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(54) **HERBICIDAL COMPOSITIONS COMPRISING  
4-AMINO-3-CHLORO-6-(4-CHLORO-2-FLUORO-3-METHOXYPHENYL)PYRIDINE-2-CARBOXYLI  
C ACID**

HERBIZIDZUSAMMENSETZUNGEN MIT

4-AMINO-3-CHLOR-6-(4-CHLOR-2-FLUOR-3-METHOXYPHENYL-)PYRIDIN-2-CARBONSÄURE

COMPOSITIONS HERBICIDES COMPRENANT DE L'ACIDE

4-AMINO-3-CHLORO-6-(4-CHLORO-2-FLUORO-3-MÉTHOXYPHÉNYL)PYRIDINE-2-CARBOXYLI  
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**EP 2 947 988 B9**

**Description**Field

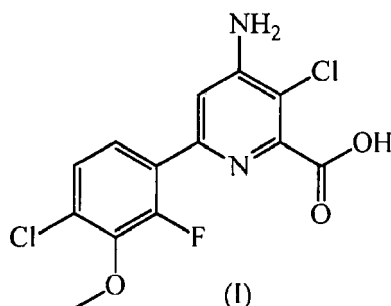
**[0001]** Provided herein are herbicidal compositions and methods for controlling undesirable vegetation.

Background

**[0002]** 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

**[0003]** Provided herein are herbicidal compositions comprising a herbicidally effective amount of (a) a compound of the formula (I)



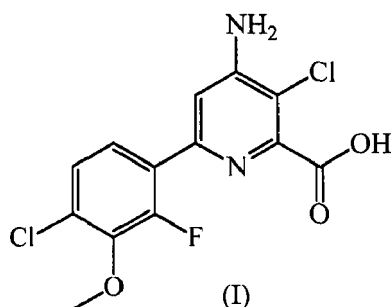
or an agriculturally acceptable salt or ester of thereof, and (b) propyzamide. The compositions may also contain an agriculturally acceptable adjuvant or carrier.

**[0004]** Also provided are methods of controlling undesirable vegetation comprising applying (a) a compound of formula (I) or an agriculturally acceptable ester or salt thereof and (b) propyzamide.

Detailed Description

## DEFINITIONS

**[0005]** As used herein, the compound of formula (I) has the following structure:



**[0006]** The compound of formula (I) can be identified by the name 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)pyridine-2-carboxylic acid and has been described in U.S. Patent 7,314,849 (B2). Exemplary uses of the compound of the formula (I) include controlling undesirable vegetation, including e.g., grass, broadleaf and sedge weeds, in multiple non-crop and cropping situations.

**[0007]** As used herein, propyzamide is 3,5-dichloro-N-(1,1-dimethylpropynyl)benzamide. Its herbicidal activity is summarized in Tomlin, C., ed. A World Compendium The Pesticide Manual. 15th ed. Alton: BCPC Publications, 2009

(hereafter "The Pesticide Manual, Fifteenth Edition, 2009."). Exemplary uses of propyzamide include its use as a herbicide to selectively control many annual and perennial grasses and some broad-leaved weeds in fruit, vines, lettuce, endive, chicory, brassicas, oilseed rape, legumes, alfalfa, clover, trefoil, sainfoin, artichokes, sugar beet, roses, ornamental trees and shrubs, warm season amenity grass, on fallow land, and in forestry.

**[0008]** As used herein, control of or controlling undesirable vegetation means killing or preventing the vegetation, or causing some other adverse modifying effect to the vegetation e.g., deviations from natural growth or development, regulation, desiccation, retardation, and the like.

**[0009]** As used herein, herbicide and herbicidal active ingredient mean a compound that controls undesirable vegetation when applied in an appropriate amount.

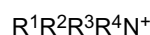
**[0010]** As used herein, a herbicidally effective or vegetation controlling amount is an amount of herbicidal active ingredient the application of which controls the relevant undesirable vegetation.

**[0011]** As used herein, applying or application of an herbicide or herbicidal composition means delivering it directly to the targeted vegetation or to the locus thereof or to the area where control of undesired vegetation is desired. Methods of application include, but are not limited to preemergence, postemergence, foliar, soil, and in-water applications. Described herein are methods of controlling undesirable vegetation through the application of certain herbicide combinations or compositions.

**[0012]** As used herein, plants and vegetation include, but are not limited to, dormant seeds, germinant seeds, emerging seedlings, plants emerging from vegetative propagules, immature vegetation, and established vegetation.

**[0013]** As used herein, agriculturally acceptable salts and esters refer to 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.

**[0014]** Exemplary salts include those derived from alkali or alkaline earth metals and those derived from ammonia and amines. Exemplary cations include sodium, potassium, magnesium, triethylammonium (TEA) and cations of the formula:



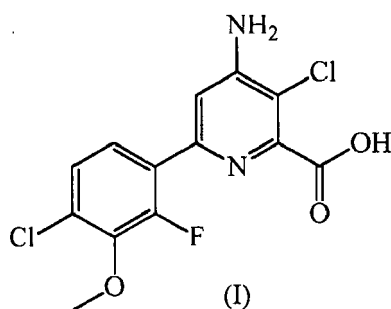
wherein  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  each, independently represents hydrogen or  $C_1$ - $C_{12}$  alkyl,  $C_3$ - $C_{12}$  alkenyl or  $C_3$ - $C_{12}$  alkynyl, each of which is optionally substituted by one or more hydroxy,  $C_1$ - $C_4$  alkoxy,  $C_1$ - $C_4$  alkylthio or phenyl groups, provided that  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  are sterically compatible. Additionally, any two of  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  together may represent an aliphatic difunctional moiety containing one to twelve carbon atoms and up to two oxygen or sulfur atoms. Salts can be prepared by treatment with a metal hydroxide, such as sodium hydroxide, with an amine, such as ammonia, trimethylamine, diethanolamine, 2-methyl-thiopropylamine, bisallylamine, 2-butoxyethylamine, morpholine, cyclododecylamine, or benzylamine or with a tetraalkylammonium hydroxide, such as tetramethylammonium hydroxide or choline hydroxide.

**[0015]** Exemplary esters include those derived from  $C_1$ - $C_{12}$  alkyl,  $C_3$ - $C_{12}$  alkenyl,  $C_3$ - $C_{12}$  alkynyl or  $C_7$ - $C_{10}$  aryl-substituted alkyl alcohols, such as methyl alcohol, isopropyl alcohol, 1-butanol, 2-ethylhexanol, butoxyethanol, methoxypropanol, allyl alcohol, propargyl alcohol, cyclohexanol or unsubstituted or substituted benzyl alcohols. Benzyl alcohols may be substituted with from 1-3 substituents independently selected from halogen,  $C_1$ - $C_4$  alkyl or  $C_1$ - $C_4$  alkoxy. Esters can be prepared by coupling of the acids with the alcohol using any number of suitable activating agents such as those used for peptide couplings such as dicyclohexylcarbodiimide (DCC) or carbonyl diimidazole (CDI); by reacting the acids with alkylating agents such as alkylhalides or alkylsulfonates in the presence of a base such as triethylamine or lithium carbonate; by reacting the corresponding acid chloride of an acid with an appropriate alcohol; by reacting the corresponding acid with an appropriate alcohol in the presence of an acid catalyst or by transesterification.

**[0016]** As used herein in expressing weight ratios, in cases where a salt or ester of the compound of formula (I) is used, the weight referred to for the salt or ester is the acid equivalent weight.

## COMPOSITIONS AND METHODS

**[0017]** Provided herein are herbicidal compositions comprising an herbicidally effective amount of (a) a compound of the formula (I)



or an agriculturally acceptable salt or ester of thereof, and (b) propyzamide.

**[0018]** Also provided are methods of controlling undesirable vegetation comprising applying an herbicidally effective amount of the compound of formula (I) or an agriculturally acceptable salt or ester thereof and (b) propyzamide. In certain

**[0019]** Furthermore, the combination of compound (I) or agriculturally acceptable salt or ester thereof and propyzamide exhibits synergism, e.g., the herbicidal active ingredients are more effective in combination than when applied individually. Synergism has been defined as "an interaction of two or more factors such that the effect when combined is greater than the predicted effect based on the response of each factor applied separately." Senseman, S., ed. *Herbicide Handbook*. 9th ed. Lawrence: Weed Science Society of America, 2007. In certain embodiments, the compositions exhibit synergy as determined by the Colby's equation. Colby, S.R. 1967. Calculation of the synergistic and antagonistic response of herbicide combinations. *Weeds* 15:20-22.

**[0020]** In certain embodiments of the compositions and methods described herein, the compound of formula (I), i.e., the carboxylic acid, is employed. In certain embodiments, a carboxylate salt of the compound of formula (I) is employed, such as the TEA or potassium salt. In certain embodiments, a C<sub>1-4</sub> alkyl, e.g., methyl ester is employed. In certain embodiments, the benzyl ester is employed.

