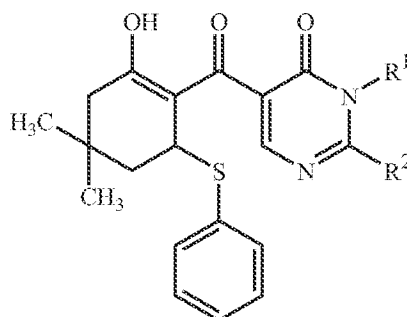
Table 2 is constructed the same as Table 1, except the structure is replaced with



The present disclosure also includes Tables 1B through 101B, which have row
5 headings for R^2 which are identical to those in Tables 1A through 101A.

TABLE 3

Table 3 is constructed the same as Table 1, except the structure is replaced with

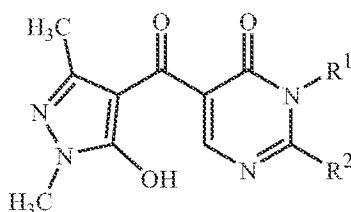


The present disclosure also includes Tables 1C through 101C, which have row
10 headings for R^2 which are identical to those in Tables 1A through 101A.

TABLE 4

Table 4 is constructed the same as Table 1, except the structure is replaced with

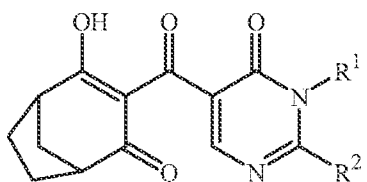
109



The present disclosure also includes Tables 1D through 101D, which have row headings for R^2 which are identical to those in Tables 1A through 101A.

TABLE 5

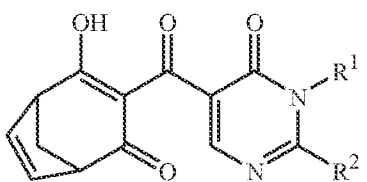
5 Table 5 is constructed the same as Table 1, except the structure is replaced with



The present disclosure also includes Tables 1E through 101E, which have row headings for R^2 which are identical to those in Tables 1A through 101A.

TABLE 6

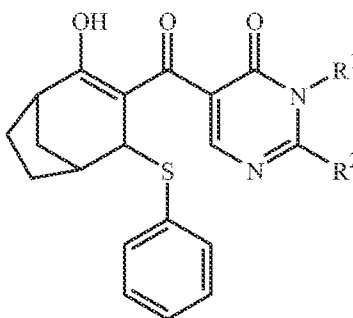
10 Table 6 is constructed the same as Table 1, except the structure is replaced with



The present disclosure also includes Tables 1F through 101F, which have row headings for R^2 which are identical to those in Tables 1A through 101A.

TABLE 7

15 Table 7 is constructed the same as Table 1, except the structure is replaced with

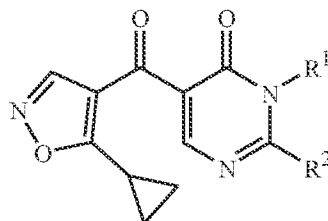


The present disclosure also includes Tables 1G through 101G, which have row headings for R^2 which are identical to those in Tables 1A through 101A.

110

TABLE 8

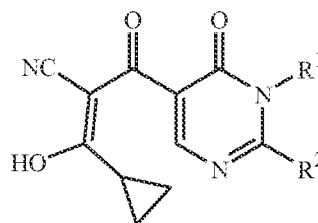
Table 8 is constructed the same as Table 1, except the structure is replaced with



The present disclosure also includes Tables 1H through 101H, which have row
5 headings for R² which are identical to those in Tables 1A through 101A.

TABLE 9

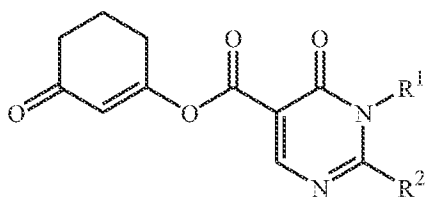
Table 9 is constructed the same as Table 1, except the structure is replaced with



The present disclosure also includes Tables 1I through 101I, which have row
10 headings for R² which are identical to those in Tables 1A through 101A.

TABLE 10

Table 10 is constructed the same as Table 1, except the structure is replaced with

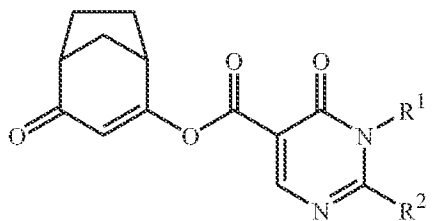


The present disclosure also includes Tables 1J through 101J, which have row headings
15 for R² which are identical to those in Tables 1A through 101A.

TABLE 11

Table 11 is constructed the same as Table 1 except the structure is replaced with

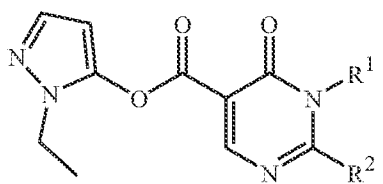
111



The present disclosure also includes Tables 1K through 101K, which have row headings for R² which are identical to those in Tables 1A through 101A.

TABLE 12

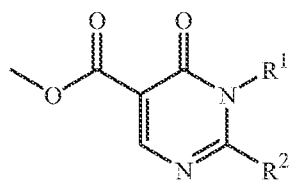
5 Table 12 is constructed the same as Table 1 except the structure is replaced with



The present disclosure also includes Tables 1L through 101L, which have row headings for R² which are identical to those in Tables 1A through 101A.

TABLE 13

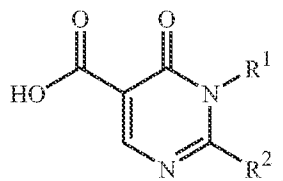
10 Table 13 is constructed the same as Table 1 except the structure is replaced with



The present disclosure also includes Tables 1M through 101M, which have row headings for R² which are identical to those in Tables 1A through 101A.

TABLE 14

15 Table 14 is constructed the same as Table 1 except the structure is replaced with



The present disclosure also includes Tables 1N through 101N, which have row headings for R² which are identical to those in Tables 1A through 101A.

Formulation/Utility

A compound of Formula 1 of this invention will generally be used as a herbicidal active ingredient in a composition, i.e. formulation, with at least one additional component selected from the group consisting of surfactants, solid diluents and liquid diluents, which serves as a carrier. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature.

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

The general types of solid compositions are dusts, powders, granules, pellets, prills, pastilles, tablets, filled films (including seed coatings) and the like, which can be water-dispersible ("wetttable") 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, alkyl peg (polyethylene glycol) resins, graft or comb polymers and star polymers; polyethylene glycols (pegs); polyethylene glycol fatty acid esters; silicone-based surfactants; and sugar-derivatives such as sucrose esters, alkyl polyglycosides and alkyl polysaccharides.

Useful anionic surfactants include, but are not limited to: alkylaryl sulfonic acids and their salts; carboxylated alcohol or alkylphenol ethoxylates; diphenyl sulfonate derivatives; lignin and lignin derivatives such as lignosulfonates; maleic or succinic acids or their anhydrides; olefin sulfonates; phosphate esters such as phosphate esters of alcohol alkoxylates, phosphate esters of alkylphenol alkoxylates and phosphate esters of styryl phenol ethoxylates; protein-based surfactants; sarcosine derivatives; styryl phenol ether sulfate; sulfates and sulfonates of oils and fatty acids; sulfates and sulfonates of ethoxylated

alkylphenols; sulfates of alcohols; sulfates of ethoxylated alcohols; sulfonates of amines and amides such as *N,N*-alkyltaurates; sulfonates of benzene, cumene, toluene, xylene, and dodecyl and tridecylbenzenes; sulfonates of condensed naphthalenes; sulfonates of naphthalene and alkyl naphthalene; sulfonates of fractionated petroleum; sulfosuccinamates; and sulfosuccinates and their derivatives such as dialkyl sulfosuccinate salts.

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

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

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

The compound of Formula 1 and any other active ingredients are typically incorporated into the present compositions by dissolving the active ingredient in a solvent or

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

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

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

Example AHigh Strength Concentrate

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

Example BWettable Powder

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

Example CGranule

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

Example DExtruded Pellet

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

5

Example EEmulsifiable Concentrate

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

Example FMicroemulsion

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

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.

5 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
10 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
15 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
20 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
25 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-
30 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,
35 butylate, cafenstrole, carbetamide, carfentrazone-ethyl, catechin, chlomethoxyfen, chloramben, chlorbromuron, chlorflurenol-methyl, chloridazon, chlorimuron-ethyl, chlorotoluron, chlorpropham, chlorsulfuron, chlorthal-dimethyl, chlorthiamid, cinidon-ethyl,

cinmethylin, cinosulfuron, clefoxydim, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, clopyralid-olamine, cloransulam-methyl, cumyluron, cyanazine, cycloate, cyclosulfamuron, cycloxydim, cyhalofop-butyl, 2,4-D and its butotyl, butyl, isooctyl and isopropyl esters and its dimethylammonium, diolamine and trolamine salts, daimuron,

5 dalapon, dalapon-sodium, dazomet, 2,4-DB and its dimethylammonium, potassium and sodium salts, desmedipham, desmetryn, dicamba and its diglycolammonium, dimethylammonium, potassium and sodium salts, dichlobenil, dichlorprop, diclofop-methyl, diclosulam, difenzoquat metilsulfate, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimethipin, dimethylarsinic

10 acid and its sodium salt, dinitramine, dinoterb, diphenamid, diquat dibromide, dithiopyr, diuron, DNOC, endothal, EPTC, esprocarb, ethalfluralin, ethametsulfuron-methyl, ethiozin, ethofumesate, ethoxyfen, ethoxysulfuron, etobenzanid, fenoxaprop-ethyl, fenoxaprop-P-ethyl, fenoxasulfone, fentrazamide, fenuron, fenuron-TCA, flamprop-methyl, flamprop-M-isopropyl, flamprop-M-methyl, flazasulfuron, florasulam, fluazifop-butyl,

15 fluazifop-P-butyl, fluazolate, flucarbazone, flucetosulfuron, fluchloralin, flufenacet, flufenpyr, flufenpyr-ethyl, flumetsulam, flumiclorac-pentyl, flumioxazin, fluometuron, fluoroglycofen-ethyl, flupoxam, flupyrsulfuron-methyl and its sodium salt, flurenol, flurenol-butyl, fluridone, flurochloridone, fluroxypyr, flurtamone, fluthiacet-methyl, fomesafen, foramsulfuron, fosamine-ammonium, glufosinate, glufosinate-ammonium,

20 glyphosate and its salts such as ammonium, isopropylammonium, potassium, sodium (including sesquisodium) and trimesium (alternatively named sulfosate), halosulfuron-methyl, haloxyfop-etotyl, haloxyfop-methyl, hexazinone, imazamethabenz-methyl, imazamox, imazapic, imazapyr, imazaquin, imazaquin-ammonium, indaziflam, imazethapyr, imazethapyr-ammonium, imazosulfuron, indanofan,

25 iodosulfuron-methyl, ioxynil, ioxynil octanoate, ioxynil-sodium, ipfencarbazone, IR6396, 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),

30 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, methylaldimron, metobenzuron, metobromuron, metolachlor, S-metolachlor, metosulam, metoxuron, metribuzin, metsulfuron-methyl, molinate, monolinuron, naproanilide,

35 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,
 5 prosulfuron, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazoxyfen, pyrazosulfuron-ethyl, pyribenzoxim, pyributicarb, pyridate, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid (CAS number 943832-60-8), 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-2-pyridinecarboxylic acid methyl ester (CAS number
 10 943831-98-9) pyriftalid, pyriminobac-methyl, pyrimisulfan, pyrithiobac, pyrithiobac-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,
 15 tembotrione, tepraloxydim, terbacil, terbumeton, terbuthylazine, terbutryn, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron-methyl, thiobencarb, tiocarbazil, topramezone, tralkoxydim, tri-allate, triasulfuron, triaziflam, tribenuron-methyl, triclopyr, triclopyr-butotyl, triclopyr-triethylammonium, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron-methyl, tritosulfuron and vernolate. Other herbicides also include
 20 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
 25 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,
 30 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
 35 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.

5 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
10 Component (a) compound is typically applied to a field-grown crop relative to Component (b). Thus, for example, the first line of Table A1 specifically discloses the combination of Component (a) (i.e. Compound 1 in Index Table A) with 2,4-D is typically applied in a weight ratio between 1:192 to 6:1. The remaining lines of Table A1 are to be construed similarly.

15

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	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	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	Aminoocyclopyrachlor	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

<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	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	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
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	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-methyl	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	Cyclosulfamuron	1:17 to 68:1	1:5 to 23:1	1:2 to 5:1

<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	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
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	Diflufenican	1:857 to 2:1	1:285 to 1:3	1:107 to 1:12
Compound 1	Diflufenzopyr	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	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

<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	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	Flupyr-sulfuron-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
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-methyl	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-methyl	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

<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	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
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	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

<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	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
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	Pyraclostrobin	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	Pyrifthalid	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	Pyriothiac	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	Pyroxulam	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

<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	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
Compound 1	Tembotrione	1:31 to 37:1	1:10 to 13:1	1:3 to 3:1
Compound 1	Tepraloxym	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	Terbutylatrazine	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	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	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

Table A2 is constructed the same as Table A1 above except that entries below the “Component (a)” column heading are replaced with the respective Component (a) Column Entry shown below. Compound 2 in the Component (a) column is identified in Index Table A. Thus, for example, in Table A2 the entries below the “Component (a)” column heading all recite “Compound 2” (i.e. Compound 2 identified in Index Table A), and the first line

below the column headings in Table A2 specifically discloses a mixture of Compound 2 with 2,4-D. Tables A3 through A34 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	A19	Compound 19
A3	Compound 3	A20	Compound 20
A4	Compound 4	A21	Compound 21
A5	Compound 5	A22	Compound 22
A6	Compound 6	A23	Compound 23
A7	Compound 7	A24	Compound 24
A8	Compound 8	A25	Compound 25
A9	Compound 9	A26	Compound 26
A10	Compound 10	A27	Compound 27
A11	Compound 11	A28	Compound 28
A12	Compound 12	A29	Compound 29
A13	Compound 13	A30	Compound 30
A14	Compound 14	A31	Compound 31
A15	Compound 15	A32	Compound 32
A16	Compound 16	A33	Compound 33
A17	Compound 17	A34	Compound 34
A18	Compound 18		

In certain instances, combinations of a compound of this invention with other biologically active (particularly herbicidal) compounds or agents (i.e. active ingredients) can result in a greater-than-additive (i.e. synergistic) effect on weeds and/or a less-than-additive effect (i.e. safening) on crops or other desirable plants. Reducing the quantity of active ingredients released in the environment while ensuring effective pest control is always desirable. Ability to use greater amounts of active ingredients to provide more effective weed control without excessive crop injury is also desirable. When synergism of herbicidal active ingredients occurs on weeds at application rates giving agronomically satisfactory levels of weed control, such combinations can be advantageous for reducing crop production cost and decreasing environmental load. When safening of herbicidal active ingredients occurs on crops, such combinations can be advantageous for increasing crop protection by reducing weed competition.

