

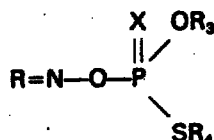
Description

This invention relates to certain insecticidal, acaricidal and nematocidal oxime phosphate compounds. This invention also relates to pesticidal compositions for controlling insects and mites, as well as to methods of controlling insects and mites by subjecting them to an insecticidally, miticidally or nematocidally effective amount of a compound of this invention.

In FR—A—2209767, its equivalent US—A—3949023 and in US—A—3281430 certain oxime—phosphate compounds are disclosed, but which, although structurally closely related to the compounds of the present invention, lack the thiolate group on the phosphorus atom thereof as required by claim 1 of this application.

Example 15 of the French patent was repeated, but the Applicants found that the ethoxymethyl derivative appeared inherently unstable and could not be isolated. However, the methoxyethyl derivative was prepared and it was unexpectedly found that dramatic changes occurred in the pesticidal activity of the resulting compounds by changing the O-ethyl group on the phosphorus head to S-n-propyl.

The compounds of the present invention are compounds of the general formula:



wherein:

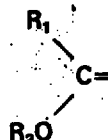
X is oxygen or sulfur;

R₃ and R₄ are individually alkyl; provided that the total number of aliphatic carbon atoms in each of R₃

and R₄ does not exceed six;

R is either:

1.

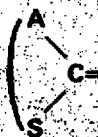


wherein:

R₁ is alkyl, cycloalkyl or phenyl, all of which may be unsubstituted or substituted with one or more alkyl, halogen, alkoxy or alkylthio substituents; provided that the total number of aliphatic carbon atoms in any alkyl, alkoxy or alkylthio substituent may not exceed eight; provided also that the total number of aliphatic carbon atoms in R₁ may not exceed sixteen; and provided further that when R₁ is cycloalkyl, the total number of aliphatic carbon atoms in the cycloalkyl ring structure may not exceed six; and

R₂ is alkyl, provided that the total number of aliphatic carbon atoms in R₂ does not exceed eight; or

2.



wherein:

A is a three- or four-membered divalent aliphatic chain, which may be optionally substituted by one or more alkyl or acyl groups each containing no more than six carbon atoms, and which may include in said chain one or more divalent:

sulfur, sulfinyl, sulfonyl, oxygen, carbonyl, thiono or dicyanomethylidene moieties, or

amino moieties, which may be optionally substituted with alkyl, alkenyl, alkoxyalkyl, or acyl groups having no more than six carbon atoms, or imino moieties of the formula:



wherein Y is alkyl, alkenyl, alkynyl, dialkylamino, cyano, alkylsulfonyl, aryl or arylsulfonyl groups, said aryl groups being optionally substituted with halogen or alkyl substituents having no more than ten carbon atoms.

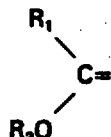
Generally, the preferred compounds of this invention are those wherein:

R_3 and R_4 are different alkyl moieties;

R_3 is ethyl and R_4 is n-propyl.

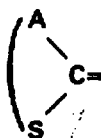
Also preferred are those compounds wherein X is oxygen.

Also preferred are compounds wherein R is a group of the formula:



wherein R_1 is alkyl and R_2 is methyl or ethyl; or R_1 is phenyl and R_2 is methyl or ethyl.

Additional preferred compounds are those wherein R is a group of the formula:

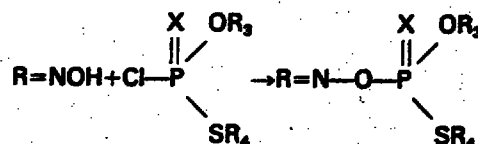


wherein A, C and S form a 2 - oximino - 1,4 - dithiane; 2 - oximino - 1,3 - dithiane; 4 - oximino - 1,3 - dithiolane; 2 - oximino - tetrahydro - 1,4 - thiazine - 3 - one; 2 - oximino - 1,3 - dithiolane; 2 - dicyanomethylidene - 4 - oximino - 1,3 - dithiolane; 2 - oximinothiophane; 4 - oximino - 1,3 - oxathiolane; 5 - oximino - 1,3 - thiazolidin - 4 - one, 2 - oximino - 1,3 - thiazolidin - 4 - one; 2 - oximino - tetrahydro - 1,4 - thiazine; 2 - oximino - 4 - thiono - 1,3 - thiazolidine; 2 - oximino - tetrahydro - 1,4 - thiazin - 5 - one ring structure, wherein said 2 - oximino - tetrahydro - 1,4 - thiazine ring may be substituted by an acyl substituent on its nitrogen moiety.

Activity is particularly great in compounds wherein R is a 2 - imino - 4 - oximino - 1,3 - dithiolane ring structure substituted with alkyl or dialkylamino moieties or wherein R is a 2 - oximino - 1,3 - thiazolidin - 4 - one ring structure substituted with alkyl, alkoxyalkyl, or alkenyl moieties.

The oxime phosphate compounds of this invention can be conveniently prepared by three general methods. The first method is illustrated by the general reaction method set forth below:

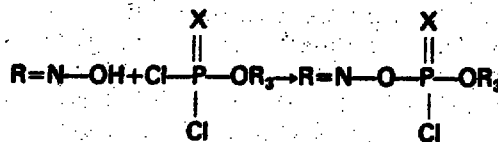
Method I



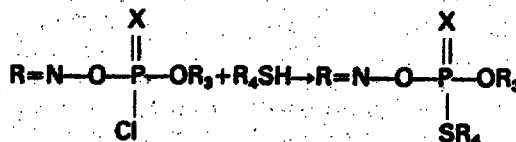
Method I is a one-step reaction wherein an appropriate oxime is reacted with a stoichiometric amount of an appropriate chlorophosphate compound in the presence of at least a stoichiometric amount of an acid acceptor and an inert solvent.

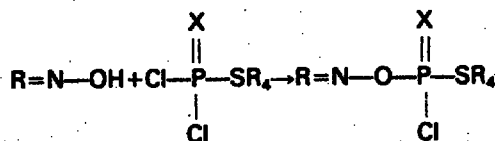
Methods II and III, illustrated by the general reaction methods below, are two-step methods wherein an appropriate oxime is reacted with an appropriate dihalophosphorus compound in the presence of a stoichiometric amount or slight excess of an acid acceptor and an inert solvent.

Method II Step A

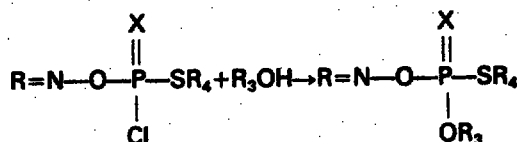


Step B



Method III
Step A

Step B



The reactions illustrated above in Methods I, II and III are conducted in the presence of an acid acceptor which can be either an organic or inorganic base. Illustrative of organic bases which may be used are tertiary amines such as trimethyl amine, triethyl amine, pyridine, 4-dimethylamino pyridine, 1,4-diazabicyclo [2.2.2.] octane. Examples of inorganic bases which may be used are sodium carbonate, potassium carbonate, sodium hydroxide, and sodium hydride.

When an inorganic base is used phase transfer agents may be used to facilitate the transfer of the base across the organic/inorganic phase interface. Illustrative of useful phase transfer agents are crown ether compounds, and quaternary ammonium halide compounds.

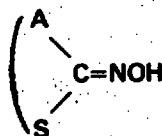
It is preferable to conduct the reactions in the presence of an inert solvent. In general, most organic solvents that are inert to the reactants or reaction conditions may be employed. Illustrative of suitable solvents are aromatic hydrocarbons such as toluene, xylene, and naphthalene; aliphatic hydrocarbons such as methylene chloride, chloroform, carbon tetrachloride and mono-, di- and trichloro ethylene; low-boiling aliphatic ketones and nitriles such as acetone, methylethyl ketone, methylisopropyl ketone, methylisobutyl ketone, acetonitrile, and propionitrile, and ethers such as diethylether, dioxane and tetrahydrofuran. Solvents which are most preferred are acetone, acetonitrile and methylene chloride.

The reactions may also be conducted in the presence of an excess of an acid acceptor which also functions as the solvent. Illustrative of such multi-functional solvents are N,N-dimethyl aniline, pyridine, α-picoline, and any lutidine, collidine or any like aromatic or heterocyclic tertiary amine compound.

The reactions may be conducted over a wide range of temperatures and pressures. It is preferable to conduct them at a temperature between -40°C and 120°C and at atmospheric or autogeneous pressure.

The phosphorus halides and dihalides used as reactants in the above methods are known materials which can be obtained commercially or prepared in accordance with conventional methods known to those skilled in the art.

The alicyclic oxime precursors of the formula:



used in the preparation of the oxime phosphate compounds of this invention can be prepared by a variety of methods.

The oximino-thiazin-5-one compounds used as starting materials in preparing the compounds of this invention can be prepared by the methods disclosed in US-A-4,071,627. In one method, a solution of α-aminoisobutyraldoxime and water is stirred and cooled to 0°C. Chlorine is added to the solution and the mixture is stirred. Ethyl mercaptoacetate and a base, such as sodium hydroxide, are added to produce an oximino - tetrahydro - 1,4 - thiazin - 5 - one.

