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(71) Anmelder: **BAYER AKTIENGESELLSCHAFT** [DE/DE]; Kaiser-Wilhelm-Allee 1, 51373 Leverkusen (DE).

(72) Erfinder: **JESCHKE, Peter**; Kalmüntener Str. 44a, 51467 Bergisch Gladbach (DE). **GUTBROD, Oliver**; Grenzstraße 16, 40764 Langenfeld (DE). **FISCHER, Reiner**; Nelly-Sachs-Str. 23, 40789 Monheim (DE). **HELLWEGE, Elke**; Rietherbach 13B, 40764 Langenfeld (DE). **LOESEL, Peter**; Am Schokker 5, 51371 Leverkusen (DE). **EILMUS, Sascha**; Neuenkamp 9a, 42799 Leichlingen (DE). **ILG, Kerstin**; Neusser Wall 32, 50670 Köln (DE). **HERRMANN, Stefan**; Virneburgstraße 4a, 40764 Langenfeld (DE). **GÖRGENS, Ulrich**; Festerstraße 37, 40882 Ratingen (DE). **LINKA, Marc**; Merkurstraße 52, 40223 Düsseldorf (DE). **TURBERG, Andreas**; Sinterstraße 86, 42781 Haan (DE).

(74) Anwalt: **BIP PATENTS**; Alfred-Nobel-Str. 10, 40789 Monheim am Rhein NRW (DE).

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Erklärungen gemäß Regel 4.17:

— *hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii)*

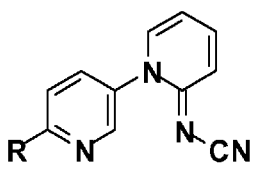
Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

WO 2019/105871 A1

(54) **Title:** NITROGENOUS HETEROCYCLES AS A PESTICIDE

(54) **Bezeichnung:** STICKSTOFFHALTIGE HETEROCYCLEN ALS SCHÄDLINGSBEKÄMPFUNGSMITTEL



(I)

(57) **Abstract:** The present invention relates to novel heterocyclic compounds of the formula (I) wherein R has the meanings cited in the description, to methods and intermediates for the production thereof, and to the use thereof for controlling animal pests.

(57) **Zusammenfassung:** Die vorliegende Anmeldung betrifft neue heterocyclische Verbindungen der Formel (I), in welchen R die in der Beschreibung genannten Bedeutungen hat, Verfahren und Zwischenprodukte zu ihrer Herstellung und ihre Verwendung zur Bekämpfung von tierischen Schädlingen.

Nitrogenous heterocycles as a pesticide

The present application relates to novel heterocyclic compounds, to processes and intermediates for the preparation thereof, and their use for controlling animal pests.

DE 10024938 A1 describes the preparation of phenyliminoazines having herbicidal activity.

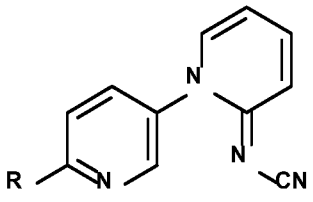
US 2007/0259924 A1 describes imidazoles containing an *N*-[1-aryl-2(1*H*)-pyridinylidene]cyanamide fragment as factor Xa inhibitors.

Nitrogen-containing heterocycles as pesticides are disclosed in WO 2017/005673 A1.

Crop protection agents, which also include pesticides, have to meet many demands, for example in relation to extent, persistence, and spectrum of their action and possible use. Questions of toxicity and of combinability with other active ingredients or formulation auxiliaries play a role, as does the question of the cost and complexity involved in the synthesis of an active ingredient. In addition, resistances can occur. For all these reasons, the search for novel crop protection agents cannot be considered to be complete, and there is a constant need for novel compounds having properties which, compared to the known compounds, are improved at least in relation to individual aspects.

It was an object of the present invention to provide compounds which widen the spectrum of the pesticides under various aspects.

The object, and further objects which are not stated explicitly but can be discerned or derived from the connections discussed herein, are achieved by compounds of the formula (I)



(I) ,

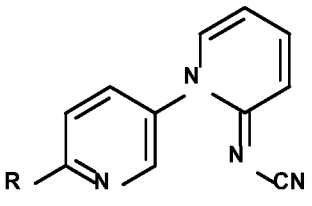
in which

R represents a radical from the group consisting of hydrogen, cyano, fluoromethyl, difluoromethyl, fluorochloromethyl, fluorobromomethyl, difluorochloromethyl, difluorobromomethyl, difluoroiodomethyl, 1-fluoroethyl, 1,1-difluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, 1-fluoro-2,2,2-trifluoroethyl, cyano-substituted haloalkyl, C_1-C_4-haloalkoxy, C_1-C_4-haloalkylthio, C_1-C_4-haloalkylsulfinyl, C_1-C_4-haloalkylsulfonyl, optionally halogen-substituted C_1-C_4-alkoxy-C_1-C_4-alkyl, optionally halogen-substituted C_1-C_4-alkylthio-C_1-C_4-alkyl, C_1-C_4-alkylsulfinyl-C_1-C_4-alkyl, C_1-C_4-alkylsulfonyl-C_1-C_4-alkyl and halogen-, cyano-, alkyl- or haloalkyl-substituted cycloalkyl.

Preference is given to compounds of the formula (I) in which

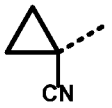
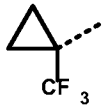
R represents a radical from the group consisting of hydrogen, cyano, fluoromethyl, difluoromethyl, fluorochloromethyl, fluorobromomethyl, difluorochloromethyl, difluorobromomethyl, difluoroiodomethyl, 1-fluoroethyl, 1,1-difluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, 1-fluoro-2,2,2-trifluoroethyl, cyanofluoromethyl, cyanodifluoromethyl, difluoromethoxy, trifluoromethoxy, 2,2-difluoroethoxy, 2,2,2-trifluoroethoxy, difluoromethylthio, trifluoromethylthio, difluoromethylsulfinyl, trifluoromethylsulfinyl, difluoromethylsulfonyl, trifluoromethylsulfonyl, H_3C-O-F_2C, H_3C-S-F_2C, H_3C-S(O)-F_2C, H_3C-O_2S-F_2C, H_3C-S-H_2C, H_3C-S(O)-H_2C, H_3C-O_2S-H_2C, 1-fluorocyclopropyl, 1-cyanocyclopropyl and 1-trifluoromethylcyclopropyl.

Each individual compound of the formula (I) listed in the table below represents a very particularly preferred embodiment of the invention:



(I)

No.	R

1	H
2	F_2HC
3	F_2ClC
4	H_3C-F_2C
5	*(R,S)*-H_3C-HFC
6	(*R,S*)-FClHC
7	(*R,S*)-FBrHC
8	F_2BrC
9	F_2IC
10	F_3C-H_2C
11	F_2HC-H_2C
12	F_3C-O
13	F_3C-S
14	*(R,S)*-F_3C-(O)S
15	F_3C-O_2S
16	F_2HC-O
17	F_2HC-S
18	*(R,S)*-F_2HC-(O)S
19	F_2HC-O_2S
20	F_3C-H_2C-O
21	F_2HC-H_2C-O
22	H_3C-S-H_2C
23	H_3C-S(O)-H_2C
24	H_3C-O_2S-H_2C
25	
26	

27	
28	NC
29	H_3C-O-F_2C
30	H_3C-S-F_2C
31	F-H_2C
32	NC-FHC
33	NC-F_2C
34	(*R,S*)-F_3C-HFC

The compounds of the formula (I) according to the invention and their acid addition salts and metal salt complexes are highly active, in particular in the control of animal pests including arthropods and in particular insects.

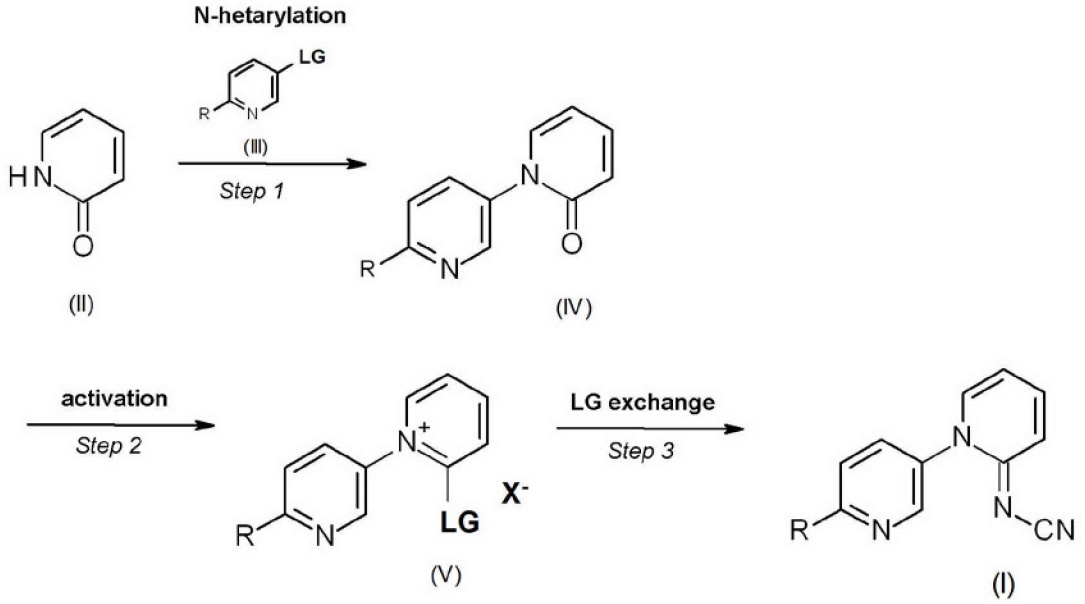
Suitable salts of the compounds of the formula (I) which may be mentioned are customary nontoxic salts, i.e. salts with appropriate bases and salts with added acids. Preference is given to salts with inorganic bases, such as alkali metal salts, for example sodium, potassium or caesium salts, alkaline earth metal salts, for example calcium or magnesium salts, ammonium salts, salts with organic bases and with inorganic amines, for example triethylammonium, dicyclohexylammonium, *N,N*'-dibenzylethylenediammonium, pyridinium, picolinium or ethanolammonium salts, salts with inorganic acids, for example hydrochlorides, hydrobromides, dihydrosulfates, trihydrosulfates, or phosphates, salts with organic carboxylic acids or organic sulfonic acids, for example formates, acetates, trifluoroacetates, maleates, tartrates, methanesulfonates, benzenesulfonates or *para*-toluenesulfonates, salts with basic amino acids, for example arginates, aspartates or glutamates, and the like.

Furthermore, it was found that the compounds of the formula (I) can be prepared by the processes described below (cf. also WO 2017/005673 A1 and the preparation examples).

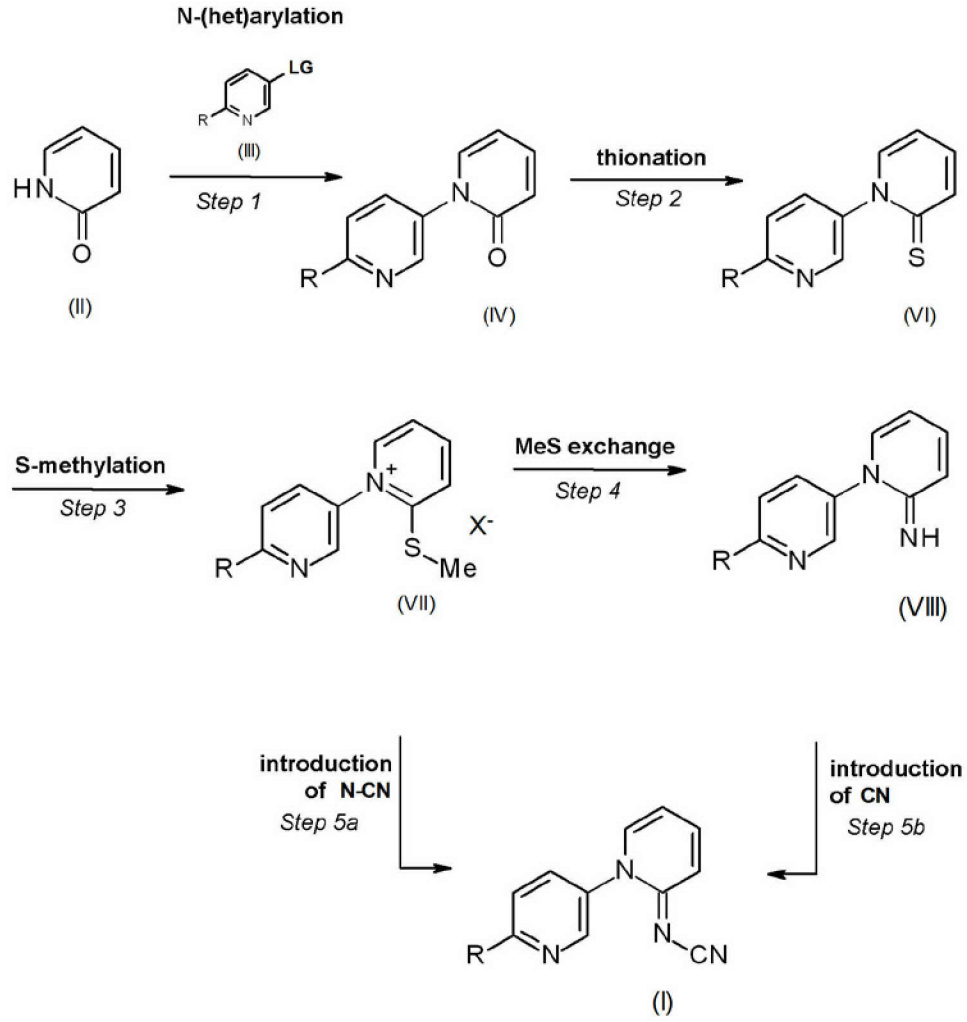
Compounds of the formula (I) in which the radical R has the meaning given above can be prepared, for example, according to Reaction Scheme I by processes A, B and C.

Reaction Scheme I

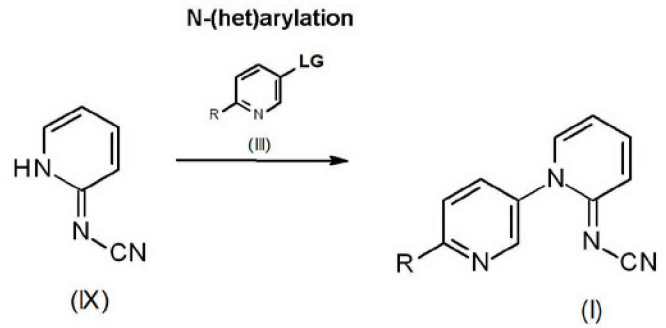
Process A



Process B



Process C



For example, the compounds of the formula (I) can be obtained from compounds of the formula (II).

Process A

According to process A, the compounds of the formula (II) can be converted in a first reaction step by means of an *N*-hetarylation reaction with corresponding halogenated pyridine compounds of the formula (III) in the presence of catalysts and basic reaction auxiliaries into compounds of the formula (IV), which compounds can then be reacted in a second reaction step in the presence of a suitable halogenating agent, for example phosphoryl chloride, to form the activated compounds (V), which are then reacted in a third reaction step to give the compounds of the formula (I).

According to the invention, the activation (Step 2) can also be carried out with other acid halides, for example with phosphoryl bromide. In this case, the corresponding substituted pyridinium bromides (V) are formed which, in the third reaction step, can be converted for example with cyanamide into the compounds of the formula (I) (cf. WO 2017/005673 A1).

In process A, to prepare the compounds of the formula (I) it is also possible to use, as compound of the formula (II), the 2(1*H*)-pyridinone and, as compound of the formula (III), for example the 6-substituted 3-pyridinylboronic acid (cf. WO 2017/005673 A1).

The compound of the formula (II), 2(1*H*)-pyridinone (CAS No. 142-08-5), is commercially available (cf. ABCR GmbH, Aldrich, etc.).

Some of the compounds of the formula (III) in which LG represents a nucleofugic leaving group optionally generated *in situ* are known and commercially available or can be obtained by preparation processes known in principle.

The compounds of the formula (III) in which LG represents halogen are known and some of them are commercially available. Examples include the following 3-substituted pyridines, in which LG represents halogen such as bromine or iodine: 3-bromopyridine [R = H; LG = Br, commercially available from: ABCR] (CAS No. 626-55-1) or 3-iodopyridine [R = H; LG = I, commercially available from: ABCR] (CAS No. 1120-90-7); 5-bromo-2-(difluoromethyl)pyridine [R = F_2HC; LG = Br, commercially available from: ABCR] (CAS

No. 845827-13-6); 5-bromo-2-(chlorodifluoromethyl)pyridine [R = ClF_2C; LG = Br, commercially available from: FCH Group] (CAS No. 2092697-33-9); 5-bromo-2-(bromodifluoromethyl)pyridine [R = BrF_2C; LG = Br, commercially available from: FCH Group Reagents for Synthesis, Enamine Building Blocks] (CAS No. 2091049-56-6); 5-bromo-2-(1,1-difluoroethyl)pyridine [R = H_3CF_2C; LG = Br, commercially available from: FCH Group] (CAS No. 1256821-91-6); 5-bromo-2-(2,2,2-trifluoroethyl)pyridine [R = F_3CH_2C; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1335050-19-5); 5-bromo-2-(2,2-difluoroethyl)pyridine [R = F_2HC-H_2C; LG = Br] (CAS No. 1335053-88-7); 5-bromo-2-(trifluoromethoxy)pyridine [R = F_3CO; LG = Br, commercially available from: ABCR] (CAS No. 886371-77-3); 5-bromo-2-[(trifluoromethyl)thio]pyridine [R = F_3C-S; LG = Br, commercially available from: Enamine Building Blocks] (CAS No. 1204234-35-4); 5-bromo-2-[(trifluoromethyl)sulfonyl]pyridine [R = F_3C-SO_2 ; LG = Br, commercially available from: Enamine Building Blocks] (CAS No. 2092700-59-7); 5-bromo-2-(difluoromethoxy)pyridine [R = F_2HC-O; LG = Br, commercially available from: ABCR] (CAS No. 899452-26-7); 5-bromo-2-[(difluoromethyl)thio]pyridine [R = F_2HC-S; LG = Br, known from: Wu, Jiang; et al. *Chemical Science* (2016), 7 (6), 3757-3762] (CAS No. 1887223-33-7); 5-bromo-2-(2,2,2-trifluoroethoxy)pyridine [R = F_3CH_2CO; LG = Br, commercially available from: ABCR] (CAS No. 126728-58-3); 5-bromo-2-(2,2-difluoroethoxy)pyridine [R = F_2HC-H_2CO; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 494771-64-1); 5-bromo-2-[(methylthio)methyl]pyridine [R = H_3CSH_2C; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1566292-79-2); 5-bromo-2-[(methylsulfinyl)methyl]pyridine [R = H_3C-SO-H_2C; LG = Br, known from : US 2016/0075647 A1] (CAS No. 1632310-40-7); 5-bromo-2-[(methylsulfonyl)methyl]pyridine [R = H_3C-SO_2-H_2C; LG = Br, commercially available from: FCH Group] (CAS No. 1352754-05-2); 1- (5-bromo-2-pyridinyl)cyclopropanecarbonitrile [R = 1-cyanocyclopropyl; LG = Br, commercially available from: ABCR] (CAS No. 827628-15-9); 5-bromo-2-[1-(trifluoromethyl)cyclopropyl]pyridine [R = 1-trifluoromethylcyclopropyl; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1431616-44-2); 5-bromo-2-(1-fluorocyclopropyl)pyridine [R = 1-fluorocyclopropyl; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1936113-44-8); 5-bromo-2-pyridinecarbonitrile [R = cyano; LG = Br, commercially available from: ABCR] (CAS No. 97483-77-7); 5-bromo-2-(fluoromethyl)pyridine [R = FH_2C; LG = Br, commercially available

from: FCH Group Reagents for Synthesis] (CAS No. 1335050-09-3); 5-bromo-α-fluoro-2-pyridineacetonitrile [R = NC-FHC; LG = Br, commercially available from: Apichemical (Shanghai) Product List, China] (CAS No. 1582263-08-8); 5-bromo-α,α-difluoro-2-pyridineacetonitrile [R = NC-F_2C; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1823829-77-1) or 5-bromo-2-(1,2,2,2-tetrafluoroethyl) pyridine [R = F_3C-FHC; LG = Br, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 60715-33-5).

The compounds of the formula (III) in which LG represents halogen can also be obtained from 6-substituted 3-pyridinamines (for example 6-(1-fluoroethyl)-3-pyridinamines [R = H_3C-FHC; commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1780164-15-9), for example by diazotization using *tert*-butyl nitrite in the presence of copper(I) bromide according to a Sandmeyer-analogous reaction (cf. for R = CF_3; E. Pinard, et al. *J. Med. Chem.*, 53(12), 4603-4614; **2010**).

Furthermore, the 6-substituted pyridines having a suitable leaving group in the 3-position (LG = $B(OH)_2$) or $B(OR)_2$) can be reacted with the appropriate compounds of the formula (II) according to known methods (cf. *Chem. Rev.* **1995**, *95*, 2457-2483; *Tetrahedron* **2002**, *58*, 9633-9695; *Metal-Catalyzed Cross-Coupling Reactions* (Eds.: A. de Meijere, F. Diederich), 2nd ed., Wiley-VCH, Weinheim, **2004**) in the presence of suitable catalysts from the group of the transition metal salts to give compounds of the formula (I).

Some of the 6-substituted pyridines having a suitable leaving group (LG = $B(OH)_2$ or $B(OR)_2$) in the 3-position are known and commercially available, or they can be prepared by known methods: e.g. 2- (difluoromethyl)-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine [R = F_2HC; LG = $B(OCMe_2)_2$, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1220696-57-0) or B-[6-(2,2,2-trifluoroethyl)-3-pyridinyl]boronic acid [R = F_3C-H_2C; LG = $B(OH)_2$, commercially available from: FCH Group Reagents for Synthesis] (CAS No. 1356109-90-4).

Individual compounds of the formula (IV) are known and commercially available (cf. for example 1(2*H*),3'-bipyridin]-2-one [R = H; commercially available from: Chemieliva Pharmaceutical Product List, China] (CAS No. 60532-44-7).

The compounds of the formula (IV) can then be converted according to Step 2 of Preparation Process A using suitable activating agents, for example with acid halides of inorganic acids such as sulfuryl chloride, phosphoryl chloride, phosphorus pentachloride, phosphoryl bromide, phosphorus pentabromide or with acid halides of organic acids such as oxalyl chloride into the compounds of the formula (V) in which X^- represents an appropriate halide anion, for example chloride or bromide, and LG represents a nucleofugic leaving group optionally generated *in situ* (cf. WO 2017/005673 A1).

By replacing the leaving group LG in Reaction Step 3 with cyanamide, the compounds of the formula (I) in which R has the meaning given above can then be formed.

Process B

According to the preferred Process B, first the compounds of the formula (IV) are obtained, which are then converted into compounds of the formula (VI) by thionation (Step 2). Subsequent *S*-methylation affords compounds of the formula (VII). In this case, the *S*-methyl group as the nucleofugic leaving group LG can be exchanged for ammonia, for example, to form the compounds of the formula (VIII) in Step 4. In this manner, the compounds of the formula (I) can be obtained in a simple manner by introduction of the substituent "CN" with cyanogen bromide or exchange of the nucleofugic leaving group LG = *S*-methyl (SMe) using cyanamide or, for example, using sodium hydrogen cyanamide (cf., for example, Preparation Examples 1 to 5).

If, in Process B, the compound of the formula (II) used is 2(1*H*)-pyridinone and the compound of the formula (III) used is 5-bromo-2-(difluoromethyl)pyridine (R = F_2HC; LG = Br), 6'-difluoromethyl-[1(2*H*),3'-bipyridin]-2-one (R = F_2HC) of the formula (IV) is initially formed. Subsequent thionation (Step 2) using diphosphorus pentasulfide then leads to 6'-difluoromethyl-[1(2*H*),3'-bipyridine]-2-thione of the formula (VI) which is then *S*-methylated with methyl iodide in a third reaction step with formation of [1-[6-difluoromethylpyridin-3-yl]-2-(methylthio)pyridinium iodide of the formula (VII). Exchange of the nucleofugic leaving group LG = methylthio (SMe) with sodium hydrogen cyanamide then leads to [1-[6-difluoromethylpyridin-3-yl]-2(1*H*)pyridinylidene]cyanamide of the formula (I) (R = F_2HC) (cf, for example, M. C. Christensen *et al. Synthesis* **1980**, *5*, 405-407 and Preparation Example 2).

A large number of different thionizing agents (sulfurizing agents) are described in the literature, such as, for example, hydrogen sulfide (H_2S), hydrogen sulfide/hydrogen chloride (H_2S/HCl), hydrogen persulfide/hydrogen chloride(H_2S_2/HCl), di(diethylaluminium) sulfide [$(Et_2Al)_2S$], polymeric ethylaluminium sulfide [$(EtAlS)_n$], silicon disulfide (SiS_2), diboron trisulfide (B_2S_3), phorphorus pentachloride/dialuminium trisulfide/sodium sulfate (PCl_5/ Al_2S_3/Na_2SO_4), sodium sulfide/sulfuric acid (Na_2S/H_2SO_4), diphosphorus pentasulfide (P_2S_5), diphosphorus pentasulfide/pyridine (P_2S_5/Py), diethylthiocarbamoyl chloride, diphosphorus pentasulfide/triethylamine (P_2S_5/NEt_3), diphosphorus pentasulfide/n-butyllithium (P_2S_5/*n*-BuLi), diphosphorus pentasulfide/sodium bicarbonate (P_2S_5/$NaHCO_3$; "Scheeren's reagent", formation of $Na^{2+}[P_4S_{10}O]^{2-}$), diphosphorus pentasulfide/methanol (P_2S_5/MeOH), SCN-CO-OEt, $PSCl_x \cdot (NMe_2)_{3-x}$ (X = 0-3), bis(tricyclohexyltin) sulfide/boron trihalide $[(C_6H_{11})_3Sn]S_2$ + BX_3 (X = Cl, F) (cf. EP 0280867 A1), bis(1,5-cyclooctanediylboryl) sulfide [(9-BBN)$_2$S] as sulfurizing agent or as phosphorus pentasulfide substitute, 2,4-bis(methylthio)-1,3,2,4-dithiadiphosphetane 2,4-disulfide "*Davy reagent methyl*" (DR-Me), 2,4-bis(ethylthio)-1,3,2,4-dithiadiphosphetane 2,4-disulfide "Davy reagent *p*-tolyl or Heimgartner's reagent" (DR-T), 2,4-bis-(4-phenoxyphenyl)-2,4-dithioxo-1,3,2,4-dithiaphosphetan "*Belleau's reagent*" (BR), 2,4-bis-(4-phenylthiophenyl)-2,4-dithioxo-1,3,2,4-dithiaphosphetane, 2,4-bis-(4-methoxyphenyl)-2,4-dithioxo-1,3,2,4-dithiaphosphetane "*Lawesson's reagent*" (LR) (cf. WO 98/43965 A1 and the literature cited therein).

Preferred thionating agents (sulfurizing agents) are diphosphorus pentasulfide (P_2S_5), diphosphorus pentasulfide/pyridine (P_2S_5/Py), 2,4-bis-(4-phenoxyphenyl)-2,4-dithioxo-1,3,2,4-dithiaphosphetane *"Belleau's reagent"* (BR) or 2,4-bis-(4-methoxyphenyl)-2,4-dithioxo-1,3,2,4-dithiaphosphetane *"Lawesson's reagent"* (LR).

