SPOOR & FISHER

200603291

BD

FORM P.8
(To be lodged in duplicate)

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PUBLICATION PARTICULARS AND ABSTRACT

(Section 32(3)(a) – Regulation 22(1)(g) and 31)

OFFICIAL APPLICATION NO.		LODGING DATE		ACCEPTANCE DATE	
21	01 2006/03291	22	25 APR 2006	43	09-05-2007

INTERNATIONAL CLASSIFICATION		NOT FOR PUBLICATION
51	A01N	CLASSIFIED BY: JAPAN PATENT OFFICE

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EARLIEST PRIORITY CLAIMED

COUNTRY		NUMBER		DATE	
33	JP	31	2005-127591	32	26 APR 2005

TITLE OF INVENTION

54	HERBICIDAL METHOD

57	ABSTRACT (NOT MORE THAT 150 WORDS)	NUMBER OF SHEETS	24

If no classification is finished, Form P.9 should accompany this form.
The figure of the drawing to which the abstract refers is attached.

Abstract

A combination of N-(7-fluoro-3,4-dihydro-3-oxo-4-prop-2-ynyl-2H-1,4-benzoxadin-6-yl)cyclohex-1-ene-1,2-dicarboxamide [Flumioxazin] and 1-(2-chloroimidazo[1,2-a]pyridin-3-ylsulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)urea [Imazosulfuron], wherein the weight ratio of Flumioxazin : Imazosulfuron is 1:0.1-20, is useful for controlling weeds in peanut field, vegetable field, tree field or non-cultivated land.

Technical Field

This invention directs to herbicidal method.

Background Art

N-(7-fluoro-3,4-dihydro-3-oxo-4-prop-2-ynyl-2H-1,4-benzoxadin-6-yl) cyclohex-1-ene-1,2-dicarboxamide [Flumioxazin] is a herbicidal compound described in USP-4,640,707. 1-(2-chloroimidazo[1,2-a]pyridin-3-ylsulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)urea [Imazosulfuron] is also a herbicidal compound described in USP-5,017,212. Further, it is suggested that the combination of Flumioxazin and Imazosulfuron may be used for controlling weeds in rice field in WO 00/27203.

Disclosure of the Invention

This invention is to provide a method for controlling many species of weeds by excellent herbicidal effect without phytotoxicity to crops. In detail, the invention provides a method for controlling weeds in peanut field, vegetable field and tree field. Further, the invention also provides a method for controlling weeds in non-cultivated land.

According to the present invention, a combination of Flumioxazin and Imazosulfuron, wherein the weight ratio of Flumioxazin : Imazosulfuron is 1:0.1-20, is useful for controlling weeds in peanut field, vegetable field, tree field and non-cultivated land. Each of Flumioxazin and Imazosulfuron can be applied separately to weeds or to soil in a place where the weeds grow or will grow. In that case, a formulation of Flumioxazin and a formulation of Imazosulfuron are applied simultaneously or sequentially in general. However, Flumioxazin and Imazosulfuron are usually mixed and formulated in advance to a herbicidal composition comprising both of Flumioxazin and Imazosulfuron as

active ingredients, which is applied to weeds or to soil in a place where the weeds grow or will grow.

The composition comprising Flumioxazin and Imazosulfuron is used for controlling many species of weeds effectively in the fields where crops are cultivated with or without tillage such as peanut field, vegetable field and tree field. In those cases, it does not cause significant phytotoxicity to useful plants. Further, it also can be used for controlling weeds in non-cultivated land.

In the composition, the mixing ratio of Flumioxazin : Imazosulfuron used as active ingredients is about 1:0.1-20, preferably about 1:0.2-10.

The composition is usually used for being formulated to emulisiable concentrates, wettable powders, suspensible concentrates, granules and so on by mixing a solid carrier or liquid carrier and optionally surfactant and the other auxiliary for formulation. These formulations generally contain about 0.1 to 90% by weight, preferably about 1 to 80% by weight of the total amount of Flumioxazin and Imazosulfuron.

Examples of the solid carrier used for formulating the composition include fine powders and granules of clays such as kaolinite, diatomaceous earth, Fubasami clay, bentonite and terra alba; synthetic hydrated silica; talc; sericite; quartz; and the other inorganic minerals such as sulfur, activated carbon and calcium carbonate; and chemical fertilizer such as ammonium sulfate, ammonium phosphate, ammonium nitrate, ammonium chloride and urea. Examples of the liquid carrier include water; alcohols such as methanol and ethanol; ketones such as acetone, ethyl methyl ketone and cyclohexanone; aromatic hydrocarbons such as toluene, xylene, ethylbenzene and methylnaphthalene; non-aromatic hydrocarbons such as hexane, cyclohexane and kerosene; esters such as ethyl acetate and butyl acetate; nitriles such as acetonitrile and isobutyronitrile; ethers such as dioxane and diisopropyl ether; acid amides such as dimethylformamide and dimethylacetamide; and halogenated hydrocarbons such as dichloroethane and trichloroethylene.