**[0021]** In some embodiments, the compound of formula (I) or salt or ester thereof and propyzamide are formulated in one composition, tank mixed, applied simultaneously, or applied sequentially.

**[0022]** Herbicidal activity is exhibited by the compositions when they are applied, i.e. delivered directly to the plant or to the locus of the plant at any stage of growth, or to the area where control is desired. The effect observed depends upon the plant species to be controlled, the stage of growth of the plant, 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. These and other factors can be adjusted to promote non-selective or selective herbicidal action. In some

**[0023]** In some embodiments, the compositions and methods provided herein are utilized to control weeds in crops, including but not limited to winter/spring oilseed rape, winter/spring canola, vegetables, Brassica spp, ornamentals, rice, wheat, triticale, barley, oats, rye, sorghum, corn/maize, sunflower, row crops, pastures, grasslands, rangelands, fallow-land, sugarcane, turf, tree and vine orchards, industrial vegetation management and rights of way.

**[0024]** The compositions and methods described herein be used to control undesirable vegetation in glyphosate-tolerant-, glufosinate-tolerant-, dicamba-tolerant-, phenoxy auxin-tolerant-, pyridyloxy auxin-tolerant-, aryloxyphenoxypropionate-tolerant-, acetyl CoA carboxylase (ACCase) inhibitor-tolerant-, imidazolinone-tolerant-, acetolactate synthase (ALS) inhibitor-tolerant-, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitor -tolerant-, protoporphyrinogen oxidase (PPO) inhibitor -tolerant-, triazine-tolerant- and bromoxynil-tolerant-crops (such as, but not limited to, soybean, cotton, canola/oilseed rape, sunflower, rice, cereals, corn, turf, tree and vine, sugarcane, etc), for example, in conjunction with glyphosate, glufosinate, dicamba, phenoxy auxins, pyridyloxy auxins, aryloxyphenoxypropionates, ACCase inhibitors, imidazolinones, ALS inhibitors, HPPD inhibitors, PPO inhibitors, triazines, and bromoxynil. The compositions and methods may be used in controlling undesirable vegetation in crops possessing multiple or stacked traits conferring tolerance to multiple chemistries and/or inhibitors of multiple modes of action. In some embodiments, the compound of formula (I) or salt or ester thereof and complementary herbicide or salt or ester thereof are used in combination with 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 embodiments, the compositions described herein and other complementary herbicides are applied at the same time, either as a combination formulation or as a tank mix.

**[0025]** The compositions and methods provided herein are utilized to control undesirable vegetation. Undesirable vegetation includes, but is not limited to, undesirable vegetation that occurs in oilseed rape, canola, vegetables, Brassica spp, ornamentals, rice, wheat, triticale, barley, oats, rye, sorghum, corn/maize, sunflower, row crops, pastures, grass-

lands, rangelands, fallowland, sugarcane, turf, tree and vine orchards, industrial vegetation management and rights of way.

**[0026]** In certain embodiments, the methods and compositions utilizing the compound of formula (I) or salt or ester thereof in combination with propyzamide are used to provide synergistic control of GLXMA, IPOHE, ABUTH, POLCO, SETFA, BRSNW, AMARE, EPHHL, CHEAL, STEME, VIOTR, CIRRAR, GERSS, POANN, or VERSS.

**[0027]** In some embodiments, the methods provided herein are utilized to control undesirable vegetation in oilseed rape, canola, drilled crops and cereal crops. In certain embodiments, the undesirable vegetation is *Alopecurus myosuroides* Huds. (blackgrass, ALOMY), *Apera spica-venti* (L.) Beauv. (windgrass, APESV), *Avena fatua* L. (wild oat, AVEFA), *Bromus tectorum* L. (downy brome, BROTE), *Lolium multiflorum* Lam. (Italian ryegrass, LOLMU), *Lolium rigidum* (rigid ryegrass), *Lolium multiflorum subsp. Gaudini* (annual ryegrass), *Phalaris minor* Retz. (littleseed canarygrass, PHAMI), *Poa annua* L. (annual bluegrass, POANN), *Setaria pumila* (Poir.) Roemer & J.A. Schultes (yellow foxtail, SETLU), *Setaria viridis* (L.) Beauv. (green foxtail, SETVI), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRAR), *Galium aparine* L. (catchweed bedstraw, GALAP), *Kochia scoparia* (L.) Schrad. (kochia, KCHSC), *Lamium purpureum* L. (purple deadnettle, LAMPU), *Matricaria recutita* L. (wild chamomile, MATCH), *Matricaria matricarioides* (Less.) Porter (pineappleweed, MATMT), *Papaver rhoeas* L. (common poppy, PAPRH), *Polygonum convolvulus* L. (wild buckwheat, POLCO), *Salsola tragus* L. (Russian thistle, SASKR), *Stellaria media* (L.) Vill. (common chickweed, STEME), *Veronica persica* Poir. (Persian speedwell, VERPE), *Viola arvensis* Murr. (field violet, VIOAR), or *Viola tricolor* L. (wild violet, VIOTR).

**[0028]** In some embodiments, the methods provided herein are utilized to control undesirable vegetation in rice. In certain embodiments, the undesirable vegetation is *Brachiaria platyphylla* (Groseb.) Nash (broadleaf signalgrass, BRAPP), *Digitaria sanguinalis* (L.) Scop. (large crabgrass, DIGSA), *Echinochloa crus-galli* (L.) P. Beauv. (barnyardgrass, ECHCG), *Echinochloa colonum* (L.) LINK (junglerice, ECHCO), *Echinochloa oryzoides* (Ard.) Fritsch (early watergrass, ECHOR), *Echinochloa oryzicola* (Vasinger) Vasinger (late watergrass, ECHPH), *Ischaemum rugosum* Salisb. (saramolagrass, ISCRU), *Leptochloa chinensis* (L.) Nees (Chinese sprangletop, LEFCH), *Leptochloa fascicularis* (Lam.) Gray (bearded sprangletop, LEFFA), *Leptochloa panicoides* (Presl.) Hitchc. (Amazon sprangletop, LEFPA), *Panicum dichotomiflorum* (L.) Michx. (fall panicum, PANDI), *Paspalum dilatatum* Poir. (dallisgrass, PASDI), *Cyperus difformis* L. (small-flower flatsedge, CYPDI), *Cyperus esculentus* L. (yellow nutsedge, CYPES), *Cyperus iria* L. (rice flatsedge, CYPRI), *Cyperus rotundus* L. (purple nutsedge, CYPRO), *Eleocharis* species (ELOSS), *Fimbristylis miliacea* (L.) Vahl (globe fringerush, FIMMI), *Schoenoplectus juncooides* Roxb. (Japanese bulrush, SPCJU), *Schoenoplectus maritimus* L. (sea clubrush, SCPMA), *Schoenoplectus mucronatus* L. (ricefield bulrush, SCPMU), *Aeschynomene* species, (jointvetch, AESSS), *Alternanthera philoxeroides* (Mart.) Griseb. (alligatorweed, ALRPH), *Alisma plantago-aquatica* L. (common waterplantain, ALSPA), *Amaranthus* species, (pigweeds and amaranths, AMASS), *Ammannia coccinea* Rottb. (redstem, AMMCO), *Eclipta alba* (L.) Hassk. (American false daisy, ECLAL), *Heteranthera limosa* (SW.) Willd./Vahl (ducksalad, HETLI), *Heteranthera reniformis* R. & P. (roundleaf mudplantain, HETRE), *Ipomoea hederacea* (L.) Jacq. (ivyleaf morningglory, IPOHE), *Lindernia dubia* (L.) Pennell (low false pimpernel, LIDDU), *Monochoria korsakowii* Regel & Maack (monochoria, MOOKA), *Monochoria vaginalis* (Burm. F.) C. Presl ex Kuhth. (monochoria, MOOVA), *Murdannia nudiflora* (L.) Brenan (doveweed, MUDNU), *Polygonum pensylvanicum* L. (Pennsylvania smartweed, POLPY), *Polygonum persicaria* L. (ladysthumb, POLPE), *Polygonum hydropiperoides* Michx. (POLHP, mild smartweed), *Rotala indica* (Willd.) Koehne (Indian toothcup, ROTIN), *Sagittaria* species, (arrowhead, SAGSS), *Sesbania exaltata* (Raf.) Cory/Rydb. Ex Hill (hemp sesbania, SEBEX), or *Sphenoclea zeylanica* Gaertn. (gooseweed, SPDZE).

