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(54) Title: COMPOSITIONS COMPRISING PYRIDINE CARBOXYLATE HERBICIDES AND ACETYL COA CARBOXYLASE (ACCASE) INHIBITOR HERBICIDES

(57) Abstract: Disclosed herein are compositions comprising (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) an ACCase inhibitor herbicide. Also disclosed herein are methods of controlling undesirable vegetation, comprising applying to vegetation or an area adjacent the vegetation or applying in soil or water to control the emergence or growth of vegetation (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof, and (b) a ACCase inhibitor herbicide.



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**COMPOSITIONS COMPRISING PYRIDINE CARBOXYLATE
HERBICIDES AND ACETYL COA CARBOXYLASE (ACCASE)
INHIBITOR HERBICIDES**

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority of U.S. Provisional Application No. 62/756,716, filed November 7, 2018, which is incorporated by reference herein in its entirety.

FIELD

[0002] The present disclosure includes compositions comprising (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) an acetyl CoA carboxylase (ACCCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof. The present disclosure also includes methods of controlling undesirable vegetation using the same.

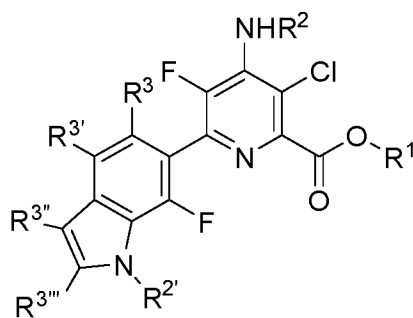
BACKGROUND

[0003] Many recurring problems in agriculture involve controlling the growth of undesirable vegetation that can, for instance, negatively affect the growth of desirable vegetation. To help control undesirable vegetation, researchers have produced a variety of chemicals and chemical formulations effective in controlling such unwanted growth. However, there exists a need for new herbicide compositions and methods to control the growth of undesirable vegetation with desired crops.

SUMMARY

[0004] Disclosed herein are compositions that may be used as herbicides, for example, in crops. The compositions may contain (a) a pyridine carboxylate herbicide or agriculturally acceptable N-oxide, salt, or ester thereof and (b) an acetyl CoA carboxylase (ACCCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof. The weight ratio of (a) to (b) can be from 1:3000 to 150:1 (*e.g.*, from 1:2000 to 75:1, from 1:1000 to 25:1, from 1:30 to 10:1, from 1:24 to 8:1, from 1:12 to 6:1, or from 1:5 to 5:1).

[0005] In some aspects, the composition comprises (a) a pyridine carboxylate herbicide defined by Formula (I):



Formula I

wherein:

R¹ is cyanomethyl or propargyl;

R² and R^{2'} are independently hydrogen, C₁-C₆ alkyl, formyl, alkoxy carbonyl, or acyl;

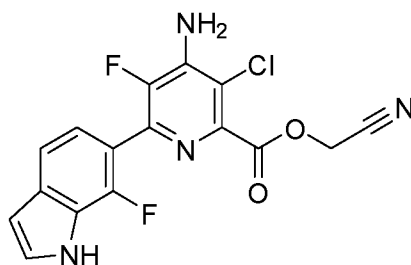
R³, R^{3'}, R^{3''}, and R^{3'''} are independently hydrogen, halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₃ alkoxy, or C₁-C₃ haloalkoxy;

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0006] In some aspects, the composition comprises:

(a) the pyridine carboxylate herbicide compound cyanomethyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate, referred to hereinafter as Compound A:



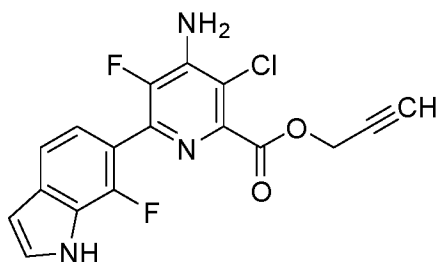
Compound A

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0007] In some aspects, the composition comprises:

(a) the pyridine carboxylate herbicide compound propargyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate, referred to hereinafter as Compound B:



Compound B

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0008] In some aspects, (b) can comprise an aryloxyphenoxypropionate herbicide. In some aspects, (b) can include clodinafop, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop, propaquizafop, quizalofop, agriculturally acceptable salts or esters thereof, or combinations thereof.

[0009] In some aspects, (b) can comprise a cyclohexanedione herbicide. In some aspects, (b) can include alloxydim, butoxydim, clethodim, cloproxydim, cycloxydim, profoxydim, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts or esters thereof, or combinations thereof.

[0010] In some aspects, (b) can comprise a phenylpyrazoline herbicide. In some aspects, (b) can include pinoxaden, or agriculturally acceptable salts or esters thereof.

[0011] In some aspects, the composition comprises a mixture of the pyridine carboxylate herbicide (a) and the ACCase inhibitor herbicide (b). In some aspects, the composition comprises a mixture of the pyridine carboxylate herbicide (a) and one or more ACCase inhibitor herbicides (b). In some aspects, the composition comprises a mixture of one or more pyridine carboxylate herbicides (a) and one or more ACCase inhibitor herbicides (b). In some aspects, (b) is alloxydim, butoxydim, clethodim, clodinafop, cloproxydim, cycloxydim, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts or esters thereof, or combinations thereof.

[0012] In some aspects, the composition can further comprise an agriculturally acceptable adjuvant or carrier, a herbicidal safener, an additional pesticide, or combinations thereof. In some

aspects, the only active ingredients in the composition are (a) and (b). In some aspects, the composition can be provided as a herbicidal concentrate.

[0013] Also disclosed herein are methods of controlling undesirable vegetation, comprising applying to vegetation, to an area adjacent the vegetation, or to soil or water to control the emergence or growth of vegetation, a composition comprising: (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof. In some aspects, (a) and (b) are applied simultaneously. In some aspects, (a) and (b) are applied sequentially. In some aspects, (a) and (b) are applied pre-emergence of the undesirable vegetation. In some aspects, (a) and (b) are applied post-emergence of the undesirable vegetation. In some aspects, the undesirable vegetation is in cereals. In some aspects, the undesirable vegetation is in maize, wheat, barley, rice, sorghum, millet, or oats. In some aspects, the undesirable vegetation is in broadleaf crops. In some aspects, the undesirable vegetation is in canola, flax, sunflower, soy, or cotton.

[0014] In some aspects, the pyridine carboxylate herbicide (a) can be applied in an amount of from 0.1 gram acid equivalent per hectare (g ae/ha) to 300 g ae/ha (*e.g.*, from 30 g ae/ha to 40 g ae/ha). In some aspects, the ACCase inhibitor herbicide (b) can be applied in an amount of from 2 g ai/ha to 1500 g ai/ha (*e.g.*, from 50 g ai/ha to 200 g ai/ha). In some aspects, (a) and (b) can be applied in a weight ratio of from 1:3000 to 150:1 (*e.g.*, from 1:2000 to 75:1, from 1:1000 to 25:1, from 1:30 to 10:1, from 1:24 to 8:1, from 1:12 to 6:1, or from 1:5 to 5:1).

[0015] The description below sets forth details of one or more aspect of the present disclosure. Other features, objects, and advantages will be apparent from the description and from the claims.

DETAILED DESCRIPTION

[0016] The present disclosure includes compositions comprising: (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof. The present disclosure also includes methods for controlling undesirable vegetation. In some aspects, the undesirable vegetation is in cereals. In some aspects, the undesirable vegetation is in maize, wheat, barley, rice, sorghum, millet, or oats. In some aspects, the undesirable vegetation is in broadleaf crops. In some aspects, the undesirable vegetation is in canola, flax, sunflower, soy, or cotton.

I. Definitions

[0017] Terms used herein will have their customary meaning in the art unless specified otherwise. The singular forms "a" and "the" include plural references unless stated otherwise. To the extent that the term "or" is employed (*e.g.*, A or B) it is intended to mean "A or B or both." If this disclosure intends to indicate "only A or B but not both" then the term "only A or B but not both" will be employed. Thus, use of the term "or" herein is the inclusive and not the exclusive use.

[0018] The chemical moieties mentioned when defining variable positions within the general formulae described herein (*e.g.*, the term "alkyl") are collective terms for the individual substituents encompassed by the chemical moiety. The prefix C_n-C_m preceding a group or moiety indicates, in each case, the possible number of carbon atoms in the group or moiety that follows.

[0019] As used herein, the terms "herbicide" and "herbicidal active ingredient" may be understood to include an active ingredient that kills, controls, or otherwise adversely modifies the growth of vegetation, particularly undesirable vegetation such as weed species, when applied in an appropriate amount.

[0020] As used herein, the term "herbicidal effect" may be understood to include an adversely modifying effect of an active ingredient on vegetation, including, for example, a deviation from natural growth or development, killing, regulation, desiccation, growth inhibition, growth reduction, and retardation. The term "herbicidal activity" refers generally to herbicidal effects of an active ingredient. As used herein, the term "prevents" or similar terms such as "preventing" may be understood by a person of ordinary skill to include any combination that shows herbicidal effect or reduces the competitive capability of the weed with respect to a crop.

[0021] As used herein, "applying" a herbicide or herbicidal composition refers to delivering it directly to the targeted vegetation or to the locus thereof or to the area where control of undesirable vegetation is desired. Methods of application include, but are not limited to, pre-emergently contacting soil or water, post-emergently contacting the undesirable vegetation, or contacting the area adjacent to the undesirable vegetation.

[0022] As used herein, the term "vegetation" can include, for instance, dormant seeds, germinating seeds, emerging seedlings, plants propagating from vegetative propagules, immature vegetation, and established vegetation.

[0023] As used herein, the term "crop" refers to desired vegetation, for instance, plants that are grown to provide food, shelter, pasture, erosion control, etc. Example crops include cereals,

legumes, vegetables, orchard and timber trees, grapevines, etc. Preferably, herbicides or herbicidal compositions have zero or minimal herbicidal effect on crops.

[0024] As used herein, the term "undesirable vegetation" refers to vegetation that is not wanted in a given area, for instance, weed species. Herbicides or herbicidal compositions are used to control undesirable vegetation. Preferably, herbicides or herbicidal compositions have a large or complete herbicidal effect on undesirable vegetation.

[0025] As used herein, "active ingredient" or "ai" may be understood to include a chemical compound or composition that has an effect on vegetation, for example, a herbicidal effect or a safening effect on the vegetation.

[0026] As used herein, "acid equivalent" or "ae" may be understood to include the amount of the acid form of an active ingredient that is calculated from the amount of a salt or ester form of that active ingredient. For example, if the acid form of an active ingredient "Z" has a molecular weight of 100 Dalton, and the salt form of Z has a molecular weight of 130 Dalton, an application of 130 g ai/ha of the Z salt would be equal to applying 100 g ae/ha of the acid form of Z:

$$130 \text{ g ai/ha } Z \text{ salt} * (100 \text{ Da } Z \text{ acid} / 130 \text{ Da } Z \text{ salt}) = 100 \text{ g ae/ha } Z \text{ acid.}$$

[0027] As used herein, unless otherwise specified, the term "acyl" may be understood to include a group of formula $-C(O)R$, where "C(O)" is short-hand notation for $C=O$. In the acyl group, the R may be alkyl (e.g., C₁-C₆ alkyl), haloalkyl (e.g., C₁-C₆ haloalkyl), alkenyl (e.g., C₂-C₆ alkenyl), haloalkenyl (e.g., C₂-C₆ haloalkenyl), alkynyl (e.g., C₂-C₆ alkynyl), aryl or heteroaryl, or arylalkyl (e.g., C₇-C₁₀ arylalkyl).

[0028] As used herein, the term "alkyl" may be understood to include straight-chained, branched, or cyclic saturated hydrocarbon moieties. Unless otherwise specified, C₁-C₂₀ (e.g., C₁-C₁₂, C₁-C₁₀, C₁-C₈, C₁-C₆, or C₁-C₄) alkyl groups are intended. Examples of alkyl groups include methyl, ethyl, propyl, cyclopropyl, 1-methyl-ethyl, butyl, cyclobutyl, 1-methyl-propyl, 2-methyl-propyl, 1,1-dimethyl-ethyl, pentyl, cyclopentyl, 1-methyl-butyl, 2-methyl-butyl, 3-methyl-butyl, 2,2-dimethyl-propyl, 1-ethyl-propyl, hexyl, cyclohexyl, 1,1-dimethyl-propyl, 1,2-dimethyl-propyl, 1-methyl-pentyl, 2-methyl-pentyl, 3-methyl-pentyl, 4-methyl-pentyl, 1,1-dimethyl-butyl, 1,2-dimethyl-butyl, 1,3-dimethyl-butyl, 2,2-dimethyl-butyl, 2,3-dimethyl-butyl, 3,3-dimethyl-butyl, 1-ethyl-butyl, 2-ethyl-butyl, 1,1,2-trimethyl-propyl, 1,2,2-trimethyl-propyl, 1-ethyl-1-methyl-propyl, and 1-ethyl-2-methyl-propyl. Alkyl substituents may also be substituted with one or more chemical moieties. Examples of suitable substituents include, for example, hydroxy, nitro, cyano, formyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ acyl, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₁-C₆

alkoxycarbonyl, C₁-C₆ haloalkoxycarbonyl, C₁-C₆ carbamoyl, C₁-C₆ halocarbamoyl, hydroxycarbonyl, C₁-C₆ alkylcarbonyl, C₁-C₆ haloalkylcarbonyl, aminocarbonyl, C₁-C₆ alkylaminocarbonyl, haloalkylaminocarbonyl, C₁-C₆ dialkylaminocarbonyl, and C₁-C₆ dihaloalkylaminocarbonyl, provided that the substituents are sterically compatible and the rules of chemical bonding and strain energy are satisfied. Preferred substituents include cyano and C₁-C₆ alkoxy.

[0029] As used herein, the term “haloalkyl” may be understood to include alkyl groups wherein the hydrogen atoms may partially or entirely be substituted with halogen atoms. Unless otherwise specified, C₁-C₂₀ (e.g., C₁-C₁₂, C₁-C₁₀, C₁-C₈, C₁-C₆, or C₁-C₄) alkyl groups are intended. Examples include chloromethyl, bromomethyl, dichloromethyl, trichloromethyl, fluoromethyl, difluoromethyl, trifluoromethyl, chlorofluoromethyl, dichlorofluoromethyl, chlorodifluoromethyl, 1-chloroethyl, 1-bromoethyl, 1-fluoroethyl, 2-fluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, 2-chloro-2-fluoroethyl, 2-chloro-2,2-difluoroethyl, 2,2-dichloro-2-fluoroethyl, 2,2,2-trichloroethyl, pentafluoroethyl, and 1,1,1-trifluoroprop-2-yl. Haloalkyl substituents may also be substituted with one or more chemical moieties. Examples of suitable substituents include, for example, hydroxy, nitro, cyano, formyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ acyl, C₁-C₆ alkylthio, C₁-C₆ haloalkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ haloalkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ haloalkylsulfonyl, C₁-C₆ alkoxycarbonyl, C₁-C₆ haloalkoxycarbonyl, C₁-C₆ carbamoyl, C₁-C₆ halocarbamoyl, hydroxycarbonyl, C₁-C₆ alkylcarbonyl, C₁-C₆ haloalkylcarbonyl, aminocarbonyl, C₁-C₆ alkylaminocarbonyl, haloalkylaminocarbonyl, C₁-C₆ dialkylaminocarbonyl, and C₁-C₆ dihaloalkylaminocarbonyl, provided that the substituents are sterically compatible and the rules of chemical bonding and strain energy are satisfied. Preferred substituents include cyano and C₁-C₆ alkoxy.

[0030] As used herein, the term “alkoxy” may be understood to include a group of the formula R-O-, where R is unsubstituted or substituted alkyl as defined above. Unless otherwise specified, alkoxy groups wherein R is a C₁-C₂₀ (e.g., C₁-C₁₂, C₁-C₁₀, C₁-C₈, C₁-C₆, or C₁-C₄) alkyl group are intended. Examples include methoxy, ethoxy, propoxy, 1-methyl-ethoxy, butoxy, 1-methyl-propoxy, 2-methyl-propoxy, 1,1-dimethyl-ethoxy, pentoxy, 1-methyl-butyloxy, 2-methyl-butoxy, 3-methyl-butoxy, 2,2-dimethyl-propoxy, 1-ethyl-propoxy, hexoxy, 1,1-dimethyl-propoxy, 1,2-dimethyl-propoxy, 1-methyl-pentoxy, 2-methyl-pentoxy, 3-methyl-pentoxy, 4-methyl-pentoxy, 1,1-dimethyl-butoxy, 1,2-dimethyl-butoxy, 1,3-dimethyl-butoxy, 2,2-dimethyl-butoxy, 2,3-dimethyl-butoxy, 3,3-dimethyl-butoxy, 1-ethyl-butoxy, 2-ethylbutoxy, 1,1,2-trimethyl-propoxy, 1,2,2-trimethyl-propoxy, 1-ethyl-1-methyl-propoxy, and 1-ethyl-2-methyl-propoxy.

[0031] As used herein, the term "alkoxycarbonyl" may be understood to include a group of the formula $-C(O)OR$, where R is an unsubstituted or substituted alkyl as defined above. Unless otherwise specified, alkoxycarbonyl groups wherein R is a C_1 - C_{20} (e.g., C_1 - C_{12} , C_1 - C_{10} , C_1 - C_8 , C_1 - C_6 , or C_1 - C_4) alkyl group are intended. Examples include methoxycarbonyl, ethoxycarbonyl, propoxycarbonyl, 1-methyl-ethoxycarbonyl, butoxycarbonyl, 1-methyl-propoxycarbonyl, 2-methyl-propoxycarbonyl, 1,1-dimethyl-ethoxycarbonyl, pentoxycarbonyl, 1-methyl-butoxycarbonyl, 2-methyl-butoxycarbonyl, 3-methyl-butoxycarbonyl, 2,2-dimethyl-propoxycarbonyl, 1-ethyl-propoxycarbonyl, hexoxycarbonyl, 1,1-dimethyl-propoxycarbonyl, 1,2-dimethyl-propoxycarbonyl, 1-methyl-pentoxycarbonyl, 2-methyl-pentoxycarbonyl, 3-methyl-pentoxycarbonyl, 4-methyl-pentoxycarbonyl, 1,1-dimethyl-butoxycarbonyl, 1,2-dimethyl-butoxycarbonyl, 1,3-dimethyl-butoxycarbonyl, 2,2-dimethyl-butoxycarbonyl, 2,3-dimethyl-butoxycarbonyl, 3,3-dimethyl-butoxycarbonyl, 1-ethyl-butoxycarbonyl, 2-ethylbutoxycarbonyl, 1,1,2-trimethyl-propoxycarbonyl, 1,2,2-trimethyl-propoxycarbonyl, 1-ethyl-1-methyl-propoxycarbonyl, and 1-ethyl-2-methyl-propoxycarbonyl.

[0032] As used herein, the term "haloalkoxy" may be understood to include a group of the formula $R-O-$, where R is unsubstituted or substituted haloalkyl as defined above. Unless otherwise specified, haloalkoxy groups wherein R is a C_1 - C_{20} (e.g., C_1 - C_{12} , C_1 - C_{10} , C_1 - C_8 , C_1 - C_6 , or C_1 - C_4) alkyl group are intended. Examples include chloromethoxy, bromomethoxy, dichloromethoxy, trichloromethoxy, fluoromethoxy, difluoromethoxy, trifluoromethoxy, chlorofluoromethoxy, dichlorofluoromethoxy, chlorodifluoromethoxy, 1-chloroethoxy, 1-bromoethoxy, 1-fluoroethoxy, 2-fluoroethoxy, 2,2-difluoroethoxy, 2,2,2-trifluoroethoxy, 2-chloro-2-fluoroethoxy, 2-chloro-2,2-difluoroethoxy, 2,2-dichloro-2-fluoroethoxy, 2,2,2-trichloroethoxy, pentafluoroethoxy, and 1,1,1-trifluoroprop-2-oxy.

[0033] As used herein, the term "aryl," as well as derivative terms such as aryloxy, may be understood to include groups that include a monovalent aromatic carbocyclic group of from 6 to 14 carbon atoms. Aryl groups can include a single ring or multiple condensed rings. In some aspects, aryl groups include C_6 - C_{10} aryl groups. Examples of aryl groups include, but are not limited to, phenyl, biphenyl, naphthyl, tetrahydronaphthyl, phenylcyclopropyl, and indanyl. In some aspects, the aryl group can be a phenyl, indanyl or naphthyl group.

[0034] As used herein, the term "heteroaryl," as well as derivative terms such as "heteroaryloxy," may be understood to include a 5- or 6-membered aromatic ring containing one or more heteroatoms, for example, N, O or S. Heteroaryl rings may be fused to other aromatic systems. The aryl or heteroaryl substituents may also be substituted with one or more chemical

moieties. Examples of suitable substituents include, for example, hydroxy, nitro, cyano, formyl, C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₁-C₆ alkoxy, C₁-C₆ haloalkyl, C₁-C₆ haloalkoxy, C₁-C₆ acyl, C₁-C₆ alkylthio, C₁-C₆ alkylsulfinyl, C₁-C₆ alkylsulfonyl, C₁-C₆ alkoxy carbonyl, C₁-C₆ carbamoyl, hydroxycarbonyl, C₁-C₆ alkyl carbonyl, aminocarbonyl, C₁-C₆ alkylaminocarbonyl, C₁-C₆ dialkylaminocarbonyl, provided that the substituents are sterically compatible and the rules of chemical bonding and strain energy are satisfied. Preferred substituents include halogen, C₁-C₄ alkyl and C₁-C₄ haloalkyl.