Process C

Alternatively, according to Process C, the compound of the formula (IX) can be reacted with compounds of the formula (III) in which R has the meaning given above and LG represents a nucleofugic leaving group LG which is optionally generated *in situ*, to give compounds of the formula (I).

The compound of the formula (IX), *N*-2-pyridinylcyanamide (CAS No. 21418-21-3), is known and commercially available (FCH Groups Reagents for Synthesis, Small Molecules Product List, etc).

According to Processes A and B, the preparation of compounds of the formula (IV) in which R has the meaning mentioned above is preferably carried out in the presence of copper(I) iodide or copper(I) acetate, reaction auxiliaries and in suitable solvents or diluents.

Suitable reaction auxiliaries used for preparing the compounds of the formula (IV) are basic reaction auxiliaries.

Examples which may be mentioned are the hydroxides, hydrides, oxides and carbonates of lithium, sodium, potassium, magnesium, calcium and barium, furthermore further basic compounds such as amidine bases or guanidine bases, such as 7-methyl-1,5,7-triazabicyclo[4.4.0]dec-5-ene (MTBD); diazabicyclo[4.3.0]nonene (DBN), diazabicyclo[2.2.2]octane (DABCO), 1,8-diazabicyclo[5.4.0]undecene (DBU), cyclohexyltetrabutylguanidine (CyTBG), cyclohexyltetramethylguanidine (CyTMG), *N,N,N,N*-tetramethyl-1,8-naphthalenediamine, pentamethylpiperidine, tertiary amines, such as triethylamine, trimethylamine, tribenzylamine, triisopropylamine, tributylamine, tricyclohexylamine, triamylamine, trihexylamine, *N,N*-dimethylaniline, *N,N*-dimethyltoluidine, *N,N*-dimethyl-p-aminopyridine, *N*-methylpyrrolidine, *N*-methylpiperidine, *N*-methylimidazole, *N*-methylpyrazole, *N*-methylmorpholine, *N*-methylhexamethylenediamine, pyridine, 4-pyrrolidinopyridine, 4-dimethylaminopyridine, quinoline, α-picoline, β-picoline, isoquinoline, pyrimidine, acridine, *N,N,N`,N`*-tetramethylenediamine, *N,N`,N`*-tetraethylenediamine, quinoxaline, *N*-propyldiisopropylamine, *N*-ethyldiisopropylamine (*"Hünig's base"*), *N,N`*-dimethylcyclohexylamine, 2,6-lutidine, 2,4-lutidine or triethyldiamine.

Suitable for use as basic reaction auxiliaries for carrying out the Processes A and B according to Reaction Scheme I are all suitable acid binders, for example alkali metal carbonates or amines.

Preference is given to using potassium carbonate, *trans*-N,N'-dimethylcyclohexane-1,2-diamine or pyridine.

Suitable solvents or diluents include all inert organic solvents, for example aliphatic or aromatic hydrocarbons (such as petroleum ether, toluene), halogenated hydrocarbons (such as chlorotoluene, dichloromethane, chloroform, 1,2-dichloroethane), ethers (such as diethyl ether, dioxane, tetrahydrofuran, 1,2-dimethoxyethane), esters (such as ethyl acetate or methyl acetate), nitrohydrocarbons (such as nitromethane, nitroethane, nitrobenzene), nitriles (such as acetonitrile, benzonitrile), amides (such as *N,N*-dimethylformamide, *N,N*-dimethylacetamide, *N*-methylformanilide, *N*-methylpyrrolidone, hexamethylphosphoric triamide), and also dimethyl sulfoxide or water or mixtures of the solvents mentioned.

Preference is given to using, as solvents, halogenated hydrocarbons such as dichloromethane or 1,2-dichloroethane and amides such as *N,N*-dimethylformamide.

According to Process A, the preparation of compounds of the formula (V) is preferably carried out in the presence of inorganic acid halides, a catalytic amount of a basic reaction auxiliary and in the presence of suitable solvents or diluents.

Preference is given to using, as solvents, phosphoryl halides, halogenated hydrocarbons such as dichloromethane or 1,2-dichloroethane and amides such as *N,N*-dimethylformamide.

According to Process A, the compounds of the formula (I) in which R has the meaning mentioned above are preferably prepared in the presence of a basic reaction auxiliary and in the presence of suitable solvents or diluents.

The basic reaction auxiliaries and solvents or diluents employed are preferably potassium carbonate and nitriles such as acetonitrile, respectively.

According to Process B, the preparation of compounds of the formula (VI) in which R has the meaning mentioned above is preferably carried out in the presence of a thionating agent (sulfurizing agents) and in the presence of a basic reaction auxiliary and of suitable solvents or diluents.

The thionating agents (sulfurizing agents), basic reaction auxiliaries and solvents or diluents used are preferably diphosphorus pentasulfide (P_2S_5), sodium bicarbonate and 1,4-dioxane, respectively, or pyridine is used as basic reaction auxiliary, solvent or diluent.

According to Process B, the preparation of compounds of the formula (VII) in which R has the meaning mentioned above is preferably carried out in the presence of a suitable S-alkylating agent and in the presence of a suitable solvent or diluent.

The *S*-alkylating agent and solvents or diluents used are preferably methyl iodide and a nitrile, for example acetonitrile, respectively.

According to Process B, the compounds of the formula (I) in which R has the meaning mentioned above are preferably prepared in the presence of a basic reaction auxiliary and in the presence of suitable solvents or diluents.

The basic reaction auxiliaries and solvents or diluents employed are preferably hydrazine hydrate or pyridine and nitriles such as acetonitrile, respectively.

According to Process C, the preparation of the compounds of the formula (I) in which R has the meaning mentioned above is preferably carried out in the presence of copper(I) iodide, reaction auxiliaries and in suitable solvents or diluents.

The reaction auxiliaries and solvents or diluents employed are preferably potassium acetate and amides such as *N,N*-dimethylformamide, respectively.

Isomers

Depending on the nature of the substituents, the compounds of the formula (I) may be in the form of geometric and/or optically active isomers or corresponding isomer mixtures in different compositions. These stereoisomers are, for example, enantiomers, diastereomers, atropisomers or geometric isomers. The invention therefore encompasses both pure stereoisomers and any desired mixtures of these isomers.

Methods and uses

The invention also relates to methods for controlling animal pests, in which compounds of the formula (I) are allowed to act on animal pests and/or their habitat. The control of the animal pests is preferably conducted in agriculture and forestry, and in material protection. This preferably excludes methods for surgical or therapeutic treatment of the human or animal body and diagnostic methods carried out on the human or animal body.

The invention further relates to the use of the compounds of the formula (I) as pesticides, especially crop protection agents.

In the context of the present application, the term "pesticides" in each case also always encompasses the term "crop protection agents".

The compounds of the formula (I), given good plant tolerance, favourable endotherm toxicity and good environmental compatibility, are suitable for protecting plants and plant organs against biotic and abiotic stress factors, for increasing harvest yields, for improving the quality of the harvested material and for controlling animal pests, especially insects, arachnids, helminths, especially nematodes and molluscs, which are encountered in agriculture, in horticulture, in animal husbandry, in aquatic cultures, in forests, in gardens and leisure facilities, in the protection of stored products and of materials, and in the hygiene sector.

In the context of the present patent application, the term "hygiene" should be understood to mean any and all measures, provisions and procedures which have the aim of preventing diseases, especially infection diseases, and which serve to protect the health of humans and animals and/or protect the environment and/or maintain cleanliness. According to the invention, this especially includes measures for cleaning, disinfection and sterilization, for example of textiles or hard surfaces, especially surfaces made of glass, wood, cement, porcelain, ceramic, plastic or else metal(s), in order to ensure that these are free of hygiene pests and/or their secretions. The scope of protection of the invention in this regard preferably excludes surgical or therapeutic treatment procedures to be applied to the human body or the bodies of animals, and diagnostic procedures which are conducted on the human body or the bodies of animals.

The term "hygiene sector" covers all areas, technical fields and industrial applications in which these hygiene measures, provisions and procedures are important, for example with regard to hygiene in kitchens, bakeries, airports, bathrooms, swimming pools, department stores, hotels, hospitals, stables, animal keeping, etc.

The term "hygiene pest" should therefore be understood to mean one or more animal pests whose presence in the hygiene sector is problematic, especially for reasons of health. A main aim is therefore that of avoiding, or limiting to a minimum degree, the presence of hygiene

pests and/or the exposure to these in the hygiene sector. This can especially be achieved through the use of a pesticide which can be used both for prevention of infestation and for prevention of an existing infestation. It is also possible to use formulations which prevent or reduce exposure to pests. Hygiene pests include, for example, the organisms mentioned below.

The term "hygiene protection" thus covers all acts by which these hygiene measures, provisions and procedures are maintained and/or improved.

The compounds of the formula (I) can preferably be used as pesticides. They are active against normally sensitive and resistant species and also against all or specific stages of development. The abovementioned pests include:

pests from the phylum of the Arthropoda, especially from the class of the Arachnida, for example Acarus spp., e.g. Acarus siro, Aceria kuko, Aceria sheldoni, Aculops spp., Aculus spp., e.g. Aculus fockeui, Aculus schlechtendali, Amblyomma spp., Amphitetranychus viennensis, Argas spp., Boophilus spp., Brevipalpus spp., e.g. Brevipalpus phoenicis, Bryobia graminum, Bryobia praetiosa, Centruroides spp., Chorioptes spp., Dermanyssus gallinae, Dermatophagoides pteronyssinus, Dermatophagoides farinae, Dermacentor spp., Eotetranychus spp., e.g. Eotetranychus hicoriae, Epitrimerus pyri, Eutetranychus spp., e.g. Eutetranychus banksi, Eriophyes spp., e.g. Eriophyes pyri, Glycyphagus domesticus, Halotydeus destructor, Hemitarsonemus spp., e.g. Hemitarsonemus latus (=Polyphagotarsonemus latus), Hyalomma spp., Ixodes spp., Latrodectus spp., Loxosceles spp., Neutrombicula autumnalis, Nuphersa spp., Oligonychus spp., e.g. Oligonychus coffeae, Oligonychus coniferarum, Oligonychus ilicis, Oligonychus indicus, Oligonychus mangiferus, Oligonychus pratensis, Oligonychus punicae, Oligonychus yothersi, Ornithodorus spp., Ornithonyssus spp., Panonychus spp., e.g. Panonychus citri (=Metatetranychus citri), Panonychus ulmi (=Metatetranychus ulmi), Phyllocoptruta oleivora, Platytetranychus multidigituli, Polyphagotarsonemus latus, Psoroptes spp., Rhipicephalus spp., Rhizoglyphus spp., Sarcoptes spp., Scorpio maurus, Steneotarsonemus spp., Steneotarsonemus spinki, Tarsonemus spp., e.g. Tarsonemus confusus, Tarsonemus pallidus, Tetranychus spp., e.g. Tetranychus canadensis, Tetranychus cinnabarinus, Tetranychus turkestani, Tetranychus urticae, Trombicula alfreddugesi, Vaejovis spp., Vasates lycopersici;

from the class of the Chilopoda, for example Geophilus spp., Scutigera spp.;

from the order or the class of the Collembola, for example Onychiurus armatus, Sminthurus viridis;

from the class of the Diplopoda, for example Blaniulus guttulatus;

from the class of the Insecta, for example from the order of the Blattodea, e.g. Blatta orientalis, Blattella asahinai, Blattella germanica, Leucophaea maderae, Loboptera decipiens, Neostylopyga rhombifolia, Panchlora spp., Parcoblatta spp., Periplaneta spp., e.g. Periplaneta americana, Periplaneta australasiae, Pycnoscelus surinamensis, Supella longipalpa;

from the order of the Coleoptera, for example Acalymma vittatum, Acanthoscelides obtectus, Adoretus spp., Aethina tumida, Agelastica alni, Agrilus spp., e.g. Agrilus planipennis, Agrilus coxalis, Agrilus bilineatus, Agrilus anxius, Agriotes spp., e.g. Agriotes linneatus, Agriotes mancus, Alphitobius diaperinus, Amphimallon solstitialis, Anobium punctatum, Anoplophora spp., e.g. Anoplophora glabripennis, Anthonomus spp., e.g. Anthonomus grandis, Anthrenus spp., Apion spp., Apogonia spp., Atomaria spp., e.g. Atomaria linearis, Attagenus spp., Baris caerulescens, Bruchidius obtectus, Bruchus spp., e.g. Bruchus pisorum, Bruchus rufimanus, Cassida spp., Cerotoma trifurcata, Ceutorrhynchus spp., e.g. Ceutorrhynchus assimilis, Ceutorrhynchus quadridens, Ceutorrhynchus rapae, Chaetocnema spp., e.g. Chaetocnema confinis, Chaetocnema denticulata, Chaetocnema ectypa, Cleonus mendicus, Conoderus spp., Cosmopolites spp., e.g. Cosmopolites sordidus, Costelytra zealandica, Ctenicera spp., Curculio spp., e.g. Curculio caryae, Curculio caryatrypes, Curculio obtusus, Curculio sayi, Cryptolestes ferrugineus, Cryptolestes pusillus, Cryptorhynchus lapathi, Cryptorhynchus mangiferae, Cylindrocopturus spp., Cylindrocopturus adspersus, Cylindrocopturus furnissi, Dendroctonus spp., e.g. Dendroctonus ponderosae, Dermestes spp., Diabrotica spp., e.g. Diabrotica balteata, Diabrotica barberi, Diabrotica undecimpunctata howardi, Diabrotica undecimpunctata undecimpunctata, Diabrotica virgifera virgifera, Diabrotica virgifera zeae, Dichocrocis spp., Dicladispa armigera, Diloboderus spp., Epicaerus spp., Epilachna spp., e.g. Epilachna borealis, Epilachna varivestis, Epitrix spp., e.g. Epitrix cucumeris, Epitrix fuscula, Epitrix hirtipennis, Epitrix subcrinita, Epitrix tuberis, Faustinus spp., Gibbium psylloides, Gnathocerus cornutus, Hellula undalis, Heteronychus arator, Heteronyx spp., Hylamorpha elegans, Hylotrupes bajulus, Hypera postica, Hypomeces squamosus, Hypothenemus spp., e.g. Hypothenemus hampei, Hypothenemus obscurus, Hypothenemus pubescens, Lachnosterna

consanguinea, Lasioderma serricorne, Latheticus oryzae, Lathridius spp., Lema spp., Leptinotarsa decemlineata, Leucoptera spp., e.g. Leucoptera coffeella, Limonius ectypus, Lissorhoptrus oryzophilus, Listronotus (= Hyperodes) spp., Lixus spp., Luperodes spp., Luperomorpha xanthodera, Lyctus spp., Megacyllene spp., e.g. Megacyllene robiniae, Megascelis spp., Melanotus spp., e.g. Melanotus longulus oregonensis, Meligethes aeneus, Melolontha spp., e.g. Melolontha melolontha, Migdolus spp., Monochamus spp., Naupactus xanthographus, Necrobia spp., Neogalerucella spp., Niptus hololeucus, Oryctes rhinoceros, Oryzaephilus surinamensis, Oryzaphagus oryzae, Otiorhynchus spp., e.g. Otiorhynchus cribricollis, Otiorhynchus ligustici, Otiorhynchus ovatus, Otiorhynchus rugosostriarus, Otiorhynchus sulcatus, Oulema spp., e.g. Oulema melanopus, Oulema oryzae, Oxycetonia jucunda, Phaedon cochleariae, Phyllophaga spp., Phyllophaga helleri, Phyllotreta spp., e.g. Phyllotreta armoraciae, Phyllotreta pusilla, Phyllotreta ramosa, Phyllotreta striolata, Popillia japonica, Premnotrypes spp., Prostephanus truncatus, Psylliodes spp., e.g. Psylliodes affinis, Psylliodes chrysocephala, Psylliodes punctulata, Ptinus spp., Rhizobius ventralis, Rhizopertha dominica, Rhynchophorus spp., Rhynchophorus ferrugineus, Rhynchophorus palmarum, Scolytus spp., e.g. Scolytus multistriatus, Sinoxylon perforans, Sitophilus spp., e.g. Sitophilus granarius, Sitophilus linearis, Sitophilus oryzae, Sitophilus zeamais, Sphenophorus spp., Stegobium paniceum, Sternechus spp., e.g. Sternechus paludatus, Symphyletes spp., Tanymecus spp., e.g. Tanymecus dilaticollis, Tanymecus indicus, Tanymecus palliatus, Tenebrio molitor, Tenebrioides mauretanicus, Tribolium spp., e.g. Tribolium audax, Tribolium castaneum, Tribolium confusum, Trogoderma spp., Tychius spp., Xylotrechus spp., Zabrus spp., e.g. Zabrus tenebrioides;

from the order of the Dermaptera, for example Anisolabis maritime, Forficula auricularia, Labidura riparia;

from the order of the Diptera, for example Aedes spp., for example Aedes aegypti, Aedes albopictus, Aedes sticticus, Aedes vexans, Agromyza spp., for example Agromyza frontella, Agromyza parvicornis, Anastrepha spp., Anopheles spp., for example Anopheles quadrimaculatus, Anopheles gambiae, Asphondylia spp., Bactrocera spp., for example Bactrocera cucurbitae, Bactrocera dorsalis, Bactrocera oleae, Bibio hortulanus, Calliphora erythrocephala, Calliphora vicina, Ceratitis capitata, Chironomus spp., Chrysomya spp., Chrysops spp., Chrysozona pluvialis, Cochliomya spp., Contarinia spp., for example

Contarinia johnsoni, Contarinia nasturtii, Contarinia pyrivora, Contarinia schulzi, Contarinia sorghicola, Contarinia tritici, Cordylobia anthropophaga, Cricotopus sylvestris, Culex spp., for example Culex pipiens, Culex quinquefasciatus, Culicoides spp., Culiseta spp., Cuterebra spp., Dacus oleae, Dasineura spp., for example Dasineura brassicae, Delia spp., for example Delia antiqua, Delia coarctata, Delia florilega, Delia platura, Delia radicum, Dermatobia hominis, Drosophila spp., for example Drosphila melanogaster, Drosophila suzukii, Echinocnemus spp., Euleia heraclei, Fannia spp., Gasterophilus spp., Glossina spp., Haematopota spp., Hydrellia spp., Hydrellia griseola, Hylemya spp., Hippobosca spp., Hypoderma spp., Liriomyza spp., for example Liriomyza brassicae, Liriomyza huidobrensis, Liriomyza sativae, Lucilia spp., for example Lucilia cuprina, Lutzomyia spp., Mansonia spp., Musca spp., for example Musca domestica, Musca domestica vicina, Oestrus spp., Oscinella frit, Paratanytarsus spp., Paralauterborniella subcincta, Pegomya or Pegomyia spp., for example Pegomya betae, Pegomya hyoscyami, Pegomya rubivora, Phlebotomus spp., Phorbia spp., Phormia spp., Piophila casei, Platyparea poeciloptera, Prodiplosis spp., Psila rosae, Rhagoletis spp., for example Rhagoletis cingulata, Rhagoletis completa, Rhagoletis fausta, Rhagoletis indifferens, Rhagoletis mendax, Rhagoletis pomonella, Sarcophaga spp., Simulium spp., for example Simulium meridionale, Stomoxys spp., Tabanus spp., Tetanops spp., Tipula spp., for example Tipula paludosa, Tipula simplex, Toxotrypana curvicauda;

from the order of the Hemiptera, for example Acizzia acaciaebaileyanae, Acizzia dodonaeae, Acizzia uncatoides, Acrida turrita, Acyrthosipon spp., e.g. Acyrthosiphon pisum, Acrogonia spp., Aeneolamia spp., Agonoscena spp., Aleurocanthus spp., Aleyrodes proletella, Aleurolobus barodensis, Aleurothrixus floccosus, Allocaridara malayensis, Amrasca spp., e.g. Amrasca bigutulla, Amrasca devastans, Anuraphis cardui, Aonidiella spp., e.g. Aonidiella aurantii, Aonidiella citrina, Aonidiella inornata, Aphanostigma piri, Aphis spp., e.g. Aphis citricola, Aphis craccivora, Aphis fabae, Aphis forbesi, Aphis glycines, Aphis gossypii, Aphis hederae, Aphis illinoisensis, Aphis middletoni, Aphis nasturtii, Aphis nerii, Aphis pomi, Aphis spiraecola, Aphis viburniphila, Arboridia apicalis, Arytainilla spp., Aspidiella spp., Aspidiotus spp., e.g. Aspidiotus nerii, Atanus spp., Aulacorthum solani, Bemisia tabaci, Blastopsylla occidentalis, Boreioglycaspis melaleucae, Brachycaudus helichrysi, Brachycolus spp., Brevicoryne brassicae, Cacopsylla spp., e.g. Cacopsylla pyricola, Calligypona marginata, Capulinia spp., Carneocephala fulgida, Ceratovacuna lanigera, Cercopidae, Ceroplastes spp.,

Chaetosiphon fragaefolii, Chionaspis tegalensis, Chlorita onukii, Chondracris rosea, Chromaphis juglandicola, Chrysomphalus aonidum, Chrysomphalus ficus, Cicadulina mbila, Coccomytilus halli, Coccus spp., e.g. Coccus hesperidum, Coccus longulus, Coccus pseudomagnoliarum, Coccus viridis, Cryptomyzus ribis, Cryptoneossa spp., Ctenarytaina spp., Dalbulus spp., Dialeurodes chittendeni, Dialeurodes citri, Diaphorina citri, Diaspis spp., Diuraphis spp., Doralis spp., Drosicha spp., Dysaphis spp., e.g. Dysaphis apiifolia, Dysaphis plantaginea, Dysaphis tulipae, Dysmicoccus spp., Empoasca spp., e.g. Empoasca abrupta, Empoasca fabae, Empoasca maligna, Empoasca solana, Empoasca stevensi, Eriosoma spp., e.g. Eriosoma americanum, Eriosoma lanigerum, Eriosoma pyricola, Erythroneura spp., Eucalyptolyma spp., Euphyllura spp., Euscelis bilobatus, Ferrisia spp., Fiorinia spp., Furcaspis oceanica, Geococcus coffeae, Glycaspis spp., Heteropsylla cubana, Heteropsylla spinulosa, Homalodisca coagulata, Hyalopterus arundinis, Hyalopterus pruni, Icerya spp., e.g. Icerya purchasi, Idiocerus spp., Idioscopus spp., Laodelphax striatellus, Lecanium spp., e.g. Lecanium corni (=Parthenolecanium corni), Lepidosaphes spp., e.g. Lepidosaphes ulmi, Lipaphis erysimi, Lopholeucaspis japonica, Lycorma delicatula, Macrosiphum spp., e.g. Macrosiphum euphorbiae, Macrosiphum lilii, Macrosiphum rosae, Macrosteles facifrons, Mahanarva spp., Melanaphis sacchari, Metcalfiella spp., Metcalfa pruinosa, Metopolophium dirhodum, Monellia costalis, Monelliopsis pecanis, Myzus spp., e.g. Myzus ascalonicus, Myzus cerasi, Myzus ligustri, Myzus ornatus, Myzus persicae, Myzus nicotianae, Nasonovia ribisnigri, Neomaskellia spp., Nephotettix spp., e.g. Nephotettix cincticeps, Nephotettix nigropictus, Nettigoniclla spectra, Nilaparvata lugens, Oncometopia spp., Orthezia praelonga, Oxya chinensis, Pachypsylla spp., Parabemisia myricae, Paratrioza spp., e.g. Paratrioza cockerelli, Parlatoria spp., Pemphigus spp., e.g. Pemphigus bursarius, Pemphigus populivenae, Peregrinus maidis, Perkinsiella spp., Phenacoccus spp., e.g. Phenacoccus madeirensis, Phloeomyzus passerinii, Phorodon humuli, Phylloxera spp., e.g. Phylloxera devastatrix, Phylloxera notabilis, Pinnaspis aspidistrae, Planococcus spp., e.g. Planococcus citri, Prosopidopsylla flava, Protopulvinaria pyriformis, Pseudaulacaspis pentagona, Pseudococcus spp., e.g. Pseudococcus calceolariae, Pseudococcus comstocki, Pseudococcus longispinus, Pseudococcus maritimus, Pseudococcus viburni, Psyllopsis spp., Psylla spp., e.g. Psylla buxi, Psylla mali, Psylla pyri, Pteromalus spp., Pulvinaria spp., Pyrilla spp., Quadraspidiotus spp., e.g. Quadraspidiotus juglansregiae, Quadraspidiotus ostreaeformis, Quadraspidiotus perniciosus, Quesada gigas, Rastrococcus spp., Rhopalosiphum spp., e.g.

Rhopalosiphum maidis, Rhopalosiphum oxyacanthae, Rhopalosiphum padi, Rhopalosiphum rufiabdominale, Saissetia spp., e.g. Saissetia coffeae, Saissetia miranda, Saissetia neglecta, Saissetia oleae, Scaphoideus titanus, Schizaphis graminum, Selenaspidus articulatus, Sipha flava, Sitobion avenae, Sogata spp., Sogatella furcifera, Sogatodes spp., Stictocephala festina, Siphoninus phillyreae, Tenalaphara malayensis, Tetragonocephela spp., Tinocallis caryaefoliae, Tomaspis spp., Toxoptera spp., e.g. Toxoptera aurantii, Toxoptera citricidus, Trialeurodes vaporariorum, Trioza spp., e.g. Trioza diospyri, Typhlocyba spp., Unaspis spp., Viteus vitifolii, Zygina spp.;

from the suborder of the Heteroptera, for example Aelia spp., Anasa tristis, Antestiopsis spp., Boisea spp., Blissus spp., Calocoris spp., Campylomma livida, Cavelerius spp., Cimex spp., e.g. Cimex adjunctus, Cimex hemipterus, Cimex lectularius, Cimex pilosellus, Collaria spp., Creontiades dilutus, Dasynus piperis, Dichelops furcatus, Diconocoris hewetti, Dysdercus spp., Euschistus spp., e.g. Euschistus heros, Euschistus servus, Euschistus tristigmus, Euschistus variolarius, Eurydema spp., Eurygaster spp., Halyomorpha halys, Heliopeltis spp., Horcias nobilellus, Leptocorisa spp., Leptocorisa varicornis, Leptoglossus occidentalis, Leptoglossus phyllopus, Lygocoris spp., e.g. Lygocoris pabulinus, Lygus spp., e.g. Lygus elisus, Lygus hesperus, Lygus lineolaris, Macropes excavatus, Megacopta cribraria, Miridae, Monalonion atratum, Nezara spp., e.g. Nezara viridula, Nysius spp., Oebalus spp., Pentomidae, Piesma quadrata, Piezodorus spp., e.g. Piezodorus guildinii, Psallus spp., Pseudacysta persea, Rhodnius spp., Sahlbergella singularis, Scaptocoris castanea, Scotinophora spp., Stephanitis nashi, Tibraca spp., Triatoma spp.;

from the order of the Hymenoptera, for example Acromyrmex spp., Athalia spp., e.g. Athalia rosae, Atta spp., Camponotus spp., Dolichovespula spp., Diprion spp., e.g. Diprion similis, Hoplocampa spp., e.g. Hoplocampa cookei, Hoplocampa testudinea, Lasius spp., Linepithema (Iridiomyrmex) humile, Monomorium pharaonis, Paratrechina spp., Paravespula spp., Plagiolepis spp., Sirex spp., e.g. Sirex noctilio, Solenopsis invicta, Tapinoma spp., Technomyrmex albipes, Urocerus spp., Vespa spp., e.g. Vespa crabro, Wasmannia auropunctata, Xeris spp.;

from the order of the Isopoda, for example Armadillidium vulgare, Oniscus asellus, Porcellio scaber;

from the order of the Isoptera, for example Coptotermes spp., e.g. Coptotermes formosanus, Cornitermes cumulans, Cryptotermes spp., Incisitermes spp., Kalotermes spp., Microtermes obesi, Nasutitermes spp., Odontotermes spp., Porotermes spp., Reticulitermes spp., e.g. Reticulitermes flavipes, Reticulitermes hesperus;

from the order of the Lepidoptera, for example Achroia grisella, Acronicta major, Adoxophyes spp., e.g. Adoxophyes orana, Aedia leucomelas, Agrotis spp., e.g. Agrotis segetum, Agrotis ipsilon, Alabama spp., e.g. Alabama argillacea, Amyelois transitella, Anarsia spp., Anticarsia spp., e.g. Anticarsia gemmatalis, Argyroploce spp., Autographa spp., Barathra brassicae, Blastodacna atra, Borbo cinnara, Bucculatrix thurberiella, Bupalus piniarius, Busseola spp., Cacoecia spp., Caloptilia theivora, Capua reticulana, Carpocapsa pomonella, Carposina niponensis, Cheimatobia brumata, Chilo spp., e.g. Chilo plejadellus, Chilo suppressalis, Choreutis pariana, Choristoneura spp., Chrysodeixis chalcites, Clysia ambiguella, Cnaphalocerus spp., Cnaphalocrocis medinalis, Cnephasia spp., Conopomorpha spp., Conotrachelus spp., Copitarsia spp., Cydia spp., e.g. Cydia nigricana, Cydia pomonella, Dalaca noctuides, Diaphania spp., Diparopsis spp., Diatraea saccharalis, Dioryctria spp., e.g. Dioryctria zimmermani, Earias spp., Ecdytolopha aurantium, Elasmopalpus lignosellus, Eldana saccharina, Ephestia spp., e.g. Ephestia elutella, Ephestia kuehniella, Epinotia spp., Epiphyas postvittana, Erannis spp., Erschoviella musculana, Etiella spp., Eudocima spp., Eulia spp., Eupoecilia ambiguella, Euproctis spp., e.g. Euproctis chrysorrhoea, Euxoa spp., Feltia spp., Galleria mellonella, Gracillaria spp., Grapholitha spp., e.g. Grapholita molesta, Grapholita prunivora, Hedylepta spp., Helicoverpa spp., e.g. Helicoverpa armigera, Helicoverpa zea, Heliothis spp., e.g. Heliothis virescens , Hofmannophila pseudospretella, Homoeosoma spp., Homona spp., Hyponomeuta padella, Kakivoria flavofasciata, Lampides spp., Laphygma spp., Laspeyresia molesta, Leucinodes orbonalis, Leucoptera spp., e.g. Leucoptera coffeella, Lithocolletis spp., e.g. Lithocolletis blancardella, Lithophane antennata, Lobesia spp., e.g. Lobesia botrana, Loxagrotis albicosta, Lymantria spp., e.g. Lymantria dispar, Lyonetia spp., e.g. Lyonetia clerkella, Malacosoma neustria, Maruca testulalis, Mamestra brassicae, Melanitis leda, Mocis spp., Monopis obviella, Mythimna separata, Nemapogon cloacellus, Nymphula spp., Oiketicus spp., Omphisa spp., Operophtera spp., Oria spp., Orthaga spp., Ostrinia spp., e.g. Ostrinia nubilalis, Panolis flammea, Parnara spp., Pectinophora spp., e.g. Pectinophora gossypiella, Perileucoptera spp., Phthorimaea spp., e.g.

