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(54) **COMPOSITIONS AND METHODS FOR CONTROLLING NEMATODES**

ZUSAMMENSETZUNGEN UND VERFAHREN ZUR KONTROLLE VON NEMATODEN

COMPOSITIONS ET PROCÉDÉS DE LUTTE CONTRE LES NÉMATODES

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EP 2 396 321 B1

Description

BACKGROUND

[0001] Nematodes (derived from the Greek word for thread) are active, flexible, elongate, organisms that live on moist surfaces or in liquid environments, including films of water within soil and moist tissues within other organisms. While only 20,000 species of nematode have been identified, it is estimated that 40,000 to 10 million actually exist. Many species of nematodes have evolved to be very successful parasites of plants and animals and are responsible for significant economic losses in agriculture and livestock and for morbidity and mortality in humans (Whitehead (1998) Plant Nematode Control. CAB International, New York).

[0002] Nematode parasites of plants can infest all parts of plants, including roots, developing flower buds, leaves, and stems. Plant parasites are classified on the basis of their feeding habits into the broad categories migratory ectoparasites, migratory endoparasites, and sedentary endoparasites. Sedentary endoparasites, which include the root knot nematodes (*Meloidogyne*) and cyst nematodes (*Globodera* and *Heterodera*) induce feeding sites and establish long-term infections within roots that are often very damaging to crops (Whitehead, *supra*). It is estimated that parasitic nematodes cost the horticulture and agriculture industries in excess of $78 billion worldwide a year, based on an estimated average 12% annual loss spread across all major crops. For example, it is estimated that nematodes cause soybean losses of approximately $3.2 billion annually worldwide (Barker et al. (1994) Plant and Soil Nematodes: Societal Impact and Focus for the Future. The Committee on National Needs and Priorities in Nematology. Cooperative State Research Service, US Department of Agriculture and Society of Nematologists). Several factors make the need for safe and effective nematode controls urgent. Continuing population growth, famines, and environmental degradation have heightened concern for the sustainability of agriculture, and new government regulations may prevent or severely restrict the use of many available agricultural anthelmintic agents.

[0003] There are a very small array of chemicals available to effectively control nematodes (Becker (1999) Agricultural Research Magazine 47(3):22-24; US Pat. No. 6,048,714). In general, chemical nematicides are highly toxic compounds known to cause substantial environmental damage and are increasingly restricted in the amounts and locations in which they can be used. For example, the soil fumigant methyl bromide which has been used effectively to reduce nematode infestations in a variety of specialty crops, is regulated under the U.N. Montreal Protocol as an ozone-depleting substance and is undergoing phase out in the US and world wide (Carter (2001) California Agriculture, 55(3):2). It is expected that strawberry and other commodity crop industries will be significantly impacted if a suitable replacement for methyl bromide is not found. Similarly, broad-spectrum nematicides such as Telone (various formulations of 1,3-dichloropropene) have significant restrictions on their use because of toxicological concerns (Carter (2001) California Agriculture, 55(3):12-18). Organophosphate and carbamate pesticides are another important class of nematicides undergoing regulatory review and several of these compounds are currently being phase out (e.g., fenamiphos, terbufos, cadusafos).

[0004] To date little success has been achieved in finding safe effective replacements for the toxic but efficacious conventional nematicides. A recent example of the poor efficacy of many newer potential replacements for organophosphates and carbamates is the study of alternatives to fenamiphos for management of plant parasitic nematodes in bermudagrass. In these trials, none of the experimental treatments reduced population densities of the plant parasitic nematodes, or consistently promoted turf visual performance or turf root production (Crow (2005) Journal of Nematology, 37(4):477-482). Consequently there remains an urgent need to develop environmentally safe, efficacious methods of controlling plant parasitic nematodes Some plant species are known to be highly resistant to nematodes. The best documented of these include marigolds (*Tagetes* spp.), rattlebox *(Crotalaria spectabilis*), chrysanthemums *(Chrysanthemum* spp.), castor bean *(Ricinus communis),* margosa (*Azardiracta indica*), and many members of the family *Asteraceae* (family *Compositae)* (Hackney & Dickerson. (1975) J Nematol 7(1):84-90). In the case of the *Asteraceae,* the photodynamic compound alpha-terthienyl has been shown to account for the strong nematicidal activity of the roots. Castor beans are plowed under as a green manure before a seed crop is set. However, a significant drawback of the castor plant is that the seed contains toxic compounds (such as ricin) that can kill humans, pets, and livestock and is also highly allergenic. In most cases however, the active principle(s) for plant nematicidal activity has not been discovered and it remains difficult to derive commercially successful nematicidal products from these resistant plants or to transfer the resistance to crops of agronomical importance such as soybeans and cotton.

[0005] Genetic resistance to certain nematodes is available in some commercial cultivars (e.g., soybeans), but these are restricted in number and the availability of cultivars with both desirable agronomic features and resistance is limited. Furthermore, the production of nematode resistant commercial varieties by conventional plant breeding based on genetic recombination through sexual crosses is a slow process and is often further hampered by a lack of appropriate germplasm. Chemical means of controlling plant parasitic nematodes continue to be essential for many crops which lack adequate natural resistance or a source of transgenic resistance. In the specialty markets, economic hardship resulting from nematode infestation is particularly high in strawberries, bananas, and other high value vegetables and fruits. In the high-acreage crop markets, nematode damage is greatest in soybeans and cotton. There are however, dozens of

additional crops that suffer from significant nematode infestation including potato, pepper, onion, citrus, coffee, sugarcane, greenhouse ornamentals and golf course turf grasses.

[0006] To be useful in modern agriculture nematicides must have high potency, a broad spectrum of activity against different strains of nematodes and should not be toxic to non-target organisms. Nematode parasites of vertebrates (e.g., humans, livestock and companion animals) include gut roundworms, hookworms, pinworms, whipworms, and filarial worms. They can be transmitted in a variety of ways, including by water contamination, skin penetration, biting insects, or by ingestion of contaminated food.

[0007] In domesticated animals, nematode control or "de-worming" is essential to the economic viability of livestock producers and is a necessary part of veterinary care of companion animals. Parasitic nematodes cause mortality in animals (e.g., heartworm in dogs and cats) and morbidity as a result of the parasites' inhibiting the ability of the infected animal to absorb nutrients. The parasite-induced nutrient deficiency leads to disease and stunted growth in livestock and companion animals. For instance, in cattle and dairy herds, a single untreated infection with the brown stomach worm can permanently restrict an animal's ability to convert feed into muscle mass or milk.

[0008] Two factors contribute to the need for novel anthelmintics and vaccines to control animal parasitic nematodes. First, some of the more prevalent species of parasitic nematodes of livestock are building resistance to the anthelmintic drugs available currently, meaning that these products are losing their efficacy. These developments are not surprising because few effective anthelmintic drugs are available and most have been used continuously. Some parasitic species have developed resistance to most of the anthelmintics (Geents et al. (1997) Parasitology Today 13:149-151; Prichard (1994) Veterinary Parasitology 54:259-268). The fact that many of the anthelmintic drugs have similar modes of action complicates matters, as the loss of sensitivity of the parasite to one drug is often accompanied by side resistance - that is, resistance to other drugs in the same class (Sangster & Gill (1999) Parasitology Today 15(4):141-146). Secondly, there are some issues with toxicity for the major compounds currently available.

[0009] Infections by parasitic nematode worms also result in substantial human mortality and morbidity, especially in tropical regions of Africa, Asia, and the Americas. The World Health Organization estimates 2.9 billion people are infected, and in some areas, 85% of the population carries worms. While mortality is rare in proportion to infections, morbidity is substantial and rivals diabetes and lung cancer in worldwide disability adjusted life year (DALY) measurements.

[0010] Examples of human parasitic nematodes include hookworms, filarial worms, and pinworms. Hookworms (1.3 billion infections) are the major cause of anemia in millions of children, resulting in growth retardation and impaired cognitive development. Filarial worms invade the lymphatics, resulting in permanently swollen and deformed limbs (elephantiasis), and the eyes, causing African river blindness. The large gut roundworm *Ascaris lumbricoides* infects more than one billion people worldwide and causes malnutrition and obstructive bowel disease. In developed countries, pinworms are common and often transmitted through children in daycare.

[0011] Even in asymptomatic parasitic infections, nematodes can still deprive the host of valuable nutrients and increase the ability of other organisms to establish secondary infections. In some cases, infections can cause debilitating illnesses and can result in anemia, diarrhea, dehydration, loss of appetite, or death.

[0012] Despite some advances in drug availability and public health infrastructure and the near elimination of one tropical nematode (the water-borne Guinea worm), most nematode diseases have remained intractable problems. Treatment of hookworm diseases with anthelmintic drugs, for instance, has not provided adequate control in regions of high incidence because rapid re-infection occurs after treatment. In fact, over the last 50 years, while nematode infection rates have fallen in the United States, Europe, and Japan, the overall number of infections worldwide has kept pace with the growing world population. Large scale initiatives by regional governments, the World Health Organization, foundations, and pharmaceutical companies are now underway attempting to control nematode infections with currently available tools, including three programs for control of Onchocerciasis (river blindness) in Africa and the Americas using ivermectin and vector control; The Global Alliance to Eliminate Lymphatic Filariasis using DEC, albendazole, and ivermectin; and the highly successful Guinea Worm Eradication Program. Until safe and effective vaccines are discovered to prevent parasitic nematode infections, anthelmintic drugs will continue to be used to control and treat nematode parasitic infections in both humans and domestic animals.

[0013] Certain insecticidal oxazoles (US 4,791,124) and thiazoles (US 4,908,357) and nematicidal pyrazoles (US 6,310,049) have been disclosed in the art. The present invention discloses other oxazoles, oxadiazoles and thiadiazoles with surprisingly potent nematicidal activity showing activity comparable to commercial standards. Commercial level nematicidal potency has not previously been demonstrated with oxazoles, oxadiazoles and thiadiazoles. Importantly, these compounds are broadly active against nematodes yet safe to non-target organisms.

[0014] US 4,791,124 disclosed certain oxazoles and thiazoles with nematicidal activity against *Meloidogyne incognita* (root knot nematode) at 10 parts per million. However, compounds were not titrated to lower doses and not shown to have potency comparable to commercial standards.

[0015] US 6,310,049 disclosed certain nematicidal pyrazoles with activity against root knot nematode. Several pyrazole compounds are shown having activity at 100 ppm in an *in vitro* assay with a small subset of the compounds having activity at 50 ppm in a soil based greenhouse. One compound is disclosed as having greenhouse activity at 20 ppm and

a single compound as having greenhouse activity at 5 ppm. It is not clear if any of these compounds have potency comparable to commercial standards.

[0016] Some oxadiazoles compounds having substituted furan or thiophene rings but not unsubstituted furan or thiophene rings are disclosed as being apoptosis inducers and useful as chemotherapeutic against certain cancers (Zhang et al. 2005 J Med Chem. 48(16):5215-23). Notwithstanding some superficial chemical similarities the nematicidal analogs of this invention do not induce apoptosis in mammalian cells and have equal potency against wild type *C. elegans* nematodes and ced-3 or ced-4 *C. elegans* mutants deficient in apoptosis. These analogs are therefore structurally and functionally distinct from the apoptosis inducing oxadiazoles disclosed by Cai et al in US 7,041,685. WO 98/57969 discloses compounds having a 1,2,4-oxadiazole substituted by a trifluoropyridine and a phenoxy, benzyloxy, or phenothioxy moiety their use against nematodes.