Of note is a combination of a compound of the invention with at least one other herbicidal active ingredient. Of particular note is such a combination where the other herbicidal active ingredient has different site of action from the compound of the invention. In certain instances, a combination with at least one other herbicidal active ingredient having a similar spectrum of control but a different site of action will be particularly advantageous

for resistance management. Thus, a composition of the present invention can further comprise (in a herbicidally effective amount) at least one additional herbicidal active ingredient having a similar spectrum of control but a different site of action.

Compounds of this invention can also be used in combination with herbicide safeners such as allidochlor, benoxacor, BCS (1-bromo-4-[(chloromethyl)sulfonyl]benzene), cloquintocet-mexyl, cyometrinil, cyprosulfonamide, dichlormid, 4-(dichloroacetyl)-1-oxa-4-azospiro[4.5]decane (MON 4660), 2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG 191), dicyclonon, dietholate, fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, mephenate, methoxyphenone ((4-methoxy-3-methylphenyl)(3-methylphenyl)methanone), naphthalic anhydride (1,8-naphthalic anhydride) and oxabetrinil to increase safety to certain crops. Antidotally effective amounts of the herbicide safeners can be applied at the same time as the compounds of this invention, or applied as seed treatments. Therefore an aspect of the present invention relates to a herbicidal mixture comprising a compound of this invention and an antidotally effective amount of a herbicide safener. Seed treatment is particularly useful for selective weed control, because it physically restricts antidoting to the crop plants. Therefore a particularly useful embodiment of the present invention is a method for selectively controlling the growth of undesired vegetation in a crop comprising contacting the locus of the crop with a herbicidally effective amount of a compound of this invention wherein seed from which the crop is grown is treated with an antidotally effective amount of safener. Antidotally effective amounts of safeners can be easily determined by one skilled in the art through simple experimentation.

Table B1 lists specific combinations of a Component (a) with Component (b) illustrative of the mixtures, compositions and methods of the present invention. The second column of Table B1 lists the specific Component (b) compound (e.g., "Allidochlor" in the first line). The third, fourth and fifth columns of Table B1 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 B1 specifically discloses the combination of Component (a) (i.e. Compound 1 identified in Index Table A) with Allidochlor is typically applied in a weight ratio between 1:48 to 6:1. The remaining lines of Table B1 are to be construed similarly.

TABLE B1

Component (a)	Component (b)	Typical Weight Ratio	More Typical Weight Ratio	Most Typical Weight Ratio
Compound 1	Allidochlor	1:48 to 6:1	1:16 to 2:1	1:12 to 1:2
Compound 1	Benoxacor	1:17 to 17:1	1:5 to 6:1	1:4 to 3:1
Compound 1	Cloquintocet-mexyl	1:6 to 168:1	1:2 to 56:1	1:1 to 11:1

<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	Cumyluron	1:24 to 42:1	1:8 to 14:1	1:3 to 3:1
Compound 1	Cyometrinil	1:48 to 168:1	1:16 to 56:1	1:6 to 2:1
Compound 1	Cyprosulfamide	1:24 to 42:1	1:8 to 14:1	1:3 to 3:1
Compound 1	Diamuron	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Dichlormid	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Dicyclonon	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Dietholate	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Dimepiperate	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Fenchlorazole-ethyl	1:8 to 42:1	1:2 to 14:1	1:2 to 5:1
Compound 1	Fencloirim	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Flurazole	1:48 to 12:1	1:16 to 4:1	1:6 to 2:1
Compound 1	Fluxofenim	1:48 to 168:1	1:16 to 56:1	1:6 to 2:1
Compound 1	Furilazole	1:48 to 12:1	1:16 to 4:1	1:6 to 2:1
Compound 1	Isoxadifen-ethyl	1:8 to 42:1	1:2 to 14:1	1:2 to 5:1
Compound 1	Mefenpyr-diethyl	1:8 to 84:1	1:2 to 28:1	1:1 to 6:1
Compound 1	Mephenate	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Methoxyphenone	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Naphthalic anhydride	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	Oxabetrinil	1:48 to 168:1	1:16 to 56:1	1:6 to 2:1
Compound 1	2-(dichloromethyl)-2-methyl-1,3-dioxolane (MG-191)	1:48 to 12:1	1:16 to 4:1	1:12 to 1:2
Compound 1	1-(Oxa-4-aza-spiro[4.5]dec-4-yl)-ethanone (AD-67)	1:42 to 17:1	1:14 to 6:1	1:10 to 1:2
Compound 1	ethyl 1,6-dihydro-1-(2-methoxyphenyl)-6-oxo-2-phenyl-5-pyrimidinecarboxylate	1:12 to 168:1	1:4 to 56:1	1:1 to 6:1

Table B2 is constructed the same as Table B1 above except that entries below the “Component (a)” column heading are replaced with the respective Component (a) Column Entry shown below. Thus, for example, in Table B2 the entries below the “Component (a)” column heading all recite “Compound 2” (i.e. Compound 2 in Index Table A), and the first line below the column headings in Table B2 specifically discloses a mixture of Compound 2 with Allidochlor. Tables B2 through B34 are constructed similarly.

<u>Table Number</u>	<u>Component (a) Column Entries</u>	<u>Table Number</u>	<u>Component (a) Column Entries</u>
B2	Compound 2	B3	Compound 3

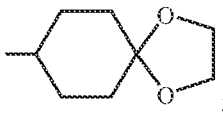
<u>Table Number</u>	<u>Component (a) Column Entries</u>	<u>Table Number</u>	<u>Component (a) Column Entries</u>
B4	Compound 4	B20	Compound 20
B5	Compound 5	B21	Compound 21
B6	Compound 6	B22	Compound 22
B7	Compound 7	B23	Compound 23
B8	Compound 8	B24	Compound 24
B9	Compound 9	B25	Compound 25
B10	Compound 10	B26	Compound 26
B11	Compound 11	B27	Compound 27
B12	Compound 12	B28	Compound 28
B13	Compound 13	B29	Compound 29
B14	Compound 14	B30	Compound 30
B15	Compound 15	B31	Compound 31
B16	Compound 16	B32	Compound 32
B17	Compound 17	B33	Compound 33
B18	Compound 18	B34	Compound 34
B19	Compound 19		

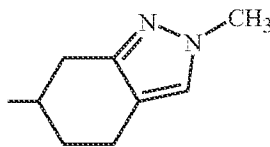
Of note is a composition comprising a compound of the invention (in a herbicidally effective amount), at least one additional active ingredient selected from the group consisting of other herbicides and herbicide safeners (in an effective amount), and at least one component selected from the group consisting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

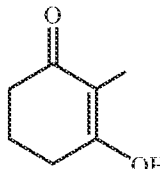
Preferred for better control of undesired vegetation (e.g., lower use rate such as from synergism, broader spectrum of weeds controlled, or enhanced crop safety) or for preventing the development of resistant weeds are mixtures of a compound of this invention with a herbicide selected from the group 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, flupyr-sulfuron-methyl, flupyr-sulfuron-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,

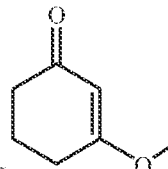
saflufenacil, sulfentrazone, thifensulfuron-methyl, triasulfuron, tribenuron-methyl, triclopyr, triclopyr-butotyl, and triclopyr-triethylammonium.

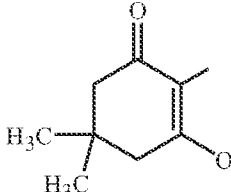
The following Tests demonstrate the herbicidal eddect of the compounds of this invention against specific weeds. The weed control afforded by the compounds is not limited, however, to the plant species tested. See Index Tables A for compound descriptions. The following abbreviations are used in the Index Tables which follow: "Cmpd." means Compound, Me is methyl, Ph is phenyl, thien means thiophene and *c*-Pr means cyclopropyl. ¹H NMR spectra are reported in CDCl₃ in ppm downfield from tetramethylsilane at 400 MHz unless otherwise noted; "s" means singlet, "m" means multiplet, "br s" means broad singlet, "d" means doublet, "dd" means doublet of doublets, "t" means triplet, "td means triplet of doublets, "dt" means doublet of triplets, and "q" means quartet. The abbreviation "Ex." stands for "Example" and is followed by a number indicating in which example the compound is prepared. In the following Index Tables:

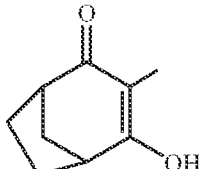
"dioxaspiro[4.5]dec-8-yl" means  ;

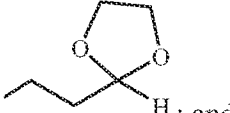
15 "tetrahydro-2-methyl-indazol-5-yl" means  ;

"A-1A" means: 

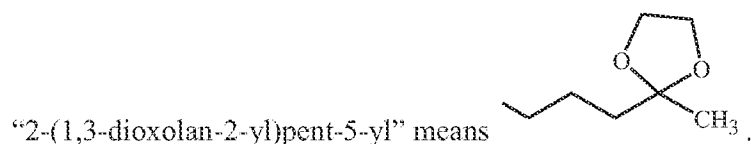
; "A'-1A" means  ;

"A-1B" means: 

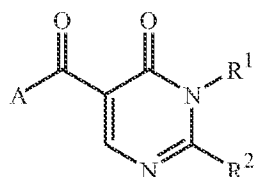
; "A-3A" means 

"1-(1,3-dioxolan-2-yl)propan-3-yl" means  ; and

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INDEX TABLE A



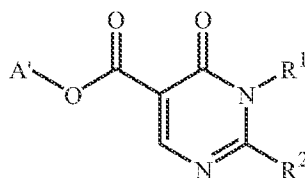
Cmpd.	R ¹	R ²	A	m.p.(°C)
1 (Ex. 1)	dioxaspiro[4.5]dec-8-yl	Ph	A-1A	*
2 (Ex. 2)	-CH ₂ CH=NOCH ₃	Ph	A-1A	*
3	dioxaspiro[4.5]dec-8-yl	Ph(3-F)	A-1A	**
4	dioxaspiro[4.5]dec-8-yl	Ph(3-F)	A-3A	**
5	dioxaspiro[4.5]dec-8-yl	Ph(3-Me)	A-1A	**
6	dioxaspiro[4.5]dec-8-yl	Ph(3-Me)	A-3A	**
7	dioxaspiro[4.5]dec-8-yl	5-Cl-3-pyridinyl	A-1A	**
8	dioxaspiro[4.5]dec-8-yl	3-pyridinyl	A-1A	**
9	dioxaspiro[4.5]dec-8-yl	Ph	A-3A	**
10	dioxaspiro[4.5]dec-8-yl	<i>c</i> -Pr	A-1A	**
11	dioxaspiro[4.5]dec-8-yl	<i>c</i> -Pr	A-3A	**
12	dioxaspiro[4.5]dec-8-yl	Ph(3-OMe)	A-1A	**
13	dioxaspiro[4.5]dec-8-yl	Ph(3-OMe)	A-3A	**
14	dioxaspiro[4.5]dec-8-yl	2-thienyl	A-1A	**
15	dioxaspiro[4.5]dec-8-yl	2-thienyl	A-3A	**
16	dioxaspiro[4.5]dec-8-yl	2-thienyl	A-1B	**
17	dioxaspiro[4.5]dec-8-yl	3-thienyl	A-1A	**
18	dioxaspiro[4.5]dec-8-yl	3-thienyl	A-1A	**
19	tetrahydro-2-methyl-indazol-5-yl	Ph	A-1A	**
20	1-morpholinyl	Ph	A-1A	**
21	1-morpholinyl	Ph	A-3A	**
22 (Ex. 3)	1-morpholinyl	<i>c</i> -Pr	A-1A	* **
23 (Ex. 4)	1-morpholinyl	<i>c</i> -Pr	A-3A	*, **
24	1-morpholinyl	Ph(3-F)	A-1A	**
25	1-morpholinyl	Ph(3-F)	A-3A	**
26	1-(3-dioxolan-2-yl)propan-3-yl	<i>c</i> -Pr	A-1A	**
27	1-(3-dioxolan-2-yl)propan-3-yl	Ph	A-1A	**

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28	1-(3-dioxolan-2-yl)propan-3-yl	Ph	A-3A	**
29	1-(3-dioxolan-2-yl)propan-3-yl	<i>c</i> -Pr	A-3A	**
30	1-(3-dioxolan-2-yl)propan-3-yl	3-thienyl	A-1A	**
31	1-(1,3-dioxolan-2-yl)propan-3-yl	3-thienyl	A-1B	**
32	1-(1,3-dioxolan-2-yl)propan-3-yl	3-thienyl	A-3A	**
33	2-(1,3-dioxolan-2-yl)pent-5-yl	Ph	A-3A	**
34	2-(1,3-dioxolan-2-yl)pent-5-yl	Ph	A-1A	**

*See synthesis examples for ^1H NMR data. **See Index Table E for ^1H NMR data

INDEX TABLE B

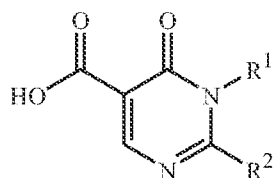


Cmpd.	R ¹	R ²	A'	m.p. (°C)
7Q	dioxaspiro[4.5]dec-8-yl	5-Cl-3-pyridinyl	A'-1	**
8Q	dioxaspiro[4.5]dec-8-yl	3-pyridinyl	A'-1	**
19Q	tetrahydro-2-methyl-indazol-5-yl	Ph	A'-1	**
22Q	1-morpholinyl	<i>c</i> -Pr	A'-1	**
24Q	1-morpholinyl	Ph(3-F)	A'-1	
26Q	1-(3-dioxolan-2-yl)propan-3-yl	<i>c</i> -Pr	A'-1	

*See synthesis examples for ^1H NMR data.

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INDEX TABLE C



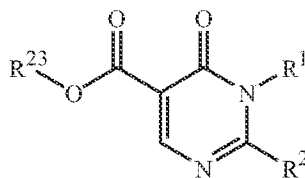
Cmpd.	R ¹	R ²	m.p. (°C)
1R (Ex. 1)	dioxaspiro[4.5]dec-8-yl	Ph	*
2R (Ex. 2)	-CH ₂ CH=NOCH ₃	Ph	*
7R	dioxaspiro[4.5]dec-8-yl	5-Cl-3-pyridinyl	**
8R	dioxaspiro[4.5]dec-8-yl	3-pyridinyl	**
11R	dioxaspiro[4.5]dec-8-yl	<i>c</i> -Pr	**
14R	dioxaspiro[4.5]dec-8-yl	2-thienyl	**
17R	dioxaspiro[4.5]dec-8-yl	3-thienyl	**
19R	tetrahydro-2-methyl-indazol-5-yl	Ph	**

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22R	1-morpholinyl	<i>c</i> -Pr	**
25R	1-morpholinyl	Ph(3-F)	**
26R	1-(3-dioxolan-2-yl)propan-3-yl	<i>c</i> -Pr	**
30R	1-(3-dioxolan-2-yl)propan-3-yl	3-thienyl	**
33R	2-(3-dioxolan-2-yl)-pent-5-yl	Ph	**

*See synthesis examples for ^1H NMR data. **See Index Table E for ^1H NMR data

INDEX TABLE D



Cmpd.	R ¹	R ²	R ²³	m.p. (°C)
1S (Ex. 1)	dioxaspiro[4.5]dec-8-yl	Ph	Me	*
2S (Ex. 2)	-CH ₂ CH=NOCH ₃	Ph	Me	*
7S	dioxaspiro[4.5]dec-8-yl	5-Cl-3-pyridinyl	Me	**
8S	dioxaspiro[4.5]dec-8-yl	3-pyridinyl	Me	**
11S	dioxaspiro[4.5]dec-8-yl	<i>c</i> -Pr	Me	**
19S	tetrahydro-2-methyl-indazol-5-yl	Ph	Me	**
22S	1-morpholinyl	<i>c</i> -Pr	Me	**
25S	1-morpholinyl	Ph(3-F)	Me	**
26S	1-(3-dioxolan-2-yl)propan-3-yl	<i>c</i> -Pr	Me	**
30S	1-(3-dioxolan-2-yl)propan-3-yl	3-thienyl	Me	**

*See synthesis examples for ^1H NMR data.

