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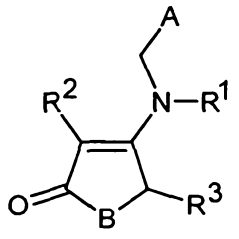
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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(54) **Title:** SUBSTITUTED ENAMINOCARBONYL COMPOUNDS

(54) **Bezeichnung:** SUBSTITUIERTE ENAMINOCARBONYLVERBINDUNGEN



(I)

(57) **Abstract:** The present application relates to novel substituted enaminocarbonyl compounds of formula (I), to a method for producing said compounds and to their use for controlling animal pests, particularly arthropods and more particularly insects.

(57) **Zusammenfassung:** Die vorliegende Anmeldung betrifft neue substituierte Enaminocarbonylverbindungen der Formel (I), Verfahren zu Ihrer Herstellung und ihre Verwendung zur Bekämpfung von tierischen Schädlingen, vor allem von Arthropoden, insbesondere Insekten.

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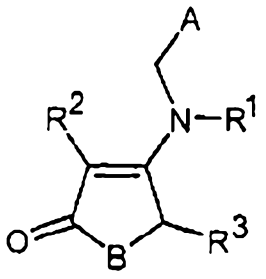
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Substituted enaminocarbonyl compounds

The present invention relates to novel substituted enaminocarbonyl compounds, to processes for their preparation and to their use for controlling animal pests, especially arthropods, in particular insects.

Substituted enaminocarbonyl compounds are already known as insecticidally active compounds (cf. EP 0 539 588 A1, DE 102004047922 A1).

In a first aspect, the present invention provides a compound of the formula (I),



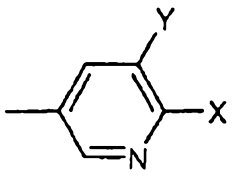
(I)

in which

A represents a pyrimidinyl, pyrazolyl, thiophenyl, oxazolyl, isoxazolyl, 1,2,4-oxadiazolyl, isothiazolyl, 1,2,4-triazolyl or 1,2,5-thiadiazolyl radical which is optionally substituted by fluorine, chlorine, bromine, cyano, nitro, C_1-C_4-alkyl (which is optionally substituted by fluorine and/or chlorine), C_1-C_3-alkylthio (which is optionally substituted by fluorine and/or chlorine), or C_1-C_3-alkylsulphonyl (which is optionally substituted by fluorine and/or chlorine),

or

A represents a radical



in which

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X represents halogen, alkyl or haloalkyl,

Y represents halogen, alkyl, haloalkyl, haloalkoxy, azido or cyano,

B represents oxygen, sulphur or methylene,

R^1 represents hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl or alkoxy,

R^2 represents hydrogen or halogen and

R^3 represents hydrogen or alkyl.

In a second aspect the present invention provides a composition comprising at least one compound of the formula (I) according to the first aspect and customary extenders and/or surfactants.

In a third aspect the present invention provides a method for controlling pests, the method comprising allowing a compound of the formula (I) according to the first aspect, or a composition according to the second aspect, to act on the pests and/or their habitat.

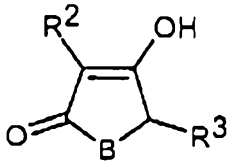
In a fourth aspect the present invention provides use of a compound of the formula (I) according to the first aspect, or of a composition according to the second aspect, for controlling pests.

Furthermore, it has been found that the novel compounds of the formula (I) are obtained when

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a) compounds of the formula (II)



(II)

in which

B, R^2 and R^3 are as defined further above

are reacted with compounds of the formula (III)

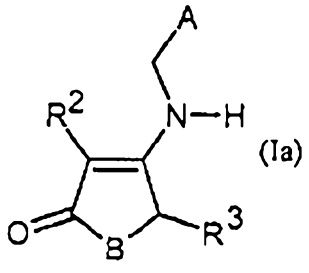
$$HN(R^1)\text{-}CH_2\text{-}A \qquad (III)$$

in which

A and R^1 are as defined further above,

if appropriate in the presence of a suitable diluent and if appropriate in the presence of an acidic auxiliary (process 1), or when

b) compounds of the formula (Ia)



(Ia)

(Ia)

in which

A, B, R^2 and R^3 are as defined further above

are reacted with compounds of the formula (IV)

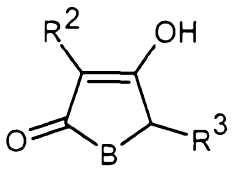
$$E\text{-}R^1 \quad (IV)$$

in which

R^1 is as defined above and

E represents a suitable leaving group such as, for example, halogen (in particular bromine, chlorine, iodine) or O-sulphonylalkyl and O-sulphonylaryl (in particular O-mesyl, O-tosyl), if appropriate in the presence of a suitable diluent and if appropriate in the presence of an acid acceptor (process 2), or when

c) compounds of the formula (II)



(II)

in which

B, R^2 and R^3 are as defined further above,

are, in a first reaction step, reacted with compounds of the formula (V)

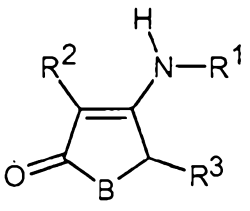
$$H_2N\text{-}R^1 \quad (V)$$

in which

R^1 is as defined further above,

if appropriate in the presence of a suitable diluent and if appropriate in the presence of an acidic auxiliary, and

the resulting compounds of the formula (VI)



(VI)

in which

B, R^1, R^2 and R^3 are as defined further above,

are then, in a second reaction step, reacted with compounds of the formula (VII)

$$E\text{-}CH_2\text{-}A \quad (VII)$$

in which

E and A are as defined further above,

if appropriate in the presence of a suitable diluent and if appropriate in the presence of an acid acceptor (process 3).

Finally, it has been found that the novel compounds of the formula (I) have pronounced biological properties and are suitable especially for controlling animal pests, in particular insects, arachnids and nematodes encountered in agriculture, in forests, in the protection of stored products and in the protection of materials, and also in the hygiene sector.

Depending inter alia on the nature of the substituents, the compounds of the formula (I) may be present as geometrical and/or as optically active isomers or corresponding isomer mixtures of varying composition. The invention relates both to the pure isomers and the isomer mixtures.

The formula (I) provides a general definition of the compounds according to the invention.

Preferred substituents or ranges of the radicals given in the formulae mentioned above and below are illustrated below.

A preferably represents pyrimidin-5-yl which is optionally substituted in the 2-position by halogen or C_1-C_4-alkyl, represents 1*H*-pyrazol-4-yl which is optionally substituted in the 1-position by C_1-C_4-alkyl and in the 3-position by halogen, represents 1*H*-pyrazol-5-yl which is optionally substituted in the 2-position by halogen or C_1-C_4-alkyl, represents isoxazol-5-yl which is optionally substituted in the 3-position by halogen or C_1-C_4-alkyl, represents 1,2,4-oxadiazol-5-yl which is optionally substituted in the 3-position by halogen or C_1-C_4-alkyl, represents 1-methyl-1,2,4-triazol-3-yl or represents 1,2,5-thiadiazol-3-yl,

furthermore

A preferably represents one of the radicals 5,6-difluoropyrid-3-yl, 5-chloro-6-fluoropyrid-3-yl, 5-bromo-6-fluoropyrid-3-yl, 5-iodo-6-fluoropyrid-3-yl, 5-fluoro-6-chloropyrid-3-yl, 5,6-

dichloropyrid-3-yl, 5-bromo-6-chloropyrid-3-yl, 5-iodo-6-chloropyrid-3-yl, 5-fluoro-6-bromopyrid-3-yl, 5-chloro-6-bromopyrid-3-yl, 5,6-dibromopyrid-3-yl, 5-iodo-6-bromopyrid-3-yl, 5-fluoro-6-iodopyrid-3-yl, 5-chloro-6-iodopyrid-3-yl, 5-bromo-6-iodopyrid-3-yl, 5,6-diiodopyrid-3-yl, 5-methyl-6-fluoropyrid-3-yl, 5-methyl-6-chloropyrid-3-yl, 5-methyl-6-bromopyrid-3-yl, 5-methyl-6-iodopyrid-3-yl, 5-difluoromethyl-6-fluoropyrid-3-yl, 5-difluoromethyl-6-chloropyrid-3-yl, 5-difluoromethyl-6-bromopyrid-3-yl, 5-difluoromethyl-6-iodopyrid-3-yl.

B preferably represents oxygen or methylene.

R^1 preferably represents C_1-C_4-alkyl, C_2-C_4-alkenyl, C_2-C_4-alkynyl, C_3-C_4-cycloalkyl or C_1-C_3-alkoxy.

R^2 preferably represents hydrogen or halogen.

R^3 preferably represents hydrogen or C_1-C_3-alkyl.

A particularly preferably represents 2-methylpyrimidin-5-yl, represents 2-chloropyrimidin-5-yl, represents 1*H*-pyrazol-4-yl which is optionally substituted in the 1-position by methyl or ethyl and in the 3-position by chlorine, represents 1*H*-pyrazol-5-yl, represents 2-methyl-pyrazol-5-yl, represents 2-bromothiazolyl, represents isoxazol-5-yl which is optionally substituted in the 3-position by methyl, ethyl, chlorine or bromine, represents 3-methyl-1,2,4-oxadiazol-5-yl, represents 1-methyl-1,2,4-triazol-3-yl or represents 1,2,5-thiadiazol-3-yl, furthermore

A particularly preferably represents 5-fluoro-6-chloropyrid-3-yl, 5,6-dichloropyrid-3-yl, 5-bromo-6-chloropyrid-3-yl, 5-fluoro-6-bromopyrid-3-yl, 5-chloro-6-bromopyrid-3-yl, 5,6-dibromopyrid-3-yl, 5-methyl-6-chloropyrid-3-yl or 5-methyl-6-bromopyrid-3-yl.

B particularly preferably represents oxygen or methylene.

R^1 particularly preferably represents methyl, ethyl, propyl, vinyl, allyl, propargyl, cyclopropyl or methoxy.

R^2 particularly preferably represents hydrogen or fluorine, chlorine, bromine.

R^3 particularly preferably represents hydrogen or methyl.

A very particularly preferably represents 2-methylpyrimidin-5-yl, 2-chloropyrimidin-5-yl, 3-methylisoxazol-5-yl, 3-bromoisoxazol-5-yl, 5-fluoro-6-chloropyrid-3-yl, 5,6-dichloropyrid-3-yl or 5-fluoro-6-bromopyrid-3-yl.

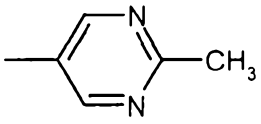
B very particularly preferably represents oxygen.

R^1 very particularly preferably represents methyl, ethyl, cyclopropyl or methoxy.

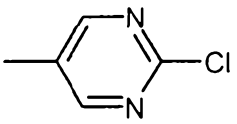
R^2 very particularly preferably represents hydrogen.

R^3 very particularly preferably represents hydrogen.

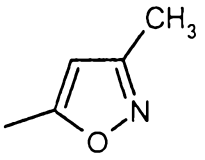
In a special group of compounds of the formula (I), A represents 2-methylpyrimidin-5-yl,



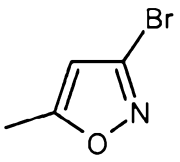
In a further special group of compounds of the formula (I), A represents 2-chloropyrimidin-5-yl,



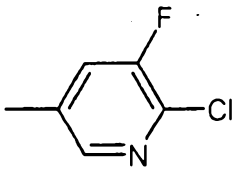
In a further special group of compounds of the formula (I), A represents 3-methylisoxazol-5-yl,



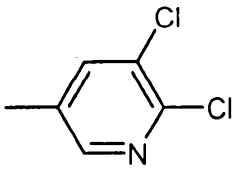
In a further special group of compounds of the formula (I), A represents 3-bromoisoxazol-5-yl,



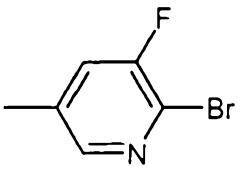
In a further special group of compounds of the formula (I), A represents 5-fluoro-6-chloropyrid-3-yl,



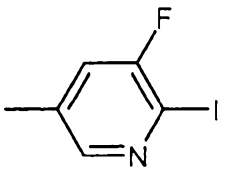
In a further special group of compounds of the formula (I), A represents 5,6-dichloropyrid-3-yl



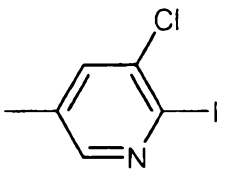
In a further special group of compounds of the formula (I), A represents 5-fluoro-6-bromopyrid-3-yl



In a further special group of compounds of the formula (I), A represents 5-fluoro-6-iodopyrid-3-yl



In a further special group of compounds of the formula (I), A represents 5-chloro-6-iodopyrid-3-yl

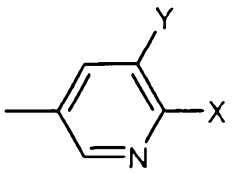


A further group of preferred compounds of the formula (I) in which

A represents a pyrimidin-5-yl radical which is substituted in the 2-position by halogen or halo-C_1-C_4-alkyl,

or

A represents a radical



in which

X represents halogen or halo-C_1-C_4-alkyl,

Y represents halogen, C_1-C_4-alkyl, halo-C_1-C_4-alkyl, halo-C_1-C_4-alkoxy, azido or cyano,

B represents oxygen, sulphur or methylene,

R^1 represents hydrogen, C_1-C_3-alkyl, C_2-C_3-alkenyl, cyclopropyl or C_1-C_2-alkoxy,

R^2 represents hydrogen or halogen and

R^3 represents hydrogen or methyl.

A preferably represents 2-chloropyrimidin-5-yl or 2-trifluoromethylpyrimidin-5-yl,

furthermore

A preferably represents one of the radicals 5,6-difluoropyrid-3-yl, 5-chloro-6-fluoropyrid-3-yl, 5-bromo-6-fluoropyrid-3-yl, 5-iodo-6-fluoropyrid-3-yl, 5-fluoro-6-chloropyrid-3-yl, 5,6-dichloropyrid-3-yl, 5-bromo-6-chloropyrid-3-yl, 5-iodo-6-chloropyrid-3-yl, 5-fluoro-6-bromopyrid-3-yl, 5-chloro-6-bromopyrid-3-yl, 5,6-dibromopyrid-3-yl, 5-fluoro-6-iodopyrid-3-yl, 5-chloro-6-iodopyrid-3-yl, 5-bromo-6-iodopyrid-3-yl, 5-methyl-6-fluoropyrid-3-yl, 5-methyl-6-chloropyrid-3-yl, 5-methyl-6-bromopyrid-3-yl, 5-methyl-6-iodopyrid-3-yl, 5-difluoromethyl-6-fluoropyrid-3-yl, 5-difluoromethyl-6-chloropyrid-3-yl, 5-difluoromethyl-6-bromopyrid-3-yl, 5-difluoromethyl-6-iodopyrid-3-yl.

B preferably represents oxygen or methylene.

R^1 preferably represents hydrogen, methyl, ethyl, *n*-propyl, vinyl, allyl, cyclopropyl or methoxy.

R^2 preferably represents hydrogen or halogen (where halogen represents in particular fluorine or chlorine).

R^3 preferably represents hydrogen.

A particularly preferably represents 2-chloropyrimidin-5-yl, 5-fluoro-6-chloropyrid-3-yl, 5,6-dichloropyrid-3-yl, 5-bromo-6-chloropyrid-3-yl, 5-fluoro-6-bromopyrid-3-yl, 5-chloro-6-bromopyrid-3-yl, 5,6-dibromopyrid-3-yl, 5-methyl-6-chloropyrid-3-yl, 5-chloro-6-iodopyrid-3-yl or 5-difluoromethyl-6-chloropyrid-3-yl.

B particularly preferably represents oxygen.

R^1 particularly preferably represents methyl, ethyl, cyclopropyl or methoxy.

R^2 particularly preferably represents hydrogen.

R^3 particularly preferably represents hydrogen.

A very particularly preferably represents 5-fluoro-6-chloropyrid-3-yl or 5-fluoro-6-bromopyrid-3-yl.

B very particularly preferably represents oxygen.

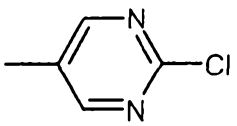
R^1 very particularly preferably represents methyl or cyclopropyl.

R^2 very particularly preferably represents hydrogen.

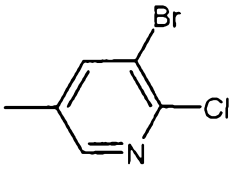
R^3 very particularly preferably represents hydrogen.

is defined below.

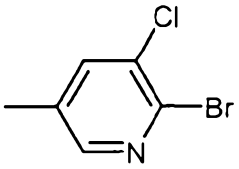
In a special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 2-chloropyrimidin-5-yl,



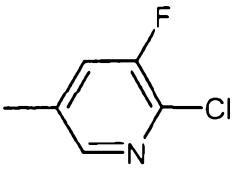
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-bromo-6-chloropyrid-3-yl



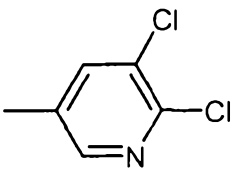
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-chloro-6-bromopyrid-3-yl



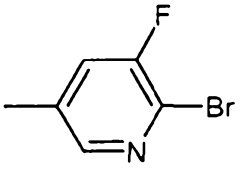
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-fluoro-6-chloropyrid-3-yl



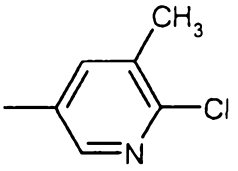
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5,6-dichloropyrid-3-yl



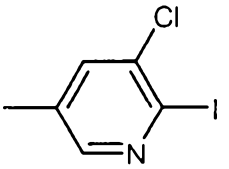
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-fluoro-6-bromopyrid-3-yl



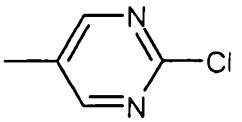
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-methyl-6-chloropyrid-3-yl



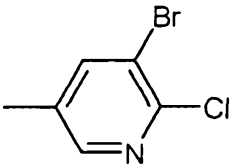
In a further special group of compounds of the formula (I), R^3 represents hydrogen, B represents oxygen and A represents 5-chloro-6-iodopyrid-3-yl



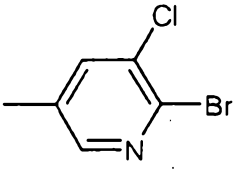
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 2-chloropyrimidin-5-yl,



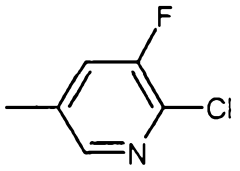
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-bromo-6-chloropyrid-3-yl,



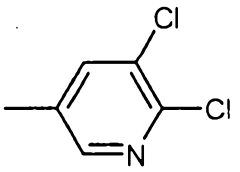
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-chloro-6-bromopyrid-3-yl,



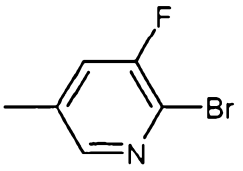
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-fluoro-6-chloropyrid-3-yl,



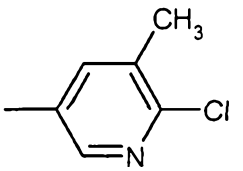
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5,6-dichloropyrid-3-yl



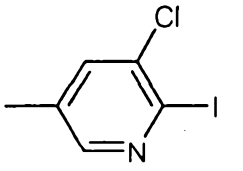
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-fluoro-6-bromopyrid-3-yl



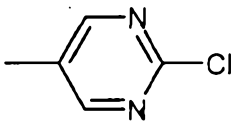
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-methyl-6-chloropyrid-3-yl



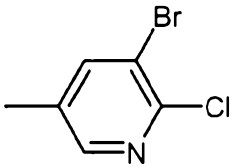
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents oxygen and A represents 5-chloro-6-iodopyrid-3-yl



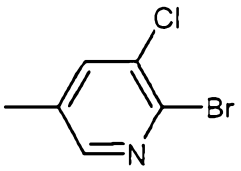
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 2-chloropyrimidin-5-yl



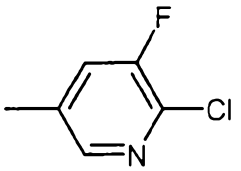
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-bromo-6-chloropyrid-3-yl,



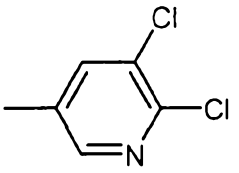
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-chloro-6-bromopyrid-3-yl



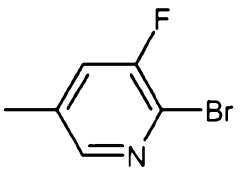
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-fluoro-6-chloropyrid-3-yl



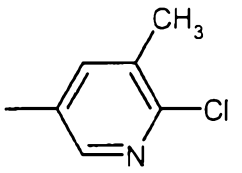
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5,6-dichloropyrid-3-yl



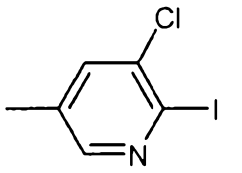
In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-fluoro-6-bromopyrid-3-yl



In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-methyl-6-chloropyrid-3-yl



In a further special group of compounds of the formula (I), R^2 and R^3 represent hydrogen, B represents methylene and A represents 5-chloro-6-iodopyrid-3-yl



In a further special group of compounds of the formula (I), R^1 represents methyl, R^2 and R^3 represent hydrogen and B represents oxygen.