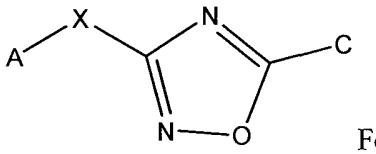
WO 00/35913 discloses compounds having a 1,2,4-oxadiazole substituted by a trifluoropyridine and a heteroaryloxy or heteroarylthioxy and their use against nematodes.

SUMMARY

[0017] Compositions and processes for controlling nematodes are described herein, e.g., nematodes that infest plants or the situs of plants. Nematodes that parasitize animals can also be controlled using the compounds described herein.

[0018] Described herein are nematicidal compositions comprising an effective amount of a compound or a mixture of compounds having any of the formula described herein.

[0019] Described herein is a compound of Formula VIII or a salt thereof,



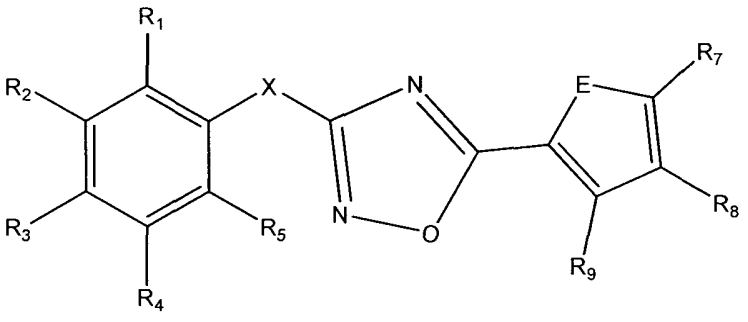
Formula VIII

wherein,

A is an optionally substituted aryl, or optionally substituted arylalkyl, or optionally substituted heteroaryl, or optionally substituted heteroarylalkyl, wherein said substituents are selected from halo, C_1-C_6 haloalkyl, C_6-C_{10} aryl, C_4-C_7 cycloalkyl, C_2-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_6-C_{10} aryl(C_1-C_6)alkyl, C_6-C_{10} aryl(C_2-C_6)alkenyl, C_6-C_{10} aryl(C_2-C_6)alkynyl, C_1-C_6 hydroxyalkyl, amino, ureido, cyano, C_1-C_6 acylamino, hydroxy, thiol, C_1-C_6 acyloxy, azido, C_1-C_6 alkoxy and carboxy, and C(H)O;

C is furanyl, oxazolyl or isoxazolyl, each of which can be optionally independently substituted with one or more substituents selected from fluorine, chlorine, CH_3 and OCF_3; and X is O or S.

[0020] A compound of Formula VIIIa or salt thereof,

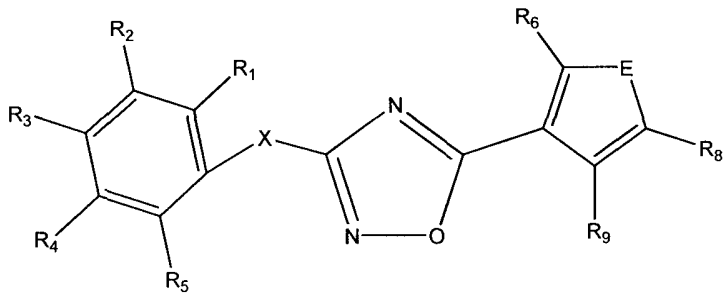


Formula VIIIa

wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, F, Cl, Br, CF_3 and OCF_3
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN and C(H)O;
R_7, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3 and OCF_3;
E is O; and
X is O or S.

[0021] A compound of Formula VIIIb or a salt thereof,



Formula VIIIb

wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, F, Cl, Br, CF_3 and OCF_3;
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN and C(H)O;
R_6, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3 and OCF_3;
E is O; and
X is O or S.

[0022] In certain embodiments: the compound has Formula VIIIb and X and E are both O.

[0023] Also described herein is a method for control of unwanted nematodes, the method comprising administering to plants, seeds or soil a composition comprising an effective amount of a compound of any of Formulas VIII, VIIIa and VIIIb.

[0024] In some cases the method entails controlling plant parasitic nematodes and comprises administering to plant subject to attack by such nematodes, the seeds of such plants or the soil in which such plants are grown or are to be planted.

[0025] Also described is a nematicidal composition comprising a compound of any of Formulas VIII, VIIIa and VIIIb at a concentration sufficient to reduce the viability of a parasitic nematode.

[0026] In some cases, the nematicidal composition further includes an aqueous surfactant. Examples of surfactants that can be used include, Span 20, Span 40, Span 80, Span 85, Tween 20, Tween 40, Tween 80, Tween 85, Triton X 100, Makon 10, Igepal CO 630, Brij 35, Brij 97, Tergitol TMN 6, Dowfax 3B2, Physan and Toximul TA 15. In some cases, the nematicidal composition further includes a permeation enhancer (e.g., cyclodextrin). In some cases, the nematicidal composition further includes a co-solvent. Examples of co-solvents that can be used include ethyl lactate, methyl soyate/ethyl lactate co-solvent blends (e.g., Steposol), isopropanol, acetone, 1,2-propanediol, n-alkylpyrrolidones (e.g., the Agsolex series), a petroleum based-oil (e.g., aromatic 200) or a mineral oil (e.g., paraffin oil)). In some cases, the nematicidal composition further includes another pesticide (e.g., nematicide, insecticide or fungicide) such as an avermectin (e.g., ivermectin), milbemycin, imidacloprid, aldicarb, oxamyl, fenamiphos, fosthiazate, metam sodium, etridiazole, penta-chloro-nitrobenzene (PCNB), flutolanil, metalaxyl, mefonoxam, and fosetyl-al. Useful fungicides include, but are not limited to, silthiofam, fludioxonil, myclobutanil, azoxystrobin, chlorothalonil, propiconazole, tebuconazole and pyraclostrobin. The composition may also comprise herbicides (e.g., trifloxysulfuron, glyphosate, halosulfuron) and other chemicals for disease control (e.g., chitosan).

[0027] Also described is a nematicidal composition comprising: oxadiazole analogs or mixtures of analogs selected from the compounds 3-(4-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole, 3-(3-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

[0028] In various embodiments the composition further comprises an aqueous surfactant. Examples of surfactants that can be used include, Span 20, Span 40, Span 80, Span 85, Tween 20, Tween 40, Tween 80, Tween 85, Triton X 100, Makon 10, Igepal CO 630, Brij 35, Brij 97, Tergitol TMN 6, Dowfax 3B2, Physan and Toximul TA 15. In some cases, the nematicidal composition further includes a permeation enhancer (e.g., cyclodextrin). In some cases, the nematicidal composition further includes a co-solvent. Examples of co-solvents that can be used include ethyl lactate, methyl soyate/ethyl lactate co-solvent blends (e.g., Steposol), isopropanol, acetone, 1,2-propanediol, n-alkylpyrrolidones (e.g., the Agsolex series), a petroleum based-oil (e.g., aromatic 200) or a mineral oil (e.g., paraffin oil)). In some cases, the nematicidal composition further includes another pesticide (e.g., nematicide, insecticide or fungicide) such as an avermectin (e.g., ivermectin), milbemycin, imidacloprid, aldicarb, oxamyl, fenamiphos, fosthiazate, metam sodium, etridiazole, penta-chloro-nitrobenzene (PCNB), flutolanil, metalaxyl, mefonoxam, and fosetyl-al. Useful fungicides include, but are not limited to, silthiofam, fludioxonil, myclobutanil, azoxystrobin, chlorothalonil, propiconazole, tebuconazole and pyraclostrobin. The composition may also comprise herbicides (e.g., trifloxysulfuron, glyphosate, halosulfuron) and other chemicals for disease control (e.g., chitosan).

[0029] Also described is a method for control of unwanted parasitic nematode (e.g., nematodes other than *C. elegans*), the method including administering to plants, seeds or soil a nematicidal composition including a compound of any of the formulae described herein in any of the nematicidal compositions described herein.

[0030] In some instances, the nematode infects plants and the nematicidal composition is applied to the soil or to plants. In some instances, the nematicidal composition is applied to soil before planting. In some instances, the nematicidal composition is applied to soil after planting. In some instances, the nematicidal composition is applied to soil using a drip system. In some instances, the nematicidal composition is applied to soil using a drench system. In some instances, the nematicidal composition is applied to plant roots or plant foliage (e.g., leaves, stems). In some instances the nematicide composition is tilled into the soil or applied in furrow. In some instances, the nematicidal composition is applied to seeds. In some instances, the nematode parasite infects a vertebrate. In some instances, the nematicidal composition is administered to non-human vertebrate. In some instances, the nematicidal composition is administered to a human. In some instances, the nematicidal composition is formulated as a drench to be administered to a non-human animal. In some instances, the nematicidal composition is formulated as an orally administered drug. In some instances, the nematicidal composition is formulated as an injectable drug. In some instances, the nematicidal composition is formulated for topical applications such as pour-ons, or for the use in tags or collars.

[0031] Also described herein is a method of treating a disorder (e.g., an infection) caused by a parasitic nematode, (e.g., *M. incognita, H. glycines, B. longicaudatus, H. contortus, A. suum, B. malayi)* in ahost plant. The method includes administering to the host plant an effective amount of a compound having formula VIII, VIIIa or VIIIb. The compound may be delivered by several means including pre-planting, post-planting and as a feed additive, drench, external application, pill or by injection. Parasitic nematode (e.g., *M. incognita, H. glycines, B. longicaudatus, H. contortus, A. suum, B. malayi*) can be inhibited by contacting the nematode (at any stage of growth), with having Formula VIII, VIIIa or VIIIb.

[0032] Reducing the viability or fecundity or slowing the growth or development or inhibiting the infectivity of a nematode can be achived by using a nematicidal compound having Formula VIII, VIIIa or VIIIb. This can be achieved by contacting the nematode with a compound having Formula VIII, VIIIa or VIIIb; (c) reducing the viability or fecundity of the nematode parasite.

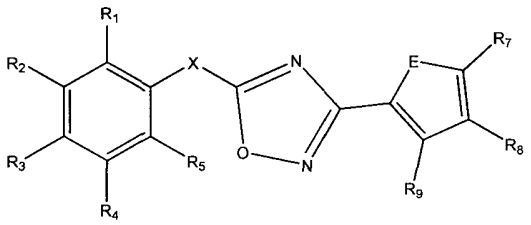
[0033] The viability, growth, or fecundity of a nematode parasite can be achived by exposing the nematode to a compound having Formula VIII, VIIIa or VIIIb. Also described is a method of protecting a plant from a nematode infection, the method comprising applying to the plant, to the soil, or to seeds of the plant an compound a compound having Formula VIII, VIIIa or VIIIb.

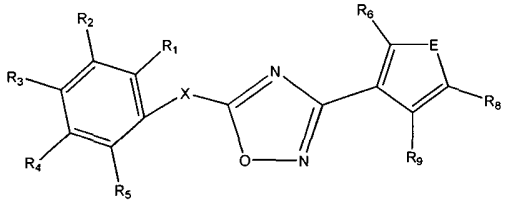
[0034] The compound having VIII, VIIIa or VIIIb can be used for preparing a medicament for protecting a vertebrate (e.g., a bird or a mammal) from a nematode infection. The bird can be a domesticated fowl (e.g., a chicken, turkey, duck, or goose). The mammal can be a domesticated animal, e.g., a companion animal (e.g., a cat, dog, horse or rabbit) or livestock (e.g., a cow, sheep, pig, goat, alpaca or llama) or can be a human.

