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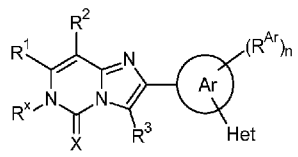
(54) Title: BICYCLIC PESTICIDAL COMPOUNDS

(57) Abstract: The present invention relates to compounds of formula (I), wherein the variables are defined as given in the description and claims. The invention further relates to uses, processes and composition for compounds (I).



(I)

Bicyclic pesticidal compounds

Description

The present invention relates to substituted bicyclic compounds of formula I as agrochemical pesticides. Furthermore, the present invention relates to processes and intermediates for preparing compounds of formula I and to active compound combinations comprising them. Moreover, the present invention relates to agricultural or veterinary compositions comprising the compounds of formula I, and to the use of the compounds of formula I or compositions comprising them for combating or controlling invertebrate pests and/or for protecting crops, plants, plant propagation material and/or growing plants from attack and/or infestation by invertebrate pests. The present invention also relates to methods of applying the compounds of formula I. Furthermore, the present invention relates to seed comprising compounds according to the invention.

Invertebrate pests and in particular insects, arachnids and nematodes destroy growing and harvested crops and attack wooden dwelling and commercial structures, thereby causing large economic loss to the food supply and to property. Accordingly, there is an ongoing need for new agents for combating invertebrate pests.

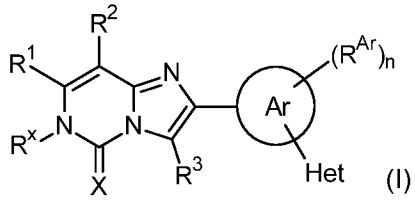
5,6-fused heterocycles are known for pesticidal use, for example, in patent publications WO 2012/086848, WO 2013/180193 and WO 2014/119670 and represent an important class of insecticide. Further, reference is made to publications WO 2017/043386, WO 2017/043386, WO 2017/025419, WO 2017/001314, and WO 2016/023954.

Due to the ability of target pests to develop resistance to pesticidally-active agents, there is an ongoing need to identify further compounds, which are suitable for combating invertebrate pests such as insects, arachnids and nematodes. Furthermore, there is a need for new compounds having a high pesticidal activity and showing a broad activity spectrum against a large number of different invertebrate pests, especially against difficult to control insects, arachnids and nematodes.

It is therefore an object of the present invention to identify and provide compounds, which exhibit a high pesticidal activity and have a broad activity spectrum against invertebrate pests.

It has been found that these objects can be achieved by substituted bicyclic compounds of formula I, as depicted and defined below, including their stereoisomers, their salts, in particular their agriculturally or veterinarily acceptable salts, their tautomers and their N-oxides.

In a first aspect, the present invention relates to the bicyclic compound of formula I,



(I)

wherein

X is O or S;

R^x is selected from the group consisting of C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-al-

kynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,

C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$, $S(=O)_mR^e$, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

R^1 is H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, or C_1-C_6-alkylsulfonyl which are substituted or unsubstituted with halogen;

R^2, R^3 independently of each other are selected from the group consisting of H, halogen, N_3, CN, NO_2, -SCN, -SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, tri-C_1-C_6-alkylsilyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxyx-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,

C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$ and $S(=O)_mR^e$, one radical may also be phenyl, phenoxy, phenylcarbonyl, phenylthio or benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

Ar is phenyl or 5- or 6-membered heteroaryl,

R^{Ar} independently of each other, are selected from the group consisting of halogen, N_3, OH, CN, NO_2, -SCN, -SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, tri-C_1-C_6-alkylsilyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,

C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$ and $S(=O)_mR^e$, one radical may also be phenyl, phenoxy, phenylcarbonyl, phenylthio or benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

Het is 5- or 6-membered heteroaryl or 5- or 6-membered heterocyclyl, which is unsubstituted or substituted with R;

R is halogen, oxo (=O), N_3, OH, CN, NO_2, SCN, SF_5, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_1-C_6-alkoxycarbonyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1- C_4 alkyl, phenyl, 5- or 6-membered heteroaryl, or 5- or 6-membered heterocyclyl, wherein cyclic groups of R are unsubstituted or substituted with radicals R^f;

provided that R^{Ar} and Het both are not present on the same atom of Ar;

each R^a is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen, C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each R^b is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen, -(C=O)R, -C(=O)OR, and -C(=O)NR, C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl is unsubstituted or substituted with radicals R^f;

each R^c is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each moiety NR^bR^c may also form an N-bound, saturated 3- to 8-membered heterocycle, which in addition to the nitrogen atom may have 1 or 2 further heteroatoms or heteroatom moieties selected from O, $S(=O)_m$ and N-R', wherein R' is H or C_1-C_6-alkyl and wherein the N-bound heterocycle is unsubstituted or substituted with radicals selected from halogen, C_1-C_4-alkyl, C_1-C_4-haloalkyl, C_1-C_4-alkoxy and C_1-C_4-haloalkoxy;

each R^d is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with R^f;

each R^f is selected from halogen, N_3, OH, CN, NO_2, SCN, SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen;

m is 0, 1 or 2;

n is 0, 1 or 2;

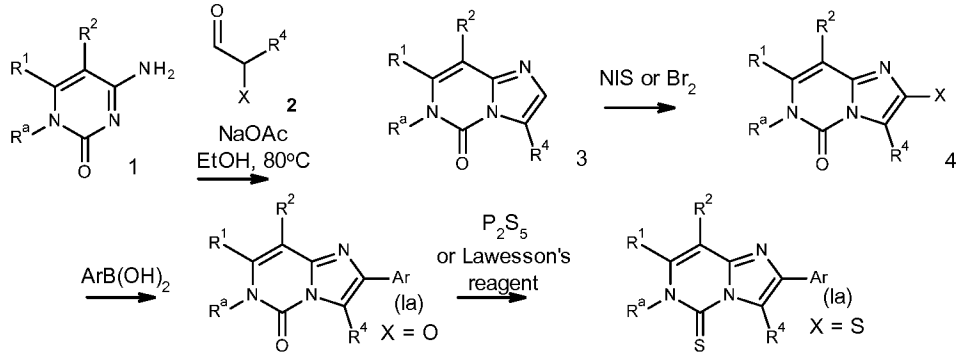
and the N-oxides, stereoisomers, tautomers and agriculturally or veterinarily acceptable salts thereof.

With due modification of the starting compounds, the compounds of formula I can be prepared by procedures as given in below schemes.

6H-imidazo[1,2-c]pyrimidin-5-thione Ia (X = S) can be prepared in 4-step synthesis starting from cytidines 1 (Scheme 1). Condensation of cytidines 1 with alpha-haloaldehydes 2 by analogy to the method described in Jansa et al. Journal of Heterocyclic Chemistry, 52(5), 1382-1389; 2015 leads to bicycles 3, which can be halogenated with, e.g. NIS or NBS, by analogy to the method described in Jansa et al. Tetrahedron, 71(1), 27-36; 2015. Halides 4 in turn can be subjected to a Suzuki coupling reaction with an arylboronic acid to form 6H-imidazo[1,2-c]pyrimidin-5-ones Ia (X = O) by analogy to the method described in Lee et al. PCT Int. Appl., 2009093981, 30 Jul 2009. Finally, reaction of compounds Ia (X = O) with a thiolating agent such as P2S5 or Lawesson's reagent will

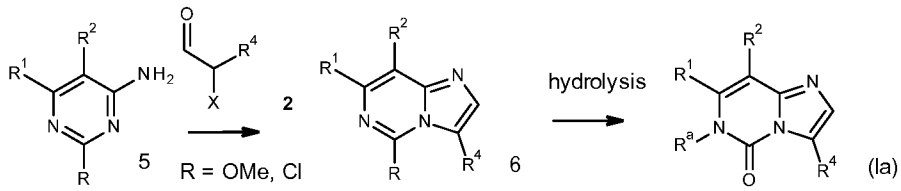
readily afford the compounds Ia (X = S) by analogy to the method described in Bigot et al. PCT Int. Appl., 2015052103, 16 Apr 2015. Preparation of trifluoromethyl-substituted cytidine 1 (R^1 = CF_3, R^2 = H, R^a = H) has been prepared previously (Gershon et al. Journal of Heterocyclic Chemistry, 20(1), 219-23; 1983).

Scheme 1



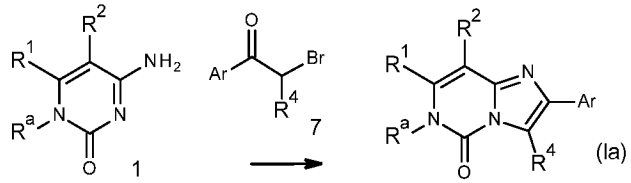
Alternatively compounds 6 can be prepared by condesation of aminopyridines 5 with an aldehyde 2 by anology to method described in Wade et al. U.S., 4503050, 05 Mar 1985 (Scheme 2). Hydrolysis of chloro or methoxy group in compounds 6 (R = Cl, OMe) under conditions known in literature can afford compounds (Ia).

Scheme 2



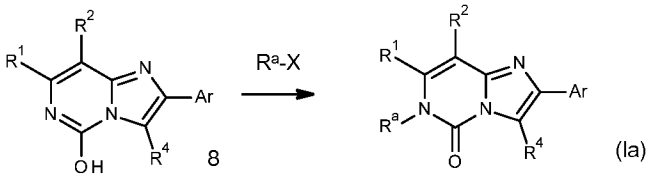
Direct condesation of alpha-halo-alpha-ketones (e.g. 7) and cytidines 1 can directly afforded compounds (Ia) by anology to method described in Meng et al. Bioorganic & Medicinal Chemistry Letters, 23(10), 2863-2867; 2013 (Scheme 3).

Scheme 3



Compounds Ia can be prepared by N-alklyation of compounds 8 with an alkylation agent Ra-X by anology to method described in Martin-Martin et al. Bioorganic & Medicinal Chemistry Letters, 25(6), 1310-1317; 2015 (Scheme 4).

Scheme 4



The procedures described above can be used individually or in combination of one another to obtain compounds of formula I.

The starting materials required for preparing the compounds of formula I are commercially available or can be prepared in accordance with the procedures known in literature.

The reaction mixtures are worked up in a customary manner, for example by mixing with water, separating the phases and, if appropriate, chromatographic purification of the crude products. Some of the intermediates and end products are obtained in the form of colorless or slightly brownish viscous oils which are purified or freed from volatile components under reduced pressure and at moderately elevated temperature. If the intermediates and end products are obtained as solids, purification can also be carried out by recrystallization or digestion.

If individual compounds of formula I cannot be obtained by the routes described above, they can be prepared by derivatization of other compounds of formula I or intermediates thereof.

If the synthesis yields mixtures of isomers, a separation is generally not necessarily required since in some cases the individual isomers can be interconverted during work-up for use or during application (for example under the action of light, acids or bases). Such conversions may also take place after use, for example in the treatment of plants in the treated plant, or in the harmful fungus to be controlled.

A skilled person will readily understand that the preferences for the substituents, also in particular the ones given in the tables below for the respective substituents, given herein in connection with compounds I apply for the intermediates accordingly. Thereby, the substituents in each case have independently of each other or more preferably in combination the meanings as defined herein.

The procedures described above can be used individually or in combination of one another to obtain compounds of formula I.

The N-oxides may be prepared from the inventive compounds according to conventional oxidation methods, e. g. by treating compounds I with an organic peracid such as metachloroperbenzoic acid (cf. WO 03/64572 or J. Med. Chem. 38(11), 1892-903, 1995); or with inorganic oxidizing agents such as hydrogen peroxide (cf. J. Heterocyc. Chem. 18(7), 1305-8, 1981) or oxone (cf. J. Am. Chem. Soc. 123(25), 5962-5973, 2001). The oxidation may lead to pure mono-N-oxides or to a mixture of different N-oxides, which can be separated by conventional methods such as chromatography.

Unless otherwise indicated, the term “compound(s) according to the invention” or “compound(s) of the invention” or “compound(s) of formula (I)”, refers to the compounds of formula I.

The term “compound(s) according to the invention”, or “compounds of formula I” comprises the compound(s) as defined herein as well as a stereoisomer, salt, tautomer or N-oxide thereof. The term “compound(s) of the present invention” is to be understood as equivalent to the term “compound(s) according to the invention”, therefore also comprising a stereoisomer, salt, tautomer or N-oxide thereof.

The term "composition(s) according to the invention" or "composition(s) of the present invention" encompasses composition(s) comprising at least one compound of formula I according to the invention as defined above. The compositions of the invention are preferably agricultural or veterinary compositions.

Depending on the substitution pattern, the compounds according to the invention may have one or more centers of chirality, in which case they are present as mixtures of enantiomers or diastereomers. The invention provides both the single pure enantiomers or pure diastereomers of the compounds according to the invention, and their mixtures and the use according to the invention of the pure enantiomers or pure diastereomers of the compounds according to the invention or their mixtures. Suitable compounds according to the invention also include all possible geometrical stereoisomers (cis/trans isomers) and mixtures thereof. Cis/trans isomers may be present with respect to an alkene, carbon-nitrogen double-bond or amide group. The term "stereoisomer(s)" encompasses both optical isomers, such as enantiomers or diastereomers, the latter existing due to more than one center of chirality in the molecule, as well as geometrical isomers (cis/trans isomers). The present invention relates to every possible stereoisomer of the compounds of formula I, i.e. to single enantiomers or diastereomers, as well as to mixtures thereof.

The compounds according to the invention may be amorphous or may exist in one or more different crystalline states (polymorphs) which may have different macroscopic properties such as stability or show different biological properties such as activities. The present invention relates to amorphous and crystalline compounds according to the invention, mixtures of different crystalline states of the respective compounds according to the invention, as well as amorphous or crystalline salts thereof.

Salts of the compounds according to the invention are preferably agriculturally and/or veterinary acceptable salts, preferably agriculturally acceptable salts. They can be formed in a customary manner, e.g. by reacting the compound with an acid of the anion in question if the compounds according to the invention have a basic functionality or by reacting acidic compounds according to the invention with a suitable base.

Veterinary and/or agriculturally useful salts of the compounds according to the invention encompass especially the acid addition salts of those acids whose cations and anions, respectively, have no adverse effect on the pesticidal action of the compounds according to the invention.

Suitable cations are in particular the ions of the alkali metals, preferably Li, Na and K, of the alkaline earth metals, preferably Ca, Mg and Ba, and of the transition metals, preferably Mn, Cu, Zn and Fe, and also ammonium (NH_4^+) and substituted ammonium in which one to four of the H atoms are replaced by C_1-C_4-alkyl, C_1-C_4-hydroxyalkyl, C_1-C_4-alkoxy, C_1-C_4-alkoxy-C_1-C_4-alkyl, hydroxy-C_1-C_4-alkoxy-C_1-C_4-alkyl, phenyl or benzyl. Examples of substituted ammonium ions comprise methylammonium, isopropylammonium, dimethylammonium, diisopropylammonium, trimethylammonium, tetramethylammonium, tetraethylammonium, tetrabutylammonium, 2-hydroxyethylammonium, 2-(2-hydroxyethoxy)ethyl-ammonium, bis(2-hydroxyethyl)ammonium, benzyltrimethylammonium and benzyltriethylammonium, furthermore phosphonium ions, sulfonium ions, preferably tri(C_1-C_4-alkyl)sulfonium, and sulfoxonium ions, preferably tri(C_1-C_4-alkyl)sulfoxonium.

Anions of useful acid addition salts are primarily chloride, bromide, fluoride, hydrogensulfate, sulfate, dihydrogenphosphate, hydrogenphosphate, phosphate, nitrate, bicarbonate, carbonate, hexafluorosilicate, hexafluorophosphate, benzoate, and the anions of C_1-C_4-alkanoic acids, preferably formate, acetate, propionate and butyrate. They can be formed by reacting compounds according

to the invention with an acid of the corresponding anion, preferably of hydrochloric acid, hydrobromic acid, sulfuric acid, phosphoric acid or nitric acid.

The term "N-oxide" includes any compound of the present invention which has at least one tertiary nitrogen atom that is oxidized to an N-oxide moiety.

The organic moieties mentioned in the above definitions of the variables are - like the term halogen - collective terms for individual listings of the individual group members. The prefix C_n-C_m indicates in each case the possible number of carbon atoms in the group.

The term “halogen” denotes in each case F, Br, Cl or I, in particular F, Br or Cl .

The term "alkyl" as used herein and in the alkyl moieties of alkylamino, alkylcarbonyl, alkylthio, alkylsulfinyl, alkylsulfonyl and alkoxyalkyl denotes in each case a straight-chain or branched alkyl group having usually from 1 to 10 carbon atoms, frequently from 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms, more preferably from 1 to 3 carbon atoms. Examples of an alkyl group are CH_3, C_2H_5, n-propyl, iso-propyl, n-butyl, 2-butyl, iso-butyl, tert-butyl, n-pentyl, 1-methylbutyl, 2-methylbutyl, 3-methylbutyl, 2,2-dimethylpropyl, 1-ethylpropyl, n-hexyl, 1,1-dimethylpropyl, 1,2-dimethylpropyl, 1-methylpentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, 1,1-dimethylbutyl, 1,2-dimethylbutyl, 1,3-dimethylbutyl, 2,2-dimethylbutyl, 2,3-dimethylbutyl, 3,3-dimethylbutyl, 1-ethylbutyl, 2-ethylbutyl, 1,1,2-trimethylpropyl, 1,2,2-trimethylpropyl, 1-ethyl-1-methylpropyl, and 1-ethyl-2-methylpropyl.

The term "haloalkyl" as used herein and in the haloalkyl moieties of haloalkylcarbonyl, haloalkoxycarbonyl, haloalkylthio, haloalkylsulfonyl, haloalkylsulfinyl, haloalkoxy and haloalkoxyalkyl, denotes in each case a straight-chain or branched alkyl group having usually from 1 to 6 carbon atoms, preferably from 1 to 4 carbon atoms, wherein the H atoms of this group are partially or fully replaced with halogen atoms. Preferred haloalkyl moieties are selected from C_1-C_4-haloalkyl, more preferably from C_1-C_3-haloalkyl or C_1-C_2-haloalkyl, in particular from C_1-C_2-fluoroalkyl such as fluoromethyl, difluoromethyl, trifluoromethyl, 1-fluoroethyl, 2-fluoroethyl, 2,2-difluoroethyl, 2,2,2-trifluoroethyl, pentafluoroethyl, and the like.

The term "alkoxy" as used herein denotes in each case a straight-chain or branched alkyl group which is bonded via an oxygen atom and has usually from 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms. Examples of an alkoxy group are methoxy, ethoxy, n-propoxy, iso-propoxy, n-butyloxy, 2-butyloxy, iso-butyloxy, tert.-butyloxy, and the like.

The term "alkoxyalkyl" as used herein refers to alkyl usually comprising 1 to 4, preferably 1 to 2 carbon atoms, wherein 1 carbon atom carries an alkoxy radical usually comprising 1 to 4, preferably 1 or 2 carbon atoms as defined above. Examples are CH_2OCH_3, CH_2-OC_2H_5, 2-(methoxy)ethyl, and 2-(ethoxy)ethyl.

The term "haloalkoxy" as used herein denotes in each case a straight-chain or branched alkoxy group having from 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms, wherein the H atoms of this group are partially or fully replaced with halogen atoms, in particular fluorine atoms. Preferred haloalkoxy moieties include C_1-C_4-haloalkoxy, in particular C_1-C_2-fluoroalkoxy, such as fluoromethoxy, difluoromethoxy, trifluoromethoxy, 1-fluoroethoxy, 2-fluoroethoxy, 2,2-difluoroethoxy, 2,2,2-trifluoroethoxy, 2-chloro-2-fluoroethoxy, 2-chloro-2,2-difluoro-ethoxy, 2,2-dichloro-2-fluorethoxy, 2,2,2-trichloroethoxy, pentafluoroethoxy and the like.

The term "alkylthio "(alkylsulfanyl: alkyl-S-)" as used herein refers to a straight-chain or branched saturated alkyl group having 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms (= C_1-C_4-alkylthio), more preferably 1 to 3 carbon atoms, which is attached via a sulfur atom. Examples include methylthio, ethylthio, propylthio, isopropylthio, and n-butylthio.

The term "haloalkylthio" as used herein refers to an alkylthio group as mentioned above wherein the H atoms are partially or fully substituted by fluorine, chlorine, bromine and/or iodine. Examples include chloromethylthio, bromomethylthio, dichloromethylthio, trichloromethylthio, fluoromethylthio, difluoromethylthio, trifluoromethylthio, chlorofluoromethylthio, dichlorofluoromethylthio, chlorodifluoromethylthio, 1-chloroethylthio, 1-bromoethylthio, 1-fluoroethylthio, 2-fluoroethylthio, 2,2-difluoroethylthio, 2,2,2-trifluoroethylthio, 2-chloro-2-fluoroethylthio, 2-chloro-2,2-difluoroethylthio, 2,2-dichloro-2-fluoroethylthio, 2,2,2-trichloroethylthio and pentafluoroethylthio and the like.

The term "alkylsulfinyl" (alkylsulfoxyl: C_1-C_6-alkyl-S(=O)-), as used herein refers to a straight-chain or branched saturated alkyl group (as mentioned above) having 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms (= C_1-C_4-alkylsulfinyl), more preferably 1 to 3 carbon atoms bonded through the sulfur atom of the sulfinyl group at any position in the alkyl group.

The term "alkylsulfonyl" (alkyl-S(=O)$_2$-) as used herein refers to a straight-chain or branched saturated alkyl group having 1 to 6 carbon atoms, preferably 1 to 4 carbon atoms (= C_1-C_4-alkylsulfonyl), preferably 1 to 3 carbon atoms, which is bonded via the sulfur atom of the sulfonyl group at any position in the alkyl group.

The term "alkoxycarbonyl" refers to an alkylcarbonyl group as defined above, which is bonded via an oxygen atom to the remainder of the molecule.

The term "alkenyl" as used herein denotes in each case a singly unsaturated hydrocarbon radical having usually 2 to 6, preferably 2 to 4 carbon atoms, wherein the double bond may be present in any position, e.g. vinyl, allyl (2-propen-1-yl), 1-propen-1-yl, 2-propen-2-yl, methallyl (2-methylprop-2-en-1-yl), 2-buten-1-yl, 3-buten-1-yl, 2-penten-1-yl, 3-penten-1-yl, 4-penten-1-yl, 1-methylbut-2-en-1-yl, 2-ethylprop-2-en-1-yl and the like.

The term "haloalkenyl" as used herein refers to an alkenyl group as defined above, wherein the H atoms are partially or fully replaced with halogen atoms.

The term "alkynyl" as used herein denotes in each case a singly unsaturated hydrocarbon radical having usually 2 to 6, preferably 2 to 4 carbon atoms, wherein the triple bond may be present in any position, e.g. ethynyl, propargyl (2-propyn-1-yl), 1-propyn-1-yl, 1-methylprop-2-yn-1-yl), 2-butyn-1-yl, 3-butyn-1-yl, 1-pentyn-1-yl, 3-pentyn-1-yl, 4-pentyn-1-yl, 1-methylbut-2-yn-1-yl, 1-ethylprop-2-yn-1-yl and the like.

The term "haloalkynyl" as used herein refers to an alkynyl group as defined above, wherein the H atoms are partially or fully replaced with halogen atoms.

The term "cycloalkyl" as used herein and in the cycloalkyl moieties of cycloalkoxy and cycloalkylthio denotes in each case a monocyclic cycloaliphatic radical having usually from 3 to 8 or from 3 to 6 carbon atoms, such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl and cyclodecyl or cyclopropyl, cyclobutyl, cyclopentyl and cyclohexyl.

The term "halocycloalkyl" as used herein and in the halocycloalkyl moieties of halocycloalkoxy and halocycloalkylthio denotes in each case a monocyclic cycloaliphatic radical having usually from

3 to 8 C atoms or 3 to 6 C atoms, wherein at least one, e.g. 1, 2, 3, 4 or 5 of the H atoms, are replaced by halogen, in particular by fluorine or chlorine. Examples are 1- and 2- fluorocyclopropyl, 1,2-, 2,2- and 2,3-difluorocyclopropyl, 1,2,2-trifluorocyclopropyl, 2,2,3,3-tetrafluorocyclpropyl, 1- and 2-chlorocyclopropyl, 1,2-, 2,2- and 2,3-dichlorocyclopropyl, 1,2,2-trichlorocyclopropyl, 2,2,3,3-tetrachlorocyclpropyl, 1-,2- and 3-fluorocyclopentyl, 1,2-, 2,2-, 2,3-, 3,3-, 3,4-, 2,5-difluorocyclopentyl, 1-,2- and 3-chlorocyclopentyl, 1,2-, 2,2-, 2,3-, 3,3-, 3,4-, 2,5-dichlorocyclopentyl and the like.

The term "cycloalkenyl" as used herein and in the cycloalkenyl moieties of cycloalkenyloxy and cycloalkenylthio denotes in each case a monocyclic singly unsaturated non-aromatic radical having usually from 3 to 8, e.g. 3 or 4 or from 5 to 10 carbon atoms, preferably from 3- to 8 carbon atoms. Exemplary cycloalkenyl groups include cyclopropenyl, cycloheptenyl or cyclooctenyl.

The term “substituted” if not specified otherwise refers to substituted by 1, 2 or maximum possible number of substituents. If substituents as defined in compounds of formula I are more than one then they are independently from each other are same or different if not mentioned otherwise.

The term “carbocycle” or “carbocyclyl” includes, unless otherwise indicated, in general a 3- to 12-membered, preferably a 3- to 8-membered or a 5- to 8-membered, more preferably a 5- or 6-membered mono-cyclic, non-aromatic ring comprising 3 to 12, preferably 3 to 8 or 5 to 8, more preferably 5 or 6 carbon atoms. Preferably, the term “carbocycle” covers cycloalkyl and cycloalkenyl groups as defined above, for example cyclopropane, cyclobutane, cyclopentane and cyclohexane rings.

The term “heterocycle” or "heterocyclyl" includes, unless otherwise indicated, in general 3- to 10-membered, preferably 3- to 8-membered or 5- to 8-membered, more preferably 5- or 6-membered, in particular 6-membered monocyclic heterocyclic non-aromatic radicals. The heterocyclic non-aromatic radicals usually comprise 1, 2, 3, 4 or 5, preferably 1, 2 or 3 heteroatoms selected from N, O and S as ring members, where S-atoms as ring members may be present as S, SO or SO_2. If not mentioned contrary, the N and S atoms of the heterocycle can be oxidized. Examples of 5- or 6-membered heterocyclic radicals comprise saturated or unsaturated, non-aromatic heterocyclic rings, such as oxiranyl, oxetanyl, thietanyl, thietanyl-S-oxid (S-oxothietanyl), thietanyl-S-dioxid (S-dioxothiethanyl), pyrrolidinyl, pyrrolinyl, pyrazolinyl, tetrahydrofuranyl, dihydrofuranyl, 1,3-dioxolanyl, thiolanyl, S-oxothiolanyl, S-dioxothiolanyl, dihydrothienyl, S-oxodihydrothienyl, S-dioxodihydrothienyl, oxazolidinyl, oxazolinyl, thiazolinyl, oxathiolanyl, piperidinyl, piperazinyl, pyranyl, dihydropyranyl, tetrahydropyranyl, 1,3- and 1,4-dioxanyl, thiopyranyl, S.oxothiopyranyl, S-dioxothiopyranyl, dihydrothiopyranyl, S-oxodihydrothiopyranyl, S-dioxodihydrothiopyranyl, tetrahydrothiopyranyl, S-oxotetrahydrothiopyranyl, S-dioxotetrahydrothiopyranyl, morpholinyl, thiomorpholinyl, S-oxothiomorpholinyl, S-dioxothiomorpholinyl, thiazinyl and the like. Examples for heterocyclic ring also comprising 1 or 2 carbonyl groups as ring members comprise pyrrolidin-2-onyl, pyrrolidin-2,5-dionyl, imidazolidin-2-onyl, oxazolidin-2-onyl, thiazolidin-2-onyl and the like.

The term “partially or fully unsaturated heterocycle” or “partially or fully unsaturated heterocyclic ring” refers to heterocycle which is partially unsaturated or heterocycle which is fully unsaturated. Partially unsaturated heterocycle includes monocyclic 3- or 6-membered partially unsaturated heterocyclic radicals comprising as ring members 1, 2, 3 or 4 heteroatoms selected from N, O and S.

Examples of 3- to 6-membered partially unsaturated heterocycles include azirine, oxeteen, dihydropyrol, dihydrofuran, dihydrothiophene, dihydrooxazole, dihydroimidazole, dihydrothiazole, tetrahydropyrazine, dihydrooxazine. Fully unsaturated heterocycle includes monocyclic 5- or 6-membered fully unsaturated heterocyclic radicals comprising as ring members 1, 2, 3 or 4 heteroatoms selected from N, O and S. Examples of 5- or 6-membered fully unsaturated heterocycles include pyridyl, i.e. 2-, 3-, or 4-pyridyl, pyrimidinyl, i.e. 2-, 4- or 5-pyrimidinyl, pyrazinyl, pyridazinyl, i.e. 3- or 4-pyridazinyl, thienyl, i.e. 2- or 3-thienyl, furyl, i.e. 2-or 3-furyl, pyrrolyl, i.e. 2- or 3-pyrrolyl, oxazolyl, i.e. 2-, 3- or 5-oxazolyl, isoxazolyl, i.e. 3-, 4- or 5-isoxazolyl, thiazolyl, i.e. 2-, 3- or 5-thiazolyl, isothiazolyl, i.e. 3-, 4- or 5-isothiazolyl, pyrazolyl, i.e. 1-, 3-, 4- or 5-pyrazolyl, i.e. 1-, 2-, 4- or 5-imidazolyl, oxadiazolyl, e.g. 2- or 5-[1,3,4]oxadiazolyl, 4- or 5-(1,2,3-oxadiazol)yl, 3- or 5-(1,2,4-oxadiazol)yl, 2- or 5-(1,3,4-thiadiazol)yl, thiadiazolyl, e.g. 2- or 5-(1,3,4-thiadiazol)yl, 4- or 5-(1,2,3-thiadiazol)yl, 3- or 5-(1,2,4-thiadiazol)yl, triazolyl, e.g. 1H-, 2H- or 3H-1,2,3-triazol-4-yl, 2H-triazol-3-yl, 1H-, 2H-, or 4H-1,2,4-triazolyl and tetrazolyl, i.e. 1H- or 2H-tetrazolyl. The term “partially or fully unsaturated heterocycle” or “partially or fully unsaturated heterocyclic ring” also includes bicyclic 8 to 10-membered partially or fully unsaturated heterocyclic radicals comprising as ring members 1, 2 or 3 heteroatoms selected from N, O and S, wherein a 5- or 6-membered hetercyclic ring is fused to a phenyl ring or to a 5- or 6-membered heteroaromatic radical. Examples of a 5- or 6-membered heteroaromatic ring fused to a phenyl ring or to a 5- or 6-membered heteroaromatic radical include benzofuranyl, benzothienyl, indolyl, indazolyl, benzimidazolyl, benzoxathiazolyl, benzoxadiazolyl, benzothiadiazolyl, benzoxazinyl, chinolinyl, isochinolinyl, purinyl, 1,8-naphthyridyl, pteridyl, pyrido[3,2-d]pyrimidyl or pyridoimidazolyl and the like. These fused hetaryl radicals may be bonded to the remainder of the molecule via any ring atom of 5- or 6-membered heteroaromatic ring or via a carbon atom of the fused phenyl moiety.

The term oxo (=O) as a substitution referes to replacement of two H by oxo (=O) radical.

The term “heteroaryl” refers to “fully unsaturated heterocycle”.

The terms “alkylene”, “alkenylene”, and “alkynylene” refer to alkyl, alkenyl, and alkynyl as defined above, respectively, which are bonded to the remainder of the molecule, via two atoms, preferably via two carbon atoms, of the respective group, so that they represent a linker between two moieties of the molecule. In particular, the term “alkylene” may refer to alkyl chains such as $-CH_2CH_2-$, $-CH(CH_3)-$, $-CH_2CH_2CH_2-$, $-CH(CH_3)CH_2-$, $-CH_2CH(CH_3)-$, $-CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2CH_2-$, and $-CH_2CH_2CH_2CH_2CH_2CH_2CH_2-$. Similarly, “alkenylene” and “alkynylene” may refer to alkenyl and alkynyl chains, respectively.

The term “CN” refers to cyano group.

With respect to the variables, the particularly preferred embodiments of the compounds of the formula I are given below.

In one preferred embodiment of compounds of formula I, X is O.

In another preferred embodiment of compounds of formula I, X is S.

In one preferred embodiment of compounds of formula I, R^x is selected from C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In more preferred embodiment of compounds of formula I, R^x is selected from C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, and C_1-C_6-haloalkyl.

In most preferred embodiment of compounds of formula I, R^x is selected from CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In perticularly preferred embodiment of compounds of formula I, R^x is CH_3 or C_2H_5.

In another preferred embodiment of compounds of formula I, R^x is selected from C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$, $S(=O)_mR^e$, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

In one preferred embodiment of compounds of formula I, R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl;

In another preferred embodiment of compounds of formula I, R^1 is partially or completely halogenated C_1-C_6-alkyl, more preferably C_1-C_4-alkyl, particularly C_1-C_2-alkyl such as CF_3, CF_2CF_3 and $CF(CF_3)_2$.

In another preferred embodiment of compounds of formula I, R^1 is H.

In another preferred embodiment of compounds of formula I, R^1 is partially or completely halogenated C_1-C_6-alkoxy, more preferably C_1-C_4-alkoxy, particularly C_1-C_2-alkoxy such as OCF_3, OCH_2CHF_2 and OCH_2CF_3.

In another preferred embodiment of compounds of formula I, R^1 is partially or completely halogenated C_2-C_6-alkenyl or C_2-C_6-alkynyl.

In another preferred embodiment of compounds of formula I, R^1 is partially or completely halogenated C_3-C_6-cycloalkyl or C_3-C_6-cycloalkoxy.

