



- (51) **International Patent Classification:**  
*A01N 43/40* (2006.01)
- (21) **International Application Number:**  
PCT/US2013/051018
- (22) **International Filing Date:**  
18 July 2013 (18.07.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
61/674,993 24 July 2012 (24.07.2012) US
- (71) **Applicant:** DOW AGROSCIENCES LLC [US/US];  
9330 Zionsville Road, Indianapolis, IN 46268 (US).
- (72) **Inventors:** YERKES, Carla N.; 4571 South State Road  
47, Crawfordsville, IN 47933 (US). MANN, Richard K.;  
1828 South 550 East, Franklin, IN 46131 (US).
- (74) **Agent:** ASAM, Michael; Dow AgroSciences LLC, 9330  
Zionsville Rd, Indianapolis, Indiana 46268 (US).
- (81) **Designated States** (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,  
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,  
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR,  
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,  
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,  
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC,  
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,  
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,  
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,  
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,  
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,  
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a  
patent (Rule 4.17(ii))

**Published:**

- with international search report (Art. 21(3))  
— before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments (Rule 48.2(h))



WO 2014/018358 A1

(54) **Title:** SAFENED HERBICIDAL COMPOSITIONS FOR USE IN RICE

(57) **Abstract:** A safened herbicidal composition for use in rice comprising a herbicidally effective amount of (a) a compound of formula (I): 4-amino-3-chloro-5-fluoro-6-(4-chloro-2-fluoro-3-methoxyphenyl)pyridine-2-carboxylic acid or an agriculturally acceptable salt or ester thereof and (b) a safener or a compatible herbicide capable of safening such as a chemical from the quinolinylxyloxy-acetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet mexyl), daimuron, dichloramid, dicyclonon, dimepiperate, fenclorim, furilazole, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA), or agriculturally acceptable salts, esters, or mixtures thereof, for use in direct-seeded, water-seeded or transplanted rice.

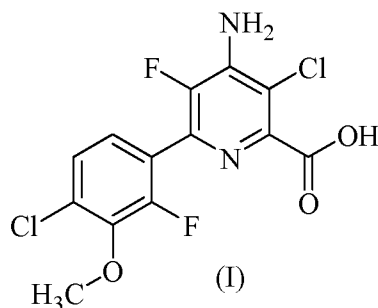
## SAFENED HERBICIDAL COMPOSITIONS FOR USE IN RICE

**BACKGROUND**

5 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. Occasionally, however, such herbicides can injure the crop being protected in addition to the weeds and other vegetation intended to be controlled.

**SUMMARY**

Provided herein are safened herbicidal compositions for use in rice comprising a herbicidally effective amount of (a) a compound of the formula (I)

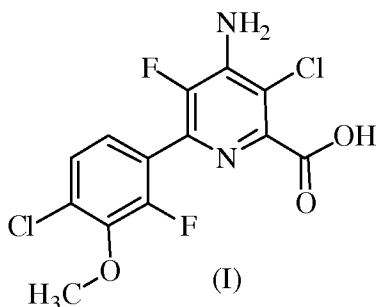


or an agriculturally acceptable salt or ester of thereof, and (b) a safener or a compatible herbicide capable of safening such as a chemical from the quinolinyloxyacetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet methyl), bispyribac-sodium, carfentrazone-ethyl, cyhalofop-butyl, daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA), oxabetrinil, or agriculturally acceptable salts, esters, or mixtures thereof. The compositions may also contain an agriculturally acceptable adjuvant or carrier.

25 Provided herein also are methods of controlling undesirable vegetation in rice comprising contacting the vegetation or applying to the soil or water to prevent the

emergence or growth of vegetation a safened herbicidal composition comprising a herbicidally effective amount of (a) a compound of the formula (I)

5



or an agriculturally acceptable salt or ester thereof and (b) a safener or a compatible herbicide capable of safening such as a chemical from the quinolinylloxyacetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet mexyl), daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA), oxabetrinil, or agriculturally acceptable salts, esters, or mixtures thereof.

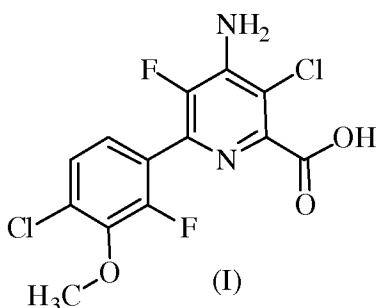
10

### DETAILED DESCRIPTION

#### 15 DEFINITIONS

As used herein, the compound of formula (I) has the following structure:

20

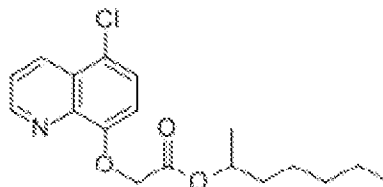


The compound of formula (I) can be identified by the name 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-5-fluoropyridine-2-carboxylic acid and has been described in U.S. Patent No. 7,314,849 (B2), which is incorporated herein by reference in its entirety.

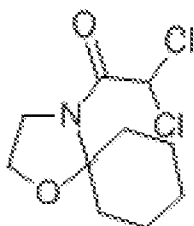
25

Exemplary uses of the compound of the formula (I) include controlling undesirable vegetation, including grass, broadleaf and sedge weeds, in multiple non-crop and cropping situations.

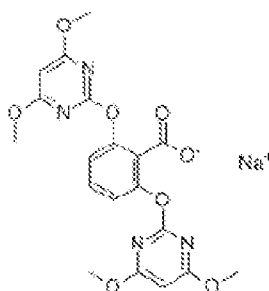
As used herein, safeners from the quinolinylloxyacetate family of chemicals are described in U.S. Patent No. 4,902,340. Safeners from the quinolinylloxyacetate family of chemicals include derivatives of cloquintocet, such as cloquintocet acid, cloquintocet mexyl, cloquintocet triisopropylamine, and cloquintocet dimethylamine. Cloquintocet is the  
5 common name for [(5-chloro-8-quinolinyl)oxy]acetic acid. Cloquintocet's safening activity is described in The Pesticide Manual, Fourteenth Edition, 2006.



As used herein, AD67 (MON 4660) is the common name for 4-(dichloroacetyl)-1-oxa-4-azaspiro-[4,5]decane. Its safening activity is described in The Pesticide Manual,  
10 Thirteenth Edition, 2003. AD67 (MON 4660) is known to be used as a safener in maize.

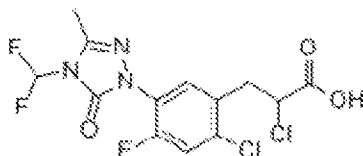


As used herein, bispyribac is the common name for 2,6-bis[(4,6-dimethoxy-2-pyrimidinyl)oxy]-benzoic acid. Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Bispyribac-sodium controls grasses, sedges and broadleaf weeds  
15 in direct-seeded rice.

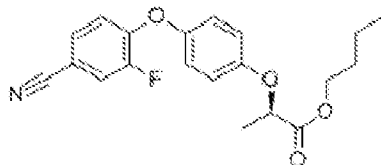


As used herein, carfentrazone is the common name for *alpha*-2-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]-4-fluorobenzenepropanoic acid. Its herbicidal activity is described in The Pesticide Manual,

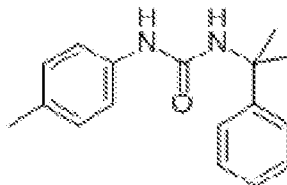
Fourteenth Edition, 2006. Carfentrazone-ethyl controls a wide range of broadleaf weeds in cereals and rice.



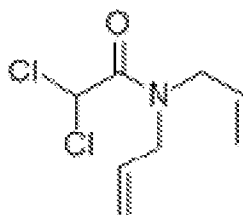
- 5 As used herein, cyhalofop is the common name for (2R)-2-[4-(4-cyano-2-fluorophenoxy)phenoxy]-propanoic acid. Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Cyhalofop-butyl is the preferred ester and controls grass weeds in rice.



- 10 As used herein, daimuron is the common name for *N*-(4-methylphenyl)-*N'*-(1-methyl-1-phenylethyl)-urea. Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Daimuron controls cyperaceous and annual grass weeds in paddy rice.

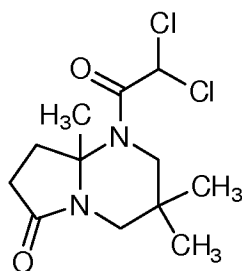


- As used herein, dichlormid is the common name for *N,N*-diallyl-2,2-dichloroacetamide. Its safening activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Dichlormid is known to be used as a safener for maize and sorghum.

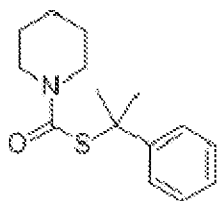


As used herein, dicyclonon is the common name for 1-(dichloroacetyl)hexahydro-3,3,8a-trimethylpyrrolo[1,2-*a*]pyrimidin-6(2*H*)-one. Its safening activity is exemplified in *e*-

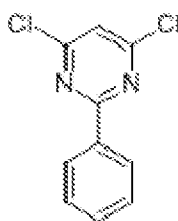
*Pesticide Manual*, Version 5.2, 2011. Dicyclonon, also known as bicyclonon, can be used to safen maize to a wide variety of herbicides.



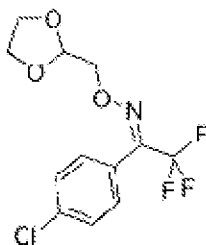
- 5 As used herein, dimepiperate is the common name for S-(1-methyl-1-phenylethyl)1-piperidine-carbothioate. Its herbicidal activity is described in *The Pesticide Manual*, Fourteenth Edition, 2006. Dimepiperate controls barnyardgrass (*Echinochloa crus-galli*) in paddy rice.



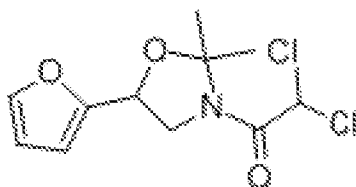
- 10 As used herein, fenclorim is the common name for 4,6-dichloro-2-phenylpyrimidine. Its safening activity is described in *The Pesticide Manual*, Fourteenth Edition, 2006. Fenclorim is known to be used as a safener in direct-seeded rice.