[0035] Described herein are methods for controlling nematodes parasites by administering to plants, seeds or soil a compound described herein. The methods include administering to plants, seeds or soil a nematicidal composition comprising:

(a) an effective amount of a compound or a mixture of compounds having any of the formulae described herein, for example one of the following formulas:

Formulas: VIIIa VIIIb





wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, F, Cl, Br, CF_3 and OCF_3;
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN and C(H)O;
R_6, R_7, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3 and OCF_3;
E is O; and X is O or S.

[0036] The compositions can also include an aqueous surfactant. Examples of surfactants that can be used include, Span 20, Span 40, Span 80, Span 85, Tween 20, Tween 40, Tween 80, Tween 85, Triton X 100, Makon 10, Igepal CO 630, Brij 35, Brij 97, Tergitol TMN 6, Dowfax 3B2, Physan and Toximul TA 15. In some cases, the nematicidal composition further includes a permeation enhancer (e.g., cyclodextrin). In some cases, the nematicidal composition further includes a co-solvent. Examples of co-solvents that can be used include ethyl lactate, methyl soyate/ethyl lactate co-solvent blends (e.g., Steposol), isopropanol, acetone, 1,2-propanediol, n-alkylpyrrolidones (e.g., the Agsolex series), a petroleum based-oil (e.g., aromatic 200) or a mineral oil (e.g., paraffin oil)). In some cases, the nematicidal composition further includes another pesticide (e.g., nematicide, insecticide or fungicide) such as an avermectin (e.g., ivermectin), milbemycin, imidacloprid, aldicarb, oxamyl, fenamiphos, fosthiazate, metam sodium, etridiazole, penta-chloro-nitrobenzene (PCNB), flutolanil, metalaxyl, mefonoxam, and fosetyl-al. Useful fungicides include silthiofam, fludioxonil, myclobutanil, azoxystrobin, chlorothalonil, propiconazole, tebuconazole and pyraclostrobin. The composition may also comprise herbicides (e.g., trifloxysulfuron, glyphosate, halosulfuron) and other chemicals for disease control (e.g., chitosan).

[0037] Also featured is a method for control of unwanted nematodes comprising administering to plants, seeds or soil a nematicidal composition comprising an effective amount of a compound selected from 3-(4-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole, 3-(3-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

[0038] In certain embodiments of the method the composition further comprises an aqueous surfactant. Examples of surfactants that can be used include, Span 20, Span 40, Span 80, Span 85, Tween 20, Tween 40, Tween 80, Tween 85, Triton X 100, Makon 10, Igepal CO 630, Brij 35, Brij 97, Tergitol TMN 6, Dowfax 3B2, Physan and Toximul TA 15. In some cases, the nematicidal composition further includes a permeation enhancer (e.g., cyclodextrin). In some cases, the nematicidal composition further includes a co-solvent. Examples of co-solvents that can be used include ethyl lactate, methyl soyate/ethyl lactate co-solvent blends (e.g., Steposol), isopropanol, acetone, 1,2-propanediol, n-alkylpyrrolidones (e.g., the Agsolex series), a petroleum based-oil (e.g., aromatic 200) or a mineral oil (e.g., paraffin oil)). In some cases, the nematicidal composition further includes another pesticide (e.g., nematicide, insecticide or fungicide) such as an avermectin (e.g., ivermectin), milbemycin, imidacloprid, aldicarb, oxamyl, fenamiphos, fosthiazate, metam sodium, etridiazole, penta-chloro-nitrobenzene (PCNB), flutolanil, metalaxyl, mefonoxam, and fosetyl-al. Useful fungicides include silthiofam, fludioxonil, myclobutanil, azoxystrobin, chlorothalonil, propiconazole, tebuconazole and pyraclostrobin. The composition may also comprise herbicides (e.g., trifloxysulfuron, glyphosate, halosulfuron) and other chemicals for disease control (e.g., chitosan); the nematode infects plants and the nematicidal composition is applied to the soil or to plants; the nematicidal composition is applied to soil before planting; the nematicidal composition is applied to soil after planting; the nematicidal composition is applied to soil using a drip system; the nematicidal composition is applied to soil using a drench system; the nematicidal composition is applied to plant roots; the pesticidal composition is applied to seeds; the nematicidal composition is applied to the foliage of plants; the nematode infects a vertebrate; the nematicidal composition is administered to a bird or non-human mammal; the nematicidal composition is administered to a human; the nematicidal composition is formulated as a drench to be administered to a non-human animal; the nematicidal composition is formulated as an orally administered drug; and the nematicidal composition is formulated as an injectable drug.

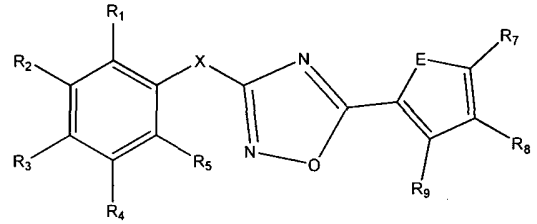
[0039] The methods described hereon are particularly valuable for the control nematodes attacking the roots of desired crop plants, ornamental plants, and turf grasses. The desired crop plants can be, for example, soybeans, cotton, corn, tobacco, wheat, strawberries, tomatoes, banana, sugar cane, sugar beet, potatoes, or citrus.

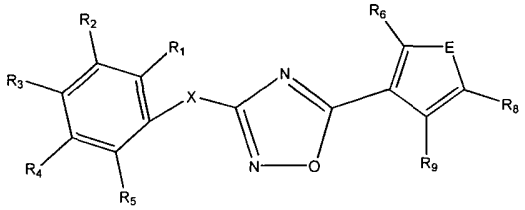
[0040] Also described is a nematicidal feed for a non-human vertebrate including: (a) a feed; and (b) a nematicidal composition, including a nematicidal composition described herein.

[0041] In some instances, the feed is selected from soy, wheat, corn, sorghum, millet, alfalfa, clover, and rye.

[0042] Also described are feeds that have been supplemented to include one or more of the compounds described herein.

[0043] A nematicidal feed for a non-human vertebrate can comprise: (a) an animal feed; and (b) an effective amount of a nematicidal compound or mixtures of compounds having any of the formulae described herein, for example having one of the formula below:





Formulas: VIIIa VIIIb

wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, F, Cl, Br, CF_3 and OCF_3;
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN and C(H)O;
R_6, R_7, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3 and OCF_3;
E is O; and X is O or S.

[0044] The feed can be selected from soy, wheat, corn, sorghum, millet, alfalfa, clover, and rye.

[0045] As used herein, an agent with "anthelmintic or anthelminthic or antihelminthic activity" is an agent, which when tested, has measurable nematode-killing activity or results in reduced fertility or sterility in the nematodes such that fewer viable or no offspring result, or compromises the ability of the nematode to infect or reproduce in its host, or interferes with the growth or development of a nematode. The agent may also display nematode repellant properties. In the assay, the agent is combined with nematodes, e.g., in a well of microtiter dish, in liquid or solid media or in the soil containing the agent. Staged nematodes are placed on the media. The time of survival, viability of offspring, and/or the movement of the nematodes are measured. An agent with "anthelmintic or anthelminthic or antihelmthic activity" can, for example, reduce the survival time of adult nematodes relative to unexposed similarly staged adults, e.g., by about 20%, 40%, 60%, 80%, or more. In the alternative, an agent with "anthelmintic or anthelminthic or antihelminthic activity" may also cause the nematodes to cease replicating, regenerating, and/or producing viable progeny, e.g., by about 20%, 40%, 60%, 80%, or more. The effect may be apparent immediately or in successive generations.

[0046] The term "halo" or "halogen" refers to any radical of fluorine, chlorine, bromine or iodine.

[0047] The term "alkyl" as employed herein by itself or as part of another group refers to both straight and branched chain radicals of up to ten carbons. Typical C1-10 alkyl groups include methyl, ethyl, propyl, isopropyl, butyl, sec-butyl, tert-butyl, 3-pentyl, hexyl and octyl groups.

[0048] The term "alkenyl" as employed herein by itself or as part of another group means a straight or branched chain radical of 2-10 carbon atoms, unless the chain length is limited thereto, including at least one double bond between two of the carbon atoms in the chain. Typical alkenyl groups include ethenyl, 1-propenyl, 2-propenyl, 2-methyl-1-propenyl, 1-butenyl and 2-butenyl.

[0049] The term "alkynyl" is used herein to mean a straight or branched chain radical of 2-10 carbon atoms, unless the chain length is limited thereto, wherein there is at least one triple bond between two of the carbon atoms in the chain. Typical alkynyl groups include ethynyl, 1-propynyl, 1-methyl-2-propynyl, 2-propynyl, 1-butynyl and 2-butynyl.

[0050] Alkoxy groups contain oxygen substituted by one of the C1-10 alkyl groups mentioned above. Alkylthio groups contain sulfur substituted by one of the C1-10 alkyl groups mentioned above. Amino groups include -N2, $-NHR_{15}$ and $-NR_{15}R_{16}$, wherein R_{15} and R_{16} are C1-10 alkyl or cycloalkyl groups, or R_{15} and R_{16} are combined with the N to form a ring structure, such as a piperidine, or R_{15} and R_{16} are combined with the N and other group to form a ring, such as a piperazine.

[0051] The term "aryl" as employed herein by itself or as part of another group refers to monocyclic, bicyclic or tricyclic aromatic groups containing from 6 to 14 carbons in the ring.

[0052] Common aryl groups include C6-14 aryl, preferably C6-10 aryl. Typical C6-14 aryl groups include phenyl, naphthyl, phenanthrenyl, anthracenyl, indenyl, azulenyl, biphenyl, biphenylenyl and fluorenyl groups.

[0053] Cycloalkyl groups are C3-8 cycloalkyl. Typical cycloalkyl groups include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl and cycloheptyl.

[0054] The term "arylalkyl" is used herein to mean any of the above-mentioned C1-10 alkyl groups substituted by any of the above-mentioned C6-14 aryl groups. Preferably the arylalkyl group is benzyl, phenethyl or naphthylmethyl. Preferred arylalkyl groups are aryl C1 alkyl and aryl C2 alkyl. The term "arylalkenyl" is used herein to mean any of the above-mentioned C2-10 alkenyl groups substituted by any of the above-mentioned C6-14 aryl groups.

[0055] The term "arylalkynyl" is used herein to mean any of the above-mentioned C2-10 alkynyl groups substituted by any of the above-mentioned C6-14 aryl groups.

[0056] The term "aryloxy" is used herein to mean oxygen substituted by one of the above-mentioned C6-14 aryl groups. Common aryloxy groups include phenoxy.

[0057] The term "arylalkoxy" is used herein to mean any of the above mentioned C1-10 alkoxy groups substituted by any of the above-mentioned aryl groups. Example arylalkoxy groups include benzyloxy and phenethyloxy.

[0058] Example haloalkyl groups include C1-10 alkyl groups substituted by one or more fluorine, chlorine, bromine or iodine atoms, e.g., fluoromethyl, difluoromethyl, trifluoromethyl, pentafluoroethyl, 1,1-difluoroethyl, chloromethyl, chlorofluoromethyl and trichloromethyl groups.

[0059] Acylamino (acylamido) groups include any C1-6 acyl (alkanoyl) attached to an amino nitrogen, e.g., acetamido, chloroacetamido, propionamido, butanoylamido, pentanoylamido and hexanoylamido, as well as aryl-substituted C1-6 acylamino groups, e.g., benzoylamido, and pentafluorobenzoylamido. Common acyloxy groups are any C1-6 acyl (al-

kanoyl) attached to an oxy (-O-) group, e.g., formyloxy, acetoxy, propionoyloxy, butanoyloxy, pentanoyloxy and hexanoyloxy.