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INDEX TABLE E

Cmpd.	^1H NMR data or M.S. data*
3	469
4	495
5	465
6	491
7	δ 16.42 (s, 1H), 8.68 (d, 1H), 8.58 (s, 1H), 7.86 (s, 1H), 7.79 (s, 1H), 3.85–3.82 (m, 5H), 2.96–2.81 (m, 2H), 2.66 (t, 2H), 2.42 (t, 2H), 2.03–2.00 (m, 2H), 1.76–1.59 (m, 4H), 1.28 (td, 2H)
8	δ 16.46 (br s, 1H), 8.72 (br s, 2H), 7.89 (s, 1H), 7.77 (d, 1H), 7.43–7.34 (m, 1H), 3.92–3.67 (m, 5H), 2.89 (d, 2H), 2.65 (br s, 2H), 2.54 (t, 2H), 2.43 (br s, 2H), 2.05–1.86 (m, 2H), 1.76–1.53 (m, 2H), 1.29–1.18 (m, 2H)
9	477
10	415

11	441
12	481
13	507
14	457 (AP+)
15	483 (AP+)
16	485 (AP+)
17	457 (AP+)
18	483 (AP+)
19	δ 16.54 (br s, 1H), 8.05 (s, 1H), 7.49 (m, 5H), 7.01 (s, 1H), 4.36 (m, 1H), 3.77 (s, 3H), 3.70 (m, 1H), 3.10 (m, 1H), 2.85 (dd, 1H), 2.73 (m, 2H), 2.64 (dd, 1H), 2.50 (m, 2H), 2.42 (m, 1H), 2.07 (m, 3H)
20	396
21	422
22	360 ESI+
23	386 ESI+
24	414
25	440
26	375
27	413 ESI+
28	437 ESI+
29	401
30	417
31	445
32	443
33	465
34	439
7Q	δ 8.72 (s, 1H), 8.63–8.48 (m, 2H), 7.78 (s, 1H), 5.93 (s, 1H), 3.99–3.71 (m, 5H), 3.02–2.88 (m, 2H), 2.61 (t, 2H), 2.38 (t, 2H), 2.05 (m, 2H), 1.74 (d, 2H), 1.62 (d, 2H), 1.31 (td, 2H)
8Q	δ 8.77 (d, 1H), 8.71 (s, 1H), 8.61 (s, 1H), 7.77 (d, 1H), 7.48–7.38 (m, 1H), 5.93 (s, 1H), 3.99–3.76 (m, 5H), 3.08–2.84 (m, 2H), 2.61 (t, 2H), 2.42–2.28 (m, 2H), 2.10–1.97 (m, 2H), 1.72 (d, 2H), 1.66–1.57 (m, 2H), 1.33–1.20 (m, 2H)
19Q	δ 8.73 (s, 1H), 7.52 (m, 5H), 7.02 (s, 1H), 6.02 (s, 1H), 4.42 (m, 1H), 3.82 (m, 1H), 3.78 (s, 3H), 3.22 (m, 1H), 2.88 (m, 1H), 2.69 (m, 2H), 2.61 (m, 1H), 2.45 (s, 3H), 2.12 (m, 2H), 2.07 (m, 1H)
22Q	360 ESI +
26Q	375
7R	δ 8.87 (s, 1H), 8.75 (d, 1H), 8.59 (d, 1H), 7.83 (t, 1H), 4.07–3.98 (m, 1H), 3.94–3.90 (m, 2H), 3.88–3.82 (m, 2H), 3.06–2.94 (m, 2H), 1.79 (d, 2H), 1.68 (d, 2H), 1.35 (td, 2H)
8R	δ 8.88 (s, 1H), 8.80 (s, 1H), 8.74 (s, 1H), 7.81 (d, 1H), 7.47 (s, 1H), 4.11–3.99 (m, 1H), 3.96–3.78 (m, 4H), 3.08–2.90 (m, 2H), 1.81–1.62 (m, 4H), 1.31 (t, 2H)

11R	321
14R	377
17R	377
19R	δ 8.98 (s, 1H), 7.54 (m, 5H), 7.05 (s, 1H), 4.56 (m, 1H), 3.80 (s, 3H), 3.78 (m, 1H), 3.18 (m, 1H), 2.93 (m, 1H), 2.67 (dd, 1H), 2.48 (m, 1H), 2.09 (m, 1H)
22R	266 ESI+
25R	320
26R	(500 MHz) δ 13.09 (br s, 1H), 8.76 (s, 1H), 5.02 (t, 1H), 4.49 (m, 2H), 4.01 (m, 2H), 3.89 (m, 2H), 2.23 (m, 2H), 2.15 (m, 1H), 1.44 (m, 2H), 1.30 (m, 2H)
30R	323
33R	345
7S	δ 8.70 (s, 1H), 8.58–8.49 (m, 2H), 7.77 (s, 1H), 3.98–3.72 (m, 10H), 3.01 (d, 2H), 1.73 (d, 2H), 1.29 (br s, 2H)
8S	δ 8.75 (dd, 1H), 8.70 (d, 1H), 8.53 (s, 1H), 7.75 (dd, 1H), 7.42 (dd, 1H), 3.88–3.78 (m, 8H), 3.07–2.95 (m, 2H), 1.71 (d, 2H), 1.59 (d, 2H), 1.25 (td, 2H)
11S	335
19S	δ 8.66 (s, 1H), 7.49 (m, 5H), 7.01 (s, 1H), 4.39 (m, 1H), 3.93 (s, 3H), 3.80 (m, 1H), 3.77 (s, 3H), 3.23 (m, 1H), 2.87 (m, 1H), 2.59 (dd, 1H), 2.44 (m, 1H), 2.04 (m, 1H)
22S	280 ESI+
25S	334
26S	295
30S	295
34S	359

**All M.S. data expressed as AP+ unless otherwise noted

BIOLOGICAL EXAMPLES OF THE INVENTION

TEST A

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

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

Table A, are based on a 0 to 100 scale where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table A		Compound		Table A		Compounds									
500 g ai/ha		1		125 g ai/ha		29	30	31	32	33	34				
Postemergence				Postemergence											
Barnyardgrass		100		Barnyardgrass		80	90	70	100	90	80				
Corn		80		Corn		20	30	40	50	10	0				
Crabgrass, Large		100		Crabgrass, Large		80	90	90	100	80	90				
Foxtail, Giant		100		Foxtail, Giant		70	80	80	100	70	50				
Morningglory		100		Morningglory		100	100	100	100	90	20				
Pigweed		100		Pigweed		100	100	90	100	100	90				
Velvetleaf		100		Velvetleaf		100	100	100	100	100	100				
Wheat		20		Wheat		0	20	30	10	0	0				
Table A		Compounds													
125 g ai/ha		1	2	3	4	5	6	7	8	9	10	11	12	13	14
5	Postemergence														
	Barnyardgrass	100	60	90	100	100	100	100	90	90	90	100	90	70	100
	Corn	40	10	70	40	60	30	40	20	10	20	20	30	0	20
	Crabgrass, Large	100	80	90	90	90	90	100	90	90	90	90	90	50	100
	Foxtail, Giant	100	30	100	100	90	90	100	90	90	80	90	100	100	100
10	Morningglory	100	50	100	90	100	100	100	100	90	90	100	100	100	100
	Pigweed	100	90	100	100	100	100	100	100	100	100	100	100	100	100
	Velvetleaf	100	100	100	100	100	100	100	100	90	100	100	100	100	100
	Wheat	10	0	0	0	20	20	0	10	0	0	20	0	0	20
Table A		Compounds													
15	125 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Postemergence														
	Barnyardgrass	100	50	90	100	100	90	100	70	50	90	100	90	60	100
	Corn	30	20	30	40	10	20	50	0	0	50	50	50	20	30
	Crabgrass, Large	100	90	90	80	100	90	90	90	90	80	90	90	90	90
20	Foxtail, Giant	100	90	100	100	90	90	100	60	40	-	-	70	80	100
	Morningglory	100	100	100	100	90	100	90	90	90	100	100	100	80	100
	Pigweed	100	100	100	100	100	100	100	90	90	100	100	100	100	100
	Velvetleaf	100	100	100	100	100	100	100	-	-	100	100	100	100	100
	Wheat	40	0	10	20	20	0	10	-	-	10	0	0	0	0

[illegible]

Table A		Compounds													
31 g ai/ha		16	17	18	19	20	21	22	23	24	25	26	27	28	29
15	Postemergence														
	Barneyardgrass	20	60	90	80	70	90	30	10	80	90	70	20	30	30
	Corn	10	20	30	0	10	10	0	0	0	0	0	0	30	0
	Crabgrass, Large	70	70	50	60	50	70	70	50	70	70	70	90	70	50
	Foxtail, Giant	80	90	90	80	70	90	10	0	-	-	30	60	90	40
	Morningglory	100	100	100	90	90	90	90	70	100	100	100	70	90	100
20	Pigweed	100	90	80	100	100	80	80	50	100	100	90	100	90	80
	Velvetleaf	100	100	80	100	90	100	-	-	90	90	100	100	100	100
	Wheat	0	0	0	0	0	0	-	-	0	0	0	0	0	0

Table A	Compounds					Table A	Compound
31 g ai/ha	30	31	32	33	34	500 g ai/ha	1
Postemergence						Preemergence	
Barnyardgrass	60	20	90	80	60	Barnyardgrass	90
Corn	10	20	20	0	0	Corn	0
Crabgrass, Large	70	70	60	60	70	Crabgrass, Large	100
Foxtail, Giant	70	70	90	40	30	Foxtail, Giant	100
Morningglory	100	100	100	70	10	Morningglory	90
Pigweed	90	80	100	90	70	Pigweed	100
Velvetleaf	100	100	100	90	100	Velvetleaf	100
Wheat	0	0	0	0	0	Wheat	10

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5	Barnyardgrass	60	10	70	50	50	60	90	50	40	90	90	20	10	60
	Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Crabgrass, Large	90	70	60	50	60	70	100	70	70	90	80	70	70	100
	Foxtail, Giant	60	0	80	40	80	60	100	50	60	60	70	90	60	90
	Morningglory	60	0	40	-	50	60	80	10	20	70	70	20	0	90
	Pigweed	100	90	90	100	90	80	100	90	100	60	30	90	90	100
	Velvetleaf	80	80	80	60	60	50	60	30	70	70	50	80	40	90
	Wheat	0	0	0	0	0	0	0	0	0	0	0	10	0	0
10	Table A		Compounds												
	125 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Preemergence														
	Barnyardgrass	0	10	50	100	20	70	50	70	80	80	70	70	50	40
	Corn	0	0	0	0	0	0	0	0	0	0	20	0	0	0
	Crabgrass, Large	30	40	50	80	90	70	30	90	100	90	90	80	60	60
	Foxtail, Giant	70	20	50	70	-	50	30	50	30	60	20	20	30	40
	Morningglory	70	30	10	20	10	10	30	80	80	70	80	70	10	10
15	Pigweed	90	80	80	90	100	70	80	100	100	100	90	90	90	90
	Velvetleaf	50	50	50	70	60	60	40	90	90	100	80	90	80	70
	Wheat	0	0	0	-	0	0	0	0	10	0	0	0	0	0
	Table A		Compounds					Table A		Compounds					
	125 g ai/ha	29	30	31	32	33	34	31 g ai/ha	30	31	32	33	34		
	Preemergence														
	Barnyardgrass	50	70	40	50	20	30	Barnyardgrass	10	0	10	0	0	0	
	Corn	0	0	0	0	0	0	Corn	0	0	0	0	0	0	
20	Crabgrass, Large	60	90	80	30	40	70	Crabgrass, Large	40	50	10	10	10		
	Foxtail, Giant	10	20	50	20	10	0	Foxtail, Giant	0	10	0	0	0		
	Morningglory	10	0	10	10	10	0	Morningglory	0	0	0	0	0		
	Pigweed	90	90	100	90	60	60	Pigweed	50	50	70	-	10		
	Velvetleaf	70	90	70	70	60	70	Velvetleaf	70	50	50	10	30		
	Wheat	0	0	0	-	0	0	Wheat	0	0	0	0	0		
	Table A		Compounds												
	31 g ai/ha	2	3	4	5	6	7	8	9	10	11	12	13	14	15
25	Preemergence														
	Barnyardgrass	0	0	10	0	0	10	0	10	20	40	0	0	10	0
	Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Crabgrass, Large	10	10	10	10	10	70	60	40	40	50	60	10	90	30

	Foxtail, Giant	0	40	10	20	0	80	30	20	40	40	60	10	50	10
	Morningglory	0	0	20	0	0	20	0	0	0	10	0	0	20	10
	Pigweed	0	60	40	50	40	90	40	30	30	0	90	20	90	40
	Velvetleaf	0	50	40	50	30	50	0	40	60	10	20	0	60	20
5	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Table A	Compounds													
	31 g ai/ha	16	17	18	19	20	21	22	23	24	25	26	27	28	29
	Preemergence														
	Barnyardgrass	0	10	10	0	10	0	40	10	20	0	10	10	10	0
10	Corn	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Crabgrass, Large	10	20	30	10	10	0	50	60	30	20	40	20	10	10
	Foxtail, Giant	0	20	0	-	0	0	0	0	10	0	0	10	0	0
	Morningglory	0	0	0	0	0	-	50	10	50	10	0	30	0	0
	Pigweed	10	0	60	40	30	10	80	50	70	70	20	40	40	10
15	Velvetleaf	20	40	20	30	20	10	70	50	40	10	80	60	50	10
	Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TEST B

Seeds of plant species selected from blackgrass (*Alopecurus myosuroides*), downy brome grass (*Bromus tectorum*), green foxtail (*Setaria viridis*), Italian ryegrass (*Lolium multiflorum*), winter wheat (*Triticum aestivum*), wild oat (*Avena fatua*), galium (catchweed bedstraw, *Galium aparine*), bermudagrass (*Cynodon dactylon*), surinam grass (*Brachiaria decumbens*), cocklebur (common cocklebur, *Xanthium strumarium*), corn (*Zea mays*), large crabgrass (*Digitaria sanguinalis*), woolly cupgrass (*Eriochloa villosa*), giant foxtail (*Setaria faberii*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), lambsquarters (*Chenopodium album*), morningglory (*Ipomoea coccinea*), nightshade (eastern black nightshade, *Solanum ptycanthum*), yellow nutsedge (*Cyperus esculentus*), pigweed (*Amaranthus retroflexus*), ragweed (common ragweed, *Ambrosia elatior*), soybean (*Glycine max*), common (oilseed) sunflower (*Helianthus annuus*), Russian thistle (*Salsola kali*), and velvetleaf (*Abutilon theophrasti*) were planted into a blend of loam soil and sand and treated preemergence with test compounds formulated in a non-phytotoxic solvent mixture which included a surfactant.