The oximino - thiazin - 3 - one compounds can be prepared in accordance with a method disclosed in US-A-3,894,150. Ethoxycarbonyl formhydroxamoyl chloride is added to a solution of sodium hydroxide, ethanol and aminoethanethiol to produce an oximino - tetrahydro - 1,4 - thiazin - 3 - one.

The thiazolidinone oxime compounds used as starting materials in Methods I, II and III can be prepared in accordance with the methods described in US-A-3,767,662. A mixture of acetone, thioglycolic acid and methylammonium carbonate in benzene is heated to produce a thiazolidinone ring. To this is added sodium hydride in anhydrous benzene and isopropyl nitrite yielding an oximino-thiazolidinone.

The oximino dithiolane ring structures used as starting materials in preparing the compounds of this invention can be prepared by one of the methods disclosed in US-A-4,156,731. An appropriately-

substituted dithiolate compound is reacted with either an appropriate 2-chlorohydroxamoyl chloride compound or nitro-substituted carbamate compound to produce the oximino-dithiolane.

The oximino-oxathiolane and oximino-oxathiane ring compounds can be prepared in accordance with the methods disclosed in US-A-3,956,500. To prepare oxathiolane oxime compounds, nitroethanol is combined with hydrochloric acid, paraformaldehyde and calcium chloride. After cooling and distilling, the mixture is combined with thiolacetic acid. The product of this reaction is reacted with sodium hydroxide to produce oximinooxathiolane. Oxathiane oximes can be prepared by reacting bis - 2 - bromoethyl ether with sodium nitrite and dimethylsulfoxide. The product of this reaction, bromoethyloxy-nitroethane is then combined with potassium thioacetate. By adding ethanolic sodium hydroxide and 2 - (2 - acetylthioethoxy) - 1 - nitroethane to the product, one skilled in the art can obtain the desired cyclic oximinooxathiane.

The following examples are illustrative of the methods of preparing the compounds of this invention:

Example I

15 Preparation of O-ethyl-S-n-propyl-O-(5,5-dimethyl-2-methylimino-1,3-dithiolane-4-ylimino)-phosphorothioate (Method I)

A 100 ml flask was equipped with a magnetic stirrer, condenser, drying tube and thermometer. The glassware was dried thoroughly and charged with 3.6 g (0.019 mole) of 5,5 - dimethyl - 2 - methylimino - 1,3 - dithiolane - 4 - oxime, 25 ml acetone and 3 g (0.021 mole) potassium carbonate. The mixture was heated to 50°C for thirty minutes and then cooled to 40°C at which time 3.44 g (0.017 mole) of O - ethyl - S - propyl phosphorochloridate was added dropwise. The material was then allowed to stir overnight at room temperature.

The material was poured into 150 ml of water and extracted with toluene (2x100 ml). The toluene layer was extracted with water (2x100 ml) and then with 2N sodium hydroxide and again with water until the pH was 7. The toluene solution was dried with anhydrous magnesium sulfate and filtered through carbon black. The resulting solution was concentrated and purified on a low pressure liquid chromatography column to yield 3.0 g of a viscous oil as the desired product.

Calc'd for $C_{11}H_{21}N_2O_3PS_2$: C, 37.08; H, 5.90

Found: C, 36.82; H, 6.04

Example II

Preparation of O-ethyl-S-propyl-O-(3-allyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)-phosphorothioate (Method I)

35 A 100 ml flask was equipped with a magnetic stirrer, condenser, drying tube and thermometer. The glassware was dried thoroughly and charged with 4.0 g (0.02 mole) of 3 - allyl - 5,5 - dimethyl - 4 - oxo - thiazolidine - 2 - oxime, 50 ml acetone, and 3.17 g (0.023 mole) potassium carbonate. The mixture was heated to 50°C for thirty minutes and then cooled to 40°C at which time 4.5 g (0.022 mole) of O - ethyl - S - n - propyl phosphorochloridate was added dropwise. The material was then allowed to stir overnight at room temperature.

The mixture was extracted with ethyl ether and toluene and the organic layers combined and washed with sodium bicarbonate until the pH 7. The organic layer was dried with anhydrous magnesium sulfate, filtered and concentrated. The residue was dissolved in pentane and cooled to -70°C at which time the pentane layer separated from an oil. The pentane was decanted and the oil taken up in ethyl ether, dried, filtered and concentrated to yield 1.0 g of the desired product.

Calc'd for $C_{13}H_{23}N_2O_4PS_2$: C, 42.62; H, 6.28

Found: C, 42.45; H, 6.50

Example III

Preparation of O-ethyl-S-propyl-O-(5-methyl-1,3-oxathiolan-4-ylimino)-phosphorothioate (Method I)

50 A 100 ml flask was equipped with a magnetic stirrer, condenser, drying tube and thermometer. The glassware was thoroughly dried and charged with 5.32 g (0.04 mole) of 5 - methyl - 4 - oximino 1,3 - oxathiolane, 50 ml acetonitrile and 6.38 (0.046 mole) potassium carbonate. The mixture was heated to 55°C for one hour and then cooled to 40°C at which time 8.10 g (0.04 mole) of O-ethyl-S-n-propyl phosphorochloridate was added dropwise. The material was then heated for an additional six hours at 55°C and then cooled to room temperature and stirred overnight.

The material was poured into 150 ml of water and extracted with ethyl ether (1x100 ml), toluene (1x100 ml) and methylene chloride (1x50 ml). The organic layers were combined and washed quickly with 200 ml 8N sodium hydroxide followed by several water washes. The organic layer was dried over magnesium sulfate (anhydrous), containing carbon black, and then filtered and concentrated. The resulting oil was purified on a low pressure liquid chromatography unit to yield 1.2 g of the desired product.

Calc'd for $C_9H_{15}NO_4PS_2$: C, 36.72; H, 6.02

Found: C, 36.54; H, 6.11

Example IV

Preparation of acetohydroxamic acid methyl ester (Method I, preparation of oxamic acid ester reactant)

A 170 g (1.23 mol) quantity of anhydrous potassium carbonate was dissolved in 375 ml of distilled water and cooled with an ice bath to 5°C. To this solution was added 67.2 g (0.61 mol) of methylacetimidate hydrochloride. The ice bath was removed and the reaction mixture was warmed to 25°C over a ten-minute period and then stirred for an additional ten minutes. The aqueous solution was extracted with ether and the combined ether layers were extracted with water. The resulting ether solution was added to a vigorously stirred solution of 52.9 g (0.76 mol) of hydroxylamine hydrochloride in 180 ml of water which had been cooled to 5°C. The reactants were stirred at 25°C for ten minutes. The ether layer was separated and the aqueous layer was extracted with ether. The combined ether layers were dried with sodium sulfate and concentrated under vacuum to give 13.1 g (24%) of acetohydroxamic acid methyl ester.

Example V

Preparation of cyclohexanehydroxamic acid methyl ester (Method I, preparation of oxamic acid ester reactant)

A 17.10 g (0.13 mol) quantity of cyclohexanecarboxyaldehyde oxime and sodium bicarbonate in an aqueous methanol reaction medium, were dissolved in 250 ml of ether and cooled in an ice bath. Into this medium was bubbled 9.55 g (0.13 mol) of chlorine gas at a rate of 0.7 g per minute. The reaction mixture was allowed to stand at 25°C for 20 minutes before filtering. Concentration of the filtrate afforded 16.7 g of cyclohexanehydroxamoyl chloride. An 8.0 g (49.5 mmol) quantity of cyclohexanehydroxamoyl chloride was dissolved in 125 ml of methanol and slowly added over 5 hours to a freshly prepared solution of sodium methoxide (4.6 g, i.e. 200 mmol of sodium in 250 ml of methanol). The reaction mixture was stirred overnight at 25°C, concentrated under vacuum and extracted with 2N sodium hydroxide. The basic aqueous solution was extracted with ether. The ether extract was concentrated under vacuum to yield 4.9 g of crude product, which was washed with hexane, leaving 1.9 g of white solid product of cyclohexanehydroxamic acid methyl ester.

Example VI

Preparation of O-ethyl-S-propyl-O-(1-methoxyethylidenamino)phosphorothioate (Method I)

A 40 g (44.9 mmol) quantity of acetohydroxamic acid methyl ester was dissolved in 85 ml of methylene chloride and cooled in an ice bath. To this mixture 6.4 ml (46 mmol) of triethylamine was added and the resulting mixture stirred at 25°C for 30 minutes. 9.39 g (46 mmol) of O-ethyl-S-propylchlorophosphate dissolved in 15 ml of dichloromethane was then added dropwise. The reaction was stirred overnight at 25°C. Ether was added before filtration and the mixture was concentrated under vacuum. The resulting oil was dissolved in ether and washed successively with water, 1% aqueous hydrochloric acid, water, 2% sodium bicarbonate, saturated sodium chloride and dried with magnesium sulfate. The product was then concentrated to afford 10.1 g of crude product. Chromatography on silica gel yielded 6.7 g (58%) of O-ethyl-S-propyl-O-(1-methoxyethylidenamino)-phosphorothioate.

Calc'd for $C_9H_{18}NO_4PS$: C, 37.64; H, 7.11; N, 5.49
Found: C, 37.95; H, 7.36; N, 5.41

O-Ethyl-S-propyl-O-(1-ethoxy-ethylidenamino)phosphorothioate can also be conveniently prepared according to method I as illustrated in Example VI, but may be purified with a sodium hydroxide wash.

