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(54) Title: HERBICIDAL COMPOUNDS AND METHODS OF USE THEREOF

(57) Abstract: The present invention relates to novel herbicidally active compounds, agrochemical composition thereof, methods of preparation thereof, and uses thereof for controlling the growth of undesirable plants (e.g., weeds), for example in crop fields.

HERBICIDAL COMPOUNDS AND METHODS OF USE THEREOF

FIELD OF THE INVENTION

[001] The present invention relates to novel herbicidally active compounds, agrochemical composition thereof, methods of preparation thereof, and uses thereof for controlling the growth of undesirable plants (e.g., weeds), for example in crop fields.

BACKGROUND OF THE INVENTION

[002] Weeds often interfere with efficient utilization of land and water resources and typically compete with desired plants for water, nutrients, light, carbon dioxide, and space. Many weeds are also aesthetically displeasing, especially when the weeds appear within a stand of a desired plant, such as St. Augustine grass or Kentucky bluegrass in a homeowner's lawn. Weeds may also obstruct visibility, become fire hazards around buildings, and reduce the efficiency of irrigation systems. When weeds appear in watercourses, such as rivers and lakes, the weeds may contribute to poor water quality, making the water unsuitable for culinary and industrial uses. Furthermore, some weeds act in a poisonous fashion against other plants, animals, and humans by secreting toxic substances known as allelopathic compounds or by spreading agents that may cause allergies and/or disease. Finally, weeds provide shelter for insects and rodents that spread disease or are otherwise harmful to desired plants, animals, or humans.

[003] Weeds cause agricultural losses to crops that consistently exceed losses caused by other classes of agricultural pests, year after year. Besides reducing the quality of the crop, weed infestation may reduce achievable crop yield by up to 100% of the theoretically achievable yield. A number of approaches, including mechanical, agricultural, biological, and chemical techniques, have evolved in an attempt to control weed infestation.

[004] Mechanical means, such as hand pulling, hoeing or cultivation, deep plowing, clipping, mowing, burning and/or mulching, may be employed in an attempt to eradicate or control weeds. Also, cover crops may be planted to keep the ground covered when not growing more valuable crops and thus weed infestation that would ordinarily be expected to occur in bare ground areas is typically minimized. Crop rotation and planting of "smother" crops that are adapted to grow more vigorously than weeds have also been attempted as means of controlling weed infestations. Besides these mechanical and agricultural techniques, biological methods of weed control, such as introduction of predator populations that feed on the weeds and thereby reduce weed population, have also been attempted.

[005] Mechanical, agricultural, and biological methods of weed control, while sometimes helping to reduce the extent of weed infestations, are not fully satisfactory. First, mechanical and agricultural techniques are quite labor intensive and require use of limited physical and capital resources. Furthermore, environmental factors beyond the control of the farmer or homeowner, such as excessive rainfall, may diminish the effectiveness of these mechanical and agricultural techniques. Likewise, biological techniques,

such as introduction of predator populations, are not entirely satisfactory, since the predators may not be selective for only the weed population.

[006] Chemically active herbicides represent another potential weed control technique. These chemical herbicides may be broken down into pre-emergent herbicides and post-emergent herbicides. Pre-emergent herbicides typically interfere with germination of weed seeds, whereas post-emergent herbicides kill the weeds after the weed seeds have germinated and weed growth has begun.

[007] Pre-emergent herbicides may be effective when present at the required dosage at the time weed seed germination is ready to occur. However, this timing issue points out a major problem with respect to pre-emergent herbicides. Specifically, if the pre-emergent herbicide is not applied, or degrades, prior to weed seed germination, the weed seeds are free to germinate and begin growing into mature weeds. Additionally, pre-emergent herbicides are typically weed specific and are not equally effective against all types of weeds. The timing problem present with pre-emergent herbicides may be avoided by employing post-emergent herbicides and by applying the post-emergent herbicide only after the weed seeds have germinated and the weeds are actively growing. However, many presently available post-emergent herbicides are non-selective herbicides and therefore will kill desirable plants in addition to weeds.

[008] Many pre- and post-emergent herbicides also suffer from another problem. Specifically, many pre-emergent herbicides and post-emergent herbicides are either moderately or highly toxic to humans and animals and may thereby have damaging effects far beyond the intended weed control effect. Toxic herbicides may cause injury either immediately or over the long term to persons applying the herbicides and to persons present when the herbicides are applied. Also, residual concentrations of toxic herbicides that remain in the soil or water after application of the herbicide may pose a significant threat to human beings and to animals, including land-based animals and amphibians and fish, upon contact with the treated area or runoff from the treated area. Furthermore, public alarm about the use of toxic chemicals as herbicides and their potential widespread and long-term effects on environmental quality dictate against the continued use of these toxic herbicides.

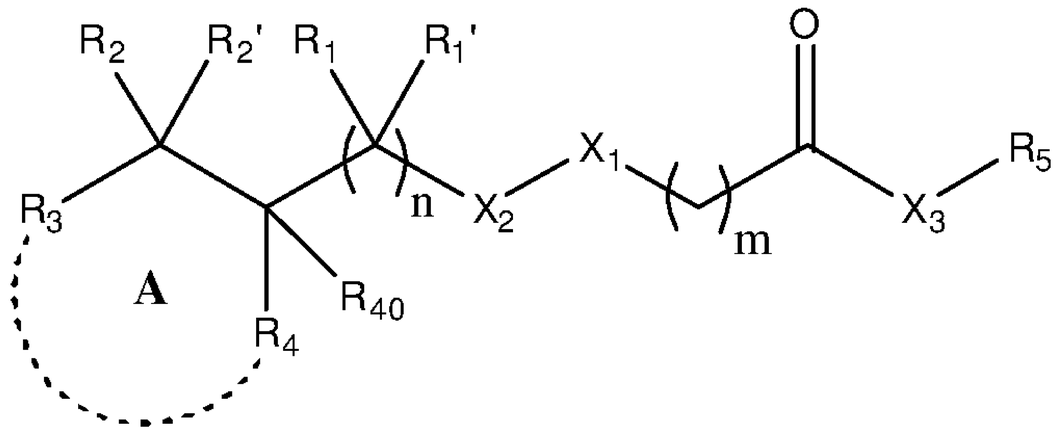
[009] There is a need for an herbicidal solution that avoids the critical timing issues of pre-emergent herbicide applications. Furthermore, there is a need for an herbicidal solution that avoids the toxic effects of presently available pre-emergent and post-emergent herbicides on human beings, animals and the environment generally. Furthermore, there is a need for an economically efficient post-emergent weed technique that selectively controls weeds without destroying or hindering the growth of desired plants. In addition, there is a need for a composition that reduces the amount of herbicides necessary to obtain sufficient weed control while minimizing the harm to crop plants.

[0010] As more weeds become resistant to herbicides, alternative compositions with high weed control are desired. Further, as no-till farming continues to increase in popularity, there is a greater need for effective herbicides. A composition with effective weed control and lower dosage rate will lead to increased crop plant yields, and decreased environmental, human, and mammalian health concerns.

SUMMARY OF THE INVENTION

[0011] In various embodiments, this invention is directed to a compound represented by the structure of formula **I, I(a)-I(ga), X** and **X(a)-X(d)** as defined herein below or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0012] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(g):**



I(g)

wherein

R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C(O)-R_{10}, or C(O)-CH_3;

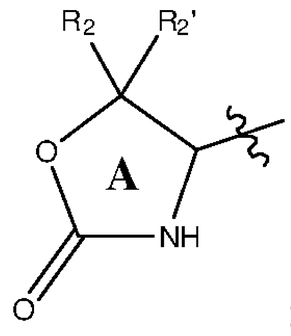
R_3 is OH, or NH_2;

R_4 is NH_2, or OH;

wherein if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH;

wherein if **R_3** is OH and **R_4** is NH_2, then **n + m** cannot be equal to 3;

or **R_3** and **R_4** are joined together to form ring **A,** represented by the following structure:



;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_{10} is H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

R is C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl;

m is 1 or 2;

n is 0, 1, 2 or 3;

$\mathbf{X_1}$ is S, O, or CH_2;

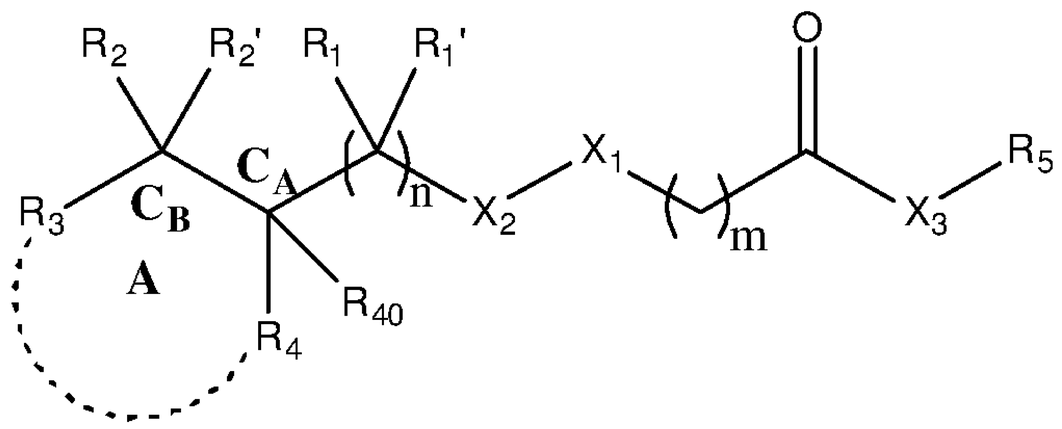
$\mathbf{X_2}$ is S, O, or CH_2;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0013] In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid or 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, the compound is a mixture of stereoisomers. In some embodiments, the compound is the substantially pure *SR* stereoisomer. In some embodiments, the compound is the substantially pure *RS* stereoisomer. In some embodiments, the substantially pure stereoisomer has a purity higher than 90%. In some embodiments, the substantially pure stereoisomer has a purity higher than 95%. In some embodiments, the substantially pure stereoisomer has a purity higher than 98%. In some embodiments, the compound is compound **101**, **102**, **104**, **105**, **113, 114, 115, 116, 117, 118, 119, 120, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 137, 138, 139, 140, 141, 142** or an agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, or isotopic variant thereof; each represents a separate embodiment according to this invention. In some embodiments, the compound is compound any one of the compounds listed in **Table 1** herein below or an agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, or isotopic variant thereof; each represents a separate embodiment according to this invention.

[0014] In various embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **I, I(a)-I(ga), X** and **X(a)-X(d)** as defined herein below, or an agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, or isotopic variant (e.g., deuterated analog) thereof; each represents a separate embodiment according to this invention.

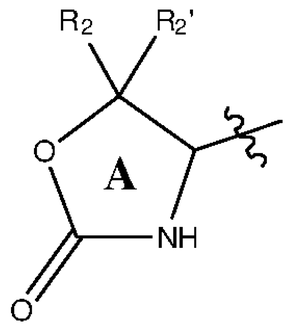
[0015] In various embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **I(ga):**



I(ga)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers, or $\mathbf{C_A}$ and $\mathbf{C_B}$ together with $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined to form ring **A,** represented by the following structure:



R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C(O)-R_{10}, or C(O)-CH_3;

R_3 is OH, SH, NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10}, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

R_4 is NH_2, $NHNH_2$, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or **R_3** and **R_4** are joined together to form ring **A** as described above;

wherein **R_3** and **R_4** cannot both be NH_2, and

wherein if **R_3** is OH and **R_4** is NH_2, then **n + m** cannot be equal to 3;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring;

R is C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

m is 1 or 2;

n is 0, 1, 2 or 3;

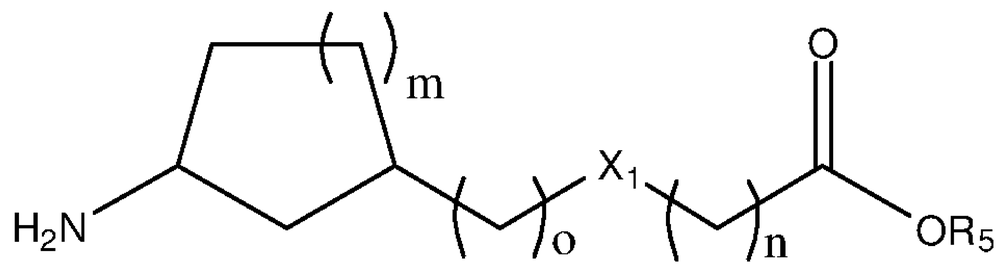
X_1 is S, O, or CH_2;

X_2 is S, O, or CH_2;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof

[0016] In some embodiments, this invention is directed to an herbicidal compound represented by the structure of any one of compounds **101**, **102**, **104-120, 123-134, 137-178** or an agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, or isotopic variant thereof; each represents a separate embodiment according to this invention. In some embodiments, the compound is compound any one of the compounds listed in Table **2** herein below or an agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, or isotopic variant thereof; each represents a separate embodiment according to this invention.

[0017] In some embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **X(a)**:



X(a)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$; or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

wherein substitutions include: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

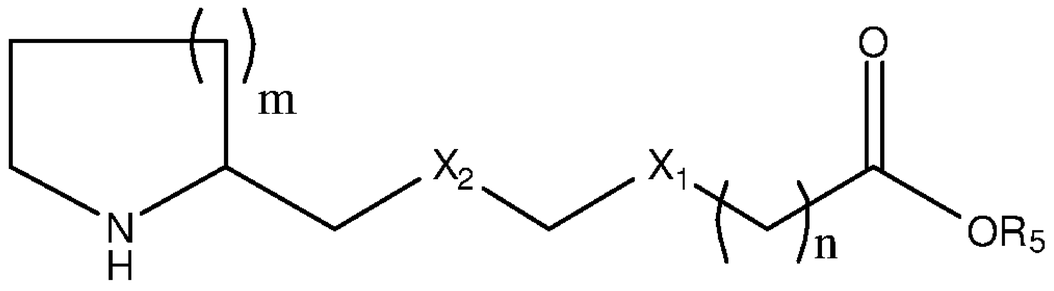
n and **o** are each independently an integer number between 0 and 2;

m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof

[0018] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(a)** as defined herein above, wherein **n** is 2; o is 0; and if X_1 is CH_2, then R_5 cannot be H.

[0019] In some embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **X(b)**:



X(b)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

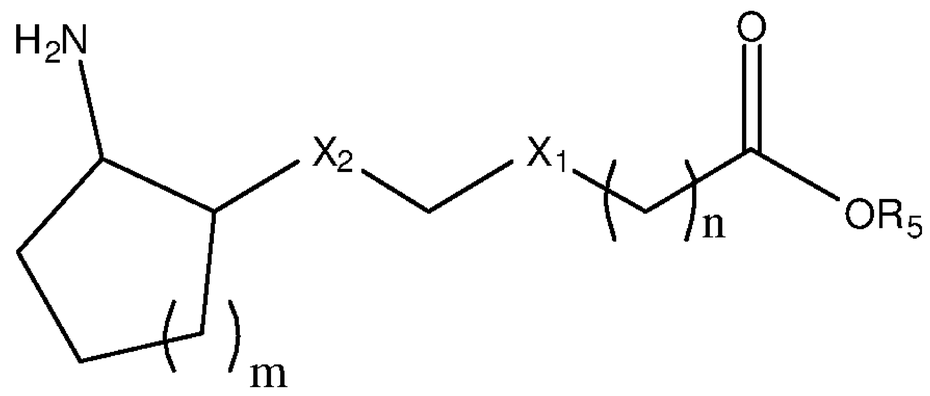
X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof

[0020] In various embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **X(c)**:



X(c)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or S(O)$_2$R; or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

wherein substitutions include: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, N(R)$_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or C(R)$_2$;

X_2 is S, O, CH_2, CH(R) or C(R)$_2$;

n is an integer number between 0 and 2;

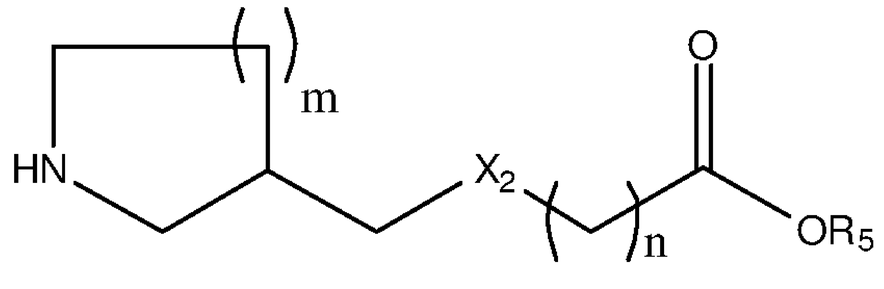
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0021] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(c)** as described hereinabove, wherein n is an integer number between 1 and 2; or its

agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0022] In various embodiments, this invention is directed to an herbicidal compound represented by the structure of formula **X(d)**:



X(d)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$; or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

wherein substitutions include: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0023] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(d)** as described hereinabove, wherein **m** is 1 or 3; or an agrochemically acceptable salt,

stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

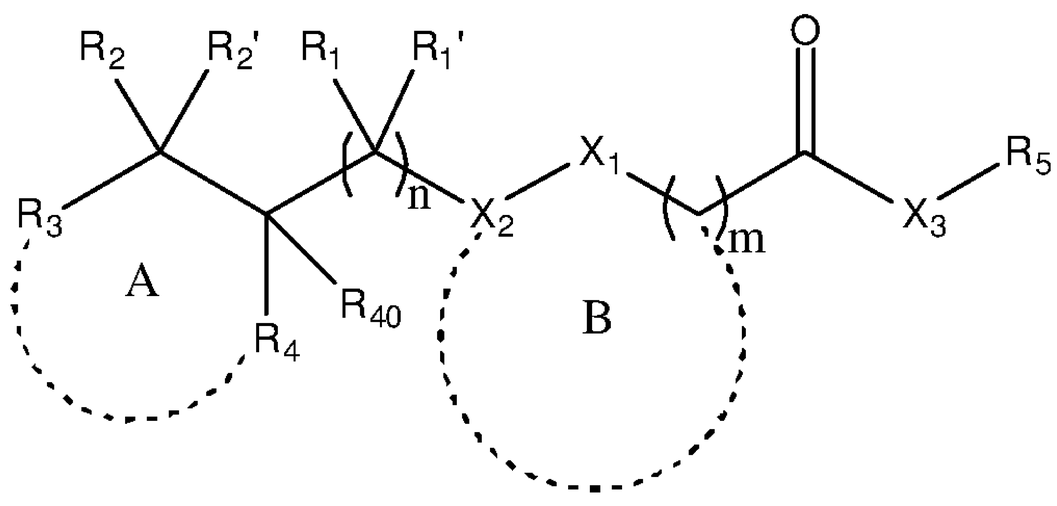
[0024] In various embodiments, this invention is directed to an agrochemical composition comprising an herbicidally effective amount of a compound according to this invention.

[0025] In various embodiments, this invention is directed to a method of controlling the growth of undesired plants, comprising applying a compound according to this invention or an agrochemical composition according to this invention, to crop fields.

[0026] In various embodiments, this invention is directed to a compound according to this invention, or an agrochemical composition according to this invention, for use in controlling the growth of undesired plants. In some embodiments, the plant is a eudicot (dicot) or a monocotyledon (monocot). In some embodiments, the plant is a weed. In some embodiments, the weed comprises: *Abutilon theophrasti* , *Amaranthus palmeri*, *Ambrosia artemisiifolia* , *Alopecurus myosuroides* , *Avena sterilis* , *Chenopodium album* , *Conyza Canadensis* , *Digitaria sanguinalis* , *Echinochloa colona*, *Euphorbia heterophylla* , *Lolium perenne* , *Lolium rigidum* , *Matricaria chamomilla* , *Phalaris paradoxa* , *Poa annua* , *Portulaca oleracea* , *Setaria viridis*, *Solanum nigrum* or any combination thereof. In some embodiments, the dicot plant is *Arabidopsis thaliana,* and/or the monocot plant is *Dactyloctenium aegyptium* or *Eragrostis teff.* In some embodiments, the compound is for use in pre-plant treatments, pre-emergence treatments, post-emergence treatments, or any combination thereof; each represents a separate embodiment according to this invention.

DETAILED DESCRIPTION OF THE INVENTION

[0027] In various embodiments, this invention is directed to a compound represented by the structure of formula (**I**):



(**I**)

wherein

A and **B** rings are absent, or are each independently a substituted or unsubstituted single or fused aromatic or heteroaromatic ring system (e.g., B: aryl, pyridine), or a substituted or unsubstituted single or fused C_3-C_{10} cycloalkyl (e.g., cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl), or a substituted or unsubstituted single or fused C_3-C_{10} heterocyclic ring (e.g., **A**: 5-methyloxazolidin-2-one, 1, 2, or 3-pyrrolidine, tetrahydropyridine, 5,6-dihydro-4H-1,3-thiazine, 4,5-dihydro-1H-imidazole, pyridine, tetrahydropyrimidine; piperidine, imidazole);

R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, F, Cl, Br, I, OH, SH, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., -CH_2-O-CH_3), R_8-(C_3-C_8 cycloalkyl) (e.g., cyclohexyl), R_8-(C_3-C_8 heterocyclic ring) (e.g., CH_2-imidazole, CH_2-indazole), CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$), R_9-R_8-$N(R_{10})(R_{11})$ (e.g., C≡C-CH_2-NH_2), $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), NHC(O)-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-$CH(CH_3)_2$, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), C_1-C_5 linear or branched, substituted or unsubstituted alkenyl (e.g., $CH=C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu), optionally wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom (e.g., O-1-oxacyclobutyl, O-2-oxacyclobutyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy (e.g., OCF_3, $OCHF_2$), C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted benzyl (e.g., benzyl, 4-Cl-benzyl, 4-OH-benzyl);

or **R_2** and **R_1** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring;

R_3 is H, F, Cl, Br, I, OH, SH, =O, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., CH_2-O-CH_3) CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$) R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), NHC(O)-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, C(OH)(CH_3)(Ph), ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-

oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane)), substituted or unsubstituted aryl (e.g., phenyl);

or **R_3** and **R_2** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring (e.g., cyclopropyl);

R_4 is H, F, Cl, Br, I, OH, SH, =O, =NH-OH, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., CH_2-O-CH_3) CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$) R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10} (e.g., NHC(O)H, $NHC(O)CH_3$), NHC(O)-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, C(OH)(CH_3)(Ph), ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole), substituted or unsubstituted aryl (e.g., phenyl);

or **R_3** and **R_4** are joined together to form ring A as defined above (e.g., cyclopropyl, 5-methyloxazolidin-2-one);

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-C(O)-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or $\mathbf{R_{10}}$ and $\mathbf{R_{11}}$ are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

$\mathbf{X_1}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

$\mathbf{X_2}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

or $\mathbf{X_2}$ together with the carbon next to $\mathbf{X_1}$ are joined to form ring B as defined above;

$\mathbf{X_3}$ is O, NH or N-R_{50};

$\mathbf{R_{50}}$ is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0028] In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined together to form ring **A.** In some embodiments, ring **B** is absent. In some embodiments, $\mathbf{R_3}$ is OH, or NH_2. In some embodiments, $\mathbf{R_4}$ is NH_2, or OH. In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_4}$ cannot both be NH_2. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In some embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if $\mathbf{R_3}$ is OH and $\mathbf{R_4}$ is NH_2, then **n** + **m** cannot be equal to 3. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, $\mathbf{R_1}$ and $\mathbf{R_1'}$ are both H. In some embodiments, $\mathbf{R_2}$ is CH_3 or CH_2CH_3. In some embodiments, $\mathbf{R_2'}$ is H or CH_3. In some embodiments, $\mathbf{R_{40}}$ is CH_3 or H. In some embodiments, $\mathbf{X_1}$ is CH_2. In some embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{X_3}$ is O, NH or N-CH_3. In some embodiments, $\mathbf{R_5}$ is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, $\mathbf{R_5}$ is a substituted or unsubstituted alkyl. In some embodiments, $\mathbf{R_5}$ is H. In some embodiments, $\mathbf{R_5}$ is H, ethyl, butyl, CH_2-CCH, CH_2-$C(O)$-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0029] In some embodiments, n is 0. In some embodiments, **A** is a substituted aryl (e.g., 2-amino-phenyl). In some embodiments, **A** is a substituted or unsubstituted cycloalkyl (e.g., cyclopentyl, cyclohexyl). In some embodiment, the substitution is at least one selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R),

NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[0030] In some embodiments, **A** is a substituted cycloalkyl. In some embodiments, **A** is substituted cyclopropyl. In some embodiments, **A** is substituted cyclobutyl. In some embodiments, **A** is substituted cyclopentyl. In some embodiments, **A** is substituted cyclohexyl. In some embodiments, **A** is substituted at least with an amine. In some embodiments, **A** is substituted at least with NH_2. In some embodiments, **A** is substituted with NH_2. In some embodiments, **A** is a cycloalkyl, substituted at least with an amine. In some embodiments, **A** is a cycloalkyl, substituted with NH_2. In some embodiments, **A** is a 5 or 6 membered nitrogen containing heterocyclic ring. In some embodiments, **A** is 1, 2, or 3-piperidine, oxazolidin-2-one, tetrahydropyrimidine, pyridine, dihydro-thiazine, dihydro-imidazole, tetrahydropyridine, or pyrrolidine, which may be substituted or unsubstituted; each is a separate embodiment according to this invention. In some embodiments, **A** is substituted with an amine. In some embodiments, **A** is substituted at least with NH_2.

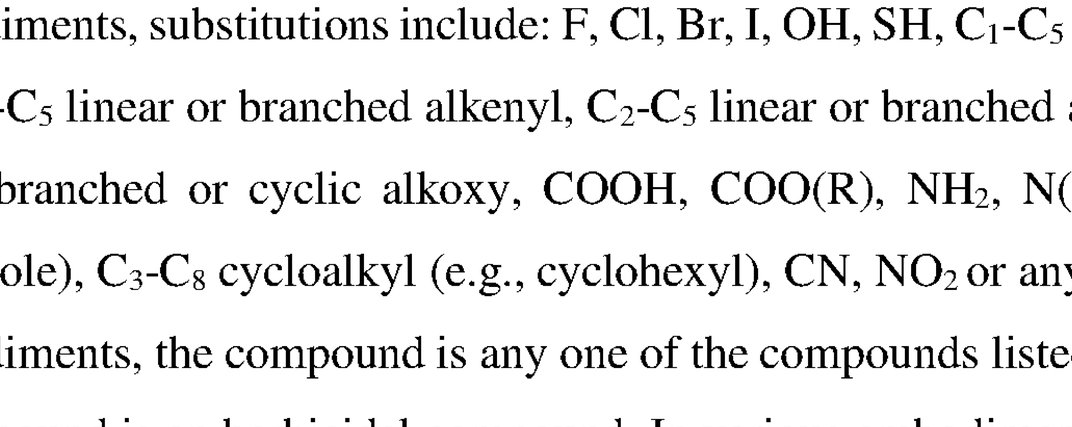
[0031] In some embodiments, **B** is absent. In some embodiment **B** is pyridine.

[0032] In some embodiments, $\mathbf{R_1}$, $\mathbf{R_1'}$, $\mathbf{R_2}$, $\mathbf{R_2'}$ and $\mathbf{R_{40}}$ are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl).

[0033] In some embodiments, substitutions include: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0034] In some embodiments, the compound is any one of the compounds listed in **Table 1**. In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants. In some embodiments, the compound is any one of the compounds listed in **Table 2**.

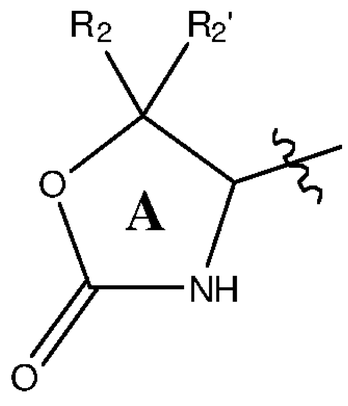
[0035] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(a)**:



I(a)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers, or $\mathbf{C_A}$ and $\mathbf{C_B}$ together with $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined to form ring **A,** represented by the following structure:



R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, F, Cl, Br, I, OH, SH, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., -CH_2-O-CH_3), R_8-(C_3-C_8 cycloalkyl) (e.g., cyclohexyl), R_8-(C_3-C_8 heterocyclic ring) (e.g., CH_2-imidazole, CH_2-indazole), CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$), R_9-R_8-$N(R_{10})(R_{11})$ (e.g., C≡C-CH_2-NH_2), $B(OH)_2$, -OC(O)CF_3, -OCH_2Ph, NHC(O)-R_{10} (e.g., NHC(O)CH_3), NHC(O)-$N(R_{10})(R_{11})$ (e.g., NHC(O)$N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-$CH(CH_3)_2$, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., CH_2C(O)CH_3), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, C(O)$N(R_{10})(R_{11})$ (e.g., C(O)$N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), C_1-C_5 linear or branched, substituted or unsubstituted alkenyl (e.g., CH=$C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu), optionally wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom (e.g., O-1-oxacyclobutyl, O-2-oxacyclobutyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy (e.g., OCF_3, $OCHF_2$), C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted benzyl (e.g., benzyl, 4-Cl-benzyl, 4-OH-benzyl);

or **R_2** and **R_1** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring;

R_3 is H, F, Cl, Br, I, OH, SH, =O, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., CH_2-O-CH_3) CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$) R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -OC(O)CF_3, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10} (e.g., NHC(O)CH_3), NHC(O)-$N(R_{10})(R_{11})$ (e.g., NHC(O)$N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., CH_2C(O)CH_3), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, C(O)$N(R_{10})(R_{11})$ (e.g., C(O)$N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, C(OH)(CH_3)(Ph), ethyl,

propyl, iso-propyl, t-Bu, iso-butyl, pentyl), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane)), substituted or unsubstituted aryl (e.g., phenyl);

or **R_3** and **R_2** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring (e.g., cyclopropyl);

R_4 is H, F, Cl, Br, I, OH, SH, =O, =NH-OH, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., CH_2-O-CH_3) CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$) R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10} (e.g., NHC(O)H, $NHC(O)CH_3$), NHC(O)-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, C(O)O-R_{10} (e.g. C(O)O-CH_3, C(O)O-CH_2CH_3), R_8-C(O)-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, C(O)-R_{10} (e.g., C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., C(O)-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, $C(OH)(CH_3)(Ph)$, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole), substituted or unsubstituted aryl (e.g., phenyl);

or **R_3** and **R_4** are joined together to form ring A as defined above (e.g., cyclopropyl, 5-methyloxazolidin-2-one);

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-C(O)-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

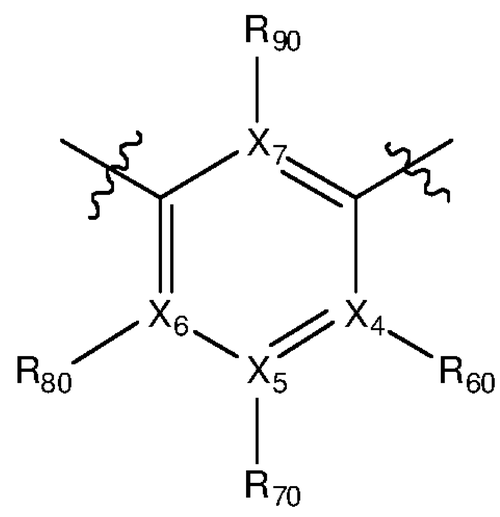
m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_2 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

or **X_2** together with the carbon next to **X_1** are joined to form ring B, represented by the following structure: (in such case, **X_1** is **X_7**):



B

wherein

X_4, X_5, X_6 and **X_7** are each independently C or N, wherein if any of **X_4**, **X_5**, **X_6** and **X_7** is N, then the respective substitution **R_{90}**, **R_{60}**, **R_{70}** or **R_{80}** is absent;

R_{60} , **R_{80}** and **R_{90}** are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, $-C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

R_{70} is selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -

$C(O)NH_2$, $C(O)NHR$, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl,

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

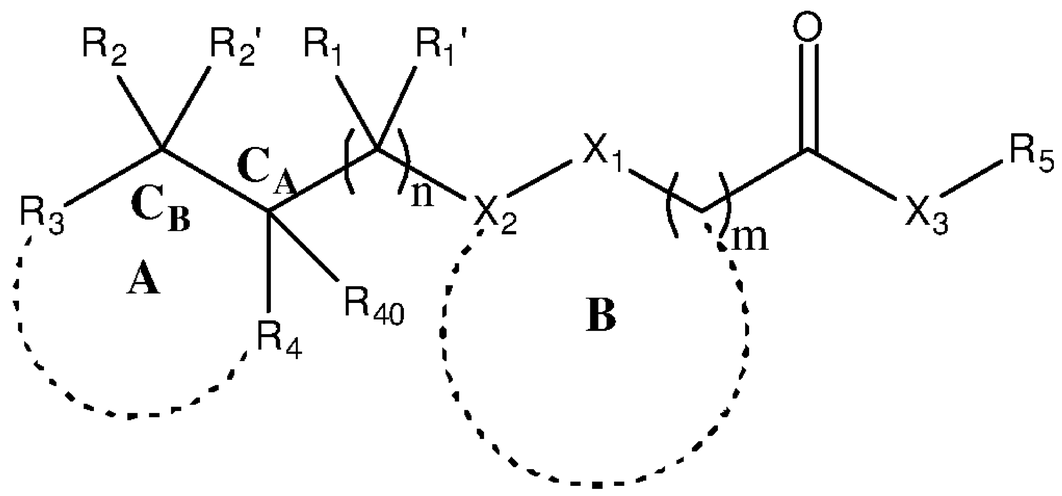
[0036] In some embodiments, **R_3** and **R_4** are joined together to form ring **A.** In some embodiments, ring **B** is absent. In some embodiment **B** is pyridine. In some embodiments, **R_3** is OH, or NH_2. In some embodiments, **R_4** is NH_2, or OH. In some embodiments, **R_3** and **R_4** cannot both be NH_2. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In some embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if **R_3** is OH and **R_4** is NH_2, then **n** + **m** cannot be equal to 3. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, **R_1, R_1', R_2, R_2'** and **R_{40}** are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, **R_1** and **R_1'** are both H. In some embodiments, **R_2** is CH_3 or CH_2CH_3. In some embodiments, **R_2'** is H or CH_3. In some embodiments, R_{40} is CH_3 or H. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_3** is O, NH or N-CH_3. In some embodiments, **R_5** is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, **R_5** is a substituted or unsubstituted alkyl. In some embodiments, **R_5** is H. In some embodiments, **R_5** is H, ethyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0037] In some embodiments, substitutions include: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0038] In some embodiments, the compound is any one of the compounds listed in **Table 1**. In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for

use in controlling the growth of undesired plants. In some embodiments, the compound is any one of the compounds listed in **Table 2**.

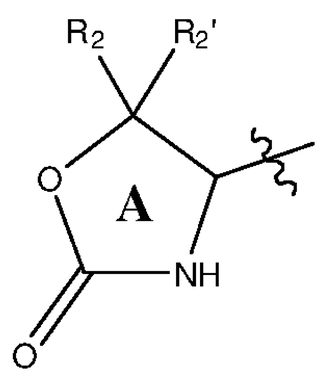
[0039] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(b)**:



I(b)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers, or $\mathbf{C_A}$ and $\mathbf{C_B}$ together with $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined to form ring **A,** represented by the following structure:



$\mathbf{R_1}$, $\mathbf{R_1'}$, $\mathbf{R_2}$, $\mathbf{R_2'}$ and $\mathbf{R_{40}}$ are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

$\mathbf{R_3}$ is OH, F, SH, R_8-OH (e.g., CH_2-OH), NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10} (e.g., NHC(O)CH_3), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or $\mathbf{R_3}$ and $\mathbf{R_2}$ are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring (e.g., cyclopropyl);

$\mathbf{R_4}$ is NH_2, OH, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, NHC(O)CH_3, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined together to form ring **A** as described above (e.g., cyclopropyl, 5-methyloxazolidin-2-one [1,3]dioxole, furan-2(3H)-one, benzene, cyclopentane, imidazole);

$\mathbf{R_5}$ is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted

alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-C(O)-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

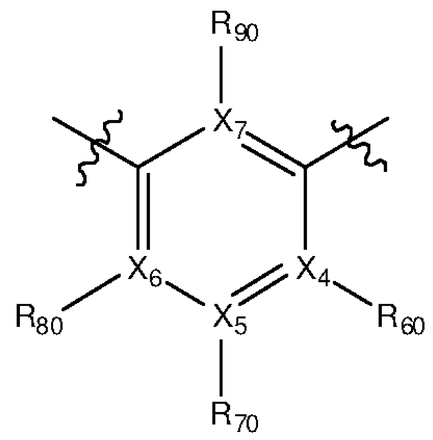
m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, or CH_2;

X_2 is S, O, or CH_2;

or **X_2** together with the carbon next to **X_1** are joined to form ring B, represented by the following structure (in such case, **X_1** is **X_7**):



B

wherein

X_4, X_5, X_6 and **X_7** are each independently C or N, wherein if any of **X_4**, **X_5**, **X_6** and **X_7** is N, then the respective substitution **R_{90}**, **R_{60}**, **R_{70}** or **R_{80}** is absent;

R_{60} , **R_{80}** and **R_{90}** are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -OC(O)CF_3, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched

alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

R_{70} is selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

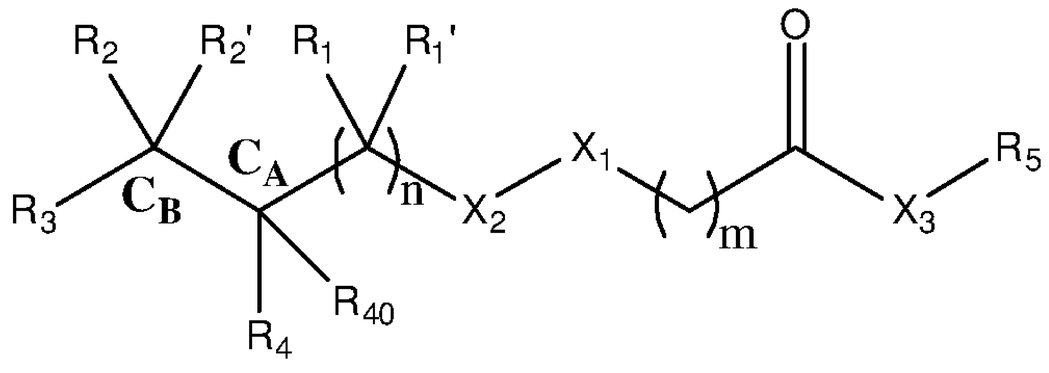
[0040] In some embodiments, **R_3** and **R_4** are joined together to form ring **A.** In some embodiments, ring **B** is absent. In some embodiment **B** is pyridine. In some embodiments, **R_3** is OH, or NH_2. In some embodiments, **R_4** is NH_2, or OH. In some embodiments, **R_3** and **R_4** cannot both be NH_2. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In some embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if **R_3** is OH and **R_4** is NH_2, then **n** + **m** cannot be equal to 3. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, **R_1, R_1', R_2, R_2'** and **R_{40}** are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, **R_1** and **R_1'** are both H. In some embodiments, **R_2** is CH_3 or CH_2CH_3. In some embodiments, **R_2'** is H or CH_3. In some embodiments, R_{40} is CH_3 or H. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_3** is O, NH or N-CH_3. In some embodiments, **R_5** is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, **R_5** is a substituted or unsubstituted alkyl. In some embodiments, **R_5** is H. In some embodiments, **R_5** is H, ethyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0041] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl

(e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0042] In some embodiments, the compound is any one of the compounds listed in **Table 1**. In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants. In some embodiments, the compound is any one of the compounds listed in **Table 2**.