Examples of the surfactant used for formulating the composition include alkyl sulfate esters, alkylsulfonate salts, alkylarylsulfonate salts, alkylaryl ethers, polyoxyethylene alkylaryl ethers, polyethylene glycol ethers, polyvalent alcohol esters and sugar alcohols. Examples of the other auxiliary for formulation include sticking agents and dispersants such as casein; gelatin; polysaccharide (e.g., starch, gum arabic, cellulose derivatives, alginic acid); lignin derivatives; bentonite; and synthetic water-soluble polymers (e.g., polyvinyl alcohol, polyvinylpyrrolidone, polyacrilic acid); and stabilizers such as PAP (isopropyl acid phosphate), BHT (2,6-tert-butyl-4-methylphenol), BHA (2-/3-tert-butyl-4-methoxyphenol), vegetable oil, mineral oil, fatty acid and fatty acid ester.

The composition can also be prepared by mixing each formulation after formulating each of the active ingredients with the above- mentioned procedure.

The composition obtained above can be applied as it is. Further, it can be diluted with water or the like, and then the dilution can be applied to soil or a plant. It may be expected to increase the herbicidal effect by using the composition together with another herbicide. Moreover, the composition can be used with an insecticide, fungicide, plant growth regulator, fertilizer, safener, soil-improving agent and so on.

The dosage of the composition depends on the mixing ratio of Flumioxazin and Imazosulfuron as active ingredients, weather condition, formulation type, application time, application method, application place, objective weeds and crops. The total amount of the active ingredients is usually about 1 to 1000g per hectare. When the formulation is emulisiable concentrate, wettable powder, suspensible concentrate, the designated amount is usually diluted with about 100 to 2000 liters of water per hectare and applied. Further, when the composition is applied to weeds by foliar treatment, it is expected to increase herbicidal effect against weeds by adding an adjuvant to the dilution of the composition.

In the vegetable field of the present invention, examples of the crop include Solanaceae crops such as eggplant, tomato, green pepper and potato; Cucurbitaceae crops such as cucumber, squash, zucchini, watermelon and melon; Crusiferae crops such as radish, turnip, horseradish, Kohlrabi, Chinese cabbage, cabbage, mustard, broccoli and cauliflower; Rosaceae crops such as strawberry; Compositae crops such as burdock, crown daisy, artichoke and lettuce; Liliaceae crops such as leek, onion, garlic and asparagus; Umbelliferae crops such as carrot, parsley, celery and parsnip; Chenopodiaceae crops such as spinach and Swiss chard; Labiatae crops such as perilla, mint, basil and lavender; Convolvulaceae crops such as sweet potato; Dioscoreaceae crops such as yam; Araceae crops such as taro; and Euphorbiaceae crops such as cassava.

The tree field of the present invention can be orchard and non-bearing tree field. Examples of the orchard include pome fruits such as apple, pear (e.g. pear, Japanese pear), quince (e.g. quince, Chinese quince); stone fruits such as peach, plum (e.g. plum, Japanese plum), nectarine, apricot (e.g. apricot, Japanese apricot) and cherry; grapes; citrus such as orange (e.g. orange, Satsuma orange), lemon, lime and grapefruit; tree nuts such as chestnut, walnut, hazel, almond, pistachio, cashew and macadamia; berries such as blueberry, cranberry, blackberry and raspberry; persimmon (e.g. persimmon, Japanese persimmon); fig; loquat; olive; palm; banana; coffee; tea; and mulberry. Examples of the non-bearing tree include Deciduous trees such as ash (*Fraxinus spp.*), birch (*Betula spp.*), dogweed (*Cornus spp.*), poplar (*Poplus spp.*), redbud (*Cercis spp.*), sycamore (*Platanus spp.*) and zelkova (*Zelkova spp.*) and Conifer such as arborvitae (*Thuja spp.*), fir (*Abies spp.*), hemlock (*Tsuga spp.*), juniper (*Juniperus spp.*), pine (*Pinus spp.*), spruce (*Picea spp.*) and yew (*Taxus spp.*). The tree field of the present invention can be tree nursery, tree farm, forest and so on.

Examples of the non-cultivated land in the present invention include playground, vacant land, neighborhood of railroad, park, car park, neighborhood of road, dry riverbed, land under power-transmission line, land for housing and

site for factory.