Phthorimaea operculella, Phyllocnistis citrella, Phyllonorycter spp., e.g. Phyllonorycter blancardella, Phyllonorycter crataegella, Pieris spp., e.g. Pieris rapae, Platynota stultana, Plodia interpunctella, Plusia spp., Plutella xylostella (=Plutella maculipennis), Podesia spp., e.g. Podesia syringae, Prays spp., Prodenia spp., Protoparce spp., Pseudaletia spp., e.g. Pseudaletia unipuncta, Pseudoplusia includens, Pyrausta nubilalis, Rachiplusia nu, Schoenobius spp., e.g. Schoenobius bipunctifer, Scirpophaga spp., e.g. Scirpophaga innotata, Scotia segetum, Sesamia spp., e.g. Sesamia inferens, Sparganothis spp., Spodoptera spp., e.g. Spodoptera eradiana, Spodoptera exigua, Spodoptera frugiperda, Spodoptera praefica, Stathmopoda spp., Stenoma spp., Stomopteryx subsecivella, Synanthedon spp., Tecia solanivora, Thaumetopoea spp., Thermesia gemmatalis, Tinea cloacella, Tinea pellionella, Tineola bisselliella, Tortrix spp., Trichophaga tapetzella, Trichoplusia spp., e.g. Trichoplusia ni, Tryporyza incertulas, Tuta absoluta, Virachola spp.;

from the order of the Orthoptera or Saltatoria, for example Acheta domesticus, Dichroplus spp., Gryllotalpa spp., e.g. Gryllotalpa gryllotalpa, Hieroglyphus spp., Locusta spp., e.g. Locusta migratoria, Melanoplus spp., e.g. Melanoplus devastator, Paratlanticus ussuriensis, Schistocerca gregaria;

from the order of the Phthiraptera, for example Damalinia spp., Haematopinus spp., Linognathus spp., Pediculus spp., Phylloxera vastatrix, Phthirus pubis, Trichodectes spp.;

from the order of the Psocoptera, for example Lepinotus spp., Liposcelis spp.;

from the order of the Siphonaptera, for example Ceratophyllus spp., Ctenocephalides spp., e.g. Ctenocephalides canis, Ctenocephalides felis, Pulex irritans, Tunga penetrans, Xenopsylla cheopis;

from the order of the Thysanoptera, for example Anaphothrips obscurus, Baliothrips biformis, Chaetanaphothrips leeuweni, Drepanothrips reuteri, Enneothrips flavens, Frankliniella spp., e.g. Frankliniella fusca, Frankliniella occidentalis, Frankliniella schultzei, Frankliniella tritici, Frankliniella vaccinii, Frankliniella williamsi, Haplothrips spp., Heliothrips spp., Hercinothrips femoralis, Kakothrips spp., Rhipiphorothrips cruentatus, Scirtothrips spp., Taeniothrips cardamomi, Thrips spp., e.g. Thrips palmi, Thrips tabaci;

from the order of the Zygentoma (= Thysanura), for example Ctenolepisma spp., Lepisma saccharina, Lepismodes inquilinus, Thermobia domestica;

from the class of the Symphyla, for example Scutigerella spp., e.g. Scutigerella immaculata;

pests from the phylum of the Mollusca, for example from the class of the Bivalvia, e.g. Dreissena spp.;

and also from the class of the Gastropoda, for example Arion spp., e.g. Arion ater rufus, Biomphalaria spp., Bulinus spp., Deroceras spp., e.g. Deroceras laeve, Galba spp., Lymnaea spp., Oncomelania spp., Pomacea spp., Succinea spp.;

plant pests from the phylum of the Nematoda, i.e. plant-parasitic nematodes, in particular Aglenchus spp., for example Aglenchus agricola, Anguina spp., for example Anguina tritici, Aphelenchoides spp., for example Aphelenchoides arachidis, Aphelenchoides fragariae, Belonolaimus spp., for example Belonolaimus gracilis, Belonolaimus longicaudatus, Belonolaimus nortoni, Bursaphelenchus spp., for example Bursaphelenchus cocophilus, Bursaphelenchus eremus, Bursaphelenchus xylophilus, Cacopaurus spp., for example Cacopaurus pestis, Criconemella spp., for example Criconemella curvata, Criconemella onoensis, Criconemella ornata, Criconemella rusium, Criconemella xenoplax (= Mesocriconema xenoplax), Criconemoides spp., for example Criconemoides ferniae, Criconemoides onoense, Criconemoides ornatum, Ditylenchus spp., for example Ditylenchus dipsaci, Dolichodorus spp., Globodera spp., for example Globodera pallida, Globodera rostochiensis, Helicotylenchus spp., for example Helicotylenchus dihystera, Hemicriconemoides spp., Hemicycliophora spp., Heterodera spp., for example Heterodera avenae, Heterodera glycines, Heterodera schachtii, Hirschmaniella spp., Hoplolaimus spp., Longidorus spp., for example Longidorus africanus, Meloidogyne spp., for example Meloidogyne chitwoodi, Meloidogyne fallax, Meloidogyne hapla, Meloidogyne incognita, Meloinema spp., Nacobbus spp., Neotylenchus spp., Paralongidorus spp., Paraphelenchus spp., Paratrichodorus spp., for example Paratrichodorus minor, Paratylenchus spp., Pratylenchus spp., for example Pratylenchus penetrans, Pseudohalenchus spp., Psilenchus spp., Punctodera spp., Quinisulcius spp., Radopholus spp., for example Radopholus citrophilus, Radopholus similis, Rotylenchulus spp., Rotylenchus spp., Scutellonema spp., Subanguina spp., Trichodorus spp., for example Trichodorus obtusus, Trichodorus primitivus,

Tylenchorhynchus spp., for example Tylenchorhynchus annulatus, Tylenchulus spp., for example Tylenchulus semipenetrans, Xiphinema spp., for example Xiphinema index.

The compounds of the formula (I) can, as the case may be, at certain concentrations or application rates, also be used as herbicides, safeners, growth regulators or agents to improve plant properties, as microbicides or gametocides, for example as fungicides, antimycotics, bactericides, virucides (including agents against viroids) or as agents against MLO (mycoplasma-like organisms) and RLO (rickettsia-like organisms). They can, as the case may be, also be used as intermediates or precursors for the synthesis of other active compounds.

Formulations

The present invention further relates to formulations and use forms prepared therefrom as pesticides, for example drench, drip and spray liquors, comprising at least one compound of the formula (I). Optionally, the use forms comprise further pesticides and/or adjuvants which improve action, such as penetrants, e.g. vegetable oils, for example rapeseed oil, sunflower oil, mineral oils, for example paraffin oils, alkyl esters of vegetable fatty acids, for example rapeseed oil methyl ester or soya oil methyl ester, or alkanol alkoxylates and/or spreaders, for example alkylsiloxanes and/or salts, for example organic or inorganic ammonium or phosphonium salts, for example ammonium sulfate or diammonium hydrogenphosphate and/or retention promoters, for example dioctyl sulfosuccinate or hydroxypropylguar polymers and/or humectants, for example glycerol and/or fertilizers, for example ammonium-, potassium- or phosphorus-containing fertilizers.

Customary formulations are, for example, water-soluble liquids (SL), emulsion concentrates (EC), emulsions in water (EW), suspension concentrates (SC, SE, FS, OD), water-dispersible granules (WG), granules (GR) and capsule concentrates (CS); these and further possible formulation types are described, for example, by Crop Life International and in Pesticide Specifications, Manual on development and use of FAO and WHO specifications for pesticides, FAO Plant Production and Protection Papers – 173, prepared by the FAO/WHO Joint Meeting on Pesticide Specifications, 2004, ISBN: 9251048576. The formulations, in addition to one or more compounds of the formula (I), optionally comprise further active agrochemical ingredients.

Preference is given to formulations or use forms comprising auxiliaries, for example extenders, solvents, spontaneity promoters, carriers, emulsifiers, dispersants, frost protection agents, biocides, thickeners and/or further auxiliaries, for example adjuvants. An adjuvant in this context is a component which enhances the biological effect of the formulation, without the component itself having any biological effect. Examples of adjuvants are agents which promote retention, spreading, attachment to the leaf surface or penetration.

These formulations are produced in a known manner, for example by mixing the compounds of the formula (I) with auxiliaries, for example extenders, solvents and/or solid carriers and/or other auxiliaries, for example surfactants. The formulations are produced either in suitable facilities or else before or during application.

The auxiliaries used may be substances suitable for imparting special properties, such as certain physical, technical and/or biological properties, to the formulation of the compounds of the formula (I), or to the use forms prepared from these formulations (for example ready-to-use pesticides such as spray liquors or seed-dressing products).

Suitable extenders are, for example, water, polar and nonpolar organic chemical liquids, for example from the classes of the aromatic and non-aromatic hydrocarbons (such as paraffins, alkylbenzenes, alkylnaphthalenes, chlorobenzenes), the alcohols and polyols (which, if appropriate, may also be substituted, etherified and/or esterified), the ketones (such as acetone, cyclohexanone), the esters (including fats and oils) and (poly)ethers, the simple and substituted amines, amides, lactams (such as N-alkylpyrrolidones) and lactones, the sulfones and sulfoxides (such as dimethyl sulfoxide), the carbonates and the nitriles.

If the extender utilized is water, it is also possible to use, for example, organic solvents as auxiliary solvents. Useful liquid solvents are essentially: aromatics such as xylene, toluene or alkylnaphthalenes, chlorinated aromatics or chlorinated aliphatic hydrocarbons such as chlorobenzenes, chloroethylenes or methylene chloride, aliphatic hydrocarbons such as cyclohexane or paraffins, for example petroleum fractions, mineral and vegetable oils, alcohols such as butanol or glycol and their ethers and esters, ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents such as dimethylformamide or dimethyl sulfoxide, carbonates such as propylene carbonate, butylene

carbonate, diethyl carbonate or dibutyl carbonate, or nitriles such as acetonitrile or propanenitrile.

In principle, it is possible to use all suitable solvents. Examples of suitable solvents are aromatic hydrocarbons, for example xylene, toluene or alkylnaphthalenes, chlorinated aromatic or chlorinated aliphatic hydrocarbons, for example chlorobenzene, chloroethylene or methylene chloride, aliphatic hydrocarbons, for example cyclohexane, paraffins, petroleum fractions, mineral and vegetable oils, alcohols, for example methanol, ethanol, isopropanol, butanol or glycol and their ethers and esters, ketones, for example acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents such as dimethyl sulfoxide, carbonates such as propylene carbonate, butylene carbonate, diethyl carbonate or dibutyl carbonate, nitriles such as acetonitrile or propanenitrile, and also water.

In principle, it is possible to use all suitable carriers. Suitable carriers include more particularly the following: for example ammonium salts and natural, finely ground rocks, such as kaolins, aluminas, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and synthetic, finely ground rocks, such as finely divided silica, aluminium oxide and natural or synthetic silicates, resins, waxes and/or solid fertilizers. It is likewise possible to use mixtures of such carriers. Useful carriers for granules include: for example crushed and fractionated natural rocks such as calcite, marble, pumice, sepiolite, dolomite, and synthetic granules of inorganic and organic flours, and also granules of organic material such as sawdust, paper, coconut shells, maize cobs and tobacco stalks.

It is also possible to use liquefied gaseous extenders or solvents. Especially suitable extenders or carriers are those which are gaseous at standard temperature and under atmospheric pressure, for example aerosol propellants such as halogenated hydrocarbons, and also butane, propane, nitrogen and carbon dioxide.

Examples of emulsifiers and/or foam formers, dispersants or wetting agents having ionic or nonionic properties or mixtures of these surface-active substances are salts of polyacrylic acid, salts of lignosulfonic acid, salts of phenolsulfonic acid or naphthalenesulfonic acid, polycondensates of ethylene oxide with fatty alcohols or with fatty acids or with fatty amines, with substituted phenols (preferably alkylphenols or arylphenols), salts of sulfosuccinic esters, taurine derivatives (preferably alkyl taurates), isethionate derivatives, phosphoric esters of

polyethoxylated alcohols or phenols, fatty acid esters of polyols, and derivatives of the compounds containing sulfates, sulfonates and phosphates, for example alkylaryl polyglycol ethers, alkylsulfonates, alkyl sulfates, arylsulfonates, protein hydrolysates, lignosulfite waste liquors and methylcellulose. The presence of a surfactant is advantageous if one of the compounds of the formula (I) and/or one of the inert carriers is insoluble in water and if the application takes place in water.

Further auxiliaries which may be present in the formulations and the use forms derived therefrom include dyes such as inorganic pigments, for example iron oxide, titanium oxide and Prussian Blue, and organic dyes such as alizarin dyes, azo dyes and metal phthalocyanine dyes, and nutrients and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

Additional components which may be present are stabilizers, such as cold stabilizers, preservatives, antioxidants, light stabilizers, or other agents which improve chemical and/or physical stability. Foam formers or antifoams may also be present.

In addition, the formulations and use forms derived therefrom may also comprise, as additional auxiliaries, stickers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders, granules or latices, such as gum arabic, polyvinyl alcohol and polyvinyl acetate, or else natural phospholipids such as cephalins and lecithins and synthetic phospholipids. Further auxiliaries may be mineral and vegetable oils.

It is possible if appropriate for still further auxiliaries to be present in the formulations and the use forms derived therefrom. Examples of such additives are fragrances, protective colloids, binders, adhesives, thickeners, thixotropic agents, penetrants, retention promoters, stabilizers, sequestrants, complexing agents, humectants, spreaders. In general, the compounds of the formula (I) can be combined with any solid or liquid additive commonly used for formulation purposes.

Useful retention promoters include all those substances which reduce dynamic surface tension, for example dioctyl sulfosuccinate, or increase viscoelasticity, for example hydroxypropylguar polymers.

Useful penetrants in the present context are all those substances which are typically used to improve the penetration of agrochemically active compounds into plants. Penetrants are defined in this context by their ability to penetrate from the (generally aqueous) application liquor and/or from the spray coating into the cuticle of the plant and hence to increase the mobility of the active compounds in the cuticle. The method described in the literature (Baur et al., 1997, Pesticide Science 51, 131-152) can be used for determining this property. Examples include alcohol alkoxylates such as coconut fatty ethoxylate (10) or isotridecyl ethoxylate (12), fatty acid esters, for example rapeseed oil methyl ester or soya oil methyl ester, fatty amine alkoxylates, for example tallowamine ethoxylate (15), or ammonium and/or phosphonium salts, for example ammonium sulfate or diammonium hydrogenphosphate.

The formulations preferably comprise between 0.00000001% and 98% by weight of the compound of the formula (I), more preferably between 0.01% and 95% by weight of the compound of the formula (I), most preferably between 0.5% and 90% by weight of the compound of the formula (I), based on the weight of the formulation.

The content of the compound of the formula (I) in the use forms prepared from the formulations (in particular pesticides) may vary within wide ranges. The concentration of the compound of the formula (I) in the use forms may typically be between 0.00000001% and 95% by weight of the compound of the formula (I), preferably between 0.00001% and 1% by weight, based on the weight of the use form. The compounds are employed in a customary manner appropriate for the use forms.

Mixtures

The compounds of the formula (I) can also be used in a mixture with one or more suitable fungicides, bactericides, acaricides, molluscicides, nematicides, insecticides, microbiological agents, beneficial organisms, herbicides, fertilizers, bird repellents, phytotonics, sterilants, safeners, semiochemicals and/or plant growth regulators, in order thus, for example, to broaden the spectrum of action, prolong the period of action, enhance the rate of action, prevent repellency or prevent evolution of resistance. In addition, active compound combinations of this kind can improve plant growth and/or tolerance to abiotic factors, for example high or low temperatures, to drought or to elevated water content or soil salinity. It is also possible to improve flowering and fruiting performance, optimize germination capacity

and root development, facilitate harvesting and improve yields, influence maturation, improve the quality and/or the nutritional value of the harvested products, prolong storage life and/or improve the processibility of the harvested products.

In addition, the compounds of the formula (I) may be present in a mixture with other active compounds or semiochemicals such as attractants and/or bird repellents and/or plant activators and/or growth regulators and/or fertilizers. Likewise, the compounds of the formula (I) can be used to improve plant properties, for example growth, yield and quality of the harvested material.

In a particular embodiment according to the invention, the compounds of the formula (I) are present in formulations or in the use forms prepared from these formulations in a mixture with further compounds, preferably those as described below.

If one of the compounds mentioned below can occur in different tautomeric forms, these forms are also included even if not explicitly mentioned in each case. All the mixing components mentioned, as the case may be, may also form salts with suitable bases or acids if they are capable of doing so on the basis of their functional groups.

Insecticides/acaricides/nematicides

The active compounds specified here with their common names are known and are described for example in "The Pesticide Manual", 16th ed., British Crop Protection Council 2012, or can be searched for on the Internet (e.g. http://www.alanwood.net/pesticides). The classification is based on the IRAC Mode of Action Classification Scheme applicable at the time of filing of this patent application.

(1) Acetylcholinesterase (AChE) inhibitors, preferably carbamates selected from alanycarb, aldicarb, bendiocarb, benfuracarb, butocarboxim, butoxycarboxim, carbaryl, carbofuran, carbosulfan, ethiofencarb, fenobucarb, formetanate, furathiocarb, isoprocarb, methiocarb, methomyl, metolcarb, oxamyl, pirimicarb, propoxur, thiodicarb, thiofanox, triazamate, trimethacarb, XMC and xylylcarb; or organophosphates selected from acephate, azamethiphos, azinphos-ethyl, azinphos-methyl, cadusafos, chlorethoxyfos, chlorfenvinphos, chlormephos, chlorpyrifos-methyl, coumaphos, cyanophos, demeton-S-methyl, diazinon,

dichlorvos/DDVP, dicrotophos, dimethoate, dimethylvinphos, disulfoton, EPN, ethion, ethoprophos, famphur, fenamiphos, fenitrothion, fenthion, fosthiazate, heptenophos, imicyafos, isofenphos, isopropyl O-(methoxyaminothiophosphoryl) salicylate, isoxathion, malathion, mecarbam, methamidophos, methidathion, mevinphos, monocrotophos, naled, omethoate, oxydemeton-methyl, parathion-methyl, phenthoate, phorate, phosalone, phosmet, phosphamidon, phoxim, pirimiphos-methyl, profenofos, propetamphos, prothiofos, pyraclofos, pyridaphenthion, quinalphos, sulfotep, tebupirimfos, temephos, terbufos, tetrachlorvinphos, thiometon, triazophos, triclorfon and vamidothion.

(2) GABA-gated chloride channel blockers, preferably cyclodiene-organochlorines selected from chlordane and endosulfan or phenylpyrazoles (fiproles) selected from ethiprole and fipronil.

(3) Sodium channel modulators, preferably pyrethroids selected from acrinathrin, allethrin, d-cis-trans allethrin, d-trans allethrin, bifenthrin, bioallethrin, bioallethrin S-cyclopentenyl isomer, bioresmethrin, cycloprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin [(1R)-trans isomer], deltamethrin, empenthrin [(EZ)-(1R) isomer], esfenvalerate, etofenprox, fenpropathrin, fenvalerate, flucythrinate, flumethrin, tau-fluvalinate, halfenprox, imiprothrin, kadethrin, momfluorothrin, permethrin, phenothrin [(1R)-trans isomer], prallethrin, pyrethrins (pyrethrum), resmethrin, silafluofen, tefluthrin, tetramethrin, tetramethrin [(1R) isomer], tralomethrin and transfluthrin or DDT or methoxychlor.

(4) Competitive modulators of the nicotinic acetylcholine receptor (nAChR), preferably neonicotinoids selected from acetamiprid, clothianidin, dinotefuran, imidacloprid, nitenpyram, thiacloprid and thiamethoxam, or nicotine, or sulfoximines selected from sulfoxaflor, or butenolides selected from flupyradifurone.

(5) Nicotinic acetylcholine receptor (nAChR) allosteric modulators, preferably spinosyns selected from spinetoram and spinosad.

(6) Glutamate-gated chloride channel (GluCl) allosteric modulators, preferably avermectins/milbemycins selected from abamectin, emamectin benzoate, lepimectin and milbemectin.

(7) Juvenile hormone mimetics, preferably juvenile hormone analogues selected from hydroprene, kinoprene and methoprene or fenoxycarb or pyriproxyfen.

(8) Miscellaneous non-specific (multi-site) inhibitors, preferably alkyl halides selected from methyl bromide and other alkyl halides; or chloropicrin or sulfuryl fluoride or borax or tartar emetic or methyl isocyanate generators selected from diazomet and metam.

(9) TRPV channel modulators of chordotonal organs selected from pymetrozine and pyrifluquinazon.

(10) Mite growth inhibitors selected from clofentezine, hexythiazox, diflovidazin and etoxazole.

(11) Microbial disruptors of the insect gut membrane selected from *Bacillus thuringiensis* subspecies *israelensis*, *Bacillus sphaericus, Bacillus thuringiensis* subspecies *aizawai*, *Bacillus thuringiensis* subspecies *kurstaki*, *Bacillus thuringiensis* subspecies *tenebrionis*, and *B.t.* plant proteins selected from Cry1Ab, Cry1Ac, Cry1Fa, Cry1A.105, Cry2Ab, VIP3A, mCry3A, Cry3Ab, Cry3Bb and Cry34Ab1/35Ab1.

(12) Inhibitors of mitochondrial ATP synthase, preferably ATP disruptors selected from diafenthiuron or organotin compounds selected from azocyclotin, cyhexatin and fenbutatin oxide, or propargite or tetradifon.

(13) Uncouplers of oxidative phosphorylation via disruption of the proton gradient selected from chlorfenapyr, DNOC and sulfluramid.

(14) Nicotinic acetylcholine receptor channel blockers selected from bensultap, cartap hydrochloride, thiocyclam, and thiosultap-sodium.

(15) Inhibitors of chitin biosynthesis, type 0, selected from bistrifluron, chlorfluazuron, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, noviflumuron, teflubenzuron and triflumuron.

(16) Inhibitors of chitin biosynthesis, type 1, selected from buprofezin.

(17) Moulting disruptors (especially in the case of Diptera) selected from cyromazine.

(18) Ecdysone receptor agonists selected from chromafenozide, halofenozide, methoxyfenozide and tebufenozide.

(19) Octopamine receptor agonists selected from amitraz.

(20) Mitochondrial complex III electron transport inhibitors selected from hydramethylnon, acequinocyl and fluacrypyrim.

(21) Mitochondrial complex I electron transport inhibitors, preferably METI acaricides selected from fenazaquin, fenpyroximate, pyrimidifen, pyridaben, tebufenpyrad and tolfenpyrad, or rotenone (Derris).

(22) Voltage-dependent sodium channel blockers selected from indoxacarb and metaflumizone.

(23) Inhibitors of acetyl-CoA carboxylase, preferably tetronic and tetramic acid derivatives selected from spirodiclofen, spiromesifen and spirotetramat.

(24) Mitochondrial complex IV electron transport inhibitors, preferably phosphines selected from aluminium phosphide, calcium phosphide, phosphine and zinc phosphide, or cyanides selected from calcium cyanide, potassium cyanide and sodium cyanide.

(25) Mitochondrial complex II electron transport inhibitors, preferably beta-keto nitrile derivatives selected from cyenopyrafen and cyflumetofen, or carboxanilides selected from pyflubumide.

(28) Ryanodine receptor modulators, preferably diamides selected from chlorantraniliprole, cyantraniliprole and flubendiamide.

(29) Modulators of chordotonal organs (with undefined target structure) selected from flonicamid.

