



**AFRICAN REGIONAL INDUSTRIAL PROPERTY  
ORGANIZATION (ARIPO)**

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(24)	Date of Grant &			(see overleaf)		
(45)	Publication	10.09.93	(74)	Representative:	HONEY & BLANCKENBERG P O Box 85 HARARE Zimbabwe	
(30)	Priority Data:					
(33)	Country:	CH				
(31)	Number:	2496/90-6				
(32)	Date:	27.07.90				
(84)	Designated States:					
	BW	GM	GH	KE	LS	MW
	SD	SZ	UG	ZM	ZW	

(51) International Patent Classification Int. C1.<sup>5</sup> C07C 69/635, 233/21, A01N 53/00  
(54) Title: CARBOXYMETHYLCYCLOPROPANE DERIVATIVES  
(57) Abstract

## Novel 2-(2-chloro-2-fluorocyclopropyl)-acetic acid derivatives of formula I



wherein

X is oxygen or -NR-,

Y is hydrogen, or is C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, benzyl or aryl, each of which is unsubstituted or substituted, and

R is hydrogen or C<sub>1</sub>-C<sub>6</sub>alkyl,

can be used as pesticides. Especially insects and arachnids can be controlled.

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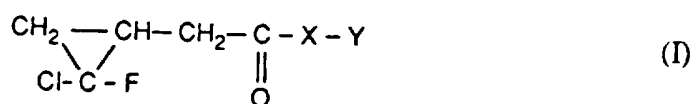
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### Carboxymethylcyclopropane derivatives

The present invention relates to novel derivatives of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid, to processes and intermediates for the preparation thereof, to pesticides comprising those compounds, and to their use in pest control.

The 2-(2-chloro-2-fluorocyclopropyl)-acetic acid derivatives according to the invention correspond to formula I



wherein

X is oxygen or -NR-,

Y is hydrogen, or is C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, benzyl or aryl, each of which is unsubstituted or substituted, and

R is hydrogen or C<sub>1</sub>-C<sub>6</sub>alkyl.

Within the scope of the present invention, Y is preferably hydrogen, C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, aryl, C<sub>3</sub>-C<sub>20</sub>haloalkenyl, C<sub>3</sub>-C<sub>20</sub>haloalkynyl; C<sub>3</sub>-C<sub>7</sub>cycloalkyl substituted by halogen or by C<sub>1</sub>-C<sub>4</sub>alkyl; aryl substituted by halogen, C<sub>1</sub>-C<sub>4</sub>alkyl, C<sub>1</sub>-C<sub>4</sub>haloalkyl, C<sub>1</sub>-C<sub>12</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>1</sub>-C<sub>4</sub>alkylthio, nitro, cyano, benzoyl, halobenzoyl, phenoxy, halophenoxy, C<sub>1</sub>-C<sub>4</sub>alkylphenoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylphenoxy, tri-C<sub>1</sub>-C<sub>4</sub>alkylsilyl, N-pyrrolidinyl, N-piperidinyl, N-pyrrolidin-2-onyl, N-piperidin-2-onyl, C<sub>1</sub>-C<sub>4</sub>alkylamino, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, anilino, N-C<sub>1</sub>-C<sub>4</sub>alkylanilino, N-formylanilino, phenylthio or by halophenylthio; or C<sub>1</sub>-C<sub>20</sub>alkyl substituted by hydroxy, halogen, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, cyano, C<sub>2</sub>-C<sub>6</sub>alkoxyalkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylthio, C<sub>1</sub>-C<sub>4</sub>alkylthio, C<sub>1</sub>-C<sub>4</sub>alkylsulfanyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyloxy, C<sub>1</sub>-C<sub>4</sub>alkylcarbonyl, C<sub>1</sub>-C<sub>4</sub>alkoxycarbonyl, C<sub>1</sub>-C<sub>6</sub>alkylcarbonyloxy, C<sub>1</sub>-C<sub>6</sub>alkoxycarbonyloxy, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, aryl, aryloxy, anilincarbonyloxy, benzyloxy, arylcarbonyloxy, arylthio, arylsulfonyl, arylsulfanyl, arylsulfonyloxy, arylcarbonyl or by pyridyl; it being possible for the aryl and pyridyl

groups each to be substituted by halogen, C<sub>1</sub>-C<sub>4</sub>alkyl, C<sub>1</sub>-C<sub>4</sub>haloalkyl, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>1</sub>-C<sub>4</sub>alkylthio, nitro, benzyloxy, cyano, phenoxy, halophenoxy, pyridyloxy, halopyridyloxy, C<sub>1</sub>-C<sub>4</sub>haloalkylpyridyloxy, C<sub>1</sub>-C<sub>4</sub>alkylthiadiazolyloxy, phenylthio or by halophenylthio.

In the definition of formula I according to the invention, the individual generic terms are to be understood as having the following meanings:

Halogen atoms that come into consideration as substituents are fluorine and chlorine and also bromine and iodine, with fluorine, chlorine and bromine being preferred. Halogen is here to be understood as being an independent substituent or part of a substituent, such as in haloalkyl, haloalkylthio, haloalkoxy, halophenylthio or halophenoxy.

Alkyl, alkylthio, alkoxyalkoxy and alkoxy radicals that come into consideration as substituents may be straight-chained or branched. There may be mentioned as examples of such alkyl radicals methyl, ethyl, propyl, isopropyl, butyl, isobutyl, sec-butyl, tert-butyl or pentyl, hexyl, octyl, decyl, dodecyl and their isomers. There may be mentioned as suitable alkoxy radicals inter alia: methoxy, ethoxy, propoxy, isopropoxy or butoxy and its isomers. Alkylthio is, for example, methylthio, ethylthio, isopropylthio, propylthio or the isomers of butylthio.

If the alkyl, alkoxy, alkenyl, alkynyl or aryl groups that come into consideration as substituents are substituted by halogen, they may be only partially halogenated or also per-halogenated. The definitions given above apply here to halogen, alkyl and alkoxy. Examples of the alkyl elements of those groups are methyl substituted from one to three times by fluorine, chlorine and/or by bromine, for example CHF<sub>2</sub> or CF<sub>3</sub>; ethyl substituted from one to five times by fluorine, chlorine and/or by bromine, for example CH<sub>2</sub>CF<sub>3</sub>, CF<sub>2</sub>CF<sub>3</sub>, CF<sub>2</sub>CCl<sub>3</sub>, CF<sub>2</sub>CHCl<sub>2</sub>, CF<sub>2</sub>CHF<sub>2</sub>, CF<sub>2</sub>CFCl<sub>2</sub>, CF<sub>2</sub>CHBr<sub>2</sub>, CF<sub>2</sub>CHClF, CF<sub>2</sub>CHBrF or CCIFCHClF; propyl or isopropyl substituted from one to seven times by fluorine, chlorine and/or by bromine, for example CH<sub>2</sub>CHBrCH<sub>2</sub>Br, CF<sub>2</sub>CHFCF<sub>3</sub>, CH<sub>2</sub>CF<sub>2</sub>CF<sub>3</sub> or CH(CF<sub>3</sub>)<sub>2</sub>; butyl or one of its isomers substituted from one to nine times by fluorine, chlorine and/or by bromine, for example CF(CF<sub>3</sub>)CHFCF<sub>3</sub> or CH<sub>2</sub>(CF<sub>2</sub>)<sub>2</sub>CF<sub>3</sub>.

If the alkyl, cycloalkyl or aryl groups defined under Y are substituted by other substituents, they may be mono- or poly-substituted by identical or different substituents selected from those listed. Preferably, the substituted groups contain one or two further

substituents.

The cycloalkyl radicals that come into consideration as substituents are, for example, cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl.

Alkenyl and alkynyl groups contain one or more, preferably not more than three, unsaturated carbon-carbon bonds. The double or triple bonds are separated from the site of linkage to the bridge X by at least one saturated carbon atom. Typical examples are allyl, methallyl, 2-butenyl, 3-butenyl, propargyl, 2-butynyl or 3-butynyl.

Aryl is an aromatic hydrocarbon radical. Aryl is preferably to be understood as being phenyl or naphthyl.

Examples of alkoxyalkoxy radicals are methoxymethoxy, methoxyethoxy, ethoxyethoxy, ethoxymethoxy, propoxymethoxy, propoxyethoxy, methoxypropoxy, butoxymethoxy or propoxyethoxy.

Examples of alkoxycarbonyl radicals are methoxycarbonyl, ethoxycarbonyl, propoxycarbonyl, isopropoxycarbonyl or butoxycarbonyl. Alkylcarbonyl is, for example, acetyl, propionyl, butyryl or valeryl, and isomers thereof. Alkylcarbonyloxy is, for example, acetoxyl, propionyloxy or butyryloxy.

In the literature, 2,2-difluorocyclopropylethane derivatives are known as pesticides from EP-A-318 425. However, these compounds are not always completely satisfactory as pesticides. There is therefore a continued need for pest control compounds having improved properties.

According to the present invention, therefore, the compounds of formula I are proposed for pest control, especially for the control of insects and representatives of the class of the Acarina.

On account of their advantageous biological activity, special mention is to be made of those sub-groups of the compounds of formula I wherein either

- a) X is oxygen, -NH-, -NCH<sub>3</sub>- or -NC<sub>2</sub>H<sub>5</sub>-, or
- b) Y is hydrogen, C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, phenyl,

naphthyl, C<sub>3</sub>-C<sub>20</sub>haloalkenyl, C<sub>3</sub>-C<sub>20</sub>haloalkynyl; C<sub>3</sub>-C<sub>7</sub>cycloalkyl substituted by fluorine, chlorine, bromine or by C<sub>1</sub>-C<sub>3</sub>alkyl; phenyl or naphthyl each substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halo-phenylthio; or C<sub>1</sub>-C<sub>20</sub>alkyl substituted by hydroxy, fluorine, chlorine, bromine, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>2</sub>-C<sub>6</sub>alkoxyalkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylthio, C<sub>1</sub>-C<sub>4</sub>alkylthio, C<sub>1</sub>-C<sub>4</sub>alkylsulfinyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyloxy, C<sub>1</sub>-C<sub>4</sub>alkylcarbonyl, C<sub>1</sub>-C<sub>4</sub>alkoxycarbonyl, C<sub>1</sub>-C<sub>6</sub>alkylcarbonyloxy, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, phenyl, phenoxy, phenylthio, phenylsulfonyloxy or by pyridyl, it being possible for the phenyl and pyridyl groups to be substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halophenylthio.

Of the compounds of sub-group a), preference is given to those wherein X is oxygen or -NH-.

Of sub-group b) of compounds of formula I, prominence is to be given on the one hand to those compounds wherein Y is

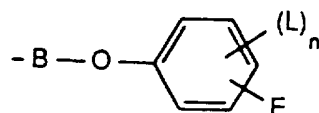
phenyl, benzyl, naphthyl or 3-pyridylmethyl, or phenyl, benzyl, naphthyl or 3-pyridylmethyl each substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halophenylthio. Of these compounds, preference is in turn given to those wherein X is oxygen or -NR- and R is hydrogen, methyl or ethyl.

Of sub-group b) of compounds of formula I, special mention is also to be made, on the other hand, of those compounds wherein Y is C<sub>1</sub>-C<sub>12</sub>alkyl or C<sub>1</sub>-C<sub>12</sub>alkyl substituted by hydroxy, fluorine, chlorine, bromine, dimethylamino, methoxy, ethoxy, methoxyethoxy, ethoxyethoxy, methylthio, ethylthio, cyclopropyl, cyclopentyl, cyclohexyl, phenyl or by phenoxy, it being possible for the phenyl or phenoxy radical to be substituted by fluorine, chlorine, bromine, phenoxy, halophenoxy or by phenylthio. Of this group of compounds, preference is given to those wherein X is oxygen or -NR- and R is hydrogen or C<sub>1</sub>-C<sub>4</sub>alkyl.