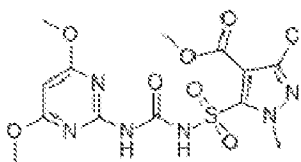
- 15 As used herein, fluxofenim is the common name for 1-(4-chlorophenyl)-2,2,2-trifluoroethane O-(1,3-dioxolan-2-ylmethyl)oxime. Its safening activity is described in *The Pesticide Manual*, Fourteenth Edition, 2006. Fluxofenim is known to be used as a safener in sorghum.



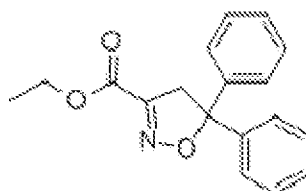
As used herein, furilazole is the common name for 3-(dichloroacetyl)-5-(2-furanyl)-  
2,2-dimethyl-oxazolidine. Its safening activity is described in The Pesticide Manual,  
5 Fourteenth Edition, 2006. Furilazole is known to be used as a safener in maize.



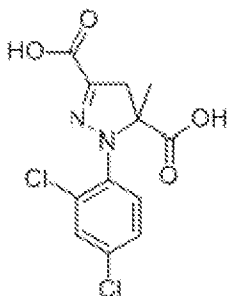
As used herein, halosulfuron is the common name for 3-chloro-5-[[[(4,6-dimethoxy-  
2-pyrimidinyl)-amino]carbonyl]amino]sulfonyl]-1-methyl-1H-pyrazole-4-carboxylic acid.  
10 Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006.  
Halosulfuron-methyl controls annual broadleaf weeds and nutsedge in rice.



As used herein, isoxadifen-ethyl is the common name for ethyl 4,5-dihydro-5,5-  
diphenyl-3-isoxazole-carboxylate. Its safening activity is described in The Pesticide Manual,  
15 Fourteenth Edition, 2006. Isoxadifen-ethyl is known to be used as a safener in maize.

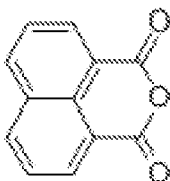


As used herein, mefenpyr-diethyl is the common name for 1-(2,4-dichlorophenyl)-4,5-dihydro-5-methyl-1H-pyrazole-3,5-dicarboxylic acid. Its safening activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Mefenpyr-diethyl is known to be used as a safener in wheat, rye, triticale and barley.



5

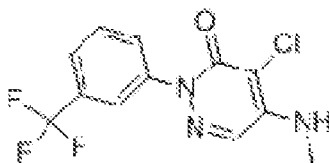
As used herein, naphthalic anhydride (NA) is the common name for 1H,3H-naphtho[1,8-*cd*]pyran-1,3-dione. Its safening activity is described in Pesticide Outlook. *The Royal Society of Chemistry*. [Online] 2001. pp. 10-15. Naphthalic anhydride is known to be used as a safener in maize.



10

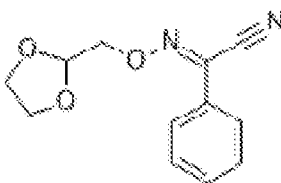
As used herein, norflurazon, is the common name for 4-chloro-5-(methylamino)-2-[3-(trifluoro-methyl)phenyl]-3(2H)-pyridazinone. Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Norflurazon is known to be used for the pre-emergence control of grasses and sedges, as well as some broadleaf weeds.

15



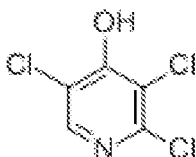
As used herein, oxabetrinil is the common name for (.alpha.*Z*)-.alpha.-[(1,3-dioxolan-2-yl)methoxyimino]-benzeneacetonitrile. Its safening activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Oxabetrinil is known to be used as a safener in sorghum.

20

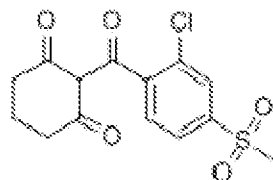


As used herein, pyriclor is the common name for 2,3,5-trichloro-4-pyridinol. Its activity is described in Buchholtz, K.P. Control of Quackgrass with Pyriclor. *Weed Science*.

5 [Online]. 1968. pp. 439-441. Pyriclor is a herbicide for the control of quackgrass and *Echinochloa crusgalli* in direct-seeded rice.



As used herein, sulcotrione is the common name for 2-[2-chloro-4-(methylsulfonyl)benzoyl]-1,3-cyclohexanedione. Its herbicidal activity is described in The Pesticide Manual, Fourteenth Edition, 2006. Sulcotrione controls grass and broadleaf weeds.



As used herein, herbicide means an active ingredient that kills, controls, or otherwise adversely modifies the growth of plants.

15 As used herein, a herbicidally effective or vegetation controlling amount is an amount of active ingredient which causes an adversely modifying effect and includes deviations from natural development, killing, regulation, desiccation, retardation, and the like.

As used herein, controlling undesirable vegetation means preventing, reducing, killing, or otherwise adversely modifying the development of plants and vegetation.

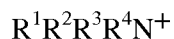
20 Described herein are methods of controlling undesirable vegetation through the application of certain herbicide combinations or compositions. Methods of application include, but are not limited to applications to the vegetation or locus thereof, as well as pre-emergence, post-

emergence, foliar (broadcast, directed, banded, spot, mechanical, over-the-top, or rescue), and in-water applications (emerged and submerged vegetation, broadcast, spot, mechanical, water-injected, granular broadcast, granular spot, shaker bottle, or stream spray) via hand, backpack, machine, tractor, or aerial (airplane and helicopter) application methods..

5 As used herein, plants and vegetation include, but are not limited to, germinant seeds, emerging seedlings, plants emerging from vegetative propagules, and established vegetation.

As used herein, a safener is a compound that selectively protects crop plants from herbicide damage without significantly reducing activity in target weed species.

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. Exemplary salts include those derived from alkali or alkaline earth metals and those derived from ammonia and amines. Exemplary cations include sodium, potassium, magnesium, and aminium 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-methylthiopropylamine, bisallylamine, 2-butoxyethylamine, morpholine, cyclododecylamine, or benzylamine or with a tetraalkylammonium hydroxide, such as tetramethylammonium hydroxide or choline hydroxide.

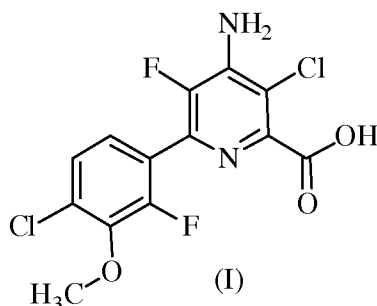
Exemplary esters include those derived from  $C_1$ - $C_{12}$  alkyl,  $C_3$ - $C_{12}$  alkenyl,  $C_3$ - $C_{12}$  alkynyl or  $C_7$ - $C_{10}$  aryl-substituted alkyl alcohols, such as methyl alcohol, isopropyl alcohol, 1-butanol, 2-ethylhexanol, butoxyethanol, methoxypropanol, allyl alcohol, propargyl alcohol, cyclohexanol or unsubstituted or substituted benzyl alcohols. Benzyl alcohols may be

substituted with from 1-3 substituents independently selected from halogen, C<sub>1</sub>-C<sub>4</sub> alkyl or C<sub>1</sub>-C<sub>4</sub> 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  
5 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.

## COMPOSITIONS AND METHODS

10 Provided herein are safened herbicidal compositions for use in rice comprising a herbicidally effective amount of (a) a compound of the formula (I)

15



or an agriculturally acceptable salt or ester of thereof, and (b) a safener or a compatible  
20 herbicide capable of safening including, but not limited to, bispyribac-sodium, carfentrazone-ethyl, a chemical from the quinolinyloxyacetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet mexyl), cyhalofop-butyl, daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA),  
25 norflurazon, oxabetrinil, pyriclor, sulcotrione, AD67, or agriculturally acceptable salts, esters, or mixtures thereof.

Provided herein are also methods of controlling undesirable vegetation in rice comprising contacting the vegetation or applying to the soil or water adjacent thereto with a

safened herbicidal composition including a herbicidally effective amount of (a) the compound of formula (I) or an agriculturally acceptable salt or ester thereof and (b) a safener or a compatible herbicide capable of safening including, but not limited to, bispyribac, carfentrazone, a chemical from the quinolinylxyacetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet mexyl), cyhalofop-butyl, 5 daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, norflurazon, oxabetrinil, pyriclor, sulcotrione, AD67, or agriculturally acceptable salts, esters, or mixtures thereof.

Rice plants to be protected from the adverse effect of undesirable plant growth may be 10 damaged to a certain degree when an effective dose or overdose of herbicide is used. Safening means preventing the adverse effect of a herbicide on the rice plant, *i.e.*, protecting the rice plant without, at the same time, noticeably influencing the herbicidal action on the undesirable plant growth, *i.e.*, weeds, to be combated. Stated another way, the safeners described herein can safen rice to the phytotoxic effects of the Compound of Formula (I) or 15 an agriculturally acceptable salt or ester thereof.

The compound of the formula (I) or an agriculturally acceptable salt or ester of thereof, and (b) a safener or a compatible herbicide capable of safening described herein can be applied either separately or together as part of a system. When part of a system, for example, the compound of the formula (I) or an agriculturally acceptable salt or ester of 20 thereof, and (b) a safener or a compatible herbicide capable of safening described herein can be formulated in one composition, tank mixed, applied simultaneously, or applied sequentially.

Herbicidal activity is exhibited by the compounds of formula (I) when they are applied directly to a plant or to the area adjacent the plant at any stage of growth. The effect 25 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 30 selective herbicidal action. The compositions of formula (I) described herein can be applied as a post-emergence application, or pre-emergence application, to relatively immature undesirable vegetation to achieve the maximum control of weeds.