At the same time, plants selected from these crop and weed species and also winter barley (*Hordeum vulgare*), canarygrass (*Phalaris minor*), chickweed (common chickweed, *Stellaria media*), windgrass (*Apera spica-venti*), and deadnettle (henbit deadnettle, *Lamium amplexicaule*) were planted in pots containing Redi-Earth[®] planting medium (Scotts Company, 14111 Scottslawn Road, Marysville, Ohio 43041) comprising sphagnum peat

moisture, 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 (1- to 4-leaf stage) for postemergence treatments.

Plant species in the flooded paddy test consisted of rice (*Oryza sativa*), umbrella sedge (*Cyperus difformis*), duck salad (*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.

10 Treated plants and controls were maintained in a greenhouse for 13 to 15 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table B, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (—) response means no test result.

Table B		Compounds													
250 g ai/ha		1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	Flood														
	Barnyardgrass	80	0	85	85	80	65	-	40	40	75	80	50	40	65
	Ducksalad	80	0	95	95	80	85	90	85	95	90	90	85	70	85
	Rice	80	0	85	15	65	30	15	40	20	50	50	40	35	80
	Sedge, Umbrella	95	0	90	75	75	80	85	100	95	75	90	85	80	80

20	Table B	Compounds													
		250 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27
	Flood														
	Barnyardgrass	40	30	20	0	60	55	60	80	75	75	0	60	0	0
	Ducksalad	80	75	70	50	95	60	80	95	80	100	0	85	75	50
25	Rice	0	60	0	10	20	45	0	80	75	90	0	25	0	0
	Sedge, Umbrella	85	70	75	65	85	30	30	90	85	100	30	80	75	75

Table B		Compounds					
250 g ai/ha		29	30	31	32	33	34
30	Flood						
	Barnyardgrass	0	20	30	15	0	30
	Ducksalad	60	60	70	0	40	90
	Rice	0	10	20	15	0	0
	Sedge, Umbrella	75	100	80	30	30	90

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	Barnyardgrass	60	0	30	0	0	20	-	0	0	65	65	15	15	40
	Ducksalad	75	0	65	30	80	85	75	75	85	85	80	80	40	75
	Rice	20	0	0	10	20	0	10	0	0	15	0	40	20	60
	Sedge, Umbrella	85	0	80	30	60	65	80	80	70	75	80	80	75	75
5	Table B	Compounds													
	125 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Flood														
	Barnyardgrass	0	0	15	0	15	40	0	75	60	60	0	30	0	0
	Ducksalad	75	70	70	40	75	40	0	85	80	75	0	65	70	50
10	Rice	0	0	0	0	0	25	0	75	60	35	0	15	0	0
	Sedge, Umbrella	80	30	70	60	80	30	0	90	75	75	0	75	40	50
	Table B	Compounds													
	125 g ai/ha	29	30	31	32	33	34								
	Flood														
15	Barnyardgrass	0	0	0	0	0	10								
	Ducksalad	0	0	0	0	0	0								
	Rice	0	0	0	0	0	0								
	Sedge, Umbrella	0	80	30	0	0	70								
	Table B	Compounds													
20	62 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Flood														
	Barnyardgrass	0	0	0	0	0	0	-	0	0	50	0	0	0	20
	Ducksalad	70	0	40	0	45	75	50	50	80	80	75	60	20	75
	Rice	0	0	0	0	0	0	0	0	0	10	0	20	0	20
25	Sedge, Umbrella	85	0	80	0	50	30	70	60	0	60	70	70	50	75
	Table B	Compounds													
	62 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Flood														
	Barnyardgrass	0	0	0	0	0	0	0	55	40	20	0	0	0	0
30	Ducksalad	75	30	50	0	60	0	0	75	50	50	0	30	20	0
	Rice	0	0	0	0	0	10	0	45	25	20	0	10	0	0
	Sedge, Umbrella	70	0	50	0	70	0	0	80	50	30	0	60	20	30
	Table B	Compounds													
	62 g ai/ha	29	30	31	32	33	34								
35	Flood														
	Barnyardgrass	0	0	0	0	0	0								

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	Ducksalad	0	0	0	0	0	0								
	Rice	0	0	0	0	0	0								
	Sedge, Umbrella	0	30	0	0	0	70								
	Table B	Compounds													
5	31 g ai/ha	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Flood														
	Barnyardgrass	0	0	0	0	0	0	-	0	0	0	0	0	0	20
	Ducksalad	70	0	0	0	0	0	0	0	0	80	50	50	0	70
	Rice	0	0	0	0	0	0	0	0	0	0	0	10	0	20
10	Sedge, Umbrella	70	0	40	0	0	0	0	0	0	40	0	0	0	45
	Table B	Compounds													
	31 g ai/ha	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Flood														
	Barnyardgrass	0	0	0	0	0	0	0	30	0	20	0	0	0	0
15	Ducksalad	65	30	0	0	40	0	0	45	0	40	0	20	0	0
	Rice	0	0	0	0	0	0	0	20	20	10	0	0	0	0
	Sedge, Umbrella	65	0	0	0	60	0	0	0	0	0	0	20	0	0
	Table B	Compounds													
	31 g ai/ha	29	30	31	32	33	34								
20	Flood														
	Barnyardgrass	0	0	0	0	0	0								
	Ducksalad	0	0	0	0	0	-								
	Rice	0	0	0	0	0	0								
	Sedge, Umbrella	0	0	0	0	0	-								
25	Table B	Compounds													
	250 g ai/ha	1	3	4	5	6	8	12	14	15	16	18	19	20	21
	Postemergence														
	Barley	80	50	5	10	5	50	15	50	5	35	5	80	5	0
	Bermudagrass	85	90	85	85	65	98	65	90	95	90	90	95	95	90
30	Blackgrass	85	85	55	40	5	70	80	15	60	5	70	80	55	10
	Bromegrass, Downy	-	5	5	35	35	90	35	70	70	10	40	95	-	15
	Canarygrass	100	85	85	85	40	100	90	55	60	90	70	100	40	10
	Chickweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Cocklebur	-	100	98	98	100	100	100	100	100	100	100	-	100	100
35	Corn	80	85	80	90	65	80	85	75	60	50	60	90	75	80
	Crabgrass, Large	98	90	90	85	95	98	80	100	98	98	75	100	95	95

	Cupgrass, Woolly	98	90	95	90	95	98	95	100	100	100	100	98	100	95
	Deadnettle	-	100	100	100	100	100	100	100	100	100	100	100	100	100
	Foxtail, Giant	100	90	95	95	95	98	95	98	98	85	98	95	98	95
	Foxtail, Green	95	100	100	95	90	90	90	98	60	70	98	100	95	100
5	Galium	-	95	95	60	-	85	85	95	85	90	80	95	70	90
	Goosegrass	95	85	90	-	85	98	90	95	98	85	95	90	98	85
	Johnsongrass	95	95	98	95	98	100	90	98	100	85	100	-	85	98
	Kochia	90	85	75	15	65	100	65	100	80	75	98	100	100	100
	Lambsquarters	100	100	100	100	100	100	100	100	100	100	100	100	100	-
10	Morningglory	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Nutsedge, Yellow	80	85	80	85	45	85	85	85	75	65	65	85	80	80
	Oat, Wild	90	95	85	60	35	98	90	95	55	85	70	95	20	5
	Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Ragweed	100	100	100	100	100	100	100	100	100	100	100	100	100	100
15	Ryegrass, Italian	45	35	40	5	5	35	20	10	10	20	20	95	5	5
	Soybean	100	98	98	98	98	100	98	100	100	100	100	100	95	98
	Surinam Grass	90	85	95	75	85	98	85	95	98	85	98	100	85	85
	Velvetleaf	100	95	85	85	80	98	100	100	95	90	90	100	100	95
	Wheat	35	0	0	5	5	40	5	20	30	0	30	95	20	20
20	Windgrass	95	85	90	45	55	98	65	90	80	65	85	100	80	85
	Table B	Compounds													
	250 g ai/ha	22	23	24	25	26	28	29	30	31	32				
	Postemergence														
	Barley	80	55	35	30	10	35	35	20	50	5				
25	Bermudagrass	98	95	98	98	95	100	95	95	85	95				
	Blackgrass	25	30	80	40	30	65	85	50	35	40				
	Bromegrass, Downy	35	80	80	10	10	45	35	45	40	55				
	Canarygrass	80	95	90	60	50	40	50	50	80	45				
	Chickweed	100	100	100	100	100	100	100	100	100	100				
30	Cocklebur	100	98	100	100	100	-	-	100	98	98				
	Corn	80	90	85	100	35	85	80	55	75	65				
	Crabgrass, Large	98	100	95	98	90	100	98	95	85	98				
	Cupgrass, Woolly	90	98	98	100	80	100	98	85	80	98				
	Deadnettle	100	100	100	100	100	100	100	100	100	100				
35	Foxtail, Giant	90	95	95	95	100	100	95	90	90	98				
	Foxtail, Green	90	98	100	100	70	100	95	95	70	95				
	Galium	95	98	95	90	90	85	90	95	95	90				

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	Nutsedge, Yellow	75	80	65	80	25	80	90	80	85	60	40	60	65	80
	Oat, Wild	90	90	80	50	35	95	15	70	90	50	50	65	95	20
	Pigweed	100	100	100	100	100	100	100	100	100	100	100	100	100	98
	Ragweed	100	100	100	100	100	100	100	100	100	100	100	100	100	98
5	Ryegrass, Italian	45	35	35	0	0	30	5	20	10	10	20	5	70	5
	Soybean	100	95	98	95	98	100	100	98	100	100	100	100	100	95
	Surinam Grass	85	80	90	75	80	95	50	85	95	95	80	90	100	80
	Velvetleaf	100	95	75	85	75	80	85	95	100	80	80	80	100	95
	Wheat	30	0	0	5	5	30	5	0	15	5	0	0	90	5
10	Windgrass	85	75	80	40	30	95	60	65	65	75	60	65	100	75
	Table B	Compounds													
	125 g ai/ha	21	22	23	24	25	26	28	29	30	31	32			
	Postemergence														
	Barley	0	60	40	35	15	5	15	35	5	35	0			
15	Bermudagrass	90	98	95	98	98	90	100	95	90	85	90			
	Blackgrass	10	25	15	80	30	10	50	70	45	30	40			
	Bromegrass, Downy	5	35	60	50	10	5	40	10	35	30	35			
	Canarygrass	5	70	60	75	45	45	15	45	35	55	45			
	Chickweed	98	100	98	100	98	100	98	100	100	100	100			
20	Cocklebur	100	95	-	98	100	-	-	-	100	95	95			
	Corn	80	80	80	85	95	20	75	70	50	65	45			
	Crabgrass, Large	85	98	100	95	98	85	100	98	90	85	85			
	Cupgrass, Woolly	85	85	95	98	100	75	100	90	75	70	95			
	Deadnettle	100	100	100	100	100	98	100	-	100	85	100			
25	Foxtail, Giant	95	85	90	95	95	100	100	95	80	85	95			
	Foxtail, Green	100	85	95	98	100	40	90	90	85	70	90			
	Galium	85	90	90	85	90	85	85	90	85	90	90			
	Goosegrass	80	90	90	95	95	75	100	90	65	80	85			
	Johnsongrass	95	70	90	98	100	55	75	75	70	70	95			
30	Kochia	90	95	100	95	95	95	100	100	80	45	95			
	Lambsquarters	-	100	100	98	100	100	100	100	100	98	100			
	Morningglory	100	100	95	100	100	95	100	100	100	98	100			
	Nutsedge, Yellow	65	90	80	90	45	80	20	70	70	40	95			
	Oat, Wild	5	60	85	60	40	10	45	30	45	45	45			
35	Pigweed	95	98	95	100	98	100	100	100	100	95	100			
	Ragweed	100	100	98	100	100	100	100	100	100	95	100			
	Ryegrass, Italian	0	30	30	5	5	30	10	15	30	20	10			

	Soybean	98	95	98	90	98	90	100	100	98	98	98			
	Surinam Grass	80	80	85	95	98	65	95	75	85	75	85			
	Velvetleaf	80	98	98	90	95	100	100	100	100	95	98			
	Wheat	10	90	80	15	35	0	35	35	40	35	40			
5	Windgrass	45	60	35	98	80	50	10	50	55	60	60			
	Table B														
	62 g ai/ha	1	3	4	5	6	7	8	10	11	12	14	15	16	17
	Postemergence														
	Barley	50	5	0	0	0	35	5	0	0	0	0	0	0	0
10	Bermudagrass	85	60	75	75	45	85	95	85	80	5	75	75	80	75
	Blackgrass	60	70	30	30	5	70	30	5	55	65	10	5	0	20
	Bromegrass, Downy	55	0	5	0	0	-	60	5	30	10	40	45	5	15
	Canarygrass	95	80	75	60	35	80	55	15	35	60	20	45	40	30
	Chickweed	100	100	100	95	100	100	100	100	100	100	100	100	100	100
15	Cocklebur	-	100	98	95	95	-	100	98	100	100	95	100	98	100
	Corn	75	70	80	70	45	90	10	20	20	65	35	25	10	60
	Crabgrass, Large	95	80	85	80	75	100	95	85	85	60	90	75	90	80
	Cupgrass, Woolly	85	85	90	80	85	100	90	60	85	85	98	90	95	98
	Deadnettle	60	95	100	95	100	85	100	100	100	100	100	100	100	100
20	Foxtail, Giant	95	85	85	85	85	98	90	80	90	85	85	90	80	85
	Foxtail, Green	75	90	95	80	85	100	60	50	85	50	80	50	50	80
	Galium	90	60	90	55	55	85	50	70	85	60	85	60	50	80
	Goosegrass	85	75	80	75	65	100	75	85	80	75	75	80	85	45
	Johnsongrass	85	85	95	80	90	100	90	25	85	60	80	98	65	70
25	Kochia	75	25	50	5	5	100	75	95	70	10	75	25	20	98
	Lambsquarters	100	100	100	100	98	100	100	100	100	100	100	100	100	100
	Morningglory	100	100	100	98	100	98	100	100	100	100	95	100	100	100
	Nutsedge, Yellow	75	80	50	80	25	85	75	85	75	80	80	50	25	90
	Oat, Wild	85	85	60	25	30	90	85	5	20	60	90	50	50	60
30	Pigweed	100	100	100	100	100	100	98	100	100	100	100	100	100	100
	Ragweed	100	100	100	100	100	100	100	100	100	100	100	100	75	100
	Ryegrass, Italian	40	25	30	0	0	20	10	0	50	10	5	5	15	0
	Soybean	100	95	98	95	98	100	100	98	98	98	100	98	100	100
	Surinam Grass	85	75	90	60	75	100	80	35	40	75	75	80	75	80
35	Velvetleaf	95	85	70	75	70	95	75	85	65	90	90	80	75	90
	Wheat	20	0	0	0	5	30	25	0	35	0	5	0	0	0
	Windgrass	70	45	60	20	5	60	70	25	60	50	55	55	40	50