[0043] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(c)**:



I(c)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers;

R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

R_3 is OH, F, R_8-OH (e.g., CH_2-OH), SH, NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10} (e.g., NHC(O)CH_3), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or **R_3** and **R_2** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring (e.g., cyclopropyl);

R_4 is OH, NH_2, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, NHC(O)CH_3, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, C(OH)(CH_3)(Ph), ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl),, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or

unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_2 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

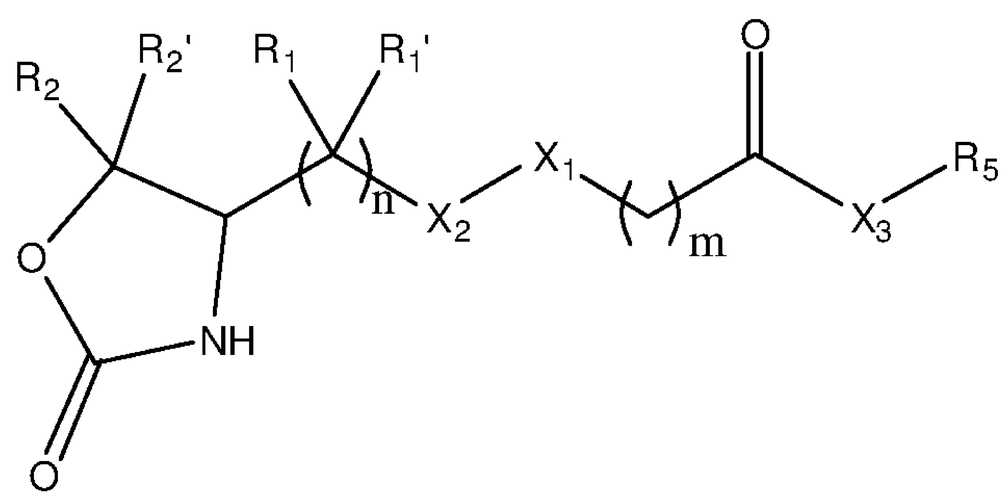
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0044] In some embodiments, **R_3** is OH, or NH_2. In some embodiments, **R_4** is NH_2, or OH. In some embodiments, **R_3** and **R_4** cannot both be NH_2. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In some embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if **R_3** is OH and **R_4** is NH_2, then **n + m** cannot be equal to 3. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, **R_1, R_1', R_2, R_2'** and **R_{40}** are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, **R_1** and **R_1'** are both H. In some embodiments, **R_2** is CH_3 or CH_2CH_3. In some embodiments, **R_2'** is H or CH_3. In some embodiments, **R_{40}** is CH_3 or H. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_3** is O, NH or N-CH_3. In some embodiments, **R_5** is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, **R_5** is a substituted or unsubstituted alkyl. In some embodiments, **R_5** is H. In some embodiments, **R_5** is H, ethyl, butyl, CH_2-CCH, CH_2-$C(O)$-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0045] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0046] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0047] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(d):**



I(d)

wherein

R_1, R_1', R_2, R_2' are each independently H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_{10} is H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

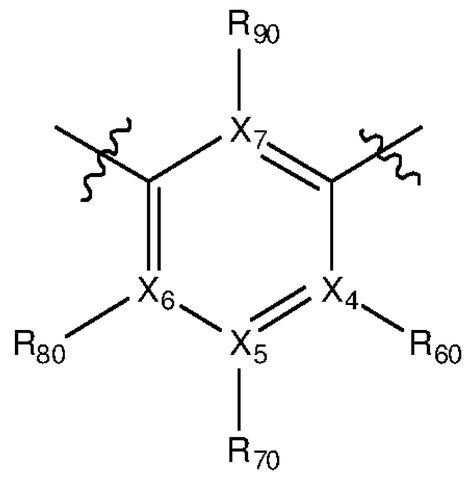
m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_2 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

or **X_2** together with the carbon next to **X_1** are joined to form ring B, represented by the following structure (in such case, **X_1** is **X_7**):



B

wherein

X_4, X_5, X_6 and **X_7** are each independently C or N, wherein if any of **X_4**, **X_5**, **X_6** and **X_7** is N, then the respective substitution **R_{90}**, **R_{60}**, **R_{70}** or **R_{80}** is absent;

R_{60} , **R_{70}** , **R_{80}** and **R_{90}** are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, $-C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

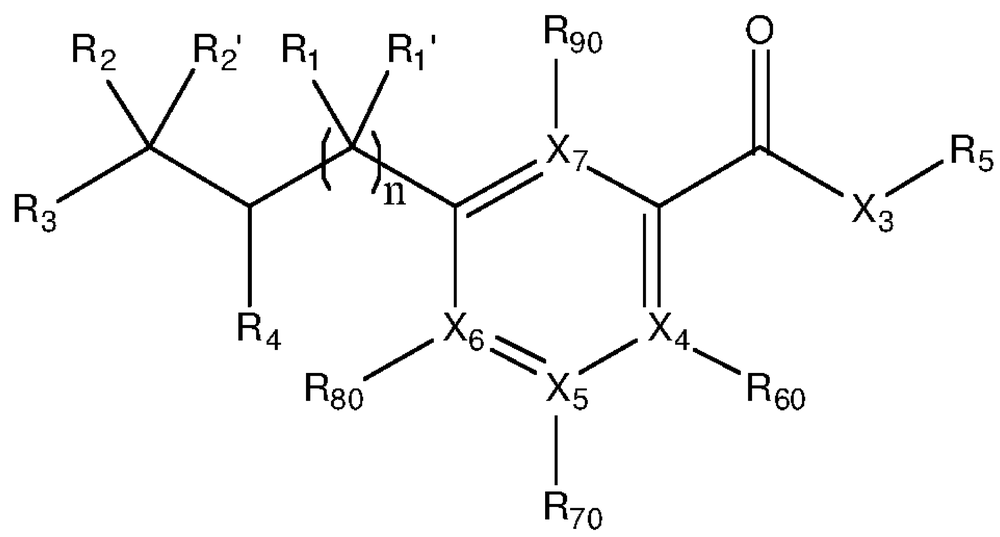
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0048] In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, **R_1, R_1', R_2, R_2'** and **R_{40}** are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, **R_1** and **R_1'** are both H. In some embodiments, **R_2** is CH_3 or CH_2CH_3. In some embodiments, **R_2'** is H or CH_3. In some embodiments, R_{40} is CH_3 or H. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_3** is O, NH or N-CH_3. In some embodiments, **R_5** is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, **R_5** is a substituted or unsubstituted alkyl. In some embodiments, **R_5** is H. In some embodiments, **R_5** is H, ethyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1. In some embodiments, the compound is compound **105, 106**; each represents a separate embodiment according to this invention.

[0049] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0050] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0051] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(e)**:



I(e)

wherein

R_1, R_1', R_2, R_2' are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

R_3 is OH, F, SH, R_8-OH (e.g., CH_2-OH), NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

R_4 is NH_2, OH, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted arylf;

or **R_3** and **R_4** are joined together to form a 5 or 6 membered substituted or unsubstituted, aliphatic or aromatic, carbocyclic or heterocyclic ring (e.g., cyclopropyl, 5-methyloxazolidin-2-one,[1,3]dioxole, furan-2(3H)-one, benzene, cyclopentane, imidazole);

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3,

C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

n is 0, 1, 2 or 3;

R_{60}, **R_{70}** , **R_{80}** and **R_{90}** are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

X_4, X_5, X_6 and **X_7** are each independently C or N, wherein if any of **X_4**, **X_5**, **X_6** and **X_7** is N, then the respective substitution **R_{90}**, **R_{60}**, **R_{70}** or **R_{80}** is absent;

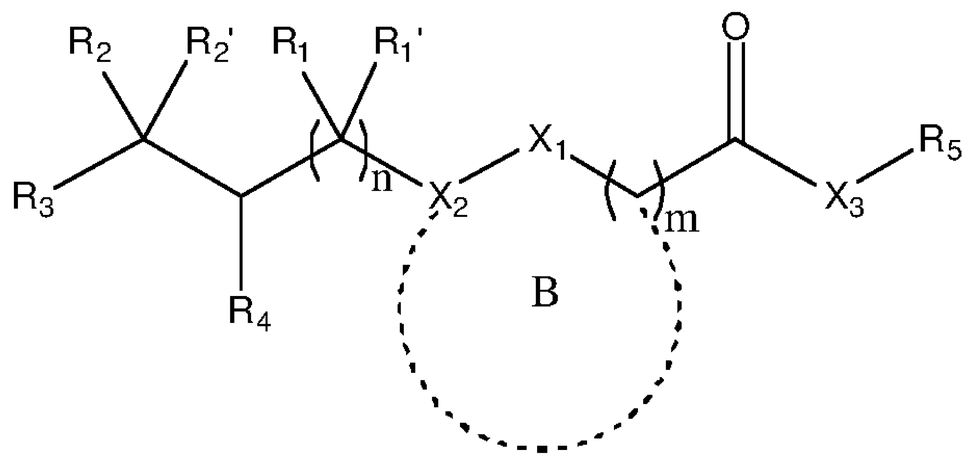
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0052] In some embodiments, if **R_4** is NH_2, then **R_3** cannot be OH. In some embodiments, if **R_3** is OH and **R_4** is NH_2, n cannot be 1. In some embodiments, if **R_3** is OH and **R_4** is NH_2, **X_7-R_{90}** cannot be CH.

[0053] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0054] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants. In some embodiments, the compound is compound **108, 109, 141, 142, 172, 173, 174, 175, 176, 177** or **178**; each represents a separate embodiment according to this invention.

[0055] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(f):**



I(f)

R_1, R_1', R_2, R_2' are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

R_3 is SH, $NHNH_2$, or NHC(O)OBz;

R_4 is NH_2, OH, $NHNH_2$, =NH-OH, =O, =N-NH_2, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring,

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substiuents are joined together to form a 5 or 6 membered heterocyclic ring;

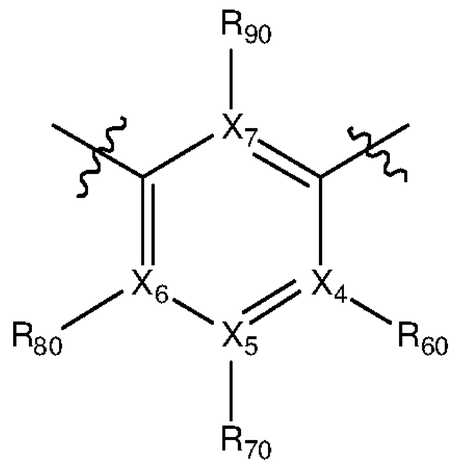
m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_2 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

or **X_2** together with the carbon next to **X_1** are joined to form ring B, represented by the following structure (in such case, **X_1** is **X_7**):



B

wherein

X_4, X_5, X_6 and **X_7** are each independently C or N, wherein if any of **X_4**, **X_5**, **X_6** and **X_7** is N, then the respective substitution **R_{90}**, **R_{60}**, **R_{70}** or **R_{80}** is absent;

R_{60} , **R_{70}** , **R_{80}** and **R_{90}** are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

X_3 is O, NH or N-R_{50};

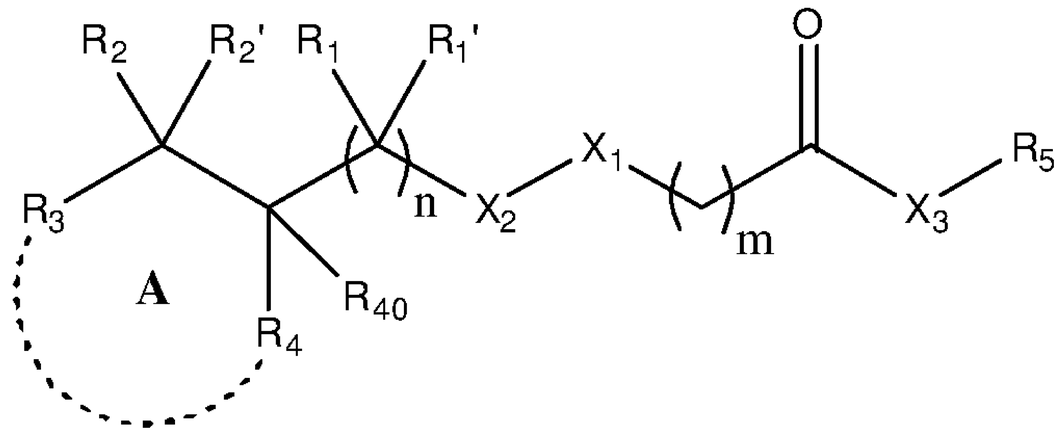
R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0056] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0057] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0058] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(g):**



I(g)

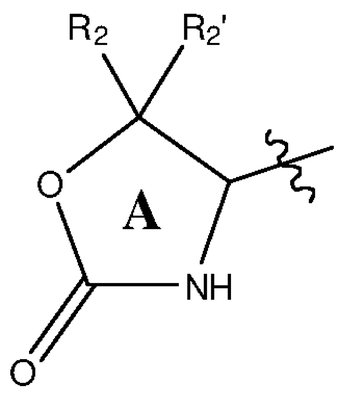
wherein

R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

R_3 is F, OH, SH, R_8-OH (e.g., CH_2-OH), NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

R_4 is OH, NH_2, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or **R_3** and **R_4** are joined to form ring **A,** represented by the following structure:



(e.g., 5-methyloxazolidin-2-one);

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or $\mathbf{R_{10}}$ and $\mathbf{R_{11}}$ are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substiuents are joined together to form a 5 or 6 membered heterocyclic ring;

m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

$\mathbf{X_1}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

$\mathbf{X_2}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

$\mathbf{X_3}$ is O, NH or N-R_{50};

$\mathbf{R_{50}}$ is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

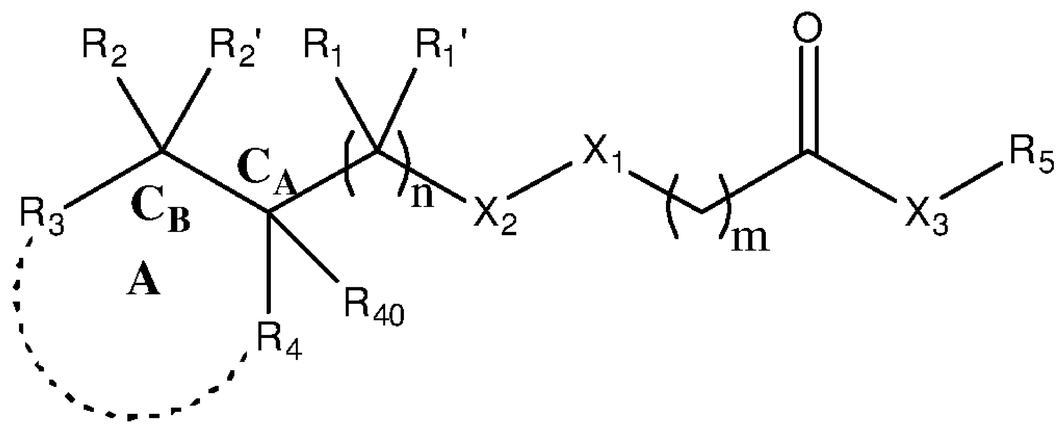
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0059] In various embodiments, $\mathbf{R_3}$ and $\mathbf{R_4}$ of compound of formula **I(g)** cannot both be NH_2. In various embodiments, if $\mathbf{R_3}$ is OH and $\mathbf{R_4}$ is NH_2, then **n** + **m** cannot be equal to 3. In various embodiments, $\mathbf{R_3}$ is OH, or NH_2. In various embodiments, $\mathbf{R_4}$ is NH_2, or OH. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In various embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, $\mathbf{R_1}$, $\mathbf{R_1'}$, $\mathbf{R_2}$, $\mathbf{R_2'}$ and $\mathbf{R_{40}}$ are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, $\mathbf{R_1}$ and $\mathbf{R_1'}$ are both H. In some embodiments, $\mathbf{R_2}$ is CH_3 or CH_2CH_3. In some embodiments, $\mathbf{R_2'}$ is H or CH_3. In some embodiments, $\mathbf{R_{40}}$ is CH_3 or H. In some embodiments, $\mathbf{X_1}$ is CH_2. In some embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{X_3}$ is O, NH or N-CH_3. In some embodiments, $\mathbf{R_5}$ is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, $\mathbf{R_5}$ is a substituted or unsubstituted alkyl. In some embodiments, $\mathbf{R_5}$ is H. In some embodiments, $\mathbf{R_5}$ is H, ethyl, butyl, CH_2-CCH, CH_2-$C(O)$-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0060] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0061] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

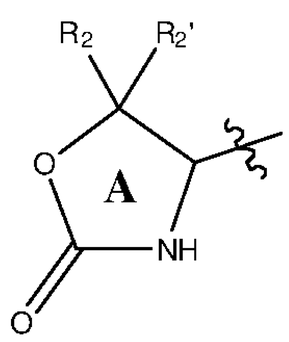
[0062] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(ga):**



I(ga)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers, or $\mathbf{C_A}$ and $\mathbf{C_B}$ together with $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined to form ring **A,** represented by the following structure:



(e.g., 5-methyloxazolidin-2-one);

$\mathbf{R_1}$, $\mathbf{R_1'}$, $\mathbf{R_2}$, $\mathbf{R_2'}$ and $\mathbf{R_{40}}$ are each independently H, F, Cl, Br, I, OH, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), or C(O)-R_{10} (e.g., C(O)-CH_3);

$\mathbf{R_3}$ is F, OH, SH, R_8-OH (e.g., CH_2-OH), NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

$\mathbf{R_4}$ is OH, NH_2, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

$\mathbf{R_5}$ is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or

unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substiuents are joined together to form a 5 or 6 membered heterocyclic ring;

m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

X_1 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_2 is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

X_3 is O, NH or N-R_{50};

R_{50} is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

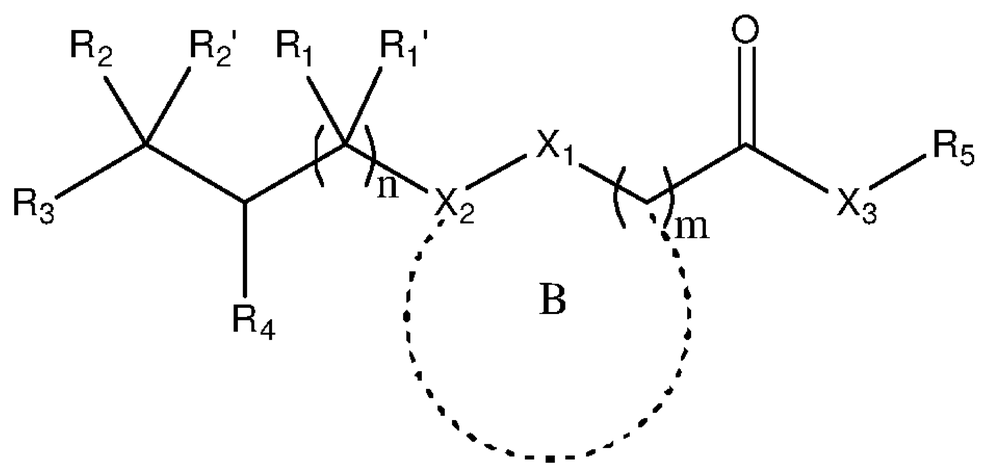
[0063] In various embodiments, **R_3** and **R_4** of compound of formula **I(ga)** cannot both be NH_2. In various embodiments, if **R_3** is OH and **R_4** is NH_2, then **n** + **m** cannot be equal to 3. In various embodiments, **R_3** is OH, or NH_2. In various embodiments, **R_4** is NH_2, or OH. In various embodiments, if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if R_3 is OH then R_4 is NH_2. In some embodiments, if R_3 is NH_2 then R_4 is OH. In some embodiments, the compound is compound **101, 102, 104, 105, 106, 113, 114, 115, 116, 117, 118, 119,** or **120**; each represents a separate embodiment according to this invention. In some embodiments, ring **A** has two chiral centers. In some embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In some embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In some embodiments, the compound is a substantially pure single stereoisomer. In some embodiments, **R_1, R_1', R_2, R_2'** and **R_{40}** are each independently H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl). In some embodiments, **R_1** and **R_1'** are both H. In some embodiments, **R_2** is CH_3 or CH_2CH_3. In some embodiments, **R_2'** is H or CH_3. In some embodiments, **R_{40}** is CH_3 or H. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_3** is O, NH or N-CH_3. In some embodiments, **R_5** is H, or C_1-C_5 linear or branched, substituted or unsubstituted alkyl, or substituted or unsubstituted alkyl sulfone. In some embodiments, **R_5** is a substituted or unsubstituted alkyl. In some embodiments, **R_5** is H. In some embodiments, **R_5** is H, ethyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3 or SO_2-CH_2-cyclopentyl; each is a separate embodiment

according to this invention. In some embodiments, n is 0, 1, 2 or 3. In some embodiments, n is 1. In some embodiments, m is 1 or 2. In some embodiments, m is 1.

[0064] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0065] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0066] In various embodiments, this invention is directed to a compound represented by the structure of formula **I(h):**



I(h)

wherein

R_1, R_1', R_2, R_2' are each independently H, F, Cl, Br, I, OH, SH, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., -CH_2-O-CH_3), R_8-(C_3-C_8 cycloalkyl) (e.g., cyclohexyl), R_8-(C_3-C_8 heterocyclic ring) (e.g., CH_2-imidazole, CH_2-indazole), CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$), R_9-R_8-$N(R_{10})(R_{11})$ (e.g., C≡C-CH_2-NH_2), $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10} (e.g., $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, $C(O)O$-R_{10} (e.g. $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3), R_8-$C(O)$-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, $C(O)$-R_{10} (e.g., $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., $C(O)$-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl), C_1-C_5 linear or branched, substituted or unsubstituted alkenyl (e.g., $CH=C(Ph)_2$)), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu), optionally wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom (e.g., O-1-oxacyclobutyl, O-2-oxacyclobutyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy (e.g., OCF_3, $OCHF_2$), C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-

oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted benzyl (e.g., benzyl, 4-Cl-benzyl, 4-OH-benzyl);

or **R_2** and **R_1** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring;

R_3 is H, F, Cl, Br, I, OH, SH, =O, R_8-OH (e.g., CH_2-OH), R_8-SH, -R_8-O-R_{10}, (e.g., CH_2-O-CH_3) CF_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$ (e.g., CH_2-NH_2, CH_2-$N(CH_3)_2$) R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10} (e.g., $NHC(O)CH_3$), NHC(O)-$N(R_{10})(R_{11})$ (e.g., $NHC(O)N(CH_3)_2$), COOH, -C(O)Ph, $C(O)O$-R_{10} (e.g. $C(O)O$-CH_3, $C(O)O$-CH_2CH_3), R_8-C(O)-R_{10} (e.g., $CH_2C(O)CH_3$), C(O)H, $C(O)$-R_{10} (e.g., $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$), C_1-C_5 linear or branched C(O)-haloalkyl (e.g., $C(O)$-CF_3), -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$ (e.g., $C(O)N(CH_3)_2$), SO_2R, $SO_2N(R_{10})(R_{11})$ (e.g., $SO_2N(CH_3)_2$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, $C(OH)(CH_3)(Ph)$, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl (e.g., CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy (e.g. methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl), C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole), substituted or unsubstituted aryl (e.g., phenyl);

R_4 is $NHNH_2$;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-$C(O)$-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-$C(O)$-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

or $\mathbf{R_{10}}$ and $\mathbf{R_{11}}$ are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

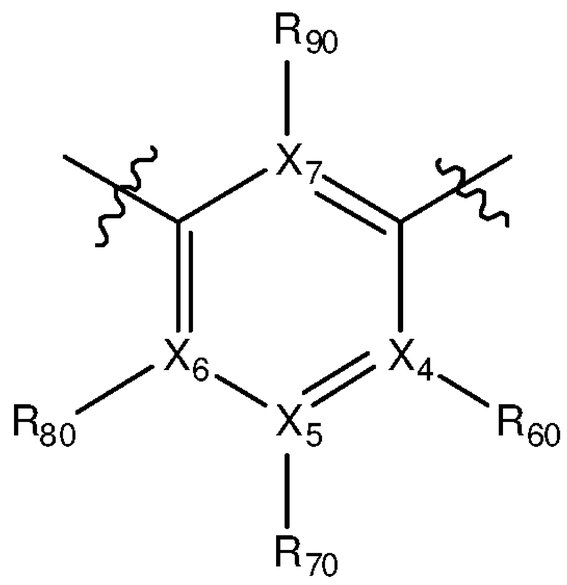
m is an integer number between 1 and 5 (e.g., 1 or 2);

n is an integer number between 0 and 5 (e.g., 0, 1, 2 or 3);

$\mathbf{X_1}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

$\mathbf{X_2}$ is S, O, N-OH, CH_2, $C(R)_2$ or N-OMe;

or $\mathbf{X_2}$ together with the carbon next to $\mathbf{X_1}$ are joined to form ring B, represented by the following structure (in such case, $\mathbf{X_1}$ is $\mathbf{X_7}$):



B

wherein

$\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$ are each independently C or N, wherein if any of $\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$ is N, then the respective substitution $\mathbf{R_{90}}$, $\mathbf{R_{60}}$, $\mathbf{R_{70}}$ or $\mathbf{R_{80}}$ is absent;

$\mathbf{R_{60}}$, $\mathbf{R_{70}}$, $\mathbf{R_{80}}$ and $\mathbf{R_{90}}$ are each independently selected from: H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl;

$\mathbf{X_3}$ is O, NH or N-R_{50};

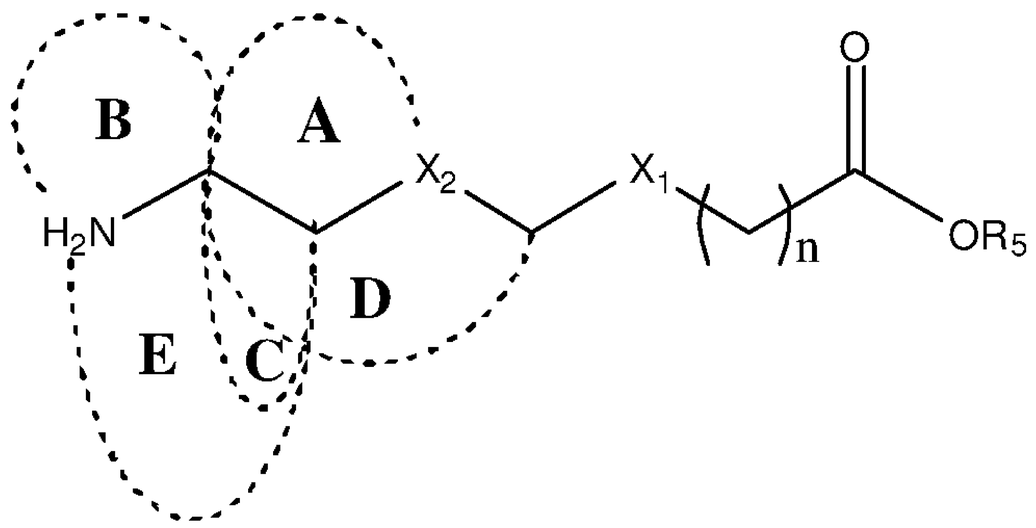
$\mathbf{R_{50}}$ is H or C_1-C_5 linear or branched, substituted or unsubstituted alkyl;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0067] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0068] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0069] In various embodiments, this invention is directed to a compound represented by the structure of formula (**X**):



(**X**)

wherein

A is a C_3-C_7 cycloalkyl or absent (e.g., cyclohexyl, cyclopropyl, cyclobutyl);

B is a 5-7 membered nitrogen-containing heterocyclic ring or absent (e.g., pyrrolidine, piperidine);

C is a C_5-C_7 a substituted or unsubstituted cycloalkyl, aromatic ring or absent (e.g., phenyl, cyclopentyl, cyclohexyl);

D is a C_5-C_7 cycloalkyl or absent (e.g., cyclopentyl);

E is substituted or unsubstituted 5-7 membered nitrogen-containing heterocyclic ring or absent (e.g., pyrrolidine, piperidine, oxazolidin-2-one);

wherein at least one of ring **A, B, C, D** or **E** is not absent;

$\mathbf{R_5}$ is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

$\mathbf{R_8}$ is $[CH_2]_p$

wherein **p** is between 1 and 10;

$\mathbf{R_9}$ is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$; or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

n is an integer number between 0 and 2;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

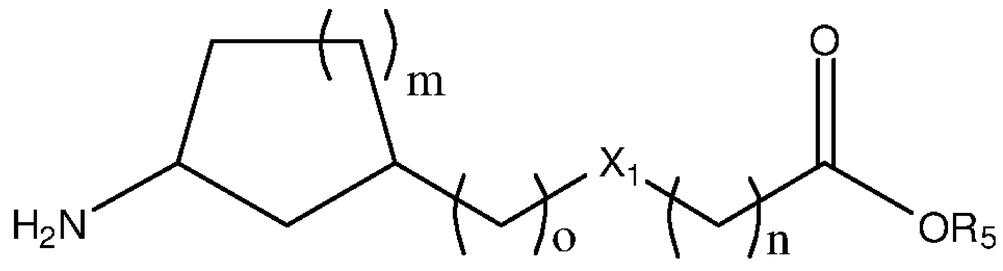
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0070] In some embodiments, at least one of rings **A – E** of compound of formula (**X**) is not absent. In some embodiments, only one of rings **A – E** is not absent. In some embodiments, **A** is absent. In some embodiments, **A** is cyclohexyl. In some embodiments, **A** is cyclopropyl. In some embodiments, **A** is cyclobutyl. In some embodiments, **B** is absent. In some embodiments, **B** is pyrrolidine. In some embodiments, **B** is piperidine. In some embodiments, **C** is absent. In some embodiments, **C** is a C_5-C_7 a substituted or unsubstituted cycloalkyl. In some embodiments, **C** is cyclopentyl. In some embodiments, **C** is cyclohexyl. In some embodiments, **C** is an aromatic ring. In some embodiments, **C** is a phenyl. In some embodiments, **D** is absent. In some embodiments, **D** is cyclopentyl. In some embodiments, **E** is absent. In some embodiments, **E** is pyrrolidine. In some embodiments, **E** is piperidine. In some embodiments, **E** is oxazolidin-2-one. In some embodiments, **E** is substituted oxazolidin-2-one. In some embodiments, **X_1** is S. In some embodiments, **X_1** is O. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is S. In some embodiments, **X_2** is O. In some embodiments, **X_2** is CH_2. In some embodiments, **n** is 0. In some embodiments, **n** is 1. In some embodiments, **n** is 2. In some embodiments, **R_5** is H. In some embodiments, **R_5** is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, **R_5** is ethyl. In some embodiments, **R_5** is butyl. In some embodiments, **R_5** is CH_2-C≡CH.

[0071] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0072] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants. In various embodiments, the compound is compound **105, 106, 123, 124, 125, 126, 129, 130, 131, 132, 133, 134, 138, 139, 143, 145, 146, 147, 148, 150, 152, 153, 154, 155, 165, 166, 167, 168** or **171**; each represents a separate embodiment according to this invention.

[0073] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(a)**:



X(a)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

n and **o** are each independently an integer number between 0 and 2;

m is an integer number between 1 and 3;

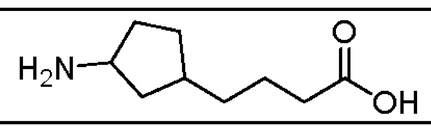
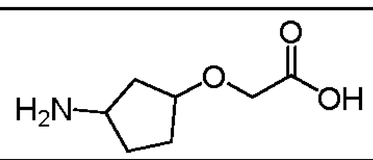
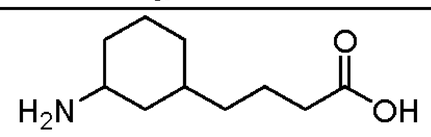
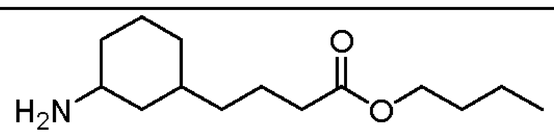
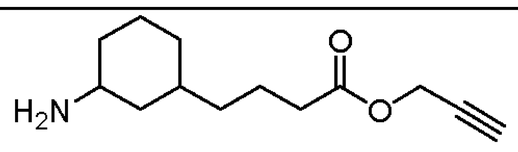
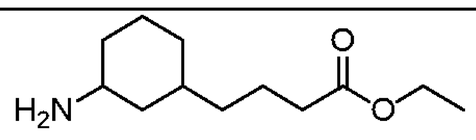
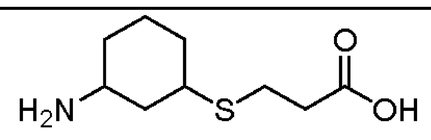
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0074] In some embodiments, m compound of formula **X(a)** is 1. In some embodiments, m is 2. In some embodiments, m is 1 or 2. In some embodiments, o is 0. In some embodiments, o is 1. In some embodiments, o is 0 or 1. In some embodiments, n is 0. In some embodiments, n is 1. In some embodiments, n is 2. In some embodiments, n is 0 or 1. In some embodiments, n is 1 or 2. In some embodiments, **X_1** is CH_2. In some embodiments, **X_1** is S. In some embodiments, **X_1** is O. In some embodiments, **R_5** is H. In some embodiments, **R_5** is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, **R_5** is ethyl. In some embodiments, **R_5** is butyl. In some

embodiments, $\mathbf{R_5}$ is substituted alkyl. In some embodiments, $\mathbf{R_5}$ is CH_2-C≡CH. In some embodiments, $\mathbf{R_5}$ is not H. In some embodiments, $\mathbf{X_1}$ is CH_2, m is 2, n is 1, and $\mathbf{R_5}$ is substituted or unsubstituted alkyl. In some embodiments, $\mathbf{X_1}$ is CH_2, m is 2, n is 1, o is 1, and $\mathbf{R_5}$ is substituted or unsubstituted alkyl. In some embodiments, $\mathbf{X_1}$ is O or S, m is 1 or 2, n is 1 or 2, o is 0 or 1, and $\mathbf{R_5}$ is H. In some embodiments, if $\mathbf{R_5}$ is H then $\mathbf{X_1}$ is not CH_2. In some embodiments, if $\mathbf{X_1}$ is O and $\mathbf{R_5}$ is H then n is not 1. In some embodiments, if $\mathbf{X_1}$ is O then n is not 1.

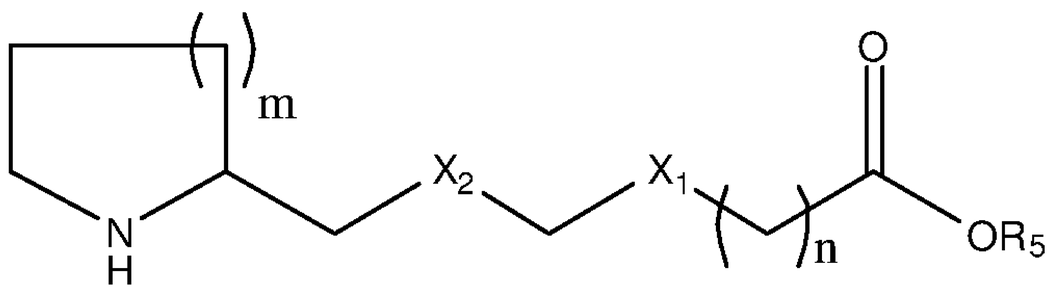
[0075] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0076] In various embodiments, the compound of formula **X(a),** is represented by any one of the following structures:

Compound	Structure
143	
144	
145	
124	
125	
126	
139	

[0077] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0078] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(b)**:



X(b)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

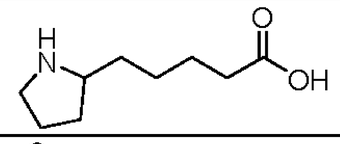
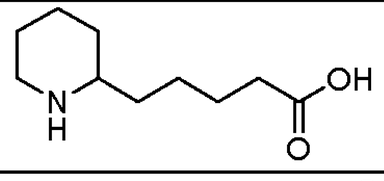
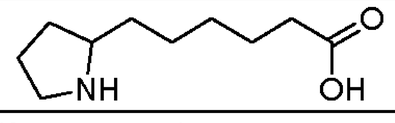
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0079] In some embodiments, m of compound of formula **X(b)** is 1. In some embodiments, m is 2. In some embodiments, m is 1 or 2. In some embodiments, n is 0. In some embodiments, n is 1. In some embodiments, n is 0 or 1. In some embodiments, **X_1** is CH_2. In some embodiments, **X_2** is CH_2. In some embodiments, **X_1** and **X_2** are CH_2. In some embodiments, **R_5** is H.

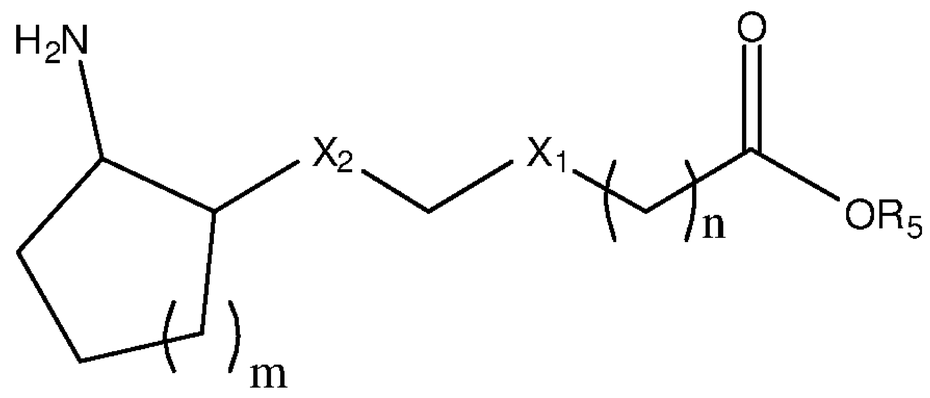
[0080] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

[0081] In various embodiments, the compound of formula **X(b)** represented by any one of the following structures:

Compound	Structure
148	
155	
166	

[0082] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0083] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(c)**:



X(c)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

$\mathbf{X_2}$ is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

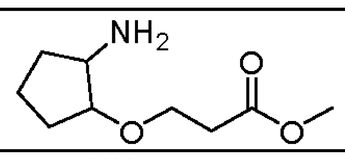
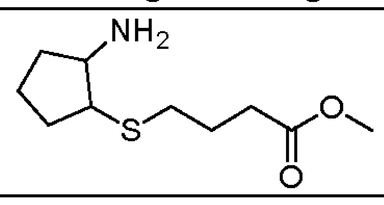
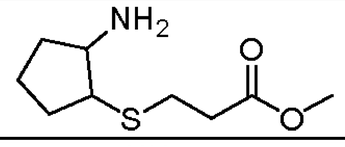
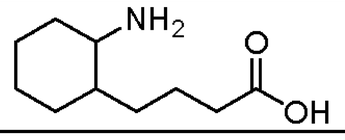
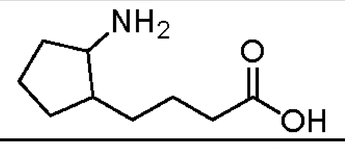
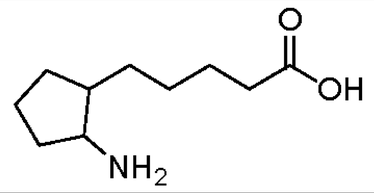
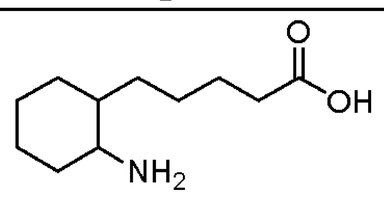
m is an integer number between 1 and 3;

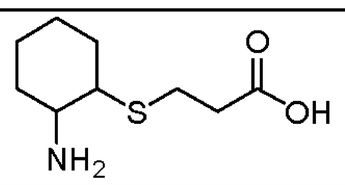
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0084] In some embodiments, m of compound of formula **X(c)** is 1. In some embodiments, m is 2. In some embodiments, m is 1 or 2. In some embodiments, n is 0. In some embodiments, n is 1. In some embodiments, n is 0 or 1. In some embodiments, $\mathbf{X_1}$ is CH_2. In some embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{X_2}$ is S. In some embodiments, $\mathbf{X_2}$ is O. In some embodiments, $\mathbf{X_1}$ and $\mathbf{X_2}$ are CH_2. In some embodiments, $\mathbf{R_5}$ is H. In some embodiments, $\mathbf{R_5}$ is substituted or unsubstituted alkyl. In some embodiments, $\mathbf{R_5}$ is methyl. In some embodiments, $\mathbf{X_1}$ and $\mathbf{X_2}$ are CH_2, n is 1, and m is 1 or 2. In some embodiments, n is 1, $\mathbf{R_5}$ is H and m is 1 or 2.