Calc'd for $C_9H_{20}NO_4PS$: C, 40.15; H, 7.43; N, 5.20.
Found: C, 40.53; H, 7.67; N, 5.62

Example VII

Preparation of O-ethyl-S-propyl-O-(1-methoxyethylidenamino)-phosphorodithioate (Method I)

A 2.0 g (22.4 mmol) quantity of acetohydroxamic acid methyl ester was dissolved in 100 ml of acetonitrile. Added to this was 1.65 g (25 mmol) of 85% powdered potassium hydroxide followed by a catalytic amount of 18-crown-6-ether. The reaction mixture was stirred for twenty minutes at 25°C. After stirring, 5.47 g (25 mmol) of O-ethyl-S-propylchlorothiophosphate was added. The reaction mixture was stirred for two days at 25°C and then filtered and concentrated under vacuum. The resulting product was dissolved in ether and washed successively with water, 1% aqueous hydrochloric acid, 2N sodium hydroxide, water, and dried with anhydrous magnesium sulfate. The product was then concentrated under vacuum to yield 4.8 g of crude product which was chromatographed on silica gel to afford 3.6 g (59%) of O-ethyl-S-propyl-O-(1-methoxyethylidenamino)-phosphorothioate.

Calc'd for $C_9H_{18}NO_3PS_2$: C, 35.41; H, 6.68; N, 5.16
Found: C, 35.68; H, 6.85; N, 5.09

The following compounds are illustrative of this invention all of which can be conveniently prepared by the processes of this invention simply by selecting appropriate starting materials:

- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - methylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - methylimino - 1,3 - dithiolan - 4 - ylimino)phosphorodithioate.
- 5 O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - isopropylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - isopropylimino - 1,3 - dithiolan - 4 - ylimino)phosphorodithioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - sec - butylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- 10 O - Ethyl - S - butyl - O - (5,5 - dimethyl - 2 - sec - butylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - tert - butylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- 15 O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - octylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - tert - octylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - (1,1 - diethylpropynylimino) - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- 20 O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - dimethylhydrazono - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - cyanoimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- 25 O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - methylsulfonylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - (4' - methylphenylsulfonylimino) - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - (4' - methylphenylsulfonylimino) - 1,3 - dithiolan - 4 - ylimino)phosphorodithioate.
- 30 O - Ethyl - S - butyl - O - (5,5 - dimethyl - 2 - (4' - methylphenylsulfonylimino) - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - dicyanomethylidene - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- 35 O - Ethyl - S - isopropyl - O - (5,5 - dimethyl - 2 - dicyanomethylidene - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - dicyanomethylidene - 1,3 - dithiolan - 4 - ylimino)phosphorodithioate.
- O - Ethyl - S - propyl - O - (3,5,5 - trimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- 40 O - Ethyl - S - isopropyl - O - (3,5,5 - trimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (3,5,5 - trimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorodithioate.
- 45 O - Ethyl - S - butyl - O - (3,5,5 - trimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - ethyl - O - (3,5,5 - trimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (3 - propyl - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- 50 O - Ethyl - S - isopropyl - O - (3 - propyl - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (3 - isopropyl - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- 55 O - Ethyl - S - propyl - O - (3 - isopropyl - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorodithioate.
- O - Ethyl - S - propyl - O - (3 - allyl - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- 60 O - Ethyl - S - propyl - O - (3 - (2 - methylallyl) - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - isopropyl - O - (3 - (2 - methylallyl) - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- O - Ethyl - S - propyl - O - (3 - (2 - methoxyethyl) - 5,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
- 65

- O - Ethyl - S - propyl - O - (3,5 - dimethyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - isopropyl - 5 - methyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 5 O - Ethyl - S - propyl - O - (3 - isopropyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - isobutyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - allyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - (2 - methylallyl) - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 10 O - Ethyl - S - propyl - O - (3,5,5 - trimethyl - 4 - thiono - 1,3 - thiazolidin - 2 - ylimino)phosphorodithioate.
 O - Ethyl - S - propyl - O - (5 - methyl - 1,3 - oxathiolan - 4 - ylimino)phosphorothioate.
 O - Ethyl - S - butyl - O - (5 - methyl - 1,3 - oxathiolan - 4 - ylimino) - phosphorothioate.
 15 O - Ethyl - S - propyl - O - (1,3 - dithiolan - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - methyl - tetrahydro - 5 - oxo - 1,4 - thiazin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1,4 - dithian - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (2 - methylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 20 O - Ethyl - S - butyl - O - (5 - hexyl - 5 - methyl - 2 - methylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 O - Propyl - S - pentyl - O - (5 - octyl - 2 - methylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 O - Propyl - S - butyl - O - (2 - dicyanomethylidene - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 25 O - Ethyl - S - sec - butyl - O - (3 - methyl - 5 - octyl - 4 - oxo - 1,3 - thiazolidin - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (3 - hexyl - 5,5 - dimethyl - 4 - thiono - 1,3 - thiazolidin - 2 - ylimino)phosphorodithioate.
 O - Ethyl - S - propyl - O - (tetrahydro - 3 - oxo - 1,4 - thiazin - 2 - ylimino)phosphorothioate.
 30 O - Ethyl - S - propyl - O - (thiophan - 2 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (5,5 - dimethyl - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - ethoxy - 2 - methylpropylidenamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - isopropoxypropylidenamino)phosphorothioate.
 35 O - Ethyl - S - propyl - O - (1 - methoxy - 4' - methylbenzylidenamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - ethoxy - 2 - methoxyethylidenamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - butoxy - 4' - chlorobenzylidenamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - methoxy - 4' - methylbenzylidenamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - ethoxycyclohexylmethylideneamino)phosphorodithioate.
 40 O - Ethyl - S - propyl - O - (1 - methoxycyclopentylmethylideneamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - methoxynonylideneamino)phosphorothioate.
 O - Ethyl - S - propyl - O - (1 - ethoxycyclopropylmethylidenamino)phosphorothioate.
 O - Ethyl - S - butyl - O - (1 - ethoxy - 2,2 - dimethylpropylidenamino)phosphorothioate.

45 Selected species of the new compounds were evaluated to determine their pesticidal activity against mites, mite eggs, an aphid, a caterpillar, a beetle, a fly and a nematode.

Suspensions of the test compounds were prepared by dissolving one gram of compound in 50 ml of acetone in which had been dissolved 0.1 g (10 per cent of the weight of the compound) of an alkylphenoxy polyethoxyethanol surfactant, as an emulsifying or dispersing agent. The resulting solution was mixed into 50 150 ml of water to give roughly 200 ml of a suspension containing the compound in finely divided form. The thus-prepared stock suspension contained 0.5 per cent by weight of compound. The concentrations in parts per million by weight employed in the tests described hereinbelow were obtained by appropriate dilutions of the stock suspension with water. The test procedures were as follows:

55 Bean aphid foliage spray test

Adults and nymphal stages of the bean aphid (*Aphis fabae* Scop.) reared on potted dwarf nasturtium plants at 18.3—21.1°C (68°—70°F) and 50±5 per cent relative humidity, constituted the test insects. For testing purposes, the number of aphids per pot was standardized to 100—150 by trimming plants containing excess aphids.

60 The test compounds were formulated by diluting the stock suspension with water to give a suspension containing 500 parts of test compound per million parts of final formulation.

The potted plants (one pot per compound tested) infested with 100—150 aphids were placed on a revolving turntable and sprayed with 100—110 milliliters of test compound formulation by use of a DeVilbiss spray gun set at 276 kN/m² (40 psig) air pressure. This application, which lasted 25 seconds, was 65 sufficient to wet the plants to run-off. As a control, 100—110 milliliters of a water-acetone-emulsifier

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solution containing no test compound were also sprayed on infested plants. After spraying, the pots were placed on their sides on a sheet of white standard mimeograph paper which had been previously ruled to facilitate counting. Temperature and humidity in the test room during the 24 hour holding period were 18.3—21.1°C (68°—70°F) and 50±5 per cent, respectively. Aphids which fell onto the paper and were unable to remain standing after being uprighted were considered dead. Aphids remaining on the plants were observed closely for movement and those which were unable to move the length of the body upon stimulation by prodding were considered dead. Per cent mortality was recorded for various concentration levels.

10 Southern armyworm leaf spray bait test

Larvae of the southern armyworm (*Spodoptera eridania*, (Cram.)), reared on Tendergreen bean plants at a temperature of 26.7±2.8°C (80±5°F.) and a relative humidity of 50±5 per cent, constituted the test insects.

The test compounds were formulated by diluting the stock suspension with water to give a suspension containing 500 parts of test compound per million parts of final formulation. Potted Tendergreen bean plants of standard height and age were placed on a revolving turntable and sprayed with 100—110 milliliters of test compound formulation by use of a DeVilbiss spray gun set at 276 kN/m² (40 psig) air pressure. This application, which lasted 25 seconds, was sufficient to wet plants to run-off. As a control, 100—110 milliliters of a water-acetone-emulsifier solution containing no test compound were also sprayed on infested plants. When dry, the paired leaves were separated and each one was placed in a 9 centimeter Petri dish lined with moistened filter paper. Five randomly selected larvae were introduced into each dish and the dishes were closed. The closed dishes were labeled and held at 26.7—29.4°C (80—85°F) for three days. Although the larvae could easily consume the whole leaf within twenty-four hours, no more food was added. Larvae which were unable to move the length of the body, even upon stimulation by prodding, were considered dead. Per cent mortality was recorded for various concentration levels.

