HU000030007T2

(19) **HU**

(11) Lajstromszám: **E 030 007**

(13) **T2**

MAGYARORSZÁG
Szellemi Tulajdon Nemzeti Hivatala

EURÓPAI SZABADALOM
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 13 157134**
(22) A bejelentés napja: **2013. 02. 28.**

(96) Az európai bejelentés bejelentési száma:
EP 20130157134
(97) Az európai bejelentés közzétételi adatai:
EP 2633756 A1 **2013. 09. 04.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 2633756 B1 **2016. 07. 13.**

(51) Int. Cl.:

A01N 43/40	*(2006.01)*
A01N 31/14	*(2006.01)*
A01N 37/50	*(2006.01)*
A01N 43/52	*(2006.01)*
A01N 43/76	*(2006.01)*
A01N 43/82	*(2006.01)*
A01N 47/02	*(2006.01)*
A01N 53/00	*(2006.01)*
A01P 7/00	*(2006.01)*
C07D 417/06	*(2006.01)*
C07D 401/06	*(2006.01)*
C07D 213/76	*(2006.01)*
C07D 213/75	*(2006.01)*
A01N 55/00	*(2006.01)*
A01N 47/40	*(2006.01)*
A01N 43/90	*(2006.01)*
A01N 43/80	*(2006.01)*
A01N 437/07	*(2006.01)*
A01N 43/42	*(2006.01)*
A01N 43/22	*(2006.01)*

(30) Elsőbbségi adatok:
2012044514 **2012. 02. 29.** **JP**

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(54) **Iminopiridin-származékot tartalmazó kártevőellenes készítmény**

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 633 756 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.07.2016 Bulletin 2016/28

(21) Application number: **13157134.1**

(22) Date of filing: **28.02.2013**

(51) Int Cl.:
A01N 43/40 *(2006.01)* ***A01N 31/14*** *(2006.01)*
A01N 37/50 *(2006.01)* ***A01N 43/22*** *(2006.01)*
A01N 43/42 *(2006.01)* ***A01N 43/52*** *(2006.01)*
A01N 43/707 *(2006.01)* ***A01N 43/76*** *(2006.01)*
A01N 43/80 *(2006.01)* ***A01N 43/82*** *(2006.01)*
A01N 43/90 *(2006.01)* ***A01N 47/02*** *(2006.01)*
A01N 47/40 *(2006.01)* ***A01N 53/00*** *(2006.01)*
A01N 55/00 *(2006.01)* ***A01P 7/00*** *(2006.01)*
C07D 401/06 *(2006.01)* ***C07D 213/75*** *(2006.01)*
C07D 213/76 *(2006.01)* ***C07D 417/06*** *(2006.01)*

(54) **PEST CONTROL COMPOSITION COMPRISING AN IMINOPYRIDINE DERIVATIVE**

ZUSAMMENSETZUNG ZUR BEKÄMPFUNG VON SCHÄDLINGEN ENTHALTEND EIN IMINOPYRIDIN DERIVAT

COMPOSITION POUR LA CONTRÔLE DES ORGANISMES NUISIBLES COMPRENANT UN DERIVÉ D'IMINOPYRIDINE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **29.02.2012 JP 2012044514**

(43) Date of publication of application:
04.09.2013 Bulletin 2013/36

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EP-A1- 2 305 658
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EP-A2- 0 432 600
WO-A1-2012/029672

Remarks:
The file contains technical information submitted after the application was filed and not included in this specification

EP 2 633 756 B1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a pest control composition containing an iminopyridine derivative and at least one of other pest control agents.

2. Description of Related Art

[0002] Although numerous pest control agents have been discovered so far, the development of novel drugs which has high safety is still required in view of the problem of reduction in drug sensitivity, the issue of long-term efficacy, safety to workers or safety in terms of environmental impacts. Further, in agriculture, in order to achieve a reduction in labor for the pest control work, it is general to mix a plurality of components of a chemical for pest control and treat seeds or farm products during the growing seedling period with the chemical, and under these circumstances, it is required to use a long-term residual efficacy type chemical having penetrating and migrating property. In addition, it is also possible to solve problems such as scattering of a chemical to the surrounding environment outside agricultural land or exposure to a person who performs pest control by seed treatment or treatment during the growing seedling period.

[0003] European Patent Application Laid-Open No. 432600 discloses a plurality of compounds having the same ring structure as that of a compound represented by Formula (I), but the compounds are used as herbicides and there is no description about pest control.

[0004] Japanese Patent Application Laid-Open (JP-A) No. 5-78323 discloses the structural formula of N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide (Compound No. 3 in Table 1 of JP-A No. 5-78323), but fails to disclose a preparation method thereof and the compound is not included in a list of the group of compounds that are recognized to have pest control activity (Tables 2 and 3 of JP-A No. 5-78323).

[0005] European Patent Application Laid-Open No. 268915 discloses the structural formula of N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide (Example No. 12 in Table 7 of European Patent Application Laid-Open No. 268915), but fails to disclose a preparation method thereof and the Example does not include the compound as an example of the compounds having pest control activity.

[0006] Chemische Berichte (1955), 88, 1103-8 discloses a plurality of compounds having a ring structure similar to that of a compound represented by Formula (I) to be described below, but the compounds are disclosed only as synthetic intermediates.

[0007] European Patent Application Laid-Open No. 259738 discloses a plurality of compounds having a ring structure similar to that of a compound represented by Formula (I), but fails to disclose or suggest a compound having a trifluoroacetic acid imino structure.

[0008] Furthermore, these documents do not describe pest control activity when the iminopyridine derivative of the present invention is mixed with another pest control agent.

SUMMARY OF THE INVENTION

[0009] The present invention is contrived to provide a novel pest control agent to solve problems which chemicals in the related art have, such as reduction in drug sensitivity, long-term efficacy, safety during the use thereof and the like in the field of pest control.

[0010] In order to solve the problems, the present inventors have intensively studies, as a result, have found that a specific iminopyridine derivace has excellent pest control effects against pests and discovered a composition showing excellent pest control effects by containing these iminopyridine derivates and at least one of other pest control agents, compared to when a single agent is used. The present invention is based on the finding.

[0011] Thus, the invention relates to a pest control composition comprising at least one iminopyridine derivative selected from the group consisting of N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide and N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroethanethioamide and an acid addition salt thereof; and at least one other pest control agent,

(i) wherein the other pest control agent is an insecticide and is selected from the group consisting of imidacloprid, clothianidin, dinotefuran, thiamethoxam, pymetrozine, spinosad, fipronil, chloranthraniliprole, cyantraniliprole, ethofenprox, silafluofen, sulfoxaflor, flupyradifurone, flometoquin, emamectin benzoate, cycloxaprid, 1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate and afidopyropen, or an agriculturally and zootechnically acceptable acid addition salt thereof, or

(ii) wherein the other pest control agent is a fungicide selected from the group consisting of azoxystrobin, orysastrobin, thifluzamide, furametpyr, tiadinil, isotianil, diclocymet, tricyclazole, tebufloquin, simeconazole, validamycin, kasugamycin and pencycuron, or

(iii) wherein the other pest control agent is a control agent for animal parasitic pests and is selected from the group consisting of fipronil, imidacloprid, dinotefuran, amitraz, pyriproxyfen, spinosad, or an agriculturally and zootechnically acceptable acid addition salt thereof.

[0012] There is provided a method for protecting useful plants or animals from pests, including: treating pests, useful plants, seeds of useful plants, soil, cultivation carriers or animals as a target with an effective amount of the pest control composition.

[0013] There is provided a use of the pest control composition for protecting useful plants or animals from pests.

DETAILED DESCRIPTION OF EMBODIMENTS

[0014] The iminopyridine derivative used in the invention is selected from the group consisting of N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide (Compound P212) and N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroethanethioamide (Compound 1-20).

[0015] In addition, in the present invention, an acid addition salt of the iminopyridine derivative (preferably, an agriculturally and zootechnically acceptable acid addition salt) may also be used, and examples thereof include an acid addition salt such as hydrochloride, nitrate, sulfate, phosphate, or acetate and the like.

[0016] The iminopyridine derivative itself shows excellent pest control effects against pest insects, and is mixed and used with other pest control agents, thereby showing excellent pest control effects compared to when a single agent is used. Therefore, the present invention provides a pest control composition prepared by containing at least one of iminopyridine derivatives and at least one of other pest control agents. Furthermore, the present invention provides an excellent pest control composition prepared by containing at least one iminopyridine derivatives and at least one of other insecticides and/or fungicides.

[0017] Examples of a pest control composition provided by the present invention include a pest control agent for agricultural and horticultural, a control agent for animal parasitic pests, an agent for controlling hygiene pests, an agent for controlling nuisance pests, an agent for controlling stored grain and stored product pests, an agent for controlling house pests and the like, preferred examples thereof include a pest control agent for agricultural and horticultural and a control agent for animal parasitic pests.

[0018] Examples of the insect species against which a pest control composition containing an iminopyridine derivative or at least one of acid addition salts thereof, and at least one of other pest control agents shows pest control effects include lepidopteran pests (for example, Spodoptera litura, cabbage armyworm, Mythimna separata, cabbageworm, cabbage moth, Spodoptera exigua, rice stem borer, grass leaf roller, tortricid, codling moth, leafminer moth, tussock moth, Agrotis spp), Helicoverpa spp, Heliothis spp and the like), hemipteran pests (for example, aphids (Aphididae, Adelgidae, Phylloxeridae) such as Myzus persicae, Aphis gossypii, Aphis fabae, corn leaf aphid, pea aphid, Aulacorthum solani, Aphis craccivora, Macrosiphum euphorbiae, Macrosiphum avenae, Methopolophium dirhodum, Rhopalosiphum padi, greenbug, Brevicoryne brassicae, Lipaphis erysimi, Aphis citricola, Rosy apple aphid, apple blight, Toxoptera aurantii and Toxoptera citricidus, leafhoppers such as Nephotettix cincticeps and Empoasca vitis, planthoppers such as Laodelphax striatellus, Nilaparvata lugens and Sogatella furcifera, Pentatomorpha such as Eysarcoris ventralis, Nezara viridula and Trigonotylus coelestialium, whiteflies (Aleyrodidae) such as silverleaf whitefly, Bemisia tabaci and greenhouse whitefly, and scale insects (Diaspididae, Margarodidae, Ortheziidae, Ac1erdiae, Dactylopiidae, Kerridae, Pseudococcidae, Coccidae, Eriococcidae, Asterolecaniidae, Beesonidae, Lecanodiaspididae, Cerococcidae and the like) such as Pseudococcus comstocki, Planococcus citri, Pseudaulacaspis pentagona and Aonidiella aurantii), coleopteran pests (for example, Lissorhoptrus oryzophilus, Callosobruchus chinensis, Tenebrio molitor, Diabrotica virgifera virgifera, Diabrotica undecimpunctata howardi, Anomala cuprea, Anomala rufocuprea, Phyllotreta striolata, Aulacophora femoralis, Leptinotarsa decemlineata, Oulema oryzae, Bostrichidae, Cerambycidae and the like), Acarina (for example, Tetranychus urticae, Tetranychus kanzawai, Panonychus citri and the like), hymenopteran pests (for example, Tenthredinidae), orthopteran pests (for example, Acridioidea), dipteran pests (for example, Agromyzidae), thysanopteran pests (for example, Thrips palmi, Frankliniella occidentalis and the like), phytoparasitic nematode (for example, Meloidogyne, Pratylenchus, Aphelenchoides besseyi, Bursaphelenchus xylophilus and the like), and the like, examples of zooparasites include Ixodidae (for example, Amblyomma americanum, Amblyomma maculatum, Boophilus microplus, Dermacentor andersoni, Dermacentor occidentalis, Dermacentor variabilis, Haemaphysalis campanulata, Haemaphysalis flava, Haemaphysalis longicornis, Haemaphysalis megaspinosa Saito, Ixodes nipponensis, Ixodes ovatus, Ixodes pacifcus, Ixodes persulcatus, Ixodes ricinus, Ixodes scapularis, Ornithodoros moubata pacifcus and Rhipicephalus sanguineus), Cheyletidae (for example, Cheyletiella blakei and Cheyletiella yasguri), Demodex (for example, Demodex canis and

