



(51) International Patent Classification:
A01N 43/90 (2006.01)

(21) International Application Number:
PCT/US2012/029153

(22) International Filing Date:
15 March 2012 (15.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/453,202 16 March 2011 (16.03.2011) US

(71) Applicant (for all designated States except US): **DOW AGROSCIENCES LLC** [US/US]; 9330 Zionsville Road, Indianapolis, IN 46268 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **MANN, Richard, K.** [US/US]; 1828 South 550 East, Franklin, IN 46131 (US).

(74) Agent: **MIXAN, Craig**; Dow AgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 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, 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, KM, 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, 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, MD, 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, 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))

(54) Title: SYNERGISTIC HERBICIDAL COMPOSITION CONTAINING PENOXSULAM AND PYROXSULAM

(57) Abstract: A synergistic mixture of penoxsulam and pyroxsulam controls weeds in rice, cereal and grain crops, tree and vine crops, pome, stone and citrus crops, pastures, rangelands, industrial vegetation management (IVM), and turf.



SYNERGISTIC HERBICIDAL COMPOSITION CONTAINING PENOXSULAM AND PYROXSULAM

This invention concerns a synergistic herbicidal composition containing (a) penoxsulam and (b) pyroxsulam for controlling weeds, especially in rice, cereal and grain
5 crops, tree and vine crops, pome, stone and citrus crops, pastures, rangelands, industrial vegetation management (IVM), and turf.

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
10 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.

In some cases, herbicidal active ingredients have been shown to be more effective in combination than when applied individually and this is referred to as “synergism.” As
15 described in the *Herbicide Handbook* of the Weed Science Society of America, Ninth Edition, 2007, p. 429 “‘synergism’ [is] an interaction of two or more factors such that the effect when combined is greater than the predicted effect based on the response to each factor applied separately.” The present invention is based on the discovery that penoxsulam and pyroxsulam, already known individually for their herbicidal efficacy, display a synergistic
20 effect when applied in combination.

The present invention concerns a synergistic herbicidal mixture comprising an herbicidally effective amount of (a) penoxsulam and (b) pyroxsulam. The compositions may also contain an agriculturally acceptable adjuvant and/or carrier.

The present invention also concerns herbicidal compositions for and methods of
25 controlling the growth of undesirable vegetation, particularly in rice, cereal and grain crops, tree and vine crops, pome, stone and citrus crops, pastures, rangelands, industrial vegetation management (IVM), and turf, and the use of these synergistic compositions.

The species spectra of penoxsulam and pyroxsulam, i.e., the weed species which the respective compounds control, are broad and highly complementary. It has now been found

that a combination of penoxsulam and pyroxsulam exhibits a synergistic action in the control of wild oat (*Avena fatua*, AVEFA); Shepherd's purse (*Capsella bursa-pastoris*, CAPBP); common lambsquarter (*Chenopodium album*, CHEAL); barnyardgrass (*Echinochloa crus-galli*, ECHCG); ryegrass (*Lolium spp.*, LOLSS); short-spiked canarygrass (*Phalaris brachystachys*, PHABR); awned canarygrass (*Phalaris paradoxa*, PHAPA); narrow-leaved plantain (*Plantago lanceolata*, PLALA); annual blackgrass (*Poa annua*, POAAN); and wild buckwheat (*Polygonum convolvulus*, POLCO).

Penoxsulam is the common name for 2-(2,2-difluoroethoxy)-*N*-(5,8-dimethoxy-[1,2,4]triazolo[1,5-*c*]pyrimidin-2-yl)-6-(trifluoromethyl)benzenesulfonamide. Its herbicidal activity is described in *The Pesticide Manual*, Fifteenth Edition, 2009. Penoxsulam controls *Echinochloa* spp., as well as many broadleaf, sedge and aquatic weeds in rice, and *Apera* spp. grass in cereals, as well as many broadleaf weeds in aquatics, many cereal crops, range and pasture, IVM and turf.

Pyroxsulam, *N*-(5,7-dimethoxy[1,2,4]triazolo[1,5-*a*]pyrimidin-2-yl)-2-methoxy-4-(trifluoromethyl)-3-pyridinesulfonamide, is a triazolopyrimidine sulfonamide herbicide, and its herbicidal activity is described in *The Pesticide Manual*, Fifteenth Edition, 2009. Pyroxsulam provides broad-spectrum, post-emergence annual grass and broadleaf weed control in cereals.