Table B		Compounds													
62 g ai/ha		18	19	20	21	22	23	24	25	26	28	29	30	31	32
Postemergence															
5	Barley	0	35	0	0	35	10	20	5	0	5	15	0	10	0
	Bermudagrass	70	95	90	85	95	95	95	95	80	100	95	90	70	90
	Blackgrass	5	65	40	0	20	10	30	15	5	40	50	35	10	30
	Bromegrass, Downy	5	90	-	0	30	15	40	5	5	30	10	5	15	10
	Canarygrass	40	95	35	0	50	45	60	30	10	10	25	35	30	20
10	Chickweed	100	100	98	98	98	95	98	98	98	98	100	100	100	100
	Cocklebur	100	-	100	98	90	-	70	98	-	-	-	100	85	95
	Corn	35	85	25	65	65	20	65	95	15	55	65	25	35	25
	Crabgrass, Large	65	95	85	75	98	98	90	95	75	80	95	80	75	75
	Cupgrass, Woolly	98	95	95	85	85	95	90	98	70	95	85	45	65	95
15	Deadnettle	100	70	100	98	90	80	98	100	98	100	90	70	75	100
	Foxtail, Giant	85	95	95	85	85	90	80	95	100	85	90	75	75	95
	Foxtail, Green	50	95	85	98	70	90	90	100	35	65	90	65	70	90
	Galium	65	80	-	80	90	90	75	90	85	80	85	80	90	85
	Goosegrass	70	85	85	80	85	90	85	90	70	85	90	55	65	80
20	Johnsongrass	85	-	75	90	65	80	98	98	50	75	65	45	70	80
	Kochia	65	100	98	80	85	98	85	85	90	98	100	75	15	75
	Lambsquarters	100	100	98	100	100	100	98	98	100	100	100	98	95	100
	Morningglory	100	100	100	100	98	90	100	100	95	100	100	100	80	100
	Nutsedge, Yellow	55	65	75	35	90	70	80	45	75	15	70	50	35	80
25	Oat, Wild	45	80	10	0	60	40	30	30	0	15	15	25	35	20
	Pigweed	100	100	98	95	95	95	98	95	100	100	100	100	90	100
	Ragweed	100	100	98	100	100	95	95	100	100	100	100	100	65	98
	Ryegrass, Italian	0	70	0	0	25	5	0	0	0	5	10	10	20	0
	Soybean	100	98	85	95	95	95	85	95	85	100	100	95	95	98
30	Surinam Grass	85	100	80	75	80	75	85	95	60	75	70	75	70	75
	Velvetleaf	75	100	90	75	95	95	80	90	100	80	98	100	95	95
	Wheat	0	85	0	0	55	55	15	25	0	10	15	35	25	35
	Windgrass	50	98	60	40	50	30	85	70	10	10	40	50	40	30
Table B		Compounds													
31 g ai/ha		1	3	4	5	6	7	8	10	11	12	14	15	16	17
Postemergence															
35	Barley	-	0	0	0	0	20	0	0	0	0	0	0	0	0
	Bermudagrass	70	55	60	65	35	85	95	80	70	5	55	75	70	25

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	Blackgrass	45	40	20	5	5	60	10	5	50	-	5	0	0	5
	Bromegrass, Downy	55	0	5	0	0	-	25	5	20	10	35	40	5	10
	Canarygrass	85	45	60	25	5	45	25	5	30	35	5	35	35	20
	Chickweed	100	100	100	95	98	100	100	100	98	100	100	100	98	100
5	Cocklebur	-	98	98	90	90	-	98	98	100	95	95	98	80	100
	Corn	45	40	60	65	20	80	5	10	15	65	15	5	5	15
	Crabgrass, Large	85	75	80	75	65	98	80	80	70	15	75	65	65	75
	Cupgrass, Woolly	75	75	75	80	75	100	75	45	55	70	80	85	95	95
	Deadnettle	45	95	70	95	60	85	80	100	100	100	100	100	100	100
10	Foxtail, Giant	95	80	70	80	75	95	80	70	85	80	75	75	75	80
	Foxtail, Green	70	80	85	60	45	100	35	25	60	50	40	40	35	40
	Galium	85	60	80	40	45	70	25	70	50	50	75	40	50	80
	Goosegrass	80	75	65	75	65	100	75	75	75	75	65	65	70	40
	Johnsongrass	75	85	80	80	85	90	80	20	65	60	75	95	60	70
15	Kochia	40	10	20	5	5	85	70	75	60	5	50	10	5	75
	Lambsquarters	100	100	98	98	80	100	98	100	100	100	100	98	90	100
	Morningglory	100	85	98	95	95	98	90	98	100	98	95	100	85	100
	Nutsedge, Yellow	65	70	45	70	10	75	75	80	70	75	75	40	15	85
	Oat, Wild	80	55	45	25	10	45	40	0	5	40	45	40	45	50
20	Pigweed	100	100	95	98	95	100	80	100	90	98	100	95	95	100
	Ragweed	98	100	100	90	98	100	100	100	100	100	100	100	60	100
	Ryegrass, Italian	15	25	30	0	0	5	0	0	15	10	5	5	10	0
	Soybean	100	95	95	95	90	100	95	98	98	98	98	98	98	100
	Surinam Grass	75	75	75	55	70	100	75	25	20	60	70	75	70	65
25	Velvetleaf	85	75	60	75	70	90	60	80	60	80	80	65	70	80
	Wheat	20	0	0	0	0	30	15	0	10	0	5	0	0	0
	Windgrass	55	25	50	5	0	60	60	5	50	30	45	55	30	25
	Table B	Compounds													
	31 g ai/ha	18	19	20	21	22	23	24	25	26	28	29	30	31	32
30	Postemergence														
	Barley	0	30	0	0	10	0	0	0	0	0	5	0	0	0
	Bermudagrass	70	85	75	85	90	95	80	95	75	80	85	80	65	85
	Blackgrass	0	60	10	0	5	10	10	10	0	30	15	35	5	0
	Bromegrass, Downy	5	80	-	0	5	10	10	0	0	10	5	5	5	5
35	Canarygrass	35	95	5	0	45	25	10	10	0	5	10	30	30	10
	Chickweed	100	100	90	98	98	95	55	95	98	85	100	100	85	100
	Cocklebur	98	-	-	90	90	-	0	-	-	-	-	98	80	85

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

Table B

Compounds

16 g ai/ha

10 11 17

Postemergence

Barley

0 0 0

Bermudagrass

75 65 10

Blackgrass

5 50 0

Bromegrass, Downy

0 5 10

Canarygrass

0 15 15

Chickweed

98 95 100

Cocklebur

95 90 100

Corn

5 5 5

Crabgrass, Large

70 60 60

Cupgrass, Woolly

20 55 95

Deadnettle

95 100 100

Foxtail, Giant

65 75 75

Table B

Compounds

8 g ai/ha

11 17

Postemergence

Barley

0 0

Bermudagrass

55 5

Blackgrass

0 0

Bromegrass, Downy

5 5

Canarygrass

5 5

Chickweed

50 100

Cocklebur

90 100

Corn

0 0

Crabgrass, Large

45 55

Cupgrass, Woolly

15 75

Deadnettle

90 100

Foxtail, Giant

70 70

Foxtail, Green	10	40	35
Galium	30	50	55
Goosegrass	75	60	5
Johnsongrass	5	45	60
Kochia	75	55	45
Lambsquarters	100	85	100
Morningglory	65	85	100
Nutsedge, Yellow	70	60	85
Oat, Wild	0	0	45
Pigweed	85	85	100
Ragweed	100	98	100
Ryegrass, Italian	0	5	0
Soybean	95	95	100
Surinam Grass	15	0	45
Velvetleaf	80	15	80
Wheat	0	5	0
Windgrass	5	10	10

Foxtail, Green	25	10
Galium	50	45
Goosegrass	35	5
Johnsongrass	10	60
Kochia	55	25
Lambsquarters	85	100
Morningglory	85	85
Nutsedge, Yellow	45	80
Oat, Wild	0	40
Pigweed	85	100
Ragweed	90	65
Ryegrass, Italian	0	0
Soybean	85	90
Surinam Grass	0	25
Velvetleaf	10	75
Wheat	0	0
Windgrass	5	5

Table B	Compounds		
250 g ai/ha	7	14	25
Preemergence			
Bermudagrass	100	100	100
Blackgrass	85	5	5
Bromegrass, Downy	15	45	0
Cocklebur	100	100	-
Corn	25	25	0
Crabgrass, Large	100	100	100
Cupgrass, Woolly	95	98	95
Foxtail, Giant	100	100	70
Foxtail, Green	100	70	70
Galium	95	98	90
Goosegrass	100	100	100
Johnsongrass	98	95	100
Kochia	98	100	100
Lambsquarters	100	100	100
Morningglory	98	100	-
Nightshade	100	100	98

Table B	Compounds		
125 g ai/ha	7	14	25
Preemergence			
Bermudagrass	100	100	100
Blackgrass	25	0	0
Bromegrass, Downy	0	5	0
Cocklebur	100	98	-
Corn	20	20	0
Crabgrass, Large	100	100	100
Cupgrass, Woolly	95	85	85
Foxtail, Giant	95	100	25
Foxtail, Green	98	40	0
Galium	95	95	90
Goosegrass	100	100	98
Johnsongrass	80	90	60
Kochia	95	100	98
Lambsquarters	100	100	100
Morningglory	80	100	-
Nightshade	100	100	98

Nutsedge, Yellow	95	95	70
Oat, Wild	10	55	0
Pigweed	100	100	100
Ragweed	100	100	100
Russian Thistle	95	100	90
Ryegrass, Italian	30	5	0
Soybean	95	98	90
Sunflower	98	98	98
Surinam Grass	95	100	98
Velvetleaf	100	100	-
Wheat	0	0	0

Nutsedge, Yellow	95	90	45
Oat, Wild	0	0	0
Pigweed	100	100	90
Ragweed	100	100	100
Russian Thistle	90	90	90
Ryegrass, Italian	0	0	0
Soybean	85	95	75
Sunflower	95	95	90
Surinam Grass	90	80	80
Velvetleaf	100	100	-
Wheat	0	0	0

Table B	Compounds		
62 g ai/ha	7	14	25
Preemergence			
Bermudagrass	100	98	100
Blackgrass	0	0	0
Bromegrass, Downy	0	5	0
Cocklebur	100	65	-
Corn	20	20	0
Crabgrass, Large	98	100	45
Cupgrass, Woolly	75	75	75
Foxtail, Giant	80	95	5
Foxtail, Green	90	5	0
Galium	85	90	85
Goosegrass	100	98	95
Johnsongrass	20	65	25
Kochia	90	80	90
Lambsquarters	100	100	100
Morningglory	65	98	-
Nightshade	100	100	98
Nutsedge, Yellow	95	85	5
Oat, Wild	0	0	0
Pigweed	100	100	85
Ragweed	100	100	100
Russian Thistle	90	90	85
Ryegrass, Italian	0	0	0

Table B	Compounds		
31 g ai/ha	7	14	25
Preemergence			
Bermudagrass	100	95	98
Blackgrass	0	0	0
Bromegrass, Downy	0	5	0
Cocklebur	100	45	-
Corn	0	5	0
Crabgrass, Large	95	95	5
Cupgrass, Woolly	45	30	70
Foxtail, Giant	75	75	0
Foxtail, Green	55	5	0
Galium	80	65	85
Goosegrass	98	95	75
Johnsongrass	0	15	0
Kochia	85	70	70
Lambsquarters	100	100	98
Morningglory	0	5	-
Nightshade	100	98	95
Nutsedge, Yellow	95	65	0
Oat, Wild	0	0	0
Pigweed	100	100	75
Ragweed	100	100	85
Russian Thistle	85	85	80
Ryegrass, Italian	0	0	0

Soybean	80	80	60	Soybean	5	75	0
Sunflower	85	85	80	Sunflower	60	65	70
Surinam Grass	90	60	40	Surinam Grass	45	45	0
Velvetleaf	85	100	-	Velvetleaf	50	75	-
Wheat	0	0	0	Wheat	0	0	0

TEST C

Seeds of plant species selected from bermudagrass (*Cynodon dactylon*), Surinam grass (*Brachiaria decumbens*), large crabgrass (*Digitaria sanguinalis*), green foxtail (*Setaria viridis*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), kochia (*Kochia scoparia*), morningglory (pitted morningglory, *Ipomoea lacunosa*), purple nutsedge (*Cyperus rotundus*), ragweed (common ragweed, *Ambrosia elatior*), black mustard (*Brassica nigra*), guineagrass (*Panicum maximum*), barnyardgrass (*Echinochloa crus-galli*), sandbur (southern sandbur, *Cenchrus echinatus*), prickly sida (*Sida spinosa*), Italian ryegrass (*Lolium multiflorum*), purslane (common purslane, *Portulaca oleracea*), signalgrass (broadleaf signalgrass, *Brachiaria platyphylla*), groundsel (common groundsel, *Senecio vulgaris*), chickweed (common chickweed, *Stellaria media*), dayflower (Virginia (VA) dayflower, *Commelina virginica*), bluegrass (annual bluegrass, *Poa annua*), itchgrass (*Rottboellia cochinchinensis*), quackgrass (*Elytrigia repens*), field bindweed (*Convolvulus arvensis*), spanishneedles (*Bidens bipinnata*), mallow (common mallow, *Malva sylvestris*), and Russian thistle (*Salsola kali*) were planted into a blend of loam soil and sand and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. At the same time, plants from these weed species were treated with postemergence applications of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

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 C, are based on a scale of 0 to 100 where 0 is no effect and 100 is complete control. A dash (–) response means no test result.