(30) Further active compounds selected from acynonapyr, afidopyropen, afoxolaner, azadirachtin, benclothiaz, benzoximate, benzpyrimoxan, bifenazate, broflanilide, bromopropylate, chinomethionat, chloroprallethrin, cryolite, cyclaniliprole, cycloxaprid, cyhalodiamide, dicloromezotiaz, dicofol, epsilon metofluthrin, epsilon momfluthrin, flometoquin, fluazaindolizine, fluensulfone, flufenerim, flufenoxystrobin, flufiprole, fluhexafon, fluopyram, flupyrimin, fluralaner, fluxametamide, fufenozide, guadipyr, heptafluthrin, imidaclothiz, iprodione, kappa bifenthrin, kappa tefluthrin, lotilaner, meperfluthrin, oxazosulfyl, paichongding, pyridalyl, pyrifluquinazon, pyriminostrobin, spirobudiclofen, spiropidion, tetramethylfluthrin, tetraniliprole, tetrachlorantraniliprole, tigolaner, tioxazafen, thiofluoximate, triflumezopyrim and iodomethane; additionally preparations based on *Bacillus firmus* (I-1582, BioNeem, Votivo), and the following compounds: 1-{2-fluoro-4-methyl-5-[(2,2,2-trifluoroethyl)sulfinyl]phenyl}-3-(trifluoromethyl)-1H-1,2,4-triazole-5-amine (known from WO2006/043635) (CAS 885026-50-6), {1'-[(2E)-3-(4-chlorophenyl)prop-2-en-1-yl]-5-fluorospiro[indole-3,4'-piperidine]-1(2H)-yl}(2-chloropyridin-4-yl)methanone (known from WO2003/106457) (CAS 637360-23-7), 2-chloro-N-[2-{1-[(2E)-3-(4-chlorophenyl)prop-2-en-1-yl]piperidin-4-yl}-4-(trifluoromethyl)phenyl]isonicotinamide (known from WO2006/003494) (CAS 872999-66-1), 3-(4-chloro-2,6-dimethylphenyl)-4-hydroxy-8-methoxy-1,8-diazaspiro[4.5]dec-3-en-2-one (known from WO 2010052161) (CAS 1225292-17-0), 3-(4-chloro-2,6-dimethylphenyl)-8-methoxy-2-oxo-1,8-diazaspiro[4.5]dec-3-en-4-yl ethylcarbonate (known from EP 2647626) (CAS-1440516-42-6), 4-(but-2-yn-1-yloxy)-6-(3,5-dimethylpiperidin-1-yl)-5-fluoropyrimidine (known from WO2004/099160) (CAS 792914-58-0), PF1364 (known from JP2010/018586) (CAS Reg.No. 1204776-60-2), (3E)-3-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-1,1,1-trifluoropropan-2-one (known from WO2013/144213) (CAS 1461743-15-6), N-[3-(benzylcarbamoyl)-4-chlorophenyl]-1-methyl-3-(pentafluoroethyl)-4-(trifluoromethyl)-1*H*-pyrazole-5-carboxamide (known from WO2010/051926) (CAS 1226889-14-0), 5-bromo-4-chloro-N-[4-chloro-2-methyl-6-(methylcarbamoyl)phenyl]-2-(3-chloro-2-pyridyl)pyrazole-3-carboxamide (known from CN103232431) (CAS 1449220-44-3), 4-[5-(3,5-dichlorophenyl)-4,5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-2-methyl-N-(cis-1-oxido-3-thietanyl)benzamide, 4-[5-(3,5-dichlorophenyl)-4,5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-2-methyl-N-(trans-1-oxido-3-thietanyl)benzamide and 4-[(5S)-5-(3,5-dichlorophenyl)-4,5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-2-methyl-N-(cis-1-oxido-3-

thietanyl)benzamide (known from WO 2013/050317 A1) (CAS 1332628-83-7), N-[3-chloro-1-(3-pyridinyl)-1H-pyrazol-4-yl]-N-ethyl-3-[(3,3,3-trifluoropropyl)sulfinyl]propanamide, (+)-N-[3-chloro-1-(3-pyridinyl)-1H-pyrazol-4-yl]-N-ethyl-3-[(3,3,3-trifluoropropyl)sulfinyl]propanamide and (-)-N-[3-chloro-1-(3-pyridinyl)-1H-pyrazol-4-yl]-N-ethyl-3-[(3,3,3-trifluoropropyl)sulfinyl]propanamide (known from WO 2013/162715 A2, WO 2013/162716 A2, US 2014/0213448 A1) (CAS 1477923-37-7), 5-[[(2E)-3-chloro-2-propen-1-yl]amino]-1-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(trifluoromethyl)sulfinyl]-1H-pyrazole-3-carbonitrile (known from CN 101337937 A) (CAS 1105672-77-2), 3-bromo-N-[4-chloro-2-methyl-6-[(methylamino)thioxomethyl]phenyl]-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide (Liudaibenjiaxuanan, known from CN 103109816 A) (CAS 1232543-85-9); N-[4-chloro-2-[[(1,1-dimethylethyl)amino]carbonyl]-6-methylphenyl]-1-(3-chloro-2-pyridinyl)-3-(fluoromethoxy)-1H-pyrazole-5-carboxamide (known from WO 2012/034403 A1) (CAS 1268277-22-0), N-[2-(5-amino-1,3,4-thiadiazol-2-yl)-4-chloro-6-methylphenyl]-3-bromo-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide (known from WO 2011/085575 A1) (CAS 1233882-22-8), 4-[3-[2,6-dichloro-4-[(3,3-dichloro-2-propen-1-yl)oxy]phenoxy]propoxy]-2-methoxy-6-(trifluoromethyl)pyrimidine (known from CN 101337940 A) (CAS 1108184-52-6); (2E)- and 2(Z)-2-[2-(4-cyanophenyl)-1-[3-(trifluoromethyl)phenyl]ethylidene]-N-[4-(difluoromethoxy)phenyl]hydrazinecarboxamide (known from CN 101715774 A) (CAS 1232543-85-9); cyclopropanecarboxylic acid 3-(2,2-dichloroethenyl)-2,2-dimethyl-4-(1H-benzimidazol-2-yl)phenyl ester (known from CN 103524422 A) (CAS 1542271-46-4); (4aS)-7-chloro-2,5-dihydro-2-[[(methoxycarbonyl)[4-[(trifluoromethyl)thio]phenyl]amino]carbonyl]indeno[1,2-e][1,3,4]oxadiazine-4a(3H)-carboxylic acid methyl ester (known from CN 102391261 A) (CAS 1370358-69-2); 6-deoxy-3-O-ethyl-2,4-di-O-methyl-1-[N-[4-[1-[4-(1,1,2,2,2-pentafluoroethoxy)phenyl]-1H-1,2,4-triazol-3-yl]phenyl]carbamate]-α-L-mannopyranose (known from US 2014/0275503 A1) (CAS 1181213-14-8); 8-(2-cyclopropylmethoxy-4-trifluoromethylphenoxy)-3-(6-trifluoromethylpyridazin-3-yl)-3-azabicyclo[3.2.1]octane (CAS 1253850-56-4), (8-anti)-8-(2-cyclopropylmethoxy-4-trifluoromethylphenoxy)-3-(6-trifluoromethylpyridazin-3-yl)-3-azabicyclo[3.2.1]octane (CAS 933798-27-7), (8-syn)-8-(2-cyclopropylmethoxy-4-trifluoromethylphenoxy)-3-(6-trifluoromethylpyridazin-3-yl)-3-azabicyclo[3.2.1]octane (known from WO 2007040280 A1, WO 2007040282 A1) (CAS 934001-66-8), N-[3-chloro-3-(3-pyridinyl)-1H-pyrazol-4-yl]-N-ethyl-3-[(3,3,3-trifluoropropyl)thio]propanamide

(known from WO 2015/058021 A1, WO 2015/058028 A1) (CAS 1477919-27-9) and N-[4-(aminothioxomethyl)-2-methyl-6-[(methylamino)carbonyl]phenyl]-3-bromo-1-(3-chloro-2-pyridinyl)-1*H*-pyrazole-5-carboxamide (known from CN 103265527 A) (CAS 1452877-50-7), 5-(1,3-dioxan-2-yl)-4-[[4-(trifluoromethyl)phenyl]methoxy]pyrimidine (known from WO 2013/115391 A1) (CAS 1449021-97-9), 3-(4-chloro-2,6-dimethylphenyl)-8-methoxy-1-methyl-1,8-diazaspiro[4.5]decane-2,4-dione (known from WO 2014/187846 A1) (CAS 1638765-58-8), ethyl 3-(4-chloro-2,6-dimethylphenyl)-8-methoxy-1-methyl-2-oxo-1,8-diazaspiro[4.5]dec-3-en-4-yl-carboxylate (known from WO 2010/066780 A1, WO 2011151146 A1) (CAS 1229023-00-0), 4-[(5S)-5-(3,5-dichloro-4-fluorophenyl)-4,5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-*N*-[(4*R*)-2-ethyl-3-oxo-4-isoxazolidinyl]-2-methylbenzamide (known from WO 2011/067272, WO2013/050302) (CAS 1309959-62-3).

Fungicides

The active compounds specified herein by their common name are known and described, for example, in "Pesticide Manual" (16th Ed. British Crop Protection Council) or can be searched for on the Internet (for example: http://www.alanwood.net/pesticides).

All the mixing components mentioned in classes (1) to (15), as the case may be, may form salts with suitable bases or acids if they are capable of doing so on the basis of their functional groups. All the fungicidal mixing components mentioned in classes (1) to (15), as the case may be, may include tautomeric forms.

1) Ergosterol biosynthesis inhibitors, for example (1.001) cyproconazole, (1.002) difenoconazole, (1.003) epoxiconazole, (1.004) fenhexamid, (1.005) fenpropidin, (1.006) fenpropimorph, (1.007) fenpyrazamine, (1.008) fluquinconazole, (1.009) flutriafol, (1.010) imazalil, (1.011) imazalil sulfate, (1.012) ipconazole, (1.013) metconazole, (1.014) myclobutanil, (1.015) paclobutrazole, (1.016) prochloraz, (1.017) propiconazole, (1.018) prothioconazole, (1.019) pyrisoxazole, (1.020) spiroxamine, (1.021) tebuconazole, (1.022) tetraconazole, (1.023) triadimenol, (1.024) tridemorph, (1.025) triticonazole, (1.026) (1R,2S,5S)-5-(4-chlorobenzyl)-2-(chloromethyl)-2-methyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol, (1.027) (1S,2R,5R)-5-(4-chlorobenzyl)-2-(chloromethyl)-2-methyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol, (1.028) (2R)-2-(1-chlorocyclopropyl)-4-[(1R)-2,2-dichlorocyclopropyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol (1.029) (2R)-2-(1-

chlorocyclopropyl)-4-[(1S)-2,2-dichlorocyclopropyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol, (1.030) (2R)-2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1H-1,2,4-triazol-1-yl)propan-2-ol, (1.031) (2S)-2-(1-chlorocyclopropyl)-4-[(1R)-2,2-dichlorocyclopropyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol, (1.032) (2S)-2-(1-chlorocyclopropyl)-4-[(1S)-2,2-dichlorocyclopropyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol, (1.033) (2S)-2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1H-1,2,4-triazol-1-yl)propan-2-ol, (1.034) (R)-[3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-1,2-oxazol-4-yl](pyridin-3-yl)methanol, (1.035) (S)-[3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-1,2-oxazol-4-yl](pyridin-3-yl)methanol, (1.036) [3-(4-chloro-2-fluorophenyl)-5-(2,4-difluorophenyl)-1,2-oxazol-4-yl](pyridin-3-yl)methanol, (1.037) 1-({(2R,4S)-2-[2-chloro-4-(4-chlorophenoxy)phenyl]-4-methyl-1,3-dioxolan-2-yl}methyl)-1H-1,2,4-triazole, (1.038) 1-({(2S,4S)-2-[2-chloro-4-(4-chlorophenoxy)phenyl]-4-methyl-1,3-dioxolan-2-yl}methyl)-1H-1,2,4-triazole, (1.039) 1-{[3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazol-5-yl thiocyanate, (1.040) 1-{[rel(2R,3R)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazol-5-yl thiocyanate, (1.041) 1-{[rel(2R,3S)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazol-5-yl thiocyanate, (1.042) 2-[(2R,4R,5R)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.043) 2-[(2R,4R,5S)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.044) 2-[(2R,4S,5R)-1-(2,4-dichloroophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.045) 2-[(2R,4S,5S)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.046) 2-[(2S,4R,5R)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.047) 2-[(2S,4R,5S)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.048) 2-[(2S,4S,5R)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.049) 2-[(2S,4S,5S)-1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.050) 2-[1-(2,4-dichlorophenyl)-5-hydroxy-2,6,6-trimethylheptan-4-yl]-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.051) 2-[2-chloro-4-(2,4-dichlorophenoxy)phenyl]-1-(1H-1,2,4-triazol-1-yl)propan-2-ol, (1.052) 2-[2-chloro-4-(4-chlorophenoxy)phenyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol, (1.053) 2-[4-(4-chlorophenoxy)-2-(trifluormethyl)phenyl]-1-(1H-1,2,4-triazol-1-yl)butan-2-ol, (1.054) 2-[4-(4-

chlorophenoxy)-2-(trifluormethyl)phenyl]-1-(1H-1,2,4-triazol-1-yl)pentan-2-ol, (1.055) 2-[4-(4-chlorophenoxy)-2-(trifluormethyl)phenyl]-1-(1H-1,2,4-triazol-1-yl)propan-2-ol, (1.056) 2-{[3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.057) 2-{[rel(2R,3R)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.058) 2-{[rel(2R,3S)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-2,4-dihydro-3H-1,2,4-triazole-3-thione, (1.059) 5-(4-chlorobenzyl)-2-(chloromethyl)-2-methyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol, (1.060) 5-(allylsulfanyl)-1-{[3-(2-chlorphenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazole, (1.061) 5-(allylsulfanyl)-1-{[rel(2R,3R)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazole, (1.062) 5-(allylsulfanyl)-1-{[rel(2R,3S)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)oxiran-2-yl]methyl}-1H-1,2,4-triazole, (1.063) N'-(2,5-dimethyl-4-{[3-(1,1,2,2-tetrafluoroethoxy)phenyl]sulfanyl}phenyl)-N-ethyl-N-methylimidoformamide, (1.064) N'-(2,5-dimethyl-4-{[3-(2,2,2-trifluoroethoxy)phenyl]sulfanyl}phenyl)-N-ethyl-N-methylimidoformamide, (1.065) N'-(2,5-dimethyl-4-{[3-(2,2,3,3-tetrafluoropropoxy)phenyl]sulfanyl}phenyl)-N-ethyl-N-methylimidoformamide, (1.066) N'-(2,5-dimethyl-4-{[3-(pentafluoroethoxy)phenyl]sulfanyl}phenyl)-N-ethyl-N-methylimidoformamide, (1.067) N'-(2,5-dimethyl-4-{3-[(1,1,2,2-tetrafluoroethyl)sulfanyl]phenoxy}phenyl)-N-ethyl-N-methylimidoformamide, (1.068) N'-(2,5-dimethyl-4-{3-[(2,2,2-trifluoroethyl)sulfanyl]phenoxy}phenyl)-N-ethyl-N-methylimidoformamide, (1.069) N'-(2,5-dimethyl-4-{3-[(2,2,3,3-tetrafluoropropyl)sulfanyl]phenoxy}phenyl)-N-ethyl-N-methylimidoformamide, (1.070) N'-(2,5-dimethyl-4-{3-[(pentafluoroethyl)sulfanyl]phenoxy}phenyl)-N-ethyl-N-methylimidoformamide, (1.071) N'-(2,5-dimethyl-4-phenoxyphenyl)-N-ethyl-N-methylimidoformamide, (1.072) N'-(4-{[3-(difluoromethoxy)phenyl]sulfanyl}-2,5-dimethylphenyl)-N-ethyl-N-methylimidoformamide, (1.073) N'-(4-{3-[(difluoromethyl)sulfanyl]phenoxy}-2,5-dimethylphenyl)-N-ethyl-N-methylimidoformamide, (1.074) N'-[5-brom-6-(2,3-dihydro-1H-inden-2-yloxy)-2-methylpyridin-3-yl]-N-ethyl-N-methylimidoformamid, (1.075) N'-{4-[(4,5-dichloro-1,3-thiazol-2-yl)oxy]-2,5-dimethylphenyl}-N-ethyl-N-methylimidoformamid, (1.076) N'-{5-bromo-6-[(1R)-1-(3,5-difluorophenyl)ethoxy]-2-methylpyridin-3-yl}-N-ethyl-N-methylimidoformamide, (1.077) N'-{5-bromo-6-[(1S)-1-(3,5-difluorophenyl)ethoxy]-2-

methylpyridin-3-yl}-N-ethyl-N-methylimidoformamide, (1.078) N'-{5-bromo-6-[(cis-4-isopropylcyclohexyl)oxy]-2-methylpyridin-3-yl}-N-ethyl-N-methylimidoformamide, (1.079) N'-{5-bromo-6-[(trans-4-isopropylcyclohexyl)oxy]-2-methylpyridin-3-yl}-N-ethyl-N-methylimidoformamide, (1.080) N'-{5-bromo-6-[1-(3,5-difluorophenyl)ethoxy]-2-methylpyridin-3-yl}-N-ethyl-N-methylimidoformamide, (1.081) mefentrifluconazole, (1.082) ipfentrifluconazole.

2) Inhibitors of the respiratory chain in complex I or II, for example (2.001) benzovindiflupyr, (2.002) bixafen, (2.003) boscalid, (2.004) carboxin, (2.005) fluopyram, (2.006) flutolanil, (2.007) fluxapyroxad, (2.008) furametpyr, (2.009) isofetamid, (2.010) isopyrazam (anti-epimeric enantiomer 1R,4S,9S), (2.011) isopyrazam (anti-epimeric enantiomer 1S,4R,9R), (2.012) isopyrazam (anti-epimeric racemate 1RS,4SR,9SR), (2.013) isopyrazam (mixture of the syn-epimeric racemate 1RS,4SR,9RS and the anti-epimeric racemate 1RS,4SR,9SR), (2.014) isopyrazam (syn-epimeric enantiomer 1R,4S,9R), (2.015) isopyrazam (syn-epimeric enantiomer 1S,4R,9S), (2.016) isopyrazam (syn-epimeric racemate 1RS,4SR,9RS), (2.017) penflufen, (2.018) penthiopyrad, (2.019) pydiflumetofen, (2.020) pyraziflumid, (2.021) sedaxane, (2.022) 1,3-dimethyl-N-(1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl)-1H-pyrazole-4-carboxamide, (2.023) 1,3-dimethyl-N-[(3R)-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1H-pyrazole-4-carboxamide, (2.024) 1,3-dimethyl-N-[(3S)-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1H-pyrazole-4-carboxamide, (2.025) 1-methyl-3-(trifluoromethyl)-N-[2'-(trifluoromethyl)biphenyl-2-yl]-1H-pyrazole-4-carboxamide, (2.026) 2-fluoro-6-(trifluoromethyl)-N-(1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl)benzamide, (2.027) 3-(difluoromethyl)-1-methyl-N-(1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl)-1H-pyrazole-4-carboxamide, (2.028) 3-(difluoromethyl)-1-methyl-N-[(3R)-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1H-pyrazole-4-carboxamide, (2.029) 3-(difluoromethyl)-1-methyl-N-[(3S)-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1H-pyrazole-4-carboxamide, (2.030) 3-(difluoromethyl)-N-(7-fluoro-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl)-1-methyl-1H-pyrazole-4-carboxamide, (2.031) 3-(difluoromethyl)-N-[(3R)-7-fluoro-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1-methyl-1H-pyrazole-4-carboxamide, (2.032) 3-(difluoromethyl)-N-[(3S)-7-fluoro-1,1,3-trimethyl-2,3-dihydro-1H-inden-4-yl]-1-methyl-1H-pyrazole-4-carboxamide, (2.033) 5,8-difluoro-N-[2-(2-fluoro-4-{[4-(trifluoromethyl)pyridin-2-yl]oxy}phenyl)ethyl]quinazolin-4-amine, (2.034) N-(2-cyclopentyl-5-fluorobenzyl)-N-

cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.035) N-(2-tert-butyl-5-methylbenzyl)-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.036) N-(2-tert-butylbenzyl)-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.037) N-(5-chloro-2-ethylbenzyl)-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.038) N-(5-chloro-2-isopropylbenzyl)-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.039) N-[(1R,4S)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.040) N-[(1S,4R)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.041) N-[1-(2,4-dichlorophenyl)-1-methoxypropan-2-yl]-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.042) N-[2-chloro-6-(trifluoromethyl)benzyl]-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.043) N-[3-chloro-2-fluoro-6-(trifluoromethyl)benzyl]-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.044) N-[5-chloro-2-(trifluoromethyl)benzyl]-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.045) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-N-[5-methyl-2-(trifluoromethyl)benzyl]-1H-pyrazole-4-carboxamide, (2.046) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-N-(2-fluoro-6-isopropylbenzyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.047) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-N-(2-isopropyl-5-methylbenzyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.048) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-N-(2-isopropylbenzyl)-1-methyl-1H-pyrazole-4-carbothioamide, (2.049) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-N-(2-isopropylbenzyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.050) N-cyclopropyl-3-(difluoromethyl)-5-fluoro-N-(5-fluoro-2-isopropylbenzyl)-1-methyl-1H-pyrazole-4-carboxamide, (2.051) N-cyclopropyl-3-(difluoromethyl)-N-(2-ethyl-4,5-dimethylbenzyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.052) N-cyclopropyl-3-(difluoromethyl)-N-(2-ethyl-5-fluorobenzyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.053) N-cyclopropyl-3-(difluoromethyl)-N-(2-ethyl-5-methylbenzyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.054) N-cyclopropyl-N-(2-cyclopropyl-5-fluorobenzyl)-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide, (2.055) N-cyclopropyl-N-(2-cyclopropyl-5-methylbenzyl)-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-

carboxamide, (2.056) N-cyclopropyl-N-(2-cyclopropylbenzyl)-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide.

3) Inhibitors of the respiratory chain at complex III, for example (3.001) ametoctradin, (3.002) amisulbrom, (3.003) azoxystrobin, (3.004) coumethoxystrobin, (3.005) coumoxystrobin, (3.006) cyazofamid, (3.007) dimoxystrobin, (3.008) enoxastrobin, (3.009) famoxadon, (3.010) fenamidon, (3.011) flufenoxystrobin, (3.012) fluoxastrobin, (3.013) kresoxim-methyl, (3.014) metominostrobin, (3.015) orysastrobin, (3.016) picoxystrobin, (3.017) pyraclostrobin, (3.018) pyrametostrobin, (3.019) pyraoxystrobin, (3.020) trifloxystrobin, (3.021) (2E)-2-{2-[({[(1E)-1-(3-{[(E)-1-fluoro-2-phenylvinyl]oxy}phenyl)ethylidene]amino}oxy)methyl]phenyl}-2-(methoxyimino)-N-methylacetamide, (3.022) (2E,3Z)-5-{[1-(4-chlorophenyl)-1H-pyrazol-3-yl]oxy}-2-(methoxyimino)-N,3-dimethylpent-3-enamide, (3.023) (2R)-2-{2-[(2,5-dimethylphenoxy)methyl]phenyl}-2-methoxy-N-methylacetamide, (3.024) (2S)-2-{2-[(2,5-dimethylphenoxy)methyl]phenyl}-2-methoxy-N-methylacetamide, (3.025) (3S,6S,7R,8R)-8-benzyl-3-[({3-[(isobutyryloxy)methoxy]-4-methoxypyridin-2-yl}carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl 2-methylpropanoate, (3.026) 2-{2-[(2,5-dimethylphenoxy)methyl]phenyl}-2-methoxy-N-methylacetamide, (3.027) N-(3-ethyl-3,5,5-trimethylcyclohexyl)-3-formamido-2-hydroxybenzamide, (3.028) (2E,3Z)-5-{[1-(4-chloro-2-fluorophenyl)-1H-pyrazol-3-yl]oxy}-2-(methoxyimino)-N,3-dimethylpent-3-enamide, (3.029) methyl {5-[3-(2,4-dimethylphenyl)-1H-pyrazol-1-yl]-2-methylbenzyl}carbamate.

4) Mitosis and cell division inhibitors, for example (4.001) carbendazim, (4.002) diethofencarb, (4.003) ethaboxam, (4.004) fluopicolid, (4.005) pencycuron, (4.006) thiabendazole, (4.007) thiophanate-methyl, (4.008) zoxamide, (4.009) 3-chloro-4-(2,6-difluorophenyl)-6-methyl-5-phenylpyridazine, (4.010) 3-chloro-5-(4-chlorophenyl)-4-(2,6-difluorophenyl)-6-methylpyridazine, (4.011) 3-chloro-5-(6-chloropyridin-3-yl)-6-methyl-4-(2,4,6-trifluorophenyl)pyridazine, (4.012) 4-(2-bromo-4-fluorophenyl)-N-(2,6-difluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.013) 4-(2-bromo-4-fluorophenyl)-N-(2-bromo-6-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.014) 4-(2-bromo-4-fluorophenyl)-N-(2-bromophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.015) 4-(2-bromo-4-fluorophenyl)-N-(2-chloro-6-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.016) 4-(2-bromo-4-fluorophenyl)-N-(2-chlorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.017) 4-(2-bromo-4-fluorophenyl)-N-(2-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.018) 4-(2-

chloro-4-fluorophenyl)-N-(2,6-difluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.019) 4-(2-chloro-4-fluorophenyl)-N-(2-chloro-6-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.020) 4-(2-chloro-4-fluorophenyl)-N-(2-chlorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.021) 4-(2-chloro-4-fluorophenyl)-N-(2-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.022) 4-(4-chlorophenyl)-5-(2,6-difluorophenyl)-3,6-dimethylpyridazine, (4.023) N-(2-bromo-6-fluorophenyl)-4-(2-chloro-4-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.024) N-(2-bromophenyl)-4-(2-chloro-4-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine, (4.025) N-(4-chloro-2,6-difluorophenyl)-4-(2-chloro-4-fluorophenyl)-1,3-dimethyl-1H-pyrazol-5-amine.

5) Compounds having capacity for multi-site activity, for example (5.001) Bordeaux mixture, (5.002) captafol, (5.003) captan, (5.004) chlorthalonil, (5.005) copper hydroxide, (5.006) copper naphthenate, (5.007) copper oxide, (5.008) copper oxychloride, (5.009) copper(2+) sulfate, (5.010) dithianon, (5.011) dodine, (5.012) folpet, (5.013) mancozeb, (5.014) maneb, (5.015) metiram, (5.016) zinc metiram, (5.017) copper oxine, (5.018) propineb, (5.019) sulfur and sulfur preparations including calcium polysulfide, (5.020) thiram, (5.021) zineb, (5.022) ziram, (5.023) 6-ethyl-5,7-dioxo-6,7-dihydro-5H-pyrrolo[3',4':5,6][1,4]dithiino[2,3-c][1,2]thiazole-3-carbonitrile.

6) Compounds capable of triggering host defence, for example (6.001) acibenzolar-S-methyl, (6.002) isotianil, (6.003) probenazole, (6.004) tiadinil.

7) Amino acid and/or protein biosynthesis inhibitors, for example (7.001) cyprodinil, (7.002) kasugamycin, (7.003) kasugamycin hydrochloride hydrate, (7.004) oxytetracycline, (7.005) pyrimethanil, (7.006) 3-(5-fluoro-3,3,4,4-tetramethyl-3,4-dihydroisoquinolin-1-yl)quinoline.

(8) ATP production inhibitors, for example (8.001) silthiofam.

9) Cell wall synthesis inhibitors, for example (9.001) benthiavalicarb, (9.002) dimethomorph, (9.003) flumorph, (9.004) iprovalicarb, (9.005) mandipropamid, (9.006) pyrimorph, (9.007) valifenalate, (9.008) (2E)-3-(4-tert-butylphenyl)-3-(2-chloropyridin-4-yl)-1-(morpholin-4-yl)prop-2-en-1-one, (9.009) (2Z)-3-(4-tert-butylphenyl)-3-(2-chloropyridin-4-yl)-1-(morpholin-4-yl)prop-2-en-1-one.

10) Lipid and membrane synthesis inhibitors, for example (10.001) propamocarb, (10.002) propamocarb hydrochloride, (10.003) tolclofos-methyl.

11) Melanin biosynthesis inhibitors, for example (11.001) tricyclazole, (11.002) 2,2,2-trifluoroethyl {3-methyl-1-[(4-methylbenzoyl)amino]butan-2-yl}carbamate.