A very interesting group of compounds of sub-group b) of formula I comprises those compounds wherein Y is C<sub>3</sub>-C<sub>12</sub>alkenyl or C<sub>3</sub>-C<sub>12</sub>alkynyl, or is C<sub>3</sub>-C<sub>12</sub>alkenyl or C<sub>3</sub>-C<sub>12</sub>alkynyl each substituted by fluorine, chlorine or by bromine. Of this group, preference is

given to those compounds wherein X is oxygen or -NR- and R is hydrogen or C<sub>1</sub>-C<sub>4</sub>alkyl.

Special mention is to be made also of the group of compounds of formula I wherein the radical Y has the following formula:



wherein

B is a C<sub>2</sub>-C<sub>6</sub>alkylene bridge,

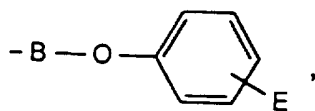
L is halogen or methyl,

n is 0, 1 or 2 and

E is benzyloxy, phenyl, halophenoxy, naphthoxy, pyridyloxy, halopyridyloxy, C<sub>1</sub>-C<sub>4</sub>haloalkylpyridyloxy, C<sub>1</sub>-C<sub>4</sub>alkylthiadiazolyloxy, phenylthio or halophenylthio.

The radical E may have, for example, the following meanings: phenoxy, phenylthio, 3,5-dichloropyrid-2-yloxy, 2-pyridyloxy, benzyloxy, 3-chlorophenoxy, 3-methyl-1,2,4-thiadiazol-5-yloxy, 4-fluorophenoxy, 3-fluorophenoxy, 2-fluorophenoxy, 3,5-difluorophenoxy, 3-isopropyl-1,2,4-thiadiazol-5-yloxy, 4-chlorophenoxy, 2-chlorophenoxy, 5-trifluoromethylpyrid-2-yloxy, 5-(2,2-dichloro-1,1,2-trifluoroethyl)-pyrid-2-yloxy, 4-chlorophenylthio, 3,4-dichlorophenylthio and 2-naphthoxy.

Special preference is given also to those compounds of formula I wherein X is oxygen and the radical Y has the formula



wherein

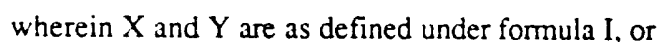
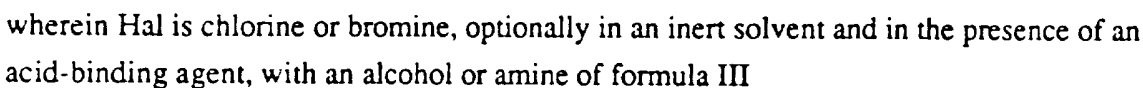
B is a bridge  $-\text{CH}_2-\text{CH}_2-$ ,  $-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-$ ,  $-\text{CH}_2-\underset{\text{CH}_3}{\text{CH}}-$  or  $-\underset{\text{CH}_3}{\text{CH}}-\underset{\text{CH}_3}{\text{CH}}-$  and

E is phenoxy, phenylthio or halophenoxy.

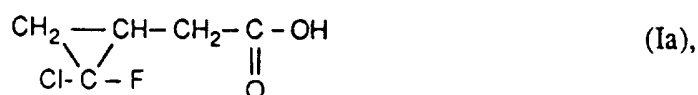
There may be mentioned as preferred individual compounds of formula I according to the

2-(2-chloro-2-fluorocyclopropyl)-acetic acid,  
2-(2-chloro-2-fluorocyclopropyl)-acetic acid benzyl ester,  
2-(2-chloro-2-fluorocyclopropyl)-acetic acid 2-(4-chlorophenoxy)-ethyl ester,  
2-(2-chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenoxyphenoxy)-ethyl ester and  
2-(2-chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenylthiophenoxy)-ethyl ester.

a) reacting a 2-(2-chloro-2-fluorocyclopropyl)-acetic acid halide of formula II


$$\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\underset{\text{O}}{\underset{\parallel}{\text{C}}}-\text{X}-\text{Y} \quad (\text{IV}),$$

c) reacting the free 2-(2-chloro-2-fluorocyclopropyl)-acetic acid of formula Ia





in the absence or presence of an inert solvent and of a catalyst or of a water-removing agent, with an alcohol or amine of formula III.

The reaction of process a) ( $\text{II} + \text{III} \rightarrow \text{I}$ ) is preferably carried out in an inert solvent that is free of hydroxy groups, in the presence of an organic base, for example pyridine, 4-dimethylaminopyridine, lutidine, collidine, trialkylamine or N,N-dialkylaniline, or of a bicyclic, non-nucleophilic base, such as 1,4-diazabicyclo[2.2.2]octane (DABCO), 1,5-diazabicyclo[4.3.0]non-5-ene (DBN) or 1,8-diazabicyclo[5.4.0]undec-7-ene (1.5-5) (DBU). The reaction is generally carried out at temperatures of from  $-30^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , preferably from  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . The reaction is advantageously carried out in the presence of a solvent or solvent mixture that is inert towards the reaction. Examples of suitable solvents are aliphatic and aromatic hydrocarbons, such as benzene, toluene, xylenes, petroleum ether, hexane; halogenated hydrocarbons, such as chlorobenzene, methylene chloride, ethylene chloride, chloroform, carbon tetrachloride, tetrachloroethylene; ethers and ethereal compounds, such as dialkyl ethers (diethyl ether, diisopropyl ether, tert-butyl methyl ether, etc.), anisole, dioxane, tetrahydrofuran; nitriles, such as acetonitrile, propionitrile; esters, such as ethyl acetate (acetic acid ethyl ester), propyl acetate or butyl acetate; ketones, such as acetone, diethyl ketone, methyl ethyl ketone; compounds such as dimethyl sulfoxide (DMSO), dimethylformamide (DMF); and mixtures of such solvents with one another. However, the reaction may also be carried out in an excess of one of the above-mentioned bases or, when the compound of formula III is an amine ( $\text{X} = \text{NR}$ ), there may be used instead of the base a second equivalent or a greater excess of the compound of formula III. The reaction is carried out under atmospheric pressure, although it could also be carried out under elevated or reduced pressure.

Suitable solvents for carrying out reaction variant b) ( $\text{IV} + \text{chlorofluorocarbene} \rightarrow \text{I}$ ) are preferably ethers, such as diglyme, triglyme or tetraglyme. Chlorofluorocarbene is produced in accordance with methods known *per se* in the specialist literature (Burton and Hahnfeld, Fluorine Chem. Rev. 8 (1977), 119ff.). Suitable chlorofluorocarbene donors are, for example, alkali metal dichlorofluoroacetates, such as sodium dichlorofluoroacetate, or halochlorofluorohydrocarbons, such as dichlorofluoromethane.

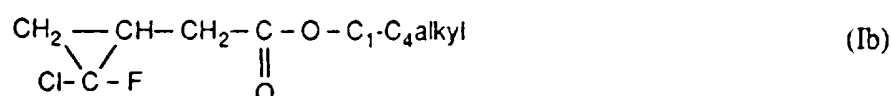
In process variant c) ( $\text{Ia} + \text{III} \rightarrow \text{I}$ ), the reaction is advantageously carried out in the presence of water-removing reagents customary for esterification reactions, for example in the presence of a carbodiimide [dicyclohexylcarbodiimide (DCC)] or of a 1-alkyl-2-halopyridinium salt, such as 1-methyl-2-chloropyridinium iodide.

Advantageously, the reaction is then carried out in the presence of a solvent or solvent mixture that is inert towards the reaction, at temperatures of from  $-30^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , preferably from  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . The reaction is preferably carried out in the presence of a base, for example in the presence of an organic amine, such as a trialkylamine (trimethylamine, triethylamine, tripropylamine or diisopropylethylamine), a pyridine (pyridine itself, 4-dimethylaminopyridine or 4-pyrrolidinopyridine), a morpholine (N-methylmorpholine) or an N,N-dialkylaniline (N,N-dimethylaniline or N-methyl-N-ethylaniline). Examples of suitable solvents for this reaction are aliphatic and aromatic hydrocarbons, such as benzene, toluene, xylenes, petroleum ether, hexane; halogenated hydrocarbons, such as chlorobenzene, methylene chloride, ethylene chloride, chloroform, carbon tetrachloride, tetrachloroethylene; ethers and ethereal compounds, such as dialkyl ethers (diethyl ether, diisopropyl ether, tert-butyl methyl ether, etc.), anisole, dioxane, tetrahydrofuran; nitriles, such as acetonitrile, propionitrile; esters, such as ethyl acetate (acetic acid ethyl ester), propyl acetate or butyl acetate; and mixtures of such solvents with one another.

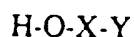
When the compound of formula III is an alcohol ( $\text{X} = \text{O}$ ), process variant c) may also be carried out in the presence of an acid catalyst, for example  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  or a sulfonic acid, such as methanesulfonic acid or p-toluenesulfonic acid. The reaction is advantageously carried out using an excess of the alcohol of formula III. In this process, water that is liberated can be removed from the reaction mixture continuously. A customary method for that purpose is removal of the water reaction product by distilling off an azeotrope of the solvent with water. Suitable solvents for that purpose are benzene, toluene, xylene, methylene chloride or chloroform.

In principle, the various derivatives of formula I are also obtainable by transesterification or amidation from the readily obtainable lower alkyl esters of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid.

For example, the ester-type derivatives of formula I ( $\text{X} = \text{O}$ ) can be obtained by base- or acid-catalysed transesterification of the lower alkyl esters of formula Ib



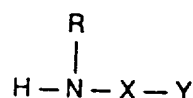
with the alcohols of formula IIIa



(IIIa)

wherein X and Y are as defined under formula I. Especially suitable acid catalysts are HCl, H<sub>2</sub>SO<sub>4</sub> or a sulfonic acid. The base used in the base-catalysed transesterification is preferably the sodium or potassium alcoholate of the alcohol of formula IIIa, which is obtainable from IIIa, for example, by the addition of sodium or potassium hydride. The transesterification reaction is preferably carried out at temperatures of from -20°C to +120°C, especially from 0°C to +100°C. The alcohol component IIIa is advantageously used in excess. Suitable solvents are ethers, such as diethyl ether, diisopropyl ether, dioxane or tetrahydrofuran, halogenated hydrocarbons or aliphatic or aromatic hydrocarbons.

Amide-type derivatives of formula I (X = NR) are obtained from the lower alkyl esters of formula Ib by reacting those esters with amines of formula IIIb



(IIIb)

wherein R, X and Y are as defined under formula I. The amidation reactions are carried out at temperatures of from 0°C to +120°C. The reactants are advantageously reacted in an inert solvent or solvent mixture. Examples of suitable solvents are aliphatic and aromatic hydrocarbons, such as benzene, toluene, xylenes, petroleum ether, hexane; halogenated hydrocarbons, such as chlorobenzene, methylene chloride, ethylene chloride, chloroform, carbon tetrachloride, tetrachloroethylene; ethers and ethereal compounds, such as dialkyl ethers (diethyl ether, diisopropyl ether, tert-butyl methyl ether, etc.), anisole, dioxane, tetrahydrofuran; nitriles, such as acetonitrile, propionitrile; alcohols, such as methanol, ethanol, propanol, isopropanol; or water. The amine component IIIb is advantageously used in excess.

Various compounds of formulae III, IIIa and IIIb and IV and their preparation are known in the literature, and some of them are available commercially. The compounds of formulae III, IIIa, IIIb and IV which have not yet been described in the literature can be obtained analogously to the known processes by customary methods of synthesis.

The compounds of formula IV can be obtained from known products, by reacting 3-butenic acid of formula V



in the absence or presence of an inert solvent and of a catalyst or of a water-removing agent, with an alcohol or amine of formula III. The reaction conditions for this esterification or amidation correspond to those of process variant c) of the process according to the invention for the preparation of the compounds of formula I.

The compound of formula II is novel. It was developed specifically for the synthesis of the compounds of formula I. The present invention therefore relates also to the compound of formula II.

The compounds of formulae Ia and II are obtained in simple manner from the readily obtainable esters of formula Ib, by hydrolysing and halogenating the latter in customary manner. Similarly, the compounds of formulae Ia and II can also be obtained from other simple esters, for example 2-(2-chloro-2-fluorocyclopropyl)-acetic acid benzyl ester. The conditions for the synthesis of the free acid of formula Ia from the basic benzyl ester or an ester of formula Ib, and the subsequent optional conversion of that acid Ia into the acid halide of formula II, correspond to the customary conditions for an acid- or base-catalysed hydrolysis, or for the halogenation of a carboxylic acid.