Mexican bean beetle leaf spray test

Fourth instar larvae of the Mexican bean beetle (*Epilachna varivestis*, Muls.), reared on Tendergreen bean plants at a temperature of 26.7±2.8°C (80±5°F.) and 50±5 per cent relative humidity, were the test insects.

The test compounds were formulated by diluting the stock suspension with water to give a suspension containing 500 parts of test compound per million parts of final formulation. Tendergreen bean plants of standard height and age were placed on a revolving turntable and sprayed with 100—110 milliliters of test compound formulation by use of a DeVilbiss spray gun set at 276 kN/m² (40 psig) air pressure. This application, which lasted 25 seconds, was sufficient to wet plants to run-off. As a control, 100—110 milliliters of a water-acetone-emulsifier solution containing no test compound were also sprayed on infested plants. When dry, the paired leaves were separated and each was placed in a 9 centimeter Petri dish lined with moistened filter paper. Five randomly selected larvae were introduced into each dish, and the dishes were closed. The closed dishes were labeled and held at a temperature of 26.7±2.8°C (80±5°F.) for three days. Although the larvae could easily consume the leaf within 24 to 48 hours, no more food was added. Larvae which were unable, to move the length of the body, even upon stimulation, were considered dead.

Southern armyworm ovicide test

The test organism was the egg of the Southern armyworm (*Spodoptera eridania* (Cram.)) as obtained from adults reared on Tendergreen bean plants at a temperature of 26.7±2.8°C (80±5°F) and a relative humidity of 50±5 per cent. The eggs were laid on freezer paper (Marlon 717, Copco paper). The paper was then cut into small sections containing one or two egg masses.

The test compounds were formulated by diluting the stock suspension with water to give a suspension containing 500 parts of test compound per million parts of final formulation. The egg masses were dipped until they were thoroughly wet (5—10 seconds). They were then placed on a paper towel face up and were allowed to dry for 15—30 minutes. The dry eggs were placed in a 15×60 mm petri dish containing a cotton dental wick saturated with a 5 per cent sodium chloride solution to maintain a high level of humidity. The closed dishes were labeled and held at a temperature of 26.7±2.8°C (80±5°F) for four days. Larvae that emerged from the eggs, even if dead at the time of observation, were recorded as hatched.

Mite foliage spray test

Adults and nymphal stage of the two-spotted mite (*Tetranychus urticae* Koch), reared on Tendergreen bean plants at 80±5 per cent relative humidity, were the test organisms. Infested leaves from a stock culture were placed on the primary leaves of two bean plants 152 to 203 mm (six to eight inches) in height, growing in a 63.5 mm (two-and-a-half inch) clay pot. 150—200 mites, a sufficient number for testing, were transferred from the excised leaves to the fresh plants in a period of twenty-four hours. Following the twenty-four hour transfer period, the excised leaves were removed from the infested plants. The test compounds were formulated by diluting the stock suspension with water to give a suspension containing 500 parts of test compound per million parts of final formulation. The potted plants (one pot per

compound) were placed on a revolving turntable and sprayed with 100—110 milliliters of test compound formulation by use of a DeVilbiss spray gun set at 276 kN/m² (40 psig.) air pressure. This application, which last 25 seconds, was sufficient to wet the plants to run-off. As a control, 100—110 milliliters of a water solution containing acetone and emulsifier in the same concentrations as the test compound formulation, but containing no test compound, were also sprayed on infested plants. The sprayed plants were held at 80±5 per cent relative humidity for six days, after which a mortality count of motile forms was made. Microscopic examination for motile forms was made on the leaves of the test plants. Any individual which was capable of locomotion upon prodding was considered living.

10 Mite ovicide test

The test organism was the egg of the two-spotted mite (*Tetranychus urticae* Koch) as obtained from adults reared on Tendergreen bean plants under controlled conditions of 26.7±2.8°C (80±5°F.) and 50±5 per cent relative humidity. Heavily infested leaves from a stock culture were placed on the primary leaves of 2 bean plants 152 to 203 mm (6 to 8 inches) in height, growing in a 63.5 mm (2-1/2 inch) clay pot. Females were allowed to oviposit for a period of 48 hours and then the leaves of the infested plants were dipped in a solution containing 800 parts of tetraethyl pyrophosphate per million parts of water in order to destroy the reproductive forms and thus prevent further egg-laying. This solution of tetraethyl pyrophosphate does not affect the viability of the eggs. The plants were allowed to dry thoroughly.

The potted plants (one pot per compound) were placed on a revolving turntable and sprayed with 100—110 milliliters of test compound formulation by use of a DeVilbiss spray gun set at 276 kN/m² (40 psig) air pressure. This application, which lasted 30 seconds, was sufficient to wet the plants to run-off. As a control, 100—110 milliliters of a water solution containing acetone and emulsifier in the same concentrations as the test compound formulation, but containing no test compound, were also sprayed on plants infested with eggs. The sprayed plants were held at 26.7±2.8°C (80±5°F) and 50±5 per cent relative humidity for 6 days, after which a microscopic examination was made of unhatched (dead) and hatched (living) eggs. Percent mortality was recorded for various concentration levels.

Fly bait test

Four to six day old adult house flies (*Musca domestica*, L.), reared according to the specifications of the Chemical Specialties Manufacturing Association (Blue Book, McNair-Dorland Co., N. Y. 1954; pages 243—244, 261) under controlled conditions of 26.7±2.8°C (80±5°F.) and 50±5 per cent relative humidity, were the test insects. The flies were immobilized by anesthetizing with carbon dioxide and twenty-five immobilized individuals, males and females, were transferred to a cage consisting of a standard food strainer about 127 mm (five inches) in diameter which was inverted over a wrapping-paper-covered surface. The test compounds were formulated by diluting the stock suspension with a 10 per cent (by weight) sugar solution to give a suspension containing 500 parts of test compound per million parts of final formulation, by weight. Ten milliliters of the test formulation were added to a souffle cup containing a 25.4 mm (one-inch) square of an adsorbent cotton pad. This bait cup was introduced and centered on the blotting paper under the good strainer prior to admitting the anesthetized flies. The cages flies were allowed to feed on the bait for twenty-four hours, at a temperature of 26.7±2.8°C (80±5°F.) and a relative humidity of 50±5 per cent. Flies which showed no sign of movement on prodding were considered dead.

Nematocide test

The test organism used was the infective migratory larvae of the root-knot nematode, *Meloidogyne incognita* var. *acrita*, reared in the greenhouse on roots of cucumber plants. Infected plants were removed from the culture, and the roots chopped very finely. A small amount of this inoculum was added to a pint jar containing approximately 180 cc. of soil. The jars were capped and incubated for one week at room temperature. During this period eggs of the nematode were hatched, and the larval forms migrated into the soil.

Ten ml. of the test formulation were added to each of the two jars for each dosage tested. Following the addition of chemical, the jars were capped, and the contents thoroughly mixed on a ball mill for 5 minutes.

The test compounds were formulated by a standard procedure of solution in acetone, addition of an emulsifier, and dilution with water. Primary screening tests were conducted at 3.33 mg. of the test compound per jar.

The jars were left capped at room temperature for a period of 48 hours, and the contents then transferred to 76 mm (3 inch) pots. Subsequently, the pots were seeded to cucumber as an indicator crop and placed in the greenhouse where they were cared for in the normal fashion for approximately 3 weeks.

The cucumber plants were then taken from the pots, the soil removed from the roots, and the amount of galling visually rated.

The results of these tests together with physical properties of the tested compounds are set forth in Table I below. In these tests the pesticidal activity of the compounds at the indicated dosage rate against aphid, mite, Southern Armyworm, Bean Beetle, housefly and was rated as follows:

A=excellent control

B=partial control

C=no control at 500 ppm.

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In the test for activity against nematodes activity was rated as follows:

1=severe galling, equal to untreated plants

2=moderate galling

3=light galling

4=very light galling

5=no galling, perfect control

Dashes indicate no test conducted.

The compounds contemplated in this invention may be applied as insecticides, miticides and nematocides according to methods known to those skilled in the art. Pesticidal compositions containing the compounds as the active toxicant will usually comprise a carrier and/or diluent, either liquid or solid.

Suitable liquid diluents or carriers include water, petroleum distillates, or other liquid carriers with or without surface active agents. Liquid concentrates may be prepared by dissolving one of these compounds with a nonphytotoxic solvent such as acetone, xylene, or nitrobenzene and dispersing the toxicants in water with the aid of suitable surface active emulsifying and dispersing agents.

The choice of dispersing and emulsifying agents and the amount employed is dictated by the nature of the composition and the ability of the agent to facilitate the dispersion of the toxicant. Generally, it is desirable to use as little of the agent as is possible, consistent with the desired dispersion of the toxicant in the spray so that rain does not re-emulsify the toxicant after it is applied to the plant and wash it off the plant. Non-ionic, anionic, amphoteric, or cationic dispersing and emulsifying agents may be employed, for example, the condensation products of alkylene oxides with phenol and organic acids, alkyl aryl sulfonates, complex ether alcohols, and quaternary ammonium compounds.