[0085] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

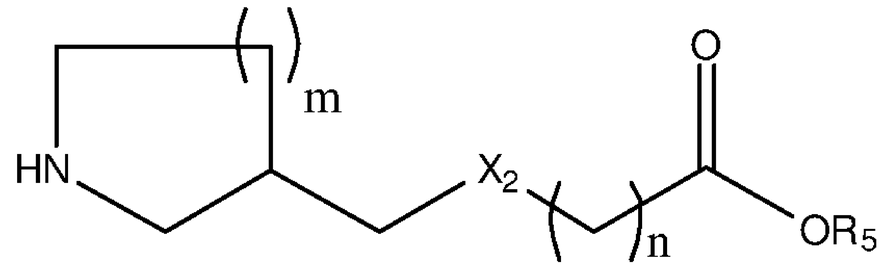
[0086] In various embodiments, the compound of formula **X(c)** is represented by any one of the following structures:

Compound	Structure
179	
146	
147	
152	
153	
131	
132	

171	

[0087] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0088] In various embodiments, this invention is directed to a compound represented by the structure of formula **X(d)**:



X(d)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_9 is $[CH]_q$, $[C]_q$

wherein **q** is between 2 and 10;

R_{10} and **R_{11}** are each independently H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

or **R_{10}** and **R_{11}** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring (e.g., piperazine, piperidine),

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

m is an integer number between 1 and 3;

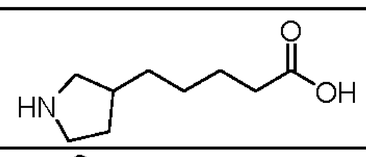
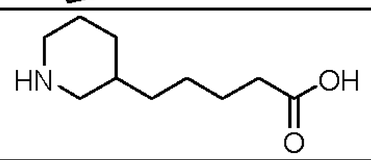
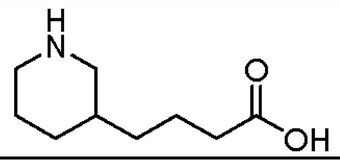
or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

[0089] In some embodiments, m of compound of formula **X(d)** is 1. In some embodiments, m is 2. In some embodiments, m is 1 or 2. In some embodiments, n is 1. In some embodiments, n is 2. In some

embodiments, n is 1 or 2. In some embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{R_5}$ is H. In some embodiments, $\mathbf{R_5}$ is H, n is 2 and m is 1. In some embodiments, $\mathbf{R_5}$ is H, $\mathbf{X_2}$ is CH_2, n is 2 and m is 1.

[0090] In some embodiments, substitutions include but not limited to: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN, NO_2 or any combination thereof.

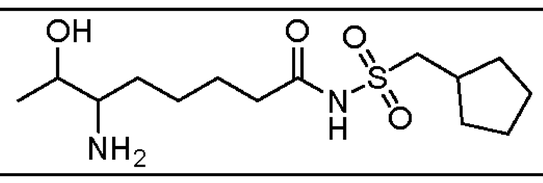
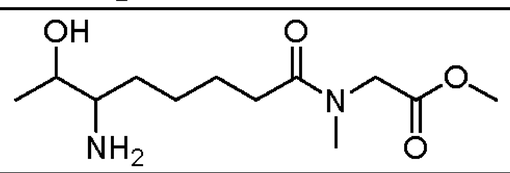
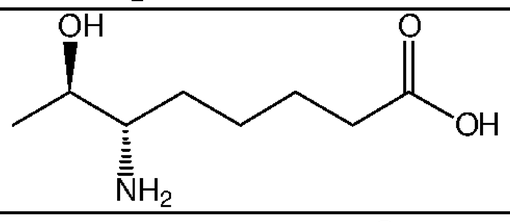
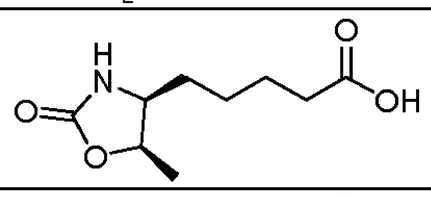
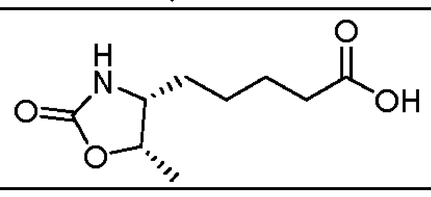
[0091] In various embodiments, the compound of formula **X(d)** is represented by any one of the following structures:

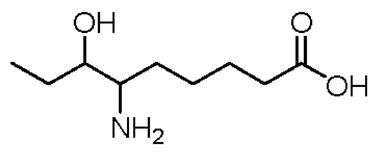
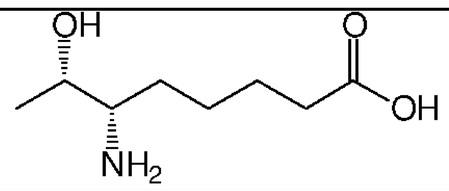
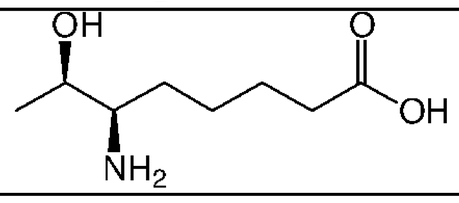
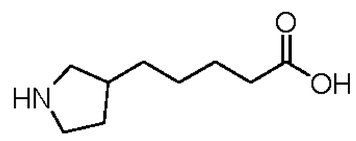
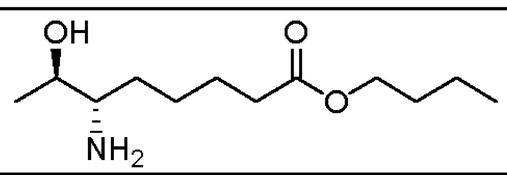
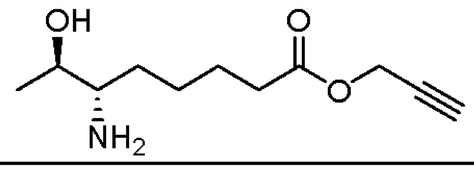
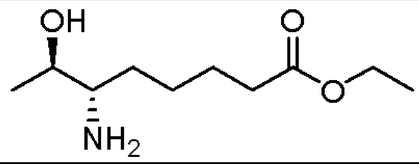
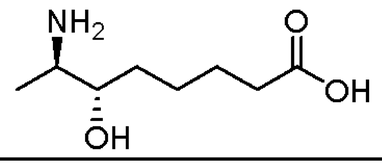
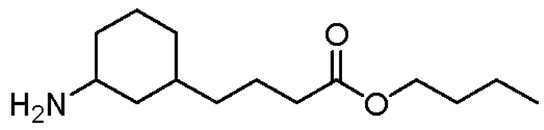
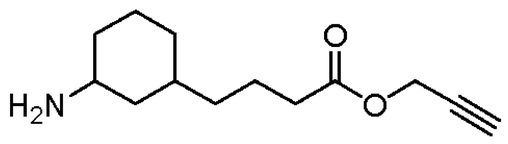
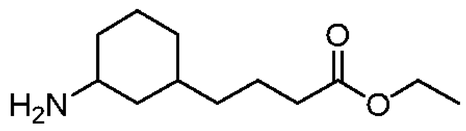
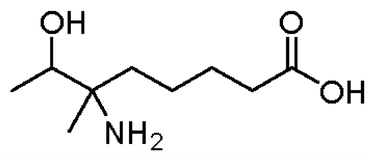
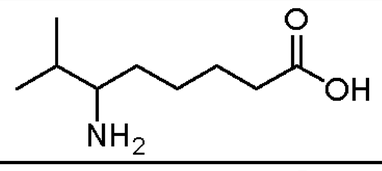
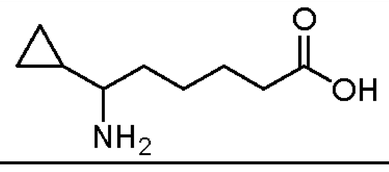
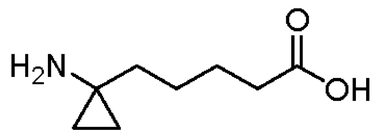
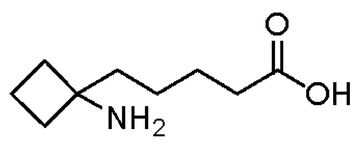
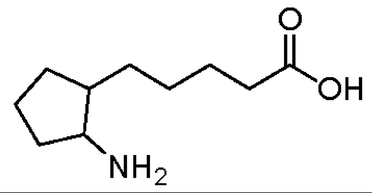
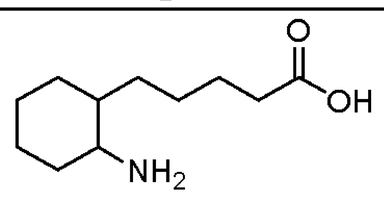
Compound	Structure
123	
181	
154	

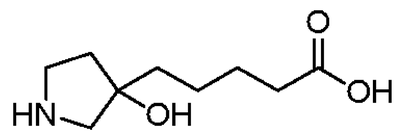
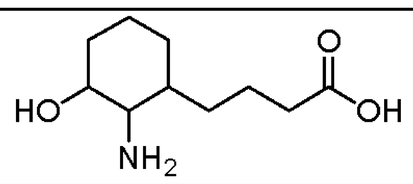
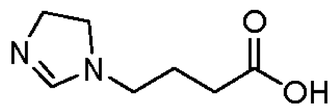
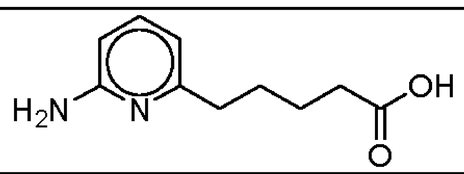
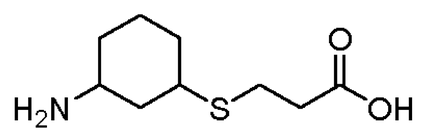
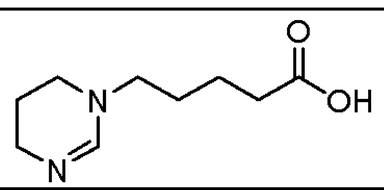
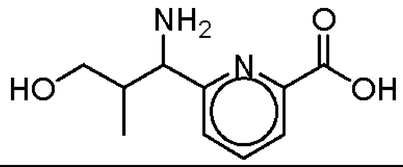
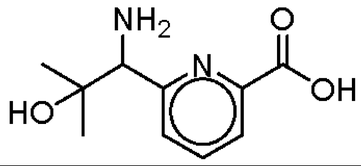
[0092] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

[0093] In various embodiments, this invention is directed to a compound represented by any one of the following structures:

Table 1:

Compound	Structure
101	
102	
104	
105	
106	

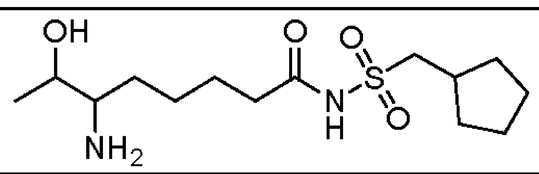
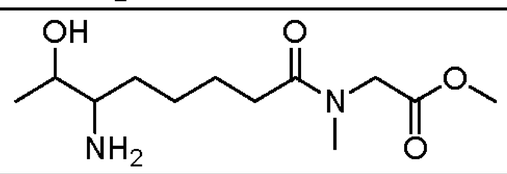
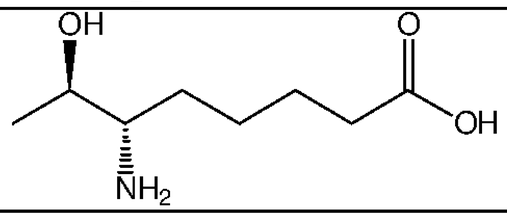
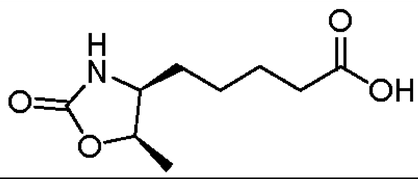
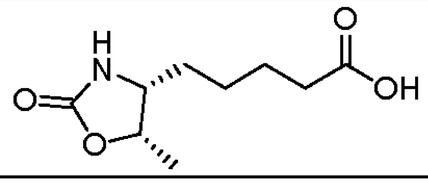
113	
114	
115	
123	
116	
117	
118	
119	
124	
125	
126	
120	
127	
128	
129	
130	
131	
132	

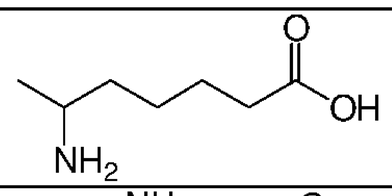
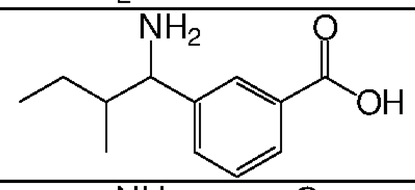
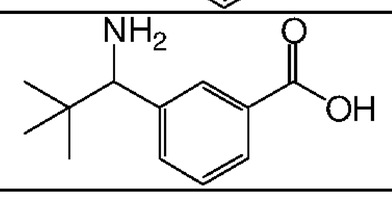
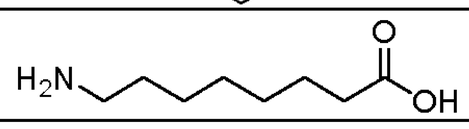
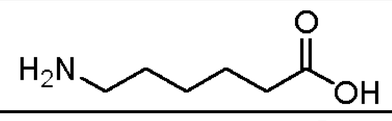
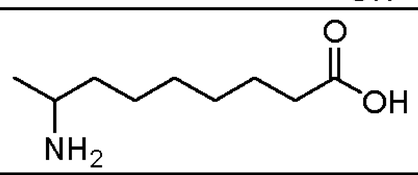
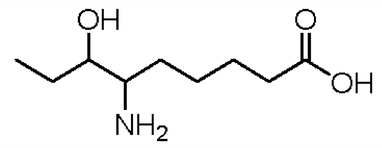
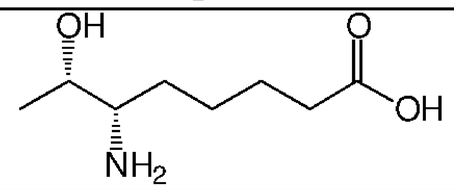
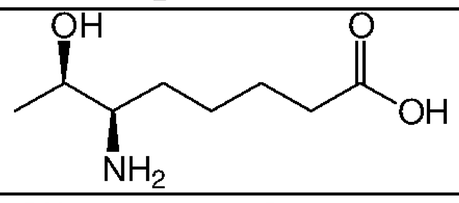
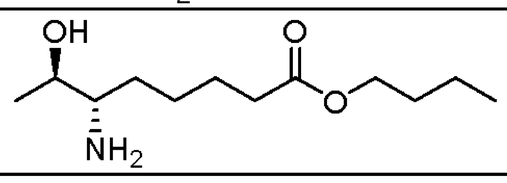
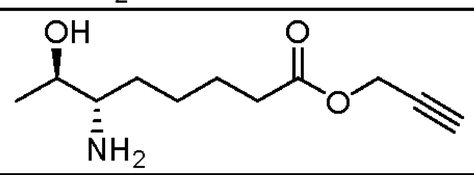
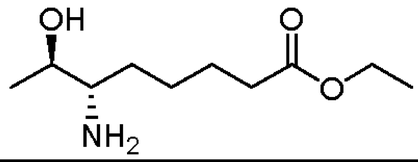
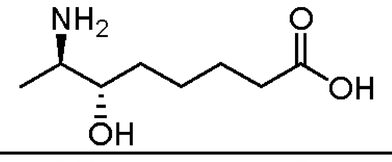
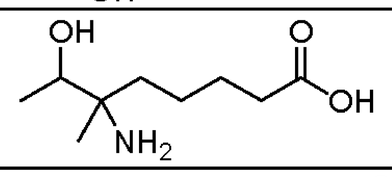
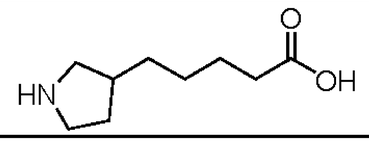
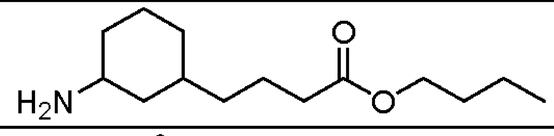
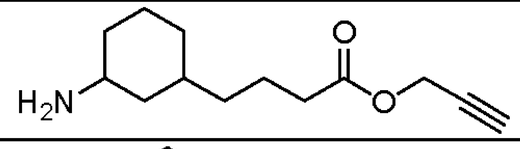
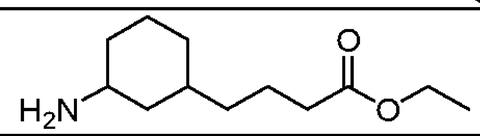
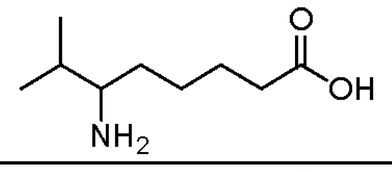
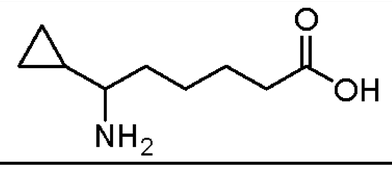
133	
134	
137	
138	
139	
140	
141	
142	

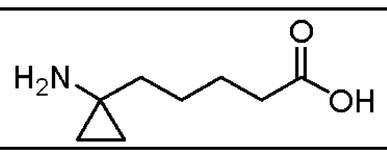
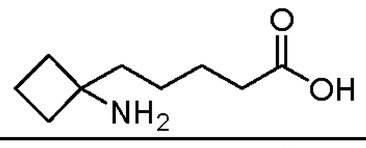
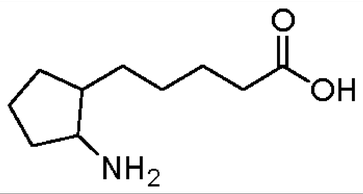
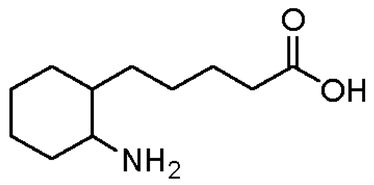
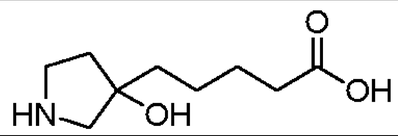
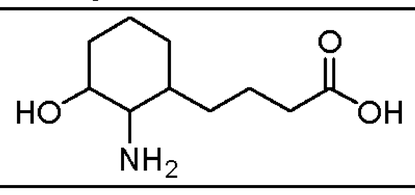
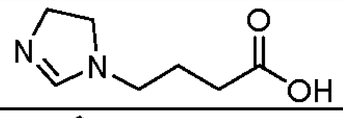
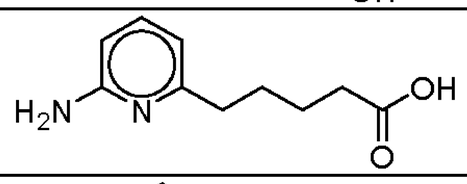
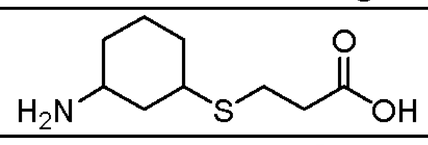
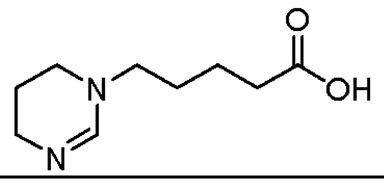
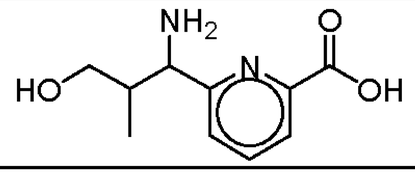
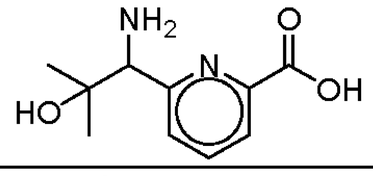
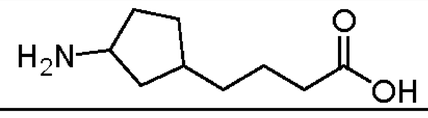
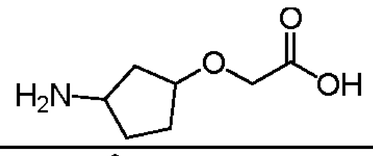
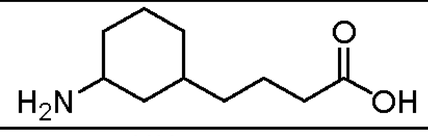
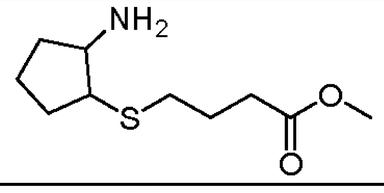
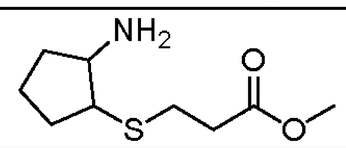
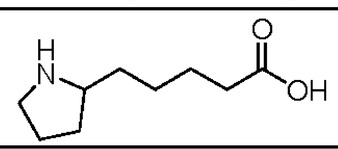
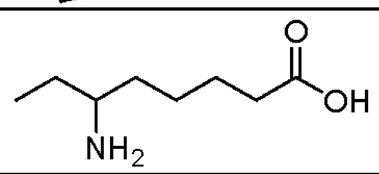
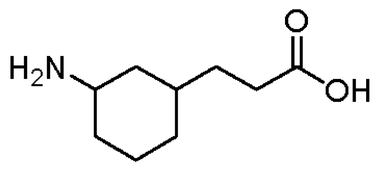
[0094] In various embodiments, the compound is an herbicidal compound. In various embodiments, the compound is for use in controlling the growth of undesired plants.

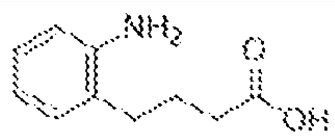
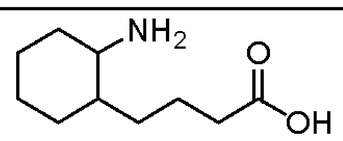
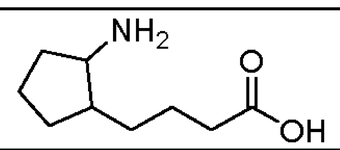
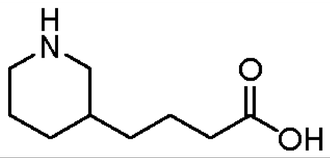
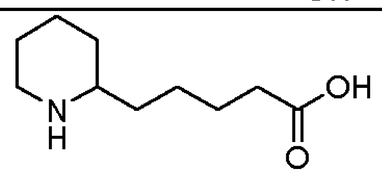
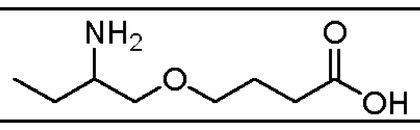
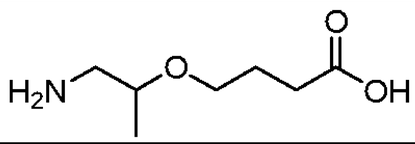
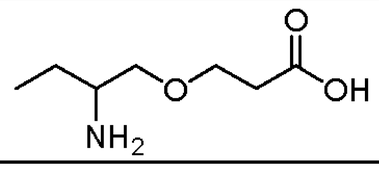
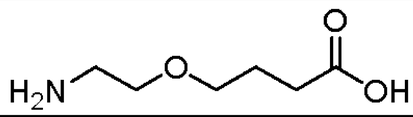
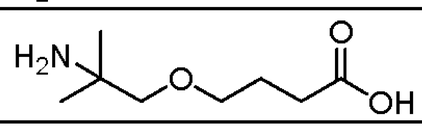
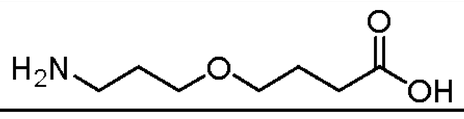
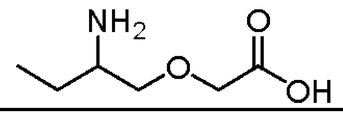
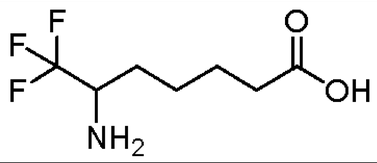
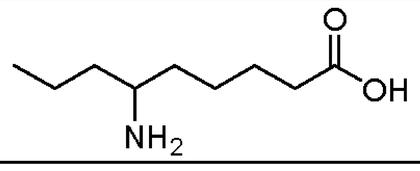
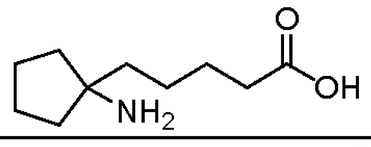
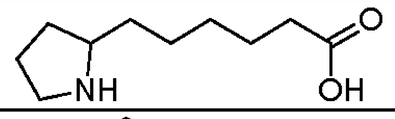
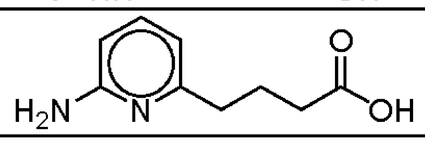
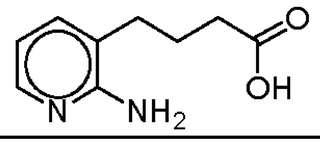
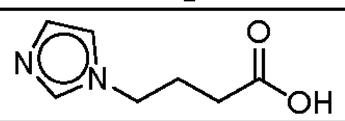
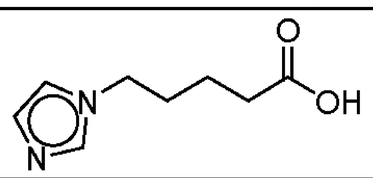
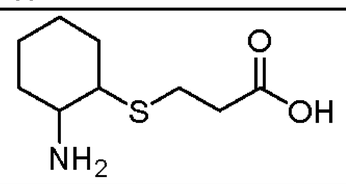
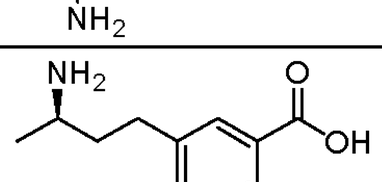
[0095] In various embodiments, this invention is directed to an herbicidal compound and/or to a use of a compound represented by any one of the following structures, or an agrochemical composition thereof, in controlling the growth of undesired plants:

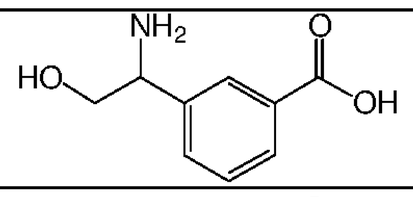
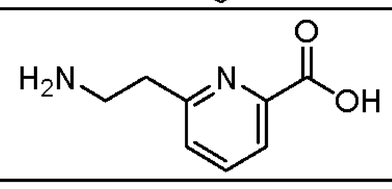
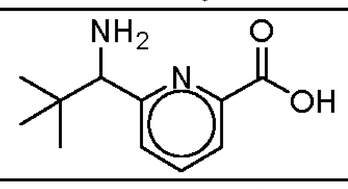
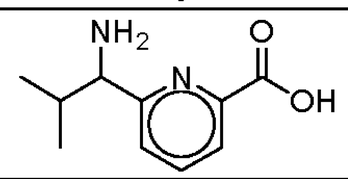
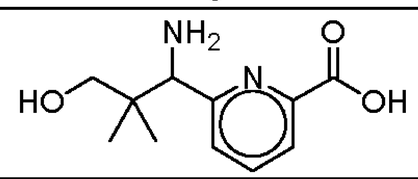
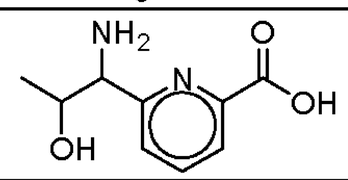
Table 2:

Compound	Structure
101	
102	
104	
105	
106	

107	
108	
109	
110	
111	
112	
113	
114	
115	
116	
117	
118	
119	
120	
123	
124	
125	
126	
127	
128	

129	
130	
131	
132	
133	
134	
137	
138	
139	
140	
141	
142	
143	
144	
145	
146	
147	
148	
149	
150	

151	
152	
153	
154	
155	
156	
157	
158	
159	
160	
161	
162	
163	
164	
165	
166	
167	
168	
169	
170	
171	
172	

173	
174	
175	
176	
177	
178	

[0096] In various embodiments, ring **A** of compound of formula **I, I(a), I(b), I(g)** and **I(ga)** has one chiral center (i.e., R_2 and R_2' are identical). In various embodiments, $\mathbf{C_B}$ of ring A of formula **I(a)** or **I(b)** is achiral (i.e., R_2 and R_2' are identical). In various embodiments, $\mathbf{C_B}$ of ring A is chiral. In various embodiments, ring A has two chiral centers (i.e., R_2 and R_2' are different)). In various embodiments, the compound is a single stereoisomer. In various embodiments, the compound is a single enantiomer.

[0097] In various embodiments, the compound comprises a substantially pure stereoisomer. By substantially pure, it is intended that a stereoisomer is at least about 90% pure, more preferably at least about 95% pure, even more preferably at least about 98% pure, most preferably at least about 99% pure. In various embodiments, the compound comprises a single stereoisomer in a purity of >80%; >85%; >90%; >91%; >92%; >93%; >94%; >95%; >96%; >97%; >98%; >99%; >99.5% enantiomeric excess (*ee)*; each represents a separate embodiment according to this invention. In various embodiments, the compound comprises a single stereoisomer in a purity >80%; >85%; >90%; >91%; >92%; >93%; >94%; >95%; >96%; >97%; >98%; >99%; >99.5% enantiomeric ratio (*er)*; each represents a separate embodiment according to this invention. In various embodiments, the compound comprises a single stereoisomer in a purity higher than 80%; 85%; 90%; 91%; 92%; 93%; 94%; 95%; 96%; 97%; 98%; 99%; 99.5%; each represents a separate embodiment according to this invention.

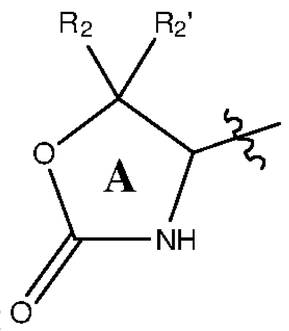
[0098] In various embodiments, the compound is a substantially pure single enantiomer. In various embodiments, the compound comprises a mixture of stereoisomers. In various embodiments, the compound comprises a mixture of enantiomers. In various embodiments, the compound is a racemate.

[0099] In various embodiments, the compound has two chiral centers. In various embodiments, the compound comprises a mixture of stereoisomers. In various embodiments, the compound comprises a mixture of 2, 3, or 4 stereoisomers; each represents a separate embodiment according to this invention. In various embodiments, the compound is a single stereoisomer. In various embodiments, the compound is a substantially pure single stereoisomer. In various embodiments, the substantially pure stereoisomer is compound **104**, **105**, **106**, **114**, **115**, **116**, **117**, **118**, or **119** as described herein below; each represents

a separate embodiment according to this invention. In various embodiments, the substantially pure stereoisomer has at least 80%, 85%, 90%, 95%, 97%, 98%, 99% purity; each represents a separate embodiment according to this invention. In various embodiments, the compound is the substantially pure ***RR*** stereoisomer. In various embodiments, the compound is the substantially pure ***SS*** stereoisomer. In various embodiments, the compound is the substantially pure ***RS*** stereoisomer. In various embodiments, the compound is 5-((*4R*,*5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In various embodiments, the compound is Compound **106**. In various embodiments, the compound is the substantially pure ***SR*** stereoisomer. In various embodiments, the compound is (*6S*,*7R*)-6-amino-7-hydroxyoctanoic acid. In various embodiments, the compound is Compound **104**. In various embodiments, the compound is 5-((*4S*,*5R*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid. In various embodiments, the compound is Compound **105**. In various embodiments, the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid. In various embodiments, the compound is not 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid.

[00100] In some embodiments, **A** of formula **I, I(a), I(b), I(g)** or **I(ga)** is absent. In some embodiments, A of formula **I,** is a substituted or unsubstituted single or fused aromatic or heteroaromatic ring system, or a substituted or unsubstituted single or fused C_3-C_{10} cycloalkyl, or a single or fused C_3-C_{10} heterocyclic ring. In some embodiments, A of formula **I,** is a substituted or unsubstituted single or fused aromatic or heteroaromatic ring system, or a substituted or unsubstituted single or fused C_4-C_{10} cycloalkyl, or a single or fused C_4-C_{10} heterocyclic ring. In some embodiments, A is a single aromatic ring system. In some embodiments, A is a substituted aryl. In some embodiments, the aryl is substituted with NH_2. In some embodiments, A is a single heteroaromatic ring. In some embodiments, A is a single C_3-C_{10} cycloalkyl. In some embodiments, A is a substituted single C_3-C_{10} cycloalkyl. In some embodiments, A is a single C_4-C_{10} cycloalkyl. In some embodiments, A is a substituted single C_4-C_{10} cycloalkyl. In some embodiments, **A** is cyclopropyl. In some embodiments, **A** is cyclobutyl. In some embodiments, **A** is cyclopentyl. In some embodiments, **A** is cyclohexyl. In some embodiments, A is further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention. In some embodiments, A is further substituted with NH_2. In some embodiments, A is a cycloalkyl, substituted with NH_2. In some embodiments, the cycloalkyl is cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl; each represents a separate embodiment according to this invention. In some embodiments, A is a single C_3-C_{10} heterocyclic ring. In some embodiments, A is a single C_4-C_{10} heterocyclic ring. In some embodiments, **A** is a substituted oxazolidin-2-one ring. In some embodiments, **A** is an alkyl substituted oxazolidin-2-one ring. In some embodiments, **A** is 5-methyloxazolidin-2-one. In some embodiments, **A** is 5-methyloxazolidin-2-one. In some embodiments, A is a nitrogen-containing heterocyclic ring. In some embodiments, **A** is 1, 2, or 3-pyrrolidine; each represents a separate embodiment according to this

invention. In some embodiments, **A** is tetrahydropyridine. In some embodiments, **A** is 5,6-dihydro-4H-1,3-thiazine. In some embodiments, **A** is 4,5-dihydro-1H-imidazole. In some embodiments, **A** is 2, 3 or 4-pyridine; each represents a separate embodiment according to this invention. In some embodiments, the pyridine is further substituted with at least NH_2. In some embodiments, **A** is tetrahydropyrimidine. In some embodiments, **A** is 1, 2 or 3-piperidine; each represents a separate embodiment according to this invention. In some embodiments, **A** is imidazole. In some embodiments, the nitrogen containing heterocyclic ring is further substituted with at least NH_2. In some embodiments, A is a fused aromatic ring system. In some embodiments, A is a fused heteroaromatic ring system. In some embodiments, A is a fused C_3-C_{10} cycloalkyl. In some embodiments, A is a fused C_3-C_{10} heterocyclic ring system. In some embodiments, A is a phenyl. In other embodiments, A is pyridinyl. In other embodiments, A is 2-pyridinyl. In other embodiments, A is 3-pyridinyl. In other embodiments, A is 4-pyridinyl. In other embodiments, A is naphthyl. In other embodiments, A is benzothiazolyl. In other embodiments, A is benzimidazolyl. In other embodiments, A is quinolinyl. In other embodiments, A is isoquinolinyl. In other embodiments, A is indolyl. In other embodiments, A is tetrahydronaphthyl. In other embodiments, A is indenyl. In other embodiments, A is benzofuran-2(3H)-one. In other embodiments, A is benzo[d][1,3]dioxole. In other embodiments, A is naphthalene. In other embodiments, A is tetrahydrothiophene1,1-dioxide. In other embodiments, A is thiazole. In other embodiments, A is benzimidazole. In other embodiments, A is piperidine. In other embodiments, A is 1-methylpiperidine. In other embodiments, A is imidazole. In other embodiments, A is 1-methylimidazole. In other embodiments, A is thiophene. In other embodiments, A is isoquinoline. In other embodiments, A is indole. In other embodiments, A is 1,3-dihydroisobenzofuran. In other embodiments, A is benzofuran. In other embodiments, A is single or fused C_3-C_{10} cycloalkyl ring. In other embodiments, A is cyclohexyl. In some embodiments, A may be further substituted, with at least one substituent selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention. In some embodiments, A may be further substituted, with NH_2.

[00101] In some embodiments, ring **A** of formula **I, I(a), I(b), I(g),** and/or **I(ga)**, is represented by the following structure: 

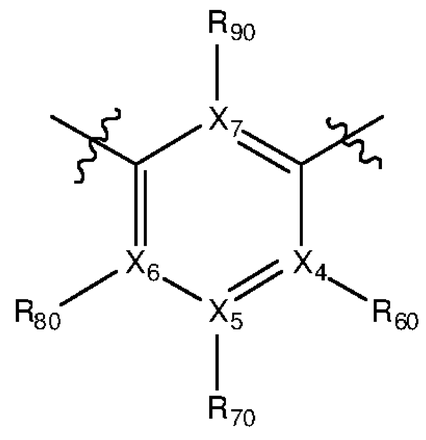
wherein R_2 and R_2' are as defined below.

[00102] It is understood that the wigly line in ring A above, represents the connection point of **A** to the rest of the molecule (i.e., to $-(C(R_1)(R_1'))_n$ of formula **I, I(a), I(b), I(g)** or **I(ga).**

[00103] In some embodiments, ring **B** of formula **I, I(a), I(b), I(f)** and/or **I(h)** is absent. In other embodiments, ring **B** is pyridine.

[00104] In some embodiments, ring **B** of formula **I,** is a single or fused aromatic or heteroaromatic ring system, or a single or fused C_3-C_{10} cycloalkyl, or a single or fused C_3-C_{10} heterocyclic ring. In some embodiments, ring **B** is a single aromatic ring system (i.e., arene). In some embodiments, ring **B** is a single heteroaromatic ring (e.g., pyridine). In some embodiments, ring **B** is a single C_3-C_{10} cycloalkyl. In some embodiments, ring **B** is a single C_3-C_{10} heterocyclic ring. In some embodiments, ring **B** is a fused aromatic ring system. In some embodiments, ring **B** is a fused heteroaromatic ring system. In some embodiments, ring **B** is a fused C_3-C_{10} cycloalkyl. In some embodiments, ring **B** is a fused C_3-C_{10} heterocyclic ring system. In some embodiments, ring **B** is an arene. In other embodiments, ring **B** is pyridine ring. In other embodiments, ring **B** is pyrazine. In other embodiments, ring **B** is pyridazine. In other embodiments, ring **B** is pyrimidine. In other embodiments, ring **B** is a triazine. In other embodiments, ring **B** is a tetrazine. In some embodiments, ring **B** may be further substituted, with at least one substituent selected from: F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, substituted or unsubstituted aryl, $C(O)$-CH_3, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, or any combination thereof; each represents a separate embodiment according to this invention.

[00105] In some embodiments, ring **B** of formula **I, I(a), I(b), I(f)** and/or **I(h)** is represented by the following structure:



In such case, $\mathbf{X_1}$ of formula **I, I(a), I(b), I(f)** and **I(h)** is represented by $\mathbf{X_7}$ in ring B, wherein $\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$, $\mathbf{R_{90}}$, $\mathbf{R_{60}}$, $\mathbf{R_{70}}$ and $\mathbf{R_{80}}$ are as defined below.