**[0029]** In some embodiments, the methods provided herein are utilized to control undesirable vegetation in range and pasture. In certain embodiments, the undesirable vegetation is *Ambrosia artemisiifolia* L. (common ragweed, AMBEL), *Cassia obtusifolia* (sickle pod, CASOB), *Centaurea maculosa* auct. non Lam. (spotted knapweed, CENMA), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRAR), *Convolvulus arvensis* L. (field bindweed, CONAR), *Euphorbia esula* L. (leafy spurge, EPHEs), *Lactuca serriola* L./Torn. (prickly lettuce, LACSE), *Plantago lanceolata* L. (buckhorn plantain, PLALA), *Rumex obtusifolius* L. (broadleaf dock, RUMOB), *Sida spinosa* L. (prickly sida, SIDSP), *Sinapis arvensis* L. (wild mustard, SINAR), *Sonchus arvensis* L. (perennial sowthistle, SONAR), *Solidago* species (goldenrod, SOOSS), *Taraxacum officinale* G.H. Weber ex Wiggers (dandelion, TAROF), *Trifolium repens* L. (white clover, TRFRE), or *Urtica dioica* L. (common nettle, URTDI).

**[0030]** In some embodiments, the methods provided herein are utilized to control undesirable vegetation found in row crops and vegetable crops. In certain embodiments, the undesirable vegetation is *Alopecurus myosuroides* Huds. (blackgrass, ALOMY), *Avena fatua* L. (wild oat, AVEFA), *Brachiaria platyphylla* (Groseb.) Nash (broadleaf signalgrass, BRAPP), *Digitaria sanguinalis* (L.) Scop. (large crabgrass, DIGSA), *Echinochloa crus-galli* (L.) P. Beauv. (barnyardgrass, ECHCG), *Echinochloa colonum* (L.) Link (junglerice, ECHCO), *Lolium multiflorum* Lam. (Italian ryegrass, LOLMU), *Panicum dichotomiflorum* Michx. (fall panicum, PANDI), *Panicum miliaceum* L. (wild-proso millet, PANMI), *Setaria faberi* Herm. (giant foxtail, SETFA), *Setaria viridis* (L.) Beauv. (green foxtail, SETVI), *Sorghum halepense* (L.) Pers. (Johnsongrass, SORHA), *Sorghum bicolor* (L.) Moench ssp. *Arundinaceum* (shattercane, SORVU), *Cyperus esculentus* L. (yellow nutsedge, CYPES), *Cyperus rotundus* L. (purple nutsedge, CYPRO), *Abutilon theophrasti* Medik. (velvetleaf, ABUTH), *Amaranthus* species (pigweeds and amaranths, AMASS), *Ambrosia artemisiifolia* L. (common ragweed, AMBEL), *Am-*

*brosia psilostachya* DC. (western ragweed, AMBPS), *Ambrosia trifida* L. (giant ragweed, AMBTR), *Asclepias syriaca* L. (common milkweed, ASCSY), *Chenopodium album* L. (common lambsquarters, CHEAL), *Cirsium arvense* (L.) Scop. (Canada thistle, CIRAR), *Commelina benghalensis* L. (tropical spiderwort, COMBE), *Datura stramonium* L. (jimsonweed, DATST), *Daucus carota* L. (wild carrot, DAUCA), *Euphorbia heterophylla* L. (wild poinsettia, EPHHL), *Erigeron bonariensis* L. (hairy fleabane, ERIBO), *Erigeron canadensis* L. (Canadian fleabane, ERICA), *Helianthus annuus* L. (common sunflower, HELAN), *Jacquemontia tamnifolia* (L.) Griseb. (smallflower morningglory, IAQTA), *Ipomoea hederacea* (L.) Jacq. (ivyleaf morningglory, IPOHE), *Ipomoea lacunosa* L. (white morningglory, IPOLA), *Lactuca serriola* L./Torn. (prickly lettuce, LACSE), *Portulaca oleracea* L. (common purslane, POROL), *Sida spinosa* L. (prickly sida, SIDSP), *Sinapis arvensis* L. (wild mustard, SINAR), *Solanum ptychanthum* Dunal (eastern black nightshade, SOLPT), or *Xanthium strumarium* L. (common cocklebur, XANST).

**[0031]** In some embodiments, the compositions and methods provided herein are utilized to control undesirable vegetation consisting of grass, broadleaf and sedge weeds.

**[0032]** In some embodiments, the combination of compound (I) or agriculturally acceptable ester or salt thereof and propyzamide is used to control *Amaranthus retroflexus* (Pigweed, redroot), *Chenopodium album* (Lambsquarters, common), *Centaurea cyanus* (Cornflower), *Descurainia Sophia* (Flixweed), *Conyza Canadensis* (Horseweed / Marestail), *Conyza bonariensis* (Fleabane), *Erodium cicutarium* (Storksbill / Redstem filaree), *Fumaria officinalis* (Fumitory), *Galeopsis tetrahit* (Hempnettle, common), *Galium aparine* (Bedstraw, catchweed / cleavers), *Geranium dissectum* (Geranium cutleaf), *Geranium pusillum* (Geranium, smallflower), *Glycine max* (volunteer soybean), *Lamium amplexicaule* (Henbit), *Lamium purpureum* (Deadnettle, purple), *Papaver rhoeas* (Poppy, common), *Stellaria media* (Chickweed, common), *Veronica persica* (Persian speedwell), *Linum usitatissimum* (Flax, volunteer), *Geranium carolinianum* (Geranium, Carolina), or *Vicia villosa* (Vetch, hairy).

**[0033]** With regard to the compositions, in some embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to propyzamide or salt thereof is within the range of from about 1:2240 to about 1:10. In certain embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to propyzamide or salt thereof is within the range of from about 1:600 to about 1:25. In certain embodiments, the weight ratio of the compound of formula (I) or salt or ester thereof to propyzamide or salt thereof is within the range of from about 1:600 to about 1:30. In certain embodiments, the compositions comprise the compound of formula (I) or its methyl ester, TEA salt, or potassium salt and propyzamide.

**[0034]** With respect to the methods, in certain embodiments, the methods comprise contacting the undesirable vegetation or locus thereof or applying to the soil to prevent the emergence or growth of vegetation a composition described herein. In some embodiments, the composition is applied at an application rate of from about 101 grams active ingredient per hectare (g ai/ha) to about 2250 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 of from about 250 g ai/ha to about 760 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 to prevent the emergence or growth of vegetation with a compound of formula (I) or salt or ester thereof and propyzamide, e.g., sequentially or simultaneously. In some embodiments, the propyzamide is applied at a rate from about 100 g ai/ha to about 2240 g ai/ha and the compound of formula (I) of salt or ester thereof is applied at a rate from about 1 g ae/ha to about 10 g ae/ha. In certain embodiments, the methods utilize the compound of formula (I) or its methyl ester, TEA salt, or potassium salt in combination with propyzamide.

**[0035]** The components of the mixtures described herein can be applied either separately or as part of a multipart herbicidal system.

**[0036]** The mixtures described herein can be applied in conjunction with one or more other herbicides to control a wider variety of undesirable vegetation. When used in conjunction with other herbicides, the composition can be formulated with the other herbicide or herbicides, tank mixed with the other herbicide or herbicides or applied sequentially with the other herbicide or herbicides. Some of the herbicides that can be employed in conjunction with the compositions and methods described herein include, but are not limited to: 4-CPA; 4-CPB; 4-CPP; 2,4-D; 2,4-D choline salt, 2,4-D esters and amines, 2,4-DB; 3,4-DA; 3,4-DB; 2,4-DEB; 2,4-DEP; 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, ametryn, amibuzin, amicarbazone, amidosulfuron, aminocyclopyrachlor, aminopyralid, amiprofos-methyl, amitrole, ammonium sulfamate, anilofos, anisuron, asulam, atraton, atrazine, azafenidin, azimsulfuron, aziprotryne, barban, BCPC, beflubutamid, benazolin, bencarbazone, benfluralin, benfuresate, bensulfuron-methyl, bensulide, benthicarb, bentazon-sodium, benzadox, benzofendazole, benzipram, benzobicyclon, benzofenap, benzofluor, benzoylprop, benzthiazuron, bicyclopyrone, bifenox, bilanafos, bispyribac-sodium, borax, bromacil, bromobonil, 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, chlorbromuron, chlorbufam, chloreturon, chlorfenac, chlorfenprop, chlorflurazole, chlorflurenol, chloridazon, chlorimuron, chlornitrofen,