In the preparation of wettable powder or dust or granulated compositions, the active ingredient is dispersed in and on an appropriately divided solid carrier such as clay, talc, bentonite, diatomaceous earth, and fullers earth. In the formulation of the wettable powders the aforementioned dispersing agents as well as lignosulfonates can be included.

The required amount of the toxicants contemplated herein may be applied in from 0.94 ml/m²—0.188 l/m² (1 to 200 gallons per acre or more of liquid carrier and/or diluent or in from 0.56 to 56 g/m² (5 to 500 pounds per acre of inert solid carrier and/or diluent. The concentration in the liquid concentrate will usually vary from 10 to 95 per cent by weight and in the solid formulations from 0.5 to 90 per cent by weight. Satisfactory sprays, dusts, or granules for general use contain from 0.028 to 1.68 g/m² (1/4 to 15 pounds per acre of active toxicant.

The pesticides contemplated herein control the population of insects, nematodes, mites and mite and insect ova upon plants or other material to which the pesticides are applied. Certain of the compounds of this invention, particularly the non-heterocyclic compounds, possess fumigant properties. Generally, when used in sufficient amount to kill or repel the insects, they do not burn or injure the plant. The toxicants are compatible with substantially any other constituents of the spray schedule, and they may be used in the soil, upon the seeds, or the roots of plants without injuring either the seeds or roots of plants. They may also be used in combination with other pesticidally active compounds.

TABLE I
Biological and analytical properties of the compounds of this invention

	Spectral data	Biological activity				
		Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly Nematode
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-methylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.58—3.98 (m, 2H, OCH ₂); 3.42—2.60 (m, 5H); 2.05—0.83 (m, 14H)	A	A	A	B	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-methylimino-1,3-dithiolan-4-ylimino)phosphorodithioate	(CDCl ₃) δ 4.63—3.98 (m, 2H, OCH ₂); 3.39—2.65 (m, 5H); 2.03—0.82 (m, 14H)	A	A	A	A	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-isopropylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.60—3.96 (m, 2H, OCH ₂); 3.61—2.59 (m, 3H); 1.98—0.82 (m, 20H)	A	A	A	A	A 3
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-isopropylimino-1,3-dithiolan-4-ylimino)phosphorodithioate	(CDCl ₃) δ 4.65—4.00 (m, 2H, OCH ₂); 3.70—2.60 (m, 3H); 2.15—0.75 (m, 20H)	A	A	A	A	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-sec-butylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.60—3.86 (m, 2H, OCH ₂); 3.40—2.52 (m, 3H); 2.05—0.80 (m, 22H)	A	A	A	A	A 5
O-Ethyl-S-butyl-O-(5,5-dimethyl-2-sec-butylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.53—3.97 (m, 2H, OCH ₂); 3.42—2.46 (m, 3H); 1.98—0.68 (m, 24H)	A	A	A	A	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-tert-butylimino-1,3-dithiolan-4-ylimino)phosphorothioate (C ₁₄ H ₂₇ N ₂ O ₃ PS ₃)	Found: C, 42.59; H, 6.87	A	A	A	A	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-octylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.50—3.92 (m, 2H, OCH ₂); 3.68—2.53 (m, 4H); 2.03—0.65 (m, 29H)	C	A	A	A	A 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-tert-octylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.53—3.84 (m, 2H, OCH ₂); 3.60—2.49 (m, 2H, SCH ₂); 2.10—0.78 (m, 31H)	C	A	C	C	A 1

TABLE I (Continued)

	Spectral data	Biological activity				
		Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly Nematode
O-Ethyl-S-butyl-O-(5,5-dimethyl-2-(4'-methylphenylsulfonylimino)-1,3-dithiolan-4-ylimino)phosphorothioate ($C_{18}H_{22}N_2O_6PS_4$)	Found: C, 43.20; H, 5.65	C	A	A	A	B 1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-dicyanomethylidene-1,3-dithiolan-4-ylimino)phosphorothioate ($C_{13}H_{16}N_4O_3PS_3$)	Found: C, 40.37; H, 4.73	A	A	A	B	A
O-Ethyl-S-isopropyl-O-(5,5-dimethyl-2-dicyanomethylidene-1,3-dithiolan-4-ylimino)phosphorothioate ($C_{13}H_{16}N_4O_3PS_3$)	Found: C, 39.87; H, 4.81	C	A	A	B	A
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-dicyanomethylidene-1,3-dithiolan-4-ylimino)phosphorodithioate ($C_{13}H_{16}N_4O_2PS_4$)	Found: C, 38.42; H, 4.53	C	A	A	B	A 1
O-Ethyl-S-propyl-O-(3,5,5-trimethyl-4-oxo-1,3-thiazolidin-2-ylimino)-phosphorothioate	(CDCl ₃) δ 4.51—3.90 (m, 2H, OCH ₂); 3.38—2.51 (m, 5H); 2.00—0.81 (m, 14H)	A	A	A	A	A 1
O-Ethyl-S-isopropyl-O-(3,5,5-trimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	(CDCl ₃) δ 4.64—3.81 (m, 3H); 3.26 (s, 3H); 2.28—0.79 (m, 15H)	B	A	A	C	A 1
O-Ethyl-S-propyl-O-(3,5,5-trimethyl-4-oxo-1,3-thiazolidin-2-ylimino)-phosphorodithioate ($C_{11}H_{12}N_2O_3PS_3$)	Found: C, 36.87; H, 6.04	A	A	A	A	A 5
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-(1,1-diethylpropynylimino)-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ 4.55—3.95 (m, 2H, OCH ₂); 3.30—2.70 (m, 2H, 5CH ₂); 2.15—0.85 (m, 25H)	C	A	A	A	A —
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-dimethylhydrazono-1,3-dithiolan-4-ylimino)phosphorothioate ($C_{12}H_{18}N_2O_3PS_3$)	Found: C, 37.49; H, 6.34	A	A	A	A	A 1

"A dash indicates no test was conducted.

TABLE 1 (Continued)

	Spectral data	Biological activity				
		Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly Nematode
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-cyanoimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ4.45—3.95 (m, 2H, OCH ₂); 3.15—2.55 (m, 2H, SCH ₂); 1.95—0.80 (m, 14H)	C	A	B	B	1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-methylsulfonylimino-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ4.65—3.85 (m, 2H, OCH ₂); 3.35—2.53 (m, 5H); 2.10—0.75 (m, 14H)	C	A	A	A	1
O-Ethyl-S-propyl-O-(5,5-dimethyl-2-(4'-methylphenylsulfonylimino)-1,3-dithiolan-4-ylimino)phosphorothioate	(CDCl ₃) δ8.07—7.11 (m, 4H, aromatic); 4.49—3.84 (m, 2H, OCH ₂); 3.23—2.52 (m, 2H, SCH ₂); 2.50—0.78 (m, 17H)	C	A	B	A	1
O-Ethyl-S-butyl-O-(3,5,5-trimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate (C ₁₂ H ₂₃ N ₂ O ₄ PS ₂)	Found: C, 40.61; H, 6.53	A	A	A	A	1
O-Ethyl-S-Ethyl-O-(3,5,5-trimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate (C ₁₀ H ₁₉ N ₂ O ₄ PS ₂)	Found: C, 37.44; H, 6.20	C	A	C	C	1
O-Ethyl-S-propyl-O-(3-propyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate (C ₁₃ H ₂₅ N ₂ O ₄ PS ₂)	Found: C, 42.89; H, 6.99	A	A	A	A	5
O-Ethyl-S-isopropyl-O-(3-propyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	(CDCl ₃) δ4.47—3.51 (m, 6H); 1.98—0.76 (m, 17H)	A	A	A	B	1
O-Ethyl-S-propyl-O-(3-isopropyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate (C ₁₃ H ₂₅ N ₂ O ₄ PS ₂)	Found: C, 42.0; H, 7.0	A	A	A	A	4
O-Ethyl-S-propyl-O-(3-isopropyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorodithioate (C ₁₃ H ₂₅ N ₂ O ₃ PS ₂)	Found: C, 41.15; H, 6.54	A	A	A	A	1

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TABLE I (Continued)