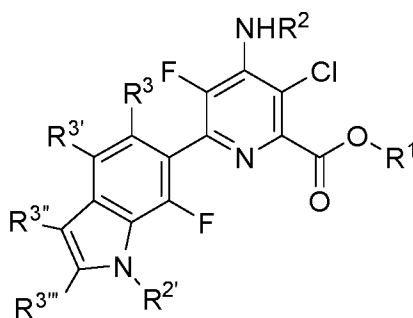
[0035] As used herein, the term “halogen,” including derivative terms such as “halo,” refers to fluorine, chlorine, bromine and iodine.

[0036] As used herein, agriculturally acceptable salts and esters may be understood to include salts and esters that exhibit herbicidal activity, or that are or can be converted in plants, water, or soil to the referenced herbicide. Exemplary agriculturally acceptable esters are those that are or can be hydrolyzed, oxidized, metabolized, or otherwise converted, *e.g.*, in plants, water, or soil, to the corresponding carboxylic acid which, depending on the pH, may be in the dissociated or undissociated form.

[0037] Compounds described herein can include N-oxides. Pyridine N-oxides can be obtained by oxidation of the corresponding pyridines. Suitable oxidation methods are described, for example, in Houben-Weyl, *Methoden der organischen Chemie [Methods in organic chemistry]*, expanded and subsequent volumes to the 4th edition, volume E 7b, p. 565 f.

II. Pyridine carboxylate Herbicides

[0038] Compositions and methods of the present disclosure include a composition comprising (a) a pyridine carboxylate herbicide defined by Formula (I):



Formula I

wherein:

R¹ is cyanomethyl or propargyl;

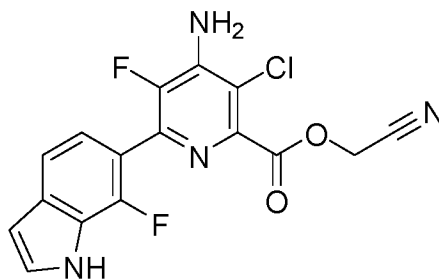
R^2 and $R^{2'}$ are independently hydrogen, C_1 - C_6 alkyl, formyl, alkoxy carbonyl, or acyl;

R^3 , $R^{3'}$, $R^{3''}$, and $R^{3'''}$ are independently hydrogen, halogen, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_3 alkoxy, or C_1 - C_3 haloalkoxy;

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0039] In some aspects, compositions and methods of the present disclosure include the composition comprising: (a) the pyridine carboxylate herbicide cyanomethyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate, Compound A:

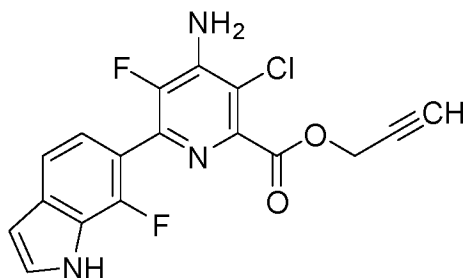


Compound A

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0040] In some aspects, compositions and methods of the present disclosure include the composition comprising: (a) the pyridine carboxylate herbicide propargyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate, Compound B:



Compound B

or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0041] Pyridine carboxylate herbicides defined by Formula (I), as well as methods of making these pyridine carboxylate herbicides, are disclosed in application PCT/US2018/031004, filed May 4, 2018, the entire disclosure of which is hereby expressly incorporated by reference.

[0042] In some aspects, the pyridine carboxylate herbicide can be provided as an agriculturally acceptable salt. Exemplary agriculturally acceptable salts of the pyridine carboxylate herbicides include, but are not limited to: sodium salts; potassium salts; ammonium salts or substituted ammonium salts, in particular mono-, di- and tri-C₁-C₈-alkylammonium salts such as methyl ammonium, dimethylammonium and isopropylammonium; mono-, di- and tri-hydroxy-C₂-C₈-alkylammonium salts such as hydroxyethylammonium, di(hydroxyethyl)ammonium, tri(hydroxyethyl)ammonium, hydroxypropylammonium, di(hydroxypropyl)ammonium and tri(hydroxypropyl)- ammonium salts; olamine salts; diglycolamine salts; choline salts; and quaternary ammonium salts such as those represented by the formula R⁹R¹⁰R¹¹R¹²N⁺ and wherein R⁹, R¹⁰, R¹¹ and R¹² (*e.g.*, R⁹-R¹²) each independently can represent hydrogen, C₁-C₁₀ alkyl, C₂-C₈ alkenyl, C₂-C₈ alkynyl, C₁-C₈ alkoxy, C₁-C₈ alkylthio, or aryl groups, provided that R⁹-R¹² are sterically compatible.

[0043] In some aspects, the pyridine carboxylate herbicide can be provided as an agriculturally acceptable ester. Exemplary agriculturally acceptable esters of the pyridine carboxylate herbicides include, but are not limited to: methyl, ethyl, propyl, 1-methyl-ethyl, butyl, 1-methyl-propyl, 2-methyl-propyl, pentyl, 1-methyl-butyl, 2-methyl-butyl, 3-methyl-butyl, 1-ethyl-propyl, hexyl, 1-methyl-hexyl (mexyl), 2-ethylhexyl, heptyl, 1-methyl-heptyl (meptyl), octyl, isooctyl (isooctyl), butoxyethyl (butotyl), and benzyl.

[0044] The pyridine carboxylate herbicide, or an agriculturally acceptable N-oxide, salt, or ester thereof, can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, the pyridine carboxylate herbicide, or an agriculturally acceptable N-oxide, salt, or ester thereof, is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 0.1 grams acid equivalent per hectare (g ae/ha) or greater, such as 0.2 g ae/ha or greater, 0.3 g ae/ha or greater, 0.4 g ae/ha or greater, 0.5 g ae/ha or greater, 0.6 g ae/ha or greater, 0.7 g ae/ha or greater, 0.8 g ae/ha or greater, 0.9 g ae/ha or greater, 1 g ae/ha or greater, 1.1 g ae/ha or greater, 1.2 g ae/ha or greater, 1.3 g ae/ha or greater, 1.4 g ae/ha or greater, 1.5 g ae/ha or greater, 1.6 g ae/ha or greater,

1.7 g ae/ha or greater, 1.8 g ae/ha or greater, 1.9 g ae/ha or greater, 2 g ae/ha or greater, 2.25 g ae/ha or greater, 2.5 g ae/ha or greater, 2.75 g ae/ha or greater, 3 g ae/ha or greater, 4 g ae/ha or greater, 5 g ae/ha or greater, 6 g ae/ha or greater, 7 g ae/ha or greater, 8 g ae/ha or greater, 9 g ae/ha or greater, 10 g ae/ha or greater, 11 g ae/ha or greater, 12 g ae/ha or greater, 13 g ae/ha or greater, 14 g ae/ha or greater, 15 g ae/ha or greater, 16 g ae/ha or greater, 17 g ae/ha or greater, 18 g ae/ha or greater, 19 g ae/ha or greater, 20 g ae/ha or greater, 22 g ae/ha or greater, 24 g ae/ha or greater, 25 g ae/ha or greater, 26 g ae/ha or greater, 28 g ae/ha or greater, 30 g ae/ha or greater, 32 g ae/ha or greater, 34 g ae/ha or greater, 35 g ae/ha or greater, 36 g ae/ha or greater, 38 g ae/ha or greater, 40 g ae/ha or greater, 42.5 g ae/ha or greater, 45 g ae/ha or greater, 47.5 g ae/ha or greater, 50 g ae/ha or greater, 52.5 g ae/ha or greater, 55 g ae/ha or greater, 57.5 g ae/ha or greater, 60 g ae/ha or greater, 65 g ae/ha or greater, 70 g ae/ha or greater, 75 g ae/ha or greater, 80 g ae/ha or greater, 85 g ae/ha or greater, 90 g ae/ha or greater, 95 g ae/ha or greater, 100 g ae/ha or greater, 110 g ae/ha or greater, 120 g ae/ha or greater, 130 g ae/ha or greater, 140 g ae/ha or greater, 150 g ae/ha or greater, 160 g ae/ha or greater, 170 g ae/ha or greater, 180 g ae/ha or greater, 190 g ae/ha or greater, 200 g ae/ha or greater, 210 g ae/ha or greater, 220 g ae/ha or greater, 230 g ae/ha or greater, 240 g ae/ha or greater, 250 g ae/ha or greater, 260 g ae/ha or greater, 270 g ae/ha or greater, 280 g ae/ha or greater, or 290 g ae/ha or greater; in an amount of 300 g ae/ha or less, such as 290 g ae/ha or less, 280 g ae/ha or less, 270 g ae/ha or less, 260 g ae/ha or less, 250 g ae/ha or less, 240 g ae/ha or less, 230 g ae/ha or less, 220 g ae/ha or less, 210 g ae/ha or less, 200 g ae/ha or less, 190 g ae/ha or less, 180 g ae/ha or less, 170 g ae/ha or less, 160 g ae/ha or less, 150 g ae/ha or less, 140 g ae/ha or less, 130 g ae/ha or less, 120 g ae/ha or less, 110 g ae/ha or less, 100 g ae/ha or less, 95 g ae/ha or less, 90 g ae/ha or less, 85 g ae/ha or less, 80 g ae/ha or less, 75 g ae/ha or less, 70 g ae/ha or less, 65 g ae/ha or less, 60 g ae/ha or less, 57.5 g ae/ha or less, 55 g ae/ha or less, 52.5 g ae/ha or less, 50 g ae/ha or less, 47.5 g ae/ha or less, 45 g ae/ha or less, 42.5 g ae/ha or less, 40 g ae/ha or less, 38 g ae/ha or less, 36 g ae/ha or less, 35 g ae/ha or less, 34 g ae/ha or less, 32 g ae/ha or less, 30 g ae/ha or less, 28 g ae/ha or less, 26 g ae/ha or less, 25 g ae/ha or less, 24 g ae/ha or less, 22 g ae/ha or less, 20 g ae/ha or less, 19 g ae/ha or less, 18 g ae/ha or less, 17 g ae/ha or less, 16 g ae/ha or less, 15 g ae/ha or less, 14 g ae/ha or less, 13 g ae/ha or less, 12 g ae/ha or less, 11 g ae/ha or less, 10 g ae/ha or less, 9 g ae/ha or less, 8 g ae/ha or less, 7 g ae/ha or less, 6 g ae/ha or less, 5 g ae/ha or less, 4 g ae/ha or less, 3 g ae/ha or less, 2.75 g ae/ha or less, 2.5 g ae/ha or less, 2.25 g ae/ha or less, 2 g ae/ha or less, 1.9 g ae/ha or less, 1.8 g ae/ha or less, 1.7 g ae/ha or less, 1.6 g ae/ha or less, 1.5 g ae/ha or less, 1.4 g ae/ha or less, 1.3 g ae/ha or less, 1.2 g ae/ha or less, 1.1 g ae/ha or less, 1 g ae/ha or less, 0.9 g ae/ha or less, 0.8 g ae/ha or less, 0.7 g ae/ha or less, 0.6 g ae/ha or less, 0.5 g ae/ha or less, 0.4 g ae/ha or less, 0.3 g ae/ha or less, or 0.2 g ae/ha or less; or in

an amount within any range defined between any pair of the preceding values, such as 0.1-300 g ae/ha, 1-150 g ae/ha, 10-200 g ae/ha, 25 g ae/ha-75 g ae/ha, or 40-100 g ae/ha.

III. ACCase Inhibitor Herbicides

[0045] In addition to the pyridine carboxylate herbicide or agriculturally acceptable N-oxide, salt or ester thereof, the compositions include an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof. ACCase inhibitor herbicides inhibit lipid biosynthesis in the plant. Examples of ACCase inhibitor herbicides include aryloxyphenoxypropionates, cyclohexanediones, and phenylpyrazolines. In some aspects, the ACCase inhibitor herbicide can include an aryloxyphenoxypropionate herbicide. In some aspects, the ACCase inhibitor herbicide can include a cyclohexanedione herbicide. In some aspects, the ACCase inhibitor herbicide can include a phenylpyrazoline herbicide.

[0046] In some aspects, the composition can include an ACCase inhibitor selected from the group of cyclohexanediones, aryloxyphenoxypropionates, phenylpyrazolines, or combinations thereof. In some cases, the composition can include clodinafop, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop, propaquizafop, quizalofop, agriculturally acceptable salts or esters thereof, or combinations thereof. In some cases, the composition can include, alloxydim, butoxydim, clethodim, cloproxydim, cycloxydim, profoxydim, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts or esters thereof, or combinations thereof. In some cases, the composition can include pinoxaden

[0047] In some aspects, the composition can include an ACCase inhibitor herbicide selected from the group consisting of alloxydim, butoxydim, clethodim, clodinafop, cloproxydim, cycloxydim, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts and esters thereof, and combinations thereof.

[0048] The ACCase inhibitor herbicide or agriculturally acceptable salt or ester thereof can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, the ACCase inhibitor herbicide or agriculturally acceptable salt or ester thereof is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 2 g ai/ha or more, such as 2.5 g ai/ha or more, 3 g ai/ha or more, 3.5 g ai/ha or more, 4 g ai/ha or more, 4.5 g ai/ha or more, 5 g ai/ha or more, 6 g ai/ha or more, 7 g ai/ha or more, 8 g ai/ha or more, 9 g ai/ha or more, 10 g ai/ha or more, 15 g ai/ha or more, 20 g ai/ha or more, 25 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or

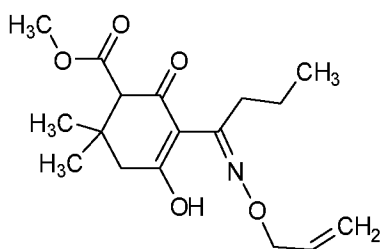
more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 250 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 350 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 450 g ai/ha or more, 500 g ai/ha or more, 550 g ai/ha or more, 600 g ai/ha or more, 650 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, 900 g ai/ha or more, 950 g ai/ha or more, 1000 g ai/ha or more, 1050 g ai/ha or more, 1100 g ai/ha or more, 1150 g ai/ha or more, 1200 g ai/ha or more, 1250 g ai/ha or more, 1300 g ai/ha or more, 1350 g ai/ha or more, 1400 g ai/ha or more, or 1450 g ai/ha or more; in an amount of 1500 g ai/ha or less, such as 1450 g ai/ha or less, 1400 g ai/ha or less, 1350 g ai/ha or less, 1300 g ai/ha or less, 1250 g ai/ha or less, 1240 g ai/ha or less, 1200 g ai/ha or less, 1150 g ai/ha or less, 1100 g ai/ha or less, 1050 g ai/ha or less, 1000 g ai/ha or less, 950 g ai/ha or less, 900 g ai/ha or less, 850 g ai/ha or less, 800 g ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 650 g ai/ha or less, 600 g ai/ha or less, 550 g ai/ha or less, 500 g ai/ha or less, 450 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 350 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 280 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 220 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 25 g ai/ha or less, 20 g ai/ha or less, 15 g ai/ha or less, 10 g ai/ha or less, 9 g ai/ha or less, 8 g ai/ha or less, 7 g ai/ha or less, 6 g ai/ha or less, 5 g ai/ha or less, 4.5 g ai/ha or less, 4 g ai/ha or less, 3.5 g ai/ha or less, 3 g ai/ha or less, or 2.5 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 2-1500 g ai/ha, 5-1300 g ai/ha, 6-250 g ai/ha, 75-1240 g ai/ha, 90-900 g ai/ha, 55-290 g ai/ha, 7-600 g ai/ha, 20-700 g ai/ha, 190-1450 g ai/ha, 65-1100 g ai/ha, 320-1000 g ai/ha, 250-750 g ai/ha, 700-1200 g ai/ha, 850-1400 g ai/ha, or 2.5-1450 g ai/ha.

[0049] In some aspects, the composition contains: (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof; and (b) alloxydim, butroxydim, clethodim, clodinafop, cloproxydim, cycloxydim, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop,

haloxyfop, metamifop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts and esters thereof, and combinations thereof.

Alloxydim

[0050] Compositions and methods of the present disclosure can include alloxydim or an agriculturally acceptable salt or ester thereof. Alloxydim, shown below, is a cyclohexanedione herbicide that provides post-emergence control of grass weeds and volunteer cereals in sugar beet, vegetables and broad-leaved crops. Alloxydim, as well as methods of preparing alloxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

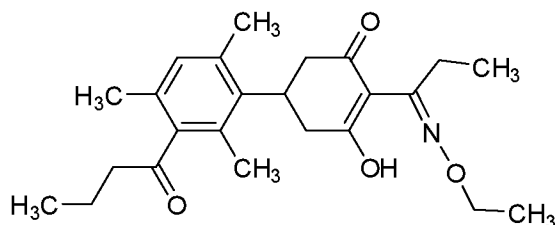


[0051] Alloxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, alloxydim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 299 g ai/ha or more, such as 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, 500 g ai/ha or more, 520 g ai/ha or more, 540 g ai/ha or more, 560 g ai/ha or more, 580 g ai/ha or more, 600 g ai/ha or more, 620 g ai/ha or more, 640 g ai/ha or more, 660 g ai/ha or more, 680 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, 900 g ai/ha or more, 950 g ai/ha or more, 1000 g ai/ha or more, 1050 g ai/ha or more, 1100 g ai/ha or more, 1200 g ai/ha or more, 1300 g ai/ha or more, 1400 g ai/ha or more, or 1500 g ai/ha or more; in an amount of 1501 g ai/ha or less, such as 1500 g ai/ha or less, 1400 g ai/ha or less, 1350 g ai/ha or less, 1300 g ai/ha or less, 1250 g ai/ha or less, 1200 g ai/ha or less, 1150 g ai/ha or less, 1100 g ai/ha or less, 1050 g ai/ha or less, 1000 g ai/ha or less, 950 g ai/ha or less, 900 g ai/ha or less, 850 g ai/ha or less, 800 g ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 680 g ai/ha or less, 660 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less,

420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, or 300 g ai/ha or less; or from any of the minimum values described above to any of the maximum values described above, such as 299–1501 g ai/ha, 380–1250 g ai/ha, 440–850 g ai/ha, 700–1000 g ai/ha, 320–950 g ai/ha, 680–1350 g ai/ha, 400–1050 g ai/ha, 500–1000 g ai/ha, 600–900 g ai/ha, 700–1300 g ai/ha, 500–700 g ai/ha, or 320–1400 g ai/ha.

Butoxydim

[0052] Compositions and methods of the present disclosure can include butoxydim or an agriculturally acceptable salt or ester thereof. Butoxydim, shown below, is a cyclohexanedione herbicide that provides post-emergence control of annual grasses in many broad-leaved crops. Butoxydim, as well as methods of preparing butoxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

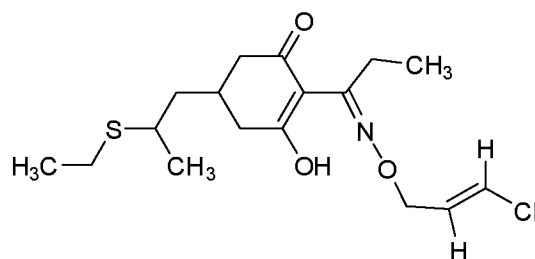


[0053] Butoxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, butoxydim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 9 g ai/ha or more, such as 10 g ai/ha or more, 15 g ai/ha or more, 20 g ai/ha or more, 25 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 105 g ai/ha or more, 110 g ai/ha or more, 115 g ai/ha or more, or 120 g ai/ha or more; in an amount of 121 g ai/ha or less, such as 120 g ai/ha or less, 115 g ai/ha or less, 110 g ai/ha or less, 105 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 25 g ai/ha or less, 20 g ai/ha or less, 15 g ai/ha or less, or 10 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 9–121 g ai/ha, 10–115 g ai/ha, 20–110 g ai/ha, 15–85 g ai/ha, 30–100 g

ai/ha, 50–95 g ai/ha, 15–60 g ai/ha, 25–85 g ai/ha, 40–80 g ai/ha, 20–75 g ai/ha, 35–110 g ai/ha, 25–105 g ai/ha, 15–55 g ai/ha, or 10–120 g ai/ha.