chloropon, chlorotoluron, chloroxuron, chloroxynil, chlorpropham, chlorsulfuron, chlorthal, chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, cisanilide, clethodim, clodinate, clodinafop-propargyl, clofop, clomazone, clomeprop, cloprop, cloproxydim, clopyralid, cloransulam-methyl, CMA, copper sulfate, CPMF, CPPC, credazine, cresol, cumyluron, cyanatryn, cyanazine, cycloate, cyclosulfamuron, cycloxydim, cycluron, cyhalofop-butyl, cyperquat, cyprazine, cyprazole, cypromid, dalapon, dazomet, delachlor, desmedipham, desmetryn, di-allate, dicamba, dichlobenil, dichloralurea, dichloromate, dichlorprop, dichlorprop-P, diclofop-methyl, diclosulam, diethamquat, diethatyl, difenopenten, difenoxuron, difenzoquat, diflufenican, diflufenzopyr, dimefuron, dimepiperate, dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimexano, dimidazon, dinitramine, dinofenat, dinoprop, dinosam, dinoseb, dinoterb, diphenamid, dipropetryn, diquat, disul, dithiopyr, diuron, DMPA, DNOC, DSMA, EBEP, eglinazone, endothal, epronaz, EPTC, erbon, esprocarb, ethalfuralin, ethbenzamide, ethametsulfuron, ethidimuron, ethiolate, ethobenzamid, etobenzamid, ethofumesate, ethoxyfen, ethoxysulfuron, etinofen, etnipromid, etobenzanid, EXD, fenasulam, fenoprop, fenoxaprop, fenoxaprop-P-ethyl, fenoxaprop-P-ethyl + isoxadifen-ethyl, fenoxasulfone, 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, fluroxyppyr, flurtamone, fluthiacet, fomesafen, foramsulfuron, fosamine, fumiclorac, furyloxyfen, glufosinate, glufosinate-ammonium, glufosinate-P-ammonium, glyphosate, halosafen, halosulfuron-methyl, haloxydine, haloxyfop-methyl, haloxyfop-P-methyl, hexachloroacetone, hexaflurate, hexazinone, imazamethabenz, imazamox, imazapic, imazapyr, imazaquin, imazosulfuron, imazethapyr, indanofan, indaziflam, iodobonil, iodometthane, iodosulfuron, iodosulfuron-ethyl-sodium, iofensulfuron, ioxynil, ipazine, ipfencarbazone, iprymidam, isocarbamid, isocil, isomethiozin, isonoruron, isopollinate, 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, metamitron, metazachlor, metazosulfuron, metflurazon, methabenzthiazuron, methalpropalin, methazole, methiobencarb, methiozolin, methiuron, methometon, methoprotetryne, methyl bromide, methyl isothiocyante, methylidymron, metobenzuron, metobromuron, metolachlor, metosulam, metoxuron, metribuzin, metsulfuron, metsulfuron-methyl, molinate, monalide, monisouron, monochloroacetic acid, monolinuron, monuron, morfamquat, MSMA, naproanilide, napropamide, naptalam, neburon, nicosulfuron, nipyraclufen, nitratin, nitrofen, nitrofluorfen, norflurazon, noruron, OCH, orbencarb, *ortho*-dichlorobenzene, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxapyrazon, oxasulfuron, oxyfluorfen, paraflufen-ethyl, parafluron, paraquat, pebulate, pelargonic acid, pendimethalin, penoxsulam, pentachlorophenol, pentanochlor, pentoxazone, perfludone, pethoxamid, phenisopham, phenmedipham, phenmedipham-ethyl, phenobenzuron, phenylmercury acetate, picloram, picolinafen, pinoxaden, piperophos, potassium arsenite, potassium azide, potassium cyanate, pretilachlor, primisulfuron-methyl, procyazine, prodiamine, profluzol, profluralin, profoxydim, proglinazone, prohexadione-calcium, prometon, prometryn, pronamide, propachlor, propanil, propaquizafop, propazine, propham, propisochlor, propoxycarbazone, propyrisulfuron, prosulfalin, prosulfocarb, prosulfuron, proxan, prynachlor, pydanon, pyraclonil, pyraflufen-ethyl, pyrasulfotole, pyrazogyl, pyrazolynate, pyrazosulfuron-ethyl, pyrazoxyfen, pyribenzoxim, pyriclor, pyridafol, pyridate, pyrifthalid, pyriminobac, pyrimisulfan, pyriothiobac-sodium, pyroxasulfone, pyroxsulam, quinclozac, quinmerac, quincloamine, quinonamid, quizalofop, quizalofop-P-ethyl, rhodethanil, rimsulfuron, saflufenacil, S-metolachlor, sebutylazine, sebumeton, sethoxydim, siduron, simazine, simeton, simetryn, SMA, sodium arsenite, sodium azide, sodium chlorate, sulcotrione, sulfallate, sulfentrazon, sulfometuron, sulfosate, sulfosulfuron, sulfuric acid, sulglycapin, swep, TCA, tebutam, tebutiuron, tefuryltrione, tembotrione, tepraloxym, terbacil, terbucarb, terbuchlor, terbumeton, terbuthylazine, terbutryn, tetrafluron, thenylchlor, thiazafuron, thiazopyr, thidiazimin, thidiazuron, thienicarbazone-methyl, thifensulfuron, thifensulfurn-methyl, thiobencarb, tiocarbamil, tioclorim, topramezone, tralkoxydim, triafamone, tri-allate, triasulfuron, triaziflam, tribenuron, tribenuron-methyl, tricamba, triclopyr choline salt, triclopyr esters and salts, tridiphane, trietazine, trifloxysulfuron, trifluralin, triflusulfuron, trifop, trifopsime, trihydroxytriazine, trimeturon, tripropindan, tritac tritosulfuron, vernolate, xylachlor and salts, esters, optically active isomers and mixtures thereof.

**[0037]** In some embodiments the methods provided herein are used to control undesirable vegetation in glyphosate-, glufosinate-, dicamba-, phenoxy auxins-, pyridyloxy auxins-, aryloxyphenoxypropionates-, acetyl CoA carboxylase (AC-Case) inhibitors-, imidazolinones-, acetolactate synthase (ALS) inhibitors-, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors-, protoporphyrinogen oxidase (PPO) inhibitors-, triazines-inhibitors, or bromoxynil-tolerant crops. Such herbicide tolerant crops may possess multiple or stacked traits conferring tolerance to multiple herbicides or multiple modes of action.

**[0038]** In some embodiments the methods provided herein are used to control undesirable vegetation that is a herbicide resistant or tolerant weed. Such herbicide resistant or tolerant weed may have a biotype with resistance or tolerance to multiple herbicides, multiple chemical classes, or multiple herbicide modes-of-action. For example, the herbicide resistant or tolerant weed may have a biotype resistant or tolerant to acetolactate synthase (ALS) inhibitors, photosystem II inhibitors, acetyl CoA carboxylase (ACCase) inhibitors, synthetic auxins, photosystem I inhibitors, 5-enolpyruvylshiki-

mate-3-phosphate (EPSP) synthase inhibitors, microtubule assembly inhibitors, 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.

**[0039]** In some embodiments, the compositions described herein are employed in combination with one or more herbicide safeners, such as AD-67 (MON 4660), benoxacor, benthocarb, brassinolide, cloquintocet (mexyl), cyometrinil, daimuron, dichlormid, dicyclonon, dimepiperate, disulfoton, fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, harpin proteins, isoxadifen-ethyl, jiecaowan, jiecaoxi, mefenpyr-diethyl, mephenate, naphthalic anhydride (NA), oxabetrinil, R29148 and *N*-phenyl-sulfonylbenzoic acid amides, to enhance their selectivity. In some embodiments, the safeners are employed in rice, cereal, corn, or maize settings. In some embodiments, the safener is cloquintocet or an ester or salt thereof. In certain embodiments, cloquintocet is utilized to antagonize harmful effects of the compositions on rice and cereals. In some embodiments, the safener is cloquintocet (mexyl).

**[0040]** In some embodiments, compositions provided herein further comprise at least one agriculturally acceptable adjuvant or carrier. Suitable adjuvants or carriers should not be phytotoxic to valuable crops, particularly at the concentrations employed in applying the compositions for selective weed control in the presence of crops, and should not react chemically with herbicidal components or other composition ingredients. Such mixtures can be designed for application directly to weeds or their locus or can be concentrates or formulations that are normally diluted with additional carriers and adjuvants before application. They can be solids, such as, for example, dusts, granules, water-dispersible granules, or wettable powders, or liquids, such as, for example, emulsifiable concentrates, solutions, emulsions or suspensions. They can also be provided as a pre-mix or tank mixed.

**[0041]** Suitable agricultural adjuvants and carriers include, but are not limited to, crop oil concentrate; nonylphenol ethoxylate; benzylcocoalkyldimethyl quaternary ammonium salt; blend of petroleum hydrocarbon, alkyl esters, organic acid, and anionic surfactant; C<sub>9</sub>-C<sub>11</sub> alkylpolyglycoside; phosphated alcohol ethoxylate; natural primary alcohol (C<sub>12</sub>-C<sub>16</sub>) ethoxylate; di-*sec*-butylphenol EO-PO block copolymer; polysiloxane-methyl cap; nonylphenol ethoxylate + urea ammonium nitrate; emulsified methylated seed oil; tridecyl alcohol (synthetic) ethoxylate (8EO); tallow amine ethoxylate (15 EO); PEG(400) dioleate-99.

**[0042]** Liquid carriers that can be employed include water and organic solvents. The organic solvents include, but are not limited to, 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. Specific organic solvents include, but are not limited to 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, glycerine, *N*-methyl-2-pyrrolidinone, *N,N*-dimethyl alkylamides, dimethyl sulfoxide, liquid fertilizers and the like. In certain embodiments, Water is the carrier for the dilution of concentrates.

