HERBICIDAL COMPOSITIONS COMPRISING 4-AMINO-3-CHLORO-5-FLUORO-6-(4-CHLORO-2-FLUORO-3-METHOXYPHENYL)PYRIDINE-2-CARBOXYLIC ACID OR A DERIVATIVE THEREOF AND CERTAIN PS II INHIBITORS

Priority Claim

This application claims the benefit of United States provisional patent application number 61/675,089 filed on July 24, 2012, and United States patent application serial number 13/840,488, filed March 15, 2013, the disclosure of each of which is incorporated herein by reference in its entirety.

Field

Provided herein are herbicidal compositions comprising and methods for controlling undesirable vegetation utilizing (a) 4-amino-3-chloro-5-fluoro-6-(4-chloro-2-fluoro-3-methoxyphenyl)pyridine-2-carboxylic acid or an agriculturally acceptable ester or salt thereof and (b) a photosystem (PS) II inhibitor selected from the group consisting of: atrazine, bentazon-sodium, bromoxynil, chlorotoluron, cyanazine, diuron, hexazinone, ioxynil, isoproturon, linuron, methibenzuron, metribuzin, propanil, pyridate, siduron, simazine, simetryne, tebuthiuron and terbuthylazine, or derivative, *e.g.*, salt or ester thereof.

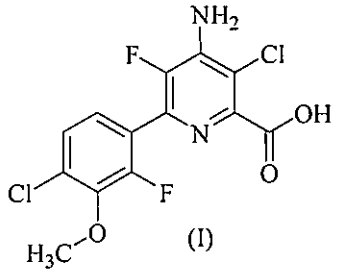
Background

The protection of crops from weeds and other vegetation which inhibit crop growth is a constantly recurring problem in agriculture. To help combat this problem, researchers in the field of synthetic chemistry have produced an extensive variety of chemicals and chemical formulations effective in the control of such unwanted growth. Chemical herbicides of many types have been disclosed in the literature and a large number are in commercial use. However, there remains a need for compositions and methods that are effective in controlling undesirable vegetation.

Summary

Several embodiments are recited below. In the embodiments, the ratio of compound (a) to compound (b) can be expressed in units of weight to weight (g to g), gae/ha to gae/ha or gae/ha to gai/ha.

~~1.~~ A first embodiment of the invention provided herein includes synergistic herbicidal compositions comprising a herbicidally effective amount of (a) a compound of the formula (I)



(I)

or an agriculturally acceptable salt or ester thereof and (b) atrazine, bentazon, bentazon-sodium, bromoxynil, chlorotoluron, cyanazine, diuron, hexazinone, ioxynil, isoproturon, linuron, methibenzuron, metribuzin, propanil, pyridate, siduron, simazine, simetryne, tebuthiuron or terbuthylazine or agriculturally acceptable salt or ester thereof.

~~2.~~ A second~~The composition of~~ embodiment ~~1, wherein~~ includes the mixture of the first embodiment in which (a) is a C_{1-4} alkyl or benzyl ester of compound (I).

~~3.~~ A third~~The composition of~~ embodiment ~~1, wherein~~ includes the mixture of the first embodiment in which (a) is a C_{1-4} alkyl ester of compound (I).

~~4.~~ A forth~~The composition of~~ embodiment ~~2, wherein~~ includes the mixture of the second embodiment in which (a) is a benzyl ester of compound (I).

~~5.~~ A fifth~~The composition of~~ embodiment ~~1, wherein~~ includes the mixture of the first embodiment in which (a) is the compound of formula (I), which is the carboxylic acid.

~~6.~~ A sixth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is atrazine.

~~7.~~ A seventh embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is bentazon or bentazon-sodium.

~~8.~~ An eighth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is bromoxynil or bromoxynil octanoate.

~~9.~~ A ninth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is chlorotoluron.

~~10.~~ A tenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is cyanazine.

~~11.~~ An eleventh embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is diuron.

~~12.~~ A twelfth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is hexazinone.

~~13.~~ A thirteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is ioxynil.

~~14.~~ A fourteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is isoproturon.

~~15.~~ A fifteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is linuron.

~~16.~~ A sixteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is methibenzuron.

~~17.~~ A seventeenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is metribuzin.

~~18.~~ An eighteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is propanil.

~~19.~~ A nineteenth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is pyridate.