[0060] The term heterocycle is used herein to mean a saturated or partially saturated 3-7 membered monocyclic, or 7-10 membered bicyclic ring system, which consists of carbon atoms and from one to four heteroatoms independently selected from O, N, and S, wherein the nitrogen and sulfur heteroatoms can be optionally oxidized, the nitrogen can be optionally quaternized, and including any bicyclic group in which any of the above-defined heterocyclic rings is fused to a benzene ring. Common saturated or partially saturated heterocyclic groups include tetrahydrofuranyl, pyranyl, piperidinyl, piperazinyl, pyrrolidinyl, imidazolidinyl, imidazolinyl, indolinyl, isoindolinyl, quinuclidinyl, morpholinyl, isochromanyl, chromanyl, pyrazolidinyl pyrazolinyl, tetronoyl and tetramoyl groups.

[0061] The term "heteroaryl" as employed herein refers to groups having 5 to 14 ring atoms; 6, 10 or 14 π electrons shared in a cyclic array; and containing carbon atoms and 1, 2 or 3 oxygen, nitrogen or sulfur heteroactoms.

[0062] Example heteroaryl groups include thienyl (thiophenyl), benzo[b]thienyl, naphtho[2,3-b]thienyl, thianthrenyl, furyl (furanyl), pyranyl, isobenzofuranyl, chromenyl, xanthenyl, phenoxanthiinyl, pyrrolyl, including without limitation 2H-pyrrolyl, imidazolyl, pyrazolyl, pyridyl (pyridinyl), including without limitation 2-pyridyl, 3-pyridyl, and 4-pyridyl, pyrazinyl, pyrimidinyl, pyridazinyl, indolizinyl, isoindolyl, 3H-indolyl, indolyl, indazolyl, purinyl, 4H-quinolizinyl, isoquinolyl, quinolyl, phthalzinyl, naphthyridinyl, quinozalinyl, cinnolinyl, pteridinyl, carbazolyl, β-carbolinyl, phenanthridinyl, acrindinyl, perimidinyl, phenanthrolinyl, phenazinyl, isothiazolyl, phenothiazinyl, isoxazolyl, furazanyl, phenoxazinyl, 1,4-dihydroquinoxaline-2,3-dione, 7-aminoisocoumarin, pyrido[1,2-α]pyrimidin-4-one, pyrazolo[1,5-α]pyrimidinyl, including without limitation pyrazolo[1,5-α]pyrimidin-3-yl, 1,2-benzoisoxazol-3-yl, benzimidazolyl, 2-oxindolyl and 2-oxobenzimidazolyl. Where the heteroaryl group contains a nitrogen atom in a ring, such nitrogen atom may be in the form of an N-oxide, e.g., a pyridyl N-oxide, pyrazinyl N-oxide and pyrimidinyl N-oxide.

[0063] The term "heteroaryloxy" is used herein to mean oxygen substituted by one of the above-mentioned heteroaryl groups. Useful heteroaryloxy groups include pyridyloxy, pyrazinyloxy, pyrrolyloxy, pyrazolyloxy, imidazolyloxy and thiophenyloxy.

[0064] The term "heteroarylalkoxy" is used herein to mean any of the above-mentioned C1-10 alkoxy groups substituted by any of the above-mentioned heteroaryl groups. A preferred pyrrolalkyl is pyrrol C1 alkyl. Preferred furanlalkyl, thienylalkyl, oxazolyalkyl and isoxazolylalkyl groups are furanl C1 alkyl, thienyl C1 alkyl, oxazoly C1 alkyl and isoxazolyl C1 alkyl, respectively.

[0065] A permeation enhancer is generally an agent that facilitates the active compounds of the invention. A co-solvent (i.e., a latent solvent or indirect solvent) is an agent that becomes an effective solvent in the presence of an active solvent and can improve the properties of the primary (active) solvent. The composition can be produced in concentrated form that includes little or no water. The composition can be diluted with water or some other solvent prior to use to treat plants, seeds, soil or vertebrates.

[0066] The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DETAILED DESCRIPTION

[0067] Described herein are certain compounds, which are oxadiazole analogs with potent broad spectrum nematicidal activity.

[0068] The nematicidal compounds may be supplied to plants exogenously, through sprays for example. These compounds may also be applied as a seed coat. The compounds can be applied to plants or the environment of plants needing nematode control, or to animals or the food of animals needing nematode parasite control. The compositions may be applied by, for example drench or drip techniques. With drip applications compounds can be applied directly to the base of the plants or the soil immediately adjacent to the plants. The composition may be applied through existing drip irrigation systems. This procedure is particularly applicable for cotton, strawberries, tomatoes, potatoes, vegetables and ornamental plants. Alternatively, a drench application can be used where a sufficient quantity of nematicidal composition is applied such that it drains to the root area of the plants. The drench technique can be used for a variety of crops and turf grasses. The drench technique can also be used for animals. Preferably, the nematicidal compositions would be administered orally to promote activity against internal parasitic nematodes. Nematicidal compositions may also be administered in some cases by injection of the host animal or by topical applications.

[0069] The concentration of the nematicidal composition should be sufficient to control the parasite without causing significant phytotoxicity to the desired plant or undue toxicity to the animal host. The compounds disclosed in this invention have a good therapeutic window.

[0070] We have surprisingly found that certainoxadiazole analogs (e.g., 3-(4-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole, 3-(3-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole) have nematicidal potencies comparable with organophosphate and carbamate standards yet display excellent selectivity for nematodes over plants and animals. Thus,

these analogs will provide useful compounds for nematode parasite control.

[0071] The nematicidal agents described herein can be applied in conjunction with another pesticidal agents. The second agent may, for example, be applied simultaneously or sequentially. Such pesticidal agents can include for example, avermectins for animal applications.

[0072] The aforementioned nematicidal compositions can be used to treat diseases or infestations caused by nematodes of the following non-limiting, exemplary genera: *Anguina, Ditylenchus, Tylenchorhynchus, Pratylenchus, Radopholus, Hirschmanniella, Nacobbus, Hoplolaimus, Scutellonema, Rotylenchus, Helicotylenchus, Rotylenchulus, Belonolaimus, Heterodera, other cyst nematodes, Meloidogyne, Criconemoides, Hemicycliophora, Paratylenchus, Tylenchulus, Aphelenchoides, Bursaphelenchus, Rhadinaphelenchus, Longidorus, Xiphinema, Trichodorus,* and *Paratrichodorus, Dirofiliaria, Onchocerca, Brugia, Acanthocheilonema, Aelurostrongylus, Anchlostoma, Angiostrongylus, Ascaris, Bunostomum, Capillaria, Chabertia, Cooperia, Crenosoma, Dictyocaulus, Dioctophyme, Dipetalonema, Dracunculus, Enterobius, Filaroides, Haemonchus, Lagochilascaris, Loa, Manseonella, Muellerius, Necator, Nematodirus,*

[0073] *Oesophagostomum,Ostertagia, Parafilaria, Parascaris, Physaloptera, Protostrongylus, Setaria, Spirocerca, Stephanogilaria, Strongyloides, Strongylus, Thelazia, Toxascaris, Toxocara, Trichinella, Trichostrongylus, Trichuris, Uncinaria,* and *Wuchereria.* Particularly preferred are nematodes including *Dirofilaria, Onchocerca, Brugia, Acanthocheilonema, Dipetalonema, Loa, Mansonella, Parafilaria, Setaria, Stephanofilaria,* and *Wucheria, Pratylenchus, Heterodera, Meloidogyne, Paratylenchus.* Species that are particularly preferred are: *Ancylostoma caninum, Haemonchus contortus, Trichinella spiralis, Trichurs muris, Dirofilaria immitis, Dirofilaria tenuis, Dirofilaria repens, Dirofilari ursi, Ascaris suum, Toxocara canis, Toxocara cati, Strongyloides ratti, Parastrongyloides trichosuri, Heterodera glycines, Globodera pallida, Meloidogyne javanica, Meloidogyne incognita,* and *Meloidogyne arenaria, Radopholus similis, Longidorus elongatus, Meloidogyne hapla,* and *Pratylenchus penetrans.*

[0074] The following examples further illustrate the invention.

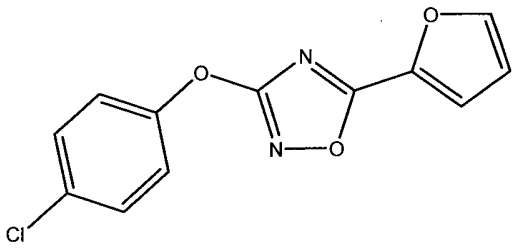
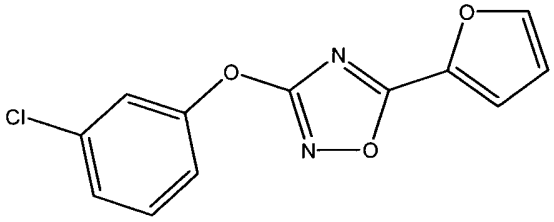
EXAMPLES

Example 1: *M. incognita* testing of several nematicidal compounds in a miniaturized greenhouse assay.

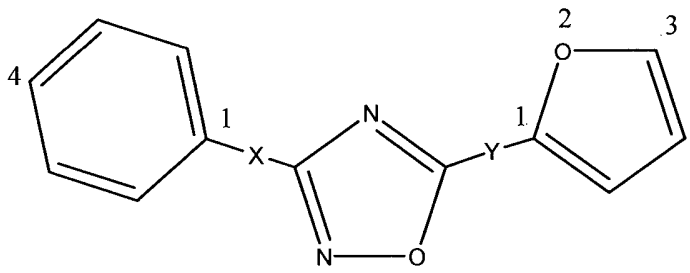
[0075] Overview: The test compound is dissolved in an acetone solution and added to water. A sprouted cucumber seedling is placed into a vial with dry sand and the water-chemical solution is added immediately. Twenty four hours later *Meloidogyne incognita* eggs are added to the vials and 10 to 12 days later the roots are evaluated for nematode galling.

[0076] Procedure: Cucumber seeds are sprouted for 3 days in moist paper towels. Acceptable sprouts should be 3 to 4 cm long with several lateral roots just emerging. Stock solutions of chemistry are prepared in a mixture of acetone and Triton X100 (412 mg in 500 ml) to a final concentration of 5 mg/ml. The chemical stock solution is then added to 10 ml deionized water plus 0.015% Triton X100 and mixed thoroughly. This is enough to test each condition in triplicate. Ten ml dry sand is added to each vial. At this time the solubility of the chemistry is visually determined and recorded as either ppt (large precipitates) or cloudy (fine precipitates). Seedlings are planted by tilting the vial and laying the seedling in the correct orientation so that the cotyledons are just above the sand and then tilting back to cover the radicles with sand. 3.3 ml water/chemical mix is added to each vial and the vials placed in racks under fluorescent light banks. The vials are inoculated two days after planting by adding 500 vermiform *M. incognita* eggs to each vial in 50 uL of deionized or spring water. The vials are then kept under the fluorescent lamps at ambient room temperature and watered as needed with 1 ml deionized water, usually twice during duration of test. Harvest of the cucumber plants is done 10 to 12 days after inoculation by washing sand off the roots. A root gall rating and visual phytotoxicity rating is assigned using the following scales: Gall rating scale (Gall: % root mass galled): 0 = 0-5%; 1 = 6-20%; 2 = 21-50%; and 3 = 51-100%. The average of the triplicate gall rating is then calculated: green = 0.00-0.33 (no galls); yellow = 0.67-1.33 (mild galling); orange = 1.67-2.33 (moderate galling); red = 2.67-3.00 (severe galling). Visual phytotoxicity scale is also assigned (Vis. tox; visual reduction in root mass compared to the control): rs1 = mild stunting; rs2 = moderate stunting; rs3 = severe stunting.