12) Nucleic acid synthesis inhibitors, for example (12.001) benalaxyl, (12.002) benalaxyl-M (kiralaxyl), (12.003) metalaxyl, (12.004) metalaxyl-M (mefenoxam).

13) Signal transduction inhibitors, for example (13.001) fludioxonil, (13.002) iprodione, (13.003) procymidone, (13.004) proquinazid, (13.005) quinoxyfen, (13.006) vinclozolin.

14) Compounds that can act as uncouplers, for example (14.001) fluazinam, (14.002) meptyldinocap.

15) Further compounds, for example (15.001) abscisic acid, (15.002) benthiazole, (15.003) bethoxazin, (15.004) capsimycin, (15.005) carvone, (15.006) chinomethionat, (15.007) cufraneb, (15.008) cyflufenamid, (15.009) cymoxanil, (15.010) cyprosulfamide, (15.011) flutianil, (15.012) fosetyl-aluminium, (15.013) fosetyl-calcium, (15.014) fosetyl-sodium, (15.015) methyl isothiocyanate, (15.016) metrafenon, (15.017) mildiomycin, (15.018) natamycin, (15.019) nickel dimethyldithiocarbamate, (15.020) nitrothal-isopropyl, (15.021) oxamocarb, (15.022) oxathiapiprolin, (15.023) oxyfenthiin, (15.024) pentachlorophenol and salts, (15.025) phosphonic acid and salts thereof, (15.026) propamocarb-fosetylate, (15.027) pyriofenone (chlazafenone) (15.028) tebufloquin, (15.029) tecloftalam, (15.030) tolnifanide, (15.031) 1-(4-{4-[(5R)-5-(2,6-difluorophenyl)-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl}piperidin-1-yl)-2-[5-methyl-3-(trifluoromethyl)-1H-pyrazol-1-yl]ethanone, (15.032) 1-(4-{4-[(5S)-5-(2,6-difluorophenyl)-4,5-dihydro-1,2-oxazol-3-yl]-1,3-thiazol-2-yl}piperidin-1-yl)-2-[5-methyl-3-(trifluoromethyl)-1H-pyrazol-1-yl]ethanone, (15.033) 2-(6-benzylpyridin-2-yl)quinazoline, (15.034) 2,6-dimethyl-1H,5H-[1,4]dithiino[2,3-c:5,6-c']dipyrrole-1,3,5,7(2H,6H)-tetrone, (15.035) 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, (15.036) 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-chloro-6-(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, (15.037) 2-[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]-1-[4-(4-{5-[2-fluoro-6-

(prop-2-yn-1-yloxy)phenyl]-4,5-dihydro-1,2-oxazol-3-yl}-1,3-thiazol-2-yl)piperidin-1-yl]ethanone, (15.038) 2-[6-(3-fluoro-4-methoxyphenyl)-5-methylpyridin-2-yl]quinazoline, (15.039) 2-{(5R)-3-[2-(1-{[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]acetyl}piperidin-4-yl)-1,3-thiazol-4-yl]-4,5-dihydro-1,2-oxazol-5-yl}-3-chlorophenyl methanesulfonate, (15.040) 2-{(5S)-3-[2-(1-{[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]acetyl}piperidin-4-yl)-1,3-thiazol-4-yl]-4,5-dihydro-1,2-oxazol-5-yl}-3-chlorophenyl methanesulfonate, (15.041) 2-{2-[(7,8-difluoro-2-methylquinolin-3-yl)oxy]-6-fluorophenyl}propan-2-ol, (15.042) 2-{2-fluoro-6-[(8-fluoro-2-methylquinolin-3-yl)oxy]phenyl}propan-2-ol, (15.043) 2-{3-[2-(1-{[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]acetyl}piperidin-4-yl)-1,3-thiazol-4-yl]-4,5-dihydro-1,2-oxazol-5-yl}-3-chlorophenyl methanesulfonate, (15.044) 2-{3-[2-(1-{[3,5-bis(difluoromethyl)-1H-pyrazol-1-yl]acetyl}piperidin-4-yl)-1,3-thiazol-4-yl]-4,5-dihydro-1,2-oxazol-5-yl}phenyl methanesulfonate, (15.045) 2-phenylphenol and salts thereof, (15.046) 3-(4,4,5-trifluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline, (15.047) 3-(4,4-difluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline, (15.048) 4-amino-5-fluoropyrimidin-2-ol (tautomeric form: 4-amino-5-fluoropyrimidin-2(1H)-one), (15.049) 4-oxo-4-[(2-phenylethyl)amino]butyric acid, (15.050) 5-amino-1,3,4-thiadiazole-2-thiol, (15.051) 5-chloro-N'-phenyl-N'-(prop-2-yn-1-yl)thiophene 2-sulfonohydrazide, (15.052) 5-fluoro-2-[(4-fluorobenzyl)oxy]pyrimidin-4-amine, (15.053) 5-fluoro-2-[(4-methylbenzyl)oxy]pyrimidin-4-amine, (15.054) 9-fluoro-2,2-dimethyl-5-(quinolin-3-yl)-2,3-dihydro-1,4-benzoxazepine, (15.055) but-3-yn-1-yl {6-[({[(Z)-(1-methyl-1H-tetrazol-5-yl)(phenyl)methylene]amino}oxy)methyl]pyridin-2-yl}carbamate, (15.056) ethyl (2Z)-3-amino-2-cyano-3-phenylacrylate, (15.057) phenazine-1-carboxylic acid, (15.058) propyl 3,4,5-trihydroxybenzoate, (15.059) quinolin-8-ol, (15.060) quinolin-8-ol sulfate (2:1), (15.061) tert-butyl {6-[({[(1-methyl-1H-tetrazol-5-yl)(phenyl)methylene]amino}oxy)methyl]pyridin-2-yl}carbamate, (15.062) 5-fluoro-4-imino-3-methyl-1-[(4-methylphenyl)sulfonyl]-3,4-dihydropyrimidin-2(1H)-one.

Biological pesticides as mixture components

The compounds of the formula (I) can be combined with biological pesticides.

Biological pesticides especially include bacteria, fungi, yeasts, plant extracts and products formed by microorganisms, including proteins and secondary metabolites.

Biological pesticides include bacteria such as spore-forming bacteria, root-colonizing bacteria and bacteria which act as biological insecticides, fungicides or nematicides.

Examples of such bacteria which are used or can be used as biological pesticides are:

Bacillus amyloliquefaciens, strain FZB42 (DSM 231179), or *Bacillus cereus,* in particular *B. cereus* strain CNCM I-1562 or *Bacillus firmus*, strain I-1582 (Accession number CNCM I-1582) or *Bacillus pumilus*, in particular strain GB34 (Accession No. ATCC 700814) and strain QST2808 (Accession No. NRRL B-30087), or *Bacillus subtilis*, in particular strain GB03 (Accession No. ATCC SD-1397), or *Bacillus subtilis* strain QST713 (Accession No. NRRL B-21661) or *Bacillus subtilis* strain OST 30002 (Accession No. NRRL B-50421), *Bacillus thuringiensis*, in particular *B. thuringiensis* subspecies *israelensis* (Serotyp H-14), strain AM65-52 (Accession No. ATCC 1276), or *B. thuringiensis subsp. aizawai*, in particular strain ABTS-1857 (SD-1372), or *B. thuringiensis subsp. kurstaki* strain HD-1, or *B. thuringiensis subsp. tenebrionis* strain NB 176 (SD-5428), *Pasteuria penetrans*, *Pasteuria spp.* (Rotylenchulus reniformis nematode)-PR3 (Accession Number ATCC SD-5834), *Streptomyces microflavus* strain AQ6121 (= QRD 31.013, NRRL B-50550), *Streptomyces galbus* strain AQ 6047 (Accession Number NRRL 30232).

Examples of fungi and yeasts which are used or can be used as biological pesticides are:

Beauveria bassiana, in particular strain ATCC 74040, *Coniothyrium minitans*, in particular strain CON/M/91-8 (Accession No. DSM-9660), *Lecanicillium spp.*, in particular strain HRO LEC 12, *Lecanicillium lecanii* (formerly known as *Verticillium lecanii*), in particular strain KV01, *Metarhizium anisopliae*, in particular strain F52 (DSM3884/ ATCC 90448), *Metschnikowia fructicola*, in particular strain NRRL Y-30752, *Paecilomyces fumosoroseus* (new: *Isaria fumosorosea*), in particular strain IFPC 200613, or strain Apopka 97 (Accession No. ATCC 20874), *Paecilomyces lilacinus*, in particular *P. lilacinus* strain 251 (AGAL 89/030550), *Talaromyces flavus*, in particular strain V117b, *Trichoderma atroviride*, in particular strain SC1 (Accession Number CBS 122089), *Trichoderma harzianum*, in particular *T. harzianum rifai* T39 (Accession Number CNCM I-952).

Examples of viruses which are used or can be used as biological pesticides are:

Adoxophyes orana (summer fruit tortrix) granulosis virus (GV), *Cydia pomonella* (codling moth) granulosis virus (GV), *Helicoverpa armigera* (cotton bollworm) nuclear polyhedrosis virus (NPV), *Spodoptera exigua* (beet armyworm) mNPV, *Spodoptera frugiperda* (fall armyworm) mNPV, *Spodoptera littoralis* (African cotton leafworm) NPV.

Also included are bacteria and fungi which are added as 'inoculant' to plants or plant parts or plant organs and which, by virtue of their particular properties, promote plant growth and plant health. Examples which may be mentioned are:

Agrobacterium spp., *Azorhizobium caulinodans*, *Azospirillum spp.*, *Azotobacter spp.*, *Bradyrhizobium spp.*, *Burkholderia spp.*, especially *Burkholderia cepacia* (formerly known as *Pseudomonas cepacia*), *Gigaspora spp.*, or *Gigaspora monosporum*, *Glomus spp.*, *Laccaria spp.*, *Lactobacillus buchneri*, *Paraglomus spp.*, *Pisolithus tinctorus*, *Pseudomonas spp.*, *Rhizobium spp.*, especially *Rhizobium trifolii*, *Rhizopogon spp.*, *Scleroderma spp.*, *Suillus spp.*, *Streptomyces spp.*

Examples of plant extracts and products formed by microorganisms, including proteins and secondary metabolites, which are used or can be used as biological pesticides are:

Allium sativum, Artemisia absinthium, azadirachtin, Biokeeper WP, Cassia nigricans, Celastrus angulatus, Chenopodium anthelminticum, chitin, Armour-Zen, Dryopteris filix-mas, Equisetum arvense, Fortune Aza, Fungastop, Heads Up (Chenopodium quinoa saponin extract), pyrethrum/pyrethrins, Quassia amara, Quercus, Quillaja, Regalia, "Requiem ™ Insecticide", rotenone, ryania/ryanodine, Symphytum officinale, Tanacetum vulgare, thymol, Triact 70, TriCon, Tropaeulum majus, Urtica dioica, Veratrin, Viscum album, Brassicaceae extract, especially oilseed rape powder or mustard powder.

Safeners as mixture components

The compounds of the formula (I) can be combined with safeners, for example benoxacor, cloquintocet (-mexyl), cyometrinil, cyprosulfamide, dichlormid, fenchlorazole (-ethyl), fenclorim, flurazole, fluxofenim, furilazole, isoxadifen (-ethyl), mefenpyr (-diethyl), naphthalic anhydride, oxabetrinil, 2-methoxy-N-({4-[(methylcarbamoyl)amino]phenyl}sulfonyl)benzamide (CAS 129531-12-0), 4-

(dichloroacetyl)-1-oxa-4-azaspiro[4.5]decane (CAS 71526-07-3), 2,2,5-trimethyl-3-(dichloroacetyl)-1,3-oxazolidine (CAS 52836-31-4).

Plants and plant parts

All plants and plant parts can be treated in accordance with the invention. Plants are understood here to mean all plants and populations of plants, such as desirable and undesirable wild plants or crop plants (including naturally occurring crop plants), for example cereals (wheat, rice, triticale, barley, rye, oats), maize, soya beans, potatoes, sugar beet, sugar cane, tomatoes, bell peppers, cucumbers, melons, carrots, water melons, onions, lettuce, spinach, leeks, beans, *Brassica oleracea* (e.g. cabbage) and other vegetable species, cotton, tobacco, oilseed rape, and also fruit plants (the fruits being apples, pears, citrus fruits and grapes). Crop plants may be plants which can be obtained by conventional breeding and optimization methods or by biotechnological and genetic engineering methods or combinations of these methods, including the transgenic plants and including the plant cultivars which are protectable or non-protectable by plant breeders' rights. Plants shall be understood to mean all development stages such as seed, seedlings, young (immature) plants, up to and including mature plants. Plant parts shall be understood to mean all parts and organs of the plants above and below ground, such as shoot, leaf, flower and root, examples given being leaves, needles, stalks, stems, flowers, fruit bodies, fruits and seeds, and also roots, tubers and rhizomes. Plant parts also include harvested plants or harvested plant parts and vegetative and generative propagation material, for example cuttings, tubers, rhizomes, slips and seeds.

The treatment according to the invention of the plants and parts of plants with the compounds of the formula (I) is effected directly or by allowing the compounds to act on the surroundings, the habitat or the storage space thereof by the customary treatment methods, for example by dipping, spraying, evaporating, fogging, scattering, painting on, injecting, and, in the case of propagation material, especially in the case of seeds, also by applying one or more coats.

As already mentioned above, it is possible to treat all plants and their parts in accordance with the invention. In a preferred embodiment, wild plant species and plant cultivars, or those obtained by conventional biological breeding methods, such as crossing or protoplast fusion, and parts thereof, are treated. In a further preferred embodiment, transgenic plants and plant cultivars obtained by genetic engineering methods, if appropriate in combination with

conventional methods (genetically modified organisms), and parts thereof are treated. The term “parts” or “parts of plants” or “plant parts” has been explained above. Particular preference is given in accordance with the invention to treating plants of the respective commercially customary plant cultivars or those that are in use. Plant cultivars are understood to mean plants having new properties (“traits”) and which have been obtained by conventional breeding, by mutagenesis or by recombinant DNA techniques. They may be cultivars, varieties, biotypes or genotypes.

Transgenic plants, seed treatment and integration events

The preferred transgenic plants or plant cultivars (those obtained by genetic engineering) which are to be treated in accordance with the invention include all plants which, through the genetic modification, received genetic material which imparts particular advantageous useful properties ("traits") to these plants. Examples of such properties are better plant growth, increased tolerance to high or low temperatures, increased tolerance to drought or to levels of water or soil salinity, enhanced flowering performance, easier harvesting, accelerated ripening, higher harvest yields, higher quality and/or higher nutritional value of the harvested products, better capability for storage and/or processability of the harvested products. Further and particularly emphasized examples of such properties are increased resistance of the plants to animal and microbial pests, such as insects, arachnids, nematodes, mites, slugs and snails, owing, for example, to toxins formed in the plants, in particular those formed in the plants by the genetic material from Bacillus thuringiensis (for example by the genes CryIA(a), CryIA(b), CryIA(c), CryIIA, CryIIIA, CryIIIB2, Cry9c, Cry2Ab, Cry3Bb and CryIF and also combinations thereof), and also increased resistance of the plants to phytopathogenic fungi, bacteria and/or viruses caused, for example, by systemic acquired resistance (SAR), systemin, phytoalexins, elicitors and resistance genes and correspondingly expressed proteins and toxins, and also increased tolerance of the plants to certain active herbicidal compounds, for example imidazolinones, sulfonylureas, glyphosate or phosphinothricin (for example the "PAT" gene). The genes which impart the desired properties (“traits”) in question may also be present in combinations with one another in the transgenic plants. Examples of transgenic plants mentioned include the important crop plants, such as cereals (wheat, rice, triticale, barley, rye, oats), maize, soya beans, potatoes, sugar beet, sugar cane, tomatoes, peas and other vegetable species, cotton, tobacco, oilseed rape, and also fruit plants (the fruits being apples,

pears, citrus fruits and grapes), particular emphasis being given to maize, soya beans, wheat, rice, potatoes, cotton, sugar cane, tobacco and oilseed rape. Properties ("traits") which are particularly emphasized are the increased resistance of the plants to insects, arachnids, nematodes and slugs and snails.

Crop protection – types of treatment

The plants and plant parts are treated with the compounds of the formula (I) directly or by action on their surroundings, habitat or storage space using customary treatment methods, for example by dipping, spraying, atomizing, irrigating, evaporating, dusting, fogging, broadcasting, foaming, painting, spreading, injecting, watering (drenching), drip irrigating and, in the case of propagation material, in particular in the case of seed, additionally by dry seed treatment, liquid seed treatment, slurry treatment, by incrusting, by coating with one or more coats, etc. It is furthermore possible to apply the compounds of the formula (I) by the ultra-low volume method or to inject the application form or the compound of the formula (I) itself into the soil.

A preferred direct treatment of the plants is foliar application, meaning that the compounds of the formula (I) are applied to the foliage, in which case the treatment frequency and the application rate should be adjusted according to the level of infestation with the pest in question.

In the case of systemically active active compounds, the compounds of the formula (I) also access the plants via the root system. The plants are then treated by the action of the compounds of the formula (I) on the habitat of the plant. This can be accomplished, for example, by drenching, or by mixing into the soil or the nutrient solution, meaning that the locus of the plant (e.g. soil or hydroponic systems) is impregnated with a liquid form of the compounds of the formula (I), or by soil application, meaning that the compounds of the formula (I) according to the invention are introduced in solid form (e.g. in the form of granules) into the locus of the plants, or by drip application (frequently also referred to as "chemigation"), meaning that the compounds of the formula (I) according to the invention are introduced via surface or underground drip lines over certain periods of time together with varying amounts of water at defined locations in the vicinity of the plants. In the case of paddy

rice crops, this can also be accomplished by metering the compound of the formula (I) in a solid application form (for example as granules) into a flooded paddy field.

Seed treatment

The control of animal pests by the treatment of the seed of plants has long been known and is the subject of constant improvements. Nevertheless, the treatment of seed entails a series of problems which cannot always be solved in a satisfactory manner. Thus, it is desirable to develop methods for protecting the seed and the germinating plant which dispense with, or at least reduce considerably, the additional application of pesticides during storage, after sowing or after emergence of the plants. It is additionally desirable to optimize the amount of active compound used so as to provide optimum protection for the seed and the germinating plant from attack by animal pests, but without damage to the plant itself by the active compound used. In particular, methods for the treatment of seed should also take account of the intrinsic insecticidal or nematicidal properties of pest-resistant or -tolerant transgenic plants in order to achieve optimal protection of the seed and also the germinating plant with a minimum expenditure on pesticides.

The present invention therefore in particular also relates to a method for the protection of seed and germinating plants from attack by pests, by treating the seed with one of the compounds of the formula (I). The method according to the invention for protecting seed and germinating plants against attack by pests further comprises a method in which the seed is treated simultaneously in one operation or sequentially with a compound of the formula (I) and a mixing component. It further also comprises a method where the seed is treated at different times with a compound of the formula (I) and a mixing component.

The invention likewise relates to the use of the compounds of the formula (I) for the treatment of seed for protecting the seed and the resulting plant from animal pests.

The invention further relates to seed which has been treated with a compound of the formula (I) according to the invention for protection from animal pests. The invention also relates to seed which has been treated simultaneously with a compound of the formula (I) and a mixing component. The invention further relates to seed which has been treated at different times with a compound of the formula (I) and a mixing component. In the case of seed which has been

treated at different times with a compound of the formula (I) and a mixing component, the individual substances may be present on the seed in different layers. In this case, the layers comprising a compound of the formula (I) and mixing components may optionally be separated by an intermediate layer. The invention also relates to seed in which a compound of the formula (I) and a mixing component have been applied as part of a coating or as a further layer or further layers in addition to a coating.

The invention further relates to seed which, after the treatment with a compound of the formula (I), is subjected to a film-coating process to prevent dust abrasion on the seed.

One of the advantages that occur when a compound of the formula (I) acts systemically is that the treatment of the seed protects not only the seed itself but also the plants resulting therefrom, after emergence, from animal pests. In this way, the immediate treatment of the crop at the time of sowing or shortly thereafter can be dispensed with.

A further advantage is that the treatment of the seed with a compound of the formula (I) can enhance germination and emergence of the treated seed.

It is likewise considered to be advantageous that compounds of the formula (I) can especially also be used for transgenic seed.

Furthermore, compounds of the formula (I) can be employed in combination with compositions of signalling technology, leading to better colonization by symbionts such as, for example, rhizobia, mycorrhizae and/or endophytic bacteria or fungi, and/or to optimized nitrogen fixation.

The compounds of the formula (I) are suitable for the protection of seed of any plant variety which is used in agriculture, in greenhouses, in forests or in horticulture. More particularly, this is the seed of cereals (for example wheat, barley, rye, millet and oats), maize, cotton, soya beans, rice, potatoes, sunflowers, coffee, tobacco, canola, oilseed rape, beets (for example sugar beets and fodder beets), peanuts, vegetables (for example tomatoes, cucumbers, beans, cruciferous vegetables, onions and lettuce), fruit plants, lawns and ornamental plants. Of particular significance is the treatment of the seed of cereals (such as wheat, barley, rye and oats), maize, soya beans, cotton, canola, oilseed rape, vegetables and rice.

As already mentioned above, the treatment of transgenic seed with a compound of the formula (I) is also of particular importance. This involves the seed of plants which generally contain at least one heterologous gene which controls the expression of a polypeptide having insecticidal and/or nematicidal properties in particular. The heterologous genes in transgenic seed may originate from microorganisms such as Bacillus, Rhizobium, Pseudomonas, Serratia, Trichoderma, Clavibacter, Glomus or Gliocladium. The present invention is particularly suitable for treatment of transgenic seed which comprises at least one heterologous gene originating from Bacillus sp. The heterologous gene is more preferably derived from Bacillus thuringiensis.

In the context of the present invention, the compound of the formula (I) is applied to the seed. The seed is preferably treated in a state in which it is sufficiently stable for no damage to occur in the course of treatment. In general, the seed can be treated at any time between harvest and sowing. It is customary to use seed which has been separated from the plant and freed from cobs, shells, stalks, coats, hairs or the flesh of the fruits. For example, it is possible to use seed which has been harvested, cleaned and dried down to a moisture content which allows storage. Alternatively, it is also possible to use seed which, after drying, has been treated with, for example, water and then dried again, for example priming. In the case of rice seed, it is also possible to use seed which has been soaked, for example in water, until it reaches a certain stage of the rice embryo ("pigeon breast stage") which results in stimulation of germination and more uniform emergence.

When treating the seed, care must generally be taken that the amount of the compound of the formula (I) applied to the seed and/or the amount of further additives is chosen in such a way that the germination of the seed is not adversely affected, or that the resulting plant is not damaged. This has to be ensured particularly in the case of active compounds which can exhibit phytotoxic effects at certain application rates.

In general, the compounds of the formula (I) are applied to the seed in the form of a suitable formulation. Suitable formulations and processes for seed treatment are known to the person skilled in the art.

The compounds of the formula (I) can be converted to the customary seed-dressing formulations, such as solutions, emulsions, suspensions, powders, foams, slurries or other coating compositions for seed, and also ULV formulations.

These formulations are prepared in a known manner, by mixing the compounds of the formula (I) with customary additives, for example customary extenders and solvents or diluents, dyes, wetting agents, dispersants, emulsifiers, antifoams, preservatives, secondary thickeners, adhesives, gibberellins, and also water.

Dyes which may be present in the seed-dressing formulations usable in accordance with the invention are all dyes which are customary for such purposes. It is possible to use either pigments, which are sparingly soluble in water, or dyes, which are soluble in water. Examples include the dyes known by the names Rhodamine B, C.I. Pigment Red 112 and C.I. Solvent Red 1.

Useful wetting agents which may be present in the seed-dressing formulations usable in accordance with the invention are all substances which promote wetting and which are customary for the formulation of agrochemically active compounds. Usable with preference are alkyl naphthalenesulfonates, such as diisopropyl or diisobutyl naphthalenesulfonates.

Suitable dispersants and/or emulsifiers which may be present in the seed-dressing formulations usable in accordance with the invention are all nonionic, anionic and cationic dispersants customary for the formulation of agrochemically active compounds. Nonionic or anionic dispersants or mixtures of nonionic or anionic dispersants can be used with preference. Suitable nonionic dispersants especially include ethylene oxide/propylene oxide block polymers, alkylphenol polyglycol ethers and tristyrylphenol polyglycol ethers, and the phosphated or sulfated derivatives thereof. Suitable anionic dispersants are especially lignosulfonates, polyacrylic acid salts and arylsulfonate-formaldehyde condensates.

Antifoams which may be present in the seed-dressing formulations usable in accordance with the invention are all foam-inhibiting substances customary for the formulation of agrochemically active compounds. Silicone antifoams and magnesium stearate can be used with preference.

Preservatives which may be present in the seed-dressing formulations usable in accordance with the invention are all substances usable for such purposes in agrochemical compositions. Examples include dichlorophene and benzyl alcohol hemiformal.

Secondary thickeners which may be present in the seed-dressing formulations usable in accordance with the invention are all substances which can be used for such purposes in agrochemical compositions. Preferred examples include cellulose derivatives, acrylic acid derivatives, xanthan, modified clays and finely divided silica.

Useful stickers which may be present in the seed-dressing formulations usable in accordance with the invention are all customary binders usable in seed-dressing products. Preferred examples include polyvinylpyrrolidone, polyvinyl acetate, polyvinyl alcohol and tylose.

Gibberellins which may be present in the seed-dressing formulations usable in accordance with the invention are preferably the gibberellins A1, A3 (= gibberellic acid), A4 and A7; particular preference is given to using gibberellic acid. The gibberellins are known (cf. R. Wegler "Chemie der Pflanzenschutz- und Schädlingsbekämpfungsmittel", vol. 2, Springer Verlag, 1970, pp. 401-412).

The seed-dressing formulations usable in accordance with the invention can be used to treat a wide variety of different kinds of seed, either directly or after prior dilution with water. For instance, the concentrates or the preparations obtainable therefrom by dilution with water can be used to dress the seed of cereals, such as wheat, barley, rye, oats and triticale, and also the seed of maize, rice, oilseed rape, peas, beans, cotton, sunflowers, soya beans and beets, or else a wide variety of different vegetable seed. The seed-dressing formulations usable in accordance with the invention, or the dilute use forms thereof, can also be used to dress seed of transgenic plants.

For the treatment of seed with the seed-dressing formulations usable in accordance with the invention, or the use forms prepared therefrom through the addition of water, all mixing units usable customarily for the seed dressing are useful. Specifically, the procedure in seed dressing is to place the seed into a mixer in batchwise or continuous operation, to add the particular desired amount of seed-dressing formulations, either as such or after prior dilution with water,

and to mix until the formulation is distributed homogeneously on the seed. If appropriate, this is followed by a drying operation.

The application rate of the seed dressing formulations usable in accordance with the invention can be varied within a relatively wide range. It is guided by the particular content of the compounds of the formula (I) in the formulations and by the seed. The application rates of the compound of the formula (I) are generally between 0.001 and 50 g per kilogram of seed, preferably between 0.01 and 15 g per kilogram of seed.

Animal health

In the animal health field, i.e. the field of veterinary medicine, the compounds of the formula (I) are active against animal parasites, in particular ectoparasites or endoparasites. The term "endoparasite" includes especially helminths and protozoa, such as coccidia. Ectoparasites are typically and preferably arthropods, especially insects or acarids.

In the field of veterinary medicine, the compounds of the formula (I) having favourable endotherm toxicity are suitable for controlling parasites which occur in animal breeding and animal husbandry in livestock, breeding animals, zoo animals, laboratory animals, experimental animals and domestic animals. They are active against all or specific stages of development of the parasites.