In a further special group of compounds of the formula (I), R^1 represents ethyl, R^2 and R^3 represent hydrogen and B represents oxygen.

In a further special group of compounds of the formula (I), R^1 represents cyclopropyl, R^2 and R^3 represent hydrogen and B represents oxygen.

In a further special group of compounds of the formula (I), R^1 represents methyl, R^2 and R^3 represent hydrogen and B represents methylene.

In a further special group of compounds of the formula (I), R^1 represents ethyl, R^2 and R^3 represent hydrogen and B represents methylene.

In a further special group of compounds of the formula (I), R^1 represents cyclopropyl, R^2 and R^3 represent hydrogen and B represents methylene.

The general or preferred radical definitions given above apply both to the end products and, correspondingly, to precursors and intermediates. These radical definitions can be combined with one another as desired, i.e. including combinations between the respective preferred ranges.

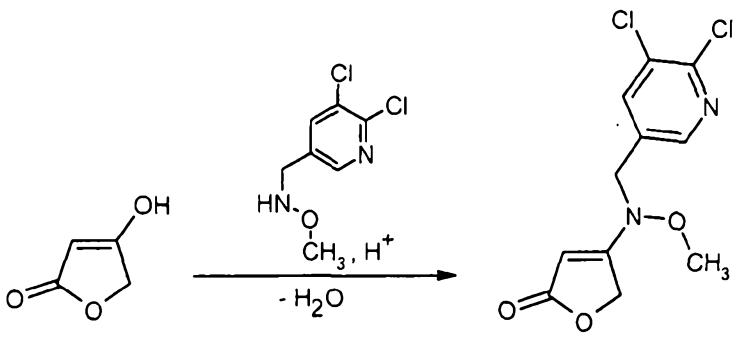
Preference according to the invention is given to the compounds of the formula (I) which contain a combination of the meanings listed above as being preferred.

Particular preference according to the invention is given to the compounds of the formula (I) which contain a combination of the meanings listed above as being particularly preferred.

Very particular preference according to the invention is given to the compounds of the formula (I) which contain a combination of the meanings listed above as being very particularly preferred.

If, in the process 1 according to the invention for preparing the novel compounds of the formula (I), the compound of the formula (II) is, for example, tetronic acid and the compound of the formula (III) is 1-(5,6-dichloropyridin-3-yl)-*N*-methoxymethanamine, preparation process 1 can be represented by the reaction scheme I below:

Scheme I



The formula (II) provides a general definition of the compounds required as starting materials for carrying out the process 1 according to the invention.

In this formula (II), B, R^2 and R^3 preferably represent those radicals which have already been mentioned in connection with the description of the compounds of the formula (I) according to the invention as preferred substituents.

Some of the compounds of the formula (II) can be obtained commercially or by methods known from the literature (cf., for example, compounds of the formula (II) in which B represents oxygen: tetronic acids (Said, A. Speciality Chemicals Magazine (1984), 4(4), 7-8; Rao, Y. S. Chem. Rev. (1976), 76, 625-694; Tejedor, D.; Garcia-Tellado, F. Org. Preparations and Procedures International (2004), 36, 35-59; Reviews); compounds of the formula (II) in which B represents sulphur: thiotetronic acids (Thomas, E. J. Special Publication - Royal Society of Chemistry (1988), 65 (Top. Med. Chem.), 284-307, Review), compounds of the formula (II) in which B represents methylene: cyclopentane-1,3-dione (Schick, Hans; Eichhorn, Inge. Synthesis (1989), (7), 477-492, Review).

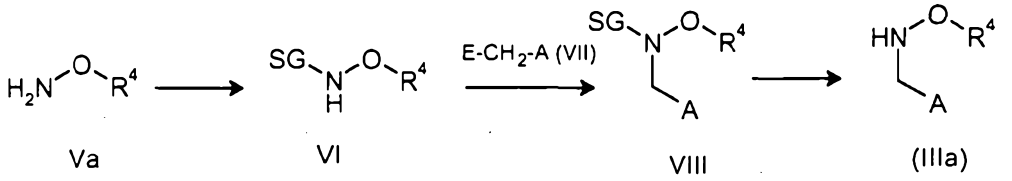
The formula (III) provides a general definition of the compounds furthermore required as starting materials for carrying out the process I according to the invention.

In formula (III), A and R^1 have the meanings already mentioned in connection with the description of the compounds of the formula (I) according to the invention.

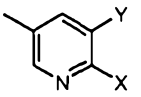
Some of the compounds of the formula (III) can be obtained commercially or by methods known from the literature (cf., for example, S. Patai "The Chemistry of Amino Group", Interscience Publishers, New York, 1968; compounds of the formula (III) in which R^1 represents hydrogen: primary amines, compounds of the formula (III) in which R^1 represents alkyl, alkenyl, alkynyl or cycloalkyl: secondary amines, compounds of the formula (III) in which R^1 represents alkoxy: *N,O*-disubstituted hydroxylamines).

Using, for example, *N,O*-disubstituted hydroxylamines (IIIa) in which R^1 represents an alkoxy radical (O-R^4) as compounds of the formula (III), these can be prepared according to reaction scheme II from suitable *N*-protected compounds of the formula (VIII):

Scheme II



PG = protective group, for example *tert*-butyloxycarbonyl (Boc)

A = as defined above, for example 

To prepare the *N*-protected compounds of the formula (VIII), for example, aminoxy compounds of the formula (Va) are, in a first reaction step, protected according to methods known from the literature with a protective group at the hydroxylamine nitrogen.

Aminoprotective groups and their introduction and removal are known per se and described, for example, in J. F. McOmie, "Protective Groups in Organic Chemistry", Plenum Press, London, New York, 1973, and T. W. Greene, "Protective Groups in Organic Synthesis", Wiley, New York, 1984.

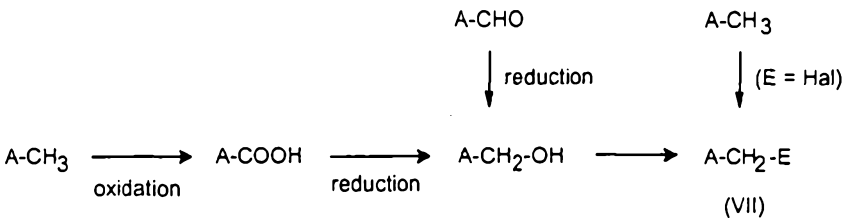
Suitable protective groups are optionally substituted alkyl groups having preferably 1 to 6, in particular 1 to 4 carbon atoms, such as, for example, *tert*-butyl, methylthiomethyl, trimethylsilyl, phenylalkyl-containing alkyl groups, such as, for example, benzyl or diphenylmethyl, heterocyclic groups, such as tetrahydropyranyl and the like.

The *N*-protected compounds of the formula (VI) are then reacted with compounds of the formula (VII) to give the corresponding *N*-protected compounds of the formula (VIII) (see also the Preparation Examples).

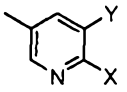
Some of the compounds of the formula (VII) are commercially available, some are known and can be obtained by known methods.

Usual routes for preparing compounds of the formula (VII) are illustrated in reaction scheme III.

Scheme III



E = as defined above, for example chlorine, bromine, iodine; O-tosyl, O-mesyl,

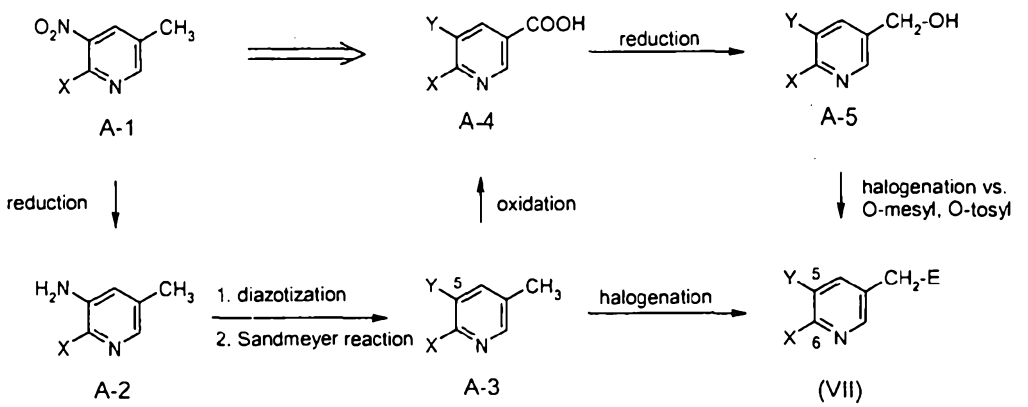
A = as defined above, for example 

Methyl-substituted compounds of the type (A-CH_3), for example, can be converted by oxidation into corresponding carboxylic acids (A-COOH, for example 5-fluoro-6-bromonicotinic acid: F. L. Setliff, G. O. Rankin, J. Chem. Eng. Data (1972), 17, 515-516; 5-chloro-6-bromonicotinic acid and 5,6-dibromonicotinic acid: F. L. Setliff et al., J. Chem. Eng. Data (1981), 26, 332-333; 5-iodo-6-bromonicotinic acid: F. L. Setliff et al., J. Chem. Eng. Data (1978), 23, 96-97, 5-fluoro-6-iodonicotinic acid and 5-bromo-6-iodonicotinic acid: F. L. Setliff et al., J. Chem. Eng. Data (1973), 18, 449-450, 5-chloro-6-iodonicotinic acid: F. L. Setliff, J. E. Lane J. Chem. Eng. Data (1976), 21, 246-247) or carboxylic esters (for example methyl 5-methyl-6-fluoronicotinate: WO 9833772 A1, 1998; methyl 5-methyl-6-bromonicotinate: WO 9730032 A1, 1997).

The carboxylic acids (A-COOH) can then be converted by methods known from the literature into the corresponding hydroxymethyl compounds (A-CH_2-OH), which are then reacted by methods known from the literature to give activated hydroxymethyl compounds (A-CH_2-E, E = O-tosyl, O-mesyl) or halomethyl compounds (A-CH_2-E, E = Hal). The latter can also be obtained from corresponding compounds which contain a methyl group (A-CH_3) using suitable halogenating agents known from the literature. The syntheses of the following halomethyl-substituted compounds: 3-chloromethyl-5-bromo-6-chloropyridine, 3-bromo-5-iodo-6-chloropyridine (S. Kagabu et al., J. Pestic. Sci. (2005), 30, 409-413) may be mentioned as examples for this procedure.

Compounds of the formula (VII) in which A represents a 5,6-disubstituted pyrid-3-yl radical can also be obtained by methods known from the literature. Suitable starting materials known from the literature are, for example, the 6-halo-substituted 5-nitro-β-picolines (A-1), which can be modified by known literature procedures, as shown in reaction scheme IV by way of example.

Scheme IV



X, Y = halogen, for example fluorine, chlorine, bromine, iodine
E = halogen, O-mesyl, O-tosyl

The reduction of the nitro group in 6-halo-substituted 5-nitro-β-picolines (A-1), for example, gives 6-halo-substituted 5-amino-β-picolines (A-2, for example 5-amino-6-chloro-β-picoline and 5-amino-6-bromo-β-picoline: Setliff, F. L. Org. Preparations and Preparations Int. (1971), 3, 217-222; Kagabu, S. et al. J. Pestic. Sci. (2005), 30, 409-413). Subsequent diazotization and Sandmeyer reaction (C. F. H. Allen, J. R. Thirtle, Org. Synth., Coll. Vol. III, 1955, p. 136) allows the introduction of halogen substituents in the 5-position (A-3, for example 5-fluoro-6-chloro-β-picoline and 5-fluoro-6-bromo-β-picoline: Setliff, F. L. Org. Preparations and Preparations Int. (1971), 3, 217-222; 5-iodo-6-chloro-β-picoline: Kagabu, S. et al. J. Pestic. Sci. (2005), 30, 409-413; 5,6-dichloropicoline: Setliff, F. L.; Lane, J. E. J. Chem. Engineering Data (1976), 21, 246-247). The oxidation of the methyl group in the 5,6-disubstituted β-picolines (A-3) leads to the corresponding 5,6-disubstituted nicotinic acids (A-4, for example 5-fluoro-6-chloronicotinic acid and 5-fluoro-6-bromonicotinic acid: Setliff F. L., Rankin G. O. J. Chem. Engineering Data (1972), 17, 515-516; 5-bromo-6-fluoronicotinic acid, 5-bromo-6-chloronicotinic acid and 5-bromo-6-bromonicotinic acid: F. L. Setliff J. Chem. Engineering Data (1970), 15, 590-591; 5-chloro-6-bromonicotinic acid and 5-iodo-6-bromonicotinic acid: Setliff, F. L., Greene, J. S. J. Chem. Engineering Data (1978), 23, 96-97; also known is 5-chloro-6-trifluoromethylnicotinic acid: F. Cottet et al., Synthesis (2004), 10, 1619-1624), which can be converted in the presence of reducing agents into the corresponding hydroxymethylated pyridines (A-5) (for example 5-bromo-6-chloro-3-hydroxymethylpyridine: Kagabu, S. et al., J. Pestic. Sci. (2005), 30, 409-413).

By reduction of 6-chloro-5-nitronicotinic acid (A-4, X=Cl, Y=NO_2; Boyer, J. H.; Schoen, W., J. Am. Chem. Soc. (1956), 78, 423-425), it is possible to form 6-chloro-3-hydroxymethyl-5-nitro-pyridine (A-5, X=Cl, Y=NO_2; Kagabu, S. et al., J. Med. Chem. (2000), 43, 5003-5009), which is then reduced to 6-chloro-3-hydroxymethyl-5-aminopyridine (A-5, X=Cl, Y=NH_2; Kagabu, S. et al.,

J. Med. Chem. (2000), 43, 5003-5009) and, via diazotisation and reaction with hydroxylamine, converted into 6-chloro-3-hydroxymethyl-5-azidopyridine (A-5, X=Cl, Y=N_3; Kagabu, S. et al., J. Med. Chem. (2000), 43, 5003-5009). Subsequent halogenation with thionyl chloride gives 6-chloro-3-chloromethyl-5-azidopyridine (VII, X=Cl, Y=N_3, E=Cl; Kagabu, S. et al., J. Med. Chem. (2000), 43, 5003-5009).

Alternatively, halogenation of the methyl group in the 3-position of (A-3) gives compounds of the formula (VII) in which E represents halogen (for example: 3-bromomethyl-6-chloro-5-fluoro-pyridine, 3-bromomethyl-6-chloro-5-iodopyridine: Kagabu, S. et al. J. Pestic. Sci. (2005), 30, 409-413). When 6-halo-substituted 5-nitro-β-picolines (A-3; Y=NO_2) are used, there may be initial halogenation of the methyl group in the 3-position (for example 3-bromomethyl-6-chloro-5-nitro-pyridine: Kagabu, S. et al., J. Pestic. Sci. (2005), 30, 409-413). If appropriate, the nitro group may also be reduced at a later stage in the reaction sequence.

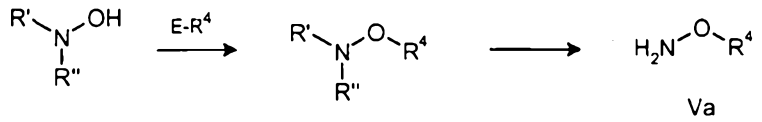
Also known from the literature is the introduction of substituents in the 5-position (for example Y=N_3) of compounds of the formula (VII) in which E represents *N*-morpholino. This radical can subsequently easily be replaced by halogen (E=Hal) (cf. S. Kagabu et al., J. Med. Chem. 2000, 43, 5003-5009; reaction conditions: ethyl chloroformate, tetrahydrofuran, 60°C).

In general, it is possible to replace halogen atoms in the vicinity of the pyridine nitrogen by other halogen atoms or halogenated groups such as, for example, trifluoromethyl (transhalogenation, for example: chlorine for bromine or iodine; bromine for iodine or fluorine; iodine for fluorine or trifluoromethyl). Thus, a further alternative synthesis route entails exchange of the halogen atom (for example X=Cl) in the 6-position of the pyrid-5-yl radicals (for example in A-4 where X, Y=Cl; 5,6-dichloronicotinic acid: Setliff, F. L.; Lane, J. E. J. Chem. Engineering Data (1976), 21, 246-247) for another halogen atom, for example iodine or fluorine (for example: A-4 where X=I; 5-bromo-6-iodonicotinic acid and A-4 where X=F; 5-bromo-6-fluoronicotinic acid: Setliff, F. L.; Price, D. W. J. Chem. Engineering Data (1973), 18, 449-450). However, this transhalogenation may also, if appropriate, be carried out later in suitable compounds of the formula (I), as illustrated in reaction scheme X and by the working examples further below.

Some of the aminoxy compounds of the formula (Va) are commercially available, and they can be obtained by known methods. A general route for preparing aminoxy compounds of the formula (Va) is, for example, the reaction of a hydroxylamine derivative which has a protective group (PG) at the nitrogen (for example R' and R'' together: a phthaloyl, isopropylidene, α-hydroxybenzylidene group) with a compound R^4-E (O-alkylation) in a diluent and the subsequent removal of the protecting group in question. In compound R^4-E, R^4 is as defined above and E is a nucleofugic

leaving group, for example aliphatically or aromatically substituted sulphonyloxy, for example methanesulphonyloxy (MesO = mesyloxy), salts of sulphonic acid, para-toluenesulphonyloxy (TosO = tosyloxy), and furthermore also, for example, halogen, in particular bromine, chlorine or iodine (cf. O-alkylation). The preparation of aminoxy compounds of the formula (Va) is shown in reaction scheme V below:

Scheme V



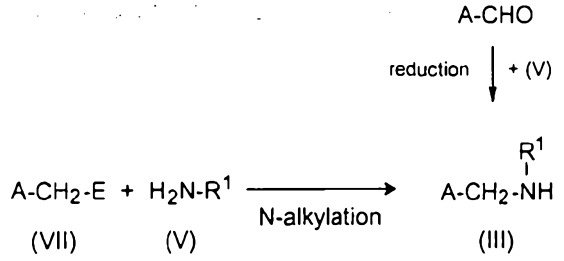
Va

Alternatively, when hydroxy compounds (R^4-OH) are used, it is possible, for example, to carry out an intermolecular dehydratization reaction. Particularly suitable for this purpose is a variant of the Mitsunobu reaction (O. Mitsunobu et al., Synthesis 1981, 1-28) where the hydroxy compound is reacted with *N*-protected hydroxylamine derivatives, such as, for example, *N*-hydroxyphthalimide, *N*-hydroxy-5-norbornene-2,3-dicarboximide or ethyl acetohydroxamate, and, for example, triphenylphosphine and diethyl *N,N'*-azodicarboxylate.