Table C	Compound	Table C	Compounds
250 g ai/ha	25	125 g ai/ha	19 25
Postemergence		Postemergence	
Barnyardgrass	90	Barnyardgrass	90 80
Bermudagrass	95	Bermudagrass	90 90
Black Mustard	95	Black Mustard	95 95
Bluegrass	70	Bluegrass	75 60
Chickweed	95	Chickweed	100 95

Crabgrass, Large	80	Crabgrass, Large	75	80
Dayflower, VA	95	Dayflower, VA	60	90
Field Bindweed	75	Field Bindweed	60	70
Foxtail, Green	90	Foxtail, Green	90	80
Goosegrass	70	Goosegrass	70	70
Groundsel	100	Groundsel	95	100
Guineagrass	90	Guineagrass	80	80
Itchgrass	85	Itchgrass	70	75
Johnsongrass	85	Johnsongrass	85	80
Kochia	70	Kochia	70	50
Mallow	60	Mallow	70	50
Morningglory	90	Morningglory	90	90
Nutsedge, Purple	10	Nutsedge, Purple	60	0
Prickly Sida	40	Prickly Sida	50	40
Purslane	60	Purslane	60	60
Quackgrass	40	Quackgrass	75	30
Ragweed	95	Ragweed	90	95
Ryegrass, Italian	0	Russian Thistle	95	95
Sandbur	85	Ryegrass, Italian	50	0
Signalgrass	90	Sandbur	85	75
Surinam Grass	90	Signalgrass	90	85
		Spanishneedles	-	90
		Surinam Grass	90	85

Table C	Compounds	Table C	Compounds
62 g ai/ha	19 25	31 g ai/ha	19 25
Postemergence		Postemergence	
Barnyardgrass	85 80	Barnyardgrass	85 75
Bermudagrass	80 75	Bermudagrass	70 75
Black Mustard	80 85	Black Mustard	80 50
Bluegrass	70 30	Bluegrass	50 10
Chickweed	95 80	Chickweed	95 75
Crabgrass, Large	70 75	Crabgrass, Large	70 60
Dayflower, VA	50 70	Dayflower, VA	50 60
Field Bindweed	50 70	Field Bindweed	50 -
Foxtail, Green	85 70	Foxtail, Green	80 -
Goosegrass	70 60	Goosegrass	65 50

Groundsel	95	100	Groundsel	90	95
Guineagrass	60	80	Guineagrass	50	55
Itchgrass	65	65	Itchgrass	50	40
Johnsongrass	70	80	Johnsongrass	60	75
Kochia	60	40	Kochia	50	30
Mallow	70	50	Mallow	50	50
Morningglory	90	80	Morningglory	85	75
Nutsedge, Purple	60	0	Nutsedge, Purple	50	0
Prickly Sida	30	20	Prickly Sida	30	20
Purslane	50	50	Purslane	50	40
Quackgrass	70	10	Quackgrass	50	5
Ragweed	90	90	Ragweed	80	90
Russian Thistle	90	70	Russian Thistle	20	-
Ryegrass, Italian	30	0	Ryegrass, Italian	15	-
Sandbur	75	70	Sandbur	70	60
Signalgrass	90	80	Signalgrass	80	75
Spanishneedles	95	85	Spanishneedles	85	-
Surinam Grass	80	80	Surinam Grass	80	75

TEST D

Seeds of plant species selected from bird's-eye speedwell (*Veronica persica*), bluegrass (annual bluegrass, *Poa annua*), blackgrass (*Alopecurus myosuroides*), canarygrass (*Phalaris minor*), chickweed (common chickweed, *Stellaria media*), galium (catchweed
5 bedstraw, *Galium aparine*), downy brome (grass (*Bromus tectorum*), field poppy (*Papaver rhoeas*), field violet (*Viola arvensis*), green foxtail (*Setaria viridis*), deadnettle (henbit deadnettle, *Lamium amplexicaule*), Italian ryegrass (*Lolium multiflorum*), kochia (*Kochia scoparia*), lambsquarters (*Chenopodium album*), oilseed rape (*Brassica napus*), pigweed (*Amaranthus retroflexus*), Russian thistle (*Salsola iberica*), scentless chamomile (*Matricaria inodora*), spring barley (*Hordeum vulgare*), spring wheat (*Triticum aestivum*), wild
10 buckwheat (*Polygonum convolvulus*), wild mustard (*Sinapis arvensis*), wild oat (*Avena fatua*), wild radish (*Raphanus raphanistrum*), windgrass (*Apera spica-venti*), winter barley (*Hordeum vulgare*), and winter wheat (*Triticum aestivum*) were planted and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which
15 included a surfactant. At the same time, plants from these crop and weed species were treated with postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage).

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 no effect and 100 is complete control. A dash (–) response means no test result.

Table D		Compounds												
125 g ai/ha		3	4	5	7	21	24	25	26	28	29	30	31	32
5	Postemergence													
	Barley, Spring	30	25	10	80	0	20	20	10	10	20	20	35	25
	Barley, Winter	40	30	35	35	10	25	10	10	5	10	20	30	20
	Blackgrass	100	60	50	80	25	35	20	30	40	15	80	30	40
	Bluegrass	85	85	75	90	40	30	30	20	60	10	45	50	30
10	Bromegrass, Downy	35	25	40	65	15	10	35	10	20	10	40	35	50
	Buckwheat, Wild	55	70	90	100	80	75	80	100	35	100	85	85	75
	Canarygrass	100	100	95	100	20	40	30	10	20	10	70	90	70
	Chamomile	100	100	100	100	100	100	100	100	98	100	100	90	100
	Chickweed	100	100	98	100	85	100	90	100	90	95	100	95	85
15	Deadnettle	100	100	100	100	100	95	100	98	100	100	100	90	90
	Field Poppy	85	100	70	70	90	40	85	95	100	60	90	70	100
	Field Violet	100	100	100	100	80	100	95	100	–	100	100	85	70
	Foxtail, Green	100	95	95	100	100	75	90	80	80	40	90	85	100
	Galium	90	85	80	85	75	75	75	90	75	75	85	90	90
20	Kochia	50	45	55	95	80	95	85	95	85	100	85	85	95
	Lambsquarters	95	98	90	100	90	100	90	98	85	100	98	85	95
	Mustard, Wild	100	90	100	100	85	90	85	95	80	75	100	95	95
	Oat, Wild	100	100	75	90	20	20	60	10	25	15	65	60	30
	Oilseed Rape	100	95	100	100	90	80	80	100	85	95	100	80	100
25	Pigweed	100	95	100	100	85	100	95	100	90	100	80	75	75
	Radish, Wild	100	100	100	100	80	75	80	98	90	80	100	85	100
	Russian Thistle	75	40	95	90	80	95	90	90	90	100	80	70	100
	Ryegrass, Italian	35	40	15	40	10	0	0	10	15	10	25	50	10
	Speedwell	100	100	100	100	100	85	100	90	100	100	100	100	100
30	Wheat, Spring	35	25	10	15	10	20	10	10	45	15	40	45	50
	Wheat, Winter	35	25	15	20	15	10	10	10	25	10	40	60	60
	Windgrass	90	90	60	85	55	85	75	35	30	15	60	35	75
Table D		Compounds												
62 g ai/ha		3	4	5	7	21	24	25	26	28	29	30	31	32
35	Postemergence													
	Barley, Spring	25	20	5	10	0	15	10	0	5	10	10	15	10
	Barley, Winter	30	20	25	25	5	10	5	0	0	10	0	20	5

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	Blackgrass	95	60	40	50	5	20	10	5	20	5	40	20	20
	Bluegrass	75	80	60	70	15	15	20	15	20	10	35	40	20
	Bromegrass, Downy	35	20	25	35	15	10	25	10	20	5	40	25	40
	Buckwheat, Wild	35	40	80	98	80	75	75	95	25	80	85	80	50
5	Canarygrass	100	100	85	90	10	20	20	5	10	5	40	70	50
	Chamomile	100	98	98	100	95	90	90	100	90	95	100	90	100
	Chickweed	98	100	95	98	80	100	90	90	75	95	90	75	85
	Deadnettle	100	90	100	100	98	95	95	98	90	70	98	80	90
	Field Poppy	40	98	70	70	85	40	80	85	98	50	80	60	100
10	Field Violet	100	100	100	100	70	100	75	95	-	95	80	80	60
	Foxtail, Green	90	85	90	100	90	70	80	65	70	40	80	80	95
	Galium	85	85	70	85	70	60	70	80	75	60	85	85	85
	Kochia	30	25	50	85	50	85	80	90	75	100	80	95	95
	Lambsquarters	95	90	90	100	90	100	80	98	85	100	85	85	85
15	Mustard, Wild	98	80	100	100	80	80	75	90	80	60	95	65	95
	Oat, Wild	98	85	30	90	15	10	20	10	20	5	30	20	25
	Oilseed Rape	100	80	85	100	75	75	75	85	80	80	95	75	75
	Pigweed	85	100	95	100	85	100	90	95	80	100	95	75	75
	Radish, Wild	100	80	100	100	60	70	70	90	90	75	100	75	85
20	Russian Thistle	75	40	80	75	70	75	90	85	85	100	60	50	90
	Ryegrass, Italian	25	20	10	40	0	0	0	5	10	0	10	30	10
	Speedwell	100	100	100	100	100	65	100	30	100	75	95	100	100
	Wheat, Spring	20	15	10	15	10	10	5	5	25	15	25	35	40
	Wheat, Winter	25	20	10	10	10	5	5	5	25	5	30	30	35
25	Windgrass	60	55	40	60	35	65	35	10	20	5	35	35	35
Table D		Compounds												
	31 g ai/ha	3	5	7	21	24	25	26	28	29	30	31	32	
Postemergence														
	Barley, Spring	15	5	10	0	10	5	0	0	0	0	10	0	
30	Barley, Winter	30	10	15	0	5	0	0	0	0	0	5	0	
	Blackgrass	70	30	30	5	0	0	0	10	0	20	10	15	
	Bluegrass	70	30	40	0	10	10	5	10	10	10	20	20	
	Bromegrass, Downy	30	20	20	10	10	5	0	15	0	20	15	30	
	Buckwheat, Wild	25	60	80	75	40	75	85	15	70	75	75	30	
35	Canarygrass	90	60	70	0	15	10	0	10	0	20	50	30	
	Chamomile	98	85	100	90	85	60	100	75	90	100	-	98	
	Chickweed	90	85	95	70	95	90	85	65	90	80	70	80	

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	Deadnettle	100	100	100	85	90	80	85	80	70	85	70	80	
	Field Poppy	50	60	60	85	40	60	80	85	50	80	60	95	
	Field Violet	100	90	100	70	95	60	95	--	90	80	40	--	
	Foxtail, Green	85	70	98	75	50	20	35	60	40	75	65	80	
5	Galium	85	60	80	60	50	65	75	75	55	80	80	85	
	Kochia	25	30	75	25	70	75	85	50	100	50	35	70	
	Lambsquarters	85	90	90	85	75	70	95	80	90	90	75	85	
	Mustard, Wild	95	90	100	50	50	65	80	80	50	90	45	85	
	Oat, Wild	90	10	30	5	10	10	5	15	0	15	10	10	
10	Oilseed Rape	80	80	100	70	50	70	85	50	75	85	50	60	
	Pigweed	80	85	98	70	95	80	95	70	100	75	70	65	
	Radish, Wild	98	95	100	60	35	70	90	65	60	95	70	85	
	Russian Thistle	60	80	65	30	75	80	80	75	80	40	50	70	
	Ryegrass, Italian	20	0	10	0	0	0	0	10	0	0	20	0	
15	Speedwell	100	100	100	100	60	90	20	75	60	95	100	100	
	Wheat, Spring	15	5	10	0	10	0	0	10	5	10	5	25	
	Wheat, Winter	15	5	5	5	5	0	0	10	0	15	10	15	
	Windgrass	50	20	35	15	40	25	0	10	0	20	10	25	
	Table D	Compounds												
20	16 g ai/ha	3	4	5	7	21	24	25	26	28	29	30	31	32
	Postemergence													
	Barley, Spring	10	5	5	5	0	0	0	0	0	0	0	5	0
	Barley, Winter	0	5	10	5	0	0	0	0	0	0	0	0	0
	Blackgrass	60	5	10	30	0	0	0	0	0	0	5	0	0
25	Bluegrass	60	35	20	15	0	10	0	0	0	0	10	10	5
	Bromegrass, Downy	20	10	10	15	0	10	0	0	0	0	10	5	10
	Buckwheat, Wild	20	20	50	50	70	25	75	85	20	40	50	45	20
	Canarygrass	70	70	25	25	0	15	0	0	5	0	10	30	10
	Chamomile	90	90	50	100	90	85	50	80	60	80	100	70	90
30	Chickweed	80	85	85	85	60	95	70	85	50	80	70	60	75
	Deadnettle	95	85	95	100	85	90	60	85	75	60	85	65	75
	Field Poppy	10	85	60	60	85	40	50	70	85	40	40	50	90
	Field Violet	100	90	85	95	60	90	50	80	--	75	80	40	50
	Foxtail, Green	80	0	55	80	75	0	10	5	55	20	75	55	70
35	Galium	80	65	60	75	60	50	60	75	60	50	75	80	80
	Kochia	20	10	20	55	20	70	75	65	45	90	40	20	50
	Lambsquarters	75	80	85	70	85	60	70	80	75	75	85	75	80

	Mustard, Wild	95	60	95	98	50	30	60	75	50	20	60	30	65
	Oat, Wild	55	40	10	10	0	10	0	0	5	0	5	0	5
	Oilseed Rape	75	70	75	98	50	50	60	80	40	75	75	20	30
	Pigweed	80	70	85	90	70	95	80	90	70	90	65	70	65
5	Radish, Wild	85	80	90	100	40	30	35	85	35	50	80	40	50
	Russian Thistle	50	30	50	55	30	75	40	75	60	60	35	50	50
	Ryegrass, Italian	10	0	0	0	0	0	0	0	5	0	0	0	0
	Speedwell	100	100	100	100	100	30	90	20	70	50	80	85	100
	Wheat, Spring	0	5	0	5	0	0	0	0	5	0	0	5	5
10	Wheat, Winter	10	10	0	5	0	0	0	0	0	0	5	5	5
	Windgrass	20	35	20	25	0	25	10	0	0	0	10	5	15

TEST E

Seeds of plant species selected from corn (*Zea mays*), soybean (*Glycine max*), velvetleaf (*Abutilon theophrasti*), lambsquarters (*Chenopodium album*), wild poinsettia (15 *Euphorbia heterophylla*), palmer pigweed (*Amaranthus palmeri*), common waterhemp (*Amaranthus rudis*), resistant common waterhemp (ALS & HPPD resistant, *Amaranthus rudis*), ladythumb smartweed (*Polygonum persicaria*), surinam grass (*Brachiaria decumbens*), large crabgrass (*Digitaria sanguinalis*), Brazilian crabgrass (*Digitaria horizontalis*), fall panicum (*Panicum dichotomiflorum*), giant foxtail (*Setaria faberii*), green (20 *foxtail* (*Setaria viridis*), goosegrass (*Eleusine indica*), johnsongrass (*Sorghum halepense*), ragweed (common ragweed, *Ambrosia elatior*), barnyardgrass (*Echinochloa crus-galli*), sandbur (southern sandbur, *Cenchrus echinatus*), arrowleaf sida (*Sida rhombifolia*), Italian ryegrass (*Lolium multiflorum*), dayflower (Virginia (VA) dayflower, *Commelina virginica*), field bindweed (*Convolvulus arvensis*), cocklebur (common cocklebur, *Xanthium strumarium*), morningglory (*Ipomoea coccinea*), nightshade (eastern black nightshade, (25 *Solanum ptycanthum*), kochia (*Kochia scoparia*), yellow nutsedge (*Cyperus esculentus*), and hairy beggarticks (*Bidens pilosa*), were planted into a silt loam soil and treated preemergence with test chemicals formulated in a non-phytotoxic solvent mixture which included a surfactant. At the same time, plants from these crop and weed species were treated with (30 postemergence applications of some of the test chemicals formulated in the same manner. Plants ranged in height from 2 to 18 cm (1- to 4-leaf stage) for postemergence treatments.

Treated plants and controls were maintained in a greenhouse for 14 to 21 days, after which time all species were compared to controls and visually evaluated. Plant response ratings, summarized in Table E, are based on a scale of 0 to 100 where 0 is no effect and 100 (35 is complete control. A dash (–) response means no test result.