Table 1: Potent nematicidal oxadiazole 2-furan analogs showing examples of substitutions compatible with high activity

Name	Analog	8 ppm gall ratings
3		0
4		0
Oxamyl (1ppm)		1.33
*Data are taken from the same test.		

[0077] A variety of single or double substitutions on the six membered aromatic ring of the phenyl-2-furan oxadiazoles are compatible with high nematicidal activity. Examples of preferred single substitutions include but are not limited to halogens, CH_3, CF_3, OCF_3 and OCH_3 especially in the para position (4-position) of the phenyl ring. The phenyl ring can also be multiply substituted in a way compatible with high nematicidal efficacy. Ring numbering system is shown below.



Example 2: General greenhouse testing protocols

[0078] Soybean planting and growth: Soybeans seeds are planted in 100% sand in two inch square plastic pots. Chemical treatment is done when the soybeans show the first trifoliate beginning to emerge about 10 to 12 days after planting. At least four hours after chemical application the nematode soybean cyst nematode (SCN) eggs are applied and 28 days after the egg inoculation the test is harvested.

[0079] Cucumber planting and growth: Cucumber seeds are planted in a sandy soil mixture in two inch square plastic pots. When the cotyledons are fully opened and just as the first leaf begins to emerge, usually 7 days after planting, chemistry for the 7-day treatment is applied. One week later the chemistry for the 0 day treatment is applied. Separate plants are used for each application. The plants are generally in the 1-2 leaf stage now. At least four hours after the chemistry application the pots are inoculated with root knot nematode (RKN) eggs. Plants are rated for galling 14 days after the egg inoculation.

[0080] Chemical formulation and application: One milligram of chemistry per four pots is equal to one kilogram per hectare of chemical. A standard test uses four replications. For rates above 2 kg/ha, the desired amount of chemical is weighed into a 30 ml vial (example: 8 kg/ha rate = 8 mg chemical in 30 ml vial). The chemical is dissolved in 2 ml of appropriate solvent, generally acetone. For rates below 2 kg/ha, 2 milligrams of chemistry is weighed into the vial and dissolved in 2 ml of the solvent. The appropriate amount of chemical concentrate is then pipetted into a separate 30 ml

vial and solvent is added to bring the volume to 2 ml (example 0.5 kg/ha = 0.5 ml of concentrate + 1.5 ml solvent). Each dissolved concentrate is then brought to a total of 20 milliliters using 0.05% Triton X 100 surfactant solution.

[0081] Chemical and nematode application: Pots to be treated are moist but not saturated. To each of four pots, five milliliters of the appropriate chemical solution is pipetted to the media surface making sure to avoid contact with the base of the plant. Immediately following chemical application, using a mist nozzle, the pot surface is wetted sufficiently to saturate the pot watering in the chemistry. The chemical application is done in the morning.

[0082] Nematode eggs, either SCN or RKN, are added to distilled water to create a concentration of 1000 vermiform eggs per liter of water. At least four hours after chemical treatment the eggs are applied to the treated pots plus non-treated check plants. A small hole about 1 cm deep is punched into the pot surface. One milliliter of the nematode egg slurry is pipetted into the hole. Immediately afterwards the hole is gently covered. Watering of the test plants is then restricted to only water as needed to prevent wilt for a period of 24 hours. After the 24 hour restricted watering, normal subirrigation watering is done for the duration of the test.

Table 2A: RKN greenhouse soil assay on cucumber plants

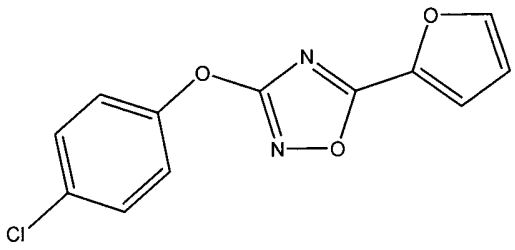
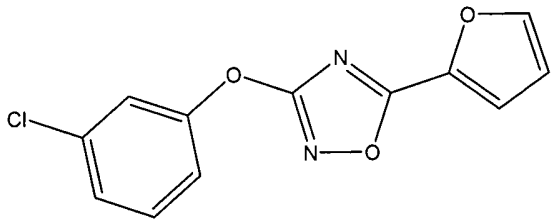
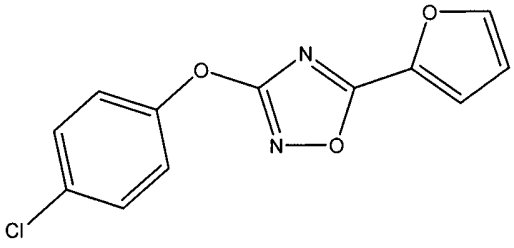
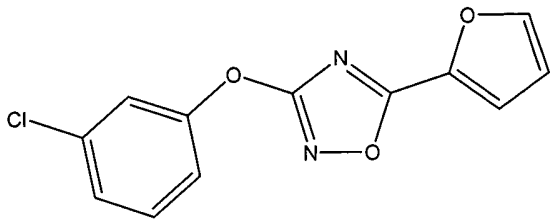
Name	Analog	0 day 1 kg/ha rate*
3		89%
4		83%
Fenamiphos		100%
*Data shows percent control (i.e., galling reduction) relative to the control blank treatment. Data are taken from the same test.		

Table 2B: SCN greenhouse soil assay on soybean plants

Name	Analog	0 day 0.25 kg/ha rate*
3		79%[a], 79%[b]

(continued)

Name	Analog	0 day 0.25 kg/ha rate*
4		67%[a], 78%[b]
Oxamyl		67%[b]
Fenamiphos		90%[a]
*Data shows percent control (i.e., cyst reduction) relative to the control blank treatment. Data with the same letters are taken from the same test.		

[0083] Certain oxadiazoles are highly efficacious nematicides in bioactive soil with potencies comparable to fenamiphos and oxamyl.

Example 3: *Belonalaimus longicaudatus* (sting nematode) testing protocols

[0084] Populations of sting *(Belonolaimus longicaudatus)* nematodes are maintained on St. Augustine turf grass on soil in 15-cm pots. At test initiation the turf is removed from the pots and the soil containing nematode eggs, juveniles, and adults is subdivided into pots each containing a volume of 125 cm^3. The compounds to be tested are dissolved in 3 ml of acetone using 3, 6, or 15 mg to achieve equivalent surface area application rates of 2, 4, or 10 kg/ha, respectively. The 3 ml acetone stock solution is added to 30 ml of water, and 5 ml of that solution is used to drench each of 6 replicate test pots prepared as described above. The treated pots containing nematodes are incubated in the laboratory at ambient temperature of approximately 25 °C. After 3 days the soil from each pot is washed onto a modified Baermann apparatus comprised of a screen supporting a layer of filter paper on which the soil sample is placed and set in a dish of water. The samples are then incubated at 25 °C for 24 hours to allow the live nematodes to migrate through the paper and screen and into a water reservoir to be collected for counting with a light microscope. Nematodes that have been killed or immobilized by the test compounds are not able to migrate into the reservoir.

Example 4: *C. elegans* testing protocols

[0085] Various compounds were tested for nematicidal activity against *C. elegans* using contact assays in wells. The assays were performed as described below. The test compounds were solubilized in DMSO at 10 mg/ml to create 100X stock solutions. A dilution series was created by diluting the stock solution with DMSO. For each well assay 4 μl of the appropriate dilution is added to a well of a test plate.

[0086] A 400 ul aliquot of bacterial stock (in M9 buffer with ampicillin and nystatin) are added to each well of the test plate. Worms are added and the test plate placed on a rotary shaker and held at 20 °C. Worms are examined and scored at 4 h, 24 h, 48 h and 72 h.

[0087] L1 worms and L4 worms were used in the assay. L1 worms are prepared by plating eggs on a plate without a bacterial feeding layer. The eggs hatch and arrest at the L1 stage. This L1 stage population is then used to create a stock for the experiments. To create an L4 stage stock a small number of worms are taken from an overgrown and starved plate of worms and seeded on a plate with a bacterial feeder layer. A 25 μl aliquot of worms is added to each well in the assay.

[0088] To demonstrate that these compounds do not affect nematodes by induction of apoptosis, *Caenorhabditis elegans* mutants defective in the apoptotic pathway, *ced-3*(n717) and *ced-4*(N1162) mutants (Ellis HM, Horvitz HR. Genetic control of programmed cell death in the nematode C. elegans. 1986 Cell 44:817-829), were evaluated for susceptibility to 10 μg/ml DC5823 on NGM agar plates. No observable phenotypic difference in susceptibility between the wild-type C. *elegans* strain (N2 Bristol) and the *ced-3* and ced-4 mutants were observed, including time to mortality. These data indicate that the claimed structures do not affect apoptosis in either mammalian cells or nematodes.

Example 5: Mouse acute toxicity testing.

[0089] Acute oral toxicity testing was performed in mice in accordance with test method P203.UDP, as administered by Eurofins/Product Safety Laboratories (Dayton, New Jersey). CD-1/Swiss derived albino mice were obtained and group housed in suspended solid bottom caging. The mice were fed rodent chow and filtered tap water was supplied *ad libitum.* Following acclimation to the laboratory setting, a group of animals was fasted overnight by removing food from the cages. After the fasting period, three female mice were selected based on vitality and initial body weights. The individual compound doses were calculated from these body weights.

[0090] The test substance was prepared as a 1% (50 mg/kg) or 5% (500 mg/kg) weight to weight (w/w) mixture in a 0.5% w/w solution of carboxymethylcellulose (CMC) in distilled water. A tissue homogenizer was used to create a homogeneous mixture. A dose of 50 or 500 mg/kg was administered to three healthy mice per dose level by oral intubation using a ball-tipped gavage needle attached to a syringe. After administration, the animals were returned to their cages, and feed was replaced immediately after dosing.

[0091] The animals were observed for mortality, signs of gross toxicity and behavioral changes during the first several hours post dosing and at least once daily for up to 14 days. Body weights were recorded prior to initiation and on Days 7 and 14 or a soon as possible after death.

Example 6: Advanced greenhouse testing protocols

[0092] Pre-plant incorporated test (PPI): The PPI test examines the effect of pre-incorporation of compounds in soil and longer aging to simulate in furrow methods of nematicide application in the field. The PPI test exposes compounds to a higher volume of soil and drying which can result in more severe soil binding. Compounds are also aged for longer periods which can lead to more extensive biotic and abiotic degradation further limiting activity.

[0093] The chemically treated soil (sandy soil mix) for all treatment days (e.g., 7 days, 14 days, 21 days) treatments is potted into their appropriate pots. On the same day the 7 day treatment pots are seeded. One week later eggs are applied and 14 days after egg application the test is harvested. The 14 day treatments are planted 7 days after the first planting. The 14 day planting and 7 day inoculation happen on the same day. One week later the 14 day treatments are inoculated with eggs. These are harvested 14 days after the inoculation. The 21 day treatments are planted 14 days after the first planting. The 14 day inoculation and 21 day planting are done on the same day. One week later the 21 day plants are inoculated with eggs. The 7 day treatment is harvested the same day as the 21 day inoculation. Fourteen days after inoculation the 21 day plants are harvested.