In another preferred embodiment of compounds of formula I, R^1 is partially or completely halogenated C_1-C_6 sulfenyl such as SCF_3, C_1-C_6 sulfinyl such as $S(=O)CF_3$ or C_1-C_6 sulfonyl such as $S(=O)_2CF_3$.

In more preferred embodiment of compounds of formula I, R^1 is CF_3, CF_2CF_3, $OCHF_2$, $CF(CF_3)_2$, SCF_3, OCF_3, $S(=O)CF_3$ or $S(=O)_2CF_3$.

In a particularly preferred embodiment of compounds of formula I, R^1 is CF_3, CF_2CF_3, $CF(CF_3)_2$, SCF_3, OCF_3, $S(=O)CF_3$ or $S(=O)_2CF_3$.

In a particular embodiment of compounds of formula I, R^1 is CF_3, CF_2CF_3, $OCHF_2$, or OCF_3.

In a particular embodiment of compounds of formula I, R^1 is CF_3.

In one preferred embodiment of compounds of formula I, R^2 is selected from H, CN, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In another preferred embodiment of compounds of formula I, R^2 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy;

In more preferred embodiment of compounds of formula I, R^2 is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In most preferred embodiment of compounds of formula I, R^2 is selected from H, CH_3 and C_2H_5.

In perticularly preferred embodiment of compounds of formula I, R^2 is H.

In one preferred embodiment of compounds of formula I, R^3 is selected from H, CN, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In more preferred embodiment of compounds of formula I, R^3 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy.

In most preferred embodiment of compounds of formula I, R^3 is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In most preferred embodiment of compounds of formula I, R^3 is selected from H, CH_3 and C_2H_5.

In perticularly preferred embodiment of compounds of formula I, R^3 is H.

In one preferred embodiment of compounds of formula I, R^a is selected from H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In most preferred embodiment of compounds of formula I, R^a is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In one preferred embodiment of compounds of formula I, R^b is selected from H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl, C_3-C_6 halocycloalkyl, -(C=O)R, -C(=O)OR, and -C(=O)NR,.

In most preferred embodiment of compounds of formula I, R^b is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In one preferred embodiment of compounds of formula I, R^c is selected from H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl, and C_3-C_6 halocycloalkyl.

In most preferred embodiment of compounds of formula I, R^c is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In one preferred embodiment of compounds of formula I, R^d is selected from H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6-haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In most preferred embodiment of compounds of formula I, R^d is selected from H, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In more preferred embodiment of compounds of formula I, R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, and C_3-C_6 halocycloalkyl.

In most preferred embodiment of compounds of formula I, R^e is selected from CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl and propargyl.

In one preferred embodiment of compounds of formula I, R^f is selected from halogen, CN, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, C_1-C_6-haloalkoxy, C_2-C_6- haloalkenyl, C_2-C_6-haloalkynyl and C_3-C_6 halocycloalkyl.

In more preferred embodiment of compounds of formula I, R^f is selected from Cl, F, Br, OCH_3, OC_2H_5, SCH_3, SC_2H_5, CN, CH_3, C_2H_5, n-propyl, isopropyl, cyclopropyl, allyl, propargyl, CF_3, CHF_2, and CF_2CF_3.

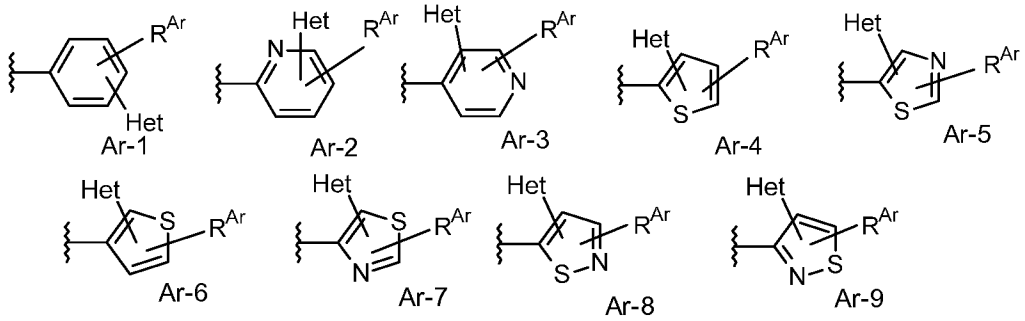
In one preferred embodiment of compounds of formula I, Ar is phenyl.

In another preferred embodiment of compound of formula I, Ar is heteroaryl.

In another preferred embodiment of compound of formula I,Ar is 5- or 6-membered heteroaryl containing one heteroatom selected from O, N, and S.

In more preferred embodiment of compound of formula I, wherein Ar is phenyl or 5-6 membered heteroaryl substituted with $S(=O)_mR^e$ at the ortho position to the bond connecting to 9-membered heteroaryl of compound of formula I, and optionally further substituted with 1 R^{Ar}, preferably selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, phenyl, and benzyl, wherein the phenyl ring is unsubstituted or substituted by radicals R^f.

In another preferred embodiment of compounds of formula I, Ar is selected from formula Ar-1 to Ar-9, wherein the formula Ar-1 to Ar-9 are substituted with Het and 1, or 2 R^{Ar}, provided Het and R^{Ar} are attached to different carbon atoms, and wherein one R^{Ar} substituent is preferably at the ortho position to bond;



In another preferred embodiment of compounds of formula I, Ar is pyridinyl or thiophenyl substituted with R^{Ar} as $S(=O)_mR^e$ at the ortho position to bond connecting to 9-membered heteroaryl of compound of formula I, and optionally further substituted with 1 R^{Ar} selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, phenyl, and benzyl, wherein the phenyl ring of R^{Ar} is unsubstituted or substituted with radicals R^f;

In one preferred embodiment of compounds of formula I, R^{Ar} is selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, $S(=O)_mR^e$, phenyl, phenoxy, phenylcarbonyl, phenylthio and benzyl, wherein the phenyl ring is unsubstituted or substituted by radicals R^f.

In more preferred embodiment of compounds of formula I, R^{Ar} is selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, $S(=O)_mR^e$, phenyl, and benzyl, wherein the phenyl ring is unsubstituted or substituted by radicals R^f.

In one preferred embodiment of compounds of formula I, R^{Ar} is selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-haloalkoxy.

In another preferred embodiment of compounds of formula I, R^{Ar} is selected from C_2-C_6-alkenyl, C_2-C_6-haloalkenyl, C_2-C_6-alkynyl, C_2-C_6-haloalkynyl, C_3-C_6-cycloalkyl, C_3-C_6 halocycloalkyl, C_3-C_6-cycloalkoxy and C_3-C_6halocycloalkoxy.

In another preferred embodiment of compounds of formula I, R^{Ar} is selected from C_1-C_6-sulfenyl, C_1-C_6-sulfinyl and C_1-C_6-sulfonyl.

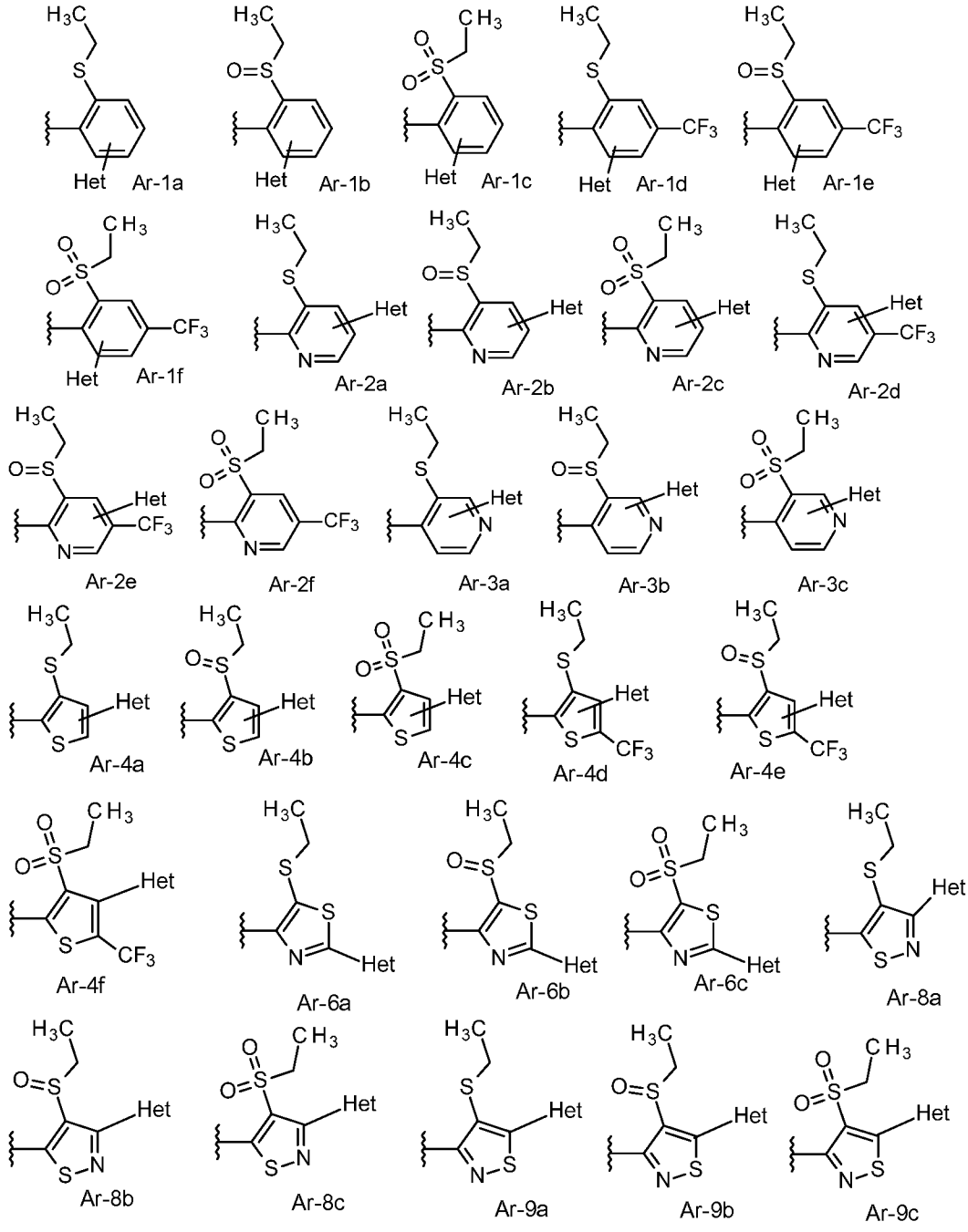
In more preferred embodiment of compounds of formula I, R^{Ar} is selected from Cl, F, Br, CH_3, SCH_3, SC_2H_5, $S(=O)CH_3$, $S(=O)C_2H_5$, $S(=O)_2CH_3$, $S(=O)_2C_2H_5$.

In most preferred embodiment of compounds of formula I, R^{Ar} is $S(=O)_2C_2H_5$.

In a preferred embodiment of the compound of formula I, n is 1 or 2.

In more preferred embodiment of the compound of formula I, n is 1.

In a particularly preferred embodiment of compound of formula I, Ar is selected from the group of formula Ar-1a to Ar-1f, Ar-2a to Ar-2f, Ar-3a to Ar-3c, Ar-4a to Ar-4f, Ar-6a to Ar-6c, Ar-8a to Ar-8c, and Ar-9a to Ar-9c:



In a preferred embodiment of the compound of formula I, Het is 5- or 6-membered heteroaryl which is unsubstituted or substituted with R;

In another preferred embodiment of the compound of formula I, Het is 5- or 6-membered heteroaryl which is substituted with R;

In another preferred embodiment of the compound of formula I, Het is 5- or 6-membered heteroaryl which is unsubstituted.

In a preferred embodiment of the compound of formula I, Het is 5- or 6-membered heterocyclyl which is unsubstituted or substituted with R;

In another preferred embodiment of the compound of formula I, Het is 5- or 6-membered heterocyclyl which is substituted with R;

In another preferred embodiment of the compound of formula I, Het is 5- or 6-membered heterocyclyl which is unsubstituted.

In another preferred embodiment of the compound of formula I, Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, tetrazolyl, and thiadiazolyl; wherein the Het is unsubstituted or substituted with R.

In another preferred embodiment of the compound of formula I, Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, tetrazolyl, and thiadiazolyl; wherein the Het is unsubstituted or substituted with R.

In another preferred embodiment of the compound of formula I, Het is selected from thiophenyl, pyrrolidinyl, piperidinyl, pyridinyl, pyrazolyl, triazolyl, and tetrazolyl; wherein the Het is unsubstituted or substituted with R.

In a preferred embodiment of the compound of formula I, R selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, and C_1-C_6-alkoxycarbonyl.

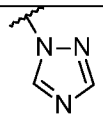
In another preferred embodiment of the compound of formula I, R is selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-alkoxycarbonyl.

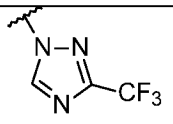
In another preferred embodiment of the compound of formula I, R is selected from halogen, oxo (=O), and C_1-C_6-haloalkyl.

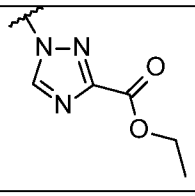
In another preferred embodiment of the compound of formula I, R is selected from C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, phenyl, 5- or 6-membered heteroaryl, or 5- or 6-membered heterocyclyl, wherein cyclic groups of R are unsubstituted or substituted with radicals R^f;

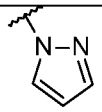
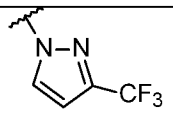
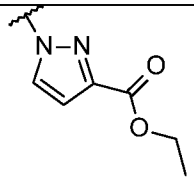
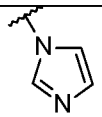
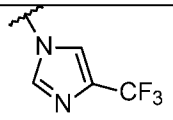
In more preferred embodiment of the compound of formula I, Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, tetrazolyl, and thiadiazolyl; wherein the Het is unsubstituted or substituted with R selected from halogen, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, and C_1-C_6-alkoxycarbonyl.

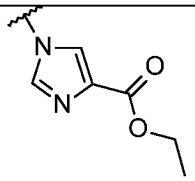
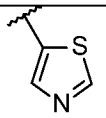
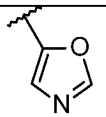
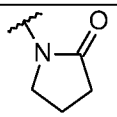
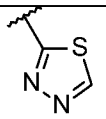
Examples of perticulalrly preferred Het are listed in Table H below,

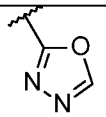
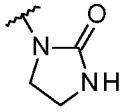
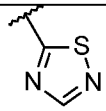
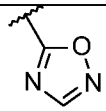
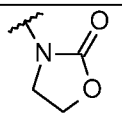
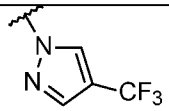
Het No.	Het structure
Het-1.	

Het No.	Het structure
Het-2.	

Het No.	Het structure
Het-3.	

Het No.	Het structure
Het-4.	
Het-5.	
Het-6.	
Het-7.	
Het-8.	

Het No.	Het structure
Het-9.	
Het-10.	
Het-11.	
Het-12.	
Het-13.	

Het No.	Het structure
Het-14.	
Het-15.	
Het-16.	
Het-17.	
Het-18.	
Het-19.	

In a more preferred embodiment of the compound of formula I, wherein

Het is as defined herein;

R^x is selected from C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, and C_1-C_6-haloalkyl;

R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl;

R^2 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy;

R^3 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy;

Ar is a phenyl or 5- or 6-membered heteroaryl;

n is 1 or 2;

R^{Ar} is selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, $S(=O)_mR^e$, phenyl, phenoxy, phenylcarbonyl, phenylthio and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, and C_3-C_6 halocycloalkyl;

R^f is selected from halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_3-C_6-cycloalkyl, C_2-C_6-alkenyl, and C_2-C_6-alkynyl, which are unsubstituted or substituted with halogen;

m is 0, 1, or 2.

In most preferred embodiment of the compound of formula I, wherein

R^x is C_1-C_6-alkyl;

R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl;

R^2 is selected from from H, halogen, and C_1-C_6-alkyl;

R^3 is selected from from H, halogen, and C_1-C_6-alkyl;

Ar is pyridinyl or thiophenyl substituted with R^{Ar} as $S(=O)_mR^e$ at the ortho position to bond connecting to 9-membered heteroaryl of compound of formula I, and optionally further substituted with 1 R^{Ar} selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, phenyl, and benzyl, wherein the phenyl ring of R^{Ar} is unsubstituted or substituted with radicals R^f;

R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, and C_3-C_6 halocycloalkyl;

R^f is selected from halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_3-C_6-cycloalkyl, C_2-C_6-alkenyl, and C_2-C_6-alkynyl, which are unsubstituted or substituted with halogen;

m is 0, 1, or 2;

Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl; preferably thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl

wherein the Het is unsubstituted or substituted with R;

R is selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-alkoxycarbonyl.

In another most preferred embodiment of the compound of formula I, wherein

X is O;

R^1 is partially or completely halogenated, C_1-C_6-alkyl;

R^x is C_1-C_6-alkyl;

R^2 is H;

R^3 is H or C_1-C_6-alkyl;

Het is selected from thiophenyl, pyrrolidinyl, piperidinyl, pyrazolyl, pyridinyl, triazolyl, and tetrazolyl;

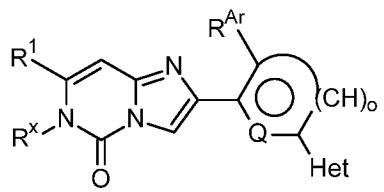
wherein the Het is unsubstituted or substituted with R;

R is selected from halogen, oxo (=O), and C_1-C_6-haloalkyl;

Ar is pyridinyl substituted with R^{Ar} as $S(=O)_mR^e$ at the ortho position to bond connecting to 9-membered heteroaryl of compound of formula I;

R^e is C_1-C_6-alkyl.

In particularly preferred embodiment the compound of formula I corresponds to the compound of formula I-a,



I-a

wherein wherein the circle in the ring containing Q denotes that the ring is aromatic ring;

Q is S or N;

R^x is C_1-C_6-alkyl;

R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl

R^{Ar} is $S(=O)_mR^e$; wherein

R^e is C_1-C_6-alkyl;

Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl; preferably thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl

wherein the Het is unsubstituted or substituted with R;

R is selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-alkoxycarbonyl;

m is 0, 1, or 2;

o is 1 or 2.

In more particularly preferred embodiment of the compound of formula I, compound of formula I is the compound of formula I-a, wherein

Q is S or N;

R^x is CH_3 or C_2H_5;

R^1 is selected from CF_3, CF_2CF_3, $CF(CF_3)_2$, SCF_3, OCF_3, $OCHF_2$, $S(=O)CF_3$, and $S(=O)_2CF_3$;

R^{Ar} is $S\text{-}CH_3$, $S(=O)\text{-}CH_3$, $S(=O)_2\text{-}CH_3$, $S\text{-}C_2H_5$, $S(=O)\text{-}C_2H_5$, or $S(=O)_2\text{-}C_2H_5$;

Het is selected from Het-1 to Het-19 from table H;

o is 1 or 2.

Each of the groups mentioned for a substituent in the tables is furthermore per se, independently of the combination in which it is mentioned, a particularly preferred aspect of the substituent in question.

according to particularly preferred embodiment of the compound of formula I, compounds of the invention are the compounds that are compiled in the Tables 1-1 to 1-18 wherein the meaning for the combination of variables R^x, R^1 and Het for each individual compound of tables 1 to 18 corresponds to each line of Table A. Each of the groups mentioned for a substituent in the tables is furthermore per se, independently of the combination in which it is mentioned, a particularly preferred aspect of the substituent in question.

Table 1-1 Compounds of formula I-a in which Q is S, R^{Ar} is $S\text{-}CH_3$ and o is 1.

Table 1-2 Compounds of formula I-a in which Q is S, R^{Ar} is $S(=O)\text{-}CH_3$ and o is 1.

Table 1-3 Compounds of formula I-a in which Q is S, R^{Ar} is $S(=O)_2\text{-}CH_3$ and o is 1.

Table 1-4 Compounds of formula I-a in which Q is S, R^{Ar} is $S\text{-}C_2H_5$ and o is 1.

Table 1-5 Compounds of formula I-a in which Q is S, R^{Ar} is $S(=O)\text{-}C_2H_5$ and o is 1.

Table 1-6 Compounds of formula I-a in which Q is S, R^{Ar} is $S(=O)_2\text{-}C_2H_5$ and o is 1.

Table 1-7 Compounds of formula I-a in which Q is N, R^{Ar} is $S\text{-}CH_3$ and o is 1.

Table 1-8 Compounds of formula I-a in which Q is N, R^{Ar} is $S(=O)\text{-}CH_3$ and o is 1.

Table 1-9 Compounds of formula I-a in which Q is N, R^{Ar} is $S(=O)_2\text{-}CH_3$ and o is 1.

Table 1-10 Compounds of formula I-a in which Q is N, R^{Ar} is $S\text{-}C_2H_5$ and o is 1.

Table 1-11 Compounds of formula I-a in which Q is N, R^{Ar} is S(=O)-C_2H_5 and o is 1.
Table 1-12 Compounds of formula I-a in which Q is N, R^{Ar} is $S(=O)_2$-C_2H_5 and o is 1.
Table 1-13 Compounds of formula I-a in which Q is N, R^{Ar} is S-CH_3 and o is 2.
Table 1-14 Compounds of formula I-a in which Q is N, R^{Ar} is S(=O)-CH_3 and o is 2.
Table 1-15 Compounds of formula I-a in which Q is N, R^{Ar} is $S(=O)_2$-CH_3 and o is 2.
Table 1-16 Compounds of formula I-a in which Q is N, R^{Ar} is S-C_2H_5 and o is 2.
Table 1-17 Compounds of formula I-a in which Q is N, R^{Ar} is S(=O)-C_2H_5 and o is 2.
Table 1-18 Compounds of formula I-a in which Q is N, R^{Ar} is $S(=O)_2$-C_2H_5 and o is 2.

Table A:

Line	R^1	R^X	Het
A-1	CF_3	CH_3	Het-1
A-2	CF_3	CH_3	Het-2
A-3	CF_3	CH_3	Het-3
A-4	CF_3	CH_3	Het-4
A-5	CF_3	CH_3	Het-5
A-6	CF_3	CH_3	Het-6
A-7	CF_3	CH_3	Het-7
A-8	CF_3	CH_3	Het-8
A-9	CF_3	CH_3	Het-9
A-10	CF_3	CH_3	Het-10
A-11	CF_3	CH_3	Het-11
A-12	CF_3	CH_3	Het-12
A-13	CF_3	CH_3	Het-13
A-14	CF_3	CH_3	Het-14
A-15	CF_3	CH_3	Het-15
A-16	CF_3	CH_3	Het-16
A-17	CF_3	CH_3	Het-17
A-18	CF_3	CH_3	Het-18
A-19	CF_3	CH_3	Het-19
A-20	CF_3	C_2H_5	Het-1
A-21	CF_3	C_2H_5	Het-2
A-22	CF_3	C_2H_5	Het-3
A-23	CF_3	C_2H_5	Het-4
A-24	CF_3	C_2H_5	Het-5
A-25	CF_3	C_2H_5	Het-6
A-26	CF_3	C_2H_5	Het-7
A-27	CF_3	C_2H_5	Het-8
A-28	CF_3	C_2H_5	Het-9
A-29	CF_3	C_2H_5	Het-10
A-30	CF_3	C_2H_5	Het-11

Line	R^1	R^X	Het
A-31	CF_3	C_2H_5	Het-12
A-32	CF_3	C_2H_5	Het-13
A-33	CF_3	C_2H_5	Het-14
A-34	CF_3	C_2H_5	Het-15
A-35	CF_3	C_2H_5	Het-16
A-36	CF_3	C_2H_5	Het-17
A-37	CF_3	C_2H_5	Het-18
A-38	CF_3	C_2H_5	Het-19
A-39	CF_2CF_3	CH_3	Het-1
A-40	CF_2CF_3	CH_3	Het-2
A-41	CF_2CF_3	CH_3	Het-3
A-42	CF_2CF_3	CH_3	Het-4
A-43	CF_2CF_3	CH_3	Het-5
A-44	CF_2CF_3	CH_3	Het-6
A-45	CF_2CF_3	CH_3	Het-7
A-46	CF_2CF_3	CH_3	Het-8
A-47	CF_2CF_3	CH_3	Het-9
A-48	CF_2CF_3	CH_3	Het-10
A-49	CF_2CF_3	CH_3	Het-11
A-50	CF_2CF_3	CH_3	Het-12
A-51	CF_2CF_3	CH_3	Het-13
A-52	CF_2CF_3	CH_3	Het-14
A-53	CF_2CF_3	CH_3	Het-15
A-54	CF_2CF_3	CH_3	Het-16
A-55	CF_2CF_3	CH_3	Het-17
A-56	CF_2CF_3	CH_3	Het-18
A-57	CF_2CF_3	CH_3	Het-19
A-58	CF_2CF_3	C_2H_5	Het-1
A-59	CF_2CF_3	C_2H_5	Het-2
A-60	CF_2CF_3	C_2H_5	Het-3

Line	R^1	R^X	Het
A-61	CF_2CF_3	C_2H_5	Het-4
A-62	CF_2CF_3	C_2H_5	Het-5
A-63	CF_2CF_3	C_2H_5	Het-6
A-64	CF_2CF_3	C_2H_5	Het-7
A-65	CF_2CF_3	C_2H_5	Het-8
A-66	CF_2CF_3	C_2H_5	Het-9
A-67	CF_2CF_3	C_2H_5	Het-10
A-68	CF_2CF_3	C_2H_5	Het-11
A-69	CF_2CF_3	C_2H_5	Het-12
A-70	CF_2CF_3	C_2H_5	Het-13
A-71	CF_2CF_3	C_2H_5	Het-14
A-72	CF_2CF_3	C_2H_5	Het-15
A-73	CF_2CF_3	C_2H_5	Het-16
A-74	CF_2CF_3	C_2H_5	Het-17
A-75	CF_2CF_3	C_2H_5	Het-18
A-76	CF_2CF_3	C_2H_5	Het-19
A-77	$CF(CF_3)_2$	CH_3	Het-1
A-78	$CF(CF_3)_2$	CH_3	Het-2
A-79	$CF(CF_3)_2$	CH_3	Het-3
A-80	$CF(CF_3)_2$	CH_3	Het-4
A-81	$CF(CF_3)_2$	CH_3	Het-5
A-82	$CF(CF_3)_2$	CH_3	Het-6
A-83	$CF(CF_3)_2$	CH_3	Het-7
A-84	$CF(CF_3)_2$	CH_3	Het-8
A-85	$CF(CF_3)_2$	CH_3	Het-9
A-86	$CF(CF_3)_2$	CH_3	Het-10
A-87	$CF(CF_3)_2$	CH_3	Het-11
A-88	$CF(CF_3)_2$	CH_3	Het-12
A-89	$CF(CF_3)_2$	CH_3	Het-13
A-90	$CF(CF_3)_2$	CH_3	Het-14
A-91	$CF(CF_3)_2$	CH_3	Het-15
A-92	$CF(CF_3)_2$	CH_3	Het-16
A-93	$CF(CF_3)_2$	CH_3	Het-17
A-94	$CF(CF_3)_2$	CH_3	Het-18
A-95	$CF(CF_3)_2$	CH_3	Het-19
A-96	$CF(CF_3)_2$	C_2H_5	Het-1
A-97	$CF(CF_3)_2$	C_2H_5	Het-2
A-98	$CF(CF_3)_2$	C_2H_5	Het-3
A-99	$CF(CF_3)_2$	C_2H_5	Het-4

Line	R^1	R^X	Het
A-100	$CF(CF_3)_2$	C_2H_5	Het-5
A-101	$CF(CF_3)_2$	C_2H_5	Het-6
A-102	$CF(CF_3)_2$	C_2H_5	Het-7
A-103	$CF(CF_3)_2$	C_2H_5	Het-8
A-104	$CF(CF_3)_2$	C_2H_5	Het-9
A-105	$CF(CF_3)_2$	C_2H_5	Het-10
A-106	$CF(CF_3)_2$	C_2H_5	Het-11
A-107	$CF(CF_3)_2$	C_2H_5	Het-12
A-108	$CF(CF_3)_2$	C_2H_5	Het-13
A-109	$CF(CF_3)_2$	C_2H_5	Het-14
A-110	$CF(CF_3)_2$	C_2H_5	Het-15
A-111	$CF(CF_3)_2$	C_2H_5	Het-16
A-112	$CF(CF_3)_2$	C_2H_5	Het-17
A-113	$CF(CF_3)_2$	C_2H_5	Het-18
A-114	$CF(CF_3)_2$	C_2H_5	Het-19
A-115	SCF_3	CH_3	Het-1
A-116	SCF_3	CH_3	Het-2
A-117	SCF_3	CH_3	Het-3
A-118	SCF_3	CH_3	Het-4
A-119	SCF_3	CH_3	Het-5
A-120	SCF_3	CH_3	Het-6
A-121	SCF_3	CH_3	Het-7
A-122	SCF_3	CH_3	Het-8
A-123	SCF_3	CH_3	Het-9
A-124	SCF_3	CH_3	Het-10
A-125	SCF_3	CH_3	Het-11
A-126	SCF_3	CH_3	Het-12
A-127	SCF_3	CH_3	Het-13
A-128	SCF_3	CH_3	Het-14
A-129	SCF_3	CH_3	Het-15
A-130	SCF_3	CH_3	Het-16
A-131	SCF_3	CH_3	Het-17
A-132	SCF_3	CH_3	Het-18
A-133	SCF_3	CH_3	Het-19
A-134	SCF_3	C_2H_5	Het-1
A-135	SCF_3	C_2H_5	Het-2
A-136	SCF_3	C_2H_5	Het-3
A-137	SCF_3	C_2H_5	Het-4
A-138	SCF_3	C_2H_5	Het-5

Line	R^1	R^X	Het
A-139	SCF_3	C_2H_5	Het-6
A-140	SCF_3	C_2H_5	Het-7
A-141	SCF_3	C_2H_5	Het-8
A-142	SCF_3	C_2H_5	Het-9
A-143	SCF_3	C_2H_5	Het-10
A-144	SCF_3	C_2H_5	Het-11
A-145	SCF_3	C_2H_5	Het-12
A-146	SCF_3	C_2H_5	Het-13
A-147	SCF_3	C_2H_5	Het-14
A-148	SCF_3	C_2H_5	Het-15
A-149	SCF_3	C_2H_5	Het-16
A-150	SCF_3	C_2H_5	Het-17
A-151	SCF_3	C_2H_5	Het-18
A-152	SCF_3	C_2H_5	Het-19
A-153	OCF_3	CH_3	Het-1
A-154	OCF_3	CH_3	Het-2
A-155	OCF_3	CH_3	Het-3
A-156	OCF_3	CH_3	Het-4
A-157	OCF_3	CH_3	Het-5
A-158	OCF_3	CH_3	Het-6
A-159	OCF_3	CH_3	Het-7
A-160	OCF_3	CH_3	Het-8
A-161	OCF_3	CH_3	Het-9
A-162	OCF_3	CH_3	Het-10
A-163	OCF_3	CH_3	Het-11
A-164	OCF_3	CH_3	Het-12
A-165	OCF_3	CH_3	Het-13
A-166	OCF_3	CH_3	Het-14
A-167	OCF_3	CH_3	Het-15
A-168	OCF_3	CH_3	Het-16
A-169	OCF_3	CH_3	Het-17
A-170	OCF_3	CH_3	Het-18
A-171	OCF_3	CH_3	Het-19
A-172	OCF_3	C_2H_5	Het-1
A-173	OCF_3	C_2H_5	Het-2
A-174	OCF_3	C_2H_5	Het-3
A-175	OCF_3	C_2H_5	Het-4
A-176	OCF_3	C_2H_5	Het-5
A-177	OCF_3	C_2H_5	Het-6

Line	R^1	R^X	Het
A-178	OCF_3	C_2H_5	Het-7
A-179	OCF_3	C_2H_5	Het-8
A-180	OCF_3	C_2H_5	Het-9
A-181	OCF_3	C_2H_5	Het-10
A-182	OCF_3	C_2H_5	Het-11
A-183	OCF_3	C_2H_5	Het-12
A-184	OCF_3	C_2H_5	Het-13
A-185	OCF_3	C_2H_5	Het-14
A-186	OCF_3	C_2H_5	Het-15
A-187	OCF_3	C_2H_5	Het-16
A-188	OCF_3	C_2H_5	Het-17
A-189	OCF_3	C_2H_5	Het-18
A-190	OCF_3	C_2H_5	Het-19
A-191	$OCHF_2$	CH_3	Het-1
A-192	$OCHF_2$	CH_3	Het-2
A-193	$OCHF_2$	CH_3	Het-3
A-194	$OCHF_2$	CH_3	Het-4
A-195	$OCHF_2$	CH_3	Het-5
A-196	$OCHF_2$	CH_3	Het-6
A-197	$OCHF_2$	CH_3	Het-7
A-198	$OCHF_2$	CH_3	Het-8
A-199	$OCHF_2$	CH_3	Het-9
A-200	$OCHF_2$	CH_3	Het-10
A-201	$OCHF_2$	CH_3	Het-11
A-202	$OCHF_2$	CH_3	Het-12
A-203	$OCHF_2$	CH_3	Het-13
A-204	$OCHF_2$	CH_3	Het-14
A-205	$OCHF_2$	CH_3	Het-15
A-206	$OCHF_2$	CH_3	Het-16
A-207	$OCHF_2$	CH_3	Het-17
A-208	$OCHF_2$	CH_3	Het-18
A-209	$OCHF_2$	CH_3	Het-19
A-210	$OCHF_2$	C_2H_5	Het-1
A-211	$OCHF_2$	C_2H_5	Het-2
A-212	$OCHF_2$	C_2H_5	Het-3
A-213	$OCHF_2$	C_2H_5	Het-4
A-214	$OCHF_2$	C_2H_5	Het-5
A-215	$OCHF_2$	C_2H_5	Het-6
A-216	$OCHF_2$	C_2H_5	Het-7