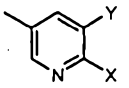
The release of the compound of the formula (Va) can be carried out under conditions known from the literature, expediently in the following manner: the hydrazinolysis is preferably carried out in a diluent, for example alcohol, at boiling point. The hydrolysis is preferably carried out in an aqueous, aqueous-alcoholic or alcoholic solution by heating for a number of hours. If R' and R'' together represent an isopropylidene group, acidic hydrolysis may be employed, and, if R' and R'' together represent an α-hydroxybenzylidene group or R'' represents a carbethoxy group, either alkaline or acidic hydrolysis may be employed.

For preparing compounds of the formula (III), for example, compounds of the formula (VII) in which A and E have the meanings mentioned further above are advantageously reacted with compounds of the formula (V) in which R^1 has the meaning mentioned further above, if appropriate in the presence of diluents and if appropriate in the presence of the basic reaction auxiliaries mentioned in preparation process 2 (cf. N-alkylation, Scheme VI).

Scheme VI



E = Hal, for example chlorine, bromine, iodine; O-tosyl, O-mesyl,

A = as defined above, for example 

In certain cases, it is alternatively also possible to prepare compounds of the formula (III) from corresponding aldehydes (A-CHO) and compounds of the general formula (V) by reductive amination (cf. Houben-Weyl, Methoden der Organischen Chemie [Methods of Organic Chemistry], Vol. XI/1, Georg Thieme Verlag Stuttgart, p. 602).

In general, it is advantageous to carry out the preparation process 1 according to the invention in the presence of diluents. Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the process 1 according to the invention are all organic solvents which are inert under the reaction conditions.

Examples which may be mentioned are: halogenated hydrocarbons, in particular chlorinated hydrocarbons, such as tetrachloroethylene, tetrachloroethane, dichloropropane, methylene chloride, dichlorobutane, chloroform, carbon tetrachloride, trichloroethane, trichloroethylene, pentachloroethane, difluorobenzene, 1,2-dichloroethane, chlorobenzene, bromobenzene, dichlorobenzene, chlorotoluene, trichlorobenzene; alcohols, such as methanol, ethanol, isopropanol, butanol; ethers, such as ethyl propyl ether, methyl *tert*-butyl ether, *n*-butyl ether, anisole, phenetole, cyclohexyl methyl ether, dimethyl ether, diethyl ether, dipropyl ether, diisopropyl ether, di-*n*-butyl ether, diisobutyl ether, diisoamyl ether, ethylene glycol dimethyl ether, tetrahydrofuran, dioxane, dichlorodiethyl ether and polyethers of ethylene oxide and/or propylene oxide; amines, such as trimethylamine, triethylamine, tripropylamine, tributylamine, *N*-methylmorpholine, pyridine and tetramethylenediamine; nitrated hydrocarbons, such as nitromethane, nitroethane, nitropropane, nitrobenzene, chloronitrobenzene, o-nitrotoluene; nitriles, such as acetonitrile, propionitrile, butyronitrile, isobutyronitrile, benzonitrile, m-chlorobenzonitrile and also compounds, such as tetrahydrothiophene dioxide and dimethyl sulphoxide, tetramethylene sulphoxide, dipropyl sulphoxide, benzylmethyl sulphoxide, diisobutyl sulphoxide, dibutyl

sulphoxide, diisoamyl sulphoxide; sulphones, such as dimethyl sulphone, diethyl sulphone, dipropyl sulphone, dibutyl sulphone, diphenyl sulphone, dihexyl sulphone, methyl ethyl sulphone, ethyl propyl sulphone, ethyl isobutyl sulphone and pentamethylene sulphone; aliphatic, cycloaliphatic or aromatic hydrocarbons, such as pentane, hexane, heptane, octane, nonane and industrial hydrocarbons, for example white spirits with components having boiling points in the range of, for example, from 40°C to 250°C, cymene, petroleum fractions having a boiling point interval of from 70°C to 190°C, cyclohexane, methylcyclohexane, petroleum ether, ligroin, octane, benzene, toluene, chlorobenzene, bromobenzene, nitrobenzene, xylene; esters, such as methyl acetate, ethyl acetate, butyl acetate, isobutyl acetate, and also dimethyl carbonate, dibutyl carbonate, ethylene carbonate; amides, such as hexamethylenephosphoric triamide, formamide, *N*-methylformamide, *N,N*-dimethylformamide, *N,N*-dipropylformamide, *N,N*-dibutylformamide, *N*-methylpyrrolidine, *N*-methylcaprolactam, 1,3-dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidine, octylpyrrolidone, octylcaprolactam, 1,3-dimethyl-2-imidazolinedione, *N*-formylpiperidine, *N,N'*-1,4-diformylpiperazine; ketones, such as acetone, acetophenone, methyl ethyl ketone, methyl butyl ketone.

It is also possible to use mixtures of the solvents and diluents mentioned for the process 1 according to the invention.

However, preferred diluents for carrying out the process according to the invention are aromatic hydrocarbons, such as benzene, toluene, chlorobenzene, bromobenzene, nitrobenzene or xylene, in particular benzene and toluene, and ethers, such as methyl *tert*-butyl ether, anisole, tetrahydrofuran, dioxane, in particular tetrahydrofuran and dioxane.

The reaction of compounds of the formula (I) according to preparation process 1 is carried out by reacting the compounds of the formula (II) in the presence of compounds of the formula (III), if appropriate in the presence of an acidic auxiliary and if appropriate in one of the diluents stated.

The reaction time is generally from 10 minutes to 48 hours.

The reaction is carried out at temperatures between -10°C and +200°C, preferably between +10°C and 180°C, particularly preferably between 20°C and 140°C. The reaction is preferably carried out under reaction conditions which allow water to be separated off or to be removed, for example with the aid of a water separator or by adding suitable molecular sieves, which also allow water to be removed.

In principle, the reaction can be carried out under atmospheric pressure. The reaction is preferably carried out under atmospheric pressure or under pressures of up to 15 bar and, if appropriate, under an atmosphere of protective gas (nitrogen, helium or argon).

For carrying out the process 1 according to the invention, in general from 0.5 to 4.0 mol, preferably from 0.7 to 3.0 mol, particularly preferably from 1.0 to 2.0 mol of amino compound of the general formula (III) are employed per mole of the compound of the formula (II).

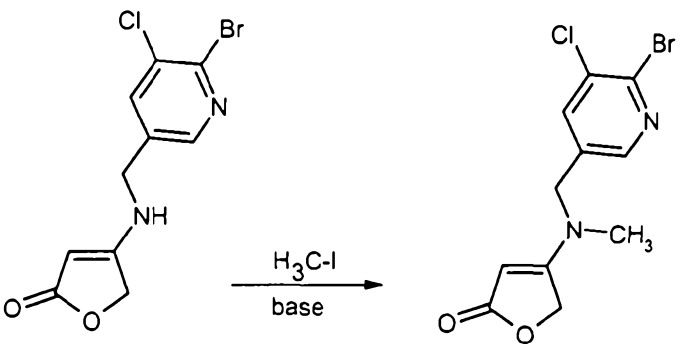
Furthermore, for carrying out the process 1 according to the invention, in general catalytic amounts of an acidic auxiliary can be added.

Suitable acidic auxiliaries are, for example, p-toluenesulphonic acid or acetic acid.

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

If, in the process 2 according to the invention for preparing the novel compounds of the formula (I), the compound of the formula (Ia) is, for example, 4-[[(6-bromo-5-chloropyridin-3-yl)methyl]amino]furan-2(5H)-one and the compound of the formula (IV) is methyl iodide, preparation process 2 can be represented by reaction scheme VII below:

Scheme VII



The formula (Ia) provides a general definition of the compounds required as starting materials for carrying out the process 2 according to the invention.

In this formula (Ia), A, B, R^2 and R^3 preferably represent those radicals which have already been mentioned in connection with the description of the compounds of the general formula (I) according to the invention as preferred substituents.

The compounds of the formula (Ia) can be obtained by preparation process 1, described further above, for example by reacting compounds of the formula (II) with compounds of the formula (III) in which R^1 represents hydrogen.

The formula (IV) provides a general definition of the compounds further to be used as starting materials for carrying out process 2 according to the invention.

In formula (IV), E and R^1 have the meanings already mentioned in connection with the description of the compounds of the formula (I) according to the invention.

Some of the compounds of the formula (IV) are commercially available, or they can be obtained by methods known from the literature (cf., for example, compounds of the formula (IV) in which E represents halogen, such as chlorine, bromine and iodine: Houben-Weyl, Methoden der Organischen Chemie, Vol. V/3, Georg Thieme Verlag Stuttgart, p. 503 and Vol. V/4 pp. 13, 517; compounds of the formula (IV) in which E represents mesylate: Crossland, R. K., Servis, K. L. J. Org. Chem. (1970), 35, 3195; compounds of the formula (IV) in which E represents tosylate: Roos, A. T. et al., Org. Synth., Coll. Vol. I, (1941), 145; Marvel, C. S., Sekera, V. C. Org. Synth., Coll. Vol. III, (1955), 366.

In general, if appropriate, it is advantageous to carry out the preparation process 2 according to the invention in the presence of diluents and, if appropriate, in the presence of basic reaction auxiliaries.

Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the process 2 according to the invention are all organic solvents which are inert under the reaction conditions.

Preferred diluents for carrying out the process 2 according to the invention are ethers, such as methyl *tert*-butyl ether, *n*-butyl ether, anisole, phenetole, cyclohexyl methyl ether, diisopropyl ether, diisobutyl ether, diisoamyl ether, ethylene glycol dimethyl ether, tetrahydrofuran, dioxane, dichlorodiethyl ether and polyethers of ethylene oxide and/or propylene oxide; amides, such as hexamethylenephosphoric triamide, formamide, *N*-methylformamide, *N,N*-dimethylformamide, *N,N*-dipropylformamide, *N,N*-dibutylformamide, *N*-methylbenzene, toluene, chlorobenzene, bromobenzene, nitrobenzene, xylene; ketones, such as acetone, acetophenone, methyl ethyl ketone or methyl butyl ketone.

It is also possible to use mixtures of the solvents and diluents mentioned for the process 2 according to the invention.

However, preferred diluents for carrying out the process 2 according to the invention are ethers, such as methyl *tert*-butyl ether or cyclic ethers, such as tetrahydrofuran and dioxane, amides, such as *N,N*-dimethylformamide, aromatic hydrocarbons, such as benzene or toluene; ketones, such as acetone, methyl ethyl ketone or methyl butyl ketone.

Suitable for use as basic reaction auxiliaries for carrying out the process 2 according to the invention are all suitable acid binders, such as amines, in particular tertiary amines, and also alkali metal and alkaline earth metal compounds.

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

diamine, quinoxaline, N-propyldiisopropylamine, *N*-ethyldiisopropylamine, *N,N'*-dimethylcyclohexylamine, 2,6-lutidine, 2,4-lutidine or triethyldiamine.

Preference is given to using hydrides of lithium or sodium.

The reaction time is generally from 10 minutes to 48 hours.

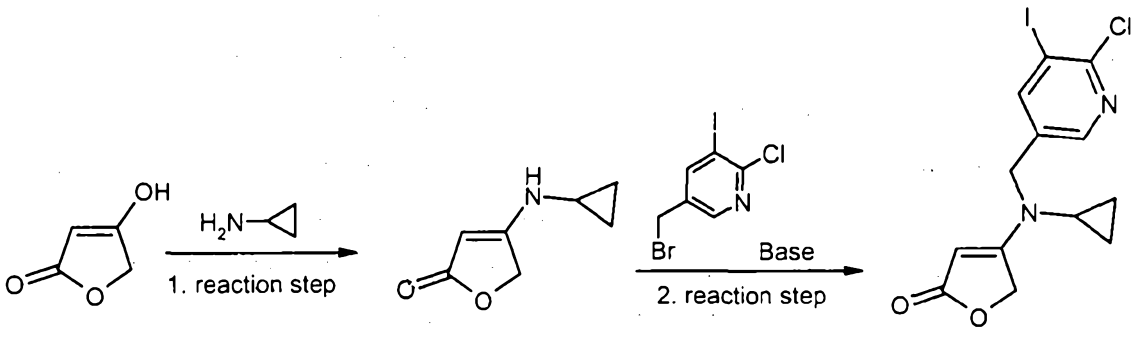
The reaction is carried out at temperatures between -10°C and +200°C, preferably between +10°C and 180°C, particularly preferably between 60°C and 140°C. In principle, the reaction can be carried out under atmospheric pressure. The reaction is preferably carried out under atmospheric pressure or under pressures of up to 15 bar and, if appropriate, under an atmosphere of protective gas (nitrogen, helium or argon).

For carrying out the process 2 according to the invention, in general from 0.5 to 4.0 mol, preferably from 0.7 to 3.0 mol, particularly preferably from 1.0 to 2.0 mol of alkylating agent of the formula (IV) are employed per mole of the compound of the formula (II).

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

If, in the process 3 according to the invention for preparing the novel compounds of the formula (I), in a first reaction step, the compound of the formula (II) used is, for example, tetronic acid and the compound of the formula (V) is cyclopropylamine, and, in a second reaction step, the resulting compound of the formula (VI) is 4-(cyclopropylamino)furan-2(5H)-one, which is N-alkylated with compounds of the formula (VII), for example 5-(bromomethyl)-2-chloro-3-iodopyridine, the preparation process 3 can be represented by reaction scheme VIII below:

Scheme VIII



The formula (II) provides a general definition of the compounds required as starting materials for carrying out the process 3 according to the invention and already described in more detail in connection with process 1, mentioned further above.

The formula (V) provides a general definition of the compounds further required as starting materials for carrying out the process 3 according to the invention.

In formula (V), R^1 has the meaning already mentioned in connection with the description of the compounds of the formula (I) according to the invention.

In many cases, some of the amino compounds of the formula (V) are commercially available, or they can be obtained in a manner known per se by the Leuckart-Wallach reaction (compounds of the general formula V in which R^1 represents alkyl, primary amines: cf., for example, Houbel-Weyl, Methoden der Organischen Chemie, Vol. XI/1, 4. Ed. 1957, G. Thieme Verlag, Stuttgart, p. 648; M. L. Moore in „The Leuckart Reaction" in: Organic Reactions, Vol. 5, 2. Ed. 1952, New York, John Wiley & Sons, Inc. London; compounds of the general formula V in which R^1 represents alkoxy, alkoxyamine: cf. reaction scheme V shown further above).

In general, it is advantageous to carry out the first reaction step of the preparation process 3 according to the invention in the presence of diluents. Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the process 3 according to the invention are all organic solvents which are inert under the reaction conditions.

However, preferred diluents for carrying out the process according to the invention are aromatic hydrocarbons, such as benzene, toluene, chlorobenzene, bromobenzene, nitrobenzene or xylene and in particular benzene and toluene, and ethers, such as methyl *tert*-butylether, anisole, tetrahydrofuran, dioxane, in particular tetrahydrofuran and dioxane, amides, such as *N,N*-dimethyl-formamide, ketones, such as acetone, methyl ethyl ketone or methyl butyl ketone.

In the second reaction step, the compounds of the formula (VI) are N-alkylated with compounds of the formula (VII).

The compounds of the formula (VI) can be obtained in a manner known per se or analogously to known preparation processes: for example. R^1 = hydrogen: DE-A 3311003; A1 R^1 = methyl: J. V. Greenhill et al., Tetrahedron Lett. 31, 2683-2684 (1974); cf. also the Preparation Examples.

In general, it is advantageous to carry out the second step of the preparation process 3 according to the invention in the presence of diluents and, if appropriate, in the presence of basic reaction auxiliaries.

Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the process 3 according to the invention are all organic solvents which are inert under the reaction conditions.

Preference is given to using ethers, such as methyl *tert*-butyl ether, anisole, tetrahydrofuran or dioxane, in particular tetrahydrofuran or dioxane.

Suitable basic reaction auxiliaries for the second reaction step for carrying out the process 3 according to the invention are, for example, hydrides of the alkali metals, in particular sodium hydride. The reaction of compounds of the formula (VI) according to preparation process 3 is carried out by reacting the compounds of the formula (VI) with compounds of the formula (VII).

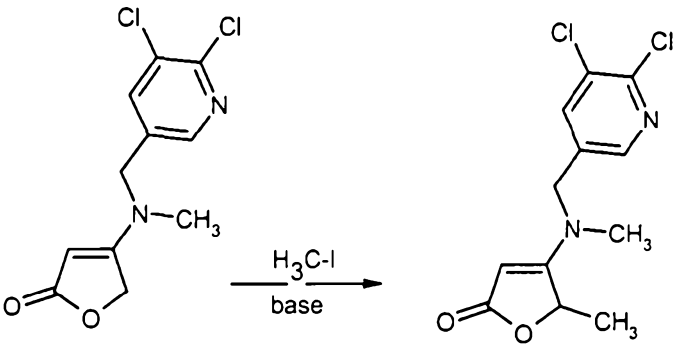
The reaction time is generally from 10 minutes to 48 hours.

The reaction is carried out at temperatures between -10°C and +200°C, preferably between +10°C and 180°C, particularly preferably between 20°C and 140°C. In the first reaction step, the reaction is preferably carried out under reaction conditions which allow water to be separated off or to be removed, for example with the aid of a water separator or by adding suitable molecular sieves, which also allow water to be removed.

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

The prepare the compounds of the formula (I) in which R^3 represents alkyl, it is alternatively also possible to react compounds of the formula (I) in which R^3 represents hydrogen with compounds of the formula (IV) in the presence of basic reaction auxiliaries according to reaction scheme (IX).

Scheme IX:



The formula (I) provides a general definition of the compounds required as starting materials for carrying out the C-alkylation and already described in more detail in process 1 mentioned further above.

In the formula (I), A, B, R^2, R^3 have the meanings mentioned further above which have already been mentioned in connection with the description of the compounds of the general formula (I); the substituent R^7 represents hydrogen.

The compounds of the formula (I) can be obtained by the preparation processes 1 to 3 mentioned above.

In general, it is advantageous to carry out the C-alkylation in the presence of diluents. Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the C-alkylation are all organic solvents which are inert under the reaction conditions.

Preferred diluents for carrying out the C-alkylation are ethers, such as methyl *tert*-butyl ether, *n*-butyl ether, anisole, phenetole, cyclohexyl methyl ether, diisopropyl ether, diisobutyl ether, diisoamyl ether, ethylene glycol dimethyl ether, tetrahydrofuran, dioxane, dichlorodiethyl ether and polyethers of ethylene oxide and/or propylene oxide.

It is also possible to use mixtures of the solvents and diluents mentioned for the process according to the invention.

However, preferred diluents for carrying out the process according to the invention are ethers, such as methyl *tert*-butyl ether or cyclic ethers, such as tetrahydrofuran and dioxane.

The C-alkylation of compounds of the formula (I) is carried out by reacting with compounds of the formula (IV) in the presence of basic reaction auxiliaries.

A suitable basic reaction auxiliary is, for example, tert-butyllithiam.