**[0043]** Suitable solid carriers include but are not limited to talc, pyrophyllite clay, silica, attapulgis clay, kaolin clay, kieselguhr, chalk, diatomaceous earth, lime, calcium carbonate, bentonite clay, Fuller's earth, cottonseed hulls, wheat flour, soybean flour, pumice, wood flour, walnut shell flour, lignin, cellulose, and the like.

**[0044]** In some embodiments, the compositions described herein further comprise one or more surface-active agents. In some embodiments, such surface-active agents are employed in both solid and liquid compositions, and in certain embodiments those designed to be diluted with carrier before application. The surface-active agents can be anionic, cationic or nonionic in character and can be employed as emulsifying agents, wetting agents, suspending agents, or for other purposes. Surfactants which may also be used in the present formulations are described, *inter alia*, in "McCutcheon's Detergents and Emulsifiers Annual," MC Publishing Corp., Ridgewood, New Jersey, 1998 and in "Encyclopedia of Surfactants," Vol. I-III, Chemical Publishing Co., New York, 1980-81. Surface-active agents include, but are not limited to salts of alkyl sulfates, such as diethanolammonium lauryl sulfate; alkylarylsulfonate salts, such as calciumdodecylbenzenesulfonate; alkylphenol-alkylene oxide addition products, such as nonylphenol-C<sub>18</sub> ethoxylate; alcohol-alkylene oxide addition products, such as tridecyl alcohol-C<sub>16</sub> ethoxylate; soaps, such as sodium stearate; alkylnaphthalene-sulfonate salts, such as sodium dibutylnaphthalenesulfonate; dialkyl esters of sulfosuccinate salts, such as sodium di(2-ethylhexyl) sulfosuccinate; sorbitol esters, such as sorbitol oleate; quaternary amines, such as lauryl trimethylammonium chloride; polyethylene glycol esters of fatty acids, such as polyethylene glycol stearate; block copolymers of ethylene oxide and propylene oxide; salts of mono and dialkyl phosphate esters; vegetable or seed oils such as soybean oil, rapeseed/canola 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; and esters of the above vegetable oils, and in certain embod-



iments, methyl esters.

[0045] In some embodiments, these materials, such as vegetable or seed oils and their esters, can be used interchangeably as an agricultural adjuvant, as a liquid carrier or as a surface active agent.

[0046] Other exemplary additives for use in the compositions provided herein include but are not limited to compatibilizing agents, antifoam agents, sequestering agents, neutralizing agents and buffers, corrosion inhibitors, dyes, odorants, spreading agents, penetration aids, sticking agents, dispersing agents, thickening agents, freezing point depressants, antimicrobial agents, and the like. The compositions may also contain other compatible components, for example, other herbicides, plant growth regulants, fungicides, insecticides, and the like and can be formulated with liquid fertilizers or solid, particulate fertilizer carriers such as ammonium nitrate, urea and the like.

[0047] In some embodiments, the concentration of the active ingredients in the compositions described herein is from about 0.0005 to 98 percent by weight. In some embodiments, the concentration is from about 0.0006 to 90 percent by weight. In compositions designed to be employed as concentrates, the active ingredients, in certain embodiments, are present in a concentration from about 0.1 to 98 weight percent, and in certain embodiments about 0.5 to 90 weight percent. Such compositions are, in certain embodiments, diluted with an inert carrier, such as water, before application. The diluted compositions usually applied to weeds or the locus of weeds contain, in certain embodiments, about 0.0005 to 15.0 weight percent active ingredient and in certain embodiments contain about 0.001 to 12.0 weight percent.

[0048] The present compositions can be applied to weeds or their locus by the use of conventional ground or aerial dusters, sprayers, and granule applicators, by addition to irrigation or paddy water, and by other conventional means known to those skilled in the art.

[0049] The described embodiments and following examples are for illustrative purposes.

## EXAMPLES

[0050] Results in Table I are greenhouse trial results for foliar applied compositions. The observed values in the table refer to % control rated visually. Colby's equation was used to determine the herbicidal effects expected from the mixtures (Colby, S.R. 1967. Calculation of the synergistic and antagonistic response of herbicide combinations. Weeds 15:20-22.). More specifically, the following equation was used to calculate the expected activity of mixtures containing two active ingredients, A and B:

$$\text{Expected} = A + B - (A \times B/100)$$

A = observed efficacy of active ingredient A at the same concentration as used in the mixture.

B = observed efficacy of active ingredient B at the same concentration as used in the mixture.

The compositions tested, application rates employed, plant species tested, and results are given in Table 1.

The following abbreviations are used in Table 1:

GLXMA *Glycine max*

IPOHE *Ipomoea hederacea* (L.) Jacq. (ivy leaf morning glory)

ABUTH *Abutilon theophrasti* Medik. (velvet leaf)

POLCO *Polygonum convolvulus* L. (wild buckwheat)

SETFA *Setaria faberi* Herrm. (giant foxtail)

BRSNW *Brassica napus* (winter)

AMARE *Amaranthus retroflexus* L.

EPHHL *Euphorbia heterophylla* L. (wild poinsettia)

CHEAL *Chenopodium album* L. (common lambsquarters)

STEME *Stellaria media* (L.) Vill. (common chickweed)

VIOTR *Viola tricolor* L. (wild violet)

CIRAR *Cirsium arvense* (L.) Scop. (Canada thistle)

g ae/ha = grams acid equivalent per hectare

g ai/ha = grams active ingredient per hectare

ob = observed value of % control rated visually

ex = expected value of % control as calculated by Colby's equation

Cmpd I = the methyl ester of the compound of formula (I)

Table 1. Synergistic activity of compositions comprising Cmpd I and propyzamide -- % control rated visually

treatment		GLXMA		IPOHE		ABUTH		POLCO		SETFA		BRSNW		AMARE		EPHHL		CHEAL		STEME		VIOTR		CIRAR	
Cmpd I (g ae/ha)	Propyz- amide (g ai/ha)	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex	ob	ex
2.5	0	80	-	20	-	87	-	35	-	0	-	0	-	50	-	85	-	82	-	50	-	30	-	47	-
5	0	87	-	38	-	85	-	25	-	5	-	0	-	58	-	93	-	90	-	57	-	43	-	53	-
10	0	100	-	43	-	90	-	48	-	35	-	10	-	77	-	100	-	91	-	72	-	62	-	65	-
0	285	10	-	10	-	5	-	5	-	0	-	5	-	0	-	0	-	0	-	7	-	0	-	0	-
0	570	15	-	17	-	0	-	15	-	0	-	20	-	10	-	0	-	0	-	75	-	0	-	0	-
2.5	285	83	82	55	28	88	87	38	38	0	0	25	5	82	50	89	85	85	82	73	53	60	30	60	47
2.5	570	88	83	47	33	93	87	68	45	10	0	10	20	82	55	94	85	89	82	67	88	65	30	68	47
5	285	95	88	63	45	94	86	50	29	10	5	15	5	88	58	98	93	92	90	85	60	67	43	70	53
5	570	97	89	70	49	96	85	63	36	40	5	30	20	86	63	99	93	92	90	77	89	75	43	72	53
10	285	96	100	78	49	96	91	80	50	60	35	18	15	91	77	100	100	93	91	87	74	78	62	80	65
10	570	100	100	78	53	98	90	80	55	68	35	30	28	92	79	100	100	94	91	92	93	78	62	82	65

### Field Trial

**[0051]** Multiple small plot research experiments were conducted to evaluate efficacy and tolerance of winter oilseed rape to compositions described herein. Typical small plots (2-4 x 4-10 m) were used in growers fields under natural conditions with normal commercial cultural practices. Backpack sprayers were used to apply all treatments based on unit area. The methyl ester of formula (I) and propyzamide were tested alone and in combination at varying rates. Application water volume was 150 L/ha. Crop stage at was Growth Stage 39-50. Visual crop injury ratings were collected 32, 49, and 74 days after treatment. In each case the rating was 0% injury. Control of GERSS, POANN, and VERSS was evaluated visually at 32, 58, and 80 days after application. The observed visual % control values are reported in the following Tables 2-4. The reported values are means. Means followed by the same letter do not significantly differ (P= .05, Student-Newman-Keuls).

**[0052]** The following abbreviations are used in Tables 2-4:

GERSS = *Geranium* sp., cranesbill

POANN = *Poa annua*, annual bluegrass

VERSS = *Veronica* sp., speedwell

g ae/ha = grams acid equivalent per hectare

g ai/ha = grams active ingredient per hectare

ob = observed value

ex = expected value as calculated by Colby's equation

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Cmpd I = the methyl ester of the compound of formula (I).