Line	R^1	R^X	Het
A-217	$OCHF_2$	C_2H_5	Het-8
A-218	$OCHF_2$	C_2H_5	Het-9
A-219	$OCHF_2$	C_2H_5	Het-10
A-220	$OCHF_2$	C_2H_5	Het-11
A-221	$OCHF_2$	C_2H_5	Het-12
A-222	$OCHF_2$	C_2H_5	Het-13
A-223	$OCHF_2$	C_2H_5	Het-14
A-224	$OCHF_2$	C_2H_5	Het-15
A-225	$OCHF_2$	C_2H_5	Het-16
A-226	$OCHF_2$	C_2H_5	Het-17
A-227	$OCHF_2$	C_2H_5	Het-18
A-228	$OCHF_2$	C_2H_5	Het-19
A-229	$S(=O)CF_3$	CH_3	Het-1
A-230	$S(=O)CF_3$	CH_3	Het-2
A-231	$S(=O)CF_3$	CH_3	Het-3
A-232	$S(=O)CF_3$	CH_3	Het-4
A-233	$S(=O)CF_3$	CH_3	Het-5
A-234	$S(=O)CF_3$	CH_3	Het-6
A-235	$S(=O)CF_3$	CH_3	Het-7
A-236	$S(=O)CF_3$	CH_3	Het-8
A-237	$S(=O)CF_3$	CH_3	Het-9
A-238	$S(=O)CF_3$	CH_3	Het-10
A-239	$S(=O)CF_3$	CH_3	Het-11
A-240	$S(=O)CF_3$	CH_3	Het-12
A-241	$S(=O)CF_3$	CH_3	Het-13
A-242	$S(=O)CF_3$	CH_3	Het-14
A-243	$S(=O)CF_3$	CH_3	Het-15
A-244	$S(=O)CF_3$	CH_3	Het-16
A-245	$S(=O)CF_3$	CH_3	Het-17
A-246	$S(=O)CF_3$	CH_3	Het-18
A-247	$S(=O)CF_3$	CH_3	Het-19
A-248	$S(=O)CF_3$	CH_3	Het-1
A-249	$S(=O)CF_3$	C_2H_5	Het-2
A-250	$S(=O)CF_3$	C_2H_5	Het-3
A-251	$S(=O)CF_3$	C_2H_5	Het-4
A-252	$S(=O)CF_3$	C_2H_5	Het-5
A-253	$S(=O)CF_3$	C_2H_5	Het-6
A-254	$S(=O)CF_3$	C_2H_5	Het-7
A-255	$S(=O)CF_3$	C_2H_5	Het-8

Line	R^1	R^X	Het
A-256	$S(=O)CF_3$	C_2H_5	Het-9
A-257	$S(=O)CF_3$	C_2H_5	Het-10
A-258	$S(=O)CF_3$	C_2H_5	Het-11
A-259	$S(=O)CF_3$	C_2H_5	Het-12
A-260	$S(=O)CF_3$	C_2H_5	Het-13
A-261	$S(=O)CF_3$	C_2H_5	Het-14
A-262	$S(=O)CF_3$	C_2H_5	Het-15
A-263	$S(=O)CF_3$	C_2H_5	Het-16
A-264	$S(=O)CF_3$	C_2H_5	Het-17
A-265	$S(=O)CF_3$	C_2H_5	Het-18
A-266	$S(=O)CF_3$	C_2H_5	Het-19
A-267	$S(=O)_2CF_3$	CH_3	Het-1
A-268	$S(=O)_2CF_3$	CH_3	Het-2
A-269	$S(=O)_2CF_3$	CH_3	Het-3
A-270	$S(=O)_2CF_3$	CH_3	Het-4
A-271	$S(=O)_2CF_3$	CH_3	Het-5
A-272	$S(=O)_2CF_3$	CH_3	Het-6
A-273	$S(=O)_2CF_3$	CH_3	Het-7
A-274	$S(=O)_2CF_3$	CH_3	Het-8
A-275	$S(=O)_2CF_3$	CH_3	Het-9
A-276	$S(=O)_2CF_3$	CH_3	Het-10
A-277	$S(=O)_2CF_3$	CH_3	Het-11
A-278	$S(=O)_2CF_3$	CH_3	Het-12
A-279	$S(=O)_2CF_3$	CH_3	Het-13
A-280	$S(=O)_2CF_3$	CH_3	Het-14
A-281	$S(=O)_2CF_3$	CH_3	Het-15
A-282	$S(=O)_2CF_3$	CH_3	Het-16
A-283	$S(=O)_2CF_3$	CH_3	Het-17
A-284	$S(=O)_2CF_3$	CH_3	Het-18
A-285	$S(=O)_2CF_3$	CH_3	Het-19
A-286	$S(=O)_2CF_3$	C_2H_5	Het-1
A-287	$S(=O)_2CF_3$	C_2H_5	Het-2
A-288	$S(=O)_2CF_3$	C_2H_5	Het-3
A-289	$S(=O)_2CF_3$	C_2H_5	Het-4
A-290	$S(=O)_2CF_3$	C_2H_5	Het-5
A-291	$S(=O)_2CF_3$	C_2H_5	Het-6
A-292	$S(=O)_2CF_3$	C_2H_5	Het-7
A-293	$S(=O)_2CF_3$	C_2H_5	Het-8
A-294	$S(=O)_2CF_3$	C_2H_5	Het-9

Line	R^1	R^X	Het
A-295	$S(=O)_2CF_3$	C_2H_5	Het-10
A-296	$S(=O)_2CF_3$	C_2H_5	Het-11
A-297	$S(=O)_2CF_3$	C_2H_5	Het-12
A-298	$S(=O)_2CF_3$	C_2H_5	Het-13
A-299	$S(=O)_2CF_3$	C_2H_5	Het-14

Line	R^1	R^X	Het
A-300	$S(=O)_2CF_3$	C_2H_5	Het-15
A-301	$S(=O)_2CF_3$	C_2H_5	Het-16
A-302	$S(=O)_2CF_3$	C_2H_5	Het-17
A-303	$S(=O)_2CF_3$	C_2H_5	Het-18
A-304	$S(=O)_2CF_3$	C_2H_5	Het-19

As used herein, the term “compound(s) of the present invention” or “compound(s) according to the invention” refers to the compound(s) of formula (I) as defined above, which are also referred to as “compound(s) of formula I” or “compound(s) I” or “formula I compound(s)”, and includes their salts, tautomers, stereoisomers, and N-oxides.

The present invention also relates to a mixture of at least one compound of the present invention with at least one mixing partner as defined herein after. Preferred are binary mixtures of one compound of the present invention as component I with one mixing partner as defined herein after as component II. Preferred weight ratios for such binary mixtures are from 5000:1 to 1:5000, preferably from 1000:1 to 1:1000, more preferably from 100:1 to 1:100, particularly preferably from 10:1 to 1:10. In such binary mixtures, components I and II may be used in equal amounts, or an excess of component I, or an excess of component II may be used.

Mixing partners can be selected from pesticides, in particular insecticides, nematicides, and acaricides, fungicides, herbicides, plant growth regulators, fertilizers, and the like. Preferred mixing partners are insecticides, nematicides and fungicides.

The following list M of pesticides, grouped and numbered according the Mode of Action Classification of the Insecticide Resistance Action Committee (IRAC), together with which the compounds of the present invention can be used and with which potential synergistic effects might be produced, is intended to illustrate the possible combinations, but not to impose any limitation:

M.1 Acetylcholine esterase (AChE) inhibitors from the class of: M.1A carbamates, for example aldicarb, alanycarb, bendiocarb, benfuracarb, butocarboxim, butoxycarboxim, carbaryl, carbofuran, carbosulfan, ethiofencarb, fenobucarb, formetanate, furathiocarb, isoprocarb, methiocarb, methomyl, metolcarb, oxamyl, pirimicarb, propoxur, thiodicarb, thiofanox, trimethacarb, XMC, xylylcarb and triazamate; or from the class of M.1B organophosphates, for example acephate, azamethiphos, azinphos-ethyl, azinphosmethyl, cadusafos, chlorethoxyfos, chlorfenvinphos, chlormephos, chlorpyrifos, 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- (methoxyaminothio-phosphoryl) salicylate, isoxathion, malathion, mecarbam, methamidophos, methidathion, mevinphos, monocrotophos, naled, omethoate, oxydemeton-methyl, parathion, parathion-methyl, phenthoate, phorate, phosalone, phosmet, phosphamidon, phoxim, pirimiphos- methyl, profenofos, propetamphos, prothiofos, pyraclofos, pyridaphenthion, quinalphos, sulfotep, tebupirimfos, temephos, terbufos, tetrachlorvinphos, thiometon, triazophos, trichlorfon and vamidothion;

M.2. GABA-gated chloride channel antagonists such as: M.2A cyclodiene organochlorine compounds, as for example endosulfan or chlordane; or M.2B fiproles (phenylpyrazoles), as for example ethiprole, fipronil, flufiprole, pyrafluprole and pyriprole;

M.3 Sodium channel modulators from the class of M.3A pyrethroids, for example acrinathrin, allethrin, d-cis-trans allethrin, d-trans allethrin, bifenthrin, bioallethrin, bioallethrin S-cylclopentenyl, bioresmethrin, cycloprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, gamma-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenothrin, deltamethrin, empenthrin, esfenvalerate, etofenprox, fenpropathrin, fenvalerate, flucythrinate, flumethrin, tau-fluvalinate, halfenprox, heptafluthrin, imiprothrin, meperfluthrin,metofluthrin, momfluorothrin, permethrin, phenothrin, prallethrin, profluthrin, pyrethrin (pyrethrum), resmethrin, silafluofen, tefluthrin, tetramethylfluthrin, tetramethrin, tralomethrin and transfluthrin; or M.3B sodium channel modulators such as DDT or methoxychlor;

M.4 Nicotinic acetylcholine receptor agonists (nAChR) from the class of M.4A neonicotinoids, for example acetamiprid, clothianidin, cycloxaprid, dinotefuran, imidacloprid, nitenpyram, thiacloprid and thiamethoxam; or the compounds M.4A.2: (2E-)-1-[(6-Chloropyridin-3-yl)methyl]-N'-nitro-2-pentylidenehydrazinecarboximidamide; or M4.A.3: 1-[(6-Chloropyridin-3-yl)methyl]-7-methyl-8-nitro-5-propoxy-1,2,3,5,6,7-hexahydroimidazo[1,2-a]pyridine; or from the class M.4B nicotine;

M.5 Nicotinic acetylcholine receptor allosteric activators from the class of spinosyns, for example spinosad or spinetoram;

M.6 Chloride channel activators from the class of avermectins and milbemycins, for example abamectin, emamectin benzoate, ivermectin, lepimectin or milbemectin;

M.7 Juvenile hormone mimics, such as M.7A juvenile hormone analogues as hydroprene, kinoprene and methoprene; or others as M.7B fenoxycarb or M.7C pyriproxyfen;

M.8 miscellaneous non-specific (multi-site) inhibitors, for example M.8A alkyl halides as methyl bromide and other alkyl halides, or M.8B chloropicrin, or M.8C sulfuryl fluoride, or M.8D borax, or M.8E tartar emetic;

M.9 Selective homopteran feeding blockers, for example M.9B pymetrozine, or M.9C flonicamid;

M.10 Mite growth inhibitors, for example M.10A clofentezine, hexythiazox and diflovidazin, or M.10B etoxazole;

M.11 Microbial disruptors of insect midgut membranes, for example *bacillus thuringiensis* or *bacillus sphaericus* and the insecticdal proteins they produce such as *bacillus thuringiensis subsp. israelensis*, *bacillus sphaericus*, *bacillus thuringiensis subsp. aizawai*, *bacillus thuringiensis subsp. kurstaki* and *bacillus thuringiensis subsp. tenebrionis*, or the Bt crop proteins: Cry1Ab, Cry1Ac, Cry1Fa, Cry2Ab, mCry3A, Cry3Ab, Cry3Bb and Cry34/35Ab1;

M.12 Inhibitors of mitochondrial ATP synthase, for example M.12A diafenthiuron, or M.12B organotin miticides such as azocyclotin, cyhexatin or fenbutatin oxide, or M.12C propargite, or M.12D tetradifon;

M.13 Uncouplers of oxidative phosphorylation via disruption of the proton gradient, for example chlorfenapyr, DNOC or sulfluramid;

M.14 Nicotinic acetylcholine receptor (nAChR) channel blockers, for example nereistoxin analogues as bensultap, cartap hydrochloride, thiocyclam or thiosultap sodium;

M.15 Inhibitors of the chitin biosynthesis type 0, such as benzoylureas as for example bistrifluron, chlorfluazuron, diflubenzuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, noviflumuron, teflubenzuron or triflumuron;

M.16 Inhibitors of the chitin biosynthesis type 1, as for example buprofezin;

M.17 Moulting disruptors, Dipteran, as for example cyromazine;

M.18 Ecdyson receptor agonists such as diacylhydrazines, for example methoxyfenozide, tebufenozide, halofenozide, fufenozide or chromafenozide;

M.19 Octopamin receptor agonists, as for example amitraz;

M.20 Mitochondrial complex III electron transport inhibitors, for example M.20A hydramethylnon, or M.20B acequinocyl, or M.20C fluacrypyrim;

M.21 Mitochondrial complex I electron transport inhibitors, for example M.21A METI acaricides and insecticides such as fenazaquin, fenpyroximate, pyrimidifen, pyridaben, tebufenpyrad or tolfenpyrad, or M.21B rotenone;

M.22 Voltage-dependent sodium channel blockers, for example M.22A indoxacarb, or M.22B metaflumizone, or M.22B.1: 2-[2-(4-Cyanophenyl)-1-[3-(trifluoromethyl)phenyl]ethylidene]-N-[4-(difluoromethoxy)phenyl]-hydrazinecarboxamide or M.22B.2: N-(3-Chloro-2-methylphenyl)-2-[(4-chlorophenyl)[4-[methyl(methylsulfonyl)amino]phenyl]methylene]-hydrazinecarboxamide;

M.23 Inhibitors of the of acetyl CoA carboxylase, such as Tetronic and Tetramic acid derivatives, for example spirodiclofen, spiromesifen or spirotetramat;

M.24 Mitochondrial complex IV electron transport inhibitors, for example M.24A phosphine such as aluminium phosphide, calcium phosphide, phosphine or zinc phosphide, or M.24B cyanide;

M.25 Mitochondrial complex II electron transport inhibitors, such as beta-ketonitrile derivatives, for example cyenopyrafen or cyflumetofen;

M.28 Ryanodine receptor-modulators from the class of diamides, as for example flubendiamide, chlorantraniliprole (rynaxypyr®), cyantraniliprole (cyazypyr®), tetraniliprole, or the phthalamide compounds M.28.1: (R)-3-Chlor-N1-{2-methyl-4-[1,2,2,2 –tetrafluor-1-(trifluormethyl)ethyl]phenyl}-N2-(1-methyl-2-methylsulfonylethyl)phthalamid and M.28.2: (S)-3-Chlor-N1-{2-methyl-4-[1,2,2,2 –tetrafluor-1-(trifluormethyl)ethyl]phenyl}-N2-(1-methyl-2-methylsulfonylethyl)phthalamid, or the compound M.28.3: 3-bromo-N-{2-bromo-4-chloro-6-[(1-cyclopropylethyl)carbamoyl]phenyl}-1-(3-chlorpyridin-2-yl)-1H-pyrazole-5-carboxamide (proposed ISO name: cyclaniliprole), or the compound M.28.4: methyl-2-[3,5-dibromo-2-({[3-bromo-1-(3-chlorpyridin-2-yl)-1H-pyrazol-5-yl]carbonyl}-amino)benzoyl]-1,2-dimethylhydrazinecarboxylate; or a compound selected from M.28.5a) to M.28.5d) and M.28.5h) to M.28.5l): M.28.5a) N-[4,6-dichloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; M.28.5b) N-[4-chloro-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; M.28.5c) N-[4-chloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-6-methyl-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; M.28.5d) N-[4,6-dichloro-2-[(di-2-propyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide; M.28.5h) N-[4,6-dibromo-2-[(diethyl-lambda-4-sulfanylidene)carbamoyl]-phenyl]-2-(3-chloro-2-pyridyl)-5-(trifluoromethyl)pyrazole-3-carboxamide;

M.28.5i) 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; M.28.5j) 3-Chloro-1-(3-chloro-2-pyridinyl)-N-[2,4-dichloro-6-[[(1-cyano-1-methylethyl)amino]carbonyl]phenyl]-1H-pyrazole-5-carboxamide; M.28.5k) 3-Bromo-N-[2,4-dichloro-6-(methylcarbamoyl)phenyl]-1-(3,5-dichloro-2-pyridyl)-1H-pyrazole-5-carboxamide; M.28.5l) N-[4-Chloro-2-[[(1,1-dimethylethyl)amino]carbonyl]-6-methylphenyl]-1-(3-chloro-2-pyridinyl)-3-(fluoromethoxy)-1H-pyrazole-5-carboxamide; or

M.28.6: cyhalodiamide; or;

M.29. insecticidal active compounds of unknown or uncertain mode of action, as for example afidopyropen, afoxolaner, azadirachtin, amidoflumet, benzoximate, bifenazate, broflanilide, bromopropylate, chinomethionat, cryolite, dicloromezotiaz, dicofol, flufenerim, flometoquin, fluensulfone, fluhexafon, fluopyram, flupyradifurone, fluralaner, metoxadiazone, piperonyl butoxide, pyflubumide, pyridalyl, pyrifluquinazon, sulfoxaflor, tioxazafen, triflumezopyrim, or the compounds

M.29.3: 11-(4-chloro-2,6-dimethylphenyl)-12-hydroxy-1,4-dioxa-9-azadispiro[4.2.4.2]-tetradec-11-en-10-one, or the compound

M.29.4: 3-(4'-fluoro-2,4-dimethylbiphenyl-3-yl)-4-hydroxy-8-oxa-1-azaspiro[4.5]dec-3-en-2-one, or the compound

M.29.5: 1-[2-fluoro-4-methyl-5-[(2,2,2-trifluoroethyl)sulfinyl]phenyl]-3-(trifluoromethyl)-1H-1,2,4-triazole-5-amine, or actives on basis of *bacillus firmus* (Votivo, I-1582); or

a compound selected from the group of M.29.6, wherein the compound is selected from M.29.6a) to M.29.6k): M.29.6a) (E/Z)-N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2,2-trifluoro-acetamide; M.29.6b) (E/Z)-N-[1-[(6-chloro-5-fluoro-3-pyridyl)methyl]-2-pyridylidene]-2,2,2-trifluoro-acetamide; M.29.6c) (E/Z)-2,2,2-trifluoro-N-[1-[(6-fluoro-3-pyridyl)methyl]-2-pyridylidene]acetamide; M.29.6d) (E/Z)-N-[1-[(6-bromo-3-pyridyl)methyl]-2-pyridylidene]-2,2,2-trifluoro-acetamide; M.29.6e) (E/Z)-N-[1-[1-(6-chloro-3-pyridyl)ethyl]-2-pyridylidene]-2,2,2-trifluoro-acetamide; M.29.6f) (E/Z)-N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2-difluoro-acetamide; M.29.6g) (E/Z)-2-chloro-N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2-difluoro-acetamide; M.29.6h) (E/Z)-N-[1-[(2-chloropyrimidin-5-yl)methyl]-2-pyridylidene]-2,2,2-trifluoro-acetamide; M.29.6i) (E/Z)-N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2,3,3,3-pentafluoro-propanamide.); M.29.6j) N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2,2-trifluoro-thioacetamide; or M.29.6k) N-[1-[(6-chloro-3-pyridyl)methyl]-2-pyridylidene]-2,2,2-trifluoro-N'-isopropyl-acetamidine; or the compounds

M.29.8: fluazaindolizine; or the compounds

M.29.9.a): 4-[5-(3,5-dichlorophenyl)-5-(trifluoromethyl)-4H-isoxazol-3-yl]-2-methyl-N-(1-oxothietan-3-yl)benzamide; or M.29.9.b): fluxametamide; or

M.29.10: 5-[3-[2,6-dichloro-4-(3,3-dichloroallyloxy)phenoxy]propoxy]-1H-pyrazole; or

a compound selected from the group of M.29.11, wherein the compound is selected from M.29.11b) to M.29.11p): M.29.11.b) 3-(benzoylmethylamino)-N-[2-bromo-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]-6-(trifluoromethyl)phenyl]-2-fluoro-benzamide; M.29.11.c) 3-(benzoylmethylamino)-2-fluoro-N-[2-iodo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]-benzamide; M.29.11.d) N-[3-[[[2-iodo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]amino]carbonyl]phenyl]-N-methyl-benzamide; M.29.11.e) N-[3-[[[2-bromo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]amino]carbonyl]-2-fluorophenyl]-4-

fluoro-N-methyl-benzamide; M.29.11.f) 4-fluoro-N-[2-fluoro-3-[[[2-iodo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]amino]carbonyl]phenyl]-N-methyl-benzamide; M.29.11.g) 3-fluoro-N-[2-fluoro-3-[[[2-iodo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]amino]carbonyl]phenyl]-N-methyl-benzamide; M.29.11.h) 2-chloro-N-[3-[[[2-iodo-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]-6-(trifluoromethyl)phenyl]amino]carbonyl]phenyl]- 3-pyridinecarboxamide; M.29.11.i) 4-cyano-N-[2-cyano-5-[[2,6-dibromo-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]phenyl]carbamoyl]phenyl]-2-methyl-benzamide; M.29.11.j) 4-cyano-3-[(4-cyano-2-methyl-benzoyl)amino]-N-[2,6-dichloro-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]phenyl]-2-fluoro-benzamide; M.29.11.k) N-[5-[[2-chloro-6-cyano-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]phenyl]carbamoyl]-2-cyano-phenyl]-4-cyano-2-methyl-benzamide; M.29.11.l) N-[5-[[2-bromo-6-chloro-4-[2,2,2-trifluoro-1-hydroxy-1-(trifluoromethyl)ethyl]phenyl]carbamoyl]-2-cyano-phenyl]-4-cyano-2-methyl-benzamide; M.29.11.m) N-[5-[[2-bromo-6-chloro-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]phenyl]carbamoyl]-2-cyano-phenyl]-4-cyano-2-methyl-benzamide; M.29.11.n) 4-cyano-N-[2-cyano-5-[[2,6-dichloro-4-[1,2,2,3,3,3-hexafluoro-1-(trifluoromethyl)propyl]phenyl]carbamoyl]phenyl]-2-methyl-benzamide; M.29.11.o) 4-cyano-N-[2-cyano-5-[[2,6-dichloro-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl]carbamoyl]phenyl]-2-methyl-benzamide; M.29.11.p) N-[5-[[2-bromo-6-chloro-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl]carbamoyl]-2-cyano-phenyl]-4-cyano-2-methyl-benzamide; or

a compound selected from the group of M.29.12, wherein the compound is selected from M.29.12a) to M.29.12m): M.29.12.a) 2-(1,3-Dioxan-2-yl)-6-[2-(3-pyridinyl)-5-thiazolyl]-pyridine; M.29.12.b) 2-[6-[2-(5-Fluoro-3-pyridinyl)-5-thiazolyl]-2-pyridinyl]-pyrimidine; M.29.12.c) 2-[6-[2-(3-Pyridinyl)-5-thiazolyl]-2-pyridinyl]-pyrimidine; M.29.12.d) N-Methylsulfonyl-6-[2-(3-pyridyl)thiazol-5-yl]pyridine-2-carboxamide; M.29.12.e) N-Methylsulfonyl-6-[2-(3-pyridyl)thiazol-5-yl]pyridine-2-carboxamide; M.29.12.f) N-Ethyl-N-[4-methyl-2-(3-pyridyl)thiazol-5-yl]-3-methylthio-propanamide; M.29.12.g) N-Methyl-N-[4-methyl-2-(3-pyridyl)thiazol-5-yl]-3-methylthio-propanamide; M.29.12.h) N,2-Dimethyl-N-[4-methyl-2-(3-pyridyl)thiazol-5-yl]-3-methylthio-propanamide; M.29.12.i) N-Ethyl-2-methyl-N-[4-methyl-2-(3-pyridyl)thiazol-5-yl]-3-methylthio-propanamide; M.29.12.j) N-[4-Chloro-2-(3-pyridyl)thiazol-5-yl]-N-ethyl-2-methyl-3-methylthio-propanamide; M.29.12.k) N-[4-Chloro-2-(3-pyridyl)thiazol-5-yl]-N,2-dimethyl-3-methylthio-propanamide; M.29.12.l) N-[4-Chloro-2-(3-pyridyl)thiazol-5-yl]-N-methyl-3-methylthio-propanamide; M.29.12.m) N-[4-Chloro-2-(3-pyridyl)thiazol-5-yl]-N-ethyl-3-methylthio-propanamide; or the compounds

M.29.14a) 1-[(6-Chloro-3-pyridinyl)methyl]-1,2,3,5,6,7-hexahydro-5-methoxy-7-methyl-8-nitro-imidazo[1,2-a]pyridine; or M.29.14b) 1-[(6-Chloropyridin-3-yl)methyl]-7-methyl-8-nitro-1,2,3,5,6,7-hexahydroimidazo[1,2-a]pyridin-5-ol; or the compounds

M.29.16a) 1-isopropyl-N,5-dimethyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; or M.29.16b) 1-(1,2-dimethylpropyl)-N-ethyl-5-methyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16c) N,5-dimethyl-N-pyridazin-4-yl-1-(2,2,2-trifluoro-1-methyl-ethyl)pyrazole-4-carboxamide; M.29.16d) 1-[1-(1-cyanocyclopropyl)ethyl]-N-ethyl-5-methyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16e) N-ethyl-1-(2-fluoro-1-methyl-propyl)-5-methyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16f) 1-(1,2-dimethylpropyl)-N,5-dimethyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16g) 1-[1-(1-cyanocyclopropyl)ethyl]-N,5-dimethyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16h) N-methyl-1-

(2-fluoro-1-methyl-propyl]-5-methyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; M.29.16i) 1-(4,4-difluorocyclohexyl)-N-ethyl-5-methyl-N-pyridazin-4-yl-pyrazole-4-carboxamide; or M.29.16j) 1-(4,4-difluorocyclohexyl)-N,5-dimethyl-N-pyridazin-4-yl-pyrazole-4-carboxamide, or

M.29.17 a compound selected from the compounds M.29.17a) to M.29.17j): M.29.17a) N-(1-methylethyl)-2-(3-pyridinyl)-2H-indazole-4-carboxamide; M.29.17b) N-cyclopropyl-2-(3-pyridinyl)-2H-indazole-4-carboxamide; M.29.17c) N-cyclohexyl-2-(3-pyridinyl)-2H-indazole-4-carboxamide; M.29.17d) 2-(3-pyridinyl)-N-(2,2,2-trifluoroethyl)-2H-indazole-4-carboxamide; M.29.17e) 2-(3-pyridinyl)-N-[(tetrahydro-2-furanyl)methyl]-2H-indazole-5-carboxamide; M.29.17f) methyl 2-[[2-(3-pyridinyl)-2H-indazol-5-yl]carbonyl]hydrazinecarboxylate; M.29.17g) N-[(2,2-difluorocyclopropyl)methyl]-2-(3-pyridinyl)-2H-indazole-5-carboxamide; M.29.17h) N-(2,2-difluoropropyl)-2-(3-pyridinyl)-2H-indazole-5-carboxamide; M.29.17i) 2-(3-pyridinyl)-N-(2-pyrimidinylmethyl)-2H-indazole-5-carboxamide; M.29.17j) N-[(5-methyl-2-pyrazinyl)methyl]-2-(3-pyridinyl)-2H-indazole-5-carboxamide, or

M.29.18 a compound selected from the compounds M.29.18a) to M.29.18d): M.29.18a) N-[3-chloro-1-(3-pyridyl)pyrazol-4-yl]-N-ethyl-3-(3,3,3-trifluoropropylsulfanyl)propanamide; M.29.18b) N-[3-chloro-1-(3-pyridyl)pyrazol-4-yl]-N-ethyl-3-(3,3,3-trifluoropropylsulfinyl)propanamide; M.29.18c) N-[3-chloro-1-(3-pyridyl)pyrazol-4-yl]-3-[(2,2-difluorocyclopropyl)methylsulfanyl]-N-ethyl-propanamide; M.29.18d) N-[3-chloro-1-(3-pyridyl)pyrazol-4-yl]-3-[(2,2-difluorocyclopropyl)methylsulfinyl]-N-ethyl-propanamide; or the compound

M.29.19 sarolaner, or the compound

M.29.20 lotilaner.

The commercially available compounds of the group M listed above may be found in The Pesticide Manual, 16th Edition, C. MacBean, British Crop Protection Council (2013) among other publications. The online Pesticide Manual is updated regularly and is accessible through http://bcpcdata.com/pesticide-manual.html.

Another online data base for pesticides providing the ISO common names is http://www.alanwood.net/pesticides.

The M.4 neonicotinoid cycloxaprid is known from WO2010/069266 and WO2011/069456, the neonicotinoid M.4A.2, sometimes also to be named as guadipyr, is known from WO2013/003977, and the neonicotinoid M.4A.3 (approved as paichongding in China) is known from WO2007/101369. The metaflumizone analogue M.22B.1 is described in CN10171577 and the analogue M.22B.2 in CN102126994. The phthalamides M.28.1 and M.28.2 are both known from WO2007/101540. The anthranilamide M.28.3 is described in WO2005/077934. The hydrazide compound M.28.4 is described in WO2007/043677. The anthranilamides M.28.5a) to M.28.5d) and M.28.5h) are described in WO 2007/006670, WO2013/024009 and WO2013/024010, the anthranilamide M.28.5i) is described in WO2011/085575, M.28.5j) in WO2008/134969, M.28.5k) in US2011/046186 and M.28.5l) in WO2012/034403. The diamide compound M.28.6 can be found in WO2012/034472. The spiroketal-substituted cyclic ketoenol derivative M.29.3 is known from WO2006/089633 and the biphenyl-substituted spirocyclic ketoenol derivative M.29.4 from WO2008/067911. The triazoylphenylsulfide M.29.5 is described in WO2006/043635, and biological control agents on the basis of *bacillus firmus* are described in WO2009/124707. The compounds M.29.6a) to M.29.6i) listed under

M.29.6 are described in WO2012/029672, and M.29.6j) and M.29.6k) in WO2013/129688. The nematicide M.29.8 is known from WO2013/055584. The isoxazoline M.29.9.a) is described in WO2013/050317. The isoxazoline M.29.9.b) is described in WO2014/126208. The pyridalyl-type analogue M.29.10 is known from WO2010/060379. The carboxamides broflanilide and M.29.11.b) to M.29.11.h) are described in WO2010/018714, and the carboxamides M.29.11i) to M.29.11.p) in WO2010/127926. The pyridylthiazoles M.29.12.a) to M.29.12.c) are known from WO2010/006713, M.29.12.d) and M.29.12.e) are known from WO2012/000896, and M.29.12.f) to M.29.12.m) from WO2010/129497. The compounds M.29.14a) and M.29.14b) are known from WO2007/101369. The pyrazoles M.29.16.a) to M.29.16h) are described in WO2010/034737, WO2012/084670, and WO2012/143317, respectively, and the pyrazoles M.29.16i) and M.29.16j) are described in US 61/891437. The pyridinylindazoles M.29.17a) to M.29.17.j) are described in WO2015/038503. The pyridylpyrazoles M.29.18a) to M.29.18d) are described in US2014/0213448. The isoxazoline M.29.19 is described in WO2014/036056. The isoxazoline M.29.20 is known from WO2014/090918.