The compositions and methods provided herein can be used to control weeds in rice crops, including, but not limited to, transplanted rice, water-seeded rice, and direct-seeded rice, and also in glyphosate-tolerant, 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitor-tolerant, glufosinate-tolerant, glutamine synthetase inhibitor-tolerant, dicamba-tolerant, imidazolinone-tolerant, sulfonyleurea-tolerant, pyrimidinylthiobenzoate-tolerant, triazolopyrimidine-tolerant, sulfonylaminocarbonyltriazolinone-tolerant, phenoxy auxin-tolerant, pyridyloxy auxin-tolerant, auxin-tolerant, auxin transport inhibitor-tolerant, aryloxyphenoxypropionates-tolerant, acetyl CoA carboxylase (ACCase) inhibitor-tolerant, acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) inhibitor-tolerant, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitor-tolerant, phytoene desaturase inhibitor-tolerant, carotenoid biosynthesis inhibitor-tolerant, protoporphyrinogen oxidase (PPO) inhibitor-tolerant, cellulose biosynthesis inhibitor-tolerant, mitosis inhibitor-tolerant, microtubule inhibitor-tolerant, very long chain fatty acid inhibitor-tolerant, fatty acid and lipid biosynthesis inhibitor-tolerant, photosystem I inhibitor-tolerant, photosystem II inhibitor-tolerant, triazines-tolerant, and bromoxynil-tolerant rice crops. The compositions and methods provided herein can be used with rice seeds, applied to nursery rice, direct-seeded rice, water-seeded rice and transplanted rice, as seed treatments, pre-plant treatments and post-emergence treatments.

The compositions and methods provided herein can be used to control undesirable vegetation consisting, for example, of grass, broadleaf and sedge weeds. For example, the combination of (a) compound (I) or agriculturally acceptable ester or salt thereof and (b) a safener or a compatible herbicide capable of safening including, but not limited to, bispyribac-sodium, carfentrazone-ethyl, a chemical from the quinolinylxyacetate family of chemicals (including but not limited to derivatives of cloquintocet, such as cloquintocet mexyl), cyhalofop-butyl, daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA), norflurazon, oxabetrinil, pyriclor, sulcotrione, AD67, or agriculturally acceptable salts, esters, or mixtures thereof is used to control undesirable vegetation including grass, broadleaf and sedge weeds. For example, the compositions and methods provided herein can be used to control undesirable vegetation including, but not limited to, undesirable vegetation of the weed genera *Echinochloa*, *Leptochloa*, *Brachiaria*, *Cyperus*, *Fimbristylis*, *Scirpus* or *Schoenoplectus*, *Aeschynomene*, *Alternanthera*, *Alisma*, *Amaranthus*, *Ammannia*, *Eclipta*, *Heteranthera*, *Monochoria*, *Sagittaria*, *Sesbania*, and *Sphenoclea*. Examples of

grass weeds controlled by the compositions and methods provided herein include, but are not limited to, *Brachiaria platyphylla* (Broadleaf signalgrass, BRAPP), *Echinochloa crus-galli* (Barnyardgrass, ECHCG), *Echinochloa colonum* (Junglerice, ECHCO), *Echinochloa oryzoides* (Early watergrass, ECHOR), *Leptochloa chinensis* (Chinese sprangletop, LEFCH),  
5 *Leptochloa fascicularis* (Bearded sprangletop, LEFFA), *Ischaemum rugosum* Salisb. (Poaceae saramollagrass, ISCRU), and *Leptochloa panicoides* (Amazon sprangletop, LEFPA). Examples of sedge weeds controlled by the compositions and methods provided herein include, but are not limited to, *Cyperus difformis* (Smallflower flatsedge, CYPDI), *Cyperus esculentus* (Yellow nutsedge, CYPES), *Cyperus iria* (Rice flatsedge, CYPPIR),  
10 *Cyperus rotundus* (Purple nutsedge, CYPRO), *Fimbristylis miliacea* (Globe fringerush, FIMMI), *Schoenoplectus juncooides* (Smallflower flatsedge, SCPJU), and *Schoenoplectus mucronatus* (Ricefield bulrush, SCPMU). Examples of broadleaf weeds controlled by the compositions and methods provided herein include, but are not limited to, *Aeschynomene* species (Jointvetch, AESSS), *Alternanthera philoxeroides* (Alligatorweed, ALRPH), *Alisma plantago-aquatica* (Common waterplantain, ALSPA), *Amaranthus* species (Pigweeds, AMASS), *Ammannia coccinea* (Purple ammannia, AMMCO), *Eclipta alba* (American false daisy, ECLAL), *Heteranthera limosa* (Ducksalad, HETLI), *Monochoria vaginalis* (Monochoria, MOOVA), *Sagittaria* species (Arrowhead, SAGMO), *Sesbania exaltata* (Hemp sesbania, SEBEX), and *Sphenoclea zeylanica* (Gooseweed, SPDZE). Additional examples of  
15 weeds controlled by the compositions and methods provided herein include, but are not limited to *Echinochloa oryzicola* (Vasinger) Vasinger (ECHPH, watergrass, late); *Lindernia dubia* (L.) Pennell (LIDDU, falsepimpernel, low); *Heteranthera reniformis* R. & P. (HETRE, mudplantain, roundleaf); *Murdannia nudiflora* (L.) Brenan (MUDNU, doveweed); *Alternanthera philoxeroides* (Mart.) Griseb. (ALRPH, alligatorweed); *Monochoria korsakowii* Regel & Maack (MOOKO; monochoria) and *Schoenoplectus maritimus* L. Lye (SCPMA, sea clubrush).  
20  
25

In the compounds and methods described herein, an agriculturally acceptable ester or salt of compound (I) is employed. An agriculturally acceptable ester, such as an aralkyl or alkyl ester, can be employed. The ester can be a C<sub>1-4</sub> alkyl ester, a n-butyl ester, a benzyl  
30 ester, or a substituted benzyl ester. Additionally, the carboxylic acid form of compound (I) or the carboxylate salt of the compound of formula (I) can be used.

In the compositions and methods described herein, the compound of formula (I) or salt or ester thereof is used in combination with a safener or a compatible herbicide capable

of safening. The weight ratio of the compound of formula (I) or salt or ester thereof to the safener or a compatible herbicide capable of safening is within the range of from 1:1200 to about 300:1. The weight ratio of the compound of formula (I) or salt or ester thereof to the safener or a compatible herbicide capable of safening also can be within the range from 1:1 to 5 1:50, 2.5:1 to 1:20, 2:1 to 1:32, 2:1 to 1:28, 2:1 to 1:24, 2:1 to 1:20, 2:1 to 1:18, 2:1 to 1:16, 2:1 to 1:14, 2:1 to 1:12, 2:1 to 1:10, 2:1 to 1:9, 2:1 to 1:8, 2:1 to 1:7, 2:1 to 1:6, 2:1 to 1:5, 2:1 to 1:4.5, 2:1 to 1:4, 2:1 to 1:3.5, 2:1 to 1:3, 2:1 to 1:2.5, 2:1 to 1:2, 2:1 to 1:1.5, 2:1 to 1:1, 1:1 to 1:32, 1:1 to 1:28, 1:1 to 1:24, 1:1 to 1:20, 1:1 to 1:18, 1:1 to 1:16, 1:1 to 1:14, 1:1 to 1:12, 1:1 to 1:10, 1:1 to 1:9, 1:1 to 1:8, 1:1 to 1:7, 1:1 to 1:6, 1:1 to 1:5, 1:1 to 1:4, 1:1 to 1:3.5, 1:1 to 1:3, 1:1 to 1:2.5, 1:1 to 1:2, or 1:1 to 1:1.5. Additionally, the weight ratio of the compound 10 of formula (I) or salt or ester thereof to the safener or a compatible herbicide capable of safening can be 2.5:1, 2.4:1, 2.3:1, 2.2:1, 2.1:1, 2:1, 1.9:1, 1.8:1, 1.7:1, 1.6:1, 1.5:1, 1.4:1, 1.3:1, 1.2:1, 1.1:1, 1:1, 1:1.1, 1:1.2, 1:1.3, 1:1.4, 1:1.5, 1:1.6, 1:1.7, 1:1.8, 1:1.9, 1:2, 1:2.1, 1:2.2, 1:2.3, 1:2.4, 1:2.5, 1:2.6, 1:2.7, 1:2.8, 1:2.9, 1:3, 1:3.1, 1:3.2, 1:3.3, 1:3.4, 1:3.5, 1:3.6, 15 1:3.7, 1:3.8, 1:3.9, 1:4, 1:4.1, 1:4.2, 1:4.3, 1:4.4, 1:4.5, 1:4.6, 1:4.7, 1:4.8, 1:4.9, 1:5, 1:6, 1:7, 1:8, 1:9, 1:10, 1:11, 1:12, 1:13, 1:14, 1:15, 1:16, 1:18, 1:20, 1:24, 1:28, or 1:32.