[00106] It is understood that the wigly lines in ring **B** above, represent the connection points of ring B to the rest of the molecule (i.e., to $-(C(R_1)(R_1'))_n$ from the left and to the carbonyl carbon atom from the right)

[00107] In some embodiments, $\mathbf{R_1}$ of compound of formula **I** and/or **I(a)-I(h)** is each independently H. In some embodiments, R_1 is each independently F, Cl, Br, or I; each represents a separate embodiment according to this invention. In some embodiments, R_1 is C(O)-R_{10}, wherein R_{10} is as defined below. In some embodiments, R_1 is $C(O)$-CH_3. In some embodiments, R_1 is each independently C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_1 is methyl. In some embodiments,

R_1 is ethyl. In some embodiments, R_1 is iso-propyl. In some embodiments, R_1 is each independently methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_1 is each independently OH, SH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, -CH_2-O-CH_3, R_8-(C_3-C_8 cycloalkyl), CH_2-cyclohexyl, R_8-(C_3-C_8 heterocyclic ring), CH_2-imidazole, CH_2-indazole, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, C≡C-CH_2-NH_2, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10}, $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, $C(O)O$-R_{10}, $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3, R_8-$C(O)$-R_{10}, $CH_2C(O)CH_3$, $C(O)H$, $C(O)$-R_{10}, $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, $C(O)$-CF_3, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, $C(O)N(CH_3)_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C_1-C_5 linear or branched, substituted or unsubstituted alkenyl, $CH=C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom, O-1-oxacyclobutyl, O-2-oxacyclobutyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, OCF_3, $OCHF_2$, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl, phenyl, substituted or unsubstituted benzyl, 4-Cl-benzyl, 4-OH-benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_1 is H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, $C(O)$-R_{10} or $C(O)$-CH_3; each represents a separate embodiment according to this invention. In some embodiments each R_1 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, $COO(R)$, NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00108] In some embodiments, **R_1'** of compound of formula **I** and/or **I(a)-I(h)** is each independently H. In some embodiments, R_1' is each independently F, Cl, Br, or I; each represents a separate embodiment according to this invention. In some embodiments, R_1' is $C(O)$-R_{10}, wherein R_{10} is as defined below. In some embodiments, R_1' is $C(O)$-CH_3. In some embodiments, R_1' is each independently C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_1' is methyl. In some embodiments, R_1' is ethyl. In some embodiments, R_1' is iso-propyl. In some embodiments, R_1' is methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl; each represents a

separate embodiment according to this invention. In some embodiments, R_1' is each independently OH, SH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, -CH_2-O-CH_3, R_8-(C_3-C_8 cycloalkyl), CH_2-cyclohexyl, R_8-(C_3-C_8 heterocyclic ring), CH_2-imidazole, CH_2-indazole, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, C≡C-CH_2-NH_2, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10}, $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, $C(O)O$-R_{10}, $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3, R_8-$C(O)$-R_{10}, $CH_2C(O)CH_3$, C(O)H, $C(O)$-R_{10}, $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, $C(O)$-CF_3, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, $C(O)N(CH_3)_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C_1-C_5 linear or branched, substituted or unsubstituted alkenyl, CH=$C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom, O-1-oxacyclobutyl, O-2-oxacyclobutyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, OCF_3, $OCHF_2$, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl, phenyl, substituted or unsubstituted benzyl, 4-Cl-benzyl, 4-OH-benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_1' is H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, $C(O)$-R_{10} or $C(O)$-CH_3; each representes a separate embodiment according to this invention. In some embodiments each R_1' may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00109]In some embodiments, **R_2** of compound of formula **I** and/or **I(a)-I(h)** is H. In some embodiments, R_2 is F, Cl, Br, or I; each represents a separate embodiment according to this invention. In some embodiments, R_2 is $C(O)$-R_{10}, wherein R_{10} is as defined below. In some embodiments, R_2 is $C(O)$-CH_3. In some embodiments, R_2 is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_2 is C_1-C_5 linear or branched, unsubstituted alkyl. In some embodiments, R_2 is methyl. In some embodiments, R_2 is ethyl. In some embodiments, R_2 is iso-propyl. In some embodiments, R_2 is methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_2 is OH, SH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, -CH_2-O-CH_3, R_8-(C_3-C_8 cycloalkyl), CH_2-cyclohexyl, R_8-

(C_3-C_8 heterocyclic ring), CH_2-imidazole, CH_2-indazole, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, C≡C-CH_2-NH_2, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10}, $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, $C(O)O$-R_{10}, $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3, R_8-$C(O)$-R_{10}, $CH_2C(O)CH_3$, C(O)H, $C(O)$-R_{10}, $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, $C(O)$-CF_3, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, $C(O)N(CH_3)_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C_1-C_5 linear or branched, substituted or unsubstituted alkenyl, $CH=C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom, O-1-oxacyclobutyl, O-2-oxacyclobutyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, OCF_3, $OCHF_2$, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl, phenyl, substituted or unsubstituted benzyl, 4-Cl-benzyl, 4-OH-benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_2 is H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, $C(O)$-R_{10} or $C(O)$-CH_3; each represents a separate embodiment according to this invention. In some embodiments R_2 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00110] In some embodiments, **R_2'** of compound of **I** and/or **I(a)-I(h)** is H. In some embodiments, R_2' is F, Cl, Br, or I; each represents a separate embodiment according to this invention. In some embodiments, R_2' is $C(O)$-R_{10}, wherein R_{10} is as defined below. In some embodiments, R_2' is $C(O)$-CH_3. In some embodiments, R_2' is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_2' is C_1-C_5 linear or branched, unsubstituted alkyl. In some embodiments, R_2' is methyl. In some embodiments, R_2' is ethyl. In some embodiments, R_2' is iso-propyl. In some embodiments, R_2' is methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_2' is OH, SH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, -CH_2-O-CH_3, R_8-(C_3-C_8 cycloalkyl), CH_2-cyclohexyl, R_8-(C_3-C_8 heterocyclic ring), CH_2-imidazole, CH_2-indazole, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, C≡C-CH_2-NH_2, $B(OH)_2$, -

$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10}, $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, $C(O)O$-R_{10}, $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3, R_8-$C(O)$-R_{10}, $CH_2C(O)CH_3$, C(O)H, $C(O)$-R_{10}, $C(O)$-CH_3, $C(O)$-CH_2CH_3, $C(O)$-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, $C(O)$-CF_3, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, $C(O)N(CH_3)_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C_1-C_5 linear or branched, substituted or unsubstituted alkenyl, $CH=C(Ph)_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom, O-1-oxacyclobutyl, O-2-oxacyclobutyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, OCF_3, $OCHF_2$, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl, phenyl, substituted or unsubstituted benzyl, 4-Cl-benzyl, 4-OH-benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_2' is H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, $C(O)$-R_{10} or $C(O)$-CH_3; each represents a separate embodiment according to this invention. In some embodiments R_2' may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, $COO(R)$, NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00111]In some embodiments, $\mathbf{R_{40}}$ of compound of **I, I(a)-I(c), I(g)** and/or **I(ga)** is H. In some embodiments, $\mathbf{R_{40}}$ is F, Cl, Br, or I; each represents a separate embodiment according to this invention. In some embodiments, $\mathbf{R_{40}}$ is $C(O)$-R_{10}, wherein R_{10} is as defined below. In some embodiments, $\mathbf{R_{40}}$ is $C(O)$-CH_3. In some embodiments, $\mathbf{R_{40}}$ is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, $\mathbf{R_{40}}$ is C_1-C_5 linear or branched, unsubstituted alkyl. In some embodiments, $\mathbf{R_{40}}$ is methyl. In some embodiments, $\mathbf{R_{40}}$ is ethyl. In some embodiments, $\mathbf{R_{40}}$ is iso-propyl. In some embodiments, $\mathbf{R_{40}}$ is methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl; each represents a separate embodiment according to this invention. In some embodiments, $\mathbf{R_{40}}$ is OH, SH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, -CH_2-O-CH_3, R_8-(C_3-C_8 cycloalkyl), CH_2-cyclohexyl, R_8-(C_3-C_8 heterocyclic ring), CH_2-imidazole, CH_2-indazole, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, $C\equiv C$-CH_2-NH_2, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, $NHC(O)$-R_{10}, $NHC(O)CH_3$), $NHC(O)$-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, $C(O)O$-R_{10}, $C(O)O$-CH_3, $C(O)O$-$CH(CH_3)_2$, $C(O)O$-CH_2CH_3, R_8-$C(O)$-R_{10},

$CH_2C(O)CH_3$, C(O)H, C(O)-R_{10}, C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, C(O)-CF_3, -$C(O)NH_2$, C(O)NHR, C(O)N(R_{10})(R_{11}), C(O)N(CH_3)$_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, $SO_2NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, 2, 3, or 4-CH_2-C_6H_4-Cl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C_1-C_5 linear or branched, substituted or unsubstituted alkenyl, CH=C(Ph)$_2$), C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, O-cyclobutyl, O-cyclopentyl, O-cyclohexyl, 1-butoxy, 2-butoxy, O-tBu, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy wherein at least one methylene group (CH_2) in the alkoxy is replaced with an oxygen atom, O-1-oxacyclobutyl, O-2-oxacyclobutyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, OCF_3, $OCHF_2$, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl (e.g., cyclopropyl, cyclopentyl), substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, oxadiazole, imidazole, furane, triazole, tetrazole, pyridine (2, 3, or 4-pyridine), 3-methyl-2-pyridine, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, protonated or deprotonated pyridine oxide), substituted or unsubstituted aryl, phenyl, substituted or unsubstituted benzyl, 4-Cl-benzyl, 4-OH-benzyl; each represents a separate embodiment according to this invention. In some embodiments, R_2' is H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C(O)-R_{10} or C(O)-CH_3; each represents a separate embodiment according to this invention. In some embodiments **R_{40}** may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, N(R)$_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00112] In some embodiments, **R_2** and **R_2'** of compound of formula **I,** and **I(a)-I(h)** are identical. In some embodiments, **R_2** and **R_2'** are both H. In some embodiments, **R_2** and **R_2'** are both methyl. In some embodiments, **R_2** and **R_2'** are different. In some embodiments, **R_2** is H and **R_2'** is a C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, **R_2** is H and **R_2'** is a methyl**.** In some embodiments, **R_2** is H and **R_2'** is an ethyl**.**

[00113] In some embodiments, **R_2** and **R_1** of formula **I** and **I(a)-I(h)** (in some embodiments, where n is 1), are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring. In some embodiments, R_2 and R_1 are joined to form a C_3-C_8 carbocyclic ring (e.g., cyclopropane, cyclopentane, cyclohexane). In some embodiments, R_2 and R_1 are joined to form a C_3-C_8 heterocyclic ring.

[00114] In some embodiments, **R_3** of compound of formula **I, I(a),** and **I(h)** is H, F, Cl, Br, I, OH, SH, =O, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, CH_2-O-CH_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, N(R)$_2$, R_8-N(R_{10})(R_{11}), CH_2-NH_2, CH_2-N(CH_3)$_2$, R_9-R_8-N(R_{10})(R_{11}), $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, NHC(O)CH_3, NHC(O)-N(R_{10})(R_{11}), NHC(O)N(CH_3)$_2$, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)O-CH_3, C(O)O-CH_2CH_3, R_8-C(O)-R_{10},

$CH_2C(O)CH_3$, C(O)H, C(O)-R_{10}, C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, C(O)-CF_3, -$C(O)NH_2$, C(O)NHR, C(O)N(R_{10})(R_{11}), C(O)N(CH_3)$_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, C(OH)(CH_3)(Ph), ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, cyclopropyl, cyclopentyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, substituted or unsubstituted aryl, or phenyl; each represents a separate embodiment according to this invention.

[00115] In some embodiments, **R_3** of compound of formula **I, I(a), I(b), I(c), I(e), I(g), I(ga)** and **I(h)** is OH, F, SH, NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -$NHC(O)$-R_{10} (e.g., $NHC(O)CH_3$), C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl), substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring or substituted or unsubstituted aryl; each represents a separate embodiment according to this invention. In some embodiments, R_3 is OH. In some embodiments, R_3 is F. In some embodiments, R_3 is F, Cl, Br or I; each represents a separate embodiment. In some embodiments, R_3 is SH. In some embodiments, R_3 is NH_2. In some embodiments, R_3 is $NHNH_2$. In some embodiments, R_3 is NHR. In some embodiments, R_3 is $N(R)_2$. In some embodiments, R_3 is NHC(O)OBz. In some embodiments, R_3 is -$NHC(O)$-R_{10}. In some embodiments, R_3 is $NHC(O)CH_3$. In some embodiments, R_3 is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_3 is methyl. In some embodiments, R_3 is ethyl. In some embodiments, R_3 is propyl. In some embodiments, R_3 is iso-propyl. In some embodiments, R_3 is t-Bu. In some embodiments, R_3 is iso-butyl. In some embodiments, R_3 is pentyl. In some embodiments, R_3 is substituted or unsubstituted C_3-C_8 cycloalkyl. In some embodiments, R_3 is C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl. In some embodiments, R_3 is C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy. In some embodiments, R_3 is substituted or unsubstituted C_3-C_8 heterocyclic ring. In some embodiments, R_3 is substituted or unsubstituted aryl. In some embodiments, **R_3** of compound of formula **I(f)** is SH, $NHNH_2$, or NHC(O)OBz; each represents a separate embodiment according to this invention. In some embodiments, R_3 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention. In some embodiments, **R_3** of compound of formula **I, I(a), I(b), I(c), I(e), I(g), I(ga)** and/or **I(h)** is OH or NH_2.

[00116] In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_2}$ of compound of any one of formula **I-I(h)** are joined to form a C_3-C_8 substituted or unsubstituted, carbocyclic or heterocyclic ring. In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_2}$ are joined to form a C_3-C_8 carbocyclic ring. In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_2}$ are joined to form a cyclopropyl. In some embodiments, $\mathbf{R_3}$ and $\mathbf{R_2}$ are joined to form a heterocyclic ring.

[00117] In some embodiments, $\mathbf{R_4}$ of compound of formula **I, I(a), I(b),** and/or **I(f)** is H, F, Cl, Br, I, OH, SH, =O, =NH-OH, R_8-OH, CH_2-OH, R_8-SH, -R_8-O-R_{10}, CH_2-O-CH_3, CD_3, OCD_3, CN, NO_2, -CH_2CN, -R_8CN, NH_2, $NHNH_2$, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, CH_2-NH_2, CH_2-$N(CH_3)_2$, R_9-R_8-$N(R_{10})(R_{11})$, $B(OH)_2$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, NHC(O)-$N(R_{10})(R_{11})$, $NHC(O)N(CH_3)_2$, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)O-CH_3, C(O)O-CH_2CH_3, R_8-C(O)-R_{10}, $CH_2C(O)CH_3$, C(O)H, C(O)-R_{10}, C(O)-CH_3, C(O)-CH_2CH_3, C(O)-$CH_2CH_2CH_3$, C_1-C_5 linear or branched C(O)-haloalkyl, C(O)-CF_3, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, $C(O)N(CH_3)_2$, SO_2R, $SO_2N(R_{10})(R_{11})$, $SO_2N(CH_3)_2$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, C(OH)(CH_3)(Ph), ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, CF_3, CF_2CH_3, CF_2-cyclobutyl, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, methoxy, ethoxy, propoxy, isopropoxy, O-CH_2-cyclopropyl, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, cyclopropyl, cyclopentyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, thiophene, oxazole, isoxazole, imidazole, furane, triazole, pyridine (2, 3, or 4-pyridine), pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), indole, substituted or unsubstituted aryl, or phenyl; each represents a separate embodiment according to this invention. In some embodiments, $\mathbf{R_4}$ is H. In some embodiments, $\mathbf{R_4}$ is =O. In some embodiments, $\mathbf{R_4}$ is =NH-OH. In some embodiments, $\mathbf{R_4}$ is NH_2. In some embodiments, $\mathbf{R_4}$ is OH. In some embodiments, $\mathbf{R_4}$ is -NHC(O)-R_{10}. In some embodiments, $\mathbf{R_4}$ is NHC(O)H. In some embodiments, $\mathbf{R_4}$ is $NHC(O)CH_3$. In some embodiments, $\mathbf{R_4}$ of compound is $NHNH_2$. In some embodiments, $\mathbf{R_4}$ is alkyl. In some embodiments, $\mathbf{R_4}$ is methyl. In some embodiments, R_4 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention.

[00118] In some embodiments, $\mathbf{R_4}$ of compound of formula **I-I(c)** and/or **I(e)-I(ga)** is NH_2, OH, $NHNH_2$, NHR, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl; each represents a separate embodiment according to this invention. In some embodiments, $\mathbf{R_4}$ is NH_2. In some embodiments, $\mathbf{R_4}$ is OH. In some embodiments, $\mathbf{R_4}$ is alkyl. In some embodiments, $\mathbf{R_4}$ is methyl. In some embodiments, R_4 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl (e.g. methyl, ethyl), C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH),

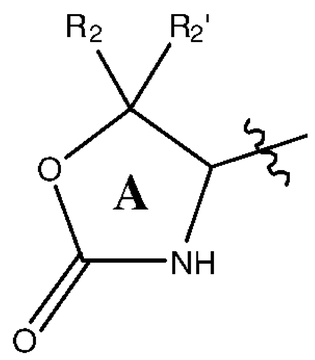
C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl (e.g., imidazole), C_3-C_8 cycloalkyl (e.g., cyclohexyl), CN and NO_2; each represents a separate embodiment according to this invention. In some embodiments, **R_4** of compound of formula **I, I(a), I(b), I(c), I(e), I(g), I(ga)** and/or **I(f)** is OH or NH_2.

[00119] In some embodiments, if R_3 of compound of formula **I, I(a), I(b), I(c), I(e), I(g), I(ga)** is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH. In some embodiments, if **R_3** is OH and **R_4** is NH_2, then **n + m** cannot be equal to 3. In some embodiments, **R_3** and **R_4** cannot both be NH_2.

[00120] In some embodiments, **R_3** and **R_4** of compound of formula **I, I(a)-I(c), I(e), I(g)** and/or **I(ga)** are joined together to form ring **A.** In some embodiments, ring **A** has two chiral centers.

[00121] In some embodiments, ring **A** of formula **I** and/or **I(e)** is a substituted aryl. In some embodiments, ring **A** is 2-amino-phenyl. In some embodiments, ring **A** is methyloxazolidin-2-one. In some embodiments, ring **A** is a substituted or unsubstituted cycloalkyl. In some embodiments, ring **A** is cyclopentyl. In some embodiments, ring **A** is cyclohexyl. In some embodiments, ring **A** is a substituted cycloalkyl. In some embodiment, the substitution is at least one selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention. In some embodiments, ring **A** is substituted cyclopropyl. In some embodiments, ring **A** is substituted cyclobutyl. In some embodiments, ring **A** is substituted cyclopentyl. In some embodiments, ring **A** is substituted cyclohexyl. In some embodiments, ring **A** is substituted at least with NH_2. In some embodiments, ring **A** is substituted with NH_2. In some embodiments, ring **A** is a cycloalkyl, substituted at least with NH_2. In some embodiments, ring **A** is a cycloalkyl, substituted with NH_2. In some embodiments, ring **A** is a 5 or 6 membered nitrogen containing heterocyclic ring. In some embodiments, ring **A** is 1, 2, or 3-piperidine, oxazolidin-2-one, tetrahydropyrimidine, pyridine, dihydro-thiazine, dihydro-imidazole, tetrahydropyridine, or pyrrolidine, which may be substituted or unsubstituted; each is a separate embodiment according to this invention. In some embodiments, ring **A** is substituted at least with NH_2. In some embodiment, R_3 and R_4 of formula **I** and/or **I(e)** are joined to form a 5 or 6 membered substituted or unsubstituted, aliphatic or aromatic, carbocyclic or heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 5 membered unsubstituted, aliphatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 6 membered unsubstituted, aliphatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 5 membered substituted, aliphatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a methyloxazolidin-2-one. In some embodiment, R_3 and R_4 are joined to form a 6 membered substituted, aliphatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 5 membered unsubstituted, aromatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 6 membered unsubstituted, aromatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 5 membered substituted, aromatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form a 6 membered substituted, aromatic heterocyclic ring. In some embodiment, R_3 and R_4 are joined to form an arene.

[00122] In some embodiment, R_3 and R_4 of compound of formula **I, I(a), I(b), I(e), I(g),** and/or **I(ga)** are joined to form ring **A** represented by the following structure, wherein R_2 and R_2' are as defined above:



[00123] It is understood that the wigly line in ring A above, represents the connection point of A to the rest of the molecule (i.e., to $-(C(R_1)(R_1'))_n$ in formula **I-I(h)**).

[00124] In some embodiment, $\mathbf{R_5}$ of compound of formula **I, I(a)-I(h)** and/or **X-X(d),** is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, CH_2SH, ethyl, iso-propyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3, C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl, CCH, CH_2-CCH, C_1-C_5 linear or branched haloalkyl, CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$, R_8-aryl, CH_2-Ph, C(=CH_2)-R_{10}, C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN, substituted or unsubstituted alkyl sulfone, SO_2-CH_2-cyclopentyl, substituted or unsubstituted aryl, phenyl, substituted or unsubstituted heteroaryl, or pyridine (2, 3, and 4-pyridine); each represents a separate embodiment according to this invention. In some embodiments, R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, ethyl, iso-propyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3, C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl, CCH, CH_2-CCH, C_1-C_5 linear or branched haloalkyl, substituted or unsubstituted alkyl sulfone, SO_2-CH_2-cyclopentyl, or substituted or unsubstituted aryl. In some embodiments, R_5 is H. In some embodiments, R_5 is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, R_5 is C_1-C_5 linear alkyl. In some embodiments, R_5 is branched C_1-C_5 alkyl. In some embodiments, R_5 is methyl. In some embodiments, R_5 is ethyl. In some embodiments, R_5 is butyl. In some embodiments, R_5 is a substituted C_1-C_5 alkyl. In some embodiments, R_5 is a C_1-C_5 alkyl substituted with a C_2-C_5 linear or branched alkynyl. In some embodiments, R_5 is CH_2-CCH. In some embodiments, R_5 is a C_1-C_5 alkyl substituted with CCH. In some embodiments, R_5 is CH_2-C(O)-OCH_3. In some embodiments, R_5 is substituted or unsubstituted alkyl sulfone. In some embodiments, R_5 of compound of formula **I, I(a)-I(h)** is substituted alkyl sulfone. In some embodiments, R_5 of compound of formula **I, I(a)-I(h)** is SO_2-CH_2-cyclopentyl. In some embodiments, R_5 may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00125] In some embodiment, $\mathbf{R_{60}}$ of compound of formula **I(a), I(b), I(d), I(e), I(f)** and/or **I(h)** is H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10},

C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl; each is a separate embodiment according to this invention. In some embodiment, $\mathbf{R_{60}}$ is H. In some embodiment, $\mathbf{R_{60}}$ is COOH. In some embodiment, $\mathbf{R_{60}}$ is absent (e.g., when X_4 is N). In some embodiments, R_{60} may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00126] In some embodiment, $\mathbf{R_{70}}$ of compound of formula **I(a), I(b), I(d), I(e), I(f)** and/or **I(h)** is H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl; each is a separate embodiment according to this invention. In some embodiments, $\mathbf{R_{70}}$ is not an alkyl. In some embodiments, $\mathbf{R_{70}}$ may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00127] In some embodiment, $\mathbf{R_{80}}$ of compound of formula **I(a), I(b), I(d), I(e), I(f)** and/or **I(h)** is H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl; each is a separate embodiment according to this invention. In some embodiment, $\mathbf{R_{80}}$ is H. In some embodiment, $\mathbf{R_{80}}$ is absent (e.g., when X_6 is N). In some embodiments, $\mathbf{R_{80}}$ may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00128] In some embodiment, **R_{90}** of compound of formula **I(a), I(b), I(d), I(e), I(f)** and/or **I(h)** is H, F, Cl, Br, I, OH, SH, R_8-OH, R_8-SH, -R_8-O-R_{10}, CF_3, CN, NO_2, NH_2, NHR, $N(R)_2$, R_8-$N(R_{10})(R_{11})$, -$OC(O)CF_3$, -OCH_2Ph, NHC(O)OBz, -NHC(O)-R_{10}, COOH, -C(O)Ph, C(O)O-R_{10}, C(O)H, C(O)-R_{10}, C_1-C_5 linear or branched C(O)-haloalkyl, -$C(O)NH_2$, C(O)NHR, $C(O)N(R_{10})(R_{11})$, SO_2R, $SO_2N(R_{10})(R_{11})$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, C_1-C_5 linear or branched thioalkoxy, C_1-C_5 linear or branched haloalkoxy, C_1-C_5 linear or branched alkoxyalkyl, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl; each is a separate embodiment according to this invention. In some embodiment, **R_{90}** is H. In some embodiment, **R_{90}** is absent (e.g., when X_7 is N). In some embodiments, **R_{90}** may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00129] In some embodiments, if ring **B** of formula **I-I(b), I(e), I(f)** or **I(h)** exists, and **R_4** is NH_2, then **R_3** cannot be OH. In some embodiments, if ring **B** of formula **I-I(b), I(e), I(f)** or **I(h)** exists, **R_3** is OH and **R_4** is NH_2, **n** cannot be 1. In some embodiments, if **R_3** is OH and **R_4** is NH_2, **X_1** or **X_7-R_{90}** of compound of formula **I-I(b), I(e), I(f)** or **I(h)** cannot be CH.

[00130] In some embodiments, **R_8** of formula **I, I(a)-I(h)** and/or **X-X(d)** is CH_2. In other embodiments, R_8 is CH_2CH_2. In other embodiments, R_8 is $CH_2CH_2CH_2$.

[00131] In some embodiments, **p** of formula **I, I(a)-I(h)** and/or **X-X(d)** is 1. In other embodiments, p is 2. In other embodiments, p is 3.

[00132] In some embodiments, **R_9** of formula **I, I(a)-I(h)** and/or **X-X(d)** is C≡C.

[00133] In some embodiments, **q** of formula **I, I(a)-I(h)** and/or **X-X(d)** is 2.

[00134] In some embodiments, **R_{10}** of formula **I, I(a)-I(h)** and/or **X-X(d)** is H. In other embodiments, **R_{10}** is H, CN, C_1-C_5 linear or branched alkyl, methyl, ethyl, C(O)R, $C(O)(OCH_3)$ or $S(O)_2R$; each represents a separate embodiment according to this invention. In other embodiments, **R_{10}** is C_1-C_5 linear or branched alkyl. In other embodiments, **R_{10}** is CH_3. In other embodiments, **R_{10}** is CH_2CH_3. In other embodiments, **R_{10}** is $CH_2CH_2CH_3$. In other embodiments, **R_{10}** is CN. In other embodiments, **R_{10}** is C(O)R. In other embodiments, **R_{10}** is $S(O)_2R$. In other embodiments, **R_{10}** is $C(O)(OCH_3)$.

[00135] In some embodiments, **R_{11}** of formula **I, I(a)-I(h)** and/or **X-X(d)** is C_1-C_5 linear or branched alkyl. In other embodiments, **R_{11}** is H. In other embodiments, **R_{11}** is H, CN, C_1-C_5 linear or branched alkyl, methyl, ethyl, C(O)R, $C(O)(OCH_3)$ or $S(O)_2R$; each represents a separate embodiment according to this invention. In other embodiments, **R_{11}** is CH_3. In other embodiments, **R_{11}** is CH_2CH_3. In other embodiments, **R_{11}** is $CH_2CH_2CH_3$. In other embodiments, **R_{11}** is CN. In other embodiments, R_{11} is C(O)R. In other embodiments, **R_{11}** is $S(O)_2R$. In other embodiments, **R_{11}** is $C(O)(OCH_3)$.

[00136] In some embodiments, **R_{10}** and **R_{11}** of formula **I, I(a)-I(h)** and/or **X-X(d)** are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring. In other embodiments, **R_{10}** and **R_{11}** are joined to form a piperazine ring. In other embodiments, **R_{10}** and **R_{11}** are joined to form a piperidine ring. In some

embodiments, the rings may be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00137] In some embodiments, **R** of formula **I, I(a)-I(h)** and/or **X-X(d)** is H. In other embodiments, **R** is C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl. In other embodiments, **R** is not H. In other embodiments, **R** is C_1-C_5 linear or branched alkyl. In other embodiments, **R** is methyl. In other embodiments, **R** is ethyl. In other embodiments, **R** is C_1-C_5 linear or branched alkoxy. In other embodiments, **R** is methoxy. In other embodiments, **R** is phenyl. In other embodiments, **R** is aryl. In other embodiments, **R** is heteroaryl. In other embodiments, two gem **R** substituents are joined together to form a 5 or 6 membered heterocyclic ring.

[00138] In some embodiments, **m** of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is 1. In some embodiments, **m** is 2. In some embodiments, **m** is 3, 4 or 5; each is a separate embodiment according to this invention.

[00139] In some embodiments, **m** of formula **X(a)-X(d)** is 1. In some embodiments, **m** is 2. In some embodiments, **m** is 3. In some embodiments, m is 1 or 2. In some embodiments, m is 1 or 3.

[00140] In some embodiments, **n** of formula **I** and/or **I(a)-I(h)** is 0. In other embodiments, **n** is 1. In other embodiments, **n** is 2. In other embodiments, **n** is 3. In some embodiments, **n** is 4. In some embodiments, **n** is 5.

[00141] In some embodiments, **n** of formula **X** and/or **X(a)-X(d)** is 1. In some embodiments, **n** is 2. In some embodiments, **n** is 0. In some embodiments, **n** is 3. In some embodiments, n is 1 or 2. In some embodiments, n is 0 or 1. In some embodiments, n is between 0 and 2.

[00142] In some embodiments, **o** of formula **X(a)** is 1. In some embodiments, **o** is 2. In some embodiments, **o** is 0. In some embodiments, **o** is 3. In some embodiments, o is 1 or 2. In some embodiments, o is 0 or 1. In some embodiments, o is between 0 and 2.

[00143] In some embodiments, $\mathbf{X_1}$ of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is S. In other embodiments, $\mathbf{X_1}$ is O. In other embodiments, $\mathbf{X_1}$ is CH_2. In some embodiments, $\mathbf{X_1}$ of formula **I**, **I(a), I(c), I(d)** and **I(f)-I(h)** is N-OH. In some embodiments, $\mathbf{X_1}$ is $C(R)_2$. In some embodiments, $\mathbf{X_1}$ is N-OMe.

[00144] In some embodiments, $\mathbf{X_1}$ of formula **X-X(c)** is S. In other embodiments, $\mathbf{X_1}$ is O. In other embodiments, $\mathbf{X_1}$ is CH_2. In some embodiments, $\mathbf{X_1}$ is CH(R). In some embodiments, $\mathbf{X_1}$ is $C(R)_2$. In some embodiments, $\mathbf{X_1}$ is S, O, or CH_2.

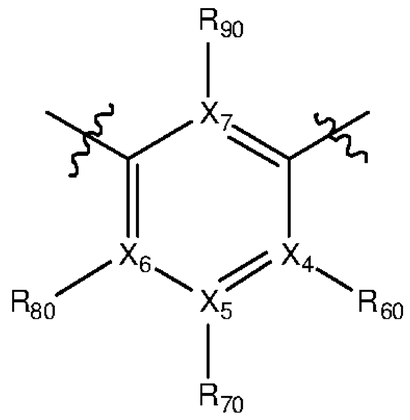
[00145] In some embodiments, $\mathbf{X_2}$ of formula **I**, **I(a)-I(d)** and **I(g)** is S. In other embodiments, $\mathbf{X_2}$ is O. In other embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{X_2}$ of formula **I**, **I(a), I(c), I(d)** and **I(f)-I(h)** is N-OH. In some embodiments, $\mathbf{X_2}$ is $C(R)_2$. In some embodiments, $\mathbf{X_2}$ is N-OMe.

[00146] In some embodiments, $\mathbf{X_2}$ of formula **I** is O, and $\mathbf{R_3}$ or $\mathbf{R_4}$ are NH_2.

[00147] In some embodiments, $\mathbf{X_2}$ of formula **X, X(b), X(c)** and/or **X(d)** is S. In other embodiments, $\mathbf{X_2}$ is O. In other embodiments, $\mathbf{X_2}$ is CH_2. In some embodiments, $\mathbf{X_2}$ is CH(R). In some embodiments, $\mathbf{X_2}$ is $C(R)_2$. In some embodiments, $\mathbf{X_2}$ is S, O, or CH_2.

[00148] In some embodiments, $\mathbf{X_1}$ and $\mathbf{X_2}$ of compound of formula **X-X(d)** are both CH_2.

[00149] In some embodiments, $\mathbf{X_2}$ together with the carbon next to $\mathbf{X_1}$ in compound of formula **I, I(a), I(b), I(f)** and/or **I(h)** are joined to form ring **B**, represented by the following structure (in such case, $\mathbf{X_1}$ is $\mathbf{X_7}$):



B

wherein $\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$ are each independently C or N, wherein if any of $\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$ is N, then the respective substitution $\mathbf{R_{90}}$, $\mathbf{R_{60}}$, $\mathbf{R_{70}}$ or $\mathbf{R_{80}}$ is absent, and wherein $\mathbf{R_{90}}$, $\mathbf{R_{60}}$, $\mathbf{R_{70}}$ or $\mathbf{R_{80}}$ are as defined above.

[00150] In some embodiments, $\mathbf{X_3}$ of formula **I** and/or **I(a)-I(h)** is O. In other embodiments, $\mathbf{X_3}$ is NH. In other embodiments, $\mathbf{X_3}$ is N-R_{50}. In other embodiments, $\mathbf{X_3}$ is S.

[00151] In some embodiments, $\mathbf{R_{50}}$ of formula **I** and/or **I(a)-I(h)** is H. In some embodiments, $\mathbf{R_{50}}$ is C_1-C_5 linear or branched, substituted or unsubstituted alkyl. In some embodiments, $\mathbf{R_{50}}$ is methyl. In some embodiments, $\mathbf{R_{50}}$ is ethyl. In some embodiments, $\mathbf{R_{50}}$ is butyl. In some embodiments, $\mathbf{R_{50}}$ is i-propyl. In some embodiments, $\mathbf{R_{50}}$ be further substituted with at least one substitution selected from: F, Cl, Br, I, OH, SH, C_1-C_5 linear or branched alkyl, C_2-C_5 linear or branched alkenyl, C_2-C_5 linear or branched alkynyl (e.g. CCH), C_3-C_8 cycloalkyl, linear, branched or cyclic alkoxy, COOH, COO(R), NH_2, $N(R)_2$, CF_3, aryl, phenyl, heteroaryl, C_3-C_8 cycloalkyl, CN and NO_2; each represents a separate embodiment according to this invention.

[00152] In some embodiments, $\mathbf{X_4}$ of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is C. In other embodiments, $\mathbf{X_4}$ is N.

[00153] In some embodiments, $\mathbf{X_5}$ of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is C. In other embodiments, $\mathbf{X_5}$ is N.

[00154] In some embodiments, $\mathbf{X_6}$ of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is C. In other embodiments, $\mathbf{X_6}$ is N.

[00155] In some embodiments, $\mathbf{X_7}$ of formula **I**, **I(a)-I(d)** and **I(f)-I(h)** is C. In other embodiments, $\mathbf{X_7}$ is N.

[00156] In some embodiments, if any of $\mathbf{X_4}$, $\mathbf{X_5}$, $\mathbf{X_6}$ and $\mathbf{X_7}$ is N, then the respective substitution $\mathbf{R_{90}}$, $\mathbf{R_{60}}$, $\mathbf{R_{70}}$ or $\mathbf{R_{80}}$ is absent.

[00157] In some embodiments, ring **A** of compound of formula **X** is a C_5-C_7 cycloalkyl. In some embodiments, ring **A** is cyclohexyl. In some embodiments, ring **A** is cyclopropyl. In some embodiments, ring **A** is cyclobutyl. In some embodiments, ring **A** is absent.

[00158] In some embodiments, ring **B** of compound of formula **X** is a 5-7 membered nitrogen-containing heterocyclic ring. In some embodiments, ring **B** is pyrrolidine. In some embodiments, ring **B** is piperidine. In some embodiments, ring **B** is absent.

[00159] In some embodiments, ring **C** of compound of formula **X** is a C_5-C_7 a substituted or unsubstituted cycloalkyl. In some embodiments, ring **C** is an unsubstituted cycloalkyl. In some embodiments, ring **C** is a substituted cycloalkyl. In some embodiments, ring **C** is a cyclopentyl. In some embodiments, ring **C** is a cyclohexyl. In some embodiments, ring **C** is aromatic ring. In some embodiments, ring **C** is a phenyl. In some embodiments, ring **C** is absent.

[00160] In some embodiments, ring **D** of compound of formula **X** is a C_5-C_7 cycloalkyl. In some embodiments, ring **D is** cyclopentyl. In some embodiments, ring **D** is absent.

[00161] In some embodiments, ring **E** of compound of formula **X** is a substituted or unsubstituted 5-7 membered nitrogen-containing heterocyclic ring. In some embodiments, ring **E** is a substituted 5-7 membered nitrogen-containing heterocyclic ring. In some embodiments, ring **E** is an unsubstituted 5-7 membered nitrogen-containing heterocyclic ring. In some embodiments, ring **E** is pyrrolidine. In some embodiments, ring **E** is piperidine. In some embodiments, ring **E** is oxazolidin-2-one. In some embodiments, **E** is substituted oxazolidin-2-one. In some embodiments, ring **E** is absent.

[00162] In some embodiments, at least one of rings **A – E** of compound of formula (**X**) is not absent. In some embodiments, only one of rings **A – E** is not absent. In some embodiments, all rings **A – E** of compound of formula (**X**) are absent.

[00163] In various embodiments, this invention is directed to any one of the compounds presented in Table 1 as described herein above, agrochemical compositions and/or method of use thereof in controlling the growth of undesired plants.

[00164] In various embodiments, this invention is directed to the use of any one of the compounds presented in Table 2 as described herein above, and/or agrochemical compositions thereof, in controlling the growth of undesired plants.

[00165] It is well understood that in structures presented in this invention wherein the carbon atom has less than 4 bonds, H atoms are present to complete the valence of the carbon. It is well understood that in structures presented in this invention wherein the nitrogen atom has less than 3 bonds, H atoms are present to complete the valence of the nitrogen.

[00166] In some embodiments, this invention is directed to the compounds listed hereinabove, agrochemical compositions and/or method of use thereof, wherein the compound is agrochemically acceptable salt, stereoisomer, optical isomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (deuterated analog), or any combination thereof. In some embodiments, the compounds are herbicides. In some embodiments, the compounds control the growth of undesired plants.

[00167] As used herein, "single or fused aromatic or heteroaromatic ring systems" can be any such ring, including but not limited to phenyl, naphthyl, pyridinyl, (2-, 3-, and 4-pyridinyl), quinolinyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, tetrazinyl, thiazolyl, isothiazolyl, oxazolyl, isoxazolyl, imidazolyl, 1-methylimidazole, pyrazolyl, pyrrolyl, furanyl, thiophene-yl, quinolinyl, isoquinolinyl, 2,3-dihydroindenyl, indenyl, tetrahydronaphthyl, 3,4-dihydro-2H-benzo[b][1,4]dioxepine , benzodioxolyl, benzo[d][1,3]dioxole, tetrahydronaphthyl, indolyl, 1H-indole, isoindolyl, anthracenyl, benzimidazolyl, 2,3-dihydro-1H-benzo[d]imidazolyl, indazolyl, 2H-indazole, triazolyl, 4,5,6,7-

tetrahydro-2H-indazole, 3H-indol-3-one, purinyl, benzoxazolyl, 1,3-benzoxazolyl, benzisoxazolyl, benzothiazolyl, 1,3-benzothiazole, 4,5,6,7-tetrahydro-1,3-benzothiazole, quinazolinyl, quinoxalinyl, 1,2,3,4-tetrahydroquinoxaline, 1-(pyridin-1(2H)-yl)ethanone, cinnolinyl, phthalazinyl, quinolinyl, isoquinolinyl, acridinyl, benzofuranyl, 1-benzofuran, isobenzofuranyl, benzofuran-2(3H)-one, benzothiophenyl, benzoxadiazole, benzo[c][1,2,5]oxadiazolyl, benzo[*c*]thiophenyl, benzodioxolyl, thiadiazolyl, [1,3]oxazolo[4,5-b]pyridine, oxadiaziolyl, imidazo[2,1-b][1,3]thiazole, 4H,5H,6H-cyclopenta[d][1,3]thiazole, 5H,6H,7H,8H-imidazo[1,2-a]pyridine, 7-oxo-6H,7H-[1,3]thiazolo[4,5-d]pyrimidine, [1,3]thiazolo[5,4-b]pyridine, 2H,3H-imidazo[2,1-b][1,3]thiazole, thieno[3,2-d]pyrimidin-4(3H)-one, 4-oxo-4H-thieno[3,2-d][1,3]thiazin, imidazo[1,2-a]pyridine, 1H-imidazo[4,5-b]pyridine, 1H-imidazo[4,5-c]pyridine, 3H-imidazo[4,5-c]pyridine, pyrazolo[1,5-a]pyridine, imidazo[1,2-a]pyrazine, imidazo[1,2-a]pyrimidine, 1H-pyrrolo[2,3-b]pyridine, pyrido[2,3-b]pyrazine, pyrido[2,3-b]pyrazin-3(4H)-one, 4H-thieno[3,2-b]pyrrole, quinoxalin-2(1H)-one, 1H-pyrrolo[3,2-b]pyridine, 7H-pyrrolo[2,3-d]pyrimidine, oxazolo[5,4-b]pyridine, thiazolo[5,4-b]pyridine, thieno[3,2-c]pyridine, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, methyloxazolidin-2-one, etc; each represents a separate embodiment according to this invention.