The esters of formula Ib and the corresponding benzyl ester can readily be prepared by the addition of chlorofluorocarbene to 3-butenic acid lower alkyl ester ( $\text{C}_1\text{-C}_4$ ) or 3-butenic acid benzyl ester. The reaction conditions correspond to those of reaction variant b) for the chlorofluorocarbene addition.

Unless expressly mentioned, the compounds of formula I are in the form of a mixture of two diastereoisomeric enantiomer pairs. The pure enantiomer pairs are obtained by means of customary physical separation methods. The optically pure isomers can be obtained by using optically pure starting materials, such as RR-, RS-, SR- or SS-2-(2-chloro-2-fluorocyclopropyl)-acetic acid, or their halides, or by separating the optically pure isomers from the enantiomer pairs (racemates) by methods known per se.

For example, the optical isomers of the free acids of the general formula Ia are obtained by

reacting compounds of the general formula II or Ia with a chiral auxiliary reagent, for example an optically active amine or an optically active alcohol, and then separating the resulting diastereoisomers by means of physical methods (Tetrahedron 33, 2725 (1977)), such as crystallisation, distillation or solid/liquid chromatography, and subsequent hydrolytic cleavage of the resulting pure diastereoisomers, which may be carried out with either acid or base catalysis. The compounds of formula I according to the invention can be obtained in optically pure form according to process variant c) from the optical isomers of the free acid.

The mixtures of optical isomers of the general formula I that are formed during the synthesis can also be separated into the enantiomers by chromatography on chiral stationary phases, for example optically active amino acid derivatives bound to cyclodextrins, starches or to polymers (Angew. Chem. 92, 14 (1980)).

It has now been found that the compounds of formula I according to the invention are valuable active ingredients in pest control while being well tolerated by warm-blooded animals, fish and plants. The compounds according to the invention can be used especially against insects and arachnids which occur on useful plants and ornamentals in agriculture, especially in cotton, vegetable and fruit crops, in forestry, in the protection of stored goods and material stocks, and also in the hygiene sector, especially on domestic animals and productive livestock. They are effective against all or individual development stages of normally sensitive and also resistant species. Their action may manifest itself in the death of the pests immediately or only at a later date, for example at moulting, or in reduced oviposition and/or a reduced hatching rate. The above-mentioned pests include:

of the order Lepidoptera, for example,

Acleris spp., Adoxophyes spp., Aegeria spp., Agrotis spp., Alabama argillaceae, Amylois spp., Anticarsia gemmatilis, Archips spp., Argyrotaenia spp., Autographa spp., Busseola fusca, Cadra cautella, Carposina nipponensis, Chilo spp., Choristoneura spp., Clysia ambiguella, Cnaphalocrocis spp., Cnephasia spp., Cochylis spp., Coleophora spp., Crocidolomia binotalis, Cryptophlebia leucotreta, Cydia spp., Diatraea spp., Diparopsis castanea, Earias spp., Ephestia spp., Eucosma spp., Eupoecilia ambiguella, Euproctis spp., Euxoa spp., Grapholita spp., Hedya nubiferana, Heliothis spp., Hellula undalis, Hyphantria cunea, Keiferia lycopersicella, Leucoptera scitella, Lithocollethis spp., Lobesia botrana, Lymantria spp., Lyonetia spp., Malacosoma spp., Mamestra brassicae, Manduca sexta, Operophtera spp., Ostrinia nubilalis, Pammene spp., Pandemis spp., Panolis flammea,

*Pectinophora gossypiella*, *Phthorimaea operculella*, *Pieris rapae*, *Pieris* spp., *Plutella xylostella*, *Prays* spp., *Scirpophaga* spp., *Sesamia* spp., *Sparganothis* spp., *Spodoptera* spp., *Synanthedon* spp., *Thaumatopoea* spp., *Tortrix* spp., *Trichoplusia ni* and *Yponomeuta* spp.;

of the order Coleoptera, for example,

*Agriotes* spp., *Anthonomus* spp., *Atomaria linearis*, *Chaetocnema tibialis*, *Cosmopolites* spp., *Curculio* spp., *Dermestes* spp., *Diabrotica* spp., *Epilachna* spp., *Eremnus* spp., *Leptinotarsa decemlineata*, *Lissorhoptrus* spp., *Melolontha* spp., *Oryzaephilus* spp., *Otiorynchus* spp., *Phlyctinus* spp., *Popillia* spp., *Psylliodes* spp., *Rhizopertha* spp., *Scarabeidae*, *Sitophilus* spp., *Sitotroga* spp., *Tenebrio* spp., *Tribolium* spp. and *Trogoderma* spp.; of the order Orthoptera, for example, *Blatta* spp., *Blattella* spp., *Grylotalpa* spp., *Leucophaea maderae*, *Locusta* spp., *Periplaneta* spp. and *Schistocerca* spp.;

of the order Isoptera, for example,

*Reticulitermes* spp.; of the order Psocoptera, for example, *Liposcelis* spp.; of the order Anoplura, for example, *Haematopinus* spp., *Linognathus* spp., *Pediculus* spp., *Pemphigus* spp. and *Phylloxera* spp.; of the order Mallophaga, for example, *Damalinea* spp. and *Trichodectes* spp.;

of the order Thysanoptera, for example,

*Frankliniella* spp., *Hercinothrips* spp., *Taeniothrips* spp., *Thrips palmi*, *Thrips tabaci* and *Scirtothrips aurantii*;

of the order Heteroptera, for example,

*Cimex* spp., *Distantiella theobroma*, *Dysdercus* spp., *Euchistus* spp., *Eurygaster* spp., *Leptocoris* spp., *Nezara* spp., *Piesma* spp., *Rhodnius* spp., *Sahlbergella singularis*, *Scotinophara* spp. and *Triatoma* spp.;

of the order Homoptera, for example,

*Aleurothrixus floccosus*, *Aleyrodes brassicae*, *Aonidiella* spp., *Aphididae*, *Aphis* spp., *Aspidiotus* spp., *Bemisia tabaci*, *Ceroplaster* spp., *Chrysomphalus aonidium*, *Chrysomphalus dictyospermi*, *Coccus hesperidum*, *Empoasca* spp., *Eriosoma larigerum*, *Erythroneura* spp., *Gascardia* spp., *Laodelphax* spp., *Lecanium corni*, *Lepidosaphes* spp., *Macrosiphus* spp., *Myzus* spp., *Nephotettix* spp., *Nilaparvata* spp., *Paratoria* spp., *Pemphigus* spp., *Planococcus* spp., *Pseudaulacaspis* spp., *Pseudococcus* spp., *Psylla* spp., *Pulvinaria aethiopica*, *Quadraspidotus* spp., *Rhopalosiphum* spp., *Saissetia* spp., *Scaphoideus* spp., *Schizaphis* spp., *Sitobion* spp., *Trialeurodes vaporariorum*, *Trioza erytrae* and *Unaspis citri*;

of the order Hymenoptera, for example,

*Acromyrmex*, *Atta* spp., *Cephus* spp., *Diprion* spp., *Diprionidae*, *Gilpinia polytoma*, *Hoplocampa* spp., *Lastus* spp., *Monomorium pharaonis*, *Neodiprion* spp., *Solenopsis* spp. and *Vespa* spp.;

of the order *Diptera*, for example,

*Aedes* spp., *Antherigona soccata*, *Bibio hortulanus*, *Calliphora erythrocephala*, *Ceratitis* spp., *Chrysomyia* spp., *Culex* spp., *Cuterebra* spp., *Dacus* spp., *Drosophila melanogaster*, *Fannia* spp., *Gastrophilus* spp., *Glossina* spp., *Hypoderma* spp., *Hyppobosca* spp., *Liriomyza* spp., *Lucilia* spp., *Melanagromyza* spp., *Musca* spp., *Oestrus* spp., *Orseolia* spp., *Oscinella frit*, *Pegomyia hyoseyami*, *Phorbia* spp., *Rhagoletis pomonella*, *Sciara* spp., *Stomoxys* spp., *Tabanus* spp., *Tannia* spp. and *Tipula* spp.;

of the order *Siphonaptera*, for example,

*Ceratophyllus* spp., *Xenopsylla cheopis*,

of the order *Acarina*, for example,

*Acarus siro*, *Aceria sheldoni*, *Aculus schlechtendali*, *Amblyomma* spp., *Argas* spp., *Boophilus* spp., *Brevipalpus* spp., *Bryobia praetiosa*, *Calipitimerus* spp., *Chorioptes* spp., *Dermanyssus gallinae*, *Eotetranychus carpini*, *Eriophyes* spp., *Hyalomma* spp., *Ixodes* spp., *Olygonychus pratensis*, *Ornithodoros* spp., *Panonychus* spp., *Phyllocoptruta oleivora*, *Polyphagotarsonemus latus*, *Psoroptes* spp., *Rhipicephalus* spp., *Rhizoglyphus* spp., *Sarcoptes* spp., *Tarsonemus* spp. and *Tetranychus* spp.; and

of the order *Thysanura*, for example,

*Lepisma saccharina*.

In particular the compounds of formula I are suitable especially for controlling pests in fruit and vegetable crops, such as spider mites and aphids. Furthermore, the compounds of formula I can also be used in advantageous manner for controlling parasites of warm-blooded animals, such as mites and ticks.

The good pesticidal activity of the compounds of formula I according to the invention corresponds to a mortality of at least 50-60 % of the mentioned pests.

The activity of the compounds of the invention and of the compositions comprising them can be substantially broadened and adapted to prevailing circumstances by the addition of other insecticides and/or acaricides. Examples of suitable additives include representatives of the following classes of compounds: organophosphorus compounds, nitrophenols and derivatives thereof, formamidines, ureas, carbamates, pyrethroids, chlorinated hydrocarbons, and *Bacillus thuringiensis* preparations.



The compounds of formula I are used in unmodified form or, preferably, together with the adjuvants conventionally employed in formulation technology, and can therefore be formulated in known manner e.g. into emulsifiable concentrates, directly sprayable or dilutable solutions, dilute emulsions, wettable powders, soluble powders, dusts, granules, and also encapsulations in polymer substances. As with the compositions, the methods of application, such as spraying, atomising, dusting, scattering or pouring, are chosen in accordance with the intended objectives and the prevailing circumstances.

The formulations, i.e. the compositions, preparations or mixtures comprising the compound (active ingredient) of formula I, or combinations of those compounds with other insecticides or acaricides, and, where appropriate, a solid or liquid adjuvant, are prepared in known manner, e.g. by homogeneously mixing and/or grinding the active ingredients with extenders, e.g. solvents, solid carriers and, where appropriate, surface-active compounds (surfactants).

Suitable solvents are: aromatic hydrocarbons, preferably the C<sub>8</sub> to C<sub>12</sub> fractions of alkylbenzenes, e.g. xylene mixtures or alkylated naphthalenes, aliphatic or cycloaliphatic hydrocarbons such as cyclohexane, paraffins or tetrahydronaphthalene, alcohols such as ethanol, propanol or butanol, and glycols and their ethers and esters, such as propylene glycol, dipropylene glycol ether, ethylene glycol, ethylene glycol monomethyl or monoethyl ether, ketones such as cyclohexanone, isophorone or diacetone alcohol, strongly polar solvents such as N-methyl-2-pyrrolidone, dimethyl sulfoxide or dimethylformamide, or water, vegetable oils such as rape oil, castor oil, coconut oil or soybean oil; and, where appropriate, silicone oils.

The solid carriers used, e.g. for dusts and dispersible powders, are normally natural mineral fillers such as calcite, talcum, kaolin, montmorillonite or attapulgit. In order to improve the physical properties it is also possible to add highly dispersed silicic acids or highly dispersed absorbent polymers. Suitable granulated adsorptive carriers are porous types, for example pumice, broken brick, sepiolite or bentonite; and suitable nonsorbent carriers are, for example, calcite or sand. In addition, a great number of granulated materials of inorganic or organic nature can be used, e.g. especially dolomite or pulverised plant residues.