The application rate will depend upon the particular type of weed to be controlled, the degree of control required, the degree of crop safening required, and the timing and method of application. In the compositions described herein the compound of formula (I) or salt or 20 ester thereof can be applied at an application rate of from 1 grams acid equivalent per hectare (g ae/ha) to 300 g ae/ha based on the total amount of the compound of formula (I) or salt or ester thereof in the composition. Additionally, in the compositions described herein the compound of formula (I) or salt or ester thereof can be applied at an application rate of from 1 g ae/ha to 250 g ae/ha, 2 g ae/ha to 250 g ae/ha, 5 g ae/ha to 250 g ae/ha, 1 g ae/ha to 200 g 25 ae/ha, 2 g ae/ha to 200 g ae/ha, 5 g ae/ha to 200 g ae/ha, 12.5 g ae/ha to 250 g ae/ha, 12.5 g ae/ha to 200 g ae/ha, 1 g ae/ha to 150 g ae/ha, 1 g ae/ha to 100 g ae/ha, 1 g ae/ha to 75 g ae/ha, 1 g ae/ha to 50 g ae/ha, 2 g ae/ha to 50 g ae/ha, or 5 g ae/ha to 50 g ae/ha based on the total amount of the compound of formula (I) or salt or ester thereof in the composition. In the compositions described herein the safener or a compatible herbicide capable of safening can 30 be applied at an application rate of from 1 g ai/ha to 1200 g ai/ha. Additionally, in the compositions described herein the safener or a compatible herbicide capable of safening can be applied at an application rate of from 1 g ai/ha to 600 g ai/ha, 1 g ai/ha to 500 g ai/ha, 1 g ai/ha to 400 g ai/ha, 1 g ai/ha to 300 g ai/ha, 1 g ai/ha to 200 g ai/ha, 1 g ai/ha to 100 g ai/ha,

4 g ai/ha to 1200 g ai/ha, 4 g ai/ha to 600 g ai/ha, 50 g ai/ha to 600 g ai/ha, 50 g ai/ha to 500 g ai/ha, 50 g ai/ha to 400 g ai/ha, 50 g ai/ha to 300 g ai/ha, 50 g ai/ha to 200 g ai/ha, 50 g ai/ha to 150 g ai/ha, 50 g ai/ha to 100 g ai/ha, 100 g ai/ha to 1200 g ai/ha, 100 g ai/ha to 600 g ai/ha, 100 g ai/ha to 500 g ai/ha, 100 g ai/ha to 400 g ai/ha, 100 g ai/ha to 300 g ai/ha, or 100 g ai/ha to 200 g ai/ha based on the total amount of the safener or a compatible herbicide capable of safening in the composition. For example, the safener or a compatible herbicide capable of safening can be applied at a rate from 1 g ai/ha to 1200 g ai/ha and the compound of formula (I) of salt or ester thereof is applied at a rate from 1 g ae/ha to 300 g ae/ha.

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

The safened herbicide 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, alloxymid, allyl alcohol, alorac, ametrudione, 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, benthiocarb, bentazon-sodium, benzadox, benzfendizone, benzipram, benzobicyclon, benzofenap, benzofluor, benzoylprop, benzthiazuron, bialaphos, bicyclopypyrone, bifenox, bilanafos, bispyribac-sodium, borax, bromacil, bromobonil, bromobutide, bromofenoxim, bromoxynil, brompyrazon, butachlor, butafenacil, butamifos, butenachlor, buthidazole, buthiuron, butralin, butroxydim, buturon, butylate, cacodylic acid, cafenstrole, calcium chlorate, calcium cyanamide, cambendichlor, carbasulam, carbetamide, carboxazole chlorprocarb, carfentrazone-ethyl, CDEA, CEPC, chlomethoxyfen, chloramben, chloranocryl, chlorazifop, chlorazine, chlorbromuron, chlorbufam, chloreturon, chlorfenac, chlorfenprop, chlorflurazole, chlorflurenol, chloridazon, chlorimuron, chlornitrofen, chloropon, chlorotoluron, chloroxuron, chloroxynil, chlorpropham, chlorsulfuron, chlorthal,

chlorthiamid, cinidon-ethyl, cinmethylin, cinosulfuron, cisanilide, clethodim, clidinate,  
 clodinafop-propargyl, clofop, clomazone, clomeprop, cloprop, cloproxydim, clopyralid,  
 cloransulam-methyl, CMA, copper sulfate, CPMF, CPPC, credazine, cresol, cumyluron,  
 cyanatryn, cyanazine, cycloate, cyclopyrimorate, cyclosulfamuron, cycloxydim, cycluron,  
 5 cyhalofop-butyl, cyperquat, cyprazine, cyprazole, cypromid, dalapon, dazomet, delachlor,  
 desmedipham, desmetryn, di-allate, dicamba, dichlobenil, dichloralurea, dichlormate,  
 dichlorprop, dichlorprop-P, diclofop-methyl, diclosulam, diethamquat, diethatyl,  
 difenopenten, difenoxuron, difenzoquat, diflufenican, diflufenzopyr, dimefuron,  
 dimethachlor, dimethametryn, dimethenamid, dimethenamid-P, dimexano, dimidazon,  
 10 dinitramine, dinofenate, dinoprop, dinosam, dinoseb, dinoterb, diphenamid, dipropetryn,  
 diquat, disul, dithiopyr, diuron, DMPA, DNOC, DSMA, EBEP, eglinazine, endothal,  
 epronaz, EPTC, erbon, esprocarb, ethalfluralin, ethbenzamide, ethametsulfuron, ethidimuron,  
 ethiolate, ethobenzamid, etobenzamid, ethofumesate, ethoxyfen, ethoxysulfuron, etinofen,  
 etnipromid, etobenzanid, EXD, fenasulam, fenoprop, fenoxaprop, fenoxaprop-P-ethyl,  
 15 fenoxaprop-P-ethyl + isoxadifen-ethyl, fenoxasulfone, fenteracol, fenthiaprop, 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,  
 20 fluothiuron, flupoxam, flupropacil, flupropanate, flupyrasulfuron, fluridone, flurochloridone,  
 fluroxypyr, fluroxypyr-meptyl, flurtamone, fluthiacet, fomesafen, foramsulfuron, fosamine,  
 fumiclorac, furyloxyfen, glufosinate salts and esters, halauxifen, halauxifen-methyl,  
 glufosinate-ammonium, glufosinate-P-ammonium, glyphosate salts and esters, halosafen,  
 halosulfuron-methyl, haloxydine, haloxyfop-methyl, haloxyfop-P-methyl, hexachloroacetone,  
 25 hexaflurate, hexazinone, imazamethabenz, imazamox, imazapic, imazapyr, imazaquin,  
 imazosulfuron, imazethapyr, indanofan, indaziflam, iodobonil, iodomethane, iodosulfuron,  
 iodosulfuron-ethyl-sodium, iofensulfuron, ioxynil, ipazine, ipfencarbazone, iprymidam,  
 isocarbamid, isocil, isomethiozin, isonoruron, isopolinate, isopropalin, isoproturon, isouron,  
 isoxaben, isoxachlortole, isoxaflutole, isoxapyrifop, karbutilate, ketospiradox, lactofen,  
 30 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, methoprotiryne, methyl bromide, methyl isothiocyanate, methyldymron,  
 metobenzuron, metobromuron, metolachlor, metosulam, metoxuron, metribuzin, metsulfuron,  
 metsulfuron-methyl, molinate, monalide, monisouron, monochloroacetic acid, monolinuron,  
 monuron, morfamquat, MSMA, naproanilide, napropamide, naptalam, neburon, nicosulfuron,  
 5 nipyraclufen, nitralin, nitrofen, nitrofluorfen, norflurazon, noruron, OCH, orbencarb, *ortho*-  
 dichlorobenzene, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxapyrazon,  
 oxasulfuron, oxaziclomefone, oxyfluorfen, paraflufen-ethyl, parafluron, paraquat, pebulate,  
 pelargonic acid, pendimethalin, penoxsulam, pentachlorophenol, pentanochlor, pentoxazone,  
 perfluidone, pethoxamid, phenisopham, phenmedipham, phenmedipham-ethyl,  
 10 phenobenzuron, phenylmercury acetate, picloram, picolinafen, pinoxaden, piperophos,  
 potassium arsenite, potassium azide, potassium cyanate, pretilachlor, primisulfuron-methyl,  
 procyzazine, prodiamine, profluazol, profluralin, profoxydim, proglinazine, prohexadione-  
 calcium, prometon, prometryn, pronamide, propachlor, propanil, propaquizafop, propazine,  
 propham, propisochlor, propoxycarbazone, propyrisulfuron, propyzamide, prosulfalin,  
 15 prosulfocarb, prosulfuron, proxan, prynachlor, pydanon, pyraclonil, pyraflufen-ethyl,  
 pyrasulfotole, pyrazogyl, pyrazolynate, pyrazosulfuron-ethyl, pyrazoxyfen, pyribenzoxim,  
 pyributicarb, pyriclor, pyridafol, pyridate, pyrifitalid, pyriminobac, pyrimisulfan, pyriothiobac-  
 sodium, pyroxasulfone, pyroxsulam, quinclorac, quinmerac, quinochloramine, quinonamid,  
 quizalofop, quizalofop-P-ethyl, rhodethanil, rimsulfuron, saflufenacil, S-metolachlor,  
 20 sebuthylazine, sebumeton, sethoxydim, siduron, simazine, simeton, simetryn, SMA, sodium  
 arsenite, sodium azide, sodium chlorate, sulcotrione, sulfallate, sulfentrazone, sulfometuron,  
 sulfosate, sulfosulfuron, sulfuric acid, sulglycapin, swep, SYN-523, TCA, tebutam,  
 tebuthiuron, tefuryltrione, tembotrione, tepraloxymid, terbacil, terbucarb, terbuchlor,  
 terbumeton, terbuthylazine, terbutryn, tetrafluron, thenylchlor, thiazafluron, thiazopyr,  
 25 thidiazimin, thidiazuron, thiencarbazone-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,  
 30 xylachlor and salts, esters, optically active isomers and mixtures thereof.