Table E	Compound	Table E	Compound
250 g ai/ha	15	125 g ai/ha	15

Postemergence

Barnyardgrass	98
Beggarticks	100
Corn	50
Crabgrass, Brazil	95
Dayflower, VA	95
Field Bindweed	85
Panicum, Fall	95
Pigweed, Palmer	100
Poinsettia, Wild	100
Ryegrass, Italian	0
Sandbur	75
Sida, Arrowleaf	98
Soybean	98
Waterhemp	100
Waterhemp, Res	95

Postemergence

Barnyardgrass	98
Beggarticks	100
Corn	35
Crabgrass, Brazil	80
Dayflower, VA	75
Field Bindweed	80
Panicum, Fall	90
Pigweed, Palmer	100
Poinsettia, Wild	95
Ryegrass, Italian	0
Sandbur	60
Sida, Arrowleaf	95
Soybean	98
Waterhemp	98
Waterhemp, Res	95

Table E

Compounds

62 g ai/ha	1	15
Postemergence		
Barnyardgrass	80	95
Beggarticks	90	98
Corn	30	15
Crabgrass, Brazil	65	80
Dayflower, VA	70	75
Field Bindweed	70	60
Panicum, Fall	95	75
Pigweed, Palmer	100	100
Poinsettia, Wild	80	85
Ryegrass, Italian	20	0
Sandbur	50	35
Sida, Arrowleaf	80	90
Smartweed	100	-
Soybean	100	95
Waterhemp	98	98
Waterhemp, Res	80	85

Table E

Compounds

31 g ai/ha	1	15
Postemergence		
Barnyardgrass	70	90
Beggarticks	80	95
Corn	25	5
Crabgrass, Brazil	60	60
Dayflower, VA	60	65
Field Bindweed	60	50
Panicum, Fall	95	75
Pigweed, Palmer	95	98
Poinsettia, Wild	80	-
Ryegrass, Italian	10	0
Sandbur	45	0
Sida, Arrowleaf	65	80
Smartweed	95	-
Soybean	95	95
Waterhemp	90	98
Waterhemp, Res	80	75

Table E	Compounds	
16 g ai/ha	1	15
Postemergence		
Barnyardgrass	50	75
Beggarticks	75	75
Corn	20	0
Crabgrass, Brazil	50	50
Dayflower, VA	50	15
Field Bindweed	40	50
Panicum, Fall	75	35
Pigweed, Palmer	95	95
Poinsettia, Wild	70	75
Ryegrass, Italian	10	0
Sandbur	40	0
Sida, Arrowleaf	60	70
Smartweed	90	-
Soybean	95	95
Waterhemp	85	95
Waterhemp, Res	60	70

Table E	Compound
8 g ai/ha	1
Postemergence	
Barnyardgrass	30
Beggarticks	60
Corn	5
Crabgrass, Brazil	40
Dayflower, VA	40
Field Bindweed	40
Panicum, Fall	60
Pigweed, Palmer	95
Poinsettia, Wild	50
Ryegrass, Italian	0
Sandbur	30
Sida, Arrowleaf	50
Smartweed	70
Soybean	95
Waterhemp	75
Waterhemp, Res	50

Table E	Compound
4 g ai/ha	1
Postemergence	
Barnyardgrass	20
Beggarticks	55
Corn	0
Crabgrass, Brazil	30
Dayflower, VA	30
Field Bindweed	30
Panicum, Fall	40
Pigweed, Palmer	85

Table E	Compound
4 g ai/ha	1
Postemergence	
Poinsettia, Wild	30
Ryegrass, Italian	0
Sandbur	20
Sida, Arrowleaf	50
Smartweed	60
Soybean	85
Waterhemp	70
Waterhemp, Res	50

Table E	Compounds	
250 g ai/ha	14	25
Preemergence		
Barnyardgrass	65	0

Table E	Compounds	
125 g ai/ha	14	25
Preemergence		
Barnyardgrass	-	0

Cocklebur	100	98
Corn	0	0
Crabgrass, Brazil	98	95
Crabgrass, Large	100	95
Dayflower, VA	-	25
Field Bindweed	100	65
Foxtail, Giant	-	30
Foxtail, Green	20	20
Goosegrass	98	98
Johnsongrass	98	85
Kochia	98	65
Lambsquarters	100	98
Morningglory	95	90
Nightshade	100	100
Nutsedge, Yellow	95	50
Panicum, Fall	-	98
Pigweed, Palmer	100	100
Poinsettia, Wild	98	75
Ragweed	100	98
Ryegrass, Italian	0	0
Sandbur	90	0
Sida, Arrowleaf	10	0
Soybean	90	60
Surinam Grass	98	95
Velvetleaf	95	35
Waterhemp	100	100

Table E	Compounds	
62 g ai/ha	14	25
Preemergence		
Barnyardgrass	0	0
Cocklebur	10	50
Corn	0	0
Crabgrass, Brazil	90	60
Crabgrass, Large	90	0
Dayflower, VA	-	0
Field Bindweed	0	0

Cocklebur	-	95
Corn	0	0
Crabgrass, Brazil	98	90
Crabgrass, Large	100	20
Dayflower, VA	80	-
Field Bindweed	35	5
Foxtail, Giant	0	20
Foxtail, Green	15	20
Goosegrass	80	98
Johnsongrass	70	85
Kochia	98	35
Lambsquarters	100	98
Morningglory	90	65
Nightshade	100	100
Nutsedge, Yellow	85	10
Panicum, Fall	100	75
Pigweed, Palmer	100	100
Poinsettia, Wild	95	0
Ragweed	100	90
Ryegrass, Italian	0	0
Sandbur	50	0
Sida, Arrowleaf	0	0
Soybean	70	50
Surinam Grass	75	50
Velvetleaf	85	0
Waterhemp	100	100

Table E	Compounds	
31 g ai/ha	14	25
Preemergence		
Barnyardgrass	0	0
Corn	0	0
Crabgrass, Brazil	25	10
Crabgrass, Large	90	0
Dayflower, VA	-	0
Field Bindweed	0	0
Foxtail, Giant	0	0

Foxtail, Giant	-	0
Foxtail, Green	10	10
Goosegrass	80	60
Johnsongrass	40	70
Kochia	50	0
Lambsquarters	100	98
Morningglory	70	15
Nightshade	100	-
Nutsedge, Yellow	70	5
Panicum, Fall	50	5
Pigweed, Palmer	100	100
Poinsettia, Wild	60	0
Ragweed	100	90
Ryegrass, Italian	0	0
Sandbur	0	0
Sida, Arrowleaf	0	0
Soybean	30	0
Surinam Grass	20	25
Velvetleaf	80	0
Waterhemp	100	98

Foxtail, Green	10	0
Goosegrass	65	5
Johnsongrass	5	20
Kochia	0	0
Lambsquarters	98	98
Morningglory	70	5
Nightshade	100	0
Nutsedge, Yellow	10	5
Panicum, Fall	0	0
Pigweed, Palmer	100	100
Poinsettia, Wild	10	-
Ragweed	70	60
Ryegrass, Italian	0	0
Sandbur	0	0
Sida, Arrowleaf	0	0
Soybean	20	0
Surinam Grass	10	0
Velvetleaf	65	0
Waterhemp	0	0

Table E	Compounds	
16 g ai/ha	14	25
Preemergence		
Barnyardgrass	0	0
Cocklebur	-	0
Corn	0	0
Crabgrass, Brazil	0	0
Crabgrass, Large	25	0
Dayflower, VA	0	0
Field Bindweed	0	0
Foxtail, Giant	0	0
Foxtail, Green	0	0
Goosegrass	0	5
Johnsongrass	0	0
Kochia	0	0
Lambsquarters	98	98

Table E	Compounds	
16 g ai/ha	14	25
Preemergence		
Nightshade	95	-
Nutsedge, Yellow	0	0
Panicum, Fall	0	0
Pigweed, Palmer	100	-
Poinsettia, Wild	0	0
Ragweed	-	10
Ryegrass, Italian	0	0
Sandbur	0	0
Sida, Arrowleaf	0	0
Soybean	20	0
Surinam Grass	0	0
Velvetleaf	10	0
Waterhemp	0	0

Morningglory 50 5

TEST F

Three plastic pots (ca. 16-cm diameter) per rate were partially filled with sterilized Tama silt loam soil comprising a 35:50:15 ratio of sand, silt and clay and 2.6% organic matter. Separate plantings for each of the three pots were as follows. Seeds from the U.S. of monochoria (*Monochoria vaginalis*), smallflower umbrella sedge (*Cyperus difformis*), ricefield bulrush (*Scirpus mucronatus*), and purple redstem (*Ammannia coccinea*), were planted into one 16-cm pot for each rate. Seeds from the U.S. of rice flatsedge (*Cyperus iria*), bearded sprangletop (*Leptochloa fascicularis*), one stand of 9 or 10 water seeded rice seedlings (*Oryza sativa* cv. 'Japonica – M202'), and two stands of 3 or 4 transplanted rice seedlings (*Oryza sativa* cv. 'Japonica – M202') were planted into one 16-cm pot for each rate. Seeds from the U.S. of barnyardgrass (*Echinochloa crus-galli*), and late watergrass (*Echinochloa oryzicola*) were planted into one 16-cm pot for each rate. Plantings were sequential so that crop and weed species were at the 2.0 to 2.5-leaf stage at time of treatment.

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

At time of treatment, test pots were flooded to 3 cm above the soil surface, treated by application of test compounds directly to the paddy water, and then maintained at that water depth for the duration of the test. Effects of treatments on rice and weeds were visually evaluated by comparison to untreated controls after 21 days. Plant response ratings, summarized in Table F, 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 F	Compounds	Table F	Compounds
500 g ai/ha	7 19	250 g ai/ha	7 19
Flood		Flood	
Barnyardgrass	100 85	Barnyardgrass	85 55
Bulrush, Ricefield	100 100	Bulrush, Ricefield	85 100
Flatsedge, Rice	100 85	Flatsedge, Rice	80 85
Monochoria	90 100	Monochoria	80 100
Redstem	90 100	Redstem	75 100
Rice, Transplanted	100 40	Rice, Transplanted	45 20
Rice, Water Seeded	100 70	Rice, Water Seeded	60 25
Sedge, Umbrella	90 100	Sedge, Umbrella	85 100
Sprangletop, Brdd.	100 –	Sprangletop, Brdd.	100 –
Watergrass, Late	75 80	Watergrass, Late	30 0

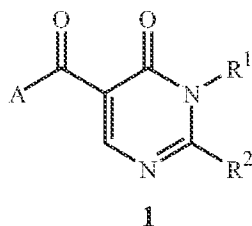
Table F	Compounds	
125 g ai/ha	7	19
Flood		
Barnyardgrass	40	0
Bulrush, Ricefield	75	100
Flatsedge, Rice	75	85
Monochoria	75	95
Redstem	0	0
Rice, Transplanted	20	0
Rice, Water Seeded	25	0
Sedge, Umbrella	85	95
Sprangletop, Brdd.	100	-
Watergrass, Late	20	0

Table F	Compounds	
64 g ai/ha	7	19
Flood		
Barnyardgrass	35	0
Bulrush, Ricefield	40	95
Flatsedge, Rice	40	85
Monochoria	20	85
Redstem	0	0
Rice, Transplanted	0	0
Rice, Water Seeded	0	0
Sedge, Umbrella	75	90
Sprangletop, Brdd.	75	-
Watergrass, Late	0	0

CLAIMS

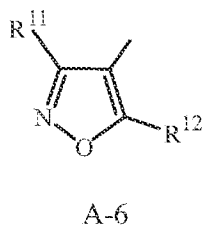
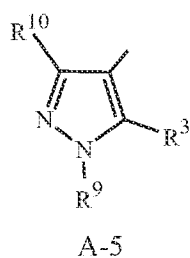
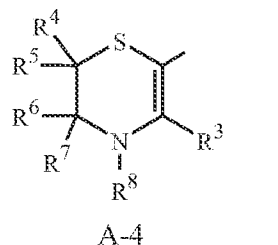
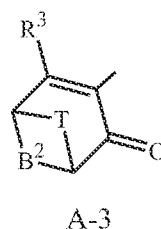
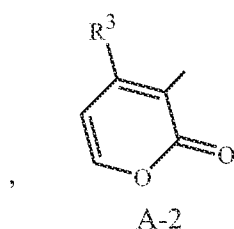
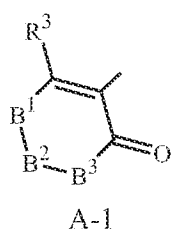
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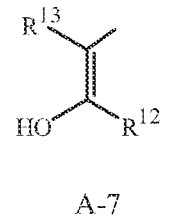


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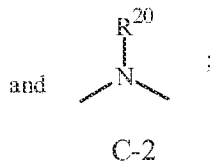
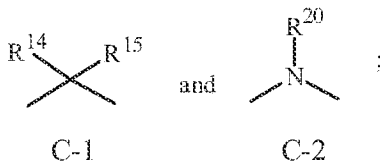
A is a radical selected from the group consisting of



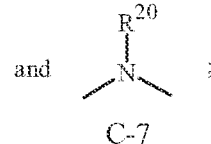
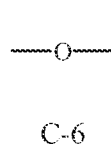
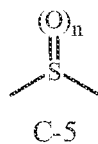
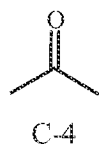
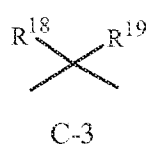
and



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



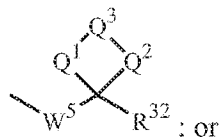
B² is a radical selected from the group consisting of



10

R¹ is

169



R^1 is $-\text{W}^1\text{C}(=\text{E}^1)\text{R}^{24}$, $-\text{W}^1\text{LC}(=\text{E}^2)\text{R}^{25}$, $-\text{W}^1\text{C}(=\text{E}^3)\text{LR}^{26}$, $-\text{W}^1\text{S}(\text{O})_x\text{NR}^{28}\text{C}(=\text{O})\text{R}^{27}$,
 $-\text{W}^1\text{S}(\text{O})_x\text{NR}^{28}\text{C}(=\text{O})\text{LR}^{27}$, $-\text{W}^1\text{S}(\text{O})_x\text{NR}^{28}\text{SO}_2\text{LR}^{27}$ or $-\text{W}^1\text{CN}$; or

R^1 is $\text{N}(\text{R}^{40})\text{R}^{41}$; or

5 R^1 is $-\text{G}^A$ or $-\text{W}^2\text{G}^A$;

each G^A is a 4- to 7-membered carbocyclic ring including ring members selected from
 $\text{C}(=\text{O})$, $\text{C}(=\text{S})$, $\text{C}(=\text{NR}^{29})$, $\text{C}(=\text{N}-\text{OR}^{30})$ or $\text{C}=\text{NN}(\text{R}^{29})_2$; or a 6- to 12-membered
saturated or partially saturated carbospirocyclic or heterospirocyclic ring system
optionally including ring members selected from $\text{C}(=\text{O})$, $\text{C}(=\text{S})$, $\text{C}(=\text{NR}^{29})$,
10 $\text{C}(=\text{N}-\text{OR}^{30})$, or $\text{C}=\text{NN}(\text{R}^{29})_2$, each ring or ring system optionally substituted
with up to five substituents selected from R^{21} on carbon ring members and R^{22}
on nitrogen ring members; or

each G^A is a 9-membered partially saturated fused ring system containing carbon ring
members and 2 nitrogen ring members, the ring optionally substituted with up to
15 2 substituents selected from R^{21} on carbon ring members and R^{22} on nitrogen
ring members;

each E^1 , E^2 , and E^3 is independently O, S, NR^{28} , NOR^{28} , $\text{NN}(\text{R}^{28})_2$, N-CN or N- NO_2 ;

each L is independently O, $\text{N}(\text{R}^{31})$ or S;

provided when E^3 is O, L is other than O;