Clethodim

[0054] Compositions and methods of the present disclosure can include clethodim or an agriculturally acceptable salt or ester thereof. Clethodim, shown below, is a cyclohexanedione herbicide that provides post-emergence control of annual and perennial grasses in a wide range of broad-leaved crops, including such field crops as canola/oilseed rape, soybean, cotton, flax, sunflowers, alfalfa, peanuts, sugar beet, tobacco, and potatoes, as well as vegetable crops, trees, and vines. Clethodim, as well as methods of preparing clethodim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

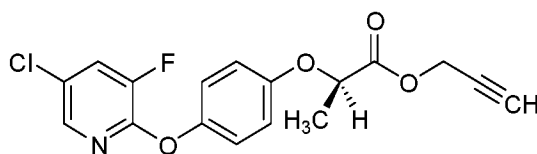


[0055] Clethodim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, clethodim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 2 g ai/ha or more, such as 3 g ai/ha or more, 4 g ai/ha or more, 6 g ai/ha or more, 8 g ai/ha or more, 10 g ai/ha or more, 12 g ai/ha or more, 14 g ai/ha or more, 16 g ai/ha or more, 18 g ai/ha or more, 20 g ai/ha or more, 22 g ai/ha or more, 24 g ai/ha or more, 26 g ai/ha or more, 28 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 60 g ai/ha or more, 70 g ai/ha or more, 80 g ai/ha or more, 90 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, 500 g ai/ha or more, 520 g ai/ha or more, 540 g ai/ha or more, 560 g ai/ha or more, 580 g ai/ha or more, 600 g ai/ha or more, 620 g ai/ha or more, 640 g ai/ha or more, 660 g ai/ha or more, 680 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, or 875 g ai/ha or more; in an amount of 900 g ai/ha or less, such as 875

g ai/ha or less, 850 g ai/ha or less, 800 g ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 680 g ai/ha or less, 660 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 235 g ai/ha or less, 230 g ai/ha or less, 225 g ai/ha or less, 220 g ai/ha or less, 215 g ai/ha or less, 210 g ai/ha or less, 205 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 90 g ai/ha or less, 80 g ai/ha or less, 70 g ai/ha or less, 60 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 28 g ai/ha or less, 26 g ai/ha or less, 24 g ai/ha or less, 22 g ai/ha or less, 20 g ai/ha or less, 18 g ai/ha or less, 16 g ai/ha or less, 14 g ai/ha or less, 12 g ai/ha or less, 10 g ai/ha or less, 8 g ai/ha or less, 6 g ai/ha or less, 4 g ai/ha or less, or 3 g ai/ha or less, or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 2–900 g ai/ha, 3–800 g ai/ha, 6–700 g ai/ha, 22–500 g ai/ha, 12–600 g ai/ha, 5–500 g ai/ha, 40–440 g ai/ha, 20–700 g ai/ha, 80–400 g ai/ha, 60–270 g ai/ha, 80–750 g ai/ha, 100–290 g ai/ha, 175–750 g ai/ha, 300–900 g ai/ha, 3–100 g ai/ha, 35–320 g ai/ha, 3–205 g ai/ha, 4–50 g ai/ha, or 3–875 g ai/ha.

Clodinafop

[0056] Compositions and methods of the present disclosure can include clodinafop or an agriculturally acceptable salt or ester thereof. Clodinafop-propargyl, shown below, is prop-2-ynyl (*R*)-2-[4-(5-chloro-3-fluoropyridin-2-yloxy)phenoxy]propionate and is used for post-emergence control of annual grasses, including *Avena*, *Lolium*, *Setaria*, *Phalaris*, and *Alopecurus* spp., in cereals.

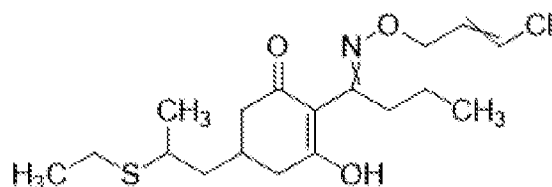


[0057] Clodinafop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, clodinafop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an

amount of 10 g ai/ha or more, such as 11 g ai/ha or more, 12 g ai/ha or more, 13 g ai/ha or more, 14 g ai/ha or more, 15 g ai/ha or more, 20 g ai/ha or more, 25 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, or 95 g ai/ha or more; in an amount of 100 g ai/ha or less, such as 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 25 g ai/ha or less, 20 g ai/ha or less, 15 g ai/ha or less, 14 g ai/ha or less, 13 g ai/ha or less, 12 g ai/ha or less, or 11 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 10–100 g ai/ha, 15–90 g ai/ha, 12–80 g ai/ha, 25–70 g ai/ha, 14–40 g ai/ha, 20–85 g ai/ha, 30–60 g ai/ha, 40–90 g ai/ha, 50–100 g ai/ha, 20–90 g ai/ha, 50–95 g ai/ha, 30–90 g ai/ha, 20–60 g ai/ha, 30–80 g ai/ha, 13–75 g ai/ha, or 11–95 g ai/ha.

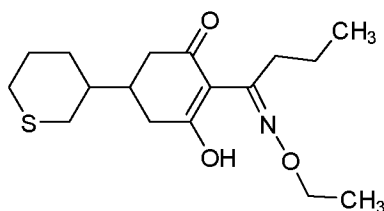
Cloproxydim

[0058] Compositions and methods of the present disclosure can include cloproxydim or an agriculturally acceptable salt or ester thereof. Cloproxydim, shown below, is a cyclohexanedione herbicide that has been evaluated by the Chevron Chemical Company. Cloproxydim provides post-emergence control of a wide range of annual and perennial grasses in beans, cotton, potatoes, sugar beets, and most vegetable crops. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.



Cycloxydim

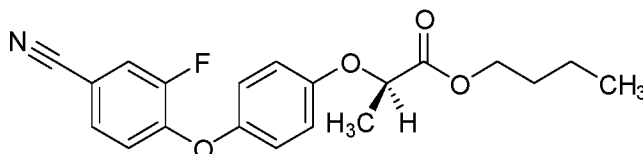
[0059] Compositions and methods of the present disclosure can include cycloxydim or an agriculturally acceptable salt or ester thereof. Cycloxydim, shown below, is a cyclohexanedione herbicide that provides post-emergence control of annual and perennial grasses (except red fescue and *Poa* spp.) in canola/oilseed rape, beans, potatoes, brassicas, cotton, celery, fennel, beetroot, sugar beets, fodder beets, sunflowers, soybeans, flax, alfalfa, crucifers, and alliums. Cycloxydim, as well as methods of preparing cycloxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.



[0060] Cycloxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, cycloxydim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 50 g ai/ha or more, such as 55 g ai/ha or more, 60 g ai/ha or more, 70 g ai/ha or more, 80 g ai/ha or more, 90 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 225 g ai/ha or more, 250 g ai/ha or more, 275 g ai/ha or more, 300 g ai/ha or more, 325 g ai/ha or more, 350 g ai/ha or more, 375 g ai/ha or more, 400 g ai/ha or more, 425 g ai/ha or more, 450 g ai/ha or more, 475 g ai/ha or more, 500 g ai/ha or more, 525 g ai/ha or more, 550 g ai/ha or more, 575 g ai/ha or more, 600 g ai/ha or more, 625 g ai/ha or more, 650 g ai/ha or more, or 675 g ai/ha or more; in an amount of 700 g ai/ha or less, such as 675 g ai/ha or less, 650 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 145 g ai/ha or less, 140 g ai/ha or less, 135 g ai/ha or less, 130 g ai/ha or less, 125 g ai/ha or less, 120 g ai/ha or less, 115 g ai/ha or less, 110 g ai/ha or less, 105 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, or 55 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 50–700 g ai/ha, 60–600 g ai/ha, 90–400 g ai/ha, 100–580 g ai/ha, 50–300 g ai/ha, 75–460 g ai/ha, 110–620 g ai/ha, 190–280 g ai/ha, 140–400 g ai/ha, 95–660 g ai/ha, 80–580 g ai/ha, 200–700 g ai/ha, 250–300 g ai/ha, 65–400 g ai/ha, 90–320 g ai/ha, or 55–675 g ai/ha.

Cyhalofop

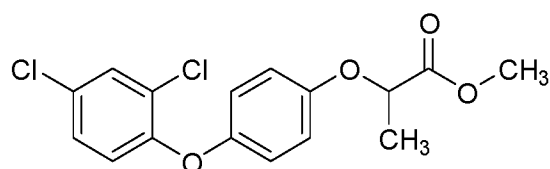
[0061] Compositions and methods of the present disclosure can include cyhalofop or an agriculturally acceptable salt or ester thereof. Cyhalofop, as well as methods of preparing cyhalofop, are known in the art. Cyhalofop is an aryloxyphenoxypropionate ester that is used for post-emergence control of grass weeds in rice. Cyhalofop-butyl, shown below, is an ester of cyhalofop.



[0062] Cyhalofop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, cyhalofop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 20 g ai/ha or more, such as 25 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 50 g ai/ha or more, 60 g ai/ha or more, 70 g ai/ha or more, 80 g ai/ha or more, 90 g ai/ha or more, 100 g ai/ha or more, 120 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 180 g ai/ha or more, 200 g ai/ha or more, 225 g ai/ha or more, 250 g ai/ha or more, 275 g ai/ha or more, 300 g ai/ha or more, 325 g ai/ha or more, 350 g ai/ha or more, 375 g ai/ha or more, 400 g ai/ha or more, 425 g ai/ha or more, 450 g ai/ha or more, 475 g ai/ha or more, or 500 g ai/ha or more; in an amount of 500 g ai/ha or less, such as 475 g ai/ha or less, 450 g ai/ha or less, 425 g ai/ha or less, 400 g ai/ha or less, 375 g ai/ha or less, 350 g ai/ha or less, 325 g ai/ha or less, 300 g ai/ha or less, 275 g ai/ha or less, 250 g ai/ha or less, 225 g ai/ha or less, 200 g ai/ha or less, 180 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 120 g ai/ha or less, 100 g ai/ha or less, 90 g ai/ha or less, 80 g ai/ha or less, 70 g ai/ha or less, 60 g ai/ha or less, 50 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, or 25 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 20–500 g ai/ha, 20–450 g ai/ha, 25–200 g ai/ha, 40–400 g ai/ha, 60–375 g ai/ha, 40–350 g ai/ha, 50–250 g ai/ha, 60–325 g ai/ha, 90–275 g ai/ha, 70–325 g ai/ha, 40–225 g ai/ha, 140–300 g ai/ha, 35–160 g ai/ha, 80–350 g ai/ha, 150–450 g ai/ha, 200–425 g ai/ha, or 25–475 g ai/ha.

Diclofop

[0063] Compositions and methods of the present disclosure can include diclofop or an agriculturally acceptable salt or ester thereof. Diclofop-methyl, shown below, is an aryloxyphenoxypropionate that is used for post-emergence control of wild oats, wild millets, and other annual grass weeds in wheat, barley, rye, red fescue, and broad-leaved crops such as soybeans, sugar beets, fodder beets, flax, legumes, canola/oilseed rape, sunflowers, clover, alfalfa, peanuts, brassicas, carrots, celery, parsnips, lettuce, spinach, potatoes, cucumbers, peas, beans, tomatoes, fennel, alliums, and herbs. Diclofop, as well as methods of preparing diclofop, are known in the art.

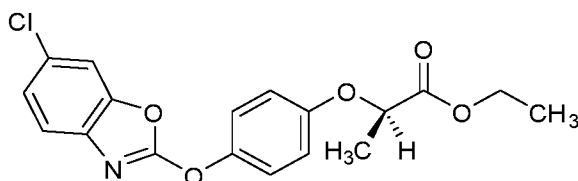


[0064] Diclofop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, diclofop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount 100 g ai/ha or more, such as 150 g ai/ha or more, 175 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, 500 g ai/ha or more, 520 g ai/ha or more, 540 g ai/ha or more, 560 g ai/ha or more, 580 g ai/ha or more, 600 g ai/ha or more, 620 g ai/ha or more, 640 g ai/ha or more, 660 g ai/ha or more, 680 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, 900 g ai/ha or more, 950 g ai/ha or more, 1000 g ai/ha or more, 1050 g ai/ha or more, 1100 g ai/ha or more, 1150 g ai/ha or more, or 1200 g ai/ha or more; in an amount of 1200 g ai/ha or less, such as 1150 g ai/ha or less, 1100 g ai/ha or less, 1050 g ai/ha or less, 1000 g ai/ha or less, 950 g ai/ha or less, 900 g ai/ha or less, 850 g ai/ha or less, 800 g ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 680 g ai/ha or less, 660 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 280 g ai/ha or less, 260 g ai/ha or less, 240 g ai/ha or less, 220 g ai/ha or less, 200 g ai/ha or less, 175 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha

or less, 110 g ai/ha or less, or 101 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 100–1200 g ai/ha, 120–1200 g ai/ha, 140–1100 g ai/ha, 150–900 g ai/ha, 175–1000 g ai/ha, 200–1150 g ai/ha, 360–1050 g ai/ha, 220–640 g ai/ha, 240–800 g ai/ha, 110–700 g ai/ha, 300–440 g ai/ha, 750–1000 g ai/ha, 360–950 g ai/ha, 175–850 g ai/ha, 400–650 g ai/ha, 150–280 g ai/ha, 500–600 g ai/ha, or 110–1150 g ai/ha).

Fenoxaprop

[0065] Compositions and methods of the present disclosure can include fenoxaprop or an agriculturally acceptable salt or ester thereof. Fenoxaprop is an aryloxyphenoxypropionate that is used for post-emergence control of annual and perennial grass weeds in potatoes, beans, soybeans, beets, vegetables, peanuts, and cotton; and (when applied with the herbicide safener fenchlorazole-ethyl) annual and perennial grass weeds and wild oats in wheat, rye, and triticale. Fenoxaprop-P-ethyl, shown below, is an ester of fenoxaprop. Fenoxaprop, as well as methods of preparing fenoxaprop, are known in the art.

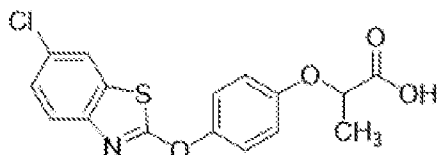


[0066] Fenoxaprop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, fenoxaprop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 25 g ai/ha or more, such as 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 105 g ai/ha or more, 110 g ai/ha or more, 115 g ai/ha or more, 120 g ai/ha or more, 125 g ai/ha or more, 130 g ai/ha or more, 135 g ai/ha or more, 140 g ai/ha or more, 145 g ai/ha or more, or 150 g ai/ha or more; in an amount of 151 g ai/ha or less, such as 150 g ai/ha or less, 145 g ai/ha or less, 140 g ai/ha or less, 135 g ai/ha or less, 130 g ai/ha or less, 125 g ai/ha or less, 120 g ai/ha or less, 115 g ai/ha or less, 110 g ai/ha or less, 105 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, or 25 g

ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 25–151 g ai/ha, 30–150 g ai/ha, 35–140 g ai/ha, 50–130 g ai/ha, 30–125 g ai/ha, 85–150 g ai/ha, 45–145 g ai/ha, 25–110 g ai/ha, 40–90 g ai/ha, 55–120 g ai/ha, 40–115 g ai/ha, 60–110 g ai/ha, 30–105 g ai/ha, 90–151 g ai/ha, 25–95 g ai/ha, 50–80 g ai/ha, 60–125 g ai/ha, or 25–145 g ai/ha.

Fenthiaprop

[0067] Compositions and methods of the present disclosure can include fenthiaprop or an agriculturally acceptable salt or ester thereof. Fenthiaprop, shown below, is an aryloxyphenoxypropionate herbicide that is used for post-emergence control of many annual and perennial grasses and volunteer cereals in canola/oilseed rape, potatoes, and sugar beets.

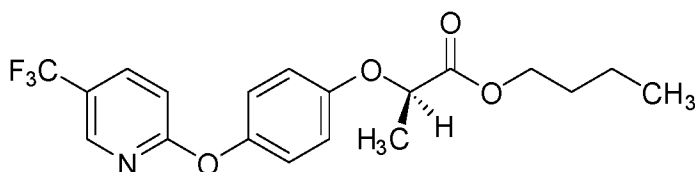


[0068] Fenthiaprop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, fenthiaprop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount 150 g ai/ha or more, such as 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 250 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 350 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 450 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, 500 g ai/ha or more, 520 g ai/ha or more, 540 g ai/ha or more, 550 g ai/ha or more, 560 g ai/ha or more, 580 g ai/ha or more, 600 g ai/ha or more, 620 g ai/ha or more, 640 g ai/ha or more, 650 g ai/ha or more, 660 g ai/ha or more, 680 g ai/ha or more, 700 g ai/ha or more, or 725 g ai/ha or more; in an amount of 750 g ai/ha or less, such as 725 g ai/ha or less, 700 g ai/ha or less, 680 g ai/ha or less, 660 g ai/ha or less, 650 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 550 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 450 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 350 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 280 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 220 g ai/ha or less, 200 g ai/ha or less, 190 g

ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, or 160 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 150–750 g ai/ha, 180–600 g ai/ha, 170–650 g ai/ha, 250–700 g ai/ha, 280–450 g ai/ha, 360–580 g ai/ha, 220–640 g ai/ha, 240–725 g ai/ha, 340–440 g ai/ha, 260–550 g ai/ha, 170–250 g ai/ha, 400–650 g ai/ha, 190–580 g ai/ha, 500–600 g ai/ha, or 160–725 g ai/ha.

[0069] Fluzifop

[0070] Compositions and methods of the present disclosure can include fluzifop or an agriculturally acceptable salt or ester thereof. Fluzifop is an aryloxyphenoxypropionate that is used for post-emergence control of annual and perennial grass weeds in broad-leaved crops, including control of volunteer cereals and other grass weeds in canola/oilseed rape, sugar beet, fodder beet, potatoes, cotton, soybeans, peanuts, pome fruit, bush fruit, vines, citrus fruit, pineapples, bananas, strawberries, sunflowers, alfalfa, coffee, ornamentals and many vegetables. Fluzifop-P-butyl, shown below, is an ester of fluzifop. Fluzifop, as well as methods of preparing fluzifop, are known in the art.

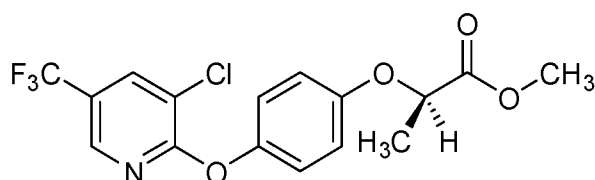


[0071] Fluzifop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, fluzifop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 100 grams active ingredient per hectare (g ai/ha) or more, such as 105 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 225 g ai/ha or more, 250 g ai/ha or more, 275 g ai/ha or more, 300 g ai/ha or more, 325 g ai/ha or more, 350 g ai/ha or more, 375 g ai/ha or more, 400 g ai/ha or more, 425 g ai/ha or more, 450 g ai/ha or more, 475 g ai/ha or more, 500 g ai/ha or more, 550 g ai/ha or more, 600 g ai/ha or more, 650 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, 900 g ai/ha or more, 950 g ai/ha or more, 1000 g ai/ha or more, 1100 g ai/ha or more, 1200 g ai/ha or more, 1300 g ai/ha or more, or 1350 g ai/ha or more; in an amount of 1400 g ai/ha or less, such as 1350 g ai/ha or less, 1300 g ai/ha or less, 1200 g ai/ha or less, 1100 g ai/ha or less, 1000 g ai/ha or less, 950 g ai/ha or less, 900 g ai/ha or less, 850 g ai/ha or less, 800 g

ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 650 g ai/ha or less, 600 g ai/ha or less, 550 g ai/ha or less, 500 g ai/ha or less, 475 g ai/ha or less, 450 g ai/ha or less, 425 g ai/ha or less, 400 g ai/ha or less, 375 g ai/ha or less, 350 g ai/ha or less, 325 g ai/ha or less, 300 g ai/ha or less, 275 g ai/ha or less, 250 g ai/ha or less, 225 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less or 105 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, e.g., 100–1400 g ai/ha, 140–1300 g ai/ha, 180–1200 g ai/ha, 200–950 g ai/ha, 300–800 g ai/ha, 250–700 g ai/ha, 130–450 g ai/ha, 100–500 g ai/ha, 190–850 g ai/ha, 110–375 g ai/ha, 225–475 g ai/ha, 130–600 g ai/ha, 150–1200 g ai/ha, 190–700 g ai/ha, 175–350 g ai/ha, 500–1100 g ai/ha, or 105–1350 g ai/ha.

[0072] Haloxyfop

[0073] Compositions and methods of the present disclosure can include haloxyfop or an agriculturally acceptable salt or ester thereof. Haloxyfop is an aryloxyphenoxypropionate that is used post-emergence for control of annual and perennial grasses in sugar beets, fodder beets, canola/oilseed rape, potatoes, leafy vegetables, onions, flax, sunflowers, soybeans, vines, strawberries and other crops. Haloxyfop-P-methyl, shown below, is an ester of haloxyfop; haloxyfop-R-methyl is the racemic form of this herbicide. Haloxyfop, as well as methods of preparing haloxyfop, are known in the art.



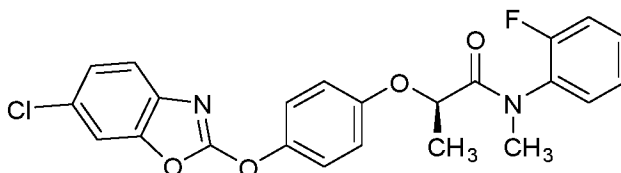
[0074] Haloxyfop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, haloxyfop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 24 g ai/ha or more, such as 25 g ai/ha or more, 30 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g

ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 210 g ai/ha or more, 220 g ai/ha or more, 230 g ai/ha or more, 240 g ai/ha or more, or 245 g ai/ha or more;

[0075] in an amount of 250 g ai/ha or less, such as 245 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, or 25 g ai/ha or less; in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 24–250 g ai/ha, 25–225 g ai/ha, 35–200 g ai/ha, 55–190 g ai/ha, 25–180 g ai/ha, 30–175 g ai/ha, 30–230 g ai/ha, 130–220 g ai/ha, 60–160 g ai/ha, 75–150 g ai/ha, 35–150 g ai/ha, 60–140 g ai/ha, 80–230 g ai/ha, 90–210 g ai/ha, 55–110 g ai/ha, 70–240 g ai/ha, or 25–245 g ai/ha.