The safened compositions and methods for their use described herein, can, further, be used in conjunction with glyphosate, 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibitors, glufosinate, glutamine synthetase inhibitors, dicamba, phenoxy auxins, pyridyloxy

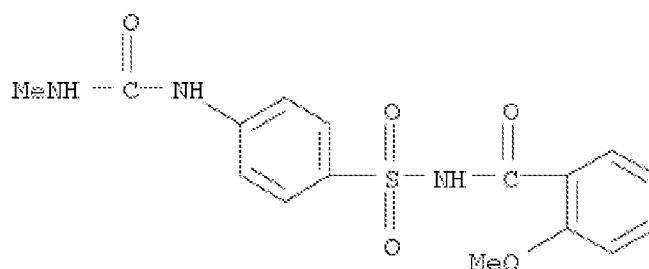
auxins, synthetic auxins, auxin transport inhibitors, aryloxyphenoxypropionates, cyclohexanediones, phenylpyrazolines, acetyl CoA carboxylase (ACCase) inhibitors, imidazolinones, sulfonylureas, pyrimidinylthiobenzoates, triazolopyrimidines, sulfonylaminocarbonyltriazolinones, acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) inhibitors, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitors, phytoene desaturase inhibitors, carotenoid biosynthesis inhibitors, protoporphyrinogen oxidase (PPO) inhibitors, cellulose biosynthesis inhibitors, mitosis inhibitors, microtubule inhibitors, very long chain fatty acid inhibitors, fatty acid and lipid biosynthesis inhibitors, photosystem I inhibitors, photosystem II inhibitors, triazines, and bromoxynil on glyphosate-tolerant, glufosinate-tolerant, glutamine synthetase inhibitor-tolerant, dicamba-tolerant, phenoxy auxin-tolerant, pyridyloxy auxin-tolerant, auxin-tolerant, auxin transport inhibitor-tolerant, aryloxyphenoxypropionate-tolerant, cyclohexanedione-tolerant, phenylpyrazoline-tolerant, ACCase-tolerant, imidazolinone-tolerant, sulfonylurea-tolerant, pyrimidinylthiobenzoate-tolerant, triazolopyrimidine-tolerant, sulfonylaminocarbonyltriazolinone-tolerant, ALS- or AHAS tolerant, HPPD-tolerant, phytoene desaturase inhibitor-tolerant, carotenoid biosynthesis inhibitor tolerant, PPO-tolerant, cellulose biosynthesis inhibitor-tolerant, mitosis inhibitor-tolerant, microtubule inhibitor-tolerant, very long chain fatty acid inhibitor-tolerant, fatty acid and lipid biosynthesis inhibitor-tolerant, photosystem I inhibitor-tolerant, photosystem II inhibitor-tolerant, triazine-tolerant, and bromoxynil-tolerant crops, and crops possessing multiple or stacked traits conferring tolerance to multiple chemistries and/or multiple modes of action via single and/or multiple resistance mechanisms. The compound of formula (I) or salt or ester thereof and complementary herbicide or salt or ester thereof can be 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. The compositions described herein and other complementary herbicides can be applied at the same time, either as a combination formulation or as a tank mix.

The compositions and methods may be used in controlling undesirable vegetation in rice genetically modified to express specialized traits. Examples of specialized traits include agronomic stress tolerance (including but not limited to drought, cold, heat, salt, water, nutrient, fertility, pH), pest tolerance (including but not limited to insects, fungi and pathogens) and crop improvement traits (including but not limited to yield; protein,

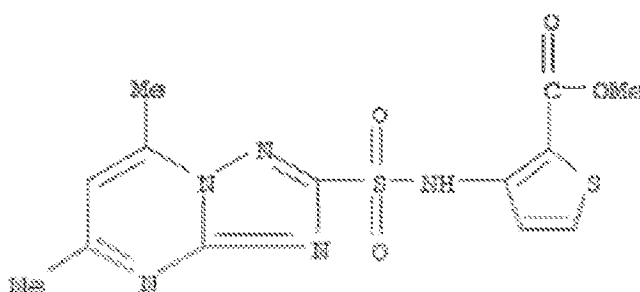
carbohydrate, or oil content; protein, carbohydrate, or oil composition; plant stature and plant architecture).

The safened compositions described herein can also include with one or more additional herbicide safeners, such as AD-67 (MON 4660), benoxacor, benthocarb, brassinolide, cyometrinil, dicyclonon, disulfoton, fenclorim, flurazole, fluxofenim, harpin proteins, jiecaowan, jiecaoxi, mephenate, oxabetrinil, R29148 and *N*-phenyl-sulfonylbenzoic acid amides, to enhance their selectivity.

The compositions and methods described herein can be used in combination with one or more seed treatments known to be employed in the safening of rice and compounds of formula (I), including naphthalic anhydride and CAS registry number 129531-12-0 (N-(2-Methoxybenzoyl)-4-[(methylaminocarbonyl)amino]benzenesulfonamide) as depicted by:



and CAS registry number 98967-94-3 (2-Thiophenecarboxylic acid, 3-[[5,7-dimethyl[1,2,4]triazolo[1,5-a]pyrimidin-2-yl)sulfonyl]amino]-, methyl ester) as depicted by:



15

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. In some embodiments, the safener is cloquintocet (mexyl).

In some embodiments, the safener is isoxadifen-ethyl or an ester or salt thereof. In certain embodiments, isoxadifen-ethyl is utilized to antagonize harmful effects of the compositions on rice.

5 In some embodiments, the safener is daimuron. In some embodiments, the safener is daimuron or an ester or salt thereof. In certain embodiments daimuron is utilized to antagonize harmful effects of the compositions on rice.

In some embodiments, the safener is dichlormid. In some embodiments, the safener is dichlormid or an ester or salt thereof. In certain embodiments dichlormid is utilized to antagonize harmful effects of the compositions on rice.

10 In some embodiments, the safener is dimepiperate. In some embodiments, the safener is dimepiperate or an ester or salt thereof. In certain embodiments dimepiperate is utilized to antagonize harmful effects of the compositions on rice.

15 In some embodiments, the safener is dicyclonon. In some embodiments, the safener is dicyclonon or an ester or salt thereof. In certain embodiments, dicyclonon is utilized to antagonize harmful effects of the compositions on rice.

In some embodiments, the safener is fenclorim. In some embodiments, the safener is fenclorim or an ester or salt thereof. In certain embodiments, fenclorim is utilized to antagonize harmful effects of the compositions on rice.

20 In some embodiments, the safener is furilazole. In some embodiments, the safener is furilazole or an ester or salt thereof. In certain embodiments, furilazole is utilized to antagonize harmful effects of the compositions on rice.

In some embodiments, the safener is mefenpyr-diethyl. In some embodiments, the safener is mefenpyr-diethyl or an ester or salt thereof. In certain embodiments, mefenpyr-diethyl is utilized to antagonize harmful effects of the compositions on rice.

25 In some embodiments, the safener is naphthalic anhydride. In some embodiments, the safener is naphthalic anhydride or an ester or salt thereof. In certain embodiments, naphthalic anhydride is utilized to antagonize harmful effects of the compositions on rice.

The compositions described herein can be employed in combination with one or more plant growth regulators, such as 2,3,5-tri-iodobenzoic acid, IAA, IBA, naphthaleneacetamide,  $\alpha$ -naphthaleneacetic acids, benzyladenine, 4-hydroxyphenethyl alcohol, kinetin, zeatin, endothal, pentachlorophenol, thidiazuron, tribufos, aviglycine, ethephon, maleic hydrazide, gibberellins, gibberellic acid, abscisic acid, ancymidol, fosamine, glyphosine, isopyrimol, jasmonic acid, maleic hydrazide, mepiquat, 2,3,5-tri-iodobenzoic acid, morphactins, dichlorflurenol, flurprimidol, mefluidide, paclobutrazol, tetcyclacis, uniconazole, brassinolide, brassinolide-ethyl, cycloheximide, ethylene, methasulfocarb, prohexadione, triapenthenol, and trinexapac. The plant growth regulator can be mixed with the compound of formula (I), or mixed with the compound of formula (I) to cause a preferentially advantageous effect on plants.

The compositions provided herein can further include one or more 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. The adjuvants or carriers 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. Additionally, the adjuvants or carriers can also be provided as a pre-mix or tank mixed.

Suitable agricultural adjuvants and carriers are well known to those of skill in the art and 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.

Examples of liquid carriers that can be used in the compositions and methods described herein include water and organic solvents. Examples of useful 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  
5 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,  
10 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. Water is useful as a carrier for the dilution of concentrates.

Suitable solid carriers include but are not limited to talc, pyrophyllite clay, silica,  
15 attapulgus 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.

The compositions described herein may further include one or more surface-active agents. Such surface-active agents can be used in both solid and liquid compositions, and can  
20 be 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  
25 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 calcium dodecylbenzenesulfonate; 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;  
30 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, *e.g.*, methyl esters. These  
5 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.

Other additives useful 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  
10 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.

15 The concentration of active ingredients in the compositions described herein is generally from 0.0005 to 98 percent by weight. Additionally, concentration is from 0.0006 to 90 percent by weight can be used. In compositions designed to be employed as concentrates, the active ingredients, can be present in a concentration from 0.1 to 98 weight percent, or from 0.5 to 90 weight percent. Such compositions can be diluted with an inert carrier, such  
20 as, for example, water, before application. The diluted compositions usually applied to vegetation or the soil or water adjacent thereto can contain from 0.0006 to 15.0 weight percent active ingredient or from 0.001 to 10.0 weight percent.

The present compositions can be applied to vegetation or the soil or water adjacent thereto by the use of conventional ground or aerial dusters, sprayers, and granule applicators,  
25 by addition to irrigation or paddy water, and by other conventional means known to those skilled in the art.

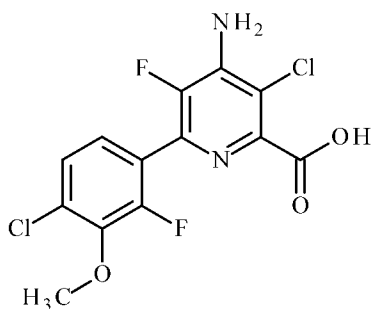
The following Examples are presented to illustrate various aspects of the compositions and methods described herein and should not be construed as limitations to the claims.