The following list of fungicides, in conjunction with which the compounds of the present invention can be used, is intended to illustrate the possible combinations but does not limit them:

A) Respiration inhibitors

- Inhibitors of complex III at Q_o site (e. g. strobilurins): azoxystrobin (A.1.1), coumethoxystrobin (A.1.2), coumoxystrobin (A.1.3), dimoxystrobin (A.1.4), enestroburin (A.1.5), fenaminstrobin (A.1.6), fenoxystrobin/flufenoxystrobin (A.1.7), fluoxastrobin (A.1.8), kresoxim-methyl (A.1.9), mandestrobin (A.1.10), metominostrobin (A.1.11), orysastrobin (A.1.12), picoxy.strobin (A.1.13), pyraclostrobin (A.1.14), pyrametostrobin (A.1.15), pyraoxystrobin (A.1.16), trifloxystrobin (A.1.17), 2-(2-(3-(2,6-dichlorophenyl)-1-methyl-allylideneaminooxymethyl)-phenyl)-2-methoxyimino-N-methyl-acetamide (A.1.18), pyribencarb (A.1.19), triclopyricarb/chlorodincarb (A.1.20), famoxadone (A.1.21), fenamidone (A.1.21), methyl-*N*-[2-[(1,4-dimethyl-5-phenyl-pyrazol-3-yl)oxylmethyl]phenyl]-N-methoxy-carbamate (A.1.22), 1-[3-chloro-2-[[1-(4-chlorophenyl)-1H-pyrazol-3-yl]oxymethyl]phenyl]-4-methyl-tetrazol-5-one (A.1.23), 1-[3-bromo-2-[[1-(4-chlorophenyl)pyrazol-3-yl]oxymethyl]phenyl]-4-methyl-tetrazol-5-one (A.1.24), 1-[2-[[1-(4-chlorophenyl)pyrazol-3-yl]oxymethyl]-3-methyl-phenyl]-4-methyl-tetrazol-5-one (A.1.25), 1-[2-[[1-(4-chlorophenyl)pyrazol-3-yl]oxymethyl]-3-fluoro-phenyl]-4-methyl-tetrazol-5-one (A.1.26), 1-[2-[[1-(2,4-dichlorophenyl)pyrazol-3-yl]oxymethyl]-3-fluoro-phenyl]-4-methyl-tetrazol-5-one (A.1.27), 1-[2-[[4-(4-chlorophenyl)thiazol-2-yl]oxymethyl]-3-methyl-phenyl]-4-methyl-tetrazol-5-one (A.1.28), 1-[3-chloro-2-[[4-(p-tolyl)thiazol-2-yl]oxymethyl]phenyl]-4-methyl-tetrazol-5-one (A.1.29), 1-[3-cyclopropyl-2-[[2-methyl-4-(1-methylpyrazol-3-yl)phenoxy]methyl]phenyl]-4-methyl-tetrazol-5-one (A.1.30), 1-[3-(difluoromethoxy)-2-[[2-methyl-4-(1-methylpyrazol-3-yl)phenoxy]methyl]phenyl]-4-methyl-tetrazol-5-one (A.1.31), 1-methyl-4-[3-methyl-2-[[2-methyl-4-(1-methylpyrazol-3-yl)phenoxy]methyl]phenyl]tetrazol-5-one (A.1.32), 1-methyl-4-[3-methyl-2-[[1-[3-(trifluoromethyl)phenyl]-ethylideneamino]oxymethyl]phenyl]tetrazol-5-one (A.1.33), (*Z*,2*E*)-5-[1-(2,4-dichlorophenyl)pyrazol-3-yl]-oxy-2-methoxyimino-*N*,3-dimethyl-pent-3-enamide (A.1.34), (*Z*,2*E*)-5-[1-(4-chlorophenyl)pyrazol-3-yl]oxy-2-methoxyimino-*N*,3-dimethyl-pent-3-enamide (A.1.35), (*Z*,2*E*)-5-[1-(4-chloro-2-fluoro-phenyl)pyrazol-3-yl]oxy-2-methoxyimino-*N*,3-dimethyl-pent-3-enamide (A.1.36),

- inhibitors of complex III at Q_i site: cyazofamid (A.2.1), amisulbrom (A.2.2), [(3S,6S,7R,8R)-8-benzyl-3-[(3-acetoxy-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate (A.2.3), [(3S,6S,7R,8R)-8-benzyl-3-[[3-(acetoxymethoxy)-4-methoxy-pyridine-2-carbonyl]amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate (A.2.4), [(3S,6S,7R,8R)-8-benzyl-3-[(3-isobutoxycarbonyloxy-4-methoxy-pyridine-2-carbonyl)amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate (A.2.5), [(3S,6S,7R,8R)-8-benzyl-3-[[3-(1,3-benzodioxol-5-ylmethoxy)-4-methoxy-pyridine-2-carbonyl]amino]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl] 2-methylpropanoate (A.2.6); (3S,6S,7R,8R)-3-[[(3-hydroxy-4-methoxy-2-pyridinyl)carbonyl]amino]-6-methyl-4,9-dioxo-8-(phenylmethyl)-1,5-dioxonan-7-yl 2-methylpropanoate (A.2.7), (3S,6S,7R,8R)-8-benzyl-3-[3-[(isobutyryloxy)methoxy]-4-methoxypicolinamido]-6-methyl-4,9-dioxo-1,5-dioxonan-7-yl isobutyrate (A.2.8);

- inhibitors of complex II (e. g. carboxamides): benodanil (A.3.1), benzovindiflupyr (A.3.2), bixafen (A.3.3), boscalid (A.3.4), carboxin (A.3.5), fenfuram (A.3.6), fluopyram (A.3.7), flutolanil (A.3.8), fluxapyroxad (A.3.9), furametpyr (A.3.10), isofetamid (A.3.11), isopyrazam (A.3.12), mepronil (A.3.13), oxycarboxin (A.3.14), penflufen (A.3.14), penthiopyrad (A.3.15), sedaxane (A.3.16), tecloftalam (A.3.17), thifluzamide (A.3.18), N-(4'-trifluoromethylthiobiphenyl-2-yl)-3-difluoromethyl-1-methyl-1H-pyrazole-4-carboxamide (A.3.19), N-(2-(1,3,3-trimethyl-butyl)-phenyl)-1,3-dimethyl-5-fluoro-1H-pyrazole-4-carboxamide (A.3.20), 3-(difluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide (A.3.21), 3-(trifluoromethyl)-1-methyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide (A.3.22), 1,3-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide (A.3.23), 3-(trifluoromethyl)-1,5-dimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide (A.3.24), 1,3,5-trimethyl-N-(1,1,3-trimethylindan-4-yl)pyrazole-4-carboxamide (A.3.25), N-(7-fluoro-1,1,3-trimethyl-indan-4-yl)-1,3-dimethyl-pyrazole-4-carboxamide (A.3.26), N-[2-(2,4-dichlorophenyl)-2-methoxy-1-methyl-ethyl]-3-(difluoromethyl)-1-methyl-pyrazole-4-carboxamide (A.3.27);

- other respiration inhibitors (e. g. complex I, uncouplers): diflumetorim (A.4.1), (5,8-difluoro-quinazolin-4-yl)-{2-[2-fluoro-4-(4-trifluoromethylpyridin-2-yloxy)-phenyl]-ethyl}-amine (A.4.2); nitrophenyl derivates: binapacryl (A.4.3), dinobuton (A.4.4), dinocap (A.4.5), fluazinam (A.4.6); ferimzone (A.4.7); organometal compounds: fentin salts, such as fentin-acetate (A.4.8), fentin chloride (A.4.9) or fentin hydroxide (A.4.10); ametoctradin (A.4.11); and silthiofam (A.4.12);

B) Sterol biosynthesis inhibitors (SBI fungicides)

- C14 demethylase inhibitors (DMI fungicides): triazoles: azaconazole (B.1.1), bitertanol (B.1.2), bromuconazole (B.1.3), cyproconazole (B.1.4), difenoconazole (B.1.5), diniconazole (B.1.6), diniconazole-M (B.1.7), epoxiconazole (B.1.8), fenbuconazole (B.1.9), fluquinconazole (B.1.10), flusilazole (B.1.11), flutriafol (B.1.12), hexaconazole (B.1.13), imibenconazole (B.1.14), ipconazole (B.1.15), metconazole (B.1.17), myclobutanil (B.1.18), oxpoconazole (B.1.19), paclobutrazole (B.1.20), penconazole (B.1.21), propiconazole (B.1.22), prothioconazole (B.1.23), simeconazole (B.1.24), tebuconazole (B.1.25), tetraconazole (B.1.26), triadimefon (B.1.27), triadimenol (B.1.28), triticonazole (B.1.29), uniconazole (B.1.30), 1-[*rel*-(2*S*;3*R*)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-oxiranylmethyl]-5-thiocyanato-1H-[1,2,4]triazolo (B.1.31), 2-[*rel*-(2*S*;3*R*)-3-(2-chlorophenyl)-2-(2,4-difluorophenyl)-oxiranylmethyl]-2H-[1,2,4]triazole-3-thiol (B.1.32), 2-[2-chloro-4-(4-

chlorophenoxy)phenyl]-1-(1,2,4-triazol-1-yl)pentan-2-ol (B.1.33), 1-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-cyclopropyl-2-(1,2,4-triazol-1-yl)ethanol (B.1.34), 2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1,2,4-triazol-1-yl)butan-2-ol (B.1.35), 2-[2-chloro-4-(4-chlorophenoxy)phenyl]-1-(1,2,4-triazol-1-yl)butan-2-ol (B.1.36), 2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-3-methyl-1-(1,2,4-triazol-1-yl)butan-2-ol (B.1.37), 2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1,2,4-triazol-1-yl)propan-2-ol (B.1.38), 2-[2-chloro-4-(4-chlorophenoxy)phenyl]-3-methyl-1-(1,2,4-triazol-1-yl)butan-2-ol (B.1.39), 2-[4-(4-chlorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1,2,4-triazol-1-yl)pentan-2-ol (B.1.40), 2-[4-(4-fluorophenoxy)-2-(trifluoromethyl)phenyl]-1-(1,2,4-triazol-1-yl)propan-2-ol (B.1.41), 2-[2-chloro-4-(4-chlorophenoxy)phenyl]-1-(1,2,4-triazol-1-yl)pent-3-yn-2-ol (B.1.51); imidazoles: imazalil (B.1.42), pefurazoate (B.1.43), prochloraz (B.1.44), triflumizol (B.1.45); pyrimidines, pyridines and piperazines: fenarimol (B.1.46), nuarimol (B.1.47), pyrifenox (B.1.48), triforine (B.1.49), [3-(4-chloro-2-fluoro-phenyl)-5-(2,4-difluorophenyl)isoxazol-4-yl]-(3-pyridyl)methanol (B.1.50);

- Delta14-reductase inhibitors: aldimorph (B.2.1), dodemorph (B.2.2), dodemorph-acetate (B.2.3), fenpropimorph (B.2.4), tridemorph (B.2.5), fenpropidin (B.2.6), piperalin (B.2.7), spiroxamine (B.2.8);
- Inhibitors of 3-keto reductase: fenhexamid (B.3.1);

C) Nucleic acid synthesis inhibitors

- phenylamides or acyl amino acid fungicides: benalaxyl (C.1.1), benalaxyl-M (C.1.2), kiralaxyl (C.1.3), metalaxyl (C.1.4), metalaxyl-M (mefenoxam, C.1.5), ofurace (C.1.6), oxadixyl (C.1.7);
- others: hymexazole (C.2.1), octhilinone (C.2.2), oxolinic acid (C.2.3), bupirimate (C.2.4), 5-fluorocytosine (C.2.5), 5-fluoro-2-(p-tolylmethoxy)pyrimidin-4-amine (C.2.6), 5-fluoro-2-(4-fluorophenylmethoxy)pyrimidin-4-amine (C.2.7);

D) Inhibitors of cell division and cytoskeleton

- tubulin inhibitors, such as benzimidazoles, thiophanates: benomyl (D1.1), carbendazim (D1.2), fuberidazole (D1.3), thiabendazole (D1.4), thiophanate-methyl (D1.5); triazolopyrimidines: 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)-[1,2,4]triazolo[1,5-a]pyrimidine (D1.6);
- other cell division inhibitors: diethofencarb (D2.1), ethaboxam (D2.2), pencycuron (D2.3), fluopicolide (D2.4), zoxamide (D2.5), metrafenone (D2.6), pyriofenone (D2.7);

E) Inhibitors of amino acid and protein synthesis

- methionine synthesis inhibitors (anilino-pyrimidines): cyprodinil (E.1.1), mepanipyrim (E.1.2), pyrimethanil (E.1.3);
- protein synthesis inhibitors: blasticidin-S (E.2.1), kasugamycin (E.2.2), kasugamycin hydrochloride-hydrate (E.2.3), mildiomycin (E.2.4), streptomycin (E.2.5), oxytetracyclin (E.2.6), polyoxine (E.2.7), validamycin A (E.2.8);

F) Signal transduction inhibitors

- MAP / histidine kinase inhibitors: fluoroimid (F.1.1), iprodione (F.1.2), procymidone (F.1.3), vinclozolin (F.1.4), fenpiclonil (F.1.5), fludioxonil (F.1.6);
- G protein inhibitors: quinoxyfen (F.2.1);

G) Lipid and membrane synthesis inhibitors

- Phospholipid biosynthesis inhibitors: edifenphos (G.1.1), iprobenfos (G.1.2), pyrazophos

(G.1.3), isoprothiolane (G.1.4);

- lipid peroxidation: dicloran (G.2.1), quintozene (G.2.2), tecnazene (G.2.3), tolclofos-methyl (G.2.4), biphenyl (G.2.5), chloroneb (G.2.6), etridiazole (G.2.7);
- phospholipid biosynthesis and cell wall deposition: dimethomorph (G.3.1), flumorph (G.3.2), mandipropamid (G.3.3), pyrimorph (G.3.4), benthiavalicarb (G.3.5), iprovalicarb (G.3.6), valifenalate (G.3.7) and N-(1-(1-(4-cyano-phenyl)ethanesulfonyl)-but-2-yl) carbamic acid-(4-fluorophenyl) ester (G.3.8);
- compounds affecting cell membrane permeability and fatty acides: propamocarb (G.4.1);
- fatty acid amide hydrolase inhibitors: oxathiapiprolin (G.5.1), 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 (G.5.2), 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 (G.5.3);

H) Inhibitors with Multi Site Action

- inorganic active substances: Bordeaux mixture (H.1.1), copper acetate (H.1.2), copper hydroxide (H.1.3), copper oxychloride (H.1.4), basic copper sulfate (H.1.5), sulfur (H.1.6);
- thio- and dithiocarbamates: ferbam (H.2.1), mancozeb (H.2.2), maneb (H.2.3), metam (H.2.4), metiram (H.2.5), propineb (H.2.6), thiram (H.2.7), zineb (H.2.8), ziram (H.2.9);
- organochlorine compounds (e. g. phthalimides, sulfamides, chloronitriles): anilazine (H.3.1), chlorothalonil (H.3.2), captafol (H.3.3), captan (H.3.4), folpet (H.3.5), dichlofluanid (H.3.6), dichlorophen (H.3.7), hexachlorobenzene (H.3.8), pentachlorphenole (H.3.9) and its salts, phthalide (H.3.10), tolylfluanid (H.3.11), N-(4-chloro-2-nitro-phenyl)-N-ethyl-4-methyl-benzenesulfonamide (H.3.12);
- guanidines and others: guanidine (H.4.1), dodine (H.4.2), dodine free base (H.4.3), guazatine (H.4.4), guazatine-acetate (H.4.5), iminoctadine (H.4.6), iminoctadine-triacetate (H.4.7), iminoctadine-tris(albesilate) (H.4.8), dithianon (H.4.9), 2,6-dimethyl-1H,5H-[1,4]dithiino[2,3-c:5,6-c']dipyrrole-1,3,5,7(2H,6H)-tetraone (H.4.10);

I) Cell wall synthesis inhibitors

- inhibitors of glucan synthesis: validamycin (I.1.1), polyoxin B (I.1.2);
- melanin synthesis inhibitors: pyroquilon (I.2.1), tricyclazole (I.2.2), carpropamid (I.2.3), diclomet (I.2.4), fenoxanil (I.2.5);

J) Plant defence inducers

- acibenzolar-S-methyl (J.1.1), probenazole (J.1.2), isotianil (J.1.3), tiadinil (J.1.4), prohexadione-calcium (J.1.5); phosphonates: fosetyl (J.1.6), fosetyl-aluminum (J.1.7), phosphorous acid and its salts (J.1.8), potassium or sodium bicarbonate (J.1.9);

K) Unknown mode of action

- bronopol (K.1.1), chinomethionat (K.1.2), cyflufenamid (K.1.3), cymoxanil (K.1.4), dazomet (K.1.5), debacarb (K.1.6), diclomezine (K.1.7), difenzoquat (K.1.8), difenzoquat-methylsulfate (K.1.9), diphenylamin (K.1.10), fenpyrazamine (K.1.11), flumetover (K.1.12), flusulfamide (K.1.13), flutianil (K.1.14), methasulfocarb (K.1.15), nitrapyrin (K.1.16), nitrothal-isopropyl (K.1.18), oxathiapiprolin (K.1.19), tolprocarb (K.1.20), oxin-copper (K.1.21), proquinazid (K.1.22), tebufloquin (K.1.23), tecloftalam (K.1.24), triazoxide (K.1.25), 2-butoxy-6-iodo-3-propylchromen-4-one (K.1.26),

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 (K.1.27), 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 (K.1.28), 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 (K.1.29), N-(cyclopropylmethoxyimino-(6-difluoro-methoxy-2,3-difluoro-phenyl)-methyl)-2-phenyl acetamide (K.1.30), N'-(4-(4-chloro-3-trifluoromethyl-phenoxy)-2,5-dimethyl-phenyl)-N-ethyl-N-methyl formamidine (K.1.31), N'-(4-(4-fluoro-3-trifluoromethyl-phenoxy)-2,5-dimethyl-phenyl)-N-ethyl-N-methyl formamidine (K.1.32), N'-(2-methyl-5-trifluoromethyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine (K.1.33), N'-(5-difluoromethyl-2-methyl-4-(3-trimethylsilanyl-propoxy)-phenyl)-N-ethyl-N-methyl formamidine (K.1.34), methoxy-acetic acid 6-tert-butyl-8-fluoro-2,3-dimethyl-quinolin-4-yl ester (K.1.35), 3-[5-(4-methylphenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine (K.1.36), 3-[5-(4-chloro-phenyl)-2,3-dimethyl-isoxazolidin-3-yl]-pyridine (pyrisoxazole) (K.1.37), N-(6-methoxy-pyridin-3-yl) cyclopropanecarboxylic acid amide (K.1.38), 5-chloro-1-(4,6-dimethoxy-pyrimidin-2-yl)-2-methyl-1H-benzoimidazole (K.1.39), 2-(4-chloro-phenyl)-N-[4-(3,4-dimethoxy-phenyl)-isoxazol-5-yl]-2-prop-2-ynyloxy-acetamide, ethyl (Z)-3-amino-2-cyano-3-phenyl-prop-2-enoate (K.1.40), picarbutrazox (K.1.41), pentyl N-[6-[[(Z)-[(1-methyltetrazol-5-yl)-phenyl-methylene]amino]oxymethyl]-2-pyridyl]carbamate (K.1.42), 2-[2-[(7,8-difluoro-2-methyl-3-quinolyl)oxy]-6-fluoro-phenyl]propan-2-ol (K.1.43), 2-[2-fluoro-6-[(8-fluoro-2-methyl-3-quinolyl)oxy]phen-yl]propan-2-ol (K.1.44), 3-(5-fluoro-3,3,4,4-tetramethyl-3,4-dihydroisoquinolin-1-yl)quinoline (K.1.45), 3-(4,4-difluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline (K.1.46), 3-(4,4,5-trifluoro-3,3-dimethyl-3,4-dihydroisoquinolin-1-yl)quinoline (K.1.47), 9-fluoro-2,2-dimethyl-5-(3-quinolyl)-3H-1,4-benzoxazepine (K.1.48).

The fungicides described by common names, their preparation and their activity e.g. against harmful fungi is known (cf.: http://www.alanwood.net/pesticides/); these substances are commercially available.

The fungicides described by IUPAC nomenclature, their preparation and their pesticidal activity is also known (cf. Can. J. Plant Sci. 48(6), 587-94, 1968; EP-A 141 317; EP-A 152 031; EP-A 226 917; EP-A 243 970; EP-A 256 503; EP-A 428 941; EP-A 532 022; EP-A 1 028 125; EP-A 1 035 122; EP-A 1 201 648; EP-A 1 122 244, JP 2002316902; DE 19650197; DE 10021412; DE 102005009458; US 3,296,272; US 3,325,503; WO 98/46608; WO 99/14187; WO 99/24413; WO 99/27783; WO 00/29404; WO 00/46148; WO 00/65913; WO 01/54501; WO 01/56358; WO 02/22583; WO 02/40431; WO 03/10149; WO 03/11853; WO 03/14103; WO 03/16286; WO 03/53145; WO 03/61388; WO 03/66609; WO 03/74491; WO 04/49804; WO 04/83193; WO 05/120234; WO 05/123689; WO 05/123690; WO 05/63721; WO 05/87772; WO 05/87773; WO 06/15866; WO 06/87325; WO 06/87343; WO 07/82098; WO 07/90624, WO 11/028657, WO2012/168188, WO 2007/006670, WO 2011/77514; WO13/047749, WO 10/069882, WO 13/047441, WO 03/16303, WO 09/90181, WO 13/007767, WO 13/010862, WO 13/127704, WO 13/024009, WO 13/024010 and WO 13/047441, WO 13/162072, WO 13/092224, WO 11/135833).

Biopesticides

Suitable mixing partners for the compounds of the present invention also include biopesticides.

Biopesticides have been defined as a form of pesticides based on micro-organisms (bacteria, fungi, viruses, nematodes, etc.) or natural products (compounds, such as metabolites, proteins, or extracts from biological or other natural sources) (U.S. Environmental Protection Agency: http://www.epa.gov/pesticides/biopesticides/). Biopesticides fall into two major classes, microbial and biochemical pesticides:

(1) Microbial pesticides consist of bacteria, fungi or viruses (and often include the metabolites that bacteria and fungi produce). Entomopathogenic nematodes are also classified as microbial pesticides, even though they are multi-cellular.

(2) Biochemical pesticides are naturally occurring substances or or structurally-similar and functionally identical to a naturally-occurring substance and extracts from biological sources that control pests or provide other crop protection uses as defined below, but have non-toxic mode of actions (such as growth or developmental regulation, attractents, repellents or defence activators (e.g. induced resistance) and are relatively non-toxic to mammals.

Biopesticides for use against crop diseases have already established themselves on a variety of crops. For example, biopesticides already play an important role in controlling downy mildew diseases. Their benefits include: a 0-Day Pre-Harvest Interval, the ability to use under moderate to severe disease pressure, and the ability to use in mixture or in a rotational program with other registered pesticides.

A major growth area for biopesticides is in the area of seed treatments and soil amendments. Biopesticidal seed treatments are e.g. used to control soil borne fungal pathogens that cause seed rots, damping-off, root rot and seedling blights. They can also be used to control internal seed borne fungal pathogens as well as fungal pathogens that are on the surface of the seed. Many biopesticidal products also show capacities to stimulate plant host defenses and other physiological processes that can make treated crops more resistant to a variety of biotic and abiotic stresses or can regulate plant growth. Many biopesticidal products also show capacities to stimulate plant health, plant growth and/or yield enhancing activity.

The following list of biopesticides, in conjunction with which the compounds of the present invention can be used, is intended to illustrate the possible combinations but does not limit them:

L) Biopesticides

L1) Microbial pesticides with fungicidal, bactericidal, viricidal and/or plant defense activator activity: *Ampelomyces quisqualis*, *Aspergillus flavus*, *Aureobasidium pullulans*, *Bacillus altitudinis, B. amyloliquefaciens*, *B. megaterium*, *B. mojavensis*, *B. mycoides*, *B. pumilus*, *B. simplex*, *B. solisalsi*, *B. subtilis*, *B. subtilis* var. *amyloliquefaciens*, *Candida oleophila*, *C. saitoana*, *Clavibacter michiganensis* (bacteriophages), *Coniothyrium minitans*, *Cryphonectria parasitica*, *Cryptococcus albidus*, *Dilophosphora alopecuri*, *Fusarium oxysporum*, *Clonostachys rosea* f. *catenulate* (also named *Gliocladium catenulatum*), *Gliocladium roseum*, *Lysobacter antibioticus*, *L. enzymogenes*, *Metschnikowia fructicola*, *Microdochium dimerum*, *Microsphaeropsis ochracea*, *Muscodor albus*, *Paenibacillus alvei*, *Paenibacillus polymyxa*, *Pantoea vagans*, *Penicillium bilaiae*, *Phlebiopsis gigantea*, *Pseudomonas* sp., *Pseudomonas chloraphis*, *Pseudozyma flocculosa*, *Pichia anomala*, *Pythium oligandrum*, *Sphaerodes mycoparasitica*, *Streptomyces griseoviridis*, *S. lydicus*, *S. violaceusniger*,

Talaromyces flavus, *Trichoderma asperelloides, T. asperellum*, *T. atroviride*, *T. fertile*, *T. gamsii*, *T. harmatum*, *T. harzianum*, *T. polysporum*, *T. stromaticum*, *T. virens*, *T. viride*, *Typhula phacorrhiza*, *Ulocladium oudemansii*, *Verticillium dahlia*, zucchini yellow mosaic virus (avirulent strain);

L2) Biochemical pesticides with fungicidal, bactericidal, viricidal and/or plant defense activator activity: harpin protein, *Reynoutria sachalinensis* extract;

L3) Microbial pesticides with insecticidal, acaricidal, molluscidal and/or nematicidal activity: *Agrobacterium radiobacter*, *Bacillus cereus*, *B. firmus*, *B. thuringiensis*, *B. thuringiensis* ssp. *aizawai*, *B. t.* ssp. *israelensis*, *B. t.* ssp. *galleriae*, *B. t.* ssp. *kurstaki*, *B. t.* ssp. *tenebrionis*, *Beauveria bassiana*, *B. brongniartii*, *Burkholderia* spp., *Chromobacterium subtsugae*, *Cydia pomonella* granulovirus (CpGV), *Cryptophlebia leucotreta* granulovirus (CrleGV), *Flavobacterium* spp., *Helicoverpa armigera* nucleopolyhedrovirus (HearNPV), *Helicoverpa zea* nucleopolyhedrovirus (HzNPV), *Helicoverpa zea* single capsid nucleopolyhedrovirus (HzSNPV), *Heterorhabditis bacteriophora*, *Isaria fumosorosea*, *Lecanicillium longisporum*, *L. muscarium*, *Metarhizium anisopliae*, *Metarhizium anisopliae* var. *anisopliae*, *M. anisopliae* var. *acridum*, *Nomuraea rileyi*, *Paecilomyces fumosoroseus, P. lilacinus*, *Paenibacillus popilliae*, *Pasteuria* spp., *P. nishizawae*, *P. penetrans*, *P. ramosa*, *P. thornea*, *P. usgae*, *Pseudomonas fluorescens*, *Spodoptera littoralis* nucleopolyhedrovirus (SpliNPV), *Steinernema carpocapsae*, *S. feltiae*, *S. kraussei, Streptomyces galbus*, *S. microflavus*;

L4) Biochemical pesticides with insecticidal, acaricidal, molluscidal, pheromone and/or nematicidal activity: L-carvone, citral, (E,Z)-7,9-dodecadien-1-yl acetate, ethyl formate, (E,Z)-2,4-ethyl decadienoate (pear ester), (Z,Z,E)-7,11,13-hexadecatrienal, heptyl butyrate, isopropyl myristate, lavanulyl senecioate, cis-jasmone, 2-methyl 1-butanol, methyl eugenol, methyl jasmonate, (E,Z)-2,13-octadecadien-1-ol, (E,Z)-2,13-octadecadien-1-ol acetate, (E,Z)-3,13-octadecadien-1-ol, R-1-octen-3-ol, pentatermanone, (E,Z,Z)-3,8,11-tetradecatrienyl acetate, (Z,E)-9,12-tetradecadien-1-yl acetate, Z-7-tetradecen-2-one, Z-9-tetradecen-1-yl acetate, Z-11-tetradecenal, Z-11-tetradecen-1-ol, extract of *Chenopodium ambrosiode*s, Neem oil, Quillay extract;

L5) Microbial pesticides with plant stress reducing, plant growth regulator, plant growth promoting and/or yield enhancing activity: *Azospirillum amazonense*, *A. brasilense*, *A. lipoferum*, *A. irakense*, *A. halopraeferens*, *Bradyrhizobium* spp., *B. elkanii*, *B. japonicum*, *B. liaoningense*, *B. lupini*, *Delftia acidovorans*, *Glomus intraradices*, *Mesorhizobium* spp., *Rhizobium leguminosarum* bv. *phaseoli*, *R. l.* bv. *trifolii*, *R. l.* bv. *viciae*, *R. tropici*, *Sinorhizobium meliloti.*

The biopesticides from group L1) and/or L2) may also have insecticidal, acaricidal, molluscidal, pheromone, nematicidal, plant stress reducing, plant growth regulator, plant growth promoting and/or yield enhancing activity. The biopesticides from group L3) and/or L4) may also have fungicidal, bactericidal, viricidal, plant defense activator, plant stress reducing, plant growth regulator, plant growth promoting and/or yield enhancing activity. The biopesticides from group L5) may also have fungicidal, bactericidal, viricidal, plant defense activator, insecticidal, acaricidal, molluscidal, pheromone and/or nematicidal activity.

Many of these biopesticides have been deposited under deposition numbers mentioned herein (the prefices such as ATCC or DSM refer to the acronym of the respective culture collection, for details see e. g. here: http://www. wfcc.info/ccinfo/collection/by_acronym/), are referred to in literature, registered and/or are commercially available: mixtures of *Aureobasidium pullulans* DSM 14940 and

DSM 14941 isolated in 1989 in Konstanz, Germany (e. g. blastospores in BlossomProtect® from bio-ferm GmbH, Austria), *Azospirillum brasilense* Sp245 originally isolated in wheat reagion of South Brazil (Passo Fundo) at least prior to 1980 (BR 11005; e. g. GELFIX® Gramíneas from BASF Agricultural Specialties Ltd., Brazil), *A. brasilense* strains Ab-V5 and Ab-V6 (e. g. in AzoMax from Novozymes BioAg Produtos papra Agricultura Ltda., Quattro Barras, Brazil or Simbiose-Maíz® from Simbiose-Agro, Brazil; Plant Soil 331, 413-425, 2010), *Bacillus amyloliquefaciens* strain AP-188 (NRRL B-50615 and B-50331; US 8,445,255); *B. amyloliquefaciens* spp. *plantarum* D747 isolated from air in Kikugawa-shi, Japan (US 20130236522 A1; FERM BP-8234; e. g. Double Nickel™ 55 WDG from Certis LLC, USA), *B. amyloliquefaciens* spp. *plantarum* FZB24 isolated from soil in Brandenburg, Germany (also called SB3615; DSM 96-2; J. Plant Dis. Prot. 105, 181–197, 1998; e. g. Taegro® from Novozyme Biologicals, Inc., USA), *B. amyloliquefaciens* ssp. *plantarum* FZB42 isolated from soil in Brandenburg, Germany (DSM 23117; J. Plant Dis. Prot. 105, 181–197, 1998; e. g. RhizoVital® 42 from AbiTEP GmbH, Germany), *B. amyloliquefaciens* ssp. *plantarum* MBI600 isolated from faba bean in Sutton Bonington, Nottinghamshire, U.K. at least before 1988 (also called 1430; NRRL B-50595; US 2012/0149571 A1; e. g. Integral® from BASF Corp., USA), *B. amyloliquefaciens* spp. *plantarum* QST-713 isolated from peach orchard in 1995 in California, U.S.A. (NRRL B-21661; e. g. Serenade® MAX from Bayer Crop Science LP, USA), *B. amyloliquefaciens* spp. *plantarum* TJ1000 isolated in 1992 in South Dakoda, U.S.A. (also called 1BE; ATCC BAA-390; CA 2471555 A1; e. g. QuickRoots™ from TJ Technologies, Watertown, SD, USA), *B. firmus* CNCM I-1582, a variant of parental strain EIP-N1 (CNCM I-1556) isolated from soil of central plain area of Israel (WO 2009/126473, US 6,406,690; e. g. Votivo® from Bayer CropScience LP, USA), *B. pumilus* GHA 180 isolated from apple tree rhizosphere in Mexico (IDAC 260707-01; e. g. PRO-MIX® BX from Premier Horticulture, Quebec, Canada), *B. pumilus* INR-7 otherwise referred to as BU-F22 and BU-F33 isolated at least before 1993 from cucumber infested by *Erwinia tracheiphila* (NRRL B-50185, NRRL B-50153; US 8,445,255), *B. pumilus* KFP9F isolated from the rhizosphere of grasses in South Africa at least before 2008 (NRRL B-50754; WO 2014/029697; e. g. BAC-UP or FUSION-P from BASF Agricultural Specialities (Pty) Ltd., South Africa), *B. pumilus* QST 2808 was isolated from soil collected in Pohnpei, Federated States of Micronesia, in 1998 (NRRL B-30087; e. g. Sonata® or Ballad® Plus from Bayer Crop Science LP, USA), *B. simplex* ABU 288 (NRRL B-50304; US 8,445,255), *B. subtilis* FB17 also called UD 1022 or UD10-22 isolated from red beet roots in North America (ATCC PTA-11857; System. Appl. Microbiol. 27, 372-379, 2004; US 2010/0260735; WO 2011/109395); *B. thuringiensis* ssp. *aizawai* ABTS-1857 isolated from soil taken from a lawn in Ephraim, Wisconsin, U.S.A., in 1987 (also called ABG-6346; ATCC SD-1372; e. g. XenTari® from BioFa AG, Münsingen, Germany), *B. t.* ssp. *kurstaki* ABTS-351 identical to HD-1 isolated in 1967 from diseased Pink Bollworm black larvae in Brownsville, Texas, U.S.A. (ATCC SD-1275; e. g. Dipel® DF from Valent BioSciences, IL, USA), *B. t.* ssp. *kurstaki* SB4 isolated from *E. saccharina* larval cadavers (NRRL B-50753; e. g. Beta Pro® from BASF Agricultural Specialities (Pty) Ltd., South Africa), *B. t.* ssp. *tenebrionis* NB-176-1, a mutant of strain NB-125, a wild type strain isolated in 1982 from a dead pupa of the beetle Tenebrio molitor (DSM 5480; EP 585 215 B1; e. g. Novodor® from Valent BioSciences, Switzerland), *Beauveria bassiana* GHA (ATCC 74250; e. g. BotaniGard® 22WGP from Laverlam Int. Corp., USA), *B. bassiana* JW-1 (ATCC 74040; e. g.