Metamifop

[0076] Compositions and methods of the present disclosure can include metamifop. Metamifop, shown below, is an aryloxyphenoxypropionate that is used for post-emergence control of annual and perennial grass weeds (including *Echinochloa* spp., *Leptochloa chinensis*, *Digitaria* spp. and *Eleusine indica*) in rice, wheat, soybeans, cotton, and turf grass. Metamifop, as well as methods of preparing metamifop, are known in the art.

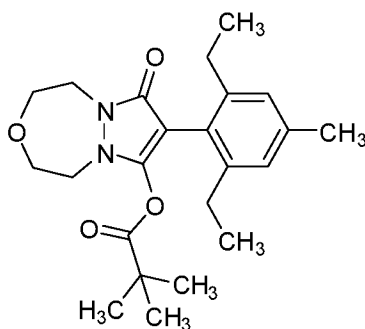


[0077] Metamifop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, metamifop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 50 g ai/ha or more, such as 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 105 g ai/ha or more, 110 g ai/ha or more, 115 g ai/ha or more, 120 g ai/ha or more, 125 g ai/ha or more, 130 g ai/ha or more, 135 g ai/ha or more, 140 g ai/ha or more, 145 g ai/ha or more, 150 g ai/ha or more, 155 g ai/ha or more, 160 g ai/ha or more, 165 g ai/ha or more, 170 g ai/ha or more, 175 g ai/ha or more, 180 g ai/ha or more, 185 g ai/ha or

more, 190 g ai/ha or more, 195 g ai/ha or more, 200 g ai/ha or more, 210 g ai/ha or more, 220 g ai/ha or more, 230 g ai/ha or more, 240 g ai/ha or more, 250 g ai/ha or more, 260 g ai/ha or more, 270 g ai/ha or more, 280 g ai/ha or more, 290 g ai/ha or more, or 295 g ai/ha or more; in an amount of 300 g ai/ha or less, such as 295 g ai/ha or less, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 145 g ai/ha or less, 140 g ai/ha or less, 135 g ai/ha or less, 130 g ai/ha or less, 125 g ai/ha or less, 120 g ai/ha or less, 115 g ai/ha or less, 110 g ai/ha or less, 105 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, or 55 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 50–300 g ai/ha, 60–275 g ai/ha, 80–250 g ai/ha, 55–125 g ai/ha, 60–200 g ai/ha, 70–160 g ai/ha, 80–210 g ai/ha, 90–270 g ai/ha, 100–175 g ai/ha, 120–230 g ai/ha, 145–250 g ai/ha, or 55–295 g ai/ha.

Pinoxaden

[0078] Compositions and methods of the present disclosure can include pinoxaden or an agriculturally acceptable salt or ester thereof. Pinoxaden, shown below, is a phenylpyrazoline herbicide that provides post-emergence control of grass weeds in wheat, barley, lawns, and turf. Pinoxaden, as well as methods of preparing pinoxaden, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.



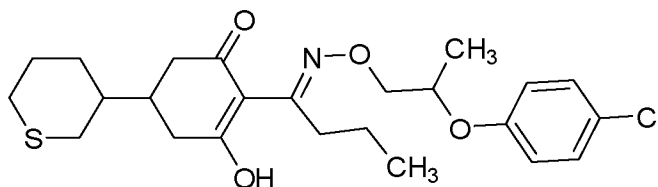
[0079] Pinoxaden can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, pinoxaden is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 2 g ai/ha or more, such as 2.5 g ai/ha or more, 3 g ai/ha or more, 4 g ai/ha or more, 5 g

ai/ha or more, 6 g ai/ha or more, 8 g ai/ha or more, 10 g ai/ha or more, 12 g ai/ha or more, 14 g ai/ha or more, 16 g ai/ha or more, 18 g ai/ha or more, 20 g ai/ha or more, 22 g ai/ha or more, 24 g ai/ha or more, 26 g ai/ha or more, 28 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 60 g ai/ha or more, 70 g ai/ha or more, 80 g ai/ha or more, 90 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, or 490 g ai/ha or more; in an amount of 500 g ai/ha or less, such as 490 g ai/ha or less, 480 g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 235 g ai/ha or less, 230 g ai/ha or less, 225 g ai/ha or less, 220 g ai/ha or less, 215 g ai/ha or less, 210 g ai/ha or less, 205 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 90 g ai/ha or less, 80 g ai/ha or less, 70 g ai/ha or less, 60 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 28 g ai/ha or less, 26 g ai/ha or less, 24 g ai/ha or less, 22 g ai/ha or less, 20 g ai/ha or less, 18 g ai/ha or less, 16 g ai/ha or less, 14 g ai/ha or less, 12 g ai/ha or less, 10 g ai/ha or less, 8 g ai/ha or less, 6 g ai/ha or less, 5 g ai/ha or less, 4 g ai/ha or less, 3 g ai/ha or less, or 2.5 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 2–500 g ai/ha, 3–400 g ai/ha, 5–300 g ai/ha, 8–100 g ai/ha, 5–500 g ai/ha, 10–120 g ai/ha, 22–190 g ai/ha, 40–300 g ai/ha, 30–400 g ai/ha, 80–270 g ai/ha, 100–480 g ai/ha, 150–250 g ai/ha, 110–380 g ai/ha, 8–235 g ai/ha, 30–260 g ai/ha, 24–50 g ai/ha, 10–300 g ai/ha, 16–180 g ai/ha, or 2.5–490 g ai/ha.

Profoxydim

[0080] Compositions and methods of the present disclosure can include profoxydim or an agriculturally acceptable salt or ester thereof. Profoxydim, shown below, is a cyclohexanedione herbicide. Profoxydim is used for control of grass weeds, including *Echinochloa* spp., *Brachiaria* spp., *Digitaria* spp., *Eleusine* spp., *Leptochloa* spp., *Setaria* spp., *Ischaemum rugosum* and

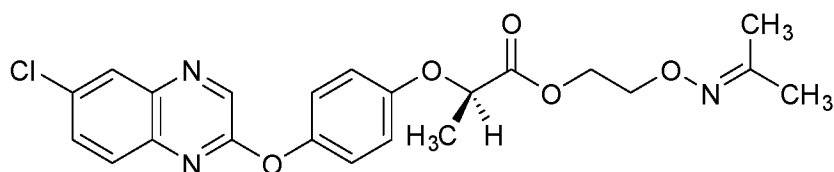
Rottboellia exaltata, in rice. Profoxydim, as well as methods of preparing profoxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.



[0081] Profoxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, profoxydim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 50 g ai/ha or more, such as 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 105 g ai/ha or more, 110 g ai/ha or more, 115 g ai/ha or more, 120 g ai/ha or more, 125 g ai/ha or more, 130 g ai/ha or more, 135 g ai/ha or more, 140 g ai/ha or more, 145 g ai/ha or more, 150 g ai/ha or more, 155 g ai/ha or more, 160 g ai/ha or more, 165 g ai/ha or more, 170 g ai/ha or more, 175 g ai/ha or more, 180 g ai/ha or more, 185 g ai/ha or more, 190 g ai/ha or more, 195 g ai/ha or more, 200 g ai/ha or more, 210 g ai/ha or more, 220 g ai/ha or more, 230 g ai/ha or more, 240 g ai/ha or more, 250 g ai/ha or more, 260 g ai/ha or more, 270 g ai/ha or more, 280 g ai/ha or more, or 290 g ai/ha or more; in an amount of 300 g ai/ha or less (*e.g.*, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 145 g ai/ha or less, 140 g ai/ha or less, 135 g ai/ha or less, 130 g ai/ha or less, 125 g ai/ha or less, 120 g ai/ha or less, 115 g ai/ha or less, 110 g ai/ha or less, 105 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, or 55 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 50–300 g ai/ha., 60–275 g ai/ha, 85–250 g ai/ha, 60–220 g ai/ha, 120–280 g ai/ha, 150–180 g ai/ha, 70–160 g ai/ha, 55–240 g ai/ha, 90–290 g ai/ha, 75–100 g ai/ha, 115–270 g ai/ha, 70–200 g ai/ha, or 55–290 g ai/ha.

[0082] Propaquizafop

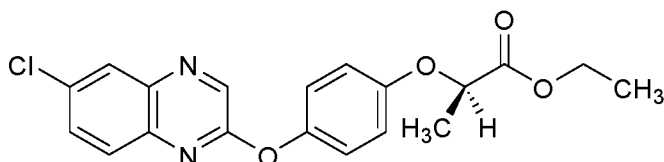
[0083] Compositions and methods of the present disclosure can include propaquizafop. Propaquizafop, shown below, is an aryloxyphenoxypropionate that is to control a wide range of annual and perennial grasses in soybeans, cotton, sugar beets, potatoes, peanuts, peas, canola/oilseed rape and vegetables. Propaquizafop, as well as methods of preparing propaquizafop, are known in the art.



[0084] Propaquizafop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, propaquizafop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 29 g ai/ha or more, such as 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 210 g ai/ha or more, 220 g ai/ha or more, 230 g ai/ha or more, 240 g ai/ha or more, 250 g ai/ha or more, 260 g ai/ha or more, 270 g ai/ha or more, 280 g ai/ha or more, or 290 g ai/ha or more; in an amount of 300 g ai/ha or less (*e.g.*, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, or 30 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 29–300 g ai/ha, 30–290 g ai/ha, 35–180 g ai/ha, 40–270 g ai/ha, 45–200 g ai/ha, 50–250 g ai/ha, 60–140 g ai/ha, 80–230 g ai/ha, 40–220 g ai/ha, 65–290 g ai/ha, 35–200 g ai/ha, 80–180 g ai/ha, 60–260 g ai/ha, 30–120 g ai/ha, 80–190 g ai/ha, 160–270 g ai/ha, or 30–290 g ai/ha.

Quizalofop

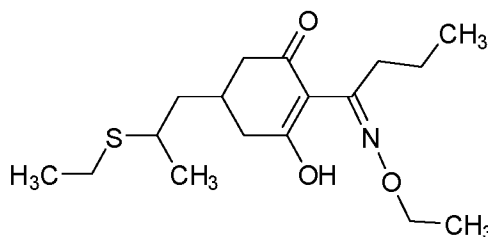
[0085] Compositions and methods of the present disclosure can include quizalofop or an agriculturally acceptable salt or ester thereof. Quizalofop is an aryloxyphenoxypropionate that is used for selective post-emergence control of annual and perennial grass weeds in potatoes, soybeans, sugar beets, peanuts, canola/oilseed rape, sunflowers, vegetables, cotton and flax. Quizalofop-P-ethyl, shown below, is an ester of quizalofop. Quizalofop, as well as methods of preparing quizalofop, are known in the art.



[0086] Quizalofop can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, quizalofop is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 24 g ai/ha or more, such as 25 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 125 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 175 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 210 g ai/ha or more, 220 g ai/ha or more, 225 g ai/ha or more, 230 g ai/ha or more, 240 g ai/ha or more, or 245 g ai/ha or more; in an amount of 250 g ai/ha or less (*e.g.*, 245 g ai/ha or less, 240 g ai/ha or less, 230 g ai/ha or less, 225 g ai/ha or less, 220 g ai/ha or less, 210 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 125 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, or 25 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 24–250 g ai/ha, 25–225 g ai/ha, 55–200 g ai/ha, 40–190 g ai/ha, 25–80 g ai/ha, 60–175 g ai/ha, 110–225 g ai/ha, 75–160 g ai/ha, 45–220 g ai/ha, 80–150 g ai/ha, 30–90 g ai/ha, 40–100 g ai/ha, 50–180 g ai/ha, 60–230 g ai/ha, 60–120 g ai/ha, 40–100 g ai/ha, or 25–245 g ai/ha.

Sethoxydim

[0087] Compositions and methods of the present disclosure can include sethoxydim or an agriculturally acceptable salt or ester thereof. Sethoxydim, shown below, is a cyclohexanedione herbicide that is used for controlling annual and perennial grasses in broad-leaved crops, including canola/oilseed rape, soybean, cotton, fodder beets, sunflowers, spinach, potatoes, tobacco, peanuts, strawberries, alfalfa, flax, vegetables, and sugar beet. Sethoxydim, as well as methods of preparing sethoxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

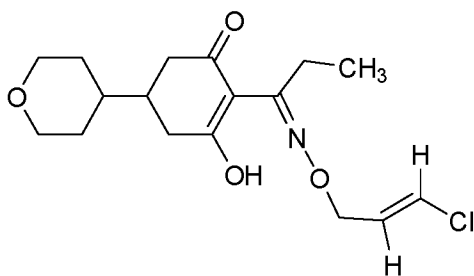


[0088] Sethoxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, sethoxydim is applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 2 g ai/ha or more, such as 3 g ai/ha or more, 4 g ai/ha or more, 5 g ai/ha or more, 6 g ai/ha or more, 8 g ai/ha or more, 10 g ai/ha or more, 12 g ai/ha or more, 14 g ai/ha or more, 16 g ai/ha or more, 18 g ai/ha or more, 20 g ai/ha or more, 22 g ai/ha or more, 24 g ai/ha or more, 26 g ai/ha or more, 28 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 60 g ai/ha or more, 70 g ai/ha or more, 80 g ai/ha or more, 90 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 220 g ai/ha or more, 240 g ai/ha or more, 260 g ai/ha or more, 280 g ai/ha or more, 300 g ai/ha or more, 320 g ai/ha or more, 340 g ai/ha or more, 360 g ai/ha or more, 380 g ai/ha or more, 400 g ai/ha or more, 420 g ai/ha or more, 440 g ai/ha or more, 460 g ai/ha or more, 480 g ai/ha or more, 500 g ai/ha or more, 520 g ai/ha or more, 540 g ai/ha or more, 560 g ai/ha or more, 580 g ai/ha or more, 600 g ai/ha or more, 620 g ai/ha or more, 640 g ai/ha or more, 660 g ai/ha or more, 680 g ai/ha or more, 700 g ai/ha or more, 750 g ai/ha or more, 800 g ai/ha or more, 850 g ai/ha or more, or 900 g ai/ha or more; in an amount of 900 g ai/ha or less, such as 850 g ai/ha or less, 800 g ai/ha or less, 750 g ai/ha or less, 700 g ai/ha or less, 680 g ai/ha or less, 660 g ai/ha or less, 640 g ai/ha or less, 620 g ai/ha or less, 600 g ai/ha or less, 580 g ai/ha or less, 560 g ai/ha or less, 540 g ai/ha or less, 520 g ai/ha or less, 500 g ai/ha or less, 480

g ai/ha or less, 460 g ai/ha or less, 440 g ai/ha or less, 420 g ai/ha or less, 400 g ai/ha or less, 380 g ai/ha or less, 360 g ai/ha or less, 340 g ai/ha or less, 320 g ai/ha or less, 300 g ai/ha or less, 290 g ai/ha or less, 280 g ai/ha or less, 270 g ai/ha or less, 260 g ai/ha or less, 250 g ai/ha or less, 240 g ai/ha or less, 235 g ai/ha or less, 230 g ai/ha or less, 225 g ai/ha or less, 220 g ai/ha or less, 215 g ai/ha or less, 210 g ai/ha or less, 205 g ai/ha or less, 200 g ai/ha or less, 195 g ai/ha or less, 190 g ai/ha or less, 185 g ai/ha or less, 180 g ai/ha or less, 175 g ai/ha or less, 170 g ai/ha or less, 165 g ai/ha or less, 160 g ai/ha or less, 155 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 90 g ai/ha or less, 80 g ai/ha or less, 70 g ai/ha or less, 60 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, 28 g ai/ha or less, 26 g ai/ha or less, 24 g ai/ha or less, 22 g ai/ha or less, 20 g ai/ha or less, 18 g ai/ha or less, 16 g ai/ha or less, 14 g ai/ha or less, 12 g ai/ha or less, 10 g ai/ha or less, 8 g ai/ha or less, 6 g ai/ha or less, 5 g ai/ha or more, 4 g ai/ha or less, or 3 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 2–900 g ai/ha, 3–500 g ai/ha, 5–270 g ai/ha, 10–600 g ai/ha, 22–440 g ai/ha, 35–560 g ai/ha, 10–400 g ai/ha, 20–700 g ai/ha, 40–280 g ai/ha, 60–680 g ai/ha, 100–750 g ai/ha, 90–300 g ai/ha, 200–700 g ai/ha, 300–500 g ai/ha, 3–100 g ai/ha, 5–90 g ai/ha, 12–105 g ai/ha, or 3–850 g ai/ha.

Tepaloxymid

[0089] Compositions and methods of the present disclosure can include tepaloxymid or an agriculturally acceptable salt or ester thereof. Tepaloxymid, shown below, is a cyclohexanedione herbicide that is used for broad-spectrum post-emergence grass weed control, especially *Poa annua* and volunteer maize, and also *Sorghum halepense* and *Elymus repens*, in broad-leaved crops. Tepaloxymid, as well as methods of preparing tepaloxymid, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

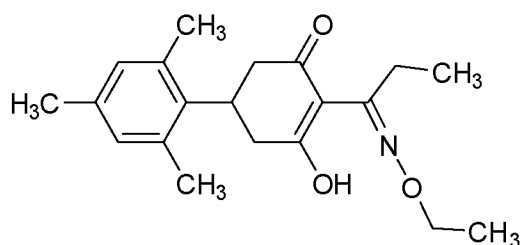


[0090] Tepaloxymid can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount sufficient to induce a herbicidal effect. In some aspects, tepaloxymid is applied to vegetation or an area adjacent the

vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 25 g ai/ha or more, such as 27.5 g ai/ha or more, 30 g ai/ha or more, 35 g ai/ha or more, 40 g ai/ha or more, 45 g ai/ha or more, 50 g ai/ha or more, 55 g ai/ha or more, 60 g ai/ha or more, 65 g ai/ha or more, 70 g ai/ha or more, 75 g ai/ha or more, 80 g ai/ha or more, 85 g ai/ha or more, 90 g ai/ha or more, 95 g ai/ha or more, 100 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more, 130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, or 195 g ai/ha or more; in an amount of 200 g ai/ha or less, such as 195 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, 100 g ai/ha or less, 95 g ai/ha or less, 90 g ai/ha or less, 85 g ai/ha or less, 80 g ai/ha or less, 75 g ai/ha or less, 70 g ai/ha or less, 65 g ai/ha or less, 60 g ai/ha or less, 55 g ai/ha or less, 50 g ai/ha or less, 45 g ai/ha or less, 40 g ai/ha or less, 35 g ai/ha or less, 30 g ai/ha or less, or 27.5 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 25–200 g ai/ha, 25–190 g ai/ha, 60–180 g ai/ha, 35–170 g ai/ha, 45–120 g ai/ha, 25–65 g ai/ha, 90–160 g ai/ha, 75–195 g ai/ha, 25–150 g ai/ha, 30–190 g ai/ha, 35–130 g ai/ha, 50–120 g ai/ha, 65–180 g ai/ha, or 27.5–195 g ai/ha.

Tralkoxydim

[0091] Compositions and methods of the present disclosure can include tralkoxydim or an agriculturally acceptable salt or ester thereof. Tralkoxydim is a cyclohexanedione herbicide that has the chemical name 2-[1-(ethoxyimino)propyl]-3-hydroxy-5-mesitylcyclohex-2-enone, and has the following structure:



[0092] Tralkoxydim is used for post-emergence control of annual grass weeds (including *Avena* spp., *Lolium* spp., *Setaria viridis*, *Phalaris* spp., *Alopecurus myosuroides*, and *Apera spica-venti*) in wheat and barley. Tralkoxydim, as well as methods of preparing tralkoxydim, are known in the art. Its herbicidal activity is described in *The Pesticide Manual*, Seventeenth Edition, 2016.

[0093] Tralkoxydim can be applied to vegetation or an area adjacent the vegetation or applied to soil or water to prevent the emergence or growth of vegetation in an amount of 95 g ai/ha or more, such as 100 g ai/ha or more, 105 g ai/ha or more, 110 g ai/ha or more, 120 g ai/ha or more,

130 g ai/ha or more, 140 g ai/ha or more, 150 g ai/ha or more, 160 g ai/ha or more, 170 g ai/ha or more, 180 g ai/ha or more, 190 g ai/ha or more, 200 g ai/ha or more, 225 g ai/ha or more, 250 g ai/ha or more, 275 g ai/ha or more, 300 g ai/ha or more, 325 g ai/ha or more, 350 g ai/ha or more, 375 g ai/ha or more, 400 g ai/ha or more, 425 g ai/ha or more, 450 g ai/ha or more, 475 g ai/ha or more, or 500 g ai/ha or more; in an amount of 501 g ai/ha or less, such as 500 g ai/ha or less, 475 g ai/ha or less, 450 g ai/ha or less, 425 g ai/ha or less, 400 g ai/ha or less, 375 g ai/ha or less, 350 g ai/ha or less, 325 g ai/ha or less, 300 g ai/ha or less, 275 g ai/ha or less, 250 g ai/ha or less, 225 g ai/ha or less, 200 g ai/ha or less, 190 g ai/ha or less, 180 g ai/ha or less, 170 g ai/ha or less, 160 g ai/ha or less, 150 g ai/ha or less, 140 g ai/ha or less, 130 g ai/ha or less, 120 g ai/ha or less, 110 g ai/ha or less, or 100 g ai/ha or less; or in an amount ranging from any of the minimum values described above to any of the maximum values described above, such as 95–501 g ai/ha, 100–475 g ai/ha, 120–450 g ai/ha, 110–425 g ai/ha, 225–400 g ai/ha, 150–425 g ai/ha, 180–375 g ai/ha, 190–350 g ai/ha, 110–225 g ai/ha, 180–500 g ai/ha, or 100–500 g ai/ha.