Demodex cati), Psoroptidae (for example, Psoroptes communis), Sarcoptidae (for example, Chorioptes bovis and Otodectes cynotis), Dermanyssidae (for example, Ornithonyssus sylviarum), Dermanyssus gallinae, Pterolichus (for example, Megninia cubitalis and Pterolichus obtusus), Trombiculidae (for example, Helenicula miyagawai and Leptotrombidium akamushi), Shiphonaptera (for example, Ctenocephalides felis, Pulex irritans, Xenopsylla cheopis and Xenopsylla), Mallophaga (for example, Trichodectes canis and Menopon gallinae), Anoplura (for example, Haematopinus suis, Linognathus setosus, Pediculus humanus humanus, Pediculus humanus, Pthirus pubis and Cimex lectularius), Diptera (for example, Musca domestica, Hypoderma bovis, Stomoxys calcitrans and Gasterophilus), Psychodidae (for example, Phlebotomus), Glossina morsitans, Tabanidae, Ormosia tokionis (for example, Aedes albopictus and Aedes aegypti), Culicidae (for example, Culex pipiens pallens), Anophelini, Ceratopogonidae and the like), Simuliidae, Ceratopogonidae, Reduviidae, Monomorium pharaonis, Nematoda (for example, Strongyloides, Ancylostomatoidea, Strongyloidea (for example, Haemonchus contortus and Nippostrongylus braziliensis), Trichostrongyloidea, Metastrongyloidea (for example, Metastrongylus elongatus, Angiostrongylus cantonensis and Aelurostrongylus abstrutus), Oxyuroidea, Haterakoidea (for example, Ascaridia galli), Ascaridoidea (for example, Anisakis simplex, Ascaris suum, Parascaris equorum, Toxocara canis and Toxocara cati), Spiruroidea (for example, Subuluroidea, Gnathostoma spinigerum, Physaloptea praeputialis, Ascarops strongylina, Draschia megastoma and Ascaria hamulosa, Dracunculus medinensis), Filarioidea (for example, Dirofilaria immitis, lymphatic filarial, Onchocerca volvulus and Loa loa), Dioctophymatoidea, Trichinella (for example, Trichuris vulpis and Trichinella spiralis), Trematoda (for example, Schistosoma japonicum and Fasciola hepatica), Acanthocephala, Taenia (for example, Pseudophyllidea (for example, Spirometra erinaceieuropaei) and Cyclophyllidea (for example, Dipylidium caninum)), Protozoa, and the like, and examples of hygiene pests include Periplaneta (for example, Blattella germanica), Acaridae (for example, Tyrophagus putrescentiae), and Isoptera (for example, Coptotermes formosanus). Among them, preferred examples of an insect species, to which the pest control agent of the present invention is applied, include lepidopteran pests, hemipteran pests, thysanopteran pests, dipteran pests, coleopteran pests, zooparasitic Shiphonaptera or Acari, Dirofilaria immitis, Periplaneta and Isoptera (for example, at least one insect species selected from the group consisting of cabbage moth, Spodoptera litura, Aphis gossypii, Myzus persicae, Laodelphax striatellus, Nilaparvata lugens, Sogatella furcifera, Nephotettix cincticeps, Frankliniella occidentalis, Aulacophora femoralis, Oulema oryzae, Lissorhoptrus oryzophilus, Trigonotylus coelestialium, Musca domestica, Haemaphysalis longicornis, Dirofilaria immitis, Blattella germanica and Coptotermes formosanus), and particularly preferred examples thereof include cabbage moth, Aphis gossypii, Myzus persicae, Laodelphax striatellus, Nilaparvata lugens, Sogatella furcifera, Nephotettix cincticeps, Aulacophora femoralis, Oulema oryzae, Lissorhoptrus oryzophilus, Trigonotylus coelestialium, Musca domestica and Haemaphysalis longicornis.

[0019] In the present specification, examples of other pest control agents which may be mixed with the iminopyridine derivative include an insecticide, a fungicide, a miticide, a herbicide, a plant growth regulator and a control agent for animal parasites, and examples of a specific chemical include those described in The Pesticide Manual (13th edition and published by the British Crop Protection Council) and the SHIBUYA INDEX (15th edition, 2010 and published by SHIBUYA INDEX RESEARCH GROUP).

[0020] Examples of other pest control agents which may be mixed with the iminopyridine derivative preferably include an insecticide, a fungicide, a herbicide and a control agent for animal parasitic pests, and also those prepared by mixing a fungicide with an insecticide.

[0021] The other pest control agent includes imidacloprid, clothianidin, dinotefuran, thiamethoxam, pymetrozine, spinosad, fipronil, cloranthraniliprole, cyantraniliprole, ethofenprox, silafluofen, sulfoxaflor, flupyradifurone, flometoquin, emamectin benzoate, cycloxaprid, cycloxaprid, 1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate and afidopyropen, or an agriculturally and zootechnically acceptable acid addition salt thereof, as an insecticide; azoxystrobin, orysastrobin, thifluzamide, furametpyr, tiadinil, isotianil, diclocymet, tricyclazole, tebufloquin, simeconazole, validamycin, kasugamycin and pencycuron, as a fungicide; and fipronil, imidacloprid, dinotefuran, amitraz, pyriproxyfen, spinosad, or an agriculturally and zootechnically acceptable acid addition salt thereof, as a control agent for animal parasitic pests.

[0022] The pest control composition of the present invention may be prepared using the iminopyridine derivative other insecticides, fungicides, herbicides, or control agents for animal parasites, and an agriculturally and zootechnically acceptable carrier (solid carrier, liquid carrier, gaseous carrier, surfactant, dispersant, and other preparation adjuvants).

(Specific examples of pesticide preparations)

[0023] When the pest control composition of the present invention is a pest control agent for agricultural and horticultural, the composition is usually mixed with an agriculturally and horticulturally acceptable carrier (solid carrier, liquid carrier, gaseous carrier, surfactant, dispersant and other adjuvants for preparation to be provided in any formulation form of emulsifiable concentrates, liquid formulations, suspensions, wettable powders, flowables, dust, granules, tablets, oils, aerosols, fumigants and the like.

[0024] Examples of the solid carrier include talc, bentonite, clay, kaolin, diatomaceous earth, vermiculite, white carbon,

calcium carbonate and the like.

[0025] Examples of the liquid carrier include alcohols such as methanol, n-hexanol and ethylene glycol, ketones such as acetone, methyl ethyl ketone and cyclohexanone, aliphatic hydrocarbons such as n-hexane, kerosene and lamp oil, aromatic hydrocarbons such as toluene, xylene and methyl naphthalene, ethers such as diethyl ether, dioxane and tetrahydrofuran, esters such as ethyl acetate, nitriles such as acetonitrile and isobutyl nitrile, acid amides such as dimethylformamide and dimethylacetamide, vegetable oils such as soybean oil and cottonseed oil, dimethyl sulfoxide, water and the like.

[0026] Further, examples of the gaseous carrier include LPG, air, nitrogen, carbonic acid gas, dimethyl ether and the like.

[0027] As the surfactant or dispersant for emulsification, dispersion, spreading and the like, it is possible to use, for example, alkylsulfate esters, alkyl (aryl) sulfonates, polyoxyalkylene alkyl (aryl) ethers, polyhydricalcohol esters, lignin sulfonates or the like.

[0028] In addition, as the adjuvant for improving the properties of the preparation, it is possible to use, for example, carboxymethylcellulose, gum arabic, polyethylene glycol, calcium stearate or the like.

[0029] The aforementioned solid carriers, liquid carriers, gaseous carriers, surfactants, dispersants and adjuvants may be used either alone or in combination, if necessary.

[0030] The content of active ingredients in the preparation is not particularly limited, but is usually in the range of 1 to 75% by weight for the emulsifiable concentrate, 0.3 to 25% by weight for the dust, 1 to 90% by weight for the wettable powder, and 0.5 to 10% by weight for the granular formulation.

[0031] The iminopyridine derivatives a preparation including the same and a mixed formulation of other pest control agents with the same may be applied to pest insects, plants, plant propagation materials (for example, seeds, plant leaves and stems, roots, soil, water surface and materials for cultivation), rooms which require disturbing the invasion of pests and the like. The application thereof may be performed before and after the invasion of pests.

[0032] A pest control agent including at least one of the iminopyridine derivatives may also be applied to genetically-modified crops.

[0033] In a preferred aspect thereof, examples of a pest control composition further including an agriculturally and horticulturally acceptable carrier include:

(1) a wettable powder composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 0.6 to 30% by weight of a wetting agent and a dispersant, and 20 to 95% by weight of an extender,

(2) a water dispersible granule composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 0.6 to 30% by weight of a wetting agent, a dispersant and a binder, and 20 to 95% by weight of an extender,

(3) a flowable composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 5 to 40% by weight of a dispersant, a thickener, an antifreeze, an antiseptic and an antifoaming agent, and 20 to 94% by weight of water,

(4) an emulsifiable concentrate composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 1 to 30% by weight of an emulsifier and an emulsion stabilizer, and 20 to 97% by weight of an organic solvent,

(5) a dust composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, and 70 to 99.8% by weight of an extender,

(6) a low drift dust composition containing 0.1 to 80% by weight of the iminopyridine derivative 0.1 to 80% by weight of an insecticide as another pest control agent, and 70 to 99.8% by weight of an extender,

(7) a microgranule fine composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 0.2 to 10% by weight of a solvent or binder, and 70 to 99.6% by weight of an extender,

(8) a granule composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 0.5 to 30% by weight of a granulation auxiliary (surfactant) and a binder, and 20 to 98% by weight of an extender, and

(9) a microcapsule composition containing 0.1 to 80% by weight of the iminopyridine derivative, 0.1 to 80% by weight of an insecticide as another pest control agent, 1 to 50% by weight of a covering agent, an emulsifier, a dispersant and an antiseptic, and 20 to 98% by weight of water. Preferably, examples thereof include compositions of (2), (3), (6) and (8).

(Specific examples of formulations for animals)

[0034] When the pest control agent of the present invention is a control agent for animal parasitic pests, the agent is

provided in the form of liquid formulations, emulsifiable concentrates, liquid drops, sprays, foam preparations, granules, fine granules, dust, capsules, pills, tablets, chewable formulations, injections, suppositories, creams, shampoos, rinses, resin agents, fumigants, poison baits and the like, and is particularly preferably provided in the form of liquid formulations and liquid drops. These forms can be prepared using the following pharmaceutically acceptable carriers.

[0035] The liquid formulation may also be blended with a typical adjuvant for preparation, such as an emulsifier, a dispersant, a spreading agent, a wetting agent, a suspending agent, a preservative and a propellant, and may also be blended with a typical film former. As the surfactant for emulsification, dispersion, spreading and the like, it is possible to use, for example, soaps, polyoxyalkylene alkyl (aryl) ethers, polyoxyethylene alkyl aryl ethers, polyoxyethylene fatty acid ester, higher alcohols, alkyl aryl sulfonates and the like. Examples of dispersants include casein, gelatin, polysaccharides, lignin derivatives, saccharides, synthetic water soluble polymers and the like. Examples of spreading·wetting agents include glycerin, polyethylene glycol and the like. Examples of suspending agents include casein, gelatin, hydroxypropylcellulose, gum arabic and the like, and examples of stabilizers include phenolic antioxidants (BHT, BHA and the like), amine antioxidants (diphenylamine and the like), organic sulfur antioxidants and the like. Examples of preservatives include methyl p-oxybenzoate, ethyl p-oxybenzoate, propyl p-oxybenzoate, butyl p-oxybenzoate and the like. The aforementioned carriers, surfactants, dispersants and adjuvants may be used either alone or in combination, if necessary. Furthermore, perfumes, synergists and the like may also be incorporated. The suitable content of the active ingredients in the pest control agent of the present invention is usually 1 to 75% by weight for the liquid formulation.

[0036] Examples of carriers used for the preparation of creams include non-volatile hydrocarbons (liquid paraffin and the like), lanolin hydrogenated fats and oils, higher fatty acids, fatty acid esters, animal and vegetable oils, silicone oils, water and the like. Further, emulsifiers, humectants, antioxidants, perfumes, borax and ultraviolet absorbers may also be used either alone or in combination, if necessary. Examples of emulsifiers include fatty acid sorbitan, polyoxyethylene alkyl ethers, and fatty acid polyoxyethylene and the like. The suitable content of the active ingredients in the pest control agent of the present invention is usually 0.5 to 75% by weight for the cream.

[0037] The capsules, pills or tablets may be used such that the active ingredients in the composition of the present invention are mixed with a carrier such as starch, lactose or talc, a disintegrator and/or a binder, such as magnesium stearate is added thereto, and, if necessary, the mixture is tableted.

[0038] Carriers for the preparation of injections need to be prepared as an aseptic solution, but the solution may contain other substances, for example, a salt or glucose enough to isotonicate the solution with blood. As available carriers, "injections need to be prepared as an aseptic solution. For injections, the solution may contain, for example, a salt or glucose enough to isotonicate the solution with blood. Examples of available carriers for the preparation of injections include esters such as fatty acid derivatives of glyceride, benzyl benzoate, isopropyl myristate and propylene glycol, and organic solvents such as N-methylpyrrolidone and glycerol formal. The content of the active ingredients in the pest control agent of the present invention is usually 0.01 to 10% by weight for the injection.