Depending on the nature of the compound of formula I to be formulated, or of the



combinations of those compounds with other insecticides or acaricides, suitable surface-active compounds are non-ionic, cationic and/or anionic surfactants having good emulsifying, dispersing and wetting properties. The term "surfactants" will also be understood as comprising mixtures of surfactants.

Both so-called water-soluble soaps and water-soluble synthetic surface-active compounds are suitable anionic surfactants.

Suitable soaps are the alkali metal salts, alkaline earth metal salts or unsubstituted or substituted ammonium salts of higher fatty acids ( $C_{10}$ - $C_{22}$ ), e.g. the sodium or potassium salts of oleic or stearic acid, or of natural fatty acid mixtures which can be obtained e.g. from coconut oil or tall oil. Mention may also be made of fatty acid methyltaurin salts.

More frequently, however, so-called synthetic surfactants are used, especially fatty sulfonates, fatty sulfates, sulfonated benzimidazole derivatives or alkylarylsulfonates.

The fatty sulfonates or sulfates are usually in the form of alkali metal salts, alkaline earth metal salts or unsubstituted or substituted ammonium salts and generally contain a  $C_8$ - $C_{22}$ alkyl radical, which also includes the alkyl moiety of acyl radicals, e.g. the sodium or calcium salt of lignosulfonic acid, of dodecyl sulfate or of a mixture of fatty alcohol sulfates obtained from natural fatty acids. These compounds also comprise the salts of sulfated and sulfonated fatty alcohol/ethylene oxide adducts. The sulfonated benzimidazole derivatives preferably contain 2 sulfonic acid groups and one fatty acid radical containing approximately 8 to 22 carbon atoms. Examples of alkylarylsulfonates are the sodium, calcium or triethanolamine salts of dodecylbenzenesulfonic acid, dibutyl-naphthalenesulfonic acid, or of a condensate of naphthalenesulfonic acid and formaldehyde. Also suitable are corresponding phosphates, e.g. salts of the phosphoric acid ester of an adduct of p-nonylphenol with 4 to 14 mol of ethylene oxide, or phospholipids.

Non-ionic surfactants are preferably polyglycol ether derivatives of aliphatic or cycloaliphatic alcohols, saturated or unsaturated fatty acids and alkylphenols, said derivatives containing 3 to 30 glycol ether groups and 8 to 20 carbon atoms in the (aliphatic) hydrocarbon moiety and 6 to 18 carbon atoms in the alkyl moiety of the alkylphenols. Further suitable non-ionic surfactants are the water-soluble adducts of polyethylene oxide with polypropylene glycol, ethylenediaminopolypropylene glycol and

alkylpolypropylene glycol containing 1 to 10 carbon atoms in the alkyl chain, which adducts contain 20 to 250 ethylene glycol ether groups and 10 to 100 propylene glycol ether groups. These compounds usually contain 1 to 5 ethylene glycol units per propylene glycol unit.

Representative examples of non-ionic surfactants are nonylphenolpolyethoxyethanols, castor oil polyglycol ethers, polypropylene/polyethylene oxide adducts, tributylphenoxy-polyethoxyethanol, polyethylene glycol and octylphenoxypolyethoxyethanol. Fatty acid esters of polyoxyethylene sorbitan, e.g. polyoxyethylene sorbitan trioleate, are also suitable non-ionic surfactants.

Cationic surfactants are preferably quaternary ammonium salts which contain, as N-substituent, at least one  $C_8$ - $C_{22}$ alkyl radical and, as further substituents, unsubstituted or halogenated lower alkyl, benzyl or hydroxy-lower alkyl radicals. The salts are preferably in the form of halides, methyl sulfates or ethyl sulfates, e.g. stearyltrimethylammonium chloride or benzyldi(2-chloroethyl)ethylammonium bromide.

The surfactants customarily employed in formulation technology are described, for example, in the following publications:

"McCutcheon's Detergents and Emulsifiers Annual", MC Publishing Corp., Glen Rock, NJ, USA, 1988",

H. Stache, "Tensid-Taschenbuch", 2nd edition, C. Hanser Verlag, Munich, Vienna, 1981,

M. and J. Ash, "Encyclopedia of Surfactants", Vol. I-III, Chemical Publishing Co., New York, 1980-1981.

The pesticidal compositions usually comprise 0.1 to 99 %, preferably 0.1 to 95 %, of a compound of formula I or combinations of that compound with other insecticides or acaricides, 1 to 99.9 % of a solid or liquid adjuvant, and 0 to 25 %, preferably 0.1 to 25 %, of a surfactant. Whereas commercial products will preferably be formulated as concentrates, the end user will normally employ dilute formulations comprising considerably lower active ingredient concentrations. Typical application concentrations are from 0.1 to 1000 ppm, preferably from 0.1 to 500 ppm. The rates of application per hectare are generally from 1 to 1000 g of active ingredient per hectare, preferably from 25 to

500 g/ha.

Preferred formulations have especially the following compositions (throughout, percentages are by weight):

Emulsifiable concentrates:

active ingredient:	1 to 90 %, preferably 5 to 20 %
surface-active agent:	1 to 30 %, preferably 10 to 20 %
liquid carrier:	5 to 94 %, preferably 70 to 85 %

Dusts:

active ingredient:	0.1 to 10 %, preferably 0.1 to 1 %
solid carrier:	99.9 to 90 %, preferably 99.9 to 99 %

Suspension concentrates:

active ingredient:	5 to 75 %, preferably 10 to 50 %
water:	94 to 24 %, preferably 88 to 30 %
surface-active agent:	1 to 40 %, preferably 2 to 30 %

Wettable powders:

active ingredient:	0.5 to 90 %, preferably 1 to 80 %
surface-active agent:	0.5 to 20 %, preferably 1 to 15 %
solid carrier:	5 to 95 %, preferably 15 to 90 %

Granules:

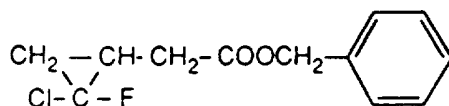
active ingredient:	0.5 to 30 %, preferably 3 to 15 %
solid carrier:	99.5 to 70 %, preferably 97 to 85 %

The compositions may also comprise further auxiliaries such as stabilisers, e.g. vegetable oils or epoxidised vegetable oils (epoxidised coconut oil, rape oil or soybean oil), anti-foams, e.g. silicone oil, preservatives, viscosity regulators, binders, tackifiers as well as fertilisers or other active ingredients for obtaining special effects.

The following Examples serve to illustrate the invention, but do not limit the invention.

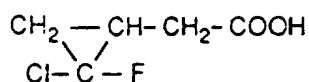
### Preparation Examples

#### Example P1: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid benzyl ester



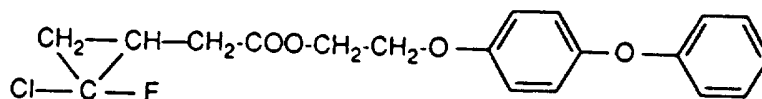
10.6 g of 3-butenic acid benzyl ester are dissolved in 40 ml of diethylene glycol dimethyl ether (diglyme), and a solution of 20.3 g of sodium dichlorofluoroacetate in 40 ml of diglyme is added over a period of 4 hours at +165°C. The mixture is stirred for a further 4 hours at +165°C and then cooled. The resulting sodium chloride is separated off and then washed with a small amount of diglyme. The solvent is evaporated off under a high vacuum at +40°C and the residue is taken up in 80 ml of diethyl ether, washed twice with 20 ml of water each time, dried over sodium sulfate and concentrated by evaporation. The oily residue is then fractionated under a high vacuum, yielding 2-(2-chloro-2-fluorocyclopropyl)-acetic acid benzyl ester in the form of a colourless liquid, b.p. 110°C/0.25 mbar,  $n_D^{20}$ : 1.5031.

#### Example P2: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid



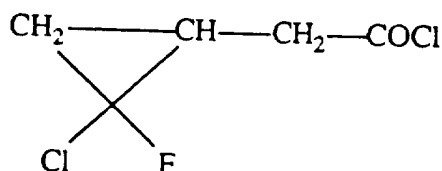
8.0 g of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid benzyl ester are added dropwise, while cooling with ice, to a solution of 1.85 g of potassium hydroxide in 25 ml of methanol, and the mixture is stirred for 4 hours at room temperature. The solvent is then evaporated off, 30 ml of ether are added to the residue, and the resulting potassium salt is separated off. The salt is dissolved in 20 ml of water, acidified with 3.5 ml of concentrated HCl and extracted three times with 20 ml of ethyl acetate each time. The combined ethyl acetate phase is washed twice with 10 ml of brine each time, dried over sodium sulfate and concentrated by evaporation, yielding 2-(2-chloro-2-fluorocyclopropyl)-acetic acid in the form of a yellowish oil having a refractive index of  $n_D^{20}$ : 1.4442.

Example P3: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenoxyphenoxy)-ethyl ester



50 mg of 4-pyrrolidinopyridine and 1.51 g of 2-(4-phenoxyphenoxy)-ethanol are added to a solution of 1.0 g of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid in 20 ml of dichloromethane, and the mixture is cooled to 0°C. At a temperature of from 0°C to +5°C, 1.50 g of N,N-dicyclohexylcarbodiimide are added in portions, and the reaction mixture is then stirred at room temperature for 5 hours. The resulting N,N-dicyclohexylurea is filtered off and the filtrate is washed twice with 10 ml of water each time, dried and concentrated by evaporation. The residue is purified by column chromatography on silica gel (eluant: hexane/ethyl acetate, 9:1), yielding 2-(2-chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenoxyphenoxy)-ethyl ester in the form of a slightly yellowish oil having a refractive index of  $n_D^{20}$ : 1.5461.

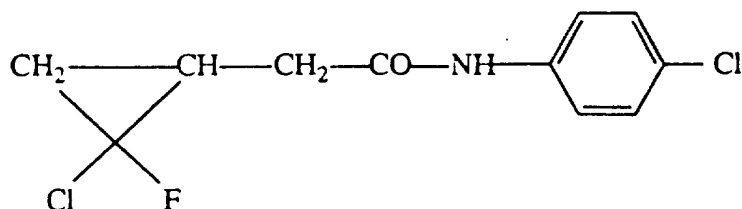
Example P4: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid chloride



1.42 g of oxalyl chloride are added to a solution of 1.53 g of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid in 25 ml of tetrahydrofuran and one drop of dimethylformamide, and the mixture is then stirred for one hour at room temperature. The reaction mixture is then concentrated by evaporation using a rotary evaporator at 80 mbar and at a bath temperature of +50°C.

2-(2-Chloro-2-fluorocyclopropyl)-acetic acid chloride is thus obtained in the form of a yellowish liquid.

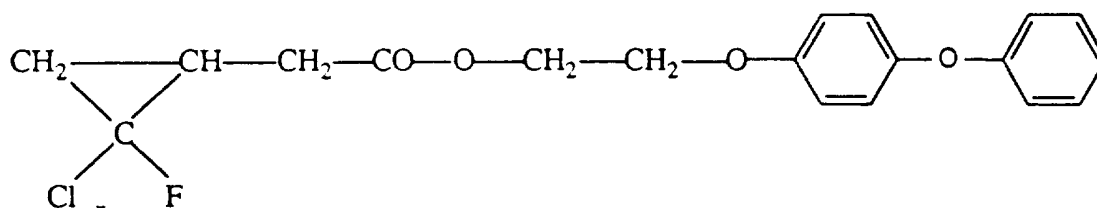
Example P5: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid 4-chloroanilide



Without further purification, the 2-(2-chloro-2-fluorocyclopropyl)-acetic acid chloride obtained in Example P4 is taken up in 40 ml of toluene, and a solution of 1.02 g of 4-chloroaniline and 0.95 ml of pyridine in 10 ml of toluene is slowly added dropwise at from 0°C to +5°C. The reaction mixture is then stirred at room temperature for 2 hours and is then washed three times with 10 ml of brine each time, dried over sodium sulfate and concentrated by evaporation. The residue is recrystallised from an ethyl acetate/hexane mixture.