Examples of the weeds include:

Polygonaceae weeds such as *Polygonum convolvulus* (wild buckwheat), *Polygonum lapathifolium* (pale smartweed), *Polygonum pensylvanicum* (Pennsylvania smartweed), *Polygonum persicaria* (ladysthumb), *Rumex crispus* (curly dock), *Rumex obtusifolius* (European dock) and *Polygonum cuspidatum* (Japanese knotweed);

Portulacaceae weeds such as *Portulaca oleracea* (common purslane);

Caryophyllaceae weeds such as *Stellaria media* (common chickweed);

Chenopodiaceae weeds such as *Chenopodium album* (common lambsquarters) and *Kochia scoparia* (fireweed);

Amaranthaceae weeds such as *Amaranthus retroflexus* (redroot pigweed) and *Amaranthus hybridus* (smooth pigweed);

Crusiferae weeds such as *Raphanus raphanistrum* (wild radish), *Sinapis arvensis* (wild mustard) and *Capsella bursa-pastoris* (shepherdspurse);

Leguminosae weeds such as *Sesbania exaltata* (hemp sesbania), *Cassia obtusifolia* (sicklepod), *Desmodium tortuosum* (Florida beggarweed) and *Trifolium repens* (white clover);

Malvaceae weeds such as *Abutilon theophrasti* (velvetleaf) and *Sida spinosa* (prickly sida);

Violaceae weeds such as *Viola arvensis* (field pansy) and *Viola tricolor* (wild pansy);

Rubiaceae weeds such as *Galium aparine* (cleavers);

Convolvulaceae weeds such as *Ipomoea hederacea* (ivyleaf morningglory), *Ipomoea purpurea* (tall morningglory), *Ipomoea hederacea var integriuscula* (entireleaf morningglory), *Ipomoea lacunose* (pitted morningglory) and *Convolvulus arvensis* (field bindweed);

Labiatae weeds such as *Lamium purpureum* (purple deadnettle) and *Lamium amplexicaule* (henbit);

Solanaceae weeds such as *Datura stramonium* (jimsonweed) and *Solanum nigrum* (black nightshade);
Scrophulariaceae weeds such as *Veronica persica* (Persian speedwell) and *Veronica hederaefolia* (ivyleaf speedwell);
Compositae weeds such as *Xanthium pensylvanicum* (common cocklebur), *Helianthus annuus* (common sunflower), *Matricaria inodora* (scentless chamomile), *Chrysanthemum segetum* (corn marigold), *Matricaria matricarioides* (pineappleweed), *Ambrosia artemisiifolia* (common ragweed), *Ambrosia trifida* (giant ragweed), *Erigeron Canadensis* (horseweed), *Artemisia princes* (Japanese mugwort) and *Solidago altissima* (tall goldenrod);
Boraginaceae weeds such as *Myosotis arvensis* (forget-me-not);
Asclepiadaceae weeds such as *Asclepias syriaca* (common milkweed);
Euphorbiaceae weeds such as *Euphorbia helioscopia* (sun spurge) and *Euphorbia maculata* (spotted spurge);
Gramineae weeds such as *Echinochloa crus-galli* (barnyardgrass), *Setaria viridis* (green foxtail), *Setaria faberi* (giant foxtail), *Digitaria sanguinalis* (southern crabgrass), *Eleusine indica* (goosegrass), *Poa annua* (annual bluegrass), *Alopecurus myosuroides* (blackgrass), *Avena fatus* (wild oats), *Sorghum halepense* (Johnsongrass), *Agropyron repens* (quackgrass), *Bromus tectorum* (downy brome), *Cynodone dactylon* (Bermudagrass), *Panicum dichotomiflorum* (fall panicum), *Panicum texanum* (Texas panicum), *Sorghum vulgare* (shattercane) and *Lolium multiflorum* (Italian ryegrass);
Commelinaceae weeds such as *Commelina communis* (Asiatic dayflower) and *Commelina benghalensis* (Bengal dayflower);
Equisetaceae weeds such as *Equisetum arvense* (field horsetail); and
Cyperaceae weeds such as *Cyperus iria* (rice flatsedge), *Cyperus rotundus* (purple nutsedge) and *Cyperus esculentus* (yellow nutsedge).

Examples

Hereinafter, the present invention is explained by examples in detail; however, the invention is not restricted by the following examples.

Formulation examples of the composition for using the method of the present invention are given below. In the examples, part(s) means part(s) by weight.

Formulation example 1

Twenty-five parts of Flumioxazin, 25 parts of Imazosulfuron, 3 parts of calcium ligninsulfonate, 2 parts of sodium laurylsulfate and 45 parts of synthetic hydrated silica are well pulverized and mixed to give wettable powder.

Formulation example 2

Seventy parts of Flumioxazin, 14 parts of Imazosulfuron, 3 parts of calcium ligninsulfonate, 2 parts of sodium laurylsulfate and 11 parts of synthetic hydrated silica are well pulverized and mixed to give wettable powder.

[0019]

Formulation example 3

Fourteen parts of Flumioxazin, 70 parts of Imazosulfuron, 3 parts of calcium ligninsulfonate, 2 parts of sodium laurylsulfate and 11 parts of synthetic hydrated silica are well pulverized and mixed to give wettable powder.