Agricultural livestock include, for example, mammals, such as sheep, goats, horses, donkeys, camels, buffalo, rabbits, reindeer, fallow deer and especially cattle and pigs; or poultry such as turkeys, ducks, geese and especially chickens; or fish or crustaceans, for example in aquaculture; or, as the case may be, insects such as bees.

Domestic animals include, for example, mammals, such as hamsters, guinea pigs, rats, mice, chinchillas, ferrets, and particularly dogs, cats, caged birds; reptiles, amphibians or aquarium fish.

In a specific embodiment, the compounds of the formula (I) are administered to mammals.

In another specific embodiment, the compounds of the formula (I) are administered to birds, namely caged birds or particularly poultry.

Use of the compounds of the formula (I) for the control of animal parasites is intended to reduce or prevent illness, cases of death and reductions in performance (in the case of meat, milk, wool, hides, eggs, honey and the like), such that more economical and simpler animal husbandry is enabled and better animal well-being is achievable.

In relation to the field of animal health, the term "control" or "controlling" in the present context means that the compounds of the formula (I) are effective in reducing the incidence of the particular parasite in an animal infected with such parasites to an innocuous degree. More specifically, "controlling" in the present context means that the compounds of the formula (I) kill the respective parasite, inhibit its growth, or inhibit its proliferation.

The arthropods include, for example, but are not limited to,

from the order of Anoplurida, for example, Haematopinus spp., Linognathus spp., Pediculus spp., Phtirus spp. and Solenopotes spp.;

from the order of Mallophagida and the suborders Amblycerina and Ischnocerina, for example, Bovicola spp., Damalina spp., Felicola spp.; Lepikentron spp., Menopon spp., Trichodectes spp., Trimenopon spp., Trinoton spp., Werneckiella spp;

from the order of Diptera and the suborders Nematocerina and Brachycerina, for example, Aedes spp., Anopheles spp., Atylotus spp., Braula spp., Calliphora spp., Chrysomyia spp., Chrysops spp., Culex spp., Culicoides spp., Eusimulium spp., Fannia spp., Gasterophilus spp., Glossina spp., Haematobia spp., Haematopota spp., Hippobosca spp., Hybomitra spp., Hydrotaea spp., Hypoderma spp., Lipoptena spp., Lucilia spp., Lutzomyia spp., Melophagus spp., Morellia spp., Musca spp., Odagmia spp., Oestrus spp., Philipomyia spp., Phlebotomus spp., Rhinoestrus spp., Sarcophaga spp., Simulium spp., Stomoxys spp., Tabanus spp., Tipula spp., Wilhelmia spp., Wohlfahrtia spp.;

from the order of Siphonapterida, for example, Ceratophyllus spp., Ctenocephalides spp., Pulex spp., Tunga spp., Xenopsylla spp.;

from the order of Heteropterida, for example Cimex spp., Panstrongylus spp., Rhodnius spp., Triatoma spp.; and also nuisance and hygiene pests from the order Blattarida.

In addition, in the case of the arthropods, mention should be made by way of example, without limitation, of the following Acari:

from the subclass of Acari (Acarina) and the order of Metastigmata, for example from the family of Argasidae such as Argas spp., Ornithodorus spp., Otobius spp., from the family of Ixodidae such as Amblyomma spp., Dermacentor spp., Haemaphysalis spp., Hyalomma spp., Ixodes spp., Rhipicephalus (Boophilus) spp., Rhipicephalus spp. (the original genus of multi-host ticks); from the order of Mesostigmata such as Dermanyssus spp., Ornithonyssus spp., Pneumonyssus spp., Raillietia spp., Sternostoma spp., Tropilaelaps spp., Varroa spp.; from the order of the Actinedida (Prostigmata), for example Acarapis spp., Cheyletiella spp., Demodex spp., Listrophorus spp., Myobia spp., Neotrombicula spp., Ornithocheyletia spp., Psorergates spp., Trombicula spp.; and from the order of the Acaridida (Astigmata), for example Acarus spp., Caloglyphus spp., Chorioptes spp., Cytodites spp., Hypodectes spp., Knemidocoptes spp., Laminosioptes spp., Notoedres spp., Otodectes spp., Psoroptes spp., Pterolichus spp., Sarcoptes spp., Trixacarus spp., Tyrophagus spp.

Examples of parasitic protozoa include, but are not limited to:

Mastigophora (Flagellata), such as:

Metamonada: from the order of Diplomonadida, for example Giardia spp., Spironucleus spp.

Parabasala: from the order of Trichomonadida, for example Histomonas spp., Pentatrichomonas spp., Tetratrichomonas spp., Trichomonas spp., Tritrichomonas spp.

Euglenozoa: from the order of Trypanosomatida, for example Leishmania spp., Trypanosoma spp.

Sarcomastigophora (Rhizopoda) such as Entamoebidae, for example Entamoeba spp., Centramoebidae, for example Acanthamoeba sp., Euamoebidae, e.g. Hartmanella sp.

Alveolata such as Apicomplexa (Sporozoa): e.g. Cryptosporidium spp.; from the order of Eimeriida, for example, Besnoitia spp., Cystoisospora spp., Eimeria spp., Hammondia spp., Isospora spp., Neospora spp., Sarcocystis spp., Toxoplasma spp.; from the order of Adeleida, for example, Hepatozoon spp., Klossiella spp.; from the order of Haemosporida, for example,

Leucocytozoon spp., Plasmodium spp.; from the order of Piroplasmida, for example, Babesia spp., Ciliophora spp., Echinozoon spp., Theileria spp.; from the order of Vesibuliferida, for example, Balantidium spp., Buxtonella spp.

Microspora such as Encephalitozoon spp., Enterocytozoon spp., Globidium spp., Nosema spp., and also, for example, Myxozoa spp.

The helminths that are pathogenic to humans or animals include, for example, Acanthocephala, nematodes, Pentastoma and Platyhelminths (e.g. Monogenea, cestodes and trematodes).

Exemplary helminths include, but are not limited to:

Monogenea: e.g. Dactylogyrus spp., Gyrodactylus spp., Microbothrium spp., Polystoma spp., Troglecephalus spp.;

Cestodes: from the order of Pseudophyllidea, for example: Bothridium spp., Diphyllobothrium spp., Diplogonoporus spp., Ichthyobothrium spp., Ligula spp., Schistocephalus spp., Spirometra spp.

from the order of Cyclophyllida, for example: Andyra spp., Anoplocephala spp., Avitellina spp., Bertiella spp., Cittotaenia spp., Davainea spp., Diorchis spp., Diplopylidium spp., Dipylidium spp., Echinococcus spp., Echinocotyle spp., Echinolepis spp., Hydatigera spp., Hymenolepis spp., Joyeuxiella spp., Mesocestoides spp., Moniezia spp., Paranoplocephala spp., Raillietina spp., Stilesia spp., Taenia spp., Thysaniezia spp., Thysanosoma spp.

Trematodes: from the class of Digenea, for example: Austrobilharzia spp., Brachylaima spp., Calicophoron spp., Catatropis spp., Clonorchis spp. Collyriclum spp., Cotylophoron spp., Cyclocoelum spp., Dicrocoelium spp., Diplostomum spp., Echinochasmus spp., Echinoparyphium spp., Echinostoma spp., Eurytrema spp., Fasciola spp., Fasciolides spp., Fasciolopsis spp., Fischoederius spp., Gastrothylacus spp., Gigantobilharzia spp., Gigantocotyle spp., Heterophyes spp., Hypoderaeum spp., Leucochloridium spp., Metagonimus spp., Metorchis spp., Nanophyetus spp., Notocotylus spp., Opisthorchis spp., Ornithobilharzia spp., Paragonimus spp., Paramphistomum spp., Plagiorchis spp.,

Posthodiplostomum spp., Prosthogonimus spp., Schistosoma spp., Trichobilharzia spp., Troglotrema spp., Typhlocoelum spp.

Nematodes: from the order of Trichinellida, for example: Capillaria spp., Trichinella spp., Trichomosoides spp., Trichuris spp.

From the order of Tylenchida, for example: Micronema spp., Parastrangyloides spp., Strongyloides spp.

From the order of Rhabditina, for example: Aelurostrongylus spp., Amidostomum spp., Ancylostoma spp., Angiostrongylus spp., Bronchonema spp., Bunostomum spp., Chabertia spp., Cooperia spp., Cooperioides spp., Crenosoma spp., Cyathostomum spp., Cyclococercus spp., Cyclodontostomum spp., Cylicocyclus spp., Cylicostephanus spp., Cylindropharynx spp., Cystocaulus spp., Dictyocaulus spp., Elaphostrongylus spp., Filaroides spp., Globocephalus spp., Graphidium spp., Gyalocephalus spp., Haemonchus spp., Heligmosomoides spp., Hyostrongylus spp., Marshallagia spp., Metastrongylus spp., Muellerius spp., Necator spp., Nematodirus spp., Neostrongylus spp., Nippostrongylus spp., Obeliscoides spp., Oesophagodontus spp., Oesophagostomum spp., Ollulanus spp.; Ornithostrongylus spp., Oslerus spp., Ostertagia spp., Paracooperia spp., Paracrenosoma spp., Parafilaroides spp., Parelaphostrongylus spp., Pneumocaulus spp., Pneumostrongylus spp., Poteriostomum spp., Protostrongylus spp., Spicocaulus spp., Stephanurus spp., Strongylus spp., Syngamus spp., Teladorsagia spp., Trichonema spp., Trichostrongylus spp., Triodontophorus spp., Troglostrongylus spp., Uncinaria spp.

From the order Spirurida, for example: Acanthocheilonema spp., Anisakis spp., Ascaridia spp.; Ascaris spp., Ascarops spp., Aspiculuris spp., Baylisascaris spp., Brugia spp., Cercopithifilaria spp., Crassicauda spp., Dipetalonema spp., Dirofilaria spp., Dracunculus spp.; Draschia spp., Enterobius spp., Filaria spp., Gnathostoma spp., Gongylonema spp., Habronema spp., Heterakis spp.; Litomosoides spp., Loa spp., Onchocerca spp., Oxyuris spp., Parabronema spp., Parafilaria spp., Parascaris spp., Passalurus spp., Physaloptera spp., Probstmayria spp., Pseudofilaria spp., Setaria spp., Skjrabinema spp., Spirocerca spp., Stephanofilaria spp., Strongyluris spp., Syphacia spp., Thelazia spp., Toxascaris spp., Toxocara spp., Wuchereria spp.

Acanthocephala: from the order of Oligacanthorhynchida, for example: Macracanthorhynchus spp., Prosthenorchis spp.; from the order of Moniliformida, for example: Moniliformis spp.

From the order of Polymorphida, for example: Filicollis spp.; from the order of Echinorhynchida, for example Acanthocephalus spp., Echinorhynchus spp., Leptorhynchoides spp.

Pentastoma: from the order of Porocephalida, for example Linguatula spp.

In the veterinary field and in animal husbandry, the compounds of the formula (I) are administered by methods generally known in the art, such as via the enteral, parenteral, dermal or nasal route in the form of suitable preparations. Administration may be prophylactic, metaphylactic or therapeutic.

Thus, one embodiment of the present invention refers to the compounds of the formula (I) for use as a medicament.

A further aspect relates to the compounds of the formula (I) for use as an antiendoparasitic agent.

A further specific aspect of the invention relates to the compounds of the formula (I) for use as an antihelminthic agent, especially for use as a nematicide, platyhelminthicide, acanthocephalicide or pentastomicide.

A further specific aspect of the invention relates to the compounds of the formula (I) for use as an antiprotozoic agent.

A further aspect relates to the compounds of the formula (I) for use as an antiectoparasitic agent, especially an arthropodicide, very particularly an insecticide or an acaricide.

Further aspects of the invention are veterinary medicine formulations comprising an effective amount of at least one compound of the formula (I) and at least one of the following: a pharmaceutically acceptable excipient (e.g. solid or liquid diluents), a pharmaceutically acceptable auxiliary (e.g. surfactants), especially a pharmaceutically acceptable excipient used conventionally in veterinary medicine formulations and/or a pharmaceutically acceptable auxiliary conventionally used in veterinary medicine formulations.

A related aspect of the invention is a method for production of a veterinary medicine formulation as described here, which comprises the step of mixing at least one compound of the formula (I) with pharmaceutically acceptable excipients and/or auxiliaries, especially with pharmaceutically acceptable excipients used conventionally in veterinary medicine formulations and/or auxiliaries used conventionally in veterinary medicine formulations.

Another specific aspect of the invention is veterinary medicine formulations selected from the group of ectoparasiticidal and endoparasiticidal formulations, especially selected from the group of anthelmintic, antiprotozoic and arthropodicidal formulations, very particularly selected from the group of nematicidal, platyhelminthicidal, acanthocephalicidal, pentastomicidal, insecticidal and acaricidal formulations, according to the aspects mentioned, and methods for production thereof.

Another aspect relates to a method for treatment of a parasitic infection, especially an infection caused by a parasite selected from the group of the ectoparasites and endoparasites mentioned here, by use of an effective amount of a compound of the formula (I) in an animal, especially a nonhuman animal, having a need therefor.

Another aspect relates to a method for treatment of a parasitic infection, especially an infection caused by a parasite selected from the group of the ectoparasites and endoparasites mentioned here, by use of a veterinary medicine formulation as defined here in an animal, especially a nonhuman animal, having a need therefor.

Another aspect relates to the use of the compounds of the formula (I) in the treatment of a parasite infection, especially an infection caused by a parasite selected from the group of the ectoparasites and endoparasites mentioned here, in an animal, especially a nonhuman animal.

In the present context of animal health or veterinary medicine, the term "treatment" includes prophylactic, metaphylactic and therapeutic treatment.

In a particular embodiment, in this way, mixtures of at least one compound of the formula (I) with other active compounds, especially with endo- and ectoparasiticides, are provided for the field of veterinary medicine.

In the field of animal health, "mixture" means not just that two (or more) different active compounds are formulated in a common formulation and are correspondingly employed together, but also relates to products comprising formulations separated for each active compound. Accordingly, when more than two active compounds are to be employed, all active compounds can be formulated in a common formulation or all active compounds can be formulated in separate formulations; likewise conceivable are mixed forms in which some of the active compounds are formulated together and some of the active compounds are formulated separately. Separate formulations allow the separate or successive application of the active compounds in question.

The active ingredients specified here by their common names are known and are described, for example, in the "Pesticide Manual" (see above) or can be searched for on the Internet (e.g.: http://www.alanwood.net/pesticides).

Illustrative active compounds from the group of the ectoparasiticides as mixing components, without any intention that this should constitute a restriction, include the insecticides and acaricides listed in detail above. Further usable active compounds are listed below in accordance with the abovementioned classification based on the current IRAC Mode of Action Classification Scheme: (1) acetylcholinesterase (AChE) inhibitors; (2) GABA-gated chloride channel blockers; (3) sodium channel modulators; (4) nicotinic acetylcholine receptor (nAChR) competitive modulators; (5) nicotinic acetylcholine receptor (nAChR) allosteric modulators; (6) glutamate-gated chloride channel (GluCl) allosteric modulators; (7) juvenile hormone mimetics; (8) miscellaneous non-specific (multi-site) inhibitors; (9) chordotonal organ modulators; (10) mite growth inhibitors; (12) inhibitors of mitochondrial ATP synthase, such as ATP disruptors; (13) uncouplers of oxidative phosphorylation via disruption of the proton gradient; (14) nicotinic acetylcholine receptor channel blockers; (15) inhibitors of chitin biosynthesis, type 0; (16) inhibitors of chitin biosynthesis, type 1; (17) moulting disruptors (especially in Diptera); (18) ecdysone receptor agonists; (19) octopamine receptor agonists; (21) mitochondrial complex I electron transport inhibitors; (25) mitochondrial complex II electron transport inhibitors; (20) mitochondrial complex III electron transport inhibitors; (22) voltage-dependent sodium channel blockers; (23) inhibitors of acetyl CoA carboxylase; (28) ryanodine receptor modulators;

active compounds having unknown or non-specific mechanisms of action, e.g. fentrifanil, fenoxacrim, cycloprene, chlorobenzilate, chlordimeform, flubenzimin, dicyclanil, amidoflumet, quinomethionat, triarathene, clothiazoben, tetrasul, potassium oleate, petroleum, metoxadiazone, gossyplur, flutenzine, brompropylate, cryolite;

compounds from other classes, for example butacarb, dimetilan, cloethocarb, phosphocarb, pirimiphos(-ethyl), parathion(-ethyl), methacrifos, isopropyl o-salicylate, trichlorfon, tigolaner, sulprofos, propaphos, sebufos, pyridathion, prothoate, dichlofenthion, demeton-S-methyl sulfone, isazofos, cyanofenphos, dialifos, carbophenothion, autathiofos, aromfenvinfos(-methyl), azinphos(-ethyl), chlorpyrifos(-ethyl), fosmethilan, iodofenphos, dioxabenzofos, formothion, fonofos, flupyrazofos, fensulfothion, etrimfos;

organochlorine compounds, for example camphechlor, lindane, heptachlor; or phenylpyrazoles, e.g. acetoprole, pyrafluprole, pyriprole, vaniliprole, sisapronil; or isoxazolines, e.g. sarolaner, afoxolaner, lotilaner, fluralaner;

pyrethroids, e.g. (cis-, trans-)metofluthrin, profluthrin, flufenprox, flubrocythrinate, fubfenprox, fenfluthrin, protrifenbut, pyresmethrin, RU15525, terallethrin, cis-resmethrin, heptafluthrin, bioethanomethrin, biopermethrin, fenpyrithrin, cis-cypermethrin, cis-permethrin, clocythrin, cyhalothrin (lambda-), chlovaporthrin, or halogenated hydrocarbon compounds (HCHs),

neonicotinoids, e.g. nithiazine

dicloromezotiaz, triflumezopyrim

macrocyclic lactones, e.g. nemadectin, ivermectin, latidectin, moxidectin, selamectin, eprinomectin, doramectin, emamectin benzoate; milbemycin oxime

triprene, epofenonane, diofenolan;

biologicals, hormones or pheromones, for example natural products, e.g. thuringiensin, codlemone or neem components

dinitrophenols, e.g. dinocap, dinobuton, binapacryl;

benzoylureas, e.g. fluazuron, penfluron,

amidine derivatives, e.g. chlormebuform, cymiazole, demiditraz

beehive varroa acaricides, for example organic acids, e.g. formic acid, oxalic acid.

Illustrative active compounds from the group of the endoparasiticides, as mixing components, include, but are not limited to, active anthelmintic ingredients and active antiprotozoic ingredients.

The anthelmintic active compounds include but are not limited to the following nematicidally, trematicidally and/or cestocidally active compounds:

from the class of the macrocyclic lactones, for example: eprinomectin, abamectin, nemadectin, moxidectin, doramectin, selamectin, lepimectin, latidectin, milbemectin, ivermectin, emamectin, milbemycin;

from the class of the benzimidazoles and probenzimidazoles, for example: oxibendazole, mebendazole, triclabendazole, thiophanate, parbendazole, oxfendazole, netobimin, fenbendazole, febantel, thiabendazole, cyclobendazole, cambendazole, albendazole sulfoxide, albendazole, flubendazole;

from the class of the depsipeptides, preferably cyclic depsipeptides, especially 24-membered cyclic depsipeptides, for example: emodepside, PF1022A;

from the class of the tetrahydropyrimidines, for example: morantel, pyrantel, oxantel;

from the class of the imidazothiazoles, for example: butamisole, levamisole, tetramisole;

from the class of the aminophenylamidines, for example: amidantel, deacylated amidantel (dAMD), tribendimidine;

from the class of the aminoacetonitriles, for example: monepantel;

from the class of the paraherquamides, for example: paraherquamide, derquantel;

from the class of the salicylanilides, for example: tribromsalan, bromoxanide, brotianide, clioxanide, closantel, niclosamide, oxyclozanide, rafoxanide;

from the class of the substituted phenols, for example: nitroxynil, bithionol, disophenol, hexachlorophene, niclofolan, meniclopholan;

from the class of the organophosphates, for example: trichlorfon, naphthalofos, dichlorvos/DDVP, crufomate, coumaphos, haloxon;

from the class of the piperazinones/quinolines, for example: praziquantel, epsiprantel;

from the class of the piperazines, for example: piperazine, hydroxyzine;

from the class of the tetracyclines, for example: tetracycline, chlorotetracycline, doxycycline, oxytetracycline, rolitetracycline;

from various other classes, for example: bunamidine, niridazole, resorantel, omphalotin, oltipraz, nitroscanate, nitroxynil, oxamniquin, mirasan, miracil, lucanthon, hycanthon, hetolin, emetin, diethylcarbamazine, dichlorophen, diamfenetide, clonazepam, bephenium, amoscanate, clorsulon.

Active antiprotozoic ingredients include, but are not limited to, the following active compounds:

from the class of the triazines, for example: diclazuril, ponazuril, letrazuril, toltrazuril;

from the class of polyether ionophores, for example: monensin, salinomycin, maduramicin, narasin;

from the class of the macrocyclic lactones, for example: milbemycin, erythromycin;

from the class of the quinolones, for example: enrofloxacin, pradofloxacin;

from the class of the quinines, for example: chloroquine;

from the class of the pyrimidines, for example: pyrimethamine;

from the class of the sulfonamides, for example: sulfaquinoxaline, trimethoprim, sulfaclozin;

from the class of the thiamines, for example: amprolium;

from the class of the lincosamides, for example: clindamycin;

from the class of the carbanilides, for example: imidocarb;

from the class of the nitrofurans, for example: nifurtimox;

from the class of the quinazolinone alkaloids, for example: halofuginone;

from various other classes, for example: oxamniquine, paromomycin;

from the class of the vaccines or antigens from microorganisms, for example: Babesia canis rossi, Eimeria tenella, Eimeria praecox, Eimeria necatrix, Eimeria mitis, Eimeria maxima, Eimeria brunetti, Eimeria acervulina, Babesia canis vogeli, Leishmania infantum, Babesia canis canis, Dictyocaulus viviparus.

All the mixing components mentioned, as the case may be, may also form salts with suitable bases or acids if they are capable of doing so on the basis of their functional groups.

Vector control

The compounds of the formula (I) can also be used in vector control. In the context of the present invention, a vector is an arthropod, especially an insect or arachnid, capable of transmitting pathogens, for example viruses, worms, single-cell organisms and bacteria, from a reservoir (plant, animal, human, etc.) to a host. The pathogens can be transmitted either mechanically (for example trachoma by non-stinging flies) onto a host or after injection into a host (for example malaria parasites by mosquitoes).

Examples of vectors and the diseases or pathogens they transmit are:

1) Mosquitoes

- Anopheles: malaria, filariasis;

- Culex: Japanese encephalitis, filariasis, other viral diseases, transmission of other worms;

- Aedes: yellow fever, dengue fever, further viral disorders, filariasis;

- Simuliidae: transmission of worms, especially Onchocerca volvulus;

- Psychodidae: transmission of leishmaniasis

2) Lice: skin infections, epidemic typhus;

3) Fleas: plague, endemic typhus, tapeworms;

4) Flies: sleeping sickness (trypanosomiasis); cholera, other bacterial diseases;

5) Mites: acariosis, epidemic typhus, rickettsialpox, tularaemia, Saint Louis encephalitis, tick-borne encephalitis (TBE), Crimean-Congo haemorrhagic fever, borreliosis;

6) Ticks: borrelioses such as Borrelia bungdorferi sensu lato., Borrelia duttoni, tick-borne encephalitis, Q fever (Coxiella burnetii), babesioses (Babesia canis canis), ehrlichiosis.

Examples of vectors in the context of the present invention are insects, for example aphids, flies, leafhoppers or thrips, which can transmit plant viruses to plants. Other vectors capable of transmitting plant viruses are spider mites, lice, beetles and nematodes.

Further examples of vectors in the context of the present invention are insects and arachnids such as mosquitoes, especially of the genera Aedes, Anopheles, for example A. gambiae, A. arabiensis, A. funestus, A. dirus (malaria) and Culex, Psychodidae such as Phlebotomus, Lutzomyia, lice, fleas, flies, mites and ticks, which can transmit pathogens to animals and/or humans.

Vector control is also possible if the compounds of the formula (I) are resistance-breaking.

Compounds of the formula (I) are suitable for use in the prevention of diseases and/or pathogens transmitted by vectors. Thus, a further aspect of the present invention is the use of compounds of the formula (I) for vector control, for example in agriculture, in horticulture, in forests, in gardens and in leisure facilities, and also in the protection of materials and stored products.

Protection of industrial materials

The compounds of the formula (I) are suitable for protecting industrial materials against attack or destruction by insects, for example from the orders of Coleoptera, Hymenoptera, Isoptera, Lepidoptera, Psocoptera and Zygentoma.

Industrial materials in the present context are understood to mean inanimate materials, such as preferably plastics, adhesives, sizes, papers and cards, leather, wood, processed wood products and coating compositions. The use of the invention for protection of wood is particularly preferred.

In a further embodiment, the compounds of the formula (I) are used together with at least one further insecticide and/or at least one fungicide.

In a further embodiment, the compounds of the formula (I) take the form of a ready-to-use pesticide, meaning that they can be applied to the material in question without further modifications. Useful further insecticides or fungicides especially include those mentioned above.

Surprisingly, it has also been found that the compounds of the formula (I) can be employed for protecting objects which come into contact with saltwater or brackish water, in particular hulls, screens, nets, buildings, moorings and signalling systems, against fouling. It is equally possible to use the compounds of the formula (I), alone or in combinations with other active compounds, as antifouling agents.

Control of animal pests in the hygiene sector

The compounds of the formula (I) are suitable for controlling animal pests in the hygiene sector. More particularly, the invention can be used in the domestic protection sector, in the hygiene protection sector and in the protection of stored products, particularly for control of insects, arachnids, ticks and mites encountered in enclosed spaces, for example dwellings, factory halls, offices, vehicle cabins, animal breeding facilities. For controlling animal pests, the compounds of the formula (I) are used alone or in combination with other active compounds and/or auxiliaries. They are preferably used in domestic insecticide products. The compounds of the formula (I) are effective against sensitive and resistant species, and against all developmental stages.

These pests include, for example, pests from the class Arachnida, from the orders Scorpiones, Araneae and Opiliones, from the classes Chilopoda and Diplopoda, from the class Insecta the order Blattodea, from the orders Coleoptera, Dermaptera, Diptera, Heteroptera, Hymenoptera, Isoptera, Lepidoptera, Phthiraptera, Psocoptera, Saltatoria or Orthoptera, Siphonaptera and Zygentoma and from the class Malacostraca the order Isopoda.

Application is effected, for example, in aerosols, unpressurized spray products, for example pump and atomizer sprays, automatic fogging systems, foggers, foams, gels, evaporator products with evaporator tablets made of cellulose or plastic, liquid evaporators, gel and membrane evaporators, propeller-driven evaporators, energy-free, or passive, evaporation systems, moth papers, moth bags and moth gels, as granules or dusts, in baits for spreading or bait stations.

Analytical determinations

The analytical determination methods described below apply to all statements in the entire document unless the respective analytical determination method is specially described in the relevant text passage.

The ^{1}H NMR spectra were measured with a Bruker Avance III 400 MHz spectrometer fitted with a 1.7 mm TCI sample head using tetramethylsilane as standard (0.00 ppm), of solutions in the solvents CD_3CN, $CDCl_3$ or d_6-DMSO. Alternatively, a Bruker Avance III 600 MHz spectrometer fitted with a 5 mm CPNMP sample head or a Bruker Avance NEO 600 MHz spectrometer fitted with a 5 mm TCI sample head was employed for the measurements. In general, the measurements were carried out at a sample head temperature of 298 K. If other measurement temperatures were used, this is specifically mentioned.