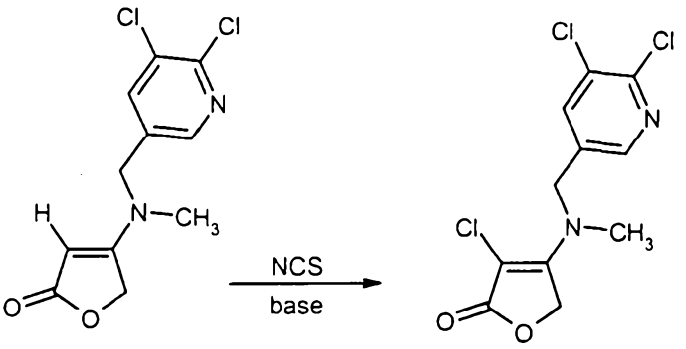
The reaction time is generally from 10 minutes to 48 hours.

The reaction is carried out at temperatures between -100°C and +20°C, preferably between -90°C and 10°C, particularly preferably between -80°C and 0°C.

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

To prepare the compounds of the formula (I) in which R^2 represents halogen, it is alternatively also possible to react compounds of the formula (I) in which R^2 represents hydrogen with halogenating agents in the presence of basic auxiliaries, according to reaction scheme (X).

Scheme X:



NCS: *N*-chlorosuccinimide

The formula (I) provides a general definition of the compounds, already described in more detail further above, required as starting materials for carrying out the halogenation.

In the formula (I), A, B, R^1 and R^3 have the meanings mentioned further above which have already been mentioned in connection with the description of the compounds of the general formula (I) according to the invention; the substituent R^2 represents hydrogen.

The compounds of the formula (I) can be obtained by the preparation processes 1 to 3 mentioned above.

In general, it is advantageous to carry out the halogenation in the presence of diluents. Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable

during the entire process. Suitable diluents for carrying out the halogenation are all organic solvents which are inert under the reaction conditions.

Preferred diluents for carrying out the halogenation are, for example, nitriles, such as acetonitrile, propionitrile, butyronitrile, isobutyronitrile, benzonitrile or m-chlorobenzonitrile.

It is also possible to use mixtures of the solvents and diluents mentioned for the process according to the invention.

However, preferred diluents for carrying out the process according to the invention are nitriles, such as acetonitrile, propionitrile or butyronitrile.

Suitable halogenating agents for carrying out the process according to the invention are all suitable halogenating agents, for example *N*-halo compounds.

Examples which may be mentioned are *N*-haloamines, such as 1-chloromethyl-4-fluorodiazoniabicyclo[2.2.2]octane-bis-(tetrafluoroborate) (Selectfluor®), *N,N*-dihaloamines, *N*-halocarboxamides, *N*-halocarbamidic acid esters, *N*-halourea, *N*-halosulphonylamides, *N*-halodisulphonylamides, *N*-halosulphonylimides, such as *N*-fluorobis[(trifluoromethyl)sulphonyl]imide, and *N*-halocarboxylic acid diamides, such as *N*-chlorophthalimide, *N*-bromophthalimide, *N*-iodophthalimide, *N*-chlorosuccinimide (NCS), *N*-bromosuccinimide (NBS), *N*-bromosaccharin or *N*-iodosuccinimide.

Preferred halogenating agents for carrying out the halogenation are *N*-halocarboxylic acid diamides or 1-chloromethyl-4-fluorodiazoniabicyclo[2.2.2]octane-bis-(tetrafluoroborate) (Selectfluor®).

Suitable basic reaction auxiliaries are in particular tertiary amines, such as, for example, triethylamine.

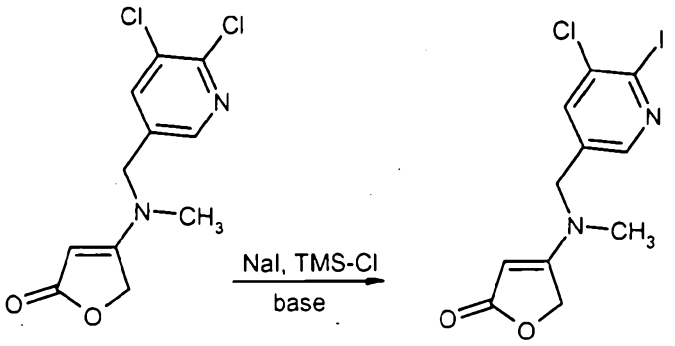
The reaction time is generally from 10 minutes to 48 hours.

The reaction is carried out at temperatures between -10°C and +100°C, preferably between 0°C and 60°C, particularly preferably between 10°C and room temperature.

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

To prepare the compounds of the formula (I) in which A represents a 5,6-disubstituted pyrid-3-yl radical, it is alternatively also possible to react compounds of the formula (I) which carry in the 6-position of the pyrid-3-yl radical a halogen, in particular chlorine, bromine or iodine, with suitable metal halides and, if appropriate, in the presence of special reagents according to reaction scheme (XI).

Scheme XI:



TMS-Cl: trimethylsilyl chloride

The formula (I) provides a general definition of the compounds required as starting materials for the transhalogenation.

In formula (I), A, B, R^1, R^2 and R^3 have the meanings mentioned further above which have already been mentioned in connection with the description of the compounds of the general formula (I) according to the invention.

The compounds of the formula (I) can be obtained by the preparation processes 1 to 3 described above.

In general, it is advantageous to carry out the transhalogenation in the presence of diluents. Diluents are advantageously employed in such an amount that the reaction mixture remains readily stirrable during the entire process. Suitable diluents for carrying out the transhalogenation are all organic solvents which are inert under the reaction conditions.

Preferred diluents for carrying out the transhalogenation are nitriles, such as acetonitrile, propionitrile, butyronitrile, isobutyronitrile, benzonitrile, m-chlorobenzonitrile, dimethyl - sulphoxide, tetramethylene sulphoxide, dipropyl sulphoxide, benzyl methyl sulphoxide, diisobutyl sulphoxide, dibutyl sulphoxide or diisoamyl sulphoxide.

It is also possible to use mixtures of the solvents and diluents mentioned for the process according to the invention.

However, preferred diluents for carrying out the process according to the invention are nitriles, such as acetonitrile, propionitrile or butyronitrile, and dimethyl sulphoxide.

The transhalogenation of compounds of the formula (I) is carried out by reacting these with suitable metal halides and halogen-containing trialkylsilanes.

Suitable metal halides for carrying out the process according to the invention are alkali metal salts. By way of example, mention may be made of the fluorides, chlorides, bromides or iodides of lithium, sodium or potassium and in particular those of sodium or potassium.

Suitable halogen-containing trialkylsilanes for carrying out the process according to the invention are, preferably, trimethylsilanes. By way of example, mention may be made of chlorotrimethylsilane (TMS-Cl) and sodium iodide (for introducing iodine), bromotrimethylsilane (TMS-Br, for introducing bromine) or trifluoromethyltrimethylsilane (TMS-CF_3, for introducing trifluoromethyl; Cottet, M. et al., Eur. J. Org. Chem. (2003), 1559).

The transhalogenation of iodine for fluorine may be carried out by methods known from the literature using potassium fluoride in the presence of Kryptofix (4,7,13,16,21,24.hexaoxa-1,10-diazabicyclo[8.8.8]hexacosane).

The reaction time is generally from 10 minutes to 48 hours.

The reaction is carried out at temperatures between -10°C and +160°C, preferably between 0°C and +140°C, particularly preferably between 10°C and +120°C.

After the reaction has gone to completion, the entire reaction mixture is concentrated. The products obtained after work-up can be purified in a customary manner by recrystallization, distillation under reduced pressure or column chromatography (cf. also the Preparation Examples).

If appropriate, the compounds of the formula (I) can be present in different polymorphic forms or as a mixture of different polymorphic forms. Both the pure polymorphs and the polymorph mixtures are provided by the invention and can be used according to the invention.

The active compounds according to the invention, in combination with good plant tolerance and favourable toxicity to warm-blooded animals and being tolerated well by the environment, are suitable for protecting plants and plant organs, for increasing the harvest yields, for improving the quality of the harvested material and for controlling animal pests, in particular insects, arachnids,

helminths, nematodes and molluscs, which are encountered in agriculture, in horticulture, in animal husbandry, in forests, in gardens and leisure facilities, in the protection of stored products and of materials, and in the hygiene sector. They may be preferably employed as plant protection agents. They are active against normally sensitive and resistant species and against all or some stages of development. The abovementioned pests include:

From the order of the Anoplura (Phthiraptera), for example, Damalinia spp., Haematopinus spp., Linognathus spp., Pediculus spp., Trichodectes spp.

From the class of the Arachnida, for example, Acarus siro, Aceria sheldoni, Aculops spp., Aculus spp., Amblyomma spp., Argas spp., Boophilus spp., Brevipalpus spp., Bryobia praetiosa, Chorioptes spp., Dermanyssus gallinae, Eotetranychus spp., Epitrimerus pyri, Eutetranychus spp., Eriophyes spp., Hemitarsonemus spp., Hyalomma spp., Ixodes spp., Latrodectus mactans, Metatetranychus spp., Oligonychus spp., Ornithodoros spp., Panonychus spp., Phyllocoptruta oleivora, Polyphagotarsonemus latus, Psoroptes spp., Rhipicephalus spp., Rhizoglyphus spp., Sarcoptes spp., Scorpio maurus, Stenotarsonemus spp., Tarsonemus spp., Tetranychus spp., Vasates lycopersici.

From the class of the Bivalva, for example, Dreissena spp.

From the order of the Chilopoda, for example, Geophilus spp., Scutigera spp.

From the order of the Coleoptera, for example, Acanthoscelides obtectus, Adoretus spp., Agelastica alni, Agriotes spp., Amphimallon solstitialis, Anobium punctatum, Anoplophora spp., Anthonomus spp., Anthrenus spp., Apogonia spp., Atomaria spp., Attagenus spp., Bruchidius obtectus, Bruchus spp., Ceuthorhynchus spp., Cleonus mendicus, Conoderus spp., Cosmopolites spp., Costelytra zealandica, Curculio spp., Cryptorhynchus lapathi, Dermestes spp., Diabrotica spp., Epilachna spp., Faustinus cubae, Gibbium psylloides, Heteronychus arator, Hylamorpha elegans, Hylotrupes bajulus, Hypera postica, Hypothenemus spp., Lachnosterna consanguinea, Leptinotarsa decemlineata, Lissorhoptrus oryzophilus, Lixus spp., Lyctus spp., Meligethes aeneus, Melolontha melolontha, Migdolus spp., Monochamus spp., Naupactus xanthographus, Niptus hololeucus, Oryctes rhinoceros, Oryzaephilus surinamensis, Otiorrhynchus sulcatus, Oxycetonia jucunda, Phaedon cochleariae, Phyllophaga spp., Popillia japonica, Premnotrypes spp., Psylliodes chrysocephala, Ptinus spp., Rhizobius ventralis, Rhizopertha dominica, Sitophilus spp., Sphenophorus spp., Sternechus spp., Symphyletes spp., Tenebrio molitor, Tribolium spp., Trogoderma spp., Tychius spp., Xylotrechus spp., Zabrus spp.

From the order of the Collembola, for example, Onychiurus armatus.

From the order of the Dermaptera, for example, Forficula auricularia.

From the order of the Diplopoda, for example, Blaniulus guttulatus.

From the order of the Diptera, for example, Aedes spp., Anopheles spp., Bibio hortulanus, Calliphora erythrocephala, Ceratitis capitata, Chrysomyia spp., Cochliomyia spp., Cordylobia anthropophaga, Culex spp., Cuterebra spp., Dacus oleae, Dermatobia hominis, Drosophila spp., Fannia spp., Gastrophilus spp., Hylemyia spp., Hyppobosca spp., Hypoderma spp., Liriomyza spp., Lucilia spp., Musca spp., Nezara spp., Oestrus spp., Oscinella frit, Pegomyia hyoscyami, Phorbia spp., Stomoxys spp., Tabanus spp., Tannia spp., Tipula paludosa, Wohlfahrtia spp.

From the class of the Gastropoda, for example, Arion spp., Biomphalaria spp., Bulinus spp., Deroceras spp., Galba spp., Lymnaea spp., Oncomelania spp., 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., 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 stercoralis, Stronyloides spp., Taenia saginata, Taenia solium, Trichinella spiralis, Trichinella nativa, Trichinella britovi, Trichinella nelsoni, Trichinella pseudopsiralis, Trichostrongulus spp., Trichuris trichuria, Wuchereria bancrofti.

It is furthermore possible to control protozoa, such as Eimeria.

From the order of the Heteroptera, for example, Anasa tristis, Antestiopsis spp., Blissus spp., Calocoris spp., Campylomma livida, Cavelerius spp., Cimex spp., Creontiades dilutus, Dasynus piperis, Dichelops furcatus, Diconocoris hewetti, Dysdercus spp., Euschistus spp., Eurygaster spp., Heliopeltis spp., Horcias nobilellus, Leptocorisa spp., Leptoglossus phyllopus, Lygus spp., Macropes excavatus, Miridae, Nezara spp., Oebalus spp., Pentomidae, Piesma quadrata, Piezodorus spp., Psallus seriatus, Pseudacysta persea, Rhodnius spp., Sahlbergella singularis, Scotinophora spp., Stephanitis nashi, Tibraca spp., Triatoma spp.

From the order of the Homoptera, for example, Acyrthosipon spp., Aeneolamia spp., Agonoscena spp., Aleurodes spp., Aleurolobus barodensis, Aleurothrixus spp., Amrasca spp., Anuraphis cardui, Aonidiella spp., Aphanostigma piri, Aphis spp., Arboridia apicalis, Aspidiella spp., Aspidiotus

spp., Atanus spp., Aulacorthum solani, Bemisia spp., Brachycaudus helichrysii, Brachycolus spp., Brevicoryne brassicae, Calligypona marginata, Carneocephala fulgida, Ceratovacuna lanigera, Cercopidae, Ceroplastes spp., Chaetosiphon fragaefolii, Chionaspis tegalensis, Chlorita onukii, Chromaphis juglandicola, Chrysomphalus ficus, Cicadulina mbila, Coccomytilus halli, Coccus spp., Cryptomyzus ribis, Dalbulus spp., Dialeurodes spp., Diaphorina spp., Diaspis spp., Doralis spp., Drosicha spp., Dysaphis spp., Dysmicoccus spp., Empoasca spp., Eriosoma spp., Erythroneura spp., Euscelis bilobatus, Geococcus coffeae, Homalodisca coagulata, Hyalopterus arundinis, Icerya spp., Idiocerus spp., Idioscopus spp., Laodelphax striatellus, Lecanium spp., Lepidosaphes spp., Lipaphis erysimi, Macrosiphum spp., Mahanarva fimbriolata, Melanaphis sacchari, Metcalfiella spp., Metopolophium dirhodum, Monellia costalis, Monelliopsis pecanis, Myzus spp., Nasonovia ribisnigri, Nephotettix spp., Nilaparvata lugens, Oncometopia spp., Orthezia praelonga, Parabemisia myricae, Paratrioza spp., Parlatoria spp., Pemphigus spp., Peregrinus maidis, Phenacoccus spp., Phloeomyzus passerinii, Phorodon humuli, Phylloxera spp., Pinnaspis aspidistrae, Planococcus spp., Protopulvinaria pyriformis, Pseudaulacaspis pentagona, Pseudococcus spp., Psylla spp., Pteromalus spp., Pyrilla spp., Quadraspidiotus spp., Quesada gigas, Rastrococcus spp., Rhopalosiphum spp., Saissetia spp., Scaphoides titanus, Schizaphis graminum, Selenaspidus articulatus, Sogata spp., Sogatella furcifera, Sogatodes spp., Stictocephala festina, Tenalaphara malayensis, Tinocallis caryaefoliae, Tomaspis spp., Toxoptera spp., Trialeurodes vaporariorum, Trioza spp., Typhlocyba spp., Unaspis spp., Viteus vitifolii.

From the order of the Hymenoptera, for example, Diprion spp., Hoplocampa spp., Lasius spp., Monomorium pharaonis, Vespa spp.

From the order of the Isopoda, for example, Armadillidium vulgare, Oniscus asellus, Porcellio scaber.

From the order of the Isoptera, for example, Reticulitermes spp., Odontotermes spp.

From the order of the Lepidoptera, for example, Acronicta major, Aedia leucomelas, Agrotis spp., Alabama argillacea, Anticarsia spp., Barathra brassicae, Bucculatrix thurberiella, Bupalus piniarius, Cacoecia podana, Capua reticulana, Carpocapsa pomonella, Cheimatobia brumata, Chilo spp., Choristoneura fumiferana, Clysia ambiguella, Cnaphalocerus spp., Earias insulana, Ephestia kuehniella, Euproctis chrysorrhoea, Euxoa spp., Feltia spp., Galleria mellonella, Helicoverpa spp., Heliothis spp., Hofmannophila pseudospretella, Homona magnanima, Hyponomeuta padella, Laphygma spp., Lithocolletis blancardella, Lithophane antennata, Loxagrotis albicosta, Lymantria spp., Malacosoma neustria, Mamestra brassicae, Mocis repanda, Mythimna separata, Oria spp., Oulema oryzae, Panolis flammea, Pectinophora gossypiella, Phyllocnistis citrella, Pieris spp.,

Plutella xylostella, Prodenia spp., Pseudaletia spp., Pseudoplusia includens, Pyrausta nubilalis, Spodoptera spp., Thermesia gemmatalis, Tinea pellionella, Tineola bisselliella, Tortrix viridana, Trichoplusia spp.

From the order of the Orthoptera, for example, Acheta domesticus, Blatta orientalis, Blattella germanica, Gryllotalpa spp., Leucophaea maderae, Locusta spp., Melanoplus spp., Periplaneta americana, Schistocerca gregaria.

From the order of the Siphonaptera, for example, Ceratophyllus spp., Xenopsylla cheopis.

From the order of the Symphyla, for example, Scutigerella immaculata.

From the order of the Thysanoptera, for example, Baliothrips biformis, Enneothrips flavens, Frankliniella spp., Heliothrips spp., Hercinothrips femoralis, Kakothrips spp., Rhipiphorothrips cruentatus, Scirtothrips spp., Taeniothrips cardamoni, Thrips spp.

From the order of the Thysanura, for example, Lepisma saccharina.

The phytoparasitic nematodes include, for example, Anguina spp., Aphelenchoides spp., Belonoaimus spp., Bursaphelenchus spp., Ditylenchus dipsaci, Globodera spp., Heliocotylenchus spp., Heterodera spp., Longidorus spp., Meloidogyne spp., Pratylenchus spp., Radopholus similis, Rotylenchus spp., Trichodorus spp., Tylenchorhynchus spp., Tylenchulus spp., Tylenchulus semipenetrans, Xiphinema spp.

If appropriate, the compounds according to the invention can, at certain concentrations or application rates, also be used as herbicides, safeners, growth regulators or agents to improve plant properties, or as microbicides, for example as fungicides, antimycotics, bactericides, viricides (including agents against viroids) or as agents against MLO (Mycoplasma-like organisms) and RLO (Rickettsia-like organisms). If appropriate, they can also be employed as intermediates or precursors for the synthesis of other active compounds.

The active compounds can be converted to the customary formulations, such as solutions, emulsions, wettable powders, water- and oil-based suspensions, powders, dusts, pastes, soluble powders, soluble granules, granules for broadcasting, suspension-emulsion concentrates, natural materials impregnated with active compound, synthetic materials impregnated with active compound, fertilizers and microencapsulations in polymeric substances.

These formulations are produced in a known manner, for example by mixing the active compounds with extenders, that is liquid solvents and/or solid carriers, optionally with the use of surfactants, that

is emulsifiers and/or dispersants and/or foam-formers. The formulations are prepared either in suitable plants or else before or during the application.