Naturalis® from CBC (Europe) S.r.l., Italy), *B. bassiana* PPRI 5339 isolated from the larva of the tortoise beetle *Conchyloctenia punctata* (NRRL 50757; e. g. BroadBand® from BASF Agricultural Specialities (Pty) Ltd., South Africa), *Bradyrhizobium elkanii* strains SEMIA 5019 (also called 29W) isolated in Rio de Janeiro, Brazil and SEMIA 587 isolated in 1967 in the State of Rio Grande do Sul, from an area previously inoculated with a North American isolate, and used in commercial inoculants since 1968 (Appl. Environ. Microbiol. 73(8), 2635, 2007; e. g. GELFIX 5 from BASF Agricultural Specialties Ltd., Brazil), *B. japonicum* 532c isolated from Wisconsin field in U.S.A. (Nitragin 61A152; Can. J. Plant. Sci. 70, 661-666, 1990; e. g. in Rhizoflo®, Histick®, Hicoat® Super from BASF Agricultural Specialties Ltd., Canada), *B. japonicum* E-109 variant of strain USDA 138 (INTA E109, SEMIA 5085; Eur. J. Soil Biol. 45, 28–35, 2009; Biol. Fertil. Soils 47, 81–89, 2011); *B. japonicum* strains deposited at SEMIA known from Appl. Environ. Microbiol. 73(8), 2635, 2007: SEMIA 5079 isolated from soil in Cerrados region, Brazil by Embrapa-Cerrados used in commercial inoculants since 1992 (CPAC 15; e. g. GELFIX 5 or ADHERE 60 from BASF Agricultural Specialties Ltd., Brazil), *B. japonicum* SEMIA 5080 obtained under lab condtions by Embrapa-Cerrados in Brazil and used in commercial inoculants since 1992, being a natural variant of SEMIA 586 (CB1809) originally isolated in U.S.A. (CPAC 7; e. g. GELFIX 5 or ADHERE 60 from BASF Agricultural Specialties Ltd., Brazil); *Burkholderia sp.* A396 isolated from soil in Nikko, Japan, in 2008 (NRRL B-50319; WO 2013/032693; Marrone Bio Innovations, Inc., USA), *Coniothyrium minitans* CON/M/91-08 isolated from oilseed rape (WO 1996/021358; DSM 9660; e. g. Contans® WG, Intercept® WG from Bayer CropScience AG, Germany), harpin (alpha-beta) protein (Science 257, 85-88, 1992; e. g. Messenger™ or HARP-N-Tek from Plant Health Care plc, U.K.), *Helicoverpa armigera* nucleopolyhedrovirus (HearNPV) (J. Invertebrate Pathol. 107, 112–126, 2011; e. g. Helicovex® from Adermatt Biocontrol, Switzerland; Diplomata® from Koppert, Brazil; Vivus® Max from AgBiTech Pty Ltd., Queensland, Australia), *Helicoverpa zea* single capsid nucleopolyhedrovirus (HzSNPV) (e. g. Gemstar® from Certis LLC, USA), *Helicoverpa zea* nucleopolyhedrovirus ABA-NPV-U (e. g. Heligen® from AgBiTech Pty Ltd., Queensland, Australia), *Heterorhabditis bacteriophora* (e. g. Nemasys® G from BASF Agricultural Specialities Limited, UK), *Isaria fumosorosea* Apopka-97 isolated from mealy bug on gynura in Apopka, Florida, U.S.A. (ATCC 20874; Biocontrol Science Technol. 22(7), 747-761, 2012; e. g. PFR-97™ or PreFeRal® from Certis LLC, USA), *Metarhizium anisopliae* var. *anisopliae* F52 also called 275 or V275 isolated from codling moth in Austria (DSM 3884, ATCC 90448; e. g. Met52® Novozymes Biologicals BioAg Group, Canada), *Metschnikowia fructicola* 277 isolated from grapes in the central part of Israel (US 6,994,849; NRRL Y-30752; e. g. formerly Shemer® from Agrogreen, Israel), *Paecilomyces ilacinus* 251 isolated from infected nematode eggs in the Philippines (AGAL 89/030550; WO1991/02051; Crop Protection 27, 352-361, 2008; e. g. BioAct®from Bayer CropScience AG, Germany and MeloCon® from Certis, USA), *Paenibacillus alvei* NAS6G6 isolated from the rhizosphere of grasses in South Africa at least before 2008 (WO 2014/029697; NRRL B-50755; e.g. BAC-UP from BASF Agricultural Specialities (Pty) Ltd., South Africa), *Pasteuria nishizawae* Pn1 isolated from a soybean field in the mid-2000s in Illinois, U.S.A. (ATCC SD-5833; Federal Register 76(22), 5808, February 2, 2011; e.g. Clariva™ PN from Syngenta Crop Protection, LLC, USA), *Penicillium bilaiae* (also called *P. bilaii*) strains ATCC 18309 (= ATCC 74319), ATCC 20851 and/or ATCC 22348 (= ATCC 74318) originally isolated from

soil in Alberta, Canada (Fertilizer Res. 39, 97-103, 1994; Can. J. Plant Sci. 78(1), 91-102, 1998; US 5,026,417, WO 1995/017806; e. g. Jump Start®, Provide® from Novozymes Biologicals BioAg Group, Canada), *Reynoutria sachalinensis* extract (EP 0307510 B1; e. g. Regalia® SC from Marrone BioInnovations, Davis, CA, USA or Milsana® from BioFa AG, Germany), *Steinernema carpocapsae* (e. g. Millenium® from BASF Agricultural Specialities Limited, UK), *S. feltiae* (e. g. Nemashield® from BioWorks, Inc., USA; Nemasys® from BASF Agricultural Specialities Limited, UK), *Streptomyces microflavus* NRRL B-50550 (WO 2014/124369; Bayer CropScience, Germany), *Trichoderma asperelloides* JM41R isolated in South Africa (NRRL 50759; also referred to as *T. fertile*; e. g. Trichoplus® from BASF Agricultural Specialities (Pty) Ltd., South Africa), *T. harzianum* T-22 also called KRL-AG2 (ATCC 20847; BioControl 57, 687-696, 2012; e. g. Plantshield® from BioWorks Inc., USA or SabrEx™ from Advanced Biological Marketing Inc., Van Wert, OH, USA).

According to the invention, the solid material (dry matter) of the biopesticides (with the exception of oils such as Neem oil) are considered as active components (e.g. to be obtained after drying or evaporation of the extraction or suspension medium in case of liquid formulations of the microbial pesticides).

In accordance with the present invention, the weight ratios and percentages used herein for a biological extract such as Quillay extract are based on the total weight of the dry content (solid material) of the respective extract(s).

The total weight ratios of compositions comprising at least one microbial pesticide in the form of viable microbial cells including dormant forms, can be determined using the amount of CFU of the respective microorganism to calclulate the total weight of the respective active component with the following equation that 1 x 10^{10} CFU equals one gram of total weight of the respective active component. Colony forming unit is measure of viable microbial cells, in particular fungal and bacterial cells. In addition, here “CFU” may also be understood as the number of (juvenile) individual nematodes in case of (entomopathogenic) nematode biopesticides, such as *Steinernema feltiae*.

When mixtures comprising microbial pesticides are employed in crop protection, the application rates preferably range from about 1 x 106 to 5 x 1015 (or more) CFU/ha, preferably from about 1 x 108 to about 1 x 1013 CFU/ha, and even more preferably from about 1 x 109 to about 1 x 1012 CFU/ha. In the case of (entomopathogenic) nematodes as microbial pesticides (e. g. Steinernema feltiae), the application rates preferably range inform about 1 x 105 to 1 x 1012 (or more), more preferably from 1 x 108 to 1 x 1011, even more preferably from 5 x 108 to 1 x 1010 individuals (e. g. in the form of eggs, juvenile or any other live stages, preferably in an infetive juvenile stage) per ha.

When mixtures comprising microbial pesticides are employed in seed treatment, the application rates with respect to plant propagation material preferably range from about 1 x 106 to 1 x 1012 (or more) CFU/seed. Preferably, the concentration is about 1 x 106 to about 1 x 109 CFU/seed. In the case of the microbial pesticides II, the application rates with respect to plant propagation material also preferably range from about 1 x 107 to 1 x 1014 (or more) CFU per 100 kg of seed, preferably from 1 x 109 to about 1 x 1012 CFU per 100 kg of seed.

The invention also relates to agrochemical compositions comprising an auxiliary and at least one compound of the present invention or a mixture thereof.

An agrochemical composition comprises a pesticidally effective amount of a compound of the present invention or a mixture thereof. The term "pesticidally effective amount" is defined below.

The compounds of the present invention or the mixtures thereof can be converted into customary types of agro-chemical compositions, e. g. solutions, emulsions, suspensions, dusts, powders, pastes, granules, pressings, capsules, and mixtures thereof. Examples for composition types are suspensions (e.g. SC, OD, FS), emulsifiable concentrates (e.g. EC), emulsions (e.g. EW, EO, ES, ME), capsules (e.g. CS, ZC), pastes, pastilles, wettable powders or dusts (e.g. WP, SP, WS, DP, DS), pressings (e.g. BR, TB, DT), granules (e.g. WG, SG, GR, FG, GG, MG), insecticidal articles (e.g. LN), as well as gel formulations for the treatment of plant propagation materials such as seeds (e.g. GF). These and further compositions types are defined in the “Catalogue of pesticide formulation types and international coding system”, Technical Mono-graph No. 2, 6th Ed. May 2008, CropLife International.

The compositions are prepared in a known manner, such as described by Mollet and Grubemann, Formulation technology, Wiley VCH, Weinheim, 2001; or Knowles, New developments in crop protection product formulation, Agrow Reports DS243, T&F Informa, London, 2005.

Examples for suitable auxiliaries are solvents, liquid carriers, solid carriers or fillers, surfac-tants, dispersants, emulsifiers, wetters, adjuvants, solubilizers, penetration enhancers, protec-tive colloids, adhesion agents, thickeners, humectants, repellents, attractants, feeding stimu-lants, compatibilizers, bactericides, anti-freezing agents, anti-foaming agents, colorants, tackifi-ers and binders.

Suitable solvents and liquid carriers are water and organic solvents, such as mineral oil frac-tions of medium to high boiling point, e.g. kerosene, diesel oil; oils of vegetable or animal origin; aliphatic, cyclic and aromatic hydrocarbons, e. g. toluene, paraffin, tetrahydronaphthalene, al-kylated naphthalenes; alcohols, e.g. ethanol, propanol, butanol, benzylalcohol, cyclo¬hexanol; glycols; DMSO; ketones, e.g. cyclohexanone; esters, e.g. lactates, carbonates, fatty acid esters, gamma-butyrolactone; fatty acids; phosphonates; amines; amides, e.g. N-methylpyrrolidone, fatty acid dimethylamides; and mixtures thereof.

Suitable solid carriers or fillers are mineral earths, e.g. silicates, silica gels, talc, kaolins, limestone, lime, chalk, clays, dolomite, diatomaceous earth, bentonite, calcium sulfate, magnesium sulfate, magnesium oxide; polysaccharide powders, e.g. cellulose, starch; fertilizers, e.g. ammonium sulfate, ammonium phosphate, ammonium nitrate, ureas; products of vegetable origin, e.g. cereal meal, tree bark meal, wood meal, nutshell meal, and mixtures thereof.

Suitable surfactants are surface-active compounds, such as anionic, cationic, nonionic and amphoteric surfactants, block polymers, polyelectrolytes, and mixtures thereof. Such surfactants can be used as emusifier, dispersant, solubilizer, wetter, penetration enhancer, protective colloid, or adjuvant. Examples of surfactants are listed in McCutcheon’s, Vol.1: Emulsifiers & Detergents, McCutcheon’s Directories, Glen Rock, USA, 2008 (International Ed. or North American Ed.).

Suitable anionic surfactants are alkali, alkaline earth or ammonium salts of sulfonates, sul-fates, phosphates, carboxylates, and mixtures thereof. Examples of sulfonates are alkylaryl-sulfonates, diphenylsulfonates, alpha-olefin sulfonates, lignine sulfonates, sulfonates of fatty acids and oils, sulfonates of ethoxylated alkylphenols, sulfonates of alkoxylated arylphenols, sulfonates of condensed

naphthalenes, sulfonates of dodecyl- and tridecylbenzenes, sulfonates of naphthalenes and alkyl¬naphthalenes, sulfosuccinates or sulfosuccinamates. Examples of sulfates are sulfates of fatty acids and oils, of ethoxylated alkylphenols, of alcohols, of ethox-ylated alcohols, or of fatty acid esters. Examples of phosphates are phosphate esters. Exam-ples of carboxylates are alkyl carboxylates, and carboxylated alcohol or alkylphenol eth-oxylates.

Suitable nonionic surfactants are alkoxylates, N-subsituted fatty acid amides, amine oxides, esters, sugar-based surfactants, polymeric surfactants, and mixtures thereof. Examples of alkoxylates are compounds such as alcohols, alkylphenols, amines, amides, arylphenols, fatty acids or fatty acid esters which have been alkoxylated with 1 to 50 equivalents. Ethylene oxide and/or propylene oxide may be employed for the alkoxylation, preferably ethylene oxide. Exam-ples of N-subsititued fatty acid amides are fatty acid glucamides or fatty acid alkanolamides. Examples of esters are fatty acid esters, glycerol esters or monoglycerides. Examples of sugar-based surfactants are sorbitans, ethoxylated sorbitans, sucrose and glucose esters or alkylpolyglucosides. Examples of polymeric surfactants are homo- or copolymers of vinylpyrrolidone, vinylalcohols, or vinylacetate.

Suitable cationic surfactants are quaternary surfactants, for example quaternary ammonium compounds with one or two hydrophobic groups, or salts of long-chain primary amines. Suitable amphoteric surfactants are alkylbetains and imidazolines. Suitable block polymers are block polymers of the A-B or A-B-A type comprising blocks of polyethylene oxide and polypropylene oxide, or of the A-B-C type comprising alkanol, polyethylene oxide and polypropylene oxide. Suitable polyelectrolytes are polyacids or polybases. Examples of polyacids are alkali salts of polyacrylic acid or polyacid comb polymers. Examples of polybases are polyvinylamines or polyethyleneamines.

Suitable adjuvants are compounds, which have a neglectable or even no pesticidal activity themselves, and which improve the biological performance of the compounds of the present invention on the target. Examples are surfactants, mineral or vegetable oils, and other auxilaries. Further examples are listed by Knowles, Adjuvants and additives, Agrow Reports DS256, T&F Informa UK, 2006, chapter 5.

Suitable thickeners are polysaccharides (e.g. xanthan gum, carboxymethylcellulose), anorganic clays (organically modified or unmodified), polycarboxylates, and silicates.

Suitable bactericides are bronopol and isothiazolinone derivatives such as alkylisothiazoli-nones and benzisothiazolinones.

Suitable anti-freezing agents are ethylene glycol, propylene glycol, urea and glycerin.

Suitable anti-foaming agents are silicones, long chain alcohols, and salts of fatty acids.

Suitable colorants (e.g. in red, blue, or green) are pigments of low water solubility and water-soluble dyes. Examples are inorganic colorants (e.g. iron oxide, titan oxide, iron hexacyanofer-rate) and organic colorants (e.g. alizarin-, azo- and phthalocyanine colorants).

Suitable tackifiers or binders are polyvinylpyrrolidons, polyvinylacetates, polyvinyl alcohols, polyacrylates, biological or synthetic waxes, and cellulose ethers.

Examples for composition types and their preparation are:

i) Water-soluble concentrates (SL, LS)

10-60 wt% of a compound I according to the invention and 5-15 wt% wetting agent (e.g. alcohol alkoxylates) are dissolved in water and/or in a water-soluble solvent (e.g. alcohols) up to 100 wt%. The active substance dissolves upon dilution with water.

ii) Dispersible concentrates (DC)

5-25 wt% of a compound I according to the invention and 1-10 wt% dispersant (e. g. polyvi-nylpyrrolidone) are dissolved in up to 100 wt% organic solvent (e.g. cyclohexanone). Dilution with water gives a dispersion.

iii) Emulsifiable concentrates (EC)

15-70 wt% of a compound I according to the invention and 5-10 wt% emulsifiers (e.g. calcium dodecylbenzenesulfonate and castor oil ethoxylate) are dissolved in up to 100 wt% water-insoluble organic solvent (e.g. aromatic hydrocarbon). Dilution with water gives an emulsion.

iv) Emulsions (EW, EO, ES)

5-40 wt% of a compound I according to the invention and 1-10 wt% emulsifiers (e.g. calcium dodecylbenzenesulfonate and castor oil ethoxylate) are dissolved in 20-40 wt% water-insoluble organic solvent (e.g. aromatic hydrocarbon). This mixture is introduced into up to 100 wt% water by means of an emulsifying machine and made into a homogeneous emulsion. Dilution with water gives an emulsion.

v) Suspensions (SC, OD, FS)

In an agitated ball mill, 20-60 wt% of a compound I according to the invention are comminuted with addition of 2-10 wt% dispersants and wetting agents (e.g. sodium lignosulfonate and alcohol ethoxylate), 0,1-2 wt% thickener (e.g. xanthan gum) and up to 100 wt% water to give a fine active substance suspension. Dilution with water gives a stable suspension of the active sub-stance. For FS type composition up to 40 wt% binder (e.g. polyvinylalcohol) is added.

vi) Water-dispersible granules and water-soluble granules (WG, SG)

50-80 wt% of a compound I according to the invention are ground finely with addition of up to 100 wt% dispersants and wetting agents (e.g. sodium lignosulfonate and alcohol ethoxylate) and prepared as water-dispersible or water-soluble granules by means of technical appliances (e. g. extrusion, spray tower, fluidized bed). Dilution with water gives a stable dispersion or solution of the active substance.

vii) Water-dispersible powders and water-soluble powders (WP, SP, WS)

50-80 wt% of a compound I according to the invention are ground in a rotor-stator mill with addition of 1-5 wt% dispersants (e.g. sodium lignosulfonate), 1-3 wt% wetting agents (e.g. alcohol ethoxylate) and up to 100 wt% solid carrier, e.g. silica gel. Dilution with water gives a stable dis-persion or solution of the active substance.

viii) Gel (GW, GF)

In an agitated ball mill, 5-25 wt% of a compound I according to the invention are comminuted with addition of 3-10 wt% dispersants (e.g. sodium lignosulfonate), 1-5 wt% thickener (e.g. carboxymethylcellulose) and up to 100 wt% water to give a fine suspension of the active sub-stance. Dilution with water gives a stable suspension of the active substance.

ix) Microemulsion (ME)

5-20 wt% of a compound I according to the invention are added to 5-30 wt% organic solvent blend (e.g. fatty acid dimethylamide and cyclohexanone), 10-25 wt% surfactant blend (e.g. alkohol ethoxylate and arylphenol ethoxylate), and water up to 100 %. This mixture is stirred for 1 h to produce spontaneously a thermodynamically stable microemulsion.

x) Microcapsules (CS)

An oil phase comprising 5-50 wt% of a compound I according to the invention, 0-40 wt% water insoluble organic solvent (e.g. aromatic hydrocarbon), 2-15 wt% acrylic monomers (e.g. methylmethacrylate, methacrylic acid and a di- or triacrylate) are dispersed into an aqueous solution of a protective colloid (e.g. polyvinyl alcohol). Radical polymerization initiated by a radi-cal initiator results in the formation of poly(meth)acrylate microcapsules. Alternatively, an oil phase comprising 5-50 wt% of a compound I according to the invention, 0-40 wt% water insolu-ble organic solvent (e.g. aromatic hydrocarbon), and an isocyanate monomer (e.g. diphenylme-thene-4,4'-diisocyanatae) are dispersed into an aqueous solution of a protective colloid (e.g. polyvinyl alcohol). The addition of a polyamine (e.g. hexamethylenediamine) results in the for-mation of a polyurea microcapsule. The monomers amount to 1-10 wt%. The wt% relate to the total CS composition.

xi) Dustable powders (DP, DS)

1-10 wt% of a compound I according to the invention are ground finely and mixed intimately with up to 100 wt% solid carrier, e.g. finely divided kaolin.

xii) Granules (GR, FG)

0.5-30 wt% of a compound I according to the invention is ground finely and associated with up to 100 wt% solid carrier (e.g. silicate). Granulation is achieved by extrusion, spray-drying or the fluidized bed.

xiii) Ultra-low volume liquids (UL)

1-50 wt% of a compound I according to the invention are dissolved in up to 100 wt% organic solvent, e.g. aromatic hydrocarbon.

The compositions types i) to xi) may optionally comprise further auxiliaries, such as 0.1-1 wt% bactericides, 5-15 wt% anti-freezing agents, 0.1-1 wt% anti-foaming agents, and 0.1-1 wt% colorants.

The agrochemical compositions generally comprise between 0.01 and 95%, preferably be-tween 0.1 and 90%, and most preferably between 0.5 and 75%, by weight of active sub-stance. The active substances are employed in a purity of from 90% to 100%, preferably from 95% to 100% (according to NMR spectrum).

Various types of oils, wetters, adjuvants, fertilizer, or micronutrients, and other pesticides (e.g. herbicides, insecticides, fungicides, growth regulators, safeners) may be added to the active substances or the compositions com¬prising them as premix or, if appropriate not until immediately prior to use (tank mix). These agents can be admixed with the compositions according to the invention in a weight ratio of 1:100 to 100:1, preferably 1:10 to 10:1.

The user applies the composition according to the invention usually from a predosage de-vice, a knapsack sprayer, a spray tank, a spray plane, or an irrigation system. Usually, the agrochemical composition is made up with water, buffer, and/or further auxiliaries to the desired application con-

centration and the ready-to-use spray liquor or the agrochemical composition according to the invention is thus obtained. Usually, 20 to 2000 liters, preferably 50 to 400 liters, of the ready-to-use spray liquor are applied per hectare of agricultural useful area.

According to one embodiment, individual components of the composition according to the invention such as parts of a kit or parts of a binary or ternary mixture may be mixed by the user himself in a spray tank and further auxiliaries may be added, if appropriate.

In a further embodiment, either individual components of the composition according to the invention or partially premixed components, e. g. components comprising compounds of the present invention and/or mixing partners as defined above, may be mixed by the user in a spray tank and further auxiliaries and additives may be added, if appropriate.

In a further embodiment, either individual components of the composition according to the invention or partially premixed components, e. g. components comprising compounds of the present invention and/or mixing partners as defined above, can be applied jointly (e.g. after tank mix) or consecutively.

The compounds of the present invention are suitable for use in protecting crops, plants, plant propagation materials, such as seeds, or soil or water, in which the plants are growing, from attack or infestation by animal pests. Therefore, the present invention also relates to a plant protection method, which comprises contacting crops, plants, plant propagation materials, such as seeds, or soil or water, in which the plants are growing, to be protected from attack or infestation by animal pests, with a pesticidally effective amount of a compound of the present invention.

The compounds of the present invention are also suitable for use in combating or controlling animal pests. Therefore, the present invention also relates to a method of combating or controlling animal pests, which comprises contacting the animal pests, their habitat, breeding ground, or food supply, or the crops, plants, plant propagation materials, such as seeds, or soil, or the area, material or environment in which the animal pests are growing or may grow, with a pesticidally effective amount of a compound of the present invention.

The compounds of the present invention are effective through both contact and ingestion. Furthermore, the compounds of the present invention can be applied to any and all developmental stages, such as egg, larva, pupa, and adult.

The compounds of the present invention can be applied as such or in form of compositions comprising them as defined above. Furthermore, the compounds of the present invention can be applied together with a mixing partner as defined above or in form of compositions comprising said mixtures as defined above. The components of said mixture can be applied simultaneously, jointly or separately, or in succession, that is immediately one after another and thereby creating the mixture “in situ” on the desired location, e.g. the plant, the sequence, in the case of separate application, generally not having any effect on the result of the control measures.

The application can be carried out both before and after the infestation of the crops, plants, plant propagation materials, such as seeds, soil, or the area, material or environment by the pests.

Suitable application methods include inter alia soil treatment, seed treatment, in furrow application, and foliar application. Soil treatment methods include drenching the soil, drip irrigation (drip application onto the soil), dipping roots, tubers or bulbs, or soil injection. Seed treatment techniques

include seed dressing, seed coating, seed dusting, seed soaking, and seed pelleting. In furrow applications typically include the steps of making a furrow in cultivated land, seeding the furrow with seeds, applying the pesticidally active compound to the furrow, and closing the furrow. Foliar application refers to the application of the pesticidally active compound to plant foliage, e.g. through spray equipment. For foliar applications, it can be advantageous to modify the behavior of the pests by use of pheromones in combination with the compounds of the present invention. Suitable pheromones for specific crops and pests are known to a skilled person and publicly available from databases of pheromones and semiochemicals, such as http://www.pherobase.com.

As used herein, the term "contacting" includes both direct contact (applying the compounds/compositions directly on the animal pest or plant - typically to the foliage, stem or roots of the plant) and indirect contact (applying the compounds/compositions to the locus, i.e. habitat, breeding ground, plant, seed, soil, area, material or environment in which a pest is growing or may grow, of the animal pest or plant).

The term “animal pest” includes arthropods, gastropods, and nematodes. Preferred animal pests according to the invention are arthropods, preferably insects and arachnids, in particular insects. Insects, which are of particular relevance for crops, are typically referred to as crop insect pests.

The term "crop" refers to both, growing and harvested crops.

The term “plant” includes cereals, e.g. durum and other wheat, rye, barley, triticale, oats, rice, or maize (fodder maize and sugar maize / sweet and field corn); beet, e.g. sugar beet or fodder beet; fruits, such as pomes, stone fruits or soft fruits, e.g. apples, pears, plums, peaches, nectarines, almonds, cherries, papayas, strawberries, raspberries, blackberries or gooseberries; leguminous plants, such as beans, lentils, peas, alfalfa or soybeans; oil plants, such as rapeseed (oilseed rape), turnip rape, mustard, olives, sunflowers, coconut, cocoa beans, castor oil plants, oil palms, ground nuts or soybeans; cucurbits, such as squashes, pumpkins, cucumber or melons; fiber plants, such as cotton, flax, hemp or jute; citrus fruit, such as oranges, lemons, grapefruits or mandarins; vegetables, such as eggplant, spinach, lettuce (e.g. iceberg lettuce), chicory, cabbage, asparagus, cabbages, carrots, onions, garlic, leeks, tomatoes, potatoes, cucurbits or sweet peppers; lauraceous plants, such as avocados, cinnamon or camphor; energy and raw material plants, such as corn, soybean, rapeseed, sugar cane or oil palm; tobacco; nuts, e.g. walnuts; pistachios; coffee; tea; bananas; vines (table grapes and grape juice grape vines); hop; sweet leaf (also called Stevia); natural rubber plants or ornamental and forestry plants, such as flowers (e.g. carnation, petunias, geranium/pelargoniums, pansies and impatiens), shrubs, broad-leaved trees (e.g. poplar) or evergreens, e.g. conifers; eucalyptus; turf; lawn; grass such as grass for animal feed or ornamental uses. Preferred plants include potatoes sugar beets, tobacco, wheat, rye, barley, oats, rice, corn, cotton, soybeans, rapeseed, legumes, sunflowers, coffee or sugar cane; fruits; vines; ornamentals; or vegetables, such as cucumbers, tomatoes, beans or squashes.

The term “plant” is to be understood as including wild type plants and plants, which have been modified by either conventional breeding, or mutagenesis or genetic engineering, or by a combination thereof.

Plants, which have been modified by mutagenesis or genetic engineering, and are of particular commercial importance, include alfalfa, rapeseed (e.g. oilseed rape), bean, carnation, chicory, cotton, eggplant, eucalyptus, flax, lentil, maize, melon, papaya, petunia, plum, poplar, potato, rice, soybean, squash, sugar beet, sugarcane, sunflower, sweet pepper, tobacco, tomato, and cereals (e.g. wheat), in particular maize, soybean, cotton, wheat, and rice. In plants, which have been modified by mutagenesis or genetic engineering, one or more genes have been mutagenized or integrated into the genetic material of the plant. The one or more mutagenized or integrated genes are preferably selected from pat, epsps, cry1Ab, bar, cry1Fa2, cry1Ac, cry34Ab1, cry35AB1, cry3A, cryF, cry1F, mcry3a, cry2Ab2, cry3Bb1, cry1A.105, dfr, barnase, vip3Aa20, barstar, als, bxn, bp40, asn1, and ppo5. The mutagenesis or integration of the one or more genes is performed in order to improve certain properties of the plant. Such properties, also known as traits, include abiotic stress tolerance, altered growth/yield, disease resistance, herbicide tolerance, insect resistance, modified product quality, and pollination control. Of these properties, herbicide tolerance, e.g. imidazolinone tolerance, glyphosate tolerance, or glufosinate tolerance, is of particular importance. Several plants have been rendered tolerant to herbicides by mutagenesis, for example Clearfield® oilseed rape being tolerant to imidazolinones, e.g. imazamox. Alternatively, genetic engineering methods have been used to render plants, such as soybean, cotton, corn, beets and oil seed rape, tolerant to herbicides, such as glyphosate and glufosinate, some of which are commercially available under the trade names RoundupReady® (glyphosate) and LibertyLink® (glufosinate). Furthermore, insect resistance is of importance, in particular lepidopteran insect resistance and coleopteran insect resistance. Insect resistance is typically achieved by modifying plants by integrating cry and/or vip genes, which were isolated from *Bacillus thuringiensis* (Bt), and code for the respective Bt toxins. Genetically modified plants with insect resistance are commercially available under trade names including WideStrike®, Bollgard®, Agrisure®, Herculex®, YieldGard®, Genuity®, and Intacta®. Plants may be modified by mutagenesis or genetic engineering either in terms of one property (singular traits) or in terms of a combination of properties (stacked traits). Stacked traits, e.g. the combination of herbicide tolerance and insect resistance, are of increasing importance. In general, all relevant modified plants in connection with singular or stacked traits as well as detailed information as to the mutagenized or integrated genes and the respective events are available from websites of the organizations “International Service for the Acquisition of Agri-biotech Applications (ISAAA)” (http://www.isaaa.org/gmapprovaldatabase) and “Center for Environmental Risk Assessment (CERA)” (http://cera-gmc.org/GMCropDatabase).

It has surprisingly been found that the pesticidal activity of the compounds of the present invention may be enhanced by the insecticidal trait of a modified plant. Furthermore, it has been found that the compounds of the present invention are suitable for preventing insects to become resistant to the insecticidal trait or for combating pests, which already have become resistant to the insecticidal trait of a modified plant. Moreover, the compounds of the present invention are suitable for combating pests, against which the insecticidal trait is not effective, so that a complementary insecticidal activity can advantageously be used.

The term "plant propagation material" refers to all the generative parts of the plant such as seeds and vegetative plant material such as cuttings and tubers (e.g. potatoes), which can be used for the

multiplication of the plant. This includes seeds, roots, fruits, tubers, bulbs, rhizomes, shoots, sprouts and other parts of plants. Seedlings and young plants, which are to be transplanted after germination or after emergence from soil, may also be included. These plant propagation materials may be treated prophylactically with a plant protection compound either at or before planting or transplanting.

The term “seed” embraces seeds and plant propagules of all kinds including but not limited to true seeds, seed pieces, suckers, corms, bulbs, fruit, tubers, grains, cuttings, cut shoots and the like, and means in a preferred embodiment true seeds.

In general, "pesticidally effective amount" means the amount of active ingredient needed to achieve an observable effect on growth, including the effects of necrosis, death, retardation, prevention, and removal, destruction, or otherwise diminishing the occurrence and activity of the target organism. The pesticidally effective amount can vary for the various compounds/compositions used in the invention. A pesticidally effective amount of the compositions will also vary according to the prevailing conditions such as desired pesticidal effect and duration, weather, target species, locus, mode of application, and the like.

In the case of soil treatment, in furrow application or of application to the pests dwelling place or nest, the quantity of active ingredient ranges from 0.0001 to 500 g per 100 m^2, preferably from 0.001 to 20 g per 100 m^2.

For use in treating crop plants, e.g. by foliar application, the rate of application of the active ingredients of this invention may be in the range of 0.0001 g to 4000 g per hectare, e.g. from 1 g to 2 kg per hectare or from 1 g to 750 g per hectare, desirably from 1 g to 100 g per hectare, more desirably from 10 g to 50 g per hectare, e.g., 10 to 20 g per hectare, 20 to 30 g per hectare, 30 to 40 g per hectare, or 40 to 50 g per hectare.

The compounds of the present invention are particularly suitable for use in the treatment of seeds in order to protect the seeds from insect pests, in particular from soil-living insect pests, and the resulting seedling’s roots and shoots against soil pests and foliar insects. The present invention therefore also relates to a method for the protection of seeds from insects, in particular from soil insects, and of the seedling's roots and shoots from insects, in particular from soil and foliar insects, said method comprising treating the seeds before sowing and/or after pregermination with a compound of the present invention. The protection of the seedling's roots and shoots is preferred. More preferred is the protection of seedling’s shoots from piercing and sucking insects, chewing insects and nematodes.

The term “seed treatment” comprises all suitable seed treatment techniques known in the art, such as seed dressing, seed coating, seed dusting, seed soaking, seed pelleting, and in-furrow application methods. Preferably, the seed treatment application of the active compound is carried out by spraying or by dusting the seeds before sowing of the plants and before emergence of the plants.

The present invention also comprises seeds coated with or containing the active compound. The term "coated with and/or containing" generally signifies that the active ingredient is for the most part on the surface of the propagation product at the time of application, although a greater or lesser

part of the ingredient may penetrate into the propagation product, depending on the method of application. When the said propagation product is (re)planted, it may absorb the active ingredient.

Suitable seed is for example seed of cereals, root crops, oil crops, vegetables, spices, ornamentals, for example seed of durum and other wheat, barley, oats, rye, maize (fodder maize and sugar maize / sweet and field corn), soybeans, oil crops, crucifers, cotton, sunflowers, bananas, rice, oilseed rape, turnip rape, sugarbeet, fodder beet, eggplants, potatoes, grass, lawn, turf, fodder grass, tomatoes, leeks, pumpkin/squash, cabbage, iceberg lettuce, pepper, cucumbers, melons, Brassica species, melons, beans, peas, garlic, onions, carrots, tuberous plants such as potatoes, sugar cane, tobacco, grapes, petunias, geranium/pelargoniums, pansies and impatiens.

In addition, the active compound may also be used for the treatment of seeds from plants, which have been modified by mutagenisis or genetic engineering, and which e.g. tolerate the action of herbicides or fungicides or insecticides. Such modified plants have been described in detail above.

Conventional seed treatment formulations include for example flowable concentrates FS, solutions LS, suspoemulsions (SE), powders for dry treatment DS, water dispersible powders for slurry treatment WS, water-soluble powders SS and emulsion ES and EC and gel formulation GF. These formulations can be applied to the seed diluted or undiluted. Application to the seeds is carried out before sowing, either directly on the seeds or after having pregerminated the latter. Preferably, the formulations are applied such that germination is not included.

The active substance concentrations in ready-to-use formulations, which may be obtained after two-to-tenfold dilution, are preferably from 0.01 to 60% by weight, more preferably from 0.1 to 40 % by weight.