Formulation example 4

Ten parts of Flumioxazin, 5 parts of Imazosulfuron, 3 parts of calcium ligninsulfonate, 2 parts of sodium laurylsulfate and 80 parts of synthetic hydrated silica are well pulverized and mixed to give wettable powder.

[0020]

Formulation example 5

Twenty parts of Flumioxazin, 20 parts of Imazosulfuron, 3 parts of polyoxyethylene sorbitan monooleate, 3 parts of CMC (carboxymethylcellulose) and 54 parts of water are mixed and wet-pulverized to make the particle diameter to 5 μ or less to give suspensible concentrate.

Formulation example 6

Fifty parts of Flumioxazin, 10 parts of Imazosulfuron, 3 parts of polyoxyethylene sorbitan monooleate, 3 parts of CMC (carboxymethylcellulose) and 34 parts of water are mixed and wet-pulverized to make the particle diameter to 5 μ or less to give suspensible concentrate.

Formulation example 7

Five parts of Flumioxazin, 25 parts of Imazosulfuron, 3 parts of polyoxyethylene sorbitan monooleate, 3 parts of CMC (carboxymethylcellulose) and 64 parts of water are mixed and wet-pulverized to make the particle diameter to 5 μ or less to give suspensible concentrate.

Formulation example 8

Four parts of Flumioxazin, 2 parts of Imazosulfuron, 3 parts of polyoxyethylene sorbitan monooleate, 3 parts of CMC (carboxymethylcellulose) and 88 parts of water are mixed and wet-pulverized to make the particle diameter to 5 μ or less to give suspensible concentrate.

Biological tests are given below.

Valuation basis

The herbicidal activity is evaluated at 6 levels using the indices of 0 to 5, i.e., shown by "0", "1", "2", "3", "4" or "5", wherein a score of "0" means that there is no or little difference in the degree of growth between treated plants and untreated plants at the time of observation and a score of "5" means that the test plants die completely or their growth is completely inhibited. The herbicidal values of "4" and "5" show excellent herbicidal activity. The phytotoxicity is evaluated at 4 levels using "no damage", "small", "medium" or "severe", wherein "no damage" means that no damage is found or the damage practically causes no problem, "small" means that the damage is light but practically impermissible, "medium" means that the damage is medium and "severe" means that severe damage is found.

Test example 1 (Test for peanut field)

Plastic pots each having a diameter of 18cm and depth of 14cm were filled with upland soil, and then seeded with yellow nutsedge (*Cyperus esculentus*), hemp sesbania (*Sesbania exaltata*) and sicklepod (*Cassia obtusifolia*). In a greenhouse, they were grown for 12 days. Flumioxazin water dispersible granules (commercial name: Valor SX, produced by Valent U.S.A.), Imazosulfuron emulsifiable concentrate (produced by mixing well 5 parts of Imazosulfuron, 65 parts of cyclohexanone, 13 parts of Sorpol 2680 (Toho Chemical's product) and 17 parts of dimethylformamide) and a mixture of the Flumioxazin water dispersible granules and the Imazosulfuron emulsifiable concentrate were independently diluted in their designated amounts with water. Each dilution was uniformly sprayed over the test plants with a small sprayer. After the application, the test plants were grown in the greenhouse for 7 days, and the herbicidal activity was then examined. Further, the pots were seeded with peanut (*Arachis hypogea*) 7 days after the application, and the phytotoxicity against the crop was examined 10 days after the seeding. The results are shown in Table 1.

Table 1

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity			Phytotoxicity against crop
		Ce	Se	Co	Peanut
Flumioxazin	30	0	1	0	No damage
Flumioxazin	60	0	1	1	No damage
Imazosulfuron	60	2	2	1	No damage
Imazosulfuron	120	2	3	1	No damage
Flumioxazin + Imazosulfuron	30 + 60	4	5	4	No damage
Flumioxazin + Imazosulfuron	30 + 120	4	5	5	No damage
Flumioxazin + Imazosulfuron	60 + 60	4	5	4	No damage
Flumioxazin + Imazosulfuron	60 + 120	5	5	4	No damage

In the above table, Ce means yellow nutsedge, Se means hemp sesbania and Co means sicklepod.

As shown in Table 1 above, excellent herbicidal effect was provided in the area treated with Flumioxazin and Imazosulfuron compared to the area treated with Flumioxazin or Imazosulfuron solely. Further, there was no damage practically causes problem for the crop. Thus, the weed selected from the group consisting of *Cyperus spp.*, *Sesbania spp.* and *Cassia spp.* can be controlled well in peanut field by the application of Flumioxazin and Imazosulfuron.

Test example 2 (Test for vegetable field)

Plastic pots each having a diameter of 18cm and depth of 14cm were filled with upland soil, and then seeded with barnyardgrass (*Echinochloa crus-galli*) and onion (*Allium cepa*). The next day, a designated amount of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.), Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company), or a mixture of Flumioxazin granules and Imazosulfuron granules was independently applied to a soil surface. After the application, the test plants were grown for 29 days, and the herbicidal activity and phytotoxicity were then examined. The results are shown in Table 2.