Examples:*Example I: Evaluation of Postemergence Foliar-Applied Herbicides and Safeners in Direct-Seeded Rice*

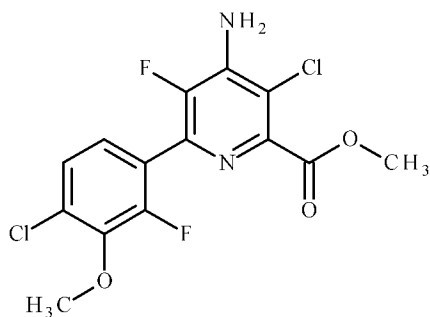
Seeds or nutlets of the desired test plant species were planted in a soil matrix prepared  
5 by mixing a loam or sandy loam soil (e.g., 28.6 percent silt, 18.8 percent clay, and 52.6  
percent sand, with a pH of about 5.8 and an organic matter content of about 1.8 percent) and  
calcareous grit in an 80 to 20 ratio. The soil matrix was contained in plastic pots with a  
surface area of 84.6 square centimeters (cm<sup>2</sup>). When required to ensure good germination  
and healthy plants, a fungicide treatment and/or other chemical or physical treatment was  
10 applied. The plants were grown for 8-22 days in a greenhouse with an approximate 14 hr  
photoperiod which was maintained at about 29° C during the day and 26° C during the night.  
Nutrients (Peters Excel 15-5-15 5-Ca 2-Mg and iron chelate) were applied in the irrigation  
solution as needed and water was added on a regular basis. Supplemental lighting was  
provided with overhead metal halide 1000-Watt lamps as necessary. The plants were  
15 employed for testing when they reached the second or third true leaf stage.

Treatments consisted of the acid or esters of 4-amino-3-chloro-5-fluoro-6-(4-chloro-2-  
fluoro-3-methoxy-phenyl)pyridine-2-carboxylic acid (compound A) and various safener  
components alone and in combination. Forms of compound A (technical material) were  
applied on an acid equivalent basis. Safener components were applied on an active  
20 ingredient basis. Dichlormid, dicyclonon, dimepiperate, fenclorim, furilazole, isoxadifen-  
ethyl, and naphthalic anhydride were technical grade material. Cloquintocet-mexyl and  
daimuron were formulated as emulsifiable concentrates (EC), and mefenpyr-diethyl was  
formulated as a wettable granule (WG).

Forms of compound A (compound of formula I) tested include:

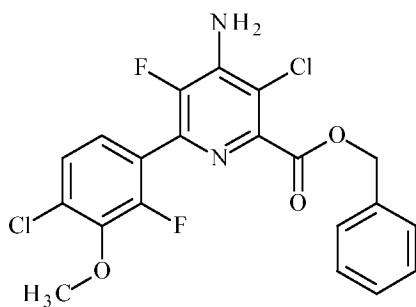


Compound A Acid



5

Compound A Methyl Ester



Compound A Benzyl Ester

10

Treatment requirements were calculated based upon the rates being tested, the concentration of active ingredient or acid equivalent in the formulation, and a 12 mL application volume at a rate of 187 L/ha.

For treatments comprised of formulated compounds, measured amounts of  
5 compounds were placed individually in 25 mL glass vials and diluted in a volume of 1.25% (v/v) Agri-dex crop oil concentrated to obtain 12X stock solutions. If a test compound did not dissolve readily, the mixture was warmed and/or sonicated. Application solutions were prepared by adding an appropriate amount of each stock solution (*e.g.*, 1 mL) and diluted to the appropriate final concentrations with the addition of 10 mL of an aqueous mixture of  
10 1.25% (v/v) Agri-dex crop oil concentrate so that the final spray solutions contained 1.25% (v/v) Agri-dex crop oil concentrate.

For treatments comprised of technical compounds, weighed amounts were placed individually in 25 mL glass vials and dissolved in a volume of 97:3 v/v acetone/DMSO to obtain 12X stock solutions. If a test compound did not dissolve readily, the mixture was  
15 warmed and/or sonicated. Application solutions were prepared by adding an appropriate amount of each stock solution (*e.g.*, 1 mL) and diluted to the appropriate final concentrations with the addition of 10 mL of an aqueous mixture of 1.5% (v/v) Agri-dex crop oil concentrate so that the final spray solutions contained 1.25% (v/v) Agri-dex crop oil concentrate. When technical materials were used, the concentrated stock solutions were added to the spray  
20 solutions so that the final acetone and DMSO concentrations of the application solutions were 16.2% and 0.5%, respectively.

For treatments comprised of formulated and technical compounds, weighed amounts of the technical materials were placed individually in 25 mL glass vials and dissolved in a volume of 97:3 v/v acetone/DMSO to obtain 12X stock solutions, and measured amounts of  
25 the formulated compounds were placed individually in 25 mL glass vials and diluted in a volume of 1.5% (v/v) Agri-dex crop oil concentrate or water to obtain 12X stock solutions. If a test compound did not dissolve readily, the mixture was warmed and/or sonicated. Application solutions were prepared by adding an appropriate amount of each stock solution (*e.g.*, 1 mL) and diluted to the appropriate final concentrations with the addition of an  
30 appropriate amount of an aqueous mixture of 1.5% (v/v) Agri-dex crop oil concentrate so that the final spray solutions contained 1.25% (v/v) Agri-dex crop oil concentrate. When required, additional water and/or 97:3 v/v acetone/DMSO was added to individual application

solutions so that the final acetone and DMSO concentrations of the application solutions being compared were 8.1% and 0.25%, respectively.

All stock solutions and applications solutions were visually inspected for compound compatibility prior to application. Spray solutions were applied to the plant material with an overhead Mandel track sprayer equipped with a 8002E nozzles calibrated to deliver 187 L/ha over an application area of 0.503 m<sup>2</sup> at a spray height of 18 to 20 inches (46 to 50 cm) above average plant canopy height. Control plants were sprayed in the same manner with the solvent blank.

The treated plants and control plants were placed in a greenhouse as described above and watered by sub-irrigation to prevent wash-off of the test compounds. After approximately 3 weeks, the condition of the test plants as compared with that of the untreated plants was determined visually and scored on a scale of 0 to 100 percent where 0 corresponds to no injury or growth inhibition and 100 corresponds to complete kill.

Some of the safener-herbicide combinations tested, application rates and ratios employed, plant species tested, and results are given in Tables 1-15. The results demonstrate the utility of Compound I acid and benzyl ester as post-emergence treatments in seeded rice, with increased tolerance of rice to Compound I benzyl ester in comparison to Compound I acid, and significant ECHCG weed control activity at rates safe to rice. In the Tables, DAA = Days After Application; ECHCG = *Echinochloa crus-galli*; NT = not tested; and ORYSA = *Oryza sativa*, Rice.

**Table 1: Safening Activity in Rice (Cloquintocet-mexyl)**

Compound A g ae/ha	Cloquintocet-mexyl g ai/ha	Herbicide to safener ratio	Visual Injury (%) - 21 DAA					
			ORYSA – 'Neptune'		ORYSA – 'Wells'		ORYSA – 'Clearfield 171'	
			Obs	Exp	Obs	Exp	Obs	Exp
Acid - 70	0	-	40	-	12	-	22	-
Benzyl -70	0		5	-	0	-	0	-
0	70		0	-	0	-	0	-
0	140		0	-	0	-	0	-
0	280		0	-	0	-		-
Acid - 70	70	1 to 1	17	40	3	12	8	22
Acid - 70	140	1 to 2	17	40	0	12	3	22
Acid - 70	280	1 to 4	10	40	0	12	3	22
Benzyl -70	70	1 to 1	3	5	0	0	0	0

Benzyl -70	140	1 to 2	3	5	0	0	0	0
Benzyl -70	280	1 to 4	0	5	0	0	0	0

**Table 2: Safening Activity in Rice (Daimuron)**

Compound A	Daimuron g ai/ha	Herbicide to safener ratio	Visual Injury (%) - 21 DAA					
			ORYSA – 'Neptune'		ORYSA – 'Wells'		ORYSA – 'Clearfield 171'	
			Obs	Exp	Obs	Exp	Obs	Exp
Acid - 70	0	-	40	-	12	-	22	-
Benzyl -70	0	-	5	-	0	-	0	-
0	70	-	0	-	0	-	0	-
0	140	-	0	-	0	-	0	-
0	280	-	0	-	0	-		-
Acid - 70	70	1 to 1	35	40	3	12	17	22
Acid - 70	140	1 to 2	37	40	3	12	15	22
Acid - 70	280	1 to 4	22	40	7	12	20	22
Benzyl - 70	70	1 to 1	8	5	3	0	0	0
Benzyl - 70	140	1 to 2	20	5	0	0	0	0
Benzyl - 70	280	1 to 4	15	5	0	0	0	0

**Table 3: Safening Activity in Rice (Dichlormid)**

Compound A	Dichlormid g ai/ha	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
			ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0	-	13	-	98	-
0	140	-	0	-	NT	-
0	280	-	0	-	0	-
Acid - 140	140	1 to 1	63	43	99	NT
Acid - 140	280	1 to 2	55	43	99	98
Benzyl - 140	140	1 to 1	12	13	99	NT
Benzyl - 140	280	1 to 2	8	13	98	98

**Table 4: Safening Activity in Rice (Dimepiperate)**

Compound A	Dimepiperate	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0		13	-	98	-
0	140		7	-	0	-
0	280	-	3	-	0	-
Acid - 140	140	1 to 1	60	47	98	98
Acid - 140	280	1 to 2	65	45	99	98
Benzyl - 140	140	1 to 1	7	19	96	98
Benzyl - 140	280	1 to 2	20	16	97	98

5

**Table 5: Safening Activity in Rice (Furilazole)**

Compound A	Furilazole	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	38	-	96	-
Methyl - 140	0		12	-	98	-
Benzyl - 140	0		15	-	99	-
0	140	-	0	-	0	-
0	280		0	-	0	-
Acid - 140	140	1 to 1	30	38	99	96
Acid - 140	280	1 to 2	20	38	99	96
Methyl - 140	140	1 to 1	0	12	93	98
Methyl - 140	280	1 to 2	0	12	95	98
Benzyl - 140	140	1 to 1	17	15	99	99
Benzyl - 140	280	1 to 2	20	15	100	99

**Table 6: Safening Activity in Rice (Furilazole)**

Compound A	Furilazole	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0		13	-	98	-
0	140		7	-	0	-
0	280	-	18	-	0	-
Acid - 140	140	1 to 1	57	47	96	98
Acid - 140	280	1 to 2	55	54	95	98
Benzyl - 140	140	1 to 1	12	19	96	98
Benzyl - 140	280	1 to 2	8	29	95	98