~~20.~~ A twentieth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1,~~ ~~wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is siduron.

~~21.~~ A twenty-first embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is simazine.

~~22.~~ A twenty-second embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is simetryne.

~~23.~~ A twenty-third embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is tebuthiuron.

~~24.~~ A twenty-fourth embodiment includes the mixture of the first~~The composition of~~ embodiment ~~1, wherein~~in which (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is terbuthylazine.

~~25.~~ A twenty-fifth embodiment includes the mixture ~~The composition~~ of any of the first through twenty-fourth embodiments ~~1-24,~~ further comprising a herbicide safener.

~~26.~~ A twenty-sixth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of compound of formula (I) or agriculturally acceptable salt or ester thereof to atrazine or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2240 to about 6:1, about 1:1120 to about 3:1, about 1:256 to about 1:16, about 6:1, about 1:7, about 1:9, about 1:16, about 1:17.5, about 1:32, about 1:35, about 1:64, about 1:70, about 1:128, about 1:140, about 1:256, and about 1:2240, or within any range defined between any pair of the foregoing values.

~~27.~~ A twenty-seventh embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to bentazon, bentazon-sodium, or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:1120 to about 3:1, about 1:560 to about 2:1, about 1:256 to about 1.4:1, about 1:96 to about 1:3.4, about 3:1, about 1:3.4, about 1:6, about 1:7, about 1:12, about 1:14, about 1:16, about 1:20, about 1:24, about 1:26, about 1:32, about 1:40, about 1:48, about 1:52.5, about 1:96, about 1:256, and about 1:1120, or within any range defined between any pair of the foregoing values.

~~28.~~ A twenty-eigth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to bromoxynil or agriculturally acceptable salt or ester thereof is selected from the group of ranges of ratios and ratios consisting of: from about 1:280 to about 12:1, about 1:140 to about 6:1, about 1:70 to about 3:1, about 1:35 to about 2:1, about 1:17.5 to about 1:1, about 12:1, about 1:1, about 1:2, about 1:4, about 1:4.4, about 1:8, about 1:12.5, about 1:17.5, and about 1:280, or within any range defined between any pair of the foregoing values.

~~29.~~ A twenty-ninth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to chlorotoluron or agriculturally acceptable salt or ester thereof is from about 1:1750 to about 1.5:1.

~~30.~~ A thirtieth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to cyanazine or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2650 to about 6:1, about 1:1325 to about 3:1,

about 1:662 to about 2:1, about 1:110 to about 1:5.3, about 6:1, about 1:5.3, about 1:8.6, about 1:13.8, about 1:17.2, about 1:25, about 1:27.5, about 1:34.4, about 1:110, about 1:662, about 1:1325, and about 1:2650, or within any range defined between any pair of the foregoing values.

~~31.~~ A thirty-first embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to diuron or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:3600 to about 6:1, about 1:1800 to about 3:1, about 1:900 to about 1:2, about 1:70 to about 1:9, about 6:1, about 1:9, about 1:17.5, about 1:35, about 1:70, about 1:900, about 1:1800, and about 1:3600, or within any range defined between any pair of the foregoing values.

~~32.~~ A thirty-second embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to hexazinone or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2500 to about 12:1, about 1:1250 to about 2:1, about 1:625 to about 1:1, about 1:156 to about 1:20, about 12:1, about 1:20, about 1:39, about 1:78, about 1:156, and about 1:2500, or within any range defined between any pair of the foregoing values.

~~33.~~ A thirty-third embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to ioxynil or agriculturally acceptable salt or ester thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:200 to about 12:1, about 1:100 to about 1:1, about 1:37.5 to about 1:9, about 12:1, about 1:9.4, about 1:19, about 1:37.5, and about 1:200, or within any range defined between any pair of the foregoing values.

~~34.~~ A thirty-fourth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to isoproturon or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:750 to about 12:1, about 1:375 to about 6:1, about 1:600 to about 1:37.5, about 1:300 to about 1:75, about 1:750, about 1:600, about 1:375, about 1:300, about 1:150, about 1:75, about 1:37.5, about 1:1, about 6:1, and about 12:1.

~~35.~~ A thirty-fifth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to linuron or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: from about 1:2250 to about 6:1, about 1:1125 to about 3:1, about 1:562 to about 1:1, about 1:39 to about 1:19, about 6:1, about 3:1, about 1:19.4, about

1:38.8, about 1:562, about 1:1125, and about 1:2250, or within any range defined between any pair of the foregoing values.