[0039] Examples of carriers for the preparation of resin agents include vinyl chloride polymers, polyurethane and the like. Plasticizers such as phthalic acid esters, adipic acid esters and stearic acid may be added to these bases, if necessary. After the active ingredients are kneaded into the base, the kneaded product may be molded by injection molding, extrusion molding, press molding and the like. In addition, the molded product may also be properly subjected to processes such as molding or cutting to form an ear tag for animals or insecticidal collar for animals.

[0040] Examples of carriers for toxic baits include bait substances and attraction substances (farina such as wheat flour and corn flour, starch such as corn starch and potato starch, saccharides such as granulated sugar, malt sugar and honey, food flavors such as glycerin, onion flavor and milk flavor, animal powders such as pupal powder and fish powder, various pheromones and the like). The suitable content of the active ingredients in the pest control agent of the present invention is usually 0.0001 to 90% by weight for the toxic bait.

[0041] The pest control composition according to the present invention may be used such that a preparation form prepared by independently including at least one of the iminopyridine derivative as the active ingredient in the composition, or acid addition salts thereof and at least one of other pest control agents as specified before alone is formulated and these ingredients when used are mixed on the spot.

[0042] Therefore, according to another aspect of the present invention, there is provided a combined product prepared by including at least one of the iminopyridine derivative as the active ingredient or acid addition salts thereof and at least one of other pest control agents as specified in claim 1.

[0043] According to another preferred aspect of the present invention, in the combined product, the iminopyridine derivative or acid addition salts thereof is provided as a first composition prepared by including the same as active ingredients, and other pest control agents is provided as a second composition prepared by including the same as active ingredients. In this case, the first composition and the second composition may be any formulation form which uses appropriate carriers or adjuvants in combination thereof in the same manner as in the case of the aforementioned pest control composition. The combined product may be provided in the form of a pharmaceutical set.

[0044] According to still another aspect of the present invention, there is provided a method for protecting useful plants or animals from pests, including: simultaneously or independently (preferably, each ingredient simultaneously) applying

at least one of the iminopyridine derivative, enantiomers thereof, mixtures thereof or acid addition salts thereof as an active ingredient and at least one of other pest control agents to a region to be treated.

[0045] In the method, "simultaneously" applying also includes mixing at least one of the iminopyridine derivative or acid addition salts thereof and at least one of other pest control agents before being applied to a region to be treated, and applying the mixture thereto. "Independently" applying includes, without mixing these ingredients in advance, applying the iminopyridine derivative or acid addition salts thereof earlier than the other ingredients, or applying the iminopyridine derivative or acid addition salts thereof later than the other ingredients.

[0046] According to still another preferred aspect of the present invention,
there is provided a method for protecting useful plants or animals from pests, including: applying

(1) a first composition prepared by including at least one of the iminopyridine derivative represented by Formula (I) or acid addition salts thereof as an active ingredient, and
(2) a second composition prepared by including at least one of other pest control agents as an active ingredient to a region to be treated.

[0047] According to yet another aspect of the present invention, there is provided a method for protecting useful plants from pests, including: applying the composition or combined product of the present invention as it is or diluted to pests, useful plants, seeds of useful plants, soil, cultivation carriers or animals as a target, and preferably to useful plants, soil or animals.

[0048] According to still yet another aspect of the present invention, there is provided a use of the composition or combined product of the present invention in order to protect useful plants or animals from pests.

[0049] Furthermore, preferred examples of the method for applying the composition or combined product of the present invention to pests, useful plants, seeds of useful plants, soil or cultivation carriers as a target include spray treatment, water surface treatment, soil treatment (mixing, irrigation and the like), nursery box treatment, surface treatment (application, dust coating and covering) or fumigation treatment (treatment in enclosed space, such as covering soil with a polyfilm after soil injection) and the like, and more preferred examples include water surface treatment, soil treatment, nursery box treatment or surface treatment.

[0050] The throughput in the case of application to plants by spray treatment is 0.1 g to 10 kg per 10 ares of cultivated land and preferably 1 g to 1 kg, as an amount of active ingredients of the composition of the present invention.

[0051] Further, examples of a method for treating seeds, roots, tubers, bulbs or rhizomes of plants include a dipping method, a dust coating method, a smearing method, a spraying method, a pelleting method, a coating method and a fumigating method for the seed. The dipping method is a method in which seeds are dipped in a liquid chemical solution, and the dust coating method is classified into a dry dust coating method in which a granular chemical is adhered onto dry seeds, and a wet dust coating method in which a powdery chemical is adhered onto seeds which have been slightly soaked in water. In addition, the smearing method is a method in which a suspended chemical is applied on the surface of seeds within a mixer and the spraying method is a method in which a suspended chemical is sprayed onto the surface of seeds. Furthermore, the pelleting method is a method in which a chemical is mixed with a filler and treated when seeds are pelleted together with the filler to form pellets having certain size and shape, the coating method is a method in which a chemical-containing film is coated onto seeds, and the fumigating method is a method in which seeds are sterilized with a chemical which has been gasified within a hermetically sealed container.

[0052] Examples of the preferred treatment method of the composition of the present invention include a dipping method, a dust coating method, a smearing method, a spraying method, a pelleting method and a coating method.

[0053] Further, the composition of the present invention may also be used to, in addition to seeds, germinated plants which are transplanted after germination or after budding from soil, and embryo plants. These plants may be protected by the treatment of the whole or a part thereof by dipping before transplantation.

[0054] The throughput in the case of application to seeds of plants is not particularly limited, but preferably 1 g to 10 kg and more preferably 100 g to 1 kg per 100 kg of seeds, as an amount of active ingredients of the composition of the present invention.

[0055] In addition, the method for application of the composition of the present invention to soil is not particularly limited, but preferred application methods are as follows.

[0056] Examples of the method include a method in which granules including the composition of the present invention are applied into soil or on soil. Particularly preferred soil application methods include spraying, stripe application, groove application, and planting hole application.

[0057] Furthermore, application by irrigating soil with a solution prepared by emulsifying or dissolving the composition of the present invention in water is also a preferred soil application method.

[0058] Besides these methods, examples of preferred soil application methods include application into a nutrient solution in nutrient solution culture systems such as solid medium culture, for example, hydroponic culture, sand culture, NFT (nutrient film technique), rock wool culture and the like for the production of vegetables and flowering plants, or

application into a nursery box for paddy rice seedling (mixing with bed soil and the like). The compound of the present invention may be applied directly to artificial culture soil including vermiculite and a solid medium including an artificial mat for growing seedling.

[0059] The throughput of the composition of the present invention into water surface, a nursery box or soil is not particularly limited, but is 0.1 g to 10 kg of preferably active ingredients per 10 ares of cultivated land and preferably 1 g to 1 kg. Further, as the method for applying the composition or combined product of the present invention to an applied organism, it is possible to control pests by administering the pest control composition of the present invention into the applied organism either orally or by injection, wholly or partly administering the composition into the body surface of an applied animal, or mounting the pest control agent formulated into a resin preparation or sheet preparation on the applied organism. In addition, it is also possible to control pests by covering places in which the invasion, parasitism and movement of pests are expected with the pest control composition of the present invention.

[0060] The pest control composition of the present invention may be used as it is, but may be diluted with water, liquid carriers, commercially available shampoos, rinses, baits, breed cage bottoms and the like and applied in some cases. When the pest control composition of the present invention is diluted with a dilution liquid (water) such as an emulsifiable concentrate, a flowable and a wettable powder and used, the amount is not particularly limited, but, preferably, the composition is applied by diluting the composition in water and spraying the mixture such that the concentration of active ingredients is 10 to 10,000 ppm. Furthermore, when the pest control composition of the present invention is administered to a target organism, the administration amount thereof is not particularly limited, but when the composition is percutaneously applied, the amount of the composition is preferably in a range from 0.01 to 500 mg per 1 kg of the body weight of the target organism. When the composition is orally administered, the amount of the composition is in a range from 0.01 to 100 mg per 1 kg of the body weight of the target organism. When a resin preparation is mounted on the target organism, the amount of the composition contained in the resin preparation is preferably in a range from 0.01 to 50% by weight per weight of the resin preparation.

[Examples]

[0061] Hereinafter, the present invention will be specifically described with reference to the Examples.

Synthetic Example P1: N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide (Compound P212)

[0062]

(1) 25 g (270 mmol) of 2-aminopyridine was dissolved in 200 ml of anhydrous dichloromethane, 41 ml (30 g, 300 mmol) of triethylamine was added thereto, and the mixture was cooled to 0°C. 38 ml (57 g, 270 mmol) of anhydrous trifluoroacetic acid was added dropwise thereto over 15 minutes, and the resulting mixture was stirred at room temperature for 2 hours. After the reaction was completed, the reaction solution was injected into about 100 ml of iced water, and the mixture was stirred for 10 minutes. The mixture was transferred to a separatory funnel to perform liquid separation, and the organic layer was washed twice with 150 ml of water and twice with 150 ml of a 1% HCl aqueous solution, dried over anhydrous magnesium sulfate and concentrated under reduced pressure to obtain 36 g (yield 71%) of 2,2,2-trifluoro-N-(pyridin-2(1H)-ylidene)acetamide.
1H-NMR (CDCl3, δ, ppm): 7.20(1H, ddd), 7.83(1H, td), 8.20(1H, d), 8.35(1H, d), 10.07(1H, brs)
13C-NMR (CDCl3, δ, ppm): 115.3, 115.5(q), 121.6, 139.1, 147.9, 149.5, 155.3(q)
MS: m/z = 191(M+H)

(2) 20 g (126 mmol) of 2-chloro-5-chloromethyl pyridine was dissolved in 200 ml of anhydrous acetonitrile, 24 g (126 mmol) of 2,2,2-trifluoro-N-(pyridin-2(1H)-ylidene)acetamide obtained by the above-described method and 21 g (151 mmol) of potassium carbonate were added thereto, and the resulting mixture was heated and refluxed for 6 hours, and then stirred at room temperature for 10 hours. After the reaction was completed, the reaction solution was filtered and the liquid was concentrated under reduced pressure. Diethyl ether was added thereto for crystallization, and the crystals thus obtained were collected and washed well with diethyl ether and water.

[0063] The crystals thus obtained were dried under reduced pressure at 60°C for 1 hour to obtain the subject material. Amount obtained 26 g (yield 66%).

1H-NMR (CDCl3, δ, ppm): 5.57(2H, s), 6.92(1H, td), 7.31(1H, d), 7.80(1H, td), 7.87(1H, dd), 7.99(1H, dd), 8.48(2H, m)
13C-NMR (CDCl3, δ, ppm): 53.8, 115.5, 117.2(q), 122.1, 124.7, 130.0, 139.2, 140.0, 142.5, 149.7, 151.8, 158.9, 163.5(q)
MS: m/z = 316(M+H)

(3) Powder X-ray crystal analysis

[0064] In the powder X-ray diffraction, measurement was performed under the following conditions.

Device name: RINT-2200 (Rigaku Corporation)
X-ray: Cu-Kα (40 kV, 20 mA)
Scanning range: 4 to 40°, sampling width: 0.02° and scanning rate: 1°/min

[0065] The results are as follows.

Diffraction angle (2θ) 8.7°, 14.2°, 17.5°, 18.3°, 19.8°, 22.4°, 30.9° and 35.3°

(4) Differential Scanning Calorimetry (DSC)

[0066] In the differential scanning calorimetry, measurement was performed under the following conditions.

Device name: DSC-60
Sample cell: aluminum
Temperature range: 50°C to 250°C (heating rate: 10°C/min)

[0067] As a result, the melting point was observed at 155°C to 158°C.

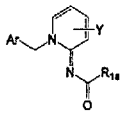
Another method of Synthetic Example P1

[0068] 3.00 g (18.6 mmol) of 2-chloro-5-chloromethyl pyridine was dissolved in 20 ml of anhydrous DMF, 1.75 g (18.6 mmol) of 2-aminopyridine was added thereto, and the resulting mixture was stirred at 80°C for 8 hours and at room temperature for 5 hours. After the reaction was completed, DMF was distilled off under reduced pressure, acetonitrile was added thereto to precipitate a solid, and the solid was collected, washed well with acetonitrile and dried to obtain 2.07 g (yield 44%) of 1-[(6-chloropyridin-3-yl)methyl]pyridin-2(1H)-imine hydrochloride.

1H-NMR (DMSO-d6, δ, ppm): 5.65(2H, s), 6.96(1H, t), 7.23(1H, m), 7.57(1H, d), 7.80(1H, m), 7.91(1H, m), 8.28(1H, m), 8.49(1H, d), 9.13(2H, brs)

[0069] 50 mg (0.20 mmol) of the 1-[(6-chloropyridin-3-yl)methyl]pyridin-2(1H)-imine hydrochloride obtained by the above-described method was dissolved in 5 ml of anhydrous dichloromethane, 122 mg (1.00 mmol)of DMAP and 50 mg (0.24 mmol) of anhydrous trifluoroacetic acid were added thereto in sequence under ice cold conditions, and the resulting mixture was stirred at room temperature for 1 hour. After the reaction was completed, the reaction solution was diluted with dichloromethane, washed with 1% hydrochloric acid, and then dried over anhydrous magnesium sulfate. Dichloromethane was distilled off under reduced pressure to obtain the subject material. Amount obtained 42 mg (yield 67%). NMR was the same as that of the above-described method.