[00168] As used herein, the term "alkyl" can be any linear- or branched-chain alkyl group containing up to about 30 carbons unless otherwise specified. In various embodiments, an alkyl includes C_1-C_5 carbons. In some embodiments, an alkyl includes C_1-C_6 carbons. In some embodiments, an alkyl includes C_1-C_8 carbons. In some embodiments, an alkyl includes C_2-C_5 carbons. In some embodiments, an alkyl includes C_2-C_8 carbons. In some embodiments, an alkyl includes C_1-C_{10} carbons. In some embodiments, an alkyl is a C_1-C_{12} carbons. In some embodiments, an alkyl is a C_1-C_{20} carbons. In some embodiments, branched alkyl is an alkyl substituted by alkyl side chains of 1 to 5 carbons. In various embodiments, the alkyl group may be unsubstituted. In some embodiments, the alkyl group may be substituted by a halogen, haloalkyl, hydroxyl, alkoxy, carbonyl, amido, alkylamido, dialkylamido, cyano, nitro, CO_2H, amino, alkylamino, dialkylamino, carboxyl, thio, thioalkyl, C_1-C_5 linear or branched haloalkoxy, CF_3, phenyl, halophenyl, (benzyloxy)phenyl, -CH_2CN, NH_2, NH-alkyl, N(alkyl)$_2$, -$OC(O)CF_3$, -OCH_2Ph, -NHC(O)-alkyl, -C(O)Ph, C(O)O-alkyl, C(O)H, -$C(O)NH_2$ or any combination thereof.

[00169] The alkyl group can be a sole substituent, or it can be a component of a larger substituent, such as in an alkoxy, alkoxyalkyl, haloalkyl, arylalkyl, alkylamino, dialkylamino, alkylamido, alkylurea, etc. Preferred alkyl groups are methyl, ethyl, and propyl, and thus halomethyl, dihalomethyl, trihalomethyl, haloethyl, dihaloethyl, trihaloethyl, halopropyl, dihalopropyl, trihalopropyl, methoxy, ethoxy, propoxy, arylmethyl, arylethyl, arylpropyl, methylamino, ethylamino, propylamino, dimethylamino, diethylamino, methylamido, acetamido, propylamido, halomethylamido, haloethylamido, halopropylamido, methyl-urea, ethyl-urea, propyl-urea, 2, 3, or 4-CH_2-C_6H_4-Cl, C(OH)(CH_3)(Ph), etc.

[00170] As used herein, the term "alkenyl" can be any linear- or branched-chain alkenyl group containing up to about 30 carbons as defined hereinabove for the term "alkyl" and at least one carbon-carbon double bond. Accordingly, the term alkenyl as defined herein includes also alkadienes, alkatrienes, alkatetraenes, and so on. In some embodiments, the alkenyl group contains one carbon-

carbon double bond. In some embodiments, the alkenyl group contains two, three, four, five, six, seven or eight carbon-carbon double bonds; each represents a separate embodiment according to this invention. Non limiting examples of alkenyl groups include: Ethenyl, Propenyl, Butenyl (i.e., 1-Butenyl, *trans*-2-Butenyl, *cis*-2-Butenyl, and Isobutylenyl), Pentene (i.e., 1-Pentenyl, *cis*-2-Pentenyl, and *trans*-2-Pentenyl), Hexene (e.g., 1-Hexenyl, (*E*)-2-Hexenyl, (*Z*)-2-Hexenyl, (*E*)-3-Hexenyl, (*Z*)-3-Hexenyl, 2-Methyl-1-Pentene , etc.), which may all be substituted as defined herein above for the term "alkyl".

[00171] As used herein, the term "alkynyl" can be any linear- or branched-chain alkynyl group containing up to about 30 carbons as defined hereinabove for the term "alkyl" and at least one carbon-carbon triple bond. Accordingly, the term alkynyl as defined herein includes also alkadiynes, alkatriynes, alkatetraynes, and so on. In some embodiments, the alkynyl group contains one carbon-carbon triple bond. In some embodiments, the alkynyl group contains two, three, four, five, six, seven or eight carbon-carbon triple bonds; each represents a separate embodiment according to this invention. Non limiting examples of alkynyl groups include: acetylenyl, Propynyl, Butynyl (i.e., 1-Butynyl, 2-Butynyl, and Isobutylynyl), Pentyne (i.e., 1-Pentynyl, 2-Pentynyl), Hexyne (e.g., 1-Hexynyl, 2-Hexynyl, 3-Hexynyl, etc.), which may all be substituted as defined herein above for the term "alkyl".

[00172] As used herein, the term "aryl" refers to any aromatic ring that is directly bound to another group and can be either substituted or unsubstituted. The aryl group can be a sole substituent, or the aryl group can be a component of a larger substituent, such as in an arylalkyl, arylamino, arylamido, etc. Exemplary aryl groups include, without limitation, phenyl, tolyl, xylyl, furanyl, naphthyl, pyridinyl, pyrimidinyl, pyridazinyl, pyrazinyl, triazinyl, thiazolyl, oxazolyl, isooxazolyl, pyrazolyl, imidazolyl, thiophene-yl, pyrrolyl, indolyl, phenylmethyl, phenylethyl, phenylamino, phenylamido, 3-methyl-4H-1,2,4-triazolyl, 5-methyl-1,2,4-oxadiazolyl, etc. Substitutions include but are not limited to: F, Cl, Br, I, C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched haloalkyl, C_1-C_5 linear or branched alkoxy, C_1-C_5 linear or branched haloalkoxy, CF_3, phenyl, halophenyl, (benzyloxy)phenyl, CN, NO_2, -CH_2CN, NH_2, NH-alkyl, N(alkyl)$_2$, hydroxyl, -$OC(O)CF_3$, -OCH_2Ph, -NHC(O)-alkyl, COOH, -C(O)Ph, C(O)O-alkyl, C(O)H, -$C(O)NH_2$ or any combination thereof.

[00173] As used herein, the term "alkoxy" refers to an ether group substituted by an alkyl group as defined above. Alkoxy refers both to linear and to branched alkoxy groups. Nonlimiting examples of alkoxy groups are methoxy, ethoxy, propoxy, *iso*-propoxy, *tert*-butoxy.

[00174] A "haloalkyl" group refers, in some embodiments, to an alkyl group as defined above, which is substituted by one or more halogen atoms, e.g. by F, Cl, Br or I. The term "haloalkyl" include but is not limited to fluoroalkyl, i.e., to an alkyl group bearing at least one fluorine atom. Nonlimiting examples of haloalkyl groups are CF_3, CF_2CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$ and $CF(CH_3)$-$CH(CH_3)_2$.

[00175] A "halophenyl" group refers, in some embodiments, to a phenyl substitutent which is substituted by one or more halogen atoms, e.g. by F, Cl, Br or I. In one embodiment, the halophenyl is 4-chlorophenyl.

[00176] An "alkoxyalkyl" group refers, in some embodiments, to an alkyl group as defined above, which is substituted by alkoxy group as defined above, e.g. by methoxy, ethoxy, propoxy, i-propoxy, t-butoxy etc. Nonlimiting examples of alkoxyalkyl groups are $-CH_2-O-CH_3$, $-CH_2-O-CH(CH_3)_2$, $-CH_2-O-C(CH_3)_3$, $-CH_2-CH_2-O-CH_3$, $-CH_2-CH_2-O-CH(CH_3)_2$, $-CH_2-CH_2-O-C(CH_3)_3$.

[00177] A "cycloalkyl" or "carbocyclic" group refers, in various embodiments, to a ring structure comprising carbon atoms as ring atoms, which may be either saturated or unsaturated, substituted or unsubstituted, single or fused. In some embodiments the cycloalkyl is a 3-10 membered ring. In some embodiments the cycloalkyl is a 3-12 membered ring. In some embodiments the cycloalkyl is a 6 membered ring. In some embodiments the cycloalkyl is a 5-7 membered ring. In some embodiments the cycloalkyl is a 3-8 membered ring. In some embodiments, the cycloalkyl group may be unsubstituted or substituted by a halogen, alkyl, haloalkyl, hydroxyl, alkoxy, carbonyl, amido, alkylamido, dialkylamido, cyano, nitro, CO_2H, amino, alkylamino, dialkylamino, carboxyl, thio, thioalkyl, C_1-C_5 linear or branched haloalkoxy, CF_3, phenyl, halophenyl, (benzyloxy)phenyl, $-CH_2CN$, NH_2, NH-alkyl, $N(alkyl)_2$, $-OC(O)CF_3$, $-OCH_2Ph$, -NHC(O)-alkyl, -C(O)Ph, C(O)O-alkyl, C(O)H, $-C(O)NH_2$ or any combination thereof. In some embodiments, the cycloalkyl ring may be fused to another saturated or unsaturated cycloalkyl or heterocyclic 3-8 membered ring. In some embodiments, the cycloalkyl ring is a saturated ring. In some embodiments, the cycloalkyl ring is an unsaturated ring. Non limiting examples of a cycloalkyl group comprise cyclohexyl, cyclohexenyl, cyclopropyl, cyclopropenyl, cyclopentyl, cyclopentenyl, cyclobutyl, cyclobutenyl, cyclooctyl, cyclooctadienyl (COD), cyclooctane (COE) etc.

[00178] A "heterocycle" or "heterocyclic" group refers, in various embodiments, to a ring structure comprising in addition to carbon atoms, sulfur, oxygen, nitrogen or any combination thereof, as part of the ring. A "heteroaromatic ring" refers in various embodiments, to an aromatic ring structure comprising in addition to carbon atoms, sulfur, oxygen, nitrogen, selenium or any combination thereof, as part of the ring. In some embodiments the heterocycle or heteroaromatic ring is a 3-10 membered ring. In some embodiments the heterocycle or heteroaromatic ring is a 3-12 membered ring. In some embodiments the heterocycle or heteroaromatic ring is a 6 membered ring. In some embodiments the heterocycle or heteroaromatic ring is a 5-7 membered ring. In some embodiments the heterocycle or heteroaromatic ring is a 3-8 membered ring. In some embodiments, the heterocycle group or heteroaromatic ring may be unsubstituted or substituted by a halogen, alkyl, haloalkyl, hydroxyl, alkoxy, carbonyl, amido, alkylamido, dialkylamido, cyano, nitro, CO_2H, amino, alkylamino, dialkylamino, carboxyl, thiol, thioalkyl, C_1-C_5 linear or branched haloalkoxy, CF_3, phenyl, halophenyl, (benzyloxy)phenyl, $-CH_2CN$, NH_2, NH-alkyl, $N(alkyl)_2$, $-OC(O)CF_3$, $-OCH_2Ph$, -NHC(O)-alkyl, -C(O)Ph, C(O)O-alkyl, C(O)H, $-C(O)NH_2$ or any combination thereof. In some embodiments, the heterocycle ring or heteroaromatic ring may be fused to another saturated or unsaturated cycloalkyl or heterocyclic 3-8 membered ring. In some embodiments, the heterocyclic ring is a saturated ring. In some embodiments, the heterocyclic ring is an unsaturated ring. Non limiting examples of a heterocyclic ring or heteroaromatic ring systems comprise pyridine, piperidine, morpholine, piperazine, thiophene, pyrrole, benzodioxole, benzofuran-2(3H)-one, benzo[d][1,3]dioxole, indole, oxazole, isoxazole, imidazole and 1-methylimidazole, furane, triazole, pyrimidine, pyrazine, oxacyclobutane (1 or 2-oxacyclobutane), naphthalene, tetrahydrothiophene 1,1-dioxide, thiazole, benzimidazole, piperidine, 1-

methylpiperidine, isoquinoline, 1,3-dihydroisobenzofuran, benzofuran, 3-methyl-4H-1,2,4-triazole, 5-methyl-1,2,4-oxadiazole, oxazolidin-2-one, methyloxazolidin-2-one or indole; each is a separate embodiment according to this invention.

[00179] In various embodiments, this invention provides a compound of this invention or its agrochemically acceptable salt, stereoisomer, optical isomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variants (e.g., deuterated analog), or any combination thereof. In various embodiments, this invention provides a single stereoisomer of the compound of this invention. In some embodiments, this invention provides an optical isomer of the compound of this invention. In some embodiments, this invention provides an agrochemically acceptable salt of the compound of this invention. In some embodiments, this invention provides a tautomer of the compound of this invention. In some embodiments, this invention provides a hydrate of the compound of this invention. In some embodiments, this invention provides an *N*-oxide of the compound of this invention. In some embodiments, this invention provides a reverse amide analog of the compound of this invention. In some embodiments, this invention provides an isotopic variant (including but not limited to deuterated analog) of the compound of this invention. In some embodiments, this invention provides a polymorph of the compound of this invention. In some embodiments, this invention provides a crystal of the compound of this invention. In some embodiments, this invention provides an agrochemical composition comprising a compound of this invention, as described herein, or, in some embodiments, any combination of a stereoisomer, optical isomer, agrochemically acceptable salt, tautomer, hydrate, *N*-oxide, isotopic variant (deuterated analog), polymorph, or crystal of the compound of this invention.

[00180] In various embodiments, the term "isomer" includes, but is not limited to, stereoisomers including optical isomers and analogs, structural isomers and analogs, conformational isomers and analogs, and the like. In some embodiments, the isomer is a stereoisomer. In another embodiment, the isomer is an optical isomer.

[00181] In various embodiments, this invention encompasses the use of various stereoisomers of the compounds of the invention. It will be appreciated by those skilled in the art that the compounds of the present invention may contain at least one chiral center. Accordingly, the compounds used in the methods of the present invention may exist in, and be isolated in, optically-active or racemic forms. The compounds according to this invention may further exist as stereoisomers which may be also optically-active isomers (e.g., enantiomers such as (*R*) or (*S*)), as enantiomerically enriched mixtures, racemic mixtures, or as single diastereomers, diastereomeric mixtures, or any other stereoisomers, including but not limited to: *(R)(R), (R)(S), (S)(S), (S)(R), (R)(R)(R), (R)(R)(S), (R)(S)(R), (S)(R)(R), (R)(S)(S), (S)(R)(S), (S)(S)(R)* or *(S)(S)(S)* stereoisomers. Some compounds may also exhibit polymorphism. It is to be understood that the present invention encompasses any racemic, optically-active, polymorphic, or

stereroisomeric form, or mixtures thereof, which form possesses properties useful in controlling the growth of various undesired plants as described herein.

[00182] It is well known in the art how to prepare optically-active forms (for example, by resolution of the racemic form by recrystallization techniques, by synthesis from optically-active starting materials, by chiral synthesis, or by chromatographic separation using a chiral stationary phase).

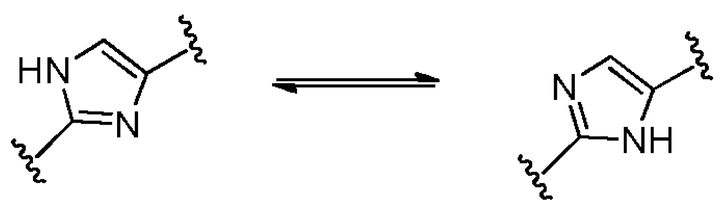
[00183] The compounds of the present invention can also be present in the form of a racemic mixture, containing substantially equivalent amounts of stereoisomers. In some embodiments, the compounds of the present invention can be prepared or otherwise isolated, using known procedures, to obtain a stereoisomer substantially free of its corresponding stereoisomer (i.e., substantially pure). By substantially pure, it is intended that a stereoisomer is at least about 95% pure, more preferably at least about 98% pure, most preferably at least about 99% pure.

[00184] Compounds of the present invention can also be in the form of a hydrate, which means that the compound further includes a stoichiometric or non-stoichiometric amount of water bound by non-covalent intermolecular forces.

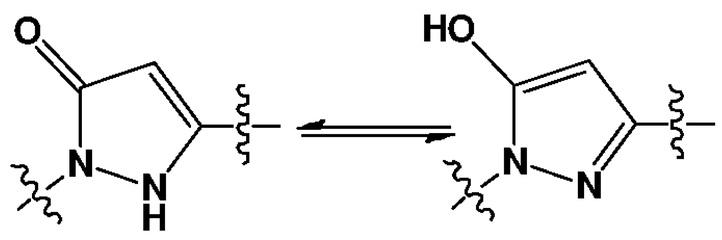
[00185] As used herein, when some chemical functional group (e.g. alkyl or aryl) is said to be "substituted", it is herein defined that one or more substitutions are possible.

[00186] Compounds of the present invention may exist in the form of one or more of the possible tautomers and depending on the conditions it may be possible to separate some or all of the tautomers into individual and distinct entities. It is to be understood that all of the possible tautomers, including all additional enol and keto tautomers and/or isomers are hereby covered. For example, the following tautomers, but not limited to these, are included:

Tautomerization of the imidazole ring



Tautomerization of the pyrazolone ring:



[00187] The invention includes "agrochemically acceptable salts" of the compounds of this invention, which may be produced, by reaction of a compound of this invention with an acid or base. Certain compounds, particularly those possessing acidic or basic groups, can also be in the form of a salt, preferably an agrochemically acceptable salt. The term "agrochemically acceptable salt" refers to those salts that retain the agrochemical effectiveness and properties of the free bases or free acids, which are not agrochemically or otherwise undesirable. The salts are formed with inorganic acids such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, phosphoric acid and the like, and organic acids such as acetic acid, propionic acid, glycolic acid, pyruvic acid, oxalic acid, maleic acid, malonic acid, succinic acid, fumaric acid, tartaric acid, citric acid, benzoic acid, cinnamic acid, mandelic acid, methanesulfonic acid, ethanesulfonic acid, *p*-toluenesulfonic acid, salicylic acid, *N*-acetylcysteine and

the like. Other salts are known to those of skill in the art and can readily be adapted for use in accordance with the present invention.

[00188] Suitable agrochemically-acceptable salts of amines of the compounds of this invention may be prepared from an inorganic acid or from an organic acid. In various embodiments, examples of inorganic salts of amines are bisulfates, borates, bromides, chlorides, hemisulfates, hydrobromates, hydrochlorates, 2-hydroxyethylsulfonates (hydroxyethanesulfonates), iodates, iodides, isothionates, nitrates, persulfates, phosphates, sulfates, sulfamates, sulfanilates, sulfonic acids (alkylsulfonates, arylsulfonates, halogen substituted alkylsulfonates, halogen substituted arylsulfonates), sulfonates and thiocyanates.

[00189] In various embodiments, examples of organic salts of amines may be selected from aliphatic, cycloaliphatic, aromatic, araliphatic, heterocyclic, carboxylic and sulfonic classes of organic acids, examples of which are acetates, aspartates, ascorbates, adipates, anthranilates, algenates, alkane carboxylates, substituted alkane carboxylates, alginates, benzenesulfonates, benzoates, bisulfates, butyrates, bicarbonates, bitartrates, citrates, camphorates, camphorsulfonates, cyclohexylsulfamates, cyclopentanepropionates, calcium edetates, camsylates, carbonates, clavulanates, cinnamates, dicarboxylates, digluconates, dodecylsulfonates, dihydrochlorides, decanoates, enanthuates, ethanesulfonates, edetates, edisylates, estolates, esylates, fumarates, formates, fluorides, galacturonates gluconates, glutamates, glycolates, glucorate, glucoheptanoates, glycerophosphates, gluceptates, glycollylarsanilates, glutarates, glutamate, heptanoates, hexanoates, hydroxymaleates, hydroxycarboxlic acids, hexylresorcinates, hydroxybenzoates, hydroxynaphthoates, hydrofluorates, lactates, lactobionates, laurates, malates, maleates, methylenebis(beta-oxynaphthoate), malonates, mandelates, mesylates, methane sulfonates, methylbromides, methylnitrates, methylsulfonates, monopotassium maleates, mucates, monocarboxylates, naphthalenesulfonates, 2-naphthalenesulfonates, nicotinates, nitrates, napsylates, *N*-methylglucamines, oxalates, octanoates, oleates, pamoates, phenylacetates, picrates, phenylbenzoates, pivalates, propionates, phthalates, phenylacetate, pectinates, phenylpropionates, palmitates, pantothenates, polygalacturates, pyruvates, quinates, salicylates, succinates, stearates, sulfanilate, subacetates, tartrates, theophyllineacetates, *p*-toluenesulfonates (tosylates), trifluoroacetates, terephthalates, tannates, teoclates, trihaloacetates, triethiodide, tricarboxylates, undecanoates and valerates.

[00190] In various embodiments, examples of inorganic salts of carboxylic acids or hydroxyls may be selected from ammonium, alkali metals to include lithium, sodium, potassium, cesium; alkaline earth metals to include calcium, magnesium, aluminum; zinc, barium, cholines, quaternary ammoniums.

[00191] In some embodiments, examples of organic salts of carboxylic acids or hydroxyl may be selected from arginine, organic amines to include aliphatic organic amines, alicyclic organic amines, aromatic organic amines, benzathines, *t*-butylamines, benethamines (*N*-benzylphenethylamine), dicyclohexylamines, dimethylamines, diethanolamines, ethanolamines, ethylenediamines, hydrabamines, imidazoles, lysines, methylamines, meglamines, *N*-methyl-*D*-glucamines, *N,N'*-dibenzylethylenediamines, nicotinamides, organic amines, ornithines, pyridines, picolies, piperazines,

procain, tris(hydroxymethyl)methylamines, triethylamines, triethanolamines, trimethylamines, tromethamines and ureas.

[00192] In various embodiments, the salts may be formed by conventional means, such as by reacting the free base or free acid form of the product with one or more equivalents of the appropriate acid or base in a solvent or medium in which the salt is insoluble or in a solvent such as water, which is removed in vacuo or by freeze drying or by exchanging the ions of an existing salt for another ion or suitable ion-exchange resin.

Agrochemical composition

[00193] Another aspect of the present invention relates to an agrochemical composition including an agrochemically acceptable carrier or diluent and a compound according to the aspects of the present invention. The agrochemical composition can contain one or more of the above-identified compounds of the present invention. Typically, the agrochemical composition of the present invention will include a compound of the present invention or its agrochemically acceptable salt, as well as an agrochemically acceptable carrier or diluent. The term "agrochemically acceptable carrier" refers to any suitable adjuvants, carriers, excipients, or stabilizers, and can be in solid or liquid form such as sprays, aerosols, powders, solutions, suspensions, or emulsions.

[00194] The compounds according to the invention can be used as herbicidal agents in unmodified form, but they are generally formulated into compositions in various ways using formulation adjuvants, such as carriers, solvents and surface-active substances. The formulations can be in various physical forms, e.g. in the form of dusting powders, gels, wettable powders, water-dispersible granules, water- dispersible tablets, effervescent pellets, emulsifiable concentrates, microemulsifiable concentrates, oil- in-water emulsions, oil-flowables, aqueous dispersions, oily dispersions, suspo-emulsions, capsule suspensions, emulsifiable granules, soluble liquids, water-soluble concentrates (with water or a water- miscible organic solvent as carrier), impregnated polymer films or in other forms known. Such formulations can either be used directly or diluted prior to use. The dilutions can be made, for example, with water, liquid fertilizers, micronutrients, biological organisms, oil or solvents.

[00195] Typically, the composition will contain from about 0.01 to 99 percent, preferably from about 20 to 75 percent of active compound(s), together with the adjuvants, carriers and/or excipients. While individual needs may vary, determination of optimal ranges of effective amounts of each component is within the skill of the art.

[00196] The formulations can be prepared e.g. by mixing the active ingredient with the formulation adjuvants in order to obtain compositions in the form of finely divided solids, granules, solutions, dispersions or emulsions. The active ingredients can also be formulated with other adjuvants, such as finely divided solids, mineral oils, oils of vegetable or animal origin, modified oils of vegetable or animal origin, organic solvents, water, surface-active substances or combinations thereof.

[00197] The active ingredients can also be contained in very fine microcapsules. Microcapsules contain the active ingredients in a porous carrier. This enables the active ingredients to be released into the environment in controlled amounts (e.g. slow-release). Microcapsules usually have a diameter of from 0.1

to 500 microns. They contain active ingredients in an amount of about from 25 to 95 % by weight of the capsule weight. The active ingredients can be in the form of a monolithic solid, in the form of fine particles in solid or liquid dispersion or in the form of a suitable solution. The encapsulating membranes can comprise, for example, natural or synthetic rubbers, cellulose, styrene/butadiene copolymers, polyacrylonitrile, polyacrylate, polyesters, polyamides, polyureas, polyurethane or chemically modified polymers and starch xanthates or other polymers that are known to the person skilled in the art. Alternatively, very fine microcapsules can be formed in which the active ingredient is contained in the form of finely divided particles in a solid matrix of base substance, but the microcapsules are not themselves encapsulated.

[00198] The formulation adjuvants that are suitable for the preparation of the compositions according to the invention are known per se. As liquid carriers there may be used: water, toluene, xylene, petroleum ether, vegetable oils, acetone, methyl ethyl ketone, cyclohexanone, acid anhydrides, acetonitrile, acetophenone, amyl acetate, 2-butanone, butylene carbonate, chlorobenzene, cyclohexane, cyclohexanol, alkyl esters of acetic acid, diacetone alcohol, 1,2-dichloropropane, diethanolamine, p-diethylbenzene, diethylene glycol, diethylene glycol abietate, diethylene glycol butyl ether, diethylene glycol ethyl ether, diethylene glycol methyl ether, dimethylformamide (DMF), dimethyl sulfoxide (DMSO), 1,4-dioxane, dipropylene glycol, dipropylene glycol methyl ether, dipropylene glycol dibenzoate, diproxitol, alkylpyrrolidone, ethyl acetate, 2-ethylhexanol, ethylene carbonate, 1,1,1-trichloroethane, 2-heptanone, alpha-pinene, d-limonene, ethyl lactate, ethylene glycol, ethylene glycol butyl ether, ethylene glycol methyl ether, gamma-butyrolactone, glycerol, glycerol acetate, glycerol diacetate, glycerol triacetate, hexadecane, hexylene glycol, isoamyl acetate, isobornyl acetate, isooctane, isophorone, isopropylbenzene, isopropyl myristate, lactic acid, laurylamine, mesityl oxide, methoxypropanol, methyl isoamyl ketone, methyl isobutyl ketone, methyl laurate, methyl octanoate, methyl oleate, methylene chloride, m-xylene, n-hexane, n-octylamine, octadecanoic acid, octylamine acetate, oleic acid, oleylamine, o-xylene, phenol, polyethylene glycol, propionic acid, propyl lactate, propylene carbonate, propylene glycol, propylene glycol methyl ether, p-xylene, toluene, triethyl phosphate, triethylene glycol, xylenesulfonic acid, paraffin, mineral oil, trichloroethylene, perchloroethylene, ethyl acetate, amyl acetate, butyl acetate, propylene glycol methyl ether, diethylene glycol methyl ether, methanol, ethanol, isopropanol, and alcohols of higher molecular weight, such as amyl alcohol, tetrahydrofurfuryl alcohol, hexanol, octanol, ethylene glycol, propylene glycol, glycerol, methyl-2-pyrrolidone and the like.

[00199] Suitable solid carriers are, for example, talc, titanium dioxide, pyrophyllite clay, silica, attapulgite clay, kieselguhr, limestone, calcium carbonate, bentonite, calcium montmorillonite, cottonseed husks, wheat flour, soybean flour, pumice, wood flour, ground walnut shells, lignin and similar substances.

[00200] A large number of surface-active substances can advantageously be used in both solid and liquid formulations, especially in those formulations which can be diluted with a carrier prior to use. Surface-active substances may be anionic, cationic, non-ionic or polymeric and they can be used as emulsifiers, wetting agents or suspending agents or for other purposes. Typical surface-active substances include, for example, salts of alkyl sulfates, such as diethanolammonium lauryl sulfate; salts of alkylarylsulfonates, such as calcium dodecylbenzenesulfonate; alkylphenol/alkylene oxide addition products, such as nonylphenol

ethoxylate; alcohol/alkylene oxide addition products, such as tridecylalcohol ethoxylate; soaps, such as sodium stearate; salts of alkylnaphthalenesulfonat.es, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2- ethylhexyl)sulfosuccinate; sorbitol esters, such as sorbitol oleate; quaternary amines, such as lauryltrimethylammonium chloride, polyethylene glycol esters of fatty acids, such as polyethylene glycol stearate; block copolymers of ethylene oxide and propylene oxide; and salts of mono- and di-alkylphosphate esters; as well as further substances known to the skilled in the arts.

[00201] Further adjuvants that can be used in herbicidal formulations include crystallization inhibitors, viscosity modifiers, suspending agents, dyes, anti-oxidants, foaming agents, light absorbers, mixing auxiliaries, antifoams, complexing agents, neutralizing or pH-modifying substances and buffers, corrosion inhibitors, fragrances, wetting agents, take-up enhancers, micronutrients, plasticizers, glidants, lubricants, dispersants, thickeners, antifreezes, microbicides, and liquid and solid fertilizers.

[00202] The compositions according to the invention can include an additive comprising an oil of vegetable or animal origin, a mineral oil, alkyl esters of such oils or mixtures of such oils and oil derivatives. The amount of oil additive in the composition according to the invention is generally from 0.01 to 10 %, based on the mixture to be applied. For example, the oil additive can be added to a spray tank in the desired concentration after a spray mixture has been prepared. Preferred oil additives comprise mineral oils or an oil of vegetable origin, for example rapeseed oil, olive oil or sunflower oil, emulsified vegetable oil, alkyl esters of oils of vegetable origin, for example the methyl derivatives, or an oil of animal origin, such as fish oil or beef tallow. Preferred oil additives comprise alkyl esters of C_8-C_{22} fatty acids, especially the methyl derivatives of C_{12}-C_{18} fatty acids, for example the methyl esters of lauric acid, palmitic acid and oleic acid (methyl laurate, methyl palmitate and methyl oleate, respectively). Other oil derivatives are known to the skilled in the arts, for examples from the Compendium of Herbicide Adjuvants, 10th Edition, Southern Illinois University, 2010.

[00203] The herbicidal compositions generally comprise from 0.1 to 99 % by weight, especially from 0.1 to 95 % by weight, compounds according to this invention and from 1 to 99.9 % by weight of a formulation adjuvant which preferably includes from 0 to 25 % by weight of a surface-active substance. The inventive compositions generally comprise from 0.1 to 99 % by weight, especially from 0.1 to 95 % by weight, of compounds of the present invention and from 1 to 99.9 % by weight of a formulation adjuvant which preferably includes from 0 to 25 % by weight of a surface-active substance. Whereas commercial products may preferably be formulated as concentrates, the end user will normally employ dilute formulations.

[00204] The rates of application vary within wide limits and depend on the nature of the soil, the method of application, the crop plant, the pest to be controlled, the prevailing climatic conditions, and other factors governed by the method of application, the time of application and the target crop. As a general guideline, compounds may be applied at a rate of from 1 to 2000 l/ha, especially from 10 to 1000 l/ha. Preferred formulations can have the following compositions (weight %):

[00205] Emulsifiable concentrates:

- active ingredient: 1 to 95 %, preferably 60 to 90 %

- surface-active agent: 1 to 30 %, preferably 5 to 20 %
- liquid carrier: 1 to 80 %, preferably 1 to 35 %

[00206] Dusts:

- active ingredient: 0.1 to 10 %, preferably 0.1 to 5 %
- solid carrier: 90 to 99.9 %, preferably 99 to 99.9 %

[00207] Suspension concentrates:

- active ingredient: 5 to 75 %, preferably 10 to 50 %
- water: 24 to 94 %, preferably 30 to 88 %
- surface-active agent: 1 to 40 %, preferably 2 to 30 %

[00208] Wettable powders:

- active ingredient: 0.5 to 90 %, preferably 1 to 80 %
- surface-active agent 0.5 to 20 %, preferably 1 to 15 %
- solid carrier: 5 to 95 %, preferably 15 to 90 %

[00209] Granules:

- active ingredient: 0.1 to 30 %, preferably 0.1 to 15 %
- solid carrier: 70 to 99.5 %, preferably 85 to 97 %

[00210] When the compounds or agrochemical compositions of the present invention are administered to control the growth of undesired plants, the agrochemical composition can also contain, or can be administered in conjunction with, other agrochemical agents or treatment regimen presently known or hereafter developed for the growth control of various types of plants.

[00211] Accordingly, the composition of the present invention may further comprise at least one additional pesticide including but not limited to herbicide. For example, the compounds according to the invention can also be used in combination with other herbicides or plant growth regulators. In a preferred embodiment the additional pesticide is an herbicide and/or herbicide safener.

[00212] Examples of herbicides that can be used in combination with the compounds of the invention, include but are not limited to: acetochlor, acifluorfen (including acifluorfen-sodium), aclonifen, alachlor, alloxydim, ametryn, amicarbazone, amidosulfuron, aminocyclopyrachlor , aminopyralid, amitrole, asulam, atrazine, bensulfuron (including bensulfuron-methyl), bentazone, bicyclopyrone, bilanafos, bifenox, bispyribac-sodium, bixlozone, bromacil, bromoxynil, butachlor, butafenacil, cafenstrole, carfentrazone (including carfentrazone-ethyl); cloransulam (including cloransulam-methyl), chlorimuron (including chlorimuron-ethyl), chlorotoluron, cinosulfuron, chlorsulfuron, cinmethylin, clacyfos, clethodim, clodinafop (including clodinafop-propargyl), clomazone, clopyralid, cyclopyranil, cyclopyrimorate, cyclosulfamuron, cyhalofop (including cyhalofop-butyl), 2,4-D (including the choline salt and 2-ethylhexyl ester thereof), 2,4-DB, daimuron, desmedipham, dicamba (including the aluminum, aminopropyl, bis-aminopropylmethyl, choline, dichloroprop, diglycolamine, dimethylamine, dimethylammonium, potassium and sodium salts thereof), diclofop-methyl, diclosulam, diflufenican, difenzoquat, diflufenican, diflufenzopyr, dimethachlor, dimethenamid-P, diquat dibromide, diuron, esprocarb, ethalfluralin, ethofumesate, fenoxaprop (including fenoxaprop-P-ethyl), fenoxasulfone, fenquinotrione, fentrazamide,

flazasulfuron, florasulam, florpyrauxifen, fluazifop (including fluazifop-P-butyl), flucarbazone (including flucarbazone-sodium);, flufenacet, flumetralin, flumetsulam, flumioxazin, flupyrsulfuron (including flupyrsulfuron-methyl-sodium);, fluroxypyr (including fluroxypyr-meptyl);, fluthiacet-methyl, fomesafen, foramsulfuron, glufosinate (including the ammonium salt thereof), glyphosate (including the diammonium, isopropylammonium and potassium salts thereof), halauxifen (including halauxifen-methyl), halosulfuron-methyl, haloxyfop (including haloxyfop- methyl), hexazinone, hydantocidin, imazamox, imazapic, imazapyr, imazaquin, imazethapyr, indaziflam, iodosulfuron (including iodosulfuron-methyl-sodium), iofensulfuron, iofensulfuron-sodium, ioxynil, ipfencarbazone, isoproturon, isoxaben, isoxaflutole, lactofen, lancotrione, linuron, MCPA, MCPB, mecoprop-P, mefenacet, mesosulfuron, mesosulfuron-methyl, mesotrione, metamitron, metazachlor, methiozolin, metobromuron, metolachlor, metosulam, metoxuron, metribuzin, metsulfuron, molinate, napropamide, nicosulfuron, norflurazon, orthosulfamuron, oxadiargyl, oxadiazon, oxasulfuron, oxyfluorfen, paraquat dichloride, pendimethalin, penoxsulam, phenmedipham, picloram, picolinafen, pinoxaden, pretilachlor, primisulfuron-methyl, prodiamine, prometryn, propachlor, propanil, propaquizafop, propham, propyrisulfuron, propyzamide, prosulfocarb, prosulfuron, pyraclonil, pyraflufen (including pyraflufen-ethyl), pyrasulfotole, pyrazolynate, pyrazosulfuron-ethyl, pyribenzoxim, pyridate, pyriftalid, pyrimisulfan, pyrithiobac-sodium, pyroxasulfone, pyroxsulam , quinclorac, quinmerac, quizalofop (including quizalofop-P-ethyl and quizalofop-P-tefuryl),, rimsulfuron, saflufenacil, sethoxydim, simazine, S-metolachlor, sulcotrione, sulfentrazone, sulfosulfuron, tebuthiuron, tefuryltrione, tembotrione, terbuthylazine, terbutryn, thiencarbazone, thifensulfuron, tiafenacil, tolpyralate, topramezone, tralkoxydim, triafamone, triallate, triasulfuron, tribenuron (including tribenuron-methyl), triclopyr, trifloxysulfuron (including trifloxysulfuron-sodium), trifludimoxazin, trifluralin, triflusulfuron, tritosulfuron, 4-hydroxy-1-methoxy-5-methyl-3-[4-(trifluoromethyl)-2- pyridyl]imidazolidin-2-one, 4-hydroxy-1 ,5-dimethyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 5-ethoxy-4-hydroxy-1-methyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 4-hydroxy-1- methyl-3-[4-(trifluoromethyl)-2-pyridyl]imidazolidin-2-one, 4-hydroxy-1 ,5-dimethyl-3-[1-methyl-5- (trifluoromethyl)pyrazol-3-yl]imidazolidin-2-one, (4R)1-(5-tert-butylisoxazol-3-yl)-4-ethoxy-5-hydroxy- 3-methyl-imidazolidin-2-one, 3-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine-4- carbonyl]bicyclo[3.2.1]octane-2,4-dione, 2-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine-4- carbonyl]-5-methyl-cyclohexane-1 ,3-dione, 2-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine- 4-carbonyl]cyclohexane-1 ,3-dione, 2-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine-4- carbonyl]-5,5-dimethyl-cyclohexane-1 ,3-dione, 6-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo- pyridazine-4-carbonyl]-2,2,4,4-tetramethyl-cyclohexane-1 ,3,5-trione, 2-[2-(3,4-dimethoxyphenyl)-6- methyl-3-oxo-pyridazine-4-carbonyl]-5-ethyl-cyclohexane-1 ,3-dione, 2-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine-4-carbonyl]-4,4,6,6-tetramethyl-cyclohexane-1 ,3-dione, 2-[6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]-5-methyl-cyclohexane-1 ,3-dione, 3-[6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]bicyclo[3.2.1]octane-2,4-dione, 2- [6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]-5,5-dimethyl-cyclohexane-1 ,3-dione, 6-[6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]-2,2,4,4-tetramethyl-cyclohexane-1 ,3,5-trione, 2-[6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]cyclohexane-1 ,3-dione, 4-[2-(3,4-dimethoxyphenyl)-6-methyl-3-oxo-pyridazine-4-carbonyl]-

2,2,6,6-tetramethyl-tetrahydropyran-3,5-dione and I + 4-[6-cyclopropyl-2-(3,4-dimethoxyphenyl)-3-oxo-pyridazine-4-carbonyl]-2,2,6,6-tetramethyl-tetrahydropyran-3,5-dione. These additional agenters may also be present in the form of esters or salts thereof.