~~36.~~ A thirty-sixth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to methibenzuron or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:1400 to about 4:1, about 1:700 to about 2:1, and about 1:350 to about 1:1.

~~37.~~ A thirty-seventh embodiment includes the mixture of the second~~The composition~~ embodiment ~~2 wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to metribuzin or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2800 to about 6:1, about 1:1400 to about 3:1, about 1:700 to about 2:1, about 1:168 to about 1.3:1, about 1:26 to about 1:5, about 6:1, about 3:1, about 2:1, about 1:3, about 1:5, about 1:6.7, about 1:10, about 1:13, about 1:20, about 1:26, about 1:168, about 1:700, about 1:1400, and about 1:2800, or within any range defined between any pair of the foregoing values.

~~38.~~ A thirty-eighth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2 wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to propanil or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2800 to about 1:1, about 1:1400 to about 1:4, about 1:767 to about 1:24, about 1:767 to about 1:12, about 1:384 to about 1:48, about 1:1, about 1:4, about 1:12, about 1:24, about 1:48, about 1:96, about 1:173, about 1:192, about 1:210, about 1:384, about 1:560, about 1:767, about 1:1400, and about 1:2800, or within any range defined between any pair of the foregoing values.

~~39.~~ A thirty-ninth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to pyridate or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:800 to about 12:1, about 1:800 to about 6:1, about 1:800 to about 3:1, about 1:800 to about 1:1, about 1:400 to about 6:1, about 1:400 to about 3:1, about 1:400 to about 1:1,and about 1:200 to about 1:16.

~~40.~~ A fortieth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2. wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to siduron or agriculturally acceptable salt thereof is from selected from the group of ranges of ratios and ratios consisting of: about 1:4500 to about 2:1, about 1:2250 to about 1:1, about 1:1125 to about 1:5: and about 1:625 to about 1:50.

41. A forty-first embodiment includes the mixture of the second~~The composition of~~ embodiment 2, ~~wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to simazine or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:4250 to about 2:1, about 1:2125 to about 1:1, about 1:560 to about 1:8, about 1:280 to about 1:17.5, about 1:140 to about 1:17.5, about 2:1, about 1:8, about 1;17.5, about 1:35, about 1:70, about 1:140, about 1:280, about 1:560, about 1:2125, and about 1:4250, or within any range defined between any pair of the foregoing values.

42. A forty-second embodiment includes the mixture of the second~~The composition of~~ embodiment 2, ~~wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to simetryne or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:1000 to about 12:1, about 1:500 to about 6:1, about 1:250 to about 1:1, about 1:56 to about 1:3.5, about 12:1, about 6:1, about 1.3.5, about 1:1, about 1:7, about 1:14, about 1:28, about 1:56, about 1:250, about 1:500, and about 1:1000, or within any range defined between any pair of the foregoing values.

43. A forty-third embodiment includes the mixture of the second~~The composition of~~ embodiment 2, ~~wherein~~in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to tebuthiuron or agriculturally acceptable salt thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:2240 to about 2:1, about 1:1120 to about 1:1, about 1:840 to about 1:6, about 1:210 to about 1:6, about 2:1, about 1:1, about 1:2, about 1:3, about 1:6, about 1:9, about 1:13, about 1:17.5, about 1:26, about 1:35, about 1:52.5, about about 1:70, about 1:105, about 1:140, about1:210, about 1:840, and about 1:2240, or within any range defined between any pair of the foregoing values.

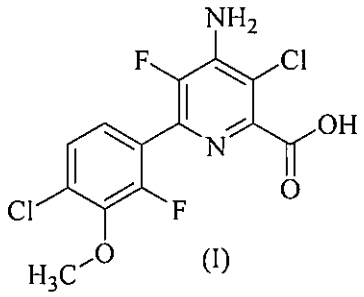
44. A forty-fourth embodiment includes the mixture of the second~~The composition of~~ embodiment ~~2, wherein~~ in which the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to terbuthylazine or agriculturally acceptable thereof is selected from the group of ranges of ratios and ratios consisting of: about 1:1500 to about 2.4:1, about 1:750 to about 1:1, about 1:375 to about 1:3, about 1:200 to about 1:10, about 1:62.5 to about 1:31, about 2.4:1, about 1:31.3, about 1:62.5, and about 1:1500, or within any range defined between any pair of the foregoing values.