	Spectral data	Biological activity				
		Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly Nematode
O-Ethyl-S-propyl-O-(3-allyl-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{13}H_{23}N_2O_4PS_2$)	Found: C, 42.45; H, 6.50	A	A	A	A	1
O-ethyl-S-propyl-O-(3-(2-methylallyl)-5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{14}H_{25}N_2O_4PS_2$)	Found: C, 44.61; H, 6.87	A	A	A	A	1
O-Ethyl-S-isopropyl-O-(3-(2-methylallyl)-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{14}H_{25}N_2O_4PS_2$)	Found: C, 44.84; H, 6.83	C	A	A	C	1
O-Ethyl-S-propyl-O-(3-(2-methoxyethyl)-5,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{13}H_{25}N_2O_5PS_2$)	Found: C, 40.24; H, 6.85	A	A	A	A	5
O-Ethyl-S-propyl-O-(3,5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	($CDCl_3$) δ 4.60—3.82 (m, 3H); 3.15—2.54 (m, 5H); 2.16—0.80 (m, 11H)	A	A	A	A	4
O-ethyl-S-propyl-O-(3-isopropyl-5-dimethyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	($CDCl_3$) δ 4.95—3.55 (broad, 4H); 3.26—2.51 (m, 2H, SCH_2); 1.90—0.82 (m, 17H)	A	A	A	A	4
O-Ethyl-S-propyl-O-(3-isopropyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	($CDCl_3$) δ 4.90—3.85 (m, 3H); 3.68—3.22 (q, 2H); 3.20—2.45 (m, 2H, SCH_2); 2.10—0.73 (m, 14H)	B	A	B	A	3
O-Ethyl-S-propyl-O-(3-isobutyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	($CDCl_3$) δ 4.59—3.95 (m, 2H); 3.82 (s, 2H); 3.72—2.64 (m, 5H); 1.98—0.77 (m, 14H)	B	A	B	B	1
O-Ethyl-S-propyl-O-(3-allyl-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate	($CDCl_3$) δ 6.35—5.13 (m, 3H, vinyl); 4.65—3.75 (m, 6H); 3.30—2.60 (m, 2H, SCH_2); 2.05—0.82 (m, 8H)	B	A	A	A	1

TABLE I (Continued)

	Spectral data	Biological activity				
		Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly Nematode
O-Ethyl-S-propyl-O-(3-(2-methylallyl)-4-oxo-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{12}H_{21}N_2O_4PS_2$)	Found: C, 40.44; H, 6.03	A	A	A	A	4
O-Ethyl-S-propyl-O-(3,5,5-trimethyl-4-thiono-1,3-thiazolidin-2-ylimino)phosphorothioate ($C_{11}H_{21}N_2O_3PS_2$)	Found: C, 37.17; H, 5.96	A	A	A	A	5
O-Ethyl-S-propyl-O-(5-methyl-1,3-oxathiolan-4-ylimino)phosphorothioate	($CDCl_3$) δ 5.26 (g, 2H); 4.84–3.88 (m, 3H); 3.22–2.53 (m, 2H, SCH_2); 1.98–0.82 (m, 11H)	A	A	B	B	1
O-Ethyl-S-butyl-O-(5-methyl-1,3-oxathiolan-4-ylimino)phosphorothioate ($C_{16}H_{29}NO_4PS_2$)	Found: C, 37.88; H, 6.40	A	A	C	C	1
O-Ethyl-S-propyl-O-(5-methyl-1,3-oxathiolan-4-ylimino)phosphorodithioate ($C_8H_{18}NO_3PS_2$)	Found: C, 34.76; H, 5.85	A	A	A	A	1
O-Ethyl-S-ethyl-O-(5-methyl-1,3-oxathiolan-4-ylimino)phosphorodithioate ($C_8H_{18}NO_3PS_2$)	Found: C, 33.69; H, 5.83	C	A	C	A	1
O-Ethyl-S-propyl-O-(1,4-dithian-2-ylimino)phosphorothioate	($CDCl_3$) δ 4.58–4.00 (m, 2H, OCH_2); 3.59 (s, 2H); 3.29–2.62 (m, 6H); 1.99–0.83 (m, 8H)	A	A	A	B	1
O-Ethyl-S-propyl-O-(1-methoxyethylideneamino)phosphorothioate ($C_8H_{18}NO_4PS$)	Found: C, 37.95; H, 7.36	C	A	A	A	5
O-Ethyl-S-propyl-O-(1-ethoxyethylidenamino)phosphorothioate	($CDCl_3$) δ 4.49–3.86 (m, 4H); 3.25–2.52 (m, 2H, SCH_2); 2.05 (s, 3H) 1.90–0.82 (m, 11H)	A	A	A	A	5

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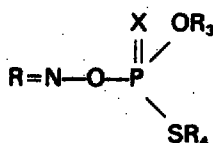
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TABLE I (Continued)

	Spectral data		Biological activity				
	Elemental analysis/NMR	Bean aphid	Mite	Southern armyworm	Mexican bean beetle	Housefly	Nematode
O-Ethyl-S-propyl-O-(1-isopropoxyethylidenamino)phosphorothioate ($C_{10}H_{22}NO_4PS \cdot H_2O$)	Found: C, 39.43; H, 7.86	A	A	C	A	A	A
O-Ethyl-S-propyl-O-(1-methoxy-2,2-dimethylpropyldienamino)phosphorothioate ($C_{11}H_{24}NO_4PS$)	Found: C, 43.87; H, 8.14	A	A	A	A	A	A
O-Ethyl-S-propyl-O-(1-ethoxy-2,2-dimethylpropyldienamino)phosphorothioate ($C_{12}H_{26}NO_4PS$)	Found: C, 46.19; H, 8.60	A	A	A	A	A	A
O-Ethyl-S-propyl-O-(1-isopropoxy-2,2-dimethylpropyldienamino)phosphorothioate ($C_{13}H_{28}NO_4PS \cdot H_2O$)	Found: C, 45.86; H, 8.49	A	C	C	C	C	C
O-Ethyl-S-propyl-O-(1-methoxybenzylidenamino)phosphorothioate ($C_{13}H_{20}NO_4PS \cdot H_2O$)	Found: C, 46.58; H, 6.67	A	A	A	A	A	A
O-Ethyl-S-propyl-O-(1-ethoxybenzylidenamino)phosphorothioate ($C_{14}H_{22}NO_4PS$)	Found: C, 50.51; H, 7.06	A	A	A	A	A	A
O-Ethyl-S-propyl-O-(1-isopropoxybenzylidenamino)phosphorothioate ($C_{15}H_{24}NO_4PS$)	Found: C, 52.88; H, 7.22	A	A	C	A	A	A
O-Ethyl-S-propyl-O-(1-methoxycyclohexylmethylidenamino)phosphorothioate ($C_{13}H_{26}NO_4PS$)	Found: C, 47.48; H, 8.25	A	A	C	C	A	3
O-Ethyl-S-propyl-O-(1-ethoxycyclohexylmethylidenamino)phosphorothioate ($C_{14}H_{28}NO_4PS$)	Found: C, 50.12; H, 8.64	C	C	C	A	C	1
O-Ethyl-S-propyl-O-(1-methoxyethylidenamino)phosphorodithioate ($C_8H_{18}NO_3PS_2$)	Found: C, 35.68; H, 6.95	A	A	B	B	B	5
O-Ethyl-S-propyl-O-(1-ethoxyethylidenamino)phosphorodithioate ($C_9H_{20}NO_3PS_2$)	Found: C, 37.92; H, 7.39	C	A	B	A	A	5

Claims

1. A compound of the general formula:



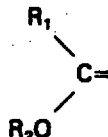
wherein:

X is oxygen or sulfur;

R₃ and R₄ are individually alkyl provided that the total number of aliphatic carbon atoms in each of R₃ and R₄ does not exceed six;

R is either:

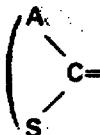
a.



wherein:

R₁ is alkyl, cycloalkyl or phenyl, all of which may be unsubstituted or substituted with one or more alkyl, halogen, alkoxy, or alkylthio substituents; provided that the total number of aliphatic carbon atoms in any alkyl, alkoxy or alkylthio substituent may not exceed eight; provided also that the total number of aliphatic carbon atoms in R₁ may not exceed sixteen; and provided further that when R₁ is cycloalkyl, the total number of aliphatic carbon atoms in said cycloalkyl ring structure may not exceed six; and R₂ is alkyl, provided that the total number of aliphatic carbon atoms in R₂ does not exceed eight; or

b.



wherein:

A is a three or four-membered divalent aliphatic chain, which may be optionally substituted by one or more alkyl or acyl groups each containing no more than six carbon atoms, and which may include in said chain one or more divalent:

sulfur, sulfinyl, sulfonyl, oxygen, carbonyl, thiono or dicyanomethylidene moieties; or amino moieties, which may be optionally substituted with alkyl, alkenyl, alkoxyalkyl or acyl groups having no more than six carbon atoms; or imino moieties of the formula:

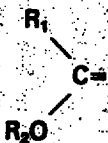


wherein Y is alkyl, alkenyl, alkynyl, dialkylamino, cyano, alkylsulfonyl, aryl or arylsulfonyl groups, aryl groups being optionally substituted with halogen or alkyl substituents having no more than ten carbon atoms.

2. A compound as claimed in claim 1 wherein X is oxygen.

3. A compound as claimed in claim 1 or claim 2 wherein R₃ is ethyl and R₄ is propyl.

4. A compound as claimed in any one of the preceding claims wherein R is the group:



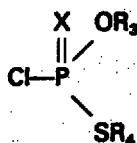
wherein R₁ is alkyl, phenyl or phenyl substituted with at least one alkyl group, and R₂ is methyl or ethyl.