20 each R^{24} , R^{25} , R^{26} and R^{27} is independently hydrogen; or C_1 - C_6 alkyl, C_2 - C_6 alkenyl,
 C_2 - C_6 alkynyl or C_3 - C_6 cycloalkyl each optionally substituted with one or more
substituents selected from the group consisting of halogen, CN, NO_2 , hydroxy,
 C_1 - C_4 alkoxy, C_1 - C_4 alkylsulfinyl, C_1 - C_4 alkylsulfonyl, C_1 - C_4 alkylamino,
 C_2 - C_8 dialkylamino, C_3 - C_6 cycloalkylamino and $(\text{C}_1$ - C_4 alkyl) C_3 - C_6
25 cycloalkylamino;

each R^{28} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;

each R^{29} is independently H, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkylcarbonyl,
 C_1 - C_6 alkylsulfonyl or C_1 - C_6 haloalkylsulfonyl;

each Q^1 and Q^2 is independently O, S or $\text{N}(\text{R}^{31})$;

30 Q^3 is C_1 - C_4 alkylene optionally substituted with up to 4 substituents selected from
 C_1 - C_6 alkyl, C_2 - C_6 alkenyl, C_2 - C_6 alkynyl and C_3 - C_6 cycloalkyl;

R^{30} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;

R^{31} is independently H, C_1 - C_6 alkyl or C_1 - C_6 haloalkyl;

R^{32} is H or C_1 - C_6 alkyl;

35 each x is 0, 1 or 2;

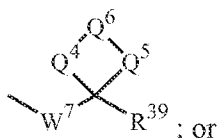
W⁵ is C₁-C₆ alkylene;

W¹ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene; or -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;

W² is C₁-C₆ alkylene;

- 5 R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to five substituents selected from R²¹; or -G or -W⁴G; 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-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, C₃-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



R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴, -W⁶C(=E⁶)L¹R³⁵, -W⁶S(O)_yNR³⁷C(=O)R³⁶ or -W⁶S(O)_yNR³⁷C(=O)L¹R³⁶;

each E⁴, E⁵, and E⁶ is independently O, S, NR³⁷, NOR³⁷, NN(R³⁷)₂, N-CN or N-NO₂;

each L¹ is independently O, N(R³⁸) or S;

each R³³, R³⁴, R³⁵ and R³⁶ is independently hydrogen; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₆ cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino and (C₁-C₄ alkyl)C₃-C₆ cycloalkylamino;

each R³⁷ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;

each Q⁴ and Q⁵ is independently O, S or N(R³⁸);

Q⁶ is C₁-C₄ alkylene optionally substituted with up to 4 substituents selected from

C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl and C₃-C₆ cycloalkyl;

R³⁸ is independently H, C₁-C₆ alkyl or C₁-C₆ haloalkyl;

R³⁹ is H or C₁-C₆ alkyl;

each y is 0, 1 or 2;

W⁷ is C₁-C₆ alkylene;

W⁶ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene; or -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;

W³ is C₁-C₆ alkylene, C₂-C₆ alkenylene or C₂-C₆ alkynylene;

W⁴ is C₁-C₆ alkylene;

R³ 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, C₃-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, -SF₃, -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;

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

5 R⁴⁰ is C₁-C₆ alkyl; and

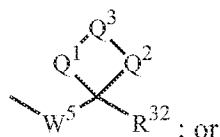
R⁴¹ is C₁-C₆ alkyl; or

R⁴⁰ and R⁴¹ are taken together as -(CH₂)₄-, -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

2. A compound of Claim 1 wherein

10 A is A-1, A-3, A-4, A-5 or A-6;

R¹ is



R¹ is -W¹C(=E¹)R²⁴, -W¹LC(=E²)R²⁵ or -W¹C(=E³)LR²⁶; or

R¹ is N(R⁴⁰)R⁴¹; or

15 R¹ is G^A or -W²G^A;

G^A is a 9- to 11-membered saturated or partially saturated carbospirocyclic or heterospirocyclic ring system optionally including ring members selected from C(=O), C(=N-OR³⁰) or C=NN(R²⁹), each ring or ring system optionally substituted with up to three substituents selected from R²¹ on carbon ring members and R²² on nitrogen ring members; or

20 each G^A is a 9-membered partially saturated fused ring system containing carbon ring members and 2 nitrogen ring members, the ring substituted with 1 substituent selected from R²² on one nitrogen ring member;

each E¹, E² and E³ is independently O, NOR²⁸ or NN(R²⁸)₂;

25 L is independently O or N(R³¹);

each R²⁴, R²⁵ and R²⁶ is independently hydrogen; or C₁-C₄ alkyl or C₃-C₅ cycloalkyl each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl and C₁-C₄ alkylsulfonyl;

30 each R²⁸ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;

each R²⁹ is independently H, C₁-C₃ alkyl, C₁-C₃ haloalkyl, C₁-C₃ alkylcarbonyl, C₁-C₃ alkylsulfonyl or C₁-C₃ haloalkylsulfonyl;

each Q¹ and Q² is independently O or N(R³¹);

- Q³ is C₂-C₃ alkylene optionally substituted with up to 2 substituents selected from C₁-C₄ alkyl;
- R³⁰ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- R³¹ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- 5 R³² is H or C₁-C₃ alkyl;
- W¹ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;
- W² is C₁-C₃ alkylene;
- W⁵ is C₁-C₄ alkylene;
- R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to
- 10 five substituents selected from R²¹; or -G; or 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, C₄-C₁₀ cycloalkoxylalkoxyalkyl, C₃-C₁₀ alkoxyalkoxyalkyl, C₂-C₈ alkylthioalkyl, C₂-C₈ alkylsulfinylalkyl, C₂-C₈ alkylsulfonylalkyl, C₂-C₈ alkylcarbonyl, C₄-C₁₀ cycloalkenylalkyl, C₂-C₈ haloalkoxyalkyl, C₂-C₈ alkoxyhaloalkyl, C₂-C₈ haloalkoxyhaloalkyl, C₄-C₁₀ halocycloalkoxyalkyl, C₄-C₁₀ cycloalkenyloxyalkyl, C₄-C₁₀ halocycloalkenyloxyalkyl, C₃-C₁₀ dialkoxyalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₃-C₈ cycloalkoxy, C₃-C₈ halocycloalkoxy, C₄-C₁₀ cycloalkylalkoxy, C₂-C₆ alkenyloxy, C₂-C₆ haloalkenyloxy, C₃-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, C₃-C₈ cycloalkylsulfinyl or C₃-C₁₀ halotrialkylsilyl; or
- 20 R² is -W⁶C(=E⁴)R³³, -W⁶L¹C(=E⁵)R³⁴ or -W⁶C(=E⁶)L¹R³⁵;
- each E⁴, E⁵, and E⁶ is independently O, NOR³⁷ or NN(R³⁷)₂;
- each L¹ is independently O or N(R³⁸);
- 35 each R³³, R³⁴ and R³⁵ is independently hydrogen; or C₁-C₄ alkyl, C₃-C₅ cycloalkyl each optionally substituted with one or more substituents selected from the group

- consisting of halogen, CN, hydroxy, C₁-C₂ alkoxy, C₁-C₂ alkylsulfinyl and C₁-C₂ alkylsulfonyl;
- each R³⁷ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- R³⁸ is independently H, C₁-C₃ alkyl or C₁-C₃ haloalkyl;
- 5 W³ is -CH₂-;
- W⁶ is C₂-C₄ alkylene, -(CH₂)₂OCH₂- or -(CH₂)₃OCH₂-;
- R³ is hydroxy, -O-M⁺, C₂-C₈ alkylcarbonyloxy, C₂-C₈ haloalkylcarbonyloxy, C₄-C₁₀ cycloalkylcarbonyloxy or C₃-C₁₀ alkylcarbonylalkoxy; or benzyloxy, phenyloxy, benzylcarbonyloxy, phenylcarbonyloxy, phenylsulfonyloxy or
- 10 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;
- 15 R¹¹ is H or C₁-C₆ alkyl;
- R¹² is H, halogen, cyano, hydroxy, amino or C₁-C₆ alkyl;
- each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃;
- R²⁰ is H or CH₃;
- T is -CH₂CH₂- or -CH=CH-;
- 20 each G is G-1 through G-20 (as depicted in Embodiment 116);
- r is 0, 1, 2 or 3;
- 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;
- 30 each R²² is independently C₁-C₆ alkyl or C₁-C₆ haloalkyl;
- 35 R⁴⁰ is ethyl or *i*-propyl; and
- R⁴¹ is ethyl or *i*-propyl; or
- R⁴⁰ and R⁴¹ are taken together as -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

3. A compound of Claim 2 wherein

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

B¹ is C-1;

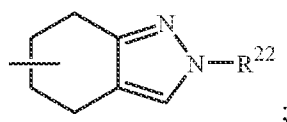
B² is C-3;

5 B³ is C-1;

R¹ is -G^A;

each G^A is selected from G^A-1, G^A-2, G^A-3, G^A-7, G^A-8 and G^A-9; or

each G^A is



10 R² is phenyl or -W³(phenyl), each optionally substituted on ring members with up to two substituents selected from R²¹; or -G; or C₁-C₆ alkyl or C₃-C₈ cycloalkyl;

R³ is hydroxy or C₂-C₈ alkylcarbonyloxy;

R⁹ is CH₂CH₃;

R¹⁰ is H or CH₃;

15 T is -CH₂CH₂-;

G is G-2, G-3 or G-15; and

R²¹ is independently halogen, nitro, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy or C₁-C₆ alkylthio;

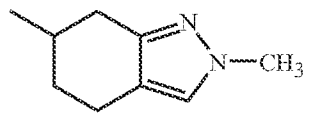
each R²² is independently CH₃ or CH₂CF₃; and

20 R⁴⁰ and R⁴¹ are taken together as -(CH₂)₅-, -CH₂CH=CHCH₂- or -(CH₂)₂O(CH₂)₂-.

4. A compound of Claim 3 wherein

A is A-1;

each G^A is



25 R² is phenyl;

R³⁰ is H or methyl;

R²¹ halogen or C₁-C₃ alkyl; and

R²² is CH₃.

5. A compound of Claim 3 wherein

30 A is A-1;

G^A is G^A-2;

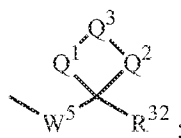
R² is phenyl, 2-thienyl, 5-chloro-2-pyridinyl or cyclopropyl;

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R³ is hydroxy; and
each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H.

6. A compound of Claim 3 wherein
A is A-1;
A is A-3;
G^A is G^A-2;
R² is phenyl, 2-thienyl 5-chloro-2-pyridinyl or cyclopropyl; and
R³ is hydroxyl.

7. A compound of Claim 2 wherein
A is A-1;
R¹ is



each Q¹ and Q² is O;
Q³ is C₂-alkylene;
R³² is H or methyl;
W⁵ is C₂-C₃ alkylene;
R² is phenyl, 2-methylphenyl, 3-methylphenyl, 3-bromophenyl, 3-chlorophenyl,
4-chlorophenyl, 3-fluorophenyl 3,5-difluorophenyl, 3-thienyl or 2-thienyl;
R³ is hydroxy or -OC(=O)CH₂CH(CH₃)₂; and
each R¹⁴, R¹⁵, R¹⁸ and R¹⁹ is H or CH₃.

8. A compound of Claim 7 wherein
W⁵ is C₂ alkylene or C₃ alkylene;
R² is phenyl, 3-thienyl cyclopropyl; and
R³ is hydroxy.

9. A compound of Formula 1 in Claim 1 selected from
3-(1,4-Dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-phenyl-4(3*H*)-pyrimidinone,
5-[(2-Hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-6-oxo-2-phenyl-1(6*H*)-pyrimidineacetaldehyde 1-(O-methyloxime)
2-(5-chloro-3-pyridinyl)-3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-4(3*H*)-pyrimidinone,
2-cyclopropyl-3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-4(3*H*)-pyrimidinone,

3-(1,4-dioxaspiro[4.5]dec-8-yl)-5-[(2-hydroxy-4-oxobicyclo[3.2.1]oct-2-en-3-yl)carbonyl]-2-(2-thienyl)-4(3*H*)-pyrimidinone and
5-[(2-hydroxy-6-oxo-1-cyclohexen-1-yl)carbonyl]-2-phenyl-3-(4,5,6,7-tetrahydro-2-methyl-2*H*-indazol-5-yl)-4(3*H*)-pyrimidinone.

- 5 10. A herbicidal mixture comprising (a) a compound of Formula 1 and (b) at least one additional active ingredient selected from (b1) photosystem II inhibitors, (b2) AHAS inhibitors, (b3) ACCase inhibitors, (b4) auxin mimics, (b5) EPSP inhibitors, (b6) photosystem I electron diverters, (b7) PPO (protoporphyrinogen oxidase) inhibitors, (b8) GS (glutamine synthetase) inhibitors, (b9) VLCFA (very long chain fatty acid) elongase
10 inhibitors, (b10) auxin transport inhibitors, (b11) PDS (phytoene desaturase) inhibitors, (b12) HPPD (4-hydroxyphenyl-pyruvate-dioxygenase) inhibitors, (b13) HST (homogentisate solanesyltransferase) inhibitors, (b14) other herbicides including mitotic disruptors, organic arsenicals, asulam, difenzoquat, bromobutide, flurenol, cinmethylin, cumyluron, dazomet, dymron, methyl dymron, etobenzanid, fosamine, fosamine-ammonium, metam,
15 oxaziclomefone, oleic acid, pelargonic acid and pyributicarb, and (b15) herbicide safeners; and salts of compounds of (b1) through (b15).
11. The herbicidal mixture of Claim 10 comprising (a) a compound of Claim 1 and (b) at least one additional active ingredient selected from (b1) photosystem II inhibitors.
12. The herbicidal mixture of Claim 11 wherein (b) is bromoxynil.
- 20 13. The herbicidal mixture of Claim 10 comprising (a) a compound of Claim 1 and (b) at least one additional active ingredient selected from (b15) herbicide safeners.
14. 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.
- 25 15. 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/US2012/027889

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D239/36 C07D405/06 C07D405/14 C07D409/06 C07D409/14
C07D411/14 C07D413/06 C07D413/14 C07D417/06 C07D417/14

ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07D

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

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

EPO-Internal, 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	EP 1 982 978 A1 (KUMIAI CHEMICAL INDUSTRY CO [JP]; IHARA CHEMICAL IND CO [JP]) 22 October 2008 (2008-10-22) cited in the application page 1; claim 1	1-15
Y	EP 0 568 041 A1 (SUMITOMO CHEMICAL CO [JP]) 3 November 1993 (1993-11-03) page 2; claim 1	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

14 May 2012

Date of mailing of the international search report

22/05/2012

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/027889

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 1982978	A1	22-10-2008	EP 1982978 A1	22-10-2008
		US 2010222592 A1	02-09-2010	
		WO 2007088876 A1	09-08-2007	

EP 0568041	A1	03-11-1993	BR 9301666 A	03-11-1993
		CA 2094949 A1	29-10-1993	
		EP 0568041 A1	03-11-1993	
		US 5366955 A	22-11-1994	