Table 2

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity	Phtotoxicity
		Barnyardgrass	Onion
Flumioxazin	20	1	No damage
Imazosulfuron	50	0	No damage
Flumioxazin + Imazosulfuron	20 + 50	4	No damage

As shown in Table 2, excellent herbicidal effect was provided in the area treated with the composition of the invention compared to the area treated with

Flumioxazin or Imazosulfuron solely. Further, there was no damage practically causes problem for the crop. Thus, the weed of *Echinochloa sp.* can be controlled well in onion field by the application of Flumioxazin and Imazosulfuron.

Test example 3 (Test for vegetable field)

Plastic pots (32cm × 22cm, depth: 8cm) were filled with upland soil, seedlings of eggplant (*Solanum melongena*) and tomato (*Lycopersicum esculentum*) were transplanted and then seeded with black nightshade (*Solanum nigrum*), jimsonweed (*Datura stramonium*), giant foxtail (*Setaria faberi*), southern crabgrass (*Digitaria sanguinalis*), common chickweed (*Stellaria media*), common lambsquarters (*Chenopodium album*) and redroot pigweed (*Amaranthus retroflexus*). The next day, a designated amount of a mixture of Flumioxazin water dispersible granules (commercial name: ValorSX, produced by Valent U.S.A.) and Imazosulfuron Suspensible concentrates (commercial name: Sibatito 40, produced by Sumitomo Chemical Takeda Agro Company) was diluted with water and applied uniformly to a soil surface with a small sprayer. After the application, the test plants were grown in the greenhouse for 17 days, and the herbicidal activity and phytotoxicity were then examined. The results are shown in Table 3.

Table 3

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity							Phtotoxicity	
		Sn	Ds	Sf	Dg	St	Ca	Ar	eggplant	tomato
Flumioxazin+ Imazosulfuron	20 + 50	5	5	5	5	5	5	5	No damage	No damage
Flumioxazin+ Imazosulfuron	20 + 250	5	5	5	5	5	5	5	No damage	No damage

In the above table, Sn means black nightshade, Ds means jimsonweed, Sf means giant foxtail, Dg means southern crabgrass, St means common chickweed, Ca means common lambsquarters and Ar means redroot pigweed.

As shown in the above results, the weed selected from the group consisting of *Solanum spp.*, *Datura spp.*, *Setaria spp.*, *Digitaria spp.*, *Stellaria spp.*, *Chenopodium spp.* and *Amaranthus spp.* can be controlled well in eggplant or tomato field by the application of Flumioxazin and Imazosulfuron.

Test example 4 (Test for vegetable field)

Plastic pots (26cm × 19cm, depth: 7cm) were filled with upland soil, seedlings of cabbage (*Brassica Oleracea*) were transplanted and then seeded with shepherdspurse (*Capsella bursa-pastoris*), wild mustard (*Sinapis arvensis*), giant foxtail (*Setaria faberi*), southern crabgrass (*Digitaria sanguinalis*), common chickweed (*Stellaria media*), common lambsquarters (*Chenopodium album*) and redroot pigweed (*Amaranthus retroflexus*). The next day, a designated amount of a mixture of Flumioxazin water dispersible granules (commercial name: ValorSX, produced by Valent U.S.A.) and Imazosulfuron Suspensible concentrates (commercial name: Sibatito 40, produced by Sumitomo Chemical Takeda Agro Company) was diluted with water and applied uniformly to a soil surface with a small sprayer. After the application, the test plants were grown in the greenhouse for 17 days, and the herbicidal activity and phytotoxicity were then examined. The results are shown in Table 4.

Table 4

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity							Phtotoxicity
		Cb	Sa	Sf	Dg	St	Ca	Ar	cabbage
Flumioxazin+ Imazosulfuron	20 + 50	5	5	5	5	5	5	5	No damage
Flumioxazin+ Imazosulfuron	20 + 250	5	5	5	5	5	5	5	No damage
Flumioxazin+ Imazosulfuron	100 + 50	5	5	5	5	5	5	5	No damage
Flumioxazin+ Imazosulfuron	100 + 250	5	5	5	5	5	5	5	No damage

In the above table, Cb means shepherdspurse, Sa means wild mustard, Sf means giant foxtail, Dg means southern crabgrass, St means common chickweed, Ca means common lambsquarters and Ar means redroot pigweed.

As shown in the above results, the weed selected from the group consisting of *Capsella spp.*, *Sinapis spp.*, *Setaria spp.*, *Digitaria spp.*, *Stellaria spp.*, *Chenopodium spp.* and *Amaranthus spp.* can be controlled well in cabbage field by the application of Flumioxazin and Imazosulfuron.