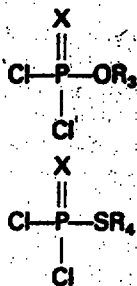
5. A compound as claimed in any one of claims 1 to 3 wherein A is a three or four-membered divalent chain which may include one or more sulfur or oxygen atoms; or nitrogen atoms which are optionally substituted with alkyl, alkenyl, alkoxyalkyl, or acyl groups containing no more than six aliphatic carbon atoms; or carbon atoms which are optionally substituted with an oxo or dicyanomethylidene moiety; or an imino moiety which may be substituted with alkyl or dialkylamino groups containing no more than ten carbon atoms; or one or more alkyl groups containing no more than six carbon atoms.
6. A compound as claimed in claim 5 wherein A, C and S complete a 2 - oximino - 1,4 - dithiane; 2 - oximino - 1,3 - dithiane; 4 - oximino - 1,3 - dithiolane; 2 - oximino - tetrahydro - 1,4 - thiazine - 3 - one; 2 - oximino - 1,3 - dithiolane; 2 - dicyanomethylidene - 4 - oximino - 1,3 - dithiolane; 2 - oximinothiophanes; 4 - oximino - 1,3 - oxathiolane; 5 - oximino - 1,3 - thiazolidin - 4 - one; 2 - oximino - 1,3 - thiazolidin - 4 - one; 2 - oximino - tetrahydro - 1,4 - thiazine; 2 - oximino - 4 - thiono - 1,3 - thiazolidene; 2 - oximino - tetrahydro - 1,4 - thiazin - 5 - one ring structure; wherein said 2 - oximino - tetrahydro - 1,4 - thiazine ring may be substituted by an acyl substituent on its nitrogen moiety.
7. A compound as claimed in claim 5 wherein A, C and S complete a 2 - oximino - 1,3 - thiazolidin - 4 - one ring structure substituted with at least one alkyl, or alkenyl, or alkoxyalkyl group.
8. A compound as claimed in claim 5 wherein A, C and S complete a 2 - imino - 1,3 - dithiolane - 5 - oximino ring structure substituted with at least one alkyl group, and wherein said imino nitrogen is substituted with at least one alkyl or dialkyl-amino group.
9. O - Ethyl - S - propyl - O - (1 - methoxyethyl - idenamino)phosphorothioate.
10. O - Ethyl - S - propyl - O - (1 - ethoxyethyl - idenamino)phosphorothioate.
11. O - Ethyl - S - propyl - O - (1 - ethoxybenzyl - idenamino)phosphorothioate.
12. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - isopropylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
13. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - sec - butylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
14. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - tert - butylimino - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
15. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - dimethylhydrazono - 1,3 - dithiolan - 4 - ylimino)phosphorothioate.
16. An insecticidal, miticidal and nematocidal composition comprising an acceptable carrier and as the active toxicant a pesticidally effective amount of a compound as claimed in any one of the preceding claims.
17. A method of controlling insects, mites or nematodes which comprises subjecting them to an insecticidally, miticidally or nematocidally effective amount of a compound or a composition as claimed in any one of the preceding claims.
18. A method of preparing a compound as claimed in claim 1 which comprises reacting, in the presence of at least a stoichiometric amount of an acid acceptor and an inert solvent, an oxime of the general formula:



with either (1) a chlorophosphate compound of the general formula:



or (2) a dihalophosphorus compound of the general formula:

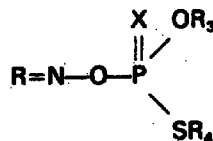


followed by reaction with R_4SH or R_3OH , as appropriate.



Patentansprüche

1. Eine Verbindung der allgemeinen Formel



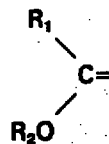
in welcher

X Sauerstoff oder Schwefel ist;

R₃ und R₄ jeweils Alkyl sind, vorausgesetzt, daß die Gesamtzahl der aliphatischen Kohlenstoffatome jeweils in R₃ und R₄ 6 nicht übersteigt;

R entweder für

a)

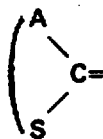


steht, worin

R₁ Alkyl, Cycloalkyl oder Phenyl ist, die alle unsubstituiert oder mit einem oder mehreren Alkyl-, Halogen-, Alkoxy- oder Alkylthiosubstituenten substituiert sein können, vorausgesetzt, daß die Gesamtzahl der aliphatischen Kohlenstoffatome in irgendeinem Alkyl-, Alkoxy- oder Alkylthiosubstituenten 8 nicht übersteigt; mit der weiteren Bedingung, daß die Gesamtzahl der aliphatischen Kohlenstoffatome in R₁ 16 nicht übersteigt und mit der weiteren Bedingung, daß—wenn R₁ Cycloalkyl ist—die Gesamtzahl der aliphatischen Kohlenstoffatome in der Cycloalkylringstruktur 6 nicht übersteigt; und

R₂ Alkyl ist, vorausgesetzt, daß die Gesamtzahl der aliphatischen Kohlenstoffatome in R₂ 8 nicht übersteigt; oder

b)



steht, worin

A eine drei- oder viergliedrige zweiwertige aliphatische Kette ist, die wahlweise durch eine oder mehrere Alkyl- oder Acylgruppen substituiert sein kann, die jeweils nicht mehr als 6 Kohlenstoffatome enthalten, und die in der Kette ein oder mehrere zweiwertige

Schwefel-, Sulfinyl-, Sufonyl-, Sauerstoff-, Carbonyl-, Thiono- oder Dicyanmethyldenteile; oder Aminoteile, die wahlweise mit Alkyl-, Alkenyl-, Alkoxyalkyl- oder Acylgruppen mit nicht mehr als 6 Kohlenstoffatomen substituiert sein können; oder Iminoteile der Formel

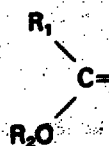


worin Y eine Alkyl-, Alkenyl-, Alkinyl-, Dialkylamino-, Cyan-, Alkylsulfonyl-, Aryl- oder Arylsulfonylgruppe bedeutet und die Arylgruppen wahlweise mit Halogen- oder Alkylsubstituenten mit nicht mehr als 10 Kohlenstoffatomen substituiert sein können, einschließen können.

2. Eine Verbindung nach Anspruch 1, in welcher X Sauerstoff ist.

3. Eine Verbindung nach Anspruch 1 oder 2, in welcher R₃ Ethyl und R₄ Propyl ist.

4. Eine Verbindung nach einem der vorhergehenden Ansprüche, in welcher R die Gruppe



ist, worin R, Alkyl, Phenyl oder Phenyl, das mit mindestens einer Alkylgruppe substituiert ist, bedeutet und R₂ Methyl oder Ethyl ist.

5. Eine Verbindung nach einem der Ansprüche 1 bis 3, in welcher A eine drei- oder viergliedrige zweiwertige Kette ist, die ein oder mehrere

5 Schwefel- oder Sauerstoffatome; oder

Stickstoffatome, die wahlweise mit Alkyl-, Alkenyl-, Alkoxyalkyl- oder Acylgruppen, die nicht mehr als 6 aliphatische Kohlenstoffatome enthalten, substituiert sind; oder

Kohlenstoffatome, die wahlweise mit einem Oxo- oder Dicyanmethylen substituiert sind; oder einen Iminenteil, der mit Alkyl- oder Dialkylaminogruppen, die nicht mehr als 10 Kohlenstoffatome

10 enthalten, substituiert sein kann; oder

ein oder mehrere Alkylgruppen mit nicht mehr als 6 Kohlenstoffatomen einschließen kann.

6. Eine Verbindung nach Anspruch 5, in welcher A, C und S eine 2 - Oximino - 1,4 - dithian - , 2 - Oximino - 1,3 - dithian - , 4 - Oximino - 1,3 - dithiolan - , 2 - Oximino - tetrahydro - 1,4 - thiazin - 3 - on - , 2 - Oximino - 1,3 - dithiolan - , 2 - Dicyanmethylen - 4 - oximino - 1,3 - dithiolan - , 2 -

15 Oximinothiophan - , 4 - Oximino - 1,3 - oxathiolan - , 5 - Oximino - 1,3 - thiazolidin - 4 - on - , 2 - Oximino - 1,3 - thiazolidin - 4 - on - , 2 - Oximino - tetrahydro - 1,4 - thiazin - , 2 - Oximino - 4 - thion - 1,3 - thiazolidin - , 2 - Oximino - tetrahydro - 1,4 - thiazin - 5 - on - ringstruktur vervoll-

ständigen, worin der 2 - Oximino - tetrahydro - 1,4 - thiazinring durch einen Acylsubstituenten auf seinem Stickstoffteil substituiert sein kann.

20 7. Eine Verbindung nach Anspruch 5, in welcher A, X und S eine 2 - Oximino - 1,3 - thiazolidin - 4 - on - ringstruktur vervollständigen, die durch mindestens eine Alkyl- oder Alkenyl- oder Alkoxyalkylgruppe substituiert ist.

8. Eine Verbindung nach Anspruch 5, in welcher A, X und S eine 2 - Imino - 1,3 - dithiolan - 5 - oximinoringstruktur vervollständigen, die durch mindestens eine Alkylgruppe substituiert ist und in

25 welcher der Iminostickstoff mit mindestens einer Alkyl- oder Dialkylaminogruppe substituiert ist.