[Table 40-1]

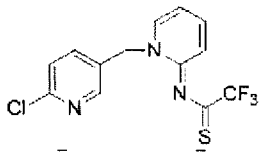


Comp ound No.	Ar	R1a	Y	^{1}H-NMR (CDCl3, δ, ppm)	IR (KBr, v, cm^{-1}) or MS
P212	6-chloro-3-pyridyl	CF3	H	5.57 (2H, s), 6.92 (1H, td), 7.31 (1H, d), 7.80 (1H, td), 7.87 (1H, dd), 7.99 (1H, dd), 8.48 (2H, m)	m/z = 316 (M+H)

Synthetic Example 4: N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroethanethioamide (Compound 1-20)

[0070]

[Chemical Formula 49]



(1) 25 g (270 mmol) of 2-aminopyridine was dissolved in 200 ml of anhydrous dichloromethane, 41 ml (30 g, 300 mmol) of triethylamine was added thereto, and the mixture was cooled to 0°C. 38 ml (57 g, 270 mmol) of anhydrous trifluoroacetic acid was added dropwise thereto over 15 minutes, and the resulting mixture was stirred at room temperature for 2 hours. After the reaction was completed, the reaction solution was injected into about 100 ml of iced water, and the mixture was stirred for 10 minutes.

The mixture was transferred to a separatory funnel to perform liquid separation, and the organic layer was washed twice with 150 ml of water and twice with 150 ml of a 1% HCl aqueous solution, dried over anhydrous magnesium sulfate and concentrated under reduced pressure to obtain 36 g (yield 71%) of 2,2,2-trifluoro-N-(pyridin-2(1H)-ylidene)acetamide.

1H-NMR (CDCl3, δ, ppm): 7.20(1H, m), 7.83(1H, m), 8.20(1H, d), 8.35(1H, d), 10.07(1H, brs)

13C-NMR (CDCl3, δ, ppm): 115.3, 115.5(q), 121.6, 139.1, 147.9, 149.5, 155.3(q)

(2) 20 g (126 mmol) of 2-chloro-5-chloromethyl pyridine was dissolved in 200 ml of anhydrous acetonitrile, 24 g (126 mmol) of 2,2,2-trifluoro-N-(pyridin-2(1H)-ylidene)acetamide obtained by the above-described method and 21 g (151 mmol) of potassium carbonate were added thereto, and the resulting mixture was heated and refluxed for 6 hours, and then stirred at room temperature for 10 hours. After the reaction was completed, the reaction solution was filtered and the filtrate was concentrated under reduced pressure. Diethyl ether was added thereto for crystallization, and the crystals thus obtained were collected and washed well with diethyl ether and water.

The crystals thus obtained were dried under reduced pressure at 60°C for 1 hour to obtain N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide (P212). Amount obtained 26 g (yield 66%).

1H-NMR (CDCl3, δ, ppm): 5.57(2H, s), 6.92(1H, td), 7.31(1H, d), 7.80(1H, td), 7.87(1H, dd), 7.99(1H, dd), 8.48(2H, m)

13C-NMR (CDCl3, δ, ppm): 53.8, 115.5, 117.2(q), 122.1, 124.7, 130.0, 139.2, 140.0, 142.5, 149.7, 151.8, 158.9, 163.5(q)

MS: m/z = 316(M+H)

(3) 180 ml of toluene was added to 16.3 g (36.7 mmol) of phosphorus pentasulfide, 6.72 g (63.4 mmol) of sodium carbonate was added thereto and the resulting mixture was stirred at room temperature for 5 minutes. 20.0 g (63.4 mmol) of the N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide obtained by the above-described method was added thereto, and the resulting mixture was stirred at 50°C for 19 hours. 150 ml of ethyl acetate was added to the reaction solution, the resulting mixture was stirred at 50°C for 10 minutes, then insoluble materials were filtered off, and 250 ml of ethyl acetate was used to wash the mixture. The mixture was transferred to a separatory funnel, washed therein with 300 ml of a saturated sodium bicarbonate water and 200 ml of a saturated saline solution, and then concentrated under reduced pressure. 200 ml of water was added thereto to precipitate crystals. The mixture was stirred at room temperature for 1 hour, and then the crystals were collected, subjected to slurry washing twice with 150 ml of water and twice with 150 ml of hexane, and dried at 60°C under reduced pressure for 2 hours to obtain the subject material. Amount obtained 19.5 g (yield 94%).

1H-NMR (CDCl3, δ, ppm): 5.48(2H, s), 7.12(1H, td), 7.34(1H, d), 7.77(1H, dd), 7.96(1H, m), 8.05(1H, dd), 8.45(1H, d), 8.56(1H, d)

MS: m/z = 332(M+H)

[0071] The compounds shown in the following Table were prepared by the method in accordance with Synthetic Examples 1 to 4.

[Table 42-3]

1-20	20.0 g (63.4 mmol) of N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide	16.3 g (36.7 mmol) of phosphorus pentasulfide	6.72 mg (63.4 mmol) of sodium carbonate	Toluene	50°C, 19h	D	94

[Table 43-2]

3-3	116 mg (0.72 mmol) of 2-fluoro-5-(bromomethyl)pyridine	116 mg (0.68 mmol) of 2,2-difluoro-N-(pyridin-2(1H)-ylidene))acetamide	110 mg (0.80 mmol) of potassium carbonate	Acetonitrile	reflux, 6h	A	27

[Table 49-1]

Compound No.	1H-NMR (CDCl3, δ, ppm)	MS or IR (KBr, v, cm^{-1})
1-20	5.48 (2H, s), 7.12 (1H, td), 7.34 (1H, d), 7.77 (1H, dd), 7.96 (1H, m), 8.05 (1H, dd), 8.45 (1H, d), 8.56 (1H, d)	m/z = 332 (M+H)

[0072] Preparation Example

[Preparation Example]

[0073]

Preparation Example 1 [Wettable powder]

Compound P212	10% by weight
Imidacloprid	20% by weight
Clay	50% by weight
White carbon	2% by weight
Diatomaceous earth	13% by weight
Calcium ligninsulfonate	4% by weight
Sodium lauryl sulfate	1% by weight

[0074] The ingredients were homogeneously mixed and ground to obtain wettable powder.

Preparation Example 2 [Water dispersible granule]

Compound P212	10% by weight
Imidacloprid	20% by weight
Clay	60% by weight
Dextrin	5% by weight
Alkyl maleate copolymer	4% by weight
Sodium lauryl sulfate	1% by weight

[0075] The ingredients were homogeneously ground and mixed, water was added thereto to knead the ingredients thoroughly and then the mixture was granulated and dried to obtain water dispersible granules.

Preparation Example 3 [Flowables]

Compound 1-20	5% by weight
Imidacloprid	20% by weight
POE polystyrylphenyl ether sulfate	5% by weight
Propylene glycol	6% by weight
Bentonite	1% by weight
1% xanthan-gum aqueous solution	3% by weight
PRONALEX-300 (TOHO Chemical Industry Co., Ltd.)	0.05% by weight
ADDAC827 (KI Chemical Industry Co., Ltd.)	0.02% by weight
Water	added to 100% by weight

[0076] All the ingredients except for the 1% xanthan-gum aqueous solution and a suitable amount of water were premixed together from the blending, and the mixture was then ground by a wet grinder. Thereafter, the 1% xanthan-gum aqueous solution and the remaining water were added thereto to obtain 100% by weight of flowables.

Preparation Example 4 [Emulsifiable concentrate]

Compound P212	2% by weight
Imidacloprid	13% by weight

(continued)

N,N-dimethylformamide	20% by weight
Solvesso 150 (Exxon Mobil Corporation)	55% by weight
Polyoxyethylene alkyl aryl ether	10% by weight

[0077] The ingredients were homogeneously mixed and dissolved to obtain an emulsifiable concentrate.

Preparation Example 5 [Dust]

Compound P212	0.5% by weight
Imidacloprid	1.5% by weight
Clay	60% by weight
Talc	37% by weight
Calcium stearate	1% by weight

[0078] The ingredients were homogeneously mixed to obtain dust.

Preparation Example 6 [DL Dust]

Compound P212	1% by weight
Tebufloquin	1% by weight
Ethofenprox	1% by weight
DL clay	94.5% by weight
White carbon	2% by weight
Light liquid paraffin	0.5% by weight

[0079] The ingredients were homogeneously mixed to obtain dust.

Preparation Example 7 [Microgranule fine]

Compound P212	1% by weight
Imidacloprid	1% by weight
Carrier	94% by weight
White carbon	2% by weight
Hisol SAS-296	2% by weight

[0080] The ingredients were homogeneously mixed to obtain dust.

Preparation Example 8 [Granules]

Compound 1-20	2% by weight
Chlorantraniliprole	1% by weight
Bentonite	39% by weight
Talc	10% by weight
Clay	46% by weight
Calcium ligninsulfonate	2% by weight

[0081] The ingredients were homogeneously ground and mixed, water was added thereto to knead the ingredients thoroughly, and then the mixture was granulated and dried to obtain granules.

Preparation Example 9 [Microcapsules]

Compound 1-20	2% by weight
Imidacloprid	3% by weight
Urethane resin	25% by weight
Emulsifier/Dispersant	5% by weight
Antiseptic	0.2% by weight

(continued)

Water	64.8% by weight

[0082] Microcapsules were obtained by forming a urethane resin coating on the surface of particles of the compound represented by Formula (I) and imidacloprid particles using the ingredients by interfacial polymerization.

Preparation Example 10 [Granules]

Compound P212	2% by weight
Probenazole	24% by weight
Sodium lauryl sulfate	1% by weight
Bentonite	2% by weight
Calcium stearate	1% by weight
PVA	2% by weight
Clay	68% by weight

[0083] The ingredients were homogeneously ground and mixed, water was added thereto to knead the ingredients thoroughly, and then the mixture was granulated and dried to obtain granules.

Preparation Example 11 [Granules]

Compound P212	2% by weight
Chlorantraniliprole	1% by weight
Probenazole	24% by weight
Bentonite	40% by weight
Talc	10% by weight
Clay	21% by weight
Calcium ligninsulfonate	2% by weight

[0084] The ingredients were homogeneously ground and mixed, water was added thereto to knead the ingredients thoroughly, and then the mixture was granulated and dried to obtain granules.

Preparation Example 12 [Liquid drops]

Compound 1-20	10% by weight
Fipronil	1% by weight
Benzyl alcohol	73.9% by weight
Propylene carbonate	15% by weight
BHT	0.1% by weight

[0085] The ingredients were homogeneously stirred and dissolved to obtain liquid drops.

Preparation Example 13 [Liquid drops]

Compound P212	48% by weight
Fipronil	2% by weight
Ethanol	50% by weight

[0086] The ingredients were homogeneously mixed to obtain liquid drops.

Preparation Example 14 [Emulsifiable concentrate]

Compound 1-20	5% by weight
Etoxazole	5% by weight
Xylene	35% by weight
Dimethyl sulfoxide	35% by weight

[0087] The ingredients were dissolved, and 14% by weight of polyoxyethylene styryl phenyl ether and 6% calcium dodecylbenzenesulfonate were added thereto, and the mixture was thoroughly stirred and mixed to obtain a 10% emulsifiable concentrate.

Preparation Example 15 [Liquid drops]

Compound P212	10% by weight
Etoxazole	5% by weight
Glycol (glycol mono alkyl ether)	85% by weight
BHT or BHA	appropriate amount

[0088] An appropriate amount of sorbitan monooleate or sorbitan monolaurate, caprylic acid monoglyceride or isostearic acid monoglyceride, or propylene glycol monocaprylate was added to the ingredients, and alcohol or propylene carbonate, N-methyl-2-pyrrolidone or water was added thereto to obtain liquid drops as 100% by weight.

Reference Test Example

<Foliar treatment test of single agent>

Reference Test Example 1 Pest control test of Plutella xylostella

[0089] A leaf disk having a diameter of 5.0 cm was cut out from a cabbage in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to the leaf disk. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0090] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 2 Pest control test of Spodoptera litura

[0091] A leaf disk having a diameter of 5.0 cm was cut out from a cabbage in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to the leaf disk. After an air drying process, third instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0092] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 500 ppm.