Test example 5 (Test for vegetable field)

Plastic pots each having a diameter of 18cm and depth of 14cm were filled with upland soil, seedlings of strawberry (*Fragaria ananassa*) was transplanted and then seeded with giant foxtail (*Setaria faberi*). The next day, a designated amount of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.), Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company), or a mixture of Flumioxazin granules and Imazosulfuron granules was independently applied to a soil surface. After the application, the test plants were grown for 17 days in the greenhouse, and the herbicidal activity and phytotoxicity were then examined. The results are shown in Table 5.

Table 5

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity	Phtotoxicity
		giant foxtail	strawberry
Flumioxazin	40	2	No damage
Imazosulfuron	50	0	No damage
Imazosulfuron	250	1	No damage
Flumioxazin + Imazosulfuron	40 + 50	5	No damage
Flumioxazin + Imazosulfuron	40 + 250	5	No damage

As shown in the above results, the weed of *Setaria sp.* can be controlled well in strawberry field by the application of Flumioxazin and Imazosulfuron.

Test example 6 (Test for vegetable field)

Plastic pots (26cm × 19cm, depth: 7cm) were filled with upland soil, seedlings of cucumber (*Cucumis sativus*), squash (*Cucurbita moschata*) and mint (*Mentha spp.*) were transplanted and then seeded with barnyardgrass (*Echinochloa crus-galli*), southern crabgrass (*Digitaria sanguinalis*), common chickweed (*Stellaria media*), redroot pigweed (*Amaranthus retroflexus*) and Persian speedwell (*Veronica persica*). The next day, a designated amount of a mixture of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.) and Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company) was applied uniformly to a soil surface. After the application, the test plants were grown in the greenhouse for 14 days in the greenhouse, and the herbicidal activity and phytotoxicity were then examined. The results are shown in Table 6.

Table 6

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity					Phtotoxicity		
		Ec	Dg	St	Ar	Vp	Cs	Cm	Ms
Flumioxazin + Imazosulfuron	40 + 50	5	5	5	5	5	No damage	No damage	No damage
Flumioxazin + Imazosulfuron	40 + 250	5	5	5	5	5	No damage	No damage	No damage

In the above table, Ec means barnyardgrass, Dg means southern crabgrass, St means common chickweed, Ar means redroot pigweed and Vp means Persian speedwell. Further, Cs means cucumber, Cm means squash and Ms means mint.

As shown in the above results, the weed selected from the group consisting of *Echinochloa spp.*, *Digitaria spp.*, *Stellaria spp.*, *Amaranthus spp.*

and *Veronica spp.* can be controlled well in cucumber, pumpkin or mint field by the application of Flumioxazin and Imazosulfuron.

Test example 7 (Test for tree field)

In the fruit tree land where Japanese pear and Satsuma orange grow, a designated amount of a mixture of Flumioxazin water dispersible granules (commercial name: ValorSX, produced by Valent U.S.A.) and Imazosulfuron Suspensible concentrates (commercial name: Sibatito 40, produced by Sumitomo Chemical Takeda Agro Company) was diluted with water and applied uniformly on ivyleaf morningglory (*Ipomoea hederacea*) and field horsetail (*Equisetum arvense*) with a carbon dioxide sprayer. The herbicidal activity and phytotoxicity were examined 63 days after the application. The results are shown in Table 7.

Table 7

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity		Phtotoxicity	
		Ih	Ea	pear	orange
Flumioxazin + Imazosulfuron	50 + 100	4	4	No damage	No damage
Flumioxazin + Imazosulfuron	50 + 1000	5	5	No damage	No damage
Flumioxazin + Imazosulfuron	500 + 100	5	4	No damage	No damage
Flumioxazin + Imazosulfuron	500 + 1000	5	5	No damage	No damage

In the above table, Ih means ivyleaf morningglory and Ea means field horsetail.

Test example 8 (Test for tree field)

In the greenhouse, plastic containers (46cm × 31cm, depth: 26cm) were filled with upland soil, peach trees were transplanted and grown, and then seeded with redroot pigweed (*Amaranthus retroflexus*), common chickweed (*Stellaria media*), southern crabgrass (*Digitaria sanguinalis*) and annual

bluegrass (*Poa annua*). Then, a designated amount of a mixture of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.) and Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company) was applied uniformly to a soil surface. The herbicidal activity and phytotoxicity were examined 23 days after the application. The results are shown in Table 8.

Table 8

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity				Phtotoxicity
		Ar	St	Dg	Pa	peach
Flumioxazin + Imazosulfuron	120 + 90	5	5	5	5	No damage

In the above table, Ar means redroot pigweed, St means common chickweed, Dg means southern crabgrass and Pa means bluegrass.

Test example 9 (Test for tree field)

In the greenhouse, plastic containers (46cm × 31cm, depth: 26cm) were filled with upland soil, grape trees were transplanted and grown, and then seeded with redroot pigweed (*Amaranthus retroflexus*), common chickweed (*Stellaria media*), southern crabgrass (*Digitaria sanguinalis*) and annual bluegrass (*Poa annua*). Then, a designated amount of a mixture of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.) and Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company) was applied uniformly to a soil surface. The herbicidal activity and phytotoxicity were examined 23 days after the application. The results are shown in Table 9.