The term herbicide is used herein to mean an active ingredient that kills, controls or otherwise adversely modifies the growth of plants. An 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. The terms plants and vegetation include germinant seeds, emerging seedlings, plants emerging from vegetative propagules, and established vegetation.

Herbicidal activity is exhibited by the compounds of the synergistic mixture when they are applied directly to the plant, to the locus of the plant at any stage of growth or before planting or emergence or after emergence. 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 as is known in the art to promote non-selective or selective herbicidal action. Generally, it is preferred to apply the composition of the present invention postemergence to relatively immature undesirable vegetation to achieve the maximum control of weeds.

5 In the composition of this invention, the weight ratio of penoxsulam to pyroxsulam at which the herbicidal effect is synergistic lies within the range of from 1:15 to 20:1. The rate at which the synergistic composition is applied will depend upon the particular type of weed to be controlled, the degree of control required, and the timing and method of application. In general, the composition of the invention can be applied at an application rate from 9 grams
10 per hectare (g/ha) to 140 g/ha based on the total amount of active ingredients in the composition. Penoxsulam is applied at a rate from 4 g/ha to 80 g/ha and pyroxsulam is applied at a rate from 5 g/ha to 60 g/ha.

The components of the synergistic mixture of the present invention can be applied either separately or as part of a multipart herbicidal system.

15 The synergistic mixture of the present invention 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
20 employed in conjunction with the synergistic composition of the present invention include: 2,4-D esters and amines, acetochlor, acifluorfen, aclonifen, alachlor, ametryn, amidosulfuron, aminocyclopyrachlor, aminopyralid, aminotriazole, amitrol, ammonium thiocyanate, anilifos, asulam, atrazine, azimsulfuron, beflubutamid, benazolin, benefin, benfuresate, bensulfuron, bensulide, bentazon, benthicarb, benzobicyclon, benzofenap, bifenox, bispyribac, bromacil,
25 bromobutide, bromoxynil, butachlor, butafenacil, butralin, cafenstrole, carbetamide, carfentrazone-ethyl, chlorflurenol, chlorimuron, chlormequat, chlorpropham, chlortoluron, cinidon-ethyl, cinosulfuron, clethodim, clodinafop-propargyl, clomazone, clomeprop, clopyralid, cloransulam, cumyluron, cyanazine, cyclosulfamuron, cycloxydim, cyhalofop, daimuron, dicamba, dichlobenil, dichlorprop, diclofop-methyl, diclosulam, diflufenican,
30 diflufenzopyr, dimefuron, dimepiperate, dimethametryn, dimethenamid, dimethenamid, diquat, dithiopyr, diuron, EK2612, EPTC, erioglaucine, esprocarb, ET-751, ethofumesate, ethoxysulfuron, ethbenzamide, etobenzanid, F7967, fenoxaprop-p-ethyl, fenoxaprop-p-ethyl

+ isoxadifen-ethyl, fenoxasulfone (KIH-071), fentrazamide, flazasulfuron, florasulam, fluazifop, flucarbazone, flucetosulfuron, flufenacet, flufenpyr, flumetsulam, flumiclorac, flumioxazin, fluometuron, flupyrsulfuron, fluroxypyr, flurtamone, fosamine, fomesafen, foramsulfuron, fumiclorac, glufosinate, glyphosate, halosulfuron, haloxyfop, hexazinone, imazamethabenz, imazamox, imazapic, imazapyr, imazaquin, imazethapyr, imazosulfuron, indanofan, indaziflam, iodosulfuron, iodosulfuron-ethyl-sodium, ioxynil, ipfencarbazone (HOK-201), IR 5790, isoproturon, isoxaben, isoxaflutole, lactofen, linuron, MCPA esters and amines, mecoprop-P, mefenacet, mesosulfuron, mesosulfuron-ethyl sodium, mesotrione, metamifop, metazosulfuron (NC-620), metolachlor, metosulam, metribuzin, metsulfuron, metsulfuron-methyl, molinate, monosulfuron, MSMA, napropamide, nicosulfuron, norflurazon, OK-9701, orthosulfamuron, oryzalin, oxadiargyl, oxadiazon, oxazichlomefone, oxyfluorfen, paraquat, pendimethalin, pentoxazone, pethoxamid, picloram, picolinafen, pinoxaden, piperophos, pretilachlor, primisulfuron-methyl, prodiamine, profluzol, profoxydim, prohexadione, prometon, pronamide, propachlor, propanil, propisochlor, propoxycarbazone, propyrisulfuron (TH-547), propyzamide, prosulfocarb, prosulfuron, pyrabuticarb, pyraclonil, pyraflufen-ethyl, pyrazogyl, pyrazolynate, pyrazosulfuron-ethyl, pyrazoxyfen, pyribenzoxim, pyridate, pyriftalid, pyriminobac, pyrimisulfan (KUH-021), pyriithiobac, pyroxasulfone (KIH-485), quinclorac, quinmerac, quinclamine, quizalofop, rimsulfuron, S-3252, saflufenacil, sethoxydim, simazine, simetryne, SL-0401, SL-0402, sulcotrione, sulfentrazone, sulfometuron, sulfosate, sulfosulfuron, tebuthiuron, tefuryltrione (AVH-301), tembotrione (AE0172747), terbacil, thenylchlor, thiazopyr, thiencarbazone, thifensulfuron, thifensulfuron-methyl, thiobencarb, topramezone, tralkoxydim, triasulfuron, tribenuron, tribenuron-methyl, triclopyr, trifloxysulfuron, trifluralin, trinexapac, tritosulfuron and salts, esters, optically active isomers and mixtures thereof.