Treatment	Planting	Inoculation	Harvest
7 day	day 0	day 7	day 21
14 day	day 7	day 14	day 28
21 day	day 14	day 21	day 35

[0094] For each compound a stock is prepared using 4 mg material in 4 ml of acetone. The soil is mixed by placing 80 ml of field soil and 320 ml of sand in a plastic bag and mixing well. The formulation for treatment is done by adding 2.13 ml (8 kg/ha rate), 1.06 ml (4 kg/ha rate) or 0.53 ml (2 kg/ha rate) to a vial and raising it with 10 ml in 0.05% X100. Soil is then treated by adding the entire 10 ml to the 400 ml of mix in the bag. The treated soil is immediately mixed well in the sealed bag to distribute the compound evenly. Approximately 95 ml is used to fill each 5.1 cm (2-inch) square pot up to the top with some soil compression and flattening. For each compound and for the control treatments 4 pots are filled. All pots are watered until moist but with no run-out through the bottom.

[0095] The PPI test simulates 8, 4 and 2 kg/ha rates incorporated 15 cm deep in the field and is equivalent to the 2, 1 and 0.5 kg/ha drench application rates in the standard 5.1 cm (2-inch) pot cucumber greenhouse assay.

Example 9: Seed treatment test of root knot nematode on cucumber plants and soybean cyst nematode on soybean plants

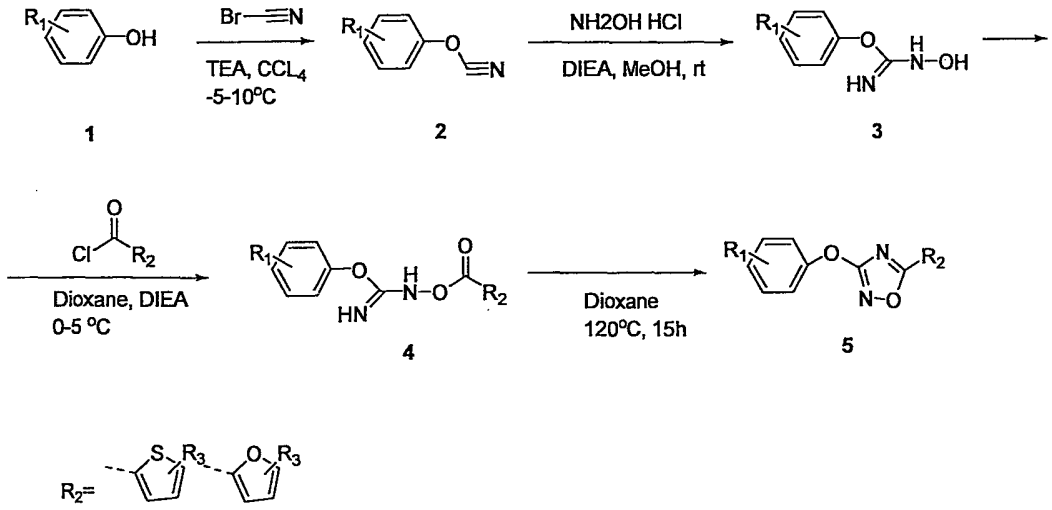
[0096] For a given concentration the chemical is dissolved in 500 μl of acetone and one gram of cucumber seed (RKN test) or soybean seed (SCN test) is added (e.g., 20 mg active ingredient in 500 ul acetone plus 1 gram of seed). The seed solutions are agitated until all seeds were thoroughly covered with the chemical solution. The acetone is then allowed to evaporate by air drying the seeds. The seeds are planted in 5.1 cm (2-inch) pots containing sandy soil and then the pots are inoculated with 1000 *Meloidogyne incognita* (RKN) or 1000 *Heterodera glycines* (SCN) eggs per pot three days after planting. Plants are rated for galling 14 days after egg inoculation for RKN or 28 days after egg inoculation for SCN.

Example 10: Description of synthesis of the compounds of the Formula VIII.

[0097] The compounds of this invention of the Formula VIII may be prepared using methods known to those skilled in the art.

[0098] Specifically, the compounds of this invention with Formula VIIIa can be prepared as illustrated by the exemplary reaction in Scheme 1.

Scheme 1: Synthetic scheme to compounds of the Formula VIIIa



[0099] First, cyanogen bromide in tetrachloromethane is reacted with the appropriate phenol analog 1 in the presence of triethylamine to give the corresponding cyanate 2 which in the next step is converted to the corresponding amidoxime 3 by reacting with hydroxylamine in methanol in the presence of DIEA. Then, the amidoxime 3 is reacted with the appropriate analog of acyl chloride to give a linear precursor 4 which after cyclization yields the desired 3,5-disubstituted-1,2,4-oxadiazole 5.

Formula VIIIa Example: 3-(4-Chloro-phenoxy)-5-furan-2-yl-[1,2,4]oxadiazole

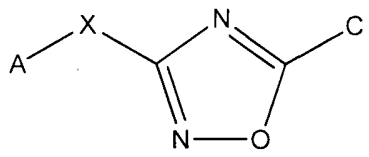
[0100] The solution of cyanogen bromide (222 mg, 2.1 mmol, 1.05 eq) in tetrachloromethane (1.5 ml) was cooled down to -5 °C. A solution of 4-chlorophenol (256 mg, 2 mmol, 1 eq) in of tetrachloromethane (1.5 ml) was added in one portion to the mixture. The resulting mixture was stirred vigorously while TEA (0.28 ml, 2 mmol, 1 eq) was added dropwise. After an additional 15 min stirring reaction was completed (monitored by LCMS). Reaction mixture was diluted with water and product was extracted with CH_2Cl_2 (2 x 50 ml). Organic phases were combined, washed with brine (2 x 50 ml), dried over anh. $N_{a2}SO_4$ and evaporated *in vacuo* to provide desired cyanate (200 mg, 65%), which was used in the next step of synthesis without further purification.

[0101] To the solution of 1-chloro-4-cyanatobenzene (200 mg, 1.3 mmol, 1 eq) in MeOH (2 ml) was added NH2OH hydrochloride (160 mg, 2.3 mmol, 1.8 eq) followed by DIEA (0.45 ml, 2,6 mmol, 2 eq) at 5 °C. After 15 min stirring at room temperature reaction was completed (by LCMS). Reaction mixture was diluted with 2M HCl (30 ml) and extracted with EtOAc (2 x 30 mL). The combined aqueous layers were adjusted to pH 8 with 2M sodium hydroxide and product was extracted with EtOAc (2 x 40 ml) and washed with brine (2 x 40 ml). Organic layer was dried over anhydrous Na_2SO_4, and concentrated *in vacuo* to give target 4-chlorophenyl hydroxycarbamimidate in a yield of 70%. Compound was used in the next step of synthesis without further purification.

[0102] To the mixture of 4-chlorophenyl hydroxycarbamimidate (0.5 mmol. 1 eq) and DIEA (1.25 mmol, 2.5 eq) in dioxane was added dropwise furan-2-carbonyl chloride (0.53 mmol, 1.05 eq) at 0 - 5 °C. The mixture was allowed to warm to room temperature and then stirred for 0.5-1 h or until complete as determined by LC-MS analysis of the reaction mixture. The cyclodehydration reaction was run at reflux (115-120 °C) overnight. The mixture was cooled down and solvent was removed *in vacuo*. The resulting residue was purified by HPLC purification to provide desired 3-(4-Chloro-phenoxy)-5-furan-2-yl-[1,2,4]oxadiazole in a yield of 50% and purity of 99.9%. LC-MS [M+H] 263.3 (C12H7ClN2O3+H, requires 263.65). ^{1}H NMR (DMSO-d_6) δ 8.17 (d, 1H, J = 1.75), 7.63 (d, 1H, J = 3.5), 7.55 (d, 2H, J = 8.8), 7.46 (d, 2H, J = 8.8), 6.87 (m, 1H).

Claims

1. A compound of Formula VIII or a salt thereof,

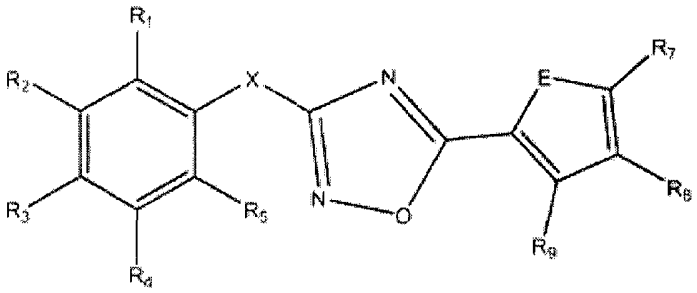


Formula VIII

wherein,

A is an optionally substituted aryl, or optionally substituted arylalkyl, or optionally substituted heteroaryl, or optionally substituted heteroarylalkyl, wherein said substituents are selected from halo, C_1-C_6 haloalkyl, C_6-C_{10} aryl, C_4-C_7 cycloalkyl, C_2-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_6-C_{10} aryl(C_1-C_6)alkyl, C_6-C_{10} aryl(C_2-C_6)alkenyl, C_6-C_{10} aryl(C_2-C_6) alkynyl, C_1-C_6 hydroxyalkyl, amino, ureido, cyano, C_1-C_6 acylamino, hydroxy, thiol, C_1-C_6 acyloxy, azido, C_1-C_6 alkoxy and carboxy, and C(H)O;
C is furanyl, oxazolyl or isoxazolyl, each of which can be optionally independently substituted with one or more substituents selected from fluorine, chlorine, CH_3 and OCF_3; and
X is O or S.

2. The compound of claim 1 of Formula VIIIa or a salt thereof,

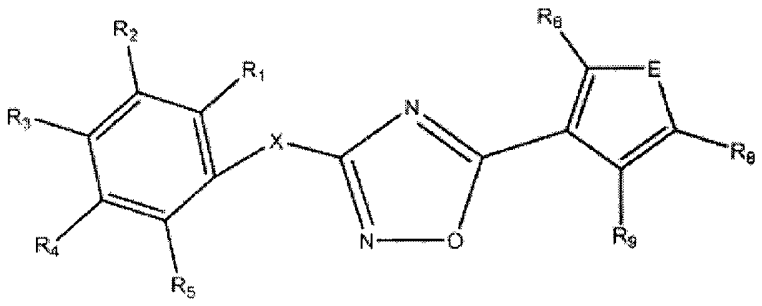


Formula VIIIa

wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, OCH_3, F, Cl, Br, CF_3 and OCF_3;
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br, CH_3, and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN, and C(H)O;
R_7, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3, and OCF_3;
E is O; and
X is O or S.

3. The compound of claim 1 of Formula VIIIb or a salt thereof,



Formula VIIIb

wherein,

R_1 and R_5 are independently selected from hydrogen, CH_3, OCH_3, F, Cl, Br, CF_3 and OCF_3;
R_2 and R_4 are independently selected from hydrogen, F, Cl, Br, CH_3, and CF_3;
R_3 is selected from hydrogen, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN, and C(H)O;
R_6, R_8 and R_9 are independently selected from hydrogen, F, Cl, CH_3, and OCF_3;
E is O; and
X is O or S.

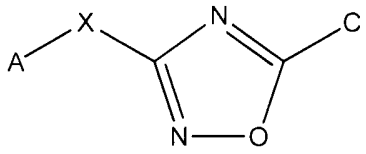
4. The compound of claim 2 or 3 wherein X is O.