2-(2-Chloro-2-fluorocyclopropyl)-acetic acid 4-chloroanilide is thus obtained in the form of a light-beige powder having a melting point of 126-128°C.

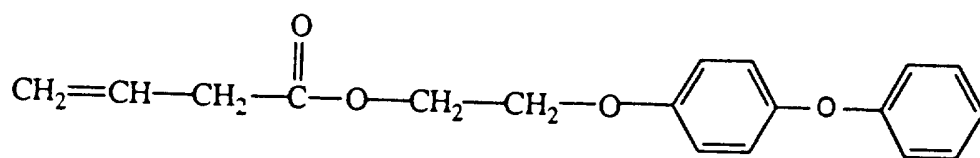
Example P6: 2-(2-Chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenoxyphenoxy)-ethyl ester



a) 3-butenic acid 2-(4-phenoxyphenoxy)-ethyl ester

0.05 g of 4-pyrrolidinopyridine and 17.25 g of 2-(4-phenoxyphenoxy)-ethanol are added at room temperature, with stirring, to a solution of 6.45 g of 3-butenic acid in 100 ml of dichloromethane. At a temperature of 0°C, 17.0 g of N,N-dicyclohexylcarbodiimide are then added in portions, and the reaction mixture is stirred at room temperature for 3 hours. The reaction mixture is filtered. The precipitate which has been separated off is discarded, and the filtrate is washed with water and dried over sodium sulfate. After concentration by evaporation, the oily residue is purified by column chromatography on silica gel with hexane/ethyl acetate (9:1), yielding 20.0 g of 3-butenic acid 2-(4-phenoxyphenoxy)-ethyl

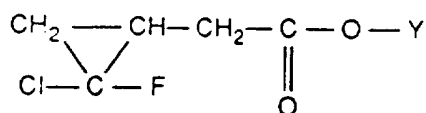
ester of the formula

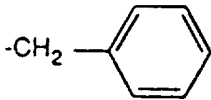
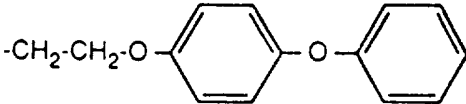
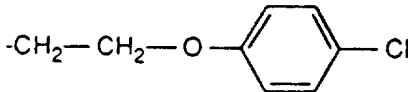


in the form of a colourless oil having a refractive index of  $n_D^{23}$ : 1.5538.

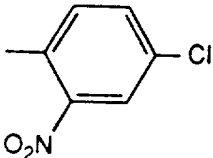
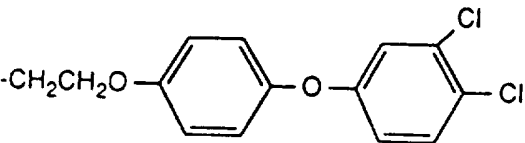
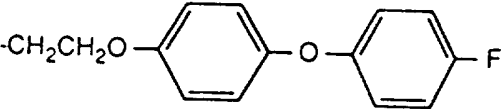
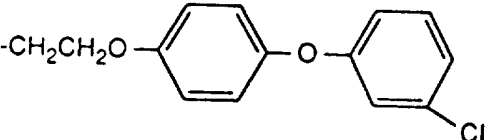
b) 14.8 g of 3-butenic acid 2-(4-phenoxyphenoxy)-ethyl ester are dissolved in 30 ml of diethylene glycol dimethyl ether (diglyme), and the solution is heated to +165°C with stirring. A solution of 16.9 g of sodium dichlorofluoroacetate in 30 ml of diglyme is then added dropwise at that temperature over a period of 8 hours. The mixture is stirred for a further one hour at +165°C and then cooled to room temperature. The reaction mixture is filtered, the residue is washed with 20 ml of diglyme and the filtrate is concentrated completely by evaporation and then taken up in 40 ml of diethyl ether, washed twice with 20 ml of water each time and dried over sodium sulfate. The solvent is concentrated by evaporation and the oily residue is then purified by column chromatography on silica gel with hexane/ethyl acetate (9:1), yielding 12.5 g of 2-(2-chloro-2-fluorocyclopropyl)-acetic acid 2-(4-phenoxyphenoxy)-ethyl ester in the form of a slightly yellowish oil having a refractive index of  $n_D^{20}$ : 1.5461.

The compounds of formula I listed in the following Tables can be prepared analogously.

Table 1:

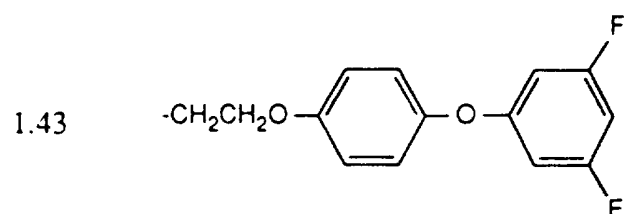
Comp. No.	Y	Physical data
1.01		$n_D^{20}$ : 1.5031
1.02	H	$n_D^{20}$ : 1.4442
1.03		$n_D^{20}$ : 1.5461
1.04		$n_D^{20}$ : 1.5168
1.05	CH <sub>3</sub>	
1.06	C <sub>2</sub> H <sub>5</sub>	
1.07	C <sub>3</sub> H <sub>7</sub> -n	
1.08	C <sub>3</sub> H <sub>7</sub> -i	
1.09	C <sub>4</sub> H <sub>9</sub> -t	
1.10	C <sub>4</sub> H <sub>9</sub> -n	
1.11	C <sub>6</sub> H <sub>13</sub> -n	
1.12	C <sub>10</sub> H <sub>21</sub> -n	
1.13	C <sub>20</sub> H <sub>41</sub> -n	
1.14	CH <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub>	$n_D^{23}$ : 1.4330
1.15	CH <sub>2</sub> CH <sub>2</sub> OH	
1.16	CH <sub>2</sub> CH <sub>2</sub> O-COCH <sub>3</sub>	
1.17	CH <sub>2</sub> CH <sub>2</sub> O-COOCH <sub>3</sub>	
1.18	CH <sub>2</sub> CH <sub>2</sub> OCONHC <sub>6</sub> H <sub>5</sub>	
1.19	CH <sub>2</sub> CH <sub>2</sub> OC <sub>2</sub> H <sub>5</sub>	
1.20	CH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>3</sub>	
1.21	CH <sub>2</sub> CCl <sub>3</sub>	
1.22	CH <sub>2</sub> CBr <sub>3</sub>	
1.23	CH <sub>2</sub> CH <sub>2</sub> SCH <sub>3</sub>	



Comp. No.	Y	Physical data
1.24	$\text{CH}_2\text{CH}_2\text{OCH}_2\text{C}_6\text{H}_5$	
1.25	$\text{CH}_2\text{CH}_2\text{Cl}$	
1.26	$\text{CH}_2\text{-C}_6\text{H}_5$	
1.27	$\text{CH}(\text{CH}_3)\text{C}_6\text{H}_5$	
1.28	$\text{CH}(\text{CH}_3)\text{C}_6\text{H}_5$ (R)	
1.29	$\text{CH}(\text{CH}_3)\text{C}_6\text{H}_5$ (S)	
1.30	$\text{CH}_2\text{-C}_6\text{H}_4\text{-NO}_2$ -(4)	
1.31	$\text{CH}_2\text{-C}_6\text{H}_4\text{-NO}_2$ -(2)	
1.32	$\text{CH}_2\text{-C}_6\text{H}_4\text{-Cl}$ -(2)	
1.33	$\text{CH}_2\text{-C}_6\text{H}_5\text{-F}$ -(4)	
1.34	$\text{CH}_2\text{-C}_6\text{H}_4\text{-O-C}_6\text{H}_5$ -(3)	
1.35	$\text{-C}_6\text{H}_5$	
1.36	$\text{-C}_6\text{H}_4\text{-O-C}_6\text{H}_5$ -(4)	$n_D^{23}$ : 1.5478
1.37	$\text{-C}_6\text{H}_4\text{-NO}_2$ -(4)	
1.38	$\text{-C}_6\text{H}_4\text{-F}$ -(4)	
1.39		
1.40	$\text{-CH}_2\text{CH}_2\text{O-}$ 	
1.41	$\text{-CH}_2\text{CH}_2\text{O-}$ 	
1.42	$\text{-CH}_2\text{CH}_2\text{O-}$ 	

Comp. No.	Y	Physical data
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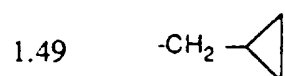
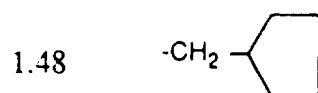
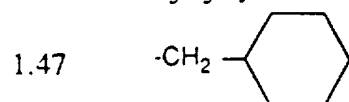
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1.44	$\text{C}_6\text{H}_{11}\text{-cycl.}$
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1.45	$\text{C}_5\text{H}_9\text{-cycl.}$
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1.46	$\text{C}_3\text{H}_5\text{-cycl.}$
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1.50	$\text{-CH}_2\text{-CH=CH}_2$
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1.51	$\text{-CH}_2\text{CH=C(CH}_3\text{)CH}_2\text{CH}_2\text{CH=C(CH}_3\text{)}_2$
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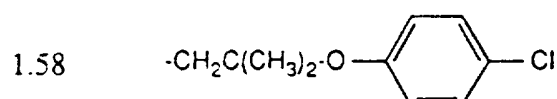
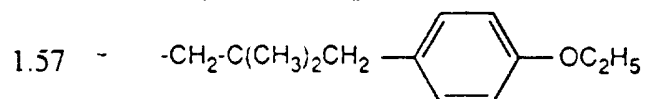
1.52	$\text{-CH}_2\text{CH=C(CH}_3\text{)CH}_2\text{CH}_2\text{CH=C(CH}_3\text{)-CH}_2\text{CH}_2\text{CH=C(CH}_3\text{)}_2$
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1.53	$\text{-CH}_2\text{-CH}\equiv\text{CH}$
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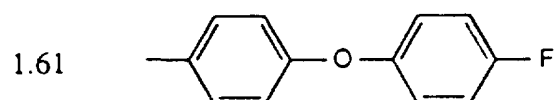
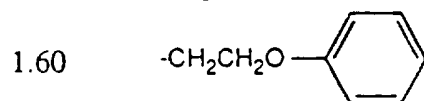
1.54	$\text{-C}_{16}\text{H}_{33}\text{-n}$
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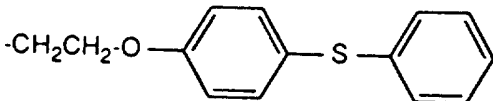
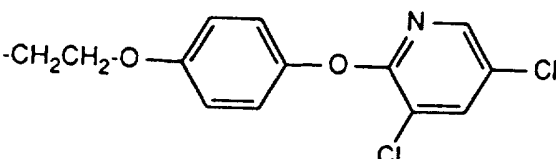
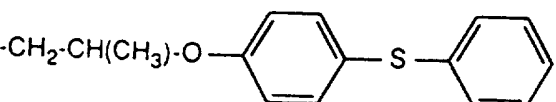
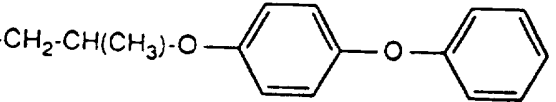
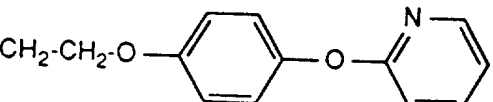
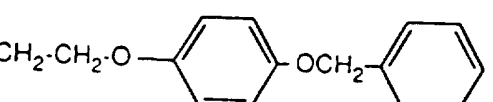
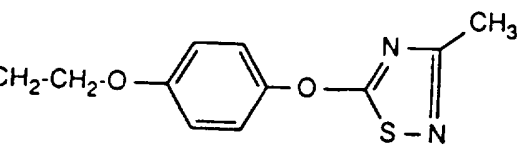
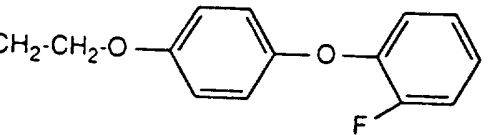
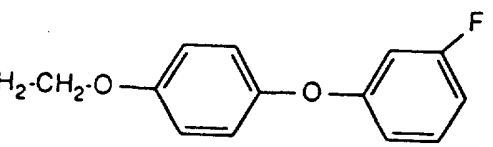
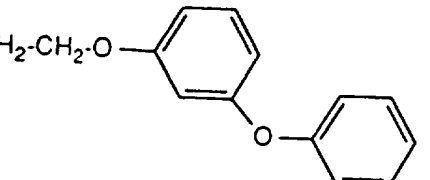
1.55	$\text{-CH(CH}_2\text{CH}_2\text{CH}_2\text{CH}_3\text{)}_2$
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1.56	$\text{-CH}_2\text{-(CH}_2\text{)}_4\text{CH}_2\text{Cl}$
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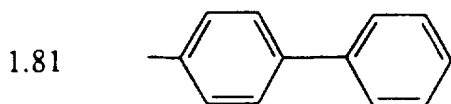
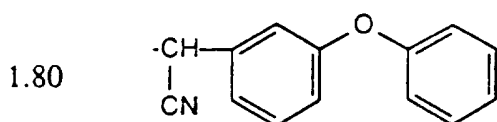
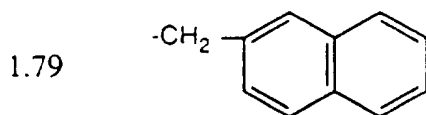
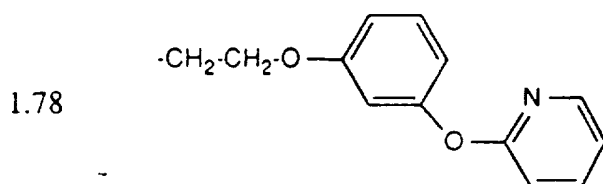
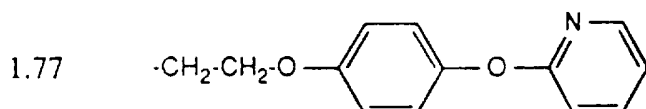
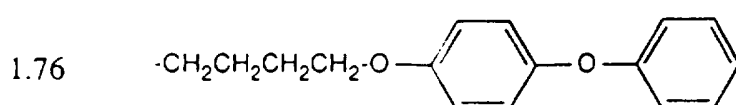
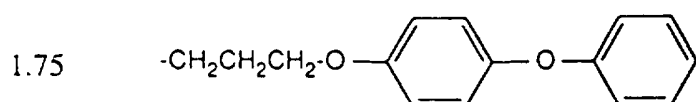
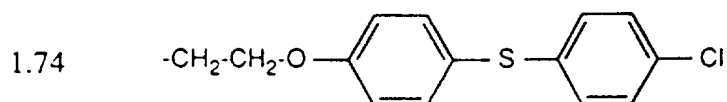
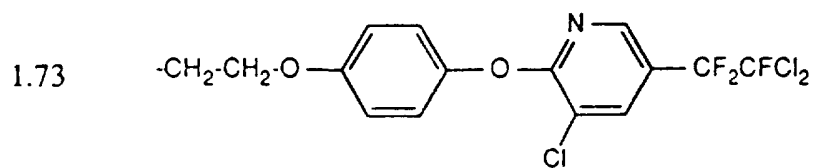
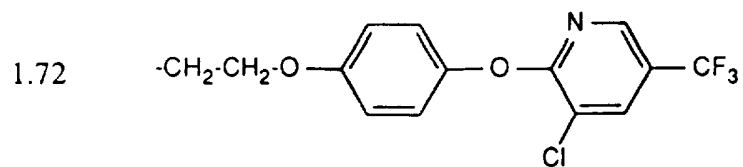