The synergistic composition of the present invention can, further, be used in conjunction with glyphosate, glufosinate, dicamba, imidazolinones, sulfonylureas, or 2,4-D on glyphosate-tolerant, glufosinate-tolerant, dicamba-tolerant, imidazolinone-tolerant, sulfonylurea-tolerant and 2,4-D-tolerant crops. It is generally preferred to use the synergistic composition of the present invention 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. It is further generally preferred to apply the synergistic composition of the present invention and other complementary herbicides at the same time, either as a combination formulation or as a tank mix.

The synergistic composition of the present invention can generally be employed in combination with known herbicide safeners, such as benoxacor, benthocarb, brassinolide, cloquintocet (mexyl), cyometrinil, daimuron, dichlormid, dicyclonon, dimepiperate, disulfoton, fenchlorazole-ethyl, fenclorim, flurazole, fluxofenim, furilazole, harpin proteins, isoxadifen-ethyl, mefenpyr-diethyl, MG 191, MON 4660, naphthalic anhydride (NA),
5 oxabetrinil, R29148 and *N*-phenyl-sulfonylbenzoic acid amides, to enhance their selectivity.

In practice, it is preferable to use the synergistic composition of the present invention in mixtures containing an herbicidally effective amount of the herbicidal components along with at least one agriculturally acceptable adjuvant or carrier. Suitable adjuvants or carriers
10 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
15 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.

Suitable agricultural adjuvants and carriers that are useful in preparing the herbicidal mixtures of the invention are well known to those skilled in the art. Some of these adjuvants
20 include, but are not limited to, crop oil concentrate (mineral oil (85%) + emulsifiers (15%)); nonylphenol ethoxylate; benzylcocoalkyldimethyl quaternary ammonium salt; blend of petroleum hydrocarbon, alkyl esters, organic acid, and anionic surfactant; C₉-C₁₁ alkylpolyglycoside; phosphated alcohol ethoxylate; natural primary alcohol (C₁₂-C₁₆) ethoxylate; di-*sec*-butylphenol EO-PO block copolymer; polysiloxane-methyl cap;
25 nonylphenol ethoxylate + urea ammonium nitrate; emulsified methylated seed oil; tridecyl alcohol (synthetic) ethoxylate (8EO); tallow amine ethoxylate (15 EO); PEG(400) dioleate-99.

Liquid carriers that can be employed include water, toluene, xylene, petroleum naphtha, crop oil, acetone, methyl ethyl ketone, cyclohexanone, trichloroethylene,
30 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. Water is generally the carrier of choice for the dilution of concentrates.

Suitable solid carriers include talc, pyrophyllite clay, silica, attapulgus clay, kaolin clay, kieselguhr, chalk, diatomaceous earth, lime, calcium carbonate, bentonite clay, Fuller's
5 earth, cottonseed hulls, wheat flour, soybean flour, pumice, wood flour, walnut shell flour, lignin, and the like.