Table 9

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity				Phtotoxicity
		Ar	St	Dg	Pa	grape
Flumioxazin +	80 +	5	5	5	5	No damage

Imazosulfuron	160					

In the above table, Ar means redroot pigweed, St means common chickweed, Dg means southern crabgrass and Pa means bluegrass.

Test example 10 (Test for tree field)

In the greenhouse, plastic containers (46cm × 31cm, depth: 26cm) were filled with upland soil, chestnut trees were transplanted and grown, and then seeded with redroot pigweed (*Amaranthus retroflexus*), common chickweed (*Stellaria media*), southern crabgrass (*Digitaria sanguinalis*) and annual bluegrass (*Poa annua*). Then, a designated amount of a mixture of Flumioxazin granules (commercial name: BroadStar, produced by Valent U.S.A.) and Imazosulfuron granules (commercial name: Takeoff Granule, produced by Sumitomo Chemical Takeda Agro Company) was applied uniformly to a soil surface. The herbicidal activity and phytotoxicity were examined 23 days after the application. The results are shown in Table 10.

Table 10

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity				Phtotoxicity
		Ar	St	Dg	Pa	chestnut
Flumioxazin + Imazosulfuron	50 + 200	5	5	5	5	No damage

In the above table, Ar means redroot pigweed, St means common chickweed, Dg means southern crabgrass and Pa means bluegrass.

As shown in Tables 7, 8, 9 and 10, the weed selected from the group consisting of *Ipomoea spp.*, *Equisetum spp.*, *Amaranthus spp.*, *Stellaria spp.*, *Digitaria spp.* and *Poa spp.* can be controlled well in tree field (e.g., pear, orange, peach, grape, chestnut) by the application of Flumioxazin and Imazosulfuron.

Test example 11 (Test for non-cultivated land)

A designated amount of a mixture of Flumioxazin water dispersible granules (commercial name: ValorSX, produced by Valent U.S.A.) and Imazosulfuron Suspensible concentrates (commercial name: Sibatito 40, produced by Sumitomo Chemical Takeda Agro Company) was diluted with water and applied uniformly onto a ground surface and growing weeds (including common vetch (*Vicia sativa*), cleavers (*Galium aparine*), Persian speedwell (*Veronica persica*), henbit (*Lamium amplexicaule*) and Carolina geranium (*Geranium carolinianum*)) on the graveled (about 10cm) land with a carbon dioxide sprayer. The herbicidal activity was examined 20 days after the application. The results are shown in Table 11. Further, the fresh weight of the growing weeds on the ground of the designated area was measured 36 days after the application. For the comparison, the fresh weight of the growing weeds without the application was measured. Furthermore, the fresh weight of the growing weeds, where the weeds had been pulled out by hand instead of the application, was also measured.

Table 11

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity				
		Vs	Ga	Vp	La	Gc
Flumioxazin + Imazosulfuron	200 + 400	5	5	5	5	5

In the above table, Vs means common vetch, Ga means cleavers, Vp means Persian speedwell, La means henbit and Gc means Carolina geranium.

Table 12

Tested area	Amount of active ingredient (g/ha)	Fresh weight of weeds (g/m^2)
Flumioxazin + Imazosulfuron	200 + 400	2.2
No treatment	0	249
Hand weeding	0	182

As shown in Table 12, the method for controlling weeds of the present invention is effective against the weeds which grow from the gap of the graveled.

Test example 12 (Test for non-cultivated land)

Plastic pots each having a diameter of 9cm and depth of 7cm were filled with upland soil, and then seeded with kudzu (*Pueraria lobata*). The next day, a designated amount of a mixture of Flumioxazin water dispersible granules (commercial name: Valor SX, produced by Valent U.S.A.) and Imazosulfuron Suspensible concentrates (commercial name: Sibatito 40, produced by Sumitomo Chemical Takeda Agro Company) was diluted with water and applied uniformly to a soil surface with a small sprayer. After the application, the test plants were grown in the greenhouse for 14 days, and the herbicidal activity was then examined. The results are shown in Table 13.

Table 13

Test compound	Amount of active ingredient (g/ha)	Herbicidal activity
		kudzu
Flumioxazin	100	1
Imazosulfuron	100	1
Imazosulfuron	500	2
Flumioxazin + Imazosulfuron	100 + 100	5
Flumioxazin + Imazosulfuron	100 + 500	5

As shown in Table 13, excellent herbicidal effect was provided in the area treated with Flumioxazin and Imazosulfuron compared to the area treated with Flumioxazin or Imazosulfuron solely. Thus, the weed of kudzu can be controlled well in non-cultivated land by the application of Flumioxazin and Imazosulfuron.