IV. Compositions

[0094] A composition comprising (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof may be mixed with or applied in combination with (b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

[0095] In some aspects, (a) and (b) are used in an amount sufficient to induce an unexpectedly enhanced herbicidal effect (*e.g.*, increased damage or injury to undesirable vegetation) while still showing good crop compatibility (*e.g.*, no increased damage to crops or minimal increased damage or injury to crops) when compared to the individual application of the herbicidal compounds (a) and (b). In some aspects, the damage or injury to undesirable vegetation caused by the compositions and methods disclosed herein is evaluated using a scale from 0% to 100%, when compared with the untreated control vegetation, wherein 0% indicates no damage to the undesirable vegetation and 100% indicates complete destruction of the undesirable vegetation.

[0096] In some aspects, the joint action of (a) the pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) the ACCase inhibitor herbicide or an agriculturally acceptable salt or ester thereof results in unexpectedly enhanced herbicidal effect against undesirable vegetation, even at application rates below those typically used for the herbicide to have a herbicidal effect on its own. In some aspects, the compositions and methods disclosed herein can, based on the individual components, be used at lower application rates to

achieve a herbicidal effect comparable to the effect produced by the individual components at normal application rates.

[0097] In some aspects, the weight ratio of (a) the pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof (in g ae/ha) to (b) the ACCase inhibitor herbicide or an agriculturally acceptable salt or ester thereof (in g ai/ha) is 1:3000 or more, such as 1:2500 or more, 1:2000 or more, 1:1500 or more, 1:1000 or more, 1:900 or more, 1:800 or more, 1:700 or more, 1:600 or more, 1:500 or more, 1:400 or more, 1:300 or more, 1:200 or more, 1:100 or more, 1:90 or more, 1:80 or more, 1:70 or more, 1:60 or more, 1:50 or more, 1:40 or more, 1:30 or more, 1:24 or more, 1:20 or more, 1:18 or more, 1:15 or more, 1:12 or more, 1:10 or more, 1:9 or more, 1:8 or more, 1:7 or more, 1:6 or more, 1:5 or more, 1:4 or more, 1:3 or more, 1:2 or more, 1:1 or more, 2:1 or more, 3:1 or more, 5:1 or more, 7:1 or more, 8:1 or more, 10:1 or more, 15:1 or more, 20:1 or more, 25:1 or more, 30:1 or more, 40:1 or more, 50:1 or more, 60:1 or more, 70:1 or more, 75:1 or more, 80:1 or more, 90:1 or more, 100:1 or more, 110:1 or more, 120:1 or more, 130:1 or more, 140:1 or more, or 145:1 or more; the weight ratio of (a) to (b) is 150:1 or less, such as 145:1 or less, 140:1 or less, 130:1 or less, 120:1 or less, 110:1 or less, 100:1 or less, 90:1 or less, 80:1 or less, 70:1 or less, 75:1 or less, 60:1 or less, 50:1 or less, 40:1 or less, 30:1 or less, 25:1 or less, 15:1 or less, 10:1 or less, 8:1 or less, 7:1 or less, 5:1 or less, 3:1 or less, 2:1 or less, 1:1 or less, 1:2 or less, 1:3 or less, 1:4 or less, 1:5 or less, 1:6 or less, 1:7 or less, 1:8 or less, 1:9 or less, 1:10 or less, 1:20 or less, 1:30 or less, 1:40 or less, 1:50 or less, 1:60 or less, 1:70 or less, 1:80 or less, 1:90 or less, 1:100 or less, 1:200 or less, 1:300 or less, 1:400 or less, 1:500 or less, 1:2000 or less, 1:2500 or less, 1:3000 or less, 1:4000 or less, 1:500 or less, 1:600 or less, 1:700 or less, 1:800 or less, 1:900 or less, 1:1000 or less, 1:1500 or less, 1:2000 or less, or 1:2500 or less; or the weight ratio of (a) to (b) can range from any of the minimum ratios to any of the maximum ratios provided above, such as from 1:3000 to 150:1, *e.g.*, from 1:700 to 75:1, from 1:40 to 15:1, from 1:10 to 10:1, from 1:8 to 8:1, from 1:6 to 6:1, or from 1:5 to 5:1.

[0098] In some aspects, the active ingredients in the compositions disclosed herein consist of (a) a pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) an ACCase inhibitor herbicide or an agriculturally acceptable salt or ester thereof. In some aspects, the composition may include other components, such as safeners or adjuvants, but does not include a herbicidal active ingredient in addition to (a) and (b).

[0099] In some aspects, (a) and (b), independently, can be employed in a purity of from 90% to 100% (*e.g.*, from 95% to 100%) according to nuclear magnetic resonance (NMR) spectroscopy.

V. Formulations

[0100] The present disclosure also includes formulations of the compositions and methods disclosed herein.

A. Additives

[0101] The compositions and methods disclosed herein can also be mixed with or applied with an additive. In some aspects, the additive is added sequentially. In some aspects, the additive is added simultaneously. In some aspects, the additive is premixed with the pyridine carboxylate herbicide or agriculturally acceptable N-oxide, salt, or ester thereof.

1. Other Pesticides

[0102] Some aspects of the described herbicidal compositions includes adding one or more additional pesticide active ingredients to the solid herbicidal compositions. These pesticide active ingredients may include one or more of an herbicide, an insecticide, a fungicide, a nematocide, a miticide, an arthropodicide, a bactericide, a plant growth regulator, or combinations thereof that are compatible with the compositions of the present disclosure.

[0103] In some aspects, the additive is an additional herbicide. For example, the compositions described herein can be applied in conjunction with one or more additional herbicides to control undesirable vegetation. The composition can be formulated with the one or more additional herbicides, tank mixed with the one or more additional herbicides, or applied sequentially with the one or more additional herbicides. Exemplary additional herbicides include, but are not limited to: 4-CPA; 4-CPB; 4-CPP; 2,4-D; 2,4-D choline salt; 2,4-D salts, esters and amines; 2,4-DB; 3,4-DA; 3,4-DB; 2,4-DEB; 2,4-DEP; 2,4-DP; 3,4-DP; 2,3,6-TBA; 2,4,5-T; 2,4,5-TB; acetochlor; acifluorfen; aclonifen; acrolein; alachlor; allidochlor; alloxydim; allyl alcohol; alorac; ametrifone; ametryne; amibuzin; amicarbazone; amidosulfuron; aminocyclopyrachlor; 4-aminopicolinic acid based herbicides, such as halauxifen, halauxifen-methyl, florypyrauxifen, and those described in U.S. Patent Nos. 7,314,849 and 7,432,227 to Balko, et al.; aminopyralid; amiprofos-methyl; amitrole; ammonium sulfamate; anilofos; anisuron; asulam; atraton; atrazine; azafenidin; azimsulfuron; aziprotryne; barban; BCPC; beflubutamid; benazolin; bencarbazone; benfluralin; benfuresate; bensulide; bensulfuron; benthiocarb; bentazone; benzadox; benzfendizone; benzipram; benzobicyclon; benzofenap; benzofluor; benzoylprop; benzthiazuron; bialaphos; bicyclopyrone; bifenox; bilanafos; bispyribac; borax; bromacil; bromobonil; bromobutide; bromofenoxim; bromoxynil; brompyrazon; butachlor; butafenacil; butamifos; butenachlor; buthidazole; buthiuron; butralin; butroxydim; buturon; butylate; cacodylic acid; cafenstrole; calcium chlorate; calcium cyanamide; cambendichlor; carbasulam; carbetamide;

carboxazole; chlorprocarb; carfentrazone-ethyl; CDEA; CEPC; chlomethoxyfen; chloramben; chloranocryl; chlorazifop; chlorazine; chlorobromuron; chlorbufam; chloreturon; chlorfenac; chlorfenprop; chlorflurazole; chlorflurenol; chloridazon; chlorimuron; chlornitrofen; chloropon; chlorotoluron; chloroxuron; chloroxynil; chlorpropham; chlorsulfuron; chlorthal; chlorthiamid; cinidon-ethyl; cinmethylin; cinosulfuron; cisanilide; clacyfos; clethodim; cliodinate; clodinafop-propargyl; clofop; clomazone; clomeprop; cloprop; cloproxydim; clocyralid; cloransulam-methyl; CMA; copper sulfate; CPMF; CPPC; credazine; cresol; cumyluron; cyanatryn; cyanazine; cycloate; cyclopyrimorate; cyclosulfamuron; cycloxydim; cycluron; cyhalofop-butyl; cyperquat; cyprazine; cyprazole; cypromid; daimuron; dalapon; dazomet; delachlor; desmedipham; desmetryn; di-allate; dicamba; dichlobenil; dichloralurea; dichlormate; dichlorprop; dichlorprop-P; diclofop-methyl; diclosulam; diethamquat; diethatyl; difenopenten; difenoxuron; difenzoquat; diflufenican; diflufenzopyr; dimefuron; dimepiperate; dimethachlor; dimethametryn; dimethenamid; dimethenamid-P; dimexano; dimidazon; dinitramine; dinofenate; dinoprop; dinosam; dinoseb; dinoterb; diphenamid; dipropetryn; diquat; disul; dithiopyr; diuron; DMPA; DNOC; DSMA; EBEP; eglazine; endothal; epronaz; EPTC; erbon; esprocarb; ethalfluralin; ethametsulfuron; ethbenzamide; ethametsulfuron; ethidimuron; ethiolate; ethobenzamid; ethofumesate; ethoxyfen; ethoxysulfuron; etinofen; etnipromid; etobenzanid; EXD; fenasulam; fenoprop; fenoxaprop; fenoxaprop-P-ethyl; fenoxaprop-P-ethyl + isoxadifen-ethyl; fenoxasulfone; fenquinotrione; fenteracol; fenthiafop; fentrazamide; fenuron; ferrous sulfate; flamprop; flamprop-M; flazasulfuron; florasulam; fluazifop; fluazifop-P-butyl; fluazolate; flucarbazone; flucetosulfuron; fluchloralin; flufenacet; flufenican; flufenpyr-ethyl; flumetsulam; flumezin; flumiclorac-pentyl; flumioxazin; flumipropyn; fluometuron; fluorodifen; fluoroglycofen; fluoromidine; fluoronitrofen; fluothiuron; flupoxam; flupropacil; flupropanate; flupyrsulfuron; fluridone; flurochloridone; fluroxypyr; fluroxypyr-meptyl; flurtamone; fluthiacet; fomesafen; foramsulfuron; fosamine; fumiclorac; furyloxyfen; glufosinate; glufosinate-ammonium; glufosinate-P-ammonium; glyphosate salts and esters; halosafen; halosulfuron; haloxydine; haloxyfop; hexachloroacetone; hexaflurate; hexazinone; imazamethabenz; imazamox; imazapic; imazapyr; imazaquin; imazethapyr; imazosulfuron; indanofan; indaziflam; iodobonil; iodomethane; iodosulfuron; iodosulfuron-ethyl-sodium; iofensulfuron; ioxynil; ipazine; ipfencarbazone; iprymidam; isocarbamid; isocil; isomethiozin; isonoruron; isopolinate; isopropalin; isoproturon; isouron; isoxaben; isoxachlortole; isoxaflutole; isoxapyrifop; karbutilate; ketospiradox; lactofen; lenacil; linuron; MAA; MAMA; MCPA esters and amines; MCPA-thioethyl; MCPB; mecoprop; mecoprop-P; medinoterb; mefenacet; mefluidide; mesoprazine; mesosulfuron; mesotrione; metam; metamifop; metamidron; metazachlor; metflurazon;

methabenzthiazuron; methalproalin; methazole; methiobencarb; methiozolin; methiuron; methometon; methoprotryne; methyl bromide; methyl isothiocyanate; methyl dymron; metobenzuron; metobromuron; metolachlor; metosulam; metoxuron; metribuzin; metsulfuron; molinate; monalide; monisouron; monochloroacetic acid; monolinuron; monuron; morfamquat; MSMA; naproanilide; napropamide; napropamide-M; naptalam; neburon; nicosulfuron; nipyraclufen; nitralin; nitrofen; nitrofluorfen; norflurazon; noruron; OCH; orbencarb; *ortho*-dichlorobenzene; orthosulfamuron; oryzalin; oxadiargyl; oxadiazon; oxapyrazon; oxasulfuron; oxaziclomefone; oxyfluorfen; paraflufen-ethyl; parafluron; paraquat; pebulate; pelargonic acid; pendimethalin; penoxsulam; pentachlorophenol; pentanochlor; pentoxazone; perfluidone; pethoxamid; phenisopham; phenmedipham; phenmedipham-ethyl; phenobenzuron; phenylmercury acetate; picloram; picolinafen; pinoxaden; piperophos; potassium arsenite; potassium azide; potassium cyanate; pretilachlor; primisulfuron; procyazine; prodiamine; profluzol; profluralin; profoxydim; proglinazine; prohexadione-calcium; prometon; prometryne; pronamide; propachlor; propanil; propaquizafop; propazine; propham; propisochlor; propoxycarbazone; propyrisulfuron; propyzamide; prosulfalin; prosulfocarb; prosulfuron; proxan; prynachlor; pydanon; pyraclonil; pyraflufen; pyrasulfotole; pyrazogyl; pyrazone; pyrazolynate; pyrazosulfuron; pyrazoxyfen; pyribenzoxim; pyributicarb; pyriclor; pyridafol; pyridate; pyriftalid; pyriminobac; pyrimisulfan; pyrithiobac-sodium; pyroxasulfone; pyroxsulam; quinclorac; quinmerac; quinclamine; quinonamid; quizalofop; quizalofop-P-ethyl; quizalofop-P-tefuryl; rhodethanil; rimsulfuron; saflufenacil; S-metolachlor; sebuthylazine; sebumeton; sethoxydim; siduron; simazine; simeton; simetryn; SMA; sodium arsenite; sodium azide; sodium chlorate; sulcotrione; sulfallate; sulfentrazone; sulfometuron; sulfosate; sulfosulfuron; sulfuric acid; sulglycapin; swep; TCA; tebutam; tebuthiuron; tefuryltrione; tembotrione; tepraloxydim; terbacil; terbucarb; terbuchlor; terbumeton; terbuthylazine; terbutryne; tetrafluron; thenylchlor; thiameturon; thiazafluron; thiazopyr; thidiazimin; thidiazuron; thiencarbazone; thifensulfuron; thiobencarb; tiafenacil; tiocarbazil; tioclorim; tolpyralate; topramezone; tralkoxydim; tri-allate; triafamone; triasulfuron; triaziflam; tribenuron; tribenuron; tricamba; triclopyr choline salt; triclopyr esters and amines; tridiphane; trietazine; trifloxysulfuron; trifludimoxazin; trifluralin; triflusulfuron; trifop; trifopsime; trihydroxytriazine; trimeturon; tripropindan; tritac; tritosulfuron; vernolate; xylachlor; and salts, esters, optically active isomers, and mixtures thereof.

[0104] In some aspects, the additional pesticide or an agriculturally acceptable salt or ester thereof is provided in a premixed formulation with (a) and (b). In some aspects, the pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof is provided in a premixed formulation with an additional pesticide. In some aspects, the ACCase inhibitor

herbicide or an agriculturally acceptable salt or ester thereof is provided in a premixed formulation with an additional pesticide.

[0105] In some aspects, the compositions may include one or more herbicidal active ingredients in addition to (a) and (b). In some aspects, the compositions do not include an herbicidal active ingredient in addition to (a) and (b). In some aspects, the compositions may exclude one or more herbicidal active ingredients specified above. In some aspects, the compositions may include one or more herbicidal active ingredients in addition to (a) and (b), but may exclude one or more herbicidal ingredients specified above.

2. Adjuvants

[0106] In some aspects, the additive includes an agriculturally acceptable adjuvant. Exemplary agriculturally acceptable adjuvants include, but are not limited to, antifreeze agents, antifoam agents, compatibilizing agents, sequestering agents, neutralizing agents and buffers, corrosion inhibitors, colorants, odorants, penetration aids, wetting agents, spreading agents, dispersing agents, thickening agents, freeze point depressants, antimicrobial agents, crop oil, adhesives (for instance, for use in seed formulations), surfactants, protective colloids, emulsifiers, tackifiers, and mixtures thereof.

[0107] Exemplary agriculturally acceptable adjuvants include, but are not limited to, crop oil concentrates (*e.g.*, 85% mineral oil + 15% emulsifiers); nonylphenol ethoxylates; benzylcocoalkyldimethyl quaternary ammonium salts; blends of petroleum hydrocarbon, alkyl esters, organic acids, and anionic surfactants; C₉-C₁₁ alkylpolyglycoside; phosphate alcohol ethoxylates; natural primary alcohol (C₁₂-C₁₆) ethoxylate; di-*sec*-butylphenol EO-PO block copolymers; polysiloxane-methyl cap; nonylphenol ethoxylate+urea ammonium nitrates; emulsified methylated seed oils; tridecyl alcohol (synthetic) ethoxylates (*e.g.*, 8 EO); tallow amine ethoxylates (*e.g.*, 15 EO); and PEG(400) dioleate-99.

[0108] Exemplary surfactants (*e.g.*, wetting agents, tackifiers, dispersants, emulsifiers) include, but are not limited to: the alkali metal salts, alkaline earth metal salts and ammonium salts of fatty acids or of aromatic sulfonic acids (*e.g.*, lignosulfonic acids, phenolsulfonic acids, naphthalenesulfonic acids, and dibutyl-naphthalenesulfonic acid); alkyl- and alkylarylsulfonates; alkyl sulfates, lauryl ether sulfates and fatty alcohol sulfates; salts of sulfated hexa-, hepta- and octadecanols; salts of fatty alcohol glycol ethers; condensates of sulfonated naphthalene and its derivatives with formaldehyde; condensates of naphthalene or of the naphthalene sulfonic acids with phenol and formaldehyde; polyoxyethylene octylphenol ether; ethoxylated isooctyl-, octyl- or nonylphenol, alkylphenyl or tributylphenyl polyglycol ether; alkyl aryl polyether alcohols;

isotridecyl alcohol; fatty alcohol/ethylene oxide condensates; ethoxylated castor oil; polyoxyethylene alkyl ethers or polyoxypropylene alkyl ethers; lauryl alcohol polyglycol ether acetate; sorbitol esters; liginosulfite waste liquors and proteins; denatured proteins, polysaccharides (e.g., methylcellulose); hydrophobically modified starches; and polyvinyl alcohol, polycarboxylates, polyalkoxylates, polyvinyl amine, polyethyleneimine, polyvinylpyrrolidone, and copolymers thereof.

[0109] Exemplary thickeners include, but are not limited to, polysaccharides (e.g., xanthan gum), organic and inorganic sheet minerals, and mixtures thereof.

[0110] Exemplary antifoam agents include, but are not limited to, silicone emulsions, long-chain alcohols, fatty acids, fatty acid salts, organofluorine compounds, and mixtures thereof.

[0111] Exemplary antimicrobial agents include, but are not limited to: bactericides based on dichlorophen and benzyl alcohol hemiformal; isothiazolinone derivatives, such as alkylisothiazolinones and benzisothiazolinones; and mixtures thereof.

[0112] Exemplary antifreeze agents, include, but are not limited to ethylene glycol, propylene glycol, urea, glycerol, and mixtures thereof.

[0113] Exemplary colorants include, but are not limited to, the dyes known under the names Rhodamine B, pigment blue 15:4, pigment blue 15:3, pigment blue 15:2, pigment blue 15:1, pigment blue 80, pigment yellow 1, pigment yellow 13, pigment red 112, pigment red 48:2, pigment red 48:1, pigment red 57:1, pigment red 53:1, pigment orange 43, pigment orange 34, pigment orange 5, pigment green 36, pigment green 7, pigment white 6, pigment brown 25, basic violet 10, basic violet 49, acid red 51, acid red 52, acid red 14, acid blue 9, acid yellow 23, basic red 10, basic red 108, and mixtures thereof.

[0114] Exemplary adhesives include, but are not limited to, polyvinylpyrrolidone, polyvinyl acetate, polyvinyl alcohol, tylose, and mixtures thereof.

3. Safeners

[0115] In some aspects, the additive is a safener. Safeners are compounds leading to better crop plant compatibility when applied with a herbicide. In some aspects, the safener itself is herbicidally active. In some aspects, the safener acts as an antidote or antagonist in the crop plants and can protect the crop plants from damage that might otherwise occur from an applied herbicide. Exemplary safeners include, but are not limited to, AD-67 (MON 4660), benoxacor, benthio carb, brassinolide, cloquintocet, cloquintocet-mexyl, cyometrinil, cyprosulfamide, daimuron, dichlormid, dicyclonon, dietholate, dimepiperate, disulfoton, fenchlorazole, fenchlorazole-ethyl,

fenclozim, flurazole, fluxofenim, furilazole, harpin proteins, isoxadifen-ethyl, jiecaowan, jiecaoxi, mefenpyr, mefenpyr-diethyl, mephenate, naphthalic anhydride, 2,2,5-trimethyl-3-(dichloroacetyl)-1,3-oxazolidine, 4-(dichloroacetyl)-1-oxa-4-azaspiro [4.5]decane, oxabetrinil, R29148, and *N*-phenyl-sulfonylbenzoic acid amides, as well as thereof agriculturally acceptable salts and, provided they have a carboxyl group, their agriculturally acceptable derivatives. In some aspects, the safener can be cloquintocet or an ester or salt thereof, such as cloquintocet-mexyl. In some aspects, the safener can be dichlormid. In some aspects, the safener can be mefenpyr or an ester or salt thereof, such as mefenpyr-diethyl. In some aspects, the safener is employed in rice, cereal, or maize. For example, dichlormid or cloquintocet can be used to antagonize harmful effects of the compositions on rice, row crops, and cereals.