5

**Table 7: Safening Activity in Rice (Isoxadifen-ethyl)**

Compound A	Isoxadifen-ethyl	Herbicide to safener ratio	Visual Injury (%) - 21 DAA					
g ae/ha	g ai/ha		ORYSA – 'Neptune'		ORYSA – 'Wells'		ORYSA – 'Clearfield 171'	
			Obs	Exp	Obs	Exp	Obs	Exp
Acid - 70	0	-	40	-	12	-	22	-
Benzyl - 70	0		5	-	0	-	0	-
0	70		0	-	0	-	0	-
0	140	-	0	-	0	-	0	-
0	280		0	-	0	-		-
Acid - 70	70	1 to 1	0	40	0	12	0	22
Acid - 70	140	1 to 2	0	40	0	12	0	22
Acid - 70	280	1 to 4	0	40	3	12	0	22
Benzyl - 70	70	1 to 1	0	5	0	0	0	0
Benzyl - 70	140	1 to 2	0	5	0	0	0	0
Benzyl - 70	280	1 to 4	0	5	0	0	0	0

**Table 8: Safening Activity in Rice (Mefenpyr-diethyl)**

Compound A	Mefenpyr-diethyl	Herbicide to safener ratio	Visual Injury (%) - 21 DAA						
			g ae/ha	g ai/ha	ORYSA – ‘Neptune’		ORYSA – ‘Wells’		ORYSA – ‘Clearfield 171’
					Obs	Exp	Obs	Exp	Obs
Acid - 70	0	-		40	-	12	-	22	-
Benzyl - 70	0	-		5	-	0	-	0	-
0	70	-		0	-	0	-	3	-
0	140	-		0	-	0	-	0	-
0	280	-		3	-	0	-		-
Acid - 70	70	1 to 1		37	40	7	12	22	24
Acid - 70	140	1 to 2		33	40	12	12	15	22
Acid - 70	280	1 to 4		25	42	10	12	18	22
Benzyl - 70	70	1 to 1		23	5	12	0	12	3
Benzyl - 70	140	1 to 2		25	5	10	0	7	0
Benzyl - 70	280	1 to 4		18	8	3	0	7	0

5

**Table 9: Safening Activity in Rice (Naphthalic anhydride)**

Compound A	Naphthalic anhydride	Herbicide to safener ratio	Visual Injury (%) - 20 DAA				
			g ae/ha	g ai/ha	ORYSA – ‘Clearfield 171’		ECHCG
					Obs	Exp	Obs
Acid - 140	0	-		38	-	96	-
Methyl - 140	0	-		12	-	98	-
Benzyl - 140	0	-		15	-	99	-
0	140	-		0	-	0	-
0	280	-		3	-	0	-
Acid - 140	140	1 to 1		38	38	98	96
Acid - 140	280	1 to 2		20	40	99	96
Methyl - 140	140	1 to 1		8	12	98	98
Methyl - 140	280	1 to 2		8	15	99	98
Benzyl - 140	140	1 to 1		10	15	99	99
Benzyl - 140	280	1 to 2		12	18	98	99

**Table 10: Safening Activity in Rice (Naphthalic anhydride)**

Compound A	Naphthalic anhydride	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – ‘Clearfield 171’		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0	-	13	-	98	-
0	140	-	0	-	0	-
0	280	-	0	-	0	-
Acid - 140	140	1 to 1	48	43	96	98
Acid - 140	280	1 to 2	58	43	95	98
Benzyl - 140	140	1 to 1	13	13	95	98
Benzyl - 140	280	1 to 2	3	13	98	98

5

**Table 11: Safening Activity in Rice (Dicyclonon)**

Compound A	Dicyclonon	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – ‘Clearfield 171’		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	38	-	96	-
Methyl - 140	0	-	12	-	98	-
Benzyl - 140	0	-	15	-	99	-
0	140	-	0	-	NT	-
0	280	-	0	-	3	-
Acid - 140	140	1 to 1	57	38	99	NT
Acid - 140	280	1 to 2	38	38	99	96
Methyl - 140	140	1 to 1	3	12	98	NT
Methyl - 140	280	1 to 2	5	12	98	98
Benzyl - 140	140	1 to 1	18	15	98	NT
Benzyl - 140	280	1 to 2	17	15	98	99

**Table 12: Safening Activity in Rice (Dicyclonon)**

Compound A	Dicyclonon	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0	-	13	-	98	-
0	140	-	0	-	NT	-
0	280	-	3	-	0	-
Acid - 140	140	1 to 1	45	43	98	NT
Acid - 140	280	1 to 2	57	45	99	98
Benzyl - 140	140	1 to 1	5	13	98	NT
Benzyl - 140	280	1 to 2	8	16	95	98

5

10

**Table 13: Safening Activity in Rice (Fenclorim)**

Compound A	Fenclorim	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	38	-	96	-
Methyl - 140	0	-	12	-	98	-
Benzyl - 140	0	-	15	-	99	-
0	140	-	0	-	0	-
0	280	-	0	-	0	-
Acid - 140	140	1 to 1	22	38	98	96
Acid - 140	280	1 to 2	20	38	99	96
Methyl - 140	140	1 to 1	7	12	98	98
Methyl - 140	280	1 to 2	0	12	95	98
Benzyl - 140	140	1 to 1	10	15	99	99
Benzyl - 140	280	1 to 2	5	15	99	99

**Table 14: Safening Activity in Rice (Fenclorim)**

Compound A	Fenclorim	Herbicide to safener ratio	Visual Injury (%) - 20 DAA			
g ae/ha	g ai/ha		ORYSA – 'Clearfield 171'		ECHCG	
			Obs	Exp	Obs	Exp
Acid - 140	0	-	43	-	98	-
Benzyl - 140	0	-	13	-	98	-
0	140	-	0	-	0	-
0	280	-	0	-	0	-
Acid - 140	140	1 to 1	58	43	98	98
Acid - 140	280	1 to 2	32	43	98	98
Benzyl - 140	140	1 to 1	3	13	95	98
Benzyl - 140	280	1 to 2	0	13	98	98

5

**Table 15: Selective Post-emergence Foliar Activity of Compound A to Rice**

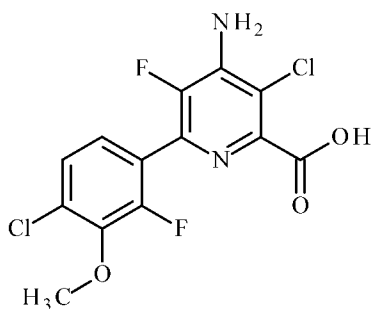
Compound A	Mean Visual Injury (%) - 20-22 DAA		
g ae/ha	ORYSA 'Clearfield 171'	ORYSA 'Wells'	ECHCG
Acid - 32	24	12	96
Acid - 16	11	7	95
Acid - 8	2	0	91
Acid - 4	0	0	81
Acid - 2	0	0	57
Benzyl - 32	3	3	96
Benzyl - 16	8	3	95
Benzyl - 8	0	0	94
Benzyl - 4	0	0	91
Benzyl - 2	0	0	63
0	0	0	0

*Example II: Evaluation of In-Water Applied Herbicides and Safeners in Transplanted Paddy Rice*

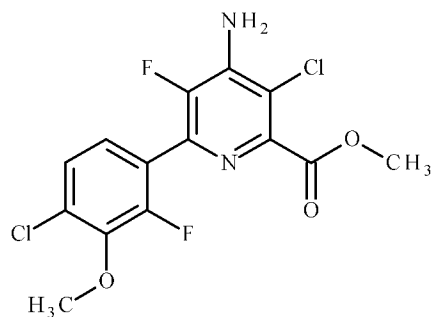
Weed seeds or nutlets of the desired test plant species were planted in puddled soil (mud) prepared by mixing a shredded, non-sterilized mineral soil (50.5 percent silt, 25.5  
5 percent clay, and 24 percent sand, with a pH of about 7.6 and an organic matter content of about 2.9 percent) and water at a 1:1 volumetric ratio. The prepared mud was dispensed in 365 mL aliquots into 16-ounce (oz.) non-perforated plastic pots with a surface area of 86.59 square centimeters (cm<sup>2</sup>) leaving a headspace of 3 centimeters (cm) in each pot. Rice seeds were planted in Sun Gro MetroMix<sup>®</sup> 306 planting mixture, which typically has a pH of 6.0 to  
10 6.8 and an organic matter content of about 30 percent, in plastic plug trays. Seedlings at the second or third leaf stage of growth were transplanted into 860 mL of mud contained in 32-oz. non-perforated plastic pots with a surface area of 86.59 cm<sup>2</sup> 4 days prior to herbicide application. The paddy was created by filling the headspace of the pots with 2.5 to 3 cm of water. When required to ensure good germination and healthy plants, a fungicide treatment  
15 and/or other chemical or physical treatment was applied. The plants were grown for 4-22 days in a greenhouse with an approximate 14 h photoperiod which was maintained at about 29°C during the day and about 26°C during the night. Nutrients were added as Osmocote<sup>®</sup> (17:6:10, N:P:K + minor nutrients) at 2 g per 16-oz. pot and 4 g per 32-oz. pot. Water was added on a regular basis to maintain the paddy flood, and supplemental lighting was provided  
20 with overhead metal halide 1000-Watt lamps as necessary. The plants were employed for testing when they reached the second or third true leaf stage.

Treatments consisted of the acid or esters of 4-amino-3-chloro-5-fluoro-6-(4-chloro-2-fluoro-3-methoxy-phenyl)pyridine-2-carboxylic acid (compound A) and various safeners  
25 alone and in combination. Forms of compound A (technical material unless otherwise noted where a suspension concentrate, SC, was used) were applied on an acid equivalent basis. Safener components (technical material) were applied on an active ingredient basis.