45. A forty-fifth embodiment includes the mixture~~The composition~~ of any of the first through forty-fourth embodiments ~~1-44,~~ further comprising an agriculturally acceptable adjuvant or carrier.

46. A forty-sixth embodiment includes the mixture~~The composition~~ of any of the first through forty-fifth embodiments ~~1-44~~ which is synergistic as determined by the Colby equation.

47. A forty-seventh embodiment includes a~~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 the composition of any of embodiments 1-46.

48. A forty-eighth embodiment includes a~~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 a herbicidally effective amount of (a) a compound of the formula (I)



(I)

or an agriculturally acceptable salt or ester thereof and (b) atrazine, bentazon, bentazon-sodium, bromoxynil, chlorotoluron, cyanazine, diuron, hexazinone, ioxynil, isoproturon, linuron, methibenzuron, metribuzin, propanil, pyridate, siduron, simazine, simetryne, tebuthiuron or terbuthylazine or agriculturally acceptable salt or ester thereof.

49. ~~——~~A forty-ninth embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the method is practiced in at least one member of the group consisting of direct-seeded, water-seeded and transplanted rice, cereals, wheat, barley, oats, rye, sorghum, corn/maize, sugarcane, sunflower, oilseed rape, canola, sugar beet, soybean, cotton, pineapple, pastures, grasslands, rangelands, fallowland, turf, tree and vine orchards, aquatics, industrial vegetation management (IVM) or rights of way (ROW).

50. ~~——~~A fiftieth embodiment includes the~~The~~ method of embodiment 47 or embodiment 48, wherein the undesirable vegetation is immature.

51. ~~——~~A fifty-first embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the (a) and (b) are applied to water.

52. ~~——~~A fifty-second embodiment includes the~~The~~ method of embodiment 51, wherein the water is part of a flooded rice paddy.

53. ~~——~~A fifty-third embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the (a) and (b) are applied pre-emergently to the weed or the crop.

54. ~~——~~A fifty-forth embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the (a) and (b) are applied post-emergently to the weed or the crop.

55. ~~——~~A fifty-fifth embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the undesirable vegetation is controlled in glyphosate-, 5-enolpyruvylshikimate-3-phosphate (EPSP)

synthase inhibitor-, glufosinate-, glutamine synthetase inhibitor-, dicamba-, phenoxy auxin-, pyridyloxy auxin-, synthetic auxin-, auxin transport inhibitor-, aryloxyphenoxypropionate-, cyclohexanedione-, phenylpyrazoline-, acetyl CoA carboxylase (ACCase) inhibitor-, imidazolinone-, sulfonylurea-, pyrimidinylthiobenzoate-, triazolopyrimidine-, sulfonylaminocarbonyltriazolinone-, acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) inhibitors-, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitor-, phytoene desaturase inhibitor-, carotenoid biosynthesis inhibitor-, protoporphyrinogen oxidase (PPO) inhibitor-, cellulose biosynthesis inhibitor-, mitosis inhibitor-, microtubule inhibitor-, very long chain fatty acid inhibitor-, fatty acid and lipid biosynthesis inhibitor-, photosystem I inhibitor-, photosystem II inhibitor-, triazine-, or bromoxynil- tolerant crops.

~~56.~~ A fifty-sixth embodiment includes the~~The~~ method of the fifty-fifth embodiment ~~55~~, wherein the tolerant crop possesses multiple or stacked traits conferring resistance or tolerance to multiple herbicides or multiple modes of action.

~~57.~~ A fifty-seventh embodiment includes the~~The~~ method of embodiment 47 or 48, wherein the undesirable vegetation comprises a herbicide resistant or tolerant weed.

~~58.~~ A fifty-eighth embodiment includes the~~The~~ method of the fifty-seventh embodiment ~~57~~, wherein the resistant or tolerant weed is a biotype with resistance or tolerance to multiple herbicides, multiple chemical classes, multiple herbicide modes-of-action or via multiple resistance mechanisms.