4. Carriers

[0116] In some aspects, the additive includes a carrier. In some aspects, the additive includes a liquid or solid carrier. In some aspects, the additive includes an organic or inorganic carrier. Exemplary liquid carriers include, but are not limited to: water; petroleum fractions or hydrocarbons such as mineral oil, aromatic solvents, paraffinic oils, and the like; vegetable oils such as soybean oil, rapeseed oil, olive oil, castor oil, sunflower seed oil, coconut oil, corn oil, cottonseed oil, linseed oil, palm oil, peanut oil, safflower oil, sesame oil, tung oil and the like; esters of the above vegetable oils; esters of monoalcohols or dihydric, trihydric, or other lower polyalcohols (4-6 hydroxy containing), such as 2-ethyl hexyl stearate, *n*-butyl oleate, isopropyl myristate, propylene glycol dioleate, di-octyl succinate, di-butyl adipate, di-octyl phthalate and the like; esters of mono, di and polycarboxylic acids and the like; toluene; xylene; petroleum naphtha; crop oil; acetone; methyl ethyl ketone; cyclohexanone; trichloroethylene; perchloroethylene; ethyl acetate; amyl acetate; butyl acetate; propylene glycol monomethyl ether and diethylene glycol monomethyl ether; methyl alcohol; ethyl alcohol; isopropyl alcohol; amyl alcohol; ethylene glycol; propylene glycol; glycerin; *N*-methyl-2-pyrrolidinone; *N,N*-dimethyl alkylamides; dimethyl sulfoxide; and liquid fertilizers, as well as mixtures thereof. Exemplary solid carriers include, but are not limited to: silicas, silica gels, silicates, talc, kaolin, limestone, lime, chalk, bole, loess, clay, dolomite, diatomaceous earth, calcium sulfate, magnesium sulfate, magnesium oxide, ground synthetic materials, pyrophyllite clay, attapulugus clay, kieselguhr, calcium carbonate, bentonite clay, Fuller's earth, cottonseed hulls, wheat flour, soybean flour, pumice, wood flour, walnut shell flour, lignin, ammonium sulfate, ammonium phosphate, ammonium nitrate, ureas, cereal meal, tree bark meal, wood meal and nutshell meal, cellulose powders, and mixtures thereof.

B. Physical States

[0117] In some aspects, the formulation of (a) the pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) the ACCase inhibitor herbicide or an agriculturally acceptable salt or ester thereof may be present in suspended, emulsified, dissolved, or solid form. Exemplary formulations include, but are not limited to, aqueous solutions, aqueous suspensions, aqueous dispersions, aqueous emulsions, aqueous microemulsions, aqueous suspo-emulsions, oil solutions, oil suspensions, oil dispersions, oil emulsions, oil microemulsions, oil suspo-emulsions, self-emulsifying formulations, pastes, powders, dusts, granules, and materials for spreading.

[0118] In some aspects, (a) and (b) are in an aqueous solution that can be diluted before use. In various aspects, (a) and (b) may be provided as a high-strength formulation such as a concentrate. In some aspects, the concentrate is stable and retains potency during storage and shipping. In some various, the concentrate is a clear, homogeneous liquid that is stable at temperatures of 54 °C or greater. In some aspects, the concentrate does not exhibit any precipitation of solids at temperatures of -10 °C or higher. In some aspects, the concentrate does not exhibit separation, precipitation, or crystallization of any components at low temperatures. For example, the concentrate remains a clear solution at temperatures below 0 °C (*e.g.*, below -5 °C, below -10 °C, below -15 °C). In some aspects, the concentrate exhibits a viscosity of less than 50 centipoise (50 megapascals), even at temperatures as low as 5 °C. In some aspects, the concentrate does not exhibit separation, precipitation, or crystallization of any components during storage for a period of 2 weeks or greater (*e.g.*, 4 weeks, 6 weeks, 8 weeks, 3 months, 6 months, 9 months, or 12 months or greater).

[0119] In some aspects, emulsions, pastes, or oil dispersions can be prepared by homogenizing (a) and (b) in water with a wetting agent, tackifier, dispersant, or emulsifier. In some aspects, concentrates suitable for dilution with water can be prepared, comprising (a), (b), a wetting agent, a tackifier, and a dispersant or emulsifier.

[0120] In some aspects, powders, materials for spreading, or dusts can be prepared by mixing or concomitant grinding of (a) and (b) and optionally other additives with a solid carrier.

[0121] In some aspects, granules (*e.g.*, coated granules, impregnated granules and homogeneous granules) can be prepared by binding the (a) and (b) to solid carriers.

[0122] In some aspects, the formulations comprise, by total weight of (a) and (b), from 1% to 99% of (a) and 1% to 99% of (b) (*e.g.*, 95% of (a) and 5% of (b); 70% of (a) and 30% of (b); or 40% of (a) and 60% of (b)). In formulations designed to be employed as concentrates, the total

amount of (a) and (b) can be present in a concentration of from about 0.1 to about 98 weight percent (wt. %), based on the total weight of the formulation. For example, the total amount of (a) and (b) can be present in a concentration as little as about 1 wt. %, about 2.5 wt. %, about 5 wt. %, about 7.5 wt. %, about 10 wt. %, about 15 wt. %, about 20 wt. %, about 25 wt. %, about 30 wt. %, about 35 wt. %, about 40 wt. %, about 45 wt. %, as high as about 50 wt. %, about 55 wt. %, about 60 wt. %, about 65 wt. %, about 70 wt. %, about 75 wt. %, about 80 wt. %, about 85 wt. %, about 90 wt. %, about 95 wt. %, about 97 wt. %, or within any range defined between any two of the forgoing values, such as between about 1 wt. % to about 97 wt. %, between about 10 wt. % to about 90 wt. %, between about 20 wt. % to about 45 wt. %, and about 25 wt. % to about 50 wt. % based on the total weight of the formulation. Concentrates can be diluted with an inert carrier, such as water, prior to application. The diluted formulations applied to undesirable vegetation or the locus of undesirable vegetation can contain from 0.0006 to 8.0 wt. % of the total amount of (a) and (b) (*e.g.*, from 0.001 to 5.0 wt. %), based on the total weight of the diluted formulation.

C. Packaging

[0123] In some aspects, the formulation can be in the form of a single package formulation including (a) the pyridine carboxylate herbicide or an agriculturally acceptable N-oxide, salt, or ester thereof and (b) the ACCase inhibitor herbicide. In some aspects, the formulation can be in the form of a single package formulation including (a) and (b), and further including at least one additive. In some aspects, the formulation can be in the form of a multi-package formulation, such as a two-package formulation, wherein one package contains (a) and optionally at least one additive while the other package contains (b) and optionally at least one additive. In some aspects of the two-package formulation, the formulation including (a) and optionally at least one additive and the formulation including (b) and optionally at least one additive are mixed before application and then applied simultaneously. In some aspects, the mixing is performed as a tank mix (*e.g.*, the formulations are mixed immediately before or upon dilution with water). In some aspects, the formulation including (a) and the formulation including (b) are not mixed but are applied sequentially (in succession), for example, immediately or within 1 hour, within 2 hours, within 4 hours, within 8 hours, within 16 hours, within 24 hours, within 2 days, or within 3 days, of each other.

VI. Methods of Use

[0124] The compositions disclosed herein can be applied in any known technique for applying herbicides. Exemplary application techniques include, but are not limited to, spraying, atomizing, dusting, spreading, or direct application into water. The method of application can vary depending

on the intended purpose. In some aspects, the method of application can be chosen to ensure the finest possible distribution of the compositions disclosed herein.

[0125] In some aspects, a method of controlling undesirable vegetation which comprises contacting the vegetation or the locus thereof with or applying to the soil or water to prevent the emergence or growth of vegetation any of the compositions is disclosed herein.

[0126] The compositions disclosed herein can be applied pre-emergence (before the emergence of undesirable vegetation) or post-emergence (*e.g.*, during and/or after emergence of the undesirable vegetation). In some aspects, the composition is applied post-emergence to the undesirable vegetation. In some aspects, the pyridine carboxylate herbicide and the ACCase inhibitor herbicide are applied simultaneously. In some aspects, the pyridine carboxylate herbicide and the ACCase inhibitor herbicide, are applied sequentially, for example, immediately or with minimal delay, within about 10 minutes, within about 20 minutes, within about 30 minutes, within about 40 minutes, within about 1 hour, within about 2 hours, within about 4 hours, within about 8 hours, within about 16 hours, within about 24 hours, within about 2 days, or within about 3 days, of each other.

[0127] When the compositions are used in crops, the compositions can be applied after seeding and before or after the emergence of the crop plants. In some aspects, the compositions disclosed herein show good crop tolerance even when the crop has already emerged and can be applied during or after the emergence of the crop plants. In some aspects, when the compositions are used in crops, the compositions can be applied before seeding of the crop plants.

[0128] In some aspects, the compositions disclosed herein are applied to vegetation or an area adjacent the vegetation or applying to soil or water to prevent the emergence or growth of vegetation by spraying (*e.g.*, foliar spraying). In some aspects, the spraying techniques use, for example, water as carrier and spray volume rates of from 2 liters per hectare (L/ha) to 2000 L/ha (*e.g.*, from 10–1000 L/ha or from 50–500 L/ha). In some aspects, the compositions disclosed herein are applied by the low-volume or the ultra-low-volume method, wherein the application is in the form of micro granules. In some aspects, wherein the compositions disclosed herein are less well tolerated by certain crop plants, the compositions can be applied with the aid of the spray apparatus in such a way that they come into little contact, if any, with the leaves of the sensitive crop plants while reaching the leaves of undesirable vegetation that grows underneath or on the bare soil (*e.g.*, post-directed or lay-by). In some aspects, the compositions disclosed herein can be applied as dry formulations (*e.g.*, granules, powders, or dusts).

[0129] In some aspects, wherein the undesirable vegetation is treated post-emergence, the compositions disclosed herein are applied by foliar application. In some aspects, herbicidal activity is exhibited by the compounds of the mixture when they are applied directly to the plant or to the locus of the plant at any stage of growth or before planting or emergence. The effect observed can depend upon the type of undesirable vegetation to be controlled, the stage of growth of the undesirable vegetation, the application parameters of dilution and spray drop size, the particle size of solid components, the environmental conditions at the time of use, the specific compound employed, the specific adjuvants and carriers employed, the soil type, and the like, as well as the amount of chemical applied. In some aspects, these and other factors can be adjusted to promote non-selective or selective herbicidal action.

[0130] The compositions and methods disclosed herein can be used to control undesirable vegetation in a variety of applications. The compositions and methods disclosed herein can be used for controlling undesirable vegetation in areas including, but not limited to, farmland, turfgrass, pastures, grasslands, rangelands, fallow land, rights-of-way, aquatic settings, tree and vine, wildlife management areas, or rangeland. In some aspects, the undesirable vegetation is controlled in a row crop. Exemplary crops include, but are not limited to, wheat, barley, triticale, rye, teff, oats, maize, cotton, soy, sorghum, rice, millet, sugarcane and range land (*e.g.*, pasture grasses). In some aspects, the compositions and methods disclosed herein can be used for controlling undesirable vegetation in maize, wheat, barley, rice, sorghum, millet, oats, or a combination thereof. In some aspects, the compositions and methods disclosed herein can be used for controlling undesirable vegetation in broadleaf crops. In some aspects, the compositions and methods disclosed herein can be used for controlling undesirable vegetation in canola, flax, sunflower, soy, or cotton. In some aspects, the compositions and methods disclosed herein can be used in industrial vegetation management (IVM) or for utility, pipeline, roadside, and railroad rights-of-way applications. In some aspects, the compositions and methods disclosed herein can also be used in forestry (*e.g.*, for site preparation or for combating undesirable vegetation in plantation forests). In some aspects, the compositions and methods disclosed herein can be used to control undesirable vegetation in conservation reserve program lands (CRP), trees, vines, grasslands, and grasses grown for seeds. In some aspects, the compositions and methods disclosed herein can be used on lawns (*e.g.*, residential, industrial, and institutional), golf courses, parks, cemeteries, athletic fields, and sod farms.

[0131] The compositions and methods disclosed herein can also be used in crop plants that are resistant to, for instance, herbicides, pathogens, and/or insects. In some aspects, the compositions and methods disclosed herein can be used in crop plants that are resistant to one or more herbicides

because of genetic engineering or breeding. In some aspects, the compositions and methods disclosed herein can be used in crop plants that are resistant to one or more pathogens such as plant pathogenic fungi owing to genetic engineering or breeding. In some aspects, the compositions and methods disclosed herein can be used in crop plants that are resistant to attack by insects owing to genetic engineering or breeding. Exemplary resistant crops include, but are not limited to, crops that are resistant to photosystem II inhibitors, or crop plants that, owing to introduction of the gene for *Bacillus thuringiensis* (or *Bt*) toxin by genetic modification, are resistant to attack by certain insects. In some aspects, the compositions and methods described herein can be used in conjunction with glyphosate, glufosinate, dicamba, phenoxy auxins, pyridyloxy auxins, aryloxyphenoxypropionates, acetyl CoA carboxylase (ACCase) inhibitors, imidazolinones, acetolactate synthase (ALS) inhibitors, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, protoporphyrinogen oxidase (PPO) inhibitors, triazines, and bromoxynil to control vegetation in crops tolerant to glyphosate, glufosinate, dicamba, phenoxy auxins, pyridyloxy auxins, aryloxyphenoxypropionates, ACCase inhibitors, imidazolinones, synthetic auxin herbicide, HPPD inhibitors, PPO inhibitors, triazines, bromoxynil, or combinations thereof. In some aspects, the undesirable vegetation is controlled in glyphosate, glufosinate, dicamba, phenoxy auxins, pyridyloxy auxins, aryloxyphenoxypropionates, ACCase inhibitors, synthetic auxin herbicide, HPPD inhibitors, PPO inhibitors, triazines, and bromoxynil tolerant crops possessing single, multiple or stacked traits conferring tolerance to single or multiple chemistries and/or multiple modes of action. In some aspects, the undesirable vegetation can be controlled in a crop that is ACCase-tolerant, ALS-tolerant, or a combination thereof. The combination of (a) and (b) can be used in combination with one or more herbicides that are selective for the crop being treated and which complement the spectrum of weeds controlled by these compounds at the application rate employed. In some aspects, the compositions described herein and other complementary herbicides are applied at the same time, either as a combination formulation or as a tank mix, or as sequential applications. The compositions and methods may be used in controlling undesirable vegetation in crops possessing agronomic stress tolerance (including but not limited to drought, cold, heat, salt, water, nutrient, fertility, pH), pest tolerance (including but not limited to insects, fungi and pathogens), and crop improvement traits (including but not limited to yield; protein, carbohydrate, or oil content; protein, carbohydrate, or oil composition; plant stature and plant architecture).

[0132] In some aspects, the compositions disclosed herein can be used for controlling undesirable vegetation including grasses, broadleaf weeds, sedge weeds, and combinations thereof. In some aspects, the compositions disclosed herein can be used for controlling undesirable

vegetation including, but not limited to, *Polygonum* species, *Amaranthus* species, *Chenopodium* species, *Sida* species, *Ambrosia* species, *Cyperus* species, *Setaria* species, *Sorghum* species, *Acanthospermum* species, *Anthemis* species, *Atriplex* species, *Brassica* species, *Cirsium* species, *Convolvulus* species, *Conyza* species, *Cassia* species, *Commelina* species, *Datura* species, *Euphorbia* species, *Geranium* species, *Galinsoga* species, *Ipomea* species, *Lamium* species, *Lolium* species, *Malva* species, *Matricaria* species, *Prosopis* species, *Rumex* species, *Sisymbrium* species, *Solanum* species, *Trifolium* species, *Xanthium* species, *Veronica* species, and *Viola* species. In some aspects, the undesired vegetation includes common chickweed (*Stellaria media*), velvetleaf (*Abutilon theophrasti*), hemp sesbania (*Sesbania exaltata* Cory), *Anoda cristata*, *Bidens pilosa*, *Brassica kaber*, shepherd's purse (*Capsella bursa-pastoris*), cornflower (*Centaurea cyanus* or *Cyanus segetum*), hempnettle (*Galeopsis tetrahit*), cleavers (*Galium aparine*), common sunflower (*Helianthus annuus*), *Desmodium tortuosum*, Italian ryegrass (*Lolium multiflorum*), kochia (*Kochia scoparia*), *Medicago arabica*, *Mercurialis annua*, *Myosotis arvensis*, common poppy (*Papaver rhoeas*), *Raphanus raphanistrum*, broad-leaf dock (*Rumex obtusifolius*), Russian thistle (*Salsola kali*), wild mustard (*Sinapis arvensis*), *Sonchus arvensis*, *Thlaspi arvense*, *Tagetes minuta*, *Richardia brasiliensis*, *Plantago major*, *Plantago lanceolata*, bird's-eye speedwell (*Veronica persica*), pigweed (*Amaranthus retroflexus*), winter rape (*Brassica napus*), lambsquarters (*Chenopodium album*), Canadian thistle (*Cirsium arvense*), nutsedge (*Cyperus esculentus*), poinsettia (*Euphorbia heterophylla*), prickly lettuce (*Lactuca serriola*), purple deadnettle (*Lamium purpureum*), wild chamomile (*Matricaria chamomilla*), false chamomile (*Matricaria inodora*), field chamomile (*Anthemis arvensis*), common buckwheat (*Fagopyrum esculentum*), wild buckwheat (*Polygonum convulvum*), giant foxtail (*Setaria faberi*), green foxtail (*Setaria viridis*), common sorghum (*Sorghum vulgare*), wild pansy (*Viola tricolor*), or a combination thereof.

[0133] The compositions described herein can be used to control herbicide resistant or tolerant weeds. The methods employing the compositions described herein may also be employed to control herbicide resistant or tolerant weeds. Exemplary resistant or tolerant weeds include, but are not limited to, biotypes resistant or tolerant to acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) inhibitors (e.g., imidazolinones, sulfonyleureas, pyrimidinylthiobenzoates, triazolopyrimidines, sulfonylaminocarbonyltriazolinones), photosystem II inhibitors (e.g., phenylcarbamates, pyridazinones, triazines, triazinones, uracils, amides, ureas, benzothiadiazinones, nitriles, phenylpyridazines), acetyl CoA carboxylase (ACCase) inhibitors (e.g., aryloxyphenoxypropionates, cyclohexanediones, phenylpyrazolines), synthetic auxins (e.g., benzoic acids, phenoxyacetic acids, pyridine carboxylates, quinoline carboxylic acids), auxin

transport inhibitors (*e.g.*, phthalamates, semicarbazones), photosystem I inhibitors (*e.g.*, bipyridyliums), 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitors (*e.g.*, glyphosate), glutamine synthetase inhibitors (*e.g.*, glufosinate, bialaphos), microtubule assembly inhibitors (*e.g.*, benzamides, benzoic acids, dinitroanilines, phosphoramidates, pyridines), mitosis inhibitors (*e.g.*, carbamates), very long chain fatty acid (VLCFA) inhibitors (*e.g.*, acetamides, chloroacetamides, oxyacetamides, tetrazolinones), fatty acid and lipid synthesis inhibitors (*e.g.*, phosphorodithioates, thiocarbamates, benzofuranes, chlorocarbonic acids), protoporphyrinogen oxidase (PPO) inhibitors (*e.g.*, diphenylethers, *N*-phenylphthalimides, oxadiazoles, oxazolidinediones, phenylpyrazoles, pyrimidindiones, thiadiazoles, triazolinones), carotenoid biosynthesis inhibitors (*e.g.*, clomazone, amitrole, aclonifen), phytoene desaturase (PDS) inhibitors (*e.g.*, amides, anilidex, furanones, phenoxybutan-amides, pyridiazinones, pyridines), 4-hydroxyphenyl-pyruvate-dioxygenase (HPPD) inhibitors (*e.g.*, callistemones, isoxazoles, pyrazoles, triketones), cellulose biosynthesis inhibitors (*e.g.*, nitriles, benzamides, quinclorac, triazolocarboxamides), herbicides with multiple modes of action such as quinclorac, and unclassified herbicides such as arylaminopropionic acids, difenzoquat, endothall, and organoarsenicals. Exemplary resistant or tolerant weeds include, but are not limited to, biotypes with resistance or tolerance to multiple herbicides, biotypes with resistance or tolerance to multiple chemical classes, biotypes with resistance or tolerance to multiple herbicide modes of action, and biotypes with multiple resistance or tolerance mechanisms (*e.g.*, target site resistance or metabolic resistance).

[0134] By way of non-limiting illustration, examples of some aspects of the present disclosure are given below. Parts and percentages are on a per weight basis unless otherwise indicated.

Examples

Greenhouse Trial Methodology - Evaluation of Postemergence Herbicidal Effect

[0135] Seeds of the desired test plant species were planted in a 90:10 % v/v (volume/volume) mixture of PRO-MIX® BX (Premier Tech Horticulture, Quakertown, PA, USA) and PROFILE® GREENS GRADE™ (Profile Products LLC, Buffalo Grove, IL, USA) planting mixture, which typically has a pH of 5.2 to 6.2 and an organic matter content of at least 50 percent, in plastic pots with a surface area of 103.2 square centimeters (cm²). In some aspects, to help ensure good germination and healthy plants, a fungicide treatment and/or other chemical or physical treatment was applied. The plants were grown for 7–36 days (d) in a greenhouse with an approximate 14-hour (h) photoperiod which was maintained at about 23 °C during the day and 22 °C during the night. Nutrients and water were added on a regular basis and supplemental lighting was provided

with overhead metal halide 1000-Watt lamps as necessary. The plants were employed for testing when they reached the second or third true leaf stage.