1.59	$\text{-CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{-C}_6\text{H}_5$
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Comp. No.	Y	Physical data
1.62		$n_D^{22}$ : 1.5744
1.63		
1.64		
1.65		
1.66		$n_D^{22}$ : 1.5449
1.67		m.p. 57-59°C
1.68		
1.69		
1.70		
1.71		

Comp. No.	Y	Physical data
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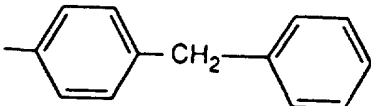
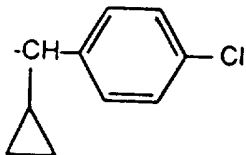
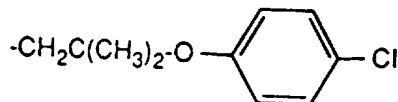
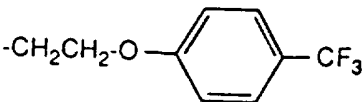
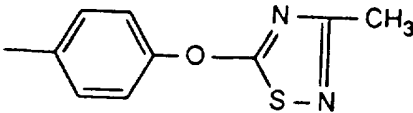
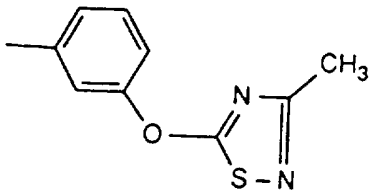
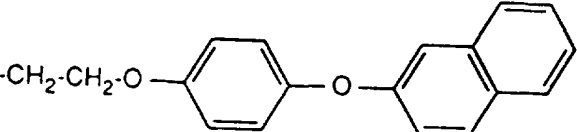
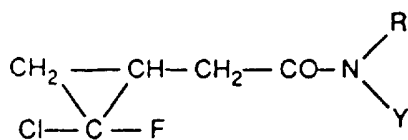
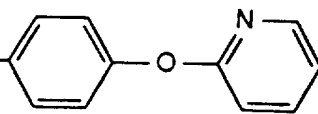
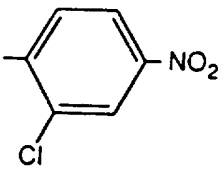
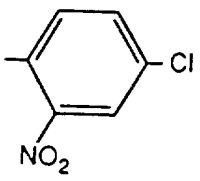
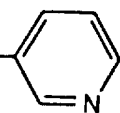
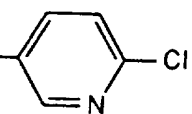
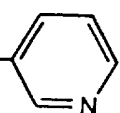
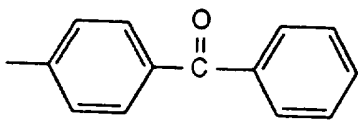
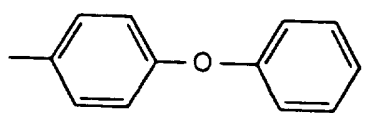
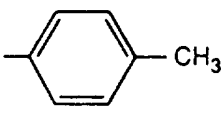
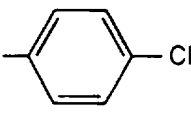
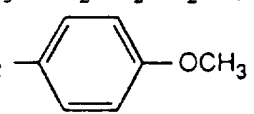
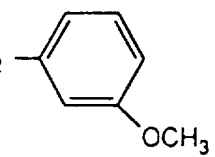
Comp. No.	Y	Physical data
1.82		
1.83		
1.84		
1.85	$-(CH_2)_2-C\equiv C-(CH_2)_4CH_3$	
1.86		
1.87		$n_D^{22}: 1.5472$
1.88		
1.89		

Table 2:


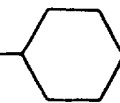
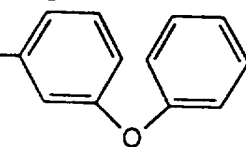
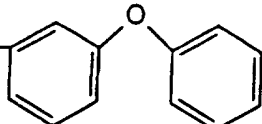
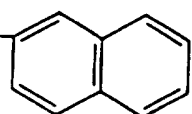


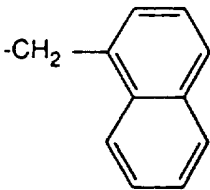
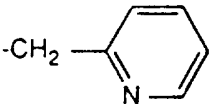
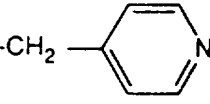
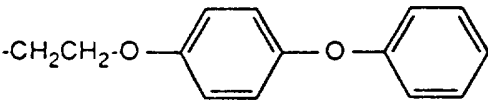
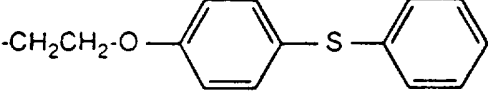
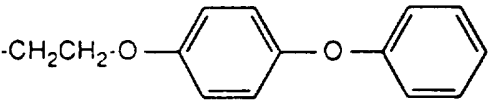
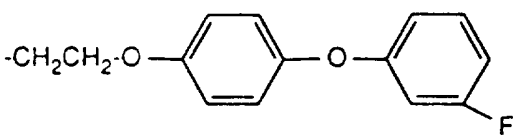
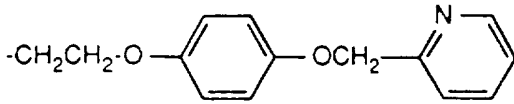
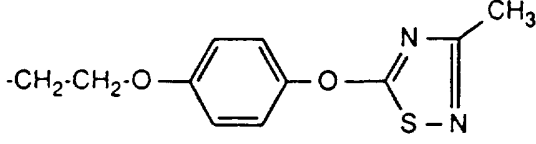
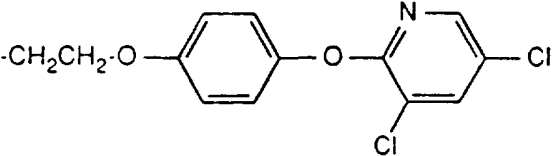
Comp. No.	R	Y	Physical data
2.01	H	-CH <sub>3</sub>	
2.02	CH <sub>3</sub>	-CH <sub>3</sub>	
2.03	C <sub>6</sub> H <sub>13</sub> -n	-C <sub>6</sub> H <sub>13</sub> -n	
2.04	H	-C <sub>6</sub> H <sub>4</sub> -F-(4)	
2.05	H	-C <sub>2</sub> H <sub>5</sub>	
2.06	H	-C <sub>3</sub> H <sub>7</sub> -n	
2.07	H	-C <sub>3</sub> H <sub>7</sub> -i	
2.08	H	-C <sub>4</sub> H <sub>9</sub> -n	
2.09	H	-C <sub>4</sub> H <sub>9</sub> -t	
2.10	H	-C <sub>6</sub> H <sub>13</sub> -n	
2.11	H	-C <sub>10</sub> H <sub>21</sub> -n	
2.12	H	-C <sub>20</sub> H <sub>41</sub> -n	
2.13	H	-CH <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub>	
2.14	H	-CH <sub>2</sub> CH <sub>2</sub> OH	
2.15	H	-CH <sub>2</sub> CH <sub>2</sub> O-COC <sub>6</sub> H <sub>5</sub>	
2.16	H	-CH <sub>2</sub> CH <sub>2</sub> O-COOCH <sub>3</sub>	
2.17	H	-CH <sub>2</sub> CH <sub>2</sub> O-CONHC <sub>6</sub> H <sub>5</sub>	
2.18	H	-CH <sub>2</sub> CH <sub>2</sub> OC <sub>2</sub> H <sub>5</sub>	
2.19	H	-CH <sub>2</sub> CF <sub>3</sub>	
2.20	H	-CH <sub>2</sub> CCl <sub>3</sub>	
2.21	H	-CH(CH <sub>3</sub> )C <sub>6</sub> H <sub>5</sub>	
2.22	H	-CH(CH <sub>3</sub> )C <sub>6</sub> H <sub>5</sub> (R)	
2.23	H	-CH(CH <sub>3</sub> )C <sub>6</sub> H <sub>5</sub> (S)	
2.24	H	-CH <sub>2</sub> -C <sub>6</sub> H <sub>5</sub>	m.p. 50-52°C
2.25	H	-CH <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -NO <sub>2</sub> -(4)	
2.26	H	-CH <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -F-(4)	
2.27	H	-CH <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -Cl-(2)	