It is usually desirable to incorporate one or more surface-active agents into the compositions of the present invention. Such surface-active agents are advantageously employed in both solid and liquid compositions, especially those designed to be diluted with
10 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 conventionally used in the art of formulation and 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
15 and in "Encyclopedia of Surfactants," Vol. I-III, Chemical Publishing Co., New York, 1980-81. Typical surface-active agents include salts of alkyl sulfates, such as diethanolammonium lauryl sulfate; alkylarylsulfonate salts, such as calcium dodecylbenzenesulfonate; alkylphenol-alkylene oxide addition products, such as nonylphenol-C₁₈ ethoxylate; alcohol-alkylene oxide addition products, such as tridecyl alcohol-C₁₆ ethoxylate; soaps, such
20 as sodium stearate; alkyl naphthalene-sulfonate salts, such as sodium dibutyl-naphthalenesulfonate; 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
25 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, particularly methyl esters.

Oftentimes, some of these materials, such as vegetable or seed oils and their esters,
30 can be used interchangeably as an agricultural adjuvant, as a liquid carrier or as a surface active agent.

Other additives commonly used in agricultural compositions include 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.

The concentration of the active ingredients in the synergistic composition of the present invention is generally from 0.1 to 98 percent by weight. Concentrations from 10 to 90 percent by weight are often employed. In compositions designed to be employed as concentrates, the active ingredients are generally present in a concentration from 5 to 98 weight percent, preferably 10 to 90 weight percent. Such compositions are typically diluted with an inert carrier, such as water, before making a postemergence, foliar application to exposed weed and crop foliage, or applied as a dry or liquid formulation directly into flooded rice fields. The diluted compositions usually applied as a postemergence, foliar application to weeds or the locus of weeds generally contain 0.001 to 20 weight percent active ingredient and preferably contain 0.002 to 10 weight percent.

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.

The following examples illustrate the present invention.

These trials were conducted under field conditions in France, Poland and Syria. Trial sites were located in commercially grown crops wheat, barley and corn. The crops were grown using normal cultural practices for fertilization, seeding, and maintenance to ensure good growth of the crop and the weeds. The trials were conducted using typical small plot herbicide research methodology. Trial plots were between 1 to 2.5 meters (m) wide by 6 to 42 m long. All treatments were applied using a randomized complete block trial design with 2 to 4 replications per treatment. The trial sites had naturally occurring populations of weeds. The weed spectrum included, but was not limited to, wild oat (*Avena fatua*, AVEFA); Shepherd's purse (*Capsella bursa-pastoris*, CAPBP); common lambsquarter (*Chenopodium*

album, CHEAL); barnyardgrass (*Echinochloa crus-galli*, ECHCG); ryegrass (*Lolium spp.*, LOLSS); short-spiked canarygrass (*Phalaris brachystachys*, PHABR); awned canarygrass (*Phalaris paradoxa*, PHAPA); narrow-leaved plantain (*Plantago lanceolata*, PLALA); annual blackgrass (*Poa annua*, POAAN); and wild buckwheat (*Polygonum convolvulus*, POLCO).

Treatments consisted of tank mixes of penoxsulam and pyroxsulam or pyroxsulam + cloquintocet (mexyl) applied in water. Where used, Actirob B adjuvant was applied at use rate of 0.2 to 1 liter per hectare (L/ha) with pyroxsulam containing treatments and in tankmixes. Penoxsulam was applied using the commercial formulation Viper/Boa which contains a built-in adjuvant at a rate of 0.7 liters per 20 grams active ingredient (ai). Pyroxsulam was applied using 15% to 25%WP formulations, with cloquintocet (mexyl) applied at a maximum rate of 18.75 gr ai/ha. Formulated products were used to make the single and tank-mix treatments. The application volumes were between 200 to 250 L/ha. All application were made using precision gas hand sprayers using a 2 to 2.5 m boom using flat fan (80° or 110°) nozzles to broadcast the treatments on the soil.

The treated plots and control plots were rated blind at various intervals after application. Ratings were based of Percent (%) Visual weed control, where 0 corresponds to no injury and 100 corresponds to complete kill.

Colby's equation was used to determine the herbicidal effects expected from the mixtures (Colby, S.R. Calculation of the synergistic and antagonistic response of herbicide combinations. *Weeds* **1967**, 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.

Some of the compounds tested, application rates employed, plant species tested, and results are given in Tables 1 – 3. All comparisons are an average of 2 to 4 replicates and are significant at the $P > 0.05$ level.

Tables

5 Table 1. Control of CAPBP, CHEAL, ECHCG and POLCO by Penoxsulam plus Pyroxsulam at 39-51 Days After Application in the field.