Forms of compound A (compound of formula I) tested include:

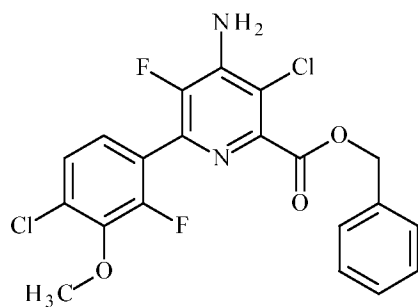


Compound A Acid



5

Compound A Methyl Ester



Compound A Benzyl Ester

10 Treatment requirements for each compound or herbicidal component were calculated based upon the rates being tested, the concentration of active ingredient or acid equivalent in

the formulation, an application volume of 2 mL per component per pot, and an application area of 86.59 cm<sup>2</sup> per pot.

For formulated compounds, a measured amount was placed in an individual 100 or 200 mL glass vial and was dissolved in a volume of 1.25% (v/v) Agri-Dex<sup>®</sup> crop oil concentrate to obtain application solutions. If the test compound did not dissolve readily, the mixture was warmed and/or sonicated.

For technical grade compounds, a weighed amount can be placed in an individual 100 to 200 mL glass vial and dissolved in a volume of acetone to obtain concentrated stock solutions. If the test compound does not dissolve readily, the mixture can be warmed and/or sonicated. The concentrated stock solutions obtained can be diluted with an equivalent volume of an aqueous mixture containing 2.5% (v/v) crop oil concentrate so that the final application solutions contain 1.25% (v/v) crop oil concentrate.

Applications were made by injecting with a pipetter appropriate amounts of the application solutions, individually and sequentially, into the aqueous layer of the paddy. Control plants were treated in the same manner with the solvent blank. Applications were made so that all treated plant material received the same concentrations of acetone and crop oil concentrate.

The treated plants and control plants were placed in a greenhouse as described above and water was added as needed to maintain a paddy flood. After approximately 3 weeks the condition of the test plants as compared with that of the untreated plants was determined visually and scored on a scale of 0 to 100 percent where 0 corresponds to no injury or growth inhibition and 100 corresponds to complete kill.

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.) .

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.

- 5 Some of the safener-herbicide combinations tested, application rates and ratios employed, plant species tested, and results are given in Tables 16-17. The results demonstrate the utility of Compound A acid and benzyl ester as in-water treatments in water-seeded rice and flooded transplanted rice, with significant ECHCG weed control activity at rates safe to rice. Based on the relative rice and barnyardgrass responses to Compound A
- 10 acid and Compound A benzyl ester, Compound A benzyl ester showed an improved selectivity margin over that of the acid. In the Tables, DAA = Days After Application; ECHCG = *Echinochloa crus-galli*; NT = not tested; and ORYSA = *Oryza sativa*, Rice.

**Table 16: Safening Activity in Rice (Isoxadifen-ethyl)**

Compound A g ae/ha	Isoxadifen-ethyl g ai/ha	Herbicide to safener ratio	Visual Injury (%) - 21 DAA	
			ORYSA – 'M202'	
			Obs	Exp
Methyl - 140	0		17.5	-
0	140		0	-
0	280	-	0	-
0	560		0	-
Methyl - 140	140	1 to 1	0	17.5
Methyl - 140	280	1 to 2	0	17.5
Methyl - 140	560	1 to 4	0	17.5

**Table 17: Selective In-Water Applied Activity of Compound A (SC 100 g ae/L) to Rice**

Compound A g ae/ha	Mean Visual Injury (%) - 21 DAA		
	ORYSA - 'M202'	ORYSA - 'Wells'	ECHCG
Acid - 140	25	8	95
Acid - 70	3	0	63
Acid - 35	0	0	10
Acid - 17.5	0	0	0
Acid - 8.75	0	0	0
Benzyl - 140	22	15	100
Benzyl - 70	0	0	100
Benzyl - 35	0	3	81
Benzyl - 17.5	0	0	43
Benzyl - 8.75	0	0	23
0	0	0	0

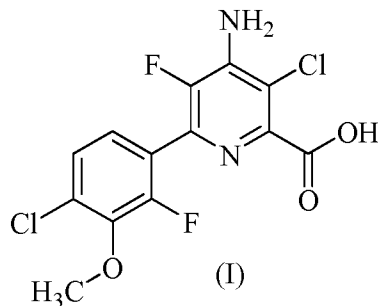
5           The present invention is not limited in scope by the embodiments disclosed herein which are intended as illustrations of a few aspects of the invention and any embodiments which are functionally equivalent are within the scope of this invention. Various modifications of the compositions and methods in addition to those shown and described herein will become apparent to those skilled in the art and are intended to fall within the

10 scope of the appended claims. Further, while only certain representative combinations of the composition components and method steps disclosed herein are specifically discussed in the embodiments above, other combinations of the composition components and method steps will become apparent to those skilled in the art and also are intended to fall within the scope of the appended claims. Thus a combination of components or method steps may be

15 explicitly mentioned herein; however, other combinations of components and method steps are included, even though not explicitly stated. The term comprising and variations thereof as used herein is used synonymously with the term including and variations thereof and are open, non-limiting terms.

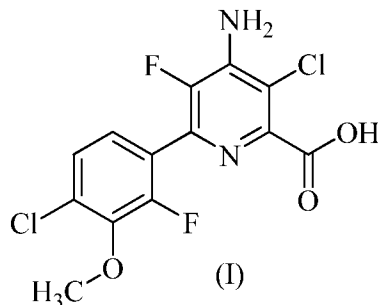
## WHAT IS CLAIMED IS:

1. A safened herbicidal composition for use in rice comprising a herbicidally effective amount of (a) a compound of the formula (I)



- 5 or an agriculturally acceptable salt or ester thereof and (b) a safener or a compatible herbicide capable of safening.

2. A method of controlling undesirable vegetation in rice comprising contacting the vegetation or applying to the soil or water adjacent thereto with a safened herbicidal composition comprising a herbicidally effective amount of (a) a compound of the formula (I)



10

or an agriculturally acceptable salt or ester thereof and (b) a safener or a compatible herbicide capable of safening.

3. The composition or method of any of claims 1 or 2, wherein (a) is a C<sub>1-4</sub> alkyl or benzyl ester of compound (I).

- 15 4. The composition or method of any of claims 1-3, wherein (a) is a benzyl ester of compound (I).

5. The composition or method of any of claims 1-4, wherein (a) is the compound of formula (I), which is the carboxylic acid.
6. The composition or method of any of claims 1-5, wherein (b) is a chemical from the quinolinylxyacetate family of chemicals, bispyribac-sodium, carfentrazone-ethyl, cyhalofop-butyl, daimuron, dichlormid, dicyclonon, dimepiperate, fenclorim, fluxofenim, furilazole, halosulfuron-methyl, isoxadifen-ethyl, mefenpyr-diethyl, naphthalic anhydride (NA), oxabetrinil, or agriculturally acceptable salts, esters, or mixtures thereof.
7. The composition or method of any of claims 1-6, wherein (b) is a chemical from the quinolinylxyacetate family of chemicals and is selected from cloquintocet acid, cloquintocet mexyl, cloquintocet triisopropylamine, or cloquintocet dimethylamine.
8. The composition or method of any of claims 1-7, wherein the weight ratio of (a) to (b) is from 1:1200 to 300:1.
9. The composition or method of any of claims 1-8, wherein the weight ratio of (a) to (b) is from 2:1 to 1:32.
10. The composition or method of any of claims 1-9, further comprising an agriculturally acceptable adjuvant or carrier.
11. The composition or method of any of claims 1-10, wherein the rice is direct-seeded, water-seeded, or transplanted paddy.
12. The composition or method of any of claims 1-11, wherein the rice is a glyphosate, glufosinate, dicamba, phenoxy auxin, pyridyloxy auxin, aryloxyphenoxypropionate, acetyl CoA carboxylase (ACCase) inhibitor, imidazolinone, acetolactate synthase (ALS) inhibitor, 4-hydroxyphenyl-pyruvate dioxygenase (HPPD) inhibitor, protoporphyrinogen oxidase (PPO) inhibitor, triazine, or bromoxynil tolerant rice possessing multiple or stacked traits conferring tolerance to multiple chemistries and/or multiple modes of action.
13. The method of any of claims 2-12, wherein the undesirable vegetation is immature.
14. The method of any of claims 2-13, wherein the (a) and (b) are applied to water.
15. The method of any of claims 2-14, wherein the water is part of a flooded rice paddy.

16. The method of any of claims 2-15, wherein the (a) and (b) are applied pre-emergently to the weed or the crop.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/51018

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A01N 43/40 (2013.01)

USPC - 504/244

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): A01N 43/40, 43/54, 57/12, 57/16, 25/00, 25/32, 63/00; A01P 13/00; C07D 213/78, 213/79, 213/72, 211/70, 401/04 (2013.01)  
USPC: 504/244, 260, 105, 103, 116.1, 118; 546/304, 310, 314, 326

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

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

MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); ProQuest; Google; Google Scholar; Scirus; PubMed; PubChem; pyridine; fluoropyridine; picolinate; herbicide; safener

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0137137 A1 (ROSINGER, CH et al.) 3 June 2010; paragraphs [0005]-[0015], [0039]-[0041], [0445], [0557], [0565], [0568], [0604]-[0605] and [0610]	1-2, 3/1-2
A	WO 2009/029518 A2 (SATCHIVI, N et al.) 5 March 2009; lines 5-21, page 2; line 10, page 2 to line 2, page 3; lines 3-8, page 7; line 10, page 20 to line 7, page 24	1-2, 3/1-2
A	US 2012/0115727 A1 (SATCHIVI, N et al.) 10 May 2012; abstract	1-2, 3/1-2

 Further documents are listed in the continuation of Box C.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

25 November 2013 (25.11.2013).

Date of mailing of the international search report

03 DEC 2013

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Shane Thomas

PCT Helpdesk: 571-272-4300  
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US13/51018

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- 1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
- 2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
- 3.  Claims Nos.: 4-16  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

- 1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
- 2.  As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
- 3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
- 4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.