Table 2. Synergistic activity of compositions comprising Cmpd I and propyzamide --% control rated visually 32 DAAA

treatment		GERSS		POANN		VERSS	
Cmpd I (g ae/ha)	Propyzamide (g ai/ha)	ob	ex	ob	ex	ob	ex
	250	5.0 e	-	12.5 cd	-	43.8 a-d	-
	500	20.0 de	-	15.0 cd	-	60.0 abc	-
	750	18.8 de	-	37.5 a-d	-	54.3 a-d	-
1.25		42.5 cd	-	7.5 cd	-	10.0 cd	-
2.5		42.5 cd	-	10.0 cd	-	26.3 a-d	-
5		89.3 ab	-	6.3 cd	-	45.0 a-d	-
7.5		91.3 ab	-	28.8 bcd	-	81.3 a	-
1.25	250	65.0 abc	45.4	15.0 cd	19.1	14.6 bcd	49.4
1.25	500	42.5 cd	54.0	35.0 a-d	21.4	71.3 ab	64.0
1.25	750	56.3 bc	53.3	72.5 a	42.2	87.5 a	58.9
2.5	250	45.0 cd	45.4	35.0 a-d	21.3	73.8 ab	58.6
2.5	500	71.3 abc	54.0	37.5 a-d	23.5	75.0 ab	70.5
2.5	750	65.0 abc	53.3	48.8 abc	43.8	92.5 a	66.3
5	250	90.0 ab	89.8	26.3 bcd	18.0	83.0 a	69.1
5	500	86.8 ab	91.4	45.0 a-d	20.4	77.5 ab	78.0
5	750	86.8 ab	91.3	46.3 a-d	41.4	91.3 a	74.9
7.5	250	90.0 ab	91.7	36.3 a-d	37.7	72.5 ab	89.5
7.5	500	92.0 ab	93.0	38.8 a-d	39.5	94.3 a	92.5
7.5	750	94.5 a	92.9	61.3 ab	55.5	91.3 a	91.5

Table 3. Synergistic activity of compositions comprising Cmpd I and propyzamide -- % control rated visually 58 DAAA

treatment		GERSS		POANN	
Cmpd I (g ae/ha)	Propyzamide (g ai/ha)	ob	ex	ob	ex
	250	17.5 d	-	12.5 e	-
	500	35.0 bcd	-	67.5 bcd	-
	750	25.0 cd	-	92.5 ab	-
1.25		62.5 abc	-	11.3 e	-
2.5		57.5 abc	-	15.0 e	-
5		77.5 a	-	12.5 e	-
7.5		91.3 a	-	28.8 e	-
1.25	250	77.0 a	69.1	83.0 abc	22.4
1.25	500	58.8 abc	75.6	82.5 abc	71.2
1.25	750	92.3 a	71.9	99.0 a	93.3
2.5	250	70.0 ab	64.9	60.0 cd	25.6
2.5	500	67.5 ab	72.4	74.5 a-d	72.4

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(continued)

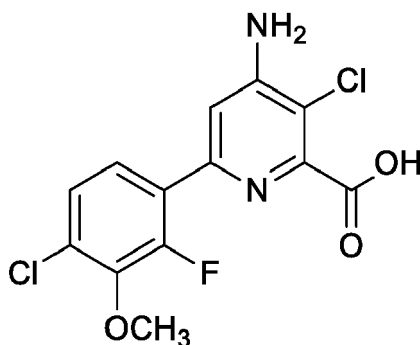
treatment		GERSS		POANN	
Cmpd I (g ae/ha)	Propyzamide (g ai/ha)	ob	ex	ob	ex
2.5	750	57.5 abc	68.1	88.8 ab	93.6
5	250	82.5 a	81.4	53.8 d	23.4
5	500	78.8 a	85.4	52.5 d	71.6
5	750	86.8 a	83.1	90.5 ab	93.4
7.5	250	92.8 a	92.8	72.5 a-d	37.7
7.5	500	98.5 a	94.3	88.8 ab	76.9
7.5	750	93.3 a	93.5	88.8 ab	94.7

Table 4. Synergistic activity of compositions comprising Cmpd I and propyzamide - % control rated visually 80 DAAA

treatment		GERSS		POANN		VERSS	
Cmpd I (g ae/ha)	Propyzamide (g ai/ha)	ob	ex	ob	ex	ob	ex
	250	22.5 d	-	45.0 c	-	100.0 a	-
	500	28.8 bcd	-	95.0 a	-	100.0 a	-
	750	33.8 a-d	-	98.3 a	-	100.0 a	-
1.25		53.8 a-d	-	16.3 d	-	80.0 a	-
2.5		67.5 a-d	-	15.0 d	-	97.5 a	-
5		69.5 a-d	-	6.3 d	-	100.0 a	-
7.5		99.8 a	-	18.8 d	-	100.0 a	-
1.25	250	93.0 a	64.2	88.0 ab	54.0	100.0 a	100.0
1.25	500	88.8 ab	67.1	92.5 a	95.8	100.0 a	100.0
1.25	750	98.8 a	69.4	100.0 a	98.6	97.5 a	100.0
2.5	250	59.8 a-d	74.8	73.8 ab	53.3	97.5 a	100.0
2.5	500	53.8 a-d	76.9	78.8 ab	95.8	95.0 a	100.0
2.5	750	25.0 cd	78.5	92.3 a	98.6	100.0 a	100.0
5	250	71.0 a-d	76.4	57.5 bc	48.5	100.0 a	100.0
5	500	55.0 a-d	78.3	57.5 bc	95.3	100.0 a	100.0
5	750	87.5 abc	79.8	98.3 a	98.4	100.0 a	100.0
7.5	250	100.0 a	99.8	83.3 ab	55.3	100.0 a	100.0
7.5	500	100.0 a	99.9	98.0 a	95.9	100.0 a	100.0
7.5	750	97.5 a	99.9	98.8 a	98.6	100.0 a	100.0

### Claims

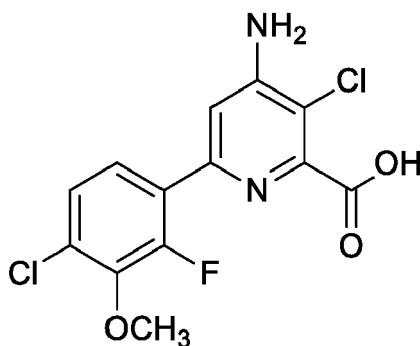
1. A herbicidal composition comprising a herbicidally effective amount of (a) a compound of formula (I)



(I)

or an agriculturally acceptable salt or ester thereof and (b) propyzamide, wherein the composition exhibits synergism.

2. The composition of claim 1, wherein (a) is the methyl ester, triethylammonium (TEA) salt, or potassium salt of the compound of formula (I).
3. The composition of any of claims 1 or 2, further comprising a herbicide safener.
4. The composition of any of claims 1-3, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to propyzamide is from 1:2240 to 1:10.
5. The composition of claims 4, wherein the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to propyzamide is from 1:600 to 1:25.
6. The composition of any of claims 1-5 comprising a herbicidally effective amount of two and only two herbicidal active ingredients, wherein the herbicidal active ingredients consist of (a) 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)pyridine-2-carboxylic acid or an agriculturally acceptable ester or salt thereof and (b) propyzamide, and the weight ratio of the compound of formula (I) or agriculturally acceptable salt or ester thereof to propyzamide is from 1:10 to 1:600.
7. 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 formula (I)



(I)

or an agriculturally acceptable salt or ester thereof and  
(b) propyzamide, or a salt thereof,  
wherein the combination of (a) and (b) exhibits synergism.

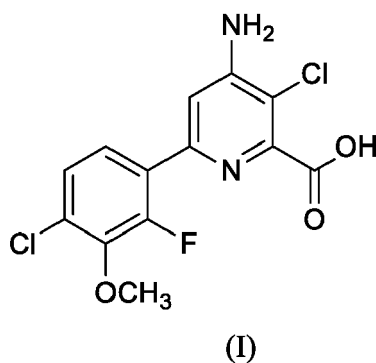
8. The method of claim 7, wherein the propyzamide is applied at a rate from 100 g ai/ha to 2240 g ai/ha and the compound of formula (I) or agriculturally acceptable salt or ester thereof is applied at a rate from 1 g ae/ha to 10 g ae/ha, preferably wherein the propyzamide is applied at a rate from 250 g ai/ha to 750 g ai/ha and the compound

of formula (I) or agriculturally acceptable salt or ester thereof is applied at a rate from 1.25 g ae/ha to 10 g ae/ha.