Reference Test Example 3 Pest control test of Aphis gossypii

[0093] A leaf disk having a diameter of 2.0 cm was cut out from a cucumber in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to the leaf disk. After an air drying process, first instar larvae were released

thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0094] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 4 Pest control test of Laodelphax striatella

[0095] A drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was foliar sprayed to a rice seedling in pot culture. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0096] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 5 Pest control test of Nilaparvata lugens

[0097] A drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was foliar sprayed to a rice seedling in pot culture. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Six days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0098] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 6 Pest control test of Sogatella furcifera

[0099] A drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was foliar sprayed to a rice seedling in pot culture. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Four days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0100] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a

foliar treatment at 100 ppm.

Reference Test Example 7 Pest control test of Nephotettix cincticeps

[0101] A drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was foliar sprayed to a rice seedling in pot culture. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Four days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0102] As a result, compound P212 exhibited insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 8 Pest control test of trialeurodes vaporariorum

[0103] Adult greenhouse whiteflies were released to a cucumber in pot culture and allowed to lay eggs overnight. One day after the onset of egg laying, the adults were removed and the eggs were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the completion of egg laying, a leaf disk having a diameter of 2.0 cm was cut out from the cucumber, it was confirmed that the eggs had been laid, and then a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to the leaf disk. After the spraying, the leaf disk was left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Fourteen days after the spraying, larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{(\text{number of eggs laid} - \text{number of survived larvae})/\text{number of eggs laid}\} \times 100$$

[0104] As a result, compound P212 exhibited high insecticidal activity having a mortality of 80% or higher by a foliar treatment at 100 ppm.

Reference Test Example 9 Pest control test of Frankliniella occidentalis

[0105] A leaf disk having a diameter of 2.8 cm was cut out from a kidney bean in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to the leaf disk. After an air drying process, first instar larvae were released to the leaf disk. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0106] As a result, compounds P212 and 1-20 exhibited high insecticidal activity having a mortality of 80% or higher by a foliage treatment at 500 ppm.

Reference Test Example 10 Pest control test of Trigonotylus caelestialium

[0107] Wheat seedling leaves and stems four days after the dissemination of seedlings were dipped for 30 seconds in a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available). After an air drying process, the wheat seedling leaves and stems were placed into a glass tube, and two second instar larvae of Trigonotylus coelestialium were released to the same glass tube. After the larvae were released, the tube was lidded to leave the larvae to stand in a thermostatic chamber at 25°C. In order to supply water to the wheat during the test, water was given to the wheat from the bottom of the glass tube. Three days after the treatment, the larvae were observed for survival or death, and the death rate of larvae was calculated by the following equation. Test in triplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0108] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher by a dipping treatment of the drug solution at 50 ppm.

Reference Test Example 11 Pest control test of Plautia crossota stali

[0109] A drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed to a young fruit of apple collected outdoors. After an air drying process, the young fruit was placed into a plastic cup, and two adults of Plautia crossota stali were released thereto. Six days after the release, the adults were observed for survival or death, the Mortality of adults was calculated by the following equation.

$$\text{Mortality of adults (\%)} = \{\text{number of dead adults}/(\text{number of survived adults} + \text{number of dead adults})\} \times 100$$

[0110] As a result, compound P212 exhibited insecticidal activity having a mortality of 60% or higher by a foliar treatment at 50 ppm.

Reference Test Example 12 Pest control test of Oulema oryzae

[0111] 1 μL (/head) of a drug solution of the compound of Formula (I) prepared at a predetermined concentration with acetone was topically applied and treated to the back of adults collected outdoors by a micro syringe. After the drug treatment, the adults were transferred to rice seedlings and left to stand in a thermostatic chamber at 25°C so as to obtain 5 heads per stem. Forty eight hours after the treatment, the adults were observed for survival or death, and the mortality of adults was calculated by the following equation. Test in duplicate.

$$\text{Mortality of adults (\%)} = \{\text{number of dead adults}/(\text{number of survived adults} + \text{number of dead adults})\} \times 100$$

[0112] As a result, compound P212 exhibited high insecticidal activity having a mortality of 80% or higher in a throughput of 0.5 μg/head.

Reference Test Example 13 Pest control test of Musca domestica

[0113] The backs of female adults raised indoors were treated with 1 μL (/head) of a drug solution of the compound of Formula (I) prepared at a predetermined concentration with acetone. After the drug treatment, the adults were transferred to a plastic cup and left to stand in a thermostatic chamber at 25°C so as to obtain 5 heads per cup. Twenty four hours after the treatment, the agony situation of the adults was observed, and the rate of agonized adults was calculated by the following equation. Test in duplicate.

$$\text{Mortality of adults (\%)} = \{\text{number of dead adults}/(\text{number of survived adults} + \text{dead adults})\} \times 100$$

[0114] As a result, compounds P212 and 1-20 exhibited high insecticidal activity having a mortality of 80% or higher in a throughput of 2 μg/head.

<Soil drench test of single agent>

Reference Test Example 14 Pest control test of Laodelphax striatella

[0115] A rice seedling in pot culture was subjected to soil drench treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 10% acetone water. Three days after the treatment, ten second instar larvae of Laodelphax striatella were each released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0116] As a result, compounds P212 and 1-20 exhibited high insecticidal activity having a mortality of 80% or higher in a throughput of 0.05 mg/seedling.

Reference Test Example 15 Pest control test of Sogatella furcifera

[0117] A rice seedling in pot culture was subjected to soil drench treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, which had been prepared so as to be a 10% acetone water. Three days after the treatment, ten second instar larvae of Sogatella furcifera were each released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0118] As a result, compounds P212 and 1-20 exhibited high insecticidal activity having a mortality of 80% or higher in a throughput of 0.05 mg/seedling.

Reference Test Example 16 Pest control test of Nilaparvata lugens

[0119] A rice seedling in pot culture was subjected to soil drench treatment with a drug solution of the compound of Formula (I), which had been prepared so as to be a 10% acetone water. Three days after the treatment, ten second instar larvae of Nilaparvata lugens were each released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0120] As a result, compounds P212 and 1-20 exhibited high insecticidal activity having a death rate of 80% or higher in a throughput of 0.05 mg/seedling.

Reference Test Example 17 Pest control test of Lissorhoptrus oryzophilus

[0121] A rice seedling in pot culture was subjected to soil drench treatment with a drug solution of the compound of Formula (I), which had been prepared so as to be a 10% acetone water. Two days after the treatment, five adults of Lissorhoptrus oryzophilus were each released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0122] As a result, compound P212 exhibited high insecticidal activity having a mortality of 80% or higher in a throughput of 0.1 mg/seedling.

Reference Test Example 18 Pest control test of Laodelphax striatella

[0123] Wheat seedling roots forty eight hours after the dissemination of seeds were treated with a drug solution of the compound of the present invention at a predetermined concentration, which had been prepared so as to be a 10% acetone water. The drug was absorbed from the roots for 72 hours, and then ten second instar larvae of Laodelphax striatella were each released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Four days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0124] As a result, compounds P212 and 1-20 exhibited insecticidal activity having a mortality of 80% or higher in a throughput of 20 μg/seedling.

[0125] The results of Reference Test Examples 1, 3 and 18 are shown in the following Table.

[Table 55-1]

Reference Example Compound No.	Ar	Y	R	Plutella xylostella (Reference Test Example 1)	Aphis gossypii (Reference Test Example 3)	Laodelphax striatella (Reference Test Example 18)
P-212	6-chloro-3-pyridyl	H	COCF3	100	100	100

[Table 55-2]

1-20	6-chloro-3-pyridyl	H	CSCF3	100	100	100

[Table 55-3]

3-3	6-fluoro-3-pyridyl	H	COCHF2	50	100	80

<Effects against insecticide resistant pests>

Reference Test Example 19 Pest control test of Nilaparvata lugens

[0126] A rice seedling in pot culture was subjected to soil drench with a solution of the compound of Formula (I), which had been prepared so as to be a 10% acetone water. Three days after the treatment, ten second instar larvae of Nilaparvata lugens, which had been collected outdoors and proliferated indoors, were each released to the rice seedling. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Six days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. Test in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0127] Furthermore, for comparison, the test against a species of Nilaparvata lugens which is highly susceptible to imidacloprid was performed by the same method as described above, and the results thereof are shown in Table 45. As described in Table 45, Compound P212 and Compound 1-20 exhibited high insecticidal effects against susceptible species and drug resistant species of Nilaparvata lugens, and the death rates of larvae at 0.005 mg/seedling were (susceptible species) 100% and 100%, (resistant population I) 95% and 77% and (resistant population II) 100% and 85%, respectively. Meanwhile, the death rates of imidacloprid at 0.05 mg/seedling were (susceptible species) 100%, (resistant population I) 38% and (resistant population II) 69%, and the insecticidal effect thereof was also low even at a high dose. From the above results, it became obvious that Compound P212 and Compound 1-20 have high insecticidal effects even against Nilaparvata lugens resistance against imidacloprid.

[0128] Further, for the origin of test pests, bugs collected outdoors from the Kumamoto prefecture (I) in 2007 and from the Fukuoka prefecture (II) in 2005 as resistant population of Nilaparvata lugens, and bugs collected from the Kagoshima prefecture and then successively reared indoors for a long time as the imidacloprid susceptible population of Nilaparvata lugens were used.

[Table 56]

Insecticidal effects against Nilaparvata lugens (death rate %)				
	Throughput (mg/seedling)	Effects against Nilaparvata lugens		
		Susceptible population	Resistant population I	Resistant population II
		six days after the treatment	six days after the treatment	six days after the treatment
P212	0.05 0.005	100 100	100 95	100 100
1-20	0.01 0.005	95 100	100 77	100 85
Imidacloprid	0.05 0.01	100 100	38	69 39

<Mixed Agent Test Example>

Test Example 1 Soil Irrigation Treatment Test of Laodelphax striatella

[0129] A rice seedling in pot culture was subjected to soil drench treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 10% acetone water. After the rice seedling was left to stand for 3 days, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0130] In addition, when there was no synergistic effect, a theoretical value was calculated by the Colby's equation shown as follows, and the results are shown in the Table.

$$\text{Colby's equation: theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212 or Compound 1-20)
B: 100 - (mortality of larvae or adults when treated only with each of imidacloprid, fipronil, chlorantraniliprole, spinosad, clothianidin, dinotefuran, sulfoxaflor, pymetrozine, thiamethoxam, flupyradifurone and cycloxaprid))

Method for judging synergistic effects

[0131] When the mortality against Laodelphax striatella in the case of a mixture with another agent exceeded the theoretical value by the Colby's equation, a synergistic effect was judged to be present.

[0132] It was demonstrated that mixed agents of the insecticides of imidacloprid, fipronil, chlorantraniliprole, spinosad, clothianidin, dinotefuran, sulfoxaflor, pymetrozine, thiamethoxam, flupyradifurone and cycoxaprid, which were provided and tested as Compound P212, all show a mortality of larvae or adults, exceed the theoretical value and have synergistic effects.

[0133] In addition, it was demonstrated that mixed agents of the insecticides of imidacloprid and fipronil, which were

provided and tested as Compound 1-20, all show a mortality of larvae or adults, exceed the theoretical value and have synergistic effects.

[0134] Furthermore, it was demonstrated that mixed agents of the fungicides of probenazole, isotianil, tiadinil and orysastrobin, which were provided and tested as Compound P212, all exhibit insecticidal effect equal to or higher than the insecticidal effect when treated with Compound P212 alone and may be mixed and treated with a fungicide. Likewise, it was demonstrated that mixed agents of the fungicide of probenazole, which was provided and tested as Compound 1-20, exhibit insecticidal effect equal to or higher than the insecticidal effect when treated with Compound 1-20 alone and may be mixed and treated with a fungicide.