Suitable for use as auxiliaries are substances which are suitable for imparting to the composition itself and/or to preparations derived therefrom (for example spray liquors, seed dressings) particular properties such as certain technical properties and/or also particular biological properties. Typical suitable auxiliaries are: extenders, solvents and carriers.

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

If the extender used is water, it is also possible to employ, for example, organic solvents as auxiliary solvents. Essentially, suitable liquid solvents are: aromatics, such as xylene, toluene or alkylnaphthalenes, chlorinated aromatics and chlorinated aliphatic hydrocarbons such as chlorobenzenes, chloroethylenes or methylene chloride, aliphatic hydrocarbons such as cyclohexane or paraffins, for example petroleum fractions, mineral and vegetable oils, alcohols such as butanol or glycol and also their ethers and esters, ketones such as acetone, methyl ethyl ketone, methyl isobutyl ketone or cyclohexanone, strongly polar solvents such as dimethyl sulphoxide, and also water.

Suitable solid carriers are:

for example, ammonium salts and ground natural minerals such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic minerals, such as finely divided silica, alumina and silicates; suitable solid carriers for granules are: for example, crushed and fractionated natural rocks such as calcite, marble, pumice, sepiolite and dolomite, and also synthetic granules of inorganic and organic meals, and granules of organic material such as paper, sawdust, coconut shells, maize cobs and tobacco stalks; suitable emulsifiers and/or foam-formers are: for example, nonionic and anionic emulsifiers, such as polyoxyethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulphonates, alkyl sulphates, arylsulphonates and also protein hydrolysates; suitable dispersants are nonionic and/or ionic substances, for example from the classes of the alcohol-POE- and/or -POP-ethers, acid and/or POP-POE esters, alkyl aryl and/or POP- POE ethers, fat- and/or POP-POE adducts, POE- and/or POP-polyol derivatives, POE- and/or POP-sorbitan or -sugar adducts, alkyl or aryl sulphates, alkyl-

or arylsulphonates and alkyl or aryl phosphates or the corresponding PO-ether adducts. Furthermore, suitable oligo- or polymers, for example those derived from vinylic monomers, from acrylic acid, from EO and/or PO alone or in combination with, for example, (poly)alcohols or (poly)amines. It is also possible to employ lignin and its sulphonic acid derivatives, unmodified and modified celluloses, aromatic and/or aliphatic sulphonic acids and their adducts with formaldehyde.

Tackifiers such as carboxymethylcellulose and natural and synthetic polymers in the form of powders, granules or latices, such as gum arabic, polyvinyl alcohol and polyvinyl acetate, as well as natural phospholipids such as cephalins and lecithins, and synthetic phospholipids, can be used in the formulations.

It is possible to use colorants such as inorganic pigments, for example iron oxide, titanium oxide and Prussian Blue, and organic dyestuffs, such as alizarin dyestuffs, azo dyestuffs and metal phthalocyanine dyestuffs, and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

Other possible additives are perfumes, mineral or vegetable, optionally modified oils, waxes and nutrients (including trace nutrients), such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc.

Stabilizers, such as low-temperature stabilizers, preservatives, antioxidants, light stabilizers or other agents which improve chemical and/or physical stability may also be present.

The formulations generally comprise between 0.01 and 98% by weight of active compound, preferably between 0.5 and 90%.

The active compound according to the invention can be used in its commercially available formulations and in the use forms, prepared from these formulations, as a mixture with other active compounds, such as insecticides, attractants, sterilizing agents, bactericides, acaricides, nematicides, fungicides, growth-regulating substances, herbicides, safeners, fertilizers or semiochemicals.

Particularly favourable mixing components are, for example, the following compounds:

Fungicides:

Inhibitors of nucleic acid synthesis

benalaxyl, benalaxyl-M, bupirimate, chiralaxyl, clozylacon, dimethirimol, ethirimol, furalaxyl, hymexazol, metalaxyl, metalaxyl-M, ofurace, oxadixyl, oxolinic acid

Inhibitors of mitosis and cell division

benomyl, carbendazim, diethofencarb, fuberidazole, pencycuron, thiabendazole, thiophanat-methyl, zoxamide

Inhibitors of respiratory chain complex I

diflumetorim

Inhibitors of respiratory chain complex II

boscalid, carboxin, fenfuram, flutolanil, furametpyr, mepronil, oxycarboxin, penthiopyrad, thifluzamide

Inhibitors of respiratory chain complex III

azoxystrobin, cyazofamid, dimoxystrobin, enestrobin, famoxadone, fenamidone, fluoxastrobin, kresoxim-methyl, metominostrobin, orysastrobin, pyraclostrobin, picoxystrobin, trifloxystrobin

Decouplers

dinocap, fluazinam

Inhibitors of ATP production

fentin acetate, fentin chloride, fentin hydroxide, silthiofam

Inhibitors of amino acid biosynthesis and protein biosynthesis

andoprim, blasticidin-S, cyprodinil, kasugamycin, kasugamycin hydrochloride hydrate, mepanipyrim, pyrimethanil

Inhibitors of signal transduction

fenpiclonil, fludioxonil, quinoxyfen

Inhibitors of lipid and membrane synthesis

chlozolinate, iprodione, procymidone, vinclozolin

ampropylfos, potassium-ampropylfos, edifenphos, iprobenfos (IBP), isoprothiolane, pyrazophos

tolclofos-methyl, biphenyl

iodocarb, propamocarb, propamocarb hydrochloride

Inhibitors of ergosterol biosynthesis

fenhexamid,

azaconazole, bitertanol, bromuconazole, cyproconazole, diclobutrazole, difenoconazole, diniconazole, diniconazole-M, epoxiconazole, etaconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, furconazole, furconazole-cis, hexaconazole, imibenconazole, ipconazole, metconazole, myclobutanil, paclobutrazole, penconazole, propiconazole, prothioconazole, simeconazole, tebuconazole, tetraconazole, triadimefon, triadimenol, triticonazole, uniconazole, voriconazole, imazalil, imazalil sulphate, oxpoconazole, fenarimol, flurprimidole, nuarimol, pyrifenox, triforine, pefurazoate, prochloraz, triflumizole, viniconazole,

aldimorph, dodemorph, dodemorph acetate, fenpropimorph, tridemorph, fenpropidin, spiroxamine,

naftifine, pyributicarb, terbinafine

Inhibitors of cell wall synthesis

benthiavalicarb, bialaphos, dimethomorph, flumorph, iprovalicarb, polyoxins, polyoxorim, validamycin A

Inhibitors of melanin biosynthesis

capropamid, diclocymet, fenoxanil, phthalid, pyroquilon, tricyclazole

Resistance inductors

acibenzolar-S-methyl, probenazole, tiadinil

Multisite

captafol, captan, chlorothalonil, copper salts such as: copper hydroxide, copper naphthenate, copper oxychloride, copper sulphate, copper oxide, oxine-copper and Bordeaux mixture, dichlofluanid, dithianon, dodine, dodine free base, ferbam, folpet, fluorofolpet, guazatine, guazatine acetate, iminoctadine, iminoctadine albesilate, iminoctadine triacetate, mancopper, mancozeb, maneb, metiram, metiram zinc, propineb, sulphur and sulphur preparations containing calcium polysulphide, thiram, tolylfluanid, zineb, ziram

Unknown mechanism

amibromdol, benthiazol, bethoxazin, capsimycin, carvone, chinomethionat, chloropicrin, cufraneb, cyflufenamid, cymoxanil, dazomet, debacarb, diclomezine, dichlorophen, dicloran, difenzoquat, difenzoquat methyl sulphate, diphenylamine, ethaboxam, ferimzone, flumetover, flusulphamide, fluopicolide, fluoroimide, hexachlorobenzene, 8-hydroxyquinoline sulphate, irumamycin, methasulfocarb, metrafenone, methyl isothiocyanate, mildiomycin, natamycin, nickel dimethyl dithiocarbamate, nitrothal-isopropyl, octhilinone, oxamocarb, oxyfenthiin, pentachlorophenol and salts, 2-phenylphenol and salts, piperalin, propanosine-sodium, proquinazid, pyrrol nitrin, quintozene, tecloftalam, tecnazene, triazoxide, trichlamide, zarilamid and 2,3,5,6-tetrachloro-4-(methylsulphonyl)pyridine, *N*-(4-chloro-2-nitrophenyl)-*N*-ethyl-4-methylbenzenesulphonamide, 2-amino-4-methyl-*N*-phenyl-5-thiazolecarboxamide, 2-chloro-*N*-(2,3-dihydro-1,1,3-trimethyl-1H-inden-4-yl)-3-pyridinecarboxamide, 3-[5-(4-chlorophenyl)-2,3-dimethylisoxazolidin-3-yl]pyridine, cis-1-(4-chlorophenyl)-2-(1H-1,2,4-triazol-1-yl)cycloheptanol, 2,4-dihydro-5-methoxy-2-methyl-4-[[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]oxy]methyl]phenyl]-3H-1,2,3-triazol-3-one (185336-79-2), methyl 1-(2,3-dihydro-2,2-dimethyl-1H-inden-1-yl)-1H-imidazole-5-carboxylate, 3,4,5-trichloro-2,6-pyridinedicarbonitrile, methyl 2-[[[cyclopropyl[(4-methoxyphenyl)imino]methyl]thio]methyl]-.alpha.-(methoxymethylene)benzacetate, 4-chloro-alpha-propynyloxy-*N*-[2-[3-methoxy-4-(2-propynyloxy)phenyl]ethyl]benzacetamide, (2S)-*N*-[2-[4-[[3-(4-chlorophenyl)-2-propynyl]oxy]-3-methoxyphenyl]ethyl]-3-methyl-2-[(methylsulphonyl)amino]butanamide, 5-chloro-7-(4-methylpiperidin-1-yl)-6-(2,4,6-trifluorophenyl)[1,2,4]-triazolo[1,5-a]pyrimidine, 5-chloro-6-(2,4,6-trifluorophenyl)-*N*-[(1R)-1,2,2-trimethylpropyl]-[1,2,4]triazolo[1,5-a]pyrimidin-7-amine, 5-chloro-*N*-[(1R)-1,2-dimethylpropyl]-6-(2,4,6-trifluorophenyl)[1,2,4]triazolo[1,5-a]pyrimidin-7-amine, *N*-[1-(5-bromo-3-chloropyridin-2-yl)ethyl]-2,4-dichloronicotinamide, *N*-(5-bromo-3-chloropyridin-2-yl)methyl-2,4-dichloronicotinamide, 2-butoxy-6-iodo-3-propylbenzopyranon-4-one, *N*-{(Z)-[(cyclopropylmethoxy)-imino][6-(difluoromethoxy)-2,3-difluorophenyl]methyl}-2-benzacetamide, *N*-(3-ethyl-3,5,5-trimethylcyclohexyl)-3-formylamino-2-hydroxybenzamide, 2-[[[[1-[3(1-fluoro-2-phenylethyl)oxy]phenyl]ethylidene]amino]oxy]methyl]-alpha-(methoxyimino)-*N*-methyl-alphaE-benzacetamide, *N*-{2-[3-chloro-5-(trifluoromethyl)pyridin-2-yl]ethyl}-2-(trifluoromethyl)benzamide, *N*-(3',4'-dichloro-5-fluorobiphenyl-2-yl)-3-(difluoromethyl)-1-methyl-1H-pyrazole-4-carboxamide, *N*-(6-methoxy-3-pyridinyl)cyclopropanecarboxamide, 1-[(4-methoxyphenoxy)methyl]-2,2-dimethylpropyl-1H-imidazole-1-carboxylic acid, O-[1-[(4-methoxyphenoxy)methyl]-2,2-dimethylpropyl]-1H-imidazole-1-carbothioic acid, 2-(2-{[6-(3-chloro-2-methylphenoxy)-5-fluoropyrimidin-4-yl]oxy}phenyl)-2-(methoxyimino)-*N*-methyl-acetamide

Bactericides:

bronopol, dichlorophen, nitrapyrin, nickel dimethyldithiocarbamate, kasugamycin, octhilinone, furancarboxylic acid, oxytetracycline, probenazole, streptomycin, tecloftalam, copper sulphate and other copper preparations.

Insecticides/acaricides/nematicides:

Acetylcholine esterase (AChE) inhibitors

carbamates,
for example alanycarb, aldicarb, aldoxycarb, allyxycarb, aminocarb, bendiocarb, benfuracarb, bufencarb, butacarb, butocarboxim, butoxycarboxim, carbaryl, carbofuran, carbosulphan, cloethocarb, dimetilan, ethiofencarb, fenobucarb, fenothiocarb, formetanate, furathiocarb, isoprocarb, metam-sodium, methiocarb, methomyl, metolcarb, oxamyl, pirimicarb, promecarb, propoxur, thiodicarb, thiofanox, trimethacarb, XMC, xylylcarb, triazamate

organophosphates,
for example acephate, azamethiphos, azinphos (-methyl, -ethyl), bromophos-ethyl, bromfenvinfos (-methyl), butathiofos, cadusafos, carbophenothion, chlorethoxyfos, chlorfenvinphos, chlormephos, chlorpyrifos (-methyl/-ethyl), coumaphos, cyanofenphos, cyanophos, chlorfenvinphos, demeton-S-methyl, demeton-S-methylsulphone, dialifos, diazinon, dichlofenthion, dichlorvos/DDVP, dicrotophos, dimethoate, dimethylvinphos, dioxabenzofos, disulphoton, EPN, ethion, ethoprophos, etrimfos, famphur, fenamiphos, fenitrothion, fensulfothion, fenthion, flupyrazofos, fonofos, formothion, fosmethilan, fosthiazate, heptenophos, iodofenphos, iprobenfos, isazofos, isofenphos, isopropyl O-salicylate, isoxathion, malathion, mecarbam, methacrifos, methamidophos, methidathion, mevinphos, monocrotophos, naled, omethoate, oxydemeton-methyl, parathion (-methyl/-ethyl), phenthoate, phorate, phosalone, phosmet, phosphamidon, phosphocarb, phoxim, pirimiphos (-methyl/-ethyl), profenofos, propaphos, propetamphos, prothiofos, prothoate, pyraclofos, pyridaphenthion, pyridathion, quinalphos, sebufos, sulfotep, sulprofos, tebupirimfos, temephos, terbufos, tetrachlorvinphos, thiometon, triazophos, triclorfon, vamidothion

Sodium channel modulators / voltage-dependent sodium channel blockers

pyrethroids,
for example acrinathrin, allethrin (d-cis-trans, d-trans), beta-cyfluthrin, bifenthrin,

bioallethrin, bioallethrin-S-cyclopentyl isomer, bioethanomethrin, biopermethrin, bioresmethrin, chlovaporthrin, cis-cypermethrin, cis-resmethrin, cis-permethrin, clocythrin, cycloprothrin, cyfluthrin, cyhalothrin, cypermethrin (alpha-, beta-, theta-, zeta-), cyphenothrin, deltamethrin, empenthrin (1R isomer), esfenvalerate, etofenprox, fenfluthrin, fenpropathrin, fenpyrithrin, fenvalerate, flubrocythrinate, flucythrinate, flufenprox, flumethrin, fluvalinate, fubfenprox, gamma-cyhalothrin, imiprothrin, kadethrin, lambda-cyhalothrin, metofluthrin, permethrin (cis-, trans-), phenothrin (1R trans-isomer), prallethrin, profluthrin, protrifenbute, pyresmethrin, resmethrin, RU 15525, silafluofen, tau-fluvalinate, tefluthrin, terallethrin, tetramethrin (1R isomer), tralomethrin, transfluthrin, ZXI 8901, pyrethrins (pyrethrum)

DDT

oxadiazines,
for example indoxacarb

semicarbazones,
for example metaflumizone (BAS3201)

Acetylcholine receptor agonists/antagonists

chloronicotinyls,
for example acetamiprid, clothianidin, dinotefuran, imidacloprid, nitenpyram, nithiazine, thiacloprid, imidaclothiz, AKD-1022, thiamethoxam

nicotine, bensultap, cartap

Acetylcholine receptor modulators

spinosyns,
for example spinosad, spinetoram (XDE-175)

GABA-controlled chloride channel antagonists

organochlorines,
for example camphechlor, chlordane, endosulfan, gamma-HCH, HCH, heptachlor, lindane, methoxychlor

fiprols,
for example acetoprole, ethiprole, fipronil, pyrafluprole, pyriprole, vaniliprole

Chloride channel activators

mectins,
for example abamectin, emamectin, emamectin benzoate, ivermectin, lepimectin, milbemycin

Juvenile hormone mimetics,
for example diofenolan, epofenonane, fenoxycarb, hydroprene, kinoprene, methoprene, pyriproxifen, triprene

Ecdysone agonists/disruptors

diacylhydrazines,
for example chromafenozide, halofenozide, methoxyfenozide, tebufenozide

Chitin biosynthesis inhibitors

benzoylureas,
for example bistrifluron, chlofluazuron, diflubenzuron, fluazuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, noviflumuron, penfluron, teflubenzuron, triflumuron

buprofezin

cyromazine

Oxidative phosphorylation inhibitors, ATP disruptors

diafenthiuron

organotin compounds,
for example azocyclotin, cyhexatin, fenbutatin oxide

Oxidative phosphorylation decouplers acting by interrupting the H-proton gradient

pyrroles,
for example chlorfenapyr

dinitrophenols,
for example binapacyrl, dinobuton, dinocap, DNOC

Site-I electron transport inhibitors

METIs,

for example fenazaquin, fenpyroximate, pyrimidifen, pyridaben, tebufenpyrad, tolfenpyrad

hydramethylnon

dicofol

Site-II electron transport inhibitors

rotenone

Site-III electron transport inhibitors

acequinocyl, fluacrypyrim

Microbial disruptors of the insect gut membrane

Bacillus thuringiensis strains

Lipid synthesis inhibitors

tetronic acids,

for example spirodiclofen, spiromesifen

tetramic acids,

for example spirotetramat

carboxamides,

for example flonicamid

octopaminergic agonists,

for example amitraz

Inhibitors of magnesium-stimulated ATPase,

propargite

nereistoxin analogues,

for example thiocyclam hydrogen oxalate, thiosultap-sodium

Ryanodin receptor agonists

benzoic acid dicarboxamides,

for example flubendiamid

anthronilamides,

for example rynaxypyr (3-bromo-*N*-{4-chloro-2-methyl-6-[(methylamino)carbonyl]phenyl}-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carboxamide)

Biologicals, hormones or pheromones

azadirachtin, Bacillus spec., Beauveria spec., codlemone, Metarrhizium spec., Paecilomyces spec., thuringiensin, Verticillium spec.

Active compounds with unknown or unspecific mechanisms of action

fumigants,
for example aluminium phosphide, methyl bromide, sulphuryl fluoride

antifeedants,
for example cryolite, flonicamid, pymetrozine

mite growth inhibitors,
for example clofentezine, etoxazole, hexythiazox

amidoflumet, benclothiaz, benzoximate, bifenazate, bromopropylate, buprofezin, chinomethionat, chlordimeform, chlorobenzilate, chloropicrin, clothiazoben, cycloprene, cyflumetofen, dicyclanil, fenoxacrim, fentrifanil, flubenzimine, flufenerim, flutenzin, gossyplure, hydramethylnone, japonilure, metoxadiazone, petroleum, piperonyl butoxide, potassium oleate, pyridalyl, sulfluramid, tetradifon, tetrasul, triarathene, verbutin

A mixture with other known active compounds, such as herbicides, fertilizers, growth regulators, safeners, semiochemicals, or else with agents for improving the plant properties, is also possible.

When used as insecticides, the active compounds according to the invention can furthermore be present in their commercially available formulations and in the use forms, prepared from these formulations, as a mixture with synergists. Synergists are compounds which increase the action of the active compounds, without it being necessary for the synergistic agent added to be active itself.