Pyrox-sulam	Penox-sulam	CAPBP		CHEAL		ECHCG		POLCO	
(rate in grams ai/ha)		Obs	Exp*	Obs	Exp*	Obs	Exp*	Obs	Exp*
4	0	70	-	65	-	65	-	35	-
0	5	20	-	10	-	0	-	50	-
4	5	100	75	91	69	94	65	85	68

CAPBP = Shepherd's purse (*Capsella bursa-pastoris*)

CHEAL = common lambsquarter (*Chenopodium album*)

10 ECHCG = barnyardgrass (*Echinochloa crus-galli*)

POLCO = wild buckwheat (*Polygonum convolvulus*)

Obs = Observed Response

Exp* = Expected Response

15

Table 2. Control of AVEFA, PHABR and PHAPA by Penoxsulam plus Pyroxsulam at 28 to 56 Days After Application in the field.

Pyrox-sulam	Penox-sulam	AVEFA		PHABR		PHAPA	
(rate in grams ai/ha)		Obs	Exp*	Obs	Exp*	Obs	Exp*
18	0	65	-	38	-	80	-
0	20	0	-	0	-	0	-
18	20	80	65	59	38	95	80

AVEFA = wild oat (*Avena fatua*)

20 PHABR = short-spiked canarygrass (*Phalaris brachystachys*)

PHAPA = awned canarygrass (*Phalaris paradoxa*)

Obs = Observed Response

Exp* = Expected Response

Table 3. Control of LOLSS, PLALA and POANN by Penoxsulam plus Pyroxsulam at
14 to 61 Days After Application in the field.

Pyrox- sulam	Penox- sulam	LOLSS		PLALA		POANN	
(rate in grams ai/ha)		Obs	Exp*	Obs	Exp*	Obs	Exp*
20	0	0	-	7	-	0	-
0	20	20	-	13	-	17	-
20	20	65	20	57	18	50	17

LOLSS = ryegrass (*Lolium spp.*)

PLALA = narrow-leaved plantain (*Plantago lanceolata*)

POANN = annual blackgrass (*Poa annua*)

Obs = Observed Response

Exp* = Expected Response

WHAT IS CLAIMED IS:

1. A synergistic herbicidal mixture comprising an herbicidally effective amount of (a) penoxsulam and (b) pyroxsulam.
2. The synergistic herbicidal mixture of Claim 1 in which the weight ratio of
5 penoxsulam to pyroxsulam is from 1:15 to 20:1.
3. An herbicidal composition comprising an herbicidally effective amount of the synergistic herbicidal mixture of Claim 1 and an agriculturally acceptable adjuvant and/or carrier.
4. A method of controlling undesirable vegetation which comprises contacting the
10 vegetation or the locus thereof with or applying to the soil to prevent the emergence or growth of vegetation, an herbicidally effective amount of the synergistic herbicidal mixture of Claim 1.
5. A method for controlling undesirable vegetation in rice, cereal and grain crops, tree
and vine crops, pome, stone and citrus crops, pastures, rangelands, industrial vegetation
15 management (IVM), and turf, which comprises contacting the vegetation or the locus thereof with or applying to the soil to prevent the emergence or growth of vegetation, an herbicidally effective amount of the synergistic herbicidal mixture of Claim 1.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/29153

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A01N 43/90 (2012.01)

USPC - 504/241

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)

USPC-504/241

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

USPC-504/241, 504/241, 132, 137, 238

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

PubWest (US Pat, PgPub, EPO, JPO), GoogleScholar (PL, NPL), FreePatentsOnline (US Pat, PgPub, EPO, JPO, WIPO, NPL); search terms: penoxsulam pyroxsulam synergistic herbicidal adjuvant carrier rice cereal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0279864 A1 (Mann et al.) 04 November 2010 (04.11.2010) para [0001], [0007],[0010]-[0015], [0021]	1-5
A	WO/2010/126812 A1 (Mann et al.) 04 November 2010 (04.11.2010) Abstract	1-5
P/A	US 2011/0190136 A1 (Hufnagl et al.) 04 August 2011 (04.08.2011) Abstract	1-5

☐ 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

"&" document member of the same patent family

Date of the actual completion of the international search

08 June 2012 (08.06.2012)

Date of mailing of the international search report

25 JUN 2012

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:

Lee W. Young

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