<Example of mixed agent with insecticide>

[0135]

[Table 57]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	39
Imidacloprid	0.005	0	70
Fipronil	0.005	26	65
Chlorantraniliprole	0.05	9	60
Spinosad	0.5	0	62

[Table 58]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0. 005
-	-	0	39
Imidacloprid	0.005	0	39
Fipronil	0.005	26	55
Chlorantraniliprole	0.05	9	44
Spinosad	0.5	0	39

[Table 59]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate	Compound	P212
	mg/Seedling	0	0.005
-	-	0	18
Clothianidin	0.005	23	56
Dinotefuran	0.005	0	30
Sulfoxaflor	0.005	1	63
Pymetrozine	0.05	15	89

[Table 60]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	18
Clothianidin	0.005	23	37
Dinotefuran	0.005	0	18
Sulfoxaflor	0.005	1	19
Pymetrozine	0.05	15	30

[Table 61]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	14
Thiamethoxam	0.01	23	45

[Table 62]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	14
Thiamethoxam	0.01	23	34

[Table 63]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate mg/Seedling	Compound P212	
		0	0.005
-	-	0	45
Flupyradifurone	0.01	5	85

[Table 64]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate mg/Seedling	Compound P212	
		0	0.005
-	-	0	45
Flupyradifurone	0.01	5	48

[Table 65]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate mg/Seedling	Compound 1-20	
		0	0.005
-	-	0	12
Imidacloprid	0.005	0	74
Fipronil	0.001	0	80

[Table 66]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate mg/Seedling	Compound 1-20	
		0	0.005
-	-	0	12
Imidacloprid	0.005	0	12
Fipronil	0.001	0	12

[Table 67]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	0
Cycloxaprid	0.005	0	7

[Table 68]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	0
Cycloxaprid	0. 005	0	0

[Table 69]

Mortality (%) of single agent and mixed agent against Laodelphax striatella					
Fungicide name	Rate	Compound P212		Compound 1-20	
	mg/Seedling	0	0. 005	0	0. 005
-	-	0	39	0	8
Probenazole	0.5	9	59	9	65

[Table 70]

Theoretical value (%) by Colby's equation					
Fungicide name	Rate	Compound P212		Compound 1-20	
	mg/Seedling	0	0. 005	0	0. 005
-	-	0	39	0	8
Probenazole	0. 5	9	44	9	16

[Table 71]

Mortality (%) of single agent and mixed agent against Laodelphax striatella			
Fungicide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	19
Isotianil	0.5	5	30
Tiadinil	0.5	8	30
Orysastrobin	0.5	4	70

[Table 72]

Theoretical value (%) by Colby's equation			
Fungicide name	Rate	Compound P212	
	mg/Seedling	0	0.005
-	-	0	19
Isotianil	0.5	5	23
Tiadinil	0.5	8	25
Orysastrobin	0.5	4	22

Test Example 2 Foliar treatment test against Laodelphax striatella

[0136] A drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was foliar sprayed to a rice seedling in pot culture. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0137] Further, when there was no synergistic effect, a theoretical value was calculated by the Colby's equation shown as follows, and the results are shown in the Table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212 or Compound 1-20)
B: 100 - (mortality of larvae or adults when treated only with etofenprox or silafluofen))

Method for judging synergistic effects

[0138] When the mortality against Laodelphax striatella in the case of a mixture with another agent exceeded the theoretical value by the Colby's equation, a synergistic effect was judged to be present.

[0139] It was demonstrated that mixed agents of the insecticides of etofenprox and silafluofen, which were provided and tested as Compound P212 or Compound 1-20, all show a mortality of larvae or adults approximately equal to the theoretical value, and may be mixed with the insecticide even in a foliar treatment-like usage.

[Table 73]

Mortality (%) of single agent and mixed agent against Laodelphax s striatella				
Insecticide name	Rate (ppm)	-	Compound P212	Compound 1-20
		0	0.625	0.625
-	-	0	95	90
Etofenprox	10	30	90	95
Silafluofen	5	55	100	100

[Table 74]

Theoretical value (%) by Colby's equation				
Insecticide name	Rate (ppm)	-	Compound P212	Compound 1-20
		0	0.625	0.625
-		0	95	90
Etofenprox	10	30	97	93
Silafluofen	5	55	98	95

Test Example 3 Pest control test of Aphis gossypii

[0140] A leaf disk having a diameter of 2.0 cm was cut out from a cucumber in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed thereto. After an air drying process, first instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0141] In addition, when there was no synergistic effect, a theoretical value was calculated by the Colby's equation

shown as follows, and the results are shown in the Table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212 or Compound 1-20)
B: 100 - (mortality of larvae or adults when treated only with afidopyropen)

Method for judging synergistic effects

[0142] When the mortality against Aphis gossypii in the case of a mixture with another agent exceeded the theoretical value by the Colby's equation, a synergistic effect was judged to be present.

[0143] It was demonstrated that mixed agents of compounds of Formula (II), which were provided and tested as Compound P212 or Compound 1-20, all show a mortality of larvae or adults, exceed the theoretical value and have synergistic effects.

[Table 75]

Mortality (%) of single agent and mixed agent against Aphis gossypii					
Insecticide name	Rate	Compound P212		Compound 1-20	
	ppm	0	0. 313	0	0. 625
-	-	0	45	0	19
Afidopyropen	0. 002	25	70	25	40

[Table 76]

Theoretical value (%) by Colby's equation					
Insecticide name	Rate	Compound P212		Compound 1-20	
	ppm	0	0.313	0	0.625
-	-	0	45	0	19
Afidopyropen	0.002	25	59	25	39

Test Example 4 Pest control test of Plutella xylostella

[0144] A leaf disk having a diameter of 5.0 cm was cut out from a cabbage in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed thereto. After an air drying process, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the mortality of larvae was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0145] Furthermore, when there was no synergistic effect, a theoretical value was calculated by the Colby's equation shown as follows, and the results are shown in the Table.

Colby's equation: Theoretical value (%) = 100 - (A × B)/100

(A: 100 - (mortality of larvae or adults when treated with only Compound P212)
B: 100 - (mortality of larvae or adults when treated with only flometoquin, spinosad, fipronil, chlorantraniliprole, 1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate, or afidopyropen))

Method for judging synergistic effects

[0146] When the mortality against Plutella xylostella in the case of a mixture with another agent exceeded the theoretical value by the Colby's equation, a synergistic effect was judged to be present.

[0147] It was demonstrated that a mixed agent of the insecticide of flometoquin, which was provided and tested, with Compound P212, shows a death rate of larvae or adults, exceeds the theoretical value and has synergistic effects.

[Table 77]

Mortality (%) of single agent and mixed agent against Plutella xylostella			
Insecticide name	Rate	Compound P212	
	ppm	0	1.25
-	-	0	0
Flometoquin	0.313	0	30

[Table 78]

Theoretical value (%) by Colby's equation			
Insecticide name	Rate	Compound P212	
	ppm	0	1.25
-	-	0	0
Flometoquin	0.313	0	0

[Table 79]

Mortality (%) of single agent and mixed agent against Plutella xylostella

Insecticide name			Compound P212 Rate ppm	
			0	1.0
–			0	40
Afidopyropen	Rate ppm	10	20	70
Spinosad		0.01	11	70

[Table 80]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm	
			0	1.0
–			0	40
Afidopyropen	Rate ppm	10	20	52
Spinosad		0.01	11	45

[Table 81]

Mortality (%) of single agent and mixed agent against Plutella xylostella

Insecticide name			Compound P212 Rate ppm: 0	Compound P212 Rate ppm: 1.0
—			0	30
Afidopyropen	Rate ppm	5	0	80

[Table 82]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm: 0	Compound P212 Rate ppm: 1.0
—			0	30
Afidopyropen	Rate ppm	5	0	30

[Table 83]

Mortality (%) of single agent and mixed agent against Plutella xylostella

Insecticide name			Compound P212	
			Rate ppm	
			0	2.0
–			0	60
Fipronil	Rate ppm	0.04	50	100
Chlorantraniliprole		0.002	60	100

[Table 84]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212	
			Rate ppm	
			0	2.0
–			0	60
Fipronil	Rate ppm	0.04	50	80
Chlorantraniliprole		0.002	60	84

[Table 85]

Mortality (%) of single agent and mixed agent against Plutella xylostella

Insecticide name			Compound P212 Rate ppm 0	Compound P212 Rate ppm 2.0
–			0	50
1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate	Rate ppm	1	30	70
Afidopyropen		5	0	100

[Table 86]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm	
			0	2.0
—			0	50
1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate	Rate ppm	1	30	65
Afidopyropen		5	0	50

Test Example 5 Pest control test of Spodoptera litura

[0148] A leaf disk having a diameter of 5.0 cm was cut out from a cabbage in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed thereto. After an air drying process, third instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0149] Furthermore, a theoretical value for the case of no synergistic effect was calculated using Colby's equation given below, and the results are shown in the tables.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212)
B: 100 - (mortality of larvae or adults when treated with only the insecticide chlorantraniliprole, emamectin benzoate, flometoquin, or afidopyropen))

Method for judging synergistic effects

[0150] When the mortality against Spodoptera litura in the case of a mixture with another agent exceeded the theoretical value given by Colby's equation, a synergistic effect was judged to be present.

[0151] It was demonstrated that a mixed agent of the insecticide chlorantraniliprole, emamectin benzoate, flometoquin, or afidopyropen tested with Compound P212 shows a mortality for larvae or adults in excess of the theoretical value and has synergistic effects.

[Table 87]

Mortality (%) of single agent and mixed agent against Spodoptera litura (1)

Insecticide name			Compound P212 Rate ppm: 0	20
–			0	40
Afidopyropen	Rate ppm	10	0	80

[Table 88]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm: 0	20
–			0	40
Afidopyropen	Rate	10	0	40

	ppm			

[Table 89]

Mortality (%) of single agent and mixed agent against Spodoptera litura (2)

Insecticide name			Compound P212 Rate ppm	
			0	20
–			0	10
Chlorantraniliprole	Rate ppm	0.02	20	30
Emamectin benzoate		0.02	0	20

[Table 90]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm	
			0	20
—			0	10
Chlorantraniliprole	Rate ppm	0.02	20	28
Emamectin benzoate		0.02	0	10

[Table 91]

Mortality (%) of single agent and mixed agent against Spodoptera litura (3)

Insecticide name			Compound P212 Rate ppm	
			0	50
–			0	10
Flometoquin	Rate ppm	5	10	20
Afidopyropen		5	0	50

[Table 92]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm	
			0	50
—			0	10
Flometoquin	Rate ppm	5	10	19
Afidopyropen		5	0	10

Test Example 6 Pest control test of Frankliniella occidentalis

[0152] A leaf disk having a diameter of 2.8 cm was cut out from the common bean in pot culture, and a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 50% acetone water (0.05% Tween20 available), was sprayed thereto. After an air drying process, first instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Three days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0153] Furthermore, a theoretical value for the case of no synergistic effect was calculated using Colby's equation given below, and the results are shown in the table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212)

B: 100 - (mortality of larvae or adults when treated with only the insecticide imidacloprid, dinotefuran, or acetamiprid))

Method for judging synergistic effects

[0154] When the mortality against Frankliniella occidentalis in the case of a mixture with another agent exceeded the theoretical value given by Colby's equation, a synergistic effect was judged to be present.

[0155] It was demonstrated that a mixed agent of the insecticide imidacloprid or dinotefuran tested with Compound P212 shows a mortality for larvae or adults in excess of the theoretical value and has synergistic effects.

[Table 93]

Mortality (%) of single agent and mixed agent against Frankliniella occidentalis(1)

Insecticide name			Compound P212 Rate ppm 0	Compound P212 Rate ppm 10
—			0	69
Imidacloprid	Rate ppm	20	69	94

[Table 94]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ppm 0	Compound P212 Rate ppm 10
—			0	69
Imidacloprid	Rate	20	69	90

	ppm			

[Table 95]

Mortality (%) of single agent and mixed agent against Frankliniella occidentalis(2)

Insecticide name			Compound P212	
			Rate ppm	
			0	20
—			0	70
Dinotefuran	Rate ppm	5	35	85

[Table 96]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212	
			Rate ppm	
			0	20
—			0	70
Dinotefuran	Rate ppm	5	35	81

Test Example 7 Soil irrigation treatment test on Chilo suppressalis

[0156] Rice seedlings in pot culture were submitted to a soil irrigation treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 10% acetone water. After standing for 3 days, second instar larvae were released thereto. This was followed by standing in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Six days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0157] Furthermore, a theoretical value for the case of no synergistic effect was calculated using Colby's equation given below, and the results are shown in the table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212)
B: 100 - (mortality of larvae or adults when treated with only the insecticide fipronil, cyantraniliprole or spinosad))

Method for judging synergistic effects

[0158] When the insecticidal effect (table) against Chilo suppressalis in the case of a mixture with another agent exceeded the theoretical value given by Colby's equation, a synergistic effect was judged to be present.

[0159] It was demonstrated that a mixed agent of the insecticide fipronil, cyantraniliprole or spinosad tested with Compound P212 shows a mortality for larvae or adults in excess of the theoretical value in both cases and has synergistic effects.