Comp. No.	R	Y	Physical data
2.28	H	-C <sub>6</sub> H <sub>5</sub>	
2.29	H	-C <sub>6</sub> H <sub>4</sub> -NO <sub>2</sub> -(4)	
2.30	H	-CH <sub>2</sub> -CH <sub>2</sub> -O- 	
2.31	H		
2.32	H		
2.33	CH <sub>3</sub>	-CH <sub>2</sub> - 	
2.34	CH <sub>3</sub>	-CH <sub>2</sub> - 	
2.35	H	-CH <sub>2</sub> - 	
2.36	H	-C <sub>6</sub> H <sub>4</sub> -CN-(4)	
2.37	H	-C <sub>6</sub> H <sub>4</sub> -CF <sub>3</sub> -(2)	
2.38	H	-C <sub>6</sub> H <sub>4</sub> -C <sub>6</sub> H <sub>5</sub> -(4)	
2.39	H	-C <sub>6</sub> H <sub>4</sub> -CF <sub>3</sub> -(3)	
2.40	H		
2.41	H		
2.42	H	-C <sub>6</sub> H <sub>4</sub> -Cl-(2)	

Comp. No.	R	Y	Physical data
2.43	H	-C <sub>6</sub> H <sub>4</sub> -Cl-(4)	m.p. 126-128°C
2.44	H	-C <sub>6</sub> H <sub>4</sub> -Cl-(3)	
2.45	H	-C <sub>6</sub> H <sub>4</sub> -OCH <sub>3</sub> -(4)	
2.46	H	-C <sub>6</sub> H <sub>4</sub> -CH <sub>3</sub> -(4)	
2.47	H	-C <sub>6</sub> H <sub>4</sub> -SCH <sub>3</sub> -(3)	
2.48	H	H	
2.49	H	-C <sub>16</sub> H <sub>33</sub> -n	
2.50	H	-C <sub>18</sub> H <sub>37</sub> -n	
2.51	H	-C <sub>12</sub> H <sub>25</sub> -n	
2.52	H	-C <sub>9</sub> H <sub>19</sub> -n	
2.53	H	-C <sub>8</sub> H <sub>17</sub> -n	
2.54	H	-CH <sub>2</sub> (CH <sub>3</sub> )-CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	
2.55	H	-CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH	
2.56	H	-CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OCH <sub>3</sub>	
2.57	H	-CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O-SO <sub>2</sub> - 	
2.58	H	-CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O-SO <sub>2</sub> CH <sub>3</sub>	
2.59	H	-CH <sub>2</sub> CH <sub>2</sub> O-CO- 	
2.60	H	-CH <sub>2</sub> CH <sub>2</sub> O-CH <sub>2</sub> CF <sub>3</sub>	
2.61	H	-CH <sub>2</sub> CH <sub>2</sub> N(CH <sub>3</sub> ) <sub>2</sub>	
2.62	H	-CH <sub>2</sub> (CH <sub>3</sub> )-CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> -N(CH <sub>2</sub> CH <sub>3</sub> ) <sub>2</sub>	
2.63	H	-CH <sub>2</sub> CH <sub>2</sub> - 	
2.64	H	-CH <sub>2</sub> CH <sub>2</sub> - 	
2.65	H	-CH <sub>2</sub> (CH <sub>3</sub> )-C(CH <sub>3</sub> ) <sub>3</sub>	
2.66	H	-CH <sub>2</sub> CH(OCH <sub>2</sub> CH <sub>3</sub> ) <sub>2</sub>	
2.67	H	-CH <sub>2</sub> -CO-C <sub>6</sub> H <sub>5</sub>	



Comp. No.	R	Y	Physical data
2.68	H	$-\text{CH}_2-$ 	
2.69	H	$-\text{CH}_2-$ 	
2.70	H	$-\text{CH}_2(\text{CH}_3)-\text{CH}_2\text{OCH}_3$	
2.71	H	$-\text{CH}_2\text{CH}_2-\text{CH}(\text{CH}_3)_2$	
2.72	H	$-\text{CH}_2(\text{CH}_2)_7-\text{CH}=\text{CH}-(\text{CH}_2)_7\text{CH}_3$	
2.73	$\text{CH}_3$	$-\text{C}_{18}\text{H}_{37}-\text{n}$	
2.74	$\text{CH}_3$	$-\text{C}_3\text{H}_7-\text{n}$	
2.75	$\text{CH}_3$	$-\text{CH}_2\text{CH}_2-\text{C}_6\text{H}_5$	
2.76	H	$-\text{CH}_2-\text{C}_6\text{H}_4-\text{OCH}_3-(4)$	
2.77	H	$-\text{CH}_2-\text{C}_6\text{H}_4-\text{F}-(2)$	
2.78	H	$-\text{CH}_2-\text{C}_6\text{H}_3-\text{F}_2-(2,6)$	
2.79	H	$-\text{CH}_2-\text{C}_6\text{H}_3-\text{F}_2-(2,4)$	
2.80	H	$-\text{CH}_2-\text{C}_6\text{H}_3-\text{F}_2-(3,4)$	
2.81	H	$-\text{CH}_2-\text{C}_6\text{H}_4-\text{Cl}-(4)$	
2.82	H	$-\text{CH}_2-\text{C}_6\text{H}_3-\text{Cl}_2-(3,4)$	
2.83	H	$-\text{CH}_2-\text{C}_6\text{H}_4-\text{CF}_3-(4)$	
2.84	H	$-\text{CH}_2-\text{C}_6\text{H}_4-\text{NO}_2-(3)$	
2.85	H	$-\text{CH}(\text{C}_6\text{H}_5)_2$	
2.86	H	$-\text{CH}_2-$ 	
2.87	H	$-\text{CH}(\text{CH}_3)-$ 	
2.88	H	$-\text{CH}_2-$ 	

Comp. No.	R	Y	Physical data
2.89	H		
2.90	H		$n_D^{23}$ : 1.5297
2.91	H		
2.92	H		m.p. 49-51°C
2.93	H		m.p. 40-43°C
2.94	CH <sub>3</sub>		
2.95	H		
2.96	H		
2.97	H		
2.98	H		

Comp. No.	R	Y	Physical data
2.99	H		m.p. 58-60°C
2.100	H		
2.101	H		
2.102	H	-C <sub>6</sub> H <sub>4</sub> -OCF <sub>3</sub> -(4)	n <sub>D</sub> <sup>22</sup> : 1.4904 m.p. 94-96°C
2.103	H	-C <sub>6</sub> H <sub>4</sub> -Si(CH <sub>3</sub> ) <sub>3</sub> -(4)	

Formulation Examples (throughout, percentages are by weight)

Example F1: Emulsifiable concentrates

	a)	b)	c)
compound no. 1.04	25 %	40 %	50 %
calcium dodecylbenzenesulfonate	5 %	8 %	6 %
castor oil polyethylene glycol ether (36 mol of ethylene oxide)	5 %	-	-
tributylphenol polyethylene glycol ether (30 mol of ethylene oxide)	-	12 %	4 %
cyclohexanone	-	15 %	20 %
xylene mixture	65 %	25 %	20 %

Emulsions of any desired concentration can be produced from such concentrates by dilution with water.

Example F2: Solutions

	a)	b)	c)	d)
compound no. 1.03	80 %	10 %	5 %	95 %
ethylene glycol monomethyl ether	20 %	-	-	-
polyethylene glycol				

(mol. wt. 400)	-	70 %	-	-
N-methyl-2-pyrrolidone	-	20 %	-	-
epoxidised coconut oil	-	-	1 %	5 %
petroleum fraction (boiling range 160-190°C)	-	-	94 %	-

The solutions are suitable for application in the form of micro-drops.

<u>Example F3: Granules</u>	a)	b)	c)	d)
compound no. 1.03	5 %	10 %	8 %	21 %
kaolin	94 %	-	79 %	54 %
highly dispersed silicic acid	1 %	-	13 %	7 %
attapulgit	-	90 %	-	18 %

The active ingredient is dissolved in methylene chloride, the solution is sprayed onto the carrier, and the solvent is subsequently evaporated off in vacuo.

<u>Example F4: Dusts</u>	a)	b)
compound no. 1.03	2 %	5 %
highly dispersed silicic acid	1 %	5 %
talcum	97 %	-
kaolin	-	90 %

Ready-for-use dusts are obtained by intimately mixing the carriers with the active ingredient.

<u>Example F5: Wetttable powders</u>	a)	b)	c)
compound no. 2.43	25 %	50 %	75 %
sodium lignosulfonate	5 %	5 %	-
sodium laurylsulfate	3 %	-	5 %
sodium diisobutyl-naphthalene-sulfonate	-	6 %	10 %
octylphenol polyethylene glycol ether (7-8 mol of ethylene oxide)	-	2 %	-
highly dispersed silicic acid	5 %	10 %	10 %

- 35 -

kaolin	62 %	27 %	-
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The active ingredient is mixed with the adjuvants and the mixture is thoroughly ground in a suitable mill, affording wettable powders which can be diluted with water to give suspensions of any desired concentration.

Example F6: Emulsifiable concentrate

compound no. 2.43	10 %
octylphenol polyethylene glycol ether (4-5 mol of ethylene oxide)	3 %
calcium dodecylbenzenesulfonate	3 %
castor oil polyglycol ether (36 mol of ethylene oxide)	4 %
cyclohexanone	30 %
xylene mixture	50 %

Emulsions of any desired concentration can be obtained from this concentrate by dilution with water.

Example F7: Dusts

	a)	b)
compound no. 2.43	5 %	8 %
talcum	95 %	-
kaolin	-	92 %

Ready-for-use dusts are obtained by mixing the active ingredient with the carrier and grinding the mixture in a suitable mill.

Example F8: Extruder granules

compound no. 2.103	10 %
sodium lignosulfonate	2 %
carboxymethylcellulose	1 %
kaolin	87 %

The active ingredient is mixed and ground with the adjuvants, and the mixture is moistened with water. The mixture is extruded, granulated and then dried in a stream of air.

Example F9: Coated granules

compound no. 2.43	3 %
polyethylene glycol (mol. wt. 200)	3 %
kaolin	94 %

The finely ground active ingredient is uniformly applied, in a mixer, to the kaolin moistened with polyethylene glycol. Non-dusty coated granules are obtained in this manner.

Example F10: Suspension concentrate

compound no. 2.43	40 %
ethylene glycol	10 %
nonylphenol polyethylene glycol ether (15 mol of ethylene oxide)	6 %
sodium lignosulfonate	10 %
carboxymethylcellulose	1 %
silicone oil in the form of a 75 % aqueous emulsion	1 %
water	32 %

The finely ground active ingredient is intimately mixed with the adjuvants, giving a suspension concentrate from which suspensions of any desired concentration can be obtained by dilution with water.

Biological Examples

Example B1: Action against Boophilus microplus

Adult female ticks which are replete with blood are affixed to a PVC plate and covered with a cotton wool swab. For treatment, 10 ml of an aqueous test solution comprising 125 ppm of the test compound are poured over the test organisms. The cotton wool swab is then removed and the ticks are incubated for 4 weeks until oviposition has taken place. The action against Boophilus microplus manifests itself either as mortality or sterility of the females or as ovicidal action in the eggs.

In this test, compounds of Tables 1 and 2 exhibit good activity against Boophilus

microplus. In particular, compounds 1.01, 1.02, 1.03, 1.04, 1.62, 2.43, 2.102 and 2.103 are more than 80 % effective.

Example B2: Action against *Nilaparvata lugens*

Rice plants are sprayed with an aqueous emulsion comprising 400 ppm of test compound. After the spray coating has dried, the rice plants are populated with cicada larvae in the 2nd and 3rd stages. Evaluation is made 21 days later. The percentage reduction in the population (% activity) is determined by comparing the number of surviving cicadas on the treated plants with that on untreated plants.

Compounds of Tables 1 and 2 exhibit good activity against *Nilaparvata lugens* in this test. In particular, compounds 1.02, 1.03, 1.04, 1.62, 2.102, 2.103 and 2.024 are more than 80 % effective.

Example B3: Action against *Tetranychus urticae*

Young bean plants are populated with a mixed population of *Tetranychus urticae* and sprayed one day later with an aqueous emulsion comprising 400 ppm of the test compound. The plants are then incubated for 6 days at 25°C and then evaluated. The percentage reduction in the population (% activity) is determined by comparing the number of dead eggs, larvae and adults on the treated plants with that on untreated plants.