[00213] Compounds of the present invention may also be combined with herbicide safeners. Example of herbicide safeners include but are not limited to: benoxacor, cloquintocet (including cloquintocet-mexyl), cyprosulfamide, dichlormid, fenchlorazole (including fenchlorazole-ethyl), fenclorim, fluxofenim, furilazole, isoxadifen (including isoxadifen-ethyl), mefenpyr (including mefenpyr-diethyl), metcamifen, N-(2- methoxybenzoyl)-4-[(methylaminocarbonyl)amino] benzenesulfonamide and oxabetrinil; all of which may be in the form of esters or salts thereof.

[00214] The compound of the invention can also be used in mixtures with other agrochemicals such as fungicides, nematicides or insecticides, examples of which are known to the skilled in the art.

[00215] The mixing ratio of compound of the invention and the additional agent, is preferably from 1: 100 to 1000: 1. Preferably the mixing ratio of compound of the invention to safener is from 100:1 to 1:10, especially from 20:1 to 1:1.

[00216] The mixtures can advantageously be used in the above-mentioned formulations (in which case "active ingredient" relates to the respective mixture of compound of the invention with the additional agent.

Herbicidal Activity

[00217] In various embodiments, the invention provides compounds and compositions, including any embodiment described herein, for use in any of the methods of this invention. In various embodiments, use of a compound of this invention or a composition comprising the same, will have utility in inhibiting, suppressing, enhancing, or stimulating a desired response, as will be understood by one skilled in the art. In some embodiments, the compositions may further comprise additional active ingredients, whose activity is useful for the particular application for which the compound of this invention is being administered.

[00218] The compounds of this invention are useful as herbicides or herbicidal compounds. The present invention therefore further comprises a method for controlling the growth of undesired plants, comprising applying to the plants or a locus comprising them, an effective amount of a compound according to this invention, or an agrochemical composition thereof, under conditions effective to control the growth of the undesired plants, in particular the growth of weeds, in crops of useful plants.

[00219] In some embodiments, “Controlling” according to this invention refers to killing, reducing or retarding growth or preventing or reducing germination. Generally, the plants to be controlled are unwanted plants (weeds).

[00220] In some embodiments, “Locus” refers to the area in which the plants are growing or will grow.

[00221] The rates of application of compounds of the invention may vary within wide limits and depend on the nature of the soil, the method of application (for example: pre-plant, pre-emergence; post-emergence; application to the seed furrow; no tillage application etc.), the crop plant, the weed(s) to be controlled, the prevailing climatic conditions, and other factors governed by the method of application, the time of

application and the target crop. The compounds of the invention are generally applied at a rate of from 10 to 2000 g/ha, especially from 50 to 1000 g/ha.

[00222] In some embodiments, the application is made by spraying the composition, typically by tractor mounted sprayer for large areas, but other methods such as dusting (for powders), drip or drench can also be used.

[00223] In some embodiments, useful plants in which the composition according to the invention can be used upon include crops such as cereals including but not limited to barley and wheat, cotton, oilseed rape, sunflower, maize, rice, soybeans, sugar beet, sugar cane and turf.

[00224] In some embodiments, crop plants also include trees, such as fruit trees, palm trees, coconut trees or other nuts. Also included are vines such as grapes, fruit bushes, fruit plants and vegetables.

[00225] In some embodiments, the crops are resistant crops. Therefore, according to some embodiments, crops also include those crops which have been rendered tolerant to herbicides or classes of herbicides (including but not limited to: ALS-, GS-, EPSPS-, PPO-, ACCase- and HPPD-inhibitors) by conventional methods of breeding or by genetic engineering. Examples of crops that have been rendered tolerant to herbicides by genetic engineering methods include but not limited to glyphosate- and glufosinate-resistant maize varieties commercially available under the trade names RoundupReady® and LibertyLink®. According to other embodiments, crops also include those which have been rendered resistant to harmful insects by genetic engineering methods, examples of such crops include but not limited to: Bt maize (resistant to European corn borer), Bt cotton (resistant to cotton boll weevil) and Bt potatoes (resistant to Colorado beetle). Non limiting examples of Bt maize include the Bt 176 maize hybrids of NK® (Syngenta Seeds). Non limiting examples of transgenic plants comprising one or more genes that code for an insecticidal resistance and express one or more toxins are: KnockOut® (maize), Yield Gard® (maize), NuCOTIN33B® (cotton), Bollgard® (cotton), NewLeaf® (potatoes), NatureGard® and Protexcta®. Plant crops or seed material thereof can be both resistant to herbicides and, at the same time, resistant to insect feeding ("stacked" transgenic events).

[00226] In some embodiments, crops include those which are obtained by conventional methods of breeding or genetic engineering and contain so-called output traits (e.g. improved storage stability, higher nutritional value and improved flavour). Other useful plants include turf grass for example in golf-courses, lawns, parks and roadsides, or grown commercially for sod, and ornamental plants such as flowers or bushes.

[00227] Herbicidal compounds, or chemically active herbicides, may be broken down into pre-plant herbicides, pre-emergent herbicides and post-emergent herbicides. Pre-plant and pre-emergent herbicides typically interfere with germination of weed seeds and are applied before and after planting or sowing, respectively, but before seed germination, whereas post-emergent herbicides kill the weeds after the weed seeds have germinated and weed growth has begun.

[00228] When administering the compounds of the present invention, they can be administered in pre-plant or pre-emergence treatments, in post-emergence treatments, or both.

[00229] In various embodiments, this invention is directed to a method of controlling the growth of undesired plants, comprising applying a compound according to this invention, or an agrochemical

composition thereof, to crop fields. In some embodiments, the compound is a pre-plant herbicide. In some embodiments, the compound is a pre-emergent herbicide. In some embodiments, the compound is a post-emergent herbicide. Therefore, in some embodiment, the compound is applied to crop fields before the undesired plants emerge (i.e. pre-emergent or pre-plant herbicide). In some embodiments, the compound is applied to crop fields after the undesired plants emerge (i.e. post-emergent herbicide).

[00230] In various embodiments, compounds according to this invention, and agrochemical compositions thereof, are used to control undesired plants, which include a wide variety of monocotyledonous and dicotyledonous weed species.

[00231] In some embodiments, the undesired plant is a weed. In some embodiments, the undesired plant is a eudicot (dicotyledonous or dicot). In some embodiments, the undesired plant is a monocotyledon (monocotyledonous or monocot).

[00232] Non limiting examples of monocotyledonous species that can typically be controlled include *Alopecurus myosuroides, Avena fatua, Brachiaria plantaginea, Bromus tectorum, Cyperus esculentus, Digitaria sanguinalis, Echinochloa crus-galli, Lolium perenne, Lolium multiflorum, Panicum miliaceum, Poa annua, Setaria viridis, Setaria faberi* and *Sorghum bicolor*; each represents a separate embodiment according to this invention.

[00233] Non limiting examples of dicotyledonous species that can be controlled *include Abutilon theophrasti, Amaranthus retroflexus, Bidens pilosa, Chenopodium album, Euphorbia heterophylla, Galium aparine, Ipomoea hederacea, Kochia scoparia, Polygonum convolvulus, Sida spinosa, Sinapis arvensis, Solanum nigrum, Stellaria media, Veronica persica* and *Xanthium strumarium*; each represents a separate embodiment according to this invention.

[00234] In some embodiments, the undesired plant is *Abutilon theophrasti* , *Amaranthus palmeri*, *Ambrosia artemisiifolia* , *Alopecurus myosuroides* , *Avena sterilis* , *Chenopodium album* , *Conyza Canadensis* , *Digitaria sanguinalis* , *Echinochloa colona*, *Euphorbia heterophylla* , *Lolium perenne* , *Lolium rigidum* , *Matricaria chamomilla* , *Phalaris paradoxa* , *Poa annua* , *Portulaca oleracea* , *Setaria viridis*, *Solanum nigrum* or any combination thereof. In some embodiments, the compound is any one of the compounds listed in Table 1 and 2; each compound represents a separate embodiment according to this invention.

[00235] In some embodiments, compounds, and compositions according to this invention are utilized to control undesirable vegetation in rice. In certain embodiments, the undesirable vegetation is *Brachiaria platyphylla* (Groseb.) Nash (broadleaf signalgrass, BRAPP), *Digitaria sanguinalis* (L.) Scop, (large crabgrass, DIGSA), *Echinochloa crus-galli* (L.) P. Beauv. (bamyardgrass, ECHCG), *Echinochloa colonum* (L.) LINK (junglerice, ECHCO), *Echinochloa oryzoides* (Ard.) Fritsch (early watergrass, ECHOR), *Echinochloa oryzicola* (Vasinger) Vasinger (late watergrass, ECHPH), *Ischaemum rugosum* Salisb. (saramollagrass, ISCRU), *Leptochloa chinensis* (L.) Nees (Chinese sprangletop, LEFCH), *Leptochloa fascicularis* (Lam.) Gray (bearded sprangletop, LEFFA), *Leptochloa panicoides* (Presl.) Hitchc. (Amazon sprangletop, LEFPA), *Panicum dichotomiflorum* (L.) Michx. (fall panicum, PANDI), *Paspalum dilatatum* Poir. (dallisgrass, PASDI), *Cyperus difformis* L. (smallflower flatsedge, CYPDI), *Cyperus esculentus* L. (yellow nutsedge, CYPES), *Cyperus iria* L. (rice flatsedge, CYPIR), *Cyperus*

rotundus L. (purple nutsedge, CYPRO), *Eleocharis* species (ELOSS), *Fimbristylis miliacea* (L.) Vahl (globe fringerush, FIMMI), *Schoenoplectus juncoides* Roxb. (Japanese bulrush, SCPJU), *Schoenoplectus maritimus* L. (sea clubrush, SCPMA), *Schoenoplectus mucronatus* L. (ricefield bulrush, SCPMU), *Aeschynomene* species, (jointvetch, AESSS), *Alternanthera philoxeroides* (Mart.) Griseb. (alligatorweed, ALRPH), *Alisma plantago-aquatica* L. (common waterplantain, ALSPA), *Amaranthus* species, (pigweeds and amaranths, AMASS), *Ammannia coccinea* Rottb. (redstem, AMMCO), *Eclipta alba* (L.) Hassk. (American false daisy, ECLAL), *Heteranthera limosa* (SW.) Willd./Vahl (ducksalad, HETLI), *Heteranthera reniformis* R. & P. (roundleaf mudplantain, HETRE), *Ipomoea hederacea* (L.) Jacq. (ivyleaf momingglory, IPOHE), *Lindernia dubia* (L.) Pennell (low false pimpernel, LIDDU), *Monochoria korsakowii* Regel & Maack (monochoria, MOOKA), *Monochoria vaginalis* (Burm. F.) C. Presl ex Kuhth, (monochoria, MOOVA), *Murdannia nudifiora* (L.) Brenan (doveweed, MUDNU), *Polygonum pensylvanicum* L. (Pennsylvania smartweed, POLPY), *Polygonum persicaria* L. (ladysthumb, POLPE), *Polygonum hydropiperoides* Michx. (POLHP, mild smartweed), *Rotala indica* (Willd.) Koehne (Indian toothcup, ROTIN), *Sagittaria* species, (arrowhead, SAGSS), *Sesbania exaltata* (Raf) Cory/Rydb. Ex Hill (hemp sesbania, SEBEX), or *Sphenoclea zeylanica* Gaertn. (gooseweed, SPDZE); each is a separate embodiment according to this invention. In some embodiments, the compound is any one of the compounds listed in Table 1 and 2; each compound represents a separate embodiment according to this invention.

[00236] In some embodiments, the compounds and compositions according to this invention are utilized to control undesirable vegetation in cereals. In certain embodiments, the undesirable vegetation is *Alopecurus myosuroides* Huds. (blackgrass, ALOMY), *Apera spica-venti* (L.) Beauv. (windgrass, APESV), *Avena fatua* L. (wild oat, AVEFA), *Bromus tectorum* L. (downy brome, BROTE), *Lolium multiflorum* Lam. (Italian ryegrass, LOLMU), *Phalaris minor* Retz. (littleseed canarygrass, PHAMI), *Poa annua* L. (annual bluegrass, POAAN), *Setaria pumila* (Poir.) Roemer & J.A. Schultes (yellow foxtail, SETLU), *Setaria viridis* (L.) Beauv. (green foxtail, SETVI), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRARy), *Galium aparine* L. (catchweed bedstraw, GALAP), *Kochia scoparia* (L.) Schrad. (kochia, KCHSC), *Lamium purpureum* L. (purple deadnettle , LAMPU), *Matricaria recutita* L. (wild chamomile, MATCH), *Matricaria matricarioides* (Less.) Porter (pineappleweed, MATMT), *Papaver rhoeas* L. (common poppy, PAPRH), *Polygonum convolvulus* L. (wild buckwheat, POLCO), *Salsola tragus* L. (Russian thistle, SASKR), *Stellaria media* (L.) VilL (common chickweed, STEME), *Veronica persica* Poir. (Persian speedwell, VERPE), *Viola arvensis* Murr. (field violet, VIOAR), or *Viola tricolor* L. (wild violet, VIOTR); each is a separate embodiment according to this invention. In some embodiments, the compound is any one of the compounds listed in Table 1 and 2; each compound represents a separate embodiment according to this invention.

[00237] In some embodiments, the compounds and compositions according to this invention are utilized to control undesirable vegetation in range and pasture. In certain embodiments, the undesirable vegetation is *Ambrosia artemisiifolia* L. (common ragweed, AMBEL), *Cassia obtusifolia* (sickle pod, CASOB), *Centaurea maculosa* auct. non Lam. (spotted knapweed, CENMA), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRAR), *Convolvulus arvensis* L. (field bindweed, CONAR), *Euphorbia esula*

L. (leafy spurge, EPHES), *Lactuca serriola* L./Tom. (prickly lettuce, LACSE), *Plantago lanceolata* L. (buckhom plantain, PLALA), *Rumex obtusifolius* L. (broadleaf dock, RUMOB), *Sida spinosa* L. (prickly sida, SIDSP), *Sinapis arvensis* L. (wild mustard, SINAR), *Sonchus arvensis* L. (perennial sowthistle, SONAR), *Solidago* species (goldenrod, SOOSS), *Taraxacum officinale* G.H. Weber ex Wiggers (dandelion, TAROF), *Trifolium repens* L. (white clover, TRFRE), or *Urtica dioica* L. (common nettle, URTDI); each is a separate embodiment according to this invention. In some embodiments, the compound is any one of the compounds listed in Table 1 and 2; each compound represents a separate embodiment according to this invention.

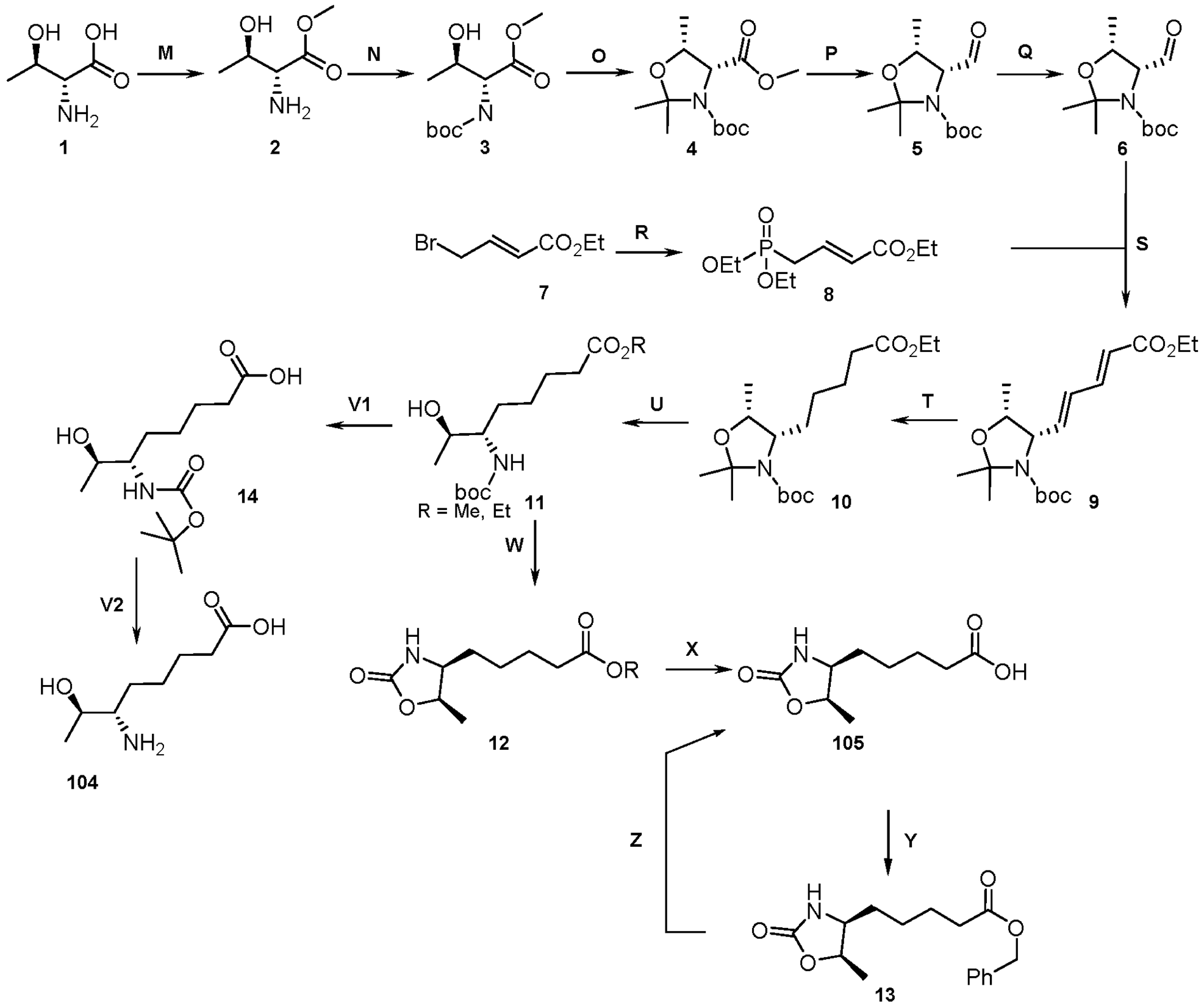
[00238] In some embodiments, the compounds and compositions according to this invention are utilized to control undesirable vegetation found in row crops. In certain embodiments, the undesirable vegetation is *Alopecurus myosuroides* Huds. (blackgrass, ALOMY), *Avena fatua* L. (wild oat, AVEFA), *Brachiaria platyphylla* (Groseb.) Nash (broadleaf signalgrass, BRAPP), *Digitaria sanguinalis* (L.) Scop, (large crabgrass, DIGSA), *Echinochloa crus-galli* (L.) P. Beauv. (bamyardgrass, ECHCG), *Echinochloa colonum* (L.) Link (junglerice, ECHCO), *Lolium multiflorum* Lam. (Italian ryegrass, LOLMU), *Panicum dichotomiflorum* Michx. (fall panicum, PANDI), *Panicum miliaceum* L. (wild-proso millet, PANMI), *Setaria faberi* Herrm. (giant foxtail, SETFA), *Setaria viridis* (L.) Beauv. (green foxtail, SETVI), *Sorghum halepense* (L.) Pers. (Johnsongrass, SORHA), *Sorghum bicolor* (L.) Moench ssp. *Arundinaceum* (shattercane, SORVU), *Cyperus esculentus* L. (yellow nutsedge, CYPES), *Cyperus rotundus* L. (purple nutsedge, CYPRO), *Abutilon theophrasti* Medik. (velvetleaf, ABUTH), *Amaranthus* species (pigweeds and amaranths, AMASS), *Ambrosia artemisiifolia* L. (common ragweed, AMBEL), *Ambrosia psilostachya* DC. (western ragweed, AMBPS), *Ambrosia trifida* L. (giant ragweed, AMBTR), *Asclepias syriaca* L. (common milkweed, ASCSY), *Chenopodium album* L. (common lambsquarters, CHEAL), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRAR), *Commelina benghalensis* L. (tropical spiderwort, COMBE), *Datura stramonium* L. (jimsonweed, DATST), *Daucus carota* L. (wild carrot, DAUCA), *Euphorbia heterophylla* L. (wild poinsettia, EPHHL), *Erigeron bonariensis* L. (hairy fleabane, ERIBO), *Erigeron canadensis* L. (Canadian fleabane, ERICA), *Helianthus annuus* L. (common sunflower, HELAN), *Jacquemontia tamnifolia* (L.) Griseb. (smallflower morningglory, IAQTA), *Ipomoea hederacea* (L.) Jacq. (ivyleaf morningglory, IPOHE), *Ipomoea lacunosa* L. (white morningglory, IPOLA), *Lactuca serriola* L./Tom. (prickly lettuce, LACSE), *Portulaca oleracea* L. (common purslane, POROL), *Sida spinosa* L. (prickly sida, SIDSP), *Sinapis arvensis* L. (wild mustard, SINAR), *Solanum ptychanthum* Dunal (eastern black nightshade, SOLPT), or *Xanthium strumarium* L. (common cocklebur, XANST); each is a separate embodiment according to this invention. In some embodiments, the compound is any one of the compounds listed in Table 1 and 2; each compound represents a separate embodiment according to this invention.

[00239] The following examples are presented in order to more fully illustrate the preferred embodiments of the invention. They should in no way, however, be construed as limiting the broad scope of the invention.

EXAMPLES

EXAMPLE 1

Synthetic Details for Compounds of the Invention



Scheme 1. Synthetic route and procedures for Compounds **104, 105, 106, 114** and **115**.

[00240] Compounds **106, 115** and **114** were prepared using the same route, with the suitable enantiomer of threonine.

Step M:

[00241] To solution of compound **1** (40 g, 336 mmol) in methanol (400 mL) was added dropwise $SOCl_2$ (39.4 mL, 543 mmol) at 0°C. The reaction mixture was refluxed, concentrated under reduced pressure to obtain crude product which was used in the next step without further purification.

Step N:

[00242] To solution from the previous step were added MeCN (300 mL) and methanol (250 mL). Then to obtain mixture at 0°C were added dropwise Boc_2O (92.2 mL, 401 mmol) and triethylamine (105 mL, 753 mmol), and it was left stirring overnight. After that it was concentrated under reduced pressure, dissolved in dichloromethane (400 mL) and water (400 mL), extracted with dichloromethane (2×200 mL).

Combined organic layers was washed with 2N HCl (200 mL), K_2CO_3, dried over Na_2SO_4, and concentrated to obtained 74.6 g of compound **3** (320 mmol, 95% yield for 2 steps).

Step O:

[00243] Compound **3** (74.6 g, 320 mmol) was dissolved in MeCN (1200 mL) and dimethoxy propane (358 mL), and after cooling to 10-15°C was added $BF_3 \cdot Et_2O$ (2.39 mL, 19.4 mmol), the solution was left stirring overnight. Then triethylamine (16 mL, 115 mmol), concentrated under reduced pressure, dissolved with water (300 mL), extracted with dichloromethane (3×300 mL), dried over Na_2SO_4, and concentrated to obtained crude product **4** which was used in the next step without further purification.

Step P:

[00244] To crude product **4** dissolved in THF (200 mL) was added dropwise solution $LiAlH_4$ (13 g, 343 mmol) in THF (700 mL) and it was stirred overnight. After that it was quench with solution of KOH (6.7 g, 119 mmol) in water (90 mL), filtered, the obtain precipitate was washed with THF, filtrate was concentrated under reduced pressure. The crude residue was purified by column chromatography to obtained 39 g of compound **5** (159 mmol, 50% yield for 2 steps).

Step Q:

[00245] To solution of compound **5** (24.05 g, 98.0 mmol) indichloromethane (420 mL) was added in portions Dess-Martin periodinane (50.4 g, 119 mmol) and the reaction mixture was stirred overnight. The solution of $NaHCO_3$ (42.2 g, 502 mmol) and Na_2SO_4 (189.2 g, 1332 mmol) in water (700 mL) were added and then it had been stirred by the time the whole precipitate was dissolved. The reaction mixture was separated, water layer was extracted with dichloromethane (2×200 mL), organic layer was dried over Na_2SO_4, and concentrated to obtained 20.3 g of compound **6** (83.4 mmol, 85% yield).

Step R:

[00246] Ethyl 4-bromocrotonate (**7**) (20.00 g, 93.24 mmol) was added in one portion to triethyl phosphine (17.71 g, 106.56 mmol) at 120-130°C and the solution was stirred for 1 h. Distillation of the resulting reaction mixture provided 20.39 g of compound **8** as a light yellow oil (81.5 mmol, 88% yield).

Step S:

[00247] K_2CO_3 (57.7 g, 418 mmol) and 18-crown-6 (36.9 g, 140 mmol) were dissolved in toluene and it was stirred for 1 h. To the solution was cooled to -20°C and then were added dropwise compound **8** (20.39 g, 81.5 mmol) and compound **6** (16.9 g, 69.5 mmol). Then the reaction mixture was heated to r.t., stirred, and monitored by TLC (for 1-2 days). After reaction was completed, water (300 mL) was added there, the solution was extracted with hexane (2×200 mL), combined organic layers were washed with water (2×150 mL), 5% citric acid (100 mL), dried over Na_2SO_4, and concentrated under reduced pressure. The crude residue was purified by column chromatography to obtained 17 g of compound **9** (50.1 mmol, 72% yield).

Step T:

[00248] To solution of compound **9** (16.5 g, 48.6 mmol) in ethanol (200 mL) was added 10% Pd/C (1 g). The reaction flask was vacuumed and the solution was stirred overnight under H_2 atmosphere. Then it was filtered and concentrated under reduced pressure to obtain 16 g of compound **10** (46.6 mmol, 96% yield).

Step U:

[00249] Compound **10** was dissolved in methanol (150 mL) and p-toluenesulfonic acid (0.1 g, 0.581 mmol) was added. The reaction mixture was stirred overnight and then it was concentrated under reduced pressure. Then was added the solution of K_2CO_3 (1 g, 7.24 mmol) in water (30 mL), extracted with MTBE (3×100 mL), dried over Na_2SO_4, and concentrated to obtained 14.1 g of mixture of esters **11** (the esterification took place under this reaction Me:Et=2:1) which was used in next step.

Step V1:

[00250] The mixture of esters **11** (2.69 g) was dissolved in solution of THF (80 mL), methanol (25 mL), and water (25 mL), then $LiOH \cdot H_2O$ (1.1 g, 26.2 mmol) was added at 0°C. The solution was heated to r.t. and left stirring. After that THF and methanol were evaporated under reduced pressure, the resultant water solution was cooled, acidified 1.2N solution of $NaHSO_4$, extracted with MTBE (3×50 mL), dried over Na_2SO_4, concentrated in vacuum, and purified by reversed-phase chromatography. On Horner stage took place partial racemization (85:15), but on stage of reverse-phase chromatography the diastereomers was separated and obtained 0.6 g of compound **14** (2.18 mmol, 25% yield).

Step V2:

[00251] Compound **14** (0.6 g, 2.18 mmol) was dissolved in MTBE (4 mL) and Di/HCl (2.5 mL) was added and the resultant mixture was stirred overnight. The occurred precipitate was filtered, washed with MTBE and dried under reduced pressure to obtain 0.36 g of hydrochloride target compound **104** (2.05 mmol, 94%).

m/z = 176.2

^{1}H NMR (400 MHz, dmso) δ (ppm): 12.04 (bs, 1H, COOH), 7.89 (bs, 3H, NH3), 5.25 (s, 1H, OH), 3.85 (m, 1H, CH), 2.97 (m, 1H, CH), 2.19 (t, *J*=7.12 Hz, 2H, C*H2*-COOH), 1.48-1.30 (m, 6H, CH2-CH2-CH2), 1.06 (d, *J*=6.36 Hz, CH3).

Step W:

[00252] To solution of NaH (1.4 g, 35.0 mmol) in THF (300 mL) at 0°C was added dropwise the solution of compound **11** (7.05 g, 28.7 mmol) in THF (30 mL). The solution was heated to r.t. and stirred overnight. Then it was poured into mixture of ice water (200 mL) and NH_4Cl (6 g, 112 mmol), the layers were separated, water layer was extracted with MTBE (3×100 mL), dried over Na_2SO_4, and concentrated to obtained 4.5 g of crude product compound **12** which was used in the next step without further purification.

Step X:

[00253] The mixture of esters **12** (1.5 g) was dissolved in solution of THF (40 mL), methanol (15 mL), and water (15 mL), then $LiOH \cdot H_2O$ (0.96 g, 22.9 mmol) was added at 0°C. The solution was heated to r.t. and left stirring. After that THF and methanol were evaporated under reduced pressure, the resultant water solution was cooled, acidified 1.2N solution of $NaHSO_4$, extracted with MTBE (3×50 mL), dried over Na_2SO_4, concentrated in vacuum to obtain 0.87 g of crude product compound **105** (62%). On Horner stage took place partial racemization (85:15).

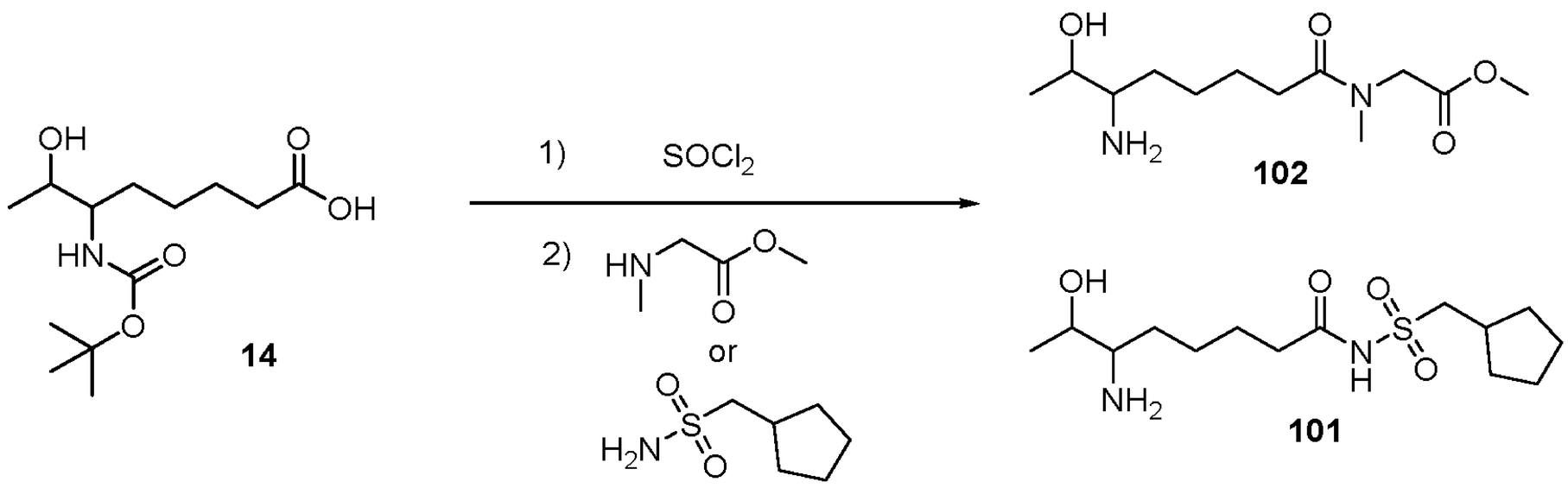
Step Y:

[00254] To solution of diastereomeric acid (0.87 g, 4.96 mmol) from the previous step in DMF (10 mL) was added K_2CO_3 (1.19 g) and benzyl bromide (0.56 mL, 4.71 mmol), and the reaction mixture was stirred overnight. Then water (40 mL) was added there, extracted with MTBE (3×50 mL), organic layer was washed with water (5×30 mL), dried over Na_2SO_4, concentrated under reduced pressure, and purified by reversed-phase chromatography to obtain 0.6 g (48%) crude product which was purified by chiral column chromatography to give 0.36 g of required diastereomer **13** (0.012 mmol, 60%).

Step Z:

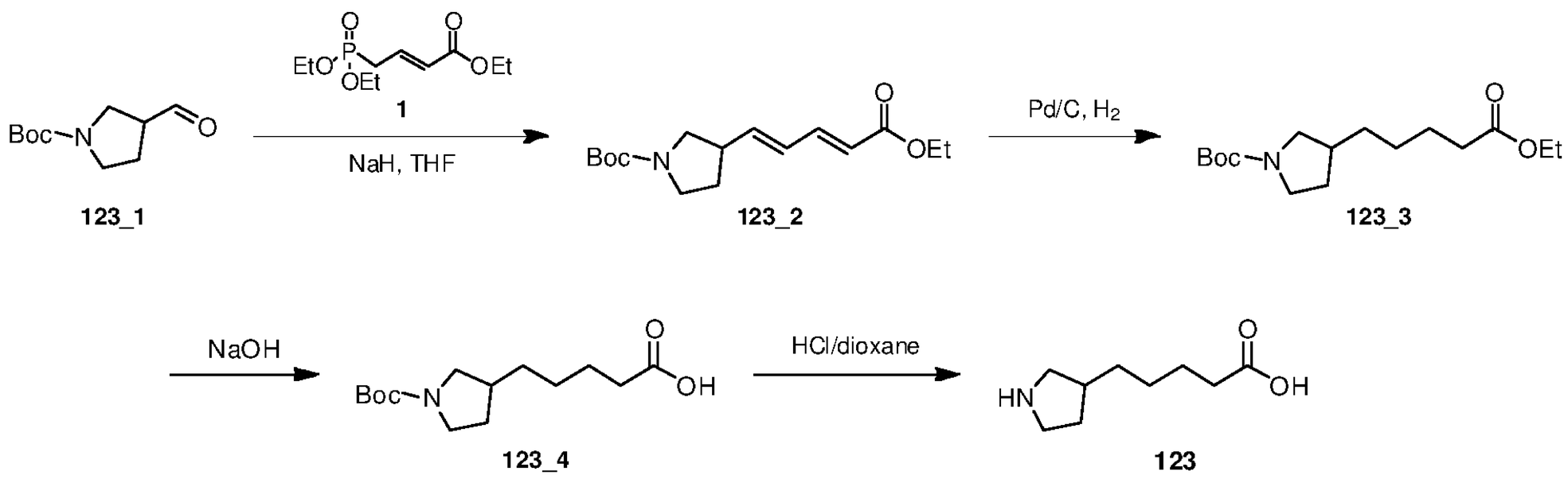
[00255] To solution of compound **13** (0.36 g, 1.31 mmol) in methanol (5 mL) was added 10% Pd(C) (0.1 g). The flask was degassed, and reaction carried out under H2 atmosphere and left stirring overnight. After that it was filtered, and filtrate concentrated under reduced pressure. The residue was purified by column chromatography to obtain 0.16 g of target compound **105** (0.795 mmol, 96%).

[00256] From compound (**14**) in above scheme, the following are obtained:



Scheme 2. Procedure adapted from Adibi, Hadi; *et al., Synthetic Communications* (**2010**), 40(18), 2753-2766.

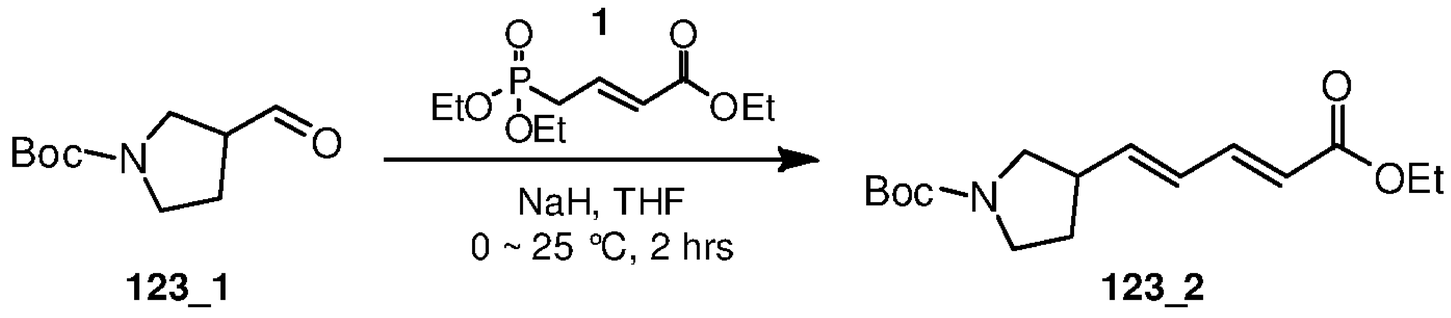
Preparation of Compounds 123 and 148



Scheme 3. Synthetic route and procedure for the preparation of Compound **123**.

[00257] Compound **148** was prepared using the same route, starting with tert-butyl 2-formylpyrrolidine-1-carboxylate (instead of tert-butyl 3-formylpyrrolidine-1-carboxylate), as described below.

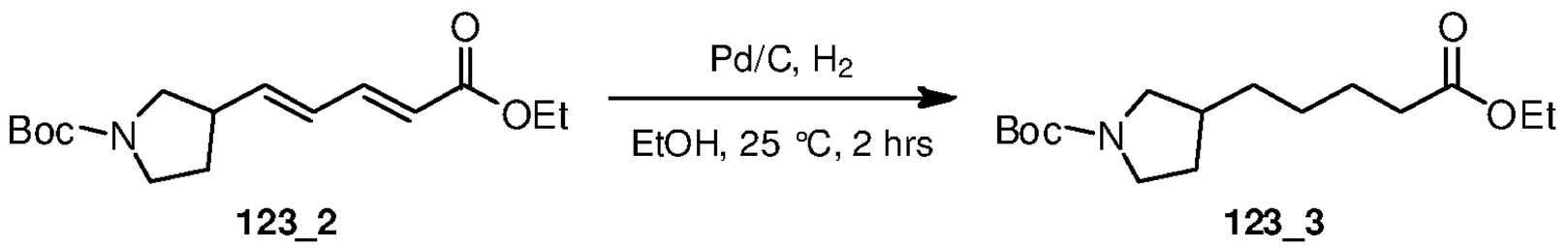
Synthesis of Compound 123



123_1 **123_2**

[00258] To a solution of compound **1** (754 mg, 3.01 mmol, 1.2 *eq*) in THF (20 mL) NaH was added (130 mg, 3.26 mmol, 60% purity, 1.3 *eq*) at 0 ~ 5 °C and stirred at 25 °C for 0.5 hr. Then Compound **123_1** (500 mg, 2.51 mmol, 1 *eq*) was added and the mixture was stirred at 25 °C for 1.5 hrs. LCMS showed the reaction was completed. The residue was poured into saturated aqueous NH_4Cl solution (50 mL). The aqueous phase was extracted with ethyl acetate (50 mL*2). The combined organic phase was washed with brine (50 mL), dried with anhydrous $MgSO_4$, filtered and concentrated in vacuum. The residue was purified by flash silica gel chromatography (ISCO®; 20 g SepaFlash® Silica Flash Column, Eluent of 0~15% Ethyl acetate/Petroleum ethergradient @ 100 mL/min) to give Compound **123_2** (420 mg, 1.41 mmol, 56.0% yield, 98.9% purity) as a colorless oil.