9. The method of claim 7, wherein the undesirable vegetation is controlled in winter/spring oilseed rape, winter/spring canola, vegetables, *Brassica* spp, ornamentals, rice, wheat, triticale, barley, oats, rye, sorghum, corn/maize, sunflower, row crops, pastures, grasslands, rangelands, fallowland, sugarcane, turf, tree and vine orchards, industrial vegetation management and rights-of-way.
10. The method of any of claims 7-9, wherein the undesirable vegetation is immature.
11. The method of any of claims 7-9, wherein the (a) and (b) are applied pre-emergently or post-emergently.
12. The method of any of claims 7-11, wherein the undesirable vegetation is controlled in a crop that is tolerant to 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, or bromoxynil, wherein the tolerant crop preferably possesses multiple or stacked traits conferring tolerance to multiple herbicides or multiple modes-of-action.
13. The method of claim 12, wherein the undesirable vegetation comprises a herbicide resistant or tolerant weed, which preferably is a biotype with resistance or tolerance to multiple herbicides, multiple chemical classes, or multiple herbicide modes-of-action, and more preferably a biotype resistant or tolerant to acetolactate synthase (ALS) inhibitors, photosystem II inhibitors, acetyl CoA carboxylase (ACCase) inhibitors, synthetic auxins, photosystem I inhibitors, 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, microtubule assembly inhibitors, 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.
14. The method of any one of claims 7-13 wherein the undesirable vegetation is *Glycine max* (GLXMA), *Ipomoea hederacea* (L.) Jacq (IPOHE), *Abutilon theophrasti* Medik (ABUTH), *Polygonum convolvulus* L. (POLCO), *Setaria faberi* Herrm. (SETFA), *Brassica napus* (BRSNW), *Amaranthus retroflexus* L. (AMARE), *Euphorbia heterophylla* L. (EPHHL), *Chenopodium album* L. (CHEAL), *Stellaria media* (L.) Vill. (STEME), *Viola tricolor* L. (VIOTR), *Cirsium arvense* (L.) Scop. (CIRAR), *Geranium* sp. (GERSS), *Poa annua* (POAAN), or *Veronica* sp. (VERSS).
15. The method of any of claims 7-14 which comprises contacting the vegetation or the locus thereof with or applying to the soil to prevent the emergence or growth of vegetation the composition of any of claims 1-6.

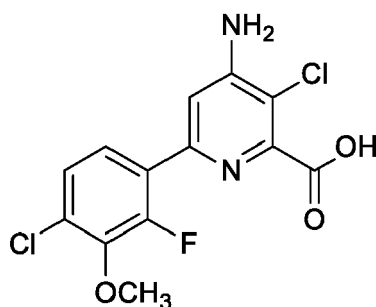
## Patentansprüche

1. Eine herbizide Zusammensetzung umfassend eine herbizid wirksame Menge von (a) einer Verbindung der Formel (I)



oder einem landwirtschaftlich akzeptablen Salz oder einem entsprechenden Ester derselben und (b) Propyzamid, wobei die Zusammensetzung Synergismus zeigt.

2. Die Zusammensetzung gemäß Anspruch 1, wobei (a) der Methylester, das Triethylammonium-(TEA)-Salz oder das Kaliumsalz der Verbindung der Formel (I) ist.
3. Die Zusammensetzung gemäß einem der Ansprüche 1 bis 2, weiterhin umfassend einen Herbizid-Safener.
4. Die Zusammensetzung gemäß einem der Ansprüche 1 bis 3, wobei das Gewichtsverhältnis der Verbindung der Formel (I) oder des landwirtschaftlich akzeptablen Salzes oder Esters derselben zu Propyzamid von 1:2240 bis 1:10 beträgt.
5. Die Zusammensetzung gemäß Anspruch 4, wobei das Gewichtsverhältnis der Verbindung der Formel (I) oder des landwirtschaftlich akzeptablen Salzes oder Esters derselben zu Propyzamid von 1:600 bis 1:25 beträgt.
6. Die Zusammensetzung gemäß einem der Ansprüche 1 bis 5, umfassend eine herbizid wirksame Menge von zwei und nur zwei herbizid wirksamen Inhaltsstoffen, wobei die herbizid wirksamen Inhaltsstoffe aus (a) 4-Amino-3-chlor-6-(4-chlor-2-fluor-3-methoxyphenyl)pyridin-2-carbonsäure oder einem landwirtschaftlich akzeptablen Ester oder Salz derselben und (b) Propyzamid bestehen und das Gewichtsverhältnis der Verbindung der Formel (I) oder des landwirtschaftlich akzeptablen Salzes oder Esters derselben zu Propyzamid von 1:10 bis 1:600 beträgt.
7. Ein Verfahren zur Bekämpfung unerwünschter Vegetation, welches das In-Kontakt-Bringen der Vegetation oder des Ortes derselben mit einer herbizid wirksamen Menge von (a) einer Verbindung der Formel (I)



(I)

- oder einem landwirtschaftlich akzeptablen Salz oder Ester derselben und (b) Propyzamid oder einem Salz davon oder das Anwenden hiervon auf den Boden oder Wasser, um das Auftreten oder Wachstum der Vegetation zu verhindern, umfasst, wobei die Kombination von (a) und (b) Synergismus zeigt.
8. Das Verfahren gemäß Anspruch 7, wobei das Propyzamid in einer Menge von 100 g ai/ha bis 2.240 g ai/ha angewandt wird und die Verbindung der Formel (I) oder ein landwirtschaftlich akzeptables Salz oder ein entsprechender Ester derselben in einer Menge von 1 g ae/ha bis 10 g ae/ha angewandt wird, wobei vorzugsweise das Propyzamid in einer Menge von 250 g ai/ha bis 750 g ai/ha angewandt wird und die Verbindung der Formel (I) oder ein landwirtschaftlich akzeptables Salz oder ein entsprechender Ester derselben in einer Menge von 1,25 g ae/ha bis 10 g ae/ha angewandt wird.
9. Das Verfahren gemäß Anspruch 7, wobei die unerwünschte Vegetation in Winter-/Sommerraps, Winter-/Sommercanola, Gemüse, *Brassica* spp., Zierpflanzen, Reis, Weizen, Triticale, Gerste, Hafer, Roggen, Sorghum, Mais, Sonnenblume, Reihenkulturen, Wiesen, Grasland, Weideflächen, Brachland, Zuckerrohr, Rasen, Baum- und Weinärten, im industriellen Vegetationsmanagement und auf Verkehrswegen bekämpft wird.
10. Das Verfahren gemäß einem der Ansprüche 7 bis 9, wobei die unerwünschte Vegetation unreif ist.
11. Das Verfahren gemäß einem der Ansprüche 7 bis 9, wobei (a) und (b) im Vorlauf oder Nachlauf angewandt werden.
12. Das Verfahren gemäß einem der Ansprüche 7 bis 11, wobei die unerwünschte Vegetation in einer Nutzpflanze kontrolliert wird, die gegenüber Glyphosat, Glufosinat, Dicamba, Phenoxyauxinen, Pyridyloxyauxinen, Aryloxyphenoxypromionaten, Acetyl-CoA-Carboxylase-(ACCase)-Inhibitoren, Imidazolinonen, Acetolactatsynthase-(ALS)-Inhibitoren, 4-Hydroxyphenyl-pyruvatdioxygenase-(HPPD)-Inhibitoren, Protoporphyrinogenoxidase-(PPO)-Inhibitoren,

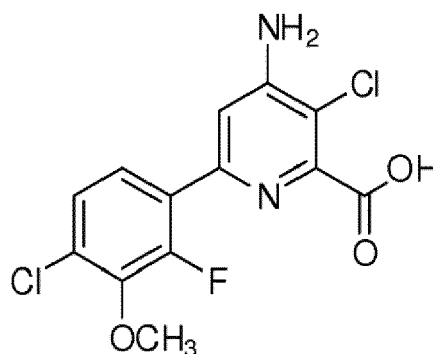
Triazininen oder Bromoxynil tolerant ist, wobei die tolerante Nutzpflanze vorzugsweise mehrere oder gestapelte Merkmale, die Toleranz gegenüber mehreren Herbiziden oder mehreren Wirkweisen verleihen, besitzt.

13. Das Verfahren gemäß Anspruch 12, wobei die unerwünschte Vegetation ein herbizidresistentes oder -tolerantes Unkraut umfasst, welches vorzugsweise ein Biotyp mit Resistenz oder Toleranz gegenüber mehreren Herbiziden, mehreren chemischen Klassen oder mehreren Herbizidwirkweisen ist und weiterhin bevorzugt ein Biotyp, der resistent oder tolerant gegenüber Acetolactatsynthase-(ALS)-Inhibitoren, Photosystem-II-Inhibitoren, Acetyl-CoA-Carboxylase-(ACCase)-Inhibitoren, synthetischen Auxinen, Photosystem-I-Inhibitoren, 5-Enolpyruvylshikimat-3-phosphat-(EPSP)-Synthase-Inhibitoren, Microtubuli-Organisationsinhibitoren, Lipidsynthese-Inhibitoren, Protoporphyrinogenoxidase-(PPO)-Inhibitoren, Inhibitoren der Carotenoid-Biosynthese, Inhibitoren der Synthese sehr langkettiger Fettsäuren (VLCFA), Phytoendesaturase-(PDS)-Inhibitoren, Glutaminsynthase-Inhibitoren, 4-Hydroxyphenylpyruvatdioxygenase-(HPPD)-Inhibitoren, Mitose-Inhibitoren, Inhibitoren der Biosynthese von Cellulose, Herbizide mit mehreren Wirkweisen, Quinclorac, Arylaminopropionsäuren, Difenzoquat, Endothall oder Organoarsenverbindungen ist.
14. Das Verfahren gemäß einem der Ansprüche 7 bis 13, wobei die unerwünschte Vegetation *Glycine max* (GLXMA), *Ipomoea hederacea* (L.) Jacq (IPOHE), *Abutilon theophrasti* Medik (ABUTH), *Polygonum convolvulus* L. (POLCO), *Setaria faberi* Herm. (SETFA), *Brassica napus* (BRSNW), *Amaranthus retroflexus* L. (AMARE), *Euphorbia heterophylla* L. (EPHHL), *Chenopodium album* L. (CHEAL), *Stellaria media* (L.) Vill. (STEME), *Viola tricolor* L. (VIOTR), *Cirsium arvense* (L.) Scop. (CIRAR), *Geranium* sp. (GERSS), *Poa annua* (POAAN) oder *Veronica* sp. (VERSS) ist.
15. Das Verfahren gemäß einem der Ansprüche 7 bis 14, welches das In-Kontakt-Bringen der Vegetation oder des Ortes derselben mit einer Zusammensetzung gemäß einem der Ansprüche 1 bis 6 oder das Anwenden derselben auf den Boden umfasst, um das Auftreten oder Wachstum der Vegetation zu verhindern.