[Table 97]

Mortality (%) of single agent and mixed agent against Chilo suppressalis(1)

Insecticide name			Compound P212 Rate mg/seedling 0	Compound P212 Rate mg/seedling 0.01
–			0	33
Cyantraniliprole	Rate mg/seedling	0.005	83	100

[Table 98]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate mg/seedling 0	Compound P212 Rate mg/seedling 0.01
–			0	33
Cyantraniliprole	Rate mg/seedling	0.005	83	89

[Table 99]

Mortality (%) of single agent and mixed agent against Chilo suppressalis(2)

Insecticide name			Compound P212 Rate mg/seedling	
			0	0.002
—			0	40
Fipronil	Rate mg/seedling	0.0005	40	80
Chlorantraniliprole		0.0005	60	80
Spinosad		0.002	80	100

[Table 100]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate mg/seedling	
			0	0.002
—			0	40
Fipronil	Rate mg/seedling	0.0005	40	64
Chlorantraniliprole		0.0005	60	76
Spinosad		0.002	80	88

Test Example 8 Soil irrigation treatment test on Naranga aenescens

[0160] Rice seedlings in pot culture were subjected to a soil irrigation treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared so as to be a 10% acetone water. After standing for 3 days, first instar larvae were released thereto. This was followed by standing in a thermostatic

chamber (16 hours of light period-8 hours of dark period) at 25°C. Five days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

$$\text{Mortality of larvae (\%)} = \{\text{number of dead larvae}/(\text{number of survived larvae} + \text{number of dead larvae})\} \times 100$$

[0161] Furthermore, a theoretical value for the case of no synergistic effect was calculated using Colby's equation given below, and the results are shown in the table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (mortality of larvae or adults when treated only with Compound P212)
B: 100 - (mortality of larvae or adults when treated with only the insecticide spinosad or fipronil))

Method for judging synergistic effects

[0162] When the mortality against Naranga aenescens in the case of a mixture with another agent exceeded the theoretical value given by Colby's equation, a synergistic effect was judged to be present.

[0163] It was demonstrated that a mixed agent of the insecticide spinosad or fipronil tested with Compound P212 shows a mortality for larvae or adults in excess of the theoretical value in all cases and has synergistic effects.

[Table 101]

Mortality (%) of single agent and mixed agent against Naranga aenescens

Insecticide name			Compound P212 Rate mg/seedling: 0	0.01
—			0	60
Spinosad	Rate mg/seedling	0.005	40	100
Fipronil		0.01	20	80

[Table 102]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate mg/seedling	
			0	0.01
—			0	60
Spinosad	Rate mg/seedling	0.005	40	76
Fipronil		0.01	20	68

Test Example 9 Test on Callosobruchus chinensis

[0164] A compound of Formula (I) and the insecticide indicated below, prepared in predetermined concentrations using acetone, were separately topically applied to the back of the same adult Callosobruchus chinensis. The Callosobruchus chinensis was then introduced into a plastic cup and held in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. One day after the release, the insects were observed for survival or death, and the insect mortality was calculated by the following equation. The test was performed in duplicate.

$$\text{Insect mortality (\%)} = \{\text{number of dead insects}/(\text{number of survived insects} + \text{number of dead insects})\} \times 100$$

[0165] Furthermore, a theoretical value for the case of no synergistic effect was calculated using Colby's equation given below, and the results are shown in the table.

$$\text{Colby's equation: Theoretical value (\%)} = 100 - (A \times B)/100$$

(A: 100 - (insect mortality for treatment with only Compound P212)
B: 100 - (insect mortality for treatment with only the insecticide fipronil or imidacloprid))

Method for judging synergistic effects

[0166] When the mortality against Callosobruchus chinensis in the case of a mixture with another agent exceeded the theoretical value given by Colby's equation, a synergistic effect was judged to be present.

[0167] It was demonstrated that co-treatment with the insecticide fipronil or imidacloprid tested with Compound P212 shows an insect mortality in excess of the theoretical value in both cases and has synergistic effects.

[Table 103]

Mortality (%) of single agent and mixed agent against Callosobruchus chinensis

Insecticide name			Compound P212 Rate ng/head 0	Compound P212 Rate ng/head 0.2
–			0	20
Fipronil	Rate ng/head	0.2	0	36
Imidacloprid		0.2	40	60

[Table 104]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate ng/head 0	Compound P212 Rate ng/head 0.2
–			0	20
Fipronil	Rate ng/head	0.2	0	20
Imidacloprid		0.2	40	52

Test Example 10 Pest control test of Rice blast

[0168] A rice seedling in pot culture was subjected to soil irrigation treatment with a drug solution of the compound of Formula (I) at a predetermined concentration, or a drug solution of a mixture of a compound of Formula (I) and an insecticide as indicated below at a predetermined concentration, which had been prepared with a 10% acetone water. Three days after the treatment, a spore suspension (2 x 10^5 ea/mL, 0.05% Tween available) of rice blast bacteria was

sprayed and inoculated thereto, and the rice seedling was placed in a moist chamber for 24 hours to promote infection. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Seven days after the inoculation, the number of lesions was measured, and the preventive value was calculated by the following equation. The test was performed in triplicate.

$$\text{Preventive value} = \{(\text{number of lesions in a zone without treatment} - \text{number of lesions in a zone with treatment})/(\text{number of lesions without treatment})\} \times 100$$

[0169] As a result, it was demonstrated that in a throughput of probenazole at 0.125 mg/ seedling, any one mixed agent of Compound P212 and Compound 1-20 exhibits insecticidal effect equal to the insecticidal effect when treated with probenazole alone and may be mixed and treated with a fungicide.

[Table 105]

Insecticide name			Compound P212		Compound 1-20	
			Rate mg/seedling			
			0	2.5	0	2.5
—			0	3.3	0	52.5
Probenazole	Rate mg/seedling	0.125	96.7	93.4	96.7	91.8

Test Example 11 Test of rice blast control (foliar treatment)

[0170] Rice seedlings were treated by foliar application with a drug solution of the compound of Formula (I), or a drug solution of a mixture of a compound of Formula (I) and the fungicide indicated below, prepared in a predetermined concentration with 10% acetone water. After the treatment, a rice blast spore suspension (1.5×10^5 ea/mL, 0.05% Tween available) was sprayed and inoculated thereto followed by holding in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. Fourteen days after the inoculation, the number of lesions was measured, and the preventive value was calculated by the following equation. The test was performed in triplicate.

$$\text{Preventive value} = \{(\text{number of lesions in a zone without treatment} - \text{number of lesions in a zone with treatment})/(\text{number of lesions in a zone without treatment})\} \times 100$$

[0171] As a result, it was demonstrated that at a treatment concentration of 0.5 ppm using tiadinil, isotianil, orysastrobin, tricyclazole, diclocymet, tebufloquin, azoxystrobin or kasugamycin, the mixed agent with Compound P212 also exhibits a fungicidal effect equal to that for treatment with tiadinil, isotianil, orysastrobin, tricyclazole, diclocymet, tebufloquin, azoxystrobin or kasugamycin alone and a mixed treatment with a fungicide is therefore possible.

[Table 106]

(Rice blast test 1)

Fungicide name			Compound P212 Rate ppm	
			0	50
—			0	4
Tiadinil	Rate	0.5	0	18
Isotianil	ppm	0.5	66	72

[Table 107]

(Rice blast test 2)

Fungicide name			Compound P212 Rate ppm	
			0	50
—			0	16
Orysastrobin	Rate ppm	0.5	20	91
Tricyclazole		0.5	72	92
Diclocymet		0.5	8	52
Tebufloquin		0.5	48	72

[Table 108]

(Rice blast test 3)

Fungicide name			Compound P212 Rate ppm	
			0	50
–			0	0
Azoxystrobin	Rate	0.5	37	35
Kasugamycin	ppm	0.5	0	37

Test Example 12 Test of control of rice sheath blight (Rhizoctonia solani)

[0172] Six weeks after planting, rice seedlings were subjected to foliar spray treatment with a drug solution of the compound of Formula (I), or a drug solution of a mixture of a compound of Formula (I) and a fungicide as indicated below, prepared in a predetermined concentration with 10% acetone water. After an air drying process, a plug of growing Rhizoctonia solani (1.0 cm^2 agar square each) was allowed to stand at the base of the rice. This was followed by holding in a thermostatic chamber (30°C day-25°C night, 16 hours of light period-8 hours of dark period). Six days after the inoculation, the lesion height was measured, and the preventive value was calculated by the following equation. The test was performed in duplicate.

$$\text{Preventive value} = \{(\text{lesion height in a zone without treatment} - \text{lesion height in a zone with treatment})/(\text{lesion height in a zone without treatment})\} \times 100$$

[0173] As a result, it was demonstrated that, at a treatment concentration of 5 ppm using thifluzamide, furametpyr, pencycuron, azoxystrobin, simeconazole, validamycin, or orysastrobin, the mixed agent with 50 ppm Compound P212 presented the same fungicidal effect as for treatment with thifluzamide, furametpyr, pencycuron, azoxystrobin, simeconazole, validamycin, or orysastrobin alone, and mixed treatment with a fungicide is therefore possible.

[Table 109]

(Sheath blight test 1)

Fungicide name			Compound P212 Rate ppm	
			0	50
–			0	14
Thifluzamide	Rate ppm	5	92	97
Furametpyr		5	77	94
Pencycuron		5	69	77

[Table 110]

(Sheath blight test 2)

Fungicide name			Compound P212 Rate ppm	
			0	50
–			0	9
Azoxystrobin	Rate ppm	5	95	100
Simeconazole		5	5	24
Validamycin		5	32	74
Orysastrobin		5	72	59

Test Example 13 Test with Laodelphax striatellus by treatment during the vegetative phase

[0174] Rice was planted in nursery boxes and emergence was carried out for three days a 30°C followed by transfer of the nursery boxes to a glass greenhouse at 25°C. During the vegetative phase five days after planting, the nursery boxes were treated with a prescribed amount of a mixed granule of 0.24 mg/mg probenazole (24%) and 0.02 mg/mg Compound P212 (2%). The rice seedlings were transplanted to 1/5000a Wagner pots 22 days after planting and were grown in a greenhouse at 25°C. Second instar larvae of Laodelphax striatellus were released at 13, 26, and 38 days post-transplantation to the Wagner pots; this was followed by holding in a glass greenhouse at 25°C. Five days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

Mortality of larvae (%) = {number of dead larvae/(number of survived larvae + number of dead larvae)} × 100

[0175] According to the results, it was shown that the mixed granule of probenazole and Compound P212 presented a high insecticidal effect of 100% mortality and exhibited control at a practical level.

Test Example 14 Test with Laodelphax striatellus by soil irrigation treatment

[0176] Rice seedlings in pot cultivation were subjected to a soil irrigation treatment with a drug solution of a compound of Formula (I) or a drug solution of a mixture of a compound of Formula (I) and a paddy herbicide as indicated below, prepared in predetermined concentrations so as to be a 10% acetone water. After standing for three days, second instar larvae were released thereto. Thereafter, the larvae were left to stand in a thermostatic chamber (16 hours of light period-8 hours of dark period) at 25°C. five days after the release, the larvae were observed for survival or death, and the larvae mortality was calculated by the following equation. The test was performed in duplicate.

Mortality of larvae (%) = {number of dead larvae/(number of survived larvae + number of dead larvae)} × 100

[0177] The mixed agent of Imazosulfuron, cafenstrole, cyhalofop-butyl, daimuron and pyrazolate tested with the Compound P212 was shown in all instances to exhibit an insecticidal effect at least equal to that for treatment with Compound P212 by itself, and a mixed treatment with a herbicide is thus possible.

[Table 111]

Herbicide name			Compound P212 Rate mg/seedling		
			0	0.005	0.01
—			0	0	100
Imazosulfuron	Rate mg/seedling	0.05	0	0	100
Cafenstrole		0.05	0	0	100
Cyhalofop-butyl		0.05	0	0	100
Daimuron		0.05	0	0	100
Pyrazolate		0.05	0	0	100

Test Example 15 Test of the control of Haemaphysalis longicornis

[0178] A capsule with a diameter of 2 cm and a height of 2 cm was attached to the dorsal surface of a mouse. A compound of Formula (I), ivermectin, moxidectin, permethrin, amitraz, fipronil, spinetram and the mixture of the compound of Formula (I) and each insecticide were dissolved in ethanol at the concentrations given in Table O, and each of these was dripped onto the surface of a mouse body within a capsule. After thorough drying, eight Haemaphysalis longicornis nymphs were released and the top of the capsule was sealed with a lid. The mouse was kept in a cage at 25°C using a 12-hour light period and a 12-hour dark period. Five days after the release, the capsule was removed and the number of surviving and dead nymphs and the number of engorged individuals were counted and the insect mortality and agonal rate was calculated by the following equation.

$$\text{Insect mortality and agonal rate (\%)} = \{\text{number of dead and agonal insects}/(\text{number of survived insects} + \text{number of dead and agonal insects})\} \times 100$$

[0179] The results showed that, at a rate of 0.009 μg of ivermectin or moxidectin, the mixed agent of either with Compound P212 also gave a tick control effect that was the same as treatment with ivermectin, moxidectin, permethrin, amitraz, fipronil and spinetram alone and mixed treatment with ivermectin, moxidectin, permethrin, amitraz, fipronil and spinetram is thus possible.