~~59.~~ A fifty-ninth embodiment includes the~~The~~ method of embodiment 57, wherein the resistant or tolerant weed is a biotype resistant or tolerant to acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) inhibitors, photosystem II inhibitors, acetyl CoA carboxylase (ACCase) inhibitors, synthetic auxins, auxin transport inhibitors, photosystem I inhibitors, 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, microtubule assembly inhibitors, fatty acid and lipid synthesis inhibitors, protoporphyrinogen oxidase (PPO) inhibitors, carotenoid biosynthesis inhibitors, very long chain fatty acid (VLCFA) inhibitors, phytoene desaturase (PDS) inhibitors, glutamine synthetase inhibitors, 4-hydroxyphenyl-pyruvate-dioxygenase (HPPD) inhibitors, mitosis inhibitors, cellulose biosynthesis inhibitors, herbicides with multiple modes-of-action, quinclorac, arylaminopropionic acids, difenzoquat, endothall, or organoarsenicals.

~~60.~~ A sixtieth embodiment includes the method~~A methods~~ of controlling undesirable vegetation including the step of applying a herbicidally effective amount of at least one mixture according to the twenty-sixth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of atrazine selected from the group of rates and ranges of rates

consisting of, about: 50, 140, 280, 560, 1120, 2240, and 4400 or within any range defined between any pair of the foregoing values.

61. A sixty-first embodiment includes the method of ~~Methods according to~~ either of the twenty-sixth or sixtieth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRAPP, CYPIR, ECHCG, ECHCO, and XANST, still other embodiments include controlling plants from the genera consisting of: *Brachiaria* or *Urochloa*, *Echinochloa*, *Bolboschoenus*, and *Xanthium*.

62. A sixty-second embodiment includes the method ~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the twenty-seventh embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of bentazon or bentazon-sodium selected from the group of rates and ranges of rates consisting of, about: 60, 105, 120, 210, 420, 840, 1120, and 2240, or within any range defined between any pair of the foregoing values.

63. A sixty-third embodiment includes the method of ~~Methods according to~~ either of the twenty-seventh or sixty-second embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRSNW, COMBE, ECHCG, ECHOR, IPOHE, LEFCH, SCPMA, and SETFA, still other embodiments include controlling plants from the genera consisting of: *Brassica*, *Commelina*, *Echinochloa*, *Ipomoea, Leptochloa, Bolboschoenus* or *Schoenoplectus,* and *Xanthium*.

64. A sixty-fourth embodiment includes the method ~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the twenty-eighth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of bromoxynil selected from the group of rates and ranges of rates consisting of, about: 25, 35, 70, 140, 280, or 560 within any range defined between any pair of the foregoing values.

~~65.~~ A sixty-fifth embodiment includes the method of~~Methods according to~~ either of the twenty-eighth or sixty-fourth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: AMARE, ECHCG, IPOHE, and SETFA, still other embodiments include controlling plants from the genera consisting of: *Amaranthus, Echinochloa*, *Ipomoea,* and *Setaria.*

~~66.~~ A sixty-sixth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the twenty-nineth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of chlorotoluron selected from the group of rates and ranges of rates consisting of, about: 200, 400, 800, 1600, or 3500 within any range defined between any pair of the foregoing values.

~~67.~~ A sixty-seventh embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirtieth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of cyanazine selected from the group of rates and ranges of rates consisting of, about: 50, 170, 275, 440, 880, 1325, 2650, or 5300 within any range defined between any pair of the foregoing values.

~~68.~~ A sixty-eighth embodiment includes the method of~~Methods according to~~ either of the thirtieth or sixty-seventh embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRAPP and IPOHE, still other embodiments include controlling plants from the genera consisting of: *Brachiaria* or *Urochloa* and *Ipomoea.*

~~69.~~ A sixty-ninth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-first embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of diuron selected from the group of rates and ranges of rates consisting of,

about: 50, 100, 140, 280, 560, 1120, 2240, 4480, or 7200 within any range defined between any pair of the foregoing values.

~~70.~~ A seventieth embodiment includes the method of~~Methods according to~~ either of the thirty-first or sixty-ninth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: ABUTH, BRAPP, ECHCG, ECHCO, SETFA, and SETVI, still other embodiments include controlling plants from the genera consisting of: *Abutilon*, *Brachiaria* or *Urochloa, Echinochloa,* and *Setaria*.

~~71.~~ A seventy-first embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-second embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of hexazinone selected from the group of rates and ranges of rates consisting of, about: 25, 50, 100, 200, 400, 625, 1250, 2500, or 5000 within any range defined between any pair of the foregoing values.