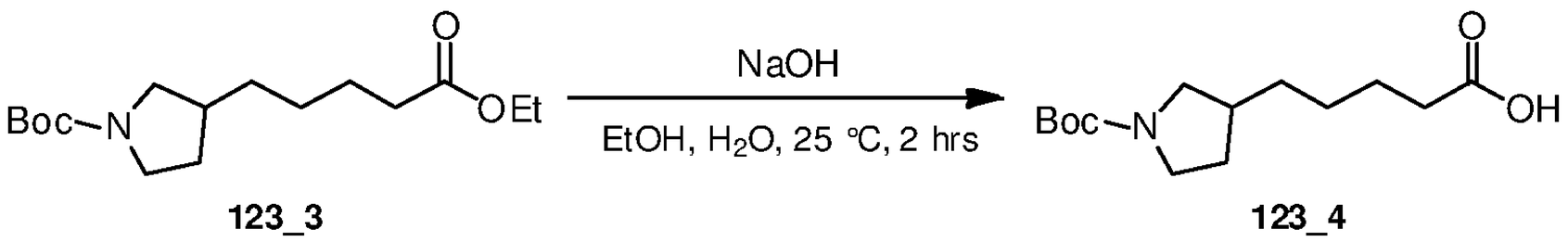
[00259] ^{1}H NMR: (400 MHz, $CDCl_3$) δ 7.19 - 7.13 (m, 1H), 6.22 - 6.05 (m, 1H), 6.02 - 5.91 (m, 1H), 5.89 - 5.72 (m, 1H), 4.23 - 4.03 (m, 2H), 3.57 - 3.47 (m, 1H), 3.42 (ddd, J = 3.4, 8.0, 10.9 Hz, 1H), 3.34 - 3.18 (m, 1H), 3.08 - 2.92 (m, 1H), 2.90 - 2.75 (m, 1H), 2.05 - 1.93 (m, 1H), 1.75 - 1.59 (m, 1H), 1.39 (s, 9H), 1.26 - 1.20 (m, 3H)



123_2 **123_3**

[00260] To a solution of Compound **123_2** (420 mg, 1.42 mmol, 1 *eq*) in EtOH (20 mL) Pd/C (200 mg, 1.42 mmol, 10% purity, 1 *eq*) was added under N_2. The suspension was degassed under vacuum and purged with H_2 several times. The mixture was stirred under H_2 (40 psi) at 25 °C for 2 hours. LCMS showed the reaction was completed. The reaction mixture was filtered and the filtrate was concentrated to give crude compound **123_3** (327 mg, 1.09 mmol, 76.8% yield) as a colorless oil, which used into the next step without further purification.

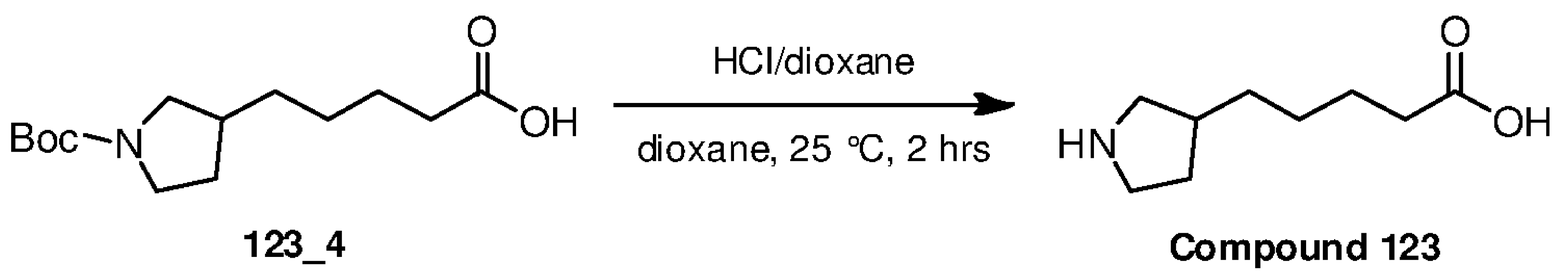
[00261] ^{1}H NMR: (400 MHz, $CDCl_3$) δ 4.12 - 3.99 (m, 2H), 3.54 - 3.27 (m, 2H), 3.24 - 3.07 (m, 1H), 2.85 - 2.67 (m, 1H), 2.23 (dt, J = 3.6, 7.2 Hz, 2H), 2.10 - 1.95 (m, 1H), 1.89 (ddt, J = 2.9, 6.6, 9.3 Hz, 1H), 1.62 - 1.50 (m, 3H), 1.39 (s, 9H), 1.35 - 1.22 (m, 4H), 1.22 - 1.16 (m, 3H)



123_3 **123_4**

[00262] To a solution of compound **123_3** (327 mg, 1.09 mmol) in EtOH (3.00 mL) and H_2O (3.00 mL) NaOH was added (87.4 mg, 2.18 mmol), the mixture was stirred at 25 °C for 2 hrs. LCMS showed the starting material was consumed. It was diluted with ethyl acetate (4 mL) and the mixture was adjusted pH to 4, the organic layer was dried over $MgSO_4$, filtered and concentrated. It was used as is in the next step without additional purification. Compound **123_4** (240 mg, 776 µmol, 71.0 % yield, 87.7 % purity) was obtained as a light yellow oil.

[00263] ^{1}H NMR: (400 MHz, DMSO-d_6) δ 11.99 (br s, 1H), 3.45 - 3.37 (m, 1H), 3.32 - 3.27 (m, 1H), 3.20 - 3.07 (m, 1H), 2.79 - 2.64 (m, 1H), 2.21 (t, J = 7.3 Hz, 2H), 2.13 - 1.98 (m, 1H), 1.91 (s, 1H), 1.56 - 1.43 (m, 2H), 1.39 (s, 9H), 1.36 - 1.21 (m, 4H)

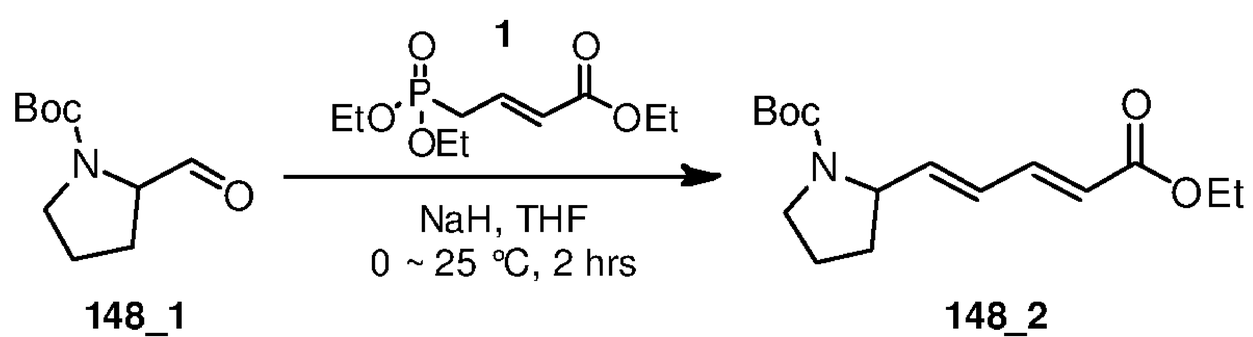


123_4 **Compound 123**

[00264] To a solution of compound **123_4** (240 mg, 884 µmol) in dioxane (2.50 mL), HCl/dioxane was added (2.50 mL) and stirred at 25 °C for 2 hrs. LCMS showed the starting material was consumed. The solvent was removed under reduced pressure to give the product. Compound **123** (150 mg, 858 µmol, 97.1 % yield, 98.0 % purity) was obtained as a light yellow solid.

[00265] ^{1}H NMR: (400 MHz, DMSO-d_6) δ 12.05 (br d, J = 1.9 Hz, 1H), 9.45 (br d, J = 1.6 Hz, 1H), 8.79 (br s, 1H), 3.25 - 3.01 (m, 2H), 2.23 (t, J = 7.3 Hz, 2H), 2.12 - 2.01 (m, 1H), 1.98 - 1.42 (m, 8H), 1.41 - 1.26 (m, 2H)

Synthesis of Compound 148

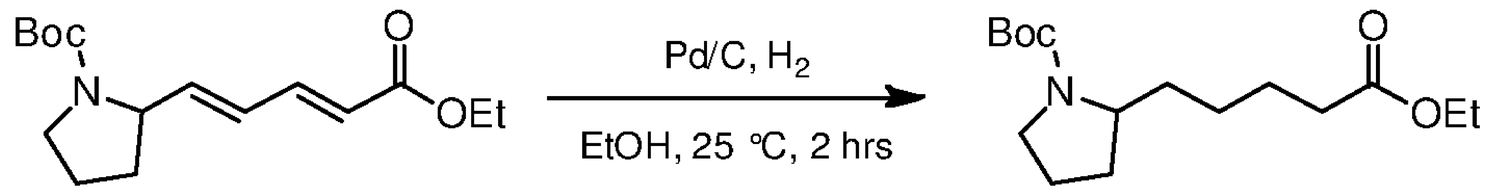


148_1 **148_2**

[00266] To a solution of compound **1** (1.51 g, 6.02 mmol, 1.2 *eq*) in THF (20 mL) NaH was added (261 mg, 6.52 mmol, 60% purity, 1.3 *eq*) at 0 ~ 5 °C and stirred at 25 °C for 0.5 hr. Then compound **148_1** (1.00 g, 5.02 mmol, 1 *eq*) was added and stirred 25 °C for 1.5 hrs. LCMS showed the reaction was completed. The residue was poured into saturated aqueous NH_4Cl solution (50 mL). The aqueous phase was extracted with ethyl acetate (50 mL*2). The combined organic phase was washed with brine (50 mL), dried with anhydrous $MgSO_4$, filtered and concentrated in vacuum. The residue was purified by flash silica gel chromatography (ISCO®; 20 g SepaFlash® Silica Flash Column, Eluent of 0~15% Ethyl acetate/Petroleum ether gradient

@ 100 mL/min) to give compound **148_2** (640 mg, 2.15 mmol, 42.9% yield, 99.3% purity) as a colorless oil.

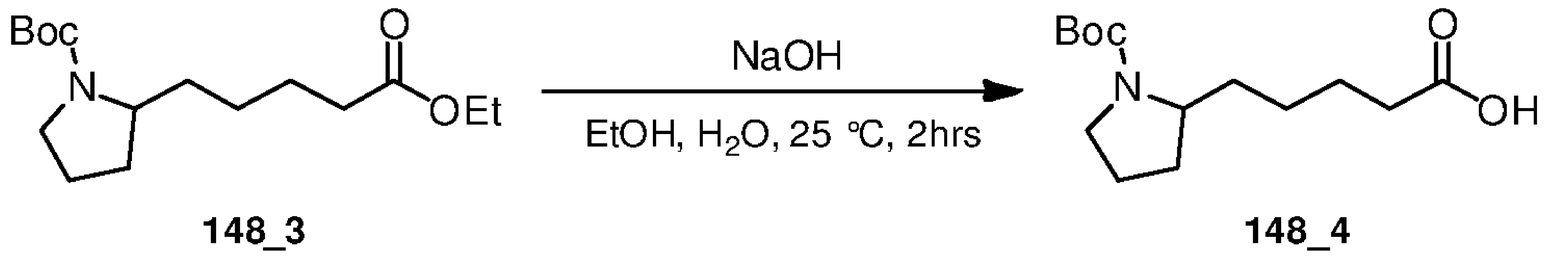
[00267] ^{1}H NMR: (400 MHz, $CDCl_3$) δ 7.65 - 7.12 (m, 2H), 6.20 - 5.50 (m, 3H), 4.81 - 3.92 (m, 3H), 3.64 - 3.06 (m, 2H), 2.17 - 1.90 (m, 1H), 1.90 - 1.71 (m, 2H), 1.71 - 1.55 (m, 1H), 1.41 - 1.27 (m, 9H), 1.23 (dt, J = 1.9, 7.1 Hz, 3H)



148_2 **148_3**

[00268] To a solution of compound **148_2** (640 mg, 2.17 mmol, 1 *eq*) in EtOH (20 mL) Pd/C (200 mg, 2.17 mmol, 10% purity, 1 *eq*) was added under N_2. The suspension was degassed under vacuum and purged with H_2 several times. The mixture was stirred under H_2 (50 psi) at 25 °C for 2 hours. LCMS showed the reaction was completed. The reaction mixture was filtered and the filtrate was concentrated to give crude compound **148_3** (540 mg, 1.80 mmol, 83.2% yield) as a colorless oil which used into the next step without further purification.

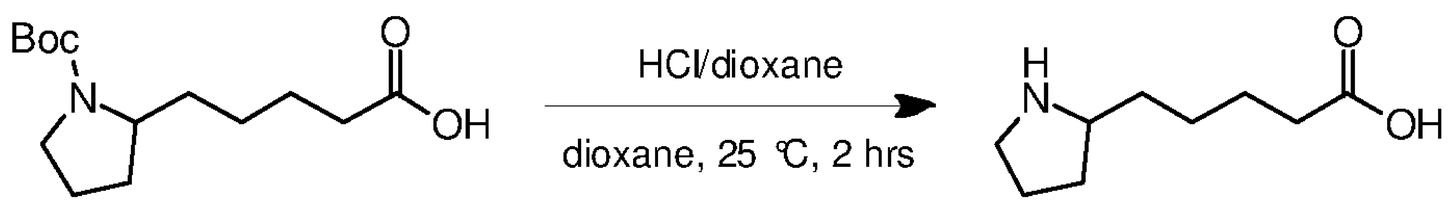
[00269] ^{1}H NMR: (400 MHz, $CDCl_3$) δ 4.05 (q, J = 7.1 Hz, 2H), 3.65 (q, J = 7.0 Hz, 1H), 3.39 - 3.14 (m, 2H), 2.23 (t, J = 7.5 Hz, 2H), 1.90 - 1.62 (m, 4H), 1.62 - 1.48 (m, 4H), 1.41 - 1.35 (m, 9H), 1.28 - 1.14 (m, 6H).



148_3 **148_4**

[00270] To a solution of compound **148_3** (540 mg, 1.80 mmol) in EtOH (5.00 mL) and H_2O (5.00 mL) NaOH was added (144 mg, 3.61 mmol), the mixture was stirred at 25 °C for 2 hrs. LCMS showed the starting material was consumed. The solvent was removed under reduced pressure to give the crude product. It was used as is in the next step without additional purification. Compound **148_4** (450 mg, 1.49 mmol, 82.8 % yield, 90.0 % purity) was obtained as a white solid.

[00271] ^{1}H NMR: (400 MHz, DMSO-d_6) δ 11.98 (br s, 2H), 3.71 - 3.54 (m, 1H), 3.28 - 3.10 (m, 2H), 2.27 - 2.13 (m, 2H), 1.90 - 1.67 (m, 3H), 1.66 - 1.43 (m, 4H), 1.42 - 1.35 (m, 9H), 1.34 - 1.12 (m, 4H)



148_4 **148**

[00272] To a solution of compound **148_4** (450 mg, 1.66 mmol) in dioxane (5.00 mL) HCl/dioxane (5.00 mL) was added and the solution was stirred at 25 °C for 2 hrs. LCMS showed the starting material was consumed. The solvent was removed under reduced pressure to give the

product. Compound **148** (200 mg, 1.14 mmol, 69.0 % yield, 98.0 % purity) was obtained as a yellow solid.

[00273] ^{1}H NMR: (400 MHz, DMSO-d_6) δ 12.18 - 11.95 (m, 1H), 9.45 (br d, J = 1.6 Hz, 1H), 8.79 (br s, 1H), 3.20 - 3.02 (m, 2H), 2.23 (t, J = 7.3 Hz, 2H), 2.12 - 1.99 (m, 1H), 1.97 - 1.45 (m, 8H), 1.40 - 1.27 (m, 2H).

EXAMPLE 2

Herbicidal Activity Data

Applications on a weed panel

[00274] Herbicidal activity of compounds (active ingredient; A.I.) was demonstrated by the following greenhouse experiments:

***In-planta* Low through-put screens (LTP) results**

Post-emergence treatments

[00275] A basic panel of eight weed species (Table 3) sowed in 4X4X7cm plastic pots containing a garden mix (klasmann). Each specie was sowed in a separate pot. In each pot, 10-15 seeds were sowed according to the specie viability. Timing of application determined at a 1-2 true leaf stage. The plants grew for 30 days in a controlled greenhouse (26±2^{O}C day, 20±2^{O}C night). Flood irrigation (tap water + Shefer 5:3:8 8mM) was given at a 50% water content by weight. Two days before application, the tested plants thinned down to three plants per pot. Compounds were soluble in water (DDW), and commercial herbicide control was soluble in formulation B (Table 4). Before application, 1% (v/v) crop oil and 0.02% (v/v) surfactant (Tergitol^{TM} 15-S-7) were added to the solution. Application was conducted with an industrial sprayer (TeeJet 6502E nozzle) at a rate of 2kg/ha and spray volume of 480l/ha. Plants were evaluated at 3 time points (4, 8, 12 days after application (DAA)). At each time point, visual phenotyping was recorded using a scale of 0-6 (0: no visible effect, 6: maximum effect). At 12 DAA, plants foliage was harvested, dried and weighed for dry weight analysis.

[00276] **Post-emergence advanced** dose response experiment included 4 species: SETVI, ECHCO, AMAPA, ABUTH (Tables 3, 5). Application was conducted at six rates between 0.6–0.0187kg/ha and spray volume of 480l/ha. Plants were evaluated at 4 time points (6, 12, 18 and 26 DAA). At each time point, visual phenotyping was recorded using a scale of 0-6 (0: no visible effect, 6: maximum effect). At 26 DAA, plants foliage was harvested, dried and weighed for dry weight analysis.

[00277] **Post-emergence advanced wide panel** experiment included 24 weed species (Table 5). Application was conducted at 2 rates of 2kg/ha and 0.25kg/ha and spray volume of 480l/ha. Visual phenotyping was recorded at 4, 11, 17 and 20 DAA using a scale of 0-6 (0: no visible effect, 6: maximum effect). At 21 DAA, plants foliage was harvested, dried, and weighed for dry weight analysis. All experiments included an untreated control, a solvent control, and a positive control (commercial herbicide A.I.). Statistical analysis for visual phenotyping determined by a median value of ≥3.5 and Fisher test

(pval≤0.05). Statistical analysis for dry weight determined by % inhibition ≥50 and T test (pval≤0.05), as well as Wilcox test (pval≤0.05).

Pre-emergence treatments

[00278] A basic panel of 8 weed species (Table 3) were sowed in 4X4X7 cm plastic pots containing inert sand (Sweet sand), intensively washed using osmosis water. Each specie was sowed in a separate pot. In each pot 10-15 seeds were sowed according to the specie viability. Sowing was performed one day before application. The plants were grown for 21 days in a controlled greenhouse (26±2°C day 20±2°C night). Flood irrigation (tap water + Shefer 5:3:8 8mM) was given at a 50% water content by weight. Compounds were soluble in water (DDW), and commercial herbicide control was soluble in formulation B (Table 4). Application was conducted with an industrial sprayer (TeeJet 6502E nozzle) at a rate of 2kg/ha and spray volume of 480l/ha.

[00279] **Pre-emergence advanced** dose response experiment application was conducted at six rates between 1–0.0312kg/ha and spray volume of 480l/ha. Percentage of emergence was evaluated at 15 DAA. Visual phenotyping was recorded using a scale of 0-6 (0: no visible effect, 6: maximum effect) at 18 DAA. All experiments included an untreated control, a solvent control and a positive control (commercial herbicide A.I.). Statistical analysis for visual phenotyping determined by a median value of ≥3.5 and Fisher test (pval≤0.05). Statistical analysis for plant emergence determined by % emergence ≥50 and T test (pval≤0.05), as well as Wilcox test (pval≤0.05).

Table 3: Basic weed panel species

Bayer code	Scientific name
ABUTH	*Abutilon theophrasti*
AMBEL	*Ambrosia artemisiifolia*
AMAPA	*Amaranthus palmeri*
MATCH	*Matricaria chamomilla*
ALOMY	*Alopecurus myosuroides*
POAAN	*Poa annua*
LOLPE	*Lolium perenne*
SETVI	*Setaria viridis*

Table 4: Formulations

Formulation	Ingredients
A	100% DDW
B	48.5% acetone 40% DDW 10% isopropyl alcohol 1.5% DMSO

Table 5: Advanced weed panel species

Bayer code	Scientific name
ABUTH	*Abutilon theophrasti*
AMBEL	*Ambrosia artemisiifolia*
AMAPA	*Amaranthus palmeri*
MATCH	*Matricaria chamomilla*
ERICA	*Conyza Canadensis*

EPHHL	*Euphorbia heterophylla*
AMARE	*Amaranthus retroflexus*
SOLNI	*Solanum nigrum*
CHEAL	*Chenopodium album*
POROL	*Portulaca oleracea*
GLXMA	*Glycine max*
BRSNN	*Brassica napus*
ALOMY	*Alopecurus myosuroides*
POAAN	*Poa annua*
LOLPE	*Lolium perenne*
SETVI	*Setaria viridis*
DIGSA	*Digitaria sanguinalis*
ECHCO	*Echinochloa colona*
LOLRI	*Lolium rigidum*
PHAPA	*Phalaris paradoxa*
ZEAMX	*Zea mays*
AVEST	*Avena sterilis*
TRZAX	*Triticum aestivum*
ORYSA	*Oryza sativa*

Results:

[00280] The *In-planta* low throughput (LTP) results for compounds **104, 109, 148, 146** and **145** are presented in Table 6 below:

Table 6. Herbicidal activity (*In-planta*) for compounds according to this invention.

LTP-Pre emergence	***Compound 104***	***Compound 109***	***Compound 148***	***Compound 146***
Dosage (g/ha)	2000	2000	2000	2000
Setaria viridis	100	0	40	60
Alopecurus myosuroides	40	0	0	0
Lolium perenne	80	0	0	40
Poa annua	100	0	60-80	0
Echinochloa colona	N/A	N/A	N/A	N/A
Phalaris paradoxa	60	N/A	N/A	N/A
Eragrostis tef	100	N/A	N/A	N/A
Amaranthus palmeri	80	40	60-80	60-80
Matricaria chamomilla	80	0	60-80	0
Abutilon theophrasti	60-80	0	40-60	0
Ambrosia artemisiifolia	0	0	60	0
Sinapis alba	40-60	N/A	N/A	N/A
Arabidopsis thaliana	40-80	N/A	N/A	N/A
LTP-Post emergence	***Compound 104***	***Compound 109***	***Compound 145***	
Dosage (g/ha)	2000	2000	2000	
Phalaris minor	20-30	N/A	0	
Lolium multiflorum	80-90	N/A	20-40	
Echinochloa crus-galli	N/A	N/A	60-80	
Digitaria sanguinalis	95	N/A	60-80	

Setaria viridis	90-95	0	60	
Alopecurus myosuroides	95	0	60-80	
Lolium perenne	85-90	0	40-60	
Poa annua	90	0	20-40	
Echinochloa colon	95	N/A	20-40	
Phalaris paradoxa	80	N/A	N/A	
Amaranthus tuberculatus	80	N/A	40-60	
Chenopodium album	90	N/A	40-60	
Conyza canadensis	95	N/A	40-60	
Galium aparine	70	N/A	40-60	
Stellaria media	95	N/A	20-40	
Solanum nigrum	80-90	N/A	40-60	
Eragrostis tef	60-100	N/A	N/A	
Amaranthus palmeri	90	40	20-40	
Matricaria chamomilla	70-80	0	0	
Abutilon theophrasti	80	0	20-40	
Ambrosia artemisiifolia	70-80	40	20-40	
Sinapis alba	60	N/A	N/A	
Arabidopsis thaliana	60	N/A	N/A	

N/A: not available

[00281] The results show excellent control of compound **104** on both monocot and eudicot weeds species in both post-emergence and pre-emergence applications modes for most of the species tested. Compound **148** shows good to moderate activity on dicots and monocots when applied pre-emergence. In addition, compounds **109** and **146** displayed moderate growth inhibition in dicot species, in either pre- or post-emergence applications. Compound **145** displayed good to moderate activity when applied post-emergence to both monocot and dicot species.

***In-planta* high through-put screens (HTPS) results**

Post-emergence applications on miniature dicot model plants

[00282] *Arabidopsis thaliana* seeds were sown in 96 well plates filled with irrigated Sweet sand (10% > clay) that is washed from salts and minerals using tap water. 5-10 seeds were sown in the center of each well. 7-8 days post sowing, at 2 true leaves stage, thinning out was performed to ensure that compound application is done on a single plant per well. The plates were placed in a controlled greenhouse in a random order inside a bath which allows flooding irrigation with tap water supplemented with a fertilizer. Applied compounds were dissolved into a final solution of 50% acetone, 49.9% DDW, 0.1% tween-20.

[00283] A 96 well plate was used as a stock plate for preparing application solutions for 8 repeats. Each row contained different concentrations per chemical. Maximal concentration for application was 1.5Kg/Ha and dilution factor is 2.5. Chemical application was performed one day after thinning out in a chemical hood. 5µL applied on first two true leaves in each well using 12 channel pipettes. Data collection: RGB (red, green, blue) data for green area per well was documented using camera. Data is collected at a few

time points during the experiment: one day after thinning and before chemical application, two-, six- or nine-days post application. During the last two documentations, visual phenotyping was performed. Data analysis: Given RGB results and visual phenotype scores, a student *t*-test conducted to compare between treatment and control performance for continuous data (RGB) and Fisher exact test to analyze the non-continuous data (phenotypic scores). Dose-Response curves are generated for each treatment to infer ED_{50} and max. inhibition parameters, using treatment's log concentration range as the dependent variable and normalized green area.

Pre-emergence applications on dicot and monocot model plants

[00284] These experiments are conducted similarly except that either *Arabidopsis thaliana* or *Eragrostis teff* seeds were sowed (5-10 or 5-7, respectively), plant thinning out was not performed, compound dissolved into a final solution of 50% acetone, 49.9% DDW, compound application was done at 30µL volume per well directly on sowed soil before plant emergence and data was collected 10 or 7 days after chemical application on dicot or monocot plants, respectively.

Imaging, RGB and statistical analysis

[00285] Plate imaging performed at 11 and 18 DAA. RGB data for green area per well was documented and used to extract % inhibition. Dose-Response curves were built for each treatment to infer EC50, EC75 and EC90 parameters, using treatment's log concentration range as the independent variable and normalized green area as the dependent variable. Treatments were compared to controls performance given RGB results and using student's *t*-test (p-val≤0.05).

Results:

[00286] Compounds **104-154** were applied in either or both pre- and post-emergence mode to either or both monocot and dicot model plants, following the methods described above. The compounds were applied as a gradient of concentrations as listed above, from which the ED_{50} was calculated.

[00287] The *in-planta* high through put screens (HTPS) results for compounds **101-154** are presented in Table 7 below:

Table 7. Herbicidal activity for compounds according to this invention.

System	Compound	Max Inhibition (%)	ED_{50} (g/ha)
HTPS Pre Monocot	**104**	100	35
	145	100	16.8
HTPS Pre Dicot	**104**	94	6
	109	100	24
	108	100	175
	147	100	N/A
HTPS Post Dicot	**101**	100	29
	102	90	2

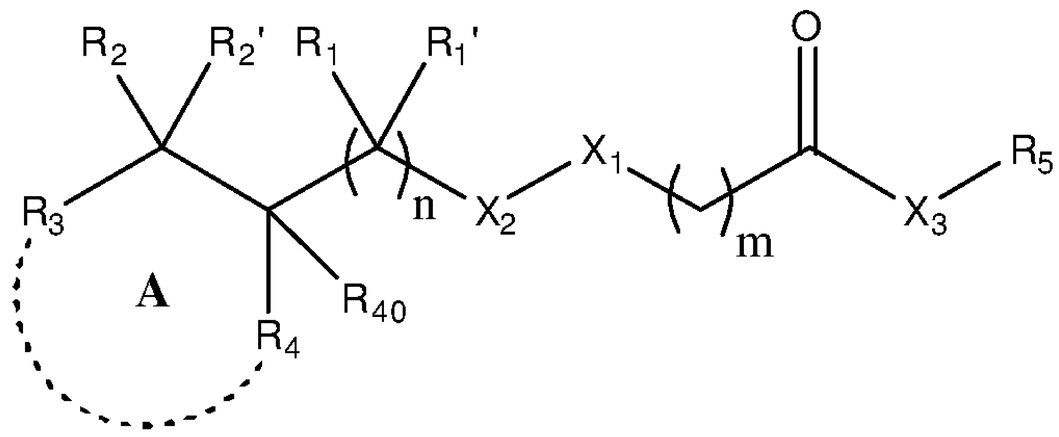
104	100	0.2
105	94	430
106	82	>1000
109	100	200
107	100	200
154	100	8
152	100	4
149	100	90
123	100	140
115	100	13
114	100	40
145	100	N/A
113	100	26
143	100	61
147	50	807
148	100	30
146	100	80

[00288] The results in the table show excellent to very good control of most compounds, (particularly compound **104**) in the systems where they were tested. Compound **149** displayed very good activity also on monocots. Some compounds show weak to median activities in dicot systems.

5

WHAT IS CLAIMED:

1. A compound represented by the structure of formula **I(g):**



I(g)

wherein

R_1, R_1', R_2, R_2' and **R_{40}** are each independently H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C(O)-R_{10}, or C(O)-CH_3;

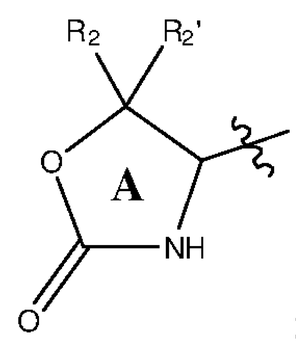
R_3 is OH, or NH_2;

R_4 is NH_2, or OH;

wherein if R_3 is OH then R_4 is NH_2 and if R_3 is NH_2 then R_4 is OH;

wherein if **R_3** is OH and **R_4** is NH_2, then **n + m** cannot be equal to 3;

or **R_3** and **R_4** are joined together to form ring **A,** represented by the following structure:



;

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

R is C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl;

m is 1 or 2;

n is 0, 1, 2 or 3;

X_1 is S, O, or CH_2;

X_2 is S, O, or CH_2;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

2. The compound of claim 1, wherein ring **A** has two chiral centers.

3. The compound of claim 1, wherein the compound is not (*6R,7S*)-6-amino-7-hydroxyoctanoic acid or 5-((*4R,5S*)-5-methyl-2-oxooxazolidin-4-yl)pentanoic acid.

4. The compound of claim 1 or 2, wherein the compound is a substantially pure single stereoisomer.

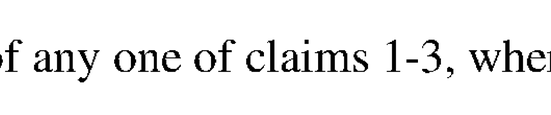
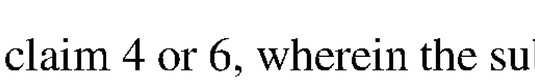
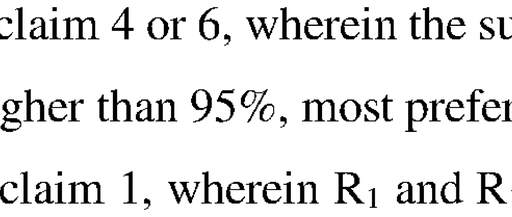
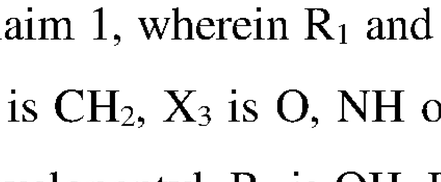
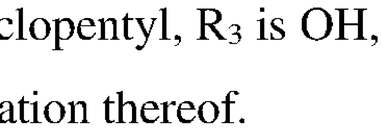
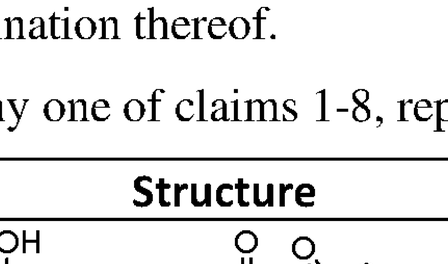
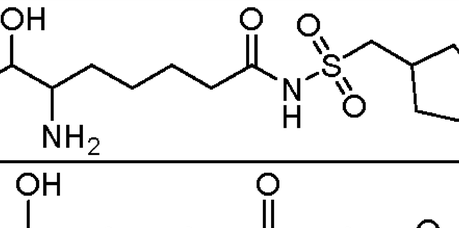
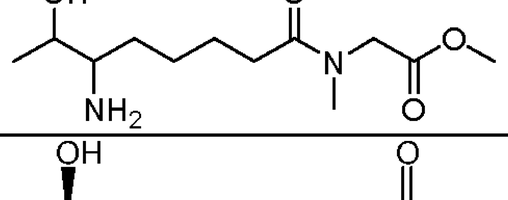
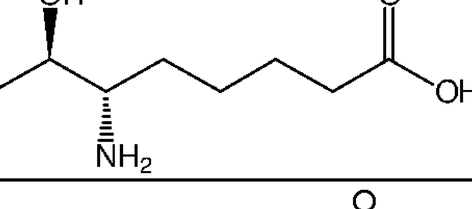
5. The compound of claim 1 or 2, wherein the compound is a mixture of stereoisomers.

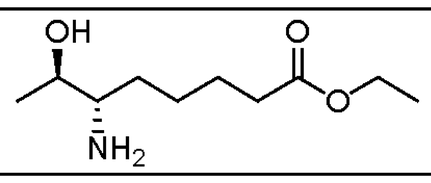
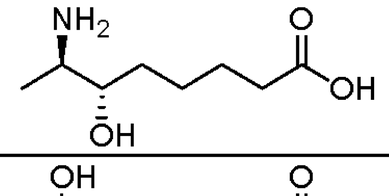
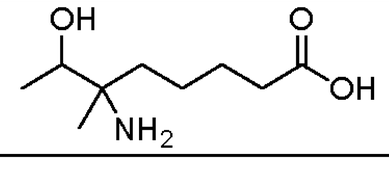
6. The compounds of any one of claims 1-3, wherein the compound is the substantially pure *SR* stereoisomer, *RS* stereoisomer, *RR* stereoisomer, or *SS* diastereomer.

7. The compound of claim 4 or 6, wherein the substantially pure stereoisomer has a purity higher than 90%, preferably higher than 95%, most preferably higher than 98%.

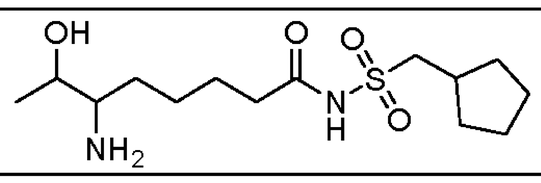
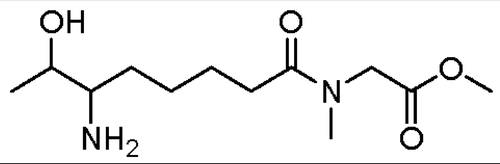
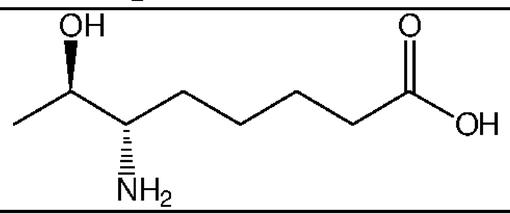
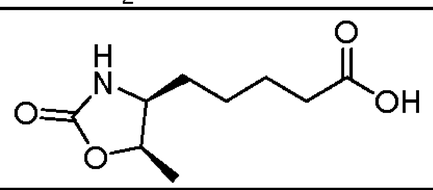
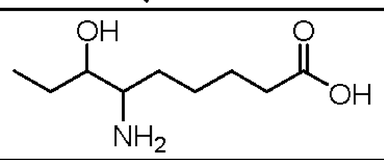
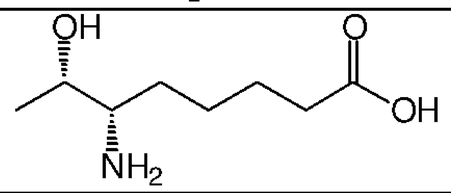
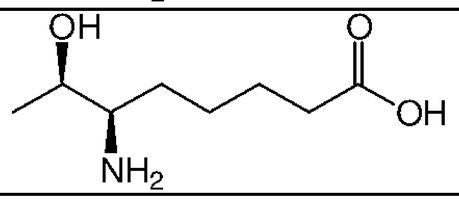
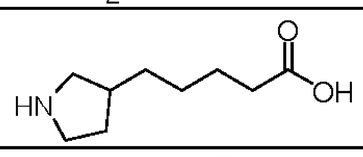
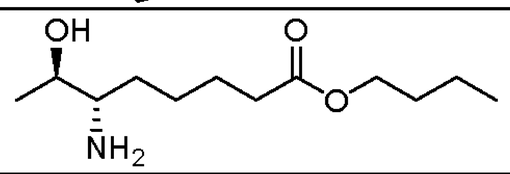
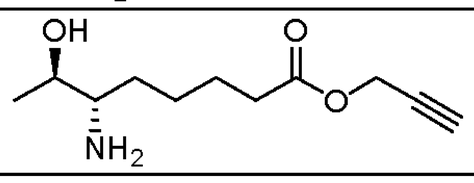
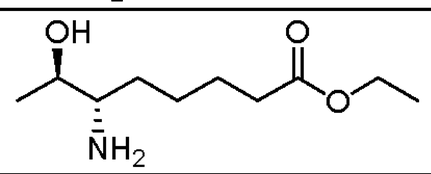
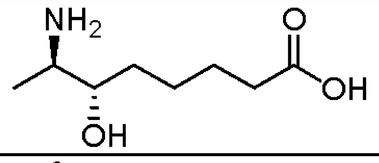
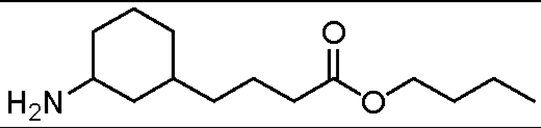
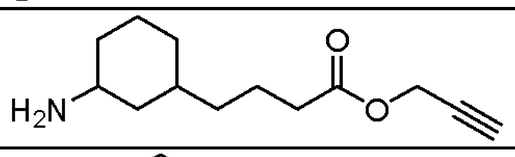
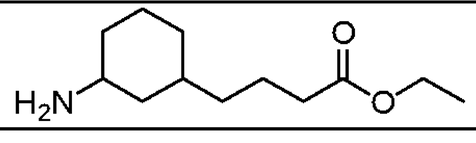
8. The compound of claim 1, wherein R_1 and R_1' are both H, R_2 is CH_3, R_2' is H or CH_3, R_{40} is H or CH_3, X_1 is CH_2, X_2 is CH_2, X_3 is O, NH or N-CH_3, R_5 is H, ethyl, butyl, CH_2-CCH, CH_2-C(O)-OCH_3 or SO_2-CH_2-cyclopentyl, R_3 is OH, R_4 is NH_2 or R_3 and R_4 are joined to form ring A, n is 1, m is 1, or any combination thereof.