5. The compound of claim 2 or 3 wherein X is S.

6. The compound of claim 1 wherein the compound is 3-(4-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

7. The compound of claim 1 wherein the compound is 3-(3-chlorophenoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

8. A method for control of unwanted nematodes, the method comprising administering to a plant, a seed, or soil a composition comprising an effective amount of a compound of Formula VIII or a salt thereof,



Formula VIII

wherein,

A is an optionally substituted aryl, or optionally substituted arylalkyl, or optionally substituted heteroaryl, or optionally substituted heteroarylalkyl, wherein said substituents are selected from the group consisting of halo, C_1-C_6 haloalkyl, C_6-C_{10} aryl, C_4-C_7 cycloalkyl, C_2-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_6-C_{10} aryl(C_1-C_6)alkyl, C_6-C_{10} aryl(C_2-C_6)alkenyl, C_6-C_{10} aryl(C_2-C_6) alkynyl, C_1-C_6 hydroxyalkyl, amino, ureido, cyano, C_1-C_6 acylamino, hydroxy, thiol, C_1-C_6 acyloxy, azido, C_1-C_6 alkoxy and carboxy, and C(H)O;
C is heteroaryl which can be optionally independently substituted with one or more substituents selected from fluorine, chlorine, CH_3 and OCF_3; and
X is O or S.

9. The method of claim 8 wherein the composition comprises a surfactant.

10. The method of claim 8 or 9 wherein the composition includes one or more of: a fungicide, a herbicide, and a pesticide.

11. A nematicidal composition comprising a compound of any of claims 1 to 7 at a concentration sufficient to reduce

the viability of a parasitic nematode.

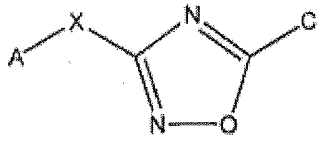
12. The nematicidal composition of claim 11 wherein the composition comprises a surfactant.

13. The nematicidal composition of claim 11 or 12 wherein the composition comprises one or more of: a fungicide, a herbicide, and a pesticide.

14. The nematicidal composition of any of claims 11 to 13 wherein the composition comprises a co-solvent.

Patentansprüche

1. Verbindung der Formel VIII oder Salz davon:

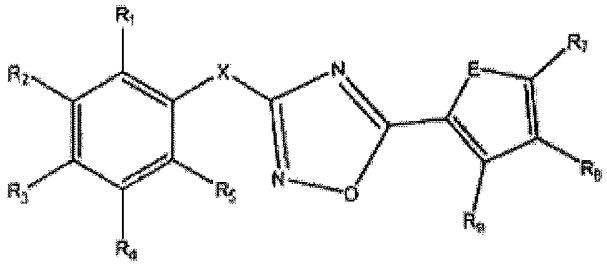


Formel VIII

wobei

A ein gegebenenfalls substituiertes Aryl oder ein gegebenenfalls substituiertes Arylalkyl oder ein gegebenenfalls substituiertes Heteroaryl oder ein gegebenenfalls substituiertes Heteroarylalkyl ist, wobei die Substituenten aus Halogen, C_1-C_6-Halogenalkyl, C_6-C_{10}-Aryl, C_4-C_7-Cycloalkyl, C_2-C_6-Alkyl, C_2-C_6-Alkenyl, C_2-C_6-Alkinyl, C_6-C_{10}-Aryl(C_1-C_6)alkyl, C_6-C_{10}-Aryl(C_2-C_6)alkenyl, C_6-C_{10}-Aryl(C_2-C_6)alkinyl, C_1-C_6-Hydroxyalkyl, Amino, Ureido, Cyano, C_1-C_6-Acylamino, Hydroxy, Thiol, C_1-C_6-Acyloxy, Azido, C_1-C_6-Alkoxy und -Carboxy sowie C(H)O ausgewählt sind;
C Furanyl, Oxazolyl oder Isoxazolyl ist, das jeweils gegebenenfalls unabhängig mit einem oder mehreren Substituenten substituiert sein kann, die aus Fluor, Chlor, CH_3 und OCF_3 ausgewählt sind; und
X O oder S ist.

2. Verbindung gemäß Anspruch 1 der Formel VIIIa oder Salz davon:

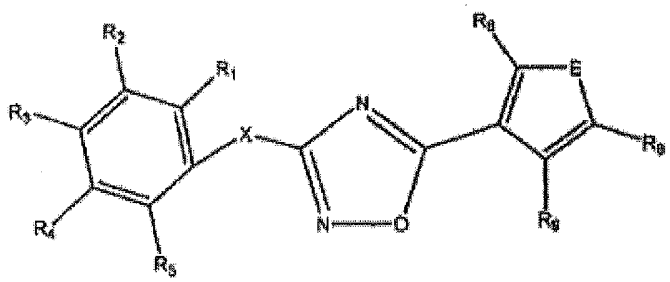


Formel VIIIa

wobei

R_1 und R_5 unabhängig aus Wasserstoff, CH_3, OCH_3, F, Cl, Br, CF_3 und OCF_3 ausgewählt sind;
R_2 und R_4 unabhängig aus Wasserstoff, F, Cl, Br, CH_3 und CF_3 ausgewählt sind;
R_3 aus Wasserstoff, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN und C(H)O ausgewählt ist;
R_7, R_8 und R_9 unabhängig aus Wasserstoff, F, Cl, CH_3 und OCF_3 ausgewählt sind;
E O ist; und
X O oder S ist.

3. Verbindung gemäß Anspruch 1 der Formel VIIIb oder Salz davon:



Formel VIIIb

wobei

R_1 und R_5 unabhängig aus Wasserstoff, CH_3, OCH_3, F, Cl, Br, CF_3 und OCF_3 ausgewählt sind;
R_2 und R_4 unabhängig aus Wasserstoff, F, Cl, Br, CH_3 und CF_3 ausgewählt sind;
R_3 aus Wasserstoff, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN und C(H)O ausgewählt ist;
R_6, R_8 und R_9 unabhängig aus Wasserstoff, F, Cl, CH_3 und OCF_3 ausgewählt sind;
E O ist; und
X O oder S ist.

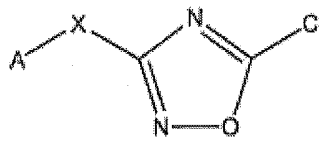
4. Verbindung gemäß Anspruch 2 oder 3, wobei X O ist.

5. Verbindung gemäß Anspruch 2 oder 3, wobei X S ist.

6. Verbindung gemäß Anspruch 1, wobei es sich bei der Verbindung um 3-(4-Chlorphenoxy)-5-(furan-2-yl)-1,2,4-oxadiazol handelt.

7. Verbindung gemäß Anspruch 1, wobei es sich bei der Verbindung um 3-(3-Chlorphenoxy)-5-(furan-2-yl)-1,2,4-oxadiazol handelt.

8. Verfahren zur Bekämpfung unerwünschter Nematoden, wobei das Verfahren das Verabreichen einer Zusammensetzung, die eine wirksame Menge einer Verbindung der Formel VIII oder eines Salzes davon umfasst, an eine Pflanze, einen Samen oder den Boden umfasst:



Formel VIII

wobei

A ein gegebenenfalls substituiertes Aryl oder ein gegebenenfalls substituiertes Arylalkyl oder ein gegebenenfalls substituiertes Heteroaryl oder ein gegebenenfalls substituiertes Heteroarylalkyl ist, wobei die Substituenten aus der Gruppe, bestehend aus Halogen, C_1-C_6-Halogenalkyl, C_6-C_{10}-Aryl, C_4-C_7-Cycloalkyl, C_2-C_6-Alkyl, C_2-C_6-Alkenyl, C_2-C_6-Alkinyl, C_6-C_{10}-Aryl(C_1-C_6)alkyl, C_6-C_{10}-Aryl(C_2-C_6)alkenyl, C_6-C_{10}-Aryl(C_2-C_6)alkinyl, C_1-C_6-Hydroxyalkyl, Amino, Ureido, Cyano, C_1-C_6-Acylamino, Hydroxy, Thiol, C_1-C_6-Acyloxy, Azido, C_1-C_6-Alkoxy und -Carboxy sowie C(H)O, ausgewählt sind;
C Heteroaryl ist, das gegebenenfalls unabhängig mit einem oder mehreren Substituenten substituiert sein kann, die aus Fluor, Chlor, CH_3 und OCF_3 ausgewählt sind; und
X O oder S ist.

9. Verfahren gemäß Anspruch 8, wobei die Zusammensetzung ein Tensid umfasst.

10. Verfahren gemäß Anspruch 8 oder 9, wobei die Zusammensetzung eines oder mehrere aus einem Fungizid, einem Herbizid und einem Pestizid umfasst.

11. Nematizide Zusammensetzung, die eine Verbindung gemäß einem der Ansprüche 1 bis 7 in einer ausreichenden Konzentration, um die Lebensfähigkeit eines parasitischen Nematoden zu reduzieren, umfasst.

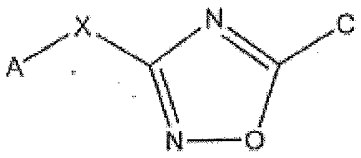
12. Nematizide Zusammensetzung gemäß Anspruch 11, wobei die Zusammensetzung ein Tensid umfasst.

13. Nematizide Zusammensetzung gemäß Anspruch 11 oder 12, wobei die Zusammensetzung eines oder mehrere aus einem Fungizid, einem Herbizid und einem Pestizid umfasst.

14. Nematizide Zusammensetzung gemäß einem der Ansprüche 11 bis 13, wobei die Zusammensetzung ein Cosolvens umfasst.

Revendications

1. Composé de formule VIII ou un sel de celui-ci,

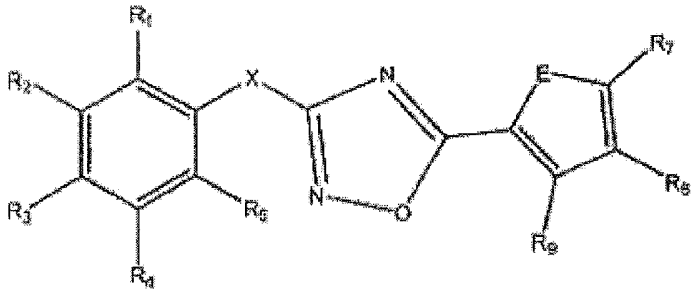


Formule VIII

dans laquelle,

A est un aryle éventuellement substitué, ou arylalkyle éventuellement substitué, ou hétéroaryle éventuellement substitué, ou hétéroarylalkyle éventuellement substitué, dans lequel lesdits substituants sont choisis parmi un halogéno, halogénoalkyle en C_1-C_6, aryle en C_6-C_{10}, cycloalkyle en C_4-C_7, alkyle en C_2-C_6, alcényle en C_2-C_6, alcynyle en C_2-C_6, aryl en C_6-C_{10}(alkyle en C_1-C_6), aryl en C_6-C_{10}(alcényle en C_2-C_6), aryl en C_6-C_{10}(alcynyle en C_2-C_6), hydroxyalkyle en C_1-C_6, amino, uréido, cyano, acylamino en C_1-C_6, hydroxy, thiol, acyloxy en C_1-C_6, azido, alcoxy en C_1-C_6 et carboxy, et C(H)O ;
C est un furanyle, oxazolyle ou isoxazolyle, qui peuvent chacun être éventuellement substitué indépendamment par un ou plusieurs substituants choisis parmi le fluor, le chlore, CH_3 et OCF_3 ; et
X est 0 ou S.