~~72.~~ A seventy-second embodiment includes the method of~~Methods according to~~ either of the thirty-second or seventy-first embodiments wherein the controlled plant is at least one plant selected from the group consisting of: ECHCG, ECHCO, and IPOHE, still other embodiments include controlling plants from the genera consisting of: *Echinochloa* and *Ipomoea*.

~~73.~~ A seventy-third embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-third embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of ioxynil selected from the group of rates and ranges of rates consisting of, about: 25, 50, 100, 200, 300, or 400 within any range defined between any pair of the foregoing values.

~~74.~~ A seventy-fourth embodiment includes the method of~~Methods according to~~ either of the thirty-third or seventy-third embodiments wherein the controlled plant is at least one plant

selected from the group consisting of: IPOHE, still other embodiments include controlling plants from the genera consisting of: *Ipomoea*.

~~75.~~ A seventy-fifth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-fourth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of isoproturon selected from the group of rates and ranges of rates consisting of, about: 25, 50, 100, 200, 400, 800, or 1500 within any range defined between any pair of the foregoing values.

~~76.~~ A seventy-sixth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-fifth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of linuron selected from the group of rates and ranges of rates consisting of, about: 50, 100, 200, 400, 620, 1125, 2250, or 4500 within any range defined between any pair of the foregoing values.

~~77.~~ A seventy-seventh embodiment includes the method of~~Methods according to~~ either of the thirty-fifth or seventy-sixth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRAPP, still other embodiments include controlling plants from the genera consisting of: *Brachiaria* or *Urochloa*.

~~78.~~ A seventy-eighth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-sixth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of methibenzuron selected from the group of rates and ranges of rates consisting of, about: 35, 70, 140, 280, 560, 700, 1400, or 2800 within any range defined between any pair of the foregoing values.

~~79.~~ A seventy-ninth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture

according to the thirty-seventh embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of metribuzin selected from the group of rates and ranges of rates consisting of, about: 25, 50, 100, 210, 420, 840, 1680, 3360, or 5600 within any range defined between any pair of the foregoing values.

~~80.~~ An eightieth embodiment includes the method of~~Methods according to~~ either of the thirty-seventh or seventy-ninth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: CHEAL, KCHSC, LAMPU, SASKR, SETFA, SINAR, still other embodiments include controlling plants from the genera consisting of: *Chenopodium, Kochia, Lamium, Salsola, Setaria,* and *Sinapsis*.

~~81.~~ An eighty-first embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-eighth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of propanil selected from the group of rates and ranges of rates consisting of, about: 60, 120, 420, 840, 1680, 3360, or 5600 within any range defined between any pair of the foregoing values.

~~82.~~ An eighty-second embodiment includes the method of~~Methods according to~~ either of the thirty-eighth or eighty-first embodiments wherein the controlled plant is at least one plant selected from the group consisting of: COMBE, ECHCG, ECHCO, IPOHE, and SCPMA, still other embodiments include controlling plants from the genera consisting of: *Commelina, Echinochloa, Ipomoea,* and *Bolboschoenus* or *Schoenoplectus*.

~~83.~~ An eighty-third embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the thirty-nineth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of pyridate selected from the group of rates and ranges of rates consisting of, about: 25, 50, 100, 200, 400, 800, or 1600 within any range defined between any pair of the foregoing values.

~~84.~~ An eighty-fourth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the fortieth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of siduron selected from the group of rates and ranges of rates consisting of, about: 70, 140, 280, 560, 1120, 2240, 4480, or 9000 within any range defined between any pair of the foregoing values.

~~85.~~ An eighty-fifth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the forty-first embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of simazine selected from the group of rates and ranges of rates consisting of, about: 70, 140, 280, 560, 1120, 2240, 4480, or 8500 within any range defined between any pair of the foregoing values.

~~86.~~ An eighty-sixth embodiment includes the method of~~Methods according to~~ either of the forty-first or eighty-fifth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRAPP, ECHCG, ECHCO, CYPIR, and XANST, still other embodiments include controlling plants from the genera consisting of: *Brachiaria* or *Urochloa, Echinochloa, Cyperus,* and *Xanthium*.

~~87.~~ An eighty-seventh embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the forty-second embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of simetryne selected from the group of rates and ranges of rates consisting of, about: 25, 50, 112.5, 225, 450, 900, 1350, and 2000 within any range defined between any pair of the foregoing values.