When used as insecticides, the active compounds according to the invention can furthermore be present in their commercially available formulations and in the use forms, prepared from these formulations, as a mixture with inhibitors which reduce degradation of the active compound after use in the environment of the plant, on the surface of parts of plants or in plant tissues.

The active compound content of the use forms prepared from the commercially available formulations can vary within wide limits. The active compound concentration of the use forms can be from 0.00000001 to 95% by weight of active compound, preferably between 0.00001 and 1% by weight.

The compounds are employed in a customary manner appropriate for the use forms.

All plants and plant parts can be treated in accordance with the invention. Plants are to be understood as meaning in the present context all plants and plant populations such as desired and undesired wild plants or crop plants (including naturally occurring crop plants). Crop plants can be plants which can be obtained by conventional plant breeding and optimization methods or by biotechnological and genetic engineering methods or by combinations of these methods, including the transgenic plants and including the plant cultivars protectable or not protectable by plant breeders' rights. Plant parts are to be understood as meaning all parts and organs of plants above and below the ground, such as shoot, leaf, flower and root, examples which may be mentioned being leaves, needles, stalks, stems, flowers, fruit bodies, fruits, seeds, roots, tubers and rhizomes. The plant parts also include harvested material, and vegetative and generative propagation material, for example cuttings, tubers, rhizomes, offshoots and seeds.

Treatment according to the invention of the plants and plant parts with the active compounds is carried out directly or by allowing the compounds to act on the surroundings, habitat or storage space by the customary treatment methods, for example by immersion, spraying, evaporation, fogging, scattering, painting on, injection and, in the case of propagation material, in particular in the case of seeds, also by applying one or more coats.

The mixtures according to the invention are particularly suitable for treating seed. Here, the combinations according to the invention mentioned above as preferred or particularly preferred may be mentioned as being preferred. Thus, a large part of the damage to crop plants which is caused by pests occurs as early as when the seed is attacked during storage and after the seed is introduced into the soil, during and immediately after germination of the plants. This phase is particularly critical since the roots and shoots of the growing plant are particularly sensitive and even minor damage can lead to the death of the whole plant. Protecting the seed and the germinating plant by the use of suitable compositions is therefore of particularly great interest.

The control of pests by treating the seeds of plants has been known for a long time and is subject-matter of continuous improvements. However, the treatment of seed frequently entails a series of problems which cannot always be solved in a satisfactory manner. Thus, it is desirable to develop methods for protecting the seed and the germinating plant which dispense with the additional application of crop protection agents after sowing or after the emergence of the plants. It is furthermore desirable to optimize the amount of active compound employed in such a way as to provide maximum protection for the seed and the germinating plant from attack by pests, but without damaging the plant itself by the active compound employed. In particular, methods for the treatment of seed should also take into consideration the intrinsic insecticidal properties of transgenic plants in order to achieve optimum protection of the seed and the germinating plant with a minimum of crop protection agents being employed.

The present invention therefore in particular also relates to a method for the protection of seed and germinating plants from attack by pests, by treating the seed with a composition according to the invention. The invention likewise relates to the use of the compositions according to the invention for the treatment of seed for protecting the seed and the germinating plant from pests. Furthermore, the invention relates to seed which has been treated with a composition according to the invention so as to afford protection from pests.

One of the advantages of the present invention is that the particular systemic properties of the compositions according to the invention mean that treatment of the seed with these compositions not only protects the seed itself, but also the resulting plants after emergence, from pests. In this manner, the immediate treatment of the crop at the time of sowing or shortly thereafter can be dispensed with.

A further advantage is the synergistically increased insecticidal activity of the compositions according to the invention in comparison with the insecticidal individual active compound, which exceeds the activity to be expected of the two active compounds when applied individually. Also advantageous is the synergistically increased fungicidal activity of the compositions according to the invention in comparison with the fungicidal individual active compound, which exceeds the activity to be expected of the active compound when applied individually.This makes possible an optimization of the amount of active compound employed.

Furthermore, it must be considered as advantageous that the mixtures according to the invention can also be employed in particular in transgenic seed, the plants arising from this seed being capable of expressing a protein directed against pests. By treating such seed with the compositions according to the invention, certain pests can be controlled merely by the expression of the, for

example, insecticidal protein, and additionally be protected by the compositions according to the invention against damage.

The compositions according to the invention are suitable for protecting seed of any plant variety as already mentioned above which is employed in agriculture, in the greenhouse, in forests or in horticulture. In particular, this takes the form of seed of maize, peanut, canola, oilseed rape, poppy, soya beans, cotton, beet (for example sugar beet and fodder beet), rice, sorghum and millet, wheat, barley, oats, rye, sunflower, tobacco, potatoes or vegetables (for example tomatoes, cabbage plants). The compositions according to the invention are likewise suitable for treating the seed of fruit plants and vegetables as already mentioned above. The treatment of the seed of maize, soya beans, cotton, wheat and canola or oilseed rape is of particular importance.

As already mentioned above, the treatment of transgenic seed with a composition according to the invention is also of particular importance. This takes the form of seed of plants which, as a rule, comprise at least one heterologous gene which governs the expression of a polypeptide with in particular insecticidal properties. In this context, the heterologous genes in transgenic seed may be derived from microorganisms such as Bacillus, Rhizobium, Pseudomonas, Serratia, Trichoderma, Clavibacter, Glomus or Gliocladium. The present invention is particularly suitable for the treatment of transgenic seed which comprises at least one heterologous gene orignating from Bacillus sp. and whose gene product shows activity against the European corn borer and/or the corn root worm. It is particularly preferably a heterologous gene derived from Bacillus thuringiensis.

In the context of the present invention, the composition according to the invention is applied to the seed either alone or in a suitable formulation. Preferably, the seed is treated in a state which is stable enough to avoid damage during treatment. In general, the seed may be treated at any point in time between harvest and sowing. The seed usually used has been separated from the plant and freed from cobs, shells, stalks, coats, hairs or the flesh of the fruits.

When treating the seed, care must generally be taken that the amount of the composition according to the invention applied to the seed and/or the amount of further additives is chosen in such a way that the germination of the seed is not adversely affected, or that the resulting plant is not damaged. This must be borne in mind in particular in the case of active compounds which may have phytotoxic effects at certain application rates.

As already mentioned above, it is possible to treat all plants and their parts according to the invention. In a preferred embodiment, wild plant species and plant cultivars, or those obtained by conventional biological breeding methods, such as crossing or protoplast fusion, and parts thereof,

are treated. In a further preferred embodiment, transgenic plants and plant cultivars obtained by genetic engineering methods, if appropriate in combination with conventional methods (Genetically Modified Organisms), and parts thereof are treated. The terms "parts", "parts of plants" and "plant parts" have been explained above.

Particularly preferably, plants of the plant cultivars which are in each case commercially available or in use are treated according to the invention. Plant cultivars are to be understood as meaning plants having novel properties ("traits") which have been obtained by conventional breeding, by mutagenesis or by recombinant DNA techniques. These can be cultivars, bio- or genotypes.

Depending on the plant species or plant cultivars, their location and growth conditions (soils, climate, vegetation period, diet), the treatment according to the invention may also result in superadditive ("synergistic") effects. Thus, for example, reduced application rates and/or a widening of the activity spectrum and/or an increase in the activity of the substances and compositions which can be used according to the invention, better plant growth, increased tolerance to high or low temperatures, increased tolerance to drought or to water or soil salt content, increased flowering performance, easier harvesting, accelerated maturation, higher harvest yields, higher quality and/or a higher nutritional value of the harvested products, better storage stability and/or processability of the harvested products are possible, which exceed the effects which were actually to be expected.

The transgenic plants or plant cultivars (obtained by genetic engineering) which are preferably to be treated according to the invention include all plants which, by virtue of the genetic modification, received genetic material which imparted particularly advantageous, useful traits to these plants. Examples of such traits are better plant growth, increased tolerance to high or low temperatures, increased tolerance to drought or to water or soil salt content, increased flowering performance, easier harvesting, accelerated maturation, higher harvest yields, higher quality and/or a higher nutritional value of the harvested products, better storage stability and/or processability of the harvested products. Further and particularly emphasized examples of such traits are a better defence of the plants against animal and microbial pests, such as against insects, mites, phytopathogenic fungi, bacteria and/or viruses, and also increased tolerance of the plants to certain herbicidally active compounds. Examples of transgenic plants which may be mentioned are the important crop plants, such as cereals (wheat, rice), maize, soya beans, potatoes, sugar beet, tomatoes, peas and other vegetable varieties, cotton, tobacco, oilseed rape and also fruit plants (with the fruits apples, pears, citrus fruits and grapes), and particular emphasis is given to maize, soya beans, potatoes, cotton, tobacco and oilseed rape. Traits that are emphasized are in particular increased defence of the plants against insects, arachnids, nematodes and slugs and snails by virtue

of toxins formed in the plants, in particular those formed in the plants by the genetic material from Bacillus thuringiensis (for example by the genes CryIA(a), CryIA(b), CryIA(c), CryIIA, CryIIIA, CryIIIB2, Cry9c, Cry2Ab, Cry3Bb and CryIF and also combinations thereof) (referred to hereinbelow as "Bt plants"). Traits that are also particularly emphasized are the increased defence of the plants against fungi, bacteria and viruses by systemic acquired resistance (SAR), systemin, phytoalexins, elicitors and resistance genes and correspondingly expressed proteins and toxins. Traits that are furthermore particularly emphasized are the increased tolerance of the plants to certain herbicidally active compounds, for example imidazolinones, sulphonylureas, glyphosate or phosphinotricin (for example the "PAT" gene). The genes which impart the desired traits in question can also be present in combination with one another in the transgenic plants. Examples of "Bt plants" which may be mentioned are maize varieties, cotton varieties, soya bean varieties and potato varieties which are sold under the trade names YIELD GARD® (for example maize, cotton, soya bean), KnockOut® (for example maize), StarLink® (for example maize), Bollgard® (cotton), Nucotn® (cotton) and NewLeaf® (potato). Examples of herbicide-tolerant plants which may be mentioned are maize varieties, cotton varieties and soya bean varieties which are sold under the trade names Roundup Ready® (tolerance to glyphosate, for example maize, cotton, soya bean), Liberty Link® (tolerance to phosphinotricin, for example oilseed rape), IMI® (tolerance to imidazolinones) and STS® (tolerance to sulphonylureas, for example maize). Herbicide-resistant plants (plants bred in a conventional manner for herbicide tolerance) which may be mentioned include the varieties sold under the name Clearfield® (for example maize). Of course, these statements also apply to plant cultivars having these genetic traits or genetic traits still to be developed, which plant cultivars will be developed and/or marketed in the future.

The plants listed can be treated according to the invention in a particularly advantageous manner with the compounds of the general formula I and/or the active compound mixtures according to the invention. The preferred ranges stated above for the active compounds or mixtures also apply to the treatment of these plants. Particular emphasis is given to the treatment of plants with the compounds or mixtures specifically mentioned in the present text.

The active compounds according to the invention act not only against plant, hygiene and stored product pests, but also in the veterinary medicine sector against animal parasites (ecto- and endoparasites), such as hard ticks, soft ticks, mange mites, leaf mites, flies (biting and licking), parasitic fly larvae, lice, hair lice, feather lice and fleas. These parasites include:

From the order of the Anoplurida, for example, Haematopinus spp., Linognathus spp., Pediculus spp., Phtirus spp., Solenopotes spp.

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

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

From the order of the Siphonapterida, for example, Pulex spp., Ctenocephalides spp., Xenopsylla spp., Ceratophyllus spp.

From the order of the Heteropterida, for example, Cimex spp., Triatoma spp., Rhodnius spp., Panstrongylus spp.

From the order of the Blattarida, for example, Blatta orientalis, Periplaneta americana, Blattela germanica, Supella spp.

From the subclass of the Acari (Acarina) and the orders of the Meta- and Mesostigmata, for example, Argas spp., Ornithodorus spp., Otobius spp., Ixodes spp., Amblyomma spp., Boophilus spp., Dermacentor spp., Haemophysalis spp., Hyalomma spp., Rhipicephalus spp., Dermanyssus spp., Raillietia spp., Pneumonyssus spp., Sternostoma spp., Varroa spp.

From the order of the Actinedida (Prostigmata) and Acaridida (Astigmata), for example, 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., Laminosioptes spp.

The active compounds of the formula (I) according to the invention are also suitable for controlling arthropods which infest agricultural productive livestock, such as, for example, cattle, sheep, goats, horses, pigs, donkeys, camels, buffalo, rabbits, chickens, turkeys, ducks, geese and bees, other pets, such as, for example, dogs, cats, caged birds and aquarium fish, and also so-called test animals, such as, for example, hamsters, guinea pigs, rats and mice. By controlling these arthropods, cases of death and reduction in productivity (for meat, milk, wool, hides, eggs, honey etc.) should be diminished, so that more economic and easier animal husbandry is possible by use

of the active compounds according to the invention.

The active compounds according to the invention are used in the veterinary sector and in animal husbandry in a known manner by enteral administration in the form of, for example, tablets, capsules, potions, drenches, granules, pastes, boluses, the feed-through process and suppositories, by parenteral administration, such as, for example, by injection (intramuscular, subcutaneous, intravenous, intraperitoneal and the like), implants, by nasal administration, by dermal use in the form, for example, of dipping or bathing, spraying, pouring on and spotting on, washing and powdering, and also with the aid of moulded articles containing the active compound, such as collars, ear marks, tail marks, limb bands, halters, marking devices and the like.

When used for cattle, poultry, pets and the like, the active compounds of the formula (I) can be used as formulations (for example powders, emulsions, free-flowing compositions), which comprise the active compounds in an amount of 1 to 80% by weight, directly or after 100 to 10 000-fold dilution, or they can be used as a chemical bath.

It has furthermore been found that the compounds according to the invention also have a strong insecticidal action against insects which destroy industrial materials.

The following insects may be mentioned as examples and as preferred - but without any limitation:

Beetles, such as Hylotrupes bajulus, Chlorophorus pilosis, Anobium punctatum, Xestobium rufovillosum, Ptilinus pecticornis, Dendrobium pertinex, Ernobius mollis, Priobium carpini, Lyctus brunneus, Lyctus africanus, Lyctus planicollis, Lyctus linearis, Lyctus pubescens, Trogoxylon aequale, Minthes rugicollis, Xyleborus spec. Tryptodendron spec. Apate monachus, Bostrychus capucins, Heterobostrychus brunneus, Sinoxylon spec. Dinoderus minutus;

Hymenopterons, such as Sirex juvencus, Urocerus gigas, Urocerus gigas taignus, Urocerus augur;

Termites, such as Kalotermes flavicollis, Cryptotermes brevis, Heterotermes indicola, Reticulitermes flavipes, Reticulitermes santonensis, Reticulitermes lucifugus, Mastotermes darwiniensis, Zootermopsis nevadensis, Coptotermes formosanus;

Bristletails, such as Lepisma saccharina.

Industrial materials in the present connection are to be understood as meaning non-living materials, such as, preferably, plastics, adhesives, sizes, papers and cardboards, leather, wood and processed wood products and coating compositions.

The ready-to-use compositions may, if appropriate, comprise further insecticides and, if

appropriate, one or more fungicides.

With respect to possible additional additives, reference may be made to the insecticides and fungicides mentioned above.

The compounds according to the invention can likewise be employed for protecting objects which come into contact with saltwater or brackish water, such as hulls, screens, nets, buildings, moorings and signalling systems, against fouling.

Furthermore, the compounds according to the invention, alone or in combinations with other active compounds, may be employed as antifouling agents.

In domestic, hygiene and stored-product protection, the active compounds are also suitable for controlling animal pests, in particular insects, arachnids and mites, which are found in enclosed spaces such as, for example, dwellings, factory halls, offices, vehicle cabins and the like. They can be employed alone or in combination with other active compounds and auxiliaries in domestic insecticide products for controlling these pests. They are active against sensitive and resistant species and against all developmental stages. These pests include:

From the order of the Scorpionidea, for example, Buthus occitanus.

From the order of the Acarina, for example, Argas persicus, Argas reflexus, Bryobia ssp., Dermanyssus gallinae, Glyciphagus domesticus, Ornithodorus moubat, Rhipicephalus sanguineus, Trombicula alfreddugesi, Neutrombicula autumnalis, Dermatophagoides pteronissimus, Dermatophagoides forinae.

From the order of the Araneae, for example, Avicullariidae, Araneidae.

From the order of the Opiliones, for example, Pseudoscorpiones chelifer, Pseudoscorpiones cheiridium, Opiliones phalangium.

From the order of the Isopoda, for example, Oniscus asellus, Porcellio scaber.

From the order of the Diplopoda, for example, Blaniulus guttulatus, Polydesmus spp.

From the order of the Chilopoda, for example, Geophilus spp.

From the order of the Zygentoma, for example, Ctenolepisma spp., Lepisma saccharina, Lepismodes inquilinus.

From the order of the Blattaria, for example, Blatta orientalies, Blattella germanica, Blattella

asahinai, Leucophaea maderae, Panchlora spp., Parcoblatta spp., Periplaneta australasiae, Periplaneta americana, Periplaneta brunnea, Periplaneta fuliginosa, Supella longipalpa.

From the order of the Saltatoria, for example, Acheta domesticus.

From the order of the Dermaptera, for example, Forficula auricularia.

From the order of the Isoptera, for example, Kalotermes spp., Reticulitermes spp.

From the order of the Psocoptera, for example, Lepinatus spp., Liposcelis spp.

From the order of the Coleoptera, for example, Anthrenus spp., Attagenus spp., Dermestes spp., Latheticus oryzae, Necrobia spp., Ptinus spp., Rhizopertha dominica, Sitophilus granarius, Sitophilus oryzae, Sitophilus zeamais, Stegobium paniceum.

From the order of the Diptera, for example, Aedes aegypti, Aedes albopictus, Aedes taeniorhynchus, Anopheles spp., Calliphora erythrocephala, Chrysozona pluvialis, Culex quinquefasciatus, Culex pipiens, Culex tarsalis, Drosophila spp., Fannia canicularis, Musca domestica, Phlebotomus spp., Sarcophaga carnaria, Simulium spp., Stomoxys calcitrans, Tipula paludosa.

From the order of the Lepidoptera, for example, Achroia grisella, Galleria mellonella, Plodia interpunctella, Tinea cloacella, Tinea pellionella, Tineola bisselliella.

From the order of the Siphonaptera, for example, Ctenocephalides canis, Ctenocephalides felis, Pulex irritans, Tunga penetrans, Xenopsylla cheopis.

From the order of the Hymenoptera, for example, Camponotus herculeanus, Lasius fuliginosus, Lasius niger, Lasius umbratus, Monomorium pharaonis, Paravespula spp., Tetramorium caespitum.

From the order of the Anoplura, for example, Pediculus humanus capitis, Pediculus humanus corporis, Pemphigus spp., Phylloera vastatrix, Phthirus pubis.

From the order of the Heteroptera, for example, Cimex hemipterus, Cimex lectularius, Rhodinus prolixus, Triatoma infestans.

In the field of household insecticides, they are used alone or in combination with other suitable active compounds, such as phosphoric esters, carbamates, pyrethroids, neonicotinoids, growth regulators or active compounds from other known classes of insecticides.

They are used in aerosols, pressure-free spray products, for example pump and atomizer sprays,

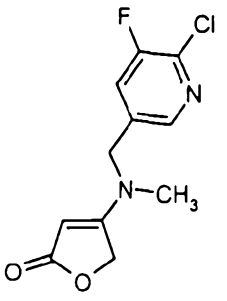
automatic fogging systems, foggers, foams, gels, evaporator products with evaporator tablets made of cellulose or polymer, liquid evaporators, gel and membrane evaporators, propeller-driven evaporators, energy-free, or passive, evaporation systems, moth papers, moth bags and moth gels, as granules or dusts, in baits for spreading or in bait stations.