9. O - Ethyl - S - propyl - O - (1 - methoxyethyl - idenamino) - phosphorthioat.

10. O - Ethyl - S - propyl - O - (1 - ethoxyethyl - indenamino) - phosphorthioat.

11. O - Ethyl - S - propyl - O - (1 - ethoxybenzylidenamino) - phosphorthioat.

12. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - isopropylimino - 1,3 - dithiolan - 4 - ylimino) -

30 phosphorthioat.

13. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - sek - butylimino - 1,3 - dithiolan - 4 - ylimino) - phosphorthioat.

14. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - tert - butylimino - 1,3 - dithiolan - 4 - ylimino) - phosphorthioat.

15. O - Ethyl - S - propyl - O - (5,5 - dimethyl - 2 - dimethylhydrazono - 1,3 - dithiolan - 4 - ylimino) - phosphorthioat.

16. Insektizide, mitizide und nematozide Zusammensetzung, enthaltend einen annehmbaren Träger und als aktiven Wirkstoff eine pestizid wirksame Menge eine Verbindung gemäß einem der vorhergehenden Ansprüche.

40 17. Verfahren zur Bekämpfung von Insekten, Milben oder Nematoden, dadurch gekennzeichnet, daß man sie einer Insektizid, mitizid oder nematozid wirksamen Menge einer Verbindung oder einer Zusammensetzung gemäß einem der vorhergehenden Ansprüche unterwirft.

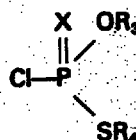
18. Verfahren zur Herstellung einer Verbindung gemäß Anspruch 1, dadurch gekennzeichnet, daß man in Anwesenheit mindestens einer stöchiometrischen Menge eines Säureakzeptors und eines inerten

45 Lösungsmittels ein Oxim der allgemeinen Formel



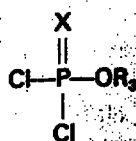
mit entweder

50 (1) einer Chlorphosphatverbindung der allgemeinen Formel



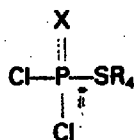
oder

(2) einer Dihalogenphosphorverbindung der allgemeinen Formel



65 oder



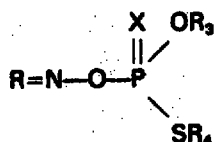


umsetzt,

worin sich eine Reaktion mit den entsprechenden R_4SH oder R_3OH anschließt.

Revendications

1. Composé de formule générale:



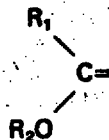
dans laquelle

X représente l'oxygène ou le soufre;

R_3 et R_4 représentent individuellement un groupe alkyle; sous réserve que le nombre total d'atomes aliphatiques de carbone dans chacun de R_3 et R_4 n'excède pas six;

R représente ou bien:

a.

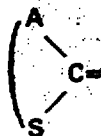


où:

R_1 est un groupe alkyle, cycloalkyle ou phényle, tous pouvant être non substitués ou substitués avec un ou plusieurs substituants alkyle, halogéno, alkoxy ou alkylthio; sous réserve que le nombre total d'atomes aliphatiques de carbone dans tout substituant alkyle, alkoxy ou alkylthio ne puisse pas dépasser huit; sous réserve également que le nombre total d'atomes aliphatiques de carbone dans R_1 ne puisse pas dépasser seize; et sous réserve en outre que lorsque R_1 est un groupe cycloalkyle, le nombre total d'atomes aliphatiques de carbone dans ledit noyau cycloalkyle ne puisse pas dépasser six; et

R_2 est un groupe alkyle, sous réserve que le nombre total d'atomes aliphatiques de carbone dans R_2 ne dépasse pas huit; ou bien

b.



où:

A est une chaîne aliphatique divalente de trois ou quatre chaînons, qui peut éventuellement être substituée par un ou plusieurs groupes alkyle ou acyle ne contenant chacun pas plus de six atomes de carbone, et ladite chaîne peut comporter une ou plusieurs portions divalentes:

soufre, sulfinyle, sulfonyle, oxygène, carbonyle, thiono ou dicyanométhylidène; ou

des portions amino qui peuvent éventuellement être substituées avec des groupes alkyle, alcényle, alkoxyalkyle ou acyle n'ayant pas plus de six atomes de carbone;

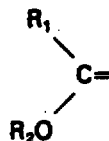
ou des portions imino de formule:



dans laquelle Y désigne des groupes alkyle, alcényle, alcynyle, dialkylamino, cyano, alkylsulfonyl, aryle ou arylsulfonyl, les groupes aryle étant éventuellement substitués avec des substituants halogéno ou alkyle



2. Composé suivant la revendication 1, dans lequel X est l'oxygène.
 3. Composé suivant la revendication 1 ou la revendication 2, dans lequel R₃ est un groupe éthyle et R₄ est un groupe propyle.
 4. Composé suivant l'une quelconque des revendications précédentes, dans lequel R est le groupe:



où R₁ est un groupe alkyle, phényle ou phényle substitué avec au moins un groupe alkyle, et R₂ est un groupe méthyle ou éthyle.

5. Composé suivant l'une quelconque des revendications 1 à 3, dans lequel A est un chaîne divalente à trois ou quatre chaînons qui peut comprendre un ou plusieurs atomes de soufre ou d'oxygène; ou atomes d'azote qui sont éventuellement substitués avec des groupes alkyle, alcényle, alkoxyalkyle ou acyle ne contenant pas plus de six atomes aliphatiques de carbone; ou atomes de carbone qui sont éventuellement substitués avec une portion oxo ou dicyanométhylidène; ou une portion imino qui peut être substituée avec des groupes alkyle ou dialkylamino ne contenant pas plus de dix atomes de carbone; ou bien un ou plusieurs groupes alkyle ne contenant pas plus de six atomes de carbone.

6. Composé suivant la revendication 5, dans lequel A, C et S forment conjointement un noyau de 2 - oximino - 1,4 - dithiane; de 2 - oximino - 1,3 - dithiane; de 4 - oximino - 1,3 - dithiolane; de 2 - oximino - tétrahydro - 1,4 - thiazine - 3 - one; de 2 - oximino - 1,3 - dithiolane; de 2 - dicyanométhylidène - 4 - oximino - 1,3 - dithiolane; de 2 - oximinothiophane; de 4 - oximino - 1,3 - oxathiolane; de 5 - oximino - 1,3 - thiazolidine - 4 - one; de 2 - oximino - 1,3 - thiazolidine - 4 - one; de 2 - oximino - tétrahydro - 1,4 - thiazine; de 2 - oximino - 4 - thiono - 1,3 - thiazolidène; de 2 - oximino - tétrahydro - 1,4 - thiazine - 5 - one; ledit noyau de 2 - oximino - tétrahydro - 1,4 - thiazine pouvant être substitué par un substituant acyle sur sa portion azotée.

7. Composé suivant la revendication 5, dans lequel A, C et S forment conjointement un noyau de 2 - oximino - 1,3 - thiazolidine - 4 - one qui est substitué avec au moins un groupe alkyle ou alcényle ou alkoxyalkyle.

8. Composé suivant la revendication 5, dans lequel A, C et S forment conjointement un noyau 2 - imino - 1,3 - dithiolane - 5 - oximino substitué avec au moins un groupe alkyle, et dont l'azote d'imine est substitué avec au moins un groupe alkyl- ou dialkylamino.

9. Le O - (1 - méthoxyéthylidène - amino)phosphorothioate de O - éthyle et de S-propyle.

10. Le O - (1 - éthoxyéthylidène - amino)phosphorothioate de O - éthyle et de S - propyle.

11. Le O - (1 - éthoxybenzylidène - amino)phosphorothioate de O - éthyle et de S - propyle.

12. Le O - (5,5 - diméthyl - 2 - isopropylimino - 1,3 - dithiolane - 4 - ylimino)phosphorothioate de O - éthyle et de S - propyle.

13. Le O - (5,5 - diméthyl - 2 - sec. - butylimino - 1,3 - dithiolane - 4 - ylimino)phosphorothioate de O - éthyle et de S - propyle.

14. Le O - (5,5 - diméthyl - 2 - tertio - butylimino - 1,3 - dithiolane - 4 - ylimino)phosphorothioate de O - éthyle et de S - propyle.

15. Le O - (5,5 - diméthyl - 2 - diméthylhydrazono - 1,3 - dithiolane - 4 - ylimino)phosphorothioate de O - éthyle et de S - propyle.

16. Composition insecticide, acaricide et nématicide, comprenant un support acceptable et, comme substance active toxique, une quantité à effet pesticide d'un composé suivant l'une quelconque des revendications précédentes.

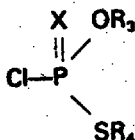
17. Procédé pour combattre des insectes, des acariens ou des nématodes, qui consiste à soumettre les parasites à une quantité à effet insecticide, acaricide ou nématicide d'un composé ou d'une composition suivant l'une quelconque des revendications précédentes.

18. Procédé de préparation d'un composé suivant la revendication 1, qui consiste à faire réagir, en présence d'au moins une quantité stoechiométrique d'un accepteur d'acide et d'un solvant inerte, une oxime de formule générale:



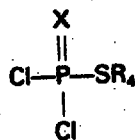
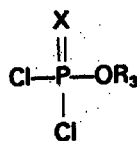
avec (1) un chlorophosphate de formule générale:





(22)

ou (2) un composé dihalogénophosphoré de formule générale:



puis à faire réagir le produit avec R_4SH ou R_3OH , selon le cas.