NMR peak lists method

The ^{1}H NMR data of selected examples are represented in the form of ^{1}H NMR peak lists. For each signal peak, first the δ value in ppm and then the signal intensity in round brackets are listed. The δ value/signal intensity number pairs for different signal peaks are listed with separation from one another by semicolons.

The peak list for one example therefore has the form:

δ_1 (intensity$_1$); δ_2 (intensity$_2$);……..; δ_i (intensity$_i$);……; δ_n (intensity$_n$)

The intensity of sharp signals correlates with the height of the signals in a printed representation of a ^{1}H NMR spectrum in cm and shows the true ratios of the signal intensities. In the case of broad signals, several peaks or the middle of the signal and the relative intensity thereof may be shown in comparison to the most intense signal in the spectrum.

Calibration of the chemical shift of ^{1}H NMR spectra is accomplished using tetramethylsilane or the chemical shift of the solvent if the sample does not contain any tetramethylsilane. Accordingly, in certain cases the ^{1}H NMR peak lists may comprise the tetramethylsilane peak.

The ^{1}H NMR peak lists are equivalent to conventional ^{1}H NMR representations and thus usually contain all peaks listed in a conventional ^{1}H NMR interpretation.

In addition, like conventional ^{1}H NMR representations, they may show solvent signals, signals of stereoisomers of the compounds according to the invention which are optionally provided by the invention, and/or peaks of impurities.

NMR solvent signals, the tetramethylsilane peak and the water signal in the solvent in question are excluded from the calibration of the relative intensity since their stated intensity values can be very high.

The peaks of (stereo)isomers of the compounds of the invention and/or peaks of impurities usually have a lower intensity on average than the peaks of the compounds of the invention (for example at a purity of > 90%).

Such stereoisomers and/or impurities may be typical of the particular preparation process. Their peaks can thus help in this case to identify reproduction of a preparation process with reference to "by-product fingerprints".

An expert calculating the peaks of the compounds according to the invention by known methods (MestreC, ACD simulation, but also with empirically evaluated expected values) can, if required, identify the peaks of the compounds of the invention, optionally using additional intensity filters. This identification is equivalent to the relevant peak listing in conventional 1H NMR interpretation.

In the JCAMP file, the solvent employed, the measuring frequency of the spectrometer and the spectrometer model can be found using the parameter “solvent”, “observe frequency” and “spectrometer/data system”, respectively.

^{13}C NMR data are stated analogously to the ^{1}H NMR data as peak lists using broadband-decoupled ^{13}C NMR spectra. Here, too, NMR solvent signals and tetramethylsilane are excluded from the calibration of the relative intensity since these signals may have very high intensity values.

Further details on ^{1}H NMR peak lists can be found in: "Citation of NMR Peaklist Data within Patent Applications" in Research Disclosure Database Number 564025.

logP values

The logP values were determined according to EEC Directive 79/831 Annex V.A8 by HPLC (high-performance liquid chromatography) on a reversed-phase column (C18) using the following methods:

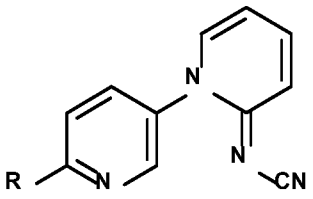
[a] The logP value is determined by LC-UV measurement in the acidic range using 0.9 ml/l formic acid in water and 1.0 ml/l formic acid in acetonitrile as mobile phases (linear gradient from 10% acetonitrile to 95% acetonitrile).

[b] The logP value is determined by LC-UV measurement in the neutral range using 79 mg/l ammonium carbonate in water and acetonitrile as mobile phases (linear gradient from 10% acetonitrile to 95% acetonitrile).

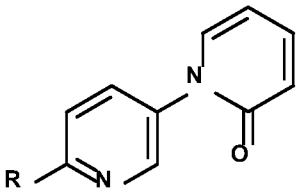
Calibration was carried out using a homologous series of straight-chain alkan-2-ones (having 3 to 16 carbon atoms) with known logP values. The values between successive alkanones are determined by linear regression.

Preparation examples

I. General synthesis of compounds of the formula (I) by Process B



Step 1: Synthesis of compounds of the formula (IV)



Under an atmosphere of protective gas (argon), 1.0 equiv. (18.6 mmol) of 2(1*H*)-pyridinone, 1.5 equiv. (27.9 mmol) of potassium carbonate and 0.05 equiv. (0.9 mmol) of copper(I) iodide were added to a solution of 1.0 equiv. (18.6 mmol) of 2-substituted 5-halopyridine (halogen = bromine or iodine) in 20 ml of *N,N*-dimethylformamide. The reaction mixture was then stirred at 120°C for one hour. For the work-up, the reaction mixture was, after cooling, filtered through Celite and concentrated under reduced pressure. The residue that remained was purified by column chromatography on silica gel (gradient: cyclohexane - acetone).

[1(2*H*),3'-Bipyridin]-2-one (IV-1)

The preparation was carried out in accordance with the general procedure using:

2459.9 mg (12.0 mmol) of 3-iodopyridine

1141.2 mg (12.0 mmol) of 2(1*H*)-pyridinone

2487.6 mg (18.0 mmol) of potassium carbonate

114.2 mg (0.60 mmol) of copper(I) iodide

12.0 ml of *N,N*-dimethylformamide

This gave 518.0 mg (25.0% of theory) of [1(2*H*),3'-bipyridin]-2-one (IV-1).

6'-Difluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-2)

The preparation was carried out in accordance with the general procedure using:

2000.0 mg (9.6 mmol) of 5-bromo-2-(difluoromethyl)pyridine

914.4 mg (9.6 mmol) of 2(1*H*)-pyridinone

1993.2 mg (14.4 mmol) of potassium carbonate

91.5 mg (0.48 mmol) of copper(I) iodide

10.0 ml of *N,N*-dimethylformamide

This gave 1200.0 mg (56.2% of theory) of 6'-difluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-2).

6'-Chlorodifluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-3)

The preparation was carried out in accordance with the general procedure using:

2000.0 mg (8.0 mmol) of 5-bromo-2-(chlorodifluoromethyl)pyridine

760.9 mg (8.0 mmol) of 2(1*H*)-pyridinone

1658.8 mg (12.0 mmol) of potassium carbonate

76.1 mg (0.40 mmol) of copper(I) iodide

6.0 ml of *N,N*-dimethylformamide

This gave 442.0 mg (21.5% of theory) of 6'-chlorodifluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-3).

6'-(1,1-Difluoroethyl)-[1(2*H*),3'-bipyridin]-2-one (IV-4)

The preparation was carried out in accordance with the general procedure using:

1600.0 mg (6.8 mmol) of 5-bromo-2-(1,1-difluoroethyl)pyridine

651.0 mg (6.8 mmol) of 2(1*H*)-pyridinone

1419.2 mg (10.2 mmol) of potassium carbonate

65.1 mg (0.34 mmol) of copper(I) iodide

5.0 ml of *N,N*-dimethylformamide

This gave 631.0 mg (39.0% of theory) of 6‘-(1,1-difluoroethyl)-[1(2*H*),3‘-bipyridin]-2-one (IV-4).

***(R,S)*-6‘-(1-Fluoroethyl)-[1(2*H*),3‘-bipyridin]-2-one (IV-5)**

The preparation was carried out in accordance with the general procedure using:

4000.0 mg (18.6 mmol) of *(R,S)*-5-bromo-2-(1-fluoroethyl)pyridine

1771.1 mg (18.6 mmol) of 2(1*H*)-pyridinone

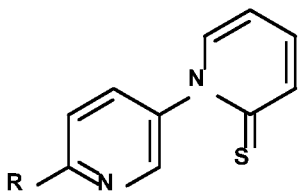
3860.8 mg (27.9 mmol) of potassium carbonate

177.3 mg (0.93 mmol) of copper(I) iodide

20.0 ml of *N,N*-dimethylformamide

This gave 2100.0 mg (51.6% of theory) of *(R,S)*-6‘-(1-fluoroethyl)-[1(2*H*), 3‘-bipyridin]-2-one (IV-5).

<u>Step 2</u>: Synthesis of compounds of the formula (VI)



1.0 equiv. (2.5 mmol) of a compound of the formula (IV) and 10.0 equiv. (25.8 mmol) of sodium bicarbonate were stirred in 60 ml of 1,4-dioxane. After addition of 5.0 equiv. (12.9 mmol) of diphosphorus pentasulfide, the reaction mixture was stirred at 80°C for about 18 hours. For the work-up, the reaction mixture was, after cooling, filtered through Celite, the filter cake was rinsed with dichloromethane and the filtrate was concentrated to dryness under reduced pressure. The residue that remained was purified by column chromatography on silica gel (gradient: cyclohexane - acetone).

[1(2*H*),3‘-Bipyridine]-2-thione (VI-1)

The preparation was carried out in accordance with the general procedure using:

1410.0 mg (8.1 mmol) of [1(2*H*),3'-bipyridin]-2-one (IV-1)

6879.1 mg (81.8 mmol) of sodium bicarbonate

9101.1 mg (40.9 mmol) of diphosphorus pentasulfide

60.0 ml of 1,4-dioxane

This gave 523.0 mg (24.7% of theory) of [1(2*H*),3'-bipyridine]-2-thione (VI-1).

6'-Difluoromethyl-[1(2*H*),3'-bipyridine]-2-thione (VI-2)

The preparation was carried out in accordance with the general procedure using:

1200.0 mg (5.4 mmol) of 6'-difluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-2)

4536.9 mg (54.0 mmol) of sodium bicarbonate

6002.3 mg (27.0 mmol) of diphosphorus pentasulfide

40.0 ml of 1,4-dioxane

This gave 880.0 mg (68.3% of theory) of 6'-difluoromethyl-[1(2*H*),3'-bipyridine]-2-thione (VI-2).

6'-Chlorodifluoromethyl-[1(2*H*),3'-bipyridine]-2-thione (VI-3)

The preparation was carried out in accordance with the general procedure using:

640.0 mg (2.4 mmol) of 6'-chlorodifluoromethyl-[1(2*H*),3'-bipyridin]-2-one (IV-3)

2094.9 mg (24.9 mmol) of sodium bicarbonate

2771.5 mg (12.4 mmol) of diphosphorus pentasulfide

20.0 ml of 1,4-dioxane

This gave 440.0 mg (64.7% of theory) of 6'-chlorodifluoromethyl-[1(2*H*),3'-bipyridin]-2-thione (VI-3).

6'-(1,1-Difluoroethyl)-[1(2*H*),3'-bipyridine]-2-thione (VI-4)

The preparation was carried out in accordance with the general procedure using:

610.0 mg (2.5 mmol) of 6'-(1,1-difluoroethyl)-[1(2*H*),3'-bipyridin]-2-one (IV-4)

2169.3 mg (25.8 mmol) of sodium bicarbonate

2870.0 mg (12.9 mmol) of diphosphorus pentasulfide

60.0 ml of 1,4-dioxane

This gave 468.0 mg (71.8% of theory) of 6‘-(1,1-difluoroethyl)-[1(2*H*),3‘-bipyridine]-2-thione (VI-4).

(*R,S*)-6‘-(1-Fluoroethyl)-[1(2*H*),3‘-bipyridine]-2-thione (VI-5)

The preparation was carried out in accordance with the general procedure using:

1550.0 mg (7.1 mmol) of *(R,S)*-6‘-(1-fluoroethyl)-[1(2H), 3‘-bipyridin]-2-one (IV-5)

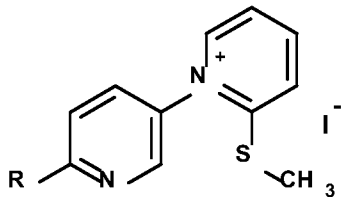
5966.6 mg (71.0 mmol) of sodium bicarbonate

7893.8 mg (35.5 mmol) of diphosphorus pentasulfide

100.0 ml of 1,4-dioxane

This gave 1630.0 mg (90.6% pure) of *(R,S)*-6‘-(1-fluoroethyl)-[1(2H),3‘-bipyridine]-2-thione (VI-5).

<u>Step 3</u>: Synthesis of compounds of the formula (VII)



1.0 equiv. (1.74 mmol) of the compound of the formula (VI) (synthesis according to Step 2) were initially charged in 30 ml of acetonitrile, 10.0 equiv. (17.4 mmol) of iodomethane were added and the mixture was stirred at room temperature for about 18 hours. LC-MS control showed that the reaction had ended. The reaction mixture was then concentrated under reduced pressure and the crude product (VII) that remained was, without further purification, reacted in the subsequent Reaction Step 4.

[1-[Pyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-1)

The preparation was carried out in accordance with the general procedure using:

520.0 mg (2.0 mmol) of [1(2H),3'-bipyridine]-2-thione (VI-1)

2862.0 mg (20.0 mmol) of iodomethane

30.0 ml of acetonitrile

The crude product (VII-2) that remained after concentration under reduced pressure was, without further purification, reacted in the subsequent Reaction Step 4.

[1-[6-Difluoromethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-2)

The preparation was carried out in accordance with the general procedure using:

850.0 mg (3.5 mmol) of 6'-difluoromethyl-[1(2H),3'-bipyridine]-2-thione (VI-2)

5063.6 mg (35.6 mmol) of iodomethane

50.0 ml of acetonitrile

The crude product (VII-2) that remained after concentration under reduced pressure was, without further purification, reacted in the subsequent Reaction Step 4.

[1-[6-Chlorodifluoromethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-3)

The preparation was carried out in accordance with the general procedure using:

420.0 mg (1.5 mmol) of 6'-chlorodifluoromethyl-[1(2H),3'-bipyridine]-2-thione (VI-3)

2186.0 mg (15.4 mmol) of iodomethane

20.0 ml of acetonitrile

The crude product (VII-2) that remained after concentration under reduced pressure was, without further purification, reacted in the subsequent Reaction Step 4.

[1-[1,1-Difluoroethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-4)

The preparation was carried out in accordance with the general procedure using:

440.0 mg (1.7 mmol) of 6'-(1,1-difluoroethyl)-[1(2H),3'-bipyridine]-2-thione (VI-4)

2475.4 mg (17.4 mmol) of iodomethane

30.0 ml of acetonitrile

The crude product (VII-2) that remained after concentration under reduced pressure was, without further purification, reacted in the subsequent Reaction Step 4.

***(R,S)*-[1-[1-Fluoroethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-5)**

The preparation was carried out in accordance with the general procedure using:

1600.0 mg (6.4 mmol) of *(R,S)*-6'-(1-fluoroethyl)-[1(2H), 3'-bipyridine]-2-thione (VI-5)

9208.1 mg (64.8 mmol) of iodomethane

70.0 ml of acetonitrile

The crude product (VII-2) that remained after concentration under reduced pressure was, without further purification, reacted in the subsequent Reaction Step 4.

Step 4: Synthesis of compounds of the formula (I)

2.0 equiv. (12.9 mmol) of sodium hydrogen cyanamide were added to 1.0 equiv. (6.4 mmol) of a compound of the formula (VII) (synthesis according to Step 3) dissolved in 100 ml of acetonitrile. The reaction mixture was then stirred at room temperature for 18 hours. For work-up, the reaction mixture was filtered, the organic phase concentrated under reduced pressure and the residue that remained was purified by column chromatography on silica gel (mobile phase gradient: cyclohexane: acetone gradient).

[1-[Pyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-1)

The preparation was carried out in accordance with the general procedure using:

660.3 mg (2.0 mmol) of [1-[pyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-1)

256.0 mg (4.0 mmol) of sodium hydrogen cyanamide

30.0 ml of acetonitrile

This gave 152.0 mg (37.7% of theory) of [1-[pyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-1).

^{13}C NMR (600 MHz, CD_3CN) σ = 111.5; 119.4; 125.0; 135.6; 140.4; 142.7; 148.5; 151.3 (=CH-); 138.7 (pyridine-C); 163.9 (C=N-); 118.0 (CN) ppm.

[1-[6-Difluoromethylpyridin-3-yl]-2-(1*H*)-pyridinylidene]cyanamide (I-2)

The preparation was carried out in accordance with the general procedure using:

1330.6 mg (3.5 mmol) of [1-[6-difluoromethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-2)

448.1 mg (7.0 mmol) of sodium hydrogen cyanamide

50.0 ml of acetonitrile

This gave 789.0 mg (91.5% of theory) of [1-[6-difluoromethylpyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-2).

[1-[6-Chlorodifluoromethylpyridin-3-yl]-2-(1*H*)-pyridinylidene]cyanamide (I-3)

The preparation was carried out in accordance with the general procedure using:

638.5 mg (1.5 mmol) of [1-[6-chlorodifluoromethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-3)

197.1 mg (3.0 mmol) of sodium hydrogen cyanamide

30.0 ml of acetonitrile

This gave 280.0 mg (64.7% of theory) of [1-[6-chlorodifluoromethylpyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-3).

[1-[1,1-Difluoroethylpyridin-3-yl]-2-(1*H*)-pyridinylidene]cyanamide (I-4)

The preparation was carried out in accordance with the general procedure using:

685.9 mg (1.7 mmol) of [1-[1,1-difluoroethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-4)

222.7 mg (3.4 mmol) of sodium hydrogen cyanamide

30.0 ml of acetonitrile

This gave 379.0 mg (83.7% of theory) of [1-[1,1-difluoroethylpyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-4).

_(R,S)_-[1-[1-Fluoroethylpyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-5)

The preparation was carried out in accordance with the general procedure using:

2437.9 mg (6.5 mmol) of *(R,S)*-[1-[1-fluoroethylpyridin-3-yl]-2-(methylthio)pyridinium iodide (VII-5)

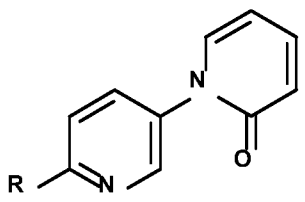
829.6 mg (13.0 mmol) of sodium hydrogen cyanamide

100.0 ml of acetonitrile

This gave 698.0 mg (44.4% of theory) of *(R,S)*-[1-[1-fluoroethylpyridin-3-yl]-2(1*H*)-pyridinylidene]cyanamide (I-5).

Table 1

Analytical data for compounds of the formula (IV)



(IV)

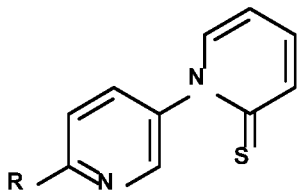
Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
IV-1	H	^{1}H-NMR (600.1 MHz, d_6-DMSO): δ = 8.6411 (10.9); 8.6382 (16.0); 8.6326 (7.3); 8.6301 (7.0); 7.9282 (4.6); 7.9256 (4.9); 7.9240 (4.7); 7.9214 (4.7); 7.9146 (5.1); 7.9121 (5.3); 7.9104 (5.4); 7.9078 (4.9); 7.7299 (5.2); 7.7288 (5.4); 7.7265 (6.0); 7.7253 (5.5); 7.7186 (5.5); 7.7174 (5.8); 7.7151 (6.0); 7.7139 (5.6); 7.5800 (5.8);

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		7.5788 (5.6); 7.5721 (5.8); 7.5708 (5.6); 7.5665 (5.6); 7.5652 (4.9); 7.5610 (5.1); 7.5585 (6.3); 7.5575 (9.3); 7.5501 (5.0); 7.5465 (5.8); 7.5457 (5.7); 7.5421 (4.8); 7.5346 (5.0); 7.5311 (4.7); 6.5260 (5.1); 6.5248 (6.3); 6.5239 (6.4); 6.5227 (5.3); 6.5106 (5.0); 6.5093 (6.2); 6.5085 (6.1); 6.5072 (5.0); 6.3734 (4.8); 6.3712 (4.8); 6.3622 (8.4); 6.3600 (8.3); 6.3510 (4.8); 6.3488 (4.6); 3.3214 (173.8); 2.6162 (0.4); 2.6132 (0.6); 2.6101 (0.4); 2.5222 (1.1); 2.5191 (1.4); 2.5160 (1.3); 2.5072 (30.0); 2.5042 (66.4); 2.5011 (92.6); 2.4981 (67.1); 2.4950 (31.7); 2.3881 (0.4); 2.3850 (0.6); 2.3820 (0.4); 2.0855 (0.7); 0.0053 (0.4); -0.0001 (13.8); -0.0057 (0.5) logP value (HCOOH) = 0.63
IV-2	F_2HC	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.8027 (0.4); 8.7870 (14.3); 8.7818 (14.7); 8.3153 (0.4); 8.1557 (7.4); 8.1497 (7.4); 8.1350 (8.6); 8.1292 (8.7); 7.8826 (14.6); 7.8617 (12.7); 7.7878 (8.1); 7.7842 (8.7); 7.7706 (8.6); 7.7669 (8.7); 7.5891 (5.2); 7.5841 (5.4); 7.5727 (5.9); 7.5664 (8.4); 7.5608 (5.8); 7.5494 (5.9); 7.5443 (5.6); 7.1930 (7.3); 7.0561 (16.0); 6.9193 (7.8); 6.5517 (11.7); 6.5286 (11.1); 6.4128 (6.1); 6.4098 (6.3); 6.3959 (11.4); 6.3930 (11.5); 6.3791 (6.0); 6.3761 (5.9); 3.3224 (191.0); 2.6702 (1.4); 2.5057 (182.8); 2.5014 (242.2); 2.4970 (181.1); 2.3279 (1.4); 2.3234 (1.1); 2.0856 (0.9); 1.3976 (3.6); 0.1459 (1.1); 0.0077 (11.8); -0.0002 (250.7); -0.1498 (1.2) logP value (HCOOH) = 0.87
IV-3	F_2ClC	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.8763 (12.1); 8.8707 (12.5); 8.2420 (7.0); 8.2360 (6.9); 8.2210 (8.8); 8.2150 (8.7); 8.0579 (16.0); 8.0369 (12.8); 7.8220 (7.2); 7.8170 (8.0); 7.8048 (7.6); 7.7998 (8.0); 7.5992 (5.0); 7.5941 (4.9); 7.5827 (5.4); 7.5772 (7.6); 7.5709 (5.4); 7.5595 (5.4); 7.5544 (5.1); 6.5667 (10.3); 6.5436 (9.9); 6.4295 (5.7); 6.4264 (5.6); 6.4126 (10.5); 6.4097 (10.0); 6.3958 (5.5); 6.3927 (5.0); 3.3210 (168.8); 2.6754 (1.0); 2.6703 (1.4); 2.6662 (1.0); 2.5236 (4.9); 2.5102 (89.7); 2.5059 (177.1); 2.5015 (229.6); 2.4970 (164.3); 2.4596 (0.4); 2.3329 (1.0); 2.3281 (1.3); 2.3239 (1.0); 1.3979 (0.7); 0.1462 (0.8); 0.0079 (7.5); -0.0002 (191.8); -0.0084 (7.9); -0.1496 (0.8) logP value (HCOOH) = 1,48
IV-4	H_3C-F_2C	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.7617 (4.5); 8.7566 (4.6); 8.1300 (2.7); 8.1239 (2.7); 8.1090 (3.3); 8.1030 (3.2); 7.8804 (5.5); 7.8594 (4.7); 7.7846 (2.7); 7.7807 (2.9); 7.7674 (2.9); 7.7634 (2.9);

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		7.5878 (1.7); 7.5828 (1.8); 7.5713 (1.9); 7.5653 (2.8); 7.5595 (1.9); 7.5481 (2.0); 7.5430 (1.8); 6.5511 (3.9); 6.5279 (3.8); 6.4097 (2.0); 6.4068 (2.0); 6.3928 (3.8); 6.3901 (3.8); 6.3761 (2.0); 6.3731 (1.9); 3.3232 (60.3); 2.6704 (0.4); 2.6661 (0.3); 2.5056 (58.7); 2.5014 (76.4); 2.4971 (56.0); 2.3279 (0.4); 2.3238 (0.3); 2.0966 (7.4); 2.0488 (16.0); 2.0010 (8.1); 0.0076 (1.4); -0.0001 (35.5); -0.0081 (1.5) logP value (HCOOH) = 1,20
IV-5	*(R,S)*-H_3C-FHC	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.6443 (8.8); 8.6384 (9.3); 8.0047 (5.2); 7.9985 (5.3); 7.9839 (5.9); 7.9778 (6.0); 7.7497 (5.2); 7.7455 (5.7); 7.7326 (5.5); 7.7283 (5.7); 7.6665 (9.4); 7.6457 (8.4); 7.5717 (3.1); 7.5668 (3.2); 7.5552 (3.4); 7.5493 (5.4); 7.5437 (3.6); 7.5321 (3.5); 7.5271 (3.4); 6.5333 (7.3); 6.5102 (7.0); 6.3857 (3.6); 6.3832 (3.8); 6.3689 (7.0); 6.3664 (7.2); 6.3521 (3.6); 6.3496 (3.7); 5.8744 (1.1); 5.8583 (3.5); 5.8422 (3.6); 5.8260 (1.2); 5.7551 (1.1); 5.7389 (3.5); 5.7227 (3.6); 5.7065 (1.2); 3.3215 (45.6); 2.6700 (0.4); 2.5053 (53.7); 2.5011 (70.7); 2.4970 (54.3); 2.3279 (0.4); 1.6985 (15.6); 1.6823 (15.7); 1.6372 (16.0); 1.6210 (15.4); 1.3971 (2.0); -0.0004 (30.0) logP value (HCOOH) = 0.91

Table 2

Analytical data for compounds of the formula (VI)



(VI)

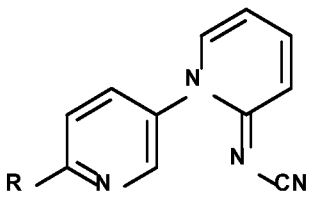
Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
VI-1	H	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.6726 (10.4); 8.6692 (11.1); 8.6606 (11.0); 8.6571 (11.0); 8.5956 (15.6); 8.5894 (16.0); 8.0736 (9.0); 8.0715 (9.3); 8.0570 (9.5); 8.0549 (9.4); 7.9184 (5.5); 7.9145 (6.6);