In a preferred embodiment a FS formulation is used for seed treatment. Typically, a FS formulation may comprise 1-800 g/l of active ingredient, 1-200 g/l Surfactant, 0 to 200 g/l antifreezing agent, 0 to 400 g/l of binder, 0 to 200 g/l of a pigment and up to 1 liter of a solvent, preferably water.

Especially preferred FS formulations of the compounds of the present invention for seed treatment usually comprise from 0.1 to 80% by weight (1 to 800 g/l) of the active ingredient, from 0.1 to 20 % by weight (1 to 200 g/l) of at least one surfactant, e.g. 0.05 to 5 % by weight of a wetter and from 0.5 to 15 % by weight of a dispersing agent, up to 20 % by weight, e.g. from 5 to 20 % of an anti-freeze agent, from 0 to 15 % by weight, e.g. 1 to 15 % by weight of a pigment and/or a dye, from 0 to 40 % by weight, e.g. 1 to 40 % by weight of a binder (sticker /adhesion agent), optionally up to 5 % by weight, e.g. from 0.1 to 5 % by weight of a thickener, optionally from 0.1 to 2 % of an anti-foam agent, and optionally a preservative such as a biocide, antioxidant or the like, e.g. in an amount from 0.01 to 1 % by weight and a filler/vehicle up to 100 % by weight.

In the treatment of seed, the application rates of the compounds of the invention are generally from 0.1 g to 10 kg per 100 kg of seed, preferably from 1 g to 5 kg per 100 kg of seed, more preferably from 1 g to 1000 g per 100 kg of seed and in particular from 1 g to 200 g per 100 kg of seed, e.g. from 1 g to 100 g or from 5 g to 100 g per 100 kg of seed.

The invention therefore also relates to seed comprising a compound of the present invention, or an agriculturally useful salt thereof, as defined herein. The amount of the compound of the present invention or the agriculturally useful salt thereof will in general vary from 0.1 g to 10 kg per 100 kg

of seed, preferably from 1 g to 5 kg per 100 kg of seed, in particular from 1 g to 1000 g per 100 kg of seed. For specific crops such as lettuce the rate can be higher.

The compounds of the present invention may also be used for improving the health of a plant. Therefore, the present invention also relates to a method for improving plant health by treating a plant, plant propagation material and/or the locus where the plant is growing or is to grow with an effective and non-phytotoxic amount of a compound of the present invention.

As used herein “an effective and non-phytotoxic amount” means that the compound is used in a quantity which allows to obtain the desired effect but which does not give rise to any phytotoxic symptom on the treated plant or on the plant grown from the treated propagule or treated soil.

The terms “plant” and “plant propagation material” are defined above.

"Plant health" is defined as a condition of the plant and/or its products which is determined by several aspects alone or in combination with each other such as yield (for example increased biomass and/or increased content of valuable ingredients), quality (for example improved content or composition of certain ingredients or shelf life), plant vigour (for example improved plant growth and/or greener leaves (“greening effect”), tolerance to abiotic (for example drought) and/or biotic stress (for example disease) and production efficiency (for example, harvesting efficiency, processability).

The above identified indicators for the health condition of a plant may be interdependent and may result from each other. Each indicator is defined in the art and can be determined by methods known to a skilled person.

The compounds of the invention are also suitable for use against non-crop insect pests. For use against said non-crop pests, compounds of the present invention can be used as bait composition, gel, general insect spray, aerosol, as ultra-low volume application and bed net (impregnated or surface applied). Furthermore, drenching and rodding methods can be used.

As used herein, the term “non-crop insect pest” refers to pests, which are particularly relevant for non-crop targets, such as ants, termites, wasps, flies, ticks, mosquitos, crickets, or cockroaches.

The bait can be a liquid, a solid or a semisolid preparation (e.g. a gel). The bait employed in the composition is a product, which is sufficiently attractive to incite insects such as ants, termites, wasps, flies, mosquitos, crickets etc. or cockroaches to eat it. The attractiveness can be manipulated by using feeding stimulants or sex pheromones. Food stimulants are chosen, for example, but not exclusively, from animal and/or plant proteins (meat-, fish- or blood meal, insect parts, egg yolk), from fats and oils of animal and/or plant origin, or mono-, oligo- or polyorganosaccharides, especially from sucrose, lactose, fructose, dextrose, glucose, starch, pectin or even molasses or honey. Fresh or decaying parts of fruits, crops, plants, animals, insects or specific parts thereof can also serve as a feeding stimulant. Sex pheromones are known to be more insect specific. Specific pheromones are described in the literature (e.g. http://www.pherobase.com), and are known to those skilled in the art.

For use in bait compositions, the typical content of active ingredient is from 0.001 weight % to 15 weight %, desirably from 0.001 weight % to 5% weight % of active compound.

Formulations of the compounds of the present invention as aerosols (e.g in spray cans), oil sprays or pump sprays are highly suitable for the non-professional user for controlling pests such as flies,

fleas, ticks, mosquitos or cockroaches. Aerosol recipes are preferably composed of the active compound, solvents, furthermore auxiliaries such as emulsifiers, perfume oils, if appropriate stabilizers, and, if required, propellants.

The oil spray formulations differ from the aerosol recipes in that no propellants are used.

For use in spray compositions, the content of active ingredient is from 0.001 to 80 weights %, preferably from 0.01 to 50 weight % and most preferably from 0.01 to 15 weight %.

The compounds of the present invention and its respective compositions can also be used in mosquito and fumigating coils, smoke cartridges, vaporizer plates or long-term vaporizers and also in moth papers, moth pads or other heat-independent vaporizer systems.

Methods to control infectious diseases transmitted by insects (e.g. malaria, dengue and yellow fever, lymphatic filariasis, and leishmaniasis) with compounds of the present invention and its respective compositions also comprise treating surfaces of huts and houses, air spraying and impregnation of curtains, tents, clothing items, bed nets, tsetse-fly trap or the like. Insecticidal compositions for application to fibers, fabric, knitgoods, nonwovens, netting material or foils and tarpaulins preferably comprise a mixture including the insecticide, optionally a repellent and at least one binder.

The compounds of the present invention and its compositions can be used for protecting wooden materials such as trees, board fences, sleepers, frames, artistic artifacts, etc. and buildings, but also construction materials, furniture, leathers, fibers, vinyl articles, electric wires and cables etc. from ants and/or termites, and for controlling ants and termites from doing harm to crops or human being (e.g. when the pests invade into houses and public facilities).

Customary application rates in the protection of materials are, for example, from 0.001 g to 2000 g or from 0.01 g to 1000 g of active compound per m^2 treated material, desirably from 0.1 g to 50 g per m^2.

Insecticidal compositions for use in the impregnation of materials typically contain from 0.001 to 95 weight %, preferably from 0.1 to 45 weight %, and more preferably from 1 to 25 weight % of at least one repellent and/or insecticide.

The compounds of the the present invention are especially suitable for efficiently combating animal pests such as arthropods, gastropods and nematodes including but not limited to:

insects from the order of Lepidoptera, for example *Achroia grisella*, *Acleris* spp. such as *A. fimbriana, A. gloverana, A. variana; Acrolepiopsis assectella, Acronicta major, Adoxophyes* spp. such as *A. cyrtosema, A. orana; Aedia leucomelas, Agrotis* spp. such as *A. exclamationis, A. fucosa, A. ipsilon, A. orthogoma, A. segetum, A. subterranea; Alabama argillacea, Aleurodicus dispersus, Alsophila pometaria, Ampelophaga rubiginosa, Amyelois transitella, Anacampsis sarcitella, Anagasta kuehniella, Anarsia lineatella, Anisota senatoria, Antheraea pernyi, Anticarsia (=Thermesia)* spp. such as *A. gemmatalis; Apamea* spp., *Aproaerema modicella, Archips* spp. such as *A. argyrospila, A. fuscocupreanus, A. rosana, A. xyloseanus; Argyresthia conjugella, Argyroploce* spp., *Argyrotaenia* spp. such as *A. velutinana; Athetis mindara, Austroasca viridigrisea, Autographa gamma, Autographa nigrisigna, Barathra brassicae, Bedellia* spp., *Bonagota salubricola, Borbo cinnara, Bucculatrix thurberiella, Bupalus piniarius, Busseola* spp., *Cacoecia* spp. such as *C. murinana, C. podana; Cactoblastis cactorum, Cadra cautella, Calingo braziliensis, Caloptilis theivora, Capua reticu-*

lana, Carposina spp. such as *C. niponensis, C. sasakii; Cephus* spp., *Chaetocnema aridula, Cheimatobia brumata, Chilo* spp. such as *C. Indicus, C. suppressalis, C. partellus; Choreutis pariana, Choristoneura* spp. such as *C. conflictana, C. fumiferana, C. longicellana, C. murinana, C. occidentalis, C. rosaceana; Chrysodeixis (=Pseudoplusia)* spp. *such as C. eriosoma, C. includens; Cirphis unipuncta, Clysia ambiguella, Cnaphalocerus* spp., *Cnaphalocrocis medinalis, Cnephasia* spp., *Cochylis hospes, Coleophora* spp., *Colias eurytheme, Conopomorpha* spp., *Conotrachelus* spp., *Copitarsia* spp., *Corcyra cephalonica, Crambus caliginosellus, Crambus teterrellus, Crocidosema (=Epinotia) aporema, Cydalima (=Diaphania) perspectalis, Cydia (=Carpocapsa)* spp. such as *C. pomonella, C. latiferreana; Dalaca noctuides, Datana integerrima, Dasychira pinicola, Dendrolimus* spp. such as *D. pini, D. spectabilis, D. sibiricus; Desmia funeralis, Diaphania* spp. such as *D. nitidalis, D. hyalinata; Diatraea grandiosella, Diatraea saccharalis, Diphthera festiva, Earias* spp. such as *E. insulana, E. vittella; Ecdytolopha aurantianu, Egira (=Xylomyges) curialis, Elasmopalpus lignosellus, Eldana saccharina, Endopiza viteana, Ennomos subsignaria, Eoreuma loftini, Ephestia* spp. such as *E. cautella, E. elutella, E. kuehniella; Epinotia aporema, Epiphyas postvittana, Erannis tiliaria, Erionota thrax, Etiella* spp., *Eulia* spp., *Eupoecilia ambiguella, Euproctis chrysorrhoea, Euxoa* spp., *Evetria bouliana, Faronta albilinea, Feltia* spp. such as *F. subterranean; Galleria mellonella, Gracillaria* spp., *Grapholita* spp. such as *G. funebrana, G. molesta, G. inopinata; Halysidota* spp., *Harrisina americana*, *Hedylepta* spp., *Helicoverpa* spp. such as *H. armigera (=Heliothis armigera), H. zea (=Heliothis zea); Heliothis* spp. such as *H. assulta, H. subflexa, H. virescens; Hellula* spp. such as *H. undalis, H. rogatalis; Helocoverpa gelotopoeon, Hemileuca oliviae, Herpetogramma licarsisalis, Hibernia defoliaria, Hofmannophila pseudospretella, Homoeosoma electellum, Homona magnanima, Hypena scabra, Hyphantria cunea, Hyponomeuta padella, Hyponomeuta malinellus, Kakivoria flavofasciata, Keiferia lycopersicella, Lambdina fiscellaria fiscellaria, Lambdina fiscellaria lugubrosa, Lamprosema indicata*, *Laspeyresia molesta, Leguminivora glycinivorella, Lerodea eufala, Leucinodes orbonalis, Leucoma salicis, Leucoptera* spp. such as *L. coffeella, L. scitella; Leuminivora lycinivorella, Lithocolletis blancardella, Lithophane antennata, Llattia octo (=Amyna axis), Lobesia botrana, Lophocampa* spp., *Loxagrotis albicosta, Loxostege* spp. such as *L. sticticalis, L. cereralis; Lymantria* spp. such as *L. dispar, L. monacha; Lyonetia clerkella, Lyonetia prunifoliella, Malacosoma* spp. such as *M. americanum, M. californicum, M. constrictum, M. neustria; Mamestra* spp. such as *M. brassicae, M. configurata; Mamstra brassicae, Manduca* spp. such as *M. quinquemaculata, M. sexta; Marasmia spp, Marmara* spp., *Maruca testulalis, Megalopyge lanata, Melanchra picta, Melanitis leda, Mocis* spp. such as *M. lapites, M. repanda; Mocis latipes, Monochroa fragariae, Mythimna separata, Nemapogon cloacella, Neoleucinodes elegantalis, Nepytia* spp., *Nymphula* spp., *Oiketicus* spp., *Omiodes indicata, Omphisa anastomosalis, Operophtera brumata, Orgyia pseudotsugata, Oria* spp., *Orthaga thyrisalis, Ostrinia* spp. such as *O. nubilalis; Oulema oryzae, Paleacrita vernata, Panolis flammea, Parnara* spp., *Papaipema nebris*, *Papilio cresphontes, Paramyelois transitella, Paranthrene regalis*, *Paysandisia archon*, *Pectinophora* spp. such as *P. gossypiella; Peridroma saucia, Perileucoptera* spp., such as *P. coffeella; Phalera bucephala, Phryganidia californica*, *Phthorimaea* spp. such as *P. operculella; Phyllocnistis citrella, Phyllonorycter* spp. such as *P. blancardella, P. crataegella, P. issikii, P. ringoniella; Pieris* spp. such as *P. brassicae, P. rapae, P. napi; Pilocrocis tripunctata, Plathypena scabra, Platynota* spp. such

as *P. flavedana, P. idaeusalis, P. stultana; Platyptilia carduidactyla, Plebejus argus, Plodia interpunctella, Plusia spp, Plutella maculipennis, Plutella xylostella, Pontia protodica, Prays* spp., *Prodenia* spp., *Proxenus lepigone, Pseudaletia* spp. such as *P. sequax, P. unipuncta; Pyrausta nubilalis, Rachiplusia nu, Richia albicosta, Rhizobius ventralis, Rhyacionia frustrana, Sabulodes aegrotata, Schizura concinna, Schoenobius* spp., *Schreckensteinia festaliella, Scirpophaga* spp. such as *S. incertulas, S. innotata; Scotia segetum, Sesamia* spp. such as *S. inferens, Seudyra subflava, Sitotroga cerealella, Sparganothis pilleriana, Spilonota lechriaspis, S. ocellana, Spodoptera (=Lamphygma)* spp. such as *S. cosmoides, S. eridania, S. exigua, S. frugiperda, S. latisfascia, S. littoralis, S. litura, S. omithogalli; Stigmella* spp., *Stomopteryx subsecivella, Strymon bazochii, Sylepta derogata, Synanthedon* spp. such as S. exitiosa, *Tecia solanivora, Telehin licus, Thaumatopoea pityocampa, Thaumatotibia (=Cryptophlebia) leucotreta, Thaumetopoea pityocampa, Thecla* spp., *Theresimima ampelophaga, Thyrinteina* spp, *Tildenia inconspicuella, Tinea* spp. such as *T. cloacella, T. pellionella; Tineola bisselliella, Tortrix* spp. such as *T. viridana; Trichophaga tapetzella, Trichoplusia* spp. such as *T. ni; Tuta (=Scrobipalpula) absoluta, Udea* spp. such as *U. rubigalis, U. rubigalis; Virachola* spp., *Yponomeuta padella, and Zeiraphera canadensis;*

insects from the order of Coleoptera, for example *Acalymma vittatum*, *Acanthoscehdes obtectus, Adoretus* spp., *Agelastica alni, Agrilus* spp. such as *A. anxius, A. planipennis, A. sinuatus; Agriotes* spp. such as *A. fuscicollis, A. lineatus, A. obscurus; Alphitobius diaperinus, Amphimallus solstitialis, Anisandrus dispar, Anisoplia austriaca, Anobium punctatum, Anomala corpulenta, Anomala rufocuprea, Anoplophora* spp. such as *A. glabripennis; Anthonomus* spp. such as *A. eugenii, A. grandis, A. pomorum; Anthrenus* spp., *Aphthona euphoridae, Apion* spp., *Apogonia* spp., *Athous haemorrhoidalis, Atomaria* spp. such as *A. linearis; Attagenus* spp., *Aulacophora femoralis, Blastophagus piniperda, Blitophaga undata, Bruchidius obtectus, Bruchus* spp. such as *B. lentis, B. pisorum, B. rufimanus; Byctiscus betulae, Callidiellum rufipenne, Callopistria floridensis, Callosobruchus chinensis, Cameraria ohridella, Cassida nebulosa, Cerotoma trifurcata, Cetonia aurata, Ceuthorrhynchus* spp. such as *C. assimilis, C. napi; Chaetocnema tibialis, Cleonus mendicus, Conoderus* spp. such as *C. vespertinus; Conotrachelus nenuphar, Cosmopolites* spp., *Costelytra zealandica, Crioceris asparagi, Cryptolestes ferrugineus, Cryptorhynchus lapathi, Ctenicera* spp. such as *C. destructor; Curculio* spp., *Cylindrocopturus* spp., *Cyclocephala* spp., *Dactylispa balyi, Dectes texanus, Dermestes* spp., *Diabrotica* spp. such as *D. undecimpunctata, D. speciosa, D. longicornis, D. semipunctata, D. virgifera; Diaprepes abbreviates, Dichocrocis* spp., *Dicladispa armigera, Diloboderus abderus, Diocalandra frumenti (Diocalandra stigmaticollis), Enaphalodes rufulus, Epilachna* spp. such as *E. varivestis, E. vigintioctomaculata; Epitrix* spp. such as *E. hirtipennis, E. similaris; Eutheola humilis, Eutinobothrus brasiliensis, Faustinus cubae, Gibbium psylloides, Gnathocerus cornutus, Hellula undalis, Heteronychus arator, Hylamorpha elegans, Hylobius abietis, Hylotrupes bajulus, Hypera* spp. such as *H. brunneipennis, H. postica; Hypomeces squamosus, Hypothenemus* spp., *Ips typographus, Lachnosterna consanguinea, Lasioderma serricorne, Latheticus oryzae, Lathridius* spp., *Lema* spp. such as *L. bilineata, L. melanopus; Leptinotarsa* spp. such as *L. decemlineata; Leptispa pygmaea, Limonius californicus, Lissorhoptrus oryzophilus, Lixus* spp., *Luperodes* spp., *Lyctus* spp. such as *L. bruneus; Liogenys fuscus, Macrodactylus* spp. such as *M. subspi-*

nosus; Maladera matrida, Megaplatypus mutates, Megascelis spp., *Melanotus communis, Meligethes* spp. such as *M. aeneus; Melolontha* spp. such as *M. hippocastani, M. melolontha; Metamasius hemipterus, Microtheca* spp., *Migdolus* spp. such as *M. fryanus, Monochamus* spp. such as *M. alternatus; Naupactus xanthographus, Niptus hololeucus, Oberia brevis, Oemona hirta, Oryctes rhinoceros, Oryzaephilus surinamensis, Oryzaphagus oryzae, Otiorrhynchus sulcatus, Otiorrhynchus ovatus, Otiorrhynchus sulcatus, Oulema melanopus, Oulema oryzae, Oxycetonia jucunda, Phaedon* spp. such as *P. brassicae, P. cochleariae; Phoracantha recurva, Phyllobius pyri, Phyllopertha horticola, Phyllophaga* spp. such as *P. helleri; Phyllotreta* spp. such as *P. chrysocephala, P. nemorum, P. striolata, P. vittula; Phyllopertha horticola, Popillia japonica, Premnotrypes* spp., *Psacothea hilaris, Psylliodes chrysocephala, Prostephanus truncates, Psylliodes* spp., *Ptinus* spp., *Pulga saltona, Rhizopertha dominica, Rhynchophorus* spp. such as *R. billineatus, R. ferrugineus, R. palmarum, R. phoenicis, R. vulneratus; Saperda candida, Scolytus schevyrewi, Scyphophorus acupunctatus, Sitona lineatus, Sitophilus* spp. such as *S. granaria, S. oryzae, S. zeamais; Sphenophorus* spp. such as *S. levis; Stegobium paniceum, Sternechus* spp. such as *S. subsignatus; Strophomorphus ctenotus, Symphyletes* spp., *Tanymecus* spp., *Tenebrio molitor, Tenebrioides mauretanicus, Tribolium* spp. such as *T. castaneum; Trogoderma* spp., *Tychius* spp., *Xylotrechus* spp. such as *X. pyrrhoderus; and, Zabrus* spp. *such as Z. tenebrioides;*

insects from the order of Diptera for example *Aedes* spp. such as *A. aegypti, A. albopictus, A. vexans; Anastrepha ludens, Anopheles* spp. such as *A. albimanus, A. crucians, A. freeborni, A. gambiae, A. leucosphyrus, A. maculipennis, A. minimus, A. quadrimaculatus, A. sinensis; Bactrocera invadens, Bibio hortulanus, Calliphora erythrocephala, Calliphora vicina, Ceratitis capitata, Chrysomyia* spp. such as *C. bezziana, C. hominivorax, C. macellaria; Chrysops atlanticus, Chrysops discalis, Chrysops silacea, Cochliomyia* spp. such as *C. hominivorax; Contarinia* spp. such as *C. sorghicola; Cordylobia anthropophaga, Culex* spp. such as *C. nigripalpus, C. pipiens, C. quinquefasciatus, C. tarsalis, C. tritaeniorhynchus; Culicoides furens, Culiseta inornata, Culiseta melanura, Cuterebra* spp., *Dacus cucurbitae, Dacus oleae, Dasineura brassicae, Dasineura oxycoccana, Delia* spp. such as *D. antique, D. coarctata, D. platura, D. radicum; Dermatobia hominis, Drosophila* spp. such as *D. suzukii, Fannia* spp. such as *F. canicularis; Gastraphilus* spp. such as *G. intestinalis; Geomyza tipunctata, Glossina* spp. such as *G. fuscipes, G. morsitans, G. palpalis, G. tachinoides; Haematobia irritans, Haplodiplosis equestris, Hippelates* spp., Hylemyia spp. such as *H. platura; Hypoderma* spp. such as *H. lineata; Hyppobosca* spp., *Hydrellia philippina, Leptoconops torrens, Liriomyza* spp. such as *L. sativae, L. trifolii; Lucilia* spp. such as *L. caprina, L. cuprina, L. sericata; Lycoria pectoralis, Mansonia titillanus, Mayetiola* spp. such as *M. destructor; Musca* spp. such as *M. autumnalis, M. domestica; Muscina stabulans, Oestrus* spp. such as *O. ovis; Opomyza florum, Oscinella* spp. such as *O. frit; Orseolia oryzae, Pegomya hysocyami, Phlebotomus argentipes, Phorbia* spp. such as *P. antiqua, P. brassicae, P. coarctata; Phytomyza gymnostoma, Prosimulium mixtum, Psila rosae, Psorophora columbiae, Psorophora discolor, Rhagoletis* spp. such as *R. cerasi, R. cingulate, R. indifferens, R. mendax, R. pomonella; Rivellia quadrifasciata, Sarcophaga* spp. such as *S. haemorrhoidalis; Simulium vittatum, Sitodiplosis mosellana, Stomoxys* spp. such as *S. calcitrans; Tabanus* spp. such as *T. atratus, T. bovinus, T. lineola,*

T. similis; Tannia spp., Thecodiplosis japonensis, Tipula oleracea, Tipula paludosa, and *Wohlfahrtia* spp;

insects from the order of Thysanoptera for example, *Baliothrips biformis, Dichromothrips corbetti, Dichromothrips* ssp., *Echinothrips americanus, Enneothrips flavens, Frankliniella* spp. such as *F. fusca, F. occidentalis, F. tritici; Heliothrips* spp., *Hercinothrips femoralis, Kakothrips* spp., *Microcephalothrips abdominalis, Neohydatothrips samayunkur, Pezothrips kellyanus, Rhipiphorothrips cruentatus, Scirtothrips* spp. such as *S. citri, S. dorsalis, S. perseae; Stenchaetothrips spp, Taeniothrips cardamoni, Taeniothrips inconsequens, Thrips* spp. such as *T. imagines, T. hawaiiensis, T. oryzae, T. palmi, T. parvispinus, T. tabaci;*

insects from the order of Hemiptera for example, *Acizzia jamatonica*, *Acrosternum* spp. such as *A. hilare;* Acyrthosipon spp. such as *A. onobrychis, A. pisum; Adelges laricis, Adelges tsugae, Adelphocoris* spp., such as *A. rapidus, A. superbus; Aeneolamia* spp., *Agonoscena* spp., *Aulacorthum solani, Aleurocanthus woglumi, Aleurodes* spp., *Aleurodicus disperses, Aleurolobus barodensis, Aleurothrixus* spp., *Amrasca* spp., *Anasa tristis, Antestiopsis* spp., *Anuraphis cardui, Aonidiella* spp., *Aphanostigma piri, Aphidula nasturtii, Aphis* spp. such as *A. craccivora, A. fabae, A. forbesi, A. gossypii, A. grossulariae, A. maidiradicis, A. pomi, A. sambuci, A. schneideri, A. spiraecola; Arboridia apicalis, Arilus critatus, Aspidiella* spp., *Aspidiotus* spp., *Atanus* spp., *Aulacaspis yasumatsui, Aulacorthum solani, Bactericera cockerelli (Paratrioza cockerelli), Bemisia* spp. such as *B. argentifolii, B. tabaci (Aleurodes tabaci); Blissus* spp. such as *B. leucopterus; Brachycaudus* spp. such as *B. cardui, B. helichrysi, B. persicae, B. prunicola; Brachycolus* spp., *Brachycorynella asparagi, Brevicoryne brassicae, Cacopsylla* spp. such as *C. fulguralis, C. pyricola (Psylla piri); Calligypona marginata, Calocoris* spp., *Campylomma livida, Capitophorus horni, Carneocephala fulgida, Cavelerius* spp., *Ceraplastes* spp., *Ceratovacuna lanigera, Ceroplastes ceriferus, Cerosipha gossypii, Chaetosiphon fragaefolii, Chionaspis tegalensis, Chlorita onukii, Chromaphis juglandicola, Chrysomphalus ficus, Cicadulina mbila, Cimex* spp. such as *C. hemipterus, C. lectularius; Coccomytilus halli, Coccus* spp. such as *C. hesperidum, C. pseudomagnoliarum*; *Corythucha arcuata, Creontiades dilutus, Cryptomyzus ribis, Chrysomphalus aonidum, Cryptomyzus ribis, Ctenarytaina spatulata, Cyrtopeltis notatus, Dalbulus* spp., *Dasynus piperis, Dialeurodes* spp. such as *D. citrifolii; Dalbulus maidis, Diaphorina* spp. such as *D. citri; Diaspis* spp. such as *D. bromeliae; Dichelops furcatus, Diconocoris hewetti, Doralis* spp., *Dreyfusia nordmannianae, Dreyfusia piceae, Drosicha* spp., *Dysaphis* spp. such as *D. plantaginea, D. pyri, D. radicola; Dysaulacorthum pseudosolani, Dysdercus* spp. such as *D. cingulatus, D. intermedius; Dysmicoccus* spp., *Edessa* spp., *Geocoris* spp., *Empoasca* spp. such as *E. fabae, E. solana; Epidiaspis leperii, Eriosoma* spp. such as *E. lanigerum, E. pyricola; Erythroneura* spp., *Eurygaster* spp. such as *E. integriceps; Euscelis bilobatus, Euschistus* spp. such as *E. heros, E. impictiventris, E. servus; Fiorinia theae, Geococcus coffeae, Glycaspis brimblecombei, Halyomorpha* spp. such as *H. halys; Heliopeltis* spp., *Homalodisca vitripennis (=H. coagulata), Horcias nobilellus, Hyalopterus pruni, Hyperomyzus lactucae, Icerya* spp. such as *I. purchase; Idiocerus* spp., *Idioscopus* spp., *Laodelphax striatellus, Lecanium* spp., *Lecanoideus floccissimus, Lepidosaphes* spp. such as *L. ulmi; Leptocorisa* spp., *Leptoglossus phyllopus, Lipaphis erysimi, Lygus* spp. such as *L. hesperus, L. lineolaris, L. pratensis; Maconellicoccus hirsutus, Marchalina hellenica, Macropes excavatus, Macrosiphum* spp. such as *M. rosae, M.*

avenae, M. euphorbiae; Macrosteles quadrilineatus, Mahanarva fimbriolata, Megacopta cribraria, Megoura viciae, Melanaphis pyrarius, Melanaphis sacchari, Melanocallis (=Tinocallis) caryaefoliae, Metcafiella spp., *Metopolophium dirhodum, Monellia costalis, Monelliopsis pecanis, Myzocallis coryli, Murgantia* spp., *Myzus* spp. such as *M. ascalonicus, M. cerasi, M. nicotianae, M. persicae, M. varians; Nasonovia ribis-nigri, Neotoxoptera formosana, Neomegalotomus spp, Nephotettix* spp. such as *N. malayanus, N. nigropictus, N. parvus, N. virescens; Nezara* spp. such as *N. viridula; Nilaparvata lugens, Nysius huttoni, Oebalus* spp. such as *O. pugnax; Oncometopia* spp., *Orthezia praelonga, Oxycaraenus hyalinipennis, Parabemisia myricae, Parlatoria* spp., *Parthenolecanium* spp. such as *P. corni, P. persicae; Pemphigus* spp. such as *P. bursarius, P. populivenae; Peregrinus maidis, Perkinsiella saccharicida, Phenacoccus* spp. such as *P. aceris, P. gossypii; Phloeomyzus passerinii, Phorodon humuli, Phylloxera* spp. such as *P. devastatrix, Piesma quadrata, Piezodorus* spp. such as *P. guildinii; Pinnaspis aspidistrae, Planococcus* spp. such as *P. citri, P. ficus; Prosapia bicincta, Protopulvinaria pyriformis, Psallus seriatus, Pseudacysta persea, Pseudaulacaspis pentagona, Pseudococcus* spp. such as *P. comstocki; Psylla* spp. such as *P. mali; Pteromalus* spp., *Pulvinaria amygdali, Pyrilla* spp., *Quadraspidiotus* spp., such as *Q. perniciosus; Quesada gigas, Rastrococcus* spp., *Reduvius senilis, Rhizoecus americanus, Rhodnius* spp., *Rhopalomyzus ascalonicus, Rhopalosiphum* spp. such as *R. pseudobrassicas, R. insertum, R. maidis, R. padi; Sagatodes* spp., *Sahlbergella singularis, Saissetia* spp., *Sappaphis mala, Sappaphis mali, Scaptocoris* spp., *Scaphoides titanus, Schizaphis graminum, Schizoneura lanuginosa, Scotinophora* spp., *Selenaspidus articulatus, Sitobion avenae, Sogata* spp., *Sogatella furcifera, Solubea insularis, Spissistilus festinus (=Stictocephala festina), Stephanitis nashi, Stephanitis pyrioides, Stephanitis takeyai, Tenalaphara malayensis, Tetraleurodes perseae, Therioaphis maculate, Thyanta* spp. such as *T. accerra, T. perditor; Tibraca* spp., *Tomaspis* spp., *Toxoptera* spp. such as *T. aurantii; Trialeurodes* spp. such as *T. abutilonea, T. ricini, T. vaporariorum; Triatoma* spp., *Trioza* spp., *Typhlocyba* spp., *Unaspis* spp. such as *U. citri, U. yanonensis; and Viteus vitifolii,*

Insects from the order Hymenoptera for example *Acanthomyops interjectus*, *Athalia rosae, Atta* spp. *such as A. capiguara, A. cephalotes, A. cephalotes, A. laevigata, A. robusta, A. sexdens, A. texana, Bombus* spp., *Brachymyrmex* spp., *Camponotus* spp. such as *C. floridanus, C. pennsylvanicus, C. modoc; Cardiocondyla nuda, Chalibion sp, Crematogaster* spp., *Dasymutilla occidentalis, Diprion* spp., *Dolichovespula maculata, Dorymyrmex* spp., *Dryocosmus kuriphilus, Formica* spp., *Hoplocampa* spp. such as *H. minuta, H. testudinea; Iridomyrmex humilis,* Lasius spp. such as *L. niger, Linepithema humile, Liometopum* spp., *Leptocybe invasa, Monomorium* spp. such as *M. pharaonis, Monomorium, Nylandria fulva, Pachycondyla chinensis, Paratrechina longicornis, Paravespula* spp., such as *P. germanica, P. pennsylvanica, P. vulgaris; Pheidole* spp. such as *P. megacephala; Pogonomyrmex* spp. such as *P. barbatus, P. californicus, Polistes rubiginosa, Prenolepis impairs, Pseudomyrmex gracilis, Schelipron* spp., *Sirex cyaneus, Solenopsis* spp. such as *S. geminata, S.invicta, S. molesta, S. richteri, S. xyloni, Sphecius speciosus, Sphex* spp., *Tapinoma* spp. such as *T. melanocephalum, T. sessile; Tetramorium* spp. such as *T. caespitum, T. bicarinatum, Vespa* spp. such as *V. crabro; Vespula* spp. such as *V. squamosal; Wasmannia auropunctata*, *Xylocopa* sp;

Insects from the order Orthoptera for example *Acheta domesticus, Calliptamus italicus, Chortoicetes terminifera, Ceuthophilus* spp., *Diastrammena asynamora, Dociostaurus maroccanus, Gryllotalpa* spp. such as *G. africana, G. gryllotalpa; Gryllus* spp., *Hieroglyphus daganensis, Kraussaria angulifera, Locusta* spp. such as *L. migratoria, L. pardalina; Melanoplus* spp. such as *M. bivittatus, M. femurrubrum, M. mexicanus, M. sanguinipes, M. spretus; Nomadacris septemfasciata, Oedaleus senegalensis, Scapteriscus* spp., *Schistocerca* spp. such as *S. americana, S. gregaria, Stemopelmatus* spp., *Tachycines asynamorus,* and *Zonozerus variegatus;*