[0136] Emulsifiable concentrates of each of each pyridine carboxylate herbicide (Compound A or Compound B) were prepared at 100 grams acid equivalent per liter (g ae/L). The emulsifiable concentrates also included a safener, cloquintocet-mexyl, at 120 grams active ingredient per liter (g ai/L), unless otherwise noted below. An aliquot of each emulsifiable concentrate was placed in a 25 mL glass vial and diluted with an aqueous mixture of 1.25% (v/v) ACTIROB® B esterified rapeseed oil (Bayer Crop Science, Research Triangle Park, NC, USA) or MSO® Concentrate with LECI-TECH® methylated soybean oil (Loveland Products, Loveland, CO, USA) to obtain concentrated stock solutions at the highest application rate for each herbicide, based upon a 12 milliliter (mL) application volume at a rate of 187 liters per hectare (L/ha). The concentrated stock solutions were further diluted with an aqueous mixture of 1.25% v/v ACTIROB® B or MSO® Concentrate with LECI-TECH® to obtain stock solutions at reduced application rates for each herbicide. Spray solutions of the herbicide combinations (Compound A or Compound B plus ACCase inhibitor herbicide) were prepared by adding weighed amounts or aliquots of the ACCase inhibitor herbicide to the stock solutions of Compound A or Compound B to form 12-mL spray solutions in two-way combinations.

[0137] The spray solutions were applied to the plant material with an overhead Mandel track sprayer equipped with 8002E nozzles calibrated to deliver 187 L/ha over an application area of 0.503 square meters (m²) at a spray height of 18 inches (43 centimeters (cm)) above the average plant canopy. Control plants were sprayed in the same manner with the solvent blank. All pyridine carboxylate herbicide (component a) application rates are given as "g ae/ha" and all ACCase inhibitor herbicide (component b) application rates are given as "g ai/ha."

[0138] The treated plants and control plants were placed in a greenhouse as described above and watered by sub-irrigation to prevent wash-off of the test compounds. After 20-22 d, the condition of the test plants as compared with that of the control plants was determined visually and scored on a scale of 0 to 100 percent where 0 corresponds to no injury and 100 corresponds to complete kill.

[0139] The details of the compositions and the crops tested are specified in the following Examples.

Example 1

[0140] Compositions comprising Compound A and clodinafop were tested on undesirable vegetation species, including rice (ORYSA, *Oryza sativa*), barnyard grass (ECHCG, *Echinochloa*

crus-galli), large crabgrass (DIGSA, *Digitaria sanguinalis*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), annual ryegrass (LOLMG, *Lolium multiflorum* subsp. *gaudini*), maize (ZEAMX, *Zea mays*), giant foxtail (SETFA, *Setaria faberi*), and nutsedge (CYPES, *Cyperus esculentus*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0141] The results are summarized in Table 1 below.

Table 1. Herbicidal Effects (% visual injury) of Compound A and Clodinafop on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Clodinafop	0	0	30	30	30
ORYSA	Obs	0	0	83	84	96
	Exp	-	-	-	83	83
	△				2	14
ECHCG	Obs	68	70	100	100	100
	Exp	-	-	-	100	100
	△				0	0
DIGSA	Obs	0	0	80	85	95
	Exp	-	-	-	80	80
	△				5	15
ALOMY	Obs	0	0	10	10	10
	Exp	-	-	-	10	10
	△				0	0
AVEFA	Obs	0	0	80	93	98
	Exp	-	-	-	80	80
	△				13	18
LOLMG	Obs	0	3	15	65	68
	Exp	-	-	-	15	17
	△				50	50
ZEAMX	Obs	0	0	90	99	100
	Exp	-	-	-	90	90
	△				9	10
SETFA	Obs	0	0	98	100	100
	Exp	-	-	-	98	98
	△				3	3
CYPES	Obs	40	45	0	15	43
	Exp	-	-	-	40	45
	△				-25	-3

g/ha = grams per hectare

ORYSA = *Oryza sativa* (common rice)

ECHCG = *Echinochloa crus-galli* (barnyardgrass)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

ALOMY = *Alopecurus myosuroides* (blackgrass)

AVEFA = *Avena fatua* (wild oat)
 LOLMG = *Lolium multiflorum subsp. gaudini* (annual ryegrass)
 ZEAMX = *Zea mays* (maize)
 SETFA = *Setaria faberi* (giant foxtail)
 CYPES = *Cyperus esculentus* (nutsedge)

Example 2

[0142] Compositions comprising Compound A and fenoxaprop were tested on undesirable vegetation species, including rice (ORYSA, *Oryza sativa*), barnyard grass (ECHCG, *Echinochloa crus-galli*), large crabgrass (DIGSA, *Digitaria sanguinalis*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), annual ryegrass (LOLMG, *Lolium multiflorum subsp. gaudini*), maize (ZEAMX, *Zea mays*), giant foxtail (SETFA, *Setaria faberi*), and nutsedge (CYPES, *Cyperus esculentus*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0143] The results are summarized in Table 2 below.

Table 2. Herbicidal Effects (% visual injury) of Compound A and Fenoxaprop on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Fenoxaprop	0	0	46	46	46
ORYSA	Obs	0	0	35	10	45
	Exp	-	-	-	35	35
	△				-25	10
ECHCG	Obs	68	70	100	100	100
	Exp	-	-	-	100	100
	△				0	0
DIGSA	Obs	0	0	96	100	100
	Exp	-	-	-	96	96
	△				4	4
ALOMY	Obs	0	0	0	0	0
	Exp	-	-	-	0	0
	△				0	0
AVEFA	Obs	0	0	68	78	93
	Exp	-	-	-	68	68
	△				10	25
LOLMG	Obs	0	3	0	0	0
	Exp	-	-	-	0	3
	△				0	-3
ZEAMX	Obs	0	0	100	100	100
	Exp	-	-	-	100	100
	△				0	0
SETFA	Obs	0	0	100	100	100
	Exp	-	-	-	100	100

	△				0	0
CYPES	Obs	40	45	0	60	50
	Exp	-	-	-	40	45
	△				20	5

g/ha = grams per hectare

- ORYSA = *Oryza sativa* (common rice)
- ECHCG = *Echinochloa crus-galli* (barnyardgrass)
- DIGSA = *Digitaria sanguinalis* (large crabgrass)
- ALOMY = *Alopecurus myosuroides* (blackgrass)
- AVEFA = *Avena fatua* (wild oat)
- LOLMG = *Lolium multiflorum subsp. gaudini* (annual ryegrass)
- ZEAMX = *Zea mays* (maize)
- SETFA = *Setaria faberi* (giant foxtail)
- CYPES = *Cyperus esculentus* (nutsedge)

Example 3

[0144] Compositions comprising Compound A and pinoxaden were tested on undesirable vegetation species, including rice (ORYSA, *Oryza sativa*), barnyard grass (ECHCG, *Echinochloa crus-galli*), large crabgrass (DIGSA, *Digitaria sanguinalis*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), annual ryegrass (LOLMG, *Lolium multiflorum subsp. gaudini*), maize (ZEAMX, *Zea mays*), giant foxtail (SETFA, *Setaria faberi*), and nutsedge (CYPES, *Cyperus esculentus*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0145] The results are summarized in Table 3 below.

Table 3. Herbicidal Effects (% visual injury) of Compound A and Pinoxaden on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Pinoxaden	0	0	30	30	30
ORYSA	Obs	0	0	99	99	100
	Exp	-	-	-	99	99
	△				0	2
ECHCG	Obs	68	70	100	100	100
	Exp	-	-	-	100	100
	△				0	0
DIGSA	Obs	0	0	5	55	80
	Exp	-	-	-	5	5
	△				50	75
ALOMY	Obs	0	0	5	5	10
	Exp	-	-	-	5	5
	△				0	5
AVEFA	Obs	0	0	88	90	96
	Exp	-	-	-	88	88

	△				3	9
LOLMG	Obs	0	3	94	100	100
	Exp	-	-	-	94	94
	△				7	6
ZEAMX	Obs	0	0	5	10	15
	Exp	-	-	-	5	5
	△				5	10
SETFA	Obs	0	0	10	15	20
	Exp	-	-	-	10	10
	△				5	10
CYPES	Obs	40	45	0	40	40
	Exp	-	-	-	40	45
	△				0	-5

g/ha = grams per hectare

- ORYSA = *Oryza sativa* (common rice)
- ECHCG = *Echinochloa crus-galli* (barnyardgrass)
- DIGSA = *Digitaria sanguinalis* (large crabgrass)
- ALOMY = *Alopecurus myosuroides* (blackgrass)
- AVEFA = *Avena fatua* (wild oat)
- LOLMG = *Lolium multiflorum subsp. gaudini* (annual ryegrass)
- ZEAMX = *Zea mays* (maize)
- SETFA = *Setaria faberi* (giant foxtail)
- CYPES = *Cyperus esculentus* (nutsedge)

Example 4

[0146] Compositions comprising Compound A and sethoxydim were tested on undesirable vegetation species, including broad-leaf dock (RUMOB, *Rumex obtusifolius*), chickweed (STEME, *Stellaria media*), spring rape (BRSNN, *Brassica napus*), kochia (KCHSC, *Kochia scoparia*), blackgrass (ALOMY, *Alopecurus myosuroides*), Italian ryegrass (LOLMU, *Lolium multiflorum*), and large crabgrass (DIGSA, *Digitaria sanguinalis*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0147] The results are summarized in Table 4 below.

Table 4. Herbicidal Effects (% visual injury) of Compound A and Sethoxydim on weed and grain crops.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Sethoxydim	0	0	70	70	70
RUMOB	Obs	13	8	0	0	23
	Exp	--	--	--	13	8
	△				-13	15

STEME	Obs	90	85	0	80	88
	Exp	--	--	--	90	85
	△				-10	3
BRSNN	Obs	23	45	0	55	50
	Exp	--	--	--	23	45
	△				33	5
KCHSC	Obs	63	70	0	65	75
	Exp	--	--	--	63	70
	△				3	5
ALOMY	Obs	0	0	58	63	55
	Exp	--	--	--	58	58
	△				5	-3
LOLMU	Obs	8	3	83	78	80
	Exp	--	--	--	84	83
	△				-6	-3
DIGSA	Obs	13	25	60	68	58
	Exp	--	--	--	65	70
	△				3	-13

g/ha = grams per hectare

RUMOB = *Rumex obtusifolius* (broad-leaf dock)

STEME = *Stellaria media* (chickweed)

BRSNN = *Brassica napus* (spring rape)

KCHSC = *Kochia scoparia* (kochia)

ALOMY = *Alopecurus myosuroides* (blackgrass)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

Example 5

[0148] Compositions comprising Compound A and tralkoxydim were tested on undesirable vegetation species, including barnyard grass (ECHCG, *Echinochloa crus-galli*), large crabgrass (DIGSA, *Digitaria sanguinalis*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), annual ryegrass (LOLMG, *Lolium multiflorum subsp. gaudini*), giant foxtail (SETFA, *Setaria faberi*), and nutsedge (CYPES, *Cyperus esculentus*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0149] The results are summarized in Table 5 below.

Table 5. Herbicidal Effects (% visual injury) of Compound A and Tralkoxydim on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Tralkoxydim	0	0	100	100	100
ECHCG	Obs	68	70	85	100	100
	Exp	-	-	-	95	96
	△				5	5
DIGSA	Obs	0	0	30	60	70
	Exp	-	-	-	30	30
	△				30	40
ALOMY	Obs	0	0	15	25	30
	Exp	-	-	-	15	15
	△				10	15
AVEFA	Obs	0	0	88	95	97
	Exp	-	-	-	88	88
	△				8	10
LOLMG	Obs	0	3	70	75	68
	Exp	-	-	-	70	71
	△				5	-3
SETFA	Obs	0	0	40	50	53
	Exp	-	-	-	40	40
	△				10	13
CYPES	Obs	40	45	5	55	63
	Exp	-	-	-	43	48
	△				12	15

g/ha = grams per hectare

ECHCG = *Echinochloa crus-galli* (barnyardgrass)DIGSA = *Digitaria sanguinalis* (large crabgrass)ALOMY = *Alopecurus myosuroides* (blackgrass)AVEFA = *Avena fatua* (wild oat)LOLMG = *Lolium multiflorum subsp. gaudini* (annual ryegrass)SETFA = *Setaria faberi* (giant foxtail)CYPES = *Cyperus esculentus* (nutsedge)Example 6

[0150] Compositions comprising Compound A and cyhalofop were tested on undesirable vegetation species, including barnyard grass (ECHCG, *Echinochloa crus-galli*), small-flower flatsedge (CYPDI, *Cyperus difformis*), and broadleaf signalgrass (BRAPP, *Brachiaria platyphylla*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0151] The results are summarized in Table 6 below.

Table 6. Herbicidal Effects (% visual injury) of Compound A and Cyhalofop on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Cyhalofop	0	0	150	150	150
ECHCG	Obs	80	85	78	98	95
	Exp	-	-	-	96	97
	△				2	-2
CYPDI	Obs	60	72	10	87	85
	Exp	-	-	-	64	75
	△				23	11
BRAPP	Obs	43	68	96	100	100
	Exp	-	-	-	98	99
	△				2	1

g/ha = grams per hectare

ECHCG = *Echinochloa crus-galli* (barnyardgrass)CYPDI = *Cyperus difformis* (small-flower flatsedge)BRAPP = *Brachiaria platyphylla* (broadleaf signalgrass)**Example 7**

[0152] Compositions comprising Compound B and clodinafop were tested on undesirable vegetation species, including nutsedge (CYPES, *Cyperus esculentus*), wild oat (AVEFA, *Avena fatua*), and Italian ryegrass (LOLMU, *Lolium multiflorum*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0153] The results are summarized in Table 7 below.

Table 7. Herbicidal Effects (% visual injury) of Compound B and Clodinafop on weeds.

Application rate (g/ha)	Compound B	7.5	10	0	7.5	10
	Clodinafop	0	0	30	30	30
CYPES	Obs	38	5	5	85	90
	Exp	-	-	-	41	38
	△				44	52
AVEFA	Obs	0	0	85	90	93
	Exp	-	-	-	85	85
	△				5	8
LOLMU	Obs	0	0	55	73	70
	Exp	-	-	-	55	55
	△				18	15

g/ha = grams per hectare

CYPES = *Cyperus esculentus* (nutsedge)AVEFA = *Avena fatua* (wild oat)LOLMU = *Lolium multiflorum* (Italian ryegrass)

Example 8

[0154] Compositions comprising Compound B and fenoxaprop were tested on undesirable vegetation species, including Italian ryegrass (LOLMU, *Lolium multiflorum*) and nutsedge (CYPES, *Cyperus esculentus*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0155] The results are summarized in Table 8 below.

Table 8. Herbicidal Effects (% visual injury) of Compound B and Fenoxaprop on weeds.

Application rate (g/ha)	Compound B	7.5	10	0	7.5	10
	Fenoxaprop	0	0	46	46	46
LOLMU	Obs	0	0	5	10	13
	Exp	-	-	-	5	5
	△				5	8
CYPES	Obs	38	35	0	83	93
	Exp	-	-	-	38	35
	△				45	58

g/ha = grams per hectare

LOLMU = *Lolium multiflorum* (Italian ryegrass)

CYPES = *Cyperus esculentus* (nutsedge)

Example 9

[0156] Compositions comprising Compound B and pinoxaden were tested on undesirable vegetation species, including nutsedge (CYPES, *Cyperus esculentus*), large crabgrass (DIGSA, *Digitaria sanguinalis*), wild oat (AVEFA, *Avena fatua*), and Italian ryegrass (LOLMU, *Lolium multiflorum*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0157] The results are summarized in Table 9 below.

Table 9. Herbicidal Effects (% visual injury) of Compound B and Pinoxaden on weeds.

Application rate (g/ha)	Compound B	7.5	10	0	7.5	10
	Pinoxaden	0	0	30	30	30
CYPES	Obs	38	35	8	78	70
	Exp	-	-	-	42	40
	△				35	30
DIGSA	Obs	25	33	35	75	75
	Exp	-	-	-	51	56
	△				24	19
AVEFA	Obs	0	0	80	88	88
	Exp	-	-	-	80	80
	△				8	8

LOLMU	Obs	0	0	90	95	93
	Exp	-	-	-	90	90
	△				5	3

g/ha = grams per hectare

CYPES = *Cyperus esculentus* (nutsedge)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

AVEFA = *Avena fatua* (wild oat)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

Example 10

[0158] Compositions comprising Compound B and tralkoxydim were tested on undesirable vegetation species, including nutsedge (CYPES, *Cyperus esculentus*), large crabgrass (DIGSA, *Digitaria sanguinalis*), blackgrass (ALOMY, *Alopecurus myosuroides*), Italian ryegrass (LOLMU, *Lolium multiflorum*), and sorghum (SORVU, *Sorghum vulgare*), to determine the efficacy of the compositions on these undesirable vegetation species.

[0159] The results are summarized in Table 10 below.

Table 10. Herbicidal Effects (% visual injury) of Compound B and Tralkoxydim on weeds.

Application rate (g/ha)	Compound B	7.5	10	0	7.5	10
	Tralkoxydim	0	0	100	100	100
CYPES	Obs	38	35	0	70	85
	Exp	-	-	-	38	35
	△				33	50
DIGSA	Obs	25	33	48	75	75
	Exp	-	-	-	61	65
	△				14	10
ALOMY	Obs	0	0	8	40	40
	Exp	-	-	-	8	8
	△				33	33
LOLMU	Obs	0	0	68	78	80
	Exp	-	-	-	68	68
	△				10	13
SORVU	Obs	10	20	65	85	93
	Exp	-	-	-	69	72
	△				17	21

g/ha = grams per hectare

CYPES = *Cyperus esculentus* (nutsedge)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

ALOMY = *Alopecurus myosuroides* (blackgrass)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

SORVU = *Sorghum vulgare* (sorghum)

Example 11

[0160] Compositions comprising Compound A (without cloquintocet-mexyl safener) and clethodim were tested to determine the efficacy of the compositions on undesirable vegetation species, including wild pansy (VIOTR, *Viola tricolor*), chickweed (STEME, *Stellaria media*), ivyleaf morningglory (IPOHE, *Ipomoea hederacea*), Canadian thistle (CIRAR, *Cirsium arvense*), velvetleaf (ABUTH, *Abutilon theophrasti*), soybean (GLXMA, *Glycine max*), broad-leaf dock (RUMOB, *Rumex obtusifolius*), winter rape (BRSNW, *Brassica napus*), wild buckwheat (POLCO, *Polygonum convolvulus*), kochia (KCHSC, *Kochia scoparia*), common sunflower (HELAN, *Helianthus annuus*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), Italian ryegrass (LOLMU, *Lolium multiflorum*), barnyard grass (ECHCG, *Echinochloa crus-galli*), nutsedge (CYPES, *Cyperus esculentus*), Chinese sprangletop (LEFCH, *Leptochloa chinensis*), large crabgrass (DIGSA, *Digitaria sanguinalis*), giant foxtail (SETFA, *Setaria faberi*), and grain sorghum (SORVU, *Sorghum vulgare*).

[0161] The results are summarized in Table 11 below.