Claims

1. A method for controlling weeds in peanut field, vegetable field, tree field or non-cultivated land which comprises applying N-(7-fluoro-3,4-dihydro-3-oxo-4-prop-2-ynyl-2H-1,4-benzoxadin-6-yl)cyclohex-1-ene-1,2-dicarboxamide [Flumioxazin] and 1-(2-chloroimidazo[1,2-a]pyridin-3-ylsulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)urea [Imazosulfuron], wherein the weight ratio of Flumioxazin : Imazosulfuron is 1:0.1-20, separately or in combination to weeds or to soil in a place where the weeds grow or will grow.

2. The method for controlling weeds in peanut field described in claim 1.

3. The method for controlling weeds in peanut field described in claim 2, wherein the weed is selected from the group consisting of *Cyperus spp.*, *Sesbania spp.* and *Cassia spp.*

4. The method for controlling weeds in vegetable field described in claim 1.

5. The method for controlling weeds according to claim 4, wherein the vegetable is onion.

6. The method for controlling weeds in onion field described in claim 5, wherein the weed is *Echinochloa sp.*

7. The method for controlling weeds according to claim 4, wherein the vegetable is eggplant.

8. The method for controlling weeds in eggplant field described in claim 7, wherein the weed is selected from the group consisting of *Solanum spp.*, *Datura spp.*, *Setaria spp.*, *Digitaria spp.*, *Stellaria spp.*, *Chenopodium spp.* and *Amaranthus spp.*

9. The method for controlling weeds according to claim 4, wherein the vegetable is tomato.

10. The method for controlling weeds in tomato field described in claim 9, wherein the weed is selected from the group consisting of *Solanum spp.*, *Datura spp.*, *Setaria spp.*, *Digitaria spp.*, *Stellaria spp.*, *Chenopodium spp.* and *Amaranthus spp.*

11. The method for controlling weeds according to claim 4, wherein the vegetable is cabbage.

12. The method for controlling weeds in cabbage field described in claim 11, wherein the weed is selected from the group consisting of *Capsella spp.*, *Sinapis spp.*, *Setaria spp.*, *Digitaria spp.*, *Stellaria spp.*, *Chenopodium spp.* and *Amaranthus spp.*

13. The method for controlling weeds according to claim 4, wherein the vegetable is strawberry.

14. The method for controlling weeds in strawberry field described in claim 13, wherein the weed is *Setaria sp.*

15. The method for controlling weeds according to claim 4, wherein the vegetable is cucumber.

16. The method for controlling weeds in cucumber field described in claim 15, wherein the weed is selected from the group consisting of *Echinochloa spp.*, *Digitaria spp.*, *Stellaria spp.*, *Amaranthus spp.* and *Veronica spp.*

17. The method for controlling weeds according to claim 4, wherein the vegetable is squash.

18. The method for controlling weeds in squash field described in claim 17, wherein the weed is selected from the group consisting of *Echinochloa spp.*, *Digitaria spp.*, *Stellaria spp.*, *Amaranthus spp.* and *Veronica spp.*

19. The method for controlling weeds according to claim 4, wherein the vegetable is mint.

20. The method for controlling weeds in mint field described in claim 19, wherein the weed is selected from the group consisting of *Echinochloa spp.*, *Digitaria spp.*, *Stellaria spp.*, *Amaranthus spp.* and *Veronica spp.*

21. The method for controlling weeds in tree field described in claim 1.

22. The method for controlling weeds in tree field described in claim 21, wherein the weed is selected from the group consisting of *Ipomoea spp.*, *Equisetum spp.*, *Amaranthus spp.*, *Stellaria spp.*, *Digitaria spp.* and *Poa spp.*

23. The method for controlling weeds according to claim 21 or 22, wherein the tree field is a pear tree field.

24. The method for controlling weeds according to claim 21 or 22, wherein the tree field is an orange tree field.

25. The method for controlling weeds according to claim 21 or 22, wherein the tree field is a peach tree field.

26. The method for controlling weeds according to claim 21 or 22, wherein the tree field is a grape tree field.

27. The method for controlling weeds according to claim 21 or 22, wherein the tree field is a nut tree field.

28. The method for controlling weeds in non-cultivated land described in claim 1.

29. Use of a combination of N-(7-fluoro-3,4-dihydro-3-oxo-4-prop-2-ynyl-2H-1,4-benzoxadin-6-yl)cyclohex-1-ene-1,2-dicarboxamide [Flumioxazin] and 1-(2-chloroimidazo[1,2-a]pyridin-3-ylsulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)urea [Imazosulfuron], wherein the weight ratio of Flumioxazin : Imazosulfuron is 1:0.1-20, as active ingredients for controlling weeds in peanut field, vegetable field, tree field or non-cultivated land.

DATED THIS 25TH DAY OF APRIL 2006

D. G. GILSON

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APPLICANT'S PATENT ATTORNEYS