Pests from the Class Arachnida for example Acari,e.g. of the families Argasidae, Ixodidae and Sarcoptidae, such as *Amblyomma* spp. (e.g. *A. americanum, A. variegatum, A. maculatum*), Argas spp. such as *A. persicu*), *Boophilus* spp. such as *B. annulatus, B. decoloratus, B. microplus, Dermacentor* spp. such as *D.silvarum, D. andersoni, D. variabilis, Hyalomma* spp. such as *H. truncatum, Ixodes* spp. such as *I. ricinus, I. rubicundus, I. scapularis, I. holocyclus, I. pacificus, Rhipicephalus sanguineus, Ornithodorus* spp. such as *O. moubata, O. hermsi, O. turicata, Ornithonyssus bacoti, Otobius megnini, Dermanyssus gallinae, Psoroptes* spp. such as *P. ovis, Rhipicephalus* spp. such as *R. sanguineus, R. appendiculatus, Rhipicephalus evertsi, Rhizoglyphus* spp., *Sarcoptes* spp. such as*S. Scabiei*; and Family Eriophyidae including *Aceria* spp. such as *A. sheldoni*, *A. anthocoptes*, *Acallitus* spp., *Aculops* spp. such as *A. lycopersici*, *A. pelekassi*; *Aculus* spp. such as *A. schlechtendali; Colomerus vitis, Epitrimerus pyri, Phyllocoptruta oleivora; Eriophytes ribis* and *Eriophyes* spp. such as *Eriophyes sheldoni*; Family Tarsonemidae including *Hemitarsonemus* spp., *Phytonemus pallidus and Polyphagotarsonemus latus, Stenotarsonemus* spp. *Steneotarsonemus spinki*; Family Tenuipalpidae including Brevipalpus spp. such as *B. phoenicis*; Family Tetranychidae including *Eotetranychus* spp., *Eutetranychus* spp., *Oligonychus* spp., *Petrobia latens*, *Tetranychus* spp. such as *T. cinnabarinus, T. evansi, T. kanzawai, T, pacificus, T. phaseulus, T. telarius* and *T. urticae*; *Bryobia praetiosa*; *Panonychus* spp. such as *P. ulmi*, *P. citri*; *Metatetranychus* spp. and *Oligonychus* spp. such as *O. pratensis, O. perseae*, *Vasates lycopersici*; *Raoiella indica, Family* Carpoglyphidae including *Carpoglyphus* spp.*; Penthaleidae* spp. such as *Halotydeus destructor*; Family Demodicidae with species such as *Demodex* spp.; Family Trombicidea including *Trombicula* spp.; Family Macronyssidae including *Ornothonyssus* spp.; Family Pyemotidae including *Pyemotes tritici*; *Tyrophagus putrescentiae*; Family Acaridae including *Acarus siro*; Family Araneida including *Latrodectus mactans*, *Tegenaria agrestis, Chiracanthium sp, Lycosa sp Achaearanea tepidariorum* and *Loxosceles reclusa*;

Pests from the Phylum Nematoda, for example, plant parasitic nematodes such as root-knot nematodes, *Meloidogyne* spp. such as *M. hapla, M. incognita, M. javanica;* cyst-forming nematodes, *Globodera* spp. such as *G. rostochiensis; Heterodera* spp. such as *H. avenae, H. glycines, H. schachtii, H. trifolii;* Seed gall nematodes, *Anguina* spp.; Stem and foliar nematodes, *Aphelenchoides* spp. such as *A. besseyi;* Sting nematodes, *Belonolaimus* spp. such as *B. longicaudatus;* Pine nematodes, *Bursaphelenchus* spp. such as *B. lignicolus, B. xylophilus;* Ring nematodes, *Criconema* spp., *Criconemella* spp. such as *C. xenoplax* and *C. ornata;* and, *Criconemoides* spp. such as *Criconemoides informis; Mesocriconema* spp.*;* Stem and bulb nematodes, *Ditylenchus* spp. such as *D. destructor, D. dipsaci;* Awl nematodes, *Dolichodorus* spp.*;* Spiral nematodes, *Helio-*

cotylenchus multicinctus; Sheath and sheathoid nematodes, *Hemicycliophora* spp. and *Hemicriconemoides* spp.*; Hirshmanniella* spp.*;* Lance nematodes, *Hoploaimus* spp.*;* False rootknot nematodes, *Nacobbus* spp.*;* Needle nematodes, *Longidorus* spp. such as *L. elongatus;* Lesion nematodes, *Pratylenchus* spp. such as *P. brachyurus, P. neglectus, P. penetrans, P. curvitatus, P. goodeyi;* Burrowing nematodes, *Radopholus* spp. such as *R. similis; Rhadopholus* spp.*; Rhodopholus* spp.*;* Reniform nematodes, *Rotylenchus* spp. such as *R. robustus, R. reniformis; Scutellonema* spp.*;* Stubby-root nematode, *Trichodorus* spp. such as *T. obtusus*, *T. primitivus; Paratrichodorus* spp. such as *P. minor;* Stunt nematodes, *Tylenchorhynchus* spp. such as *T. claytoni*, *T. dubius;* Citrus nematodes, *Tylenchulus* spp. such as *T. semipenetrans;* Dagger nematodes, *Xiphinema* spp.*;* and other plant parasitic nematode species;

Insects from the order Isoptera for example *Calotermes flavicollis, Coptotermes* spp. such as *C. formosanus, C. gestroi, C. acinaciformis; Cornitermes cumulans, Cryptotermes* spp. such as *C. brevis, C. cavifrons; Globitermes sulfureus, Heterotermes* spp. such as *H. aureus, H. longiceps, H. tenuis; Leucotermes flavipes, Odontotermes spp., Incisitermes* spp. such as *I. minor, I. Snyder*, *Marginitermes hubbardi*, *Mastotermes* spp. such as *M. darwiniensis Neocapritermes* spp. such as *N. opacus, N. parvus; Neotermes* spp.*, Procornitermes* spp.*, Zootermopsis* spp. *such as Z. angusticollis*, *Z. nevadensis*, *Reticulitermes* spp. such as *R. hesperus, R. tibialis, R. speratus, R. flavipes, R. grassei, R. lucifugus, R. santonensis, R. virginicus; Termes natalensis,*

Insects from the order Blattaria for example *Blatta* spp. such as *B. orientalis, B. lateralis; Blattella* spp. such as *B. asahinae, B. germanica; Leucophaea maderae, Panchlora nivea, Periplaneta* spp. such as *P. americana, P. australasiae, P. brunnea, P. fuligginosa, P. japonica; Supella longipalpa, Parcoblatta pennsylvanica, Eurycotis floridana, Pycnoscelus surinamensis,*

Insects from the order Siphonoptera for example *Cediopsylla simples*, *Ceratophyllus* spp.*, Ctenocephalides* spp. such as *C. felis*, *C. canis, Xenopsylla cheopis*, *Pulex irritans*, *Trichodectes canis*, *Tunga penetrans*, and *Nosopsyllus fasciatus,*

Insects from the order Thysanura for example *Lepisma saccharina*, *Ctenolepisma urbana*, and *Thermobia domestica,*

Pests from the class Chilopoda for example *Geophilus* spp.*,* Scutigera spp. such as *Scutigera coleoptrata*;

Pests from the class Diplopoda for example *Blaniulus guttulatus*, *Julus* spp.*, Narceus* spp.,

Pests from the class Symphyla for example *Scutigerella immaculata,*

Insects from the order Dermaptera*,* for example *Forficula auricularia*,

Insects from the order Collembola, for example *Onychiurus* spp., such as *Onychiurus armatus,*

Pests from the order Isopoda for example, *Armadillidium vulgare, Oniscus asellus, Porcellio scaber,*

Insects from the order Phthiraptera, for example *Damalinia* spp., Pediculus spp. such as *Pediculus humanus capitis, Pediculus humanus corporis, Pediculus humanus humanus; Pthirus pubis*, Haematopinus spp. such as *Haematopinus eurysternus*, *Haematopinus suis*; Linognathus spp. such as *Linognathus vituli; Bovicola bovis, Menopon gallinae, Menacanthus stramineus* and *Solenopotes capillatus, Trichodectes* spp.*,*

Examples of further pest species which may be controlled by compounds of fomula (I) include: from the Phylum Mollusca, class Bivalvia, for example, *Dreissena* spp.; class Gastropoda, for example, *Arion* spp., *Biomphalaria* spp., *Bulinus* spp., *Deroceras* spp., *Galba* spp., *Lymnaea* spp., *Oncomelania* spp., *Pomacea canaliclata, Succinea* spp.; from the class of the helminths, for example, *Ancylostoma duodenale, Ancylostoma ceylanicum, Acylostoma braziliensis, Ancylostoma* spp., *Ascaris lubricoides, Ascaris spp., Brugia malayi, Brugia timori, Bunostomum* spp., *Chabertia* spp., *Clonorchis* spp., *Cooperia* spp., *Dicrocoelium* spp., *Dictyocaulus filaria, Diphyllobothrium latum, Dracunculus medinensis, Echinococcus granulosus, Echinococcus multilocularis, Enterobius vermicularis, Faciola* spp., Haemonchus spp. such as *Haemonchus contortus; Heterakis* spp., *Hymenolepis nana, Hyostrongulus* spp., *Loa Loa, Nematodirus* spp., *Oesophagostomum* spp., *Opisthorchis* spp., *Onchocerca volvulus, Ostertagia* spp., *Paragonimus* spp., *Schistosomen* spp., *Strongyloides fuelleborni, Strongyloides stercora lis, Stronyloides* spp., *Taenia saginata, Taenia solium, Trichinella spiralis, Trichinella nativa, Trichinella britovi, Trichinella nelsoni, Trichinella pseudopsiralis, Trichostrongulus spp., Trichuris trichuria, Wuchereria bancrofti.*

The compounds of the present invention are suitable for use in treating or protecting animals against infestation or infection by parasites. Therefore, the present invention also relates to the use of a compound of the present invention for the manufacture of a medicament for the treatment or protection of animals against infestation or infection by parasites. Furthermore, the present invention relates to a method of treating or protecting animals against infestation and infection by parasites, which comprises orally, topically or parenterally administering or applying to the animals a parasiticidally effective amount of a compound of the present invention.

The present invention also relates to the non-therapeutic use of compounds of the present invention for treating or protecting animals against infestation and infection by parasites. Moreover, the present invention relates to a non-therapeutic method of treating or protecting animals against infestation and infection by parasites, which comprises applying to a locus a parasiticidally effective amount of a compound of the present invention.

The compounds of the present invention are further suitable for use in combating or controlling parasites in and on animals. Furthermore, the present invention relates to a method of combating or controlling parasites in and on animals, which comprises contacting the parasites with a parasitically effective amount of a compound of the present invention.

The present invention also relates to the non-therapeutic use of compounds of the present invention for controlling or combating parasites. Moreover, the present invention relates to a non-therapeutic method of combating or controlling parasites, which comprises applying to a locus a parasiticidally effective amount of a compound of the present invention.

The compounds of the present invention can be effective through both contact (via soil, glass, wall, bed net, carpet, blankets or animal parts) and ingestion (e.g. baits). Furthermore, the compounds of the present invention can be applied to any and all developmental stages.

The compounds of the present invention can be applied as such or in form of compositions comprising the compounds of the present invention.

The compounds of the present invention can also be applied together with a mixing partner, which acts against pathogenic parasites, e.g. with synthetic coccidiosis compounds, polyetherantibiotics

such as Amprolium, Robenidin, Toltrazuril, Monensin, Salinomycin, Maduramicin, Lasalocid, Narasin or Semduramicin, or with other mixing partners as defined above, or in form of compositions comprising said mixtures.

The compounds of the present invention and compositions comprising them can be applied orally, parenterally or topically, e.g. dermally. The compounds of the present invention can be systemically or non-systemically effective.

The application can be carried out prophylactically, therapeutically or non-therapeutically. Furthermore, the application can be carried out preventively to places at which occurrence of the parasites is expected.

As used herein, the term "contacting" includes both direct contact (applying the compounds/compositions directly on the parasite, including the application directly on the animal or excluding the application directly on the animal, e.g. at it's locus for the latter) and indirect contact (applying the compounds/compositions to the locus of the parasite). The contact of the parasite through application to its locus is an example of a non-therapeutic use of the compounds of the present invention.

The term "locus" means the habitat, food supply, breeding ground, area, material or environment in which a parasite is growing or may grow outside of the animal.

As used herein, the term “parasites” includes endo- and ectoparasites. In some embodiments of the present invention, endoparasites can be preferred. In other embodiments, ectoparasites can be preferred. Infestations in warm-blooded animals and fish include, but are not limited to, lice, biting lice, ticks, nasal bots, keds, biting flies, muscoid flies, flies, myiasitic fly larvae, chiggers, gnats, mosquitoes and fleas.

The compounds of the present invention are especially useful for combating parasites of the following orders and species, respectively:

fleas (Siphonaptera), e.g. *Ctenocephalides felis*, *Ctenocephalides canis, Xenopsylla cheopis*, *Pulex irritans*, *Tunga penetrans*, and *Nosopsyllus fasciatus;* cockroaches (Blattaria - Blattodea), e.g. *Blattella germanica, Blattella asahinae, Periplaneta americana, Periplaneta japonica, Periplaneta brunnea, Periplaneta fuligginosa*, *Periplaneta australasiae*, and *Blatta orientalis;* flies, mosquitoes (Diptera), e.g. *Aedes aegypti, Aedes albopictus*, *Aedes vexans, Anastrepha ludens, Anopheles maculipennis, Anopheles crucians, Anopheles albimanus, Anopheles gambiae, Anopheles freeborni, Anopheles leucosphyrus, Anopheles minimus, Anopheles quadrimaculatus*, *Calliphora vicina, Chrysomya bezziana, Chrysomya hominivorax, Chrysomya macellaria, Chrysops discalis, Chrysops silacea, Chrysops atlanticus, Cochliomyia hominivorax, Cordylobia anthropophaga, Culicoides furens, Culex pipiens, Culex nigripalpus, Culex quinquefasciatus*, *Culex tarsalis, Culiseta inornata, Culiseta melanura*, *Dermatobia hominis, Fannia canicularis, Gasterophilus intestinalis, Glossina morsitans, Glossina palpalis, Glossina fuscipes, Glossina tachinoides, Haematobia irritans, Haplodiplosis equestris, Hippelates spp., Hypoderma lineata, Leptoconops torrens, Lucilia caprina, Lucilia cuprina, Lucilia sericata, Lycoria pectoralis, Mansonia spp., Musca domestica, Muscina stabulans, Oestrus ovis, Phlebotomus argentipes, Psorophora columbiae, Psorophora discolor, Prosimulium mixtum*, *Sarcophaga haemorrhoidalis*, *Sarcophaga sp., Simulium vittatum, Stomoxys calcitrans, Tabanus bovinus, Tabanus atratus, Tabanus lineola,* and *Tabanus similis;* lice

(Phthiraptera), e.g. *Pediculus humanus capitis, Pediculus humanus corporis, Pthirus pubis*, *Haematopinus eurysternus*, *Haematopinus suis*, *Linognathus vituli, Bovicola bovis, Menopon gallinae, Menacanthus stramineus* and *Solenopotes capillatus;* ticks and parasitic mites (Parasitiformes): ticks (Ixodida), e.g. *Ixodes scapularis, Ixodes holocyclus, Ixodes pacificus, Rhiphicephalus sanguineus, Dermacentor andersoni, Dermacentor variabilis*, *Amblyomma americanum, Ambryomma maculatum, Ornithodorus hermsi, Ornithodorus turicata* and parasitic mites (Mesostigmata), e.g. *Ornithonyssus bacoti* and *Dermanyssus gallinae*; Actinedida (Prostigmata) und Acaridida (Astigmata), e.g. *Acarapis spp., Cheyletiella spp., Ornithocheyletia spp., Myobia spp., Psorergates spp., Demodex spp., Trombicula spp., Listrophorus spp., Acarus spp., Tyrophagus spp., Caloglyphus spp., Hypodectes spp., Pterolichus spp., Psoroptes spp., Chorioptes spp., Otodectes spp., Sarcoptes spp., Notoedres spp.,Knemidocoptes spp., Cytodites spp.,* and *Laminosioptes spp;* Bugs (Heteropterida): *Cimex lectularius, Cimex hemipterus, Reduvius senilis, Triatoma spp., Rhodnius ssp., Panstrongylus ssp.,* and *Arilus critatus;* Anoplurida, e.g. *Haematopinus spp., Linognathus spp., Pediculus spp., Phtirus spp.,* and *Solenopotes spp.;* Mallophagida (suborders Arnblycerina and Ischnocerina), e.g. *Trimenopon spp., Menopon spp., Trinoton spp., Bovicola spp., Werneckiella spp., Lepikentron spp., Trichodectes spp.,* and *Felicola spp.;* Roundworms Nematoda: Wipeworms and Trichinosis (Trichosyringida), e.g. Trichinellidae *(Trichinella spp.), (*Trichuridae*) Trichuris spp., Capillaria spp.;* Rhabditida, e.g. *Rhabditis spp., Strongyloides spp., Helicephalobus spp.;* Strongylida, e.g. *Strongylus spp., Ancylostoma spp., Necator americanus, Bunostomum spp. (Hookworm), Trichostrongylus spp., Haemonchus contortus, Ostertagia spp., Cooperia spp., Nematodirus spp., Dictyocaulus spp., Cyathostoma spp., Oesophagostomum spp., Stephanurus dentatus, Ollulanus spp., Chabertia spp., Stephanurus dentatus, Syngamus trachea*, *Ancylostoma spp., Uncinaria spp., Globocephalus spp., Necator spp., Metastrongylus spp., Muellerius capillaris, Protostrongylus spp., Angiostrongylus spp., Parelaphostrongylus spp., Aleurostrongylus abstrusus,* and *Dioctophyma renale;* Intestinal roundworms (Ascaridida), e.g. *Ascaris lumbricoides, Ascaris suum, Ascaridia galli, Parascaris equorum, Enterobius vermicularis (Threadworm), Toxocara canis, Toxascaris leonine, Skrjabinema spp.,* and *Oxyuris equi;* Camallanida, e.g. *Dracunculus medinensis* (guinea worm); Spirurida, e.g. *Thelazia spp., Wuchereria spp., Brugia spp., Onchocerca spp., Dirofilari spp.a, Dipetalonema spp., Setaria spp., Elaeophora spp., Spirocerca lupi,* and *Habronema spp.;* Thorny headed worms (Acanthocephala), e.g. *Acanthocephalus spp., Macracanthorhynchus hirudinaceus* and *Oncicola spp.;* Planarians (Plathelminthes): Flukes (Trematoda), e.g. *Faciola spp., Fascioloides magna, Paragonimus spp., Dicrocoelium spp., Fasciolopsis buski, Clonorchis sinensis, Schistosoma spp., Trichobilharzia spp., Alaria alata, Paragonimus spp.,* and *Nanocyetes spp.*; Cercomeromorpha, in particular Cestoda (Tapeworms), e.g. *Diphyllobothrium spp., Tenia spp., Echinococcus spp., Dipylidium caninum, Multiceps spp., Hymenolepis spp., Mesocestoides spp., Vampirolepis spp., Moniezia spp., Anoplocephala spp., Sirometra spp., Anoplocephala spp.,* and *Hymenolepis spp..*

As used herein, the term “animal” includes warm-blooded animals (including humans) and fish. Preferred are mammals, such as cattle, sheep, swine, camels, deer, horses, pigs, poultry, rabbits, goats, dogs and cats, water buffalo, donkeys, fallow deer and reindeer, and also in fur-bearing animals such as mink, chinchilla and raccoon, birds such as hens, geese, turkeys and ducks and fish

such as fresh- and salt-water fish such as trout, carp and eels. Particularly preferred are domestic animals, such as dogs or cats.

In general, "parasiticidally effective amount" means the amount of active ingredient needed to achieve an observable effect on growth, including the effects of necrosis, death, retardation, prevention, and removal, destruction, or otherwise diminishing the occurrence and activity of the target organism. The parasiticidally effective amount can vary for the various compounds/compositions used in the invention. A parasiticidally effective amount of the compositions will also vary according to the prevailing conditions such as desired parasiticidal effect and duration, target species, mode of application, and the like.

Generally, it is favorable to apply the compounds of the present invention in total amounts of 0.5 mg/kg to 100 mg/kg per day, preferably 1 mg/kg to 50 mg/kg per day.

For oral administration to warm-blooded animals, the formula I compounds may be formulated as animal feeds, animal feed premixes, animal feed concentrates, pills, solutions, pastes, suspensions, drenches, gels, tablets, boluses and capsules. In addition, the formula I compounds may be administered to the animals in their drinking water. For oral administration, the dosage form chosen should provide the animal with 0.01 mg/kg to 100 mg/kg of animal body weight per day of the formula I compound, preferably with 0.5 mg/kg to 100 mg/kg of animal body weight per day.

Alternatively, the formula I compounds may be administered to animals parenterally, for example, by intraruminal, intramuscular, intravenous or subcutaneous injection. The formula I compounds may be dispersed or dissolved in a physiologically acceptable carrier for subcutaneous injection. Alternatively, the formula I compounds may be formulated into an implant for subcutaneous administration. In addition the formula I compound may be transdermally administered to animals. For parenteral administration, the dosage form chosen should provide the animal with 0.01 mg/kg to 100 mg/kg of animal body weight per day of the formula I compound.

The formula I compounds may also be applied topically to the animals in the form of dips, dusts, powders, collars, medallions, sprays, shampoos, spot-on and pour-on formulations and in ointments or oil-in-water or water-in-oil emulsions. For topical application, dips and sprays usually contain 0.5 ppm to 5,000 ppm and preferably 1 ppm to 3,000 ppm of the formula I compound. In addition, the formula I compounds may be formulated as ear tags for animals, particularly quadrupeds such as cattle and sheep.

Suitable preparations are:

- Solutions such as oral solutions, concentrates for oral administration after dilution, solutions for use on the skin or in body cavities, pouring-on formulations, gels;
- Emulsions and suspensions for oral or dermal administration; semi-solid preparations;
- Formulations in which the active compound is processed in an ointment base or in an oil-in-water or water-in-oil emulsion base;
- Solid preparations such as powders, premixes or concentrates, granules, pellets, tablets, boluses, capsules; aerosols and inhalants, and active compound-containing shaped articles.

Compositions suitable for injection are prepared by dissolving the active ingredient in a suitable solvent and optionally adding further auxiliaries such as acids, bases, buffer salts, preservatives,

and solubilizers. Suitable auxiliaries for injection solutions are known in the art. The solutions are filtered and filled sterile.

Oral solutions are administered directly. Concentrates are administered orally after prior dilution to the use concentration. Oral solutions and concentrates are prepared according to the state of the art and as described above for injection solutions, sterile procedures not being necessary.

Solutions for use on the skin are trickled on, spread on, rubbed in, sprinkled on or sprayed on. Solutions for use on the skin are prepared according to the state of the art and according to what is described above for injection solutions, sterile procedures not being necessary.

Gels are applied to or spread on the skin or introduced into body cavities. Gels are prepared by treating solutions which have been prepared as described in the case of the injection solutions with sufficient thickener that a clear material having an ointment-like consistency results. Suitable thickeners are known in the art.

Pour-on formulations are poured or sprayed onto limited areas of the skin, the active compound penetrating the skin and acting systemically. Pour-on formulations are prepared by dissolving, suspending or emulsifying the active compound in suitable skin-compatible solvents or solvent mixtures. If appropriate, other auxiliaries such as colorants, bioabsorption-promoting substances, antioxidants, light stabilizers, adhesives are added. Suitable such auxiliaries are known in the art.

Emulsions can be administered orally, dermally or as injections. Emulsions are either of the water-in-oil type or of the oil-in-water type. They are prepared by dissolving the active compound either in the hydrophobic or in the hydrophilic phase and homogenizing this with the solvent of the other phase with the aid of suitable emulsifiers and, if appropriate, other auxiliaries such as colorants, absorption-promoting substances, preservatives, antioxidants, light stabilizers, viscosity-enhancing substances. Suitable hydrophobic phases (oils), suitable hydrophilic phases, suitable emulsifiers, and suitable further auxiliaries for emulsions are known in the art.

Suspensions can be administered orally or topically/dermally. They are prepared by suspending the active compound in a suspending agent, if appropriate with addition of other auxiliaries such as wetting agents, colorants, bioabsorption-promoting substances, preservatives, antioxidants, light stabilizers. Suitable suspending agents, and suitable other auxiliaries for suspensions including wetting agents are known in the art.

Semi-solid preparations can be administered orally or topically/dermally. They differ from the suspensions and emulsions described above only by their higher viscosity.

For the production of solid preparations, the active compound is mixed with suitable excipients, if appropriate with addition of auxiliaries, and brought into the desired form. Suitable auxiliaries for this purpose are known in the art.

The compositions which can be used in the invention can comprise generally from about 0.001 to 95% of the compound of the present invention.

Ready-to-use preparations contain the compounds acting against parasites, preferably ectoparasites, in concentrations of 10 ppm to 80 per cent by weight, preferably from 0.1 to 65 per cent by weight, more preferably from 1 to 50 per cent by weight, most preferably from 5 to 40 per cent by weight.

Preparations which are diluted before use contain the compounds acting against ectoparasites in concentrations of 0.5 to 90 per cent by weight, preferably of 1 to 50 per cent by weight.

Furthermore, the preparations comprise the compounds of formula I against endoparasites in concentrations of 10 ppm to 2 per cent by weight, preferably of 0.05 to 0.9 per cent by weight, very particularly preferably of 0.005 to 0.25 per cent by weight.

Topical application may be conducted with compound-containing shaped articles such as collars, medallions, ear tags, bands for fixing at body parts, and adhesive strips and foils.

Generally it is favorable to apply solid formulations which release compounds of the present invention in total amounts of 10 mg/kg to 300 mg/kg, preferably 20 mg/kg to 200 mg/kg, most preferably 25 mg/kg to 160 mg/kg body weight of the treated animal in the course of three weeks.

Examples:

The present invention is now illustrated in further details by the following examples, without imposing any limitation thereto.

With appropriate modification of the starting materials, the procedures as described in the examples below were used to obtain further compounds of formula I. The compounds obtained in this manner are listed in the Tables that follows, together with physical data.

LC/MS Method:

Machine: Shimadzu Nexera UHPLC + Shimadzu LCMS 20-20,ESI

Column: Phenomenex Kinetex 1,7µm XB-C18 100A, 50 x 2,1mm"

Method:

Mobile Phase: A: water + 0,1% TFA; B:ACN

Temperature: 60°C

Gradient:5% B to 100% B in 1,50min; 100% B 0,25min

Flow: 0,8ml/min to 1,0ml/min in 1,51 min

MS method: ESI positive

Mass range (m/z): 100-700

Example 1: synthesis of 2-[3-ethylsulfonyl-6-[3-(trifluoromethyl)-1,2,4-triazol-1-yl]-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (I-1-1):

a) 2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethenone was synthesized following the published procedures: WO2016/71214.

b) 1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethenone:

Step 1: To a solution of 3,6-dichloropicolinic acid (120 g, 0.628 mol) in toluene (2L), at room temperature, was added thionyl chloride (68.38 mL, 0.942 mol) and DMF (9.0 mL). The reaction was then warmed to 110˚C and stirred for 2 h. The reaction mixture was then concentrated *in* vacuo, to afford a residue. The residue was dissolved in toluene (2L) and then ethane thiol (40.8g, 0.659 mol) was added in a dropwise manner over 15 min, the reaction was then stirred for 1h at room temperature. The reaction mixture was then concentrated under reduced pressure to afford a residue. The residue was purified by column chromatography eluting with 10% EtOAc-Petether to afford S-ethyl 3,6-dichloropyridine-2-carbothioate a yellow solid (120g, 81% yield). ^{1}H NMR (400

MHz, $CDCl_3$): δ 7.77 (d, 1H, J= 8.4 Hz), 7.44 (d, 1H, J = 8.4 Hz), 3.03 (q, 2H, J = 7.2 Hz), 1.36 (t, 3H, J = 7.2 Hz).

Step 2: To a solution of sodium hydroxide (37.45 g, 0.936 mol) in water (200 mL) was added ethanethiol (67.64 mL, 0.936 mol) in a dropwise manner over 15 min, the reaction was then stirred at the same temperature for 30 min. Then tetrabutylammonium bromide (45.27 g, 0.14 mol) was added and the reaction stirred for 30 min. A solution of S-ethyl 3,6-dichloropyridine-2-carbothioate (110 g, 0.468 mol) in toluene (300 mL) was then added to the reaction mixture in dropwise manner at room temperature and the reaction stirred for an additional 5 h at room temperature. The reaction mixture was then poured in to water (500 mL) and extracted with ethylacetate (3x600 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford a residue. The crude residue was purified by column chromatography eluting with 15% EtOAc-Petether to afford S-ethyl 6-chloro-3-ethylsulfanyl-pyridine-2-carbothioate as an off white solid (98g, 80% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 7.63 (d, 1H, J = 8.4 Hz), 7.40 (d, 1H, J = 8.8 Hz), 3.02 (q, 2H, J =7. 2 Hz), 2.96 (q, 2H, J = 7.6 Hz), 1.40 (t, 3H, J = 7.2 Hz), 1.36(t, *3H,* J = 7.2 Hz)

Step 3: To a solution of S-ethyl 6-chloro-3-ethylsulfanyl-pyridine-2-carbothioate (70 g, 0.268 mol) in ethanol (300 mL) was added a solution lithium hydroxide (17.28 g, 0.402 mol) then the reaction mixture stirred at room temperature for 5 h. The reaction mixture was then concentrated under reduced pressure to afford a residue. The residue was dissolved in cooled water, acidified with 2N HCl upon which 6-chloro-3-ethylsulfanyl-pyridine-2-carboxylic acid precipitated as an off white solid. The 6-chloro-3-ethylsulfanyl-pyridine-2-carboxylic acid was collected, dried and used without further purification (55g, 94% yield). ^1H NMR (400 MHz, DMSO-d_6): δ 13.63 (s, 1H), 7.94 (d, 1H, J = 8.4 Hz), 7.63 (d, 1H, J = 8.4 Hz), 2.99 (q, 2H, J = 7.2 Hz), 1.24 (t, 3H, J = 7.2 Hz).

Step 4: To a solution of 6-chloro-3-ethylsulfanyl-pyridine-2-carboxylic acid (55 g, 0.253 mol) in toluene (600 mL) at room temperature, was added thionyl chloride (27 mL, 0.380 mol) and DMF (1.5 mL) and then the reaction mixture was warmed to 110˚C and stirred for 2 h. The reaction mixture was then cooled to room temperature and concentrated under reduced pressure to obtain a residue. The residue was taken up in DCM (1L) and added to a solution of N,O-dimethylhydroxylamine hydrochloride (47.32 g, 0.484 mol) & DIPEA (127.11 mL, 0.727 mol) in DCM (1L) in a dropwise manner at 0°C over 2 h. The reaction mixture was then allowed to warm to room temperature and stir for 4 h. The reaction mixture was then poured in to water (600 mL) and extracted with DCM (2x600 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford a residue. The crude residue was purified by column chromatography eluting with 20% EtOAc-Petether to afford 6-chloro-3-ethylsulfanyl-N-methoxy-N-methyl-pyridine-2-carboxamide as a brown gum (54g, 85% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 7.71 (d, 1H, J = 8.4 Hz), 7.31 (d, 1H, J = 8.4 Hz), 3.60 (s, 3H), 3.37 (s, 3H), 2.92 (t, 2H, J = 7.2 Hz), 1.26 (t, 3H, J = 7.2 Hz).

Step 5: To a solution of 6-chloro-3-ethylsulfanyl-N-methoxy-N-methyl-pyridine-2-carboxamide (54 g, 0.207 mol) in dry THF (500 mL) at 0°C was added CH_3MgBr (207.69 mL, 0.623 mol, 3M in diethyl ether) in a dropwise manner, then the reaction mixture was allowed to warm to room temperature and stir for 4 h. The reaction was then quenched through the addition of a saturated aqueous

NH_4Cl solution (500 mL) and extracted with EtOAc (2x700 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford a residue. The crude residue was purified by column chromatography eluting with 15% EtOAc-Petether to afford 1-(6-chloro-3-ethylsulfanyl-2-pyridyl)ethenone as an off white solid (38g, 85% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 7.64 (d, 1H, J = 8.8 Hz), 7.39 (d, 1H, J =8.4 Hz), 2.91 (q, 2H, J = 7.6 Hz), 2.69 (s, 3H), 1.39 (t, 3H, J = 7.6 Hz).

Step 6: To a solution of 1-(6-chloro-3-ethylsulfanyl-2-pyridyl)ethanone (38 g, 0.176 mol) in CH_2Cl_2 (500 mL) at 0°C was added *m*-CPBA (76.25 g, 0.441 mol) in a portionwise manner, the reaction mixture was then allowed to warm to room temperature and stir for 16 h. The reaction mixture was then poured in to water (1.0 L) and extracted with CH_2Cl_2 (2x1 L). The combined organic layers were washed with a 1M NaOH solution (2x500 mL) and water (2x500 mL), dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford a residue. The crude residue was purified by column chromatography eluting with 20% EtOAc-Petether to afford 1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethenone as a white solid (33g, 75% yield). ^1H NMR (400 MHz, $CDCl_3$): δ 8.29 (d, 1H, J = 8.4 Hz), 7.60 (d,1H, J = 8.0 Hz), 3.54 (q, 2H, J = 7.6 Hz), 2.70 (s, 3H), 1.35 (t, 3H, J = 7.2 Hz).

c) 2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethanone

To a solution of 1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethenone (10.00g, 40.4 mmol) in acetic acid (140 mL) at room temperature, was sequentially added HBr (33% in Acetic acid) (8.60g, 49.1 mmol), and bromine (6.55g, 50.0 mmol). The reaction was then stirred at room temperature overnight, and then poured into 500 mL of stirring ice water, upon which a white solid precipitated. The solid was collected dried in a vacuum oven at 50 C for 18 hrs to afford the desired product (2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethenone)contaminated with 30% of the chloride containing product (2-bromo-1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethanone). This mixture was used in the next step without further purification.

LC-MS 2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethenone: mass calculated for $C_9H_{10}NO_3SBr2$ $[M+H]^+$ 372.0, found 371.7; t_R= 1.027 min (t_R: retention time).