Compounds of Tables 1 and 2 exhibit good activity against *Tetranychus urticae* in this test. In particular, compounds 1.01, 1.02, 1.03, 1.04, 1.62, 1.66, 2.24, 2.43, 2.102 and 2.103 are more than 80 % effective.

Example B4: Action against *Aphis craccivora*

Pea seedlings are infested with *Aphis craccivora* and then sprayed with a spray mixture comprising 400 ppm of the test compound, and incubated at 20°C. Evaluation is made 3 and 6 days later. The percentage reduction in the population (% activity) is determined by comparing the number of dead aphids on the treated plants with that on untreated plants.

Compounds of Tables 1 and 2 exhibit good activity against *Aphis craccivora* in this test. In particular, compounds 1.01, 1.02, 1.03, 1.04, 1.62, 1.66, 2.24, 2.43 and 2.103 are more than 80 % effective.

Example B5: Systemic action against *Nilaparvata lugens*

Pots containing rice plants are placed in an aqueous emulsion solution comprising 400 ppm of the test compound. The rice plants are then populated with larvae in the 2nd and 3rd stages. Evaluation is made 6 days later. The percentage reduction in the population (% activity) is determined by comparing the number of cicadas on the treated plants with that on untreated plants.

Compounds of Tables 1 and 2 exhibit good activity against *Nilaparvata lugens* in this test. In particular, compounds 1.01, 2.24 and 2.103 are more than 80 % effective.

Example B6: Action against *Dermanyssus gallinae*

2 to 3 ml of a solution comprising 10 ppm of test compound, and approximately 200 mites at various stages of development, are placed in a glass container that is open at the top. The container is then closed with a cotton wool plug, shaken for 10 minutes until the mites are completely wetted, and then inverted for a short time so that the remaining test solution can be absorbed by the cotton wool. The mortality of the mites is determined 3 days later.

Compounds of Tables 1 and 2 exhibit good activity against *Dermanyssus gallinae* in this test. In particular, compounds 1.01, 1.03 and 1.04 are more than 80 % effective.

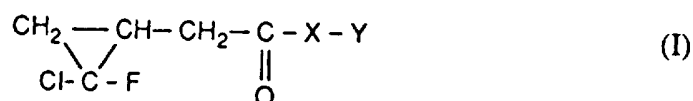
Example B7: Ovicidal/larvicidal action against *Heliothis virescens*

Egg deposits of *Heliothis virescens* on cotton are sprayed with an aqueous emulsion comprising 400 ppm of the test compound. 8 days later, the percentage of eggs which have hatched and the survival rate of the caterpillars are evaluated in comparison with untreated controls (% reduction in the population).

Compounds of Tables 1 and 2 exhibit good activity against *Heliothis virescens* in this test. In particular, compounds 1.01, 1.04, 1.14 and 2.43 are more than 80 % effective.



1. A 2-(2-chloro-2-fluorocyclopropyl)-acetic acid derivative of formula I



wherein

X is oxygen or -NR-,

Y is hydrogen, or is C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, benzyl or aryl, each of which is unsubstituted or substituted, and

R is hydrogen or C<sub>1</sub>-C<sub>6</sub>alkyl.

2. A compound according to claim 1 wherein Y is hydrogen, C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, aryl, C<sub>3</sub>-C<sub>20</sub>haloalkenyl, C<sub>3</sub>-C<sub>20</sub>haloalkynyl; C<sub>3</sub>-C<sub>7</sub>cycloalkyl substituted by halogen or by C<sub>1</sub>-C<sub>4</sub>alkyl; aryl substituted by halogen, C<sub>1</sub>-C<sub>4</sub>alkyl, C<sub>1</sub>-C<sub>4</sub>haloalkyl, C<sub>1</sub>-C<sub>12</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>1</sub>-C<sub>4</sub>alkylthio, nitro, cyano, benzoyl, halobenzoyl, phenoxy, halophenoxy, C<sub>1</sub>-C<sub>4</sub>alkylphenoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylphenoxy, tri-C<sub>1</sub>-C<sub>4</sub>alkylsilyl, N-pyrrolidinyl, N-piperidinyl, N-pyrrolidin-2-onyl, N-piperidin-2-onyl, C<sub>1</sub>-C<sub>4</sub>alkylamino, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, anilino, N-C<sub>1</sub>-C<sub>4</sub>alkylanilino, N-formylanilino, phenylthio or by halophenylthio; or C<sub>1</sub>-C<sub>20</sub>alkyl substituted by hydroxy, halogen, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, cyano, C<sub>2</sub>-C<sub>6</sub>alkoxyalkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylthio, C<sub>1</sub>-C<sub>4</sub>alkylthio, C<sub>1</sub>-C<sub>4</sub>alkylsulfinyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyloxy, C<sub>1</sub>-C<sub>4</sub>alkylcarbonyl, C<sub>1</sub>-C<sub>4</sub>alkoxycarbonyl, C<sub>1</sub>-C<sub>6</sub>alkylcarbonyloxy, C<sub>1</sub>-C<sub>6</sub>alkoxycarbonyloxy, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, aryl, aryloxy, anilino, carbonyloxy, benzyloxy, arylcarbonyloxy, arylthio, arylsulfonyl, arylsulfinyl, arylsulfonyloxy, arylcarbonyl or by pyridyl; it being possible for the aryl and pyridyl groups to be substituted by halogen, C<sub>1</sub>-C<sub>4</sub>alkyl, C<sub>1</sub>-C<sub>4</sub>haloalkyl, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>1</sub>-C<sub>4</sub>alkylthio, nitro, benzyloxy, cyano, phenoxy, halophenoxy, pyridyloxy, halopyridyloxy, C<sub>1</sub>-C<sub>4</sub>haloalkylpyridyloxy, C<sub>1</sub>-C<sub>4</sub>alkylthiadiazolyloxy, phenylthio or by halophenylthio.

3. A compound according to claim 1 wherein X is oxygen, -NH-, -NCH<sub>3</sub>- or -NC<sub>2</sub>H<sub>5</sub>-.

4. A compound according to claim 1 wherein Y is hydrogen, C<sub>1</sub>-C<sub>20</sub>alkyl, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, C<sub>3</sub>-C<sub>20</sub>alkenyl, C<sub>3</sub>-C<sub>20</sub>alkynyl, phenyl, naphthyl, C<sub>3</sub>-C<sub>20</sub>haloalkenyl,

C<sub>3</sub>-C<sub>20</sub>haloalkynyl; C<sub>3</sub>-C<sub>7</sub>cycloalkyl substituted by fluorine, chlorine, bromine or by C<sub>1</sub>-C<sub>3</sub>alkyl; phenyl or naphthyl each substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halophenylthio; or C<sub>1</sub>-C<sub>20</sub>alkyl substituted by hydroxy, fluorine, chlorine, bromine, di-C<sub>1</sub>-C<sub>4</sub>alkylamino, C<sub>1</sub>-C<sub>4</sub>alkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkoxy, C<sub>2</sub>-C<sub>6</sub>alkoxyalkoxy, C<sub>1</sub>-C<sub>4</sub>haloalkylthio, C<sub>1</sub>-C<sub>4</sub>alkylthio, C<sub>1</sub>-C<sub>4</sub>alkylsulfinyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyl, C<sub>1</sub>-C<sub>4</sub>alkylsulfonyloxy, C<sub>1</sub>-C<sub>4</sub>alkylcarbonyl, C<sub>1</sub>-C<sub>4</sub>alkoxycarbonyl, C<sub>1</sub>-C<sub>6</sub>alkylcarbonyloxy, C<sub>3</sub>-C<sub>7</sub>cycloalkyl, phenyl, phenoxy, phenylthio, phenylsulfonyloxy or by pyridyl, it being possible for the phenyl and pyridyl groups to be substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halophenylthio.

5. A compound according to claim 3 wherein X is oxygen or -NH-.

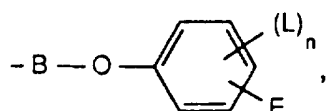
6. A compound according to claim 4 wherein Y is phenyl, benzyl, naphthyl or 3-pyridylmethyl, or phenyl, benzyl, naphthyl or 3-pyridylmethyl each substituted by fluorine, chlorine, bromine, C<sub>1</sub>-C<sub>3</sub>alkyl, C<sub>1</sub>-C<sub>3</sub>haloalkyl, C<sub>1</sub>-C<sub>3</sub>alkoxy, C<sub>1</sub>-C<sub>3</sub>haloalkoxy, C<sub>1</sub>-C<sub>3</sub>alkylthio, nitro, cyano, phenoxy, halophenoxy, phenylthio or by halophenylthio.

7. A compound according to claim 4 wherein Y is C<sub>1</sub>-C<sub>12</sub>alkyl or C<sub>1</sub>-C<sub>12</sub>alkyl substituted by hydroxy, fluorine, chlorine, bromine, dimethylamino, methoxy, ethoxy, methoxyethoxy, ethoxyethoxy, methylthio, ethylthio, cyclopropyl, cyclopentyl, cyclohexyl, phenyl or by phenoxy, it being possible for the phenyl or phenoxy radical to be substituted by fluorine, chlorine, bromine, phenoxy, halophenoxy or by phenylthio.

8. A compound according to claim 4 wherein Y is C<sub>3</sub>-C<sub>12</sub>alkynyl or C<sub>3</sub>-C<sub>12</sub>alkenyl, or is C<sub>3</sub>-C<sub>12</sub>alkenyl or C<sub>3</sub>-C<sub>12</sub>alkynyl each substituted by fluorine, chlorine or by bromine.

9. A compound according to claim 7 wherein X is oxygen or -NR- and R is hydrogen or C<sub>1</sub>-C<sub>4</sub>alkyl.

10. A compound according to claim 1 wherein the radical Y has the following formula:



C<sub>1</sub>-C<sub>4</sub>haloalkylpyridyloxy, C<sub>1</sub>-C<sub>4</sub>alkylthiadiazolyloxy, phenylthio or halophenylthio.

\*B(Oc1ccccc1F)

E is phenoxy, phenylthio or halophenoxy.

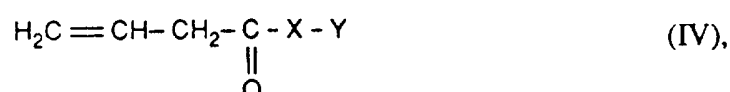
$$\begin{array}{c} \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{C} - \text{Hal} \\ | \quad / \quad || \\ \text{Cl} - \text{C} - \text{F} \\ \text{O} \end{array} \quad (\text{II}),$$

wherein Hal is chlorine or bromine, optionally in an inert solvent and in the presence of an acid-binding agent, with an alcohol or amine of formula III



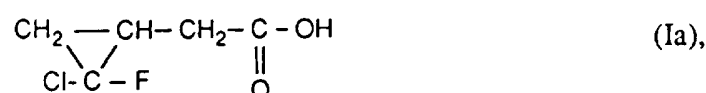
wherein X and Y are as defined under formula I, or

b) reacting a 3-butenic acid derivative of formula IV



wherein X and Y are as defined under formula I, in an inert solvent with chlorofluorocarbene, or

c) reacting the free 2-(2-chloro-2-fluorocyclopropyl)-acetic acid of formula Ia



in the absence or presence of an inert solvent and of a catalyst or of a water-removing agent, with an alcohol or amine of formula III.

14. A pesticidal composition comprising as active ingredient at least one compound of formula I according to claim 1.

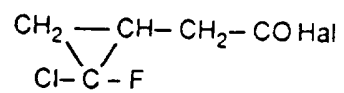
15. A composition according to claim 14 comprising in addition at least one carrier.

16. The use of a compound of formula I according to claim 1 for controlling pests of animals and plants.

17. Use according to claim 16 wherein the pests are plant-destructive insects and arachnids.

18. A method of controlling insects and arachnids that are harmful to animals and plants, which comprises treating the pests or their locus with an effective amount of a compound of formula I according to claim 1.

19. A 2-(2-chloro-2-fluorocyclopropyl)-acetic acid halide of formula II



(II)

wherein Hal is chlorine or bromine.