[Table 112]

Mortality (%) of single agent and mixed agent against Haemaphysalis longicornis(1)

Insecticide name			Compound P212 Rate μg: 0	1.18
—			0	53
Ivermectin	Rate μg	0.009	3	53
Moxidectin		0.009	6	44

[Table 113]

Mortality (%) of single agent and mixed agent against Haemaphysalis longicornis(2)

Insecticide name			Compound P212 Rate μg 0	Compound P212 Rate μg 1.18
–			0	60
Amitraz	Rate μg	0.38	41	90
Permethrin		9.5	71	86

[Table 114]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate μg 0	Compound P212 Rate μg 1.18
–			0	60
Amitraz	Rate μg	0.38	41	77
Permethrin		9.5	71	88

[Table 115]

Mortality (%) of single agent and mixed agent against Haemaphysalis longicornis(3)

Insecticide name			Compound P212 Rate μg	
			0	1.18
–			0	38
fipronil	Rate μg	0.38	78	93
spinetoram		0.38	6	22

[Table 116]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate μg	
			0	1.18
–			0	38
fipronil	Rate μg	0.38	78	86
spinetoram		0.38	6	41

[Table 117]

Mortality (%) of single agent and mixed agent against Haemaphysalis longicornis(4)

Insecticide name			Compound P212 Rate μg 0	Compound P212 Rate μg 1.18
–			0	18
pyriproxyfen	Rate μg	0.0475	2	44
spinosad		1.9	2.5	43

[Table 118]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate μg 0	Compound P212 Rate μg 1.18
–			0	18
pyriproxyfen	Rate μg	0.0475	2	20
spinosad		1.9	2.5	20

[Table 119]

Mortality (%) of single agent and mixed agent against Haemaphysalis longicornis(5)

Insecticide name			Compound P212 Rate μg	
			0	1.18
–			0	23
imidacloprid	Rate μg	1.9	7.7	60
dinotefuran		1.9	0	

[Table 120]

Theoretical value (%) by Colby's equation

Insecticide name			Compound P212 Rate μg	
			0	1.18
–			0	23
imidacloprid	Rate μg	1.9	7.7	32
dinotefuran		1.9	0	25

Claims

1. A pest control composition comprising at least one iminopyridine derivative selected from the group consisting of

N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroacetamide and N-[1-((6-chloropyridin-3-yl)methyl)pyridin-2(1H)-ylidene]-2,2,2-trifluoroethane-thioamide and an acid addition salt thereof; and at least one other pest control agent,

(i) wherein the other pest control agent is an insecticide and is selected from the group consisting of imidacloprid, clothianidin, dinotefuran, thiamethoxam, pymetrozine, spinosad, fipronil, chloranthraniliprole, cyantraniliprole, ethofenprox, silafluofen, sulfoxaflor, flupyradifurone, flometoquin, emamectin benzoate, cycloxaprid, 1-((6-chloropyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate and afidopyropen, or an agriculturally and zootechnically acceptable acid addition salt thereof, or
wherein the other pest control agent is a fungicide selected from the group consisting of azoxystrobin, orysastrobin, thifluzamide, furametpyr, tiadinil, isotianil, diclocymet, tricyclazole, tebufloquin, simeconazole, validamycin, kasugamycin and pencycuron, or
wherein the other pest control agent is a control agent for animal parasitic pests and is selected from the group consisting of fipronil, imidacloprid, dinotefuran, amitraz, pyriproxyfen, spinosad, or an agriculturally and zootechnically acceptable acid addition salt thereof.

2. The pest control composition according to claim 1 comprising an agriculturally and zootechnically acceptable carrier.

3. A method for protecting useful plants from pests comprising applying the pest control composition of claim 1 or 2 to a region to be treated.

4. A method for protecting useful plants from pests by treating pests, useful plants, seeds of useful plants, soil, or cultivation carriers as a target with an effective amount of the pest control composition of claim 1 or 2.

5. Use of the pest control composition according to claim 1 or 2 for protecting useful plants from pests.

6. The pest control composition of claim 1 or 2 for use in protecting animals from pests.

Patentansprüche

1. Schädlingsbekämpfungszusammensetzung, die mindestens ein Iminopyridinderivativ, das aus der Gruppe ausgewählt ist, die aus N-[1-((6-Chlorpyridin-3-yl)methyl)pyridin-2(1H)-yliden]-2,2,2-trifluoracetamid, N-[1-((6-Chlorpyridin-3-yl)methyl)pyridin-2(1H)-yliden]-2,2,2-trifluorethanthioamid und einem Säureadditionssalz davon besteht, und mindestens ein weiteres Schädlingsbekämpfungsmittel umfasst, wobei:

(I) das weitere Schädlingsbekämpfungsmittel ein Insektizid und aus der Gruppe ausgewählt ist, die aus Imidacloprid, Clothianidin, Dinotefuran, Thiamethoxam, Pymetrozin, Spinosad, Fipronil, Chloranthraniliprol, Cyantraniliprol, Ethofenprox, Silafluofen, Sulfoxaflor, Flupyradifuron, Flometoquin, Emamectinbenzoat, Cycloxaprid, 1-((6-Chlorpyridin-3-yl)methyl)-4-oxo-3-phenyl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olat und Afidopyropen oder einem landwirtschaftlich und tierhalterisch verträglichen Säureadditionssalz davon besteht,
das weitere Schädlingsbekämpfungsmittel ein Fungizid ist, das aus der Gruppe ausgewählt ist, die aus Azoxystrobin, Orysastrobin, Thifluzamid, Furametpyr, Tiadinil, Isotianil, Diclocymet, Tricyclazol, Tebufloquin, Simeconazol, Validamycin, Kasugamycin und Pencycuron besteht, oder
das weitere Schädlingsbekämpfungsmittel ein Mittel zur Bekämpfung parasitärer Schädlinge von Tieren und aus der Gruppe ausgewählt ist, die aus Fipronil, Imidacloprid, Dinotefuran, Amitraz, Pyriproxyfen, Spinosad oder einem landwirtschaftlich und tierhalterisch verträglichen Säureadditionssalz davon besteht.

2. Schädlingsbekämpfungszusammensetzung nach Anspruch 1, die einen landwirtschaftlich und tierhalterisch verträglichen Träger umfasst.

3. Verfahren zum Schutz von Nutzpflanzen vor Schädlingen, welches das Aufbringen der Schädlingsbekämpfungszusammensetzung nach Anspruch 1 oder 2 auf eine zu behandelnde Fläche umfasst.

4. Verfahren zum Schutz von Nutzpflanzen vor Schädlingen durch die Behandlung von Schädlingen, Nutzpflanzen, Nutzpflanzensamen, Erde oder Kultivierungssubstraten als Ziel mit einer wirksamen Menge der Schädlingsbekämpfungszusammensetzung nach Anspruch 1 oder 2.

5. Verwendung der Schädlingsbekämpfungszusammensetzung nach Anspruch 1 oder 2 zum Schutz von Nutzpflanzen vor Schädlingen.

6. Schädlingsbekämpfungszusammensetzung nach Anspruch 1 oder 2 zur Verwendung beim Schutz von Tieren vor Schädlingen.

Revendications

1. Composition pour le contrôle des nuisibles, comprenant au moins un dérivé iminopyridine choisi parmi le groupe consistant en le N-[1-((6-chloropyridin-3-yl)méthyl)pyridin-2(1H)-ylidène]-2,2,2-trifluoroacétamide, le N-[1-((6-chloropyridin-3-yl)méthyl)pyridin-2(1H)-ylidène]-2,2,2-trifluoroéthane-thioamide et un sel d'addition d'acide de ceux-ci, et au moins un autre agent de contrôle des nuisibles,

   (i) où l'autre agent de contrôle des nuisibles est un insecticide et est choisi parmi le groupe consistant en l'imidaclopride, la clothianidine, le dinotéfuranne, le thiaméthoxam, la pymétrozine, le spinosade, le fipronil, le chloranthraniliprole, le cyantraniliprole, l'éthofenprox, la silafluofen, le sulfoxaflor, la flupyradifurone, la flométoquine, le benzoate d'émamectine, le cycloxapride, le 1-((6-chloropyridin-3-yl)méthyl)-4-oxo-3-phényl-4H-pyrido[1,2-a]pyrimidin-1-ium-2-olate et l'afidopyropène, ou un sel d'addition d'acide acceptable de manière agricole et zootechnique de ceux-ci, ou
   où l'autre agent de contrôle des nuisibles est un fongicide choisi parmi le groupe consistant en l'azoxystrobine, l'orysastrobine, le thifluzamide, le furametpyr, le tiadinil, l'isotioanil, le diclocymet, le tricyclazole, la tébufloquine, le siméconazole, la validamycine, la kasugamycine et le pencycuron, ou
   où l'autre agent de contrôle des nuisibles est un agent de contrôle pour animaux parasites et est choisi parmi le groupe consistant en le fipronil, l'imidaclopride, le dinotéfurane, l'amitraz, le pyriproxyfen, le spinosade ou un sel d'addition d'acide acceptable de manière agricole et zootechnique de ceux-ci.

2. Composition pour le contrôle des nuisibles selon la revendication 1, comprenant un support acceptable de manière agricole et zootechnique.

3. Procédé de protection de plantes utiles contre les nuisibles, comprenant l'application de la composition pour le contrôle des nuisibles selon la revendication 1 ou 2, sur une zone à traiter.

4. Procédé de protection de plantes utiles contre les nuisibles, par traitement des nuisibles, des plantes utiles, des graines des plantes utiles, du sol ou des supports de culture avec une quantité efficace de la composition pour le contrôle des nuisibles selon la revendication 1 ou 2.

5. Utilisation de la composition pour le contrôle des nuisibles selon la revendication 1 ou 2, pour la protection de plantes utiles contre les nuisibles.

6. Composition pour le contrôle des nuisibles selon la revendication 1 ou 2, à utiliser dans la protection d'animaux contre les nuisibles.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 432600 A **[0003]**
- JP 5078323 A **[0004]**
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Non-patent literature cited in the description

- *Chemische Berichte,* 1955, vol. 88, 1103-8 **[0006]**

Iminopiridin-származékot tartalmazó kártevőellenes készítmény

SZABADALMI IGÉNYPONTOK

1. Kártevőellenes készítmény, amely tartalmaz legalább egy, az N-{1-[(6-klór--piridin-3-il)-metil]-piridin-2(1H)-ilidén}-2,2,2-trifluor-acetamid és az N-{1-[(6-klór-piridin-3-il)-metil]-piridin-2(1H)-ilidén}-2,2,2-trifluor-etán-tioamid és ennek egy savaddíciós sója által alkotott csoportból kiválasztott iminopiridin-származékot; és legalább egy másik kártevőellenes szert,

(i) ahol a másik kártevőellenes szer egy rovarirtó, és ezt az imidacloprid, clothianidin, dinotefuran, thiamethoxam, pymetrozine, spinosad, fipronil, chloranthraniliprole, cyantraniliprole, ethofenprox, silafluofen, sulfoxaflor, flupyradifurone, flometoquin, emamektin-ben-zoát, cycloxaprid, 1-[(6-klór-piridin-3-il)-metil]-4-oxo-3-fenil-4H-pirido[1,2-a]pirimidin-1-ium-2-olát és az afidopyropen, vagy ezek mezőgazdaságilag és állategészségügyileg elfogadható savaddíciós sói által alkotott csoportból választjuk ki, vagy

ahol a másik kártevőellenes szer egy, az azoxystrobin, orysastrobin, thifluzamide, furametpyr, tiadinil, isotianil, diclocymet, tricyclazole, tebufloquin, simeconazole, validamycin, kasugamycin és a pencycuron által alkotott csoportból kiválasztott gombaölőszer, vagy

ahol a másik kártevőellenes szer egy állatparazita kártevő, és ezt a fipronil, imidacloprid, dinotefuran, amitraz, pyriproxyfen, spinosad, vagy ezek mezőgazdaságilag és állategészségügyileg elfogadható savaddíciós sói által alkotott csoportból választjuk ki.

2. Az 1. igénypont szerinti kártevőellenes készítmény, amely tartalmaz egy mezőgazdaságilag és állategészségügyileg elfogadható hordozót.

3. Eljárás haszonnövények kártevők elleni védelmére, amely magában foglalja az 1. vagy 2. igénypont szerinti kártevőellenes készítménynek egy kezelendő részen való alkalmazását.

4. Eljárás haszonnövények kártevők elleni védelmére, a kártevőknek, a haszonnövényeknek, a haszonnövények vetőmagjainak, a talajnak vagy a termesztési hordozóknak, mint célnak, az 1. vagy 2. igénypont szerinti kártevőellenes készítmény hatékony mennyiségével való kezelése által.

5. Az 1. vagy 2. igénypont szerinti kártevőellenes készítmény alkalmazása haszonnövények kártevők elleni védelmére.

6. Az 1. vagy 2. igénypont szerinti kártevőellenes készítmény, állatok kártevőkkel szembeni védelmében való alkalmazásra.

A meghatalmazott:

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