LC-MS 2-bromo-1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethenone.: mass calculated for $C_9H_{10}NO_3SBrCl$ $[M+H]^+$ 325.9, found 325.8; t_R= 1.007 min (t_R: retention time).

d) 2-(6-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one:

A solution of 3.0g of the 7:3 mixture of 2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethenone and 2-bromo-1-(6-chloro-3-ethylsulfonyl-2-pyridyl)ethenone generated above and 4-amino-1-methyl-6-(trifluoromethyl)pyrimidin-2-one (1.55, 8.02 mmol) was dissolved in 70 ml 1,4-Dioxan and heated to 110°C for 72 hrs. The reaction was then cooled to room temperature and concentrated *in vacuo* to afford a residue. The residue was purified by silica gel chromatography (25% n-heptane/CH2Cl2) to afford 1.55g of a 7:3 mixture of 2-(6-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one and 2-(6-chloro-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one as a off white solid.

LC-MS 2-(6-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one: mass calculated for $C_{15}H_{13}N_4O_3F_3SBr$ $[M+H]^+$ 466.2, found 466.9; t_R= 1.109 min (t_R: retention time).

LC-MS 2-(6-chloro-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one: mass calculated for $C_{15}H_{13}N_4O_3F_3SCl$ $[M+H]^+$ 421.0, found 420.9; t_R= 1.089 min (t_R: retention time).

e) 2-[3-ethylsulfonyl-6-[3-(trifluoromethyl)-1,2,4-triazol-1-yl]-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (I-1-1):

To a solution 3-(trifluoromethyl)-1H-1,2,4-triazole (0.162g, 1.18 mmol) in NMP (3 mL) at room temperature, was added NaH (0.072g, 1.18 mmol, 60% suspension in mineral oil used) in one portion. The reaction was stirred at room temperature for 30 min and then the 7:3 mixture of 2-(6-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one and 2-(6-chloro-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (0.220g, 0.473 mmol) generated above, was added in one portion. The reaction was then allowed to stir at room temperature overnight. The reaction was then poured into water (50 mL) and extracted to EtOAc (3x50 mL), The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford a residue. The crude residue was purified by column chromatography eluting with 0→50% EtOAc-cyclohexane to afford 2-[3-ethylsulfonyl-6-[3-(trifluoromethyl)-1,2,4-triazol-1-yl]-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one as a brown solid (0.140g, 54% yield).

LC-MS: mass calculated for $C_{18}H_{14}N_7O_3F_6S$ $[M+H]^+$ 522.4, found 522.0; t_R= 1.270 min (t_R: retention time).

Example 2: 2-[3-ethylsulfonyl-5-(2-oxopyrrolidin-1-yl)-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (I-1-3):

a) 4-amino-1-methyl-6-(trifluoromethyl)pyrimidin-2-one

Step 1: To a solution of triphosgene (29.6 g) in CH_2Cl_2 (200 mL) was added a solution of p-methoxybenzylamine (13.7 g) in CH_2Cl_2 (200 mL), followed by the dropwise addition of Et_3N (30 mL) in CH_2Cl_2 (100 mL). The resulting mixture was stirred at 25°C for 14 h. Water (500 mL) was added and the reaction mixture was extracted with CH_2Cl_2 (3 × 200 mL). The organic layers were combined, washed with sat. NH_4Cl (600 mL), brine (600 mL), dried over Na_2SO_4, filtered, and concentrated to afford 1-(isocyanatomethyl)-4-methoxy-benzene (17 g, crude) as yellow oil. ^1H NMR ($CDCl_3$, 400 MHz) δ 7.26 (d, J=8.8 Hz, 2H), 6.95 (d, J=8.4 Hz, 2H), 4.45 (s, 2H), 3.85 (s, 3H).

Step 2: To a solution of ethyl (Z)-3-amino-4,4,4-trifluoro-but-2-enoate (19 g) in DMF (500 mL) was added NaH (6 g) in portions at 0°C. The reaction mixture was then stirred at 0°C for 1 h. The mixture was then added to 1-(isocyanatomethyl)-4-methoxy-benzene (17 g) at 0°C. The resulting mixture was stirred at 0°C to 25°C for 14 h. The solvent was removed under reduced pressure and water (1 L) was added, and the organic layer was separated. The aqueous layer was extracted with EtOAc (3 × 500 mL). The organic layers were combined, washed with brine (500 mL), dried over Na_2SO_4, filtered, and concentrated to afford crude 3-[(4-methoxyphenyl)methyl]-6-(trifluoromethyl)-1H-pyrimidine-2,4-dione (15 g) as yellow oil. ^1H NMR (MeOD, 400 MHz) δ 7.27 (d, J=8.8 Hz, 2H), 6.77 (d, J=8.4 Hz, 2H), 5.80 (s, 1H), 5.02 (s, 2H) 3.70 (s, 3H).

Step 3: To a solution of 3-[(4-methoxyphenyl)methyl]-6-(trifluoromethyl)-1H-pyrimidine-2,4-dione (35 g) and K_2CO_3 (16 g) in DMF (300 mL) was added MeI (16.5 g, 7.24 mL, 116.2 mmol) at 25°C. The resulting mixture was then stirred at 25°C for 12 h. The solvent was removed under reduced pressure. Water (300 mL) was added and the organic layer was separated. The aqueous layer was extracted with EtOAc (3 × 300 mL). The organic layers were combined, washed with brine (500 mL), dried over Na_2SO_4, filtered, and concentrated to afford crude 3-[(4-methoxyphenyl)methyl]-1-methyl-6-(trifluoromethyl)pyrimidine-2,4-dione (30 g) as yellow solid. ^{1}H NMR (MeOD, 400 MHz) δ 7.35 (d, J=8.8 Hz, 2H), 6.83 (d, J=8.8 Hz, 2H), 6.28 (s, 1H), 5.02 (s, 2H), 3.75 (s, 3H), 3.46 (s, 3H).

Step 4: To a solution of 3-[(4-methoxyphenyl)methyl]-1-methyl-6-(trifluoromethyl)pyrimidine-2,4-dione (30 g) in CH_3CN (200 mL) and water (50 mL) was added ceric ammonium nitrate (78.5 g) at 25°C. Then the reaction mixture was stirred at 25°C for 14 h then an additional portion (50 g) of ceric ammonium nitrate was added. The resulting mixture was stirred at 25°C for 14 h. Water (200 mL) was added and the organic layer was separated The aqueous layer was extracted with EtOAc (3 × 100 mL). The organic layers wwere combined, washed with aq. $NaHCO_3$ (500 mL), dried over Na_2SO_4, filtered, and concentrated. The residue was purified by silica gel chromatography (PE:EtOAc = 10:1 to 1:1 gradient) to afford 1-methyl-6-(trifluoromethyl)pyrimidine-2,4-dione (8 g) as yellow solid. ^{1}H NMR (MeOD, 400 MHz) δ 6.20 (s, 1H), 3.44 (s, 3H).

Step 5: To a solution of 1-methyl-6-(trifluoromethyl)pyrimidine-2,4-dione (8 g) in DCM (150 mL) and pyridine (30 mL) was added dropwise Tf_2O (36.7 g) at 0°C. The mixture was then stirred at 0°C to 25°C for 3 h. Gaseous ammonia was passed through MeOH (50 mL) at -70°C for 20 mins and the resulting methanol ammonia solution was poured into the reaction mixture. The resulting mixture was stirred at 25°C for 12 h. The solvent was removed under reduced pressure. The residue was purified by preparative HPLC to afford 4-amino-1-methyl-6-(trifluoromethyl)pyrimidin-2-one (3.4 g) as yellow solid. ^{1}H NMR (DMSO-d_6, 400 MHz) δ 7.62 (s, 1H), 7.52 (s, 1H), 6.24 (s, 1 H), 3.30 (s, 3H).

b) 2-(5-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one:

A solution of 4-amino-1-methyl-6-(trifluoromethyl)pyrimidin-2-one (0.900g, 4.72 mmol), and 2-bromo-1-(5-bromo-3-ethylsulfonyl-2-pyridyl)ethenone (1.60 g, 2.30 mmol) in 1,4-dioxane (40 mL) was stirred at 140°C in a microwave for 2.5 hrs. The reaction was then cooled to room temperature, diluted with EtOAc (200 mL), and washed with saturated aq. $NaHCO_3$ (100 mL), dried over Na_2SO_4, filtered, and concentrated *in vacuo* to afford a residue. The residue was purified by column chromatography over silica gel (10→80% EtOAc/cyclohexane) to afford 2-(5-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one as a white solid (0.700 g, 35% yield).

LC-MS: mass calculated for $C_{15}H_{12}N_4O_3F_3SBr$ $[M+H]^+$ 364.9, found 364.9; t_R= 1.128 min (t_R: retention time).

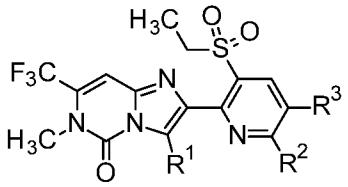
c) 2-[3-ethylsulfonyl-5-(2-oxopyrrolidin-1-yl)-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (I-1-3):

To a solution of compound 2-(5-bromo-3-ethylsulfonyl-2-pyridyl)-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one (0.150g, 0.322 mmol), in DMA (1 mL) was sequentially added pyrrolidin-

2-one (0.082g, 0.967 mmol), tris(dibenzylidene acetone)dipalladium(0) (Pd_2 dba_3) (0.026g, 0.032 mmol), xantphos (0.056g, 0.097 mmol), and Cs_2CO_3 (0.210g, 0.645 mmol). The solution was then stirred at room temperature for 10 minutes, and further reacted at 150 °C for 15 minutes in a microwave reactor (50 W irradiation). The reaction mixture was cooled to room temperature, filtered through a pad of celite and concentrated *in vacuo* to afford a residue. The residue was purified by column chromatography on silica gel (1→20% MeOH/CH_2Cl_2) to afford 2-[3-ethylsulfonyl-5-(2-oxopyrrolidin-1-yl)-2-pyridyl]-6-methyl-7-(trifluoromethyl)imidazo[1,2-c]pyrimidin-5-one as a pale-yellow solid (0.070g, 46% yield).

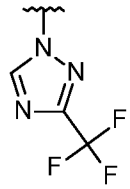
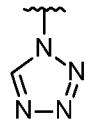
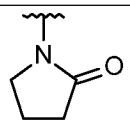
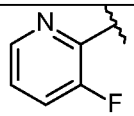
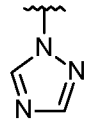
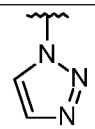
LC-MS: mass calculated for $C_{19}H_{18}N_5O_4F_3S$ $[M+H]^+$ 470.1, found 470.0; t_R= 0.986 min (t_R: retention time).

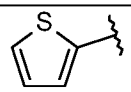
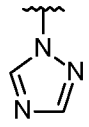
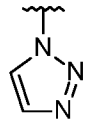
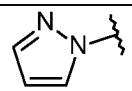
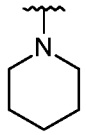
By analogous procedures to the procedure described above, the following examples of formula I-1 and I-2 were prepared.

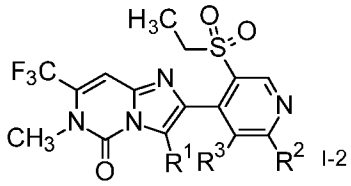


I-1

Table I-1:

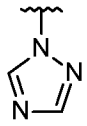
No.	R^1	R^2	R^3	RT (min)	m/z (M+H)
I-1-1	H		H	1.27	522.0
I-1-2	H		H	1.038	455.1
I-1-3	H	H		0.986	470.0
I-1-4	H	H		1.125	482.0
I-1-5	H		H	1.033	453.9
I-1-6	H		H	1.048	454.0

No.	R^1	R^2	R^3	RT (min)	m/z (M+H)
I-1-7	H	H		1.198	468.9
I-1-8	CH_3		H	1.068	467.9
I-1-9	CH_3		H	1.085	468.0
I-1-10	H		H	1.14	453.0
I-1-11	H	H		1.16	470.1



I-2

Table I-2:

No.	R^1	R^2	R^3	RT (min)	m/z (M+H)
I-2-1	H		H	1.032	453.9

The biological activity of the compounds of formula (I) of the present invention can be evaluated in biological tests as described in the following.

If not otherwise specified, most test solutions are prepared as follow:

The active compound is dissolved at the desired concentration in a mixture of 1:1 (vol:vol) distilled water : acetone. The test solution is prepared at the day of use.

Boll weevil (*Anthonomus grandis*)

For evaluating control of boll weevil (*Anthonomus grandis*) the test unit consisted of 96-well-micro-titer plates containing an insect diet and 5-10 *A. grandis* eggs.

The compounds were formulated using a solution containing 75% v/v water and 25% v/v DMSO. Different concentrations of formulated compounds were sprayed onto the insect diet at 5 µl, using a custom built micro atomizer, at two replications.

After application, microtiter plates were incubated at about 25 ± 1°C and about 75 ± 5 % relative humidity for 5 days. Egg and larval mortality was then visually assessed.

In this test, compounds I-1-1, I-2-1, I-1-2, I-1-3, I-1-4, I-1-5, I-1-6, I-1-7, I-1-9, and I-1-10 at 2500 ppm showed over 75% mortality in comparison with untreated controls.

Tobacco budworm (***Heliothis virescens***)

For evaluating control of tobacco budworm (*Heliothis virescens*) the test unit consisted of 96-well-microtiter plates containing an insect diet and 15-25 *H. virescens* eggs.

The compounds were formulated using a solution containing 75% v/v water and 25% v/v DMSO. Different concentrations of formulated compounds were sprayed onto the insect diet at 10 µl, using a custom built micro atomizer, at two replications.

After application, microtiter plates were incubated at about 28 ± 1°C and about 80 ± 5 % relative humidity for 5 days. Egg and larval mortality was then visually assessed.

In this test, compounds I-1-1, I-2-1, I-1-2, I-1-3, I-1-4, I-1-5, I-1-6, I-1-7, I-1-9, and I-1-10 at 2500 ppm showed over 75% mortality in comparison with untreated controls.

Vetch aphid (***Megoura viciae***)

For evaluating control of vetch aphid (*Megoura viciae*) through contact or systemic means the test unit consisted of 24-well-microtiter plates containing broad bean leaf disks.

The compounds were formulated using a solution containing 75% v/v water and 25% v/v DMSO. Different concentrations of formulated compounds were sprayed onto the leaf disks at 2.5 µl, using a custom built micro atomizer, at two replications.

After application, the leaf disks were air-dried and 5 – 8 adult aphids placed on the leaf disks inside the microtiter plate wells. The aphids were then allowed to suck on the treated leaf disks and incubated at about 23 ± 1°C and about 50 ± 5 % relative humidity for 5 days. Aphid mortality and fecundity was then visually assessed.

In this test, compounds I-1-2, I-1-3, I-1-4, I-1-6, I-1-9, and I-1-10
at 2500 ppm showed over 75% mortality in comparison with untreated controls.

Cowpea aphid (***Aphis craccivora***)

The active compound is dissolved at the desired concentration in a mixture of 1:1 (vol:vol) distilled water : acetone. Surfactant (Kinetic® HV) is added at a rate of 0.01% (vol/vol). The test solution is prepared at the day of use.

Potted cowpea plants were colonized with approximately 30 - 50 aphids of various stages by manually transferring a leaf tissue cut from infested plant 24 hours before application. Plants were sprayed with the test solutions using a DeVilbiss® hand atomizer at 20- 30 psi (≈ 1.38 to 2.07 bar) after the pest population has been checked. Treated plants are maintained on light carts at about 25- 26°C. Percent mortality was assessed after 72 hours.

In this test, compound I-1-2, I-1-3, I-1-4, I-1-6, I-1-7, I-1-8, and I-1-9
at 300 ppm showed over 75% mortality in comparison with untreated controls.

Rice green leafhopper (***Nephotettix virescens***)

Four to five-week old rice seedlings with cut upper leaf portion were cleaned and washed 24 hours before spraying. The active compounds were formulated in 1:1 acetone:water (vol:vol), and 0.01% vol/vol surfactant (Kinetic® HV) was added. Potted rice seedlings were sprayed with 5-6 ml test solution, air dried, covered with Mylar cages and inoculated with 10 adults. Treated rice plants were kept at about 28-29°C and relative humidity of about 50-60%. Percent mortality was recorded after 72 hours.

In this test, compound I-1-3, and I-1-8

at 300 ppm showed over 75% mortality in comparison with untreated controls.

Rice brown plant hopper (***Nilaparvata lugens***)

Four to five-week old rice seedlings were cleaned and washed 24 hours before spraying. The active compounds were formulated in 1:1 acetone:water (vol:vol) and 0.01% vol/vol surfactant (Kinetic® HV) was added. Potted rice seedlings were sprayed with 5- 6 ml test solution, air dried, covered with Mylar cages and inoculated with 10 adults. Treated rice plants were kept at about 28-29°C and relative humidity of about 50-60%. Percent mortality was recorded after 72 hours.

In this test, compound I-1-3 at 300 ppm showed over 75% mortality in comparison with untreated controls.

Diamond back moth (***Plutella xylostella***)

The active compound is dissolved at the desired concentration in a mixture of 1:1 (vol:vol) distilled water : acetone. Surfactant (Kinetic® HV) is added at a rate of 0.01% (vol/vol).The test solution is prepared at the day of use.

Leaves of cabbage were dipped in test solution and air-dried. Treated leaves were placed in petri dishes lined with moist filter paper and inoculated with ten 3rd instar larvae. Mortality was recorded 72 hours after treatment. Feeding damages were also recorded using a scale of 0-100%.

In this test, compound I-1-1, I-1-4, I-1-5, I-1-6, and I-1-8 at 300 ppm showed over 75% mortality in comparison with untreated controls.

For evaluating control of green peach aphid (*Myzus persicae*) through systemic means the test unit consisted of 96-well-microtiter plates containing liquid artificial diet under an artificial membrane.

The compounds were formulated using a solution containing 75% v/v water and 25% v/v DMSO. Different concentrations of formulated compounds were pipetted into the aphid diet, using a custom built pipetter, at two replications.

After application, 5 – 8 adult aphids were placed on the artificial membrane inside the microtiter plate wells. The aphids were then allowed to suck on the treated aphid diet and incubated at about 23 $\pm$ 1°C and about 50 $\pm$ 5 % relative humidity for 3 days. Aphid mortality and fecundity was then visually assessed.

In this test, compounds I-1-1, I-2-1, I-1-2, I-1-3, I-1-4, I-1-5, I-1-6, I-1-7, I-1-9, and I-1-10

at 2500 ppm showed over 75 % mortality in comparison with untreated controls.

Southern armyworm (*Spodoptera eridania)*

The active compounds were formulated by a Tecan liquid handler in 100% cyclohexanone as a 10,000 ppm solution supplied in tubes. The 10,000 ppm solution was serially diluted in 100% cyclohexanone to make interim solutions. These served as stock solutions for which final dilutions were made by the Tecan in 50% acetone:50% water (v/v) into 10 or 20ml glass vials. A nonionic surfactant (Kinetic®) was included in the solution at a volume of 0.01% (v/v). The vials were then inserted into an automated electrostatic sprayer equipped with an atomizing nozzle for application to plants/insects.

Lima bean plants (variety Sieva) were grown 2 plants to a pot and selected for treatment at the 1st true leaf stage. Test solutions were sprayed onto the foliage by an automated electrostatic plant sprayer equipped with an atomizing spray nozzle. The plants were dried in the sprayer fume hood and then removed from the sprayer. Each pot was placed into perforated plastic bags with a zip closure. About 10 to 11 armyworm larvae were placed into the bag and the bags zipped closed. Test plants were maintained in a growth room at about 25ºC and about 20-40% relative humidity for 4 days, avoiding direct exposure to fluorescent light (24 hour photoperiod) to prevent trapping of heat inside the bags. Mortality and reduced feeding were assessed 4 days after treatment, compared to untreated control plants.

In this test, compound I-1-1, I-2-1, I-1-2, I-1-3, I-1-4, I-1-5, I-1-6, and I-1-9 at 300 ppm showed over 75% mortality in comparison with untreated controls.

Green Soldier Stink Bug (Nezara viridula)

The active compound is dissolved at the desired concentration in a mixture of 1:1 (vol:vol) distilled water : aceteone. Surfactant (Kinetic® HV) is added at a rate of 0.01% (vol/vol).The test solution is prepared at the day of use.

Soybean pods were placed in 90 x 50 mm glass Petri dishes lined with moist filter paper and inoculated with ten late 3rd instar *N. viridula*. Using a hand atomizer, an approximately 2 ml solution is sprayed into each Petri dish. Treated cups were kept at about 25-26°C and relative humidity of about 65-70%. Percent mortality was recorded after 5 days.

In this test, compounds I-1-3, and I-1-8 at 300 ppm showed over 75% mortality in comparison with untreated controls.

Silverleaf whitefly (*Bemisia argentifolii*)

The active compounds were formulated by a Tecan liquid handler in 100% cyclohexanone as a 10,000 ppm solution supplied in tubes. The 10,000 ppm solution was serially diluted in 100% cyclohexanone to make interim solutions. These served as stock solutions for which final dilutions were made by the Tecan in 50% acetone:50% water (v/v) into 5 or 10ml glass vials. A nonionic surfactant (Kinetic®) was included in the solution at a volume of 0.01% (v/v). The vials were then inserted into an automated electrostatic sprayer equipped with an atomizing nozzle for application to plants/insects.

Cotton plants at the cotyledon stage (one plant per pot) were sprayed by an automated electrostatic plant sprayer equipped with an atomizing spray nozzle. The plants were dried in the sprayer fume hood and then removed from the sprayer. Each pot was pla-ced into a plastic cup and about 10 to 12 whitefly adults (approximately 3-5 days old) were introduced. The insects were collected using an aspirator and a nontoxic Tygon® tubing connected to a barrier pipette tip. The tip, containing the collected insects, was then gently inserted into the soil containing the treated plant, allowing insects to crawl out of the tip to reach the foliage for feeding. Cups were covered with a reusable screened lid. Test plants were maintained in a growth room at about 25ºC and about 20-40% relative humidity for 3 days, avoiding direct exposure to fluorescent light (24 hour photoperiod) to prevent trapping of heat inside the cup. Mortality was assessed 3 days after treatment, compared to untreated control plants.

In this test, compounds I-1-1, and I-1-4 at 300 ppm showed over 75% mortality in comparison with untreated controls.

Striped Stem Borer ***(Chilo suppressalis)***

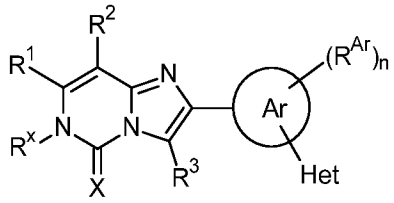
The active compound is dissolved at the desired concentration in a mixture of 1:1 (vol:vol) distilled water : acetone. Surfactant (Kinetic® HV) is added at a rate of 0.01% (vol/vol). The test solution is prepared at the day of use.

Ten first-instar larvae are allowed to crawl on sprayed petriplates for 1 minute and then provided with one freshly cut rice straw per plate. After 10 minutes when all of the larvae are inside the straw will then be covered with Petri lid. Percent mortality is recorded after 72 hours after treatment.

In this test, compounds I-1-4 at 300 ppm showed over 75 % mortality in comparison with untreated controls.

Claims,

1. A compound of formula I



(I)

wherein

X is O or S;

R^x is selected from the group consisting of C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$, $S(=O)_mR^e$, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

R^1 is H, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, or C_1-C_6-alkylsulfonyl which are substituted or unsubstituted with halogen;

R^2, R^3 independently of each other are selected from the group consisting of H, halogen, N_3, CN, NO_2, -SCN, -SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, tri-C_1-C_6-alkylsilyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxyx-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$ and $S(=O)_mR^e$, one radical may also be phenyl, phenoxy, phenylcarbonyl, phenylthio or benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

Ar is phenyl or 5- or 6-membered heteroaryl,

R^{Ar} independently of each other, are selected from the group consisting of halogen, N_3, OH, CN, NO_2, -SCN, -SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, tri-C_1-C_6-alkylsilyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
C(O)-OR^a, NR^bR^c, C_1-C_6-alkylen-NR^bR^c, O-C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, NH-C_1-C_6-alkylen-NR^bR^c, C(O)-NR^bR^c, C(O)-R^d, $SO_2NR^bR^c$ and $S(=O)_mR^e$, one radical may also be phenyl, phenoxy, phenylcarbonyl, phenylthio or benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

Het is 5- or 6-membered heteroaryl or 5- or 6-membered heterocyclyl, which is unsubstituted or substituted with R;

R is halogen, oxo (=O), N_3, OH, CN, NO_2, SCN, SF_5, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_1-C_6-alkoxycarbonyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1- C_4 alkyl, phenyl, 5- or 6-membered heteroaryl, or 5- or 6-membered heterocyclyl, wherein cyclic groups of R are unsubstituted or substituted with radicals R^f;

provided that R^{Ar} and Het both are not present on the same atom of Ar;

each R^a is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen, C_1-C_6-alkylen-NR^bR^c, C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each R^b is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen, -(C=O)R, -C(=O)OR, and -C(=O)NR, C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl is unsubstituted or substituted with radicals R^f;

each R^c is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
C_1-C_6-alkylen-CN, phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each moiety NR^bR^c may also form an N-bound, saturated 3- to 8-membered heterocycle, which in addition to the nitrogen atom may have 1 or 2 further heteroatoms or heteroatom moieties selected from O, $S(=O)_m$ and N-R', wherein R' is H or C_1-C_6-alkyl and wherein the N-bound heterocycle is unsubstituted or substituted with radicals selected from halogen, C_1-C_4-alkyl, C_1-C_4-haloalkyl, C_1-C_4-alkoxy and C_1-C_4-haloalkoxy;

each R^d is selected from H, C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;

each R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen,
phenyl and benzyl, wherein the phenyl ring is unsubstituted or substituted with R^f;

each R^f is selected from halogen, N_3, OH, CN, NO_2, SCN, SF_5, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl , C_2-C_6-alkynyl, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, C_3-C_6-cycloalkyl, C_3-C_6-cycloalkoxy, C_3-C_6-cycloalkyl-C_1-C_4-alkyl, C_3-C_6-cycloalkoxy-C_1-C_4-alkyl, which are unsubstituted or substituted with halogen;

m is 0, 1 or 2;
n is 0, 1 or 2;
and the N-oxides, stereoisomers, tautomers and agriculturally or veterinarily acceptable salts thereof.

2. The compound of formula I according to claim 1, wherein X is O.

3. The compound of formula I according to claim 1 or 2, wherein Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, tetrazolyl, and thiadiazolyl;
wherein the Het is unsubstituted or substituted with R selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-alkoxy-C_1-C_4-alkyl, C_1-C_6-alkoxy-C_1-C_4-alkoxy, and C_1-C_6-alkoxycarbonyl.

4. The compound of formula I according to any of the preceeding claims, wherein
R^x is selected from C_1-C_6-alkyl, C_2-C_6-alkenyl, C_2-C_6-alkynyl, C_3-C_6-cycloalkyl, and C_1-C_6-haloalkyl;
R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl;
R^2 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy;
R^3 is selected from H, halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_2-C_6-alkenyl, C_3-C_6-cycloalkyl, and C_3-C_6-cycloalkoxy;
Ar is a phenyl or 5- or 6-membered heteroaryl;
n is 1 or 2;
R^{Ar} is selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, $S(=O)_mR^e$, phenyl, phenoxy, phenylcarbonyl, phenylthio and benzyl, wherein the phenyl ring is unsubstituted or substituted with radicals R^f;
R^e is selected from C_1-C_6-alkyl, C_3-C_6- cycloalkyl, C_1-C_6-haloalkyl, and C_3-C_6- halocycloalkyl;
R^f is selected from halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_3-C_6-cycloalkyl, C_2-C_6-alkenyl, and C_2-C_6-alkynyl, which are unsubstituted or substituted with halogen;
m is 0, 1, or 2.

5. The compound of formula I according to claim any of the preceeding claims, wherein Ar is 5- or 6-membered heteroaryl containing one heteroatom selected from O, N, and S.

6. The compound of formula I according to any of the preceeding claims, wherein
R^x is C_1-C_6-alkyl;
R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl;

R^2 is selected from from H, halogen, and C_1-C_6-alkyl;

R^3 is selected from from H, halogen, and C_1-C_6-alkyl;

Ar is pyridinyl or thiophenyl substituted with R^{Ar} as $S(=O)_mR^e$ at the ortho position to bond connecting to 9-membered heteroaryl of compound of formula I, and optionally further substituted with 1 R^{Ar} selected from halogen, C_1-C_6-alkyl, C_1-C_6-haloalkyl, C_1-C_6-alkoxy, C_1-C_6-haloalkoxy, phenyl, and benzyl, wherein the phenyl ring of R^{Ar} is unsubstituted or substituted with radicals R^f;

R^e is selected from C_1-C_6-alkyl, C_3-C_6-cycloalkyl, C_1-C_6-haloalkyl, and C_3-C_6 halocycloalkyl;

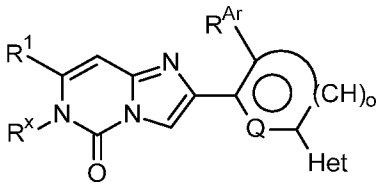
R^f is selected from halogen, C_1-C_6-alkyl, C_1-C_6-alkoxy, C_3-C_6-cycloalkyl, C_2-C_6-alkenyl, and C_2-C_6-alkynyl, which are unsubstituted or substituted with halogen;

m is 0, 1, or 2;

Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl; wherein the Het is unsubstituted or substituted with R;

R is selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-alkoxycarbonyl.

7. The compound of formula I according to any of the preceeding claims which corresponds to the compound of formula I-a,



I-a

wherein the circle in the ring containing Q denotes that the ring is aromatic ring;

Q is S or N;

R^x is C_1-C_6-alkyl;

R^1 is selected from partially or completely halogenated, C_1-C_6-alkyl, C_1-C_6-alkylsulfenyl, C_1-C_6-alkylsulfinyl, and C_1-C_6-alkylsulfonyl

R^{Ar} is $S(=O)_mR^e$; wherein

R^e is C_1-C_6-alkyl;

Het is selected from thiophenyl, oxazolidinyl, imidazolidinyl, pyrrolidinyl, piperidinyl, pyridinyl, oxazolyl, thiazolyl, pyrazolyl, imidazolyl, triazolyl, oxadiazolyl, and thiadiazolyl;

wherein the Het is unsubstituted or substituted with R;

R is selected from halogen, oxo (=O), C_1-C_6-haloalkyl, C_1-C_6-alkoxy, and C_1-C_6-alkoxycarbonyl;

m is 0, 1, or 2;

o is 1 or 2.

8. The compound of formula I according to any of the claims 1 to 6, wherein

X is O;

R^1 is partially or completely halogenated, C_1-C_6-alkyl;
R^x is C_1-C_6-alkyl;
R^2 is H;
R^3 is H or C_1-C_6-alkyl;
Het is selected from thiophenyl, pyrrolidinyl, piperidinyl, pyrazolyl, pyridinyl, triazolyl, and tetrazolyl;
wherein the Het is unsubstituted or substituted with R;
R is selected from halogen, oxo (=O), and C_1-C_6-haloalkyl;
Ar is pyridinyl substituted with R^{Ar} as $S(=O)_mR^e$ at the ortho position to bond connecting to 9-membered heteroaryl of compound of formula I;
R^e is C_1-C_6-alkyl.

9. A composition comprising the compound of formula I, as defined in any of claims 1 to 8, an N-oxide or an agriculturally acceptable salt thereof.

10. The composition according to claim 9, comprising additionally a further active substance.

11. A method for combating or controlling invertebrate pests, which method comprises contacting said pest or its food supply, habitat or breeding grounds with a pesticidally effective amount of at least one compound of the formula I according to any of claims 1 to 8 or the composition according to claim 9 or 10.

12. A method for protecting growing plants from attack or infestation by invertebrate pests, which method comprises contacting a plant, or soil or water in which the plant is growing, with a pesticidally effective amount of at least one compound of the formula I, according to any of the claims 1 to 8 or the composition according to claim 9 or 10.

13. A seed comprising a compound of the formula I, as defined in any of claims 1 to 8, or the enantiomers, diastereomers or salts thereof, or the composition, as defined in any of the claims 9 or 10, in an amount of from 0.1 g to 10 kg per 100 kg of seed.

14. A use of a compound of the formula I, as defined in any of the claims 1 to 8, and of an agriculturally acceptable salt thereof, or of the compositions as defined in any of the claims 9 or 10, for protecting growing plants from attack or infestation by invertebrate pests.

15. A method for treating or protecting an animal from infestation or infection by invertebrate pests which comprises bringing the animal in contact with a pesticidally effective amount of at least one compound of the formula I as defined in any of claims 1 to 8, a stereoisomer thereof and/or at least one veterinarily acceptable salt thereof.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061652

A. CLASSIFICATION OF SUBJECT MATTER
INV. C07D487/04 A01N43/90
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07D A01N

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, BIOSIS, CHEM ABS Data, EMBASE, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2016/023954 A2 (SYNGENTA PARTICIPATIONS AG [CH]) 18 February 2016 (2016-02-18) cited in the application Formulae (I), (I-1), (I-1a); Compounds A24-A27, A32-A33, A42-A45, A48-A49, A53, A55, A57-A58, A65, A71; Biological examples; claims; table A	1-15

Y	WO 2015/038503 A1 (DU PONT [US]) 19 March 2015 (2015-03-19) cited in the application Formulae (1), Q-3; claims; examples	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 June 2018	21/06/2018

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061652

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2017/021178 A1 (UNIV DE NANTES [FR]) 9 February 2017 (2017-02-09) Formula (I); claims; compounds 28-35 -----	1-15
X,P	WO 2017/167832 A1 (BASF SE [DE]) 5 October 2017 (2017-10-05) Formula (I-A); claims; examples C21, C24, C32, C34, C35 -----	1-15

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2018/061652

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