Table 11. Herbicidal Effects (% visual injury) of Compound A and Clethodim on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Clethodim	0	0	70	70	70
VIOTR	Obs	8	15	0	15	25
	Exp	-	-	-	8	15
	△				8	10
STEME	Obs	73	88	0	60	65
	Exp	-	-	-	73	88
	△				-13	-23
IPOHE	Obs	10	15	0	10	10
	Exp	-	-	-	10	15
	△				0	-5
CIRAR	Obs	40	28	0	58	50
	Exp	-	-	-	40	28
	△				18	23
ABUTH	Obs	70	75	0	70	83

	Exp	-	-	-	70	75
	△				0	8
GLXMA	Obs	85	85	5	95	95
	Exp	-	-	-	86	86
	△				9	9
RUMOB	Obs	38	35	0	35	50
	Exp	-	-	-	38	35
	△				-3	15
BRSNW	Obs	50	65	0	80	83
	Exp	-	-	-	50	65
	△				30	18
POLCO	Obs	80	78	0	85	90
	Exp	-	-	-	80	78
	△				5	13
KCHSC	Obs	73	88	0	80	90
	Exp	-	-	-	73	88
	△				8	3
HELAN	Obs	95	100	0	99	98
	Exp	-	-	-	95	100
	△				4	-3
ALOMY	Obs	0	0	95	94	96
	Exp	-	-	-	95	95
	△				-2	-1
AVEFA	Obs	0	0	95	97	97
	Exp	-	-	-	95	95
	△				2	2
LOLMU	Obs	0	0	95	100	100
	Exp	-	-	-	95	95
	△				5	5
ECHCG	Obs	55	58	90	98	96
	Exp	-	-	-	96	96
	△				2	0
CYPES	Obs	0	0	15	30	25

	Exp	-	-	-	15	15
	△				15	10
LEFCH	Obs	0	0	95	95	95
	Exp	-	-	-	95	95
	△				0	0
DIGSA	Obs	0	8	95	98	95
	Exp	-	-	-	95	95
	△				3	0
SETFA	Obs	0	0	90	93	95
	Exp	-	-	-	90	90
	△				3	5
SORVU	Obs	0	0	98	98	98
	Exp	-	-	-	98	98
	△				0	0

g/ha = grams per hectare

VIOTR = *Viola tricolor* (wild pansy)
 STEME = *Stellaria media* (chickweed)
 IPOHE = *Ipomoea hederacea* (ivy leaf morning glory)
 CIRAR = *Cirsium arvense* (Canadian thistle)
 ABUTH = *Abutilon theophrasti* (velvet leaf)
 GLXMA = *Glycine max* (soybean)
 RUMOB = *Rumex obtusifolius* (broad-leaf dock)
 BRSNW = *Brassica napus* (winter rape)
 POLCO = *Polygonum convolvulus* (wild buckwheat)
 KCHSC = *Kochia scoparia* (kochia)
 HELAN = *Helianthus annuus* (common sunflower)
 ALOMY = *Alopecurus myosuroides* (blackgrass)
 AVEFA = *Avena fatua* (wild oat)
 LOLMU = *Lolium multiflorum* (Italian ryegrass)
 ECHCG = *Echinochloa crus-galli* (barnyardgrass)
 CYPES = *Cyperus esculentus* (nutsedge)
 LEFCH = *Leptochloa chinensis* (Chinese sprangletop)
 DIGSA = *Digitaria sanguinalis* (large crabgrass)
 SETFA = *Setaria faberi* (giant foxtail)
 SORVU = *Sorghum vulgare* (grain sorghum)

Example 12

[0162] Compositions comprising Compound A (without cloquintocet-mexyl safener) and fluazifop were tested to determine the efficacy of the compositions on undesirable vegetation species, including wild pansy (VIOTR, *Viola tricolor*), chickweed (STEME, *Stellaria media*), ivy leaf morning glory (IPOHE, *Ipomoea hederacea*), Canadian thistle (CIRAR, *Cirsium arvense*), velvet leaf (ABUTH, *Abutilon theophrasti*), soybean (GLXMA, *Glycine max*), broad-leaf dock

(RUMOB, *Rumex obtusifolius*), winter rape (BRSNW, *Brassica napus*), wild buckwheat (POLCO, *Polygonum convolvulus*), kochia (KCHSC, *Kochia scoparia*), common sunflower (HELAN, *Helianthus annuus*), blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), Italian ryegrass (LOLMU, *Lolium multiflorum*), barnyard grass (ECHCG, *Echinochloa crus-galli*), nutsedge (CYPES, *Cyperus esculentus*), Chinese sprangletop (LEFCH, *Leptochloa chinensis*), large crabgrass (DIGSA, *Digitaria sanguinalis*), giant foxtail (SETFA, *Setaria faberi*), and grain sorghum (SORVU, *Sorghum vulgare*).

[0163] The results are summarized in Table 12 below.

Table 12. Herbicidal Effects (% visual injury) of Compound A and Fluazifop on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Fluazifop	0	0	105	105	105
VIOTR	Obs	8	15	3	40	70
	Exp	-	-	-	10	17
	△				30	53
STEME	Obs	73	88	0	65	88
	Exp	-	-	-	73	88
	△				-8	0
IPOHE	Obs	10	15	0	5	13
	Exp	-	-	-	10	15
	△				-5	-3
CIRAR	Obs	40	28	5	45	80
	Exp	-	-	-	43	31
	△				2	31
ABUTH	Obs	70	75	0	73	75
	Exp	-	-	-	70	75
	△				3	0
GLXMA	Obs	85	85	28	95	98
	Exp	-	-	-	89	89
	△				6	8
RUMOB	Obs	38	35	0	30	70
	Exp	-	-	-	38	35
	△				-8	35

BRSNW	Obs	50	65	0	65	73
	Exp	-	-	-	50	65
	△				15	8
POLCO	Obs	80	78	0	75	98
	Exp	-	-	-	80	78
	△				-5	20
KCHSC	Obs	73	88	0	75	89
	Exp	-	-	-	73	88
	△				3	2
HELAN	Obs	95	100	0	90	100
	Exp	-	-	-	95	100
	△				-5	0
ALOMY	Obs	0	0	85	90	95
	Exp	-	-	-	85	85
	△				5	10
AVEFA	Obs	0	0	95	96	96
	Exp	-	-	-	95	95
	△				1	1
LOLMU	Obs	0	0	88	88	95
	Exp	-	-	-	88	88
	△				0	8
ECHCG	Obs	55	58	95	99	99
	Exp	-	-	-	98	98
	△				1	1
CYPES	Obs	0	0	0	0	0
	Exp	-	-	-	0	0
	△				0	0
LEFCH	Obs	0	0	98	98	100
	Exp	-	-	-	98	98
	△				0	3
DIGSA	Obs	0	8	95	96	97
	Exp	-	-	-	95	95
	△				1	2

SETFA	Obs	0	0	85	85	88
	Exp	-	-	-	85	85
	△				0	3
SORVU	Obs	0	0	100	10	100
	Exp	-	-	-	100	100
	△				0	0

g/ha = grams per hectare

- VIOTR = *Viola tricolor* (wild pansy)
- STEME = *Stellaria media* (chickweed)
- IPOHE = *Ipomoea hederacea* (ivyleaf morningglory)
- CIRAR = *Cirsium arvense* (Canadian thistle)
- ABUTH = *Abutilon theophrasti* (velvetleaf)
- GLXMA = *Glycine max* (soybean)
- RUMOB = *Rumex obtusifolius* (broad-leaf dock)
- BRSNW = *Brassica napus* (winter rape)
- POLCO = *Polygonum convolvulus* (wild buckwheat)
- KCHSC = *Kochia scoparia* (kochia)
- HELAN = *Helianthus annuus* (common sunflower)
- ALOMY = *Alopecurus myosuroides* (blackgrass)
- AVEFA = *Avena fatua* (wild oat)
- LOLMU = *Lolium multiflorum* (Italian ryegrass)
- ECHCG = *Echinochloa crus-galli* (barnyardgrass)
- CYPES = *Cyperus esculentus* (nutsedge)
- LEFCH = *Leptochloa chinensis* (Chinese sprangletop)
- DIGSA = *Digitaria sanguinalis* (large crabgrass)
- SETFA = *Setaria faberi* (giant foxtail)
- SORVU = *Sorghum vulgare* (grain sorghum)

Example 13

[0164] Compositions comprising Compound A (without cloquintocet-mexyl safener) and fluazifop were tested to determine the efficacy of the compositions on undesirable vegetation species, including blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), nutsedge (CYPES, *Cyperus esculentus*), large crabgrass (DIGSA, *Digitaria sanguinalis*), barnyard grass (ECHCG, *Echinochloa crus-galli*), Chinese sprangletop (LEFCH, *Leptochloa chinensis*), Italian ryegrass (LOLMU, *Lolium multiflorum*), and giant foxtail (SETFA, *Setaria faberi*).

[0165] The results are summarized in Table 13 below.

Table 1. Herbicidal Effects (% visual injury) of Compound A and Fluazifop on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Fluazifop	0	0	105	105	105
ALOMY	Obs	5	8	93	95	95

	Exp	-	-	-	93	93
	△				2	2
AVEFA	Obs	0	0	93	98	98
	Exp	-	-	-	93	93
	△				5	5
CYPES	Obs	10	25	5	38	55
	Exp	-	-	-	15	29
	△				23	26
DIGSA	Obs	20	35	95	99	99
	Exp	-	-	-	96	97
	△				3	2
ECHCG	Obs	88	93	95	100	100
	Exp	-	-	-	99	100
	△				1	0
LEFCH	Obs	0	5	100	100	100
	Exp	-	-	-	100	100
	△				0	0
LOLMU	Obs	0	0	80	65	63
	Exp	-	-	-	80	80
	△				-15	-18
SETFA	Obs	63	60	90	93	96
	Exp	-	-	-	96	96
	△				-4	0

g/ha = grams per hectare

ALOMY = *Alopecurus myosuroides* (blackgrass)

AVEFA = *Avena fatua* (wild oat)

CYPES = *Cyperus esculentus* (nutsedge)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

ECHCG = *Echinochloa crus-galli* (barnyardgrass)

LEFCH = *Leptochloa chinensis* (Chinese sprangletop)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

SETFA = *Setaria faberi* (giant foxtail)

Example 14

[0166] Compositions comprising Compound A (without cloquintocet-mexyl safener) and haloxyfop-R-methyl were tested to determine the efficacy of the compositions on undesirable vegetation species, including blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA,

Avena fatua), nutsedge (CYPES, *Cyperus esculentus*), large crabgrass (DIGSA, *Digitaria sanguinalis*), barnyard grass (ECHCG, *Echinochloa crus-galli*), Chinese sprangletop (LEFCH, *Leptochloa chinensis*), Italian ryegrass (LOLMU, *Lolium multiflorum*), and giant foxtail (SETFA, *Setaria faberi*).

[0167] The results are summarized in Table 14 below.

Table 14. Herbicidal Effects (% visual injury) of Compound A and Haloxyfop-R-methyl on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Haloxyfop-R-methyl	0	0	70	70	70
ALOMY	Obs	5	8	100	100	100
	Exp	-	-	-	100	100
	△				0	0
AVEFA	Obs	0	0	100	100	100
	Exp	-	-	-	100	100
	△				0	0
CYPES	Obs	10	25	35	35	50
	Exp	-	-	-	42	51
	△				-7	-1
DIGSA	Obs	20	35	99	100	100
	Exp	-	-	-	99	99
	△				1	1
ECHCG	Obs	88	93	100	100	100
	Exp	-	-	-	100	100
	△				0	0
LEFCH	Obs	0	5	100	100	100
	Exp	-	-	-	100	100
	△				0	0
LOLMU	Obs	0	0	100	100	93
	Exp	-	-	-	100	100
	△				0	-8
SETFA	Obs	63	60	100	100	100
	Exp	-	-	-	100	100

	△				0	0
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g/ha = grams per hectare

ALOMY = *Alopecurus myosuroides* (blackgrass)

AVEFA = *Avena fatua* (wild oat)

CYPES = *Cyperus esculentus* (nutsedge)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

ECHCG = *Echinochloa crus-galli* (barnyardgrass)

LEFCH = *Leptochloa chinensis* (Chinese sprangletop)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

SETFA = *Setaria faberi* (giant foxtail)

Example 15

[0168] Compositions comprising Compound A (without cloquintocet mexyl safener) and quizalofop-P-ethyl were tested to determine the efficacy of the compositions on undesirable vegetation species, including blackgrass (ALOMY, *Alopecurus myosuroides*), wild oat (AVEFA, *Avena fatua*), nutsedge (CYPES, *Cyperus esculentus*), large crabgrass (DIGSA, *Digitaria sanguinalis*), barnyard grass (ECHCG, *Echinochloa crus-galli*), Chinese sprangletop (LEFCH, *Leptochloa chinensis*), Italian ryegrass (LOLMU, *Lolium multiflorum*), and giant foxtail (SETFA, *Setaria faberi*).

[0169] The results are summarized in Table 15 below.

Table 15. Herbicidal Effects (% visual injury) of Compound A and Quizalofop-P-ethyl on weeds.

Application rate (g/ha)	Compound A	7.5	10	0	7.5	10
	Quizalofop-P-ethyl	0	0	75	75	75
ALOMY	Obs	5	8	95	100	100
	Exp	-	-	-	95	95
	△				5	5
AVEFA	Obs	0	0	98	98	100
	Exp	-	-	-	98	98
	△				0	3
CYPES	Obs	10	25	0	58	73
	Exp	-	-	-	10	25
	△				48	48
DIGSA	Obs	20	35	95	98	100
	Exp	-	-	-	96	97
	△				2	3

ECHCG	Obs	88	93	100	100	100
	Exp	-	-	-	100	100
	△				0	0
LEFCH	Obs	0	5	100	100	100
	Exp	-	-	-	100	100
	△				0	0
LOLMU	Obs	0	0	100	100	90
	Exp	-	-	-	100	100
	△				0	-10
SETFA	Obs	63	60	100	100	100
	Exp	-	-	-	100	100
	△				0	0

g/ha = grams per hectare

ALOMY = *Alopecurus myosuroides* (blackgrass)

AVEFA = *Avena fatua* (wild oat)

CYPES = *Cyperus esculentus* (nutsedge)

DIGSA = *Digitaria sanguinalis* (large crabgrass)

ECHCG = *Echinochloa crus-galli* (barnyardgrass)

LEFCH = *Leptochloa chinensis* (Chinese sprangletop)

LOLMU = *Lolium multiflorum* (Italian ryegrass)

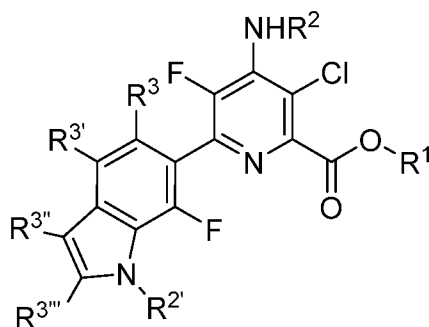
SETFA = *Setaria faberi* (giant foxtail)

[0170] The compositions and methods of the appended claims are not limited in scope by the specific compositions and methods described herein, which are intended as illustrations of a few aspects of the claims and any compositions and methods that are functionally equivalent are intended to fall within the scope of the claims. Various modifications of the compositions and methods in addition to those shown and described herein are intended to fall within the scope of the appended claims. Further, while only certain representative compositions and method steps disclosed herein are specifically described, other combinations of the compositions and method steps also are intended to fall within the scope of the appended claims, even if not specifically recited. Thus, a combination of steps, elements, components, or constituents may be explicitly mentioned herein; however, other combinations of steps, elements, components, and constituents are included, even though not explicitly stated. The term “comprising” and variations thereof as used herein is used synonymously with the term “including” and variations thereof and are open, non-limiting terms. Although the terms “comprising” and “including” have been used herein to describe various aspects, the terms “consisting essentially of” and “consisting of” can be used in

place of “comprising” and “including” to provide for more specific aspects and are also disclosed. Other than in the examples, or where otherwise noted, all numbers expressing quantities of ingredients, reaction conditions, and so forth used in the specification and claims are to be understood to be construed in light of the number of significant digits and ordinary rounding approaches, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims.

WHAT IS CLAIMED IS:

1. A composition, comprising:
 - (a) a pyridine carboxylate herbicide defined by Formula (I):



Formula (I)

wherein:

R^1 is cyanomethyl or propargyl;

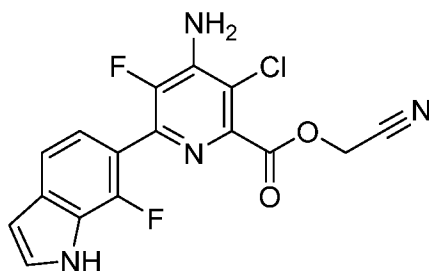
R^2 and $R^{2'}$ are independently hydrogen, C_1 - C_6 alkyl, formyl, alkoxy carbonyl, or acyl;

R^3 , $R^{3'}$, $R^{3''}$, and $R^{3'''}$ are independently hydrogen, halogen, C_1 - C_4 alkyl, C_1 - C_4 haloalkyl, C_1 - C_3 alkoxy, or C_1 - C_3 haloalkoxy;

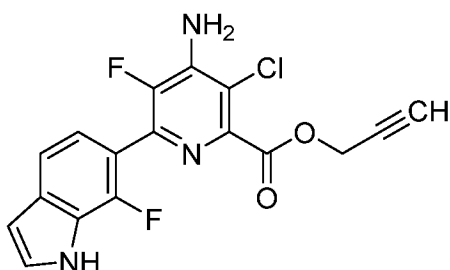
or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof.

2. The composition of claim 1, wherein the pyridine carboxylate herbicide compound is cyanomethyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate:



3. The composition of claim 1, wherein the pyridine carboxylate herbicide compound is propargyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate:



4. The composition of any one of claims 1-3, wherein the ACCase inhibitor herbicide is selected from the group consisting of alloxydim, butoxydim, clethodim, clodinafop, cloproxydim, cycloxydim, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop, pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxym, tralkoxydim, agriculturally acceptable salts or esters thereof, and combinations thereof.

5. The composition of any one of claims 1-4, wherein the weight ratio of the pyridine carboxylate herbicide (in g ae/ha) to the ACCase inhibitor herbicide (in g ai/ha) is from 1:3000 to 150:1.

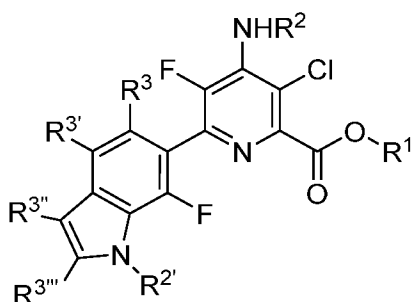
6. The composition of any one of claims 1-5, further comprising a safener.

7. The composition of any one of claims 1-6, further comprising an additional pesticide.

8. The composition of any one of claims 1-7, wherein the composition does not include a herbicidal active ingredient in addition to (a) and (b).

9. A method of controlling undesirable vegetation, comprising applying to vegetation or an area adjacent the vegetation or applying to soil or water to limit the emergence or growth of vegetation a composition, comprising:

(a) a pyridine carboxylate herbicide defined by Formula (I):



Formula (I)

wherein

R¹ is cyanomethyl or propargyl;

R² and R^{2'} are independently hydrogen, C₁-C₆ alkyl, formyl, alkoxy carbonyl, or acyl;

R³, R^{3'}, R^{3''}, and R^{3'''} are independently hydrogen, halogen, C₁-C₄ alkyl, C₁-C₄ haloalkyl, C₁-C₃ alkoxy, or C₁-C₃ haloalkoxy;

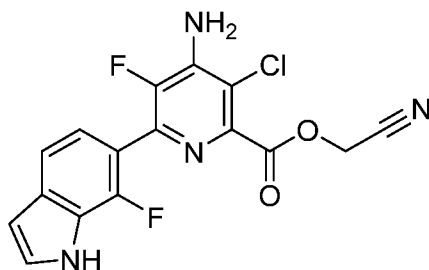
or an agriculturally acceptable N-oxide, salt, or ester thereof; and

(b) an acetyl CoA carboxylase (ACCase) inhibitor herbicide or an agriculturally acceptable salt or ester thereof;

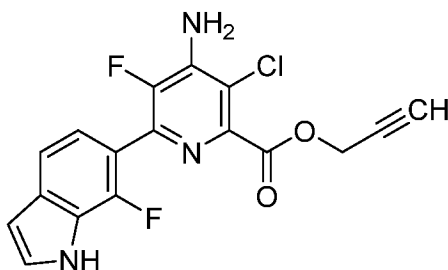
wherein the pyridine carboxylate herbicide is applied in an amount of at least 0.1 g ae/ha; and

wherein the ACCase herbicide is applied in an amount of at least 2 g ai/ha.

10. The method of claim 9, wherein the pyridine carboxylate herbicide compound is cyanomethyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate:



11. The method of claim 9, wherein the pyridine carboxylate herbicide compound is propargyl 4-amino-3-chloro-5-fluoro-6-(7-fluoro-1H-indol-6-yl)pyridine-2-carboxylate:



12. The method of any one of claims 9-11, wherein the ACCase inhibitor herbicide is selected from the group consisting of alloxydim, butoxydim, clethodim, clodinafop, cloproxydim, cycloxydim, cyhalofop, diclofop, fenoxaprop, fenthiaprop, fluazifop, haloxyfop, metamifop,

pinoxaden, profoxydim, propaquizafop, quizalofop, sethoxydim, tepraloxydim, tralkoxydim, agriculturally acceptable salts or esters thereof, and combinations thereof.

13. The method of any one of claims 9-11, wherein the weight ratio of the pyridine carboxylate herbicide (in g ae/ha) to the ACCase inhibitor herbicide (in g ai/ha) is from about 1:3000 to 150:1

14. The method of any one of claims 9-13, wherein the pyridine carboxylate herbicide and the ACCase inhibitor herbicide are applied simultaneously.

15. The method of any one of claims 9-14, further comprising applying a safener.

16. The method of any one of claims 9-16, further comprising applying an additional pesticide.

17. The method of any one of claims 9-17, wherein the composition does not include a herbicidal active ingredient in addition to (a) and (b).

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/059613

A. CLASSIFICATION OF SUBJECT MATTER					
INV.	A01N43/40	A01P13/02	A01N35/10	A01N37/50	A01N39/02
	A01N43/16	A01N43/18	A01N43/60	A01N43/76	A01N43/78
	A01N43/90				
According to International Patent Classification (IPC) or to both national classification and IPC					

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols) A01N A01P

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 2013/014165 A1 (BAYER IP GMBH [DE]; HOFFMANN MICHAEL GERHARD [DE] ET AL.) 31 January 2013 (2013-01-31) Formula (I); A15; page 118, line 20 - page 122, line 15; claims; tables 16-17	1-17
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search 24 February 2020	Date of mailing of the international search report 09/03/2020
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Kirsch, Cécile
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X,P	WO 2019/195496 A1 (DOW AGROSCIENCES LLC [US]) 10 October 2019 (2019-10-10) Formulas (I)-(III); page 11, line 16 - page 12, line 2; claims; examples; compounds 1-7 -----	1-17
X,P	WO 2018/208582 A1 (DOW AGROSCIENCES LLC [US]) 15 November 2018 (2018-11-15) cited in the application Formulas (I), (Ia)-(Ic); paragraph [0051]; example 5; compounds 5-6 -----	1-17

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Information on patent family members

International application No

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