## Revendications

1. Composition herbicide comprenant, en une quantité à effet herbicide, les composants suivants :

(a) un composé de formule (I) :



(I)

ou l'un des sels ou esters admissibles en agriculture de ce composé,  
(b) et du propyzamide,

la composition exerçant un effet de synergie.

2. Composition selon la revendication 1, dans laquelle le composant (a) est l'ester méthylique, le sel de triéthylammonium (TEA) ou le sel de potassium du composé de formule (I).
3. Composition selon n'importe laquelle des revendications 1 et 2, qui comprend en outre un agent phytoprotecteur anti-herbicide.



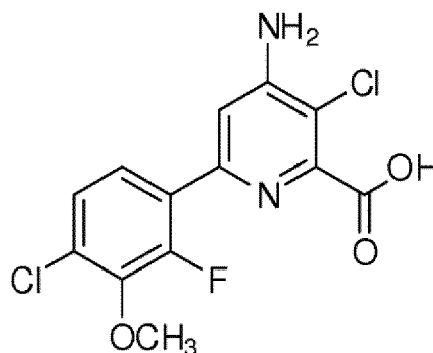
4. Composition selon n'importe laquelle des revendications 1 à 3, dans laquelle le rapport pondéral du composé de formule (I), ou de son sel ou ester admissible en agriculture, au propyzamide est compris dans l'intervalle allant de 1:2240 à 1:10.

5. Composition selon la revendication 4, dans laquelle le rapport pondéral du composé de formule (I), ou de son sel ou ester admissible en agriculture, au propyzamide est compris dans l'intervalle allant de 1:600 to 1:25.

6. Composition selon n'importe laquelle des revendications 1 à 5, comprenant, en une quantité à effet herbicide, deux et seulement deux ingrédients actifs herbicides, ces ingrédients actifs herbicides étant constitués par (a) de l'acide 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-méthoxy-phényl)-pyridine-2-carboxylique, ou un sel ou ester admissible en agriculture de cet acide, et (b) du propyzamide, et le rapport pondéral du composé de formule (I), ou de son sel ou ester admissible en agriculture, au propyzamide étant compris dans l'intervalle allant de 1:10 to 1:600.

7. Procédé de lutte contre des végétaux indésirables, comportant le fait de mettre en contact avec les végétaux ou l'endroit où ils poussent, ou d'appliquer au sol ou dans l'eau afin d'empêcher la levée ou la croissance des végétaux, en une quantité à effet herbicide, les composants suivants :

(a) un composé de formule (I) :



(I)

ou l'un des sels ou esters admissibles en agriculture de ce composé,  
(b) et du propyzamide, ou l'un de ses sels,

la combinaison des composants (a) et (b) exerçant un effet de synergie.

8. Procédé selon la revendication 7, dans lequel le propyzamide est appliqué à une dose comprise dans l'intervalle allant de 100 grammes d'ingrédient actif par hectare (g ia/ha) à 2240 g ia/ha, et le composé de formule (I), ou son sel ou ester admissible en agriculture, est appliqué à une dose comprise dans l'intervalle allant de 1 gramme d'équivalent acide par hectare (g éa/ha) à 10 g éa/ha, et, de préférence, le propyzamide est appliqué à une dose comprise dans l'intervalle allant de 250 g ia/ha à 750 g ia/ha, et le composé de formule (I), ou son sel ou ester admissible en agriculture, est appliqué à une dose comprise dans l'intervalle allant de 1,25 g éa/ha à 10 g éa/ha.

9. Procédé selon la revendication 7, dans lequel on lutte contre des végétaux indésirables dans des cultures de colza oléagineux d'hiver et de printemps, colza du type canola d'hiver et de printemps, légumes, *Brassica* spp., plantes ornementales, riz, blé, triticale, orge, avoine, seigle, sorgho, maïs et tournesol, des cultures en ligne, des pâturages, des herbages, des prairies, des terres en jachère, des plantations de canne à sucre, des terrains gazonnés, des vergers et vignobles, des espaces d'aménagement végétal intégré et des emprises ferroviaires.

10. Procédé selon n'importe laquelle des revendications 7 à 9, dans lequel les végétaux indésirables sont immatures.

11. Procédé selon n'importe laquelle des revendications 7 à 9, dans lequel les composants (a) et (b) sont appliqués au stade de pré-levée ou au stade de post-levée.

12. Procédé selon n'importe laquelle des revendications 7 à 11, dans lequel on lutte contre des végétaux indésirables

dans une culture qui est tolérante aux herbicides glyphosate, glufosinate, dicamba, auxines phénoxy, auxines pyridyloxy, aryloxyphénoxypropionates, inhibiteurs d'acétyl-CoA carboxylase (ACCase), imidazolinones, inhibiteurs d'acétolactate synthase (ALS), inhibiteurs de 4-hydroxyphénylpyruvate dioxygénase (HPPD), inhibiteurs de protoporphyrinogène oxydase (PPO), triazines ou bromoxynil, la culture tolérante possédant, de préférence, des caractères multiples ou cumulés se traduisant par une tolérance à de multiples herbicides ou de multiples modes d'action.

13. Procédé selon la revendication 12, dans lequel les végétaux indésirables comprennent une mauvaise herbe tolérante ou résistante aux herbicides, qui appartient de préférence à un biotype doté d'une tolérance ou d'une résistance à de multiples herbicides, de multiples classes de produits chimiques ou de multiples modes d'action, et mieux encore un biotype doté d'une tolérance ou d'une résistance aux herbicides suivants : inhibiteurs d'acétolactate synthase (ALS), inhibiteurs du photosystème II, inhibiteurs d'acétyl-CoA carboxylase (ACCase), auxines de synthèse, inhibiteurs du photosystème I, inhibiteurs de 5-énolpyruvyl-shikimate-3-phosphate (EPSP) synthase, inhibiteurs d'assemblage des microtubules, inhibiteurs de synthèse des lipides, inhibiteurs de protoporphyrinogène oxydase (PPO), inhibiteurs de biosynthèse des caroténoïdes, inhibiteurs d'acides gras à chaîne très longue (VLCFA), inhibiteurs de phytoène désaturase (PDS), inhibiteurs de glutamine synthétase, inhibiteurs de 4-hydroxyphénylpyruvate dioxygénase (HPPD), inhibiteurs de mitose, inhibiteurs de biosynthèse de la cellulose, herbicides à modes d'action multiples, quinclorac, acides arylamino-propioniques, difenzoquat, endothal ou herbicides organo-arsénicaux.
14. Procédé selon n'importe laquelle des revendications 7 à 13, dans lequel les végétaux indésirables appartiennent aux espèces suivantes : *Glycine max* (GLXMA), *Ipomoea hederacea* (L.) Jacq (IPOHE), *Abutilon theophrasti* Medik (ABUTH), *Polygonum convolvulus* L. (POLCO), *Setaria faberi* Herrm. (SETFA), *Brassica napus* (BRSNW), *Amaranthus retroflexus* L. (AMARE), *Euphorbia heterophylla* L. (EPHHL), *Chenopodium album* L. (CHEAL), *Stellaria media* (L.) Vill. (STEME), *Viola tricolor* L. (VIOTR), *Cirsium arvense* (L.) Scop. (CIRAR), *Geranium* sp. (GERSS), *Poa annua* (POAAN) et *Veronica* sp. (VERSS).
15. Procédé selon n'importe laquelle des revendications 7 à 14, qui comporte le fait de mettre une composition selon n'importe laquelle des revendications 1 à 6 en contact avec les végétaux ou l'endroit où ils poussent, ou de l'appliquer au sol afin d'empêcher la levée ou la croissance de ces végétaux.

## REFERENCES CITED IN THE DESCRIPTION

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