Preparation examples:

Process 1

Variant A

4-[[(6-Chloro-5-fluoropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one



Example (1)

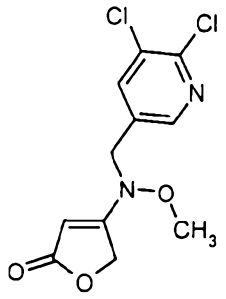
24.80 g (248 mmol) of tetronic acid are added slowly to 41.40 g (225.3 mmol) of *N*-[(6-chloro-5-fluoropyridin-3-yl)methyl]methanamine (III-1) in 64 ml of acetic acid, and the mixture is stirred at room temperature for about 16 hours. The reaction mixture is concentrated under reduced pressure, the residue is taken up in ethyl acetate and the mixture is washed successively twice with 1 N aqueous hydrochloric acid, twice with 1 N aqueous sodium hydroxide solution and saturated sodium chloride solution and dried over sodium sulphate. Concentration of the organic phase under reduced pressure and purification of the residue by recrystallization from ethyl acetate gives 30.0 g (52% of theory) of 4-[[(6-chloro-5-fluoropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 2.89 (s, 3 H), 4.40 (s, 2 H), 4.63 (s, 1 H), 4.77 (s, 2 H), 7.53 (d, 1 H), 8.14 (s, 1 H).

Compound 24 was also prepared analogously to this procedure (process 1, variant A).

Variant B

4-[[(5,6-Dichloropyridin-3-yl)methyl](methoxy)amino]furan-2(5H)-one



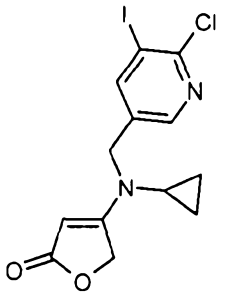
Example (2)

120 µl (2.04 mmol) of acetic acid and 422 mg (2.04 mmol) of 1-(5,6-dichloropyridin-3-yl)-*N*-methoxymethanamine (III-3) are added to 224 mg (2.24 mmol) of tetronic acid in 50 ml of toluene, and the mixture is heated under reflux on a water separator for 3 hours. The reaction mixture is concentrated under reduced pressure, the residue is taken up in ethyl acetate and the mixture is washed successively twice with 1 N aqueous hydrochloric acid, twice with 1 N aqueous sodium hydroxide solution and saturated sodium chloride solution and dried over sodium sulphate. Concentration of the organic phase under reduced pressure and purification of the residue by recrystallization from ethyl acetate gives 360 mg (59% of theory) of 4-[[(5,6-dichloropyridin-3-yl)methyl](methoxy)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 3.65 (s, 3 H), 4.56 (s, 2 H), 4.79 (s, 2 H), 4.92 (s, 1 H), 7.92 (s, 1 H), 8.31 (s, 1 H).

Process 3

4-[[(6-Chloro-5-iodopyridin-3-yl)methyl](cyclopropyl)amino]furan-2(5H)-one



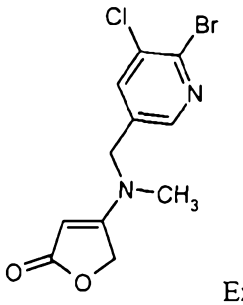
Example (3)

200 mg (1.44 mmol) of 4-(cyclopropylamino)furan-2(5H)-one (VI-1) and 86 mg (2.17 mmol) of a 60% strength dispersion of sodium hydride in mineral oil in 100 ml of tetrahydrofuran are heated under reflux for 1 hour. After cooling to room temperature, 478 mg (1.44 mmol) of 3-bromomethyl-6-chloro-5-iodopyridine (VII-3) are added, and the mixture is heated under reflux for a further 6 hours. After cooling of the reaction mixture to room temperature and addition of

methanol, the mixture is concentrated under reduced pressure. The residue is taken up in ethyl acetate and the mixture is washed successively twice with 1 N aqueous hydrochloric acid, twice with 1 N aqueous sodium hydroxide solution and saturated sodium chloride solution and dried over sodium sulphate. Concentration of the organic phase under reduced pressure and purification of the residue by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (3:1) gives 149 mg (26% of theory) of 4-[[(6-chloro-5-iodopyridin-3-yl)methyl](cyclopropyl) amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 0.78 (m, 4 H), 2.68 (m, 1 H), 4.37 (s, 2 H), 4.72 (s, 1 H), 4.85 (s, 2 H), 8.12 (s, 1 H), 8.26 (s, 1 H).

4-[[(6-Bromo-5-chloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one



Example (4)

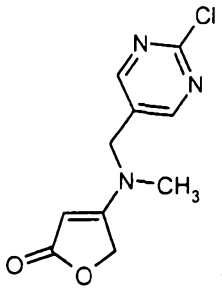
The reaction is carried out analogously to the reaction procedure of Example 3 using:

250 mg (2.21 mmol)	of 4-(methylamino)furan-2(5H)-one (J. V. Greenhill et al., Tetrahedron Lett. 1974, 2, 2683-2684)
133 mg (3.32 mmol)	of a 60% dispersion of sodium hydride in mineral oil
100 ml	of tetrahydrofuran
631 mg (2.21 mmol)	of 6-bromo-3-bromomethyl-5-chloropyridine (VII-6)

Column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (10:1) gives 186 mg (25% of theory) of 4-[[(6-bromo-5-chloropyridin-3-yl)methyl] (methyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 2.88 (s, 3 H), 4.36 (s, 2 H), 4.63 (s, 1 H), 4.77 (s, 2 H), 7.75 (s, 1 H), 8.18 (s, 1 H).

4-[[(2-Chloropyrimidin-5-yl)methyl](methyl)amino]furan-2(5H)-one



Example (5)

The reaction is carried out analogously to the reaction procedure of Example 3 using:

124.0 mg (1.10 mmol) of 4-(methylamino)furan-2(5H)-one (J. V. Greenhill et al., Tetrahedron Lett. 1974, 2, 2683-2684)

65.8 mg (1.65 mmol) of a 60% dispersion of sodium hydride in mineral oil

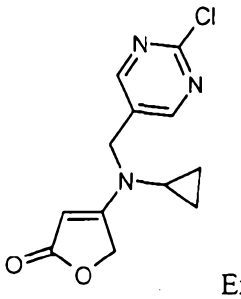
75 ml of tetrahydrofuran

350.0 mg (1.10 mmol) of 5-bromomethyl-2-chloropyrimidine (cf. EP 1 555 259 A1)

Column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase ethyl acetate gives 29 mg (10% of theory) of 4-[[(2-chloropyrimidin-5-yl)methyl](methyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 2.89 (s, 3 H), 4.38 (s, 2 H), 4.65 (s, 1 H), 4.77 (s, 2 H), 8.55 (s, 2 H).

4-[[(2-Chloropyrimidin-5-yl)methyl](cyclopropyl)amino]furan-2(5H)-one



Example (6)

The reaction is carried out analogously to the reaction procedure of Example 3 using:

152.6 mg (1.10 mmol) of 4-(cyclohexylamino)furan-2(5H)-one (VI-1)

65.7 mg (1.65 mmol) of a 60% dispersion of sodium hydride in mineral oil

75 ml of tetrahydrofuran

350.0 mg (1.10 mmol) of 5-bromomethyl-2-chloropyrimidine (cf. EP 1 555 259 A1)

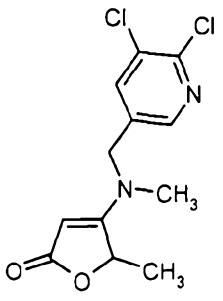
Column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (5:1) gives 54 mg (16% of theory) of 4-[[(2-chloropyrimidin-5-yl)methyl](cyclohexyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 0.79 (s, 4 H), 2.69 (m, 1 H), 4.42 (s, 2 H), 4.75 (s, 1 H), 4.86 (s, 2 H), 8.55 (s, 2 H).

Compounds (10) to (26) were also prepared analogously to this procedure (Example 3, process 3).

C-Alkylation (R^3 = alkyl)

4-[[(5,6-Dichloropyridin-3-yl)methyl](methyl)amino]-5-methylfuran-2(5H)-one



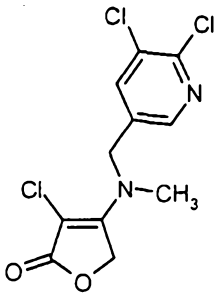
Example (7)

150 mg (0.55 mmol) of 4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one (10) are dissolved in 5 ml of tetrahydrofuran and cooled to -78°C, and 339 µl (0.58 mmol) of a 1.7 M solution of *tert.*-butyllithium in pentane are added. After 30 min of stirring at –78°C, 36 µl (0.58 mmol) of methyl iodide are added, and the mixture is stirred at –78°C for a further 30 min and then warmed to room temperature. Concentration under reduced pressure and purification of the residue by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (4:1) gives 48 mg (27% of theory) of 4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]-5-methylfuran-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 1.47 (d, 3 H), 2.90 (s, 3 H), 4.36 (d, 1 H), 4.44 (d, 1 H), 4.60 (s, 1 H), 5.08 (q, 1 H), 7.78 (s, 1 H), 8.21 (s, 1 H).

Halogenation (R^2 = halogen)

3-Chloro-4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one



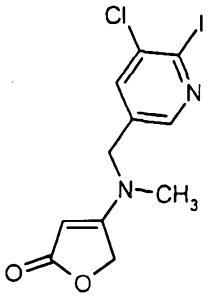
Example (8)

162 mg (0.59 mmol) of 4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one (10) are dissolved in 20 ml of acetonitrile, and 90 µl (0.65 mmol) of triethylamine and 158 mg (1.19 mmol) of *N*-chlorosuccinimide are added at room temperature. After 1 hour of stirring, the mixture is concentrated under reduced pressure. Purification of the residue by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (2:1) gives 153 mg (67% of theory) of 3-chloro-4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 3.00 (s, 3 H), 4.76 (s, 2 H), 4.79 (s, 2 H), 7.85 (s, 1 H), 8.28 (s, 1 H).

Transhalogenation (halogen in the 6-position)

4-[[(5-Chloro-6-iodopyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one



Example (9)

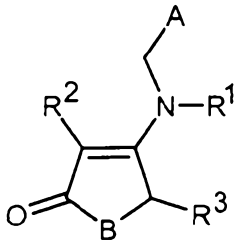
150 mg (0.55 mmol) of 4-[[(5,6-dichloropyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one (10), 1.2 ml of propionitrile, 140 µl of chlorotrimethylsilane (1.10 mmol) and 247 mg of sodium iodide (1.65 mmol) are heated under reflux for 2 hours. Concentration under reduced pressure and purification of the residue by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (5:1) gives 60 mg (29% of theory) of 4-[[(5-chloro-6-iodopyridin-3-yl)methyl](methyl)amino]furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 2.88 (s, 3 H), 4.33 (s, 2 H), 4.62 (s, 1 H), 4.77 (s, 2 H), 7.67 (s, 1 H), 8.19 (s, 1 H).

Further compounds (10) to (26) of the formula (I) are listed in Table 1 below.

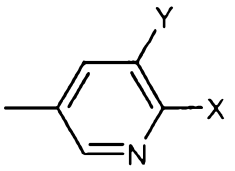
Table 1

Compounds of the formula (I)



(I)

in which A =



Ex. No.	B	R^1	R^2	R^3	X	Y	Physical Data: ^{1}H-NMR, δ [ppm]
10	O	CH_3	H	H	Cl	Cl	CD_3CN, δ = 2.88 (s, 3H), 4.38 (s, 2H), 4.63 (s, 1H), 4.78 (s, 2H), 7.78 (s, 1H), 8.21 (s, 1H)
11	O		H	H	Cl	Cl	CD_3CN, δ = 0.78 (m, 4H), 2.69 (m, 1H), 4.42 (s, 2H), 4.72 (s, 1H), 4.87 (s, 2H), 7.78 (s, 1H), 8.22 (s, 1H)
12	O		H	H	Cl	CH_3	CD_3CN, δ = 0.79 (m, 4H), 2.35 (s, 3H), 2.68 (m, 1H), 4.38 (s, 2H), 4.71 (s, 1H), 4.85 (s, 2H), 7.53 (s, 1H), 8.11 (s, 1H)
13	O	CH_3	H	H	Cl	CH_3	CD_3CN, δ = 2.35 (s, 3H), 2.88 (s, 3H), 4.33 (s, 2H), 4.63 (s, 1H), 4.78 (s, 2H), 7.53 (s, 1H), 8.11 (s, 1H)
14	O	CH_3	H	H	Cl	Br	CD_3CN, δ = 2.88 (s, 3H), 4.38 (s, 2H), 4.62 (s, 1H), 4.77 (s, 2H), 7.92 (s, 1H), 8.25 (s, 1H)
15	O		H	H	Cl	Br	CD_3CN, δ = 0.78 (m, 4H), 2.69 (m, 1H), 4.41 (s, 2H), 4.74 (s, 1H), 4.87 (s, 2H), 7.92 (s, 1H), 8.25 (s, 1H)

Ex. No.	B	R^1	R^2	R^3	X	Y	Physical Data: ^{1}H-NMR, δ [ppm]
16	O	CH_2CH_3	H	H	Cl	Cl	CD_3CN, δ = 1.13 (t, 3H), 3.25 (q, 2H), 4.39 (s, 2H), 4.59 (s, 1H), 4.80 (s, 2H),

							7.78 (s, 1H), 8.22 (s, 1H)
17	CH_2		H	H	Cl	Cl	CD_3CN, δ = 0.78 (m, 4H), 2.25 (m, 2H), 2.70 (m, 1H), 2.78 (m, 2H), 4.52 (s, 2H), 5.08 (s, 1H), 7.77 (s, 1H), 8.20 (s, 1H)
18	O	CH_3	H	H	Cl	CN	CD_3CN, δ = 2.90 (s, 3H), 4.41 (s, 2H), 4.63 (s, 1H), 4.78 (s, 2H), 8.04 (s, 1H), 8.50 (s, 1H)
19	O	CH_3	H	H	Cl	I	CD_3CN, δ = 2.88 (s, 3H), 4.33 (s, 2H), 4.64 (s, 1H), 4.77 (s, 2H), 8.12 (s, 1H), 8.28 (s, 1H)
20	O	CH_2CH_3	H	H	Cl	CH_3	CD_3CN, δ = 1.13 (t, 3H), 3.23 (q, 2H), 4.37 (s, 2H), 4.59 (s, 1H), 4.79 (s, 2H), 7.53 (s, 1H), 8.11 (s, 1H)
21	O		H	H	Br	Br	CD_3CN, δ = 0.78 (m, 4H), 2.69 (m, 1H), 4.38 (s, 2H), 4.72 (s, 1H), 4.87 (s, 2H), 7.88 (s, 1H), 8.25 (s, 1H)
22	O	CH_3	H	H	Br	Br	CD_3CN, δ = 2.88 (s, 3H), 4.33 (s, 2H), 4.63 (s, 1H), 4.77 (s, 2H), 7.89 (s, 1H), 8.25 (s, 1H)
23	O		H	H	Br	Cl	CD_3CN, δ = 0.78 (m, 4H), 2.70 (m, 1H), 4.40 (s, 2H), 4.71 (s, 1H), 4.86 (s, 2H), 7.75 (s, 1H), 8.21 (s, 1H)
24	O	CH_3	H	H	Br	F	CD_3CN, δ = 2.88 (s, 3H), 4.38 (s, 2H), 4.63 (s, 1H), 4.78 (s, 2H), 7.48 (d, 1H), 8.13 (s, 1H)
25	O		H	H	Br	F	CD_3CN, δ = 0.78 (m, 4H), 2.70 (m, 1H), 4.42 (s, 2H), 4.72 (s, 1H), 4.87 (s, 2H), 7.47 (d, 1H), 8.13 (s, 1H)
26	O		H	H	Cl	F	CD_3CN, δ = 0.78 (m, 4H), 2.70 (m, 1H), 4.45 (s, 2H), 4.72 (s, 1H), 4.87 (s, 2H), 7.52 (d, 1H), 8.14 (s, 1H)

Preparation of the starting materials

Compounds of the formula ($HN(R^1)$-CH_2-A) (III)

III-1

***N*-[(6-Chloro-5-fluoropyridin-3-yl)methyl]methanamine (R^1 = Me, A = 6-chloro-5-fluoropyridin-3-yl)**

3.70 g (20.5 mmol) of 6-chloro-3-chloromethyl-5-fluoropyridine (VII-4) in 100 ml of acetonitrile are added to 103 ml (205.5 mmol) of a 2 M solution of methylamine in methanol, and the mixture is stirred at room temperature for 1 day. The reaction mixture is concentrated under reduced pressure, and the residue is then taken up in 1 N aqueous hydrochloric acid and washed with ethyl acetate. The aqueous phase is made alkaline with 2.5 N aqueous sodium hydroxide solution and extracted repeatedly with ethyl acetate. The combined organic phases are dried over sodium sulphate and concentrated under reduced pressure. This gives 2.76 g (77% of theory) of *N*-[(6-chloro-5-fluoropyridin-3-yl)methyl]methanamine.

LC-MS (m/z,%) = 175 (MH^+, 100).

III-2

***N*-[(6-Bromo-5-fluoropyridin-3-yl)methyl]methanamine (R^1 = Me, A = 6-bromo-5-fluoropyridin-3-yl)**

Compound III-2 was also prepared analogously to the procedure for compound III-1.

^{1}H-NMR ([D_6]-DMSO): δ [ppm] = 2.27 (s, 3 H), 3.68 (s, 2 H), 7.75 (d, 1 H), 8.20 (s, 1 H).

III-3

1-(5,6-Dichloropyridin-3-yl)-*N*-methoxymethanamine (R^1 = OMe, A = 5,6-dichloropyrid-3-yl)

(a) *tert.*-Butyl [(5,6-dichloropyridin-3-yl)methyl]methoxycarbamate: 458 mg (3.11 mmol) of *tert.*-butyl methoxycarbamate are added dropwise to 125 mg (3.11 mmol) of a 60% strength dispersion of sodium hydride in mineral oil and 3 ml of toluene, and the mixture is stirred at room temperature until no further evolution of hydrogen can be observed. A solution of 750 mg (3.11 mmol) of 5-(bromomethyl)-2,3-dichloropyridine in 1 ml of toluene and 1 ml of dimethylformamide is then added dropwise. After about 16 hours of stirring at room temperature, the reaction mixture is poured into water and extracted repeatedly with dichloromethane, and the combined organic

phases are dried over sodium sulphate. Concentration gives 1.14 g of *tert.*-butyl [(5,6-dichloropyridin-3-yl)methyl]methoxycarbamate.

(b) 5 ml of conc. hydrochloric acid are added to 1.14 g (3.11 mmol) of *tert.*-butyl [(5,6-dichloropyridin-3-yl)methyl]methoxycarbamate in 2 ml of water, and the mixture is stirred at room temperature for 3 hours. The mixture is washed twice with dichloromethane, and the aqueous phase is made alkaline using potassium carbonate and extracted repeatedly with *tert.*-butyl methyl ether. The combined extracts are dried over potassium carbonate and concentrated under reduced pressure. This gives 496 mg (77% of theory) of 1-(5,6-dichloropyridin-3-yl)-*N*-methoxy-methanamine.

^{1}H-NMR (CD_3CN): δ [ppm] = 3.39 (s, 3 H), 3.97 (d, 2 H), 6.22 (m, 1 H), 7.91 (s, 1 H), 8.28 (s, 1 H).