2. Composé selon la revendication 1 de formule VIIIa ou un sel de celui-ci,



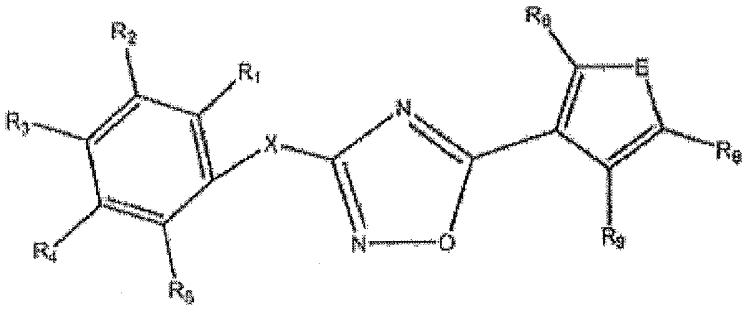
Formule VIIIa

dans laquelle,

R_1 et R_5 sont choisis indépendamment parmi un hydrogène, CH_3, OCH_3, F, Cl, Br, CF_3 et OCF_3 ;

R_2 et R_4 sont choisis indépendamment parmi un hydrogène, F, Cl, Br, CH_3 et CF_3 ;
R_3 est choisi parmi un hydrogène, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN et C(H)O ;
R_7, R_8 et R_9 sont choisis indépendamment parmi un hydrogène, F, Cl, CH_3 et OCF_3 ;
E est O ; et
X est O ou S.

3. Composé selon la revendication 1 de formule VIIIb ou un sel de celui-ci,



Formule VIIIb

dans laquelle,

R_1 et R_5 sont choisis indépendamment parmi un hydrogène, CH_3, OCH_3, F, Cl, Br, CF_3 et OCF_3 ;
R_2 et R_4 sont choisis indépendamment parmi un hydrogène, F, Cl, Br, CH_3 et CF_3 ;
R_3 est choisi parmi un hydrogène, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN et C(H)O ;
R_6, R_8 et R_9 sont choisis indépendamment parmi un hydrogène, F, Cl, CH_3 et OCF_3 ;
E est 0 ; et
X est 0 ou S.

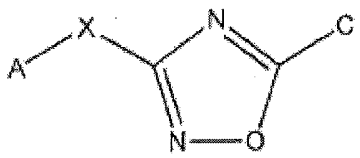
4. Composé selon la revendication 2 ou 3, dans lequel X est O.

5. Composé selon la revendication 2 ou 3, dans lequel X est S.

6. Composé selon la revendication 1, dans lequel le composé est le 3-(4-chlorophénoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

7. Composé selon la revendication 1, dans lequel le composé est le 3-(3-chlorophénoxy)-5-(furan-2-yl)-1,2,4-oxadiazole.

8. Procédé de lutte contre les nématodes non souhaitées, le procédé comprenant l'administration à une plante, une semence ou au sol d'une composition comprenant une quantité efficace d'un composé de formule VIII ou d'un sel de celui-ci,



Formule VIII

dans laquelle,

A est un aryle éventuellement substitué, ou arylalkyle éventuellement substitué, ou hétéroaryle éventuellement substitué, ou hétéroarylalkyle éventuellement substitué, dans lequel lesdits substituants sont choisis dans le

groupe constitué par un halogéno, halogénoalkyle en C_1-C_6, aryle en C_6-C_{10}, cycloalkyle en C_4-C_7, alkyle en C_2-C_6, alcényle en C_2-C_6, alcynyle en C_2-C_6, aryl en C_6-C_{10}(alkyle en C_1-C_6), aryl en C_6-C_{10}(alcényle en C_2-C_6), aryl en C_6-C_{10}(alcynyle en C_2-C_6), hydroxyalkyle en C_1-C_6, amino, uréido, cyano, acylamino en C_1-C_6, hydroxy, thiol, acyloxy en C_1-C_6, azido, alcoxy en C_1-C_6 et carboxy, et C(H)O ;
C est un hétéroaryle qui peut être éventuellement substitué indépendamment par un ou plusieurs substituants choisis parmi le fluor, le chlore, CH_3 et OCF_3 ; et
X est 0 ou S.

9. Procédé selon la revendication 8, dans lequel la composition comprend un tensioactif.

10. Procédé selon la revendication 8 ou 9, dans lequel la composition comprend un ou plusieurs éléments parmi : un fongicide, un herbicide et un pesticide.

11. Composition nématicide comprenant un composé selon l'une quelconque des revendications 1 à 7 à une concentration suffisante pour réduire la viabilité d'un nématode parasite.

12. Composition nématicide selon la revendication 11, dans laquelle la composition comprend un tensioactif.

13. Composition nématicide selon la revendication 11 ou 12, dans laquelle la composition comprend un ou plusieurs éléments parmi : un fongicide, un herbicide et un pesticide.

14. Composition nématicide selon l'une quelconque des revendications 11 à 13, dans laquelle la composition comprend un co-solvant.

REFERENCES CITED IN THE DESCRIPTION

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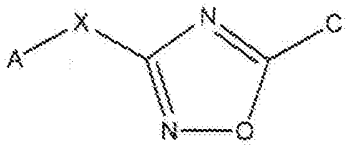
Készítmények és eljárások nematódák megfékezésére

Szabadalmi igénypontok

1. VIII képletű:



(VIII)

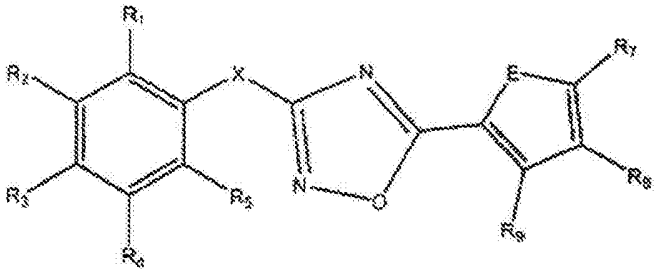
vegyület vagy valamely sója, ahol

A adott esetben szubsztituált aril, vagy adott esetben szubsztituált arilalkil, vagy adott esetben szubsztituált heteroaril, vagy adott esetben szubsztituált heteroarilalkilcsoport, ahol a szubsztituensek halogénatom, 1-6 szénatomos halogénalkil, 6-10 szénatomos aril, 4-7 szénatomos cikloalkil, 2-6 szénatomos alkil, 2-6 szénatomos alkenil, 2-6 szénatomos alkinil, 6-10 szénatomos aril(1-6 szénatomos)alkil, 6-10 szénatomos aril(2-6 szénatomos)alkenil, 6-10 szénatomos aril(2-6 szénatomos) alkinil, 1-6 szénatomos hidroxialkil, amino, ureido, ciano, 1-6 szénatomos acilamino, hidroxi, tiol, 1-6 szénatomos aciloxi, azido, 1-6 szénatomos alkoxi és karboxi, és C(H)O csoportok közül választottak;

C furanil, oxazolil vagy izoxazolilcsoport, melyek mindegyike adott esetben egymástól függetlenül egy vagy több, fluoratom, klóratom, CH_3 és OCF_3 közül választott szubsztituenst tartalmazhat; és

X jelentése O vagy S.

2. Az 1. igénypont szerinti VIIIa:



(VIIIa)

képletű vegyület vagy valamely sója, ahol

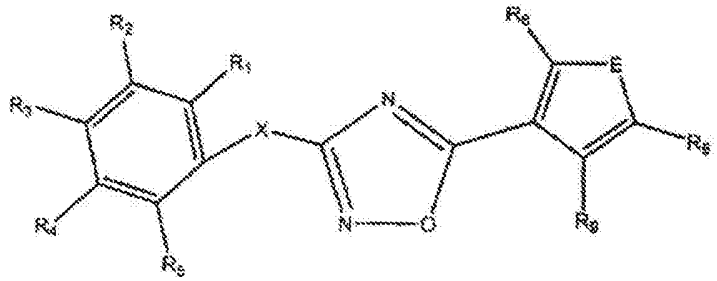
R_1 és R_5 egymástól függetlenül hidrogénatom, CH_3, OCH_3, F, Cl, Br, CF_3 és OCF_3 közül választott;

R_2 és R_4 egymástól függetlenül hidrogénatom, F, Cl, Br, CH_3, és CF_3 közül választott;

R_3 hidrogénatom, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN, és C(H)O közül választott;

R_7, R_8 és R_9 egymástól függetlenül hidrogénatom, F, Cl, CH_3, és OCF_3 közül választott;
E jelentése O; és
X jelentése O vagy S.

3. Az 1. igénypont szerinti VIIIb:



(VIIIb)

képletű vegyület vagy valamely sója, ahol
R_1 és R_5 egymástól függetlenül hidrogénatom, CH_3, OCH_3, F, Cl, Br, CF_3 és OCF_3 közül választott;
R_2 és R_4 egymástól függetlenül hidrogénatom, F, Cl, Br, CH_3, és CF_3 közül választott;
R_3 hidrogénatom, CH_3, CF_3, F, Cl, Br, OCF_3, OCH_3, CN, és C(H)O közül választott;
R6, R_8 és R_9 egymástól függetlenül hidrogénatom, F, Cl, CH_3, és OCF_3 közül választott;
E jelentése O; és
X jelentése O vagy S.

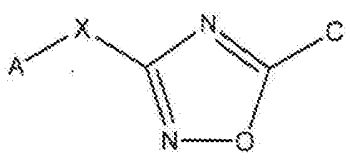
4. A 2. vagy 3. igénypont szerinti vegyület, ahol X jelentése O.

5. A 2. vagy 3. igénypont szerinti vegyület, ahol X jelentése S.

6. Az 1. igénypont szerinti vegyület, ahol a vegyület 3-(4-klórfenoxi)-5-(furan-2-il)-1,2,4-oxadiazol.

7. Az 1. igénypont szerinti vegyület, ahol a vegyület 3-(3-klórfenoxi)-5-(furan-2-il)-1,2,4-oxadiazol.

8. Eljárás nem-kívánatos nematódák megfékezésére, melynek során a növényhez, maghoz vagy talajhoz egy VIII képletű:



(VIII)

vegyületnek vagy sójának hatásos mennyiségét tartalmazó készítményt adagolunk, ahol

A adott esetben szubsztituált aril, vagy adott esetben szubsztituált arilalkil, vagy adott esetben szubsztituált heteroaril, vagy adott esetben szubsztituált heteroarilalkilcsoport, ahol a szubsztituensek halogénatom, 1-6 szénatomos halogénalkil, 6-10 szénatomos aril, 4-7 szénatomoscikloalkil, 2-6 szénatomos alkil, 2-6 szénatomos alkenil, 2-6 szénatomos alkinil, 6-10 szénatomos aril(1-6 szénatomos)alkil, 6-10 szénatomos aril(2-6 szénatomos)alkenil, 6-10 szénatomos aril(2-6 szénatomos) alkinil, 1-6 szénatomos hidroxialkil, amino, ureido, ciano, 1-6 szénatomos acilamino, hidroxi, tiol, 1-6 szénatomos aciloxi, azido, 1-6 szénatomos alkoxi és karboxi, és C(H)O csoportok közül választottak;
C heteroarilcsoport, mely adott esetben egymástól függetlenül egy vagy több, fluoratom, klóratom, CH_3 és OCF_3 közül választott szubsztituenst tartalmazhat; és
X jelentése O vagy S.

9. A 8. igénypont szerinti eljárás, ahol a készítmény egy felületaktív szert tartalmaz.

10. A 8. vagy 9. igénypont szerinti eljárás, ahol a készítmény egy vagy több fungicidet, herbicidet, és peszticidet tartalmaz.

11. Az 1-7. igénypontok bármelyike szerinti nematicid készítmény, mely az 1-7. igénypontok bármelyike szerinti vegyületet egy parazita nematóda életképességét csökkentő mennyiségen tartalmazza.

12. A 11. igénypont szerinti nematicid készítmény, ahol a készítmény egy felületaktív szert tartalmaz.

13. A 11. vagy 12. igénypont szerinti nematicid készítmény, ahol a készítmény egy vagy több fungicidet, herbicidet, és peszticidet tartalmaz.

14. A 11-13. igénypontok bármelyike szerinti nematicid készítmény, ahol a készítmény egy koszolvenst tartalmaz.