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		7.9135 (6.6); 7.9085 (5.7); 7.8981 (6.5); 7.8922 (7.6); 7.8882 (6.4); 7.6114 (9.0); 7.5993 (8.9); 7.5911 (8.2); 7.5789 (15.7); 7.5567 (12.6); 7.4930 (6.7); 7.4889 (6.9); 7.4758 (7.3); 7.4715 (10.3); 7.4670 (4.9); 7.4539 (4.7); 7.4499 (4.6); 6.9164 (5.8); 6.9129 (6.1); 6.8995 (11.0); 6.8961 (11.2); 6.8827 (5.5); 6.8792 (5.5); 3.3284 (353.7); 2.6708 (1.0); 2.6665 (0.7); 2.5238 (2.3); 2.5061 (123.4); 2.5017 (164.8); 2.4973 (120.6); 2.3326 (0.7); 2.3284 (1.0); 2.3238 (0.7); 2.0858 (0.6); 1.3974 (6.4); 0.0079 (1.5); -0.0002 (42.5); -0.0081 (2.0) logP value (HCOOH) = 0.46
VI-2	F_2HC	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.7526 (13.0); 8.7470 (13.4); 8.1461 (6.9); 8.1403 (6.9); 8.1252 (16.0); 8.1204 (14.7); 8.1075 (8.9); 7.9139 (14.0); 7.8931 (11.7); 7.5914 (7.0); 7.5704 (11.9); 7.5197 (6.4); 7.5158 (6.6); 7.5026 (6.9); 7.4984 (9.2); 7.4938 (4.4); 7.4807 (4.2); 7.4767 (4.1); 7.2112 (6.8); 7.0745 (14.9); 6.9506 (5.5); 6.9471 (5.8); 6.9374 (9.1); 6.9340 (11.5); 6.9304 (10.7); 6.9170 (5.1); 6.9135 (5.0); 3.3231 (204.4); 2.6748 (1.0); 2.6701 (1.4); 2.6656 (1.0); 2.5055 (185.2); 2.5011 (243.3); 2.4967 (183.0); 2.3322 (1.0); 2.3278 (1.4); 2.3237 (1.1); 2.0855 (1.5); 1.3975 (10.8); 0.0078 (1.0); -0.0002 (25.5); -0.0082 (1.2) logP value (HCOOH) = 1,23
VI-3	F_2ClC	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.8477 (12.4); 8.8424 (12.6); 8.2391 (6.9); 8.2332 (6.8); 8.2183 (9.2); 8.2123 (9.1); 8.1583 (8.6); 8.1568 (8.6); 8.1418 (8.9); 8.0968 (16.0); 8.0759 (11.9); 7.5975 (6.6); 7.5767 (12.0); 7.5327 (6.6); 7.5287 (6.6); 7.5157 (7.2); 7.5115 (9.0); 7.5068 (4.1); 7.4937 (4.1); 7.4897 (3.8); 6.9670 (5.6); 6.9634 (5.5); 6.9502 (10.4); 6.9466 (10.0); 6.9333 (5.2); 6.9298 (4.9); 3.3181 (25.5); 2.6745 (0.9); 2.6700 (1.2); 2.6657 (0.9); 2.5053 (142.4); 2.5009 (182.7); 2.4965 (136.1); 2.3320 (0.8); 2.3276 (1.1); 2.3234 (0.8); 2.0855 (0.3); 1.3977 (3.4); 0.0080 (2.3); -0.0001 (49.7) logP value (HCOOH) = 1.89
VI-4	H_3C-F_2C	^{1}H-NMR (400.0 MHz, d_6-DMSO): δ = 8.7273 (5.1); 8.7219 (5.1); 8.1228 (5.2); 8.1181 (6.1); 8.1031 (7.1); 7.9135 (6.1); 7.8926 (5.1); 7.5905 (2.9); 7.5687 (4.8); 7.5163 (2.4); 7.5127 (2.4); 7.4992 (2.8); 7.4952 (3.5); 7.4773 (1.6); 7.4736 (1.5); 6.9454 (2.1); 6.9423 (2.0); 6.9285 (4.0); 6.9255 (3.8); 6.9117 (2.0); 6.9086 (1.8); 3.3366 (14.8); 2.6705 (0.4); 2.5054 (57.9);

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		2.5012 (72.3); 2.4972 (52.5); 2.3278 (0.4); 2.1076 (7.6); 2.0597 (16.0); 2.0119 (8.3); 1.3975 (1.1); -0.0001 (2.8) logP value (HCOOH) = 1.56
VI-5	*(R,S)*-H_3C-FHC	^{1}H-NMR (400.0 MHz, d6-DMSO): δ = 8.6053 (8.7); 8.5993 (8.9); 8.0906 (5.4); 8.0887 (5.4); 8.0741 (5.6); 8.0722 (5.4); 7.9954 (5.2); 7.9892 (5.2); 7.9747 (5.9); 7.9685 (6.0); 7.6939 (9.1); 7.6731 (8.0); 7.5804 (4.8); 7.5598 (7.6); 7.4973 (4.1); 7.4933 (4.2); 7.4802 (4.5); 7.4760 (6.1); 7.4714 (2.9); 7.4583 (2.9); 7.4543 (2.8); 6.9219 (3.6); 6.9184 (3.6); 6.9050 (6.7); 6.9016 (6.6); 6.8882 (3.4); 6.8847 (3.3); 5.8877 (1.0); 5.8715 (3.2); 5.8553 (3.2); 5.8391 (1.1); 5.7686 (1.0); 5.7523 (3.5); 5.7360 (3.3); 5.7197 (1.1); 4.5168 (0.4); 3.8729 (0.3); 3.8476 (0.4); 3.8248 (0.4); 3.7990 (0.3); 3.7816 (0.4); 3.7628 (0.4); 3.7465 (0.6); 3.7306 (1.0); 3.7244 (0.6); 3.7161 (0.6); 3.6987 (0.3); 3.5041 (0.3); 3.4167 (0.7); 3.3362 (28.2); 3.2324 (0.5); 3.2171 (0.6); 3.2015 (0.4); 3.1851 (0.4); 3.1704 (0.6); 3.1549 (0.3); 2.6749 (0.8); 2.6704 (1.0); 2.6658 (0.8); 2.5237 (2.6); 2.5058 (134.1); 2.5014 (175.7); 2.4970 (128.4); 2.3325 (0.8); 2.3281 (1.0); 2.3236 (0.8); 2.0857 (0.3); 1.7094 (15.5); 1.6932 (15.6); 1.6480 (16.0); 1.6318 (15.2); 0.0080 (2.3); -0.0001 (65.9); -0.0083 (3.2) logP value (HCOOH) = 1,26

Table 3

Analytical data for compounds of the formula (I)



(I)

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
I-1	H	^{1}H-NMR (400,0 MHz, d_6-DMSO): δ = 8.7183 (9.7); 8.7152 (9.8); 8.7063 (10.7); 8.7030 (10.7); 8.6965 (14.8); 8.6904 (15.0); 8.6583 (1.0); 8.6527 (1.2); 8.6430 (3.6); 8.6384

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		(2.9); 8.6310 (2.2); 8.0097 (14.0); 8.0065 (13.7); 7.9918 (16.0); 7.9898 (15.6); 7.9301 (1.3); 7.9094 (1.4); 7.8927 (4.5); 7.8887 (4.4); 7.8753 (5.4); 7.8709 (8.3); 7.8665 (5.3); 7.8529 (5.2); 7.8490 (4.8); 7.8340 (0.7); 7.8176 (0.6); 7.7830 (0.4); 7.7293 (1.1); 7.7131 (1.0); 7.6889 (0.6); 7.6655 (0.9); 7.6382 (7.3); 7.6261 (7.4); 7.6177 (7.0); 7.6059 (6.6); 7.5855 (1.4); 7.5643 (1.9); 7.5527 (1.7); 7.5465 (1.1); 7.5405 (1.0); 7.5286 (0.9); 7.5245 (0.9); 7.2681 (11.0); 7.2458 (10.3); 6.8242 (5.5); 6.8071 (10.4); 6.7902 (5.3); 6.5512 (0.7); 6.5294 (1.6); 6.5053 (1.3); 6.3792 (0.7); 6.3627 (1.2); 6.3456 (0.6); 3.8133 (0.8); 3.7952 (0.9); 3.7893 (0.8); 3.7713 (0.8); 3.5822 (6.2); 3.5475 (6.2); 3.4656 (1.2); 3.4483 (3.4); 3.4307 (3.5); 3.4135 (1.8); 3.3995 (1.1); 3.3352 (9.1); 3.1470 (0.4); 2.9219 (0.4); 2.9045 (0.5); 2.8977 (0.4); 2.8902 (0.6); 2.8843 (0.8); 2.8662 (0.5); 2.8593 (0.4); 2.8457 (0.5); 2.7304 (0.5); 2.7087 (0.4); 2.6883 (0.8); 2.6699 (2.2); 2.6556 (0.3); 2.5051 (233.2); 2.5012 (295.4); 2.4973 (222.4); 2.4438 (0.7); 2.4273 (0.8); 2.4074 (0.8); 2.3872 (0.4); 2.3280 (1.7); 1.2364 (0.8); 1.1447 (1.5); 1.1268 (2.9); 1.1089 (1.5); 1.0724 (3.4); 1.0549 (6.6); 1.0375 (3.2); -0.0003 (5.5) logP value (HCOOH) = 0.18
I-2	F_2HC	^{1}H-NMR (400,0 MHz, d_6-DMSO): δ = 8.8471 (13.8); 8.8415 (13.9); 8.2419 (7.4); 8.2360 (7.3); 8.2212 (8.6); 8.2152 (8.5); 8.0471 (8.4); 8.0444 (9.0); 8.0303 (9.0); 8.0276 (9.0); 7.9415 (14.5); 7.9206 (12.8); 7.9073 (5.3); 7.9032 (5.3); 7.8901 (5.9); 7.8851 (9.2); 7.8806 (6.0); 7.8675 (5.9); 7.8633 (5.6); 7.2805 (11.7); 7.2579 (10.8); 7.2194 (7.2); 7.0827 (16.0); 6.9461 (7.9); 6.8504 (5.8); 6.8476 (6.1); 6.8334 (11.2); 6.8306 (11.4); 6.8165 (5.7); 6.8136 (5.7); 3.3209 (65.1); 2.6745 (0.8); 2.6701 (1.1); 2.6656 (0.8); 2.5054 (133.0); 2.5010 (174.5); 2.4965 (130.9); 2.3323 (0.7); 2.3278 (1.0); 2.3232 (0.7); 2.0855 (6.0); 1.3970 (0.7); -0.0002 (20.1); -0.0082 (0.9) logP value (HCOOH) = 0,97
I-3	F_2ClC	^{1}H-NMR (400,0 MHz, d_6-DMSO): δ = 8.9358 (14.1); 8.9307 (14.0); 8.3365 (7.8); 8.3307 (7.6); 8.3155 (9.7); 8.3097 (9.3); 8.1282 (16.0); 8.1073 (13.3); 8.0703 (9.1); 8.0678 (9.4); 8.0535 (9.5); 8.0510 (9.4); 7.9136 (5.2); 7.9097 (5.2); 7.8963 (6.3); 7.8917 (9.3); 7.8871 (6.1); 7.8738 (5.9); 7.8699 (5.4); 7.2889 (12.0); 7.2663 (11.1); 6.8620 (6.2); 6.8595 (6.1); 6.8450 (11.9); 6.8424 (11.2); 6.8280 (6.0); 6.8253 (5.6); 5.7537 (0.5); 3.3194 (144.8); 2.6702 (1.7); 2.6019 (0.3); 2.5056 (219.0); 2.5013 (274.4);

Example No.	R	^{1}H NMR [δ (ppm)] or logP value (HCOOH)
		2.4971 (209.1); 2.3282 (1.7); 2.0856 (1.6); 1.3981 (1.2); -0.0002 (58.3) logP value (HCOOH) = 1,60
I-4	H_3C-F_2C	^{1}H-NMR (400,0 MHz, d_6-DMSO): δ = 8.8224 (4.8); 8.8172 (4.8); 8.2186 (2.9); 8.2126 (2.8); 8.1976 (3.5); 8.1916 (3.4); 8.0464 (3.1); 8.0440 (3.2); 8.0296 (3.3); 8.0272 (3.2); 7.9406 (5.7); 7.9196 (5.0); 7.9061 (2.0); 7.9020 (1.8); 7.8889 (2.2); 7.8842 (3.3); 7.8794 (2.1); 7.8663 (2.2); 7.8622 (2.0); 7.2805 (4.2); 7.2581 (4.0); 6.8478 (2.2); 6.8450 (2.1); 6.8308 (4.2); 6.8281 (4.0); 6.8138 (2.1); 6.8110 (2.0); 3.3202 (24.8); 2.6701 (0.7); 2.6652 (0.4); 2.5055 (88.2); 2.5011 (112.9); 2.4967 (79.6); 2.3278 (0.6); 2.1086 (7.4); 2.0855 (1.3); 2.0607 (16.0); 2.0128 (8.3); -0.0001 (0.8) logP value (HCOOH) = 1,34
I-5	*(R,S)*-H_3C-FHC	^{1}H-NMR (400,0 MHz, d_6-DMSO): δ = 8.7002 (8.6); 8.6942 (9.0); 8.0874 (5.3); 8.0811 (5.3); 8.0665 (5.9); 8.0603 (5.9); 8.0220 (5.1); 8.0193 (5.5); 8.0053 (5.5); 8.0025 (5.6); 7.8944 (3.1); 7.8902 (3.1); 7.8771 (3.4); 7.8723 (5.7); 7.8677 (3.7); 7.8546 (3.6); 7.8505 (3.4); 7.7171 (9.0); 7.6963 (8.1); 7.2701 (7.2); 7.2476 (6.7); 6.8288 (3.5); 6.8261 (3.7); 6.8117 (6.7); 6.8091 (7.0); 6.7949 (3.4); 6.7921 (3.4); 5.8953 (1.1); 5.8792 (3.4); 5.8630 (3.5); 5.8468 (1.1); 5.7761 (1.1); 5.7599 (3.5); 5.7437 (3.5); 5.7275 (1.1); 3.3203 (94.4); 2.6750 (0.6); 2.6703 (0.8); 2.6657 (0.6); 2.5234 (1.9); 2.5057 (103.4); 2.5013 (138.7); 2.4969 (102.0); 2.3324 (0.6); 2.3280 (0.8); 2.3238 (0.6); 2.0857 (0.7); 1.7099 (15.5); 1.6936 (15.6); 1.6484 (16.0); 1.6322 (15.2); 0.0079 (1.2); -0.0001 (36.0); -0.0082 (1.7) logP value (HCOOH) = 1,07

Biological Examples

Ctenocephalides felis - *in vitro* contact tests with adult cat fleas

For the coating of the test tubes, 9 mg of active compound are first dissolved in 1 ml of acetone p.a. and then diluted to the desired concentration with acetone p.a. 250 µl of the solution are distributed homogeneously on the inner walls and the base of a 25 ml glass tube by turning and rocking on an orbital shaker (rocking rotation at 30 rpm for 2 h). With 900 ppm of active

compound solution and internal surface area 44.7 cm², given homogeneous distribution, an area-based dose of 5 µg/cm² is achieved.

After the solvent has evaporated off, the tubes are populated with 5-10 adult cat fleas (*Ctenocephalides felis*), sealed with a perforated plastic lid and incubated in a horizontal position at room temperature and ambient humidity. After 48 h, efficacy is determined. To this end, the tubes are stood upright and the fleas are knocked to the base of the tube. Fleas which remain motionless at the base or move in an uncoordinated manner are considered to be dead or moribund.

A substance shows good efficacy against *Ctenocephalides felis* if at least 80% efficacy was achieved in this test at an application rate of 5 µg/cm². 100% efficacy means that all the fleas were dead or moribund. 0% efficacy means that no fleas were harmed.

In this test, for example, the following compound from the preparation examples showed an efficacy of 100% at an application rate of 5 µg/cm² (= 500 g/ha): 3

***Ctenocephalides felis* - oral test**

Solvent: dimethyl sulfoxide

To produce a suitable active compound formulation, 10 mg of active compound are mixed with 0.5 ml of dimethyl sulfoxide. Dilution with citrated cattle blood gives the desired concentration.

About 20 unfed adult cat fleas (*Ctenocephalides felis*) are placed into a chamber which is closed at the top and bottom with gauze. A metal cylinder whose bottom end is closed with parafilm is placed onto the chamber. The cylinder contains the blood/active compound formulation, which can be imbibed by the fleas through the parafilm membrane.

After 2 days, the kill in % is determined. 100% means that all of the fleas have been killed; 0% means that none of the fleas have been killed.

In this test, for example, the following compound of the preparation examples showed an efficacy of 100% at an application rate of 100 ppm: 3

In this test, for example, the following compound of the preparation examples showed an efficacy of 95% at an application rate of 100 ppm: 4

In this test, for example, the following compound of the preparation examples showed an efficacy of 90% at an application rate of 100 ppm: 1

In this test, for example, the following compound of the preparation examples showed an efficacy of 80% at an application rate of 100 ppm: 5

***Lucilia cuprina* test**

Solvent: dimethyl sulfoxide

To produce a suitable active compound formulation, 10 mg of active compound are mixed with 0.5 ml of dimethyl sulfoxide, and the concentrate is diluted with water to the desired concentration.

About 20 L1 larvae of the Australian sheep blowfly (*Lucilia cuprina*) are transferred into a test vessel containing minced horsemeat and the active compound formulation of the desired concentration.

After 2 days, the kill in % is determined. 100% means that all the larvae have been killed; 0% means that no larvae have been killed.

In this test, for example, the following compounds of the preparation examples showed an efficacy of 100% at an application rate of 100 ppm: 2, 3

In this test, for example, the following compound of the preparation examples showed an efficacy of 90% at an application rate of 100 ppm: 1

***Diabrotica balteata* – spray test**

Solvent: 78 parts by weight of acetone

1.5 parts by weight of dimethylformamide

Emulsifier: alkylaryl polyglycol ether

To produce a suitable active compound preparation, 1 part by weight of active compound is dissolved using the stated parts by weight of solvent and made up with water containing an emulsifier concentration of 1000 ppm until the desired concentration is attained. To produce further test concentrations, the formulation is diluted with emulsifier-containing water.

Pre-swollen wheat grains (*Triticum aestivum*) are incubated in a multiwell plate filled with agar and a little water for one day (5 seed grains per cavity). The germinated wheat grains are sprayed with an active compound preparation of the desired concentration. Subsequently, each cavity is infected with 10-20 beetle larvae of *Diabrotica balteata*.

After 7 days, the efficacy in % is determined. 100% means that all maize plants have grown as in the untreated, uninfected control; 0% means that no maize plant has grown.

In this test, for example, the following compounds from the preparation examples showed an efficacy of 100% at an application rate of 160 µg/cavity: 1, 3, 4, 5

In this test, for example, the following compound from the preparation examples showed an efficacy of 80% at an application rate of 160 µg/cavity: 2

***Myzus persicae* – oral test**

Solvent: 100 parts by weight of acetone

To produce a suitable preparation of active compound, 1 part by weight of active compound is dissolved using the specified parts by weight of solvent and made up with water until the desired concentration is attained.

50 µl of the active compound preparation are transferred into microtitre plates and made up to a final volume of 200 µl with 150 µl of IPL41 insect medium (33% + 15% sugar). Subsequently, the plates are sealed with parafilm, which a mixed population of green peach aphids (*Myzus persicae*) within a second microtitre plate is able to puncture and imbibe the solution through.

After 5 days, the efficacy in % is determined. 100% means that all the aphids have been killed; 0% means that no aphids have been killed.

In this test, for example, the following compounds from the preparation examples showed an efficacy of 100% at an application rate of 0.8 ppm: 1, 3, 4, 5

***Myzus persicae* - spray test**

Solvent:	78	parts by weight of acetone
	1.5	parts by weight of dimethylformamide
Emulsifier:		alkylaryl polyglycol ether

To produce a suitable active compound preparation, 1 part by weight of active compound is dissolved using the stated parts by weight of solvent and made up with water containing an emulsifier concentration of 1000 ppm until the desired concentration is attained. To produce further test concentrations, the formulation is diluted with emulsifier-containing water.

Discs of Chinese cabbage leaves (*Brassica pekinensis*) infested by all stages of the green peach aphid (*Myzus persicae*) are sprayed with an active compound formulation of the desired concentration.

After 5 days, the efficacy in % is determined. 100% means that all the aphids have been killed; 0% means that no aphids have been killed.

In this test, for example, the following compounds from the preparation examples showed an efficacy of 100% at an application rate of 100 g/ha: 1, 4, 5

In this test, for example, the following compounds from the preparation examples showed an efficacy of 90% at an application rate of 100 g/ha: 2, 3

***Phaedon cochleariae* - spray test**

Solvent:	78.0	parts by weight of acetone
	1.5	parts by weight of dimethylformamide
Emulsifier:		alkylaryl polyglycol ether

To produce a suitable active compound preparation, 1 part by weight of active compound is dissolved using the stated parts by weight of solvent and made up with water containing an

emulsifier concentration of 1000 ppm until the desired concentration is attained. To produce further test concentrations, the formulation is diluted with emulsifier-containing water.

Discs of Chinese cabbage leaves (*Brassica pekinensis*) are sprayed with an active compound formulation of the desired concentration and, after drying, populated with larvae of the mustard beetle (*Phaedon cochleariae*).

After 7 days, the efficacy in % is determined. 100% means that all the beetle larvae have been killed; 0% means that no beetle larvae have been killed.

In this test, for example, the following compounds from the preparation examples showed an efficacy of 100% at an application rate of 100 g/ha: 2, 3

Diabrotica balteata test, seed application

Empty formulation:	2.0% Brilliant Ponceau 4 RC 70
	2.0% Helioechtrubin 4B 10
	5.0% Baykanol SL
	4.0% Utrasil VN3 powder
	1.5% Emulsifier 1000 TR U (ground)
	0.8% Baysilone defoamer E VM 30
	84.7% Kaolin W
Solvent:	acetone as required

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with 4 parts by weight of empty formulation and the amount of solvent required for the aggregate state of the active compound. The active compound preparation thus produced is then dried. Depending on the desired application rate, the calculated amount of the formulation is weighed out in accordance with the prepared, weighed amount of seed. With addition of water, the maize seed is dressed and dried again.

The maize is sown in sandy loam (5 seeds/pot, at least 2 pots/variant). After 3-4 days, about 40 larvae of the corn rootworm (*Diabrotica balteata*) are placed into each pot. In addition to

an untreated control with test animals, a control without test animals is also tested in order to determine the germination capacity of the maize seed.

The effect in % is determined 7 days after infection. 100% means that the emergence corresponds to that of the control plant without larvae, and 0% means that the emergence corresponds to that of the control plant with larvae.

In this test, for example, the following compounds of the preparation examples showed, at an application rate of 1 g/kg of seed, an efficacy of 100%: 1, 2, 3, 4.

Nilaparvata lugens test, seed application

Empty formulation:	2.0% Brilliant Ponceau 4 RC 70
	2.0% Helioechtrubin 4B 10
	5.0% Baykanol SL
	4.0% Utrasil VN3 powder
	1.5% Emulsifier 1000 TR U (ground)
	0.8% Baysilone defoamer E VM 30
	84.7% Kaolin W
Solvent:	acetone as required

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with 4 parts by weight of empty formulation and the amount of solvent required for the aggregate state of the active compound. The active compound preparation thus produced is dried. Depending on the desired application rate, the calculated amount of the active compound preparation is weighed out in accordance with the prepared, weighed amount of seed.

With addition of water, rice seed (*Oryza sativa*) is dressed with the active compound preparation and sown in sandy loam (10 seeds/pot, at least 2 pots/variant). After 2 weeks, the rice plants are infected with a mixed population of the brown planthopper (*Nilaparvata lugens*).

After 7 days, the kill in % is determined. 100% means that all planthoppers have been killed; 0% means that none of the planthoppers have been killed.

In this test, for example, the following compound of the preparation examples showed, at an application rate of 4 g/kg of seed, an efficacy of 100%: 2.

Rhopalosiphum padi test, seed application

Empty formulation:	2.0% Brilliant Ponceau 4 RC 70
	2.0% Helioechtrubin 4B 10
	5.0% Baykanol SL
	4.0% Utrasil VN3 powder
	1.5% Emulsifier 1000 TR U (ground)
	0.8% Baysilone defoamer E VM 30
	84.7% Kaolin W
Solvent:	acetone as required

To produce a suitable preparation of active compound, 1 part by weight of active compound is dissolved in an amount of solvent which is adapted to the aggregate state of the active compound. 4 parts by weight of empty formulation are added, mixed with the active compound solution and the resulting active compound preparation is dried. Depending on the desired application rate, the calculated amount of the active compound preparation is weighed out in accordance with the prepared, weighed amount of seed.

With addition of water, winter barley seed (*Hordeum vulgare*) is dressed with the active compound preparation and sown in sandy loam (10 seeds/pot, at least 2 pots/variant). After 1 week, the barley plants (1st-2nd leaf stage) are infected with a mixed population of oat aphids (*Rhopalosiphum padi*).

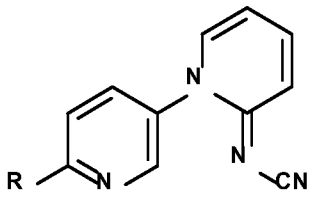
After 7 days, the kill in % is determined. 100% means that all the aphids have been killed; 0% means that no aphids have been killed.

In this test, for example, the following compounds of the preparation examples showed, at an application rate of 0.5 g/kg of seed, an efficacy of 100%: 2, 3, 4.

In this test, for example, the following compound of the preparation examples showed, at an application rate of 0.5 g/kg of seed, an efficacy of 98%: 1.

Claims

1. Compounds of the formula (I)



(I) ,

in which

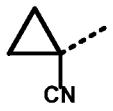
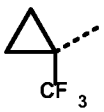
R represents a radical from the group consisting of hydrogen, cyano, fluoromethyl, difluoromethyl, fluorochloromethyl, fluorobromomethyl, difluorochloromethyl, difluorobromomethyl, difluoroiodomethyl, 1-fluoroethyl, 1,1-difluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, 1-fluoro-2,2,2-trifluoroethyl, cyano-substituted haloalkyl, C_1-C_4-haloalkoxy, C_1-C_4-haloalkylthio, C_1-C_4-haloalkylsulfinyl, C_1-C_4-haloalkylsulfonyl, optionally halogen-substituted C_1-C_4-alkoxy-C_1-C_4-alkyl, optionally halogen-substituted C_1-C_4-alkylthio-C_1-C_4-alkyl, C_1-C_4-alkylsulfinyl-C_1-C_4-alkyl, C_1-C_4-alkylsulfonyl-C_1-C_4-alkyl and halogen-, cyano-, alkyl- or haloalkyl-substituted cycloalkyl.

2. Compounds of the formula (I) according to Claim 1, in which

R represents a radical from the group consisting of hydrogen, cyano, fluoromethyl, difluoromethyl, fluorochloromethyl, fluorobromomethyl, difluorochloromethyl, difluorobromomethyl, difluoroiodomethyl, 1-fluoroethyl, 1,1-difluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, 1-fluoro-2,2,2-trifluoroethyl, cyanofluoromethyl, cyanodifluoromethyl, difluoromethoxy, trifluoromethoxy, 2,2-difluoroethoxy, 2,2,2-trifluoroethoxy, difluoromethylthio, trifluoromethylthio, difluoromethylsulfinyl, trifluoromethylsulfinyl, difluoromethylsulfonyl, trifluoromethylsulfonyl, H_3C-O-F_2C, H_3C-S-F_2C, H_3C-S(O)-F_2C, H_3C-O_2S-F_2C, H_3C-S-H_2C, H_3C-S(O)-H_2C, H_3C-O_2S-H_2C, 1-fluorocyclopropyl, 1-cyanocyclopropyl and 1-trifluoromethylcyclopropyl.

3. Compound of the formula (I) according to Claim 1 in which R is selected from the list below

No.	R
1	H
2	F_2HC
3	F_2ClC
4	H_3C-F_2C
5	*(R,S)*-H_3C-HFC
6	(*R,S*)-FClHC
7	(*R,S*)-FBrHC
8	F_2BrC
9	F_2IC
10	F_3C-H_2C
11	F_2HC-H_2C
12	F_3C-O
13	F_3C-S
14	*(R,S)*-F_3C-(O)S
15	F_3C-O_2S
16	F_2HC-O
17	F_2HC-S
18	*(R,S)*-F_2HC-(O)S
19	F_2HC-O_2S
20	F_3C-H_2C-O

21	F_2HC-H_2C-O
22	H_3C-S-H_2C
23	$H_3C-S(O)-H_2C$
24	$H_3C-O_2S-H_2C$
25	
26	
27	
28	NC
29	H_3C-O-F_2C
30	H_3C-S-F_2C
31	$F-H_2C$
32	NC-FHC
33	$NC-F_2C$
34	(*R,S*)-F_3C-HFC

4. Compositions, characterized by a content of at least one compound of the formula (I) according to any of Claims 1 to 3 and customary extenders and/or surfactants.

5. Use of a compound of the formula (I) according to any of Claims 1 to 3 or of a composition according to Claim 4 for controlling pests.

6. Use of a compound of the formula (I) according to any of Claims 1 to 3 or of a composition according to Claim 4 for the treatment of seed.

7. Seed, treated with a compound of formula (I) according to any of Claims 1 to 3 or a composition according to Claim 4.