Compounds of the formula (VI)

VI-1

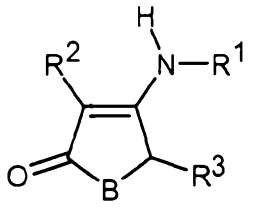
4-(Cyclopropylamino)furan-2(5H)-one

At 0°C, 10.5 ml of cyclopropylamine (149.9 mmol) are added dropwise to 10.0 g of tetronic acid (99.9 mmol) in 57 ml of acetic acid, and the mixture is stirred at 120°C for 2 h. After addition of 200 ml of toluene, the mixture is heated under reflux on a water separator for 3 hours. The reaction mixture is concentrated under reduced pressure and the residue is partitioned between 2.5 N of aqueous sodium hydroxide solution and dichloromethane. The aqueous phase is extracted a few more times with dichloromethane and the combined organic phases are dried over sodium sulphate. Concentration of the organic phase under reduced pressure and purification of the residue by recrystallization from ethanol gives 5.2 g (37% of theory) of 4-(cyclopropylamino)furan-2(5H)-one.

^{1}H-NMR (CD_3CN): δ [ppm] = 0.52 (m, 2 H), 0.70 (m, 2 H), 2.50 (m, 1 H), 4.58 (s, 2 H), 4.75 (s, 1 H), 5.82 (br. s, 1 H).

The compounds of the formulae (VI-2) to (VI-3) listed in Table 2 below were also prepared analogously to this procedure.

Table 2



(VI)

Ex. No.	B	R^1	R^2	R^3	Physical Data [a]: ^{1}H-NMR
VI-2	O	CH_2CH_3	H	H	1.17 (t, 3H), 3.12 (m, 2H), 4.53 (s, 1H), 4.68 (s, 2H), 5.58 (br. s, 1H)
VI-3	CH_2		H	H	0.52 (m, 2H), 0.71 (m, 2H), 2.20 (m, 2H), 2.50 (m, 3H), 5.17 (s, 1H), 5.90 (br. s, 1H)

[a] ^{1}H-NMR (CD_3CN), δ [ppm]

Compounds of the formula (E-CH_2-A) (VII)

VII-1

(5,6-Dichloropyridin-3-yl)methanol (E = OH, A = 5,6-dichloropyrid-3-yl) (R. Graf et al. J. Prakt. Chem. 1932, 134 177-87)

At 0°C, 859 ml (859 mmol) of a 1 M solution of borane-tetrahydrofuran complex in tetrahydrofuran are added dropwise to 110 g (573 mmol) of 5,6-dichloronicotinic acid in 250 ml of tetrahydrofuran. The mixture is warmed to room temperature and stirred at this temperature for 3 hours. After cooling to 0°C, the reaction mixture is made alkaline using saturated aqueous potassium carbonate solution, most of the tetrahydrofuran is removed using a rotary evaporator and the residue is extracted repeatedly with ethyl acetate. The combined organic phases are washed with water and saturated aqueous sodium chloride solution and dried over sodium sulphate. Concentration under reduced pressure and purification of the residue by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (1:2) gives 62 g (61% of theory) of (5,6-dichloropyridin-3-yl)methanol.

^{1}H-NMR (CD_3CN): δ [ppm] = 3.31 (t, 1 H), 4.60 (d, 2 H), 7.85 (s, 1 H), 8.26 (s, 1 H)

The compound (VII-5) from Table 3 below was also prepared analogously to the procedure for the compound (VII-1).

VII-2

3-Bromomethyl-5,6-dichloropyridin (E = Br, A = 5,6-dichloropyrid-3-yl) (cf. WO 2000046196 A1)

At 0°C, 16.40 g (62.52 mmol) of triphenylphosphine and 11.66 g (65.50 mmol) of *N*-bromosuccinimide are added to a solution of 10.60 g (59.55 mmol) of (5,6-dichloropyridin-3-yl)methanol (VII-1) in 100 ml of dichloromethane. After 2 h, the reaction mixture is substantially concentrated and the residue is purified by column chromatography on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (1:5). This gives 12.4 g (86% of theory) of 3-bromomethyl-5,6-dichloropyridine.

^{1}H-NMR (CD_3CN): δ [ppm] = 4.53 (s, 2 H), 7.97 (s, 1 H), 8.35 (s, 1 H)

The compounds (VII-6) to (VII-8) from Table 3 were prepared analogously to the procedure for the compound (VII-2).

VII-3

3-Bromomethyl-6-chloro-5-iodopyridin (E = Br, A = 6-chloro-5-iodopyrid-3-yl)

4.60 g (18.15 mmol) of 6-chloro-5-iodo-3-methylpyridine (Setliff et al., J. Chem. Engineering Data (1976), 21(2), 246-7), 3.39 g (19.06 mmol) of *N*-bromosuccinimide and 0.30 g (1.82 mmol) of 2,2'-azobis(2-methylpropanenitrile) in 500 ml of chlorobenzene are boiled under reflux for about 16 hours. The reaction mixture is washed with saturated aqueous sodium sulphite solution and sodium bicarbonate solution and then dried over sodium sulphate and concentrated under reduced pressure. Column chromatography of the residue on silica gel (silica gel 60 - Merck, particle size: 0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (1:10) gives 3.86 g (38% of theory) of 3-bromomethyl-6-chloro-5-iodopyridine.

^{1}H-NMR (CD_3CN): δ [ppm] = 4.48 (s, 2 H), 8.30 (s, 1 H), 8.40 (s, 1 H)

The compound (VII-9) of Table 3 was prepared analogously to the procedure for compound (VII-3).

VII-4

6-Chloro-3-chloromethyl-5-fluoropyridin (E = Cl, A = 6-chloro-5-fluoropyrid-3-yl)

1.00 g (6.87 mmol) of 6-chloro-5-fluoro-3-methylpyridine (F. L. Setliff, Organic Preparations and Procedures International 1971, 3, 217-222), 1.01 g (7.56 mmol) of *N*-chlorosuccinimide and 0.11 g (0.69 mmol) of 2,2'-azobis(2-methylpropanenitrile) in 100 ml of chlorobenzene are boiled under reflux for 2 days. After about 16 and 32 hours, in each case a further 1.01 g (7.56 mmol) of *N*-chlorosuccinimide and 0.11 g (0.69 mmol) of 2,2'-azobis(2-methylpropanenitrile) are added. The reaction mixture is washed with saturated aqueous sodium sulphite solution and sodium bicarbonate solution and then dried over sodium sulphate and concentrated under reduced pressure. Column chromatography of the residue on silica gel (silica gel 60 - Merck, particle size:

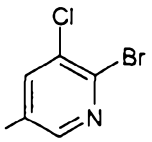
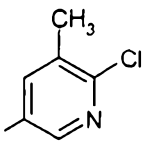
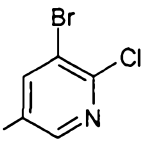
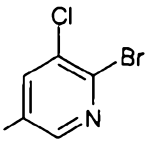
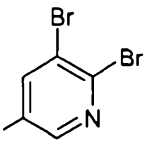
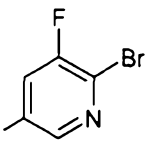
0.04 to 0.063 mm) using the mobile phase mixture ethyl acetate : cyclohexane (1:20) gives 0.65 g (53% of theory) of 6-chloro-3-chloromethyl-5-fluoropyridine.

^{1}H-NMR (CD_3CN): δ [ppm] = 4.68 (s, 2 H), 7.69 (d, 1 H), 8.27 (s, 1 H)

Further compounds (VII-5) to (VII-10) of the formula (VII) are listed in Table 3 below.

Table 3

E-CH_2-A (VII)

Ex. No.	E	A	Physical Data [a)]
VII-5	OH		3.30 (t, 1H), 4.59 (d, 2H), 7.83 (s, 1H), 8.26 (s, 1H)
VII-6	Br		2.37 (s, 3H), 4.52 (s, 2H), 7.70 (s, 1H), 8.24 (s, 1H)
VII-7	Br		4.52 (s, 2H), 8.10 (s, 1H), 8.38 (s, 1H)
VII-8	Br		4.52 (d, 2H), 7.92 (s, 1H), 8.35 (s, 1H)
VII-9	Br		4.50 (s, 2 H), 8.07 (s, 1 H), 8.37 (s, 1 H)
VII-10	Br		4.55 (s, 2H), 7.65 (d, 1H), 8.27 (s, 1H)

a) ^{1}H-NMR (CD_3CN), δ [ppm]

Comparative Biological Examples

Example No. 1

Meloidogyne test (MELGIN spray treatment)

Solvent: 80 parts by weight of acetone

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent, and the concentrate is diluted with water to the desired concentration.

Containers are filled with sand, active compound solution, Meloidogyne incognita egg/larvae suspension and lettuce seeds. The lettuce seeds germinate and the plants develop. On the roots, galls are formed.

After the desired period of time, the nematicidal activity is determined by the formation of galls in%. 100% means that no galls were found; 0% means that the number of galls on the treated plants corresponds to that of the untreated controls.

In this test, for example, the following compounds of the Preparation Examples show an activity superior to the prior art: see table

MELOIDOGYNE incognita test

Examples	Active compound concentration in ppm	Kill rate in% after 14 days
Example 88 [a)]	4	0
Example 15	4	70

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 2

Aphis gossypii test (APHIGO)

Solvent: 7 parts by weight of dimethylformamide

Emulsifier: 2 parts by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with emulsifier-containing water to the desired concentration.

Cotton leaves (*Gossypium hirsutum*) which are heavily infested by the cotton aphid (*Aphis gossypii*) are treated by being dipped into the preparation of active compound of the desired concentration.

After the desired period of time, the kill in% is determined. 100% means that all aphids have been killed; 0% means that none of the aphids have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

APHIS gossypii test

Examples	Active compound concentration in ppm	Kill rate in% after 6 days
Example 88 [a)]	0.8	0
Example 12	0.8	50
Example 15	0.8	40

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 3

Myzus persicae test, hydroponic treatment (MYZUPE sys.)

Solvent: 7 parts by weight of dimethylformamide

Emulsifier: 2 parts by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with water to the desired concentration.

The preparation of active compound is mixed with water. The stated concentration refers to the amount of active compound per volume unit of water (mg/l = ppm). The treated water is filled into containers housing a pea plant (*Pisum sativum*) which is then infected with the green peach aphid (*Myzus persicae*).

After the desired period of time, the kill in% is determined. 100% means that all aphids have been killed; 0% means that none of the aphids have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

Examples	Active compound concentration in ppm	Kill rate in% after 5 days
Example 121 [a)]	4	0
Example 4	4	100
Example 22	4	100
Example 24	4	100

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 4

Myzus test (MYZUPE spray treatment)

Solvent: 78 parts by weight of acetone
1.5 parts by weight of dimethylformamide

Emulsifier: 0.5 part by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with emulsifier-containing water to the desired concentration.

Discs of Chinese cabbage (*Brassica pekinensis*) which are infected by all stages of the green peach aphid (*Myzus persicae*) are sprayed with a preparation of active compound of the desired concentration.

After the desired period of time, the effect in% is determined. 100% means that all aphids have been killed; 0% means that none of the aphids have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

Examples	Active compound concentration in g/ha	Kill rate in% after 5 days
Example 131 [a)]	20	0
Example 10	20	100
Example 132 [a)]	100	0
Example 11	100	100

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 5

Myzus test; oral; (MYZUPE O)

Solvent: 80 parts by weight of acetone

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent, and the concentrate is diluted with water to the desired concentration.

Containers are populated with all stages of the green peach aphid (*Myzus persicae*), treatment is by sucking at the preparation of active compound of the desired concentration.

After the desired period of time, the effect in% is determined. 100% means that all aphids have been killed; 0% means that none of the aphids have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

MYZUS persicae test (ORAL)

Examples	Active compound concentration in ppm	Kill rate in% after 5 days
Example 84 [a)]	0.0064	0
Example 13	0.0064	70

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 6

Phaedon test (PHAECO spray treatment)

Solvent: 78 parts by weight of acetone
1.5 parts by weight of dimethylformamide

Emulsifier: 0.5 part by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with emulsifier-containing water to the desired concentration.

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

After the desired period of time, the effect in% is determined. 100% means that all beetle larvae have been killed; 0% means that none of the beetle larvae have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

PHAEDON cochleariae test

Examples	Active compound concentration in g/ha	Kill rate in% after 7 days
Example 131 [a)]	500	0
Example 10	500	100
Example 132 [a)]	500	0
Example 11	500	100

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 7

Diabrotica balteata test, larvae in soil (DIABBA)

Solvent: 4 parts by weight of acetone

Emulsifier: 1 part by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with water to the desired concentration.

The active compound preparation is mixed with soil. The stated concentration refers to the amount of active compound per volume unit of soil (mg/l = ppm). The treated soil is filled into pots, and 5 maize corns are placed into each pot. 3 days after sowing, larvae of the banded cucumber beetle (*Diabrotica balteata*) are placed into the treated soil.

After the desired period of time, the kill in% is determined. The efficacy is calculated from the number of maize plants that have emerged.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

DIABROTICA test (ST soil)

Examples	Active compound concentration in ppm	Kill rate in% after 10 days
Example 84 [a)]	2	0
Example 1	2	100

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 8

Lucilia cuprina test (LUCICU)

Solvent: dimethyl sulphoxide

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of water, and the concentrate is diluted with water to the desired concentration.

Containers containing horse meat treated with the preparation of active compound of the desired concentration are populated with *Lucilia cuprina* larvae.

After the desired period of time, the kill in% is determined. 100% means that all larvae have been killed; 0% means that none of the larvae have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

LUCILIA test

Examples	Active compound concentration in ppm	Kill rate in% after 2 days
Example 122 [a)]	4	0
Example 25	4	100

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 9

Ctenocephalides felis; oral (CTECFE)

Solvent: dimethyl sulphoxide

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amount of water. Part of the concentrate is diluted with citrated cattle blood, and the desired concentration is prepared.

20 unfed adult fleas (*Ctenocephalides felis*) are placed into a chamber whose top and bottom ends are closed with gauze. A metal cylinder whose bottom end is closed with parafilm is placed onto the chamber. The cylinder contains the blood/active compound preparation, which can be taken up by the fleas through the parafilm membrane. The blood is warmed to 37°C, but the flea chamber is at room temperature.

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

In this test, for example, the following compounds of the Preparation Examples show an activity superior to the prior art: see table

CTECFE test

Examples	Active compound concentration in ppm	Kill rate in% after 2 days
Example 88 [a)]	4	0
Example 11	4	50
Example 26	4	60

a) cf. EP 0539588 A1, DE 102004047922 A1

Example No. 10

Boophilus microplus test (BOOPMI injection)

Solvent: dimethyl sulphoxide

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent, and the concentrate is diluted with solvent to the desired concentration.

The solution of active compound is injected into the abdomen *(Boophilus microplus)*, and the animals are transferred into dishes and kept in a temperature-controlled room.

After the desired period of time, the effect in% is determined. 100% means that no tick has laid any fertile eggs.

In this test, for example, the following compounds of the Preparation Examples show an activity superior to the prior art: see table

BOOPMI test (INJECTION)

Examples	Active compound concentration in µg/Tier	Kill rate in% after 7 days
Example 122 [a)]	20	0
Example 23	20	30
Example 98 [a)]	20	0
Example 2	20	30
Example 88 [a)]	20	0
Example 3	20	40
Example 11	20	50
Example 85 [a)]	20	0
Example 20	20	30
Example 84 [a)]	20	0
Example 1	20	30

a) cf. EP 0539588 A1, DE 102004047922 A1

Biological Examples

Myzus test, (MYZUPE spray treatment)

Solvent: 78 parts by weight of acetone
1.5 parts by weight of dimethylformamide

Emulsifier: 0.5 part by weight of alkylaryl polyglycol ether

To produce a suitable preparation of active compound, 1 part by weight of active compound is mixed with the stated amounts of solvent and emulsifier, and the concentrate is diluted with emulsifier-containing water to the desired concentration.

Discs of Chinese cabbage (*Brassica pekinensis*) which are infected by all stages of the green peach aphid (*Myzus persicae*) are sprayed with a preparation of active compound of the desired concentration.

After the desired period of time, the effect in% is determined. 100% means that all aphids have been killed; 0% means that none of the aphids have been killed.

In this test, for example, the following compounds of the Preparation Examples show good activity: see table

MYZUS persicae test

Examples	Active compound concentration in g/ha	Kill rate in% after 5 days
Example 17	100	100
Example 18	100	100
Example 7	100	90
Example 8	100	80
Example 6	20	100
Example 14	20	100
Example 16	20	100
Example 19	20	70
Example 21	20	80
Example 5	4	100
Example 10	4	100
Example 11	4	100
Example 24	4	100
Example 25	4	100

a) cf. EP 0539588 A1, DE 102004047922 A1

2007236294 03 Sep 2012

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

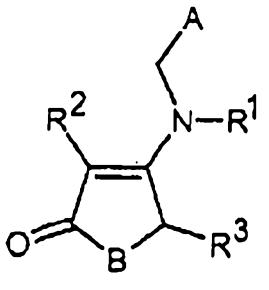
The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

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The claims defining the invention are as follows:

1. A compound of the formula (I),



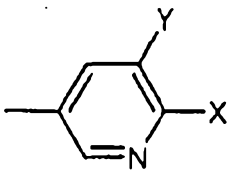
(I)

in which

A represents a pyrimidinyl, pyrazolyl, thiophenyl, oxazolyl, isoxazolyl, 1,2,4-oxadiazolyl, isothiazolyl, 1,2,4-triazolyl or 1,2,5-thiadiazolyl radical which is optionally substituted by fluorine, chlorine, bromine, cyano, nitro, C_1-C_4-alkyl (which is optionally substituted by fluorine and/or chlorine), C_1-C_3-alkylthio (which is optionally substituted by fluorine and/or chlorine), or C_1-C_3-alkylsulphonyl (which is optionally substituted by fluorine and/or chlorine),

or

A represents a radical



in which

X represents halogen, alkyl or haloalkyl,

Y represents halogen, alkyl, haloalkyl, haloalkoxy, azido or cyano,

B represents oxygen, sulphur or methylene,

R^1 represents hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl or alkoxy,

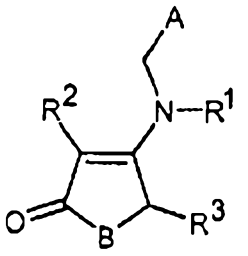
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R^2 represents hydrogen or halogen and

R^3 represents hydrogen or alkyl.

2. A compound of the formula (I),



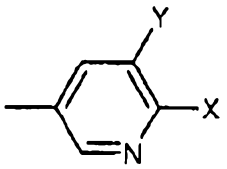
(I)

in which

A represents a pyrimidin-5-yl radical which is substituted in the 2-position by halogen or halo-C_1-C_4-alkyl,

or

A represents a radical



in which

X represents halogen or halo-C_1-C_4-alkyl,

Y represents halogen, C_1-C_4-alkyl, halo-C_1-C_4-alkyl, halo-C_1-C_4-alkoxy, azido or cyano,

B represents oxygen, sulphur or methylene,

R^1 represents hydrogen, C_1-C_3-alkyl, C_2-C_3 -alkenyl, cyclopropyl or C_1-C_2-alkoxy,

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R^2 represents hydrogen or halogen and

R^3 represents hydrogen or methyl.

3. A compound of the formula (I), as defined in Claim 1, substantially as hereinbefore described with reference to the Examples.

4. A composition comprising at least one compound of the formula (I) according to any one of Claims 1 to 3 and customary extenders and/or surfactants.

5. A method for controlling pests, the method comprising allowing a compound of the formula (I) according to any one of Claims 1 to 3, or a composition according to Claim 4 to act on the pests and/or their habitat.

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