~~88.~~ An eighty-eighth embodiment includes the method of~~Methods according to~~ either of the forty-second or eighty-seventh embodiments wherein the controlled plant is at least one plant selected from the group consisting of: CYPIR, CYPRO, ECHCO, ECHOR, FIMMI, and

LEFCH, still other embodiments include controlling plants from the genera consisting of: *Cyperus, Echinochloa, Fimbristylis,* and *Leptochloa.*

89. An eighty-ninth embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the forty-third embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of tebuthiuron selected from the group of rates and ranges of rates consisting of, about: 70, 140, 210, 280, 420, 560, 840, 1680, 3360, and 4480 within any range defined between any pair of the foregoing values.

90. A ninetieth embodiment includes the method of~~Methods according to~~ either of the forty-third or eighty-ninth embodiments wherein the controlled plant is at least one plant selected from the group consisting of: BRSNN, CIRAR, CYPES, IPOHE, and XANST, still other embodiments include controlling plants from the genera consisting of: *Brassica, Cirsium, Cyperus, Ipomoea,* and *Xanthium.*

91. A ninety-first embodiment includes the method~~Methods~~ of controlling undesirable vegetation comprising the step of applying a herbicidally effective amount of at least one mixture according to the forty-fourth embodiment wherein the amount of the mixture is applied at a rate, expressed in gai/ha or gae/ha of terbuthylazine selected from the group of rates and ranges of rates consisting of, about: 60, 125, 250, 500, 1000, 1500, and 3000 within any range defined between any pair of the foregoing values.

93. A ninety-second embodiment includes the method of~~Methods according to~~ either of the forty-fourth or ninety-first embodiments wherein the controlled plant is at least one plant selected from the group consisting of: XANST, still other embodiments include controlling plants from the genera consisting of: *Xanthium.*

94. A ninety-third embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is atrazine.

~~95.~~ A ninety-fourth embodiment includes t~~T~~he composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is bentazon-sodium.

~~96.~~ A ninety-fifth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is bromoxynil.

~~97.~~ A ninety-sixth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is chlorotoluron.

~~98.~~ A ninety-seventh embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is cyanazine.

~~99.~~ A ninety-eighth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is diuron.

~~100.~~ A ninety-ninth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is hexazinone.

~~101.~~ A one-hundredth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is ioxynil.

~~102.~~ A one-hundred-first embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is isoproturon.

~~103.~~ A one-hundred-second embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is linuron.

~~104.~~ A one-hundred-third embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is methibenzuron.

~~105.~~ A one-hundred-fourth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is metribuzin.

~~106.~~ A one-hundred-fifth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is propanil.

~~107.~~ A one-hundred-sixth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is pyridate.

~~108.~~ A one-hundred-seventh embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is siduron.

~~109.~~ A one-hundred-eighth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is simazine.

~~110.~~ A one-hundred-ninth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b is simetryne.

~~111.~~ A one-hundred-tenth embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is tebuthiuron.

~~112.~~ A one-hundred-eleventh embodiment includes the~~The~~ composition of embodiment 1, wherein (a) is the compound of formula (I) or an agriculturally acceptable benzyl ester and (b) is terbuthylazine.

~~113.~~ A one-hundred-twelfth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of compound of formula (I) or agriculturally acceptable salt or ester thereof to atrazine or agriculturally acceptable salt or ester thereof is from about 1:2240 to about 6:1.

~~114.~~ A one-hundred-thirteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to bentazon or agriculturally acceptable salt thereof is from about 1:1120 to about 3:1.

~~115.~~ A one-hundred-fourteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to bromoxynil or agriculturally acceptable salt thereof is from about 1:280 to about 12:1.

~~116.~~ A one-hundred-fifteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to chlorotoluron or agriculturally acceptable salt or ester thereof is from about 1:1750 to about 1.5:1.

~~117.~~ A one-hundred-sixteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to cyanazine or agriculturally acceptable salt thereof is from about 1:2650 to about 6:1.

~~118.~~ A one-hundred-seventeenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to diuron of agriculturally acceptable thereof is from about 1:3600 to about 6:1.

~~119.~~ A one-hundred-eighteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to hexazinone or agriculturally acceptable salt thereof is from about 1:2500 to about 12:1.