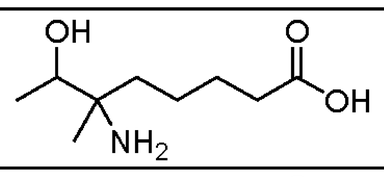
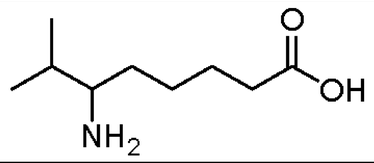
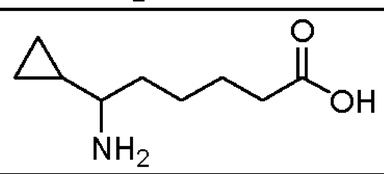
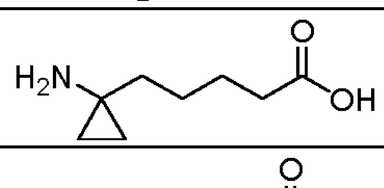
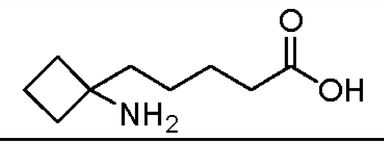
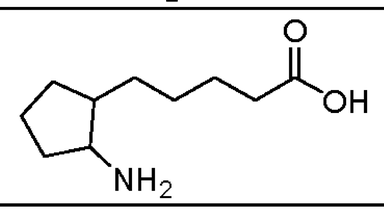
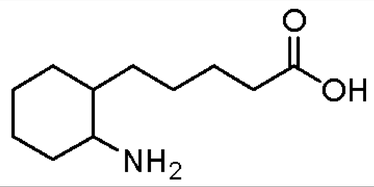
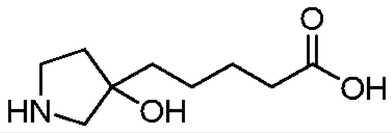
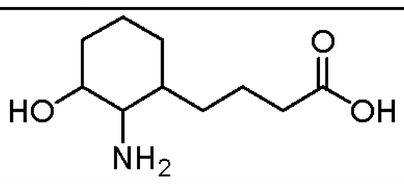
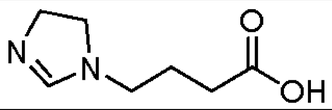
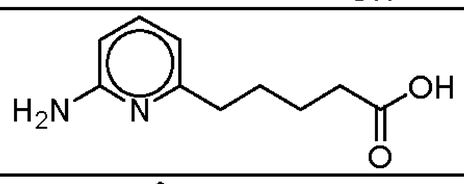
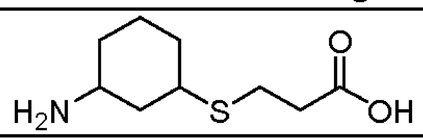
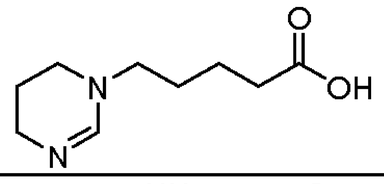
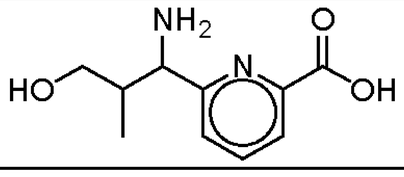
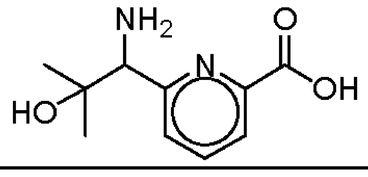
9. The compound of any one of claims 1-8, represented by any one of the following structures:

Compound	Structure
101	
102	
104	
105	
113	
114	
115	
116	
117	

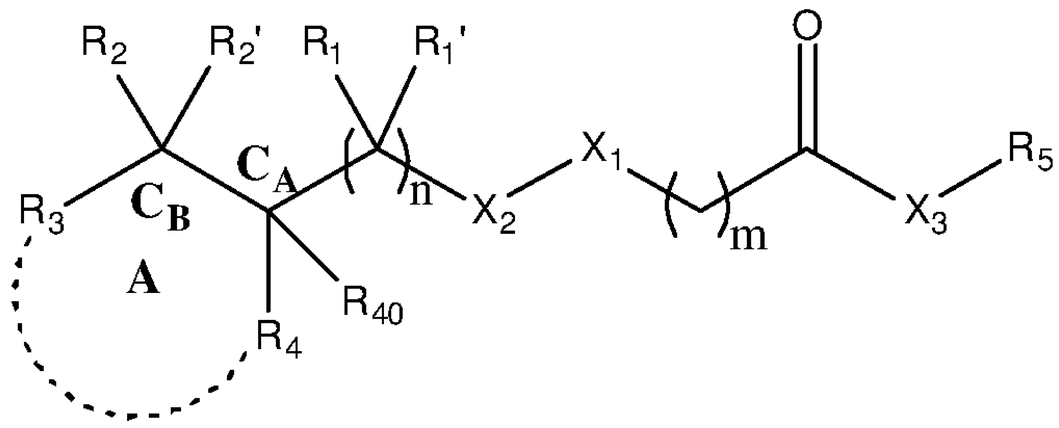
118	
119	
120	

10. A compound, represented by any one of the following structures:

Compound	Structure
101	
102	
104	
105	
113	
114	
115	
123	
116	
117	
118	
119	
124	
125	
126	

120	
127	
128	
129	
130	
131	
132	
133	
134	
137	
138	
139	
140	
141	
142	

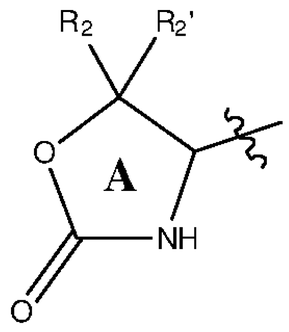
11. An herbicidal compound, represented by the structure of formula **I(ga):**



I(ga)

wherein

$\mathbf{C_A}$ and $\mathbf{C_B}$ are both chiral carbon centers, or $\mathbf{C_A}$ and $\mathbf{C_B}$ together with $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined to form ring **A,** represented by the following structure:



$\mathbf{R_1}$, $\mathbf{R_1'}$, $\mathbf{R_2}$, $\mathbf{R_2'}$ and $\mathbf{R_{40}}$ are each independently H, C_1-C_5 linear or branched, unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, benzyl, C(O)-R_{10}, or C(O)-CH_3;

$\mathbf{R_3}$ is OH, SH, NH_2, $NHNH_2$, NHR, $N(R)_2$, NHC(O)OBz, -NHC(O)-R_{10}, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, methyl, ethyl, propyl, iso-propyl, t-Bu, iso-butyl, pentyl, substituted or unsubstituted C_3-C_8 cycloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

$\mathbf{R_4}$ is NH_2, $NHNH_2$, $N(R)_2$, -NHC(O)-R_{10}, NHC(O)H, $NHC(O)CH_3$, C_1-C_5 linear or branched, substituted or unsubstituted alkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic haloalkyl, C_1-C_5 linear or branched or C_3-C_8 cyclic alkoxy, substituted or unsubstituted C_3-C_8 cycloalkyl, substituted or unsubstituted C_3-C_8 heterocyclic ring, or substituted or unsubstituted aryl;

or $\mathbf{R_3}$ and $\mathbf{R_4}$ are joined together to form ring **A** as described above;

wherein $\mathbf{R_3}$ and $\mathbf{R_4}$ cannot both be NH_2, and

wherein if $\mathbf{R_3}$ is OH and $\mathbf{R_4}$ is NH_2, then **n** + **m** cannot be equal to 3;

$\mathbf{R_5}$ is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted alkyl sulfone (e.g., SO_2-CH_2-cyclopentyl), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

$\mathbf{R_8}$ is $[CH_2]_p$

wherein **p** is between 1 and 10;

$\mathbf{R_{10}}$ and $\mathbf{R_{11}}$ are each independently H, CN, C_1-C_5 linear or branched alkyl, C(O)R, or $S(O)_2R$;

or $\mathbf{R_{10}}$ and $\mathbf{R_{11}}$ are joined to form a substituted or unsubstituted C_3-C_8 heterocyclic ring;

R is C_1-C_5 linear or branched alkyl, C_1-C_5 linear or branched alkoxy, phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

m is 1 or 2;

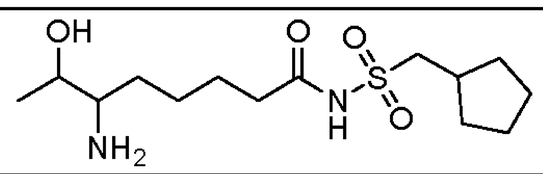
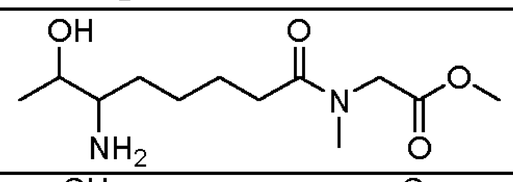
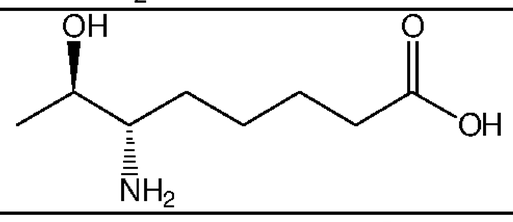
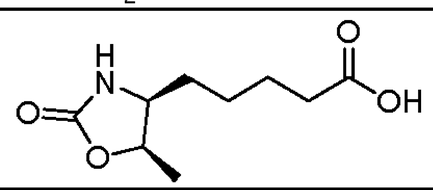
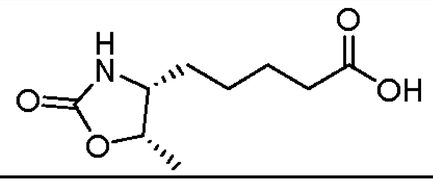
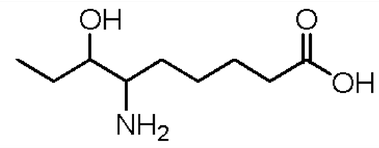
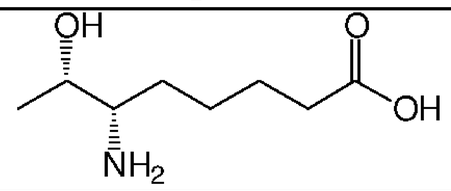
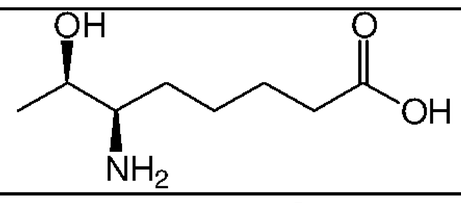
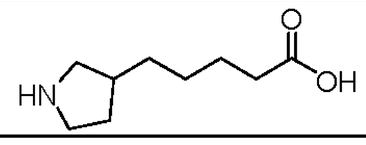
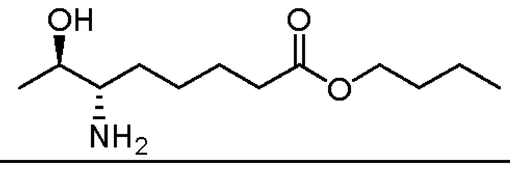
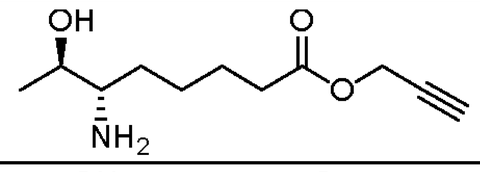
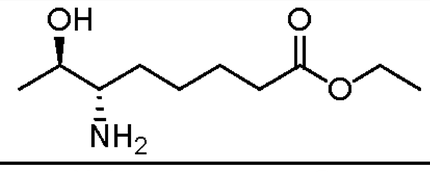
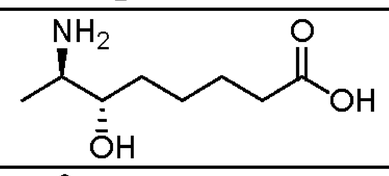
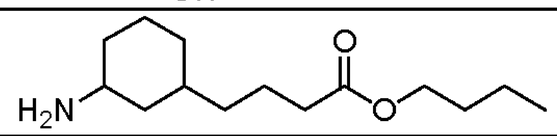
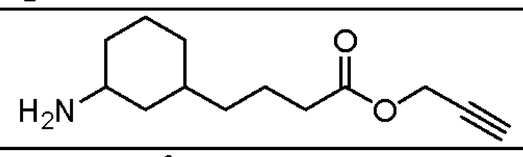
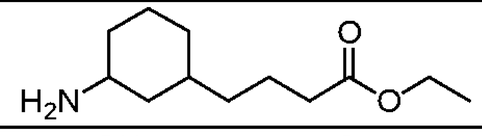
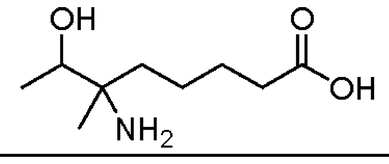
n is 0, 1, 2 or 3;

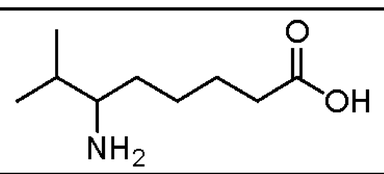
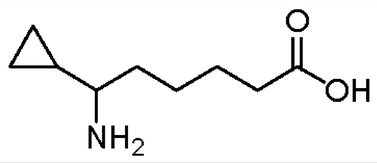
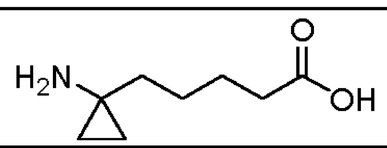
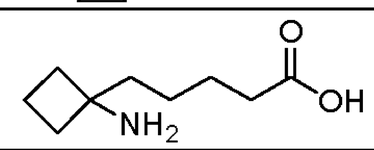
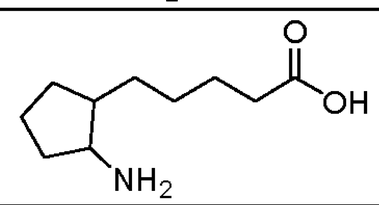
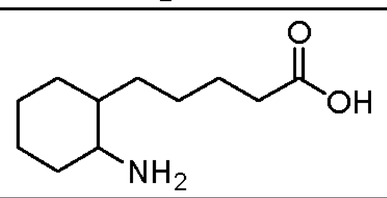
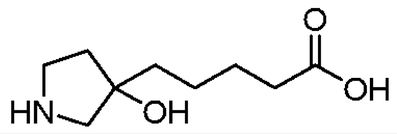
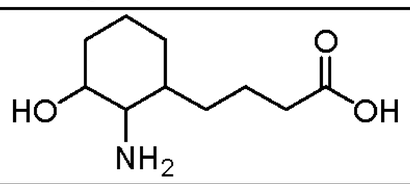
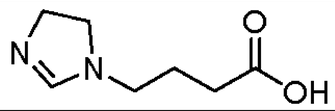
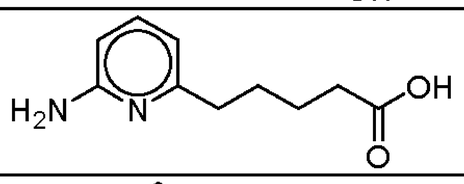
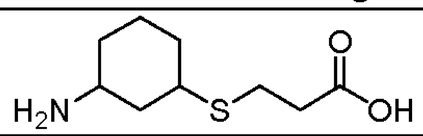
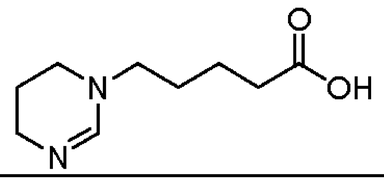
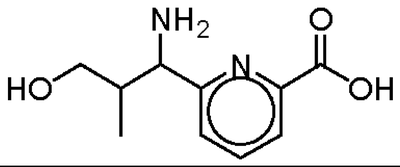
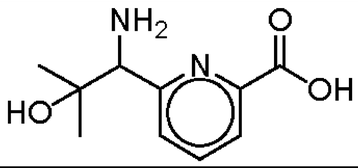
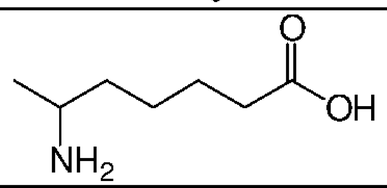
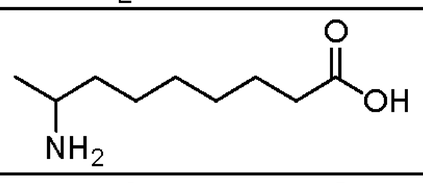
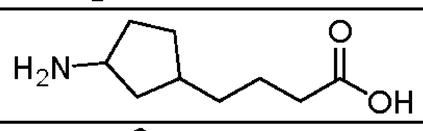
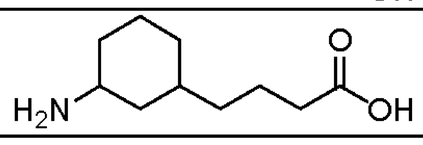
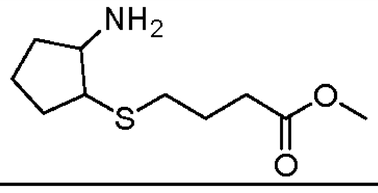
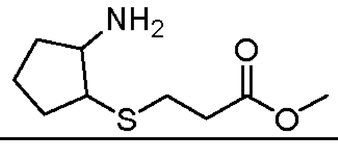
$\mathbf{X_1}$ is S, O, or CH_2;

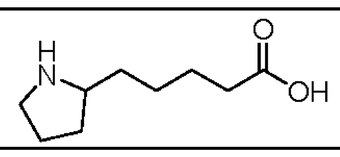
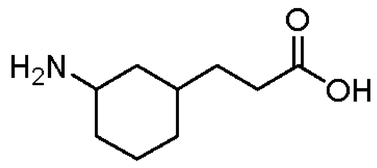
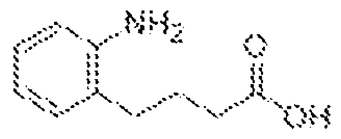
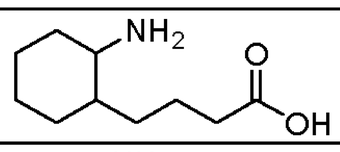
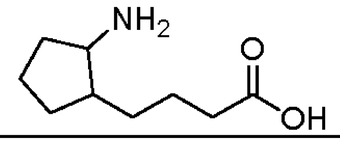
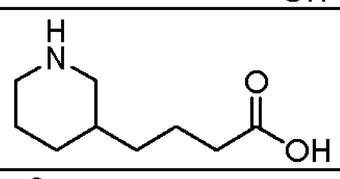
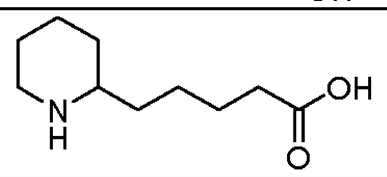
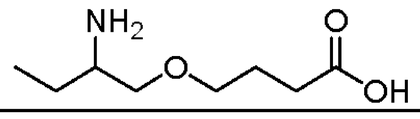
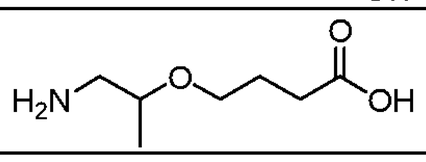
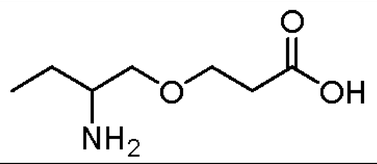
$\mathbf{X_2}$ is S, O, or CH_2;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

12. An herbicidal compound, represented by any one of the following structures:

Compound	Structure
101	
102	
104	
105	
106	
113	
114	
115	
123	
116	
117	
118	
119	
124	
125	
126	
120	

127	
128	
129	
130	
131	
132	
133	
134	
137	
138	
139	
140	
141	
142	
107	
112	
143	
145	
146	
147	

148	
150	
151	
152	
153	
154	
155	
156	
157	
158	
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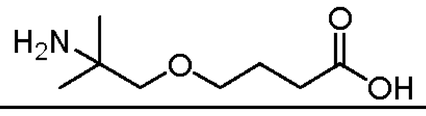
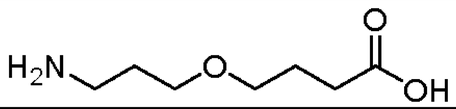
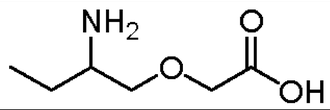
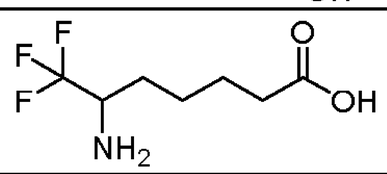
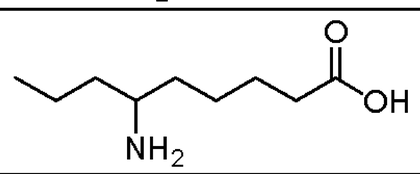
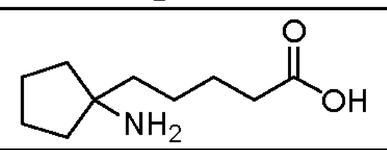
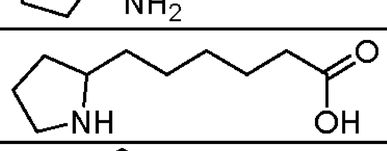
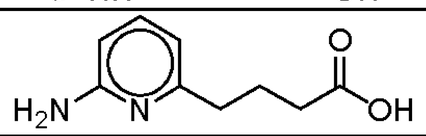
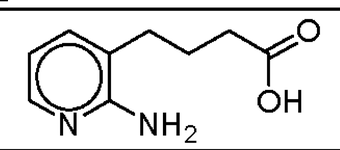
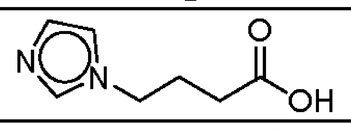
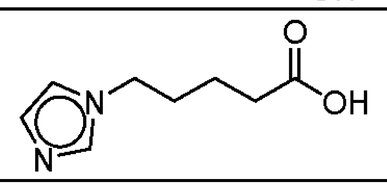
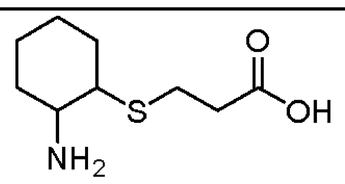
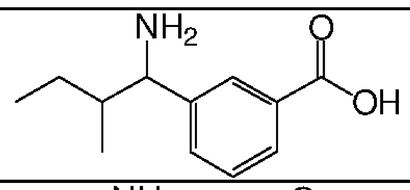
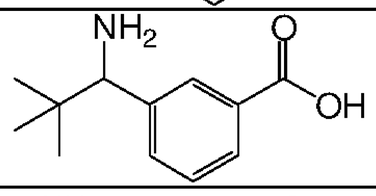
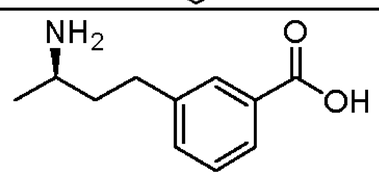
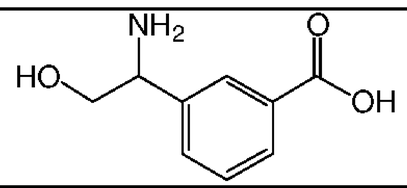
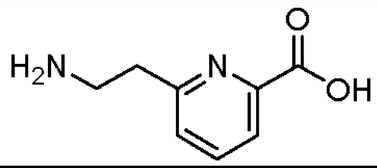
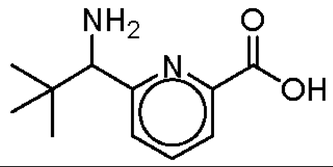
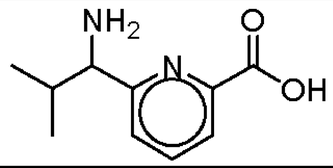
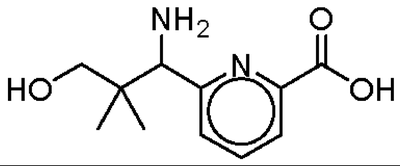
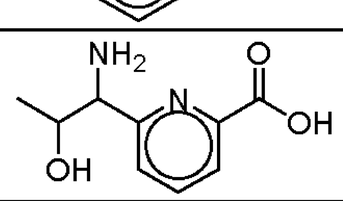
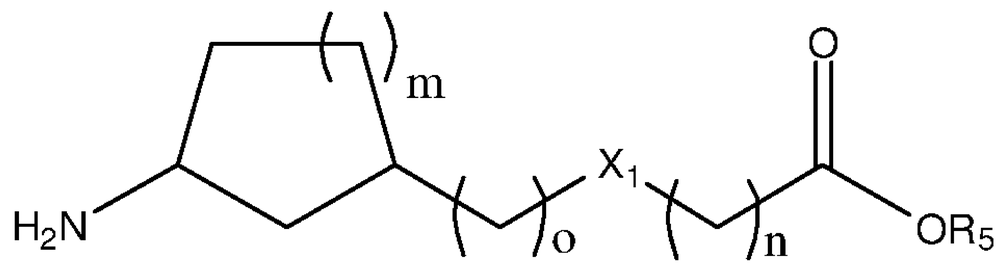
160	
161	
162	
163	
164	
165	
166	
167	
168	
169	
170	

171	
108	
109	
172	
173	
174	
175	
176	
177	
178	

13. An herbicidal compound represented by the structure of formula **X(a)**:



X(a)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

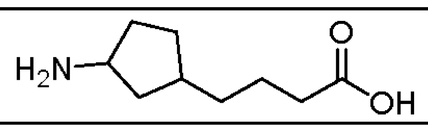
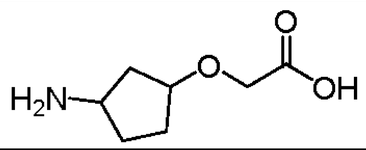
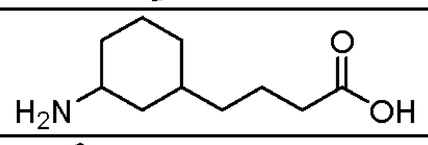
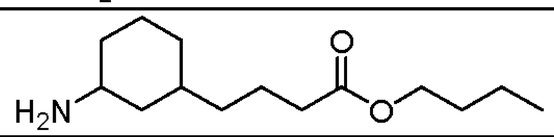
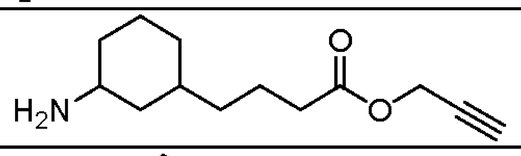
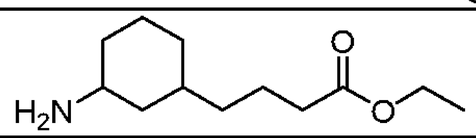
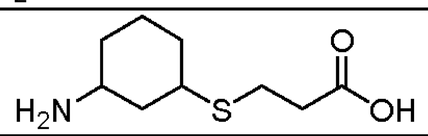
X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

n and **o** are each independently an integer number between 0 and 2;

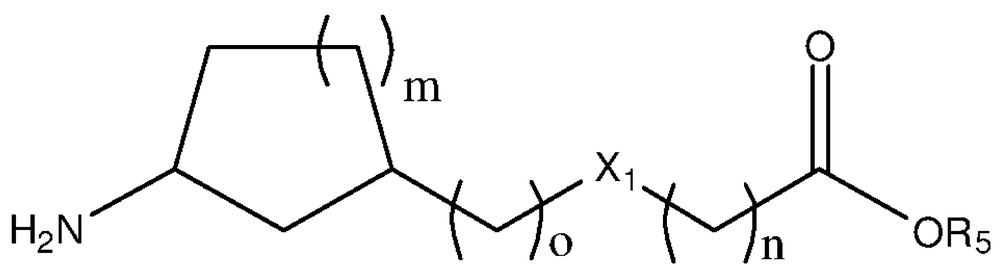
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

14. The compound of claim 13, represented by any one of the following structures:

Compound	Structure
143	
144	
145	
124	
125	
126	
139	

15. A compound represented by the structure of formula **X(a)**:



X(a)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

wherein if X_1 is CH_2, then R_5 cannot be H;

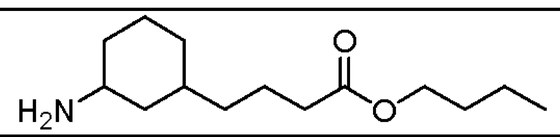
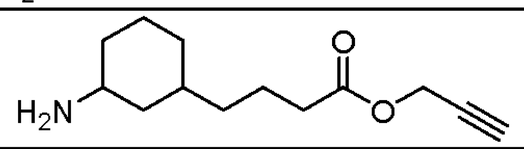
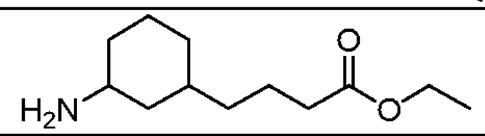
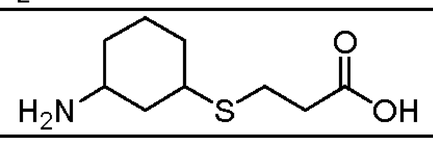
n is 2;

o is 0;

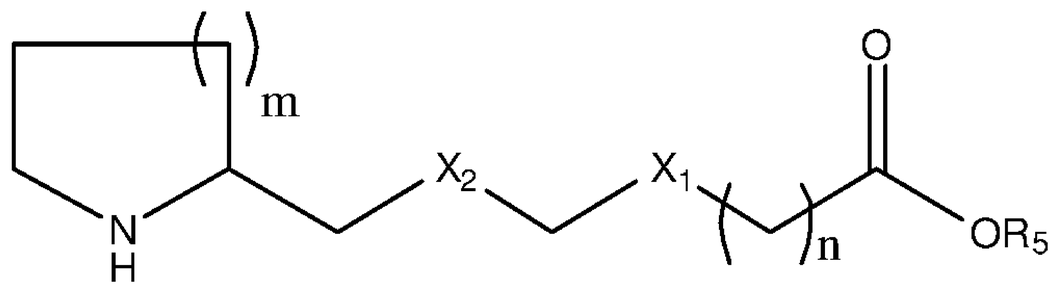
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

16. The compound of claim 15, represented by any one of the following structures:

Compound	Structure
124	
125	
126	
139	

17. An herbicidal compound represented by the structure of formula **X(b)**:



X(b)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

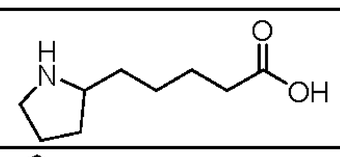
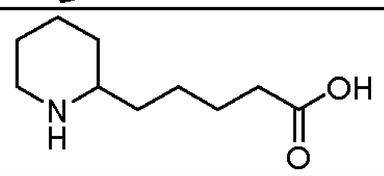
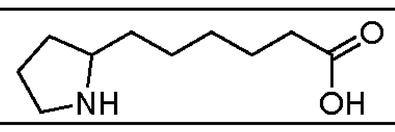
X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

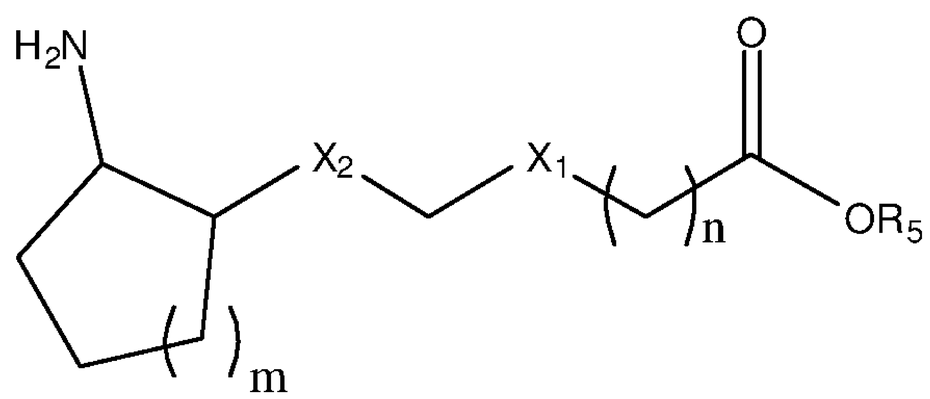
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

18. The compound of claim 17, represented by the following structures:

Compound	Structure
148	
155	
166	

19. An herbicidal compound represented by the structure of formula **X(c)**:



X(c)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

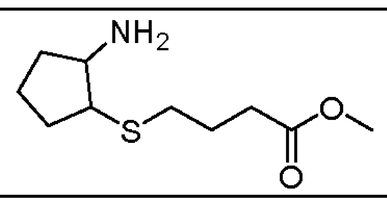
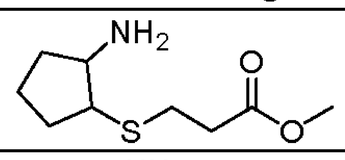
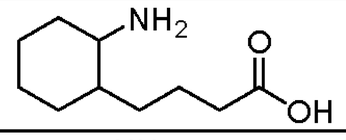
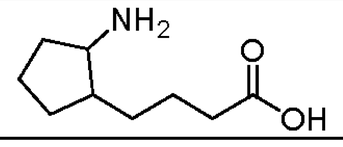
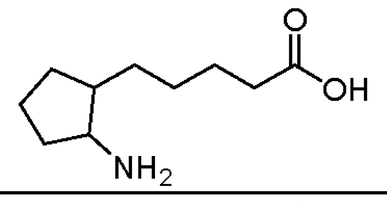
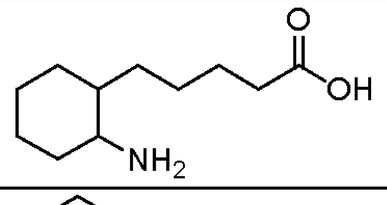
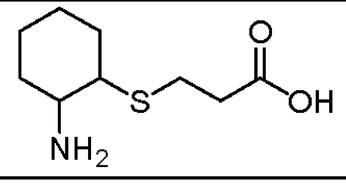
X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

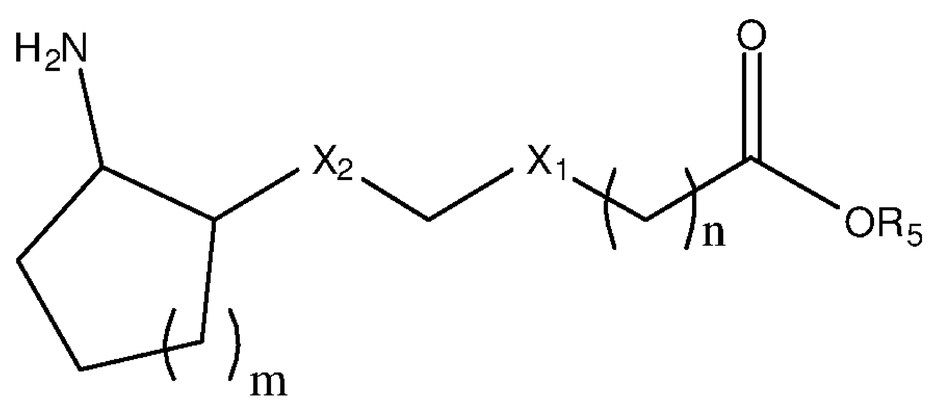
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

20. The compound of claim 19, represented by the following structures:

Compound	Structure
146	
147	
152	
153	
131	
132	
171	

21. A compound represented by the structure of formula **X(c)**:



X(c)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), C(=CH_2)-R_{10} (e.g., C(=CH_2)-C(O)-OCH_3, C(=CH_2)-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., C(O)(OCH_3)), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

X_1 is S, O, CH_2, CH(R) or $C(R)_2$;

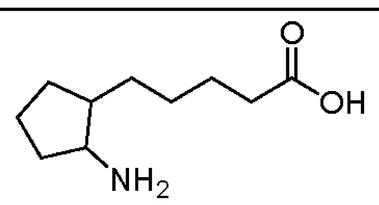
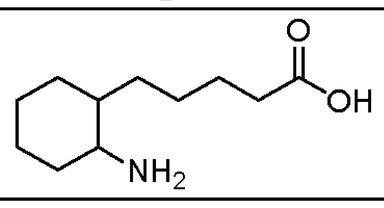
X_2 is O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 1 and 2;

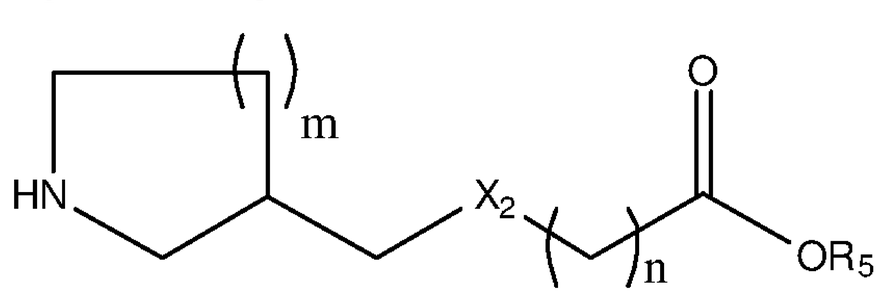
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

22. The compound of claim 21, represented by any one of the following structures:

Compound	Structure
131	
132	

23. An herbicidal compound represented by the structure of formula **X(d)**:



X(d)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$,

$CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-C(O)-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

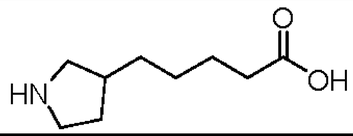
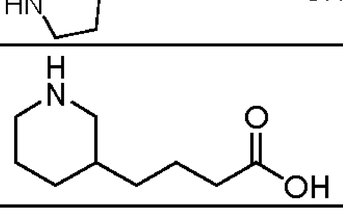
X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

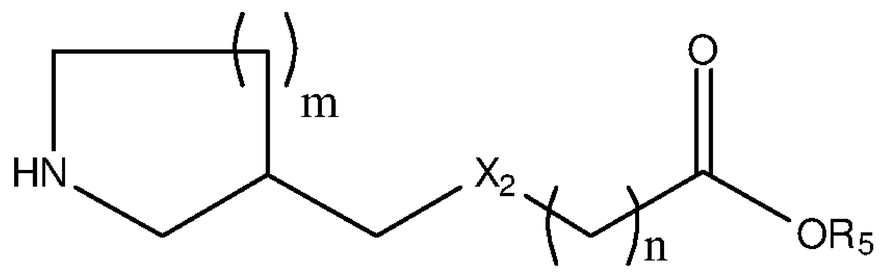
m is an integer number between 1 and 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

24. The compound of claim 23, represented by any one of the following structures:

Compound	Structure
123	
154	

25. A compound represented by the structure of formula **X(d)**:



X(d)

wherein

R_5 is H, C_1-C_5 linear or branched, substituted or unsubstituted alkyl (e.g., methyl, CH_2SH, ethyl, butyl, CH_2-CCH, iso-propyl, CH_2-C(O)-OCH_3), C_2-C_5 linear or branched, substituted or unsubstituted alkenyl, C_2-C_5 linear or branched, substituted or unsubstituted alkynyl (e.g., CCH, CH_2-CCH,), C_1-C_5 linear or branched haloalkyl (e.g., CF_3, CF_2CH_3, CH_2CF_3, $CF_2CH_2CH_3$, $CH_2CH_2CF_3$, $CF_2CH(CH_3)_2$,$CF(CH_3)$-$CH(CH_3)_2$), R_8-aryl (e.g., CH_2-Ph), $C(=CH_2)$-R_{10} (e.g., $C(=CH_2)$-C(O)-OCH_3, $C(=CH_2)$-CN), substituted or unsubstituted aryl (e.g., phenyl), substituted or unsubstituted heteroaryl (e.g., pyridine (2, 3, and 4-pyridine);

R_8 is $[CH_2]_p$

wherein **p** is between 1 and 10;

R_{10} is H, CN, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C(O)R (e.g., $C(O)(OCH_3)$), or $S(O)_2R$;

R is H, C_1-C_5 linear or branched alkyl (e.g., methyl, ethyl), C_1-C_5 linear or branched alkoxy (e.g., methoxy), phenyl, aryl or heteroaryl, or two gem R substituents are joined together to form a 5 or 6 membered heterocyclic ring;

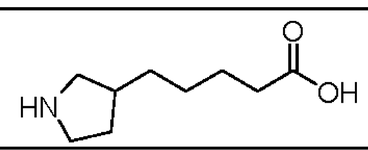
X_2 is S, O, CH_2, CH(R) or $C(R)_2$;

n is an integer number between 0 and 2;

m is 1 or 3;

or its agrochemically acceptable salt, stereoisomer, tautomer, hydrate, *N*-oxide, reverse amide analog, isotopic variant (e.g., deuterated analog), or any combination thereof.

26. The compound of claim 25, represented by the following structure:

Compound	Structure
123	

27. The compound of any one of claims 10-26, wherein the compound is a substantially pure single stereoisomer.

28. The compound of any one of claims 1-27, wherein the substantial pure stereoisomer has a purity higher than 90%, preferably higher than 95%, most preferably higher than 98%.

29. The compound of any one of claims 1-28, for use in controlling the growth of an undesired plant.

30. The compound of claim 29, wherein the plant is a eudicot (dicot) or a monocotyledon (monocot).

31. The compound of claim 29 or 30, wherein said plant is a weed.

32. The compound of claim 31, wherein said weed comprises: *Abutilon theophrasti* , *Amaranthus palmeri*, *Ambrosia artemisiifolia* , *Alopecurus myosuroides* , *Avena sterilis* , *Chenopodium album* , *Conyza Canadensis* , *Digitaria sanguinalis* , *Echinochloa colona*, *Euphorbia heterophylla* , *Lolium perenne* , *Lolium rigidum* , *Matricaria chamomilla* , *Phalaris paradoxa* , *Poa annua* , *Portulaca oleracea* , *Setaria viridis*, *Solanum nigrum* or any combination thereof.

33. The compound of claim 30, wherein the dicot plant is *Arabidopsis thaliana,* and/or the monocot plant is *Dactyloctenium aegyptium* or *Eragrostis teff.*

34. The compound of any one of claims 29-33, for use in pre-plant treatments, pre-emergence treatments, post-emergence treatments, or any combination thereof.