~~120.~~ A one-hundred-nineteenth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to ioxynil or agriculturally acceptable salt thereof is from about 1:200 to about 12:1.

~~121.~~ A one-hundred-twentiethThe composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to isoproturon or agriculturally acceptable salt thereof is from about 1:750 to about 12:1.

~~122.~~ A one-hundred-twenty-first embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to linuron or agriculturally acceptable salt thereof is from about 1:2250 to about 6:1.

~~123.~~ A one-hundred-twenty-second embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to methibenzuron or agriculturally acceptable salt thereof is from about 1:1400 to about 4:1.

~~124.~~ A one-hundred-twenty-third embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to metribuzin or agriculturally acceptable salt thereof is from about 1:2800 to about 6:1.

~~125.~~ A one-hundred-twenty-fourth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to propanil or agriculturally acceptable salt thereof is from about 1:2800 to about 1:1.

~~126.~~ A one-hundred-twenty-fifth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to pyridate or agriculturally acceptable salt thereof is from about 1:800 to about 12:1.

~~127.~~ A one-hundred-twenty-sixth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to siduron or agriculturally acceptable salt thereof is from about 1:4500 to about 2:1.

~~128.~~ A one-hundred-twenty-seventh embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to simazine or agriculturally acceptable salt thereof is from about 1:4250 to about 2:1.

~~129.~~ A one-hundred-twenty-eighth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to simetryne or agriculturally acceptable salt thereof is from about 1:1000 to about 12:1.

~~130.~~ A one-hundred-thirtieth embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to tebuthiuron or agriculturally acceptable salt thereof is from about 1:2240 to about 2:1.

~~131.~~ A one-hundred-thirty-first embodiment includes the~~The~~ composition of embodiment 1, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to terbuthylazine or agriculturally acceptable thereof is from about 1:1500 to about 3:1.

~~132.~~ A one-hundred-thirty-second embodiment includes the~~The~~ composition of any of embodiments 94-131 which is synergistic as determined by the Colby equation.

ae/ha, and bentazon-sodium is applied at a rate of about 60 g ai/ha to about 120 g ai/ha. In certain embodiments, the methods and compositions utilizing the compound of formula (I) or salt or ester thereof in combination with bentazon or salt thereof are used to control BRSNW, COMBE, ECHCG, ECHOR, IPOHE, LEFCH, SCPMA, or SETFA.

In certain embodiments of the compositions and methods described herein, the compound of formula (I) or salt or ester thereof is used in combination with bromoxynil or salt thereof. With regard to the compositions, in some embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to bromoxynil or salt thereof is within the range from about 1:280 to about 12:1. In certain embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to bromoxynil or salt thereof is within the range from about 1:254 to about 2:1. In certain embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to bromoxynil or salt thereof is within the range from about 1:18 to about 1:4. In certain embodiments, the compositions comprise the compound of formula (I) or its benzyl or n-butyl ester and bromoxynil or salt thereof. With respect to the methods, in certain embodiments, the methods comprise contacting the undesirable vegetation or locus thereof or applying to the soil or water to prevent the emergence or growth of vegetation a composition described herein. In some embodiments, the composition is applied at an application rate from about 27 grams active ingredient per hectare (g ai/ha) to about 860 g ai/ha based on the total amount of active ingredients in the composition. In certain embodiments, the composition is applied at an application rate from about 50 grams active ingredient per hectare (g ai/ha) to about 610 g ai/ha based on the total amount of active ingredients in the composition. In some embodiments, the methods comprise contacting the undesirable vegetation or locus thereof or applying to the soil or water to prevent the emergence or growth of vegetation with a compound of formula (I) or salt or ester thereof and bromoxynil or salt thereof or salt thereof, *e.g.*, sequentially or simultaneously. In some embodiments, the bromoxynil or salt thereof is applied at a rate from about 25 g ai/ha to about 560 g ai/ha and the compound of formula (I) of salt or ester thereof is applied at a rate from about 2 g ae/ha to about 300 g ae/ha. In certain embodiments, the methods utilize the compound of formula (I) or its benzyl or n-butyl ester and bromoxynil or salt thereof can be ~~use~~ used to control AMARE, ECHCG, IPOHE, or SETFA.

In certain embodiments of the compositions and methods described herein, the compound of formula (I) or salt or ester thereof is used in combination with chlorotoluron or